Environmental Assessment of the Alaskan Continental Shelf

Annual Reports of Principal Investigators for the year ending March 1977

Volume IX. Receptors — Fish, Littoral, Benthos

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration

U.S. DEPARTMENT OF INTERIOR
Bureau of Land Management

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Outer Continental Shelf Environmental Assessment Program

Boulder, Colorado

March 1977

U.S. DEPARTMENT OF COMMERCE
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Environmental Research Laboratory

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Bureau of Land Management

DISCLAIMER

VOLUME IX

RECEPTORS - FISH

Contents

* indicates final report

Institute of Arctic Biology
University of Alaska
Fairbanks, Alaska

Literature Search on the Density and Distribution of Fishes of the Beaufort Sea

James E. Morrow
Principal Investigator

Final Report

to

National Oceanic and Atmospheric Administration
Outer Continental Shelf Environmental Assessment Program
Contract 03-5-022-56
Task Order #16
Research Unit #348

Date: March 17, 1977

No. of Pages: 107

ANNUAL REPORT

I. Summary of objectives - To provide a bibliography of the fishes of the Beaufort Sea. This will serve as a reference base for further work.

II. Introduction

A. General nature and scope of study - This bibliography covers the fishes of the Beaufort Sea and adjacent areas. It includes all the references the bibliographer was able to find.

B. Specific objectives - To prepare a bibliography of the fishes of the Beaufort Sea.

C. Relevance to problems of petroleum development - The bibliography will serve as a reference base for further studies in the area.

III. Current state of knowledge - None.

IV. Study area - Beaufort Sea.

V. Sources, etc. - Libraries and data files were examined as follows: University of Alaska, Fairbanks; University of Washington, Seattle; Arctic Environmental and Data Center, Anchorage; Alaska Department of Fish and Game, Fairbanks, Anchorage, Juneau; National Marine Fisheries Service, Juneau, Seattle.

Included in the bibliography are all discovered references dealing with fishes of the Beaufort Sea and/or immediately adjacent regions. Streams of the arctic coast of North America were included, since these are important to the anadromous fishes of the study area. A number of Russian references containing information on the distribution, biology, utilization, etc., of Beaufort Sea species in Russian waters were also included.

VI. Results - The complete bibliography of 499 references is appended.

VII. Discussion - Not applicable.

VIII. Conclusions - Not applicable.

IX. Summary of 4th quarter operations.

A. Ship or laboratory activities

1. Ship or field trip schedule - None.
2. Scientific party - Dr. James E. Morrow, University of Alaska, Principal Investigator; Mrs. Wilma Pfeifer, University of Alaska, Bibliographer.
3. Methods - Not applicable.
4. Sample localities - Not applicable.
5. Data collected or analyzed - Not applicable.
6. Milestone chart - The bibliography was completed by mid-October, at which time the bibliographer submitted same to the principal investigator in the form of file cards accompanied by copious notes. Because the bibliographer was not also a biologist, it was necessary for the principal investigator to spend a good deal of time in abstracting these notes. Physical preparation of the finished product was delayed by a high turnover of personnel in the Institute of Arctic Biology typing pool; hiring difficulties caused by government regulations; and numerous breakdowns of the computerized typewriter.

B. Problems encountered - None, except for those listed in paragraph IXA6.

C. Estimate of funds expended -

Abrahamson, G. 1968. Tuktoyaktuk-Cape Parry, an Area Economic Survey. A.E.S.R. no. 62-2. Department of Indian Affairs and Northern Development, Ottawa. 83 p.

Species:
Lake herring, Whitefish, Stenodus leucichthys, Esox lucius, Catostomidae, Salvelinus namaycush, Clupea pallasii, Salvelinus alpinus.

Places:
Toker Point, Atkinson Point, Kugaluk River, Point Stevens, Tomcod Bay, Parry Peninsula, Hornaday River, Darnely Bay, Baillie Islands.

Remarks:
Coregonids abundant summer and fall. Herring abundant at Cape Parry; also charr.

Abs, Otto. 1959. Die Eskimoernahrung und ihre Gesundheitlichen aus Wirkungen. V. G. Thieme, Leipzig.

Alaska Department of Fish and Game. Division of Commercial Fisheries. 1964. Annual Report. Arctic-Yukon-Kuskokwim Area. Juneau. pp. 70-78, 106-110, 134-135.

Alaska Department of Fish and Game. Division of Commercial Fisheries. 1973. Alaska's Wildlife and Habitat.

Alaska Department of Fish and Game. 1973. Catalog of rivers, lakes and streams that are important for the spawning or migration of anadromous fish. Revised October, 1973.

Alaska, Office of the Governor. Division of Policy Development and Planning. 1975. Fish. Pages 174-194. In:

Draft Envrionmental Assessments. Proposed Beaufort Sea nearshore leasing.

Species:
Coregonus autumnalis, C. sardinella, C. nasus, C. pidschian, Salvelinus alpinus, Myoxocephalus quadricornis, Liopsetta glacialis, Thymallus arcticus, Boreogadus saida, Ammodytes hexapterus, Osmerus mordax, Oncorhynchus keta, O. gorbuscha, Coregonus laurettae.

Remarks:
Life histories and distribution summarized. First seven species abundant, others occasional inshore.

Alaska. University. Arctic Environmental Information and Data Center. 1975. Aquatic animals. Pages 137, 144, 145, 147. In: Alaska Regional Profiles. Arctic Center. Anchorage.

Species:
Mallotus villosus, Cottios, Gadidae, Ammodytes hexapterus, Oncorhynchus gorbuscha, O. keta, Boreogadus saida, Lota lota, Gasterosteidae, Thyumallus arcticus, Esox lucius, Catostomedae, Salvelinus alpinus, Angayukaksurak char, Coregonus nasus, C. pidschian, C. sardinella, C. autumnalis, Osmeridae species, Salvelinus namaycush, Pleuronectidae species.

Places:
Colville River Delta, Kavik River, Point Barrow, Point Hope, Kaktovik, Wainwright, Anaktuvak River, Hulahula River, John River.

Remarks:
Subsistence fishing emphasizes coregonids, charrs, osmerids. Colville River Delta fishery takes 3,000 C. nasus and 1,000 C. pidschian in summer; 20,000 C. sardinella and 40,000 C. autumnalis in fall. Spawning grounds in headwaters.

Alaska. University. Arctic Environmental Information and Data Center. 1975. Alaska Regional Profiles: Arctic Region. Anchorage. Pages 164, 167.

Remarks:
Fish taken for subsistence; Barrow - 61,550 lb., Kaktovik - 15,000 lb., Point Hope - 40,000 lb., Wainwright - 2,840 lb. Colville River delta, 1971-1973, took

2160-3815 lb. broad whitefish; 37,333-71,960 lb. Arctic cisco; 13,283-25,108 lb. least cisco.

Alaskan Arctic Gas Pipeline Company. 1974. Description of the environment. In: Environmental Report of Alaskan Arctic Gas Pipeline Company. Pages 55-59.

Alexander, V., D. C. Burrell, J. Chang, T. R. Cooney, C. Coulon, J. J. Crane and J. A. Dygus. 1973. Environmental Studies of an Arctic Estuarine System. Final Report. University of Alaska, Institute of Marine Science, Fairbanks, Alaska. 539 p. (IMS Report 74-1).

Aller, Barbara B. 1958. Publications of the U.S. Bureau of Fisheries, 1871-1940. U.S. Fish and Wildlife Special Scientific Report. Fish 284. 202 p.

Alt, K. T. 1965. Food habits of inconnu in Alaska. Trans. Am. Fish Soc. 94:272-274.

Alt, K. T. 1969. Taxonomy and ecology of the inconnu, Stenodus leucichthys nelma, in Alaska. Biol. Pap. Univ. Alaska no. 12.

Alt, K. T. 1971. A life history study of sheefish and whitefish in Alaska. Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Progress Report, vol. 12. Project F-9-3, Study R-11. Juneau. 31 p.

Species:
Salvelinus alpinus, Prosopium cylindraceum, Coregonus nasus, C. pidschian, C. sardinella, C. autumnalis, Stenodus, leucichthys.

Places:
Sagavanirktok River.

Remarks:
First six species present in Sagavanirktok River.

Alt, K. T. 1974. A life history study of sheefish and whitefish in Alaska; July 1, 1973 through June 30, 1974. Alaska Dep. Fish Game, Federal Aid Fish Restor. Annual Progress Report, vol. 15. Project F-9-6, Study no. R-11. Juneau.

Remarks:
Includes data on coregonids of Colville River.

Alt, K. T., and D. R. Kogl. 1973. Notes on the whitefish of the Colville River, Alaska. J. Fish. Res. Bd. Canada 30(4):554-556.

Species:
Coregonus sardinella, C. autumnalis, C. nasus, C. pidschian, Prosopium cylindraceum.

Places:
Colville River Delta, Umiat, Putu, Nanuk Lake, Kachemach River, Kalubik Creek, Itkillik River, Cliktok, Miluveach River.

Remarks:
Describes seasonal variation in numbers of the several species. 40,000 to 80,000 coregonids taken annually in Colville River commercial fishery.

Alverson, D. L., N. J. Wilimovsky and F. Wilke. 1960. Marine investigation of the Chukchi Sea. U.S. Atomic Energy Comm. Springfield, Va. (Rep. PNE-479).

Alverson, D. L., N. J. Wilimovsky and F. Wilke. 1967. Annual Technical Report. Artic-Yukon-Kuskokwim anadromous fish investigations, Alaska. Alaska Dep. of Fish and Game. National Marine Fisheries Grant-in-aid study. Alaska Project no. AFC-7. pp. 84-102.

Alyeska Pipeline Service Company. 1974. Summary report. Biological Documentation of the Trans-Alaska Pipeline: Appendix E3-1014. Houston, Texas. 361 p.

Species:
Oncorhynchus gorbuscha, O. keta, Salvelinus alpinus, Thymallus arcticus, Prosopium cylindraceum, Salvelinus namaycush, Coregonus nasus, C. pidschian, C. sardinella, C. autumnalis, Osmerus mordax, Cottus cognatus, Lota lota, Pungitius pungitius.

Places:
Prudhoe Bay, Colville River, Sagavanirktok River.

Remarks:
Movements of fish species, particularly Arctic char, are outlined. *Salvelinus alpinus*, *Thymallus arcticus*, and *Prosopium* are most numerous fish species in Sagavanirktok River while *Coregonus nasus*, *C. pidschian*, and *C. sardinella* are rarely caught. *O. keta* present in Prudhoe area; small runs of the latter occur in the Colville River.

Anderson, R. M. 1917. Canadian Arctic Expedition, 1916. Zool. Summary Report. Geological Survey Dep. of Mines, Ottawa. (Govt. of Canada Sessional Paper 26:374-384).

Anderson, R. M. 1917. Recent explorations on the Canadian Arctic coast. The Geo. Rev. (New York) 4(4):241-266 (Oct.,1917).

Anderson, R. M. 1918. Eskimo food-how it tastes to a white man. Ottawa Naturalist 32(4):59-65 (Oct., 1918).

Species:
Coregonus sp., Salvelinus (malma?), S. namaycush, Esox lucius, Thymallus arcticus, Oncorhynchus sp., Osmeridae, Lota lota, Stenodus leucichthys.

Places:
Bering Sea to Bathurst Inlet, Herschel Island.

Remarks:
Arctic fish few in species, many in numbers.

Anderson, R. M. 1951. Report on the natural history collections of the Expedition. Pages 450-455. In: V. Stefanson, ed. My life with the Eskimo. Macmillan Company, New York.

Species:
Catostomus catostomus, Argyrosomus tullibee, Leucichthys lucidus, Clupea pallasi, Stenodus mackenzii, Salvelinus malma, Cristovomer namaycush, Thymallus signifier, Osmerus dentex, Esox lucius, Platichthys stellatus, Microgadus proximus, Oncocottus hexacornis, and Lota maculosa.

Places:
Mackenzie River, Colville River, Langton Bay, Cape Bathurst, Coronation Gulf. Herschel Island, Toker Point, Shingle Point, Anderson River, Liverpool Bay. Richards Island.

Remarks:
Catostomus, Argyrosomus, Stenodus, Esox, Oncocottus, Leucichthys common in Mackenzie Delta. Clupea abundant at Cape Bathurst in August. Microgadus common at Liverpool Bay and Coronation Gulf.

Andriyashev, Anatoly P. 1935. Geographical distribution of the marine food fishes of the Bering Sea and problems connected therewith. Exploration of the seas of the U.S.S.R. 22:135-145.

Andriyashev, Anatoly P. 1937. K poznaniyu ikhtiofauny Beringova i Chukotskogo morei. Issled. Dal' nevostoch morei 25:292-355. Leningrad. [A contribution to the knowledge of the fishes from the Bering and Chukchi Seas.] Explor. Mers Russes 25:292-255. Translated from the Russian language by Lisa Lanz and Norman J. Wilimovsky. Fish. Res. Bd. Canada, Spec. Scientific Report 145. 81 p.

Species:
Lumpenus medius, Gymnelis viridis, Lycodes polaris, L. knipowitsch, L. polaris arcticus, Triglops beani, Icelus bicornis, Gymnocanthus tricuspis hudsonius, Myoxocephalus verrucosus, Artediellus scaber beringianus, Ulcina olriki, Hippoglossoides robustus.

Places:

Chukchi Sea.

Andriyashev, Anatoly P. 1939. Outline of zoogeography and origin of the fauna of fish in the Bering Sea and adjacent waters. Publication of the State University of Leningrad.

Andriyashev, Anatoly P. 1952. Ryby Chukotskogo Morya i Beringova Proliva. Kraimii Severo-Vostok Soyuza SSSR II:311-322. Izdatel' stvo Nauk SSSR.

Species:
Lists more than 30 species.

Places:
Kotzebue Sound, Chukchi Sea, Point Barrow, Mackenzie River, Herschel Island, Kobuk River.

Andriyashev, Anatoly P. 1952. Tikhookeanskiye kraby i ruby na severe. Priroda, vol. 1952(5):116.

Andriyashev, Anatoly P. 1954. Fishes of the northern seas of the U.S.S.R. Zool. Inst. Akad. Nauk SSR 53:566. Translated from the Russian by D. E. McAllister, Curator of Fishes, Nat. Mus. of Canada, Ottawa.

Andriyashev, Anatoly P. 1955. A contribution to the knowledge of the fishes from the Bering and Chukchi Seas [K. poznaniyu ikhtiofauny Beringova i Chukotskogo morei]. Issled. Dal'nevostoch Morei 25:292-355 (1937). Leningrad. Translated from the Russian language by Lisa Lanz and Norman J. Wilimovsky, Can. Fish. Res. Bd. Special Scientific Report 145 (May 1955) 81 p.

Andriyashev, Anatoly P. 1964. Fishes of the northern seas of the U.S.S.R. [Ryby severnykh morei SSSR]. Keys to the fauna of the U.S.S.R. Published by Zoological Institute of the U.S.S.R. Academy of Sciences no. 53. Izdatel'stvo Akademii Nauk SSSR, Moskva-Leningrad, 1954. Translated from the Russian by Israel Program for Scientific Translations, Jerusalem, 617 p.

Remarks:
A comprehensive list, with descriptions, illustrations, life histories and remarks on value, distribution etc. Index of Russian names, bibiography. Many species also present in Beaufort Sea.

Anonymous. 1959. North Pacific exploratory fishing program -Chukchi Sea in Northwest Alaska, surveyed for Atomic Energy Commission. M/V John N. Cobb cruise 43. Comm. Fish. Rev. 21(11):42-44.

Arctic Environmental Information and Data Center. 1975. Chukchi Sea, Bering Strait, Icy Cape; Physical and biological character of Alaskan coastal zone. Anchorage, University of Alaska. 64 p. 31 folded maps. (Sea Grant no. 75-10).

Species:
Lists 41 species found in the northeastern Chukchi Sea.

Remarks:
In order of abundance, the ten most numerous: Boreogadus saida, Clupea harengus pallasi, Gymnocanthus tricuspis, Artedielus scaber, Mallotus villosus, Hippoglossoides robustus, Osmerus dentex, Myoxocephalus scorpius, Triglops pingeli, Eleginus gracilis.

Armstrong, Alexander. 1857. A personal narrative of the discovery of the Northwest Passage with numerous incidents of travel and adventure during nearly five years' continuous service in the Arctic while in search of the Expedition under Sir John Franklin. Hurst and Blackett, London. 616p.

Places:
Prince of Wales Strait, Prince Albert Land, Banks Land, Bay of Mercy.

Remarks:
Includes notes on natural history.

Atkinson, C. E., H. J. Rose and T. O Duncan. 1967. Salmon of the North Pacific Ocean. Pt. IV. Spawning populations of North Pacific salmon. Pages 43-223. In: Pacific Salmon in the United States. U.S. Bureau of Commerical Fisheries, Seattle, Wash. (Bulletin, International North Pacific Fisheries Comm. No. 23).

Species:
Oncorhynchus keta, O. tshawytscha, O. kisutch, O. nerka, O. gorbuscha.

Remarks:
O. keta numerous along Arctic coast. O. gorbuscha occasional on north coast. Other spp. not recorded north of Kotzebue Sound. Maps show geographic limits, spawning areas.

Ayers, R. C. Jr., H. O. Jahns and J. L. Glaesner. 1974. Oil spills in the Arctic Ocean: extent of spreading and possibility of large scale thermal effects. Science 186(4166):843-846 (29 Nov., 1974).

Bain, Lawrence, H. 1974. Life histories and systematics of the Arctic charr (Salvelinus alpinus L.) in the Babbage River System, Yukon Territory. Canadian Arctic Gas Study Ltd. Biol. Rep. Ser. 18(1):156 p.

Remarks:
Salvelinus alpinus distributed throughout Polar regions of North America, Europe, and Asia; in northern hemisphere, the anadromous species restricted to coastal Arctic and subarctic areas. Literature dealing with anadromous and non-anadromous varieties is summarized. Life history aspects are presented as they relate to the Yukon Territory Beaufort Sea Drainage.

Bain, Lawrence H. Alternate life histories of Arctic charr (Salvelinus alpinus) in the Babbage River system, Beaufort Sea Drainage, Yukon Territory. M.S. disserta-

tion, University of Calgary, Dep. of Biol. Calgary, Alberta. (In preparation).

Barsdate, R., V. Alexander and R. E. Benoit. 1972. Natural oil seeps at Cape Simpson: aquatic effects. Proc. Ak. Sci. Conf. 23:122 (Abstr.).

Bean, Tarleton H. 1879. Descriptions of some genera and species of Alaskan fishes. Proc. U.S. Nat. Mus. 2:353-359.

Bean, Tarleton H. 1882. Description of new fishes from Alaska and Siberia. Proc. U.S. Nat. Mus. 4:144-159.

Remarks:
Eighty new species described or mentioned, two from Alaska. Stichaeus rothrocki from Plover Bay, Siberia, and from Cape Lisburne. Coregonus laurettae from Point Barrow and Port Clarence.

Bean, Tarleton H. 1883. List of fishes known to occur in the Arctic Ocean north of Bering Strait. Pages 118-119. In: Cruise of the revenue steamer Corwin in Alaska and the northwest Arctic Ocean in 1881. U.S. Government Printing Office, Washington, D.C. 1883.

Species:
Lists 29 species.

Places:
Various coastal localities from Kotzebue Sound north and east to the Anderson River, N.W.T.

Remarks:
Most of the scientific names are now considered synonyms.

Bean, Tarleton H. 1888a. Distribution and some characters of the Salmonidae. Amer. Nat. 22:306-314.

Species:
Coregonus laurettae, C. nelsoni, Oncorhynchus gorbuscha, Salvelinus malma, S. arcticus (S. alpinus).

Places:
Point Barrow, Colville River, 82 degrees 34' N.

Bean, Tarleton H. 1888b. Fishes determined from photographs. <u>In</u>: G. M. Dawson, ed. Report on an exploration in the Yukon District, N.W.T. Rep. Geological Survey. Canada, 1887-1888 (N.S.)3(app.4):231B.

Bean, Tarleton H. 1889. Description of <u>Coregonus pusillus</u>, a new species of whitefish from Alaska. Proc. U.S. Nat. Mus. 11:526.

Bean, Tarleton H. 1891. Report of the salmon and salmon rivers of Alaska with notes on the conditions, methods, and needs of the salmon fisheries. U.S. Government Printing Office, Washington, D.C. (51st Cong. 1st session, House of Representatives Misc. Doc't. No.11.) 50 p. Maps, plates.

Species:
Coregonus laurettae, Stenodus leucichthys, Thymallus arcticus, Oncorhynchus keta, O. gorbuscha, Mallotus villosus.

Places:
Hotham Inlet, Point Barrow, Mackenzie River.

Remarks:
Discusses distribution and abundance of listed species.

Belcher, Edward. 1855. The last of the Arctic voyages: being a narrative of the expedition in H.M.S. Assistance under the command of Captain Sir Edward Belcher, C.B., in search of Sir John Franklin during the years 1852, 1853, 1854. With notes on the natural history by Sir John Richardson, Professor Owen, Thomas Bell, J. W. Salter, and Lovell Reeve, 2v. London.

Remarks:
Appendix, vol. II, pp. 263-419, includes reports on fishes and other natural history subjects.

Bendock, Terence M. 1976. Beaufort Sea estuarine fishery study. Annual Report, July 1975-March 1976, Sport Fish Division, Alaska Department Fish Game. Pages 243-261. In: Fish, plankton, benthos, littoral: environmental assessment of the outer continental shelf. VII. Environmental Research Laboratories, Boulder, Colorado.

Species
Salvelinus alpinus, Coregonus sardinella, C. autumnalis, C. nasus, C. pidschian, Thymallus arcticus, Osmerus mordax, Mallotus villosus, Boreogadus saida, Eleginus gracilis, Myoxocephalus quadricornis, Liopsetta glacialis, Liparis sp.

Places:
Point Sorenson to Brownlow Point.

Remarks:
C. sardinella the most abundant species; M. quadricornis common throughout area. B. saida seasonally abundant. Salmonids wide spread along coast. Larvae and young of B. saida, M. villosus and Liparis spp. dominated offshore trawl catches.

Berg, Leo S. 1931. A review of the lampreys of the northern hemisphere. Erzheg. Zool. Muz. (Akad. Nauk SSSR)32:87-116.

Berg, Leo S. 1934. Ob amfiboreal' nom prery vistom rasprostranenu morskoi fauna v svernom POLUSHARII [On the amphiboreal (discontinuous) distribution of marine fauna in the northern hemisphere]. Isvestiya Geograficheskogo obshchestva 66(1):69-78.

Berg, L. S., and A. Popov. 1932. A review of the forms of Myoxocephalus quadricornis (L.). C. R. Acad. Sci. U.S.S.R. 1932-33 6:152-160.

Bergstrand, J. 1973. Fisheries resources in Alaska. Inventory. Arctic Region. Resource Planning Team, Joint Federal-State Land Use Planning Comm. for Alaska, Anchorage. 8 p.

Bernier, J. E. 1910. Report on the Dominion of Canada Government Expedition to the Arctic Islands and Hudson Strait on board the D.G.S. "Arctic". Ottawa. 529 p.

Berry, Frank B. et al. 1959. An appraisal of the health and nutritional status of the Eskimo. Report of the Internat. Comm. on Nutrition for National Defense, Dep. of Defense, Washington, D.C.

Bird, J. B., and M. B. Bird. 1961. Bathurst Inlet, Northwest Territories, Canada. Dep. of Mines and Tech. Surv., Ottawa. (Memoir 7)pp. 9, 10, 50.

Species:
Coregonus sp., Salvelinus alpinus, S. namaycush, Tomcod.

Places:
Bathurst Inlet.

Remarks:
Tomcod common in winter, other spp. more important at other times. S. alpinus particularly numerous June-August.

Bishop, Yvonne, Neal M. Carter et al. 1957. Index and list of titles, publications of the Fisheries Research Board of Canada, 1901-1954. Bull. Fish. Res. Bd. Canada 110:209 p.

Boulva, J. 1972. Morphometrics of three sympatric arctic codfishes from the genera Arctogadus and Gadus. J. Fish. Res. Bd. Canada 29:243-249.

Species:
Arctogadus, Gadus.

Places:
Cambridge Bay.

Bray, J. R. 1975. Marine fish surveys in the Mackenzie Delta area. Fish. Res. Bd. Canada, MS Report 1326, 10 p.

Species:
Clupea harengus, Osmerus eperlanus, Myoxocephalus quadricornis, Coregonus autumnalis, C. sardinella.

Remarks:
Groundfish biomass estimated at 10,000 lb/mi^2 in 1961 at Tuktoyaktuk. Declined to 3,000lb/mi^2 at 2 mi offshore.

Braznmikov, V. K. 1900-04. Rybnye Promysl' Dal'nego Vostoko [Fishery in the Far East] No. 1(1900) and 2 (1904).

Braznmikov, V. K. 1907. Materialy po fauna russikh Vostochnych morei [Data on the fauna of the far Eastern seas]. Zapiski Akademii Nauk 20(6).

Brunskill, G. J., D. M. Rosenberg, N.B. Snow, G. L. Vascotto and R. Wagemann. 1973. Ecological studies of aquatic systems in the Mackenzie-Porcupine drainage in relation to proposed pipeline and highway developments. A preliminary report for the Environmental-Social Committee, Northern Pipelines, Dep. of the Environment. Fish. Res. Bd., Fresh Water Inst., Winnipeg, Manitoba. 129 p. 15 Appendices.

Brunskill, G. J., D. M. Rosenberg, N.B. Snow and R. Wagemann. 1973. Ecological studies of aquatic systems in the Mackenzie-Porcupine Drainages in relation to proposed pipeline and highway developments. Vol. II. Environmental Soc. Comm., Northern Pipelines, Winnipeg, Manitoba. 345 p. Tables, appendices (Task Force on Northern Oil Development Rep. 73-41).

Bryan, J. E. 1973. The influence of pipeline development on freshwater fishery resources of northern Yukon Territory. Aspects of research conducted in 1971 and 1972. Northern Operations Branch, Fisheries Service, Dep. of the Environment, Ottawa. 56 p. (Task Force on Northern Oil Development. Rep. 73-6).

Bryan, J. E., C. E. Walker, R. E. Kendel and M. S. Elson. 1971. The influence of pipeline development on freshwater aquatic ecology in northern Yukon Territory. Progress Report on research conducted in 1971. Environment Canada, Fisheries Service. 45 p.

Bryan, J. E., C. E. Walker, R. E. Kendel and M. S. Elson. 1973. Freshwater ecology in the northern Yukon territory. Fisheries Service, Pacific region, Dep. of the Environment, for the Environmental Social program, Northern Pipelines, Vancouver, British Columbia, 64 p. Tables, figures, maps.(Task Force on Northern Oil Development. Rep. 73-21).

Species:
Discusses 18 species, mostly freshwater.

Places:
Blow River, Mackenzie Delta, Herschel Island.

Remarks:
Discusses distribution, commercial harvests. Tables show bio-statistics of more prevalent species.

Butorin, D. A. 1965. Areas of concentrations of Polar cod in the Arctic. Ryb. Khoz. 10(8).

Cameron, Thomas W. M. 1938. The feeding of dogs in the Canadian Arctic. Can. J. of Comp. Med. 2(7):181-185 (July, 1938).

Canada, Department of the Environment. 1973. Impact of a northern gas pipeline. Vol. 5. Impact of pipelines on traditional activities of hunter-trappers in the Territories. Fisheries Service for the Environmental-Social Program, Northern Pipelines, Ottawa.

Canada, Department of Indian Affairs and Northern Development. 1973a. Regional impact of a northern gas pipeline. Vol. 1: Summary Report. Economic Staff group, Northern Economic Development Branch for the Environmental-Social Program, Northern Pipelines. Ottawa. 187 p.

Canada, Department of Indian Affairs and Northern Development. 1973b. Atlas of wildlife habitat inventory maps for Environmental-Social program, Northern pipelines. Part of a wildlife habitat inventory of the Mackenzie Valley and northern Yukon. Set of 7 atlases. Technical and graphic design by Bryan Chubb. Ottawa. Ring binder, paper cover.

Canada, Department of Indian Affairs and Northern Development. 1975. Mackenzie Valley pipeline assessment: Environmental and socio-economic effects of the proposed Canadian Arctic gas pipeline of the Northwest Territories and Yukon. Environmental Social Program, Northern Pipelines. Ottawa. 442 p.

Canada, Environment Protection Board, 1974. Environmental impact assessment of the portion of the Mackenzie Gas Pipeline from Alaska to Alberta, Vol. III. Environmental atlas. Prepared by Interdisciplinary Systems Ltd. and Templeton Eng. Co.

Species:
Coreganus autumnalis, C. nasus, C. pidschian, C. sardinella, Prosopium cylindraceum, Thymallus arcticus, Salvelinus alpinus, Esox lucius, Catostomus catostomus.

Places:
Mackenzie Delta, Richards Island, Tieda River, Blow River, Peel River.

Remarks:
Text and maps include important fish migration, overwintering, spawning and rearing areas.

Canada, Fisheries Research Board. 1947. Northwest Canadian Fisheries Survey in 1944-45. Fish. Res. Bd. Can. Bull. 72:94.

Canada, Fisheries Research Board. 1959. List of articles in the "Translation Series" no. 1-166 with indexes to authors and translators (1959 ....continuing supplements). 32 p.

Canada, Northern Economic Development Branch. 1973. Regional impact of a Northern Gas pipeline. Pages 34,43-45, 118, 125-127. (Task Force on Northern Oil Development Report 73-32).

Species:
Clupea sp., Coregonus spp., Salvelinus alpinus, Esox lucius, Catostomus catostomus, Stenodus leucichthys, Salmonidae (trout).

Places:
Mackenzie River Delta, Mackenzie River tributaries, Tuktoyaktuk, Herschel Island, Shoalwater Bay, Aklavik.

Remarks:
Discusses distribution and value of fish catches in Mackenzie drainage.

Canadian Government. 1888. Report of the Select Committee of the Senate appointed to inquire into the resources of the Great Mackenzie Basin. 3rd Report of the Select Comm. of the Senate ... appointed to inquire into the resources that part of the Dominion... comprising the Great Mackenzie Basin... its fisheries, forests, and mines and to report upon its possible commercial and agricultural value. Ottawa.

Canadian Wildlife Service. 1969. Arctic ecology map series (maps and descriptive booklets) Ottawa.

Canadian Wildlife Service. 1972. Arctic ecology map series. Descriptive reports. 2nd ed. Data added. Environment Canada, Ottawa.

Carter, Neal M. 1965. Index and list of titles, Fisheries Research Board of Canada and associated publications, 1900-64. Bull. Fish. Res. Bd. Canada 164:649 p.

Carter, Neal M. 1968. Index and list of titles, Fisheries Research Board of Canada, and associated publications, 1900-1964. Bull. Fish. Res. Bd. Canada 164:649 p.

Carter, Neal M. 1969. Index and list of manuscript reports (Biological no. 1-900; Experimental no. 1-61; Oceanographic and Limnological no. 1-229) to their conclusion as three separate series in 1966. Fish. Res. Bd., Canada, M. S. Report Ser. (Biol.) 900:255 p.

Carter, Neal M. 1973. Index and list of titles, Fisheries Research Board of Canada, and associated publications 1965-1972. Misc. Spec. Publ. Fish. Res. Bd., Canada 18:588 p.

Caulkin, T. B. 1937. Fish. Pages 123-129. In: W. C. Bethune, ed. Canada's western northland: its history, resources, population, and administrations. Canada, Dep. of Mines and Resources, Ottawa.

Species;
Lists 26 marine, freshwater and anadromous species.

Remarks:

S. alpinus the most abundant food fish along coast from Keewatin to MacKenzie. Most important commercial species Gadus ogac, Boreogadus saida, Clupea pallasii, Osmerus dentex, Platichthys stellatus especially abundant in Cape Bathurst area. Seasonal variations are discussed.

Chance, Norman A. 1967. The eskimo of north Alaska. Holt, Rinehart, and Winston, New York.

Chitwood, Philip E. 1969. Japanese, Soviet, and South Korean fisheries off Alaska. Development and history through 1966. Natl. Marine Fish. Service, Washington, D.C. 34 p. (Circular 310).

Remarks:
By close of 1966, fisheries of Japan and U.S.S.R. utilized most of 550,000 sq. nautical miles of the Continental Shelf of Alaska from Dixon Entrance in south and east, west beyond Attu Island, and north to Arctic Ocean.

Cohen, Daniel M. 1954. Age and growth studies on two species of whitefish from Point Barrow, Alaska. Stanford Ichthyological Bull. 4(3):168-188.

Species:
Coregonus nasus, C. sardinella.

Places:
Point Barrow.

Collinson, Richard. 1889. Journal of H.M.S. Enterprise on the expedition in search of Sir John Franklin's ships by Bering Strait, 1850-1855. S. Low, Marston, Searle and Rivington Ltd., London. 531 p.

Cooney, R. T., and James Crane. 1972. Nearshore Marine Biology, Colville. Pages 217-230. In: Baseline data study of the Alaskan Arctic aquatic environment, no. R72-3. University of Alaska, Inst. of Marine Sci. Fairbanks.

Remarks:
Discusses spatial distribution and abundance of dominant epibenthic species.

Craig, P. C. 1970. Interoffice memorandum of Trans-Alaska Pipeline System concerning spawning habitat in the area of vehicular crossings of the Sagavanirktok River, dated October 1, 1970.

Craig, P. C. 1973. Preliminary report on winter fisheries between Prudhoe Bay and the Mackenzie River by Aquatic Environments for Northern Eng. Services, Ltd.

Craig, P. C. Fisheries investigations in the Canning River. Canadian Arctic Gas Study Ltd. Calgary, Canada Biol. Rep. Ser. (In preparation).

Remarks:
Indicates most commonly eaten fish in region were Boreogadus saida. Sex ratio of juvenile arctic charr in Sagavanirktok and Canning Rivers 9.2 males:7.2 females.

Craig, P. C., and G. J. Mann. 1974. Life history and distribution of the Arctic cisco (Coregonus autumnalis) along the Beaufort Sea coastline in Alaska and the Yukon Territory. In: P. J. McCart, ed. Life histories of anadromous and fresh water fish in the western Arctic. Canadian Arctic Gas Study, Ltd., Biol. Rep. Ser. 20(4):33.

Species:
Coregonus autumnalis, C. sardinella, C. clupeaformis, C. nasus, Prosopium cylindraceum, Stenodus leucichthys, Myoxocephalus quadricornis, Liopsetta glacialis, Osmerus eperlanus, Boreogadus saida, Salvelinus alpinus, Thymallus arcticus.

Remarks:
C. autumnalis in brackish water. Both *C. autumnalis* and *C. sardinella* spawn in Colville and Mackenzie Rivers, probably overwinter in delta.

Craig, P. C., and P. J. McCart. 1974a. Fall spawning and overwintering areas of fish populations along routes proposed pipeline between Prudhoe Bay and the Mackenzie Delta, 1972-1973. *In* P. J. McCart, ed. Fisheries research associated with proposed gas pipeline routes in Alaska, Yukon, and Northwest Territories. Canadian Arctic Gas Study, Ltd., Biol. Rep. Ser. 15(3):36.

Species:
Salvelinus alpinus, Thymallus arcticus, Prosopium cylindraceum, Catostomus catostomus.

Remarks:
Known overwintering sites identified. Sizes of charr populations indicated. Previous studies summarized.

Craig, P. C., and P. J. McCart. 1974b. Classification of stream types in Beaufort Sea drainages between Prudhoe Bay, Alaska, and the Mackenzie Delta. Canadian Arctic Gas Study, Ltd., Calgary. Biol. Rep. Ser. 17:1-47.

Species:
Salvelinus alpinus, Thymallus arcticus, Prosopium cylindraceum, Cottus cognatus, Pungitius pungitius.

Places:
Fifty seven locations in 17 drainages from Kuparuk River east to Mackenzie delta.

Remarks:
Streams are described on basis of physical, chemical and biological characteristics.

Craig, P. C., and P. J. McCart. 1975. Fish utilization of nearshore coastal waters between the Colville and Mackenzie Rivers with an emphasis on anadromous species. Report presented at the 3rd Internat. Conf. on Port and Ocean Engineering under Arctic conditions, held at the University of Alaska, College, Alaska, Aug. 11-15, 1975. Appendix. *In*: P. C. Craig, ed. Fisheries investigations in a coastal region of the Beaufort Sea. Canadian Arctic Gas Study, Ltd., Calgary. Biol. Rep. Ser. 34(2):172-219.

Remarks:
Distribution of 28 species of marine and freshwater fishes examined, with emphasis on life histories and migrations of S. alpinus and C. autumnalis.

Craig, P. C., and V. A. Poulin. 1974. Life history and movement of grayling (Thymallus arcticus) and juvenile Arctic charr (Salvelinus Alpinus) in a small tundra stream tributary of the Kavik River, Alaska. In: P. J. McCart, ed. Life histories of anadromous and fresh water fishes in the Western Arctic. Canadian Arctic Gas Study, Ltd., Calgary. Biol. Rep. Ser. 20(2):53.

Craig, P., and V. A. Poulin. 1975. Movements and growth of grayling (Thymallus arcticus) and of juvenile Arctic charr (Salvelinus alpinus) in a small Arctic stream, Alaska, J. Fish. Res. Bd. Canada 32:689-697.

Currie, R. 1964. The Yukon Territory Littoral, an economic development program report. Industrial Div. Dep. of Northern Affairs and Natl. Res. Ottawa. 32 p. (Area Econ. Surv. Rep. 6 3/3) Restricted.

Species:
Salvelinus alpinus, Stenodus leucichthys, Mallotus villosus, Blue herring, Cisco herring, Coregonus spp.

Places:
Clarence Lagoon, Shingle Point, Herschel Island, Blow River, Ptarmigan Bay.

Remarks:
Blue herring most abundant August, cisco herring July, Herschel Island to Blow River. Estimated potential yields of various species are given.

Dall, William H. 1870. Alaska and its resources. Lee and Shepherd, Boston

Dall, William H. and Marcus Baker. 1879. Partial list of books, pamphlets, papers in Serial Journals and other publications on Alaska and adjacent regions. Pages 225-374. In: U.S. Coast and Geodetic Survey. Pacific Coast Pilot, Coast and Islands of Alaska (2nd ser.) Appendix 1.

Day, D., and C. R. Forrester. 1971. A preliminary bibliography on the trawl fishery and groundfish of the Pacific coast of North America. Fish. Res. Bd. Canada. Technical Rep. 246. 91 p.

Dean, B. 1923. A bibliography of fishes. 3 vols. Amer. Mus. Nat. Hist., New York.

de Bruyn, M., and P. J. McCart. 1974. Life history of the grayling (*Thymallus arcticus*) in Beaufort Sea drainages. In: P. J. McCart, ed. Fisheries research associated with proposed gas pipeline routes in Alaska, Yukon and Northwest Territories. Canadian Arctic Study, Ltd., Calgary. Biol. Rept. Ser. 15(2):396.

Dees, L. T. 1963. Index of fishery biological papers by U.S. Fish and Wildlife service authors appearing in non-government publications, 1940-1956. U.S. Fish Wildl. Serv. Fish. Circ. 151:138.

De Vries, A. L. 1971. Freezing resistance in fishes. Pages 157-190. In: Hoar and Randall, eds. Fish physiology. Vol. 6 Academic Press, New York and London.

Doran, L. D. 1974. Fishes and aquatic systems. Pages 205-268. In: Canada, Environmental Protection Board, Research Report Environmental impact assessment of the portion of the Mackenzie gas pipeline from Alaska to Alberta. Winnipeg, Manitoba.

Dryden, R. L., and J. N. Stein. 1975. Guidlines for the protection of fish resources of the Northwest Territories during highway construction and operation. Fisheries and Marine Service, Environment Canada, Winnipeg, Manitoba. 32 p. Tables, figures, maps. (Technical Rep. Ser. CEN/T-75-1).

Species:
Salvelinus alpinus, Coregonus nasus, C. autumnalis, C. sardinella, C. pidschian, Stenodus leucichthys, Catostomus catostomus, C. commersoni, Thymallus arcticus, Esox lucius, Lota lota, Stizostedion vitreum, 22 additional species not abundant.

Places:
Mackenzie River, from Great Slave Lake to the delta.

Remarks:
Concern with effects of stream crossings. Distribution and ages at maturity are tabulated.

Dryden, R. L., B. G. Sutherland and J. N. Stein. 1973. An evaluation of fish resources of Mackenzie River Valley as related to pipeline development. Vol. II. Fisheries Serv. Dept. of the Environment, Ottawa. 176 p.(Task Force on Northern oil Development 73-2)

Species:
34 species noted.

Places:
Mackenzie River valley and delta.

Remarks:
Detailed descriptions of physical conditions. Migration routes, spawning areas, nursery and over-wintering areas noted for 50 streams. Stages of maturity of fishes indicated.

Dunbar, M. J. 1947. Marine young fish from the Canadian eastern Arctic. Fish. Res. Bd. Can., Bull. 73:1-11.

Species:
Boreogadus saida, Triglops pingeli, Gymnocathus galeatus, Agonus decagonus, Aspidophoroides olriki, Lumpenus lampetraformis, Stichaeus punctatus, Myoxocephalus quadricornis.

Places:
Arctic Ocean. Point Barrow, Alaskan Coast, Aleutian Islands, Pribilof Islands, Hudson Bay.

Remarks:
Discusses distribution of listed species.

Dunbar, M. J. 1951. Resources of arctic and subarctic seas. Transactions, Roy. Soc. of Canada 45: (Series III), Sec. V:61-67.

Species:
Salvelinus alpinus. Mallotus villosus, Boreogadus saida, Clupeidae.

Dunbar, M. J. 1953. Arctic and subarctic marine ecology: immediate problems. Arctic 6:75-90.

Dunbar, J. 1968. Ecological development in polar regions, a study in evolution. Prentice-Hall, Englewood Cliffs, New Jersey.

Dunbar, M. J. 1970. On the fishery potential of the sea waters of the Canadian north. Arctic 23(3):150-174.

Species:
Gadus ogac, Eleginus gracilis, Clupea harengus, Salvelinus alpinus, Anarrhichas denticulatus.

Places:
Point Barrow, Coronation Gulf, Liverpool Bay, Darnley Bay, Prince Patrick Island, Greenland.

Remarks:
Emphasis on distribution in eastern Arctic.

Dunbar, M. J. 1973. The arctic and sub-arctic marine environment. Pages 244-288. In: D. H. Pimlott, K. M. Vincent, and C. E. McKnight, eds. Arctic Alternatives. Mail O-Matic Printing, Ottawa.

Remarks:
At present little exploitation of fish in Southern Beaufort Sea but potential exists.

Dupere and Associates Inc. for the North Slope Borough. 1973. North Slope Borough reconnaissance study: an inventory of the borough and its communities.

Durrer, J. L., and J. P Hannon. 1961. Seasonal variations in the caloric intake of dogs living in an Arctic environment. Arctic Aeromed. Lab., Ft. Wainwright TR-61-33, Fairbanks, Alaska.

Remarks:
Mentions caloric value of some fishes.

Dymond, J. R. 1940. Pacific salmon in the Arctic Ocean. Proc. Pacific Sci. Cong. 6, vol. 3, 435 p.

Remarks:
Treats occurrences in Mackenzie and Arctic Red Rivers.

Dymond, J. R. 1943. The coregonine fishes of northwestern Canada. Contrib. Royal Ontario Mus., Zool. no. 124:171-232 (reprinted from Trans. Royal Canadian Inst. 24(2):171-231).

Species:
Coregonus nelsoni, C. kennicotti, C. o'donoghuei, C. atikameg, C. nasus, C. clupeaformis, C. pidschian, Prosopium quadrilaterale, P. cylindraceum, P. preblei, Leucichthys pusillus, L. sardinella, L. autumnalis, L. lauretta, L. lucidus, L. artedii, Stenodus leucichthys, S. mackenzii, Salmo (Coregonus) lucidus, Esox lucius.

Places:
Tuktoyaktuk, Mackenzie East Branch, Coppermine River, Arctic Red River, Peel River, Mackenzie River, Fort MacPherson, Great Slave Lake, Yukon River, Anderson River, Cape Bathurst, Herschel Island, Rat River, Richards Island, Kidluit.

Remarks:
Taxonomy, biology, fisheries utilization. Distribution and abundance.

Dymond, J. R. 1944. Notes on specimens, localities in the Northwest Territories of fish other than Coregonidae, in the collections of the Royal Cntario Mus. of Zool. (Unpublished).

Dymond, J. R., and V. D. Vladykov. 1934. The distribution and relationships of the Salmonoids of North America and North Asia. Proc. of the Pacific Sci. Cong., Canada, 1933, vol. 5:3741-3750. Univ. of Toronto Press, Toronto.

Species:
Salmo (Oncorhynchus), Cristivomer, Salvelinus, Hucho, Brachymystax, Stenodus, Coregonus, Thymallus, Phylogephyra.

Efimov, A. V. 1964. Otkrytiia Ameriki so storony Azii. Voprosy istorii 39(12):139-144.

Ekblau, Walter E. 1926. The material response of the Polar Eskimo to their far Arctic environment. Annals of the Assoc. of Amer. Geographers 18:(4).

Ellis, D. V. 1962. Observations on the distribution and ecology of some Arctic fish. Arctic 15:179-190.

Species:
Salvelinus alpinus, S. namaycush, Coregonus spp., C. clupeaformis, C. artedii, C. sardinella, Prosopium cylindraceum, Thymallus arcticus, Mallotus villosus, Esox lucius, Catostomus catostomus, Lota lota, Gadus ogac, Eleginus gracilis, Coryphaenoides rupestris, Pungitius pungitius, Myoxocephalus quadricornis, M. scorpius, Liopsetta glacialis, Platichthys stellatus.

Places:
Coppermine River, Bathurst Inlet, Cambridge Bay, Coronation Gulf, Spence Bay, Baffin Island, Banks Island, Eclipse Sound.

Ellis, William. 1782. An authentic narrative of a voyage performed by Captain Cook and Captain Clarke. 2 v., G. Robinson, London.

Esakov, V. A. et al. 1964. Russkie okeanicheskie i morskie issledoraniia v XIX-nachale XXV [Russian oceanic and marine investigations in the 19th to beginning of 20th century]. Moskva, Izd-vo. Nauka, 1964. 160 p.

Evermann, B. W., and E. L. Goldsborough. 1907. The fishes of Alaska. Bull. U.S. Bur. Fish. 26:219-360.

Evermann, B. W., and H. M. Smith. 1896. The whitefishes of North America. Rep. U.S. Comm. Fish. for 1894, pt 20:283-324.

Faas, R. 1968. Inshore arctic ecosystems with ice stress. Pages 987-1003. In: H. Odom and J. Copeland, eds. Coastal ecological systems of the United States: a source book for estuarine planning. University of N.C. Inst. of Marine Sci. Chapel Hill (Rep 68-128).

Federal Field Committee for Development Planning in Alaska. 1968. Alaska natives and the land. Anchorage.

Ferguson, J. D. 1961. The human ecology and social economic change in the community of Tuktoyaktuk, N.W.T. Northern Coordination and Research Center, Dep. of Northern Aff. and Natl. Res. Ottawa. 80 p. (NCRC 61-1).

Species:
Clupeidae, Coregonidae, Coregonus artedii, Stenodus leucichthys, Salvelinus alpinus, Osmerus sp., Eleginus gracilis, Lota lota, Pungitius pungitius.

Places:
Mackenzie River Delta, Tuktoyaktuk, Aklavik, Whitefish Station, Firth River, King Point Harbor, Back River, Herschel Island, Baillie Island.

Remarks:
Average annual harvest Clupeidae at Tuktoyaktuk and abundance of fishes in the area.

Fisher, A. 1820. A journal of a voyage to the Arctic regions in H. M. Ships Hecla and Griper in the years 1819 and 1820. 2nd ed. London. 320 p.

Fisher, H. D. 1958. Arctic investigations by the Fisheries Research Board of Canada, 1956-1957. Arctic 10(4):244-245.

Food and Agriculture Organization of the United Nations. 1972. Atlas of the living resources of the sea.

Foote, D. C. 1959. The economic base and seasonal activities of some northwest Alaskan villages: a preliminary study. Bioenvironmental Studies, Project Chariot, USAEC Con. No. AT(04-3)-315.

Foote, D. C. 1960a. The Eskimo hunter at Point Hope, Alaska: September, 1959 to May, 1960. Bioenvironmental Studies, Project Chariot, USAEC Con. No. AT(04-3)-315.

Foote, D. C. 1960b. The Eskimo hunter at Point Hope, Alaska. Part II, May to September, 1960. Bioenvironmental Studies, Project Chariot, USAEC Con. No. AT(04-3)-315.

Foote, D. C. 1964. Changing resource utilization by Eskimos in northwestern Arctic Alaska, 1850-1952. Paper read Arctic and Sub-arctic Sec. VII Internat. Cong. Anthro. and Ethn. Moscow. 5th August, 1964.

Foote, D. C. 1965. Exploration and resource utilization in northwestern Alaska before 1855. Ph.D. Dissertation McGill University, Dep. of Geog., Montreal. 400 p.

Species:
Coregonidae, Oncorhynchus keta, Oncorhynchus spp., Salvelinus sp., Thymallus arcticus, Arctogadus glacialis.

Places:
Noatak, Point Lay, Point Hope, Point Barrow, Kukpuk River, Colville River, Ikpikpuk River.

Remarks:
Estimates of past and present caloric intake of people and dogs. Annual harvest data on fishes.

Foote, D. C., and H. A. Williamson. 1966. A human geographical study. Pages 1041-1108. In: N. J. Wilimovsky and J. N. Wolfe, eds. Environment of the Cape Thompson Region, Alaska. Div. of Technical Information, U.S. Atomic Energy Comm. Springfield, Va.

Species:
Salvelinus alpinus, Oncorhynchus spp., Coregonidae, Thymallus arcticus, Boreogadus saida, Pleuronectidae.

Places:
Point Hope, Kukpuk River, Wulik River, Noatak River.

Remarks:
Fishing methods, catch and utilization data.

Fowler, H. W. 1905. Notes on some Arctic fishes with a description of a new Oncocottus. Proc. Acad. Nat. Sci., Philadelphia 57:362-370.

Species:
Coregonus kennicotti, C. nelsoni, Argyrosomus pusillus, Thymallus signifer, Oncocottus hexacornis, O. hexacornis gilberti, Boreogadus saida, Lota maculosa.

Places:
Point Barrow, Meade River.

Franklin, John. 1828. Narrative of a second expedition to the shores of the Polar Sea in the years 1825, 1826, 1827. J. Murray, London.

Species:
Coregonus artedii, Coregonus sp., "Trout", Thymallus arcticus, Stenodus leucichthys, Mallotus villosus, Couesius plumbeus.

Places:
Point Warren, Richards Island, Herschel Island, Kay Point, Point Sabine, Point King, Simpson Island, Mackenzie River mouth, Bear Lake River, Fort Franklin, Point Toker.

Remarks:
General information on distribution and abundance of fish and Eskimo fisheries.

Franklin, John. 1829. Journey to the shores of the Polar Sea, in 1825, 26, 27. London.

Furniss, R. A. [n.d.] Unpublished fisheries investigations at Prudhoe Bay, Alaska, 1974. Alaska Dep. of Fish Game, Fairbanks.

Remarks:
Arctic charr second most abundant species in Prudhoe Bay. Preferred inshore areas. Majority of Beaufort sea charr produced in Sagavanirktok, Canning, Kongakut rivers. Spawning areas primarily in springs in foothills.

Furniss, R. A. [n.d.] Prudhoe Bay Study. Alaska Dep. of Fish Game. (Unpublished).

Remarks:
Gives length, weight, sex, location of capture for 897 fish specimens.

Furniss, R. A. [n.d.] Lake and stream catalog. North slope 1. Alaska Dep. of Fish Game. (Unpublished).

Remarks:
Includes fish sampling - Beaufort Sea coast 1970, mainly Canning River drainages. Descriptions of lake habitats in Arctic National Wildlife Range.

Furniss, R. A. [n.d.] Lake and stream catalog. North Slope 2. Alaska Dep. of Fish Game. (Unpublished).

Remarks:
Summary reports of Colville River, Canning River Springs, Sagavanirktok River drainage.

Furniss, R. A. 1974a. Fisheries investigations at Prudhoe Bay, Alaska. Alaska Dep. of Fish Game. 16 p.

Remarks:
Studies in July-August indicate Salvelinus alpinus second most abundant Prudhoe species. Prefer nearshore Beaufort Sea area. Most spawning areas in inland areas Sagavanirktok, Canning and Kongakut River drainages, especially in springs of Brooks Range foothills.

Furniss, R. A. 1974b. Inventory and cataloging of Arctic area waters. Alaska Dep. of Fish and Game annual performance report for inventory and cataloging of Arctic area waters, Project F-9-6, Study no. G-1. Vol. 15:45.

Species:
Coregonus autumnalis, C. sardinella, C. pidschian, C. nasus, Prosopium cylindraceum, Salvelinus alpinus, S. namaycush, Thymallus arcticus, Boreogadus saida, Lota lota, Ammodytes sp., Pungitius pungitius, Cottidae.

Places:
Colville River, Barter Island, Sagavanirktok River, Chandler Lake, Shainin Lake, Itkillik Lake, Elusive Lake.

Remarks:
Data on movements, age, length, weight, sex, maturity.

Furniss, R. A. 1975. Inventory and cataloging of the Arctic area waters. Alaska Dep. of Fish and Game, Federal Aid in Fish Restoration. Annual Report of Performance, July 1, 1974 through June 30, 1975. Project F-9-7. Study G-1-1. Vol. 16:47 p.

Species:
Coregonus sardinella, C. autumnalis, C. nasus, C. pidschian, Salvelinus alpinus, Thymallus arcticus, Myoxocephalus quadricornis, Liopsetta glacialis.

Places:
Prudhoe Bay.

Remarks:
Data on movements, age, length, weight, sex, maturity.

Fyodorov, E. 1939. Scientific works of our polar expedition, January, 1929. Foreign Language Publishing House, Moscow.

Galbraith, D. F., and D. C. Fraser. 1974. Distribution and food habits of fish in eastern coastal Beaufort Sea. Beaufort Sea Project, Dep. of the Environment, Victoria, B.C. 48 p. (Interim Rep. of Beaufort Sea Project Study B1, Eastern, Dec., 1974).

Places:
Southeast Beaufort Sea, Kugmallit Bay, Tuktoyaktuk.

Remarks:
Seasonal distribution, food habits of major species described. Current state of knowledge reviewed.

Galbraith, D. F., and J. G. Hunter. 1976. Fisheries of offshore waters and Tuktoyaktuk Peninsula. Beaufort Sea Project. Dep. of the Environment, Victoria B.C. (Beaufort Sea Project Technical Rep. 7).

Species:
Coregonus autumnalis, C. sardinella, Osmerus eperlanus, Polar cod, Myoxocephalus quadricornis.

Places:

Tuktoyaktuk Peninsula, Southern Beaufort Sea, Herschel Island.

Remarks:
Results of gill netting and trawling. In gill nets, smelt and ciscoes ca. 90% of catch, cod dominated off-shore trawls. Larval smelt are important forage fish offshore.

Gavin, A. 1969. Wildlife studies, central area, North Slope, Alaska, a report to the Atlantic Richfield Co. Ten typewritten pages and appendix.

Species:
Coregonus spp., Salvelinus alpinus, Oncorhynchus sp., Thymallus arcticus.

Places:
Prudhoe Bay, Colville River, Canning River.

Remarks:
Notes paucity of information. Fishes found in rivers on seasonal basis, major runs in spring and fall.

Gavin, A. 1971. Ecological survey of Alaska's north slope, summer 1969 and 1970. Unpubl. brochure, Atlantic Richfield Corp. 13 p.

Gavin, A. 1973. Wildlife of the North Slope, a five year study, 1969-1973. Atlantic Richfield Co., 61 p.

Species:
Coregonus nasus, C. sardinella, C. pidschian, Prosopium cylindraceum, Thymallus arcticus, Salvelinus alpinus, Osmerus mordax, Catostomus catostomus, Myoxocephalus quadricornis.

Places:
Colville River, Kuparuk River, Sagavanirktok River, Prudhoe Bay, Ivishak River, Ribdon River, Accomplishment Creek, Canning River, Kavik River, Ugnuravik River.

Remarks:
Describes characteristics of streams, distribution of fishes, importance of streams in life history of fishes.

Gilbert, C. H. 1895. Notes on fishes from the basin of the Mackenzie River in British America. Bull. U.S. Fish. Comm. 14:23-25.

Species:
Coregonus kennicotti, C. lucidus, Stenodus mackenzii, Thymallus signifier.

Places:
Mackenzie River delta, Fort Good Hope, Fort Simpson, Great Bear Lake.

Remarks:
Descriptive notes.

Glova, G., and P. J., McCart. 1974. Life history of Arctic charr (Salvelinus alpinus) in the Firth River, Yukon Territory. In: P. J. McCart, ed. Life histories of anadromous and freshwater fish in the Western Arctic. Canadian Arctic Gas Study, Ltd., Calgary. Biol. Rep. Ser. 20(3).

Species:
Salvelinus alpinus, Thymallus arcticus.

Places:
Firth River.

Remarks:
Population estimated at 32,000 charr on basis of aerial surveys. Maps show distribution, spawning, nursery, wintering areas. Life history, length, weight of anadromous charr compared with resident fish. Tagging experiments analyzed.

Grainger, E. H. 1953. On the age, growth, migration, reproductive potential and feeding habits of the Arctic charr (Salvelinus alpinus) of Frobisher Bay, Baffin Island. J. Fish. Res. Bd. Canada 10(6):326-370.

Species:
Salvelinus alpinus.

Places:
Baffin Island, Frobisher Bay, Herschel Island, Aklavik.

Remarks:

Includes age, growth, fecundity, food habits data.

Grainger, E. H., and J. G. Hunter. 1959. Station list of the 1955-1958 field investigations of the Arctic unit of the Fisheries Research Board, Canada. J. Fish. Res. Bd. Canada 16(4):403-420.

Great Britain, Admiralty. 1854. Papers relative to the recent Arctic expedition in search of Sir John Franklin and the crews of H. M. Ships Erebus and Terror. London. XLII:102.

Grekov, V. I. 1960. Ochrki iz Istorii Russkith Geograficheskith Issledovanii V 1725-1765 gg. Isdatel' stvo Akademiia Nauk SSSR, Moskva.

Griffiths, W., P. Craig, G. Walder and G. Mann. 1975. Fisheries investigations in a coastal region of the Beaufort Sea (Nunaluk Lagoon, Yukon Territory). Canadian Arctic Gas Study Ltd., Calgary. Biol Rep. Ser. 34(2):519.

Species:
Coregonus autumnalis, C. sardinella, Stenodus leucichthys, Salvelinus alpinus, Thymallus arcticus, Pungitius pungitius, Myoxocephalus quadricornis, Liopsetta glacialis.

Places:
Nunaluk Lagoon, Firth River, Malcolm River, Herschel Island, Mackenzie River.

Remarks:
Abundance, age, growth, size, sex ratios, life histories of major species.

Griffiths, W., A. Sekerak and M. Jones. 1974. Distribution of fish species along alternative gas pipeline corridors in Alaska and the Yukon Territory. In: P. J.

McCart, ed. Classification of streams in Beaufort Sea Drainages and distribution of fish in Arctic and subarctic drainages. Canadian Arctic Gas Study Ltd., Calgary. Biol. Rep. Ser. 17(2):176 p.

Species:
Lists 48 species.

Remarks:
Species and locations listed with supporting data. Maps show major drainages, locations of pipeline corridors, distribution patterns of fish species. Extensive references.

Gunn, W. W., Ed. 1973. Bibliography of the Naval Arctic Research Laboratory. Technical Paper. Arctic Inst. of N. A. 24:176.

Remarks: Bibliography of oceanic and terrestrial aspects of Arctic Regions. Includes relevant publications on Arctic Marine biology and oceanography.

Halkett, A. 1913. Checklist of fishes of the Dominion of Canada and Newfoundland. King's Printer, Ottawa. 138 p.

Hall, Mark. 1971. A proposal for regional development of Arctic Alaska. Prepared for Human Population and Natural Resources. Harvard University, Cambridge, Mass.

Hanbury, David T. 1904. Sport and travel in the Northland of Canada. Macmillan, New York.

Hanson, W. C., and H. E. Palmer. [n.d.] The accumulation of fallout cesium-137 in northern Alaska natives. Work performed under contract no. AT(45-1)-1350 between the Atomic Energy Commission and General Electric Co. Hanford Lab., Gen. Electric Co., Richland, Wa.

Species:
Salvelinus alpinus, Thymallus arcticus, Coregonidae, Boreogadus saida.

Places:
Barrow, Anaktuvuk Pass, Kotzebue, Point Hope, Noatak, Kobuk, Yukon River.

Remarks:
Coregonids and grayling most important species at Barrow.

Hanson, W. C., H. E. Palmer and E. I. Griffin. 1966. Radioactivity in northern Alaskan Eskimos and their foods summer, 1962. Pages 1151-1164. In: N. J. Wilimovsky and John N. Wolfe, eds. Environment of the Cape Thompson Region Alaska. Division of Technical Information, U.S. Atomic Energy Comm. Springfield, Va.

Species:
Salvelinus alpinus, Coregonus spp., Prosopium cylindraceum, Stenodus leucichthys, Oncorhynchus gorbuscha, O. keta, Boreogadus saida, Leptocottus armatus, Cottidae.

Places:
Anaktuvuk Pass, Barrow, Point Hope, Kotzebue, Little Diomede.

Remarks:
Discusses contributions of various species to native diets.

Hatfield, C. J., J. N. Stein, M. R. Falk and C. S. Jessop. 1972. Fish resources of the Mackenzie River Valley. Interim Report, vol. 1. Fisheries Service, Environment Canada, Winnipeg. 247 p.

Remarks:
Preliminary data on distribution, relative abundance, growth, migration, general life history of anadromous species in outer Mackenzie Delta.

Hatfield, C. K., J. N. Stein, M. R. Falk, C. S. Jessop and D. N. Shepherd. 1972. Fish resources of the Mackenzie

River Valley. Interim Report, vol. 2. Fisheries Service, Environment Canada, Winnipeg. 289 p.

Species:
Coregonus autumnalis, C. pidschian, C. nasus, Stenodus leucichthys, Lota lota.

Places:
Colville River, Mackenzie River, Barter Island.

Remarks:
Details of survey methods, results. Stream catalog. Fisheries and biological data.

Hattersley-Smith, G. F. 1952. Beaufort Sea Expedition 1951. Arctic Circular 5:13-17. (Mimeo).

Healy, M. A. 1889. Report of the cruise of the Revenue Marine Steamer Corwin in the Arctic Ocean in the year 1884. U.S. Government Printing Office, Washington, D.C. (50th Cong., 1st sess., House of Rep. Misc. Sect. 602.)

Hearne, Samuel. 1968. Journals of Samuel Hearne and Philip Turnor between the years 1774 and 1792. Originally published by the Champlain Society, Toronto, 1934 (Champlain Publication XXI). Facsimile edition. Greenwood Press, New York. 611 p.

Helmericks, C., and H. Helmericks. 1948. Our summer with the Eskimos. Little, Brown and Co., Boston. 239 p.

Hennessey, Frank. 1910. Report of Mr. Frank Hennessey on the birds, animals, crustacea and fauna collected on the expedition of the Arctic in 1908-09. Pages 502-513. In: J. E. Bernier, ed. Report of the Dominion of Canada Expedition to the Arctic Islands and Hudson Strait on board the D.G.S. Arctic. Dep. of Marine and Fishery, Ottawa.

Herlininveaux, R. H. 1970. Icepack 8/68 - oceanographical and biological observations. Fish. Res. Bd. of Canada, Nanaima, B. C. 60 p. (Technical Rep. no. 159).

Hewes, C. W. 1947. Aboriginal use of fishery resources in Northwest North America. Ph.D. Thesis. University of California, Berkeley, Ca.

Hickok, D. M. 1970. Developmental trends in Arctic Alaska. Alaska Sea Grant program, Anchorage. 11 p. (Unpublished).

Hickok, D. M. 1970-1971. Development of Alaska's underutilized arctic marine resources: a coherent area project. University of Alaska, Inst. of Marine Sci. May, 1970-1971.

Hildebrand, H. 1948. Marine fish of Arctic Canada. M.S. Thesis. McGill University, Montreal. 123 p.

Holmberg, H. G. 1956. Ethnographische Skizzen uber die Volker des Russischen Amerika. Act. Soc. Sci. Fenn. 4

Hooper, C. L. 1881. Report of the cruise of the U.S. Revenue Steamer Corwin in the Arctic Ocean, 1880. U.S. Government Printing Office, 1881.

Hooper, C. L. 1884. Report of the cruise of the U.S. Revenue Steamer Corwin in the Arctic Ocean 1881. U.S. Government Printing Office, Washington, D.C.

Hooper, W. H. 1853. Ten months among the tents of the Tuski with incidents of an Arctic boat expedition in search of Sir John Franklin as far as Mackenzie River and Cape Bathurst. London.

Howard, R. L. 1974. Aquatic invertebrate-waterbird relationships on Alaska's Arctic coastal plain. M.S. Thesis. Iowa State University, Ames, Ia. 49 p.

Species:
Pungitius pungitius, Myoxocephalus quadricornis.

Places:
Prudhoe Bay.

Howard, W. L. Diary of the Point Barrow Expedition 12th April to 9th August, 1886. 56M-180 (1) 6 MS Am 1486. The Houghton Library. Harvard University, Cambridge, Mass. (Unpublished).

Howard, W. L. Sledging Expedition to the "No-talk" River, 1st December 1885 to 5th April 1885. 56M(2) 6 MS Am 1486. The Houghton Library, Harvard University, Cambridge, Mass. (Unpublished).

Hubbs, Carl L. 1925. A revision of the osmerid fishes of the North Pacific. Proc. Biol. Soc. Washington 38:49-55.

Remarks:
Five species native to Bering and Beaufort seas. Taxonomic emphasis.

Hubbs, C. L., and N. J. Wilimovsky. 1964. Distribution and synonymy in the Pacific Ocean, and variation of the Greenland halibut, Reinhardtius hippoglossoides (Walbaum). J. Fish. Res. Bd. Canada 21(5):1129-1154.

Hufford, G. L. 1971. The biological response to oil in the marine environment. Report to U.S. Coast Guard of Project no. 714141/003. Washington, D.C.

Hunt, A. D., G. M. MacNabb and J. S. Tener. 1974. Mackenzie Valley-Northern Yukon pipelines, socio-economic and environmental aspects. Environment Canada, Ottawa. Photographs, maps. (Report to Task Force on Northern Oil Development 74-17).

Species:
Herring, Coregonidae, Stenodus leucichthys, Salvelinus alpinus, S. namaycush, Thymallus arcticus, Esox lucius, Catostomidae, Lota lota.

Places:
Mackenzie River Delta and Valley, Herschel Island, Firth River, Babbage River, Blow River, Richards Island, Kugmallit Bay, Tuktoyaktuk, Eskimo Lakes.

Remarks:
Main commercial, subsistence and sport fishing sites indicated. Coregonids, salvelinids, grayling, pike are most important species.

Hunter, J. G. 1957. Fishery resources survey of the western Arctic. Arctic Biol. Station, Fish. Res. Bd. Ste. Anne de Bellevue, Quebec.

Species:
Coregonus autumnalis, C. sardinella, C. clupeaformis, C. nasus, Stenodus leucichthys, Salvelinus alpinus, Gadidae, Osmeridae, Cottidae, Pleuronectidae.

Places:
Shoalwater Bay, Herschel Island.

Remarks:
Fish concentrate in Shoalwater Bay in summer.

Hunter, J. G. 1966a. The Arctic charr: Fisheries fact sheet. Arctic Biol. Station, Canada Fish. Res. Bd. 3 p.

Hunter, J. G. 1966b. The Arctic charr fish. Canada 19(3):17-19.

Hunter, J. G. 1967. Field activities of the Fisheries Research Board in the Arctic in 1965. Arctic Circ. 17(1):14-16.

Hunter, J. G. 1971. Fisheries Research Board studies in Canada's Arctic. Can. Geogr. J. 82(5):100-107.

Hunter, J. G. 1975. Fishery resources of the western Arctic. Manuscript Rep. Ser. Fish. Res. Bd. Canada, no. 1335. 33 p.

Species:
Clupea harengus, Coregonus autumnalis, C. sardinella, C. nasus, C. clupeaformis, Stenodus leucichthys, Mallotus villosus, Osmerus mordax, Boreogadus saida.

Places:
Mackenzie River Delta, Whitefish Station East, Tuktoyaktuk Peninsula, Cape Bathurst, Arctic Red River, Beaufort Sea.

Remarks:
Whitefishes most common species. Herring fished at Cape Bathurst. Large numbers larvae at Tuktoyaktuk Peninsula. Distribution of all species patchy.

Isakson, J. S., J. M. Storie, J. Vagners et al. 1975. Offshore Prudhoe Bay, Inshore Prudhoe Bay. Pages D204 to D213. In: Comparison of ecological impacts of postulated oil spills at selected Alaskan locations. Introduction, summary, methodology, evaluation, and appendices, June, 1975. Final Report. Vol. 1, Mathematical Sci. Northwest, Inc. Bellevue, Wa.

Species:
Herring, Coregonids, Mallotus villosus, Osmeridae, "Navaga cod," Eleginus gracilis, Boreogadus saida, Theragra chalcogramma, Cottidae, Myoxocephalus quadricornis, Triglops pingeli, Ammodytes hexapterus,

Liparids, Liopsetta glacialis, Platichthys stellatus, Limanda aspera, Pleuronectes quadrituberculatus.

Places:
Prudhoe Bay, Point Barrow, Umiat, Colville River.

Remarks:
Important species tabulated, together with sensitivity to oil spills; commercial, subsistance, sport fishery importance; spawning period; depth range; life history; food habits.

Isakson, J. S., J. H. Storie, J. Vagners et al. 1975. Comparison of ecological impacts of postulated oil spills at selected Alaska locations. Final Report. Vol. II. Results, Mathematical Sci. Northwest, Inc. Bellevue, Wa.

Species:
Lists more than 30 species.

Places:
Kotzebue Sound, Cape Blossom, Prudhoe Bay, Colville River Delta, Umiat, Sagavanirktok River.

Remarks:
Summarizes information on fishes of areas treated. Discusses vulnerability of various species to different types of oil spills, and to spills in different habitats.

Jackson, H. H. T., E. M. Charters, A. J. Duvall and F. Hildebrand. 1949. Literature on the natural history of the arctic region with special reference to Alaska and Canada. Wildlife Leaflet, U.S. Fish and Wildlife Service 317:1-48.

Jenness, D. 1922a. Food. Pages 97-108. In: The Life of the Copper Eskimo. Report of the Canadian Arctic Expedition, 1913-1918. Vol. 12.

Jenness, D. 1922b. Fishing. Pages 152-157. In: The life of Copper Eskimo. Report of the Canadian Arctic Expedition, 1913-1918. Vol. 12.

Jenness, D. 1957. Dawn in Arctic Alaska. University of Minnesota, Minneapolis, Mn. 22 p.

Johansen, Frits. On arctic fishes of North America in the Division of Zoology. Natl. Mus. of Canada. (Unpublished).

Jones, M., and R. Kendel. 1973. The Beaufort Sea gillnetting program in the vicinity of King Point, Yukon. Memo. Rept. Fish. and Marine Service, Dep. of the Environment, Whitehorse, Yukon Territory.

Species:
Stenodus leucichthys, Myoxocephalus quadricornis.

Places:
Beaufort Sea, Shingle Point.

Jangaard, P. M. 1974. The capelin (Mallotus villosus): biology distribution, exploitation, utilization and composition. Bull. Fish. Res. Bd. Canada 186:70 p.

Remarks:
Summarizes existing knowledge of distribution, abundance, life history, fisheries.

Jessop, C. S., K. T. J. Chang-Kue, J. W. Lilley and R. J. Percy. 1974. A further evaluation of fish resources of Mackenzie River Valley as related to pipeline development. Fish. and Marine Service. Environment Canada, Winnipeg. 95 p. (Task Force on Northern Pipelines, Rep. no. 74-7).

Species:

Coregonus nasus, C. pidschian, Stenodus leucichthys, Salvelinus alpinus, Thymallus arcticus, Esox lucius.

Places:
Mackenzie River Delta, Beaufort Sea coast, Aklavik, Fort McPherson, Arctic Red River, Horseshoe Bend, Big Fish River.

Remarks:
Study of freshwater migration and ecology of species common in Mackenzie River delta.

Jessop, C. S., T. R. Porter, M. Blouew and R. Sopuck. 1973. Fish resources of the Mackenzie River Valley. Special Report: an intensive study of the fish resources of 2 mainstem tributaries. Fish. Service, Dep. of the Environment, Winnipeg. 148 p.

Species:
Coregonus autumnalis, C. nasus, C. pidschian, C. sardinella, Prosopium cylindraceum, P. williamsoni, Stenodus leucichthys, Salvelinus alpinus, Thymallus arcticus, Catostomus catostomus, C. commersoni, Couesius plumbeus, Notropis hudsonicus, N. atherinoides, Lota lota, Pungitius pungitius, Cottus cognatus.

Places:
Rat River, Rabbitskin River.

Jessop, C. S., and J. W. Lilley. 1975. An evaluation of the fish resources of the Mackenzie River Valley based on 1974 data. Fish. and Marine Service, Environment Canada, Winnipeg. (Technical Rep. Ser. no CEN/T-75-6)

Species:
Lists 21 species plus "others".

Places:
Aklavik, Norman Wells, Fort Simpson, Mackenzie River Delta.

Remarks:
Refines and supplements earlier data, especially relating to fry and juveniles.

Josephson, Karla. 1974. The use of the sea by Alaska natives, a historical perspective. University of Alaska, Arctic Environmental Information and Data Center, Anchorage 95 p. (Alaska Sea Grant Rept. no. 73-11)

Species:
Herring, Salmon, Whitefish, Tomcod, Sculpin.

Places:
Point Barrow, Cape Smythe, Icy Cape, Wainwright.

Remarks:
Discusses seasonal availability of fishes for food.

Johnson, M. L., C. H. Fiscus, B. T. Ostenson and M. L. Barbour. 1966. Marine Mammals. Pages 877-926. In: N. J. Wilimovsky and J. N. Wolfe, eds. Environment of the Cape Thompson Region Alaska. Division of Technical Information, U.S. Atomic Energy Comm. Springfield, Va.

Remarks:
Lists 18 species fishes utilized by ringed and bearded seals at Point Hope.

Kemp, V. A. M. 1928. Report on the fisheries of the Mackenzie River Delta. Appendix no. 11. Pages 209-210. In: Canada, Department of Marine and Fisheries, Annual Report for 1927-1928. Ottawa.

Species:
Salmon trout, Herring, Whitefish, Jackfish, Conie.

Places:
Mackenzie River Delta, Shingle Point, Kittagaruit.

Kendel, R., and M. Jones. 1973. Report on gillnetting in the Beaufort Sea near Shingle Point and King Point, April, 1973. Fish. Service Manuscript, Canadian Fish. Res. Bd. 6 p.

Kendel, R. E., R. A. C. Johnston, U. Lobsiger and M. D. Kozak. 1974. Movements, distribution, populations, and food habits of fish in the western coastal Beaufort Sea, Dec., 1974. Beaufort Sea Project, Victoria B.C. (Interim Rep. of Beaufort Sea Proj. Study B1).

Species:
Lampetra japonica, Clupea harengus, Coregonus clupeaformis, C. autumnalis, C. sardinella, C. nasus, Stenodus leucichthys, Salvelinus alpinus, Osmerus eperlanus, Mallotus villosus, Couesius plumbeus, Esox lucius, Boreogadus saida, Eleginus navaga, E. gracilis, Myoxocephalus quadricornis, Liopsetta glacialis, Platichthys stellatus.

Places:
Phillips Bay, Trent Bay, Shingle Point, King Point.

Remarks:
Largest concentrations of fish found near shore, especially Shingle Point, Trent Bay east to King Point. C. sardinella the most frequently caught species.

Kendel, R. E., R. A. C. Johnston, U. Lobsiger and M. D. Kozak. 1975. Fish of the Yukon coast. Beaufort Sea Project, Dep. of the Environment, Victoria, B.C. 114 p. (Beaufort Sea Technical Rep. no. 6).

Species:
Lampetra japonica, Clupea harengus, Coregonus clupeaformis, C. autumnalis, C. sardinella, C. nasus, Stenodus leucichthys, Salvelinus alpinus, Osmerus eperlanus, Mallotus villosus, Couesius plumbeus, Esox lucius, Boreogadus saida, Eleginus navaga, E. gracilis, Myoxocephalus quadricornis, Liopsetta glacialis, Platichthys stellatus,

Places:
Phillips Bay, Stokes Lagoon, Herschel Island, Shingle Point, Stokes Point, Kay Point, King Point, Station 200.

Remarks:
Examines aquatic environment of western Beaufort Sea. Distribution, age-maturity, food habits, migrations of major species discussed.

Kerswill, C. J. 1969. Surveys, development, and management of renewable resources, arctic fisheries and sealing. Report on Man in Cold Water Conf., May 12-13, 1969. Montreal.

Kerswill, C. J., and J. G. Hunter. 1970. Fishes. Pages 9-10. In: Fisheries Research Board studies in Canada's Arctic. Misc. Spec. Publ. Fish. Res. Bd. Canada 13.

Species:
Clupea harengus, Salvelinus alpinus, S. namaycush, Coregonidae, Mallotus villosus, Gadidae, Pleuronectidae.

Places:
Mackenzie River Delta, Yukon coast, Beaufort Sea, Banks Island.

Remarks:
S. alpinus most abundant coastal and island species. Total production from delta region estimated at 2.5 million pounds annually. Potential for arctic Canada 5 million pounds. Marine potential 20 million pounds.

Klumov, S. K. 1937. Polar cod and their importance for certain life processes in the Arctic. Izvest. Akad. Nauk. SSSR(biol.) no.1.

Kogl, D. R. 1971. Monitoring and evaluation of Arctic waters with emphasis on the North Slope Drainages: Colville River study. Annual Report of Progress. Federal Aid in Fish Restoration. Alaska Dep. of Fish and Game 12:23-61 (1970-1971). Job G-111-A, Project F-9-3.

Species:
Coregonus autumnalis, C. nasus, C. pidschian, C. sardinella, Prosopium cylindraceum, Salvelinus alpinus, S. namaycush, Thymallus arcticus, Osmerus mordax, Catostomidae, Lota lota.

Remarks:
Preliminary findings on relative abundance, distribution, age, growth, sexual maturity, spawning areas.

Kogl, D. R., and D. M. Schell. 1975. Colville River Delta fisheries research. Pages 483-504. In: V. Alexander, D. C. Burrell, J. Chang, eds. Environmental studies of an Arctic estuarine system. Final Report. U.S. Environmental Protection Agency, Corvallis, Or.

Species:
Lampetra japonica, Acipenser sp., Coregonus autumnalis, C. sardinella, C. nasus, C. pidschian, Prosopium cylindraceum, Stenodus leucichthys, Salvelinus alpinus, Oncorhynchus keta, O. gorbuscha, Osmerus mordax, Catostomus catostomus, Lota lota, Pungitius pungitius, Myoxocephalus quadricornis, Cottus cognatus, Liopsetta glacialis

Places:
Colville River Delta.

Remarks:

Describes history of regional fishery utilization. Discusses life histories and movement patterns of major species. Suggests burbot could support small fishery.

Lantis, M. 1938. The Alaskan whale cult and its affinities. Amer. Anthropol. 40:438-464.

Lantis, M. 1954. Problems in the human ecology in the North American Arctic. Arctic 7(3) and (4).

Larsen, H., and F. Rainey. 1948. Ipiutak and the Arctic whale hunting culture. Anthropoligical Papers of the Amer. Mus. of Natur. Hist. vol. 42.

Leffingwell, E. 1919. The Canning River, Northern Alaska. U.S. Government Printing Office, Washington, D.C. 251 p. (U.S. Geological Survey Professional Paper 109).

Species:
Grayling, Salmon trout, Whitefish, Humpback salmon.

Places:
Oliktok, Beechey Point, Brownlow Point, Harrison Bay, Shaviovik River.

Remarks:
Describes coastal fishing.

Lindberg, G. U. 1936. Materialy po rybam primor' ya [Data on the fishes of the Maritime Territory]. Trudy Zoologicheskogo Instituta. Akademiia Nauk SSSR III:393-407.

Lindberg, G. U. 1937. On the classification and distribution of sandlances genus Ammodytes (Pisces). East Branch Acad. Sci. U.S.S.R. Bull. 27:85-93.

Lotz, J. R. 1964. Yukon Bibliography. Northern Coordination and Res. Center, Dep. of Northern Affairs and Natural Resources, Ottawa. 155 p.

McAllister, D. E. 1960a. Keys to the marine fishes of Arctic Canada. Natural History Papers, Nat. Mus. of Canada 5:1-21.

McAllister D. E. 1960b. List of marine fishes of Canada. Nat. Mus. of Canada Bull. 168:1-76.

Remarks:
Includes 107 arctic spp., 36 endemic arctic spp., 5 spp. common to Arctic and Pacific.

McAllister D. E. 1960c. The origin and status of deepwater sculpin, Myoxocephalus thompsonii, a neartic glacial relict. Nat. Mus. of Canada Bull. 171:44-64.

Remarks:
Discussion of taxonomy and evolutionary relationships.

McAllister D. E. 1961. Revised keys to the marine fishes of Arctic Canada. Natural History Paper, Nat. Mus. of Canada 5:17 p.

McAllister D. E. 1963a. Fishes of the 1960 Salvelinus program from western Canada. Nat. Mus. of Canada Bull. 185:17-39.

Species:
Total of 36 spp. listed.

Places:
Mackenzie River and delta, Aklavik, Herschel Island, Pauline Cove, Peel Channel.

Remarks:
Thirty spp. from Herschel Island, 14 from Aklavik. Three spp. were new to Arctic Canadian fauna. Faunal relationships between Herschel Island and other areas discussed.

McAllister D. E. 1963b. A revision of the smelt family, Osmeridae. Nat. Mus. of Canada Bull. no. 191 (Biological Ser. 71).

McAllister D. E. 1966. Bibliography of the marine fishes of Arctic Canada. University of British Columbia, Institute of Fisheries, Vancouver. 16 p. (Museum Contribution no. 8).

McCart, P. 1974a. Preliminary assessment of the impact on aquatic habitats of proposed "Outer Mackenzie Delta" alternative. A report to Northern Engineering Services Co., Ltd., for Canadian Arctic Gas Study Ltd. 13 p.

McCart, P. 1974b. Late winter surveys of lakes and streams in Canada and Alaska along gas pipeline routes under consideration by Canadian Arctic Gas Study Limited, 1972-73. Canadian Arctic Gas Study Ltd. Calgary. Biological Rep. Ser. 15(1).

Species:
Arctic charr, Grayling.

Places:

Coastal rivers from Prudhoe Bay to Mackenzie River Delta.

Remarks:
Notes wintering and spawning areas.

McCart, P. 1974c. Classification of streams in Beaufort Sea drainages and distribution of fish in Arctic and sub-arctic drainages. Canadian Arctic Gas Study, Ltd. Biol. Rep. Ser. 17:223 p.

McCart, P., P. Craig and H. Bain. 1972. Report on fisheries investigations in the Sagavanirktok River and neighboring drainages. Alyeska Pipeline Service Co. Bellevue, Washington. 166 p.

Species:
Coregonus autumnalis, C. clupeaformis, C. nasus, C. sardinella, Prosopium cylindraceum, Salvelinus alpinus, S. namaycush, Thymallus arcticus, Oncorhynchus keta, O. kisutch, Lota lota, Cottus cognatus, Pungitius pungitius.

Remarks:
Streams categorized as perennial, mountain, spring or foothill. Life history data given for _S. alpinus_, _S. namaycush_, _P. cylindraceum_ and _T. arcticus_.

McCart, P., W. Griffiths, C. Gossen, H. Bain and D. Tripp. 1974. Catalog of lakes and streams in Canada along routes of the proposed Arctic Gas Pipeline from the Alaskan Canadian border to the 60th parallel. Canadian Arctic Gas Study, Ltd. Calgary. Biological Rep. Ser. 16:1-251.

Species:
Lists 34 spp. of marine, anadromous and freshwater fishes.

Remarks:
An extensive compilation of data on streams along proposed Arctic Gas pipeline routes. Includes fishes, water chemistry, benthic invertebrates, winter conditions.

M'Clure, R. J. 1856. The discovery of the Northwest Passage by H.M.S. Investigator, 1850-54. Edited by Sherard Osborn. Longmans, London. 405 p. Maps, plates.

McCormick, R. 1884. Voyages of discovery in the Arctic and Antarctic Seas, and round the world: being personal narratives of attempts to reach the North and South Poles, and of an open boat expedition up the Wellington Channel in search of Sir John Franklin and Her Majesty's Ships Erebus and Terror, in H.M.S. Forlorn Hope. 2 vol. London.

Remarks:
Includes notes on natural history at Beechey Island.

MacDonald, S. D. 1954. Report on biological investigations at Mould Bay, Prince Patrick Island, N.W.T. in 1952. Ann. Rep. Nat. Mus. of Canada 1952-53. Bull. no. 132:214-238.

Species:
Salvelinus alpinus, Lycodes pallidus, Icelus bicornis, Myoxocephalus quadricornis, Polar tomcod, Blue catfish, Lump sucker.

MacGinitie, G. E. 1955. Class Pisces. Pages 183-185. In: Distribution and ecology of the marine invertebrates of Point Barrow, Alaska. Smithsonian Misc. Collections 128(9):1-201.

Species:
Mallotus villosus, Boreogadus saida, Myoxocephalus quadricornis.

Places:
Point Barrow, Elson Lagoon.

Remarks:
Notes on abundance and economic value.

MacIntyre, R. L. 1961. List of titles of publications of Fisheries Research Board of Canada, 1955-1960. Circular, Fish. Res. Bd. Canada, Nanaimo Biol. Sta. 58:94 p.

Mackay, R. 1963. The Mackenzie Delta Area, Northwest Territory. Dep. of Mines and Tech. Surveys, Ottawa. 202 p. (Geographical Branch, Memoir 8).

Mackenzie, Alexander. 1801. Voyages from Montreal on the River St. Lawrence, through the continent of North America to the Frozen and Pacific Oceans; in the years 1789 and 1793. With a preliminary account of the rise, progress, and present state of the fur trade of that country. London. 412 p.

Mackenzie, Alexander. 1803. Voyages from Montreal on the River St. Lawrence, through the continent of North America to the Frozen and Pacific Oceans in the years 1789 and 1793. Evert Duyckinck, New York.

Mackenzie, G. P. 1927. Canada's Arctic Islands-Canadian Expeditions, 1922 and 1923. Northwest Territories and Yukon Branch, Dep. of the Interior. King's Printer, Ottawa.

McLaren, I. A. 1959. Aquatic biology. Pages 70-73. In: G. Hattersley-Smith. Operation Hazen. Narrative and preliminary reports, 1957-58. Defence Research Board, Ottawa.

McMillan, J. G. 1910. Animal life on Melville Island. Pages 473-479. In: J. E. Bernier, ed. Report of the Dominion of Canada Government Expedition to the Arctic Islands and Hudson Strait on board the D.G.S. Arctic. Ottawa.

Macoun, J. 1888. List of fishes known to occur in the Mackenzie Basin. Pages 264-265. In: Report of the Select Committee appointed to enquire into the resources of the Great Mackenzie Basin. Appendix I. Canadian Parliament Session, 1888, Senate Journals 22.

McPhail, J. D. 1960. Annotated bibliography on Arctic North American fresh water fishes. University of British Columbia, Institute of Fisheries, Vancouver. 24 p. (Museum Contribution no. 6).

McPhail, J. D. 1961. A systematic study of the *Salvelinus alpinus* complex in North America. Fish. Res. Bd. Canada 18(5):793-816.

Species:
Salvelinus malma, S. alpinus.

Places:
Seventy-seven localities from Kodiak north and east through the Canadian Arctic Archipelago.

Remarks:
A taxonomic analysis.

McPhail, J. D. 1963. Geographic variation in North American Ninespine Sticklebacks, *Pungitius pungitius*. J. Fish. Res. Bd. Canada 20(1):27-44.

Species:
Pungitius pungitius.

Places:
Meade River, Ikroavik River, Singakit River, Itkillik River, Colville River, Herschel Island, Kikiukroik River, Horton River, Aklavik River, Anderson River, Bernard Harbor, Cambridge Bay.

Remarks:
A taxonomic study.

McPhail J. D. 1966. The Coregonus autumnalis complex in Alaska and Northwestern Canada. J. Fish. Res. Bd. Canada 23(1):141-148.

Species:
Coregonus autumnalis, C. laurettae, Argyrosomus alascanus.

Places:
Point Barrow, Elson Lagoon, Oliktok, Herschel Island, Beaufort Sea, Tuktoyaktuk, Aklavik, Peel River, Liverpool Bay, Baillie Island, Victoria Island, Bathurst Inlet, Escholtz Bay, Port Clarence.

Remarks:
Taxonomic study of the C. autumnalis group.

McPhail, J. D., and C. C. Lindsey. 1970. Freshwater fishes of Northwestern Canada and Alaska. Fish. Res. Bd. Canada, Bull. 173:381 p.

Remarks:
Contains descriptions, summaries of zoogeography, biology, utilization.

McPherson, E. H. et al. 1972. Potential effects on social values in wildlife and fisheries resources. Pages 79-80. In: R. G. Leggett and I. C. MacFarlane, eds. Canadian Pipeline Research Conference, Ottawa, 1972. Proc. National Research Council of Canada, Ottawa. (National Research Council. Tech. Memo. no. 104).

McRoy, C. P., G. J. Mueller, J. Crane and S. W. Stoker. 1971. Nearshore Marine Biological results-Colville River. Pt. 5, no. 3, unnumbered paging. In: P. Kinney, et al. eds. Baseline data study of Alaskan Arctic aquatic environments: eight months progress 1970. University of Alaska, Institute of Marine Science, Fairbanks, Alaska (IMS Rep. 71-4).

Species:
Boreogadus saida, Myoxocephalus sp., Lumpenus fabricii, Liparis liparis, Liopsetta glacialis, unknown larvae.

Places:
Simpson Lagoon and barrier islands, Iliktok Point.

Remarks:
Results of experimental otter trawl sampling.

Maguire, R. 1854. Proceedings of Commander Maguire, H.M. Discovery Ship Plover. London, 1854. (Parliamentary Reports, XLII:165-185. 1854.).

Maguire, R. 1855. Proceedings of Commander Maguire, H.M. Discovery Ship Plover. Further papers relative to the recent Arctic expedition in search of Sir John Franklin, etc., p. 905 (second year). Presented to both Houses of Parliament, January, 1855. London.

Maguire, R. 1856. Account of the Plover, 1852-53. In: Sherard Osborn, ed. The discovery of the Northwest Passage by H.M.S. Investigator, Captain R. M'Clure. Longman, Brown, Green, Longmans and Roberts, London.

Mair, C., and R. MacFarlane. 1908. Through the Mackenzie Delta. William Briggs, Toronto. 494 p.

Remarks:
Inquiry into resources of Mackenzie Basin. Passing reference to fish.

Manchester, L. 1954. Fish and Fishing. Page 96. In: Clifford Wilson, ed. North of 55 degrees. Ryerson, Toronto.

Species:
Herring, Whitefish, Stenodus leucichthys, Salvelinus alpinus.

Places:
Mackenzie River Valley and Delta.

Remarks: Details quantities of fish used for human and dog food.

Mann, G. J. 1974a. Life history types of the least cisco (Coregonus sardinella Valenciennes) in Beaufort Sea drainages in the Yukon Territory, North Slope, and in the eastern Mackenzie River Delta drainages. M.S. Thesis. University of Alberta, Dep. of Zoology. 157 p.

Mann, G. J. 1974b. Alternate life histories of the least cisco (Coregonus sardinella Valenciennes) in the Yukon Territory, North Slope, and eastern Mackenzie River drainages. Canadian Arctic Gas Study Ltd. Calgary, Alberta. Biological Rep. Ser. 18(3):132 p.

Mann, G. J. 1975. Winter fisheries survey across the Mackenzie Delta. Canadian Arctic Gas Study Ltd. Calgary. Biological Rep. Ser. 34(3):54. (October, 1975).

Species:
Clupea harengus, Coregonus clupeaformis, C. nasus, C. sardinella, Stenodus leucichthys, Thymallus arcticus, Osmerus eperlanus, Esox lucius, Lota lota, Catostomus catostomus, Pungitius pungitius, "Sculpins".

Places:
Lower Mackenzie Delta.

Remarks:
Results of three winter surveys, 1974-75. Mackenzie Delta important migration path for anadromous spp. Lakes and small channels vital to survival of 23 spp.

Mann, C. V. et al. 1962. The health and nutritional status of Alaskan Eskimos. Am. J. of Clinical Nutrition 11(1):31-76. (July, 1962).

Manning, T. H. 1953. Notes on the fish of Banks Island. Arctic 6(4):276-277.

Species:
Coregonus sardinella, Coregonus spp., Salvelinus alpinus, S. namaycush, "Sculpin".

Places:
Banks Island, Sachs River, De Salis River, Castel Bay, Raddi Lake, Wollaston Lake, Victoria Island.

Remarks:
Summary of the fishes caught or seen. Eskimoes reported no fish around Banks Island except at mouths of Sachs and De Salis rivers.

Manning, T. H. 1954. Defence Research Board's 1953 Banks Island Expedition. Arctic Circular 7:11-15.

Manteufel, B. P. 1943. The Polar cod and its fishery. Arkhangelsk.

Martin, W. R. 1939. The Arctic char of North America. M.A. Thesis. University of Toronto, Toronto, Ontario. 64 p.

Mathews, D. 1973. A baseline for Beaufort. Exxon U.S.A. 12(1):2-7.

Remarks:
Beaufort Sea described as a cold, biological desert because of nutrient-poor water, year-round presence of ice and long winter darkness.

Mecham, G. F. 1855. Southern and western Melville Island. Pages 496-540. In: Great Britain. Admiralty. Further Papers relative to the recent Arctic expedition in search of Sir John Franklin. Presented to both Houses of Parliament, January, 1855. London.

Melville, J. C. D. 1914. Notes on the distribution and economic importance of "Inconnu" (Stenodus Mackenzie) in the Mackenzie River Valley. Ann. Rep. Dep. of Marine and Fisheries, Canada. 47:238-243.

Species:
Stenodus mackenzie.

Places:
Mackenzie River Valley and Delta, Slave River, Riviere de Rochers, Stony Island, Buffalo River, Great Slave Lake, Sans Sault Rapids, Fort Smith, Anderson River, Churchill, Coppermine River.

Merrell, T. R. Jr. 1971. Under ice observations, with scuba, of marine organisms, Beaufort Sea, north coast of Alaska, Feb. 1971-April 1971. Biological Lab., Nat. Marine Fisheries Service, Auke Bay, Alaska.

Milan, F. A. 1958. Observations on the contemporary Eskimo of Wainwright, Alaska. Tech. Rep. 57-14. Arctic Aeromed. Lab., Ladd A.F. Base, Fairbanks, Alaska.

Milan, F. A. 1964. The acculturation of the contemporary Eskimo of Wainwright, Alaska. Anthropological Papers, University of Alaska 11(2).

Milne, A. R., and B. D. Smiley. 1976. Offshore drilling for oil in the Beaufort Sea: a preliminary environmental assessment. Revised January 20, 1976. Beaufort Sea Project, Dep. of Environment, Victoria, B.C. (Beaufort Sea Tech. Rep. no. 39).

Species:
Clupea harengus, Coregonus artedii, C. nasus, C. pidschian, "Whitefish", Stenodus leucichthys, Salvelinus alpinus, Thymallus arcticus, Mallotus villosus, "Smelts", Gadus ogac, Eleginus gracilis, Arctogadus glacialis, Boreogadus saida, Lota lota, Esox lucius, "Sculpins", "Flatfish", Larval groundfish spp.

Places:
Mackenzie Delta, Tuktoyaktuk Peninsula, Mackenzie Bay, Liverpool Bay, Richards Island, Atkinson Point, Aklavik, Inuvik, Mason Bay, Mallik Bay, Paulatuk, Holmes Creek.

Remarks:
Describes volume of subsistence and commercial fisheries; amounts consumed by people and dogs. Possible effects of blow-outs on food chain and fisheries.

Mohr, J. L., N. J. Wilimovsky and E. Y. Dawson. 1957. An Arctic Alaskan kelp bed. Arctic 10(1):45-52.

Species:
Boreogadus saida, Gymnelis viridis, Myoxocephalus scorpius, Artediella scaber, Enophrys diceraus.

Remarks:
Discussion of fauna of a kelp bed 50 miles southwest of Barrow, Alaska.

Moiseev, P. A. 1952. Some characteristics of the distribution of bottom and demersal fishes of the far-eastern seas. Izvestiia Tikhookeanskogo no. I. Instituta Rybnovo Khoz Khoziaistva i Okeanografii 37:129-137. Vladivostok. Available in English as Fish. Res. Bd. Canada translation 94.

Moiseev, P. A. 1953a. Some characteristics of the distribution of bottom and demersal fishes of the far-eastern seas. Ivestiia Tikhookean. N-I. Instituta Ryb. Khoz. i Okeanografii 37:129-137(1952), Vladivostok. Available as Fish. Res. Bd. Canada Trans. 94. 10 p.

Moiseev, P. A. 1953b. Cod and flounders of the far-eastern sea. Ivestiia Tikhookeanskogo. N.I. Inst. Rybnogo Khoziastva i Okeanografii 40:1-287. Available in English as Fish. Res. Bd. Canada, Trans. no. 119.

Moiseev, P. A. 1954. Izuchenie morskikh i presnovodnykh bogatstv Dal'nego Vostoko [Study of marine and freshwater reserves of the Far East]. Izvestiya Tikhookeanskogo Instituta Rybnogo Khozyaistva i Okeanografii 39.

Moiseev, P. A. 1956. Peculiarities in the population dynamics of the commercial fauna in the northeastern part of the Pacific Ocean and its causes. Zool. Zh. 35(11):1601-1607.

Montgomery, D. T., and L. A. Boughton. 1974. Preliminary biological data for outer continental shelf resources reports on Alaska. Fish and Wildlife Service, U.S. Dep. of the Interior. 23 p.

Moskalenko, B. K. 1964. On the biology of Arctic cod, Boreogadus saida (Lepechin). Voprosy Ikhtiologii 4(3):32, 433-443.

Mueller, G. J. 1971. Species analysis of Oliktok-Colville Project, 61-A, 19-27 August, 1970. University of Alaska, Fairbanks. (Unpublished memo.).

Species:
Boreogadus saida, Lumpenus fabricii, Myoxocephalus quadricornis, Liparis liparis, Liopsetta glacialis, unknown larval spp.

Places:
Oliktok, Colville River, Thetis Island.

Remarks:
Results of experimental otter trawl sampling.

Murdoch, J. 1884. Fish and fishing at Point Barrow, Arctic Alaska. Trans. Amer. Fish Cultural Assoc. 13:111-115.

Species:

Coregonus kennicotti, C. laurettae, C. nelsoni, Salvelinus malma, Oncorhynchus gorbuscha, Mallotus villosus, Osmerus dentex, Boreogadus saida, Lota maculosa.

Places:
Point Barrow, Elson Bay, Wainwright Inlet, Colville River, Perginak.

Remarks:
Describes relative abundance of fishes; Eskimo fishing methods.

Murdoch, J. 1885. Fishes. Pages 129-132. In: P. H. Ray, ed. Report of the International Polar Expedition to Point Barrow, Alaska, 1882-1883. Pt IV. Sec. 3. U.S. Government Printing Office, Washington, D.C.

Species:
Coregonus kennicotti, C. laurettae, C. nelsoni, Salvelinus malma, Oncorhynchus gorbuscha, Oncorhynchus sp., Mallotus villosus, Osmerus dentex, Boreogadus saida, Lota maculosa, Gymnelis viridis, Lycodes turneri, L. coccineus, Gasterosteus pungitius, Cottus quadricornis, C. decastrensis, Liparis gibbus.

Places:
Point Barrow, Meade River, Kuaru River, Cape Smythe, Elson Bay, Pergniak, Wainwright Inlet.

Remarks:
A list of species taken, with notes on methods, abundance, distribution.

Murdoch, J. 1892. Fishes. Page 58. In: Ethnological results of the Point Barrow Expedition, International Polar Expedition to Point Barrow, Alaska, 1881-1883. Ann. Rep. Bur. Ethnol. 9.

Species:
Coregonus laurettae, C. kennicotti, C. nelsoni, Salvelinus malma, Oncorhynchus gorbuscha, Oncorhynchus sp., Thymallus signifer, Osmerus dentex, Mallotus villosus, Boreogadus saida, Cottus quadricornis, C. decastrensis.

Places:
Point Barrow, Elson Bay, Colville River mouth, Kuaru River, Kulugrua River, Ku River.

Remarks:
B. saida plentiful all year, M. villosus in summer. Greatest quantities of fish from rivers.

Murdoch, J. 1898. The animals known to the Eskimos of northwestern Alaska. Amer. Naturalist 32(382):719-734.

Musienko, R. P. 1957. Young flatfishes (Pleuronectidae) of the Far Eastern seas. Distribution, age and growth. Pages 76-98. In: G. N. Nikitin, ed. Marine biology. Trans. Inst. Oceanology, U.S.S.R. Academy of Science Press, Moscow.

Muth, K. M. 1969. Age and growth of the broad whitefish (Coregonus nasus) in the Mackenzie and Coppermine Rivers, N.W.T. J. Fish. Res. Bd. Canada 26(8):2252-2256.

Namtvedt, T., S. Parrish, N. Friese and W. Quirk. 1974. Fish. Pages 252-268. In: Alaskan arctic coast-a background study of available knowledge. Prepared for Dep. Army, Alaska District, Corps of Engineers. Alaska Office, Arctic Institute of North America.

Species:
Clupea harengus, Mallotus villosus, Osmerus mordax, Boreogadus saida, Eleginus gracilis, Artediellus scaber, Gymnocanthus tricuspis, Myoxocephalus scorpius, Triglops pingeli. Total of 69 marine and 23 freshwater spp. discussed briefly.

Places:
Kotzebue Sound to Cape Lisburne; Point Hope to Demarkation Point.

Remarks:
Outlines available knowledge of factors determining distribution and abundance of fishes in Beaufort and Chukchi seas. Anadromous fish streams from Point Hope to Demarkation Point indicated. Spawning seasons and areas tabulated.

Nelson, Edward W. 1886. Field notes on Alaskan fishes with additional notes by Tarleton H. Bean. Pages 295-322. In: L. M. Turner, ed. Contributions to the natural history of Alaska. Results of expeditions made chiefly in the Yukon District and the Aleutian Islands. Conducted under the auspices of the Signal Service, U.S. Army, extending from May, 1874 to August, 1881. U.S. Government Printing Office, Washington, D.C.

Species:
Stenodus mackenzii, Thymallus signifer, Osmerus dentex, Pleuronectes glacialis.

Places:
Bering Sea, Yukon River upstream to Fort Yukon, Kuskokwim River to Point Barrow.

Remarks:
Descriptions, brief general notes on various spp.

Nelson, R. K. 1965. Alaskan Eskimo exploitation of the sea ice environment. Prepared for the Arctic Aeromed. Lab. University of Wisconsin, Madison. 354 p.

Nelson, R. K. 1966. Literature review of Eskimo knowledge of sea ice environment. Arctic Aeromed. Lab. (AAL-TR-65-7).

Nelson, R. K. 1969. Hunters of the northern ice. University of Chicago Press, Chicago.

Nikolskii, C. V. 1947. On biological peculiarities of faunistic complexes and on the value of their analysis for zoogeography. Zool. Zhur. 26(3).

Nikolskii, G. V., and D. V. Radakov. 1968. Food interrelations of pelagic fish in the northern seas. Rapp. Proc. Verb. Cons. Int. Explor. Mer. 153:143-146.

Noerenberg, W. H. 1974. Fish and wildlife information and recommendations. Appendix E-3, 1025. July 20, 1974. Fish and Wildlife Consultant, Trans-Alaska Pipeline.

Nordenskiold, N. A. E. 1882. The voyage of the Vega round Asia and Europe with a historical review of previous journeys along the north coast of the Old World. Translated by Alexander Leslie. MacMillan Company, New York.

Nordenskiold, N. A. E. 1882-1887. Vega-expeditionens vetenskapliga iaktagelser bearbetade af Heltagare i resan och andra forskare. Volumes 1-5. F. and G. Beijers, Stockholm.

Northwest Alaska Native Association. 1973. Survey of resources harvested in the NANA region.

Nursall, J. R., and D. Buchwald. 1972. Life history and distribution of arctic lamprey, Lethenteron japonicum (Martens) of Great Slave Lake, N.W.T. Fish. Res. Bd. Can. Tech. Rep. no. 304.

Orcutt, H. G., 1950. The life history of the Starry flounder, Platichthys stellatus (Pallas). Calif. Fish. Bull. 78:1-64.

Osborn, Sherard. 1856. The discovery of the Northwest Passage by H.M.S. Investigator, Captain R. M'Clure, 1850, 1851, 1852, 1853, 1854. Edited by Commander Sherard Osborn from the logs and journals of Captain Robert M'Clure. London.

Remarks:
Describes fauna of Prince Albert Land, Banks Island, Prince of Wales Strait and Mercy Bay.

Oswalt, W. H. 1967. Alaskan Eskimos. Chandler Publishing Company, San Francisco.

Pallas, P. 1811. Zoographia Rosso-asiatica, sistens omnium animalium in extenso Imperio rossico, et adjacentibus maribus observatorium recensionem, domicilia, mores, et descriptiones, anatomen, atque icones plurimorum. Auctore Petro Pallas ... Petropoli, in officina caes, academiae scientiarum impress, Petropoli.

Parker, W., D. Swanson, V. Fischer and J. Christian. 1972. Northwest Alaska economic and transportation prospects, a survey report prepared by the Institute of Social, Economic, and Government Research, University of Alaska, Fairbanks, for Alaska District, U.S. Army Corps of Engineers.

Parry, W. E. 1824. Journal of a second voyage for the discovery of a Northwest Passage to the Pacific Ocean performed in the years 1821, 22, 23 in H.M.S. Fury and Hecla. London.

Patterson, A. 1974. Subsistence harvests in five native regions. Resource Planning Team, Joint Federal-State Land Use Planning Comm. for Alaska, Anchorage. 48 p.

Pearse, G. A. 1969. A partial bibliography of Arctic fish. Available from University of Alaska, Dep. of Wildlife Management. (Unpublished).

Pearse, G., R. Peckham, M. Kramer and K. Alt. 1976. Creel census in Prudhoe Bay. Pages 129-149. In: Inventory and cataloging of North Slope waters. Alaska Dep. Fish Game, Fed. Aid Fish Restor. Ann. Rep. Vol. 7.

Species:
Salvelinus alpinus, S. namaycush, Thymallus arcticus.

Places:
Prudhoe Bay, Sagavanirktok River and tributaries.

Remarks:
Limited angling in Prudhoe Bay in July and August. Mentions overwintering areas.

Pedersen, S. 1971. Status and trends of subsistence resource use at Point Hope. In: Point Hope Project Report. University of Alaska, Fairbanks.

Species:
Clupea harengus, Coregonus spp., Salvelinus alpinus, S. malma, Oncorhynchus gorbuscha, Thymallus arcticus, Osmerus dentex, Boreogadus saida.

Places:
Point Hope, Kukpuk River, Itublarak River.

Remarks:
Describes annual cycles of utilization of fishes.

Penhale, P. 1972. Food requirements of the ninespine stickleback, Pungitius pungitius, in an Arctic tundra lake of Alaska. M.S. Thesis. University of North Carolina, Chapel Hill.

Pennant, Thomas. 1784-1787. Arctic Zoology. 2 vol. H. Hughes, London.

Pennoyer, S. 1965. Arctic-Yukon-Kuskokwim area: salmon fishing history. Informational Leaflet, Alaska Dep. Fish Game 70:51 p.

Percy, R. 1975. Fishes of the outer Mackenzie Delta. Beaufort Sea Project, Dep. of the Environment, Victoria, B.C. 114 p. (Beaufort Sea Tech. Rep. 8).

Species:
Lampetra japonica, Clupea harengus, Coregonus autumnalis, C. clupeaformis, C. nasus, C. sardinella, Prosopium cylindraceum, Stenodus leucichthys, Salvelinus alpinus, S. namaycush, Thymallus arcticus, Osmerus eperlanus, Hypomesus olidus, Catostomus catostomus, Couesius plumbeus, Esox lucius, Eleginus gracilis, Lota lota, Percopsis omiscomaycus, Pungitius pungitius, Cottus ricei, Myoxocephalus quadricornis, Liopsetta glacialis, Platichthys stellatus.

Places:
Mackenzie River Delta, Beaufort Sea.

Remarks:
Review of existing knowledge of migration routes and timing, food habits, life histories.

Percy, R., W. Eddy and D. Munro. 1974. Anadromous and freshwater fish of the outer Mackenzie Delta. Fish. and Marine Service, Environment Canada. (Interim Rep. of the Beaufort Sea Project Study B2).

Species:
Lampetra japonica, Clupea harengus, Coregonus spp., Coregonus autumnalis, C. clupeaformis, C. nasus, C. sardinella, Prosopium cylindraceum, Stenodus leucichthys, Salvelinus namaycush, Thymallus arcticus, Hypomesus olidus, Osmerus eperlanus, Catostomus catostomus, Couesius plumbeus, Esox lucius, Lota lota, Eleginus gracilis, Persopsis omiscomaycus, Pungitius pungitius, Myoxocephalus quadricornis, Cottus ricei, Liopsetta glacialis, Platichthys stellatus.

Places:
Mackenzie River Delta, Richards Island, Mason Bay, Mallik Bay, Kugmallit Bay, Shallow Bay, Swan Channel, East Channel, Tuktoyaktuk, Kendall Island, Pullen Island, Rae Island, Holmes Creek, Tununuk.

Remarks:
Summary of abundance, summer and winter distribution, nursery areas, food habits, migrations, age-length relationships.

Peterman, A. 1852. Notes on the distribution of animals available as food in the Arctic regions. J. Roy. Geog. Soc. London 20:118-127.

Peterson, M. M. 1974. Ecology of the Canadian Arctic Archipelago: selected references. 3 vol. Annotated by Merle Peterson. Western Ecological Services, Ltd. Edmonton, Alberta.

Petroff, I. 1882. Report on the population, industries, and resources of Alaska, 1880. Census Office, U.S. Dep. of the Interior, Washington, D.C.

Species:
Oncorhynchus sp., Coregonus sp., "Salmon trout", Tomcod (Pleurogadus navaga).

Remarks:
Very little information relating to arctic fishes.

Ponomarenko, V. P. 1968a. Some data on the distribution and migrations of polar cod in the seas of the Soviet Arctic. Rapp. Proc. Verb. Cons. Int. Explor. Mer. 158:131-135.

Ponomarenko, V. P. 1968b. Migratsii sayki v Sovetskom sektore Artiki [Migration of the Polar cod in the Soviet Arctic]. Murmansk, Polyarnyy n-issl. inst. morskogo rybnogo Khozyaystva i Okeanografii. Trudy 1968, no. 23:500-512. [In Russian, English summary].

Ponomarenko, V. P., Kh. M. Natenzon and V. M. Naumov. 1962. Experimental cruise on Polar cod fishing. Ryb. Khoz. 12:36-40.

Popov, A. M. 1933. To the knowledge of the ichthyofauna of the Siberian Sea. Arctica 1:157-168.

Species:
Boreogadus saida, Artediellus scaber, Gymnocanthus tricuspis, Icelus bicornis.

Places:
Chukchi Sea.

Porsild, A. E. 1950. A biological exploration of Banks and Victoria Island. Arctic 3:45-54.

Porter, R. P. 1893. Population and resources of Alaska at the eleventh census, 1890. Census Office, Dep. of the Interior, Washington, D.C. 282 p.

Potapova, G. A. 1965. Bibliography on fishery investigations in the Northwest Pacific Ocean. Pages 297-373. In: Soviet fisheries investigations in the Northeast Pacific. Pt. IV. Translated from Russian by Israel Program for Scientific Translation, Jerusalem.

Preble, E. A. 1908. Fishes of the Athabaska-Mackenzie region. Pages 502-515. In: A biological investigation of the Athabaska-Mackenzie region. Bureau of Biological Survey, U.S. Dep. of Agriculture, Washington, D.C. (North American fauna 27).

Species:
Lampetra aurea, Coregonus spp., Argyrosomus tullibee, A. lucidus, Stenodus mackenzii, Oncorhynchus nerka, Salvelinus malma, Osmerus dentex, Pygosteus pungitius, Cottus cognatus, Oncocottus hexacornis, Lota maculosa.

Remarks:
Deals chiefly with inland areas, but includes some data relating to the Mackenzie River Delta.

Quast, J. C. 1972. Preliminary report of fish collected on WEBSEC-70. Oceanographic Unit, U.S. Coast Guard. Washington, D.C. (U.S. Coast Guard Oceanographic Rep. 50).

Remarks:

Lists 26 spp. Gives localities, depths, collection methods, temperature, life history stages. Species occurrence highest in Cape Lisburne area, lowest in NE Chukchi Sea.

Quast, J. C. 1974. Density distribution of juvenile Arctic cod, Boreogadus saida (Lepechin), in the eastern Chukchi Sea in the fall of 1970. Fish. Bull. 72(4):1094-1104.

Quast, J. C., and E. L. Hall. 1972. List of fishes of Alaska and adjacent waters with a guide to some of their literature. U.S. Dep. of Commerce, 1972. (NOAA Tech. Rep. NMFS. SSRF-658).

Rae, J. 1852. Journey from Great Bear Lake to Wollaston Land and explorations along the south and east coast of Victoria Land. Roy. Geog. Soc. 22.

Rainey, G. G. 1941. Native economy and survival in Arctic Alaska. Appl. Anthropol. 1(1).

Rainey, F. G., and H. E. Larsen. 1948. Ipiutak and the Arctic whale hunting culture. Anthro. Pap. Amer. Mus. Nat. Hist. 42:276 p.

Species:
Oncorhynchus spp., Coregonus spp., Thymallus arcticus, "Tomcod".

Remarks:
Occasional mention of fishes and fishing implements.

Rass, T. S. 1955. New regions and resources open to commercial fishing in far eastern waters. Vop. Ikhtiol. 4:71-81. Available as Trans. 143, Fish. Res. Bd. Canada. 24 p.

Rass, T. S. 1956. The possibilities of substantially increasing catches in the Far East. Ryb. Khoz. 9:57-60. [In Russian].

Rass, T. S. 1958. Ichthyological investigations of the Institute of Oceanology of the Academy of Sciences of the U.S.S.R. in the far eastern seas. Trud. Okeanogr. Kom. Acad. Nauk SSSR 3:118-121. [In Russian].

Ray, P. H. 1885. Fishes. Pages 129-132. In: J. A. Murdoch, ed. Report of the International Polar Expedition to Point Barrow, Alaska, 1882-1883. U.S. Government Printing Office, Washington, D.C.

Redburn, D. R. 1974. The ecology of the inshore marine zooplankton of the Chukchi Sea near Point Barrow, Alaska. M.S. Thesis. University of Alaska, Fairbanks.

Rendahl, H. 1931. Fische aus dem ostlichen Sibirischen Eismeer und dem Nordpazific. Arkiv Zool. 22A(10):81 p.

Remarks:
Discusses marine species of Bering Strait-Chukchi Sea.

Ricciardelli, A. F. 1953. The causes which led to the abandonment of the Arctic Slope of Alaska. M.A. Thesis. University of Pennsylvania, Philadelphia.

Richards, H. G. 1950. Postglacial marine submergence of Arctic North America with special reference to the Mackenzie Delta. Proc. Am. Phil. Soc. 94:31-3[illegible].

Richardson, J. 1823. Notices of the fishes. Pages 705-728. In: John Franklin, ed. Narrative of a journey to shores of the Polar Sea in the years 1819, 1820, 1821, and 1822. Appendix no. 6. John Murray, London.

Richardson, J. 1824. Account of some fishes observed during Captain Franklin and Dr. Richardson's journey to the Polar Seas. Memoirs Wernerian Nat. Hist. Soc. Edinburgh 5, pt. 1:509-522.

Species:
Coregonus albus, C. artedi, Hiodon clodalis.

Remarks:
Taxonomic descriptions, of historical interest only.

Richardson, J. 1835. Salmones. Pages 55-58. In: J. C. Ross, ed. Appendix to the narrative of a second voyage in search of a Northwest Passage, and of a residence in the Arctic regions during the years 1829, 1830, 1831, 1832, and 1833. A. W. Webster, London.

Richardson, J. 1836. The Fish. Part 3. In: Fauna Boreali-Americana; or the Zoology of the northern parts of British America. Richard Bentley, London. 327 p., 24 pl.

Remarks:
Detailed descriptions of 140 spp. Notes on distribution, biology.

Richardson, J. 1837. Report on North American Zoology. Pages 121-224. In: Report. 6th meeting British Association for the Advancement of Science, 1836, pt. v.

Remarks:
Many species described from Mackenzie River region.

Richardson, J. 1851. Arctic searching expedition, a journal of a boat voyage through Rupert's land and the Arctic Sea in search of the discovery ships under command of Sir John Franklin with an appendix on the physical geography of North America. 2 vol. Longman, Brown, Green, and Longman, London.

Species:
Coregonus spp., Salmo mackenzii, "Trout", Oncorhynchus sp.

Remarks:
Numerous references to fishes, native methods of catching and preserving.

Richardson, J. 1861. Zoology. Pages 274-284. _In_: The Polar regions. Edinburgh.

Remarks:
Contains brief remarks on distribution and general characteristics of more common birds, mammals, fishes.

Richardson, J. 1870. Fish. Pages 518-522, appendix. _In_: George Back, ed. Narrative of the Arctic Land Expedition to the mouth of the Great Fish River and along the shores of the Arctic Ocean in the years 1833, 1834, and 1835. Charles E. Tuttle, Rutland, Vermont. 663 p.

Species:
Coregonus spp., Salmo mackenzii, S. namaycush, Catostomus sp., Esox lucius, Lota maculosa.

Remarks:
Deals chiefly with inland spp., little information on marine forms.

Richardson, J., N. A. Vigors, G. T. Lay _et al_. 1839. Fishes. Pages 41-75. _In_: Zoology of Captain Beechey's voyages compiled from collections and notes made by Captain Beechey, the officers and naturalists of the expedition during a voyage to the Pacific and Behring's Straits performed in H.M.S. Blossom under the command of Captain F. W. Beechey ... in the years 1825, 1826, 1827, and 1828. Henry G. Bohn, London.

Riske, M. E. 1960. A comprehensive study of north Pacific and Canadian arctic herring, Clupea. M.S. Thesis. University of Alberta, Edmonton.

Remarks:
Provides life history and distribution data of species in Mackenzie Delta-Beaufort Sea area.

Rock, H. 1964. Arctic Survival. Tundra Times. Vol. 3, No. 2, 26 October, 1964.

Rockwell, J. 1972. Critical times in streams. Data supplied by H. T. Yoshihara, N. F. Netsch and K. Robertson. Interagency Fish and Wildlife Team, Anchorage, Alaska. 76 p.

Roguski, E. A., and E. Komarek, Jr. 1971. Monitoring and evaluation of Arctic waters with emphasis on North Slope drainages. Arctic Wildlife Range Study. Rep. no. F-9-3. Alaska Dep. Fish Game. 38 p.

Species:
Coregonus autumnalis, Coregonus spp., Salvelinus alpinus, Thymallus arcticus, Myoxocephalus quadricornis.

Places:
Demarkation Point, Siku Point, Pokuk Bay, Barter Island, Simpson Cove, Brownlow Point, Aichilik River, Jago River, Kaktovik, Griffin Point, Anderson Point, Canning River.

Remarks:
A study of water conditions and fish species in the Arctic National Wildlife Range. Contains data on age, growth, length frequencies, sexual maturity, distribution.

Roguski, E. A., E. Komarek, Jr. and D. R. Kogl. 1971. Annual Progress Report for monitoring and evaluation of Arctic waters with emphasis on North Slope drainages July 1, 1970 to June 30, 1971. Div. of Sport Fish, Alaska Dep. Fish Game. Job G-111-A. Vol. 12:61 p.

Species:
Coregonus autumnalis, C. nasus, C. pidschian, C. sardinella, Prosopium cylindraceum, Salvelinus alpinus, S. namaycush, Thymallus arcticus, Osmerus mordax, Catostomus catostomus, Esox lucius, Lota lota, Pungitius pungitius, Cottus cognatus, Myoxocephalus quadricornis, Liopsetta glacialis.

Places:
Arctic coast and north slope of Alaska from Demarkation Point to Colville River and south to Anaktuvuk Pass.

Remarks:
Data on ice conditions, depths, bottom type, currents, salinities at river mouths and lagoons in Arctic Wildlife Range. Age, growth, length frequencies, sexual maturity, distribution of fishes.

Romanov, N. S. 1959. Annotated bibliography on far eastern aquatic fauna, flora, and fisheries [Ukazatel' literatury po rybnomu Khazyaistvu dal'. nego Vostoko 1923-1956/gg. Izdatel'stvo Akademiya Nauk SSSR. Otodclenie Biologicheskikh Nauk, Ikhtiologicheskaya Kommisiya, Moskva. Translated by Israel Program for Scientific Translations, 1966. 391 p. Available from Nat. Marine Fish. Service, Trans. 64-11101.

Ross, C. 1835. Fish. Pages 46-54. In: John Ross, ed. Appendix to the narrative of a second voyage in search of the Northwest Passage. A. W. Webster, London.

Rostlund, E. 1952. Freshwater fish and fishing in native North America. University of California, Publ. Geog. 9:313 p.

Remarks:
Arctic charr the only fish of real economic importance to polar and central Eskimos.

Royal Northwest Mounted Police. 1919. Report of Bathurst Inlet Patrol, 1917-18. Ottawa.

Sabine, E. 1821. An account of the animals seen by the late northern expedition whilst within the Arctic Circle. Pages 33-36. In: William Parry, ed. Journal of a voyage for the discovery of a Northwest Passage from the Atlantic to the Pacific performed in the years 1819-20 in H.M.S. Hecla and Griper. 2nd ed. Appendix no. 10. John Murray, London.

Sabine, E. 1826. Fishes. Pages 109-111. In: Captain William Parry ed. Journal of a third voyage for the discovery of the Northwest Passage from the Atlantic to the Pacific performed in the years 1824-25 in H.M.S. Fury and Hecla under orders of Captain William Edward Parry. John Murray, London.

Schallock, Eldor. 1971. Sagavanirktok River Basin Study. Angling and observations. Alaska Water Lab. Environmental Protection Agency, College, Alaska. 6 p.

Schmidt, P. J., and A. P. Andriyashev. 1935. A Greenland fish in the Oknotsk Sea. Copeia 1935 (2):57-60.

Species:
Eumesogrammus praecisus.

Places:
Beaufort Sea, Bering Sea, Sea of Okhotsk.

Schmidt, W. T. 1970. A field survey of bird use at Beaufort Lagoon. Prepared for the Bur. Sport Fish. Wildl. Arctic Nat. Wildl. Range, June-September, 1970.

Remarks:
Discusses utilization of fishes by birds.

Schrader, F. C. 1904. A reconnaissance in northern Alaska across the Rocky Mountains, along Koyakuk, John, Anaktuvak, and Colville Rivers and the Arctic coast to Cape Lisburne in 1901. U.S. Government Printing Office, Washington, D.C. (U.S. Geological Survey Prof. Pap. no. 20).

Schultz, L. P., and A. D. Welander. 1935. A review of the cods of Northeastern Pacific with comparative notes on related species. Copeia 1935(3):127-139.

Scofield, N. B. 1899. List of fishes obtained in Arctic Alaska. Pages 493-509. In: David Starr Jordan, ed. The fur seals and fur seal islands of the North Pacific Ocean. Report of the fur seal investigations, 1896-97, pt. 3. U.S. Treasury Dep. Washington, D.C.

Species:
Clupea harengus, Coregonus kennicotti, Argyrosomus pusillus, A. lucidus, A. alascanus, Stenodus mackenzii, Salvelinus malma, Boreogadus saida, Oncocottus hexacornis, Cottus quadricornis, Gymnocanthus galeatus, Liparis herschelinus, Lycodalepis turneri.

Places:
Herschel Island, Mackenzie River mouth, Barter Island, Point Barrow, Point Hope, Port Clarence.

Scoresby, W. 1820. An account of the Arctic regions with a history and description of the northern whale fishery. 2 vol. A. Constable, Edinburgh.

Scott, W. B., and E. J. Crossman. 1973. Freshwater fishes of Canada. Fish. Res. Bd. Canada, Bull. 184:966 p.

Seeman, B. 1853. Narrative of the voyage of the H.M.S. Herald during the years 1845-1851. 2 vol. Reeve, London.

Sergeant, D. E. 1962. Biology and hunting of beluga and white whales in the Canadian Arctic. Arctic Unit, Fish. Res. Bd. Canada, Circular no. 8:13 p.

Species:
Arctic charr, Capelin, Cod, Sculpin.

Places:
Beaufort Sea, Amundsen Gulf, M'Clure Strait.

Sergejeff, K. 1960. Salmon species new to the Arctic Ocean. Suomen Kalastuslehti 67(6):219-221. Translation available as Trans. Ser. Fish Res. Bd. Canada 427.

Shmidt, P. Yu. 1904a. Pisces marium orientalium. Imperii Rossici. Ed. Soc. Geogr. Russ. St. Petersburg. [In Russian.]

Shmidt, P. Yu. 1904b. Ryby vostochnych morei Rosiiskoi Imperii [Fishes of the Eastern Seas of the Russian Empire]. In: Nauchnye Re zult'taty Koreiska-Sakhalinskoi Ekspeditsii Imperatorskogo Rossiiskogo Geograficheskogo Obshchestva. 466 p.

Shmidt, P. Yu. 1934. On the zoogeographical distribution of the main commercial fishes in the western part of the North Pacific. Bull. Pacific Comm. Acad. Sci. U.S.S.R. 3. [In Russian.]

Shmidt, P. Yu. 1948. The division of the fauna of the temperate zone. Its origin and the formation of the Arctic of the Arctic fish fauna. In: Fish of the Pacific Ocean. Pishchepromizdat. 1948. 54 p. [In Russian.]

Shotton, R. T. 1971. Fish survey base data report. Appendix II. In: Towards an environmental impact assessment of a gas pipeline from Prudhoe Bay, Alaska to Alberta. Report for the Environmental Protection Bd. by Inter-Disciplinary Systems, Ltd. Winnipeg, Manitoba. (Interim Rep. no. 1). 251 p. Diagrams, tables.

Remarks:
Lists 21 fish spp. S. alpinus and T. arcticus the most abundant spp. along coastal route. Some notes on spawning.

Shotton, R. T. 1973. Fish Survey 1972. Base Data Report for Environment Protection Board sponsored by Canadian Arctic Gas Study Limited. Appendix II. Towards an environmental impact assessment of the portion of the Mackenzie Gas Pipeline from Alaska to Alberta. Winnipeg, Manitoba. 199 p.

Remarks:
Notes location and frequency of occurrence of 16 spp., mostly freshwater. Most of the survey well inland.

Simpson, J. 1875. Observations on the western Eskimo and the country they inhabit, from notes taken during two years at Point Barrow. Pages 233-275. In: A selection of papers on Arctic geography and ethnology. Reprinted and presented to the Arctic Expedition of 1875 by the Roy. Geog. Soc. (Arctic Blue Book). London, 1875.

Simpson, T. 1843. Narrative of discoveries on the north coast of America effected by the officers of the Hudson's Bay Company during the years 1836-39. R. Bentley, London. 419 p.

Remarks:
Mentions 14 fishes by common names. Red River settlement to mouth of Mackenzie. Coastal explorations Coppermine River to Point Barrow.

Sinclair, S., et al. 1967. Physical and economic organization of the fisheries of the Mackenzie District, N.W.T. Fish. Res. Bd. Canada, Ottawa.

Slaney, F. F. 1973a. Environmental field program, Taglu-Richards Island. Mackenzie Delta Interim report for Imperial Oil, Ltd. Calgary, Alberta.

Slaney, F. F. 1973b. Environmental effects assessment-voyageur air cushion vehicle, Mackenzie Delta, N.W.T. Vol. 2, Field Studies. Environmental Protection Bd. Ottawa.

Slaney, F. F. 1973c. Environmental impact assessment, Immerk artificial island construction. Vol. 3, F. F. Slaney and Co. Ltd. Vancouver, B.C. 58 p.

Slaney, F. F. 1973d. Aquatic resources of Tuktoyaktuk Harbour. F. F. Slaney and Co. Ltd. Vancouver, B.C.

Slaney, F. F. 1973e. Fishes. Pages 17-19. In: Environmental impact assessment, Immerk artificial island construction, Mackenzie Bay, N.W.T. Vol. 1. Environmental Statement. Vancouver, Canada. 28 p.

Remarks:
Fishes conspicuous in the ecosystem. Study area utilized by larval fishes of unknown number of spp.

Slanney. F. F. 1973f. Fishes. Pages 28-32, app. 9-14. In: Environmental impact assessment Immerk artificial island construction Mackenzie Bay, N.W.T. Vol. 2. Environmental studies. F. F. Slaney and Co. Ltd. Vancouver. 59 p.

Species:
Lists 18 spp. fishes.

Places:
East Mackenzie Bay.

Remarks:

Data on distribution, abundance, population structure, food habits, utilization of fishes.

Slaney, F. F. 1974. 1973-74 winter benthic and oceanographic surveys, offshore Mackenzie Delta, N.W.T. F. F. Slaney and Co. Ltd. for Imperial Oil Co. Ltd. Calgary. 25 p. and appendix.

Slaney, F. F. 1975. Summer environmental program-Mackenzie River Estuary. Vol. 3. F. F. Slaney and Co. Ltd. Vancouver, B.C. 49 p.

Species:
Osmerus eperlanus, Eleginus navaga.

Slavenwhite, D. D. 1967. Arctic style charr. North 14(3):1-7.

Smith, D. G. 1969. The Mackenzie Delta, domestic economy of the native peoples. A preliminary study. Northern Coordination and Res. Center, Dep. of Indian Affairs and Northern Development, Ottawa. (Mackenzie Delta Res. Project 3).

Remarks:
Describes subsistence fisheries.

Sonnenfeld, J. 1955. Changes in subsistence among Barrow Eskimos. Terminal report, Field work, 1954. Arctic Institute of N.A. Project no. ONR-140. 589 p. (Unpublished).

Sonnenfeld, J. 1957. Changes in subsistence among the Barrow Eskimos. Ph.D. Dissertation. Johns Hopkins University, Baltimore.

Spencer, R. 1959. The North Alaskan Eskimo: a study in ecology and society. Bur. Amer. Ethnol. Bull. 171.

Sprague, J. B. 1973. Aquatic resources in the Canadian North, knowledge, dangers and research needs. Pages 169-189. In: D. H. Pimlott, K. M. Vincent and C. E. McKnight, eds. Arctic Alternatives. Mail-O-Matic Printing, Ottawa.

Stefanich, F. 1973a. Resource inventory, Northwest region. Resource Planning Team, Joint Federal-State Land Use Planning Comm. for Alaska, Anchorage. 13 p.

Stefanich, F. 1973b. Fisheries resources. 6 vol. Joint Federal-State Land Use Planning Team. Anchorage, Alaska.

Stefansson, V. 1919. The Stefansson-Anderson Expedition of the American Museum. Anthropol. Pap. Amer. Mus. Nat. Hist. 14(1-2).

Stefansson, V. 1937. Food of the ancient and modern Stone Age Man. J. Amer. Dietetic Assoc. 13(2):102-119.

Stefansson, V. 1944. Fishes. Pages 118-124. In: Arctic Manual. Prepared under the direction of the Chief of the Air Corps, U.S. Army, with a special introduction and index. Macmillan Co. New York.

Species:
Clupea pallasi, Argyrosomus tullibee, Leucichthys lucidus, Stenodus mackenzii, Salvelinus malma, Cristivomer namaycush, Thymallus signifer, Osmerus dentex, Catostomus catostomus, Esox lucius, Lota maculosa, Microgadus proximus, "Rock cod", Oncocottus hexacornis, Platichthys stellatus.

Places:
Mackenzie River Delta, Coronation Gulf, Cape Bathurst, Herschel Island, Langton Bay, Baillie Islands, Hulahula River, Chandler River, Horton River, Dease River, Toker Point, Liverpool Bay, Kittagaryuit.

Remarks:
Species, distribution, rough estimates of relative abundance based on fishing expeditions 1908-1912.

Stefansson, V. 1957. The fat of the land. Macmillan, New York.

Stefansson, V. 1960. Food and food habits in Alaska and northern Canada. Reprinted from Human Nutrition, Historic and Scientific Monograph 3:23-60. International Universities Press, New York.

Remarks:
Discusses fishing methods and use of fish as food at Mackenzie River Delta and Coppermine River.

Steigenberger, L. W., G. G. Burch, P. G. Bruce and R. A. Robertson. 1974. Northern Yukon freshwater fishery studies, 1973. Fish. and Marine Serv. Environment Canada, Ottawa. 51 p. Tables, maps. (Task Force on Northern Oil Development Rep. 74-20).

Species:
Records 25 spp. marine, anadromous and freshwater fishes.

Places:
Coastal Yukon Territory from Alaska to N.W.T. Shingle Point, Thetis Bay, Herschel Island, Komakuk Beach, Firth River, Malcolm River, Shoalwater Bay, Clarence Lagoon, Babbage River.

Remarks:
Catch data. Overwintering and spawning areas pinpointed. Emphasizes importance of estuaries and springs.

Steigenberger, L. W., M. E. Elson and R. T. Delury. 1975. Northern Yukon fisheries studies 1971-74. Vol. 1. Northern Operations Branch, Fish. and Marine Serv. Vancouver. PAC/T 75-19.

Remarks:
Discusses past and current utilization levels of fish at Herschel Island, Shingle Point, Shoalwater Bay.

Steigenberger, L. W., R. A. Robertson, K. Johansen and M. S. Elson. 1975. Biological engineering evaluation of the proposed pipeline crossing sites in Northern Yukon Territory. Pacific region, Fish. and Marine Serv. Vancouver. PAC/T 75-11.

Species:
Salvelinus alpinus, Coregonus sardinella.

Places:
Beaufort Sea, Firth River, Babbage River, Fish Creek, Shingle Point.

Remarks:
Estimates contribution of each stream to arctic charr population of Beaufort Sea.

Stein, J. N., C. S. Jessop, T. R. Porter and K. T. J. Chang-Kue. 1973a. Fish resources of the Mackenzie River Valley. Interim Rep. II. Fish. Serv. Dep. of the Environment for the Environmental-Social Program, Northern Pipelines. 260 p.

Stein, J. N., C. S. Jessop, T. R. Porter and K. T. J. Chang-Kue. 1973b. An evaluation of the fish resources of the Mackenzie River Valley as related to pipeline development. Vol. 1. Fish. Serv. Dep. of the Environment, for the Environmental-Social Program, Northern Pipelines. Ottawa. 121 p. Maps, tables, photos. (Task Force on Northern Oil Development Rep. 73-1).

Species:
Lists 34 spp. marine, anadromous and freshwater fishes.

Remarks:

Emphasis on upstream portions of Mackenzie River drainage. Data on migration routes and spawning habits.

Stein, J. N., C. S. Jessop, T. R. Porter and K. T. J. Chang-Kue. 1973c. An evaluation of fish resources of the Mackenzie River Valley. Vol. 2. Fish. Serv. Dep. of the Environment for the Environmental-Social Program, Northern Pipelines. Ottawa.

Stonehouse, B. 1971. Animals of the Arctic, the ecology of the far north. Holt, Rinehart, Winston, San Francisco. 172 p.

Stoney, G. M. 1899. Explorations in Alaska. Proc. U.S. Naval Inst. 25:533-584, 799-849.

Stuck, H. 1920. A winter circuit of our Arctic coast: a narrative of a journey with dog sleds around the entire Arctic coast of Alaska. Charles Scribner's Sons, New York. 347 p.

Sutherland, P. C. 1852. Journal of a voyage in Baffin's Bay and Barrow Straits, in the years 1850-51, performed by H.M.S. Lady Franklin and Sophia under the command of Mr. William Penny in search of the missing crews of H.M.S. Erebus and Terror: with a narrative of sledge excursions on the ice of Wellington Channel and observations on the natural history and physical features of the countries and frozen seas visited. 2 vol. Longman, Brown, London. Maps, plates, wood engravings.

Svetovidov, A. N. 1948. Fishes. Codlike fish. Fauna U.S.S.R. 9(4):1-222. [In Russian.]

Svetovidov, A. N. 1952. Fishes. Herrings (Clupeidae). Fauna U.S.S.R. 2, pt. 2(48):1-331. [In Russian.]

Swaine, C. 1749. An account of a voyage for the discovery of a Northwest Passage by Hudson's Straits to the Western and Southern ocean of America, performed in the year 1746 and 1747, in the ship California, Captain Francis Smith, Commander. 2 vol. Printed and sold by Mr. Jolliffe in St. James Street ... London.

Taranets, A. Ya. 1937. Kratkii opredelitel' ryb Sovetskogo Dal'nego vostoka i prilezhashchikh vod [A short guide to the fishes of the Soviet Far East and adjacent waters]. Izvestiya Tikhookeanskogo Instituta. Rybnogo Khozyaistva i Okeanografii (Vladivostok)11:200 p.

Thayer, A. S. (ed.) 1971. Environmental influences of oil and gas development in Arctic Slope and Beaufort Sea. U.S. Dep. of Interior, Washington, D.C. (Fish and Wildlife Resource Publ. 96).

Thayer, A. S. 1966. Surveillance in Arctic National Wildlife Range, July, 1966. U.S. Fish and Wildlife Service, Anchorage.

Thayer, A. S. 1970. Arctic National Wildlife Range, annual narrative report. U.S. Bureau of Sport Fisheries and Wildlife, Anchorage, Alaska. (Unpublished).

Thayer, A. S. (ed.). 1971. Environmental influences of oil and gas development in Arctic Slope and Beaufort Sea. U.S. Fish Wildl. Serv. Resource Publ. 96.

Species:
Gadidae, Osmeridae.

Places:
Point Barrow.

Thibault, E. 1975. Regional socio-economic overview study, Yukon Territory. Indian Affairs and Northern Development, Environment Canada for Environmental Social Program, Northern Pepelines, Ottawa. 78 p.

Troyer, W. 1973. Along the Arctic Coast. National Parks and Conservation Magazine, October, 1973. Pages 12-15.

Tuck, L. M. 1960. The murres-their distribution, population, and biology, a study of the genus Uria. Canadian Wildl. Serv. Ottawa. 260 p. (Canadian Wildl. Ser. no. 1).

Species:
Polar cod, Cod, Herring, Smelt, Greenland halibut, Arctic charr.

Places:
Beaufort Sea, Banks Island, Melville Sound.

Remarks:
Explores arctic marine ecosystems.

Uhl, E. 1962. Food in the Arctic Region, its availability, nutritive value and utilization. Conf. on Med. and Pub. Health in the Arctic and Antarctic. World Health Organization, Geneva. (Conf. Doc. no. 13).

U.S. Bureau of Indian Affairs. 1963. Anaktuvuk Pass and Wainwright in village surveys.

U.S. Bureau of Land Management. 1973a. Proposed Trans-Alaska pipeline system: environmental assessment atlas. Dep. of the Interior.

U.S. Bureau of Land Management. 1973b. Staff report on Northeastern Alaska utility corridor alternatives, June 25, 1973. Pipeline Div. Alaska State Office, U.S. Dep. of the Interior.

U.S. Bureau of Sport Fisheries and Wildlife. 1960-72. Unassembled field data and numerous unpublished reports. Files of Arctic Nat. Wildl. Range. Fairbanks, Alaska.

U.S. Bureau of Sport Fisheries and Wildlife. 1972. Arctic National Wildlife Range wilderness study report. Anchorage, Alaska. 94 p. (Unpublished).

Species:
Coregonus autumnalis, Coregonus spp., Salvelinus alpinus, Oncorhynchus keta, Thymallus arcticus, Lota lota, Gasterosteidae, Cottidae, Pleuronectidae.

Places:
Covers Arctic coast from Canadian border to Canning River and 150 miles south.

Remarks:
Distribution and relative abundance of fishes in the area.

U.S. Department of the Interior. 1970. A reconnaissance report of the impact on fish and wildlife of the North Slope oil development, Trans-Alaska Pipeline System, and marine terminal sites. U.S. Fish and Wildl. Serv. Juneau, Alaska.

Species:
Coregonus spp., Salvelinus alpinus, S. namaycush, Thymallus arcticus, Mallotus villosus, Lota lota, "Tom-cod".

Places:
Point Barrow, Beaufort Sea coast, Sagavanirktok River.

U.S. Department of the Interior. 1971a. Arctic National Wildlife Range Master Plan. Portland, Oregon.

U.S. Department of the Interior. 1971b. Fish and wildlife resources, fishery resources. Pages 53, 54, 117-119. In: Draft Environmental Impact Statement for the Trans-Alaska Pipeline. Section 102(2)c. of the National Environmental Policy Act of 1969.

Remarks:
Beaufort Sea and Sagavanirktok River habitats discussed. Subsistence fishing for cod (Gadidae sp.) and smelt (Osmerid sp.) at Point Barrow. Small fishery for Salvelinus alpinus and whitefish (Coregonus sp.) at Colville River mouth. Salvelinus alpinus and Thymallus arcticus primary species in Sagavanirktok River system with whitefish (Coregonus sp.) and Lota lota also present.

U.S. Department of the Interior. 1972. Fish and wildlife. Pages 150-158. In: Final Environmental Impact Statement. Proposed Trans-Alaska Pipeline. Vol 2. Environmental setting of the proposed Trans-Alaska Pipeline System. Prepared by a Special Interagency Task Force for the Federal Task Force on Alaskan Oil Development, Washington, D.C.

Species:
Salvelinus alpinus, S. namaycush, Oncorhynchus gorbuscha, C. keta, Thymallus arcticus, Mallotus villosus, Osmerid spp., Lota lota, Boreogadus saida, Eleginus gracilis, Tomcod, Liopsetta glacialis.

Places:
Arctic coast from Point Barrow to Banks Island and Prince Patrick Island. Sagavanirktok River.

Remarks:
Discusses oceanographic and environmental factors important to fishes, birds, marine mammals. Remarks on subsistence and sport fishing potentials. Some life history information.

U.S. Department of the Interior. Library Services Office. 1974. Trans-Alaska Pipeline and environment, bibliography. Compiled by Richard W. Schoepf. U.S. Government Printing Office, Washington, D.C. (Bibliog. Ser. 30).

U.S. Department of the Interior. 1975a. Alaska Natural Gas Transportation System. Draft Environmental Impact Statement. Part II. Alaska. Vol. 1 of 3, June, 1975. Washington, D.C.

Species:
Coregonus autumnalis, C. nasus, C. pidschian, C. sardinella, Prosopium cylindraceum, Salvelinus alpinus, S. namaycush, Oncorhynchus keta, Thymallus arcticus, Lota lota, Pungitius pungitius, Myoxocephalus quadricornis, Cottus cognatus, Liopsetta glacialis.

Places:
Arctic coastal plain of Alaska.

Remarks:
Stream classification. Distribution, abundance, overwintering requirements of fishes.

U.S. Department of the Interior. 1975b. Alaska Natural Gas Transportation System. Draft Environmental Impact Statement. Part II. Alaska. Vol. 2 of 3, June, 1975. Washington, D.C.

Remarks:
Study confined to species in inshore habitats of Beaufort Sea, especially inside barrier islands. Summary of available knowledge of fish movements in area between Prudhoe Bay and Demarkation Point.

U.S. Department of the Interior. 1975c. Fisheries Resources. Beaufort Sea (North Slope) Drainage, Mackenzie River Drainage. Pages III-563 to III-578. In: Alaska Natural Gas Transportation System. Draft Environmental Impact Statement. Part III. Canada. Vol. 1 of 3, June, 1975. Washington, D.c.

Remarks:
Maps, tables, text indicate distribution, feeding, spawning movements of fish species. Fourteen fresh water species in Beaufort Sea Drainage, 45 freshwater and anadromous species in Mackenzie watershed.

U.S. Department of the Interior. 1975d. Proposed Arctic National Wildlife Refuge, Alaska. Final Environmental Statement. Prepared by Alaska Planning Group, October, 1974. U.S. Government Printing Office, Washington, D.C.

Species:
Coregonus autumnalis, C. clupeaformis, C. nasus, C. sardinella, Prosopium cylindraceum, Stenodus leucichthys, Salvelinus alpinus, S. namaycush, Oncorhynchus gorbuscha, O. keta, Thymallus arcticus, Catostomus catostomus, Esox lucius, Pungitius pungitius, Cottus cognatus.

Remarks:
Emphasis on distribution, abundance, utilization. Water quality, stream types. Socio-economic impact.

U.S. Federal Field Committee for Development Planning. 1968. Alaska natives and the land. Anchorage, Alaska. 565 p. U.S. Government Printing Office, Washington, D.C..

U.S. Fish and Wildlife Service. 1955. Fishery Publication Index, 1920-54. Publications of the Bureau of Fisheries and Fishery Publications of the Fish and Wildlife Service, by series, authors, and subjects. U.S. Fish and Wildlife Service Circular 36.

U.S. Fish and Wildlife Service. 1959. North Pacific exploratory fishery program: Chukchi Sea in Northwest Alaska. Comm. Fish. Review 21(11):42-44.

U.S. Fish and Wildlife Service. 1966a. List of circulars of the U.S. Fish and Wildlife Service. Fishery Leaflet 596.

U.S. Fish and Wildlife Service. 1966b. List of Fishery Bulletins. U.S. Fish and Wildlife Service. Fishery Leaflet 597.

U.S. Fish and Wildlife Service. 1967. List of special scientific reports and special scientific report-Fisheries of the U.S. Fish and Wildlife Service. Fishery Leaflet 605.

U.S. Fish and Wildlife Service. 1970a. A reconnaissance report on the impact on fish and wildlife resources of the North Slope oil development, the Trans-Alaska Pipeline System and the marine terminal sites. Typewritten report. Juneau, Alaska. 57 p.

U.S. Fish and Wildlife Service. 1970b. Arctic National Wildlife Range, Alaska. Narrative 1970 by Averill Thayer. Anchorage. 71 p. Tables, charts. (Unpublished).

Remarks:
Protein flow in lagoon area ecosystem described. Thymallus arcticus, Salvelinus alpinus and ciscoes (Coregonus sp.) abundant in summer.

U.S. Fish and Wildlife Service. 1974. Narrative report FY-74. Arctic National Wildlife Range. Summary of status of wildlife populations.

Remarks:
Industrial and related activities have resulted in greater fishing pressure at Schrader Lake and North Slope charr drainages. Sea-run Salvelinus alpinus stocks not significantly affected. Subsistence fishers have traditionally netted large numbers. Salvelinus namaycush in Schrader Lake. Size of fish declining due to sport fishery.

U.S. Joint Federal-State Land Use Planning Commission for Alaska. 1972. The native subsistence values and their relationships to d(1) d(2) land classification. Anchorage, Alaska.

U.S. Joint Federal State Land Use Planning Commission. Resource Planning Team. 1974a. Inventory of recreation and preservation opportunities, Arctic region. Anchorage, Alaska. 89 p.

U.S. Joint Federal-State Land Use Planning Commission for Alaska. Resource Planning Team. 1974b. Resources of Alaska: a regional summary. The Commission, Anchorage.

Species:
Oncorhynchus spp., Salvelinus alpinus, Coregonus spp., Stenodus leucichthys.

Places:
Barrow, Colville River Delta, Kotzebue Sound, Kobuk River, Barter Island, Wulik River, Kivalina River, Noatak River, Selawik Lake.

Remarks:
Summary of fish distribution and utilization.

U.S. Revenue Service. 1899. Report on the cruise of the U.S. Revenue Cutter Bear and the Overland Expedition for the relief of the whalers in the Arctic Ocean from November 27, 1897 to September 18, 1898. Treas. Dep. Doc. 2101.

University of British Columbia. Institute of Animal Resource Ecology. [n.d.] Catalogue of fish species distribution. On file in Fish Museum.

Urban and Rural Systems Associates. 1974. An analysis of the socio-economic impact of the Alaskan Arctic Gas Pipeline Company pipeline. 360 p.

Ushakov, P. V. 1952. The Chukchi Sea and its bottom fauna. Extreme Northeast of the U.S.S.R. 2. [In Russian.]

Usher, P. J. 1965. Economic basis and resource use of the Coppermine River-Holman region, N.W.T. Northern Coordination Research Centre, Dep. of Northern Affairs and Natural Resources, Ottawa. 290 p. (NCRC-65-2)

Usher, P. J. 1966. Banks Island, an area economic survey, 1965. Industrial Division, Dep. of Indian Affairs and Northern Development, Ottawa. 91 p. (A.E.S.R. m 65/1).

Species:
Coregonus clupeaformis, C. sardinella, Coregonus sp., Salvelinus alpinus, S. namaycush, Mallotus villosus, Gadus ogac.

Places:
Banks Island, Sachs Harbor, Fish Lakes, Raddi Lake, Thomsen River, Castel Bay.

Remarks:
Moderate runs of S. alpinus at Sachs Harbor. Castel Bay fishery probably unable to support more than 2 or 3 families.

Usher, P. J. 1971. Bankslanders: economy and ecology of a frontier trapping community. Northern Administration Branch, Indian Affairs and Northern Development, Ottawa. 88 p. (N.S.R.C. 71-2).

Species:
Salvelinus alpinus, S. namaycush.

Places:
Banks Island, Sachs Harbor, Fish Lakes.

Remarks:
Runs are small, utilization minimal.

Van Stone, J. W. 1960. A successful combination of subsistence and wage economics on the village level. Economic Development and Cultural Change 8(2):174-191.

Van Stone, J. W. 1962. Point Hope, an Eskimo village in transition. University of Washington Press, Seattle.

Van Stone, J. W., and W. H. Oswalt. 1960. Three Eskimo communities. Anthropol. Pap. of the University of Alaska 9(1):17-56.

Van Wyhe, G. L. 1969. Pipeline impact on sport fish resources. Mimeo Report. Sport Fish Div. Alaska Dep. Fish Game. Fairbanks. 20 p.

Van Wyhe, G. L. 1971. Impact of North Slope oil development on sport fisheries of interior and Arctic Alaskan waters. Available at Alaska Dep. Fish Game, Fairbanks. (Unpublished. Abstract in Proc. Alaska Science Conf. 22:108).

Vincent, R. E. 1973. Data report. Late winter surveys of lakes and streams in Canada and Alaska along the gas pipeline routes under consideration by Canadian Arctic Gas Study Ltd. Prepared by Aquatic Environments, Ltd.

Vladykov, V. D. 1934. On the occurrence of some North Pacific fishes in Hudson Bay with remarks on the fish fauna of the Potter area. Proc. Pac. Sci. Congress. University of Toronto Press, Toronto. 5:3787-3789.

Species:
Raja radiata, Mallotus villosus, Boreogadus saida, Gadus ogac, Cymnelis viridis, Lycodes reticulatus, Lycodalepis (polaris?), Lumpenus fabricii, Stichaeus punctatus, Eumesogrammus praecisus, Pholis fasciatus, Myoxocephalus quadricornis, M. scorpioides, M. scorpius, Icelus bicornis, Gymnocanthus tricuspis, Aspidophoroides olrikii, Eumicrotremus derjugini, E. spinosus.

Remarks: Theories on distribution of species of arctic fishes.

Walters, V. 1953a. Notes on fishes from Prince Patrick Island and Ellesmere Islands, Canada. Am. Mus. Novitates 1643:1-17.

Species: Salvelinus alpinus, Boreogadus saida, Gymnelis viridis, Lycodes pallidus, Anarhicas denticulatus, Icelus bicornis, Myoxocephalus quadricornis, Eumicrotremus spinosus, Liparis koefoedi, Liparis liparis.

Places:
Ellesmere Island, Alert, Prince Patrick Island, Mould Bay.

Remarks:
Distributional records.

Walters, V. 1953b. The fishes collected by the Canadian Arctic Expedition, 1913-1918, with additional notes on the ichthyofauna of western Arctic Canada. Nat. Mus. Canada Bull. 128:257-274.

Species:
Mentions 41 spp. of fishes.

Places:
Cape Sabine, Alaska, to Bathurst Inlet, N.W.T., north to Borden Island.

Remarks:
Distributional records.

Walters, V. 1955. Fishes of western Arctic America and Eastern Arctic Siberia: taxonomy and zoogeography. Amer. Mus. Nat. Hist. Bull. 106(5):255-368.

Ward, D., and P. J. Craig. 1974. Catalogue of streams, lakes, and coastal areas in Alaska along routes of the proposed gas pipeline from Prudhoe Bay, Alaska to the Alaskan-Canadian border. Canadian Arctic Gas Study, Ltd. Calgary, Alberta. Biological Rep. Ser. 19:381.

Species:
Coregonus autumnalis, C. clupeaformis, C. nasus, C. sardinella, Prosopium cylindraceum, Salvelinus alpinus,

S. namaycush, Oncorhynchus gorbuscha, O. keta, Thymallus arcticus, Catostomus catostomus, Esox lucius, Boreogadus saida, Cottus cognatus, Myoxocephalus quadricornis, Liopsetta glacialis.

Remarks:
Water bodies described with respect to chemistry, winter conditions, presence of benthic invertebrates.

Washington (State) University. Fisheries Oceanography Library. 1972. Selected references to literature on marine expeditions, 1700-1960. G. K. Hall, Boston, Massachussetts. 517 p.

Watson, G. E., and G. J. Divoky. 1974. Marine birds of the western Beaufort Sea. Pages 681-695. In: J. C. Reed and J. E. Sater, eds. The coast and shelf of the Beaufort Sea. Proc. of a Symposium on Beaufort Sea coast and shelf research. Arctic Institute of N.A., Arlington, Va.

Remarks:
Five species of marine birds feed primarily on fish in coastal areas of the Yukon Territory.

Watt, R. D. 1966. The recreational potential of the Arctic Wildlife Range. M.S. Thesis. University of Alaska, Fairbanks. 103 p.

Remarks: Thymallus signifer common in larger tributary streams. Salvelinus alpinus, S. namaycush found in deeper lakes and many north slope streams. Lake Peters and Lake Schrader contain Salvelinus namaycush but probably unable to support sustained fishing pressure.

Wilimovsky, N. J. 1952a. Marine fishery resources of the Arctic regions. Special Report, U.S. Fish Wildl. Serv. no. 3. 9 p.

Wilimovsky, N. J. 1952b. The utilization of fishery resources by the Arctic Alaskan Eskimo. Stanford University, Tech. Pap. 2 on Contract N6onr-25136. 17 p.

Species:
Oncorhynchus spp., Salomonidae (trout), Salvelinus namaycush, Coregonus spp., Prosopium cylindraceum, Stenodus leucichthys, Thymallus arcticus, Osmerus sp., Mallotus villosus, Catostomus catostomus, Lota lota, Boreogadus saida, Eleginus gracilis, Limanda aspera, Liopsetta glacialis.

Remarks:
Marine spp. not fully utilized, commercial exploitation doubtful.

Wilimovsky, N. J. 1954a. Recent literature on far northern fishes. Copeia 1954(3):244-245.

Wilimovsky, N. J. 1954b. A catalog of the fishes of Alaska. Stanford Ichthyol. Bull. 4(5):279-294.

Remarks:
Lists 39 spp. with ranges.

Wilimovsky, N. J. 1956. Appendix I. In: Beaufort Sea Report. Folder at U.S. Fish Wildl. Office, Anchorage, Alaska.

Species:
Oncorhynchus spp., Osmerus sp., Mallotus villosus, Boreogadus saida, Eleginus gracilis, Limanda aspera, Liopsetta glacialis.

Remarks:
Limited sea fishing for cod and smelt. More in lagoons and inland.

Wilkinson, D. 1970. The Arctic coast. Natur. Sci. Canada, Ltd. 160 p.

Remarks:
Semi-popular account of the Canadian Arctic coast. Mentions 57 spp. fishes.

Wilson, D. S. 1956. Processing of Arctic charr at Coppermine. Northern Affairs Bull. 3(3):7-9 (April-May, 1956).

Winslow, P. C., and E. A. Roguski. 1969-70. Monitoring and evaluation of Arctic waters with emphasis on North Slope drainages. Alaska Dep. Fish Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1969-70, Project F-9-2, 11:279-302.

Remarks:
Preliminary investigations of fish populations in waters of North Slope Brooks Range, and Northwestern Alaska.

Wohlschlag, D. E. 1953. Some characteristics of the fish population in an Arctic Alaskan lake. University California Publ. Biol. Sci. 11:19-29.

Species:
Leucichthys sardinella, Prosopium cylindraceum, Pungitius pungitius.

Places:
Ikroavik Lake.

Remarks:
Biology, development, population data.

Wohlschlag, D. E. 1954a. Growth peculiarities of the cisco (<u>Coregonus sardinella, Valenciennes</u>) in vicinity of Point Barrow, Alaska. Stanford Ichthyol. Bull. 4(3):186-203.

Wohlschlag, D. E. 1954b. Mortality rates of whitefish in an Arctic lake. Ecology 35(3):388-396.

Wohlschlag, D. E. 1956. Information from studies of marked fishes in the Alaskan Arctic. Copeia 1956(4):237-242.

Species:
Coregonus sardinella, C. nasus kennicotti, Myoxocephalus quadricornis.

Remarks:
Used mark and recapture techniques to estimate populations in Ikroavik Lake and Elson Lagoon.

Wohlschlag, D. E., and D. M. Cohen. 1953. Population dynamics of isolated, unexplcited fish populations with very short growing seasons at Point Barrow, Alaska. Final Rep. on Contract Nonr-225(08). 69 p.

Woolford, R. [n.d.]. Notes on village economics and wildlife utilization in Arctic Alaska, U.S. Fish Wildl. Serv. Fairbanks, Alaska.

Species:
Coregonus spp., Stenodus leucichthys, Oncorhynchus spp., Salvelinus malma, S. namaycush, Thymallus arcticus, Osmerids, Esox lucius, Lota lota.

Places:
Point Barrow, Wainwright, Point Lay, other villages south to Kotzebue region.

Woolford, R. 1954. Village economics in Arctic and interior Alaska. Manuscript presented at Fifth Alaska Sci. Conf.

Wrangell, F. von. 1840. Narrative of an expedition to the Polar Sea in the years 1820, 1821, 1822, and 1823. Ed. by Edward Sabine. J. Madden, London.

Wynne-Edwards, V. C. 1947. Northwest Canadian fisheries survey. Fish. Res. Bd. Canada Bull. 72:21-30.

Remarks:
Survey of fishery utilization and potential of Mackenzie River. Estimates of consumption by men and dogs. Greatest abundance of fish in delta area.

Wynne-Edwards, V. C. 1952. Freshwater vertebrates of the Arctic and Subarctic. Fish. Res. Bd. Canada Bull. 94:28 p.

Remarks:
Brief summaries of life histories and habitats of 17 spp. fishes.

Yoshihara, H. T. Life history aspects of an anadromous Arctic charr (Salvelinus alpinus) in the Sagavanirktok River drainage, Alaska. Alaska Dep. Fish Game, Fairbanks. (Unpublished).

Yoshihara, H. T. 1972. Monitoring and evaluation of Arctic waters with emphasis on North Slope drainages. Alaska Dep. Fish Game. Federal Aid in Fish Restoration, Annual Report of Performance, 1971-72. Project F-9-4, 13:49 p.

Remarks:
Investigates Sagavanirktok River drainage between Prudhoe Bay and Accomplishment Creek to determine distribution and abundance of fish species, migration timing, and biological productivity. Life history aspects of Salvelinus alpinus studied.

Yoshihara, H. T. 1973. Monitoring and evaluation of Arctic waters with emphasis on North Slope Drainages. Alaska Dep. Fish Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1972-73. Project F-9-5 14:83 p.

Species:

Coregonus autumnalis, C. clupeaformis, C. nasus, C. sardinella, Prosopium cylindraceum, Salvelinus alpinus, Oncorhynchus gorbuscha, O. keta, Thymallus arcticus, Lota lota, Pungitius, pungitius, Cottus cognatus.

Places:
Alaska North Slope, Sagavanirktok River, Kivalina.

Remarks:
Emphasis on biology of S. alpinus in vicinity of oil development projects.

Yoshihara, H. T., D. R. Kogl and S. Dole. 1971. Field notes on streams and lakes of Sagavanirktok River system. Sport Fish Div. Alaska Dep. Fish Game, Fairbanks.

Zenkevitch, L. A. 1951. Morya SSSR, ikh fauna i flora [Seas of the U.S.S.R. their fauna and flora]. Uchpedgiz., Moscow. 368 p.

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ANNUAL REPORT

RECONNAISSANCE CHARACTERIZATION OF LITTORAL BIOTA, BEAUFORT AND CHUKCHI SEAS

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March 29, 1977

I. Summary of objectives, conclusions, and implications with respect to OCS oil and gas development:

Both immediate and longer range developments of presumed oil and gas reserves of the Alaskan arctic continental shelf will occur in or otherwise profoundly effect the beaches, the lagoons and barrier islands, and the near-shore littoral region of the Beaufort and Chukchi Seas. In the main, however, the biota of this region has not been known as well as has that of the deeper parts of the Arctic Ocean in which ice-breakers and other large ships have operated. This project was designed to provide lists of the principal fauna and flora of the beaches and littoral benthic region; estimates of population density; trophic and other ecological information that would help assess the biological importance of the region; and data on which a characterization of the biota could be based.

A reasonably complete species list of the benthic fauna of the nearshore water of the Beaufort Sea has been established and ten species (two annelid worms, one bivalve mollusc, five peracaridan crustaceans, a chironomid midge larva, and a fish) have been identified as the most abundant or characteristic ones. Seven species of beach plants (three sedges, two grasses, and two dichotyledonous plants) occur on half of all Beaufort Sea beaches and are the characteristic flora. Both flora and fauna are poor in diversity and biomass of standing crops, two traits of ecological fragility elsewhere. The close inshore region, however, supports, during the brief, ice-free summer, large populations of anadromous fishes and migratory shorebirds and waterfowl. Dynamics of the populations of near-shore aquatic animals and general trophic relationships within the area are yet poorly known. Beach vegetation is not only important as food for waterfowl, but has been shown to increase soil strength in a way that may retard beach recession and contribute to shoreline stability. This general characterization of the Beaufort Sea littoral flora and fauna probably also obtains for the Chukchi Sea north of Cape Lisburne. South of this cape, however, the Chukchi biota is considerably more diverse.

The sea-land interface is a region in which floating material is trapped and, hence, concentrated. This region of the Alaskan Arctic supports a possibly fragile terrestrial flora that may be a principal effector of shoreline stability and a fauna that, at least seasonally, provides food for important fish and migratory birds. An understanding of processes within this region, including the ability of the characteristic biota to resist or recover from ecological perturbations, is important to continued planning and development of energy reserves of the continental shelf.

II. Introduction

A. General nature and scope of study: This study is a survey of the coastline of the Arctic Ocean from Cape Prince of Wales to Demarcation Point. The survey is designed to characterize beach and shallow littoral habitats and biota in the region between the upper beach line (in general, the point at which beach vegetation is replaced by terrestrial plants) and the 5M isobath. Other objectives of the program are the description of ecological phenomena, in particular trophic relationships in the study area, and the establishment of stations for monitoring ecological events. The research reported here is addressed primarily to the reconnaissance phase of beach and biota characterization.

B. The specific objectives: The specific objectives of this research are:

1. To identify the plants and animals of the Beaufort and Chukchi Sea littoral zones.

2. To provide population estimates of the principal species.

3. To characterize by biota and substrate-type the habitats of the littoral region of the Beaufort and Chukchi Seas.

4. To identify trophic relationships within the study area.

C. Relevance to problems of petroleum development: The following is quoted from our April 1, 1976 report:[1]

> The shoreline or sea-land interface is a region in which flotsam comes to rest and is, thus, unusually subject to perturbation that may result from blowouts or various other, undesirable events that could accompany oil and gas exploration and development on the continental shelf. If, at the same time, the edge of the sea is of particular importance as a feeding zone or nursery area for marine animals or for birds or other, terrestrial animals, disrupting influences that are trapped at the shoreline may affect ecosystems of both the land and the sea. When species to which the shoreline is important are migratory, these effects may be felt many miles away from the locale of the actual event.

That this general statement still obtains and the relevance of this research to OCS development are evident from the following:

1. The current Beaufort Sea lease zone is the area of concern for this project.

2. The biota of the beach edge has proven to be richer than previously reported. Many of the crustacean species (see below) are known to be important food of arctic fishes. Other abundant species have no known ecological role.

3. The recent Beaufort Sea Synthesis meeting drew attention to the importance of the nearshore waters to arctic fishes, marine mammals and shorebirds,[2] and to the paucity of information on ecological processes and food webs in this area.

III. Current state of knowledge:

The Beaufort Sea benthos is known primarily through the work of Carey and that of Wacasey. The classic paper of MacGinitie dealt with invertebrates from shallow water of the Barrow region. Recent investigation by Crane and Cooney and Feder and Schamel have been directed toward shallow water benthos of Simpson Lagoon and Prudhoe Bay. Wacasey sampled shallow areas of the MacKenzie delta, and this investigation has provided information on extreme shallow water biota from the Canadian border to Point Barrow.[3] Carey[3] has stated "the inshore fauna from the shoreline to depths of about 25 meters are low in numbers, probably caused by the seasonal environmental stress of highly fluctuating salinities and by the intense ice-gouging of the sea floor to water depths of 30 to 40 meters."

Chukchi Sea benthos is known primarily from deep water collections from the John N. Cobb in 1959, the Hugh M. Smith in 1960, the Northwind in 1962, and the Glacier in 1962. Sparks and Pereyra studied shore fauna at Cape Thompson and Kivalina but here, as in all other collections, coarse nets or sieving screens were used and our knowledge of the smaller animals is sparse. Available species lists show a much more diverse fauna than is known for the shallow Beaufort Sea.[4]

IV. Study area:

The general study area is the shoreline of the Beaufort and Chukchi Seas from Demarcation Point to Cape Prince of Wales. Our data derive primarily from beach transects and seaward extensions of these in stations selected to represent the several different habitat types encountered and the complete geographic range of the Arctic Ocean coast. Beach transect data extend from the upper level of marine influence (the point at which beach vegetation is replaced by terrestrial plants) to the greatest depth of water at which sampling was possible. In instances where boats were available, this seaward extension of transects crossed lagoons or reached the 5M isobath, at which depth our sampling program interfaced with that of RU7 for Beaufort Sea benthos. In some locations the difficulty of access and logistic support has made ground operations impossible.

V. Sources, methods and rationale of data collection:

The data presented as results of this program are those collected by R.U.356 only. The sampling protocol has been dealt with in our 1975 report,[1] and is not repeated in detail here. These data fall into five categories, discussed separately below.

1. Data from aerial reconnaissance: Overflights of the coasts of the Beaufort and Chukchi coasts at low elevation were made in 1975 and 1976. A detailed record of these flights was made by combining the voice-taped observations of two scientists and notes made in flight on appropriate navigation charts or topographic maps. The principal observations made from the air were: beach sediment or other substrate type, beach slope (including depth of water as possible), and biological information. These observations were planned to provide an arctic counterpart of those made by RU 79 in the Gulf of Alaska and Bering Sea, and a preliminary categorization of habitat types.

2. Data from shallow water, benthic sampling: At each beach station the level of mean lower low water (MLLW) was determined, usually empirically. A transect line was extended from MLLW to the deepest possible position. In most instances, because sampling crews worked on foot, the seaward limit of transects was -0.5 M depth. When boats were available, transects were extended to deeper water. All samples or observations were related to the difference between the 0.0 datum (MLLW) and the elevation at which the observation or sample was made. In general, this was the same as the depth of water. With exceptions determined by local conditions, the following samples were made at beach stations: six replicate Ekman grab (0.0231 M^2) samples screened in the field on 0.516 mm screening; replicate epibenthic sea sled net (1.050 mm mesh) tows of either 100 or 50 M length; replicate seine samples (10 M length, 10 mm stretched mesh webbing) in 1975 only; surface plankton sample (1976 only); baited amphipod traps; and other collection methods including shovels, scoops and dip net collections. All samples were preserved in the field in 10% formalin. For this report, the data from the several sampling depths along a transect are pooled and reported (mean biomass/species) by seine tow, epibenthic dredge or net by grab, and other gear.

3. Data from deeper water benthic sampling: In 1976, the deeper parts of Beaufort Lagoon (Nuvagapak Bight), Kaktovik Lagoon, Bernard Harbor, Prudhoe Bay, Simpson Lagoon, and Elson Lagoon were sampled from an inflatable boat or from the R/V Natchik. Each sampling site was designated a station, and the Ekman (benthic infauna), sea-sled (epifauna), and plankton samples of the beach transects were made. In addition, stations in the Beaufort Sea were sampled from the RV Alumiak at Barter Island (2 M and 5 M depths), Narwhal Island (5 M), Heald Point (2 M and 5 M), Stump Island (2 M and 5 M), Pingok Island (2 M and 5 M), Colville River delta (3.5 M and 5 M), Pitt Point (2 M and 5 M), Ikpikpuk River delta (2 M and 5 M), and Point Barrow (2 M and 5 M). At these stations replicate informal samples were taken with a Smith-McIntrye grate (screened on board to 0.5 mm), the epifaunal sea-sled net, and plankton net.

4. Data on beach vegetation: At selected beach stations the transect lines were extended shoreward and beach vegetation sampled along these lines. Observations on beach vegetation were related to difference between the 0.0 datum (MLLW) and the elevation at which data were collected. For this report, data were grouped by 0.25 M intervals: 0.0 M; 0.0 to 0.25 M; 0.25 to 0.5 M; etc. Within these intervals frequency of occurrence of plant species was determined by recording the presence of each species in a 0.25 M^2 quadrat placed 32 times (rarely 64) in a non-repeating grid centered at a measured interval along the transect line (thus, sampling plants in 8 M^2). Diversity indices based on frequency rather than number of plant stems were calculated from these data. Plant biomass data were based on the above-ground portion of plants in a 0.25 M^2 or a 0.0652 M^2 quadrat but are reported as grams per M^2.

5. Data from substrate samples: At each sampling station a substrate sample was collected, usually with the Ekman grab, and preserved in 10 percent formalin.

Laboratory procedures: All samples of benthic biota were returned to the laboratory in Bellingham where they were first sorted under law magnification (2X) to remove organisms from whatever sediment was retained in the field screening process. Organisms were grouped by category and counted by the sorters. A second step in the analysis of samples was the identification of organisms. After identification, all organisms of the same species from each sample were weighed (net weight, blotted, one-minute air-drying) to the nearest 0.001 gram. Finally, all organisms were stored in alcohol or formalin pending instruction for archiving specimens.

Plant biomass samples were oven-dried at 100°C for 24 hours and weighed to the nearest 0.001 gram.

Analyses of sediment samples was by the technique of Buchanan and Kain.[5]

VI. Results:

Sampling stations established in 1975 and 1976 are shown in Figures 1 through 7 and described in Table 1.

The 1976 benthic samples are not yet fully analyzed (see Item X., below). All species encountered in the Beaufort Sea in 1975 are listed in Table 2. Animal species found in the Chukchi Sea in 1976 not previously also in our 1975 Beaufort Sea samples are listed in Table 3. It is necessary to emphasize here the deep water Beaufort Sea samples taken in 1976 have not been analyzed and that the identification of material from the 1976 Chukchi samples is incomplete. Both species lists may reasonably be expected to become larger.

Tables 4 through 42 present mean biomass data for all animal species encountered and diversity indices by various sampling techniques at 39 Beaufort Sea benthic stations in 1975. Except for H19, H20, and H22, these are all beach stations. Still incomplete data on relative abundance of animal species found at 47 Chukchi Sea stations sampled in 1976 are presented in Tables 43 through 89. Stations 33X, 28V, and 5U4 included samples from water deeper than 2 meters.

The species of beach plants found at 13 Beaufort Sea stations in 1975, their frequency of occurrence at several beach elevations, and Shannon-Weaver indices of diversity by station and elevation are given in Tables 90 through 102.

The results of analyses of beach substrates at 38 Chukchi Sea sampling stations are presented graphically in Figures 8 through 10. Figures 1 through 7, in addition to the locations of sampling stations, show beach substrate types observed on overflights. The scale of the charts on which results are reported,[6] renders impossible any but the coarsest resolution.

VII. Discussion:

Our shallow water Beaufort Sea species list is somewhat longer than, but not significantly different from lists previously published.[7] Carey, however, finds many more species in the benthos of deep water.[2] Chukchi Sea faunal lists[8] are not strictly comparable to ours since the collections on which they are based were made primarily in deeper water and with gear or techniques that do not capture or retain most of the organisms we found (polychaetes, oligochaetes, mysiids, isopods, amphipods), but the available data here, as in the Beaufort Sea, support the notion that "fewer species of benthic organisms live in the extreme environment of the coastal zone that is subjected seasonally to intense salinity stress and to sea ice impingement and gouging."[2]

Feder et al.[9] have suggested certain criteria, based on a combination of frequency and abundance, for Biologically Important Species. While our data do not lend themselves to precisely Feder's analysis, and extension of his concept to cover as wide an area as the Beaufort Sea presents some difficulties, it is possible to combine frequency of occurrence, frequency of local biomass preponderance, and overall biomass data to create a list of the species that are most often encountered, that most often occur in the greatest abundance in localities and that, overall, are in fact the most abundant species. This list, which is admittedly somewhat subjective at this time, constitutes the characteristic species of the Beaufort Sea littoral. The characteristic species, not listed in order of importance, are:

Polychaetes
- *Scolocolepides arctius*

Oligochaetes
- *Enchytraeidae*, unidentified

Bivalves
- *Cyrtodaria kurriana*

Crustaceans
- *Mysis relicta* (mysiid)
- *Saduria entomon* (isopod)
- *Gammarus setosa* (amphipod)
- *Onisimus glacialis* (amphipod)
- *Onisimus litoralis* (amphipod)

Insects
- *Paraclunio alaskinsis* (chironomid)

Fish
- *Myoxocephalus quadricornis* (four-horned sculpin)

Certain qualifications of this characteristic fauna may be made: Enchytraeids and *Paraclunio alaskinsis*, both among the most abundant animals of the area sampled, are found almost exclusively in depths of water of less than 1 meter. *Scolocolepides arctius* occurs most often in water deeper than 1 meter and is absent from our shallow water samples at locations north of 70°30'N. The remaining characteristic species are all highly motile and probably move into the fast ice zone as the ice melts in the early summer.

Our data further show a general decline in species diversity and biomass in the shallow water samples at the most northern (and most western) part of the Beaufort Sea.

Samples (1976 collections) as yet incompletely analyzed indicate that a marked increase in biomass and diversity occurs in samples taken from water deeper than 2 M. The data from stations H19, H20, and H22 (Tables 19, 20, and 21) support this. Scolocolipides arctius is, in fact, found in deeper water in Elson Lagoon and other locations north of 70°30'N.

The benthic fauna of the Chukchi Sea is more diverse than is that of the Beaufort (Tables 3, 43-89). North of Cape Lisburne (68°52'N), however, the resemblance between Beaufort and Chukchi shallow water biota is striking, while south of Cape Lisburne all stations sampled include species not found in the Beaufort Sea. Scolocolipides arctius, the polychaete most characteristic of and most abundant in the Beaufort Sea, occurs in shallow water samples in the Chukchi Sea only south of 70°34'N (almost exactly the latitude north of which this species is limited to deeper water of the Beaufort).

It is presently impossible to designate a "characteristic fauna" of the Chukchi Sea.

Our samples of Selawick Lake indicate a fresh water fauna.

The beach plants of the Beaufort Sea region also comprise a community of low diversity and, throughout the region, remarkable uniformity. The grass, Puccinellia phryganodes, is found at all stations sampled and the sedge, Carex subspathacea, at 92 percent of them. The grass, Dupontia fischeri, is characteristic of Beaufort Sea arctic beaches as are Stellaria humifusa (Charyophyllaceae) and Chochlearia officinalis (Cruciferae). These five species, in fact, occur on 70 percent of all beaches sampled. Two more species, Carex aquatalis, and Eriophorum angustifolium, cotton grass (a sedge), are found on half (46 percent) of Beaufort Sea beaches and, together with the five more abundant plants, comprise a characteristic beach flora. Our data on plant diversity (Tables 9-102) show the most diverse beach communities in mainland marshes (Tables 92, 96, 101) and the least diverse in river deltas (Tables 90, 100) or low barrier islands (Tables 94, 97).

Tests begun in 1976[10] have demonstrated an increase in soil strength (resistance to penetration and to shear forces) as a result of colonizing vegetation. In most situations Puccinellia phryganodes is the first and lowest number of the incipient salt marsh (or beach community), followed by Carex subspathacea and a mixed community dominated by Dupontia fischeri. This zonation (or succession) accompanies the general rise of level and increase of organic content of the soil. On the average, plants increased resistance to penetration by 70 percent and tripled the breaking strength. The natural beach vegetation, therefore, probably contributes significantly to stability of beaches and barrier islands as well as providing food for migratory waterfowl (geese).

When compared to shallow water benthic communities elsewhere, the littoral region of the Alaskan arctic is poor in diversity and biomass.[11] There are, however, unexpected and previously unreported populations of oligochaete and polychaete worms and large numbers of isopods and amphipods. At least the latter are an important source of food of local fish species but, by and large, trophic relationships with the study area are unknown.

Of interest is consideration of the food relationships that may exist between the characteristic species cited previously. The two worms probably are deposit or detritus feeders, and Cyrtodaria is a suspension feeder. Mysis probably is a suspension feeder (but see Feder and Schamel).[3] The remaining crustaceans are scavengers or predators (at least, are readily attracted to baited traps), and the sculpin is a predator, probably largely on the crustaceans. The relationship between the smaller crustaceans and the deposit or suspension feeders is, of course, unknown, but the quantity of worms in our samples argues for their having an important trophic role.

Examination of Figures 8, 9 and 10 confirms the unconsolidated sand and gravel nature of Chukchi sediments (compare to Figures 1-7).

VIII. Conclusions:

A. A resonably firm species list of beach plants and shallow water animals of the Beaufort Sea has been established. This list will increase as deeper water is sampled, but is reasonably complete for shallow (less than 2 M deep) water. A preliminary list of characteristic animal species has been presented with the inference that this may be the complete biologically important species list.

B. The beach vegetation and shallow water benthos of the Beaufort Sea are poor in number of species (diversity) and biomass.

C. The beach vegetation, however, seems to be extremely important as food for waterfowl and in stabilizing beaches. The latter conclusion is tentative or preliminary.

D. There are previously unreported populations of enchytraeid (oligochaete) worms in the shallow water of both the Beaufort and Chukchi Seas. The ecological role of these worms is unknown, but their abundance may indicate a reasonably basic function in the ecosystem. The latter is even too preliminary to be a conclusion.

E. The fauna of the shallow water of the Chukchi Sea is strikingly similar to that of the Beaufort north of Cape Lisburne. South of Cape Lisburne the benthic fauna becomes increasingly more diverse and bears less resemblance to the arctic (Beaufort Sea) fauna.

F. In both the Beaufort and Chukchi Seas there is an increase in the benthic diversity with depth of water. This probably is related to the depth to which ice freezes, and the major discontinuity may occur at a depth of about 2 meters. The latter conclusion is preliminary but analysis of samples already collected will support or fail to support it.

IX. Needs for further study:

A. Another season of shallow water sampling of Beaufort Sea beaches probably will not significantly add to the species list or list of characteristics or biologically important species. A lack of knowledge of the fauna between depths of 2 M and 10 M exists, however, and is a major gap in our knowledge.

B. A second season of sampling of Chukchi Sea beaches can reasonably be thought of as practical and profitable. Sampling of the Chukchi Sea inside the 10 M isobath is a priority item for future research when a platform is available.

C. Ecological processes (especially trophic relationships) remain a major unknown. In particular, the role of enchytraeid (oligachaete) worms and amphipods are important.

D. The ecological processes in arctic salt marshes, especially grazing rates, effects of salt water inundations, and other perturbations, and the role of vegetation in stabilizing beaches, are important, and poorly known.

E. The identification of enchytraeid worms currently is impossible. We do not even know how many species we are dealing with.

F. All of our current data are based on once per season samples. We feel a need for monitoring information collected from a few selected sites several times per year. We are especially concerned with possible population trends during the ice-free season. For this purpose, beach transects should be extended to deeper water.

IX. References

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2. Carey, A. G., 1977. Report of disciplinary session on fish/benthos/plankton; Schamel, D., 1977. Report of disciplinary session on birds. NOAA/BLM-OCSEAP Beaufort Sea Synthesis Meeting, Barrow, AK, February 7-11, 1977.

3. See Carey (l.c.); MacGinitie G. and N. MacGinitie, 1955. Smithsonian Misc. Call, 128; Crane, J. and R. T. Cooney, 1974, in Alexander, V. et al., Univ. of Alaska IMS Report 74-1; Feder, H. and D. Schamel, 1975, in Hood, D. W. and D. C. Burrell, Assessment of the Arctic Marine Environment, Occ. Pap. 4, Univ. of Alaska IMS; Wacasey, J. W., 1975. Beaufort Sea Technical Report No. 126, Beaufort Sea Project Office, Victoria, B.C.

4. Alverson, D. L. and N. J. Wilimovsky, 1966, in Wilimovsky, N. J. and J. N. Wolfe, eds. Environment of the Cape Thompson Region, Alaska. U.S. Atomic Energy Commission; McCauley, J. E., no date. U.S. Coast Guard Oceanographic Report No. 1; Abbott, D. P., 1966, in Wilimovsky and Wolfe, l.c.; Rush, D. J., 1965. Proc. U.S. Nat. Mus. 117; Naidu, A. S. and G. S. Sharma, 1972. U.S. Coast Guard Oceanographic Report No. 50; Sparks, A. K. and W. T. Pereyra, 1966 in Wilimovsky and Wolfe, l.c.

5. Buchanan, O. B. and J. M. Kain, 1971, in Holme, N. A. and A. D. McIntyre. Methods for the Study of Marine Benthos. IBP Handbook 16.

6. OCSEAP requirement!

7. Crane and Cooney, l.c.; Feder and Schamel, l.c.

8. Sparks and Pereyra, l.c.

9. Feder, H. M. G. J. Mueller, M. H. Dick and D. B. Hawkins, 1973, in Hood, D. W., W. E. Shuls and E. J. Kelly (Environmental Studies at Port Valdez. Occ. Pap. No. 3, Univ. of Alaska IMS.

10. D. T. Mason of RU 356.

11. Crane and Cooney, l.c.

X. Summary of 4th quarter operations:

A. Ship or laboratory activities

1. Ship or field trip schedule: none.

2. Scientific party (all with Western Washington State College).

a. Principal Investigator
A. C. Broad, on salary January 1 to March 15.

b. Laboratory Supervisor
Helmut Koch, January 1 to March 31.

c. Computer Programmer
Gregg Petrie, hourly wages)

d. Laboratory Assistants (all hourly wages)
Susan Broad
Mark Childers
David Cormany
Crystal Driver
James Hanes
Gary Heckman
Patricia Jackson
Wendy Pounds

3. Methods: As previously reported (item 4 of page 6 of September 30, 1976 quarterly report).

4. Sample localities: none.

5. Data collected or analyzed

a. No data collected.

b. This quarter, 276 biological and 156 sediment samples were analyzed; 474 biological and 43 sediment samples remain.

C. No miles of trackline.

6. Milestone chart and data submission schedules

a. Completion of analysis of 1976 samples will extend somewhat beyond the June 15 date projected in the December 30, 1976 Quarterly Report.

b. This slippage in schedule was caused by unsuspected amounts of peat in Chukchi Sea samples that made sorting of those more difficult.

B. Problems encountered/recommended changes. No new problems.

C. Estimate of funds expended (based on February 28 fiscal report)

	Budgeted	Used	Remaining
Salary P1	25,000	17,682	7,318
Salaries, Associates	56,000	32,226	23,774
Salaries, other	90,000	54,822	35,178
Fringe	18,000	11,349	6,651
Travel, freight	30,500	16,394	14,106
Chukchi logistics	28,000	20,940	7,060
Supplies	6,000	4,290	1,710
Equipment	15,765	1,284	14,481
Computer	5,800	1,427	4,373
Overhead	68,000	15,997	52,003
Totals	343,065	176,411	166,654

Table 1 : Sampling stations of the Beaufort and Chukchi Sea shores, R.U. 356, 1975 and 1976

No.	Station No.	North Latitude °	'	"	West Longitude °	'	"	Location
1	B06	69	50	08	142	05	04	Beaufort Lagoon, Aichilik River Delta
2	B17	69	53	20	142	18	00	Beaufort Lagoon, Nuvagapak Point
3	B1D	69	53	12	142	18	54	Nuvagapak Bight Transect
4	B1E	69	53	00	142	18	54	Nuvagapak Bight Transect
5	B18	69	53	00	142	18	07	Beaufort Lagoon, Nuvagapak Camp
6	B1A	69	53	09	142	19	18	Nuvagapak Bight Transect
7	B1B	69	53	11	142	19	06	Nuvagapak Bight Transect
8	B1C	69	53	12	142	19	00	Nuvagapak Bight Transect
9	B2A	69	53	08	142	19	36	Nuvagapak Bight Transect
10	B2B	69	53	13	142	19	24	Nuvagapak Bight Transect
11	B21	69	55	35	142	21	09	Angun Point/Nuvagapak Entrance
12	B22	69	55	30	142	21	30	Angun Point/Nuvagapak Lagoon
13	C3G	70	07	00	143	32	00	Manning Point-Barter Island Transect
14	C3H	70	07	00	143	32	42	Manning Point-Barter Island Transect
15	C3A	70	07	57	143	34	30	North Kaktoavik Lagoon
16	C3B	70	08	06	143	34	30	Bernard Harbor Transect
17	C3C	70	08	08	143	34	30	Bernard Harbor Transect
18	C3D	70	07	00	143	34	00	Manning Point-Barter Island Transect
19	C3E	70	07	54	143	35	24	Barter Island, Off Pipsuck Point
20	C3F	70	07	54	143	36	24	In Pipsuck Bight
21	C35	70	08	00	143	36	00	Barter Island, Pipsuck Point
22	C36	70	06	07	143	36	05	Barter Island, Seashore
23	C4D	70	04	42	143	37	18	South Kaktoavik Lagoon Transect
24	C4C	70	05	30	143	37	38	South Kaktoavik Lagoon Transect
25	C37	70	08	00	143	37	00	Barter Island, Pipsuck Bight Shore
26	C38	70	06	02	143	38	01	Barter Island SE, Lagoon
27	C4A	70	06	06	143	38	00	South Kaktoavik Lagoon Transect
28	C4B	70	06	00	143	38	00	South Kaktoavik Lagoon Transect
29	C39	70	08	02	143	39	02	Barter Island, North Shore
30	C4E	70	08	05	143	40	54	Barter Island North, 2 M

Table 1 : (continued), Page 2

No.	Station No.	North Latitude °	'	"	West Longitude °	'	"	Location
31	C4F	7Ø	Ø9	18	143	4Ø	42	Barter Island North, 5M
32	C4Ø	7Ø	Ø6	Ø1	143	4Ø	Ø3	Barter Island South, Lagoon
33	C41	7Ø	Ø5	Ø1	143	41	Ø1	Mainland South of Barter Island
34	DØØ	7Ø	Ø5	Ø4	143	59	Ø8	Arey Island SW, Lagoon Shore
35	F59	7Ø	12	ØØ	146	59	ØØ	Flaxman Island SE, Lagoon Beach
36	G3A	7Ø	23	57	147	3Ø	3Ø	Narwhal Island NW, 5M
37	HØA	7Ø	22	23	148	Ø7	48	Heald Point NE, 2M
38	HØB	7Ø	24	18	148	Ø6	36	Heald Point NE, 5 M
39	HØ8	7Ø	2Ø	17	148	Ø8	12	Sagavanirktok River Delta
4Ø	H12	7Ø	2Ø	42	148	12	18	Heald Point E. Side, River Shore
41	H1A	7Ø	2Ø	48	148	15	ØØ	Prudhoe Bay, S. Niakuk Islands
42	H19	7Ø	21	ØØ	148	19	ØØ	S. Prudhoe Bay Transect
43	H2Ø	7Ø	2Ø	Ø1	148	19	42	Prudhoe Bay, Mid
44	H1B	7Ø	19	ØØ	148	19	12	N. Prudhoe Bay Transect
45	H2E	7Ø	21	Ø6	148	2Ø	18	N. Prudhoe Bay Transect
46	H2A	7Ø	19	Ø6	148	2Ø	24	S. Prudhoe Bay Transect
47	H2B	7Ø	21	54	148	21	18	Prudhoe Bay, Off Gull Island
48	H22	7Ø	2Ø	Ø6	148	22	3Ø	Prudhoe Bay, Mid
49	H2C	7Ø	19	24	148	23	3Ø	S. Prudhoe Bay Transect
5Ø	H2D	7Ø	2Ø	54	148	23	36	N. Prudhoe Bay Transect
51	H2F	7Ø	19	42	148	25	48	S. Prudhoe Bay Transect
52	H28	7Ø	18	32	148	28	48	Putuligayuk River Mouth
53	H3A	7Ø	23	Ø6	148	32	ØØ	Prudhoe Bay NW, Seaward Transect
54	H3B	7Ø	24	ØØ	148	32	24	Prudhoe Bay NW, Seaward Transect
55	H3C	7Ø	24	24	148	32	12	Prudhoe Bay NW, Seaward Transect
56	H3D	7Ø	24	48	148	31	ØØ	Prudhoe Bay NW, Seaward Transect
57	H32	7Ø	22	48	148	32	48	Prudhoe Bay NW, Arco Causeway
58	H3E	7Ø	25	33	148	34	30	Stump Island N, 5M
59	H3F	7Ø	24	57	148	34	34	Stump Island N, 2M
6Ø	H39	7Ø	24	19	148	4Ø	12	Point McIntyre Airport, Mudflat

Table 1 : (continued), Page 3

No.	Station No.	North Latitude °	'	"	West Longitude °	'	"	Location
61	H40	70	24	19	148	40	12	Point McIntyre Airport, Gwydyr Bay
62	I30	70	33	24	149	30	36	Pingok Island S., Lagoon Beach
63	I3A	70	33	24	149	30	24	Simpson Lagoon, Pingok Island Transect
64	I3B	70	32	36	149	30	30	Simpson Lagoon, Pingok Island Transect
65	I3C	70	32	06	149	30	36	Simpson Lagoon, Pingok Island Transect
66	I3D	70	31	12	149	31	12	Simpson Lagoon, Pingok Island Transect
67	I31	70	33	32	149	30	36	Pingok Island N., Sea Beach
68	I3E	70	33	42	149	32	15	Pingok Island N, 2M
69	I3F	70	33	57	149	32	54	Pingok Island N, 5M
70	I50	70	30	01	149	50	18	SE Oliktok Point
71	I5C	70	30	06	149	50	00	Simpson Lagoon - Spy Island Transect
72	I5A	70	30	42	149	50	12	Simpson Lagoon - Spy Island Transect
73	I5B	70	32	06	149	51	18	Simpson Lagoon - Spy Island Transect
74	I5E	70	33	30	149	53	18	Simpson Lagoon - Spy Island Transect
75	I5F	70	33	06	149	52	30	Simpson Lagoon - Spy Island Transect
76	I5G	70	29	18	149	56	18	Simpson Lagoon, Thetis Island Transect
77	I5H	70	29	54	149	56	54	Simpson Lagoon, Thetis Island Transect
78	I58	70	28	12	149	58	42	3.5 Mi SW Oliktok Point
79	J0A	70	30	24	150	00	00	Simpson Lagoon, Thetis Island Transect
80	J0B	70	30	54	150	01	54	Simpson Lagoon, Thetis Island Transect
81	J06	70	26	00	150	06	00	Kalubik Creek Mouth
82	J0C	70	30	00	150	09	20	Colville River Delta, 3.5 M
83	J1A	70	33	03	150	14	00	Colville River Delta, 5 M
84	J22	70	26	36	150	22	06	Colville Delta, Anachlik Island, North
85	J24	70	29	55	150	24	30	Colville River Delta, Kupigruak Channel
86	M07	70	55	00	153	07	00	Pitt Point, Sea Beach
87	M08	70	55	00	153	08	00	Pitt Point, Smith River Mouth
88	M10	70	55	30	153	10	30	Pitt Point, Sea Beach
89	M11	70	55	18	153	10	36	Pitt Point, Mud Flat
90	M1A	70	55	42	153	12	42	Pitt Point, 5M

Table 1 : (continued), Page 4

No.	Station No.	North Latitude °	'	"	West Longitude °	'	"	Location
91	M1B	70	55	42	153	14	12	Pitt Point, 2 M
92	M14	70	54	30	153	14	00	Lonely Lagoon
93	N1A	70	55	14	154	13	30	Ikpikpuk River Delta, 5 M
94	N1B	70	53	54	154	11	12	Ikpikpuk River Delta, 3 M
95	N42	71	03	20	154	42	30	Cape Simpson Dewline, Mud Flat
96	N43	71	03	30	154	42	30	Cape Simpson Dewline, Sea Beach
97	N44	71	03	40	154	44	00	Cape Simpson Dewline, Lagoon
98	O1B	71	09	00	155	10	00	Dease Inlet N. Transect
99	O1B	71	08	00	155	16	00	Dease Inlet N. Transect
100	O2A	71	08	00	155	22	00	Dease Inlet N. Transect
101	O3A	71	07	00	155	30	00	Dease Inlet N. Transect
102	O39	71	14	00	155	39	00	Cooper Island N, Sea Beach
103	O40	71	14	00	155	40	00	Cooper Island S, Lagoon Beach
104	O42	71	14	00	155	42	00	Cooper Island, Harbor
105	O4A	71	15	00	155	47	00	Ross Bay-Ekilukruak Entr. Transect
106	O4B	71	14	00	155	46	00	Ross Bay-Ekilukruak Entr. Transect
107	O5A	71	13	00	155	51	00	Ross Bay-Ekilukruak Entr. Transect
108	O5B	71	12	00	155	53	00	Ross Bay-Ekilukruak Entr. Transect
109	P0A	71	15	00	156	04	00	Deadmans Isl.-Scott Pt. Transect
110	P08	71	17	00	156	08	00	Deadmans Isl.-Scott Pt. Transect
111	P1A	71	21	00	156	13	00	Deadmans Isl.-Scott Pt. Transect
112	P1B	71	20	00	156	15	00	Deadmans Isl.-Scott Pt. Transect
113	P2A	71	21	54	156	21	36	Eluitkak Pass Transect
114	P2B	71	20	54	156	25	36	Eluitkak Pass Transect
115	P2C	71	20	18	156	27	42	Eluitkak Pass Transect
116	P2D	71	23	18	156	27	06	Point Barrow, 2 M
117	P2E	71	23	24	156	27	00	Point Barrow, 5 M
118	P28	71	23	00	156	27	00	Point Barrow, Sea Beach
119	P30	71	22	00	156	30	00	Barrow Spit, Elson Lagoon
120	P31	71	22	00	156	31	00	Barrow Spit

Table 1 : (continued), Page 5

No.	Station No.	North Latitude °	'	"	West Longitude °	'	"	Location
121	P33	71	18	30	156	33	00	Elson Lagoon, Creek Mouth, W. Shore
122	P34	71	19	00	156	33	20	Elson Lagoon Near Brant Point
123	P4A	71	19	48	156	40	30	Narl, Chuckchi Beach, 3.5 M
124	P52	71	15	03	156	52	03	Nunavak Bay
125	R19	70	49	04	158	19	03	Tachinisok Inlet, Sea Beach
126	R20	70	49	05	158	19	03	Tachinisock Inlet, Lagoon Beach
127	R28	70	48	03	158	28	00	Peard Bay, Nalimiut Point
128	R40	70	47	02	158	40	00	Peard Bay, South Shore
129	S51	70	42	08	159	51	01	2 Mi. NE Sinarurok R., Sea Shore
130	S56	70	41	00	159	56	02	1 Mi. SW Sinaruruk R., Sea Shore
131	T11	70	34	03	160	11	03	3 Mi. SW Pt. Marsh, Wainwright Lagoon
132	T12	70	34	02	160	11	06	3 Mi. SW Pt. Marsh, Sea Beach
133	U51	70	17	02	161	51	09	Icy Cape, Slough
134	U55	70	17	03	161	55	06	Kasegaluk Lagoon, Opp. Icy Cape Pass
135	U57	70	16	01	161	57	02	Kasegaluk Lagoon, 2 Mi. SW Airstrip
136	Z09	68	52	07	166	09	06	Cape Lisburne
137	Z44	68	21	06	166	45	00	Maryat Inlet, West
138	Z45	68	21	06	166	45	00	N. Point Hope, Sea Beach
139	Z46	68	21	06	166	45	00	Ipiutak Lagoon
140	45Y	68	06	00	165	45	00	Ogotoruck River Mouth
141	46Y	68	06	00	165	46	00	Cape Thompson, Sea Beach
142	48Y	68	06	00	165	48	00	Cape Thompson, Crowbill Point
143	33X	67	44	29	164	33	45	Kivalina
144	44W	67	09	07	163	44	06	Cape Krusenstern
145	27V	66	56	27	162	27	23	N. Baldwin Peninsula, Lockhart Point
146	28V	66	57	00	162	28	00	Hotham Inlet-Noatak Delta Transect
147	31T	66	34	49	160	31	19	Selawick Lake, Singauruk Point
148	0U3	66	09	22	161	03	30	Buckland River Mouth
149	2U1	66	15	33	161	21	15	Eschscholtz Bay, Elephant Point
150	5U1	66	13	41	161	51	11	Chamisso Refuge, Puffin Island

Table 1 : (continued), Page 6

No.	Station No.	North Latitude °	'	"	West Longitude °	'	"	Location
151	5U2	66	26	26	161	52	Ø8	Baldwin Pen, Arctic Circle Landing Strip
152	5U4	66	15	53	161	54	22	Choris Peninsula
153	2V5	66	44	23	162	25	49	Cape Blossom, Riley's Wreck Marsh
154	2V6	66	44	23	162	26	15	Cape Blossom, Riley's Wreck
155	3V2	66	48	27	162	32	2Ø	Baldwin Peninsula NW, Sadie Creek
156	4V4	66	Ø6	11	162	44	49	Cape Deceit Bluffs
157	4V5	66	Ø5	46	162	45	31	Cape Deceit
158	1WØ	66	Ø3	33	163	1Ø	Ø7	E. of Sullivan Bluffs
159	1W2	66	Ø3	53	163	12	16	Sullivan Bluffs
16Ø	2WØ	66	Ø5	15	163	2Ø	Ø5	Rex Point
161	4W5	66	35	ØØ	163	45	ØØ	Cape Espenberg, Sea Beach
162	5W3	66	35	ØØ	163	53	ØØ	Cape Espenberg, Marsh
163	4YØ	66	Ø2	ØØ	165	4Ø	ØØ	Arctic River
164	4Y1	66	Ø6	ØØ	165	41	ØØ	Shishmaref Inlet S, Arctic River Mouth
165	5Y2	66	Ø7	ØØ	165	52	ØØ	Shishmaref Inlet S, OOpik Cliff
166	ØZ4	66	15	3Ø	166	Ø5	2Ø	Sarichef Island - Tundra Burn
167	ØZ7	66	14	45	166	Ø6	ØØ	Sarichef Island - Lagoon Beach
168	ØZ8	66	14	53	166	Ø6	3Ø	Sarichef Island - Sea Beach
169	75Ø	65	45	ØØ	167	5Ø	ØØ	Sin-I-Rock, Sea Beach
17Ø	751	65	45	ØØ	167	51	ØØ	Sin-I-Rock, Lagoon Beach
171	8Ø1	65	37	ØØ	168	Ø1	ØØ	Lopp Lagoon SW
172	8Ø2	65	37	ØØ	168	Ø2	ØØ	Lopp Lagoon SW

TABLE 2: Species of plants and animals encountered at Beaufort Sea sampling stations in 1975.

3001030201		DUPONTIA FISCHERI
3001030505		PUCCINELLIA PHRYGANODES
3001030701		ELYMUS ARENARIUS
3001040401		ERIOPHORUM ANGUSTIFOLIUM
3001040109		CAREX URSINA
3001040113		CAREX AQUATILIS
3001040107		CAREX RAMENSKII
3001040108		CAREX SUBSPATHACEA
3002010101		SALIX OVALIFOLIA
3002010110		SALIX PULCHRA
3002020101		KOENIGIA ISLANDICA
3002020202		RUMEX ARCTICUS
3002200202		POLYGONUM VIVIPARUM
3002050401		STELLARIA HUMIFUSA
3002050801		MELANDRIUM APETALUM
3002060401		COCHLEARIA OFFICINALIS
3002070201		SEDUM ROSEA
3002080108		SAXIFRAGA CERNUA
3002090501		DRYAS INTEGRIFOLIA
3002150303		PEDICULARIS SUDETICA
3002180104		ARTEMISIA ARCTICA
30010305		PUCCINELLIA (GREEN)
30010305		PUCCINELLIA (RED)
300206		CRUCIFER
21		MOSS
19		LICHEN
300103		GRASS X
3002050101		HONCKENYA PEPLOIDES
30020101		SALIX SPP.
3002110102		HIPPURUS VULGARIS
Z01	10	EGG/EGG MASS #1
Z02	10	EGG/EGG MASS #2
Z03	10	EGG/EGG MASS #3
Z04	10	EGG/EGG MASS #4
000000000000		NO ANIMAL FOUND
03		CYANOPHYTA
04010101		ULOTHRIX SP.
04010303		ENTEROMORPHA SP.
0401030303		ENTEROMORPHA CRINITA
04040101		RHIZOCLONIUM SP.
1202010102		SPHACELARIA SUBFUSCA
1205010101		STICTYOSIPHON TORTILIS
12050601		LAMINARIA SP.
13		RHODOPHYTA
13010202		PORPHYRA SP.
13050103		RHODYMENIA SP.
1305010303		RHODYMENIA PALMATA F. MOLLIS
130602		DELESSERIACEAE

13060207	PHYCODRYS SP.
1306021501	BOTRYOGLOSSUM FARLOWIANUM
3001	MONOCOTYLEDONEAE
31	FORAMINIFERA
3104080501	AMMOTIUM CASSIS
3201010203	LEUCANDRA ANANAS
3203130201	HYMENIACIDON ASSIMILIS
3203140203	HALICLONA GRACILIS
3301020101	PERIGONIMUS YOLDIA-ARCTICAE
3301030101	CORYMORPHA FLAMMEA
33010302	TUBULARIA SP.
3301030203	TUBULARIA INDIVISA
3301121001	OPERULARELLA LACERATA
33011305	THUIARIA SP.
3301270201	AGLANTHA DIGITALE
3302	SCYPHOZOA
37	CESTOIDEA
40	RHYNCOCOELA (NEMERTEANS)
44	NEMATODA
4801	POLYCHAETA
4801120102	ANAITIDES GROENLANDICA
4801120205	ETEONE LONGA
48012201	AUTOLYTUS SP.
4801250201	SPHAERODOROPSIS MINUTUM
480142	SPIONIDAE
4801420601	SCOLECOLEPIDES ARCTIUS
48014207	SPIO SP.
4801420701	SPIO FILICORNIS
48014213	PYGOSPIO SP.
480158	CAPITELLIDAE
4801650209	AMPHARETE VEGA
48016813	FABRICIA SP.
480170	SERPULIDEA
48017005	SPIRORBIS SP.
480201	ENCHYTRAEIDAE
480202	TUBIFICIDAE
48020201	HYPSIBIUS SP.
4904	PELECYPODA
4904020201	NUCULA TENUIS
4904030301	PORTLANDIA ARCTICA
49040306	YOLDIELLA SP.
4904070101	MYTILUS EDULIS
4904070402	MUSCULUS DISCORS
49041101	ASTARTE SP.
4904110101	ASTARTE BOREALIS
4904110103	ASTARTE MONTEGUI
49041801	MYSELLA SP.
4904210401	LIOCYMA FLUCTUOSA

TABLE 2 (continued)

4904290101	CYRTODARIA KURRIANA
4904290201	HIATELLA ARCTICA
4905	GASTROPODA
490506	TROCHIDAE
490525	NATICIDAE
4905250101	AMAUROPSIS PURPUREA
49053201	BUCCINUM SP.
49053302	BERINGIUS SP.
49053303	COLUS SP.
4905330810	NEPTUNEA HEROS
4905330901	PLICIFUSUS KROYERI
4905340202	MITRELLA TUBEROSA
4905490201	CYLICHNA OCCULATA
4905510102	LIMACINA HELICINA
51	ARACHNIDA
510101	HALACARIDAE (MARINE MITES)
53	CRUSTACEA
5302020101	BRANCHINECTA PALUDOSA
5303000301	LEPIDURUS ARCTIUS
53040101	DAPHNIA SP.
5307	PODOCOPA (OSTRACOD)
5310	HARPACTICOIDA
5311	CALANOIDA
5311120208	EURYTEMORA CANADENSIS
53111402	LIMNOCALANUS SP.
5318	THORACICA(NAUPLIUS)
5318020104	BALANUS CRENATUS
5327031404	MYSIS RELICTA
53280501	DIASTYLIS SP.
5328050110	DIASTYLIS LUCIFERA
5328050120	DIASTYLIS SULCATA
5330	ISOPODA
5330020101	SADURIA ENTOMON
533005	AEGIDAE(ISOPOD)
5331	AMPHIPODA
5331120101	APHERUSA GLACIALIS
5331120102	APHERUSA MAGALOPS
53311204	HALIRAGES SP.
53312014	ROZINANTE SP. (FRAGILI
5331210501	GAMMARACANTHUS LORICATUS
53312107	GAMMARUS SP.
5331210701	GAMMARUS LOCUSTA
5331210702	GAMMARUS SETOSA
5331210704	GAMMARUS ZADDACHI
5331211402	WEYPRECHTIA PINGUIS
5331220201	PONTOPOREIA FEMORATA
5331220202	PONTOPOREIA AFFINIS
5331340702	BOECKOSIMUS AFFINIS

5331340712	BOECKOSIMUS BOTKINI
5331342701	ONISIMUS BIRULAI
5331342702	ONISIMUS GLACIALIS
5331342703	ONISIMUS LITORALIS
5331370101	ACANTHOSTEPHEIA BEHRINGIENSIS
5331370103	ACANTHOSTEPHEIA INCARINATA
5331370201	ACEROIDES LATIPES
53313708	MONOCULODES SP.
5331370803	MONOCULODES BOREALIS
5331370907	MONOCULOPSIS LONGICORNIS
5331371202	PAROEDICEROS LYNCEUS
5331371203	PAROEDICEROS PROPINQUUS
5331371602	OEDICEROS SAGINATUS
53314802	METOPA SP.
5331800105	HYPERIA MEDUSARUM HYLSTRIX
5331801002	PARATHEMISTO LIBELLULA
5332020902	THYSANOESSA INERMIS
5332020905	THYSANOESSA LONGIPES
5332020906	THYSANOESSA RASCHI
533311	PAGURIDAE
5333110219	PAGARUS TRIGONOCHEIRUS
53331702	HYAS SP.
5333170202	HYAS COARCTATUS ALUTACEUS
5402	COLLEMBOLA
5403	DIPTERA
540301	TIPULIDAE (CRANE FLY)
540302	CHIRONOMIDAE
5403020101	PARACLUNIO ALASKENSIS
54030202	SAUNDERIA SP.
5403020201	SAUNDERIA CLAVICORNIS
5404	COLEOPTERA
6101010101	HALICRIPTUS SPINULOSUS
6101010202	PRIAPULUS CAUDATUS
6601	CHEILOSTOMATA
6601020101	EUCRATEA LORICATA
6603010104	ALCIONIDIUM DISCIFORME
7100000303	SAGITTA ELEGANS
7203040101	MOLGULA GRIFFITHSII
7909020201	BOREOGADUS SAIDA
7914010201	PUNGITIUS PUNGITIUS
791504	COTTIDAE
79150422	MYOXOCEPHALUS SP.

Table 3 : Species encountered in the Chukchi Sea sampling program (1976) not previously found in Beaufort Sea samples (1975).

Species	Code
Phylum Cnidaria (Coelenterata)	33
Class Hydrozoa	3301
Coryne tubulosa	3301060101
Obelia borealis	3301090202
Abietinaria sp.	33011304
Phylum Annelida	48
Class Polychaeta	4801
Polynoidae	480101
Eunoe sp.	48010105
Gattyana sp.	48010106
Anaitides medipapillata	4801120103
Syllis sp.	48012203
Eusyllis blomstrandi	4801220602
Nephtys (caeca?)	4801240103
Nephtys longaseta	4801240109
Glycinde sp.	48012701
Dorvilleidae	480135
Magelona sp.	48014301
Heteromastus filiformis	4801580201
Arenicola marina glacialis	4801600202
Axiothella catenata (?)	4801610801
Pectinaria belgica	4801640301
Sabella sp.	48016808
Class Hirudinea	4803
Hirudinea, unidentified	4803
Phylum Mollusca	49
Class Pelecypoda	4904
Mytilus edulis	4904070101
Lucinoma annulata (?)	4904140201
Diplodonta sp.	49041601

Table 3 : (continued), Page 2

Species	Code
Clinocardium nuttalli	4904200102
Macoma sp.	49042401
Macoma (inquinata?)	4904240116
Siliqua sp.	49042701
Cryptomya sp. (?)	49042801
Entodesma saxicola	4904330101
Class Gastropoda	4905
Margarites sp.	49050603
Epitonium sp.	49052101
Natica sp.	49052502
Searlesia sp.	49053202
Liomesus sp.	49053305
Phylum Arthropoda	
Class Pycnogonida	52
Nymphon (pixellae?)	52000101
Class Crustacea	
Acanthomysis (costata?)	53270301
Acanthomysis pseudomacropsis	5327030106
Boreomysis sp. (?)	53270304
Neomysis awatschensis	5327031501
Neomysis czerniawskii	5327031502
Neomysis intermedia	5327031503
Neomysis kadiakensis	5327031504
Neomysis (mercedis?)	5327031505
Neomysis mirabilis	5327031506
Stylocheiron longicorne	5327032001
Lamprops fuscata	5328020101
Lamprops sarsi	5328020106
Diastylis alaskensis	5328050101
Leptostylis sp.	53280504
Pseudocuma sp. (?)	53280602

Table 3 : (continued), Page 3

Species	Code
Atylus (collingi?)	53310901
Calliopius laeviusculus	5331120201
Halirages (mixtus?)	53311204
Accedomoera sp. (?)	53312001
Paramoera sp.	53312010
Paramoera (carlottensis?)	5331201001
Pontogeneia (inermis?)	53312012
Anisogammarus sp.	53312101
Photis sp.	53312602
Protomedeia sp.	53312603
Ischyrocerus sp.	53312702
Monoculodes (kroyeri)	53313708
Parapleustes pugettensis	5331430302
Pleusymptes sp. (?)	53314305
Dulichia (arctica)	53314401
Paradulichia (spinifera)	53314403
Metopelloides (stephenseni?)	53314804
Metopa (bruzelii?)	53314802
Caprella (drepanochir?)	5331980706
Pandalus montagui tridens (?)	5333040104
Crangon (nigricauda?)	5333060101
Crangon septemspinosa	5333060104
Phylum Echiura	60
Echiurus echiurus alaskana	6001020101
Phylum Ectoprocta	68
Terminoflustra membranacea-truncata	6601050201
Phylum Echinodermata	68
Class Asteroidea	6801
Pisaster (brevispinus?)	6801120501
Pisaster ochraceus	6801120502

Table 3 : (continued), Page 4

Species	Code
Class Echinoidea	6802
Dendraster excentricus	6802010101
Class Ophiuroidea	6803
Ophiuroidea, unidentified	6803
Phylum Chordata	72
Class Ascidiacea	7203
Boltenia sp.	72030302
Subphylum Vertebrata	76
Class Chondrichthyes	7602
Squatina sp.	76020601
Class Osteichthyes	
Agonidae	791505
Scytalina cerdale (?)	7916140101
Ammodytes hexapterus	7916170101
Hippoglossiodes sp. (?)	79170206
Uncoded species	
Scolelepis sp.	
Caenestheriella sp.	
Leucotrichia pictipes (?)	
Doridacea	
Flounder	

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION B06
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION B06 : 69°50'08" N; 142°05'04" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 1.64.

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
44	NEMATODA			0.00024	XXX
4801420601	SCOLECOLEPIDES ARCTIUS			0.00069	
480201	ENCHYTRAEIDAE			0.02034	XXX
5327031404	MYSIS RELICTA		0.29550		
5330020101	SADURIA ENTOMON		0.00200	0.18351	
5331210702	GAMMARUS SETOSA				XXX
5331210704	GAMMARUS ZADDACHI		0.00056		
5331220202	PONTOPOREIA AFFINIS		0.00019	0.02597	
5331342702	ONISIMUS GLACIALIS		0.03056	0.18082	XXX
5331370103	ACANTHOSTEPHEIA INCARINA TA		0.00775		
53313708	MONOCULODES SP.		0.01575	0.00130	XXX
5331370907	MONOCULOPSIS LONGICORNIS		0.00025		
5403020101	PARACLUNIO ALASKENSIS		0.00010	0.10560	XXX
7915042206	MYOXOCEPHALUS QUADRICORN IS		0.11450		

TABLE 4 CONTINUED

29

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
TOTAL			0.46716	0.51847	
SHANNON WEAVER DIVERSITY INDEX			1.05	1.04	

TABLE 5

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION B18
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION B18 : 69°53'60"; 142°18'07" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 1.56

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
40	RHYNCOCOELA (NEMERTEANS)			0.00043	
44	NEMATODA			0.00704	
4801120205	ETEONE LONGA			0.00072	
4801420601	SCOLECOLEPIDES ARCTIUS		0.00065	0.52112	
48016813	FABRICIA SP.			0.00058	
480201	ENCHYTRAEIDAE			0.00072	
4904290101	CYRTODARIA KURRIANA			4.86178	
5327031404	MYSIS RELICTA		1.18550		
53280501	DIASTYLIS SP.			0.00072	
5328050120	DIASTYLIS SULCATA		0.00200		
5330020101	SADURIA ENTOMON		0.04775	2.27883	
5331120101	APHERUSA GLACIALIS		0.00375		
53312014	ROZINANTE SP. (FRAGILIS?)		0.00306		
5331210501	GAMMARACANTHUS LORICATUS		0.03275		

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
5331210702	GAMMARUS SETOSA		0.26575	0.04797	XXX
5331210704	GAMMARUS ZADDACHI		0.01825	0.00036	
5331220201	PONTOPOREIA FEMORATA		0.00375	0.10207	
5331220202	PONTOPOREIA AFFINIS		0.02625		
5331340712	BOECKOSIMUS BOTKINI			0.04184	
5331342702	ONISIMUS GLACIALIS		0.13575	0.06413	
5331370101	ACANTHOSTEPHEIA BEHRINGI ENSIS		0.01175		
5331370103	ACANTHOSTEPHEIA INCARINA TA		0.04725	0.00289	
5331370201	ACEROIDES LATIPES		0.00300		
53313708	MONOCULODES SP.		0.24700	0.00072	
5331370907	MONOCULOPSIS LONGICORNIS		0.00325		
5331371202	PAROEDICEROS LYNCEUS		0.00031		
5331371203	PAROEDICEROS PROPINQUUS		0.00225		
6101010101	HALICRIPTUS SPINULOSUS			0.28969	
791504	COTTIDAE		0.00800		
TOTAL			2.04802	8.22160	
SHANNON WEAVER DIVERSITY INDEX			1.20	1.77	

TABLE 6

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION B21
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION B21 : 69°53'35" N; 142°21'09" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 0.92.

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
40	RHYNCOCOELA (NEMERTEANS)		0.00500		
4801250201	SPHAERODOROPSIS MINUTUM			0.00144	
4801420701	SPIO FILICORNIS			0.00581	
480201	ENCHYTRAEIDAE			0.00024	
4904290101	CYRTODARIA KURRIANA			0.02164	
5327031404	MYSIS RELICTA		0.37450		
5330020101	SADURIA ENTOMON		0.00015	4.44822	
5331120101	APHERUSA GLACIALIS		0.00100		
5331210704	GAMMARUS ZADDACHI				XXX
5331340702	BOECKOSIMUS AFFINIS		0.00012		
5331342702	ONISIMUS GLACIALIS		0.00700	0.00721	XXX
5331342703	ONISIMUS LITORALIS		0.00850		XXX
5331370103	ACANTHOSTEPHEIA INCARINA TA		0.00400		
53313708	MONOCULODES SP.				XXX

TABLE 6 CONTINUED

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
5331370907	MONOCULOPSIS LONGICORNIS		0.01850		
5331371202	PAROEDICEROS LYNCEUS		0.03012		
TOTAL			0.44890	4.48457	
SHANNON WEAVER DIVERSITY INDEX			0.78	1.52	

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION B22
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION B22 : 69°55'30" N; 142°21'30" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 2.22.

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
44	NEMATODA			0.00003	XXX
4801120205	ETEONE LONGA				XXX
4801420601	SCOLECOLEPIDES ARCTIUS		0.00500	0.00118	XXX
48014207	SPIO SP.		0.00450		
4801420701	SPIO FILICORNIS				XXX
48014213	PYGOSPIO SP.				XXX
4904290101	CYRTODARIA KURRIANA		0.00150		
5307	PODOCOPA (OSTRACOD)			0.00039	XXX
5327031404	MYSIS RELICTA		0.10050		
53280501	DIASTYLIS SP.		0.00750		
5328050110	DIASTYLIS LUCIFERA				XXX
5328050120	DIASTYLIS SULCATA				XXX
5330020101	SADURIA ENTOMON		0.03650	1.12134	
5331210501	GAMMARACANTHUS LORICATUS		0.31700		

TABLE 7 CONTINUED

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
5331210702	GAMMARUS SETOSA		0.43750		
5331210704	GAMMARUS ZADDACHI		0.48750		
5331220201	PONTOPOREIA FEMORATA				XXX
5331220202	PONTOPOREIA AFFINIS		0.00350		XXX
5331342702	ONISIMUS GLACIALIS		0.07100	0.06689	
5331342703	ONISIMUS LITORALIS			0.03935	
53313708	MONOCULODES SP.		0.06750		
5331370907	MONOCULOPSIS LONGICORNIS		0.00075		XXX
5331371202	PAROEDICEROS LYNCEUS		0.00250		
6101010101	HALICRIPTUS SPINULOSUS				XXX
6601020101	EUCRATEA LORICATA				XXX
TOTAL			1.54275	1.22918	
SHANNON WEAVER DIVERSITY INDEX			2.13	1.47	

TABLE 8

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION C36
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION C36 : 70°06'07" N; 143°36'05" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 0.88.

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
3203140203	HALICLONA GRACILIS				XXX
44	NEMATODA			0.00283	
480201	ENCHYTRAEIDAE			0.11902	
5331210702	GAMMARUS SETOSA			0.40395	XXX
5403020201	SAUNDERIA CLAVICORNIS			0.23371	
7909020201	BOREOGADUS SAIDA				XXX
7915042206	MYOXOCEPHALUS QUADRICORNIS				XXX
AL				0.75951	
ANNON WEAVER DIVERSITY INDEX				0.88	

TABLE 9

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION C37
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION C37 : 70°08'00" N; 143°37'00" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 1.39

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
33010302	TUBULARIA SP.		0.01340		
44	NEMATODA			0.00042	XXX
4801420601	SCOLECOLEPIDES ARCTIUS			0.00806	
48014213	PYGOSPIO SP.			0.05071	
480201	ENCHYTRAEIDAE			0.00097	XXX
4904290101	CYRTODARIA KURRIANA			0.94321	
5327031404	MYSIS RELICTA		0.49456		
5331210501	GAMMARACANTHUS LORICATUS		0.01950		
5331210702	GAMMARUS SETOSA		1.23445	0.16342	XXX
5331342702	ONISIMUS GLACIALIS		0.06043	0.17200	
53313708	MONOCULODES SP.		0.01181	0.00037	
5331370907	MONOCULOPSIS LONGICORNIS		0.00080		
540302	CHIRONOMIDAE				XXX
6101010101	HALICRIPTUS SPINULOSUS			0.07790	

TABLE 9 CONTINUED

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
7915042206	MYOXOCEPHALUS QUADRICORN IS		0.57929		
TOTAL			2.41423	1.41706	
SHANNON WEAVER DIVERSITY INDEX			1.25	1.94	

TABLE 10

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION C38
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION C38 : 70°06'02" N. 143°38'01" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 1.41.

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
33010302	TUBULARIA SP.		0.00466	0.01207	
3301030203	TUBULARIA INDIVISA			0.68337	XXX
44	NEMATODA			0.00131	XXX
4801120205	ETEONE LONGA			0.00228	
4801420601	SCOLECOLEPIDES ARCTIUS			0.00159	
48014213	PYGOSPIO SP.		0.00001	0.50247	
480201	ENCHYTRAEIDAE		0.01473	1.00113	XXX
4904290101	CYRTODARIA KURRIANA			14.10244	
4905250101	AMAUROPSIS PURPUREA			0.46013	
5327031404	MYSIS RELICTA		0.25743		
5330020101	SADURIA ENTOMON		0.01029	0.04100	
53312107	GAMMARUS SP.		0.00004	0.00228	
5331210701	GAMMARUS LOCUSTA		0.00056		
5331210702	GAMMARUS SETOSA		0.20871	0.10478	XXX

TABLE 10 CONTINUED 40

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
5331210704	GAMMARUS ZADDACHI		0.00518	0.00057	
5331220202	PONTOPOREIA AFFINIS			0.00057	
5331342702	ONISIMUS GLACIALIS		0.04132	0.23007	XXX
53313708	MONOCULODES SP.		0.00021		
6101010101	HALICRIPTUS SPINULOSUS		0.00043	1.39316	
7203040101	MOLGULA GRIFFITHSII		0.02586		
791504	COTTIDAE		0.00743		
7915042206	MYOXOCEPHALUS QUADRICORN IS		0.01643		
TOTAL			0.59328	18.53918	
SHANNON WEAVER DIVERSITY INDEX			1.33	0.70	

TABLE 11

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION C39
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION C39 : 70°08'02" N; 143°39'02" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 1.50.

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
4801420701	SPIO FILICORNIS				XXX
5327031404	MYSIS RELICTA		0.05856		
5330020101	SADURIA ENTOMON			0.51431	
5331120101	APHERUSA GLACIALIS		0.00901		
5331210501	GAMMARACANTHUS LORICATUS		0.00332		
5331210702	GAMMARUS SETOSA		0.55556	0.37509	XXX
5331210704	GAMMARUS ZADDACHI				XXX
5331340702	BOECKOSIMUS AFFINIS				XXX
5331342702	ONISIMUS GLACIALIS		0.10529	0.04328	
5331342703	ONISIMUS LITORALIS			0.48329	XXX
TOTAL			0.73173	1.41598	
SHANNON WEAVER DIVERSITY INDEX			1.47	1.33	

TABLE 12

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION C40
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION C40 : 70°06'01" N; 143°40'03" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 0.95

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
5203140203	HALICLONA GRACILIS				XXX
44	NEMATODA			0.00396	XXX
4801420601	SCOLECOLEPIDES ARCTIUS		0.00030	0.00072	
480201	ENCHYTRAEIDAE		0.00701	1.21316	XXX
4904210401	LIOCYMA FLUCTUOSA				XXX
490525	NATICIDAE				XXX
5327031404	MYSIS RELICTA		0.20445	0.00048	
5330020101	SADURIA ENTOMON		0.00015		
5331210702	GAMMARUS SETOSA		0.00651		
5331210704	GAMMARUS ZADDACHI		0.01276	0.05290	
5331342702	ONISIMUS GLACIALIS		0.02377	0.01539	
53313708	MONOCULODES SP.		0.00469	0.00060	
5402020101	PARACLUNIO ALASKENSIS		0.01226	9.73318	XXX
6603010104	ALCYONIDIUM DISCIFORME				XXX

TABLE 12 CONTINUED

43

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
TOTAL			0.27191	11.02038	
SHANNON WEAVER DIVERSITY INDEX			1.61	0.37	

TABLE 13

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION C41
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION C41 : 70°05'01" N; 143°41'01" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 1.19.

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
33010302	TUBULARIA SP.				XXX
44	NEMATODA			0.00012	XXX
48014213	PYGOSPIO SP.			0.16611	
480201	ENCHYTRAEIDAE		0.00004	0.49061	XXX
5327031404	MYSIS RELICTA		3.76525		
5330020101	SADURIA ENTOMON		0.11475	0.02955	
5331210501	GAMMARACANTHUS LORICATUS		0.01850		
5331210704	GAMMARUS ZADDACHI		0.00650	0.00031	
5331220202	PONTOPOREIA AFFINIS		0.01225		
5331342702	ONISIMUS GLACIALIS		0.61300	0.17615	
5331370103	ACANTHOSTEPHEIA INCARINATA		0.00350		
53313708	MONOCULODES SP.		0.00606		
5331370907	MONOCULOPSIS LONGICORNIS		0.00012		
5403	DIPTERA			0.00124	

TABLE 13 CONTINUED

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
7915042206	MYOXOCEPHALUS QUADRICORN IS		0.09625		
TOTAL			4.63622	0.86409	
SHANNON WEAVER DIVERSITY INDEX			0.80	0.52	

TABLE 14

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION DOO
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION DOO : 70°05'04"N; 143°59'08" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 1.51.

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
4801120205	ETEONE LONGA			0.00108	
4801420601	SCOLECOLEPIDES ARCTIUS			0.06297	
48014213	PYGOSPIO SP.			0.00173	
480201	ENCHYTRAEIDAE			0.00249	XXX
4904110103	ASTARTE MONTEGUI				XXX
5327031404	MYSIS RELICTA		0.47767		
5330020101	SADURIA ENTOMON		0.01343	5.52534	XXX
5331120101	APHERUSA GLACIALIS		0.00267		
53312014	ROZINANTE SP. (FRAGILIS?)		0.00008		
5331210701	GAMMARUS LOCUSTA				XXX
5331210702	GAMMARUS SETOSA				XXX
5331210704	GAMMARUS ZADDACHI		0.06167		
5331220202	PONTOPOREIA AFFINIS		0.06833	0.88724	
5331342702	ONISIMUS GLACIALIS		0.04733	0.11956	XXX

TABLE 14 CONTINUED

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
5331342703	CNISIMUS LITORALIS		0.01000	0.13471	XXX
5331370103	ACANTHOSTEPHEIA INCARINA TA		0.01500		
5331370907	MONOCULOPSIS LONGICORNIS		0.03319	0.00054	
5331371202	PAROEDICEROS LYNCEUS		0.00008		
54030202	SAUNDERIA SP.				XXX
6601	CHEILOSTOMATA (?)		0.00010		
7915042206	MYOXOCEPHALUS QUADRICORN IS		0.00733		
TOTAL			0.73689	6.73566	
SHANNON WEAVER DIVERSITY INDEX			1.19	1.39	

TABLE 15

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION H08
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION H08 : 70°20'17" N; 148°08'12" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 1.16.

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
33010302	TUBULARIA SP.			0.00162	
44	NEMATODA			0.00008	
480201	ENCHYTRAEIDAE		0.00004	0.00097	
5327031404	MYSIS RELICTA		2.47917		
5330020101	SADURIA ENTOMON			0.09738	
5331120101	APHERUSA GLACIALIS		0.00042		
5331210501	GAMMARACANTHUS LORICATUS		0.06917		
5331210701	GAMMARUS LOCUSTA			0.00541	
5331220202	PONTOPOREIA AFFINIS		0.00250		
5331342702	ONISIMUS GLACIALIS			0.01623	
5403020101	PARACLUNIO ALASKENSIS		0.01333	1.11446	
5403020201	SAUNDERIA CLAVICORNIS			0.00325	
7915042205	MYOXOCEPHALUS QUADRICORN IS		0.21417		
TOTAL			2.77879	1.23940	

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
SHANNON WEAVER DIVERSITY INDEX			0.68	0.91	

TABLE 16

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION H12
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION H12 : 70°20'42" N; 148°12'18" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 0.69.

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
3301030203	TUBULARIA INDIVISA	0.00040			
40	RHYNCOCOELA (NEMERTEANS)			0.00118	
44	NEMATODA			0.00327	
4801420601	SCOLECOLEPIDES ARCTIUS			0.00118	
480201	ENCHYTRAEIDAE	0.00002		0.00177	
5327031404	MYSIS RELICTA	53.03499	7.78916	0.03541	
5330020101	SADURIA ENTOMON	0.11100	0.06833	0.00511	
5331120102	APHERUSA MAGALOPS		0.00021		
5331210501	GAMMARACANTHUS LORICATUS	3.47000	0.80000		
5331210702	GAMMARUS SETOSA	0.00800			
5331220202	PONTOPOREIA AFFINIS	0.02100	0.00437	2.20728	XXX
5331342702	ONISIMUS GLACIALIS	0.02350	0.02083	0.01574	XXX
53313708	MONOCULODES SP.	0.00037	0.00583		
540302	CHIRONOMIDAE			0.00020	

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
6601020101	EUCRATEA LORICATA	0.00500			
791504	COTTIDEA	0.33750			
7915042206	MYOXOCEPHALUS QUADRICORN IS	14.32749	0.86667		
TOTAL		71.33971	9.55541	2.27113	
SHANNON WEAVER DIVERSITY INDEX		0.51	0.32	0.22	

TABLE 17

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION H19
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION H19 : 70°21'00" N; 148°19'00" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 1.40.

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
3301030203	TUBULARIA INDIVISA			0.00577	
40	RHYNCOCOELA (NEMERTEANS)			0.01226	
44	NEMATODA			0.00017	
4801120205	ETEONE LONGA			0.00361	
4801250201	SPHAEROCOROPSIS MINUTUM			0.00361	
4801420601	SCOLECOLEPIDES ARCTIUS			4.06831	
480158	CAPITELLIDAE			0.00721	
[illegible]01650209	AMPHARETE VEGA			1.83399	
[illegible]16813	FABRICIA SP.			0.20558	
4904290101	CYRTODARIA KURRIANA			0.11902	
5327031404	MYSIS RELICTA		5.90100		
53280501	DIASTYLIS SP.			0.00072	
5330020101	SADURIA ENTOMON		2.69250	0.00721	
53312014	POZINANTE SP. (FRAGILIS?)		0.05150		

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
5331210702	GAMMARUS SETOSA		0.00012		
5331210704	GAMMARUS ZADDACHI		0.00072		
5331220202	PONTOPOREIA AFFINIS		0.00050		
5331342702	ONISIMUS GLACIALIS		0.31400	0.06492	
5331370101	ACANTHOSTEPHEIA BEHRINGI ENSIS		0.01200	0.00180	
5331370103	ACANTHOSTEPHEIA INCARINA TA		0.06200	0.00721	
5331370201	ACEROIDES LATIPES		0.00600		
53313708	MONOCULODES SP.		0.36600	0.00902	
5331370907	MONOCULOPSIS LONGICORNIS		0.04100		
5331371203	PAROEDICEROS PROPINQUUS		0.00194	0.00180	
6101010101	HALICRIPTUS SPINULOSUS			3.12337	
TOTAL			9.44928	9.47558	
SHANNON WEAVER DIVERSITY INDEX			1.17	1.86	

TABLE 18

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION H20
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION H20 : 70°20'01" N; 148°19'42" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 1.07

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
40	RHYNCOCOELA (NEMERTEANS)			0.00216	
4801	POLYCHAETA			0.05049	
4801420601	SCOLECOLEPIDES ARCTIUS		0.00108	0.38086	
48016813	FABRICIA SP.		0.00002	0.02103	
5327031404	MYSIS RELICTA		18.70831	0.10820	
5330020101	SADURIA ENTOMON		0.01167		
5331120102	APHERUSA MAGALOPS		0.13583		
53312014	ROZINANTE SP. (FRAGILIS?)		0.00667		
5331210501	GAMMARACANTHUS LORICATUS		1.01167		
5331210702	GAMMARUS SETOSA		0.00021		
5331342702	ONISIMUS GLACIALIS		0.01500	0.00721	
5331370103	ACANTHOSTEPHEIA INCARINA TA		0.01500		
53313708	MONOCULODES SP.		0.65000	0.00902	
5331370907	MONOCULOPSIS LONGICORNIS		0.00771	0.00541	

CODE	NAME	SEINE 50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
5331371203	PAROEDICEROS PROPINQUUS		0.04000		
6101010101	HALICRIPTUS SPINULOSUS			0.31739	
6101010202	PRIAPULUS CAUDATUS			0.09377	
7100000303	SAGITTA ELEGANS		0.00417		
TOTAL			20.60725	0.99555	
SHANNON WEAVER DIVERSITY INDEX			1.04	1.85	

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION H22
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION H22 : 70°20'06" N; 148°22'30" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 0.58

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
33010302	TUBULARIA SP.			0.02164	
40	RHYNCOCOELA (NEMERTEANS)			0.00216	
44	NEMATODA			0.00006	
4801420601	SCOLECOLEPIDES ARCTIUS			2.31187	
4801650209	AMPHARETE VEGA			0.11036	
48016813	FABRICIA SP.			0.02691	
4904110103	ASTARTE MONTEGUI			3.64273	
5327031404	MYSIS RELICTA		3.46200		
53312014	ROZINANTE SP. (FRAGILIS?)		0.00062		
5331210501	GAMMARACANTHUS LORICATUS		0.00500		
5331342702	ONISIMUS GLACIALIS		0.00037		
5331370103	ACANTHOSTEPHEIA INCARINA TA		0.00050		
53313708	MONOCULODES SP.		0.06100	0.00721	
5331370907	MONOCULOPSIS LONGICORNIS		0.00287		

TABLE 19 CONTINUED

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
5331371202	PAROEDICEROS LYNCEUS		0.00062		
5331371203	PAROEDICEROS PROPINQUUS		0.00050		
6101010101	HALICRIPTUS SPINULOSUS			1.48739	
6601	CHEILOSTOMATA (?)		0.01600		
6601020101	EUCRATEA LORICATA		0.00600		
TOTAL			3.55550	7.61034	
SHANNON WEAVER DIVERSITY INDEX			0.48	1.67	

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION H28
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION H28 : 70°18'32" N; 148°28'48" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 1.32

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
33010302	TUBULARIA SP.		0.15750	0.00216	
44	NEMATODA			0.00073	
480201	ENCHYTRAEIDAE		0.00750	0.07694	
5327031404	MYSIS RELICTA		1.52250		
5330020101	SADURIA ENTOMON		0.00083	0.02404	
5331210501	GAMMARACANTHUS LORICATUS		1.41167	0.17492	
5331342702	ONISIMUS GLACIALIS		0.02083		XXX
53313708	MONOCULODES SP.		0.01000		
5402	COLLEMBOLA			0.00159	
5403020101	PARACLUNIO ALASKENSIS		0.00210		
6601020101	SUCRATEA LORICATA		0.73608	0.00649	
791504	COTTIDAE		0.00167		
7915042206	MYOXOCEPHALUS QUADRICORNIS		0.15667		
TOTAL			4.02734	0.28689	

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
SHANNON WEAVER DIVERSITY INDEX			1.19	0.51	

TABLE 21

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION H32
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION H32 : 70°22'48" N; 148°32'48" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 0.79

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
33010302	TUBULARIA SP.			0.00519	
33011305	THUIARIA SP.			0.00866	
44	NEMATODA			0.00007	XXX
480201	ENCHYTRAEIDAE			0.00939	XXX
5327031404	MYSIS RELICTA		0.13880		
5330020101	SADURIA ENTOMON		0.15937		
5331210501	GAMMARACANTHUS LORICATUS		0.00013		
5331210701	GAMMARUS LOCUSTA		0.00007	0.00433	
5331210702	GAMMARUS SETOSA	0.34550	0.00007	0.96082	
5331220202	PONTOPOREIA AFFINIS		0.00007		
5331342702	ONISIMUS GLACIALIS	0.00312	0.01230		
53313708	MONOCULODES SP.		0.00026		
5402	COLLEMBOLA				XXX
5403020201	SAUNDERIA CLAVICORNIS				XXX

TABLE 21 CONTINUED

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
6601	CHEILOSTOMATA (BUGULA-TYPE)				XXX
6601020101	EUCRATEA LORICATA			0.01039	XXX
7915042206	MYOXOCEPHALUS QUADRICORNIS	0.79800			
TOTAL		1.14662	0.31107	0.99854	
SHANNON WEAVER DIVERSITY INDEX		1.03	0.48	1.01	

TABLE 22

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION H39
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION H39 : 70°24'19" N; 148°40'12" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 0.78

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
3301020101	PERIGONIMUS YOLDIA-ARCTICAE				XXX
44	NEMATODA			0.00365	
480201	ENCHYTRAEIDAE			0.57624	XXX
5327031404	MYSIS RELICTA			0.01237	
5330	ISOPODA			0.00618	
5330020101	SADURIA ENTOMON			0.00804	
5331210501	GAMMARACANTHUS LORICATUS			0.01855	XXX
5331210701	GAMMARUS LOCUSTA			0.01237	
5331210702	GAMMARUS SETOSA			0.26586	
5331220202	PONTOPOREIA AFFINIS			0.01237	
53313708	MONOCULODES SP.			0.00155	
5331800105	HYPERIA MEDUSARUM HYLSTRIX				XXX
5403020101	PARACLUNIO ALASKENSIS			0.06183	XXX
5403020201	SAUNDERIA CLAVICORNIS			0.00247	

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
7915042206	MYOXOCEPHALUS QUADRICORN IS				XXX
TOTAL				0.98146	
SHANNON WEAVER DIVERSITY INDEX				0.78	

TABLE 23

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION H40
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION H40 : 70°24'19" N; 148°40'12" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 0.24

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
33010302	TUBULARIA SP.				XXX
5327031404	MYSIS RELICTA	10.27728	1.71916		
5330020101	SADURIA ENTOMON	0.00100	0.00333		
5331210501	GAMMARACANTHUS LORICATUS		0.02833		XXX
5331210702	GAMMARUS SETOSA	0.03103	0.00021		XXX
5331210704	GAMMARUS ZADDACHI	0.00150	0.00167		
5331220202	PONTOPOREIA AFFINIS		0.00021		XXX
5331342702	ONISIMUS GLACIALIS	0.00100	0.02083		
53313708	MONOCULODES SP.		0.00062		XXX
791504	COTTIDEA	0.01752			
TOTAL		10.32932	1.77437		
SHANNON WEAVER DIVERSITY INDEX		0.10	0.67		

TABLE 24

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION I30
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION I30 : 70°33'24" N; 149°30'36" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 1.18

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
44	NEMATODA			0.00819	
480201	ENCHYTRAEIDAE			0.13417	XXX
5311120208	EURYTEMORA CANADENSIS				XXX
53111402	LIMNOCALANUS SP.				XXX
5327031404	MYSIS RELICTA	1.73450	1.20833		
5331120102	APHERUSA MAGALOPS		0.00167		
5331210501	GAMMARACANTHUS LORICATUS	0.04500			
5331210702	GAMMARUS SETOSA	0.03150	0.02833		
5331210704	GAMMARUS ZADDACHI			0.00866	XXX
5331340702	BOECKOSIMUS AFFINIS				XXX
5331342702	ONISIMUS GLACIALIS		0.00167	0.06059	XXX
5403020101	PARACLUNIO ALASKENSIS			3.23734	
5403020201	SAUNDERIA CLAVICORNIS			0.14715	
TOTAL		1.81100	1.24000	3.59610	
SHANNON WEAVER DIVERSITY INDEX		0.14	0.19	0.85	

TABLE 25

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION I31
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION I31 : 70°33'32" N; 149°30'36" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 0.72

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
44	NEMATODA			0.06028	
480201	ENCHYTRAEIDAE			0.19476	
5331342702	ONISIMUS GLACIALIS			0.10820	
5331342703	ONISIMUS LITTORALIS				XXX
5331370907	MONOCULOPSIS LONGICORNIS			0.01082	
5403020101	PARACLUNIO ALASKENSIS			3.52732	
TOTAL				3.90138	
SHANNON WEAVER DIVERSITY INDEX				0.72	

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION I50
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION I50 : 70°30'01" N; 149°50'18" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 1.45

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
3301030203	TUBULARIA INDIVISA	0.06100	0.60055	0.07213	
33011305	THUIARIA SP.		0.00025		
480201	ENCHYTRAEIDAE	0.00007	0.00044	0.00036	
5327031404	MYSIS RELICTA	3.79850	0.77452		
53280501	DIASTYLIS SP.		0.01126		
5330020101	SADURIA ENTOMON		0.11512		
5331120101	APHERUSA GLACIALIS	0.00200	0.03929		
5331210501	GAMMARACANTHUS LORICATUS		0.13764		
5331210701	GAMMARUS LOCUSTA		0.00075		
5331210702	GAMMARUS SETOSA		0.48418		XXX
5331220201	PONTOPOREIA FEMORATA		0.00050		
5331220202	PONTOPOREIA AFFINIS		0.00131		
5331342702	ONISIMUS GLACIALIS	0.00900	0.04229		XXX
5331370103	ACANTHOSTEPHEIA INCARINATA		0.00006		

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
53313708	MONOCULODES SP.		0.00031	0.00180	
5331370907	MONOCULOPSIS LONGICORNIS		0.00013		
6601	CHEILOSTOMATA (?)		0.06006		
6601020101	EUCRATEA LORICATA	0.03300	0.29004	0.00216	
791504	COTTIDAE		0.02477		
7915042206	MYOXOCEPHALUS QUADRICORN IS	0.03100			
TOTAL		3.93457	2.58347	0.07646	
SHANNON WEAVER DIVERSITY INDEX		0.18	1.67	0.69	

TABLE 27

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION I58
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION I58 : 70°28'12" N; 149°58'42" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 0.09

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
33010302	TUBULARIA SP.	0.01451		1.68792	
3301030203	TUBULARIA INDIVISA			0.17312	
44	NEMATODA			0.00208	
5327031404	MYSIS RELICTA	60.82982	6.20250		
5330020101	SADURIA ENTOMON		0.00025		
5331342702	ONISIMUS GLACIALIS		0.00771	0.00135	
53313708	MONOCULODES SP.		0.01500		
5403020101	PARACLUNIO ALASKENSIS			0.00108	
6601	CHEILOSTOMATA (?)			0.00270	
6601020101	EUCRATEA LORICATA			0.14228	XXX
7100000303	SAGITTA ELEGANS		0.00167		
7909020201	BOREOGADUS SAIDA	15.98093			
791504	COTTIDAE		0.01000		
7915042203	MYOXOCEPHALUS QUADRICORN IS	8.84884			

TABLE 27 CONTINUED

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
TOTAL		35.67413	6.23712	2.01054	
SHANNON WEAVER DIVERSITY INDEX		0.02	0.29	1.67	

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION J22
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION J22 : 70°26'36" N; 150°22'06" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 0.93.

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
33010302	TUBULARIA SP.			0.00721	
40	RHYNCHOCOELA (NEMERTEANS)			0.00108	
44	NEMATODA			0.00019	
4801420601	SCOLECOLEPIDES ARCTIUS			0.11109	
5327031404	MYSIS RELICTA		0.23478		
5330020101	SADURIA ENTOMON	0.00591	0.95170	0.23083	XXX
5331210501	GAMMARACANTHUS LORICATUS		0.04254		XXX
5331220202	PONTOPOREIA AFFINIS		0.00019	0.00992	
5403020101	PARACLUNIO ALASKENSIS			0.00144	
7915042206	MYOXOCEPHALUS QUADRICORN IS		0.54855		
TOTAL		0.00591	1.77776	0.36176	
SHANNON WEAVER DIVERSITY INDEX		1.28	0.27	1.05	

TABLE 29

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION J24
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION J24 : 70°29'55" N; 150°24'30" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 1.23

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
40	RHYNCOCOELA (NEMERTEANS)			0.01443	
4801420601	SCOLECOLEPIDES ARCTIUS			0.34259	
480201	ENCHYTRAEIDAE			0.00048	
5330020101	SADURIA ENTOMON			0.04809	
TOTAL				0.40539	
SHANNON WEAVER DIVERSITY INDEX				1.23	

TABLE 30

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION MOB
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION MOB : 70°55'00" N; 153°08'00" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 1.88

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
3301030101	CORYMORPHA FLAMMEA		0.00267		
480201	ENCHYTRAEIDAE				XXX
4905510102	LIMACINA HELICINA		0.01200		
5327031404	MYSIS RELICTA		1.04800		XXX
5328050120	DIASTYLIS SULCATA		0.00533		
5330020101	SADURIA ENTOMON		0.00833		XXX
5331120101	APHERUSA GLACIALIS				XXX
5331120102	APHERUSA MAGALOPS		0.00008		
53311204	HALIRAGES SP.				XXX
5331210501	GAMMARACANTHUS LORICATUS		0.03200		XXX
5331210701	GAMMARUS LOCUSTA		0.00133		
5331210702	GAMMARUS SETOSA		0.29033		
5331210704	GAMMARUS ZADDACHI		0.00008		XXX
5331211402	WEYPRECHTIA PINGUIS				XXX

TABLE 30 CONTINUED

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
5331220202	PONTOPOREIA AFFINIS		0.00167		XXX
5331342702	ONISIMUS GLACIALIS		0.02600		XXX
5331342703	ONISIMUS LITORALIS		0.01808		XXX
5331370101	ACANTHOSTEPHEIA BEHRINGIENSIS				XXX
5331371602	OEDICEROS SAGINATUS				XXX
53314802	METOPA SP.				XXX
5331801002	PARATHEMISTO LIBELLULA		0.01633		XXX
5332020902	THYSANOESSA INERMIS				XXX
5332020906	THYSANOESSA RASCHI		0.01433		XXX
5403020101	PARACLUNIO ALASKENSIS				XXX
7100000303	SAGITTA ELEGANS		0.05700		XXX
7909020201	BOREOGADUS SAIDA				XXX
7914010201	PUNGITIUS PUNGITIUS		0.20400		
7915042206	MYOXOCEPHALUS QUADRICORNIS		0.00567		
TOTAL			1.74324		
SHANNON WEAVER DIVERSITY INDEX			1.88		

TABLE 31

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION M10
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION M10 : 70°55'30" N; 153°10'30" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 1.69

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
3301030101	CORYMORPHA FLAMMEA		0.00580		
5307	PODOCOPA (OSTRACOD)			0.00130	
5327031404	MYSIS RELICTA		0.26234		
53280501	DIASTYLIS SP.		0.00017		
5328050110	DIASTYLIS LUCIFERA		0.00010		
5330020101	SADURIA ENTOMON		0.02096	0.00260	
5331120101	APHERUSA GLACIALIS		0.00273		
5331210501	GAMMARACANTHUS LORICATUS		0.04722		
5331210702	GAMMARUS SETOSA		0.08125		XXX
5331210704	GAMMARUS ZADDACHI		0.16810	0.00216	
5331220202	PONTOPOREIA AFFINIS		0.00609		
5331342702	ONISIMUS GLACIALIS		0.16917	0.07790	
5331342703	ONISIMUS LITORALIS			0.00216	XXX
53313708	MONOCULODES SP.			0.00216	XXX

TABLE 31 CONTINUED

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
5331370907	MONOCULOPSIS LONGICORNIS		0.00030		
5331801002	PARATHEMISTO LIBELLULA		0.02101		
5332020906	THYSANOESSA RASCHI		0.17381		
7100000303	SAGITTA ELEGANS		1.83335	0.01298	XXX
TOTAL			2.79238	0.10127	
SHANNON WEAVER DIVERSITY INDEX			1.66	1.86	

TABLE 32

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION M11
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION M11 : 70°55'18" N; 153°12'42" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 0.96

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
44	NEMATODA			0.09036	XXX
48017005	SPIRORBIS SP.			0.00404	
480201	ENCHYTRAEIDAE			3.03939	XXX
49040306	YOLDIELLA SP.			0.00087	
4904210401	LYOCYMA FLUCTUOSA			0.02599	
4904290101	CYRTODARIA KURRIANA			0.00289	
4905340202	MITRELLA TUBEROSA			0.00866	
4905490201	CYLICHNA OCCULATA			0.04039	
5307	PODOCOPA (OSTRACOD)			0.15489	
5331210702	GAMMARUS SETOSA				XXX
540302	CHIRONOMIDAE				XXX
5403020101	PARACLUNIO ALASKENSIS			13.36419	
5403020201	SAUNDERIA CLAVICORNIS			0.01870	
TOTAL				16.75037	
SHANNON WEAVER DIVERSITY INDEX				0.96	

TABLE 33

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION M14
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION M14 : 70°54'30" N; 153°14'00" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 0.24

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
44	NEMATODA				XXX
480201	ENCHYTRAEIDAE			0.35060	XXX
5327031404	MYSIS RELICTA				XXX
5331210702	GAMMARUS SETOSA			1.41381	XXX
5331210704	GAMMARUS ZADDACHI			0.00180	XXX
5331342702	ONISIMUS GLACIALIS			0.00180	
79150422	MYOXOCEPHALUS SP.				XXX
TOTAL				1.76801	
SHANNON WEAVER DIVERSITY INDEX				0.24	

TABLE 34

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION N42
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION N42 : 71°03'20" N; 154°42'30" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 0.03

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
44	NEMATODA			0.06333	XXX
480201	ENCHYTRAEIDAE			2.28617	XXX
5403020101	PARACLUNIO ALASKENSIS			0.04203	
TOTAL				2.39154	
SHANNON WEAVER DIVERSITY INDEX				0.03	

TABLE 35

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION N43
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION N43 : 71°03'30" N; 154°42'30" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 1.54

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
4904020201	NUCULA TENUIS			1.14328	XXX
49040306	YOLDIELLA SP.			0.00556	XXX
4905	GASTROPODA				XXX
49053303	COLUS SP.			0.06801	
5307	PODOCOPA (OSTRACOD)			0.20821	
5327031404	MYSIS RELICTA		0.08500		
5330020101	SADURIA ENTOMON		0.00050		
5331120101	APHERUSA GLACIALIS		0.35500		XXX
5331210702	GAMMARUS SETOSA		1.61167	3.66025	XXX
5331210704	GAMMARUS ZADDACHI			0.03091	
5331342702	ONISIMUS GLACIALIS		0.29750	0.11902	
5331342703	ONISIMUS LITORALIS			0.03864	XXX
79150422	MYOXOCEPHALUS SP.		0.09083		
TOTAL			2.44050	5.27388	
SHANNON WEAVER DIVERSITY INDEX			1.02	1.48	

TABLE 36

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION N44
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION N44 : 71°03'40" N; 154°44'00" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 0.41

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
44	NEMATODA			0.00408	
480201	ENCHYTRAEIDAE			0.72116	
5327031404	MYSIS RELICTA				XXX
5331210702	GAMMARUS SETOSA			0.75121	XXX
5331210704	GAMMARUS ZADDACHI			0.26692	XXX
5331342702	ONISIMUS GLACIALIS				XXX
5331342703	ONISIMUS LITORALIS				XXX
TOTAL				1.74337	
SHANNON WEAVER DIVERSITY INDEX				0.41	

TABLE 37

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION 039
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION 039 : 71°14'00" N; 155°39'00" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 1.63

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
3301020101	PERIGONIMUS YOLDIA-ARCTICAE			0.03462	
3301270201	AGLANTHA DIGITALE			0.15581	
4801420701	SPIO FILICORNIS		0.00387	0.01410	XXX
5307	PODOCOPA (OSTRACOD)			0.00147	
5331120101	APHERUSA GLACIALIS		0.04583		
5331210704	GAMMARUS ZADDACHI		0.05000		
5331342702	ONISIMUS GLACIALIS		0.06583	0.11794	
5331342703	ONISIMUS LITORALIS			0.34624	
TOTAL			0.16554	0.67019	
SHANNON WEAVER DIVERSITY INDEX			1.25	1.50	

TABLE 38

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION 040
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION 040 : 71°14'00" N; 155°40'00" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 1.16

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
44	NEMATODA			0.00040	
480201	ENCHYTRAEIDAE			0.16848	
5330020101	SADURIA ENTOMON		0.00025		
5331120101	APHERUSA GLACIALIS		0.01104		—
5331120102	APHERUSA MAGALOPS		0.00021		—
5331210704	GAMMARUS ZADDACHI		0.10667	0.00077	
5331220201	PONTOPOREIA FEMORATA		0.00021		
5331220202	PONTOPOREIA AFFINIS		0.00021		—
5331342702	ONISIMUS GLACIALIS		0.00021	0.17776	XXX
5331342703	ONISIMUS LITORALIS		0.02271	0.02164	
5331370101	ACANTHOSTEPHEIA BEHRINGI ENSIS			0.04328	—
53313708	MONOCULODES SP.		0.00021		
5332020906	THYSANOESSA RASCHI		0.00583		
5403020101	PARACLUNIO ALASKENSIS			0.18549	

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
7100000303	SAGITTA ELEGANS		0.16500	0.00155	
TOTAL			0.31254	0.59937	
SHANNON WEAVER DIVERSITY INDEX			1.65	0.68	

TABLE 39

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION 042
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION 042 : 71°14'00" N; 155°42'00" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 1.39

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
33010302	TUBULARIA SP.		0.00025		
3302	SCYPHOZOA		0.00083		
48014213	PYGOSPIO SP.			0.00031	
480201	ENCHYTRAEIDAE		0.04750	0.37174	
5330020101	SADURIA ENTOMON		0.00333	0.02782	
5331120101	APHERUSA GLACIALIS		0.02417	0.00077	XXX
5331210702	GAMMARUS SETOSA		0.33583		
5331210704	GAMMARUS ZADDACHI		0.01417		
5331342702	ONISIMUS GLACIALIS		0.59167	0.49154	
53313708	MONOCULODES SP.		0.00917	0.00697	
5331370907	MONOCULOPSIS LONGICORNIS		0.00583	0.00077	
6601020101	EUCRATEA LORICATA		0.00025		
7100000303	SAGITTA ELEGANS		0.01833		
TOTAL			1.05133	0.89993	
SHANNON WEAVER DIVERSITY INDEX			1.56	0.63	

TABLE 40

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION P30
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION P30 : 71°22'00" N; 156°30'00" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 0.02

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
44	NEMATODA			0.00003	
4801120205	ETEONE LONGA			0.00197	XXX
480201	ENCHYTRAEIDAE			14.89202	XXX
5327031404	MYSIS RELICTA			0.00079	XXX
5330020101	SADURIA ENTOMON			0.00118	XXX
5331210702	GAMMARUS SETOSA				XXX
5331210704	GAMMARUS ZADDACHI			0.02361	XXX
5331342702	ONISIMUS GLACIALIS				XXX
5331342703	ONISIMUS LITORALIS			0.00295	
5402	COLLEMBOLA				XXX
5403020101	PARACLUNIO ALASKENSIS			0.01221	
5403020201	SAUNDERIA CLAVICORNIS			0.00986	
7100000303	SAGITTA ELEGANS			0.00984	XXX
TOTAL				14.95445	
SHANNON WEAVER DIVERSITY INDEX				0.02	

TABLE 41

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION P33
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION P33 : 71°18'30" N; 156°33'00" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 0.24

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
33010302	TUBULARIA SP.			0.03493	
44	NEMATODA			0.00216	
480201	ENCHYTRAEIDAE		0.73788	0.78973	
5327031404	MYSIS RELICTA		0.01010		
5330020101	SADURIA ENTOMON			0.55888	
5331120101	APHERUSA GLACIALIS		0.01530		
5331210704	GAMMARUS ZADDACHI		0.03061		
5331342702	ONISIMUS GLACIALIS		0.01010		
5331801002	PARATHEMISTO LIBELLULA				XXX
7100000303	SAGITTA ELEGANS				XXX
TOTAL			0.85399	1.38570	
SHANNON WEAVER DIVERSITY INDEX			0.26	0.14	

TABLE 42

MEAN BIOMASS IN GRAMS AND DIVERSITY FOR ANIMAL SPECIES OF THE CLOSE INSHORE BENTHOS SAMPLED BY VARIOUS METHODS AT STATION P34
DATA ARE BASED ON SAMPLES FROM ALL DEPTHS.

STATION P34 : 71°19'00" N; 156°33'20" W.

POOLED SHANNON WEAVER DIVERSITY INDEX (H) = 0.67

CODE	NAME	SEINE /50M TOW	EPIBENTHIC DREDGE /50M TOW	EKMAN GRAB /M2	OTHER NON-QUANTITATIVE
48014213	PYGOSPIO SP.			0.00036	
5327031404	MYSIS RELICTA				XXX
5330020101	SADURIA ENTOMON			0.00216	XXX
5331210501	GAMMARACANTHUS LORICATUS				XXX
53312107	GAMMARUS SP.			0.00325	
5331210704	GAMMARUS ZADDACHI			0.00902	
5331342702	ONISIMUS GLACIALIS			0.21991	XXX
5331801002	PARATHEMISTO LIBELLULA				XXX
7100000303	SAGITTA ELEGANS				XXX
TOTAL				0.23470	
SHANNON WEAVER DIVERSITY INDEX				0.67	

Table 43 : Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other general nonquantitative samples at station P28, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station P28: Latitude 71°23'03"; longitude 156°27'02".

Code	Species	Epibenthic Dredge	Ekman Grab	Other
3301	Hydrozoan	D		
480201	Enchytraeidae		D	
5327031403	Mysis relicta	D		
5331120101	Apherusa glacialis	D		
5331210702	Gammarus setosa	D	D	
5331342703	Onisimus litoralis	D	D	C
7100000303	Sagitta elegans	D		
7915042206	Myoxocephalus quadricornis	D		

Table 44 : Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other, general nonquantitative samples at station P31, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station P31: Latitude 71°22'00"; Longitude 156°31'00"

Code	Species	Epibenthic Dredge	Ekman Grab	Other
3301	Hydrozoan	D		
480201	Enchytraeidae		D	
4904140201	Lucinoma annulata		D	
49054902	Cylichna sp.		D	
5327031403	Mysis relicta	D		
53280602	Pseudocuma sp. (?)		D	
5331120101	Apherusa glacialis	D		D
53312010	Paramoera sp.		D	
53312014	Rozinante sp.	D		D
5331210501	Gammaracanthus loricatus	D		
5331210702	Gammarus setosa	B		
5331210704	Gammarus zaddachi			D
53312702	Ischyrocerus sp.	D		
5331342703	Onisimus litoralis	B	D	B
53313708	Monoculodes (kryoyeri)	D		
533148	Stenothoidae		D	
7100000303	Sigitta elegans	D	D	D
7915042206	Myoxocephalus quadricornis	D		

Table 45 : Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other, general nonquantitative samples at station P52, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station P52: Latitude 71°15'03"; Longitude 156°52'03".

Code	Species	Epibenthic Dredge	Ekman Grab	Other
480201	Enchytraeidae	A	C	
53312012	Pontogeneia (inermis?)	D		
5331210501	Gammaracanthus loricatus	D		
5331210702	Gammarus setosa	A		
5331342701	Onisimus birulai	D		
5331342703	Onisimus litoralis	A		D
5327031404	Mysis relicta	D		
540302	Chironomidae	D	D	
7100000303	Sagitta elegans	D		
7915042206	Myoxocephalus quadricornis	D		
	Doridacea	C		

Table 46 : Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other, general nonquantitative samples at station R28, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station R28: Latitude 70°48'03"; Longitude 158°28'00"

Code	Species	Epibenthic Dredge	Ekman Grab	Other
48014213	Pygospio sp.		D	
480201	Enchytraeidae	B	B	D
4904140201	Lucinoma annulata	D	D	
4904290101	Cyrtodaria kurriana	D		
4905	Gastropoda		D	
49054902	Cylichna sp.	D		
5327031403	Mysis relicta	C		D
5330020101	Saduria entomon	D	D	
5331210704	Gammarus zaddachi	B		
5331342701	Onisimus birulai		D	
5331342702	Onisimus glacialis		D	D
5331342703	Onisimus litoralis	D		D
5331980706	Caprella (drepanochir)	D		
6101010101	Halicriptus spinulosus		D	
7100000303	Sagitta elegans	D		
7915042206	Myoxocephalus quadricornis	D		D

Table 47: Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other general nonquantitative samples at station R19, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station R19: Latitude 70°49'04"; Longitude 158°19'03".

Code	Species	Epibenthic Dredge	Ekman Grab
3301	Hydrozoan	D	
480201	Enchytraeidae		C
5330021001	Saduria entomon	D	
5331342703	Onisimus litoralis	D	
5331800105	Hyperia medusarum hylstrix	D	
7915042206	Myoxocephalus quadricornis	D	

Table 48 : Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other general nonquantitative samples at station R20, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station R20: Latitude 70°49'05"; Longitude 158°19'03".

Code	Species	Epibenthic Dredge	Ekman Grab	Other
480201	Enchytraeidae	D	C	
4904	Pelecypoda		D	
5330020101	Saduria entomon	D		
5331210501	Gammaracanthus loricatus	D		
5331210702	Gammarus setosa		D	
5331210704	Gammarus zaddachi	C		D
5331342701	Onisimus birulai	C	D	A
5331342702	Onisimus glacialis			B
5332	Euphausid			D
5327031404	Mysis relicta	B		
7915042206	Myoxocephalus quadricornis	C		D

Table 49 : Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other general nonquantitative samples at station R40, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station R40: Latitude 70°47'02"; Longitude 158°40'00".

Code	Species	Epibenthic Dredge	Ekman Grab	Other
480201	Enchytraeidae		D	
4904	Pelecypoda			D
5327031403	Mysis relicta	A		C
5330020101	Saduria entomon	B	D	D
5331210501	Gammaracanthus loricatus	D		D
5331210702	Gammarus setosa		D	
5331210704	Gammarus zaddachi	D		
5331220202	Pontoporeia affinis			D
5331342703	Onisimus litoralis	C		D
5331370103	Acanthostephia incarinata	D		
7915042206	Myoxocephalus quadricornis	D		

Table 50 : Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other, general nonquantitative samples at station S56, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station S56: Latitude 70°41'00"; Longitude 159°56'02".

Code	Species	Epibenthic Dredge	Ekman Grab	Other
48012201	Autolytus sp.	D		
4801220602	Eusyllis blomstrandi			D
49042401	Macoma sp.			D
4905	Gastropoda			D
49050603	Margarites sp.			D
4905250101	Amauropsis purpurea			D
49052502	Natica sp. (?)			D
49052504	Polinices sp. (?)			D
49053202	Searlesia sp.			D
4905330810	Neptunea heros	D		D
5331120101	Apherusa glacialis	D		
5331210702	Gammarus setosa	D	D	D
5331210704	Gammarus zaddachi			D
5331342701	Onisimus birulai			D
5331342703	Onisimus litoralis	D		D
5331430302	Parapleustes pugettensis	D		
53314804	Metopelloides (stephenseni?)	D		D
5333110209	Pagarus beringanus	D		D
537031404	Mysis relicta	D		

Table 51 : Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other, general nonquantitative samples at station S51, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station S51: Latitude 70°42'08"; Longitude 159°51'01"

Code	Species	Epibenthic Dredge	Ekman Grab	Other
480201	Enchytraeidae		D	
49042401	Macoma sp.			D
4905	Gastropoda			D
49050603	Margarites sp.			D
49052502	Natica sp.			D
49052504	Polinices sp.			D
4905330810	Neptunea heros			D
4905330901	Plicifusus kroyeri			D
5331120101	Apherusa glacialis		D	
5331210704	Gammarus zaddachi	D	D	
5331342701	Onisimus birulai			D
5331342703	Onisimus litoralis	D		D
5333110209	Pagurus beringanus			D
7100000303	Sagitta elegans	D		D
7915042206	Myoxocephalus quadricornis	D		

Table 52 : Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other general nonquantitative samples at station , Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station : Latitude 70°37'; Longitude 160°06'.

Code	Species	Epibenthic Dredge	Ekman Grab	Other
3301	Hydrozoan			D
48012203	Syllis sp.			D
480135	Dorvilleidae			D
4904	Pelecypoda			D
4905	Gastropoda			D
49052502	Natica sp.			D
5330020101	Saduria entomon			A
5333110209	Pagurus (beringanus?)			D
7915042206	Myoxocephalus quadricornis			D

Table 53 : Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other, general nonquantitative samples at station T11, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station T11: Latitude 70°34'03"; Longitude 160°11'03"

Code	Species	Epibenthic Dredge	Ekman Grab	Other
4801420601	Scolecolepides arctius		D	
480201	Enchytraeidae	A	C	
5327031403	Mysis relicta	C	D	
5330020101	Saduria entomon	D	D	
5331210702	Gammarus setosa		D	
5331210704	Gammarus zaddachi	A	D	D
5331342701	Onisimus birulai			D
5331342702	Onisimus glacialis	B	D	D
5331342703	Onisimus litoralis			D
7915042206	Myoxocephalus quadricornis	D	D	D

Table 54 : Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other general nonquantitative samples at station T12, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+, B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station T12: Latitude 70°34'02"; Longitude 160°11'06".

Code	Species	Epibenthic Dredge	Ekman Grab	Other
3301	Hydromedusae			D
5331120101	Apherusa glacialis			D
5331342701	Onisimus birulai			C
5331342703	Onisimus litoralis	C	D	A
5331800101	Hyperia galba			D
7100000303	Sagitta elegans			D
7915042206	Myoxocephalus quadricornis	D		
	Ichneumonidae			D

Table 55 : Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other general nonquantitative samples at station U51, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+, B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station U51: Latitude 70°17'02"; Longitude 161°51'09".

Code	Species	Epibenthic Dredge	Ekman Grab
48014213	Pygospio sp.		D
480201	Enchytraeidae	D	B
5327031403	Mysis relicta	A	
540302	Chironomidae	C	C
	Flounder fry	D	

Table 56: Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other general nonquantitative samples at station , Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station ___: Latitude 70°14'30"; Longitude 160°52'.

Code	Species	Epibenthic Dredge	Ekman Grab	Other
4904	Pelecypoda			D
4904070101	Mytilus edulis			D
49041101	Astarte sp.			D
4904240116	Macoma (inquinata?)			D
4905	Gastropoda			D
49052101	Epitonium sp.			D
4905250101	Amauropsis purpurea			D
49053305	Liomesus sp.			D
5318020104	Balanus crenatus			D
5330020101	Saduria entomon			D
5331210702	Gammarus setosa			D
5333110209	Pagarus beringanus			D
6601050201	Terminoflustra membranaceatruncata			D
72030302	Boltenia sp.			D

Table 57 : Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other, general nonquantitative samples at station U55, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station U55: Latitude 70°17'03"; Longitude 161°55'06"

Code	Species	Epibenthic Dredge	Ekman Grab	Other
480201	Enchytraeidae		D	
4803	Hirudinea		D	
4904140201	Lucinoma annulata		D	
49041601	Diplodonta sp. (?)		D	
4904290101	Cyrtodaria kurriana		D	
5330020101	Saduria entomon	C	C	
5331210702	Gammarus setosa	D		D
5331210704	Gammarus zaddachi		D	D
5331342701	Onisimus birulai	A	D	B
5331342702	Onisimus glacialis		D	
5331370103	Acanthostephia incarinata	D		
53313708	Monoculodes sp.		D	
5331370818	Monoculodes (minutus?)	D		
5331370907	Monoculopsis longicornis	D		
5327031403	Mysis relicta	D		
7100000303	Sagitta elegans	D		D
7915042206	Myoxocephalus quadricornis	D		

Table 58: Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other general nonquantitative samples at station U57, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station U57: Latitude 70°16'01"; Longitude 161°57'02".

Code	Species	Epibenthic Dredge	Ekman Grab	Other
3301	Hydrozoan	D	D	
48014213	Pygospio sp.		D	
480201	Enchytraeidae		D	
4904140201	Lucinoma annulata		D	
5327031403	Mysis relicta	D		
5330020101	Saduria entomon	D	D	
5331210704	Gammarus zaddachi	D		
5331342701	Onisimus birulai	C	D	
5331342702	Onisimus glacialis		D	C
7100000303	Sagitta elegans	D		

Table 59 : Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other general nonquantitative samples at station , Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station : Latitude 68°51'; Longitude 165°34'.

Code	Species	Epibenthic Dredge	Ekman Grab
3301	Hydrozoan	D	
5331210702	Gammarus setosa	C	

Table 60 : Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other, general nonquantitative samples at station 46Y, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station 46Y: Latitude 68°06'00"; Longitude 165°46'00"

Code	Species	Epibenthic Dredge	Ekman Grab	Other
3301	Hydrozoan			D
480201	Enchytraeidae	D	D	
533120	Eusiridae (?)			C
53312001	Accedomoera sp. (?)	D		
53312010	Paramoera sp.	C	B	B
5331210702	Gammarus setosa			A
5331210704	Gammarus zaddachi/setosa	D		

Table 61 : Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other general nonquantitative samples at station , Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station : Latitude 68°44'; Longitude 166°12'.

Code	Species	Epibenthic Dredge	Ekman Grab	Other
3301	Hydrozoan			D
5331210702	Gammarus setosa			D
7100000303	Sagitta elegans			D

Table 62: Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other general nonquantitative samples at station , Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station : Latitude 68°53'; Longitude 166°14'.

Code	Species	Epibenthic Dredge	Ekman Grab	Other
6801120502	Pisaster ochraceus			D
72	Ascidiacea #1			D
72	Ascidiacea #2			D

Table 63: Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other, general nonquantitative samples at station Z09, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station Z09: Latitude 68°52'07", Longitude 166°09'06"

Code	Species	Epibenthic Dredge	Ekman Grab	Other
480201	Enchytraeidae		D	
53310901	Atylus sp.	D		
5331120201	Calliopius laeviusculus	C		
53312010	Paramoera sp.	D		
53312107	Gammarus sp.	C		
5331210704	Gammarus zaddachi	B	D	
5331342701	Onisimus birulai			D
5331342702	Onisimus glacialis			D
7100000303	Sagitta elegans	D		

Table 64 : Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other, general nonquantitative samples at station Z44, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station Z44: Latitude 68°21'06"; Longitude 166°45'00".

Code	Species	Epibenthic Dredge	Ekman Grab
480201	Enchytraeidae	C	B
4904140201	Lucinoma annulata	D	D
5331210704	Gammarus zaddachi	D	
5327031403	Mysis relicta	D	
540302	Chironomidae	D	

Table 65: Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other, general nonquantitative samples at station Z45, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station Z45: Latitude 68°21'06"; Longitude 166°45'00"

Code	Species	Epibenthic Dredge	Ekman Grab
480201	Enchytraeidae	D	C
5331201001	Paramoera (carlottensis?)	D	D
5331210704	Gammarus zaddachi	D	D

Table 66: Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other general nonquantitative samples at station Z46, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station Z46: Latitude 68°21'06"; Longitude 166°45'00".

Code	Species	Epibenthic Dredge	Ekman Grab	Other
480201	Enchytraeidae	B	B	C
4904140201	Lucinoma annulata (?)		D	
53312010	Paramoera sp.	D		
5331210704	Gammarus zaddachi	D		D
540302	Chironomidae	B	D	B
7915042206	Myoxocephalus quadricornis	D		
	Mosquito larvae	D		C

Table 67 : Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other general nonquantitative samples at station 48Y, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station 48Y: Latitude 68°06'00"; Longitude 165°48'00".

Code	Species	Epibenthic Dredge	Ekman Grab	Other
533120	Eusiridae			D
53312010	Paramoera sp.			D
5331210702	Gammarus setosa			B
5331210704	Gammarus zaddachi			A

Table 68 : Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other, general nonquantitative samples at station 44W, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station 44W: Latitude 67°09'07"; Longitude 163°44'06".

Code	Species	Epibenthic Dredge	Ekman Grab
480101	Polynoidae		D
53312010	Paramoera (carlottensis?)		D
5331210704	Gammarus zaddachi	D	
	Fish	D	

Table 69: Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other, general nonquantitative samples at station 33X, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station 33X: Latitude 67°44'29"; Longitude 164°33'45".

Code	Species	Epibenthic Dredge	Ekman Grab
40	Rhynchocoela		D
480101	Polynoidae	D	D
48011201	Anaitides sp.		D
4801120103	Anaitides medipapillata (?)		D
4801120205	Eteone longa		D
4801240109	Nephtys longaseta		D
4801240103	Nephtys (caeca?)		D
48012701	Glycinde sp.		D
4801420601	Scolecolepides arctius		D
48014301	Magelona sp.		D
4801580201	Heteromastus filiformis		D
4801600202	Arenicola marina glacialis		D
4801610801	Axiothella catenata (?)		D
4801640301	Pectinaria belgica (?)		D
48016808	Sabella sp.		D
480201	Enchytraeidae	C	C
4904140201	Lucinoma annulata (?)		D
49041801	Mysella sp.		D
4904200102	Clinocardium nuttalli	D	
49042701	Siliqua sp.	D	D
49042801	Cryptomya sp. (?)		D
4904290101	Cyrtodaria kurriana	D	
4905490201	Cylichna occulata		D
5318020104	Balanus crenatus		D
53270301	Acanthomysis (costata?)	D	
5327030106	Acanthomysis pseudomacropsis	D	
53270304	Boreomysis sp. (?)	D	

Table 69,
Station 33X (p. 2)

Code	Species	Epibenthic Dredge	Ekman Grab
5327031403	Mysis oculata	D	
53270315	Neomysis sp.	D	
5327031501	Neomysis awatschensis	D	
5327031504	Neomysis kadiakensis	D	
5327031505	Neomysis (mercedis?)	D	
5328020101	Lamprops fuscata	D	D
5328050101	Diastylis alaskensis		D
5328050110	Diastylis lucifera	D	
53280504	Leptostylis sp.	D	D
5330020101	Saduria entomon		D
53310901	Atylus (collingi?)	D	D
5331120102	Apherusa megalops	D	
5331120201	Calliopius laeviusculus	D	
5331201401	Rozinante fragilis	D	
53312101	Anisogammarus sp.	A	
5331210702	Gammarus setosa		D
5331210704	Gammarus zaddachi	D	B
53312602	Photis sp.	D	D
5[illegible]2603	Protomedeia sp.		D
5331342703	Onisimus litoralis		D
5331370103	Acanthostephia incarinata	C	
5331370201	Aceroides latipes		D
53313708	Monoculodes sp.	D	
53313708	Monoculodes (kroyeri)	A	
5331370907	Monoculopsis longicornis	D	
5331371202	Paroediceros lynceus	D	
5331371203	Paroediceros propinquus	B	D
53314305	Pleusymptes sp. (?)	D	
53314401	Dulichia (arctica)	D	D
53314403	Paradulichia (spinifera)	D	
5331800101	Hyperia galba	D	
5331800105	Hyperia medusarum hylstrix	D	
5333040104	Pandalus montagui tridens (?)	D	

Table 69,
Station 33X (p. 3)

Code	Species	Epibenthic Dredge	Ekman Grab
53330601	Crangon sp.	D	
5333060101	Crangon (nigricauda?)	D	
5333060104	Crangon septemspinosa	D	
540302	Chironomidae		D
6001020101	Echiurus echiurus alaskana		D
62	Tardigrada	D	
66	Ectoprocta		D
6603010104	Alcyonidium disciforme	D	D
6802010101	Dendraster excentricus		D
6803	Ophiuroidea	D	D
76020601	Squatina sp.	D	
7915042206	Myoxocephalus quadricornis	D	
791505	Agonidae	D	
7916170101	Ammodytes hexapterus	D	
	Scolelepis sp.		D
	Fish larvae	D	D
	Flounder	D	

Table 70: Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other, general nonquantitative samples at station 28V, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station 28V: Latitude 66°57'00"; Longitude 162°28'00".

Code	Species	Epibenthic Dredge	Ekman Grab
480201	Enchytraeidae	D	
4904140201	Lucinoma annulata (?)		D
5327031403	Mysis oculata	D	
5327031404	Mysis relicta	D	
53270315	Neomysis sp.	D	
5327031502	Neomysis czerniawskii	D	
5327031503	Neomysis intermedia	B	
5327032001	Stylocheiron longicorne	D	
5331210704	Gammarus zaddachi	D	
53330601	Crangon sp.	C	

Table 71 : Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other, general nonquantitative samples at station 27V, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station 27V: Latitude 66°56'27"; Longitude 162°27'23"

Code	Species	Epibenthic Dredge	Ekman Grab
40	Rhynococoela (?)	D	
480202	Tubificidae	D	
5327031503	Neomysis intermedia	A	
5331210501	Gammaracanthus loricatus	D	
53319807	Caprella sp.	D	
5333060104	Crangon septemspinosa	D	
6803	Ophiuroidea	D	

Table 72: Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other, general nonquantitative samples at station 31T, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station 31T: Latitude 66°34'49"; Longitude 160°31'19"

Code	Species	Epibenthic Dredge	Ekman Grab
4803	Hirundinea	D	
53040101	Daphnia sp.	D	
5327031503	Neomysis intermedia	A	

Table 73 : Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other, general nonquantitative samples at station OU3, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station OU3: Latitude 66°09'22"; Longitude 161°03'30"

Code	Species	Epibenthic Dredge	Ekman Grab	Other
4801420601	Scolecolepides arctius		D	
480201	Enchytraeidae		D	
53270315	Neomysis sp.		D	
5327031503	Noemysis intermedia		D	A
5327031505	Neomysis mercedis			A
5330020101	Saduria entomon		D	
5331210501	Gammaracanthus loricatus		D	
5331210704	Gammarus zaddachi		D	
53319807	Caprella sp.		D	
5331980706	Caprella (drepanochir?)		C	
540302	Chironomidae		D	

Table 74 : Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other, general nonquantitative samples at station 2U1, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station 2U1: Latitude 66°15'33"; Longitude 161°21'15".

Code	Species	Epibenthic Dredge	Ekman Grab
4801120205	Eteone longa		D
4801420601	Scolecolepides arctius		D
480201	Enchytraeidae		D
4904140201	Lucinoma annulata (?)		D
49041801	Mysella sp. (?)		D
49042801	Cryptomya sp.		D
4904330101	Entodesma saxicola		D
4905250101	Amauropsis purpurea		D
53280201	Lamprops sp.		D
5328050110	Diastylis lucifera		D
5331370907	Monoculopsis longicornis		D
5331371202	Paroediceros lynceus		D

Table 75: Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other general nonquantitative samples at station 5U4, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station 5U4: Latitude 66°15'53"; Longitude 161°54'22".

Code	Species	Epibenthic Dredge	Ekman Grab
3301	Hydrozoan	C	
3301090202	Obelia borealis	A	
33011304	Abietinaria sp.	C	
48010105	Eunoe sp.	D	
480201	Enchyraeidae	D	
4904	Pelecypoda #1	D	
4904	Pelecypoda #2	A	
49040704	Musculus sp. (?)	D	
49041801	Mysella sp. (?)	D	
52000101	Nymphon (pixellae?)	D	
5318020104	Balanus crenatus	D	
5327031506	Neomysis mirabilis	D	
5328020106	Lamprops sarsi	D	
53310901	Atylus (carinatus?)	D	
5331120201	Calliopius laeviusculus	D	
53311204	Halirages (mixtus?)	D	
5331210702	Gammarus setosa	D	
5331210704	Gammarus zaddachi	D	
5333060104	Crangon septemspinosa	D	
5331370103	Acanthostepheia incarinata	C	
533148	Stenothoidae	D	
53314802	Metopa (bruzelii?)	D	
53319807	Caprella sp. #1	A	
5331980706	Caprella (drepanochir?)	C	
66	Ectoprocta	D	
6803	Ophiuroidea	D	
72030401	Molgula sp.	D	
	Fish larvae	D	

Table 76 : Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other, general nonquantitative samples at station 3V2, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station 3V2: Latitude 66°48'27"; Longitude 162°32'20".

Code	Species	Epibenthic Dredge	Ekman Grab
33011305	Thuiaria sp.	D	
4904070101	Mytilus edulis		D
5327031506	Neomysis mirabilis	D	
5330020101	Saduria entomon	D	
5331120201	Calliopius laeviusculus	D	
53319807	Caprella sp.	D	
	Fish larvae	D	

Table 77: Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other, general nonquantitative samples at station 4V5, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station 4V5: Latitude 66°05'46"; Longitude 162°45'31".

Code	Species	Epibenthic Dredge	Ekman Grab
4904070101	Mytilus edulis	D	
5327031403	Mysis oculata	D	
5331210702	Gammarus setosa	D	
7100000303	Sagitta elegans	D	
	Fish larvae	D	

Table 78 : Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other, general nonquantitative samples at station 1WO, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station 1WO: Latitude 66°03'33"; Longitude 163°10'07".

Code	Species	Epibenthic Dredge	Ekman Grab	Other
5327031506	Neomysis mirabilis	D		
5330020101	Saduria entomon	A		D
5331342703	Onisimus litoralis	D		A
5331370103	Acanthostepheia incarinata	D		
5333060104	Crangon septemspinosa	D		
7916140101	Scytalina cerdale (?)	D		
79170206	Hippoglossiodes sp.?	D		
	Fish	D		

Table 79 : Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other, general nonquantitative samples at station 2V6, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station 2V6: Latitude 66°44'23"; Longitude 162°26'15".

Code	Species	Epibenthic Dredge	Ekman Grab
3301	Hydrozoan	D	
480201	Enchytraeidae		D
4904070101	Mytilus edulis		D
5327031506	Neomysis mirabilis	D	
5331120201	Calliopius laeviusculus	D	
5331210704	Gammarus zaddachi	D	D
	Scolelepis sp. (?)	D	
	Fish larvae	D	

Table 80 : Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other, general nonquantitative samples at station 1W2, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals

Station 1W2: Latitude 66°03'53"; Longitude 163°12'16".

Code	Species	Epibenthic Dredge	Ekman Grab
480201	Enchytraeida		C
4904070101	Mytilus edulis		D
53270301	Acanthomysis (costata?)	D	
53270314	Mysis sp.	D	
5327031503	Neomysis intermedia	D	
5330020101	Saduria entomon	D	
5331120201	Calliopius laeviusculus	D	
5331210702	Gammarus setosa	D	
5331210704	Gammarus zaddachi	D	
	Fish #1	D	
	Fish #2	D	
	Fish #3	D	

Table 81: Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other, general nonquantitative samples at station 2WO, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station 2WO: Latitude 66°05'15"; Longitude 163°20'05"

Code	Species	Epibenthic Dredge	Ekman Grab	Other
480201	Enchytraeidae	D	D	
4904070101	Mytilus edulis	D	D	
5327031502	Neomysis czerniawskii/ mirabilis	D		
5330020101	Saduria entomon	B	D	D
5331120201	Calliopius laeviusculus	D	D	
5331210702	Gammarus setosa	D	D	C
5331210704	Gammarus zaddachi	C	D	C
5331370103	Acanthostepheia incarinata	D		D
5333060104	Crangon septemspinosa	D		
7915042206	Myoxocephalus quadricornis	D		

Table 82: Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other, general nonquantitative samples at station 4YO, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station 4YO: Latitude 66°02'; Longitude 165°40'.

Code	Species	Epibenthic Dredge	Ekman Grab
510101	Halacaridae	C	
5327031404	Mysis relicta	D	
5327031503	Neomysis intermedia	A	
5328020106	Lamprops sarsi	D	
540302	Chironomidae	A	C
7915042206	Myoxocephalus quadricornis	D	
	Caenestheriella sp.	D	
	Leucotrichia pictipes?	D	

Table 83: Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other, general nonquantitative samples at station 4Y1, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station 4Y1: Latitude 66°06'; Longitude 165°41'.

Code	Species	Epibenthic Dredge	Ekman Grab
3301	Hydrozoan	D	
480142	Spionidae		D
4801420601	Scolecolepides arctius	D	D
480201	Enchytraeidae		C
4904070101	Mytilus edulis		D
5327031404	Mysis relicta	D	
5327031503	Neomysis intermedia	C	
5331210704	Gammarus zaddachi	D	
5331220202	Pontoporeia affinis	D	D
5331370101	Acanthostepheia incarinata	D	
5333060104	Crangon septemspinosa	C	
540302	Chironomidae	B	B
	Doridacea	D	
	Flounder	D	

Table 84: Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other, general nonquantitative samples at station 4W5, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station 4W5: Latitude 66°35'; Longitude 163°45'

Code	Species	Epibenthic Dredge	Ekman Grab
3301020101	Perigonimus yoldiaarcticae	D	
3301090202	Obelia borealis	D	
3302	Scyphozoa	D	
49042401	Macoma sp.	D	
5327031503	Neomysis intermedia	D	
5327031506	Neomysis mirabilis	A	
5328020106	Lamprops sarsi	D	
5330020101	Saduria entomon	D	
53310901	Atylus sp.	C	
5331120201	Calliopius laeviusculus	D	
5331210702	Gammarus setosa	D	
5331210704	Gammarus zaddachi	D	
5331800105	Hyperia medusarum	D	
53310807	Caprella sp.	D	
5333060104	Crangon septemspinosa	D	
303	Ophiuroidea	D	
[illegible]00000303	Sagitta elegans	D	
	Fish	D	
	Fish larva	D	

Table 85 : Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other, general nonquantitative samples at station 5Y2, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station 5Y2: Latitude 66°07'; Longitude 165°52'.

Code	Species	Epibenthic Dredge	Ekman Grab
3301	Hydrozoan	D	
3301060101	Coryne tubulosa	D	
53270301	Acanthomysis sp.	B	
5327031404	Mysis relicta	D	
5327031502	Neomysis czerniawskii	A	D
5330020101	Saduria entomon	D	
5331210704	Gammarus zaddachi	D	
5333060104	Crangon septemspinosa	D	
	Fish larva	D	

Table 86 : Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other, general nonquantitative samples at station 0Z7, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station 0Z7: Latitutde 66°14'45"; Longitude 166°06'00".

Code	Species	Epibenthic Dredge	Ekman Grab
4801420601	Scolecolepides arctius		D
480201	Enchytraeidae		D
5327031506	Neomysis mirabilis	D	
53280201	Lamprops sp.	D	
5330020101	Saduria entomon	D	
5331370101	Acanthostephia incarinata	D	
5331370907	Monoculopsis longicornis	D	
5333060104	Crangon septemspinosa	D	
	Scolelepis sp.		D
	Flounder	D	

Table 87: Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other, general nonquantitative samples at station OZ8, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station OZ8: Latitude 66°14'53"; Longitude 166°06'30".

Code	Species	Epibenthic Dredge	Ekman Grab
3301090202	Obelia borealis	D	
48010106	Gattyana sp.	D	
5327031403	Mysis oculata	D	
53270315	Neomysis sp.	D	
5327031502	Neomysis czerniwaskii	D	
5327031506	Neomysis mirabilis	D	
53280201	Lamprops sp.	D	
5331370101	Acanthostephia behringiensis	D	
53319807	Caprella sp.	D	
5333060104	Crangon septemspinosa	D	
6801120501	Pisaster (brevispinus?)	D	

Table 88 : Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other, general nonquantitative samples at station 751, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station 751: Latitude 65°45'; Longitude 167°51'.

Code	Species	Epibenthic Dredge	Ekman Grab
3301090202	Obelia borealis		D
48010106	Gattyana sp.	D	
48012401	Nephtys sp.	D	D
48012701	Glycinde sp.	D	D
480160	Arenicolidae	D	D
4904070101	Mytilus edulis		D
53270314	Mysis sp.	D	
5327031502	Neomysis czerniawskii	C	C
5328020106	Lamprops sarsi	C	C
53310901	Atylus sp.	D	D
5331120201	Calliopius laeviusculus	D	D
5331201002	Paramoera (carlottensis?)	D	
5331210704	Gammarus zaddachi	D	D
5331342703	Onisimus litotalis		D
5331370101	Acanthostepheia incarinata	D	D
5333060104	Crangon septemspinosa		D
5333060110	Crangon intermedia	D	
7915042206	Myoxocephalus quadricornis		D

Table 89 : Relative abundance of nearshore benthic animals in epibenthic dredge, Ekman grab, and other, general nonquantitative samples at station 802, Chukchi Sea shore. Data are maxima for each gear type used at this station. A = 500+; B = 251 to 500; C = 51 to 250; D = 1 to 50 individuals.

Station 802: Latitude 65°37'; Longitude 168°02'.

Code	Species	Epibenthic Dredge	Ekman Grab
48014213	Pygospio (elegans?)		D
480201	Echytraeidae		D
53270315	Neomysis sp.		D
5331210702	Gammarus setosa		D

TABLE 90
FREQUENCY OF OCCURRENCE AND OTHER DATA FOR PLANT SPECIES
AT SEVERAL BEACH ELEVATIONS ABOVE MLLW AT STATION B06

STATION B06 : 69°50'08" N; 142°05'04" W.

POOLED SHANNON WEAVER DIVERSITY INDEX IS 1.36.

CODE/SPECIES	ELEVATION(M) 2.0<	<=2.0 1.5<	<=1.5 1.0<	<=1.0 .75<	<=.75 0.5<	<=.5 .25<	<=.25 0.0<
3001030301 DUPONTIA FISCHERI						1.00	0.13
3001030505 PUCCINELLIA PHRYGANODES						0.28	1.00
3001040108 CAREX SUBSPATHACEA						1.00	1.00
3002050401 STELLARIA HUMIFUSA						0.78	1.00
MASS (G/M2)						122.8	246.5
DIVERSITY						1.30	1.14

TABLE 91

FREQUENCY OF OCCURRENCE AND OTHER DATA FOR PLANT SPECIES AT SEVERAL BEACH ELEVATIONS ABOVE MLLW AT STATION C37

STATION C37 : 70°08'00" N; 143°37'00" W.

POOLED SHANNON WEAVER DIVERSITY INDEX IS 1.95.

CODE/SPECIES	ELEVATION(M) 2.0<	<=2.0 1.5<	<=1.5 1.0<	<=1.0 .75<	<=.75 0.5<	<=.5 .25<	<=.25 0.0<
3001030301 DUPONTIA FISCHERI					0.72	0.72	
3001030505 PUCCINELLIA PHRYGANODES							1.00
3001040113 CAREX AQUATILIS					1.00	1.00	
3001040108 CAREX SUBSPATHACEA						1.00	0.91
3002020101 KOENIGIA ISLANDICA					0.06		
3002050401 STELLARIA HUMIFUSA					0.69	1.00	0.72
3002060401 COCHLEARIA OFFICINALIS					0.63	0.94	0.03
3002080108 SAXIFRAGA CERNUA					0.03		
21 MOSS					0.31	0.91	
MASS (G/M2)					410.3	111.9	129.4
DIVERSITY					1.65	1.79	1.14

TABLE 92
FREQUENCY OF OCCURRENCE AND OTHER DATA FOR PLANT SPECIES
AT SEVERAL BEACH ELEVATIONS ABOVE MLLW AT STATION C38

STATION C38 : 70°06'02" N; 143°38'0_" W.

POOLED SHANNON WEAVER DIVERSITY INDEX IS 2.43.

	ELEVATION(M)						
CODE/SPECIES	2.0<	<=2.0 1.5<	<=1.5 1.0<	<=1.0 .75<	<=.75 0.5<	<=.5 .25<	<=.25 0.0<
3001030301 DUPONTIA FISCHERI					0.80	0.03	
3001030505 PUCCINELLIA PHRYGANODES					0.06	0.88	0.91
3001040401 ERIOPHORUM ANGUSTIFOLIUM					0.42		
3001040113 CAREX AQUATILIS					1.00		
3001040108 CAREX SUBSPATHACEA							0.88
3002010101 SALIX OVALIFOLIA					1.00		
3002200202 POLYGONUM VIVIPARUM					0.31		
3002050401 STELLARIA HUMIFUSA					0.47	1.00	0.22
3002050801 MELANDRIUM APETALUM					0.13		
3002060401 COCHLEARIA OFFICINALIS					1.00	0.19	0.69
3002080108 SAXIFRAGA CERNUA					0.09		
3002150303					0.06		

TABLE 92 (continued)

CODE/SPECIES	2.0<	<=2.0 1.5<	<=1.5 1.0<	<=1.0 .75<	<=.75 0.5<	<=.5 .25<	<=.25 0.0<
				ELEVATION(M)			
PEDICULARIS SUDETICA							
30010305 PUCCINELLIA (RED)						0.88	
300206 CRUCIFER					0.06		
21 MOSS					0.93	0.06	
19 LICHEN					0.50		
MASS (G/M2)					865.7	82.7	
DIVERSITY					2.21	1.38	1.28

TABLE 93
FREQUENCY OF OCCURRENCE AND OTHER DATA FOR PLANT SPECIES AT SEVERAL BEACH ELEVATIONS ABOVE MLLW AT STATION C41

STATION C41 : 70°05'01" N; 143°41'01" W.

POOLED SHANNON WEAVER DIVERSITY INDEX IS 2.12.

	ELEVATION(M)						
CODE/SPECIES	2.0<	<=2.0 1.5<	<=1.5 1.0<	<=1.0 .75<	<=.75 0.5<	<=.5 .25<	<=.25 0.0<
3001030301 DUPONTIA FISCHERI					0.38	0.88	
3001030505 PUCCINELLIA PHRYGANODES					0.06	0.69	
3001040113 CAREX AQUATILIS						0.94	
3001040107 CAREX RAMENSKII						0.22	
3001040108 CAREX SUBSPATHACEA						0.69	
3002050401 STELLARIA HUMIFUSA					1.00	0.56	
3002060401 COCHLEARIA OFFICINALIS					1.00	0.80	
21 MOSS					0.34	0.38	
19 LICHEN					1.00		
300103 GRASS X						0.72	
DIVERSITY					1.57	2.07	
MASS (G/M2)					199.2	592.4	

TABLE 94

FREQUENCY OF OCCURRENCE AND OTHER DATA FOR PLANT SPECIES AT SEVERAL BEACH ELEVATIONS ABOVE MLLW AT STATION DCO

STATION DCO : 70°05'04" N; 143°59'08" W.

POOLED SHANNON WEAVER DIVERSITY INDEX IS 0.80.

CODE/SPECIES	ELEVATION(M) 2.0<	<=2.0 1.5<	<=1.5 1.0<	<=1.0 .75<	<=.75 0.5<	<=.5 .25<	<=.25 0.0<
3001030505 PUCCINELLIA PHRYGANODES							0.21
3001040108 CAREX SUBSPATHACEA							0.11
3002050401 STELLARIA HUMIFUSA							0.09
3002050101 HONCKENYA PEPLOIDES					0.16		
MASS (G/M2)					1.4		59.3
DIVERSITY							0.57

TABLE 95
SPECIES LIST OF BEACH VEGETATION AT STATION H12

STATION H12 : 70°20'42" N; 148°12'18" W.

3001040401
ERIOPHORUM ANGUSTIFOLIUM

3001040109
CAREX URSINA

3001040108
CAREX SUBSPATHACEA

3002070201
SEDUM ROSEA

3002080108
SAXIFRAGA CERNUA

3002090501
DRYAS INTEGRIFOLIA

3002180104
ARTEMISIA ARCTICA

30010305
PUCCINELLIA (RED)

30020101
SALIX SPP.

TABLE 96
FREQUENCY OF OCCURRENCE AND OTHER DATA FOR PLANT SPECIES
AT SEVERAL BEACH ELEVATIONS ABOVE MLLW AT STATION H32

STATION H32 : 70°22'48" N; 148°32'48" W.

POOLED SHANNON WEAVER DIVERSITY INDEX IS 2.49.

CODE/SPECIES	ELEVATION(M) 2.0<	<=2.0 1.5<	<=1.5 1.0<	<=1.0 .75<	<=.75 0.5<	<=.5 .25<	NO INFO.
3001030301 DUPONTIA FISCHERI							0.72
3001030505 PUCCINELLIA PHRYGANODES							0.51
3001040401 ERIOPHORUM ANGUSTIFOLIUM							0.88
3001040109 CAREX URSINA							0.25
3001040113 CAREX AQUATILIS							0.88
3001040108 CAREX SUBSPATHACEA							0.77
3002010101 SALIX OVALIFOLIA							0.63
3002010110 SALIX PULCHRA							0.19
3002050401 STELLARIA HUMIFUSA							0.48
3002050801 MELANDRIUM APETALUM							0.19
3002060401 COCHLEARIA OFFICINALIS							0.60
3002150303							

TABLE 96 (continued)

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CODE/SPECIES	ELEVATION(M) 2.0<	<=2.0 1.5<	<=1.5 1.0<	<=1.0 .75<	<=.75 0.5<	<=.5 .25<	NO INFO.
PEDICULARIS SUDETICA							0.06
30010305 PUCCINELLIA (RED)							0.63
21 MOSS							0.89
19 LICHEN							0.66
MASS (G/M2)							472.9
DIVERSITY							2.49

TABLE 97
FREQUENCY OF OCCURRENCE AND OTHER DATA FOR PLANT SPECIES
AT SEVERAL BEACH ELEVATIONS ABOVE MLLW AT STATION I30

STATION I30 : 70°33'24" N; 149° 30' 36" W.

POOLED SHANNON WEAVER DIVERSITY INDEX IS 1.77

CODE/SPECIES	ELEVATION(M)						
	2.0<	<=2.0 1.5<	<=1.5 1.0<	<=1.0 .75<	<=.75 0.5<	<=.5 .25<	<=.25 0.0<
3001030505 PUCCINELLIA PHRYGANODES			0.16		0.88		
3001030701 ELYMUS ARENARIUS	1.00		0.25				
3001040109 CAREX URSINA			0.06				
3001040108 CAREX SUBSPATHACEA			0.25		0.81		
3002050401 STELLARIA HUMIFUSA			0.19		1.00		
3002060401 COCHLEARIA OFFICINALIS			0.19		0.13		
30010305 PUCCINELLIA (RED)			0.13				
3002050101 HONCKENYA PEPLOIDES			0.38				
MASS (G/M2)	101.2		248.7		482.8		
DIVERSITY			1.94		1.23		

TABLE 98
FREQUENCY OF OCCURRENCE AND OTHER DATA FOR PLANT SPECIES
AT SEVERAL BEACH ELEVATIONS ABOVE MLLW AT STATION I50

STATION I50 : 70°30'0" N; 149°50'18" W.

POOLED SHANNON WEAVER DIVERSITY INDEX IS 1.99.

CODE/SPECIES	ELEVATION(M) 2.0<	<=2.0 1.5<	<=1.5 1.0<	<=1.0 .75<	<=.75 0.5<	<=.5 .25<	<=.25 0.0<
3001030301 DUPONTIA FISCHERI		0.28	0.91				
3001030505 PUCCINELLIA PHRYGANODES		0.25					
3001040401 ERIOPHORUM ANGUSTIFOLIUM		0.03					
3001040109 CAREX URSINA		0.28					
3001040113 CAREX AQUATILIS			0.94				
3001040108 CAREX SUBSPATHACEA		0.44	0.38				
3002050401 STELLARIA HUMIFUSA		0.56	0.97				
3002060401 COCHLEARIA OFFICINALIS		0.88	0.94				
21 MOSS		0.03	0.88				
19 LICHEN							
30020101 SALIX SPP.		0.13					

CODE/SPECIES	ELEVATION(M) 2.0<	<=2.0 1.5<	<=1.5 1.0<	<=1.0 .75<	<=.75 0.5<	<=.5 .25<	<=.25 0.0<
MASS (G/M2)		123.2	195.6				
DIVERSITY		1.87	1.75				

TABLE 59
FREQUENCY OF OCCURRENCE AND OTHER DATA FOR PLANT SPECIES
AT SEVERAL BEACH ELEVATIONS ABOVE MLLW AT STATION I58

STATION I58 : 70°28'12" N; 149°58'42" W.

POOLED SHANNON WEAVER DIVERSITY INDEX IS 1.78.

CODE/SPECIES	ELEVATION(M) 2.0<	<=2.0 1.5<	<=1.5 1.0<	<=1.0 .75<	<=.75 0.5<	<=.5 .25<	NO INFO.
3001030301 DUPONTIA FISCHERI				0.75			0.94
3001030505 PUCCINELLIA PHRYGANODES				0.06			
3001040401 ERIOPHORUM ANGUSTIFOLIUM				0.06			
3001040108 CAREX SUBSPATHACEA				0.06			1.00
3002020202 RUMEX ARCTICUS							
3002050401 STELLARIA HUMIFUSA				0.94			0.38
3002060401 COCHLEARIA OFFICINALIS				0.94			0.81
3002180104 ARTEMISIA ARCTICA				0.13			
30010305 PUCCINELLIA (RED)							
21 MOSS							
3002050101 HONCKENYA PEPLOIDES				0.13			
30020101				0.81			0.31

TABLE 99 (continued) 151

CODE/SPECIES				ELEVATION(M)			
	2.0<	<=2.0 1.5<	<=1.5 1.0<	<=1.0 .75<	<=.75 0.5<	<=.5 .25<	NO INFO.
SALIX SPP.							
MASS (G/M2)							
DIVERSITY				1.75			1.51

TABLE 100
FREQUENCY OF OCCURRENCE AND OTHER DATA FOR PLANT SPECIES
AT SEVERAL BEACH ELEVATIONS ABOVE MLLW AT STATION J22

STATION J22 : 70°26'36" N; 150°22'06" W.

POOLED SHANNON WEAVER DIVERSITY INDEX IS 1.07.

	ELEVATION(M)						
CODE/SPECIES	2.0<	<=2.0 1.5<	<=1.5 1.0<	<=1.0 .75<	<=.75 0.5<	<=.5 .25<	<=.25 0.0<
30010305 PUCCINELLIA (GREEN)						1.00	
30010305 PUCCINELLIA (RED)						0.48	
21 MOSS						0.59	
30020101 SALIX SPP.							
3002110102 HIPPURUS VULGARIS							
MASS (G/M2)						388.3	
DIVERSITY						1.07	

TABLE 101

FREQUENCY OF OCCURRENCE AND OTHER DATA FOR PLANT SPECIES AT SEVERAL BEACH ELEVATIONS ABOVE MLLW AT STATION M11

STATION M11 : 70°55'18" N; 153°10'36" W.

POOLED SHANNON WEAVER DIVERSITY INDEX IS 2.22.

CODE/SPECIES	ELEVATION(M) 2.0<	<=2.0 1.5<	<=1.5 1.0<	<=1.0 .75<	<=.75 0.5<	<=.5 .25<	<=.25 0.0<
3001030301 DUPONTIA FISCHERI				0.92	0.83	1.00	
3001030505 PUCCINELLIA PHRYGANODES				0.41	1.00		
3001040401 ERIOPHORUM ANGUSTIFOLIUM					0.72	0.55	
3001040113 CAREX AQUATILIS					0.97	1.00	
3001040108 CAREX SUBSPATHACEA					1.00		
3002010101 SALIX OVALIFOLIA					1.00		
3002050401 STELLARIA HUMIFUSA				0.88	0.74	0.06	
3002050801 MELANDRIUM APETALUM				0.22			
3002060401 COCHLEARIA OFFICINALIS				1.00	0.55	0.75	
3002080108 SAXIFRAGA CERNUA				0.03	0.25	0.06	
30010305 PUCCINELLIA (RED)				0.44			
21				0.89	0.91	0.96	

TABLE 101 (continued)

CODE/SPECIES	ELEVATION(M)						
	2.0<	<=2.0 1.5<	<=1.5 1.0<	<=1.0 .75<	<=.75 0.5<	<=.5 .25<	<=.25 0.0<
MOSS							
19					0.95	0.04	
LICHEN							
MASS (G/M2)							
DIVERSITY				1.74	2.18	1.64	

TABLE 102
FREQUENCY OF OCCURRENCE AND OTHER DATA FOR PLANT SPECIES
AT SEVERAL BEACH ELEVATIONS ABOVE MLLW AT STATION 040

STATION 040 : 71°14'00" N; 155°40'00" W.

POOLED SHANNON WEAVER DIVERSITY INDEX IS 1.93.

CODE/SPECIES	ELEVATION(M)						
	2.0<	<=2.0 1.5<	<=1.5 1.0<	<=1.0 .75<	<=.75 0.5<	<=.5 .25<	<=.25 0.0<
3001030301 DUPONTIA FISCHERI						1.00	0.22
3001030505 PUCCINELLIA PHRYGANODES				0.03		0.50	1.00
3001030701 ELYMUS ARENARIUS				0.97			
3001040108 CAREX SUBSPATHACEA						0.84	1.00
3002050401 STELLARIA HUMIFUSA				0.81		0.75	1.00
3002060401 COCHLEARIA OFFICINALIS				0.69			
30010305 PUCCINELLIA (RED)				0.78		0.73	
21 MOSS				0.47		0.03	
MASS (G/M2)							
DIVERSITY				1.62		1.61	1.27

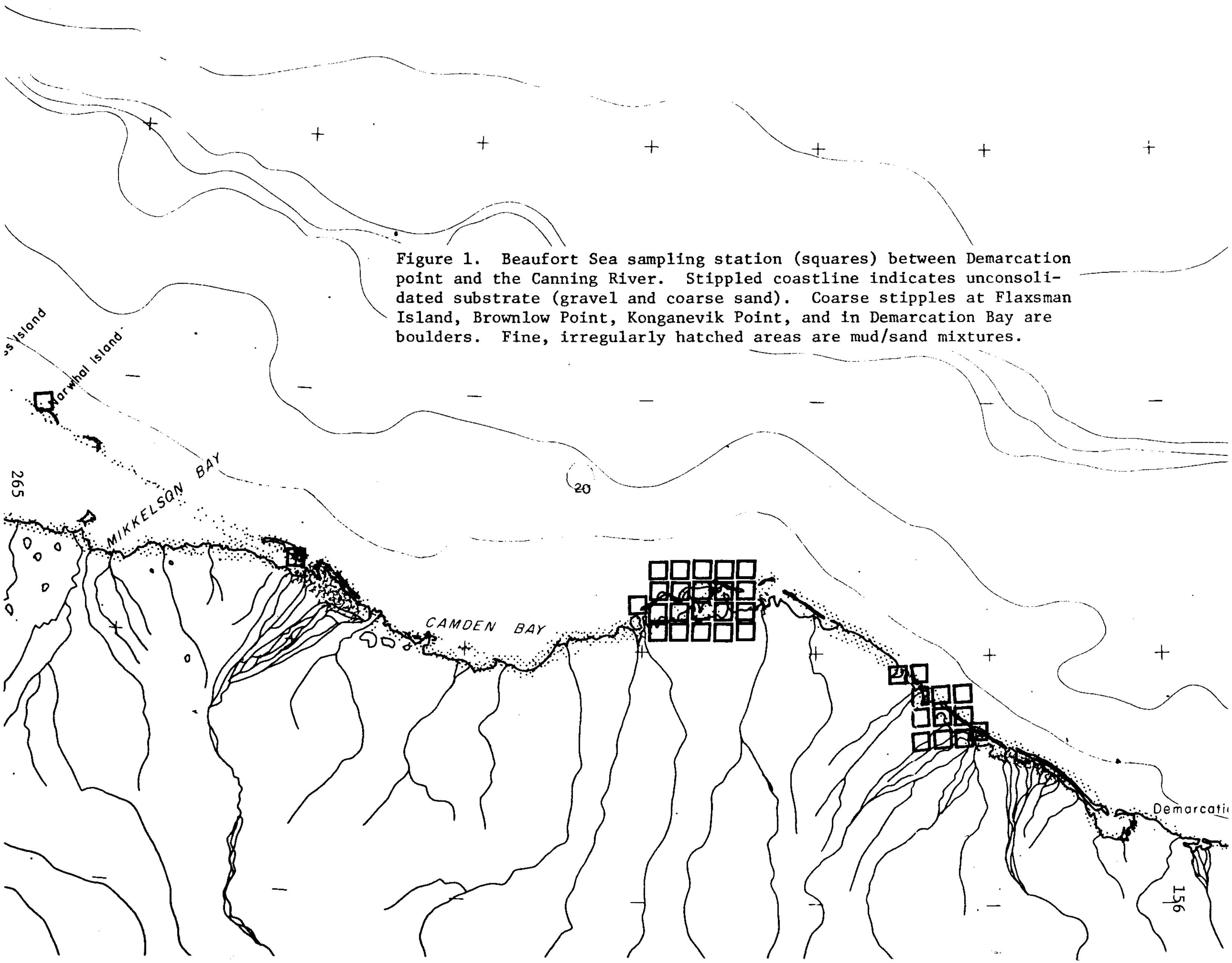


Figure 1. Beaufort Sea sampling station (squares) between Demarcation point and the Canning River. Stippled coastline indicates unconsolidated substrate (gravel and coarse sand). Coarse stipples at Flaxsman Island, Brownlow Point, Konganevik Point, and in Demarcation Bay are boulders. Fine, irregularly hatched areas are mud/sand mixtures.

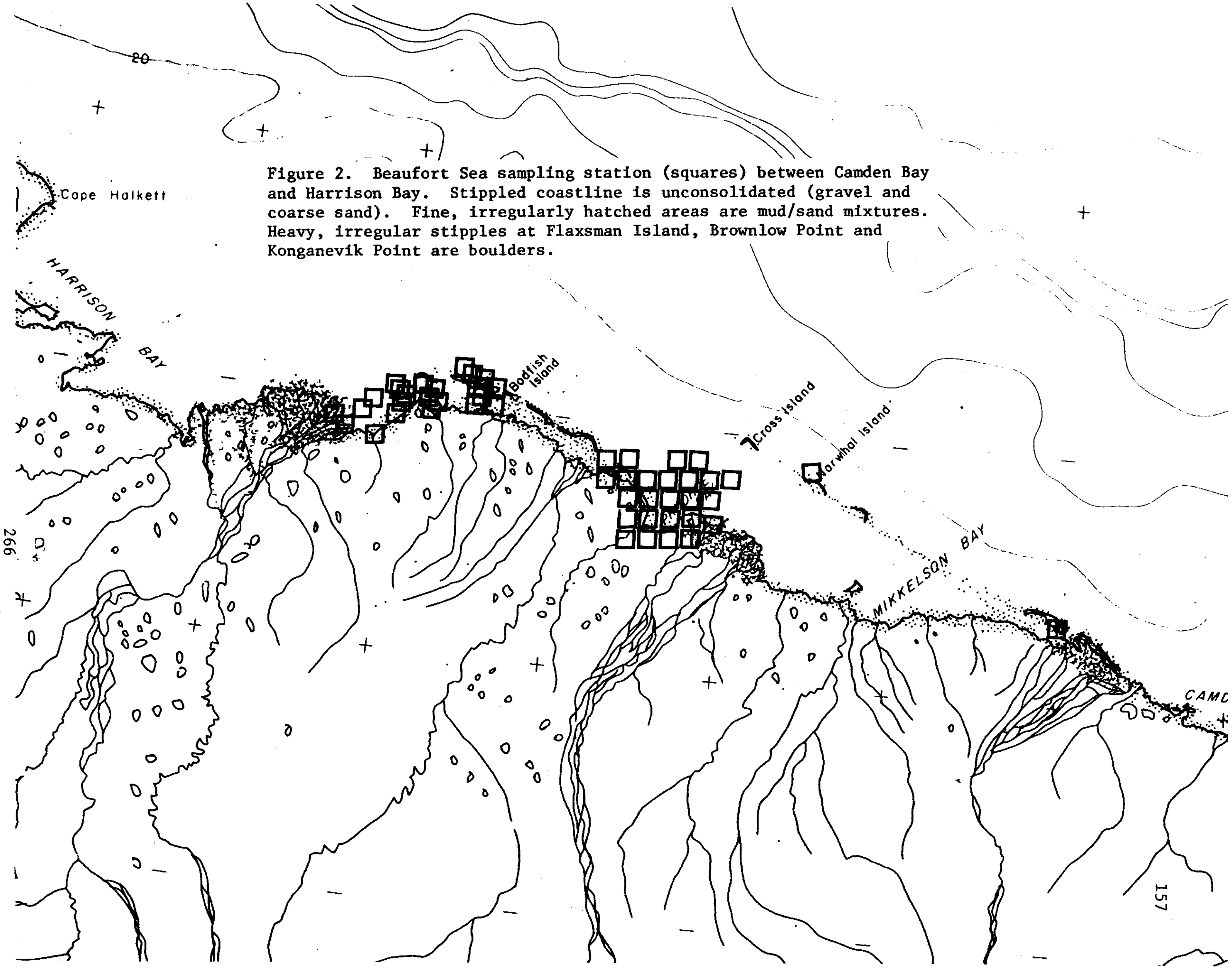


Figure 2. Beaufort Sea sampling station (squares) between Camden Bay and Harrison Bay. Stippled coastline is unconsolidated (gravel and coarse sand). Fine, irregularly hatched areas are mud/sand mixtures. Heavy, irregular stipples at Flaxsman Island, Brownlow Point and Konganevik Point are boulders.

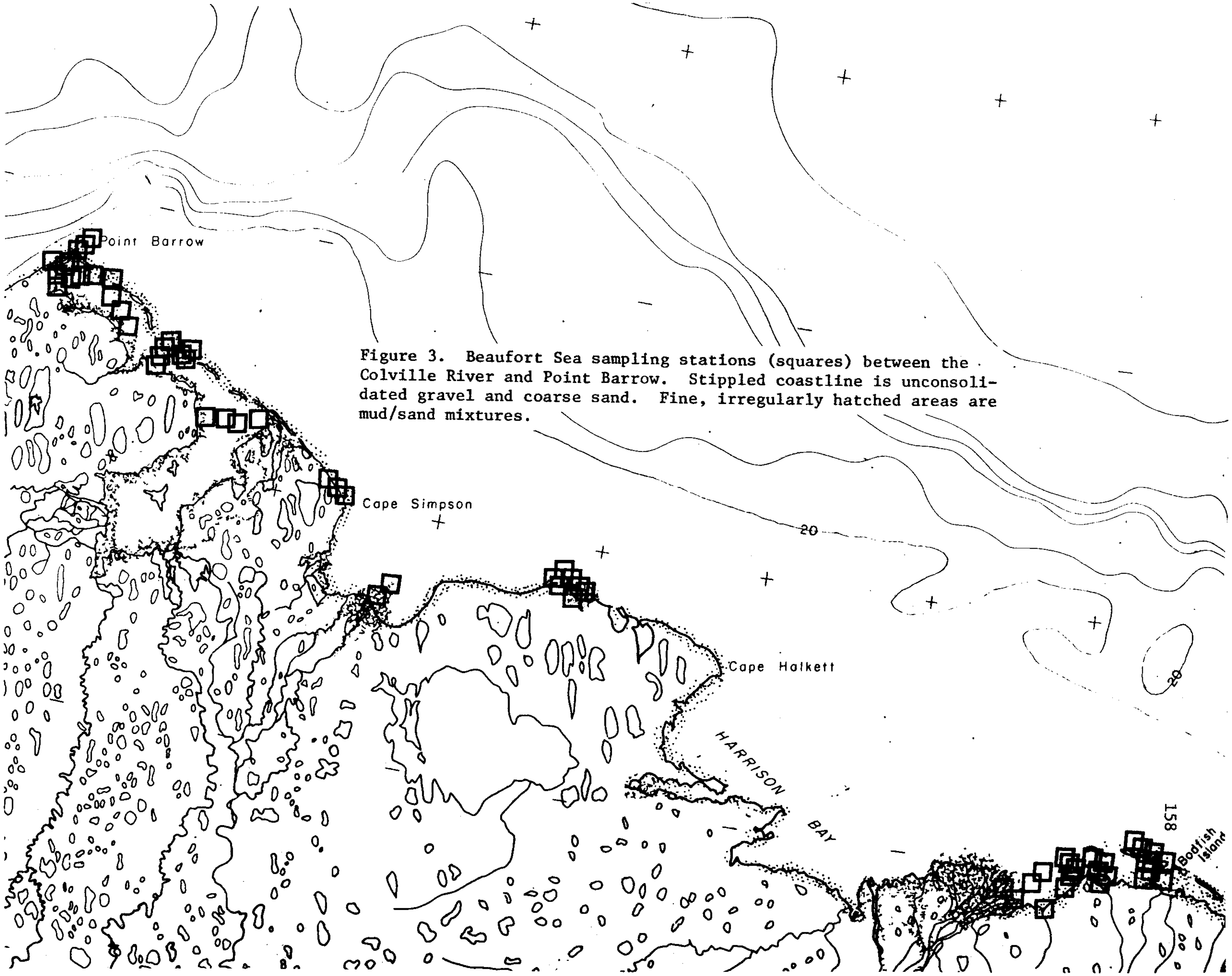


Figure 3. Beaufort Sea sampling stations (squares) between the Colville River and Point Barrow. Stippled coastline is unconsolidated gravel and coarse sand. Fine, irregularly hatched areas are mud/sand mixtures.

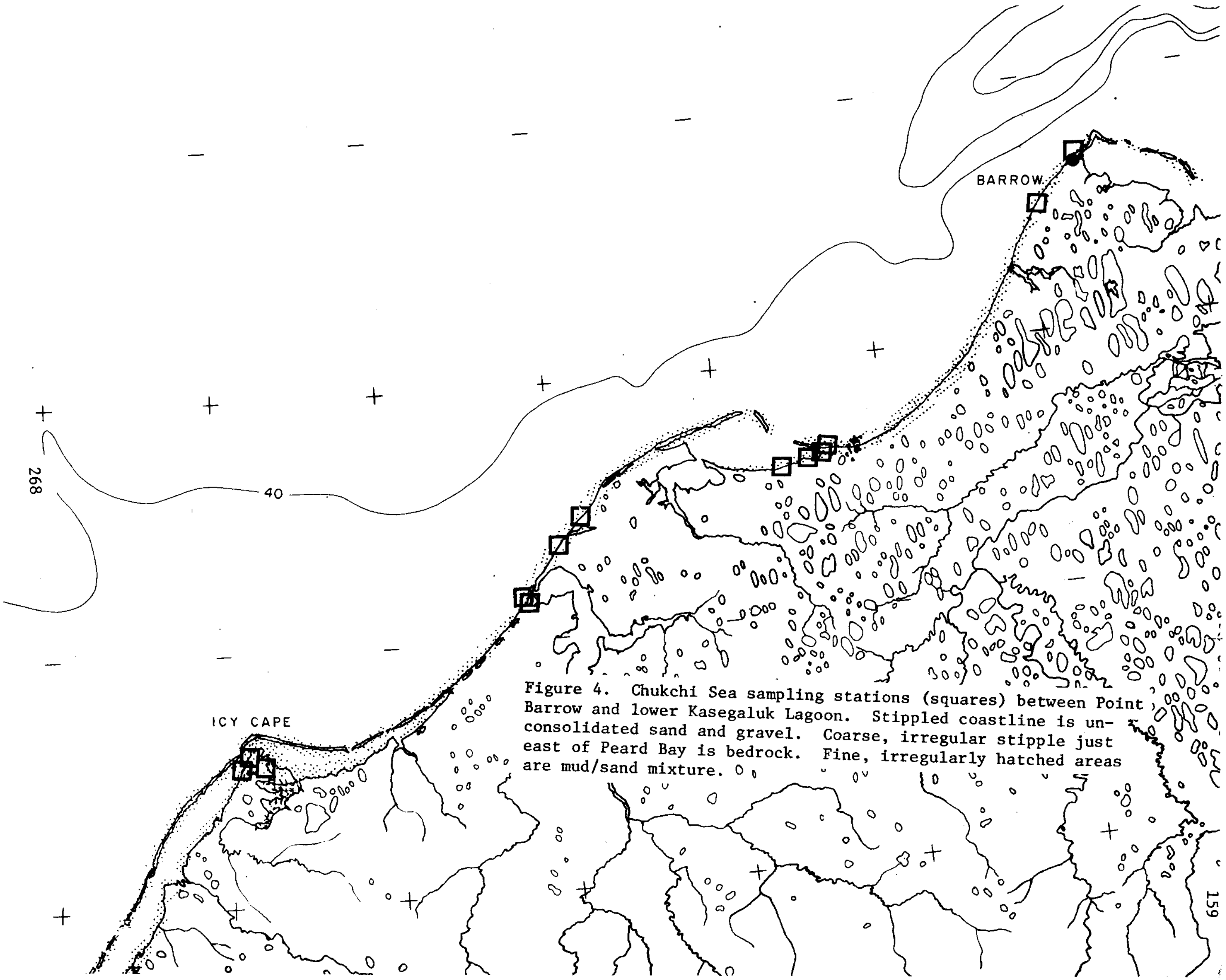


Figure 4. Chukchi Sea sampling stations (squares) between Point Barrow and lower Kasegaluk Lagoon. Stippled coastline is unconsolidated sand and gravel. Coarse, irregular stipple just east of Peard Bay is bedrock. Fine, irregularly hatched areas are mud/sand mixture.

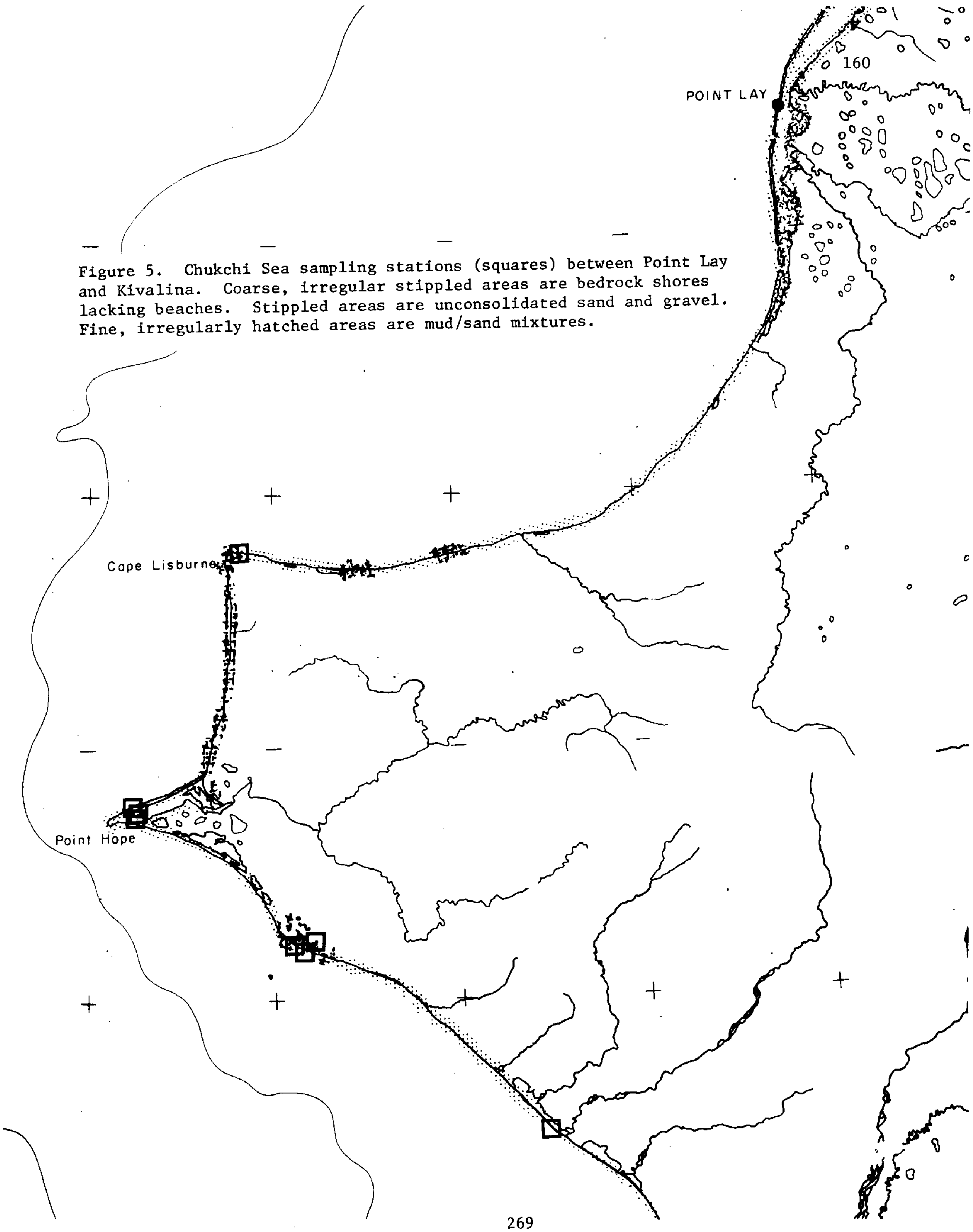


Figure 5. Chukchi Sea sampling stations (squares) between Point Lay and Kivalina. Coarse, irregular stippled areas are bedrock shores lacking beaches. Stippled areas are unconsolidated sand and gravel. Fine, irregularly hatched areas are mud/sand mixtures.

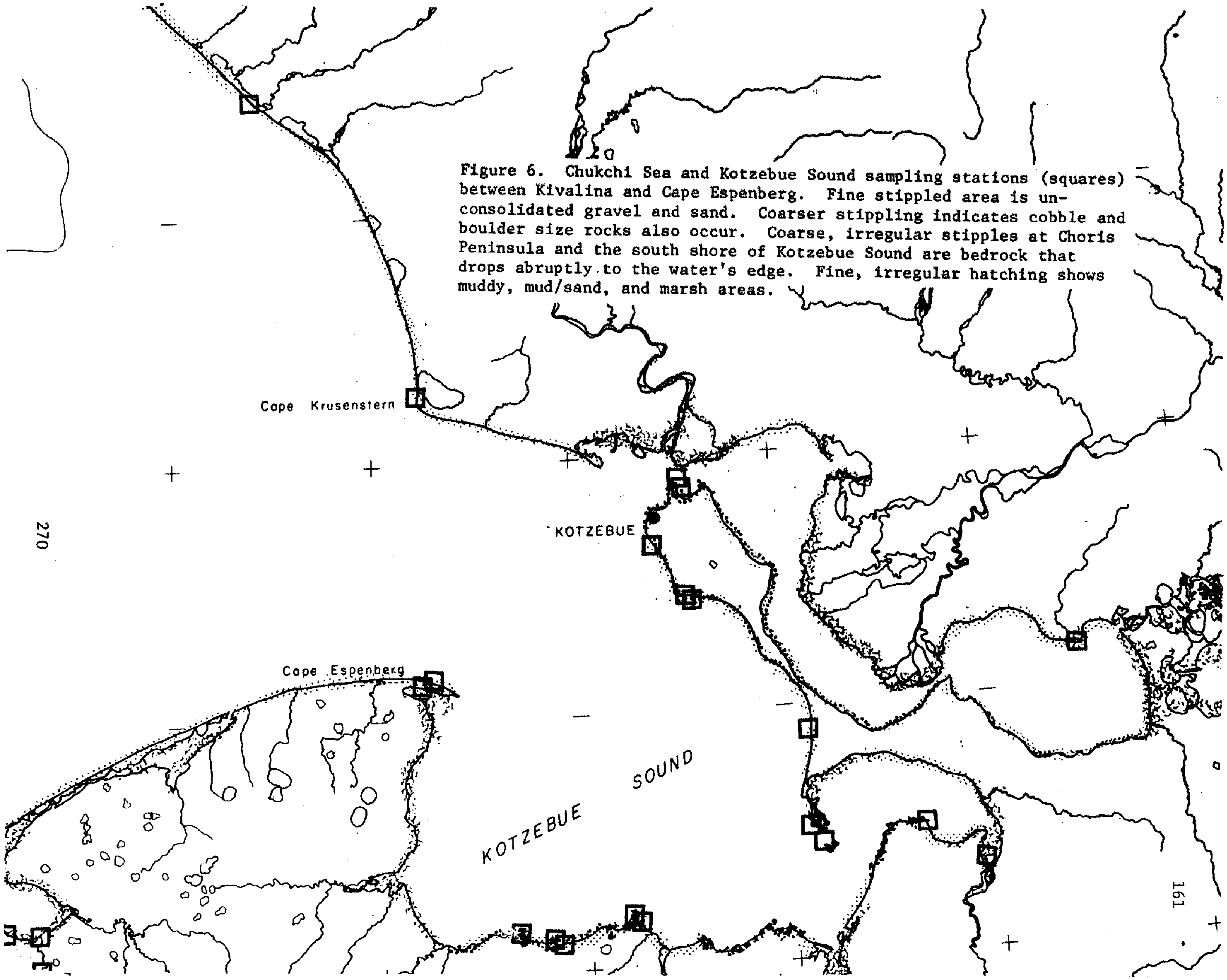


Figure 6. Chukchi Sea and Kotzebue Sound sampling stations (squares) between Kivalina and Cape Espenberg. Fine stippled area is unconsolidated gravel and sand. Coarser stippling indicates cobble and boulder size rocks also occur. Coarse, irregular stipples at Choris Peninsula and the south shore of Kotzebue Sound are bedrock that drops abruptly to the water's edge. Fine, irregular hatching shows muddy, mud/sand, and marsh areas.

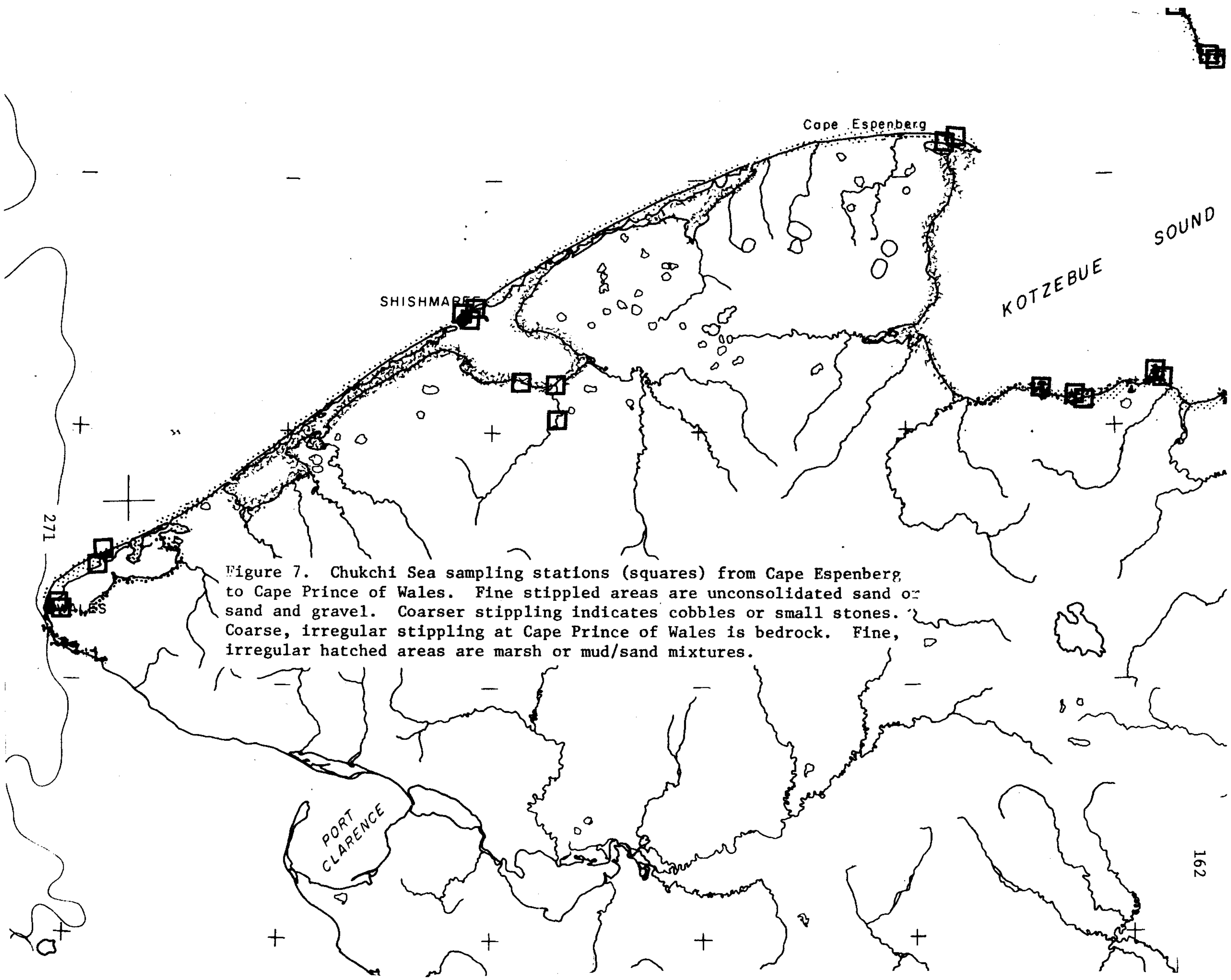


Figure 7. Chukchi Sea sampling stations (squares) from Cape Espenberg to Cape Prince of Wales. Fine stippled areas are unconsolidated sand or sand and gravel. Coarser stippling indicates cobbles or small stones. Coarse, irregular stippling at Cape Prince of Wales is bedrock. Fine, irregular hatched areas are marsh or mud/sand mixtures.

Figure 8. Composition of sediment samples taken at 0.0 M depth at various Chukchi Sea stations. Gravel = > 2.0 mm; sand = .0625 mm to 2.0 mm; mud (silt and clay) = < .0625 mm. The 90 to 100% sand vertex is enlarged. Stations are identified by the sequence number from Table 1 which gives latitude, longitude and location of all stations.

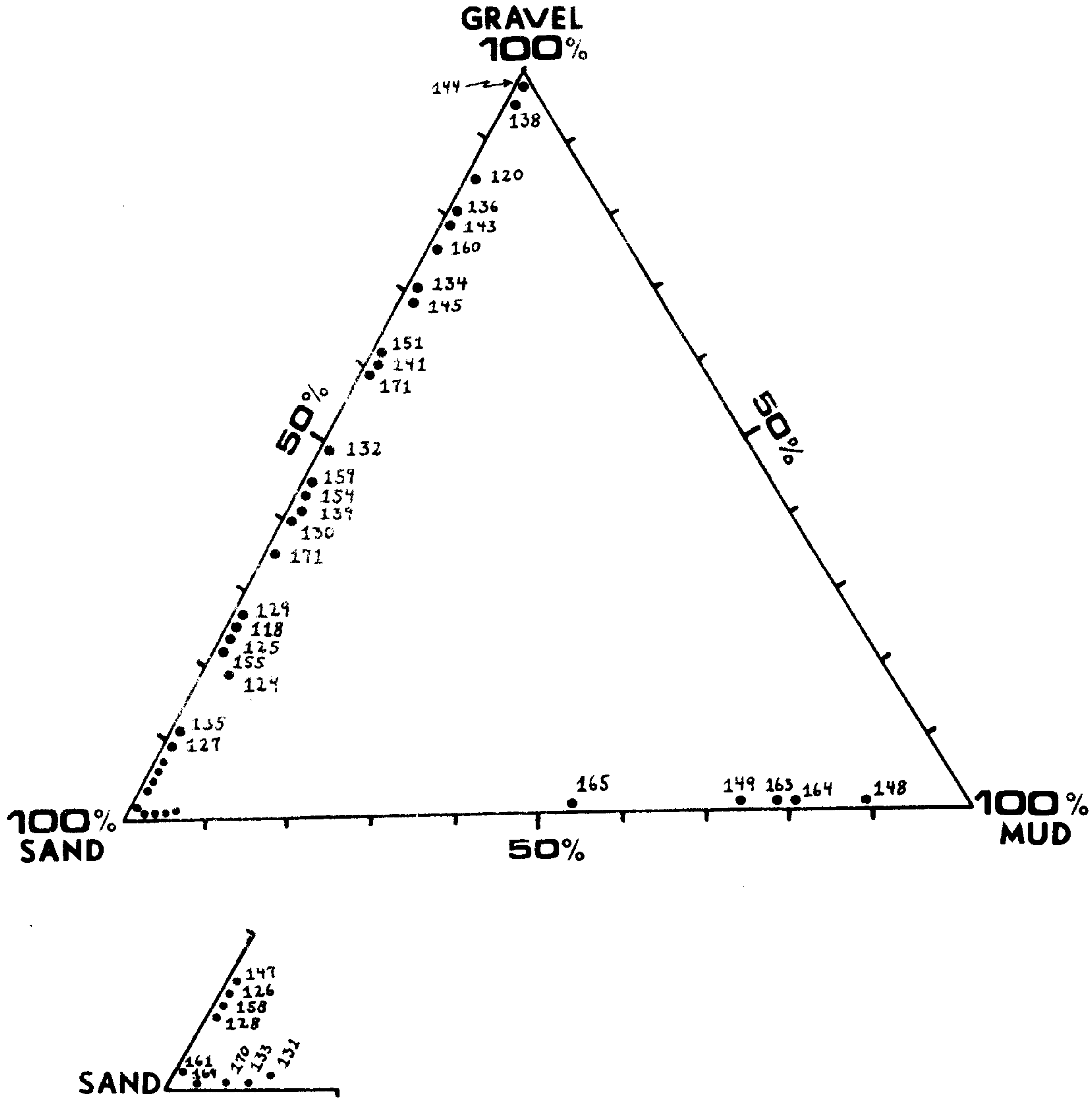


Figure 9. Composition of sediment samples taken at -0.25M depth at various Chukchi Sea stations. Gravel = > 2.0 mm; sand = .0625 mm to 2.0 mm; mud (silt and clay) = < .0625 mm. The 90 to 100% sand vertex is enlarged. Stations are identified by the sequence number from Table 1 which gives latitude, longitude and location of all stations.

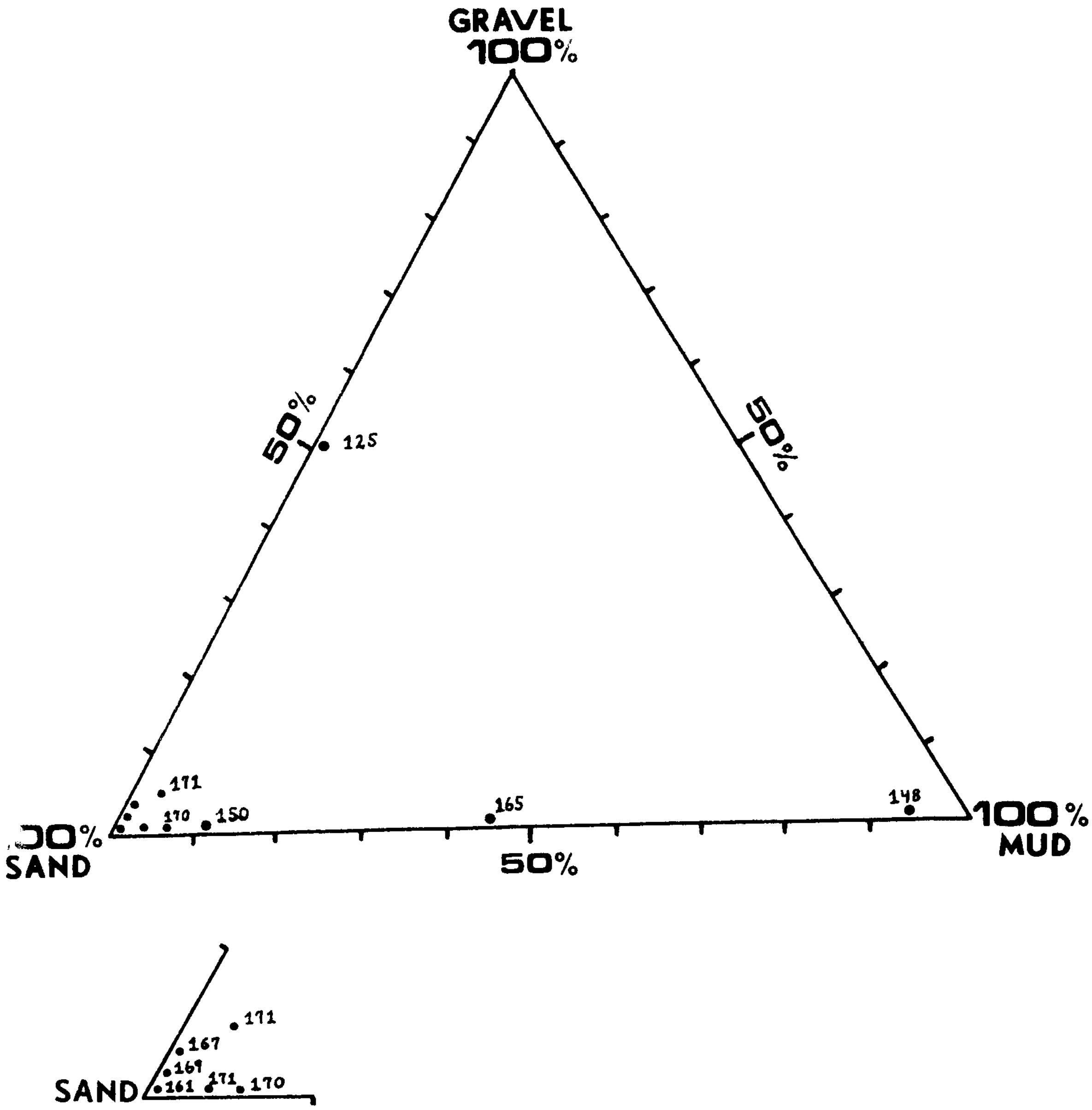
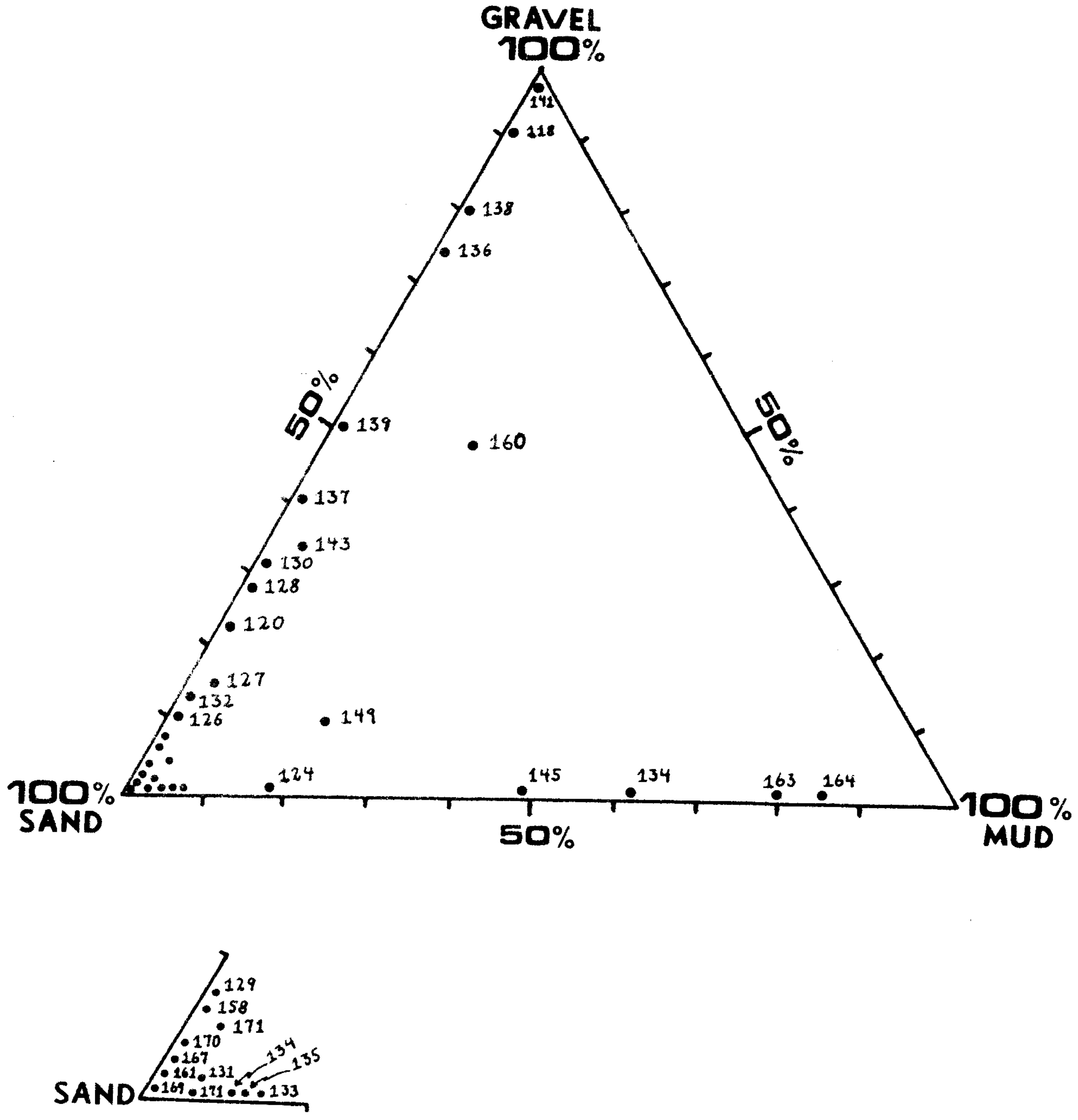


Figure 10. Composition of sediment samples taken at -0.50M depth at various Chukchi Sea stations. Gravel = > 2.0 mm; sand = .0625 mm to 2.0 mm; mud (silt and clay) = < .0625 mm. The 90 to 100% sand vertex is enlarged. Stations are identified by the sequence number from Table 1 which gives latitude, longitude and location of all stations.



FINAL REPORT

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BEAUFORT SEA PLANKTON STUDIES

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1 April 1977

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REF: A77-4

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SECTION 1

Nearshore

Prudhoe Bay and USCGC *Glacier*

Rita A. Horner

Kevin D. Wyman

Thomas R. Kaperak

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I. Summary of objectives, conclusions, and implications with respect to OCS oil and gas development

The primary objectives of this project were to determine the seasonal density distribution and environmental requirements of principal species of phytoplankton, zooplankton, and ichthyoplankton, and to determine seasonal indices of phytoplankton production. A secondary objective was to summarize existing literature, unpublished data, and archived samples.

Most of our conclusions must be preliminary because so little information is available concerning plankton of the Beaufort Sea. In general, the distribution of individual phytoplankton species appears to be widespread within the Beaufort Sea, while the distribution of some zooplankton species is influenced by local hydrographic regimes. Primary production and standing stocks of phytoplankton are variable and patchy based on data from one summer (August) sampling period. Highest primary productivity occurs below the surface , usually between 5 and 20 m, and where diatoms are the most abundant organisms. Meroplankton comprise a large part of the zooplankton of the western Beaufort Sea. Expatriate species are found with the intrusion of Bering Sea water into the Beaufort Sea.

Most of the basic background information necessary to make adequate assessments of the impact of oil and gas development on the plankton is still not available. Changes in species composition or loss of some planktonic species because of an oil spill would probably affect higher levels of the food chain and be damaging to fish, birds and mammals. Basic life history information is not known for most planktonic species and there are essentially no experimental studies concerning the effects of oil on Arctic plankton. Our studies point out the lack of available knowledge on the plankton.

II. Introduction

A. General nature and scope of study

As primary producers and primary and secondary consumers, phytoplankton and zooplankton play an important role in the Beaufort Sea ecosystem. Our purpose was to provide basic biological information about these organisms in order to understand their relationships within the ecosystem.

B. Specific objectives

The specific objectives of this project were to

1. Determine the seasonal density distribution and environmental requirements of principal species of phytoplankton, zooplankton, and ichthyoplankton;

2. Determine seasonal indices of phytoplankton production;

3. Summarize existing literature, unpublished data, and archived samples.

C. Relevance to problems of petroleum development

The development of gas and oil reserves has had, and will continue to have, an impact on the marine environment of the Beaufort Sea. In order to detect changes and predict or assess adverse effects caused by this development, it is necessary to have basic background information on productivity, species composition, distributions, abundances, life cycles and migration patterns of planktonic organisms.

Potential dangers to the plankton community include reduced primary productivity caused by direct toxicity effects or reduced light penetration into the water column as a result of a surface oil slick, and possible changes in the phytoplankton species composition with possible concurrent changes in the zooplankton because of modified food sources.

Some life cycle stages, especially larvae, are more susceptible to pollutants than other stages. It is important to know what these stages are and when and where they occur in the water column.

Oil trapped under the ice would affect the ice algae community that commonly occurs in spring. While the areal extent of this community is not well known, it is important in the shallow water areas (10 to 15 m) along the Beaufort Sea coast and provides a source of food for a number of important species, including amphipods, that are in turn utilized as food by birds and mammals.

In addition to the chemical effects of possible oil pollution, physical changes in the environment will also be critical. Construction of causeways and other structures or dredging of channels that could change circulation patterns will have an effect on primary productivity through changes in nutrient supply, and on planktonic organisms in general through changes in possible migration patterns and recruitment rates.

D. Acknowledgements

We would like to thank Deborah White, Rich McKinney, and Michael Macaulay for their help in the field in 1975. The field party at the AIDJEX camp in 1975 consisted of Clarence Pautzke, Kevin Wyman, Jerry Hornof, and Maureen McCrae. Special thanks go to the officers and men of USCGC *Glacier* for their assistance during the 1976 cruise. We thank Tom Kaperak for assistance in the field, analyzing samples, and data processing; Kevin Wyman and Leanne Legacie for analyzing zooplankton and ichthyoplankton samples; Deborah White for analyzing the 1975 phytoplankton samples; Clarence Pautzke and Jerry Hornof for data processing; and Michael Macaulay for data processing and management. Sue Latourell put in many hours of secretarial assistance. The section on the AIDJEX study is the work of Clarence Pautzke, Jerry Hornof, and Kevin Wyman.

III. Current state of knowledge

Little is known about the biology of the plankton in the Chukchi and Beaufort seas. Table 1 lists expeditions, collections, and publications on plankton from this area. The earliest collections were made during the Canadian Arctic Expedition, 1913-1918. Major groups of zooplankton reported from this expedition included ctenophores and hydromedusae (Bigelow 1920), amphipods (Shoemaker 1920), copepods (Willey 1920), and schizopod crustaceans (Schmitt 1919). The primary constituents of the zooplankton in these samples were crustaceans, particularly copepods. Diatoms, described by Mann (1925), were primarily benthic forms.

Johnson (1956) reported on zooplankton collected in the Chukchi and Beaufort seas in 1950 and 1951 and demonstrated, for the first time, the presence of Bering Sea water in the Beaufort Sea based on zooplankton distributions. Hand and Kan (1961) described the hydromedusae from these samples, including breeding ranges and the influence of hydrography on species distribution.

Wing (1974) described the kinds and abundance of zooplankton from the eastern Chukchi Sea in September and October 1970. Quast (1974) reported the density distribution of juvenile Arctic cod (*Boreogadus saida* Lepechin) from the same cruise and considered Arctic cod to be a "key species in the ecology of the arctic seas", being important as a major secondary consumer.

Studies concerned with annual cycles, biomass, population dynamics, and production of both phytoplankton and zooplankton have been done primarily at Pt. Barrow (MacGinitie 1955; Johnson 1958, Bursa 1963; Horner 1969, 1972; Redburn 1974). MacGinitie (1955), concerned mainly with benthic invertebrates, included a limited discussion of phytoplankton and zooplankton based on relative abundances and reproductive periods. Johnson (1958) described the qualitative and quantitative composition of the inshore zooplankton community for one month in summer.

Redburn (1974) described the zooplankton community in terms of species abundance and composition, life cycles, and relationship to the hydrographic regime. Copepods were the major constituents of the community along with large numbers of meroplanktonic larvae. The occurrence of Bering Sea water was indicated by the presence of several expatriate species of copepods and several populations of copepods and hydromedusae that breed from the Bering Sea to Barrow.

Bursa (1963) studied the taxonomy, ecology, and abundance of phytoplankton from several habitats near Barrow. Horner (1969, 1972) reported a bimodal annual phytoplankton cycle with a spring maximum in June and early July before ice breakup and a fall maximum in August-September.

In the nearshore area of the Beaufort Sea, Alexander (1974) has reported primary productivity, chlorophyll *a*, and biomass data for the phytoplankton community in the Colville River system, including Harrison Bay and Simpson Lagoon. Coyle (1974) and Horner *et al.* (1974)

Table 1. Expeditions, publications, and subjects of marine biological studies in coastal waters of the Beaufort Sea

Expedition or location	References	Subject
Canadian Arctic Exped. 1913-18 Chukchi - Beaufort	Bigelow 1920	hydromedusae ctenophores
	Shoemaker 1920	amphipods
	Willey 1920	copepods
	Schmitt 1919	schizopod crustaceans
	Mann 1925	diatoms
Chelan 1934	Johnson 1936	zooplankton
	1953	zooplankton
Burton Island 1950, 1951	Johnson 1956	copepods
LCM *Ripley* 1954	Hand & Kan 1961	hydromedusae
	Mohr *et al.* 1957	fish
Barrow: mainly Chukchi Sea	MacGinitie 1955	some zooplankton and phytoplankton
	Shoemaker 1955	amphipods
	Johnson 1958	inshore zooplankton (summer)
	Bursa 1963	phytoplankton
	Horner 1969	phytoplankton
	1972	phytoplankton
	Horner & Alexander 1972	ice algae
	Matheke 1973 Matheke & Horner 1974	benthic microalgae
	Alexander, Horner & Clasby 1974	ice algae, some phytoplankton
	Redburn 1974	zooplankton

Table 1. (continued)

Expedition or location	References	Subject
Oliktok	Alexander 1974	phytoplankton
Prudhoe Bay	Horner, Coyle, Redburn 1974	phytoplankton, zooplankton
	Coyle 1974	phytoplankton
WEBSEC		
Glacier 1970, 1971, 1972, 1973	Quast 1974	Arctic cod - Chukchi
	Cobb & McConnell no date	zooplankton 1971
	Wing 1974	zooplankton - Chukchi
	Horner unpubl	phytoplankton - chl *a*, standing stock
Staten Island 1974	Horner unpubl	phytoplankton - chl *a*, standing stock
OCSEAP		
1975 Prudhoe Bay	English, Horner OCS reps.	phytoplankton
Glacier 1976 Beaufort Sea to P.B. Chukchi Sea Icy Cape - Brw.	English, Horner OCS reps.	phytoplankton - chl *a*, species, prim. prod. zooplankton - species standing stock ichthyoplankton - species, standing stock
Southern Beaufort Sea	Grainger & Grohe 1975	zooplankton
	Adams 1974	prim. prod., oil under ice
	Hsiao 1976	phytoplankton

studied the Prudhoe Bay plankton in terms of primary productivity, standing stock, species composition, and spatial variability, along with local hydrographic conditions.

Cobb and McConnell (unpubl. ms.) have described the species composition, relative abundances, and distributions of zooplankton collected in summer 1971. Horner (unpubl.) has data on phytoplankton standing stock, distribution, and chlorophyll *a* concentrations from summer 1973 and 1974.

Hsiao (1976) and Grainger and Grohe (1975) have reported on phytoplankton and zooplankton studies in the southern Beaufort Sea (Mackenzie River delta), and Adams (1975) studied light intensity and primary productivity under sea ice containing oil.

With the exception of Adams (1975), these studies have been concerned with species composition, abundance, and distribution. Few attempts have been made to determine energy flow within the Arctic ecosystem and only Adams (1975) and Hsiao (1976) have studied the effects of oil on phytoplankton productivity in the Beaufort Sea.

IV. Study area

Plankton collections were made in Prudhoe Bay in Aug-Sep 1975 (Fig. 1) and in the Chukchi and Beaufort seas in Aug-Sep 1976 (Fig. 2 to 3, Table 2). The Prudhoe Bay samples were collected when and where local weather and ice conditions permitted. Plankton collections were made in the Chukchi Sea early during the *Glacier* cruise because ice conditions prevented the ship from entering the Beaufort Sea. Beaufort Sea stations were generally taken along the transects designated by OCS off Pitt Point and Narwhal Island. Ice prevented our working the transect off Barter Island. Additional stations were taken where investigators requested and ice permitted.

V. Sources, methods, and rationale of data collection

Phytoplankton samples were collected in Prudhoe Bay with a 6-ℓ Scott-Richards water bottle (modified Van Dorn bottle). Following collection, the water samples were drained into 4-ℓ polyethylene bottles, kept in a cool place, and returned to the shore laboratory at the V & E Construction camp, Deadhorse, for further processing.

In the laboratory, portions of each water sample were used for chlorophyll *a*, primary productivity, standing stock, and salinity. Water for chlorophyll *a* determination was filtered through 47 mm Millipore HA (0.45 μm) filters. A few drops of a saturated $MgCO_3$ solution were added and the filter tower rinsed with filtered seawater. The filters were folded into quarters, placed in a dessicator, and frozen. At the University of Washington, the chlorophyll concentrations were determined using a Turner fluorometer (Strickland and Parsons 1968).

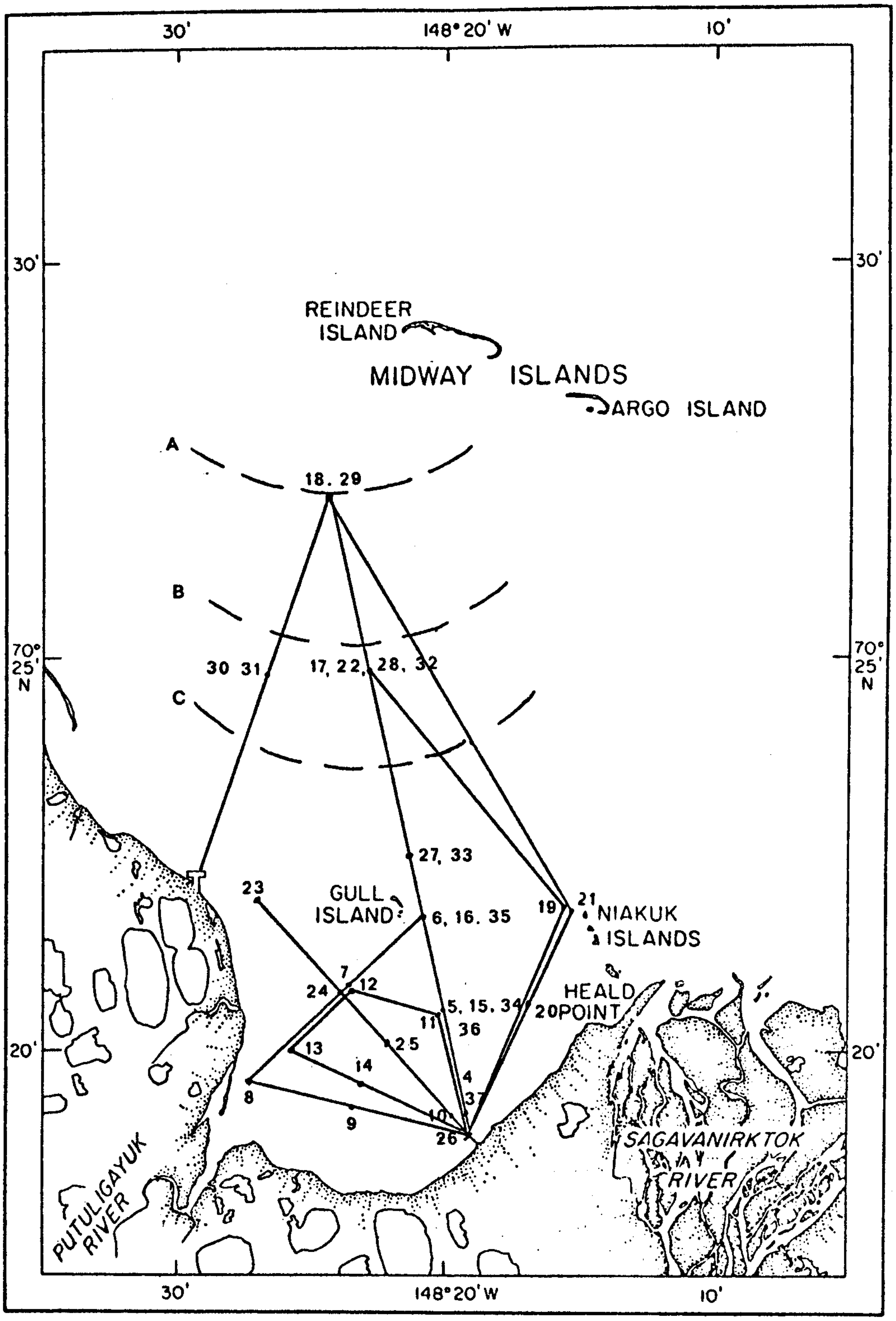

Fig. 1. Station locations, Prudhoe Bay, Sep 1975. A is ice edge 10 Sep; B is ice edge 11 Sep; C is ice edge 14 Sep.

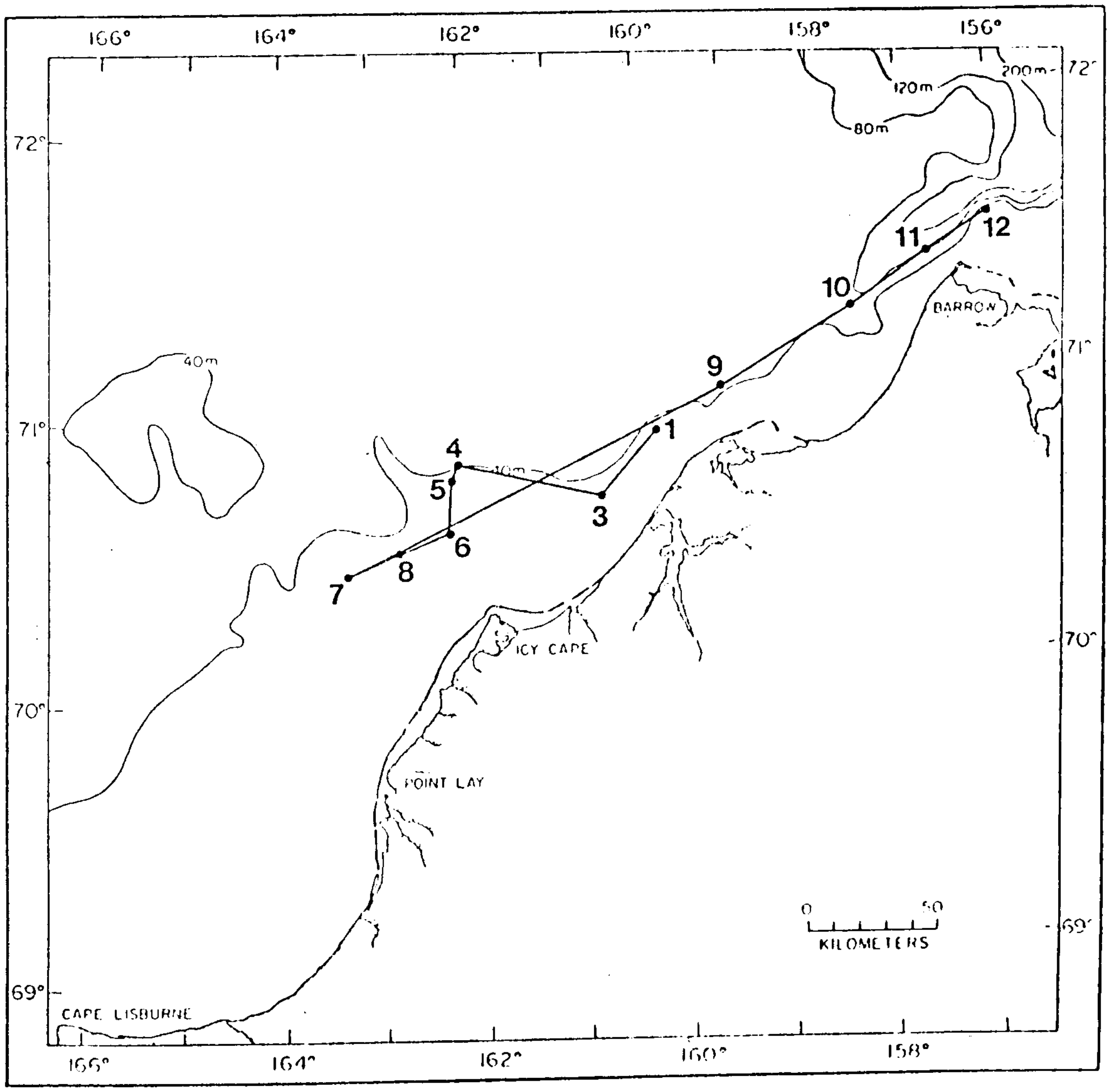

Fig. 2. Chukchi Sea cruise track and station locations, USCGC *Glacier*, 7 Aug to 4 Sep 1976.

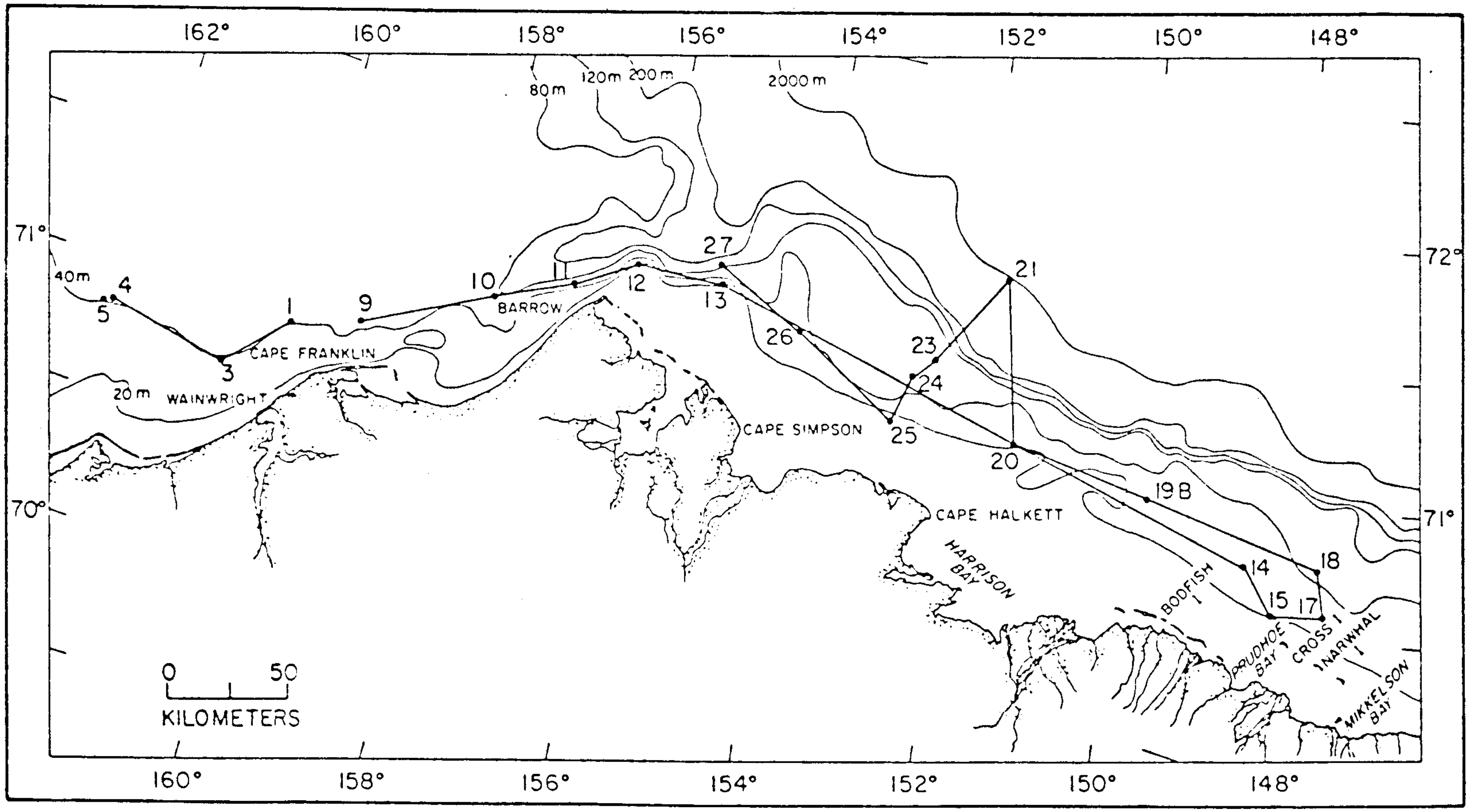

Fig. 3. Beaufort Sea cruise track and station locations, USCGC *Glacier*, 7 Aug to 4 Sep 1976.

Table 2. Station locations, USCGC *Glacier*, 7 Aug to 4 Sep 1976

Station	Latitude (N)	Longitude (W)	Chart Depth (m)	Location
1	70° 54'	160° 04'	54	Chukchi Sea
3	70° 43'	160° 40'	20	Chukchi Sea
4	70° 50'	162° 09'	40	Chukchi Sea
5	70° 47'	162° 14'	36	Chukchi Sea
6	70° 39'	162° 16'	36	Chukchi Sea
7	70° 28'	163° 26'	40	Chukchi Sea
8	70° 34'	162° 50'	27	Chukchi Sea
9	71° 03'	159° 17'	61	Chukchi Sea
10	71° 16'	157° 43'	70	Chukchi Sea
11	71° 25.5'	156° 54.8'	106	Chukchi Sea
12	71° 31.5'	156° 09'	139	Chukchi Sea
13	71° 31'	155° 05'	31	Beaufort Sea
14	71° 11'	153° 09'	25	Beaufort Sea
15	70° 36'	148° 12'	16	Beaufort Sea
17	70° 32'	147° 33'	25	Beaufort Sea
18	70° 39'	147° 37'	25	Beaufort Sea
19B	70° 57'	149° 33'	30	Beaufort Sea
20	71° 08'	151° 19'	34	Beaufort Sea
21	71° 43'	151° 47'	1700	Beaufort Sea
23	71° 22'	152° 20'	75	Beaufort Sea
24	71° 19'	152° 32'	52	Beaufort Sea
25	71° 08'	152° 57'	22	Beaufort Sea
26	71° 23'	154° 21'	30	Beaufort Sea
27	71° 36'	155° 32'	171	Beaufort Sea

Primary productivity experiments were run in 60 ml reagent bottles. Two light bottles and one dark bottle were used for each depth. Two ml of $NaH^{14}CO_3$ solution were added to each bottle, aluminum foil was placed around the dark bottle, and the samples were incubated in a plastic bucket filled with water under daylight illumination and ambient air temperature. After a 4 hr incubation period, the samples were filtered onto 25 mm Millipore HA (0.45 μm) filters, rinsed with 5 ml filtered seawater, and the filters were placed in liquid scintillation vials. In Seattle, radioactive uptake was measured using a Packard Tri-Carb Liquid Scintillation Spectrometer with Aquasol (New England Nuclear) as the scintillation cocktail.

Standing stock samples were preserved with 5 to 10 ml of 4% formalin buffered with sodium acetate. Cell counts and species identification were made using a Zeiss phase-contrast inverted microscope following the method of Utermöhl (1931). Species identifications were made using standard phytoplankton reference books with Hustedt (1930, 1959) and Schiller (1933, 1937) as the main authorities. Voucher specimens were not kept.

Nutrient determinations were made on Millipore filtered seawater that was frozen and returned to Seattle. Autoanalyzer methods (Strickland and Parsons 1968) were used to determine nutrient concentrations. Filtered seawater was also used to determine salinity. These samples were analyzed at the Naval Arctic Research Laboratory, Barrow, Alaska, using a Beckman RS 7 B induction salinometer using Copenhagen seawater as the standard.

During the cruise of the USCGC *Glacier* zooplankton and ichthyoplankton were sampled with bongo nets and 0.75-m ring nets. The bongo net consists of a double-mouthed frame, each mouth with an inside diameter of 60 cm and an area of 0.2827 m^2. Nets with a mesh size of 505 μm (8:1 OAR) and 333 μm (8:1 OAR) were attached to the frame. A TSK flow meter was mounted in the mouth of each net to determine the amount of water filtered, and a bathykymograph (BKG) was attached at the center of the frame to determine tow depth. Two or three 25-lb cannon ball weights were attached to the frame. Tows were double oblique with deployment at approximately 50 m/min, with a 30 sec soaking time, and retrieval at 20 m/min. Sampling depth varied because of the shallow water, but the net was placed as close to the bottom as possible without endangering the net. Because of adverse ice conditions, only 10 bongo tows were made.

The ring net has a mesh size of 308 μm (2:1 OAR) and is mounted on a 0.75-m ring. This net was lowered to a predetermined depth, usually 10 or 20 m, allowed to soak for 10 sec, and vertically hauled to the surface. Depending on the water depth, two or more tows were made at a station, with 51 tows being done during the cruise.

The zooplankton samples were concentrated by gently swirling the sample in a net collection bucket to remove excess water. The samples were then placed in 250 or 500 ml jars and preserved with 100% formalin and saturated sodium borate solution. The amount of formalin and buffer depended on the jar size. A label containing collection data was put in the jar, seawater was added, if necessary to fill the jar, and the jar was tightly capped for storage.

The zooplankton samples were first sorted for large or rare organisms, then each sample was split in a Folsom plankton splitter until a subsample containing 100 specimens of the most abundant species was obtained. The organisms were identified and counted using a dissecting microscope. Voucher specimens have been kept for some species. References used to identify zooplankton are given in Table 3.

Acoustic surveys were conducted using a Ross 200A Fine Line Echosounder system operating with a frequency of 105 kHz. A 10° transducer mounted in a 0.6 m V-Fin depressor was lowered to the water surface when the ship was stopped on station. The incoming signal was recorded on a paper chart marked with the station number, date, time (LDT), and other pertinent information. When ice and time allowed, the incoming signal was also recorded on magnetic tape for later analysis. Most of the recording was done in the 0-50 fm range because of the shallowness of the water. Few acoustic measurements were made because of ice conditions.

Phytoplankton samples were collected with 5-ℓ Niskin bottles. Subsamples were taken for salinity, standing stock, primary productivity, and chlorophyll *a* determinations. Salinity was measured on board using a Bisset Berman Hytech salinometer Model 6220 (USCG # 4691 m). Standing stock samples were preserved with approximately 10 ml of 4% formalin. Cell counts and species identifications were made using a Zeiss phase-contrast inverted microscope following the method of Utermöhl (1931). Five and 50-ml settling chambers were set up for each sample. Rare organisms and cells larger than 50 μm were counted at 10 X in the 50-ml chambers and small, abundant organisms were counted at 25 X in the 5-ml chambers. Usually 1/5 of each chamber was counted. Species identifications were made using standard phytoplankton reference books with Hustedt (1930, 1959) and Schiller (1933, 1937) as the main authorities. Voucher specimens were not kept. Standing stock samples collected in the Chukchi Sea have not been analyzed because of time limitations.

Primary productivity measurements were made in 60 ml reagent bottles. Two light bottles and one dark bottle were used for each depth. Two ml of $NaH^{14}CO_3$ solution were added to each bottle, aluminum foil was placed around the dark bottle, and the samples were incubated in a sink in the laboratory. A bank of cool white fluorescent lights was set up over the sink. Light levels were measured at the beginning and end of the incubation period with a Gossen Super Pilot photographic light meter. Low temperature in the sink was maintained by running seawater; temperature was measured at the beginning and end of the incubation period. The incubation period was usually 3-4 hours. The samples were filtered onto 25 mm Millipore HA (0.45 μm) filters, rinsed with approximately 5 ml filtered seawater and 5 ml 0.01 N HCL, and placed in liquid scintillation vials. Radioactive uptake was measured using a Packard Tri-Carb Liquid Scintillation Spectrometer with Aquasol (New England Nuclear) as the scintillation cocktail. Primary productivity was calculated using the equation

$$Ps\ (mg\ C\ m^{-3} \cdot hr^{-1}) = \frac{(L-D) \times W \times 1.05}{R \times T}$$

Table 3. References aiding identification of zooplankton

Taxon	References
Copepoda	Brodskii, 1950 Heron and Damkaer, 1976 Jaschnov, 1948 Mori, 1937 Sars, 1900 Sars, 1903 Vidal, 1971
Euphausiacea	Leung, 1970a
Ostracoda	Leung, 1972c Sars, 1928
Mysidacea	Leung, 1972b
Decapoda	Leung, Havens, and Rork, 1971 Makarov, 1967
Amphipoda	Sars, 1895 Tencati, 1970
Polychaeta	Pettibone, 1954 Yingst, 1972
Appendicularia	Leung, 1972a
Chaetognatha	Dawson, 1971
Hydrozoa	Naumov, 1960 Shirley and Leung, 1970
Ctenophora	Leung, 1970b
Pteropoda	Leung, 1971
Pisces	Blackburn, 1973 Ehrenbaum, 1909 Gorbunova, 1954 Rass, 1949

where (L-D) is light-dark bottle disintegrations per minute; W is carbonate carbon; 1.05 is a ^{14}C isotope factor; R is the activity of the ^{14}C used; and T is the incubation time.

Water for chlorophyll *a* determinations was filtered through 47 mm Millipore HA (0.45 μm) filters. A few drops of a saturated $MgCO_3$ solution were added and the filter tower was rinsed with filtered seawater. The filters were folded into quarters, placed in labelled coin envelopes, and frozen. The samples were analyzed using a Turner fluorometer (Strickland and Parsons 1968). Calculations were done using the equations

$$\text{chl } a = \frac{\dfrac{F_o/F_{a_{max}}}{F_o/F_{a_{max}}-1}(K_x)(F_o - F_a)}{\text{Vol filtered}}$$

$$\text{Phaeo} = \frac{\left(\dfrac{F_o/F_{a_{max}}}{F_o/F_{a_{max}}-1}\right)(K_x)\left[F_o(F_a/F_{o_{max}}) - F_a\right]}{\text{Vol filtered}}$$

where F_o is fluorometer reading before acidification; F_a is fluorometer reading after acidification; K is fluorometer door calibration factor; and Vol filtered is the volume of sample filtered.

Temperatures, measured using reversing thermometers, were corrected using the calibration factors provided by the Coast Guard and following the procedure outlined in U.S. Naval Oceanographic Office Publ 607 (1968).

VI. Results

A. Prudhoe Bay

Hydrographic data are given in Table 4. Chlorophyll *a* concentrations were generally < 1 mg m^{-3}, except for near-bottom samples at stations 24, 27, and 30, where concentrations were 2 to 3 mg m^{-3}. Different species accounted for the higher chlorophyll *a* concentrations in the deeper water with pennate diatoms being most abundant at station 30-15 and *Chaetoceros furcellatus* Bailey being most abundant at station 24-7.

Temperature ranged from -1.0 to +3.0° C with the lowest and highest temperatures at the surface. Salinity ranged from 11.648 to 24.959 ‰ with higher salinities generally being in deeper water.

Phosphate concentrations ranged from 0.03 to 1.31 μg at ℓ^{-1}, generally being below 0.60 μg at ℓ^{-1}. Silicate concentrations ranged

Table 4. Hydrographic data for OCS stations taken during Sep 1975 in Prudhoe Bay

Sta. No.	Date (1975) (ADT)	Sample Depth	T	S°/₀₀	Nutrients (μg at ℓ) PO_4	Si	NO_3	NO_2	NH_4	Chl. *a* ($mg\ m^3$)
P-1	9-5	0	-1.0	12.844	0.36	16.60	0.20	0.12	0.86	0.845
P-2	9-5	0	-1.0	20.208	0.52	10.14	0.35	0.24	0.80	1.284
P-3	9-5	0	-1.0	22.126	0.71	8.00	1.19	0.06	1.86	0.777
P-4	9-7	0	0.2	13.168	0.94	20.95	0.27	0.10	0.52	0.879
		7	1.2	12.642	0.95	20.64	1.15	0.10	1.08	0.811
P-5	9-7	0	-0.8	14.054	0.73	19.21	0.16	0.13	0.94	0.714
		8	-0.4	18.948	0.36	12.47	0.85	0.21	1.62	1.048
P-6	9-7	0	-0.8	17.317	0.57	11.21	0.37	0.17	1.29	0.545
		3	-1.5	(No bottom samples taken here)						
P-7	9-7	0	-0.8	16.107	0.52	14.16	0.92	0.21	1.90	0.642
		5	-1.2	19.497	0.58	7.91	0.24	0.39	0.60	0.946
P-8	9-7	0	-1.0	20.579	1.28	10.38	0.08	0.57	0.88	1.169
		2	-1.0	(No bottom samples taken here)						
P-9	9-7	0	-1.0	14.778	0.48	14.65	0.58	0.42	2.01	0.777
		7	-1.0	12.317	0.43	20.92	0.08	0.30	1.09	0.533
P-10	9-8	0	0.8	17.186	0.22	4.72	0.20	0.05	0.85	0.879
		6	0.8	13.405	0.29	5.65	0.35	0.05	0.84	0.630
P-11	9-8	0	-0.8	12.570	0.47	20.20	1.19	0.11	1.82	0.436
		7	-0.4	19.148	0.36	10.91	0.24	0.06	0.62	0.787

Table 4. (continued)

Sta. No.	Date (1975) (ADT)	Sample Depth	T	S°/₀₀	Nutrients (µg at ℓ)					Chl. *a*
					PO_4	Si	NO_3	NO_2	NH_4	(mg m^3)
P-12	9-8	0	-0.5	12.456	0.45	15.91	1.15	0.11	1.15	0.472
		8	-0.2	19.416	0.63	8.92	0.15	0.05	1.04	1.220
P-13	9-8	0	-0.4	12.522	0.49	20.71	0.86	0.13	1.70	0.521
		6	-0.2	16.811	0.36	14.48	0.40	0.10	1.39	0.606
P-14	9-8	0	-1.0	11.648	0.28	20.22	0.92	0.09	2.03	0.351
		5	-0.5	17.687	0.38	8.33	0.23	0.01	0.74	0.845
P-15	9-10	0	0.5	16.067	0.17	14.35	0.11	0.00	1.03	0.557
		5	0.2	17.675	0.40	15.45	0.59	0.28	2.17	0.946
P-16	9-10	0	1.0	17.572	0.27	15.61	0.10	0.07	1.26	0.424
		4	0.8	18.031	0.51	14.15	0.15	0.09	2.65	0.823
P-17	9-10	0	0.8	22.618	0.53	14.22	0.27	0.12	2.57	0.460
		23	0.5	23.091	0.72	11.80	0.56	0.09	1.23	0.606
P-18	9-10	0	1.2	23.366	0.50	11.47	0.14	0.07	0.93	0.279
		30	0.5	24.959	0.70	10.17	0.82	0.10	1.47	0.465
P-19	9-10	0	1.2	21.462	0.45	12.17	0.42	0.14	1.17	0.254
		11	1.0	22.134	0.61	12.49	0.33	0.08	1.30	0.509
P-20	9-11	0	1.5	15.494	--	--	--	--	--	0.855
		7	1.2	18.356	--	--	--	--	--	1.790
P-21	9-11	0	1.2	16.227	--	--	--	--	--	0.823
		8	1.2	17.708	--	--	--	--	--	0.799

Table 4. (continued)

Sta. No.	Date (1975) (ADT)	Sample Depth	T	S°/₀₀	Nutrients (µg at ℓ) PO_4	Si	NO_3	NO_2	NH_4	Chl. *a* (mg m^3)
P-22	9-11	0	1.2	23.166	--	--	--	--	--	0.606
		19	1.2	23.186	--	--	--	--	--	0.545
P-23	9-13	0	2.5	19.660	0.47	9.64	0.13	0.26	2.52	0.472
		5	2.3	20.002	0.46	8.97	0.26	0.46	2.40	1.217
P-24	9-13	0	2.2	20.491	0.45	10.77	0.54	0.28	1.03	0.799
		7	2.2	20.832	0.47	10.33	0.15	0.29	0.67	2.907
P-25	9-13	0	1.9	19.571	0.21	11.26	0.80	0.80	1.25	0.799
		8	2.2	20.693	0.29	10.42	0.38	1.10	0.94	0.690
P-26	9-13	0	1.8	17.010	0.19	8.24	0.05	0.07	1.06	0.642
		6	1.8	18.895	0.28	11.03	0.32	1.05	1.01	0.690
P-27	9-14	0	2.2	17.489	0.03	13.01	0.09	0.13	2.18	0.339
		5	1.8	21.055	0.56	11.25	0.03	0.09	0.21	2.260
P-28	9-14	0	1.5	19.314	0.16	12.64	0.03	0.13	0.21	1.048
		20	0.3	23.530	1.09	11.20	0.28	0.27	0.21	0.744
P-29	9-14	0	0.3	21.759	0.45	9.96	0.12	0.15	--	0.246
		19	0.0	23.587	1.31	11.25	0.21	0.36	--	0.777
P-30	9-14	0	1.9	17.261	0.33	13.83	0.04	0.18	--	0.173
		15	0.6	22.801	--	--	--	--	--	2.330
P-31	9-16	0	2.2	17.600	--	--	--	--	--	0.642
		15	1.4	20.872	--	--	--	--	--	0.744

Table 4. (continued)

Sta. No.	Date (1975) (ADT)	Sample Depth	T	S°/₀₀	Nutrients (µg at ℓ) PO_4	Si	NO_3	NO_2	NH_4	Chl. *a* (mg m^3)
P-32	9-16	0	1.2	22.217	--	--	--	--	--	1.180
		20	1.1	22.258	--	--	--	--	--	0.702
P-33	9-16	0	1.9	20.767	--	--	--	--	--	0.363
		15	1.5	21.274	--	--	--	--	--	0.744
P-34	9-16	0	2.0	14.567	--	--	--	--	--	0.630
		7	3.0	18.690	--	--	--	--	--	0.879
P-35	9-16	0	2.1	20.067	--	--	--	--	--	0.702
		6	2.0	20.094	--	--	--	--	--	0.879
P-36	9-16	0	2.0	20.071	--	--	--	--	--	0.375
		7	1.7	20.097	--	--	--	--	--	0.545
P-37	9-16	0	2.0	19.916	--	--	--	--	--	0.744
		5	2.0	19.930	--	--	--	--	--	0.507

from 4.72 to 20.95 μg at ℓ^{-1}. The lowest silicate concentration was at station 10 and the highest at station 4, both located inside the bay near the east dock. The samples were collected one day apart and few diatoms were present at either station. Nitrate concentrations ranged from 0.03 to 1.19 μg at ℓ^{-1}; nitrite ranged from 0.00 to 0.57 μg at ℓ^{-1}; ammonia ranged from 0.60 to 2.57 μg at ℓ^{-1}.

Primary productivity was generally low, ranging from 0.01 to 2.97 mg C $m^{-3} \cdot hr^{-1}$, with the highest occurring at station 24-7 where the chlorophyll *a* concentration was also high.

Inside Prudhoe Bay, small species of the diatom genus *Chaetoceros*, especially *Ch. furcellatus*, were dominant. Pennate diatoms, mostly unidentified, were also present, but usually not in large numbers. At station 33, slightly north of Gull Island, at 15 m, small flagellates were abundant along with *Chaetoceros* spp. Small flagellates were also abundant at the surface at station 30. Ciliates were abundant at stations 6, 14, 15, 16, 23, 24, and 31, probably grazing on the phytoplankton.

B. USCGC *Glacier*

1. Hydrography

Hydrographic data for stations taken in the Chukchi and Beaufort Seas are given in Table 5. Temperature and salinity depth profiles are plotted in Fig. 4. Bering Sea water, indicated by higher temperatures, can be seen at 10 to 20 m at stations 13, 21, 23, 24, 26, 27, and possibly 20. The presence of Bering Sea water in the Beaufort Sea is important when discussing distribution patterns of phytoplankton and zooplankton.

2. Primary productivity and chlorophyll *a*

Primary productivity and chlorophyll *a* values are listed in Table 5, and depth profiles are shown in Fig. 4. Integrated values for carbon assimilation, chlorophyll *a*, and phaeophytin are given in Figs. 5 to 10. In general, high chlorophyll *a* concentrations were found at the same depths as high primary productivity. High productivity and high phytoplankton cell counts did not always occur at the same depth. The same species were usually abundant at the depth of greatest primary productivity with the exceptions of stations 23 and 24. At these stations, highest productivity occurred at 15 m in Bering Sea water where *Leptocylindrus minimus* Gran and *Nitzschia closterium* (Ehrb.) W. Smith were the most abundant species.

Relatively high production and chlorophyll *a* concentrations were found in the Prudhoe Bay area (stations 15, 17, and 18) except at the surface where small flagellates comprised about 75% of the population. Primary productivity was generally < 1 mg C $m^{-3} \cdot hr^{-1}$ at stations and depths where flagellates were the most abundant.

Table 5. Hydrographic data for OCS stations taken during Aug-Sep 1976, USCGC *Glacier*, in the Chukchi and Beaufort Seas

Sta No	Date (1976) (GMT)	Time (GMT)	Latitude (N)	Longitude (W)	Sonic Depth (m)	Sample Depth (m)	S°/₀₀	Temp. (°C)	Chl *a* (mg m^{-3})	Phaeo (mg m^{-3})	Primary Prod. (mg C $m^{-3} \cdot hr^{-1}$)
01	09 Aug	0635	70°54.0'	160°04.0'	54	000	28.54	0.93	0.17	0.03	0.170
						005	30.09	-0.33	0.14	0.32	1.603
						010	31.82	-1.32	0.95	0.19	--
						015	32.15	-1.72	1.94	0.12	6.793
						020	32.25	-1.85	5.96	0.09	5.135
						025	32.67	-1.72	0.63	0.25	2.835
						030	32.97	-1.25	3.19	0.28	0.610
						045	33.01	-1.27	0.70	0.34	0.426
02	No hydrographic station										
03	09 Aug	2300	70°43.0'	160°40.0'	20	000	29.27	2.06	0.18	0.04	0.068
						005	29.25	1.96	0.12	0.04	0.113
						010	29.20	1.95	0.16	0.04	0.076
						015	31.65	-1.17	0.18	0.09	0.180
						020	32.49	-1.47	0.83	0.38	0.715
						035	32.93	-1.19	0.29	0.22	0.452
04	10 Aug	1800	70° .0'	162°09.0'	40	000	29.88	3.97	0.19	0.04	0.105
						005	29.90	4.04	0.16	0.03	0.096
						010	29.91	3.90	0.16	0.04	0.120
						015	31.57	3.01	0.30	0.05	0.436
						020	31.86	0.66	0.22	0.05	0.580
						025	32.63	-0.57	0.66	0.27	0.698
						035	32.59	MALF	0.48	0.25	0.425

Table 5. (continued)

Sta No	Date (1976) (GMT)	Time (GMT)	Latitude (N)	Longitude (W)	Sonic Depth (m)	Sample Depth (m)	S°/oo	Temp. (°C)	Chl *a* (mg m^{-3})	Phaeo (mg m^{-3})	Primary Prod. (mg C $m^{-3} \cdot hr^{-1}$)
05	11 Aug	1453	70°47.0'	162°14.0'	36	000	29.19	5.02	0.18	0.02	0.131
						005	29.42	4.77	0.23	0.02	0.139
						010	29.98	3.78	0.20	0.06	0.244
						015	30.94	1.94	0.25	0.09	0.251
						020	32.16	-0.20	0.41	0.19	0.266
						025	32.49	-0.85	0.49	0.28	0.471
						030	32.66	-1.07	0.71	0.54	0.488
						035	32.64	-1.04	0.66	0.44	0.589
06	11 Aug	2308	70°39.0'	162°16.0'	36	000	32.48	4.78	0.22	0.03	0.154
						005	32.48	5.45	0.31	0.04	0.189
						010	32.28	5.91	0.24	0.03	0.210
						015	32.23	1.65	0.26	0.05	0.239
						020	32.06	0.12	1.69	0.38	1.721
						025	31.00	-0.84	2.59	0.34	3.012
						030	30.90	-1.03	0.47	0.29	0.615
						035	29.66	-1.00	0.57	0.42	0.647
07	12 Aug	1510	70°28.0'	163°26.0'	40	000	30.30	4.82	0.27	0.03	0.172
						005	30.27	4.82	0.26	0.03	0.226
						010	30.32	4.90	0.17	0.32	0.148
						015 no	sample	4.81			
						020	30.62	5.01	0.22	0.02	0.128
						025	32.44	-0.85	0.94	0.12	1.034
						030	32.44	-0.09	1.34	0.11	1.573
						040	32.44	-0.13	1.64	0.02	1.412
08	13 Aug	0745	70°34.0'	162°50.0'	27	000	29.34	3.78	0.23	0.04	0.111
						005	29.57	2.95	0.18	0.03	0.129
						010	no sample				
						015	30.74	-0.09	0.25	0.04	0.205

Table 5. (continued)

Sta No	Date (1976) (GMT)	Time (GMT)	Latitude (N)	Longitude (W)	Sonic Depth (m)	Sample Depth (m)	S°/∘∘	Temp. (°C)	Chl *a* (mg m^{-3})	Phaeo (mg m^{-3})	Primary Prod. (mg C m^{-3}·hr^{-1})
09	14 Aug	1843	71°03.0'	159°17.0'	61	000	29.81	2.08	0.19	0.03	0.082
						005	29.81	1.94	0.17	0.03	0.038
						010	31.73	-1.08	0.20	0.07	0.090
						015	32.67	-1.33	8.00	0.32	4.528
						020	32.79	-1.29	2.71	0.22	1.990
						025	32.81	-1.28	3.00	0.17	1.684
						035	32.71	-1.27	2.55	0.17	1.484
						055	32.77	-1.26	2.49	0.30	1.605
10	15 Aug	1843	71°16.0'	157°43.0'	70	000	29.10	2.42	0.24	0.04	0.144
						005	29.42	2.20	0.28	0.03	0.284
						010	30.68	-1.08	0.81	0.18	0.942
						015	32.67	-1.24	2.69	0.21	2.022
						020	32.70	-1.26	2.54	0.44	2.954
						025	32.70	-1.25	3.43	0.24	2.762
						045	no sample	-1.33			
						065	32.94	-1.47	3.30	0.14	2.527
11	16 Aug	1538	71°25.5'	156°54.8'	106	000	28.57	3.26	0.37	0.07	0.375
						005	28.76	2.54	0.33	0.05	0.397
						010	28.90	2.26	0.29	0.06	0.394
						015	32.51	-1.38	14.20	0.28	0.955
						025	32.74	-1.32	1.72	0.18	1.557
						050	32.79	-1.38	1.99	0.24	1.742
						075	32.94	-1.51	2.38	0.25	1.697
						100	33.03	-1.58	2.65	0.38	1.912

Table 5. (continued)

Sta No	Date (1976)	Time (GMT)	Latitude (N)	Longitude (W)	Sonic Depth (m)	Sample Depth (m)	S°/∘∘	Temp. (°C)	Chl *a* (mg m^{-3})	Phaeo (mg m^{-3})	Primary Prod. (mgC $m^{-3}\cdot hr^{-1}$)
12	17 Aug	1545	71°31.5'	156°09.0'	139	000	29.09	3.23	0.31	0.04	0.145
						005	29.06	3.23	0.27	0.02	0.198
						010	29.25	3.46	0.31	0.04	0.163
						015	29.64	2.54	0.54	0.23	0.447
						025	31.88	-0.72	0.56	0.19	0.448
						050	32.67	-1.33	3.10	0.25	2.812
						075	32.69	-1.29	2.90	0.40	1.753
						100	32.74	-1.34	2.60	0.37	1.812
13	18 Aug	1555	71°31.0'	155°05.0'	31	000	15.35	1.03	0.62	0.09	0.359
						005	28.22	2.54	0.49	0.10	0.516
						010	29.44	2.82	0.59	0.13	0.427
						015	29.63	2.53	0.51	0.08	0.544
						020	29.90	2.09	0.54	0.10	0.538
						025	30.56	0.72	0.47	0.10	0.622
14	21 Aug	0100	71°11.0'	153°09.0'	25	000	07.84	1.78	0.29	0.06	0.164
						005	27.72	-0.80	0.81	0.02	0.550
						010	29.67	-0.67	0.18	0.06	0.070
						015	31.29	-0.67	0.15	0.11	0.094
						020	31.46	-0.87	0.12	0.12	0.066
15	24 Aug	0053	70°36.0'	148°12.0'	16	000	10.04	-0.21	0.32	0.03	0.224
						005	28.48	-0.91	5.07	0.18	4.362
						010	28.23	-1.41	5.20	0.08	3.936
						015	30.32	-1.43	5.38	0.14	4.198
16	No hydrographic data										

Table 5. (continued)

Sta No	Date (1976) (GMT)	Time (GMT)	Latitude (N)	Longitude (W)	Sonic Depth (m)	Sample Depth (m)	S°/°°	Temp. (°C)	Chl *a* ($mg\ m^{-3}$)	Phaeo ($mg\ m^{-3}$)	Primary Prod. ($mgC\ m^{-3} \cdot hr^{-1}$)
17	26 Aug	0518	70°32.0'	147°33.0'	25	000	06.02	-1.34	0.48	0.06	0.194
						005	28.88	-1.56	3.22	0.51	4.334
						010	30.06	-1.48	3.80	0.25	5.979
						015	30.72	-1.54	2.93	0.36	3.400
						020	31.72	0.67	1.64	0.18	1.672
18	26 Aug	1808	70°39.0'	147°37.0'	25	000	05.05	0.33	0.36	0.05	0.094
						005	25.90	-0.84	2.00	0.08	2.364
						010	29.70	-1.56	3.36	0.34	3.947
						015	30.21	-1.60	3.08	0.21	3.366
19A	Salinity at 0 & 20 m only from this station					000	10.75				
						020	31.90				
19B	27 Aug	0900	70°57.0'	149°33.0'	30	000	07.64	0.43	0.43	0.08	0.335
						005	24.63	-1.15	0.71	0.07	0.447
						010	30.01	-1.12	0.38	0.07	0.144
						015	31.44	-1.16	0.23	0.13	0.183
						020	30.43	-1.01	0.32	0.21	0.037
						025	31.62	-1.05	0.20	0.15	0.123
20	28 Aug	2327	71°08.0'	151°19.0'	34	000	19.05	MALF	0.30	0.03	0.098
						005	22.81	0.78	1.76	0.06	0.861
						010	32.25	-1.36	3.90	0.75	2.449
						015	30.73	-0.57	0.50	0.12	0.465
21	30 Aug	0035	71°43.0'	151°47.0'	1700	000	10.18	0.28	0.18	0.03	0.095
						005	25.63	-0.98	0.48	0.10	0.356
						010	28.06	-1.02	0.65	0.02	0.493
						015	29.54	-0.96	0.53	0.04	0.377
						020	30.04	0.54	0.74	0.10	0.718
						025	30.58	0.53	0.63	0.03	0.375

Table 5. (continued)

Sta No	Date (1976) (GMT)	Time (GMT)	Latitude (N)	Longitude (W)	Sonic Depth (m)	Sample Depth (m)	S°/₀₀	Temp. (°C)	Chl a (mg m^{-3})	Phaeo (mg m^{-3})	Primary Prod. (mg C $m^{-3} \cdot hr^{-1}$)
21 (cont.)	29 Aug	2355	71°43.0'	151°47.0'	1700	030	30.85	MALF	0.22	0.03	0.131
						040	31.33	-0.12	0.25	0.10	0.174
						050	32.04	-0.77	0.24	0.18	0.134
						060	32.44	-1.19	0.39	0.26	
						075	32.62	-1.30	0.39	0.25	0.119
						100	32.74	-1.49	0.62	0.20	0.318
	29 Aug	2300				500	no sample	0.33			
						510	34.79	0.34	0.11	0.14	
						700	34.84	0.05	0.35	0.30	
						800	34.84	-0.04	0.09	0.11	
						900	34.85	-0.09	0.19	0.30	
						1000	34.85	-0.18	0.18	0.28	
22	No hydrographic data										
23	31 Aug	0112	71°22.0'	152°20.0'	75	000	15.71	0.54	0.53	0.04	0.232
						005	25.52	1.45	0.67	0.08	0.318
						010	27.43	1.91	0.83	0.06	0.599
						015	28.84	2.67	1.98	0.83	0.756
						020	30.98	0.92	0.41	0.09	0.315
						025	31.25	0.52	0.38	0.11	0.271
						030	24.05	1.33	0.73	0.14	0.363
						040	28.34	2.34	1.00	0.06	0.972
						050	31.10	-0.12	0.36	0.12	0.250
						060	31.59	-0.66	0.27	0.13	0.166
						075	32.22	-0.94	0.77	0.35	0.546

Table 5. (continued)

Sta No	Date (1976) (GMT)	Time (GMT)	Latitude (N)	Longitude (W)	Sonic Depth (m)	Sample Depth (m)	S°/∘∘	Temp. (°C)	Chl *a* (mg m^{-3})	Phaeo (mg m^{-3})	Primary Prod. (mg C $m^{-3} \cdot hr^{-1}$)
24	31 Aug	1715	71°19.0'	152°32.0'	52	000	17.36	0.27	0.58	0.07	0.233
						005	25.83	1.68	0.75	0.09	0.422
						010	27.87	3.18	0.89	0.12	0.583
						015	28.55	2.78	1.03	0.09	0.767
						020	29.42	2.32	0.74	0.06	0.527
						025	30.09	1.91	0.49	0.05	0.364
						030	30.60	2.05	0.34	0.07	0.217
						045	31.47	-0.30	0.46	0.16	0.206
25	01 Sep	1625	71°08.0'	152°57.0'	22	000	20.47	1.79	0.19	0.03	0.123
						005	26.24	-0.26	0.47	0.07	0.353
						010	28.99	-0.41	2.20	0.60	2.250
						015	30.09	0.30	1.08	0.14	0.734
26	02 Sep	1420	71°23.0'	154°21.0'	30	000	17.40	1.15	0.22	0.03	0.063
						005	25.27	0.19*	0.44	0.08	0.286
						010	27.55	2.95	0.69	0.10	0.380
						015	28.77	2.73	0.62	0.09	0.479
						020	29.15	2.15	0.66	0.09	0.372
						025	29.38	2.13	0.36	0.06	0.168
27	02 Sep	2158	71°36.0'	155°32.0'	171	000	08.35	0.14	1.00	0.20	0.298
						005	25.79	2.31	0.54	0.05	0.315
						010	27.73	2.12	0.46	0.05	0.344
						015	28.48	-0.67	0.53	0.04	0.299
						020	31.05	-1.34	1.28	0.01	1.240
						025	31.92	0.23	0.69	0.12	0.361
						030	32.00	0.19	0.51	0.15	0.334

* One thermometer malfunctioned; this temperature based on only one thermometer.

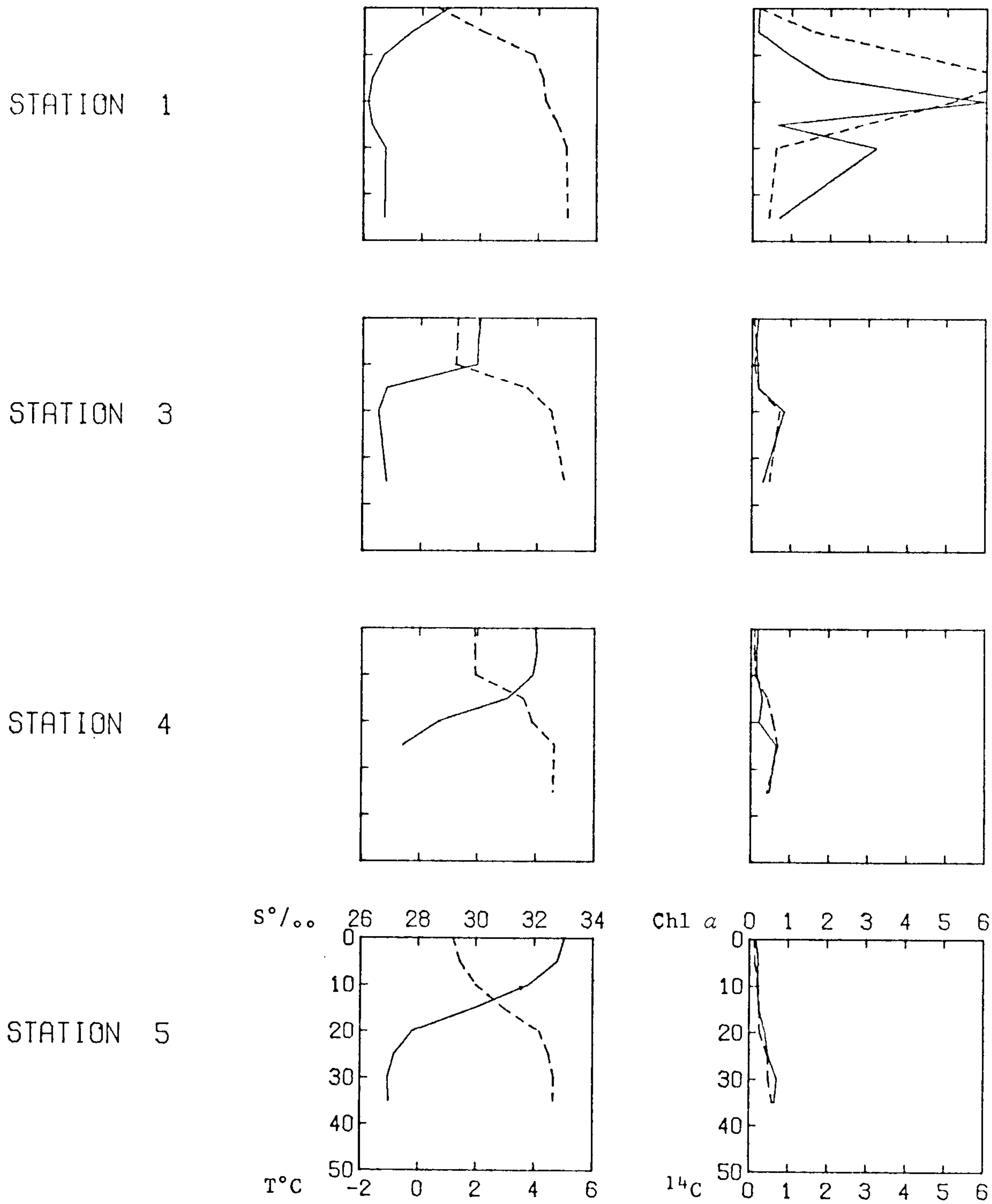

Fig. 4. Depth profiles of temperature-salinity and chlorophyll *a*-^{14}C assimilation in the Chukchi and Beaufort seas, Aug-Sep 1976. Salinity ---; temperature ——; chl *a*, mg m^{-3} ——; ^{14}C assimilation, mg C $m^{-3} \cdot hr^{-1}$ ---.

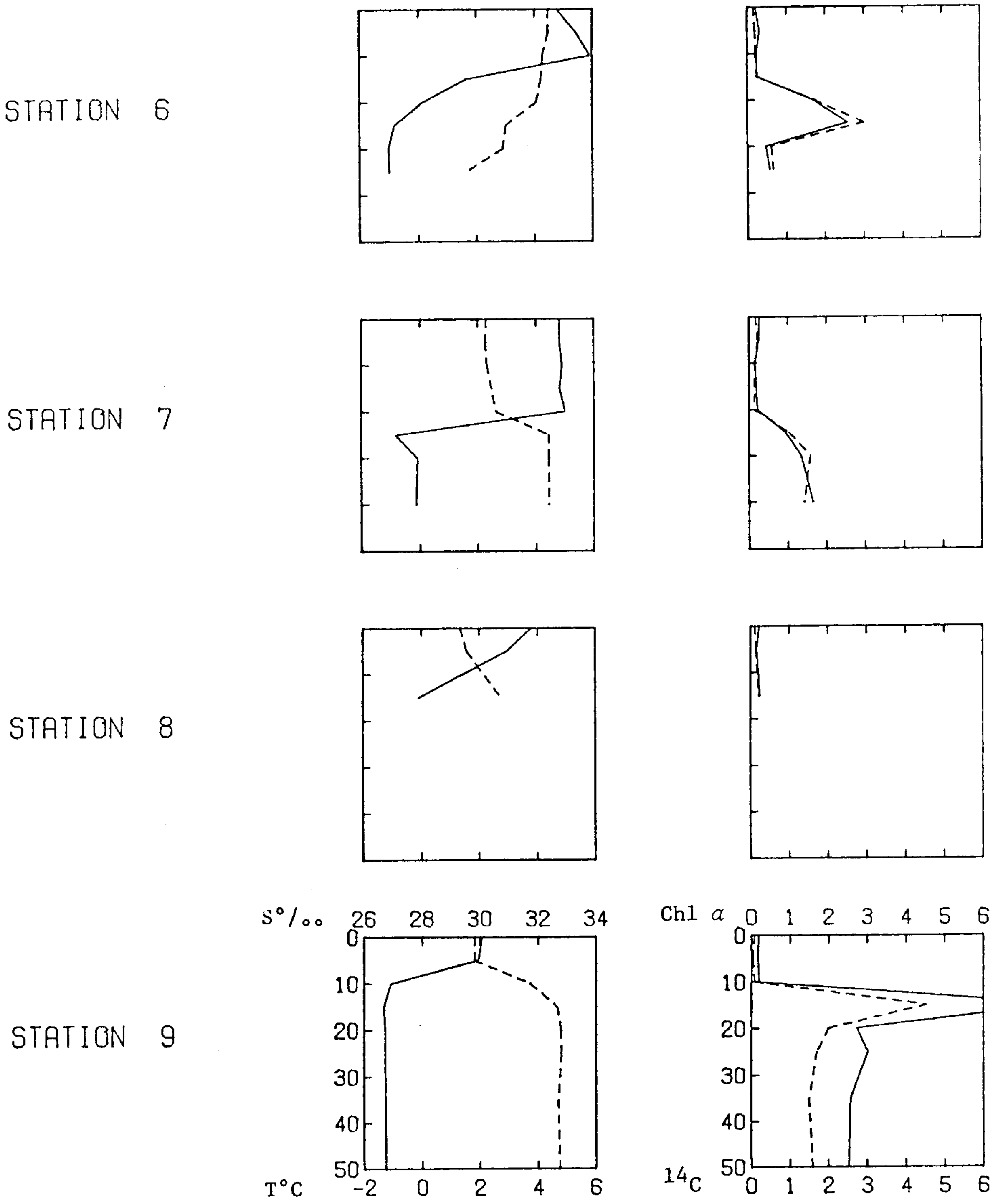

Fig. 4. (continued)

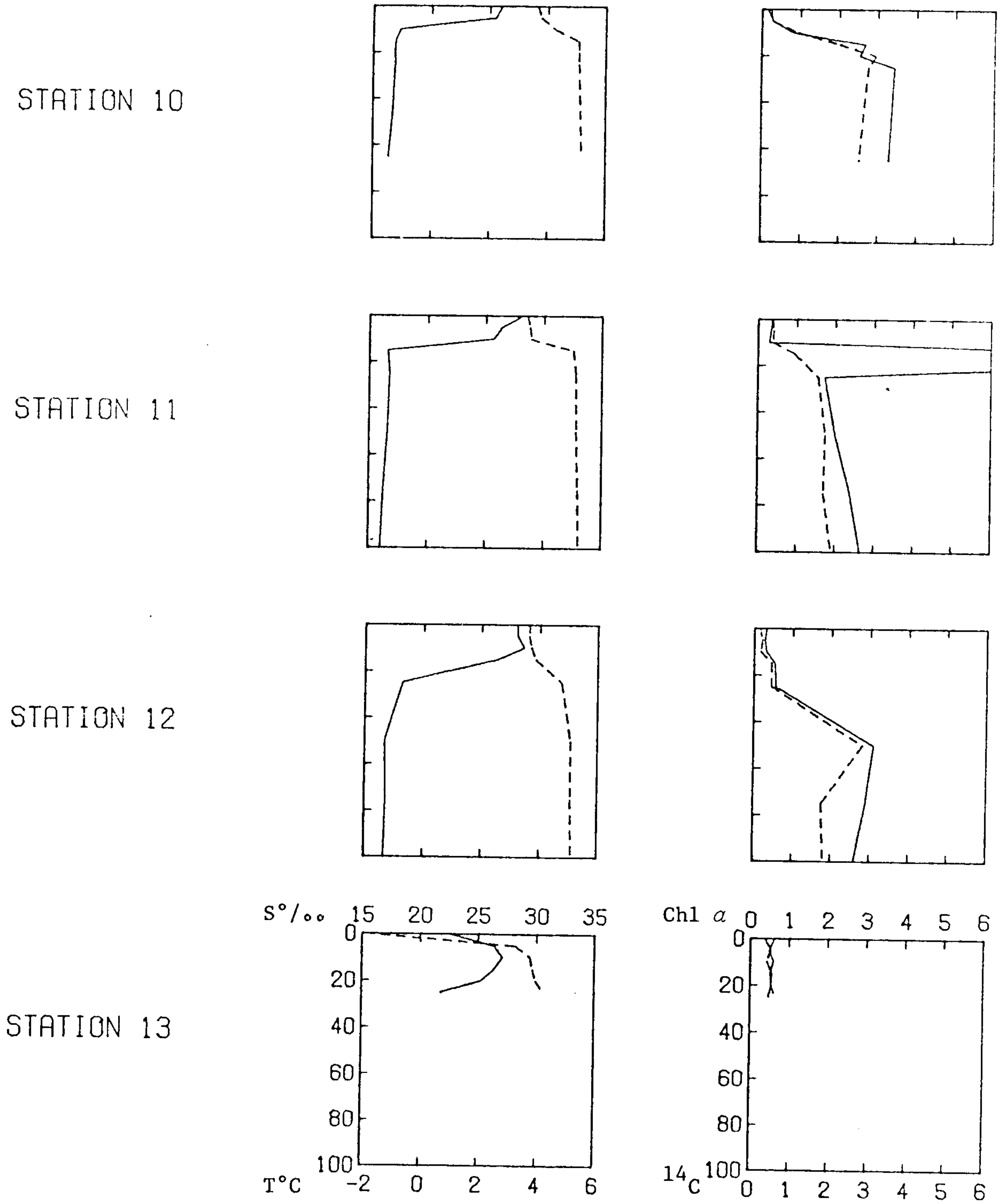

Fig. 4. (continued)

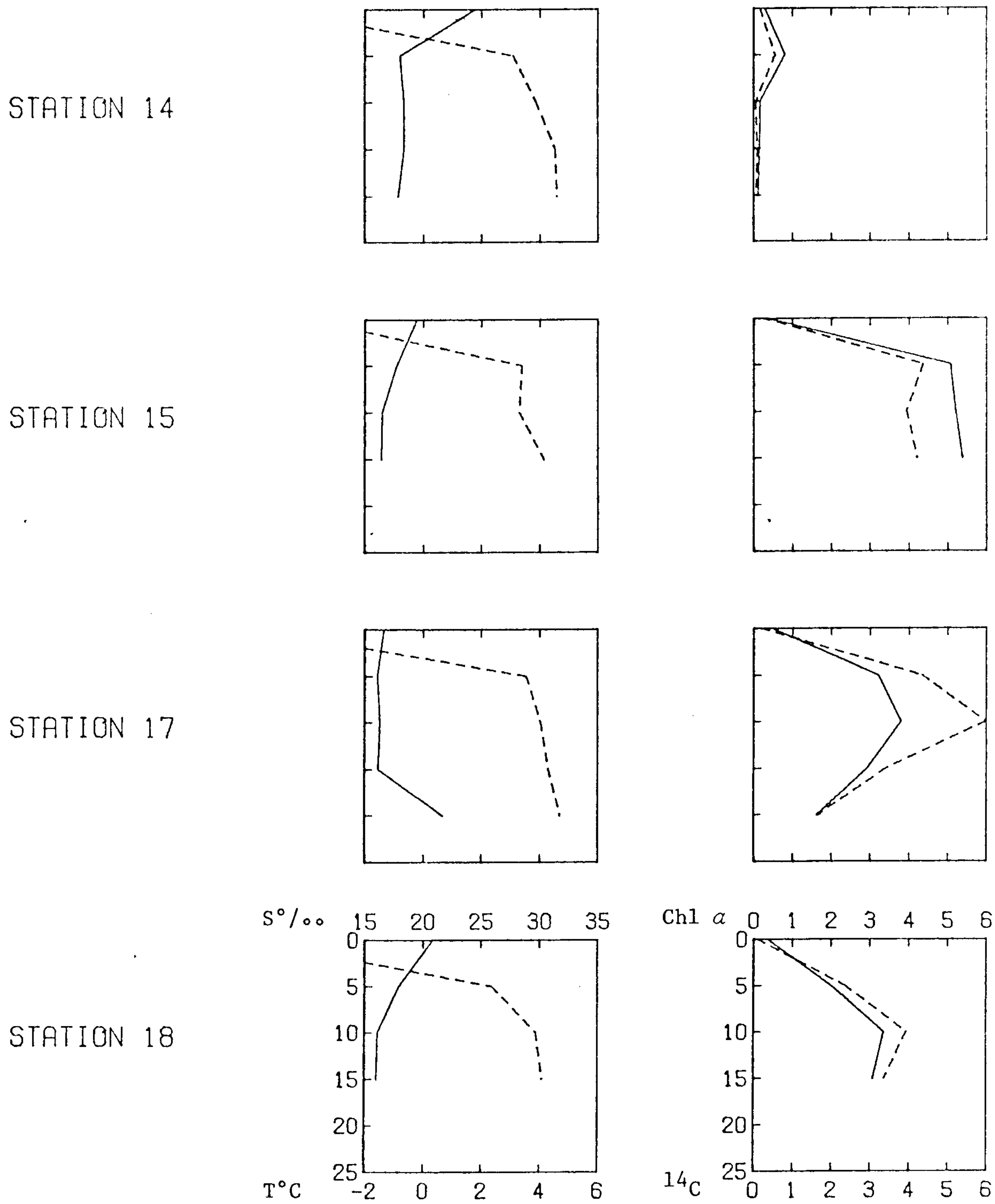

Fig. 4. (continued)

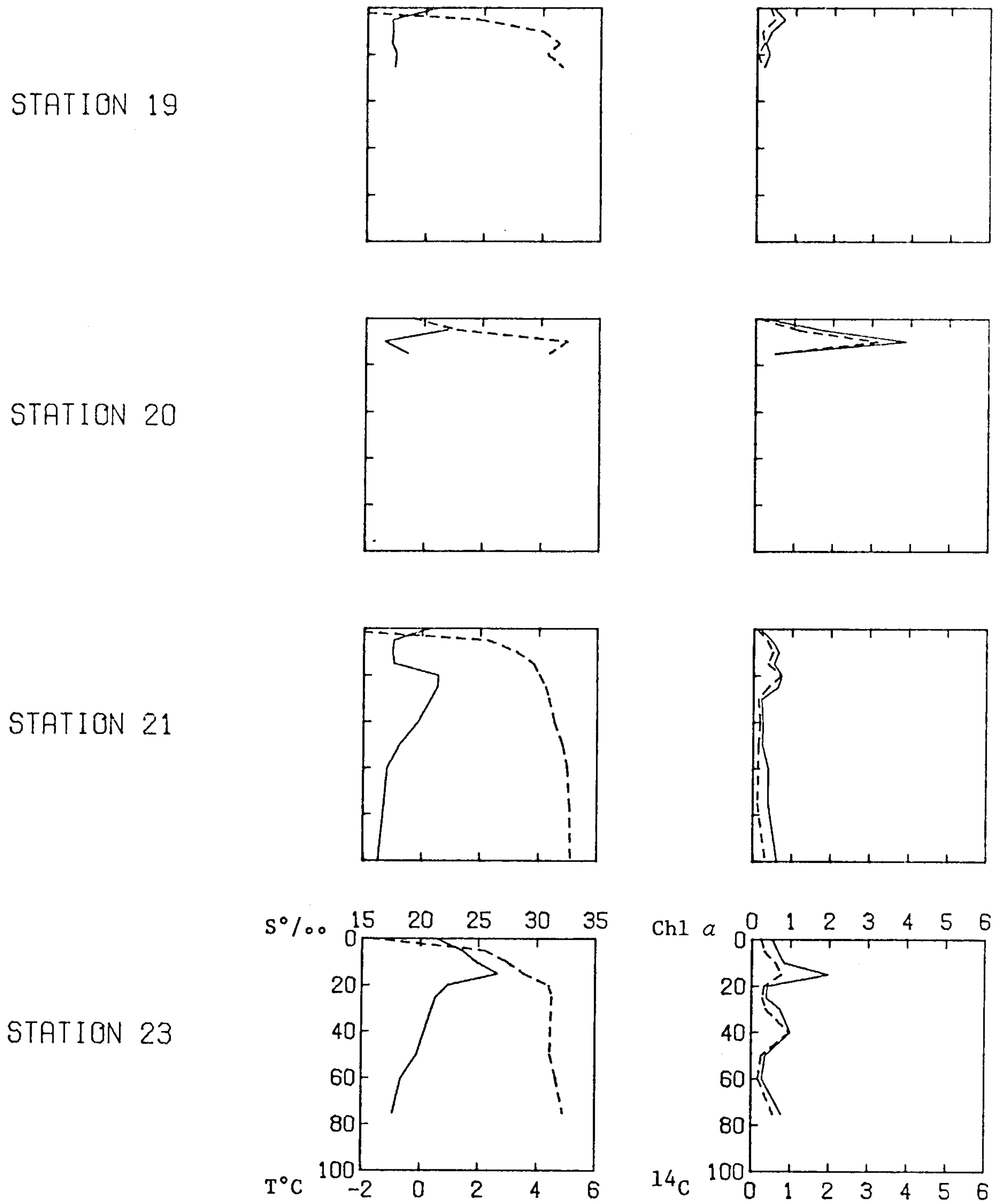

Fig. 4. (continued)

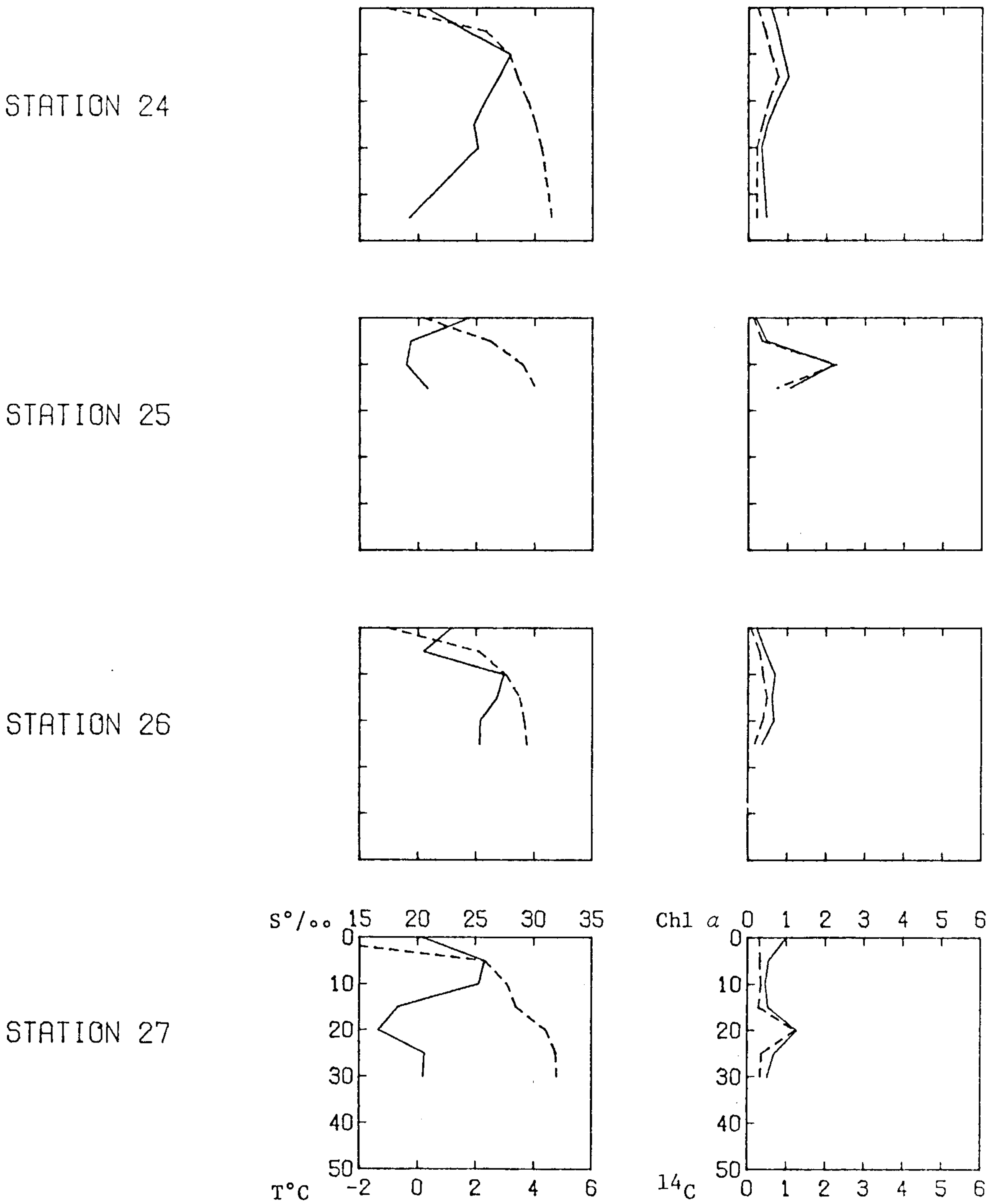

Fig. 4. (continued)

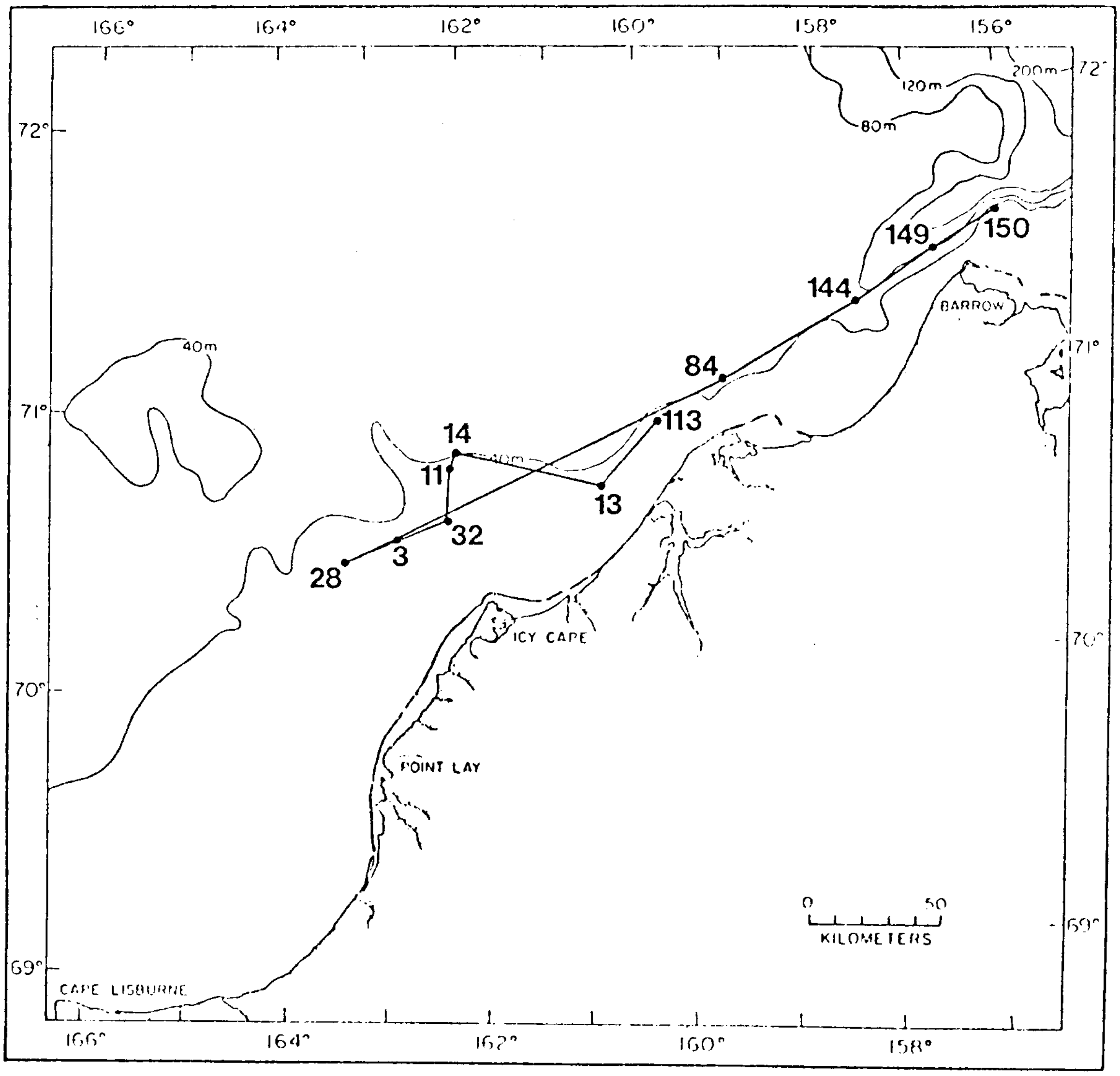

Fig. 5. Integrated ^{14}C uptake (mg C $m^{-2} \cdot hr^{-1}$), Chukchi Sea stations, Aug 1976.

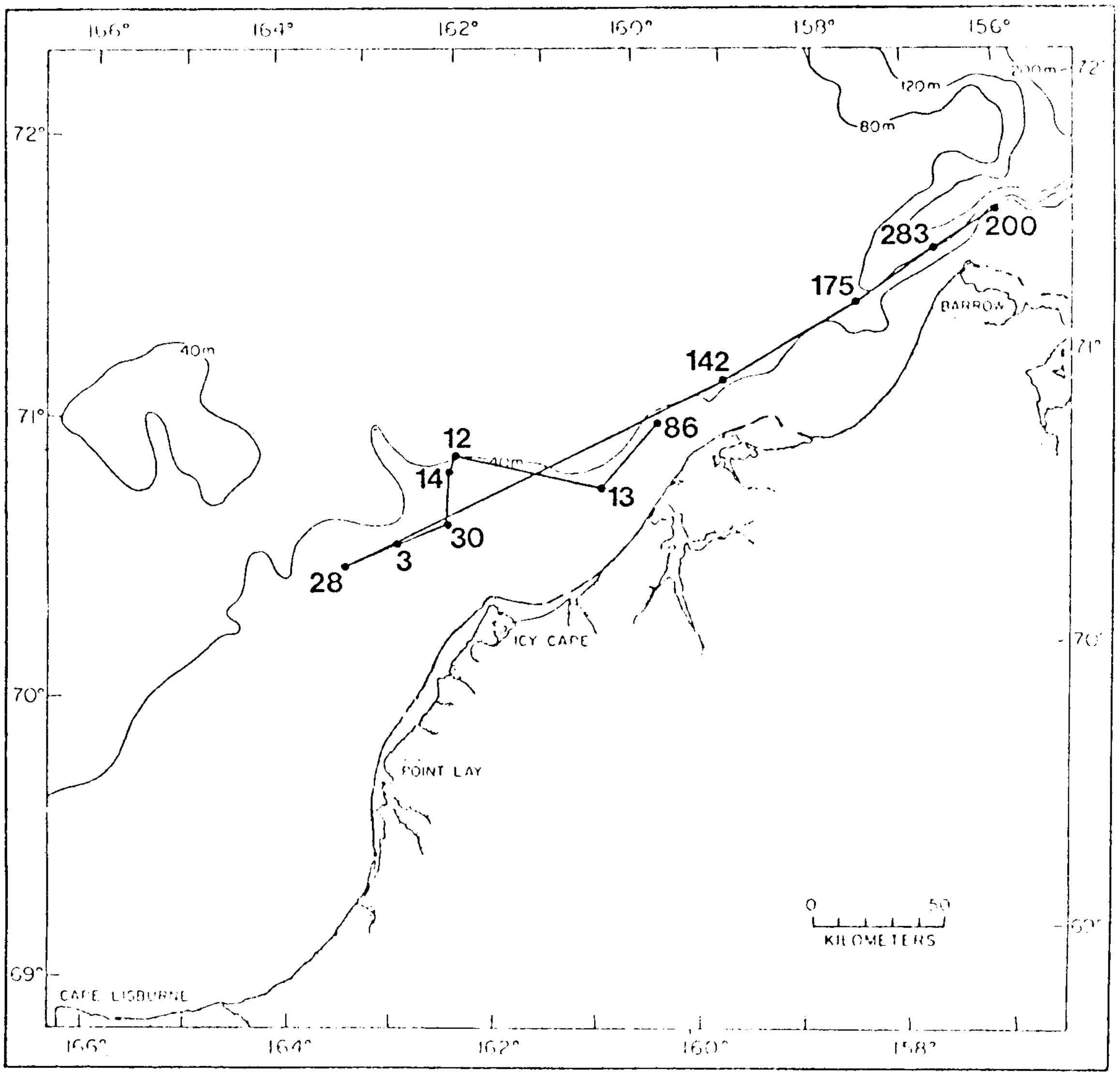

Fig. 6 . Integrated chlorophyll *a* concentrations (mg m^{-2}), Chukchi Sea stations, Aug 1976.

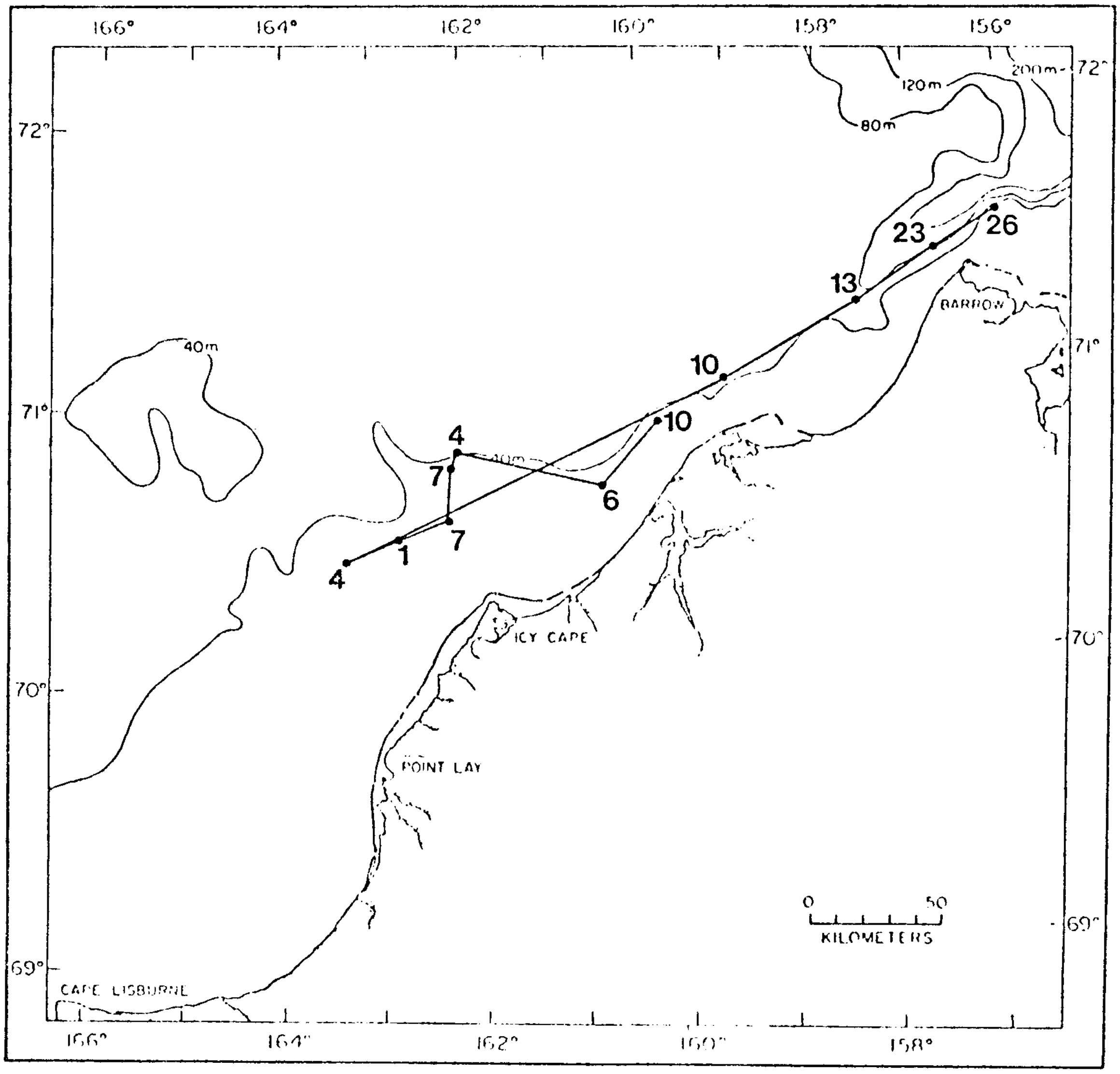

Fig. 7. Integrated phaeophytin concentrations (mg m^{-2}), Chukchi Sea stations, Aug-Sep 1976.

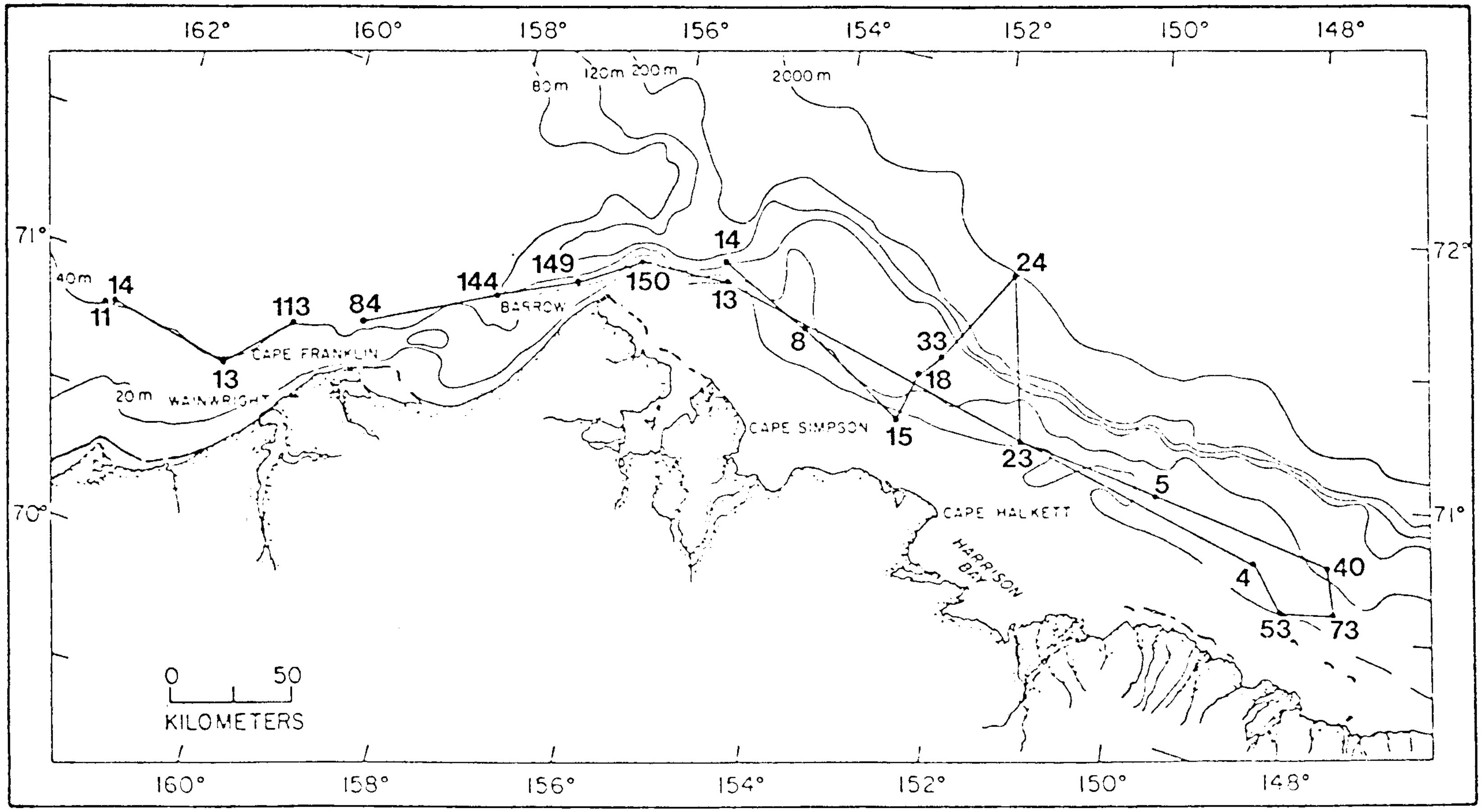

Fig. 8. Integrated ^{14}C uptake (mg C $m^{-2} \cdot hr^{-1}$), Beaufort Sea stations, Aug-Sep 1976.

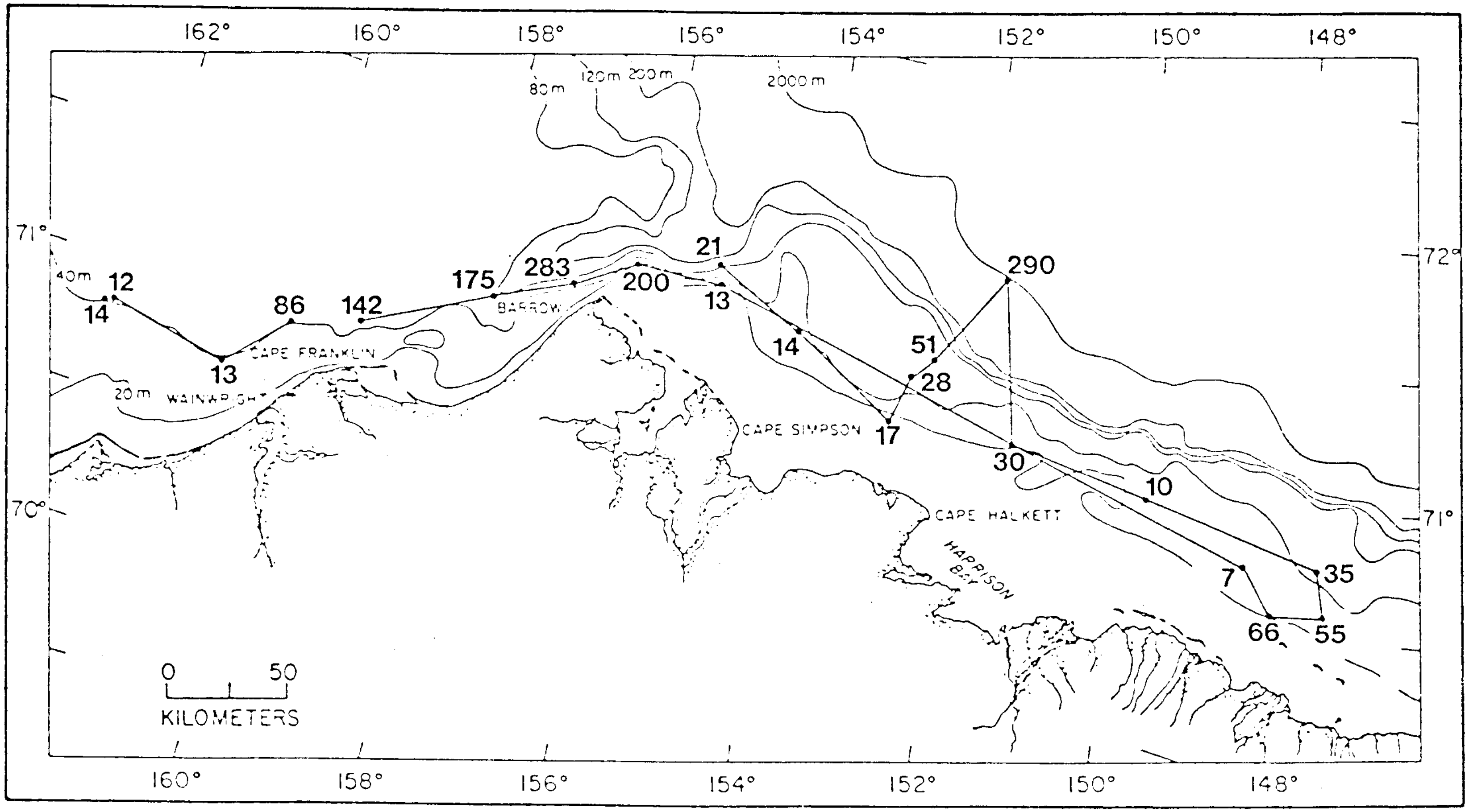

Fig. 9. Integrated chlorophyll *a* concentrations (mg m^{-2}), Beaufort Sea stations, Aug-Sep 1976.

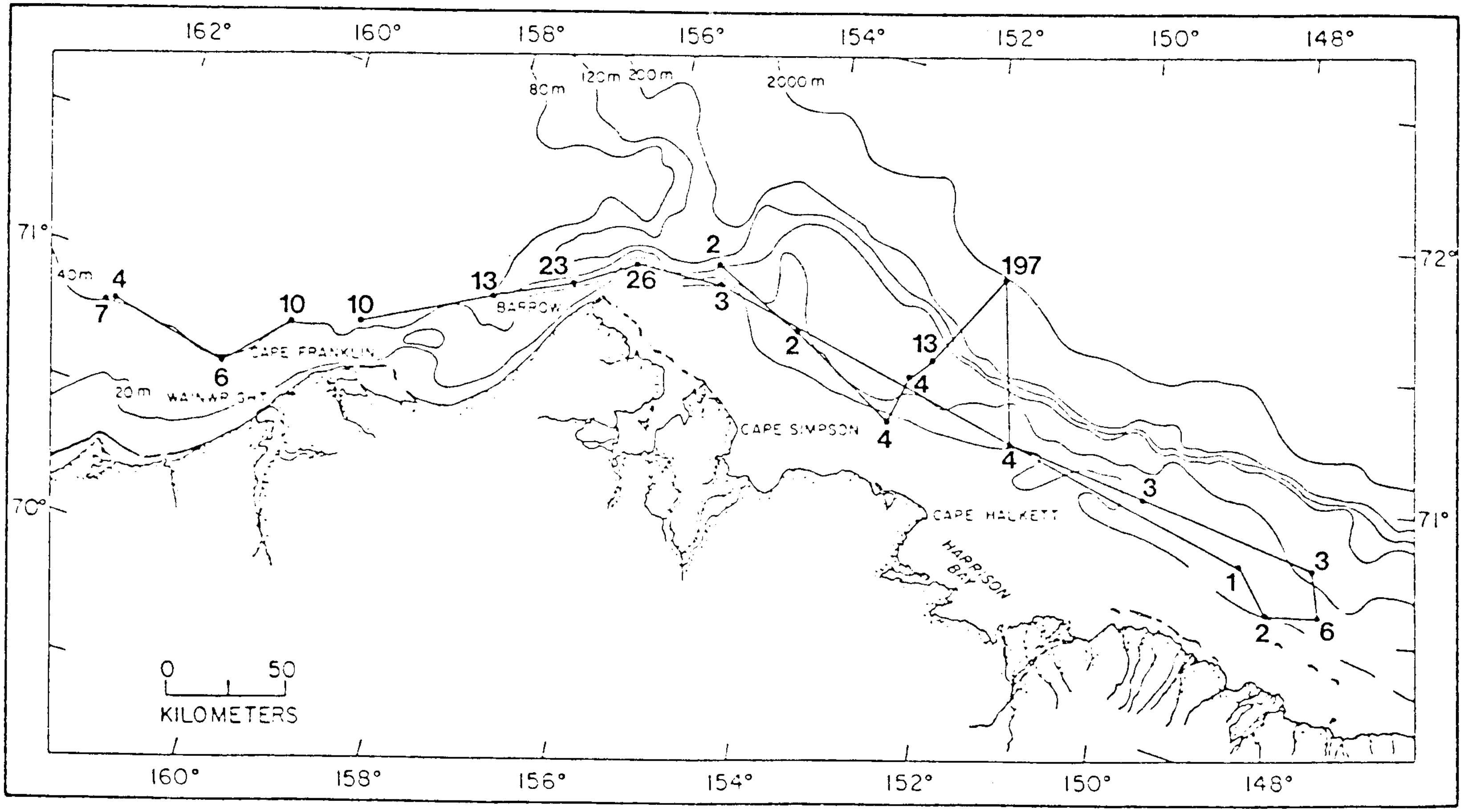

Fig. 10. Integrated phaeophytin concentrations (mg m^{-2}), Beaufort Sea stations, Aug-Sep 1976.

3. Phytoplankton standing stock

A list of phytoplankton species known to occur in the Beaufort Sea is given in Table 6. Not all of these species were found in the *Glacier*-76 samples, although 75 categories from 6 phyla, including 61 species and 14 other categories including unidentified species and groups of species were present. With the exception of *Leptocylindrus minimus*, all species identified in the *Glacier*-76 samples have previously been reported from the Chukchi and Beaufort seas (Bursa 1963, Horner 1969, Hsiao 1976).

The phytoplankton have been grouped into four major categories based on taxonomic group and abundance in the samples. The percentage of phytoplankton by major category at the depth of greatest carbon uptake at each station is given in Fig. 11 and Table 7. The percentage of phytoplankton by major category by depth for each station is given in Fig. 12 and Table 8. Table 9 lists the number of cells per liter by depth.

Standing stock ranged from *ca.* 1.0×10^5 cells $\cdot \ell^{-1}$ at station 14-20 to 5.0×10^6 cells $\cdot \ell^{-1}$ at station 15-10. Small flagellates were the most abundant organisms at station 14-20, with *ca.* 5.0×10^4 cells cells $\cdot \ell^{-1}$, while *Chaetoceros* spp., with 4.7×10^6 cells $\cdot \ell^{-1}$, was most abundant at station 15-10.

Species of the genus *Chaetoceros* were the most abundant organisms at most stations and were especially numerous below the surface at stations 15, 17, and 18 near Prudhoe Bay. The category *Chaetoceros* spp. includes *Ch. fragilis* Meunier, *Ch. furcellatus*, *Ch. gracilis* Schütt, *Ch. socialis* Lauder, and *Ch. wighami* Brightwell which were not separated in the cell counts (listed on data cards as *Chaetoceros* spp.), along with *Ch. atlanticus* Cleve, *Ch. compressus* Lauder, *Ch. concavicornis* Mangin, *Ch. debilis* Cleve, *Ch. septentrionalis* Østrup, and several other species present in smaller numbers.

At stations 23 and 24, the diatoms *Nitzschia closterium* and *Leptocylindrus minimus* were most abundant in Bering Sea water.

Small flagellates, mostly < 10 μm in diameter, were generally more abundant at western stations and at the surface at the eastern stations (Fig. 12). Where flagellates were abundant, productivity and chlorophyll *a* concentrations were low, suggesting that many of the flagellates were probably not photosynthetic.

Dinoflagellates, while never very abundant, ranged from *ca.* 2.0×10^3 to 61.2×10^3 cells $\cdot \ell^{-1}$, and were always present. They occurred in larger numbers at stations taken toward the end of August and in early September.

4. Zooplankton standing stock

A list of zooplankton species found in the Beaufort Sea is

Table 6. Preliminary list of phytoplankton species in the Beaufort Sea. This list does not include species that are known primarily from the ice or the benthos.

Bacillariophyta

Amphiprora hyperborea

Bacterosira fragilis

Biddulphia aurita

Chaetoceros atlanticus
borealis
ceratosporum
compressus
concavicornis
danicus
debilis
decipiens
fragilis
furcellatus
gracilis
karianus
radicans
septentrionalis
socialis
subsecundus
teres
wighami

Coscinodiscus centralis
curvatulus
excentricus
oculus-iridis

Coscinosira (Thalassiosira) polychorda

Detonula confervacea

Eucampia zoodiacus

Gomphonema sp.

Leptocylindrus danicus
minimus

Melosira arctica
juergensi
moniliformis

Navicula pelagica
transitans
spp.

Nitzschia closterium
delicatissima
frigida
grunowii
seriata
spp.

Porosira glacialis

Rhizosolenia alata
hebatata

Skeletonema costatum

Stauroneis granii

Thalassionema nitzschioides

Thalassiosira antarctica
decipiens
gravida
hyalina
nordenskioeldii
spp.

unidentified diatoms, mostly pennates

Pyrrophyta

Amphidinium cf. *longum*

Ceratium arcticum
longipes

Dinophysis acuta
norvegica
rotundata

Gonyaulax catenata
spinifera
sp.

Gymnodinium lohmanni
spp.

Table 6. (continued)

Oxytoxum spp.

Peridinium belgicum
brevipes
conicum
depressum
groenlandicum
minusculum
pallidum
triquetrum
trochoideum
spp.

Protoceratium reticulatum

unidentified dinoflagellates, mostly athecate

Flagellates

Calycomonas gracilis
ovalis

Craspedomonadaceae

Chroomonas spp.

Cryptomonas spp.

Dinema litorale

Diaphanoeca grandis

Dinobryon balticum
petiolatum

Ebria tripartita

Eutreptiella braarudii

Monosiga marina

Parvicorbicula socialis

Platymonas spp.

Pterosperma spp.

Unknown organisms

Piropsis polita

Polyasterias problematica

Radiospermum corbiferum

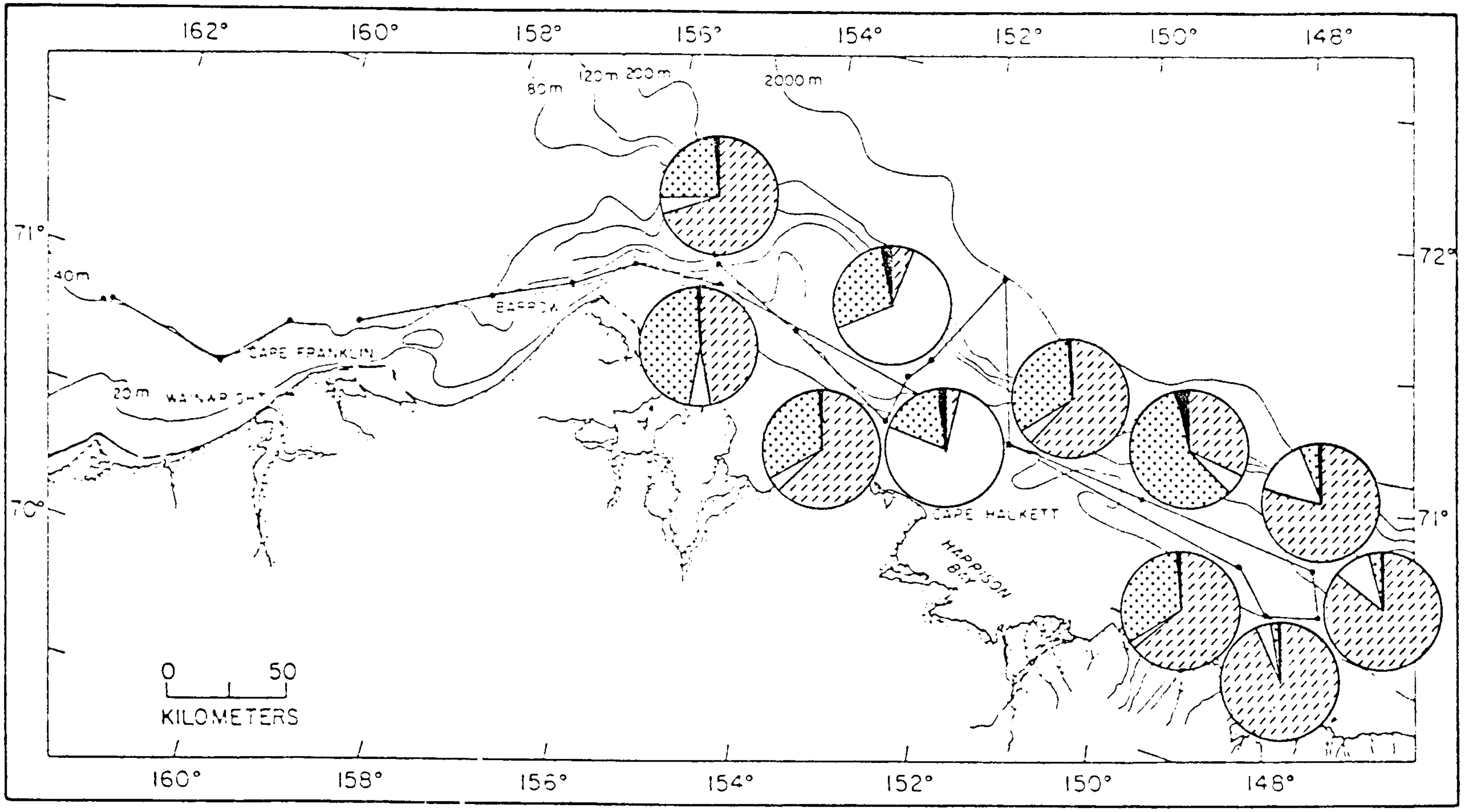

Fig. 11. Per cent *Chaetoceros* species (broken lines), all other diatoms (white), flagellates (stippled), and dinoflagellates (black) at depth of greatest carbon assimilation.

Table 7. Per cent *Chaetoceros* species, all other diatoms, flagellates, and dinoflagellates at depth of greatest carbon uptake

Category / Station Depth	*Chaetoceros* spp.	All other diatoms	Flagellates	Dinoflagellates
13-20	46	6	46	2
14-05	65	2	33	< 1
15-05	93	4	2	< 1
17-10	85	11	4	< 1
18-10	79	15	6	< 1
19-05	32	6	59	4
20-10	62	4	33	< 1
23-15	6	63	28	3
24-15	4	78	16	2
25-10	63	4	32	1
27-10	71	5	24	1

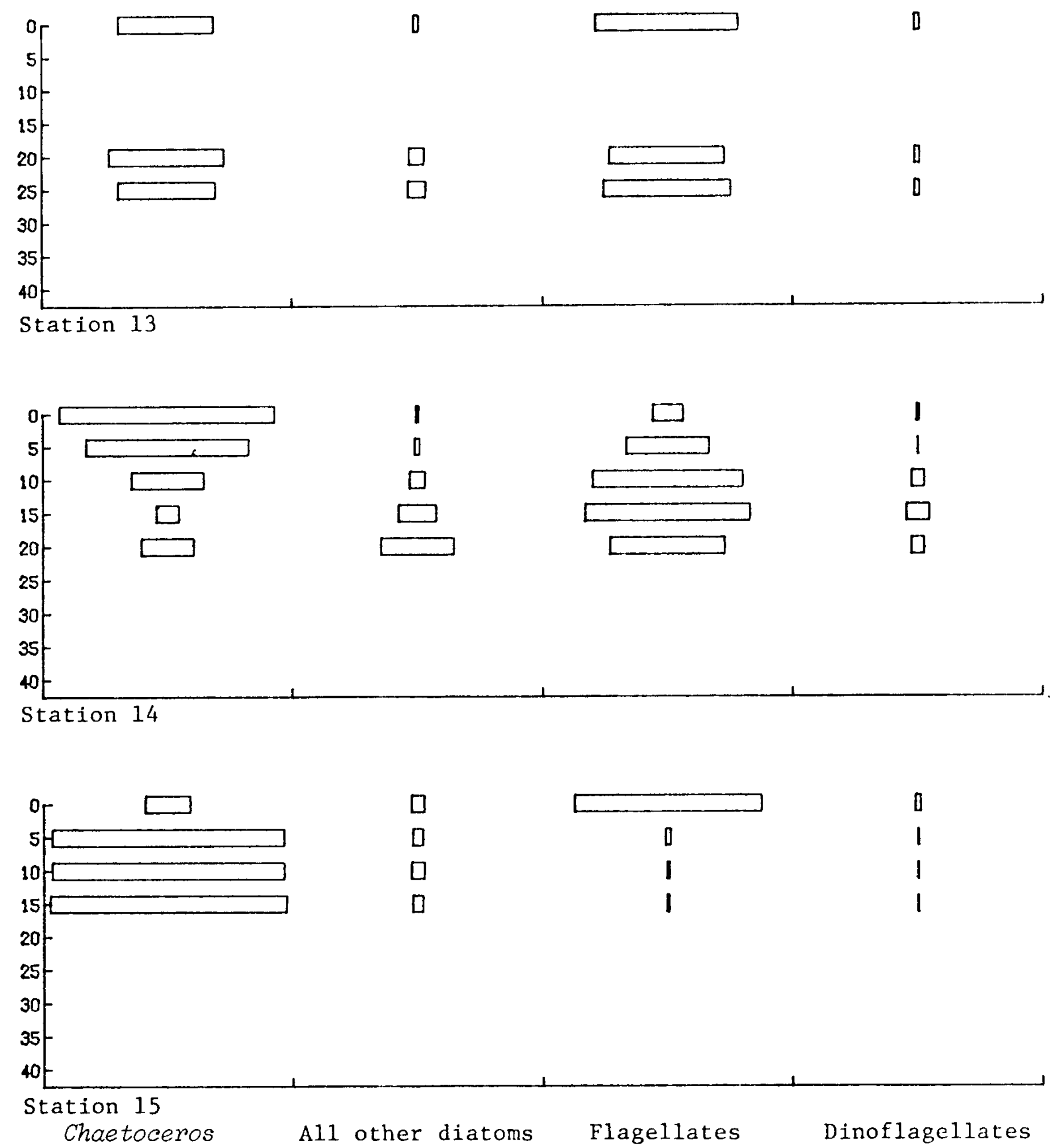

Fig. 12. Percentage of phytoplankton by major category by depth for each station. Blanks indicate depths where samples were not analyzed. Percentages add up to 100% running from left to right across the diagram.

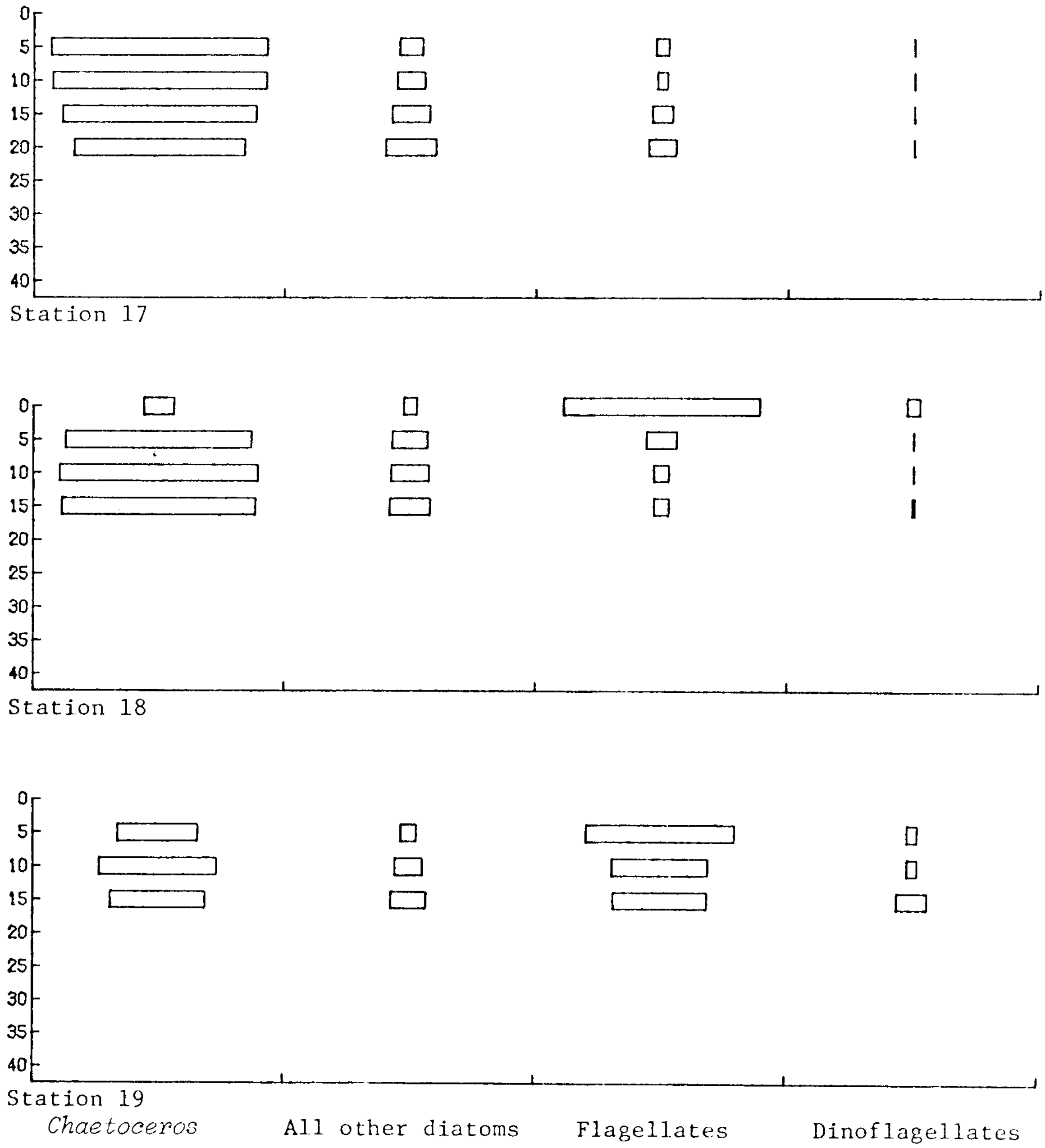

Fig. 12. (continued)

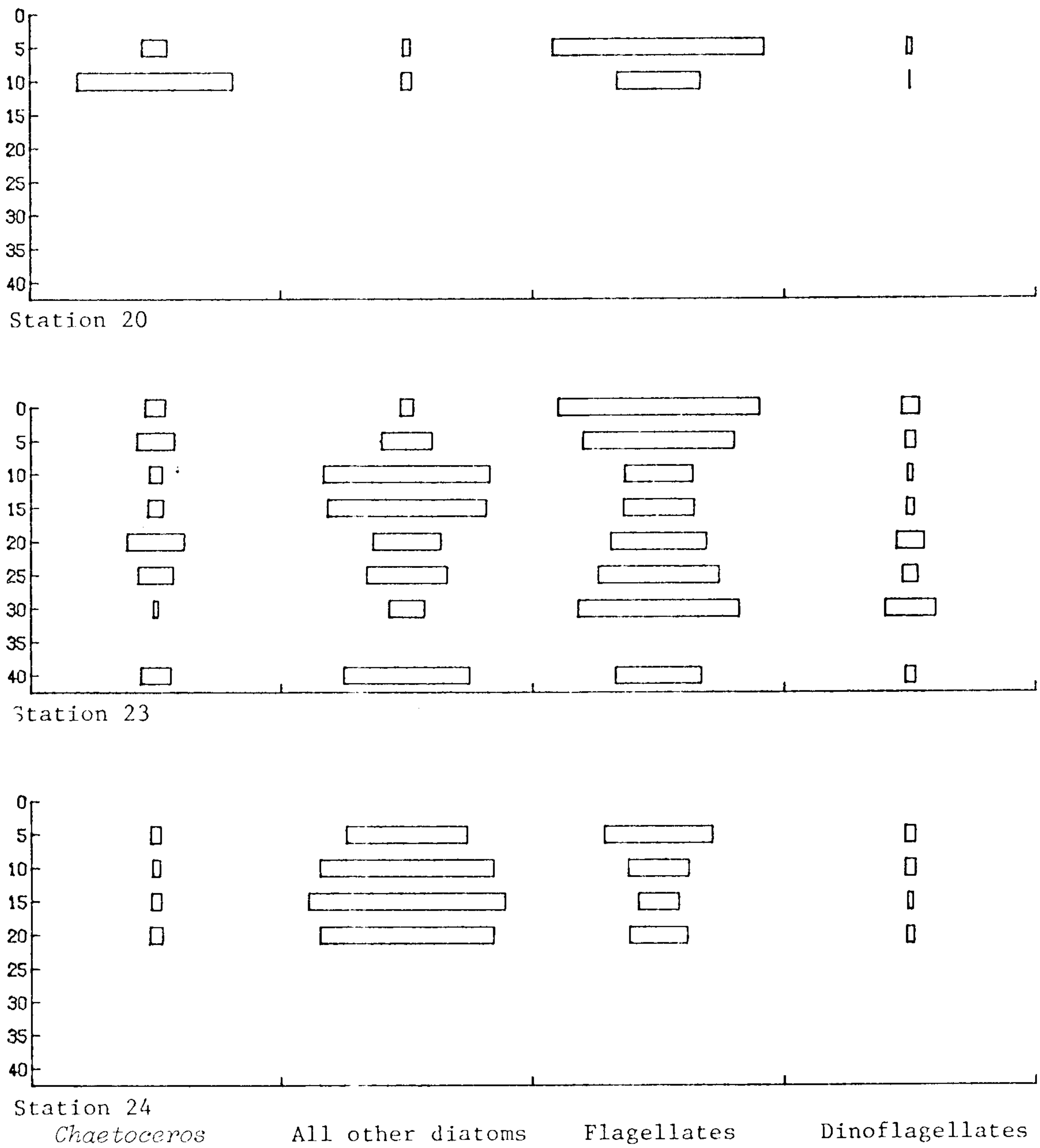

Fig. 12. (continued)

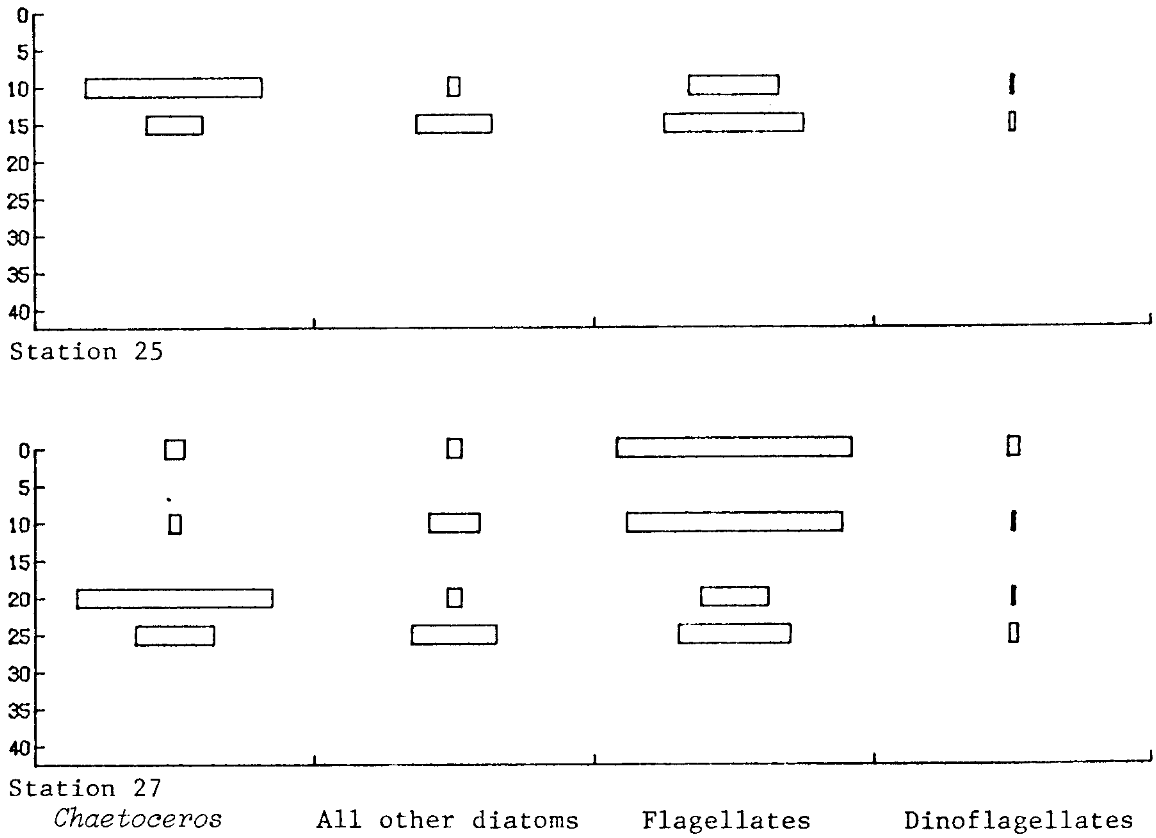

Fig. 12. (continued)

Table 8. Percentage of phytoplankton by major category for the upper 40 m. Where no number is present, the sample was not analyzed.

Station Number	Depth	*Chaetoceros*	All other diatoms	Flagellates	Dino-flagellates
		(Per Cent)			
13	00	38	2	57	2
	05				
	10				
	15				
	20	46	6	46	2
	25	39	7	51	2
14	00	86	1	12	1
	05	65	2	33	< 1
	10	29	6	60	5
	15	9	15	66	9
	20	21	29	46	5
15	00	18	5	75	2
	05	93	4	2	< 1
	10	93	5	1	< 1
	15	95	4	1	< 1
17	00				
	05	86	9	5	< 1
	10	85	11	4	< 1
	15	77	15	8	< 1
	20	68	20	11	< 1
18	00	12	5	78	5
	05	74	14	12	< 1
	10	79	15	6	< 1
	15	77	16	6	1
19	00				
	05	32	6	59	4
	10	47	11	38	4
	15	38	14	37	12
	20				
	25				
20	00				
	05	10	3	84	2
	10	62	4	33	< 1
	15				

Table 8. (continued)

Station Number	Depth	*Chaetoceros*	All other diatoms	Flagellates	Dino-flagellates
		(Per Cent)			
23	00	8	8	80	7
	05	15	20	60	4
	10	5	66	27	2
	15	6	63	28	3
	20	23	27	38	11
	25	14	32	48	6
	30	2	14	64	20
	40	12	50	34	4
24	00				
	05	4	48	43	4
	10	3	69	24	4
	15	4	78	16	2
	20	5	69	23	3
	25				
	30				
	45				
25	00				
	05				
	10	63	4	32	1
	15	20	27	50	2
27	00	7	5	84	4
	05				
	10	4	18	77	1
	15				
	20	71	5	24	1
	25	28	30	40	3
	30				

Table 9. Total number of phytoplankton cells by major category for the upper 40 m. Where no number is present, the sample was not analyzed.

Station Number	Depth	*Chaetoceros*	All other diatoms	Flagellates	Dino-flagellates
13	00	467600	23200	698400	26420
	05				
	10				
	15				
	20	105600	13860	105600	3760
	25	57600	10880	75600	3680
14	00	2228600	22200	317400	30920
	05	321000	10160	164000	1960
	10	39000	8000	79000	6560
	15	11200	18400	79200	11200
	20	22400	31200	49600	5680
15	00	153000	40000	618000	16400
	05	4113000	187000	103080	15000
	10	4732000	268240	74160	7160
	15	4680000	193400	45300	6200
17	00				
	05	2824000	284000	169000	2000
	10	3053000	388400	126000	9300
	15	1987000	378900	195000	6000
	20	907000	265400	150000	4000
18	00	101000	37000	636200	43000
	05	2257000	425300	356000	7200
	10	3162000	611200	227000	12400
	15	2917000	616500	234000	19000
19	00				
	05	159000	29000	295000	17900
	10	87000	20300	71000	8300
	15	51000	18400	50000	16000
	20				
	25				
20	00				
	05				
	10	87000	20300	71000	8300
	15	51000	18400	50000	16000

Table 9. (continued)

Station Number	Depth	*Chaetoceros*	All other diatoms	Flagellates	Dino-flagellates
23	00	55000	32000	528000	47600
	05	86000	113200	337000	23700
	10	38000	505700	207000	16500
	15	55000	610900	272000	29400
	20	99000	117200	162000	49000
	25	49000	117000	173000	23500
	30	5000	44000	194000	61200
	40	57000	235000	158000	17300
24	00				
	05	22000	244100	217000	22500
	10	16000	326200	114000	17800
	15	37000	713400	151000	18600
	20	25000	350100	116000	14500
	25				
	30				
	45				
25	00				
	05				
	10	1175000	75400	594000	14400
	15	62000	83700	154000	6300
27	00	125000	80000	1437000	68300
	05				
	10	39000	178400	781000	13700
	15				
	20	1132000	73800	383000	16800
	25	143000	151400	203000	13700
	30				

given in Table 10. Sixty-one categories of zooplankton were identified from 12 stations, representing 8 phyla, 42 species, and 19 other categories including larval stages and categories where identification was made to order, suborder or family (Tables 11 to 16). Abundance of all zooplankton at each station collected in vertical ring net hauls is given in Fig. 13. The percentages of copepods, barnacle larvae, and all other zooplankton collected in vertical ring net hauls are given in Figs. 14 and 15. Presence or abundance by species or taxonomic category found at each station is given in Figs. 16 to 39.

Maximum abundances of total zooplankton occurred at stations 13 and 26, while minimum abundances were found at stations 14 and 15 for 20 - 0 m and 10 - 0 m hauls. Barnacle larvae comprised the largest percentage of zooplankton at stations with maximum abundances and copepods comprised the largest percentage of zooplankton at stations with minimum abundances.

Results for each taxonomic category are given in alphabetical order under major taxonomic categories.

COPEPODA

Twenty-four species of copepods were found, including two unidentified calanoid species, one unidentified cyclopoid species, and two unidentified harpacticoid species. Four species showed a widespread distribution; three of these occurred at all 12 stations. The occurrence of other species was primarily dependent upon hydrographic conditions and depth of sampling. Included among these are four characteristically deep-water species, three neritic species associated with lower salinity, three species characteristically found in larger numbers offshore, five expatriate species from the south, and one species previously undescribed in the area.

Acartia spp.

Two species, *Acartia longiremis* (Lilljeborg) and *Acartia clausi* Giesbrecht have been reported in the plankton off Pt. Barrow (Redburn 1974). However, juveniles of these two species were not easily distinguishable and therefore have been grouped together as *Acartia* spp. Juveniles were present as stage IV and V copepodites of *Acartia* spp. Only adult female *A. longiremis* were found in our samples.

Acartia spp. showed a widespread distribution occurring at 8 stations, but absent from the eastern-most stations (Fig. 16). Maximum abundances occurred at station 21 ($326/m^2$) and station 13 ($290/m^2$) for 20 - 0 m and 10 - 0 m vertical net hauls. *Acartia longiremis* is a widespread species characteristic of neritic surface waters; *A. clausi* is characteristic of warmer surface water and probably occurs in the Beaufort Sea as an expatriate from the south. *Acartia* spp. was taken from hauls as deep as 50 m at station 24.

Table 10. Zooplankton found in Beaufort Sea samples collected from 18 Aug to 2 Sep 1976.

COPEPODA

Calanoida

Acartia longiremis
Acartia clausi
Calanus cristatus
Calanus glacialis
Calanus hyperboreus
Calanus plumchrus
Centropages abdominalis
Derjuginia tolli
Eucalanus bungii bungii
Euchaeta glacialis
Eurytemora richingsi
Limnocalanus grimaldii
Metridia longa
Microcalanus pygmaeus
Pseudocalanus minutus
Pseudocalanus major
Pseudocalanus sp.
Scaphocalanus magnus
unidentified Calanoida

Cyclopoida

Oithona similis
Oncaea borealis
unidentified Cyclopoida

Harpacticoida

unidentified Harpacticoida

Copepod nauplii

CIRRIPEDIA

Balanus spp. nauplii
Balanus spp. cypris

EUPHAUSIACEA

Thysanoessa inermis
Thysanoessa longipes
Thysanoessa raschii
Thysanoessa spp. larvae

OSTRACODA

Conchoecia borealis maxima
Philomedes globosus

CLADOCERA

unidentified Cladocera

MYSIDACEA

Mysis litoralis
Mysis oculata
unidentified larvae

DECAPODA

Anomura

unidentified zoea

Brachyura

Chionoecetes opilio zoea
unidentified zoea

Caridea

unidentified larvae

AMPHIPODA

unidentified Gammaridea
unidentified Hyperiidea

POLYCHAETA

pelagic larvae

APPENDICULARIA

Fritellaria borealis
Oikopleura spp.

CHAETOGNATHA

Sagitta elegans

Table 10. (continued)

CNIDARIA

Hydrozoa

Aeginopsis laurentii
Aglantha digitale
Bougainvillia superciliaris
Corymorpha flammea
Perigonimus yoldia-arcticae
Plotocnide borealis
Rathkea octopunctata
unidentified Hydrozoa

Scyphozoa

Cyanea capillata

CTENOPHORA

Beroe cucumis
unidentified Ctenophora

PTEROPODA

Spiratella helicina

ECHINODERMATA

Unidentified larvae

PISCES

Boreogadus saida
Lumpenus sp.
unidentified Cyclopteridae
unidentified Gadidae

Table 11. Abundances of zooplankton collected in 0.75 m ring net hauls from 10-0 m. Quantities are abundance m^2.

Taxon	Station Numbers											
	13	14	15	17	18	19B	20	21	23	24	25	26
Copepoda												
Acartia spp.	290	9	.[1]	.	.	36	18	108	72	145	36	.
Calanus cristatus	.	.	.	.	.	.	.	.	.	.	.	.
Calanus glacialis	P[2]	398	P	154	145	1557	652	905	P	72	597	P
Calanus hyperboreus	.	.	.	45	54	36	18	36	.	.	36	.
Calanus plumchrus	.	.	.	.	.	.	.	.	.	.	.	.
Centropages abdominalis	.	.	.	.	.	.	.	.	.	.	.	.
Derjuginia tolli	.	.	109	.	.	.	.	.	.	.	.	.
Eucalanus bungii bungii	.	.	.	.	.	.	.	.	.	.	.	.
Euchaeta glacialis	.	.	.	.	.	.	.	.	.	.	.	.
Eurytemora richingsi	.	.	.	.	.	.	.	.	.	.	.	.
Limnocalanus grimaldii	.	9	.	9	1303	18	.	36	.	.	.	.
Metridia longa	.	.	.	18	.	.	.	.	.	.	.	.
Microcalanus pygmaeus	.	.	P	615	18	.	.	.	.	.	.	.
Oithona similis	1086	p	54	552	145	P	18	181	217	217	145	72
Oncaea borealis	.	.	.	.	.	.	.	.	.	.	.	.
Pseudocalanus spp.	72	380	1846	1339	1050	2534	923	1376	145	290	434	72
Scaphocalanus magnus	.	.	.	.	.	.	.	.	.	.	.	.
unidentified calanoida	.	.	253	.	36	36	.	.	72	.	.	.
unidentified cyclopoida	.	.	18	9	.	.	.	.	.	.	.	.
unidentified Harpacticoida	72	18	18	.	54	36	36	36	72	.	36	.
miscellaneous nauplii	1086	54	.	127	145	1285	398	1050	72	507	289	145
Cirripedia												
Balanus spp. nauplii	13032	588	109	.	P	235	1448	6154	11005	5502	4109	12887
Balanus spp. cyprids	1375	706	36	.	.	163	851	253	2606	2679	832	9412

[1] Not observed in sample
[2] P indicates present in sample but not subsample

Table 11. (continued)

Taxon	Station Numbers											
	13	14	15	17	18	19B	20	21	23	24	25	26
Euphausiacea												
Thysanoessa inermis	.	.	.	.	.	.	.	.	.	.	.	.
Thysanoessa longipes	.	.	.	.	.	.	.	.	.	.	.	.
Thysanoessa raschii	.	.	.	.	.	.	.	.	.	.	.	.
Thysanoessa spp. larvae	.	.	.	.	.	.	.	2	2	.	2	.
Ostracoda												
Conchoecia borealis maxima	.	.	.	.	.	.	.	.	.	.	.	.
Philomedes globosus	.	.	.	.	.	.	.	.	.	.	.	.
Cladocera												
unidentified Polyphemidae	.	.	.	.	.	.	.	.	.	.	.	.
Mysidacea												
Mysis litoralis	.	.	.	.	.	.	.	.	.	.	.	.
Mysis oculata	.	.	.	.	.	.	.	.	.	.	.	.
unidentified larvae	.	.	.	.	.	.	.	.	.	.	.	.
Decapoda												
Anomuran zoea	9	5	.	.	.	2	2	.	.	.	5	.
Brachyuran zoea	23	5	2	.	.	2	9	2	.	13	9	7
Caridea larvae	9	2	.	2	.	.	11	.	.	.	5	.
Amphipoda												
Gammaridea	.	11	7	2	2	20	27	2	5	2	13	2
Hyperiidea	.	.	.	.	.	.	.	.	.	.	.	.

Table 11. (continued)

Taxon	Station Numbers											
	13	14	15	17	18	19B	20	21	23	24	25	26
Polychaeta												
pelagic larvae	1376	624	36	45	18	1701	1701	1376	1882	2751	1792	9774
Appendicularia												
Fritellaria borealis	1810	36	.	308	796	941	742	2425	579	217	814	724
Oikopleura spp.	290	308	.	9	36	344	778	290	362	217	1068	724
Chaetognatha												
Sagitta elegans	217	145	.	.	.	145	724	1412	1158	579	1285	796
Hydrozoa												
Aeginopsis laurentii	.	.	.	.	2	.	.	.	.	.	.	.
Aglantha digitale	145	45	.	.	.	90	2	P	1231	4489	253	10932
Bougainvillia superciliaris	.	.	.	.	.	.	.	.	.	.	.	.
Corymorpha flammea	.	.	.	.	.	.	.	.	.	.	.	.
Perigonimus yoldia-arcticae	.	2	.	.	.	5	45	.	.	.	.	.
Plotocnide borealis		.	.	.	.	2	.	.	.	.	.	.
Rathkea octopunctata	.	18	.	.	.	18	18	.	145	72	.	145
unidentified Hydrozoa	145	2	.	.	.	.	9	.	.	.	.	.
Scyphozoa												
Cyanea capillata	2	.	.	.	.	.	.	5	2	7	2	2
Ctenophora												
Beroe cucumis	.	9	.	.	.	5	P	.	.	.	.	.
unidentified Ctenophora	.	.	.	.	.	.	.	.	.	.	.	.

Table 11. (continued)

Taxon	Station Number											
	13	14	15	17	18	19B	20	21	23	24	25	26
Mollusca												
Spiratella helicina	2	9	.	136	.	.	18	72	2	P	18	P
Lamellibranch larvae	.	.	.	.	.	.	.	36	.	72	.	.
Gastropod veligers	.	.	.	.	.	.	.	.	.	.	54	145
Echinodermata												
unidentified larvae	.	18	.	9	163	36	145	72	.	.	90	.
Pisces												
Boreogadus saida	.	.	.	.	.	.	.	.	2	.	.	2
Lumpenus sp.	.	.	.	.	.	.	.	.	.	.	.	.
unidentified Cyclopteridae	.	.	.	.	.	.	.	.	.	.	.	.
unidentified Gadidae	.	.	.	.	.	.	.	.	.	.	.	.
TOTAL	21041	3401	2488	3379	3967	9247	8553	15829	19631	17831	11924	45841

Table 12. Abundances of zooplankton collected in 0.75 m ring net hauls from 20-10 m. Quantities are abundance m^2.

Taxon	Station Number											
	13	14	15	17	18	19B	20	21	23	24	25	26
Copepoda												
Acartia spp.	290	18	–[1]	.[2]	.	72	.	326	217	.	.	.
Calanus cristatus	.	.	–	.	.	.	.	.	.	.	.	.
Calanus glacialis	145	597	–	181	507	4851	1013	1158	579	P[3]	724	72
Calanus hyperboreus	.	.	–	253	290	145	36	145	.	.	145	.
Calanus plumchrus	.	.	–	.	.	.	.		.	.	.	.
Centropages abdominalis	.	.	–	.	.	.	.	.	.	145	.	.
Derjuginia tolli	.	36	–	.	.	.	72	36	.	.	.	.
Eucalanus bungii bungii	.	.	–	.		.	.	.	.	.	.	.
Euchaeta glacialis	.	.	–	36	.	.	.	.	.	.	.	.
Eurytemora richingsi	.	.	–	.	.	.	.	.	.	.	.	.
Limnocalanus grimaldii	.	.	–	.	1557	72	.	.	.	.	.	.
Metridia longa	.	.	–	145	72	.	.	.	.	.	.	.
Microcalanus pygmaeus	.	.	–	3946	471	.	.	.	.	.	.	.
Oithona similis	9846	.	–	1194	72	72	P	2498	652	145	1303	652
Oncaea borealis	.	.	–	.	.	.	.	.	.	.	.	.
Pseudocalanus spp.	2172	2244	–	6190	4090	11946	2027	1665	1158	145	1701	217
Scaphocalanus magnus	.	.	–	.	.	.	.	.	.	.	.	.
unidentified Calanoida	.	.	–	.	290	72	.	.	.	.	36	72
unidentified Cyclopoida	.	.	–	2	.	.	.	.	.	.	.	.
unidentified Harpacticoida	290	.	–	.	.	.	72	181	290	434	72	217
miscellaneous nauplii	6805	18	–	145	398	3620	507	1376	579	579	615	434
Cirripedia												
Balanus spp. nauplii	24036	1140	–	36	109	217	1014	8362	14624	18534	2896	13176
Balanus spp. cyprids	5937	1267	–	.	.	290	1158	941	6009	6950	1303	7964

[1] No 20-0 m haul taken
[2] Not observed in sample
[3] P indicates present in sample but not subsample

Table 12. (continued)

Taxon	Station Number											
	13	14	15	17	18	19B	20	21	23	24	25	26
Euphausiacea												
Thysanoessa inermis	.	.	–	2	.	.	2	.	.	.	2	.
Thysanoessa longipes	.	.	–	.	.	.	.	.	.	.	.	.
Thysanoessa raschii	.	.	–	.	.	.	.	.	.	.	.	.
Thysanoessa spp. larvae	.	.	–	.	.	.	.	.	5	.	.	2
Ostracoda												
Conchoecia borealis maxima	.	.	–	.	.	.	.	.	.	.	.	.
Philomedes globosus	.	.	–	.	.	.	.	.	2	.	.	.
Cladocera												
unidentified Polyphemidae	.	.	–	.	.	.	.	.	.	.	2	.
Mysidacea												
Mysis litoralis	.	.	–	.	.	.	.	.	.	.	.	.
Mysis oculata	.	.	–	.	.	.	.	.	.	.	.	.
unidentified larvae	.	.	–	.	.	.	2	5	.	.	.	.
Decapoda												
Anomuran zoea	29	2	–	.	.	7	2	2	2	7	18	9
Brachyuran zoea	45	2	–	.	2	.	.	9	.	27	23	36
Caridea larvae	50	5	–	9	5	2	.	5	2	9	5	5
Amphipoda												
Gammaridea	2	7	–	.	.	16	34	5	.	2	23	2
Hyperiidea	2	7	–	2	2	2	2	.	.	.	.	2

Table 12. (continued)

Taxon	Station Number											
	13	14	15	17	18	19B	20	21	23	24	25	26
Polychaeta												
pelagic larvae	8833	471	-	36	796	2824	2389	2570	6371	4778	3005	10715
Appendicularia												
Fritellaria borealis	7240	18	-	326	869	3258	1231	5792	1593	2027	1013	579
Oikopleura spp.	290	253	-	72	398	2172	1701	688	362	724	833	1158
Chaetognatha												
Sagitta elegans	2751	253	-	.	.	1231	724	5394	2100	1448	1013	1520
Hydrozoa												
Aeginopsis laurentii	.	.	-	.	.	.	2	.	.	.	.	.
Aglantha digitale	P	36	-	36	.	145	P	72	2389	3909	109	8398
Bougainvillia superciliaris	.	.	-	.	.	.	.	.	.	.	.	.
Corymorpha flammea	.	.	-	2	.	.	.	.	.	.	.	.
Perigonimus yolidia-arcticae	.	7	-	.	.	.	.	.	.	.	.	.
Plotocnide borealis	.	.	-	.	.	.	.	.	.	.	.	.
Rathkea octopunctata	.	18	-	.	.	72	36	36	.	.	.	72
unidentified Hydrozoa	.	.	-	.	.	.	.	.	.	.	.	.
Scyphozoa												
Cyanea capillata	2	5	-	.	.	2	5	2	9	2	2	18
Ctenophora												
Beroe cucumis	.	90	-	.	.	.	.	.	.	.	.	.
unidentified Ctenophora	.	.	-	.	.	.	.	2	.	.	.	.

Table 12. (continued)

Taxon	Station Number											
	13	14	15	17	18	19B	20	21	23	24	25	26
Mollusca												
Spiratella helicina	.	.	-	290	615	.	.	290	.	145	72	.
Lamellibranch larvae	869	18	-	.	.	.	72	145	72	290	290	72
Gastropod veligers	.	18	-	.	.	.	36	72	.	145	72	72
Echinodermata												
unidentified larvae	.	.	-	.	1448	217	398	579	217	.	253	217
Pisces												
Boreogadus saida	.	2	-	.	.	2	.	.	.	.	.	.
Lumpenus sp.	.	.	-	.	.	.	.	.	.	.	.	.
unidentified Cyclopteridae	.	.	-	.	.	.	.	.	.	.	.	.
unidentified Gadidae	.	.	-	.	.	.	.	.	.	.	2	.
TOTAL	69634	6532	-	12903	11991	31307	12535	32356	37232	40445	15532	45681

Table 13. Abundances of zooplankton collected in 0.75 m ring net hauls from 50-0 m. Quantities are abundance m^2.

Taxon	Station Number											
	13	14	15	17	18	19B	20	21	23	24	25	26
Copepoda												
Acartia spp.	–[1]	–	–	–	–	–	–	.[2]	.	869	–	–
Calanus cristatus	–	–	–	–	–	–	–	.	.	.	–	–
Calanus glacialis	–	–	–	–	–	–	–	1883	3477	2318	–	–
Calanus hyperboreus	–	–	–	–	–	–	–	362	434	.	–	–
Calanus plumchrus	–	–	–	–	–	–	–	.	11	7	–	–
Centropages abdominalis	–	–	–	–	–	–	–	.	.	.	–	–
Derjuginia tolli	–	–	–	–	–	–	–	P[3]	.	.	–	–
Eucalanus bungii bungii	–	–	–	–	–	–	–	.	2	.	–	–
Euchaeta glacialis	–	–	–	–	–	–	–	.	.	.	–	–
Eurytemora richingsi	–	–	–	–	–	–	–	.	.	.	–	–
Limnocalanus grimaldii	–	–	–	–	–	–	–	.	.	.	–	–
Metridia longa	–	–	–	–	–	–	–	.	.	.	–	–
Microcalanus pygmaeus	–	–	–	–	–	–	–	.	.	.	–	–
Oithona similis	–	–	–	–	–	–	–	4123	5505	5360	–	–
Oncaea borealis	–	–	–	–	–	–	–	.	.	.	–	–
Pseudocalanus spp.	–	–	–	–	–	–	–	10358	16804	4346	–	–
Scaphocalanus magnus	–	–	–	–	–	–	–	.	.	.	–	–
unidentified Calanoida	–	–	–	–	–	–	–	.	.	.	–	–
unidentified Cyclopoida	–	–	–	–	–	–	–	.	.	.	–	–
unidentified Harpacticoida	–	–	–	–	–	–	–	507	145	579		
miscellaneous nauplii	–	–	–	–	–	–	–	3332	4925	3911	–	–
Cirripedia												
Balanus spp. nauplii	–	–	–	–	–	–	–	5505	13617	28248	–	–
Balanus spp. cyprids	–	–	–	–	–	–	–	1086	5215	8402	–	–

[1] No 50-0 m haul taken
[2] Not observed in sample
[3] P indicates present in sample but not subsample

Table 13. (continued)

Taxon	Station Number											
	13	14	15	17	18	19B	20	21	23	24	25	26
Euphausiacea												
Thysanoessa inermis	-	-	-	-	-	-	-	.	.	.	-	-
Thysanoessa longipes	-	-	-	-	-	-	-	.	.	.	-	-
Thysanoessa raschii	-	-	-	-	-	-	-	.	.	.	-	-
Thysanoessa spp. larvae	-	-	-	-	-	-	-	.	2	5	-	-
Ostracoda												
Conchoecia borealis maxima	-	-	-	-	-	-	-	.	.	.	-	-
Philomedes globosus	-	-	-	-	-	-	-	.	.	.	-	-
Cladocera												
unidentified Polyphemidae	-	-	-	-	-	-	-	.	.	.	-	-
Mysidacea												
Mysis litoralis	-	-	-	-	-	-	-	.	.	.	-	-
Mysis oculata	-	-	-	-	-	-	-	.	.	.	-	-
unidentified larvae	-	-	-	-	-	-	-	.	.	.	-	-
Decapoda												
Anomuran zoea	-	-	-	-	-	-	-	7	.	25	-	-
Brachyuran zoea	-	-	-	-	-	-	-	5	5	72	-	-
Caridea larvae	-	-	-	-	-	-	-	5	.	14	-	-
Amphipoda												
Gammaridea	-	-	-	-	-	-	-	.	5	5	-	-
Hyperiidea	-	-	-	-	-	-	-	.	2	2	-	-

Table 13. (continued)

Taxon	Station Number											
	13	14	15	17	18	19B	20	21	23	24	25	26
Polychaeta												
pelagic larvae	-	-	-	-	-	-	-	7533	18397	25785	-	-
Appendicularia												
Fritellaria borealis	-	-	-	-	-	-	-	7605	4780	3911	-	-
Oikopleura spp.	-	-	-	-	-	-	-	217	.	724	-	-
Chaetognatha												
Sagitta elegans	-	-	-	-	-	-	-	2608	2318	4201	-	-
Hydrozoa												
Aeginopsis laurentii	-	-	-	-	-	-	-	.	.	.	-	-
Aglantha digitale	-	-	-	-	-	-	-	72	1449	4346	-	-
Bougainvillia superciliaris	-	-	-	-	-	-	-	.	.	.	-	-
Corymorpha flammea	-	-	-	-	-	-	-	.	.	.	-	-
Perigonimus yoldia-arcticae	-	-	-	-	-	-	-	.	.	.	-	-
Plotocnide borealis	-	-	-	-	-	-	-	.	.	.	-	-
Rathkea octopunctata	-	-	-	-	-	-	-	P	P	145	-	-
unidentified Hydrozoa	-	-	-	-	-	-	-	7	.	.	-	-
Scyphozoa												
Cyanea capillata	-	-	-	-	-	-	-	2	9	11	-	-
Ctenophora												
Beroe cucumis	-	-	-	-	-	-	-	.	.	.	-	-
unidentified Ctenophora	-	-	-	-	-	-	-	.	2	.	-	-

Table 13. (continued)

Taxon	Station Number											
	13	14	15	17	18	19B	20	21	23	24	25	26
Mollusca												
Spiratella helicina	-	-	-	-	-	-	-	507	P	.	-	-
Lamellibranch larvae	-	-	-	-	-	-	-	1738	2028	3766	-	-
Gastropod veligers	-	-	-	-	-	-	-	.	.	145	-	-
Echinodermata												
unidentified larvae	-	-	-	-	-	-	-	1521	1593	579	-	-
Pisces												
Boreogadus saida	-	-	-	-	-	-	-	.	.	.	-	-
Lumpenus sp.	-	-	-	-	-	-	-	.	.	.	-	-
unidentified Cyclopteridae	-	-	-	-	-	-	-	.	.	.	-	-
unidentified Gadidae	-	-	-	-	-	-	-	.	.	.	-	-
TOTAL	-	-	-	-	-	-	-	48983	80725	97776	-	-

Table 14. Abundances of zooplankton collected in 0.75 m ring net hauls from 100-0 m. Quantities are abundance m^2.

Taxon	Station Number											
	13	14	15	17	18	19B	20	21	23	24	25	26
Copepoda												
Acartia spp.	–[1]	–	–	–	–	–	–	.[2]	–	–	–	–
Calanus cristatus	–	–	–	–	–	–	–	.	–	–	–	–
Calanus glacialis	–	–	–	–	–	–	–	1449	–	–	–	–
Calanus hyperboreus	–	–	–	–	–	–	–	579	–	–	–	–
Calanus plumchrus	–	–	–	–	–	–	–	.	–	–	–	–
Centropages abdominalis	–	–	–	–	–	–	–	.	–	–	–	–
Derjuginia tolli	–	–	–	–	–	–	–	P[3]	–	–	–	–
Eucalanus bungii bungii	–	–	–	–	–	–	–	2	–	–	–	–
Euchaeta glacialis	–	–	–	–	–	–	–	.	–	–	–	–
Eurytemora richingsi	–	–	–	–	–	–	–	.	–	–	–	–
Limnocalanus grimaldii	–	–	–	–	–	–	–	.	–	–	–	–
Metridia longa	–	–	–	–	–	–	–	P	–	–	–	–
Microcalanus pygmaeus	–	–	–	–	–	–	–	.	–	–	–	–
Oithona similis	–	–	–	–	–	–	–	3187	–	–	–	–
Oncaea borealis	–	–	–	–	–	–	–	.	–	–	–	–
Pseudocalanus spp.	–	–	–	–	–	–	–	31000	–	–	–	–
Scaphocalanus magnus	–	–	–	–	–	–	–	.	–	–	–	–
unidentified Calanoida	–	–	–	–	–	–	–	.	–	–	–	–
unidentified Cyclopoida	–	–	–	–	–	–	–	.	–	–	–	–
unidentified Harpacticoida	–	–	–	–	–	–	–	290	–	–	–	–
miscellaneous nauplii	–	–	–	–	–	–	–	3187	–	–	–	–
Cirripedia												
Balanus spp. nauplii	–	–	–	–	–	–	–	6374	–	–	–	–
Balanus spp. cyprids	–	–	–	–	–	–	–	1449	–	–	–	–

[1] No 100-0 m haul taken
[2] Not observed in sample
[3] P indicates present in sample but not subsample

Table 14. (continued)

Taxon	Station Number											
	13	14	15	17	18	19B	20	21	23	24	25	26
Euphausiacea												
Thysanoessa inermis	-	-	-	-	-	-	-	.	-	-	-	-
Thysanoessa longipes	-	-	-	-	-	-	-	.	-	-	-	-
Thysanoessa raschii	-	-	-	-	-	-	-	.	-	-	-	-
Thysanoessa spp. larvae	-	-	-	-	-	-	-	.	-	-	-	-
Ostracoda												
Conchoecia borealis maxima	-	-	-	-	-	-	-	.	-	-	-	-
Philomedes globosus	-	-	-	-	-	-	-	.	-	-	-	-
Cladocera												
unidentified Polyphemidae	-	-	-	-	-	-	-	.	-	-	-	-
Mysidacea												
Mysis litoralis	-	-	-	-	-	-	-	.	-	-	-	-
Mysis oculata	-	-	-	-	-	-	-	.	-	-	-	-
unidentified larvae	-	-	-	-	-	-	-	.	-	-	-	-
Decapoda												
Anomuran zoea	-	-	-	-	-	-	-	.	-	-	-	-
Brachyuran zoea	-	-	-	-	-	-	-	14	-	-	-	-
Caridea larvae	-	-	-	-	-	-	-	.	-	-	-	-
Amphipoda												
Gammaridea	-	-	-	-	-	-	-	9	-	-	-	-
Hyperiidea	-	-	-	-	-	-	-	7	-	-	-	-

Table 14. (continued)

Taxon	Station Number											
	13	14	15	17	18	19B	20	21	23	24	25	26
Polychaeta												
pelagic larvae	-	-	-	-	-	-	-	11010	-	-	-	-
Appendicularia												
Fritellaria borealis	-	-	-	-	-	-	-	18253	-	-	-	-
Oikopleura spp.	-	-	-	-	-	-	-	290	-	-	-	-
Chaetognatha												
Sagitta elegans	-	-	-	-	-	-	-	2028	-	-	-	-
Hydrozoa												
Aeginopsis laurentii	-	-	-	-	-	-	-	.	-	-	-	-
Aglantha digitale	-	-	-	-	-	-	-	27	-	-	-	-
Bougainvillia superciliaris	-	-	-	-	-	-	-	.	-	-	-	-
Corymorpha flammea	-	-	-	-	-	-	-	2	-	-	-	-
Perigonimus yoldiaarcticae	-	-	-	-	-	-	-	2	-	-	-	-
Plotocnide borealis	-	-	-	-	-	-	-	.	-	-	-	-
Rathkea octopunctata	-	-	-	-	-	-	-	P	-	-	-	-
unidentified Hydrozoa	-	-	-	-	-	-	-	.	-	-	-	-
Scyphozoa												
Cyanea capillata	-	-	-	-	-	-	-	5	-	-	-	-
Ctenophora												
Beroe cucumis	-	-	-	-	-	-	-	P	-	-	-	-
unidentified Ctenophora	-	-	-	-	-	-	-	.	-	-	-	-

Table 14. (continued)

Taxon	Station Number											
	13	14	15	17	18	19B	20	21	23	24	25	26
Mollusca												
Spiratella helicina	–	–	–	–	–	–	–	1159	–	–	–	–
Lamellibranch larvae	–	–	–	–	–	–	–	.	–	–	–	–
Gastropod veligers	–	–	–	–	–	–	–	.	–	–	–	–
Echinodermata												
unidentified larvae	–	–	–	–	–	–	–	1739	–	–	–	–
Pisces												
Boreogadus saida	–	–	–	–	–	–	–	.	–	–	–	–
Lumpenus sp.	–	–	–	–	–	–	–	.	–	–	–	–
unidentified Cyclopteridae	–	–	–	–	–	–	–	.	–	–	–	–
unidentified Gadidae	–	–	–	–	–	–	–	.	–	–	–	–
TOTAL	–	–	–	–	–	–	–	82062	–	–	–	–

Table 15. Abundances of zooplankton collected in 0.75 m ring net hauls from 200-0 m. Quantities are abundance m^2.

Taxon	Station Number											
	13	14	15	17	18	19B	20	21	23	24	25	26
Copepoda												
Acartia spp.	–[1]	–	–	–	–	–	–	.[2]	–	–	–	–
Calanus cristatus	–	–	–	–	–	–	–	.	–	–	–	–
Calanus glacialis	–	–	–	–	–	–	–	6374	–	–	–	–
Calanus hyperboreus	–	–	–	–	–	–	–	2318	–	–	–	–
Calanus plumchrus	–	–	–	–	–	–	–	.	–	–	–	–
Centropages abdominalis	–	–	–	–	–	–	–	.	–	–	–	–
Derjuginia tolli	–	–	–	–	–	–	–	P[3]	–	–	–	–
Eucalanus bungii bungii	–	–	–	–	–	–	–	.	–	–	–	–
Euchaeta glacialis	–	–	–	–	–	–	–	11	–	–	–	–
Eurytemora richingsi	–	–	–	–	–	–	–	.	–	–	–	–
Limnocalanus grimaldii	–	–	–	–	–	–	–	.	–	–	–	–
Metridia longa	–	–	–	–	–	–	–	1738	–	–	–	–
Microcalanus pygmaeus	–	–	–	–	–	–	–	.	–	–	–	–
Oithona similis	–	–	–	–	–	–	–	9561	–	–	–	–
Oncaea borealis	–	–	–	–	–	–	–	290	–	–	–	–
Pseudocalanus spp.	–	–	–	–	–	–	–	58814	–	–	–	–
Scaphocalanus magnus	–	–	–	–	–	–	–	5	–	–	–	–
unidentified Calanoida	–	–	–	–	–	–	–	290	–	–	–	–
unidentified Cyclopoida	–	–	–	–	–	–	–	.	–	–	–	–
unidentified Harpacticoida	–	–	–	–	–	–	–	.	–	–	–	–
miscellaneous nauplii	–	–	–	–	–	–	–	5505	–	–	–	–
Cirripedia												
Balanus spp. nauplii	–	–	–	–	–	–	–	5213	–	–	–	–
Balanus spp. cyprids	–	–	–	–	–	–	–	2027	–	–	–	–

[1] No 200-0 m haul taken
[2] Not observed in sample
[3] P indicates present in sample but not subsample

Table 15. (continued)

Taxon	Station Number											
	13	14	15	17	18	19B	20	21	23	24	25	26
Euphausiacea												
Thysanoessa inermis	-	-	-	-	-	-	-	2	-	-	-	-
Thysanoessa longipes	-	-	-	-	-	-	-	.	-	-	-	-
Thysanoessa raschii	-	-	-	-	-	-	-	.	-	-	-	-
Thysanoessa spp. larvae	-	-	-	-	-	-	-	.	-	-	-	-
Ostracoda												
Conchoecia borealis maxima	-	-	-	-	-	-	-	23	-	-	-	-
Philomedes globosus	-	-	-	-	-	-	-	.	-	-	-	-
Cladocera												
unidentified Polyphemidae	-	-	-	-	-	-	-	.	-	-	-	-
Mysidacea												
Mysis litoralis	-	-	-	-	-	-	-	.	-	-	-	-
Mysis oculata	-	-	-	-	-	-	-	.	-	-	-	-
unidentified larvae	-	-	-	-	-	-	-	.	-	-	-	-
Decapoda												
Anomuran zoea	-	-	-	-	-	-	-	16	-	-	-	-
Brachyuran zoea	-	-	-	-	-	-	-	7	-	-	-	-
Caridea larvae	-	-	-	-	-	-	-	5	-	-	-	-
Amphipoda												
Gammaridea	-	-	-	-	-	-	-	57	-	-	-	-
Hyperiidea	-	-	-	-	-	-	-	7	-	-	-	-

Table 15. (continued)

Taxon	Station Number											
	13	14	15	17	18	19B	20	21	23	24	25	26
Polychaeta												
pelagic larvae	-	-	-	-	-	-	-	10720	-	-	-	-
Appendicularia												
Fritellaria borealis	-	-	-	-	-	-	-	31290	-	-	-	-
Oikopleura spp.	-	-	-	-	-	-	-	290	-	-	-	-
Chaetognatha												
Sagitta elegans	-	-	-	-	-	-	-	2028	-	-	-	-
Hydrozoa												
Aeginopsis laurentii	-	-	-	-	-	-	-	.	-	-	-	-
Aglantha digitale	-	-	-	-	-	-	-	27	-	-	-	-
Bougainvillia superciliaris	-	-	-	-	-	-	-	.	-	-	-	-
Corymorpha flammea	-	-	-	-	-	-	-	.	-	-	-	-
Perigonimus yoldia-arcticae	-	-	-	-	-	-	-	.	-	-	-	-
Plotocnide borealis	-	-	-	-	-	-	-	.	-	-	-	-
Rathkea octopunctata	-	-	-	-	-	-	-	.	-	-	-	-
unidentified Hydrozoa	-	-	-	-	-	-	-	2	-	-	-	-
Scyphozoa												
Cyanea capillata	-	-	-	-	-	-	-	.	-	-	-	-
Ctenophora												
Beroe cucumis	-	-	-	-	-	-	-	2	-	-	-	-
unidentified Ctenophora	-	-	-	-	-	-	-	.	-	-	-	-

Table 15. (continued)

Taxon	Station Number											
	13	14	15	17	18	19B	20	21	23	24	25	26
Mollusca												
Spiratella helicina	-	-	-	-	-	-	-	290	-	-	-	-
Lamellibranch larvae	-	-	-	-	-	-	-	.	-	-	-	-
Gastropod veligers	-	-	-	-	-	-	-	.	-	-	-	-
Echinodermata												
unidentified larvae	-	-	-	-	-	-	-	869	-	-	-	-
Pisces												
Boreogadus saida	-	-	-	-	-	-	-	.	-	-	-	-
Lumpenus sp.	-	-	-	-	-	-	-	.	-	-	-	-
unidentified Cyclopteridae	-	-	-	-	-	-	-	.	-	-	-	-
unidentified Gadidae	-	-	-	-	-	-	-	.	-	-	-	-
TOTAL								137781				

Table 16. Abundances of zooplankton collected in bongo net hauls. Quantities are abundance/100 m^3.

Taxon	Station 20[1]		Station 25[2]	
	500 μ	333 μ	500 μ	333 μ
Copepoda				
Acartia spp.	.[3]	33	.	70
Calanus cristatus	.	.	.	9
Calanus glacialis	2933	4180	7067	5635
Calanus hyperboreus	38	.	133	348
Calanus plumchrus	.	.	.	.
Centropages abdominalis	.	.	.	.
Derjuginia tolli	76	98	67	4
Eucalanus bungii bungii	.	.	.	.
Euchaeta glacialis	.	.	.	.
Eurytemora richingsi	.	.	.	4
Limnocalanus grimaldii	.	.	.	.
Metridia longa	.	.	.	.
Microcalanus pygmaeus	.	.	.	.
Oithona similis	19	65	200	4939
Oncaea borealis	.	.	.	.
Pseudocalanus spp.	38	2874	267	5496
Scaphocalanus magnus	.	.	.	.
unidentified Calanoida	.	2	8	.
unidentified Cyclopoida	.	.	.	.
unidentified Harpacticoida	.	196	.	139
miscellaneous nauplii	38	229	67	626
Cirripedia				
Balanus spp. nauplii	6286	9371	18267	24974
Balanus spp. cyprids	76	6759	467	13009

[1] Double oblique haul from 10-0 m.
[2] Double oblique haul from 20-0 m.
[3] Not observed in sample

Table 16. (continued)

Taxon	Station 20		Station 25	
	500 µ	333 µ	500 µ	333 µ
Euphausiacea				
Thysanoessa inermis	.	.	.	4
Thysanoessa longipes	.	.	8	.
Thysanoessa raschii	.	.	33	22
Thysanoessa spp. larvae	–	65	25	9
Ostracoda				
Conchoecia borealis maxima	.	.	.	.
Philomedes globosus	.	.	.	.
Cladocera				
unidentified Polyphemidae	.	.	.	.
Mysidacea				
Mysis litoralis	.	2	8	9
Mysis oculata	.	2	17	.
unidentified larvae	2	4	.	.
Decapoda				
Anomuran zoea	14	12	50	44
Brachyuran zoea	36	35	142	126
Caridea larvae	41	33	108	57
Amphipoda				
Gammaridea	364	302	142	87
Hyperiidea	12	6	17	13

Table 16. (continued)

Taxon	Station 20		Station 25	
	500 µ	333 µ	500 µ	333 µ
Polychaeta				
pelagic larvae	171	3037	1467	7165
Appendicularia				
Fritellaria borealis	381	784	200	1809
Oikopleura spp.	P	131	400	67
Chaetognatha				
Sagitta elegans	762	1404	3867	2991
Hydrozoa				
Aeginopsis laurentii	.	.	.	.
Aglantha digitale	19	65	92	139
Bougainvillia superciliaris	2	.	.	.
Corymorpha flammea	.	.	.	9
Perigonimus yoldiaarcticae	19	18	17	4
Plotocnide borealis	.	.	.	.
Rathkea octopunctata	19	2	.	.
unidentified Hydrozoa	10	.	17	.
Scyphozoa				
Cyanea capillata	5	.	33	9
Ctenophora				
Beroe cucumis	.	.	.	.
unidentified Ctenophora	.	4	8	.

Table 16. (continued)

Taxon	Station 20		Station 25	
	500 μ	333 μ	500 μ	333 μ
Mollusca				
Spiratella helicina	P	65	133	139
Lamellibranch larvae	.	.	.	139
Gastropod veligers	.	.	.	.
Echinodermata				
unidentified larvae	.	33	.	.
Pisces				
Boreogadus saida	10	6	33	17
Lumpenus sp.	2	6	.	.
unidentified Cyclopteridae	.	2	.	.
unidentified Gadidae	.	.	8	4

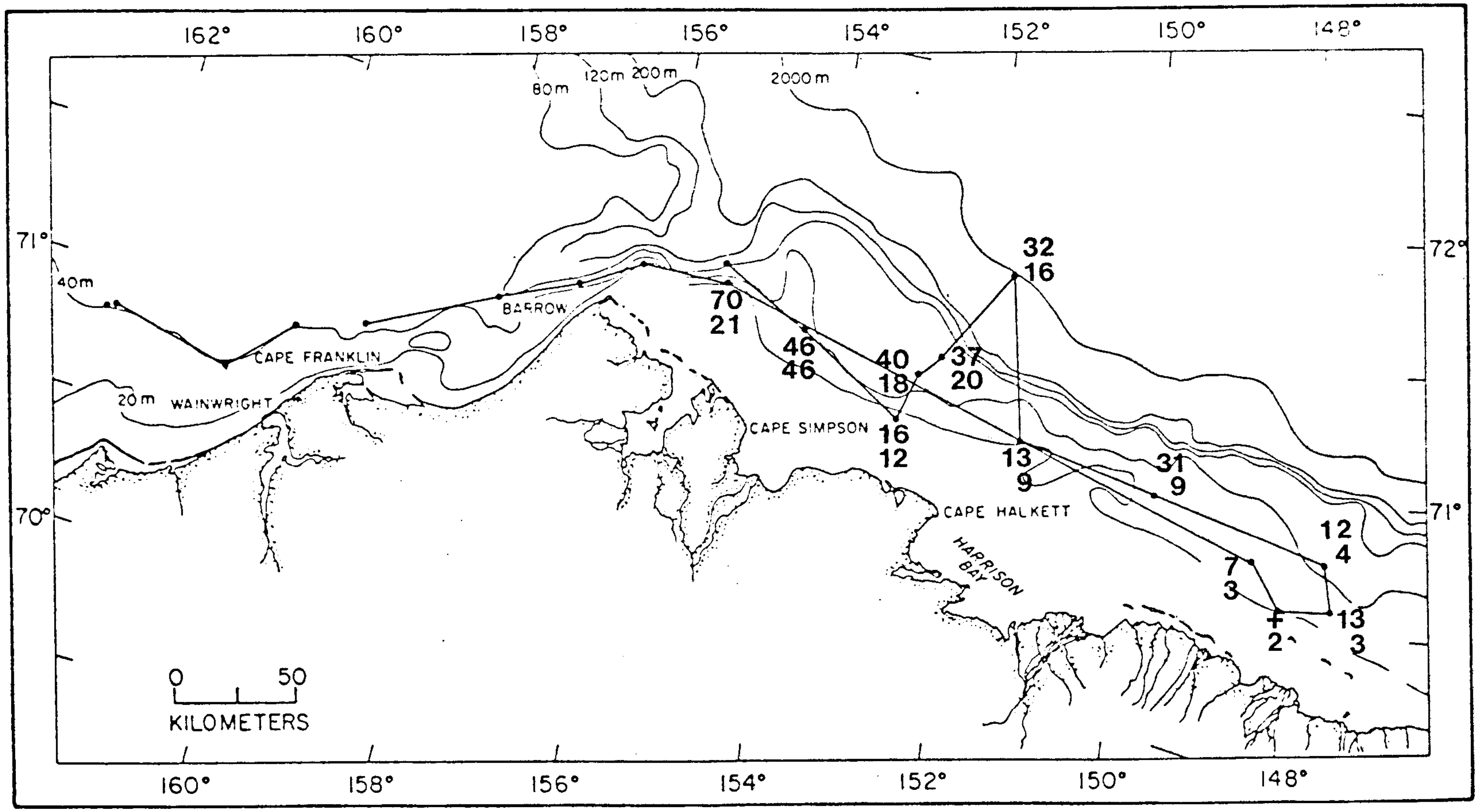

Fig. 13. Abundance of zooplankton (number $m^2 \times 10^2$) collected by USCGC *Glacier* in the Beaufort Sea, 18 Aug to 2 Sep 1976. Upper number represents 20-0 m haul; lower number represents 10-0 m haul. No 20-0 m haul was taken at station 15.

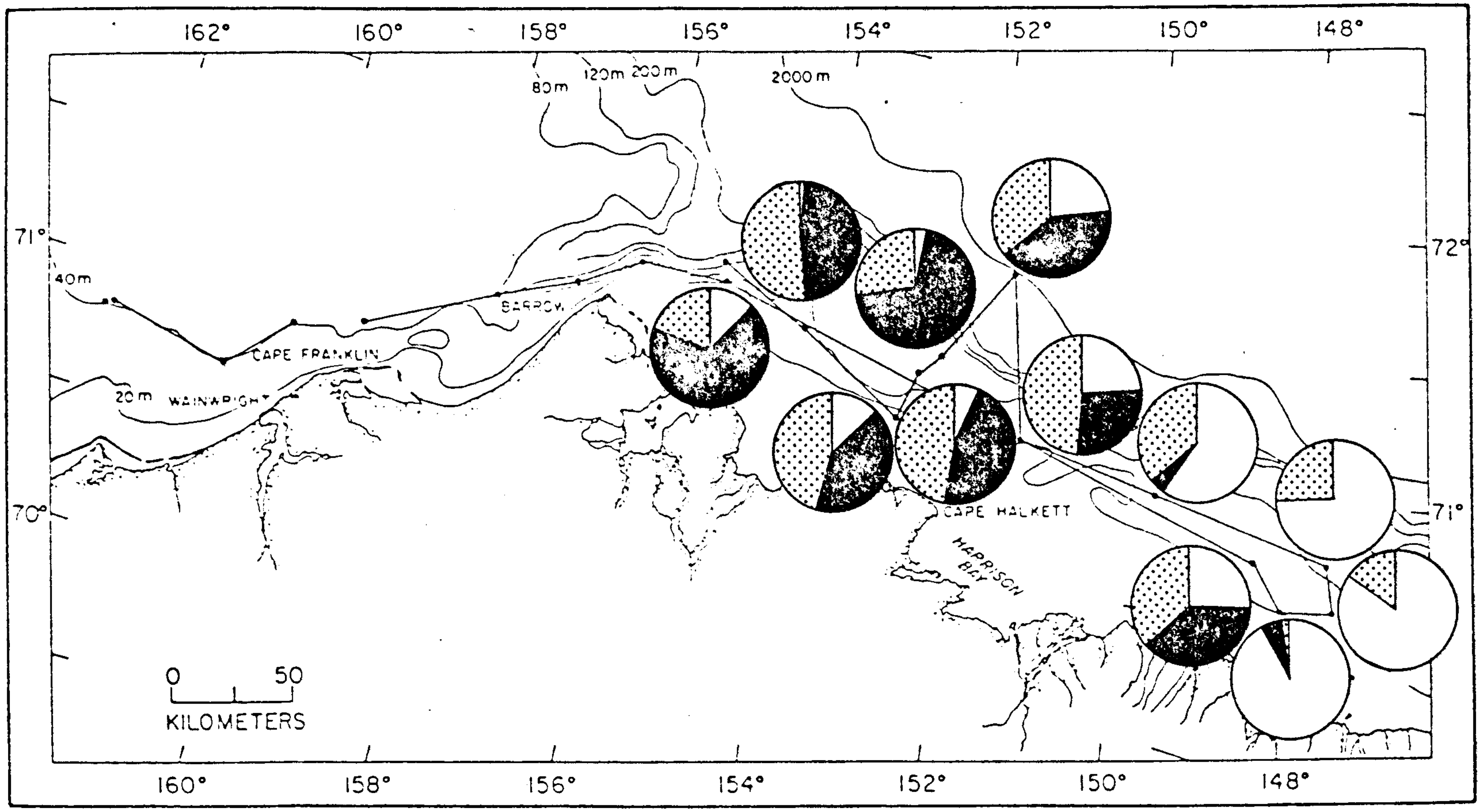

Fig. 14. Percentage of zooplankton composed of copepods (white), barnacle larvae (black), and all other zooplankton (stippled) from 10-0 m hauls.

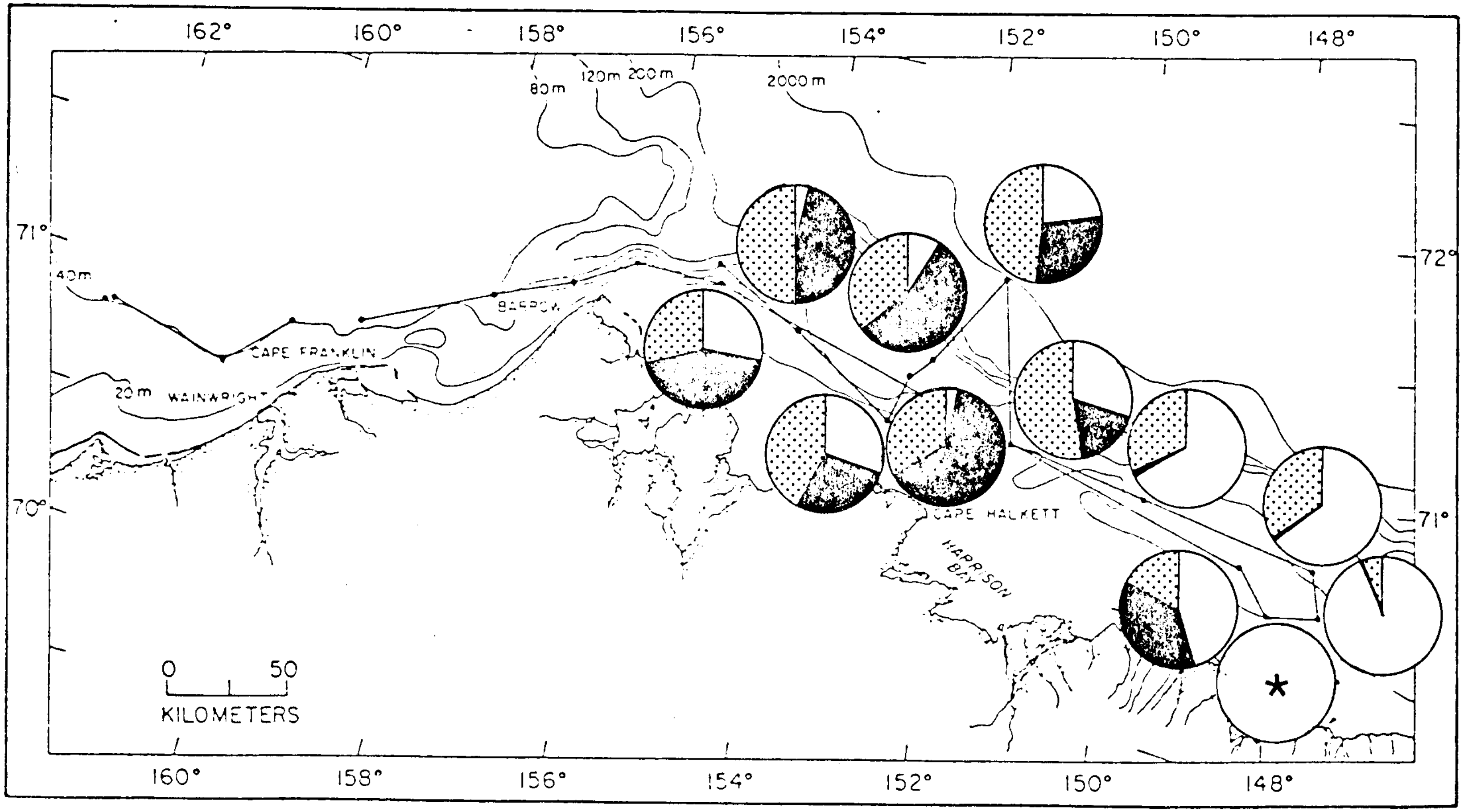

Fig. 15. Percentage of zooplankton composed of copepods (white), barnacle larvae (black) and all other zooplankton (stippled) from 20-0 m hauls.

*No 20-0 m haul was taken at station 15.

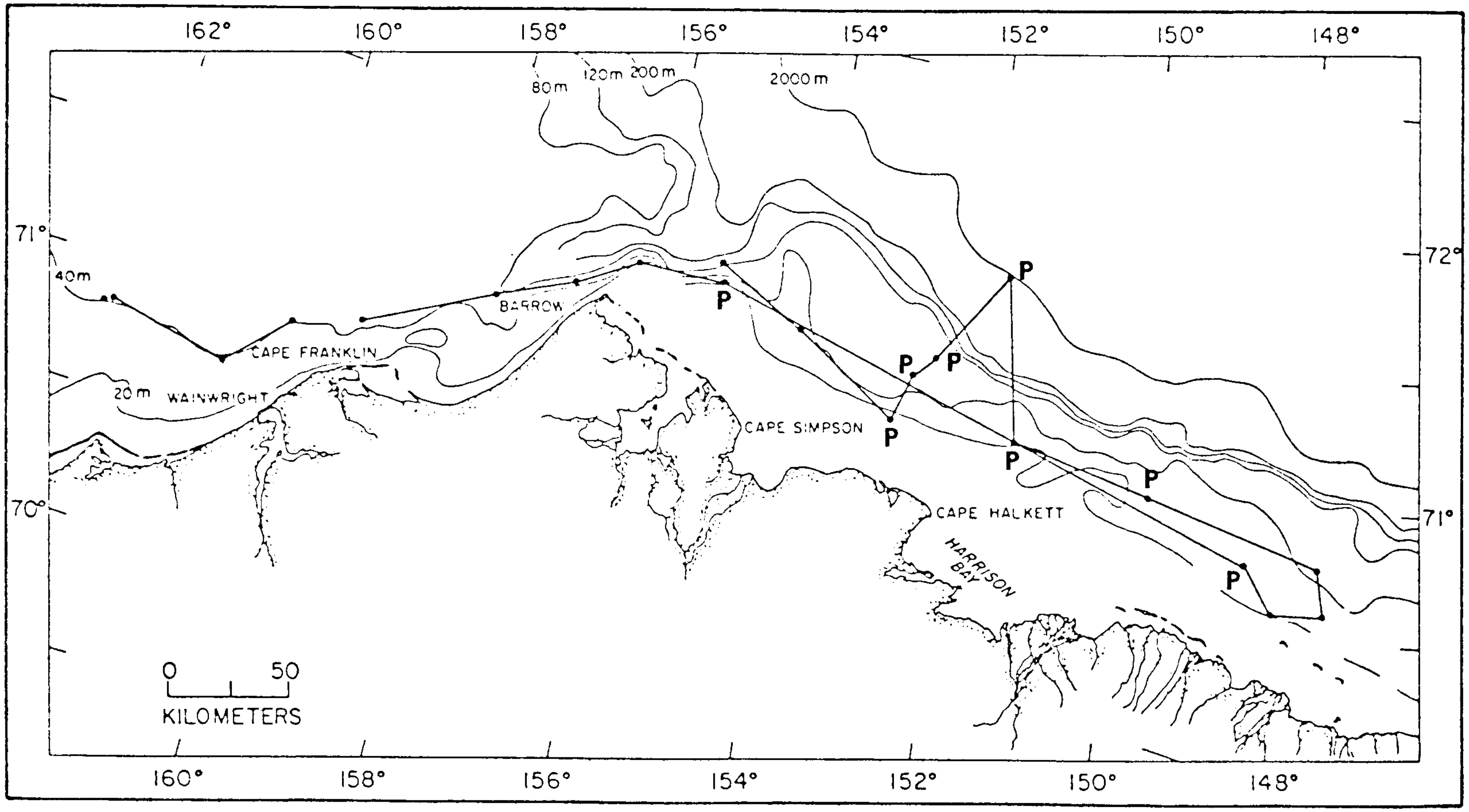

Fig. 16. Stations where *Acartia* spp. were present (P).

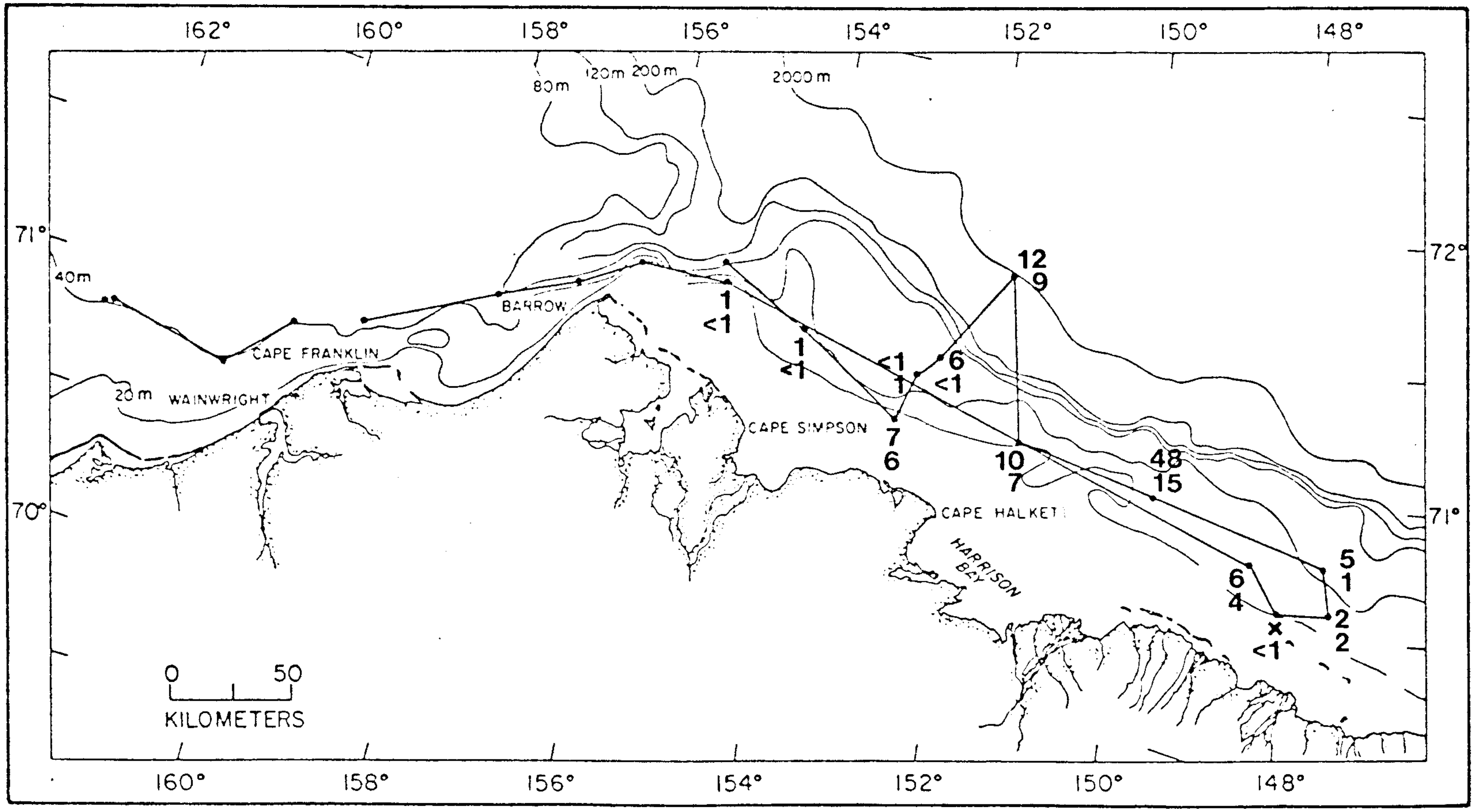

Fig. 17. Abundance of *Calanus glacialis* (number m^2 x 10^2). Upper number represents 20-0 m haul; lower number represents 10-0 m haul. No 20-0 m haul was taken at station 15.

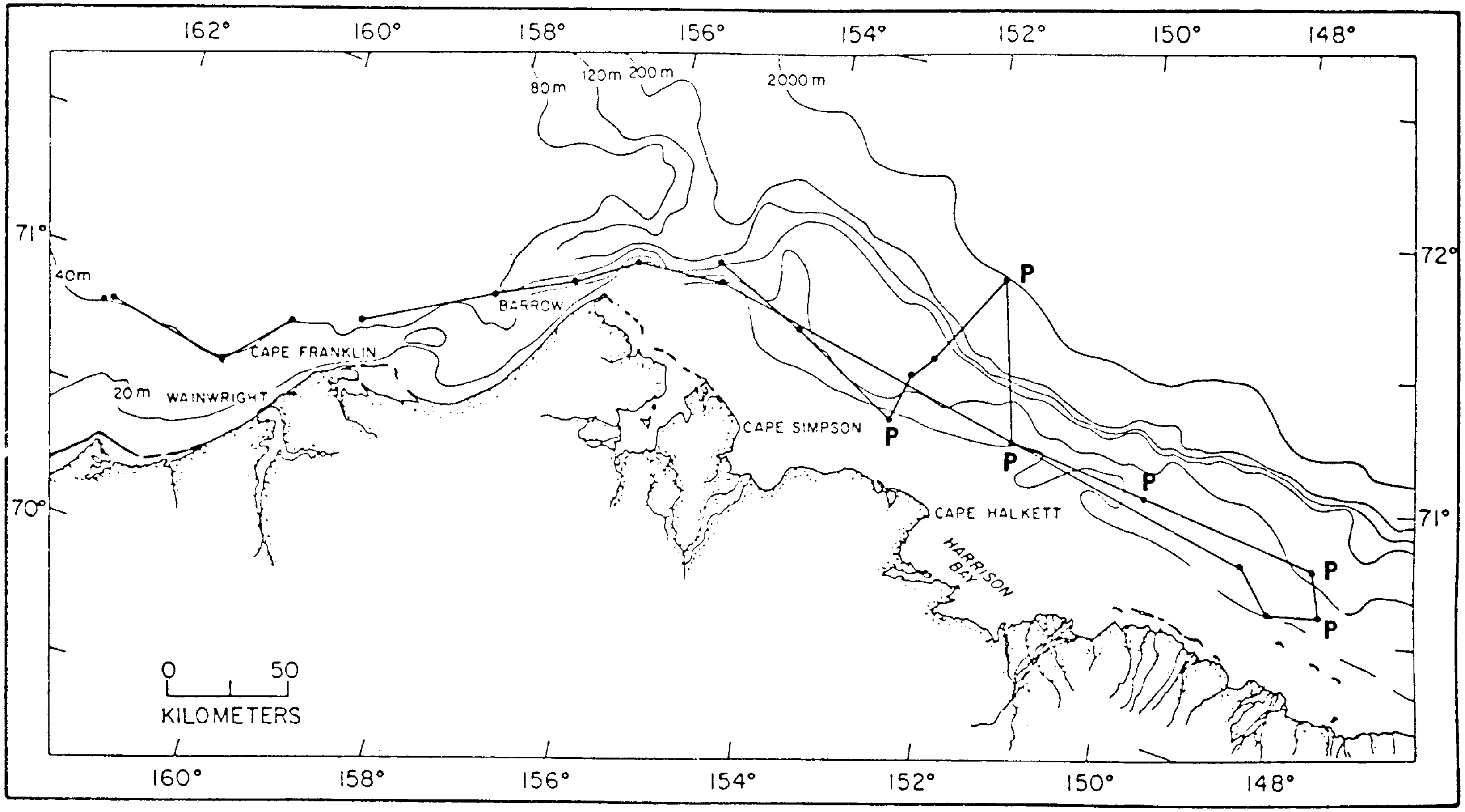

Fig. 18. Stations where *Calanus hyperboreus* was present (P).

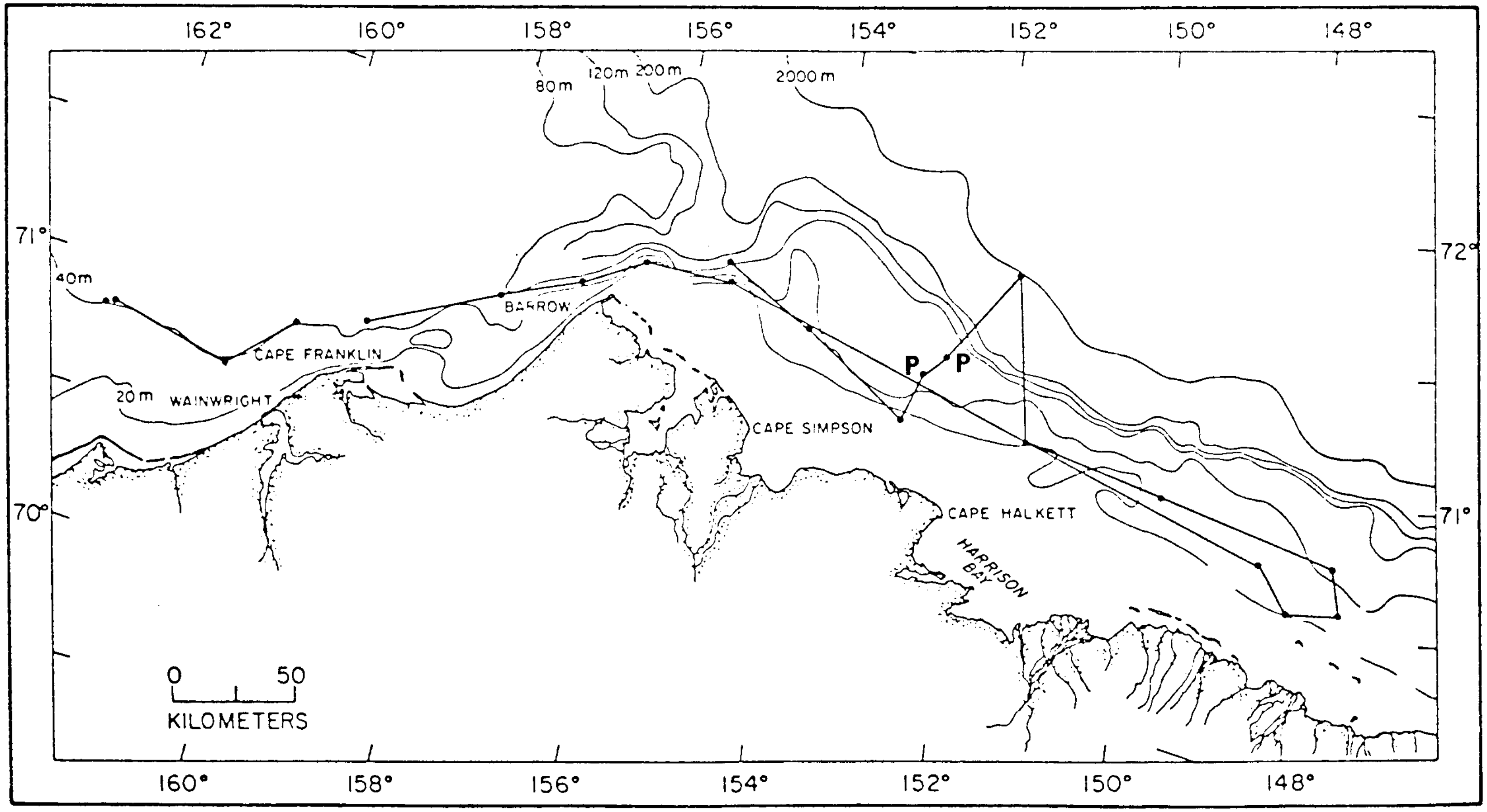

Fig. 19. Stations where *Calanus plumchrus* was present (P) in 50-0 m hauls.

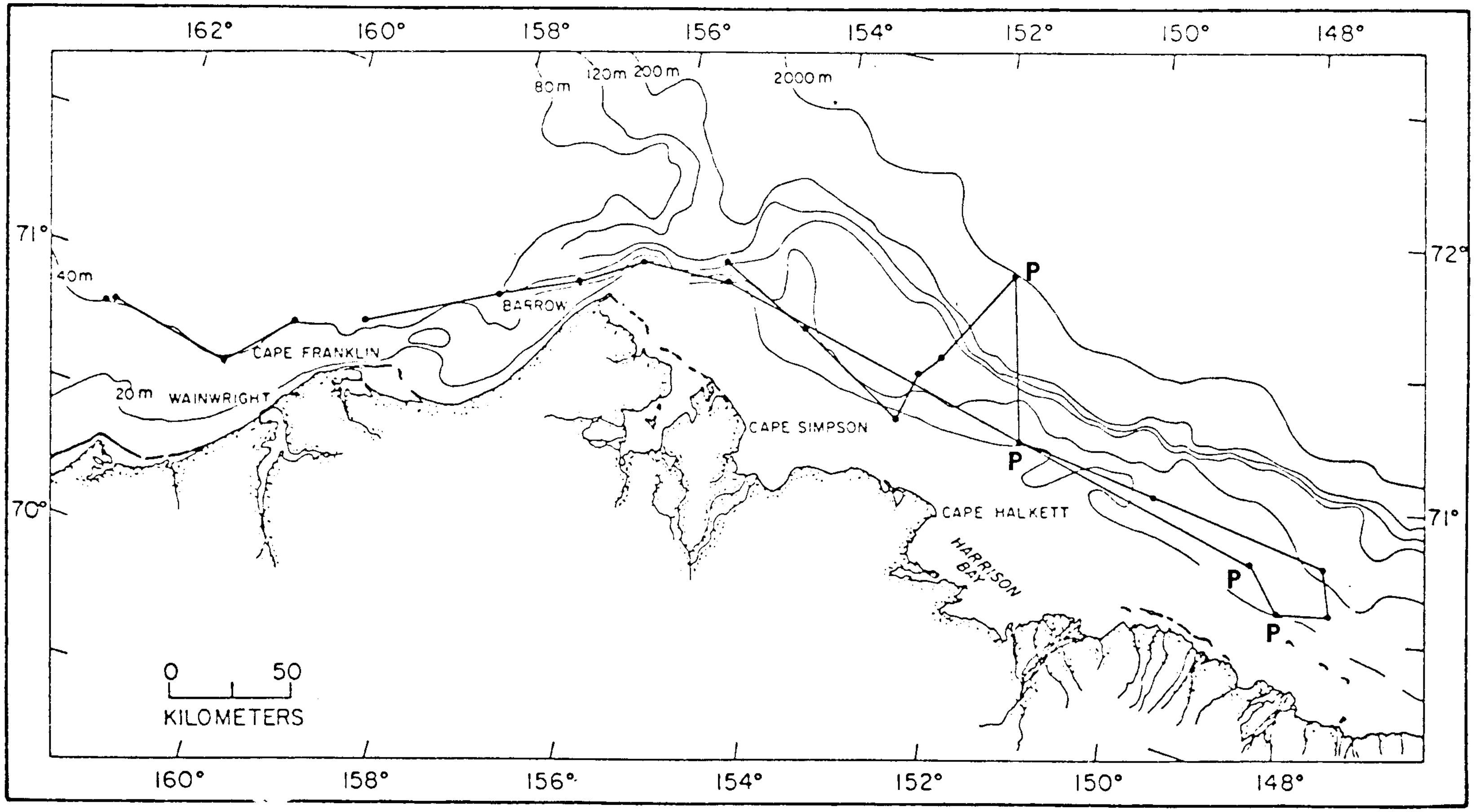

Fig. 20. Stations where *Derjuginia tolli* was present (P).

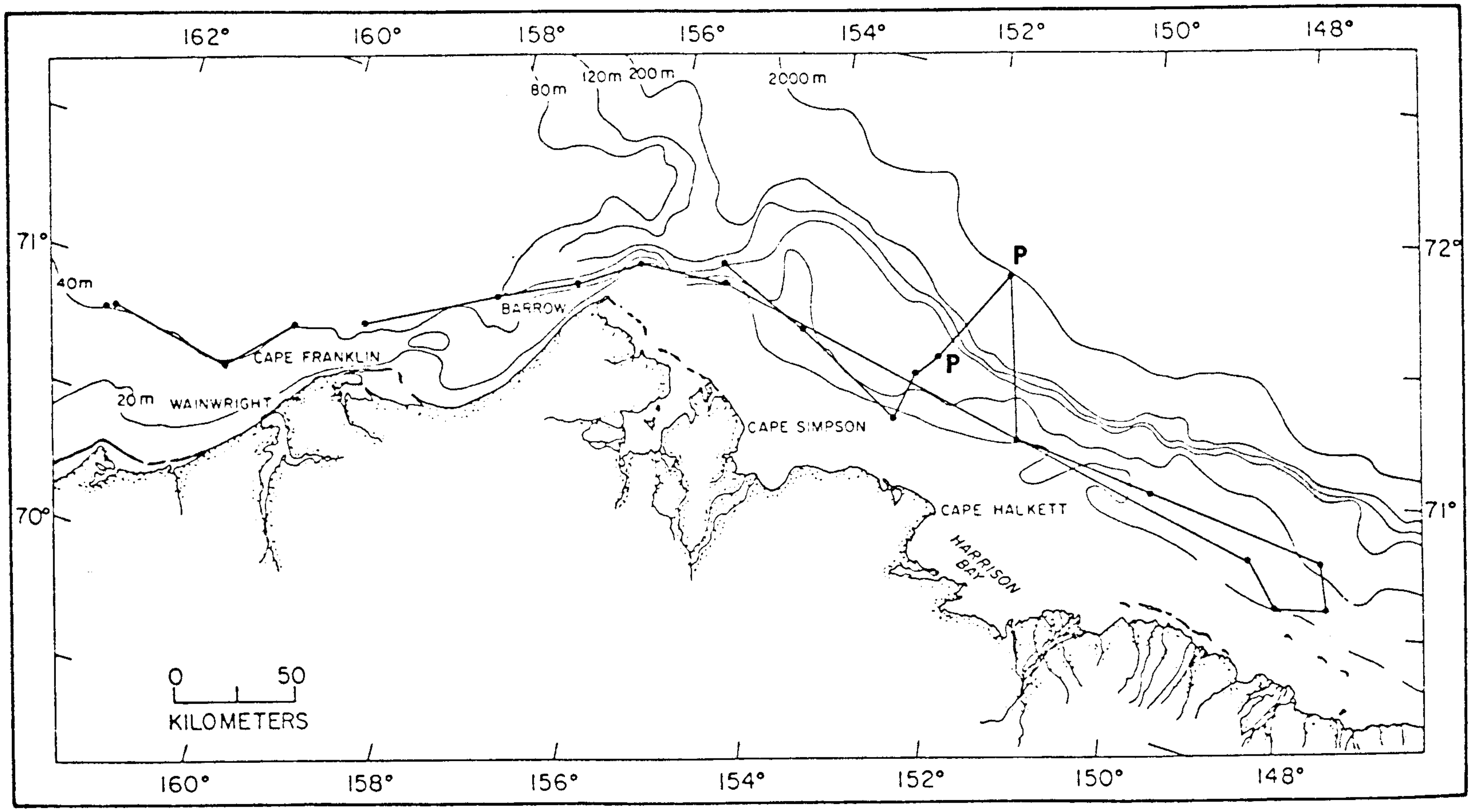

Fig. 21. Stations where *Eucalanus bungii bungii* was present (P). One individual was taken from a 100-0 m haul at station 21 and one individual was taken from a 50-0 m haul at station 24.

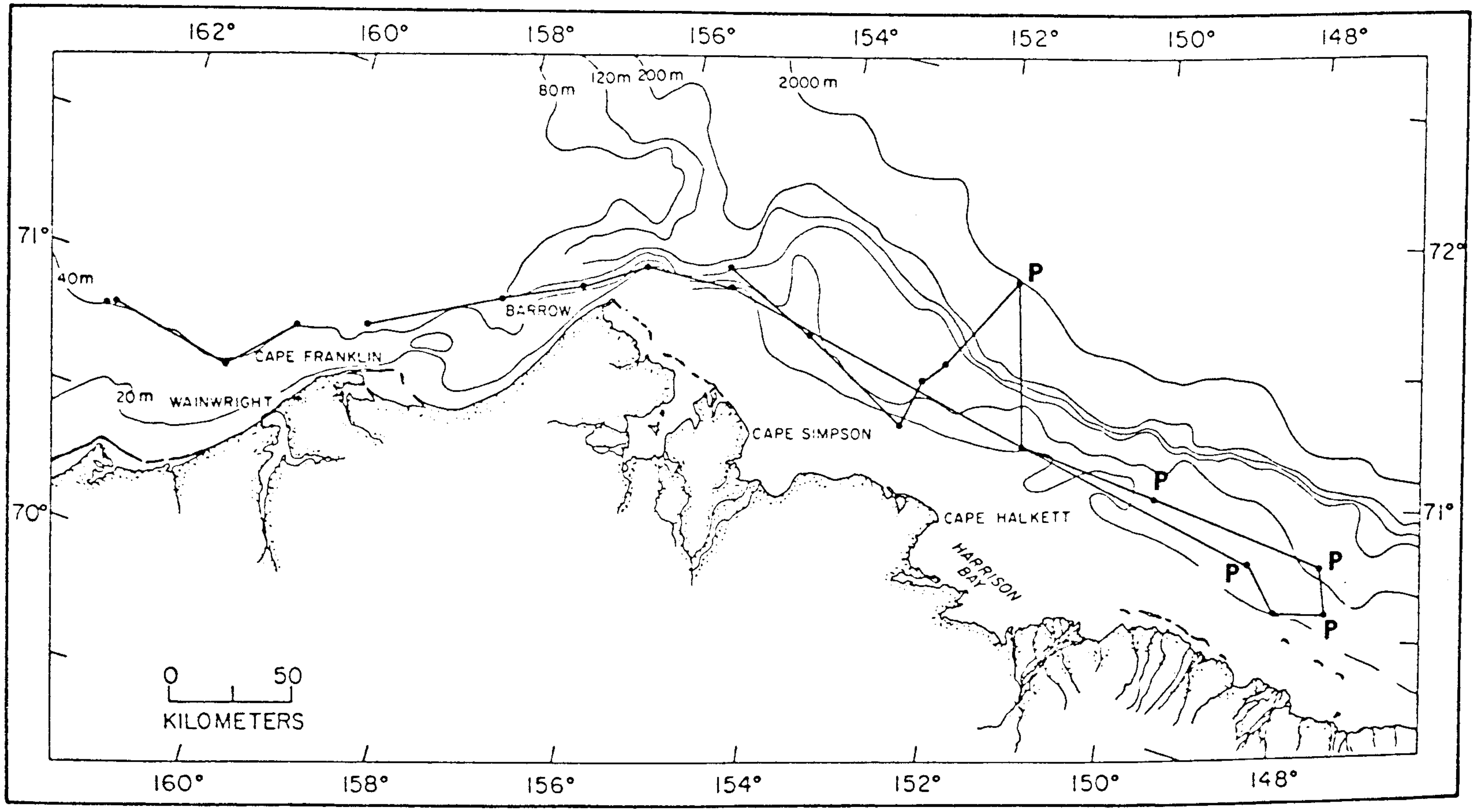

Fig. 22. Stations where *Limnocalanus grimaldii* was present (P).

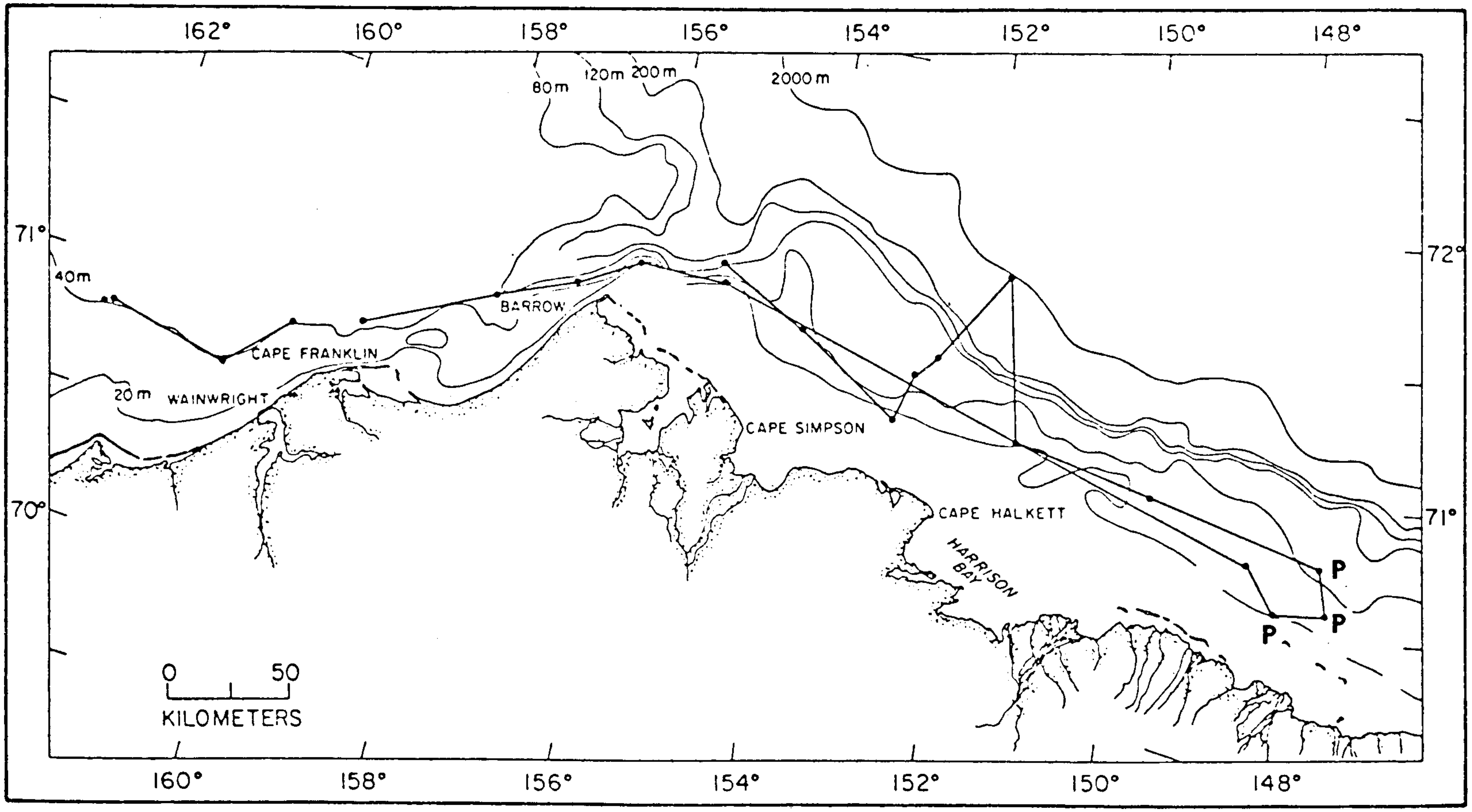

Fig. 23. Stations where *Microcalanus pygmaeus* was present (P).

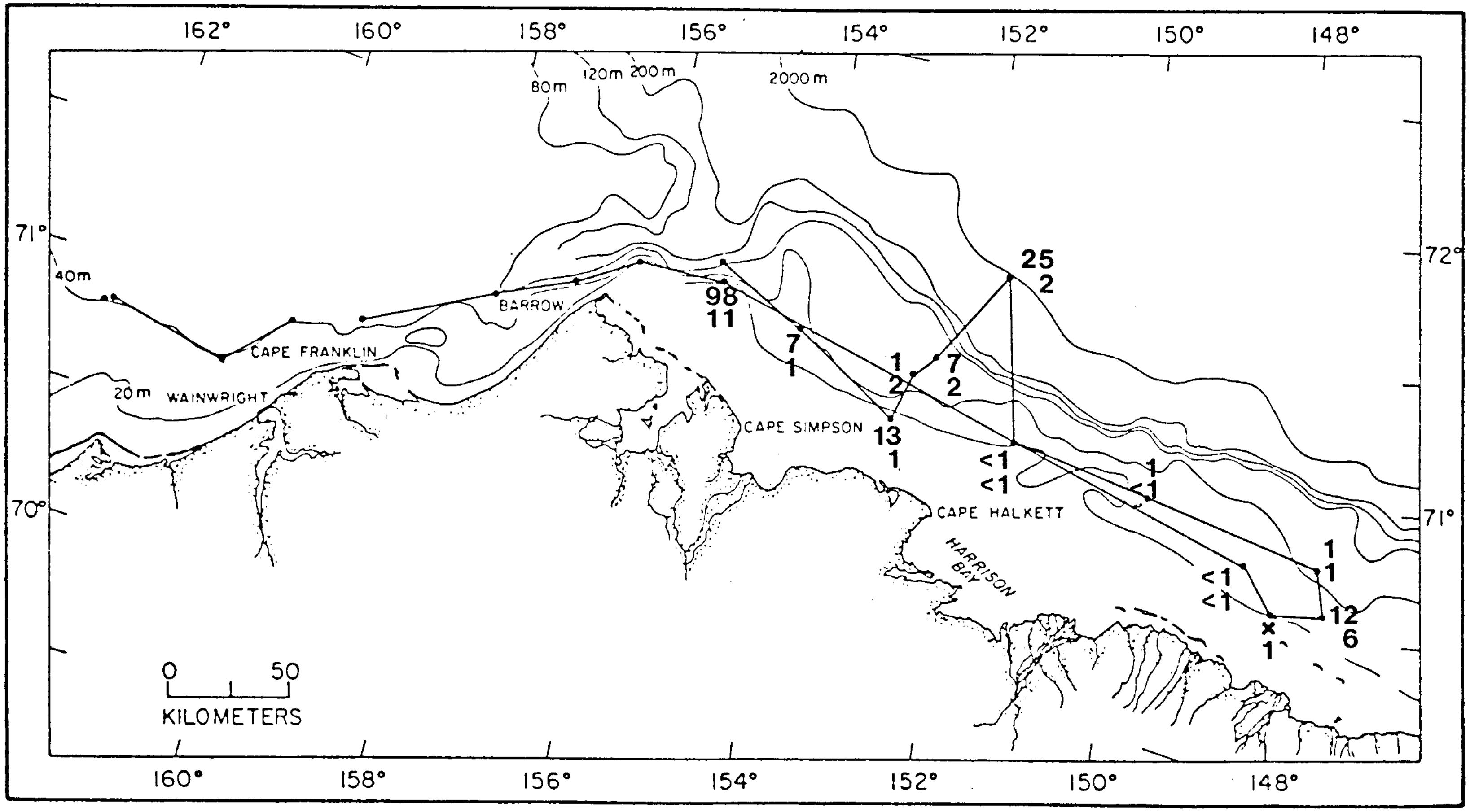

Fig. 24. Abundance of *Oithona similis* (number m^2 x 10^2). Upper number represents a 20-0 m haul; lower number represents a 10-0 m haul. No 20-0 m haul was taken at station 15.

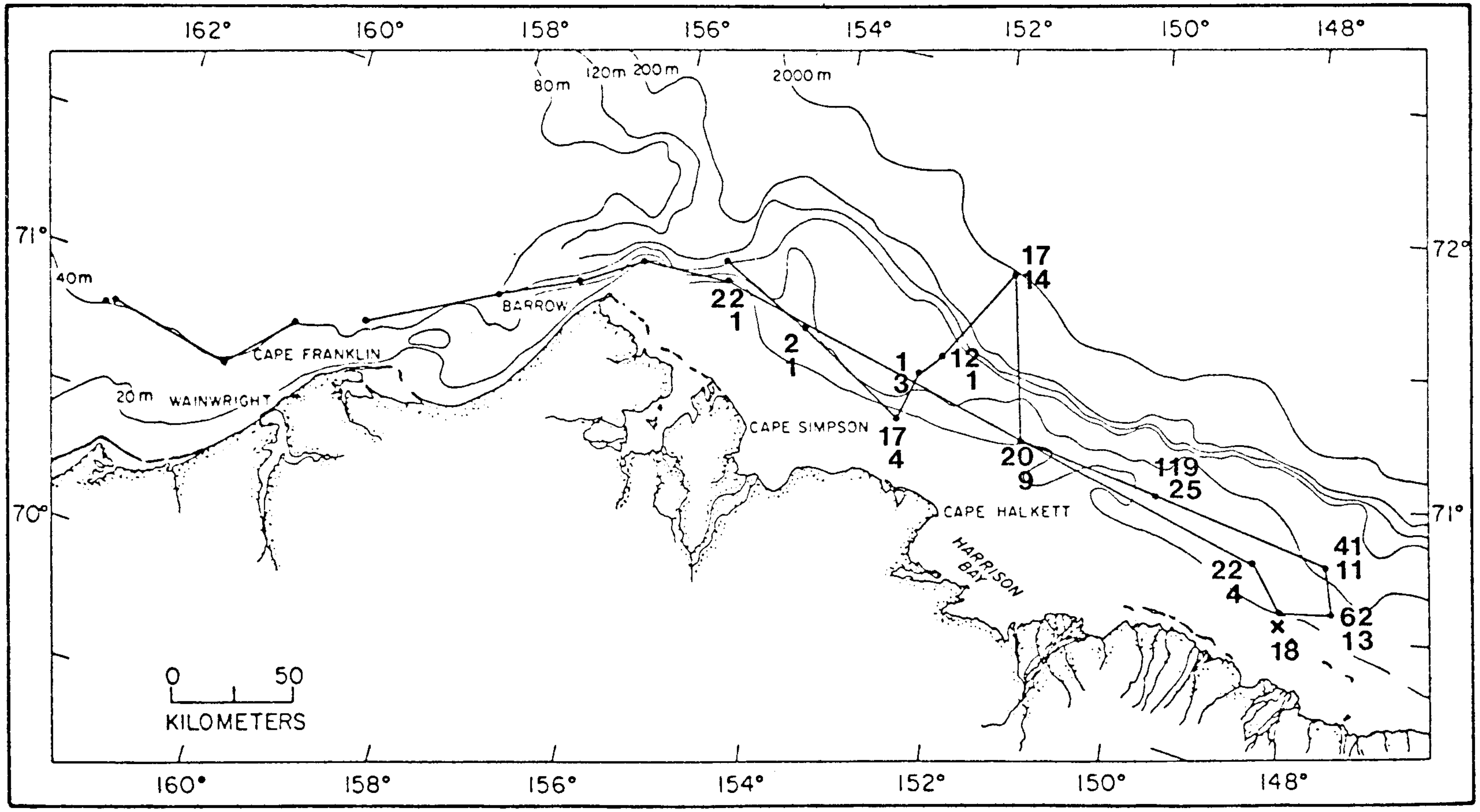

Fig. 25. Abundance of *Pseudocalanus* spp. (number m^2 x 10^2). Upper number represents 20-0 m haul; lower number represents 10-0 m haul. No 20-0 m haul was taken at station 15.

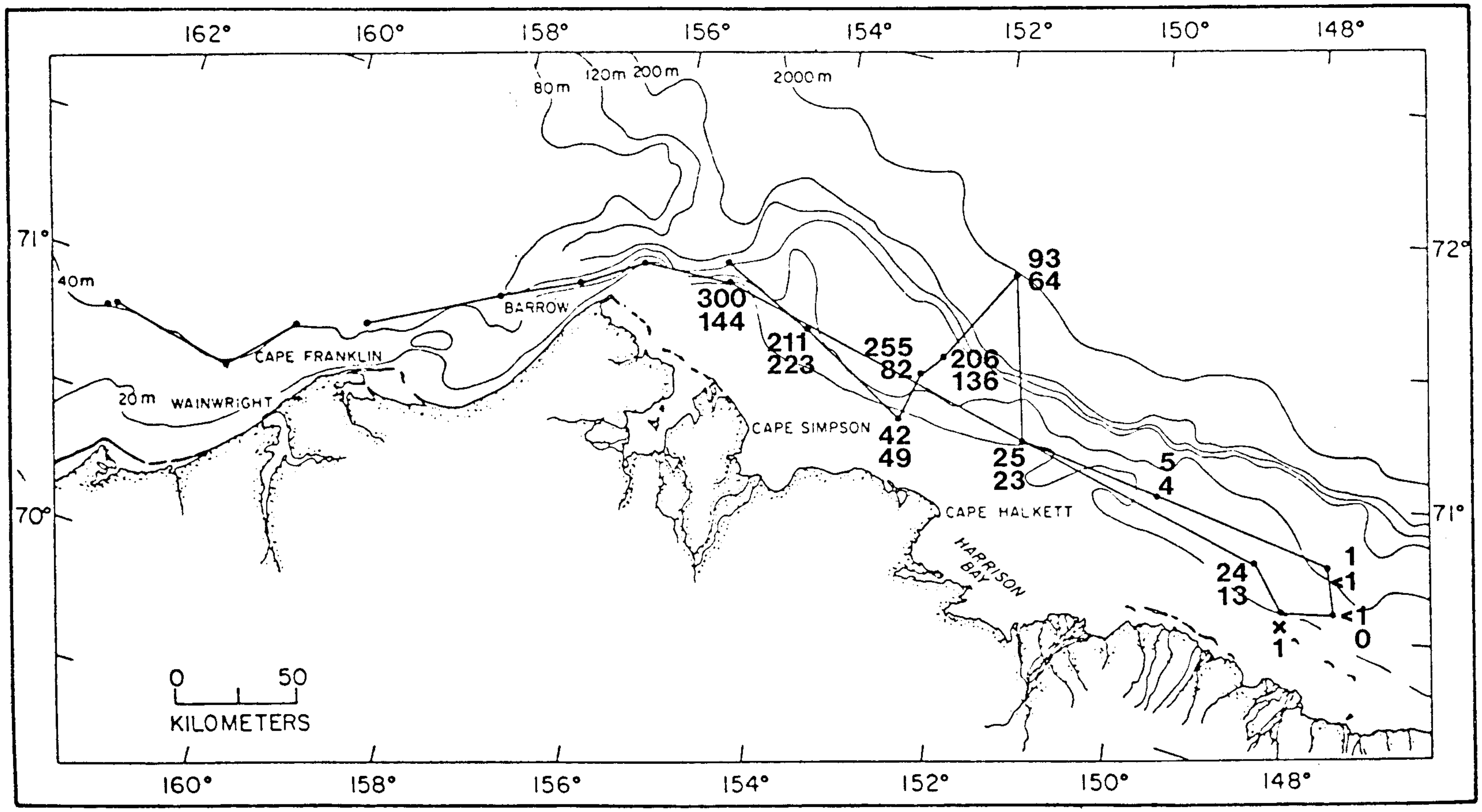

Fig. 26. Abundance of barnacle larvae (number $m^2 \times 10^2$). Upper number represents 20-0 m haul; lower number represents 10-0 m haul. No 20-0 m haul was taken at station 15.

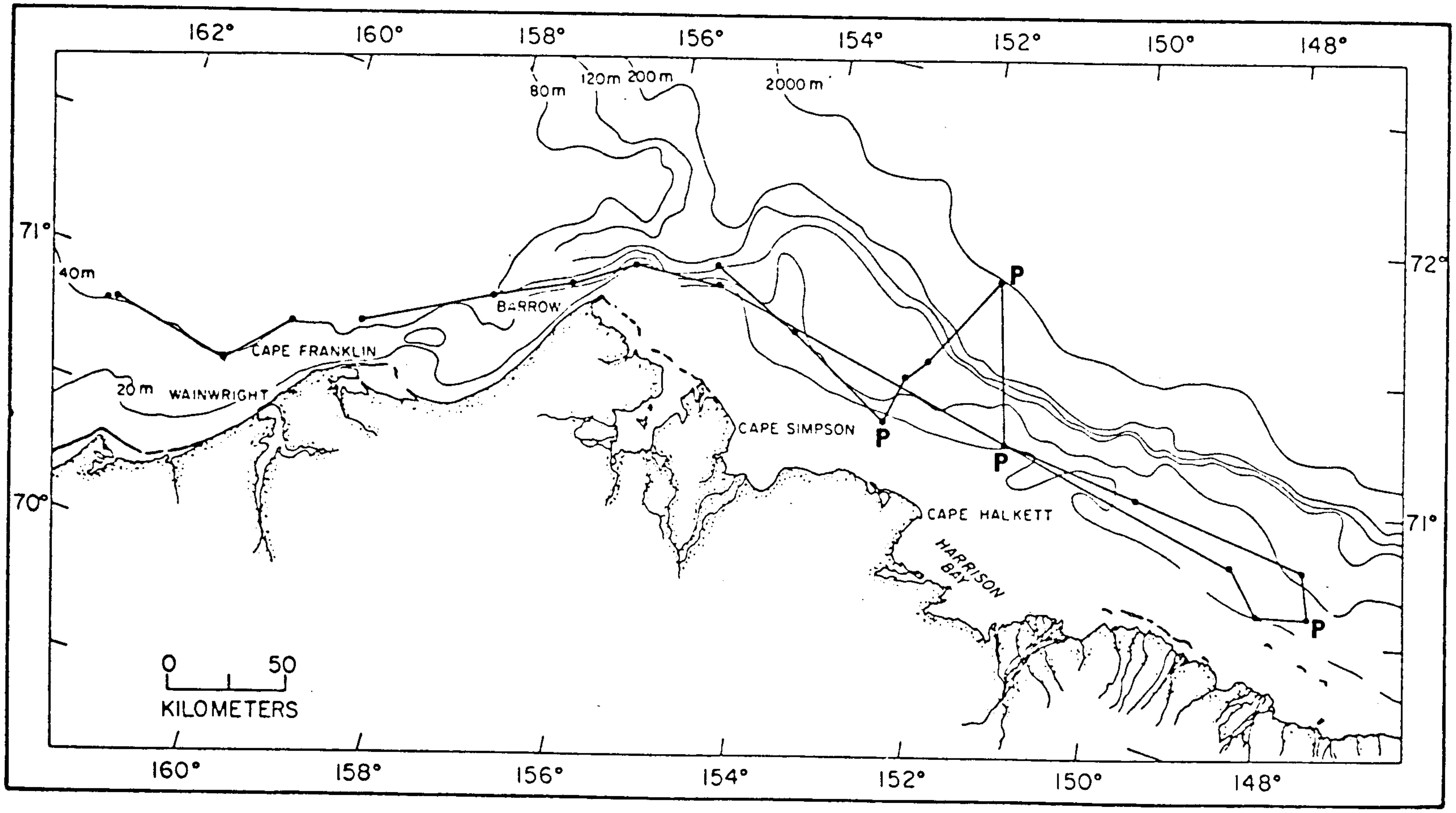

Fig. 27. Stations where *Thysanoessa inermis* was present (P).

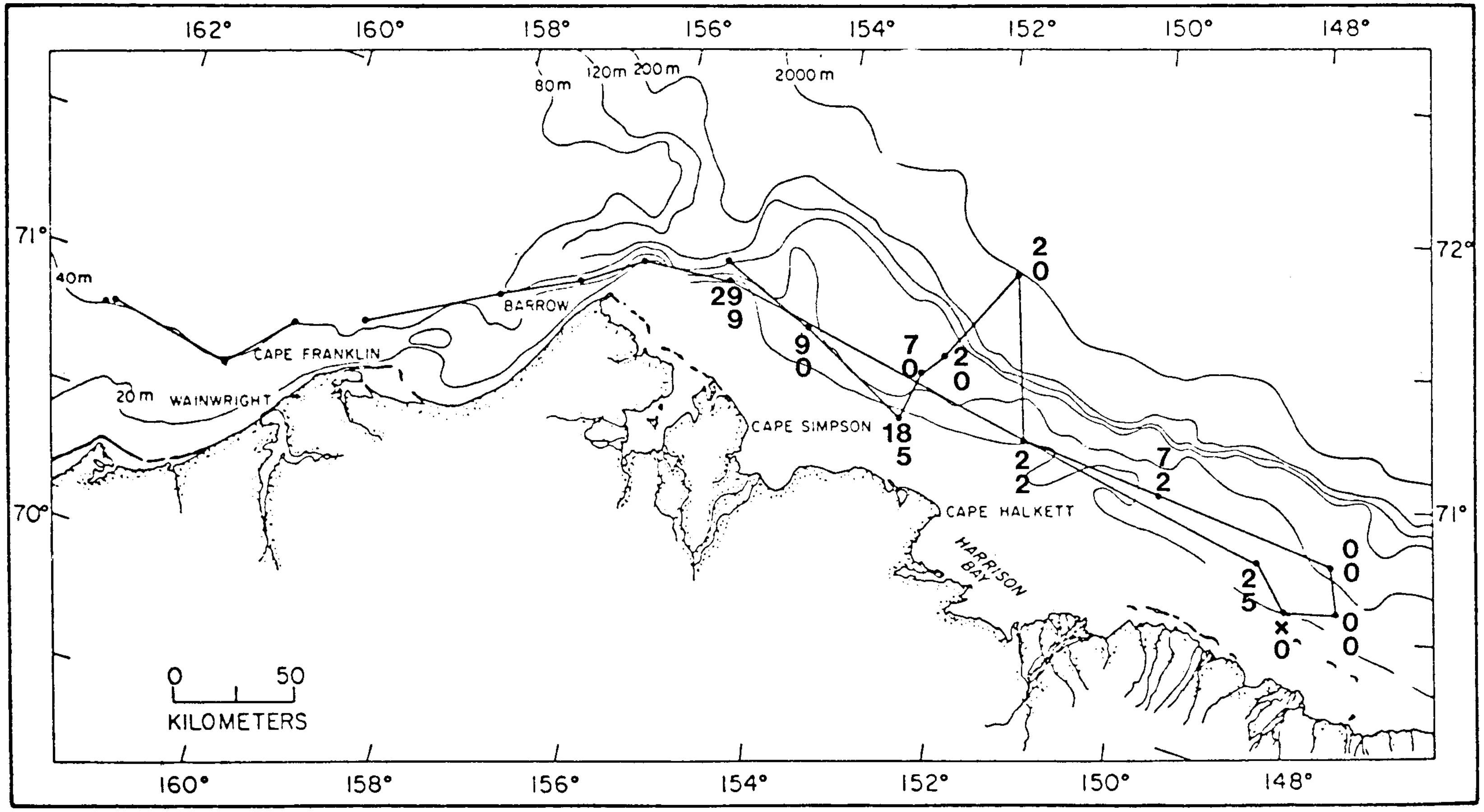

Fig. 28. Abundance of anomuran zoea (number m^2). Upper number represents 20-0 m haul; lower number represents a 10-0 m haul. No 20-0 m haul was taken at station 15.

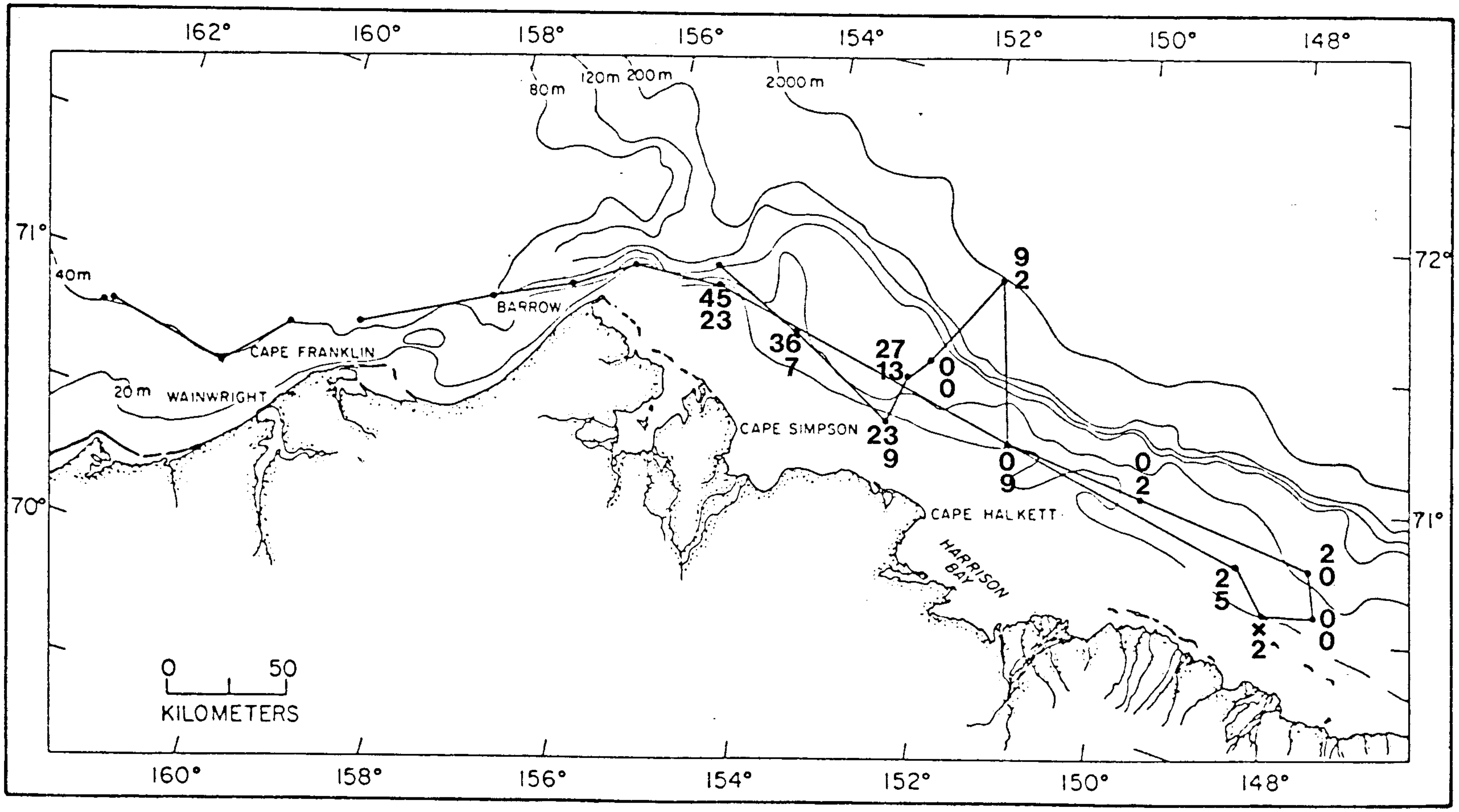

Fig. 29. Abundance of brachyuran zoea (number m2). Upper number represents 20-0 m haul; lower number represents 10-0 m haul. No 20-0 m haul was taken at station 15.

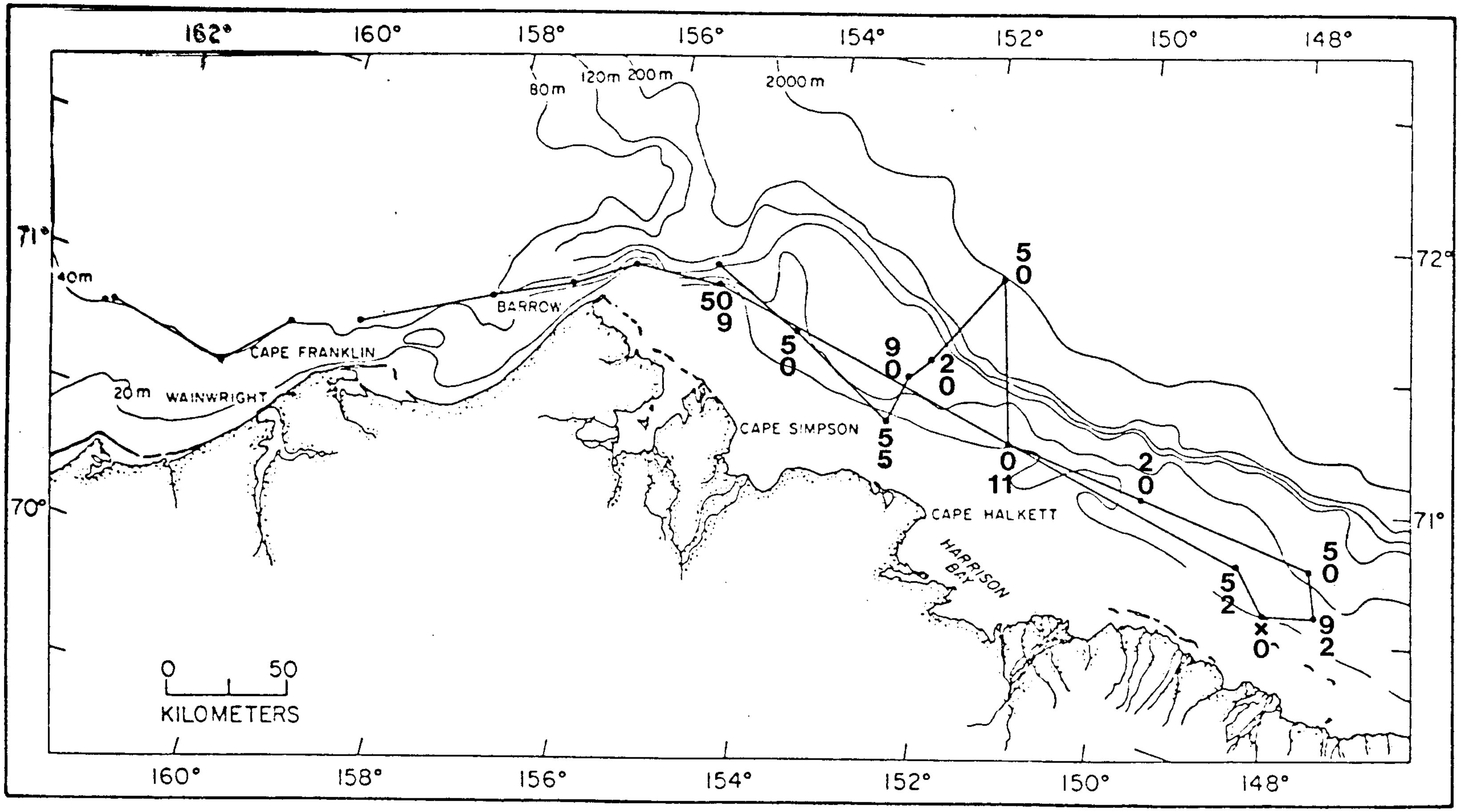

Fig. 30. Abundance of shrimp larvae (number m2). Upper number represents 20-0 m haul; lower number represents 10-0 m haul. No 20-0 m haul was taken at station 15.

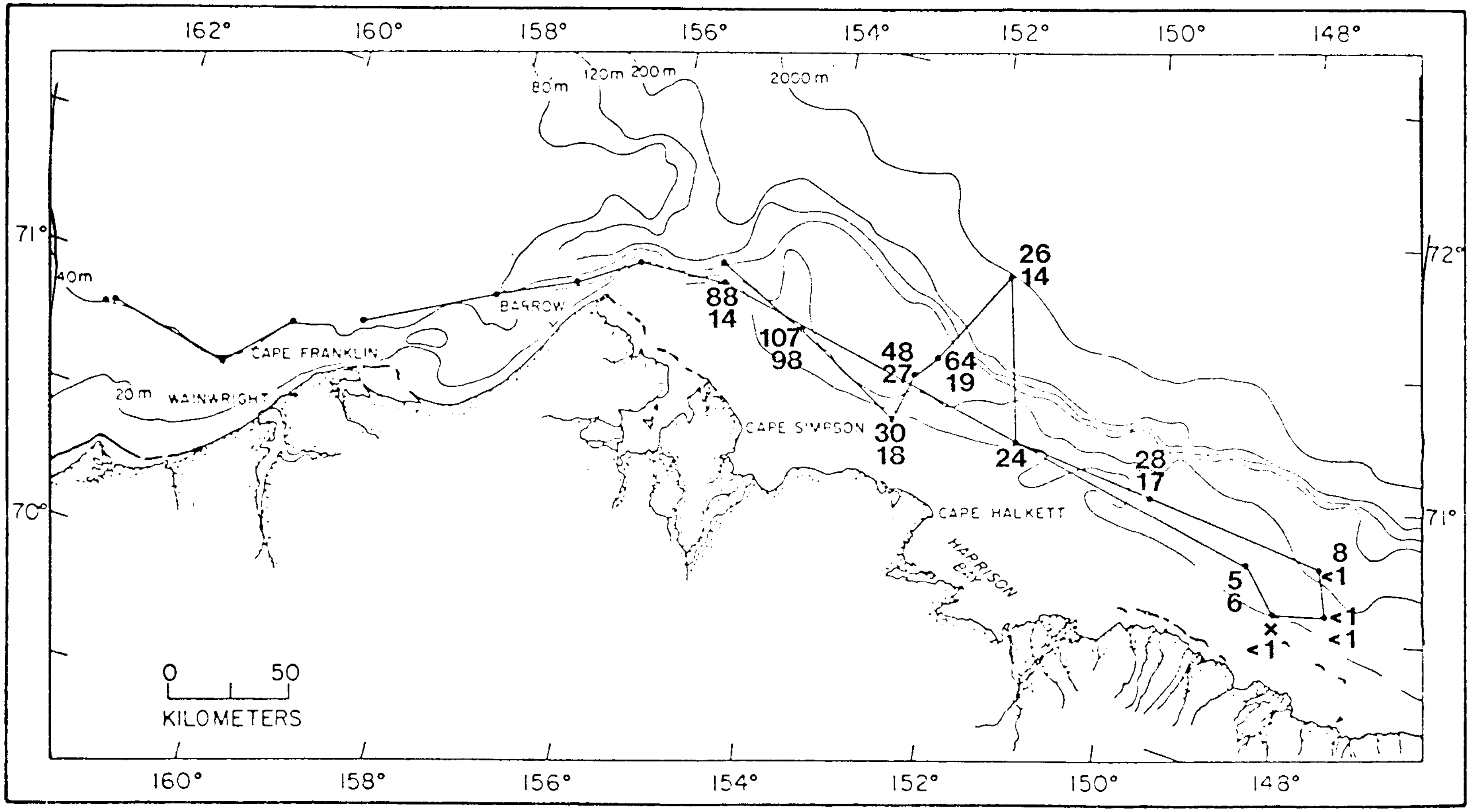

Fig. 31. Abundance of polychaete larvae (number $m^2 \times 10^2$). Upper number represents 20-0 m haul; lower number represents 10-0 m haul. No 20-0 m haul was taken at station 15.

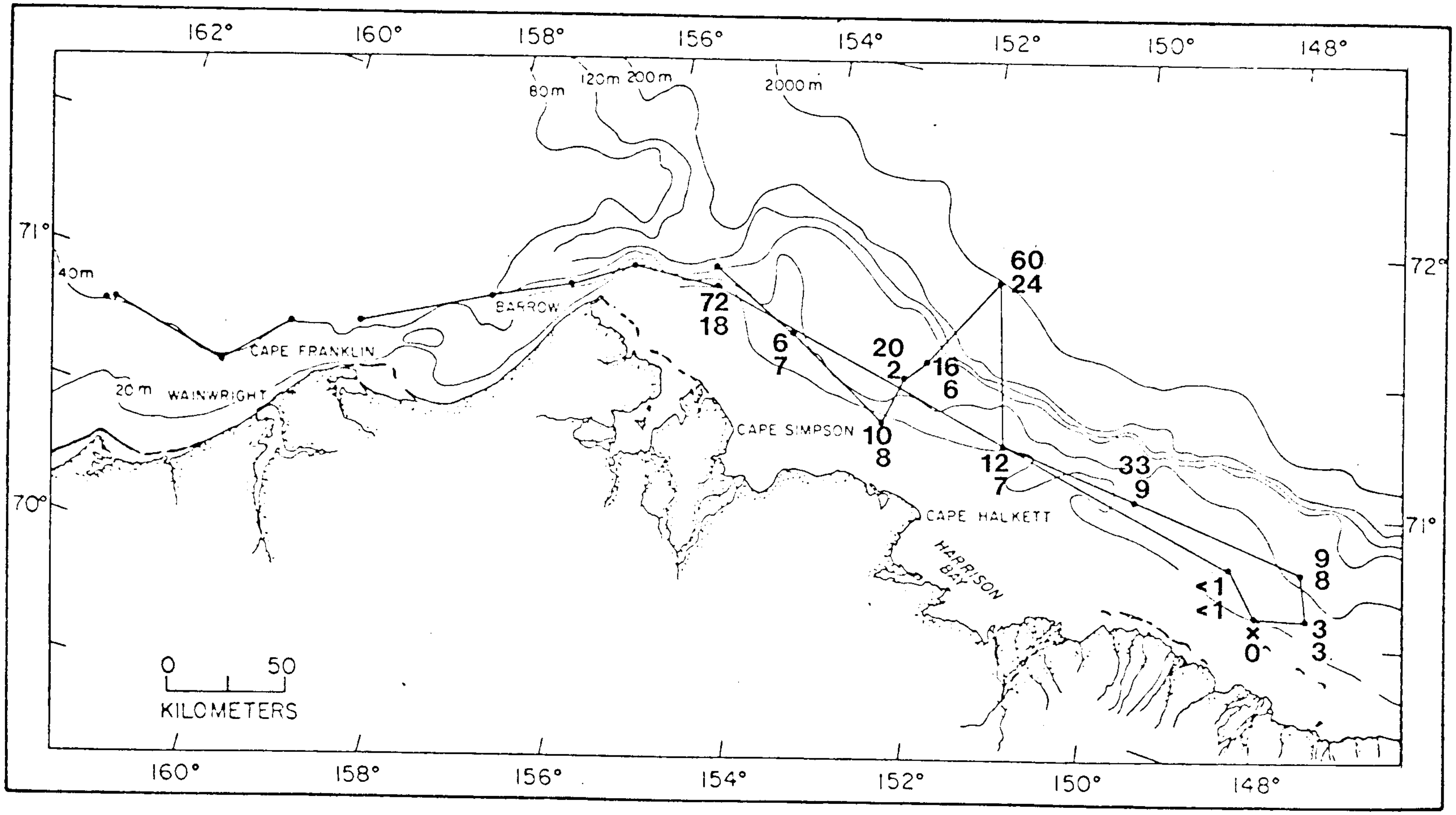

Fig. 32. Abundance of *Fritellaria borealis* (number $m^2 \times 10^2$). Upper number represents 20-0 m haul; lower number represents 10-0 m haul. No 20-0 m haul was taken at station 15.

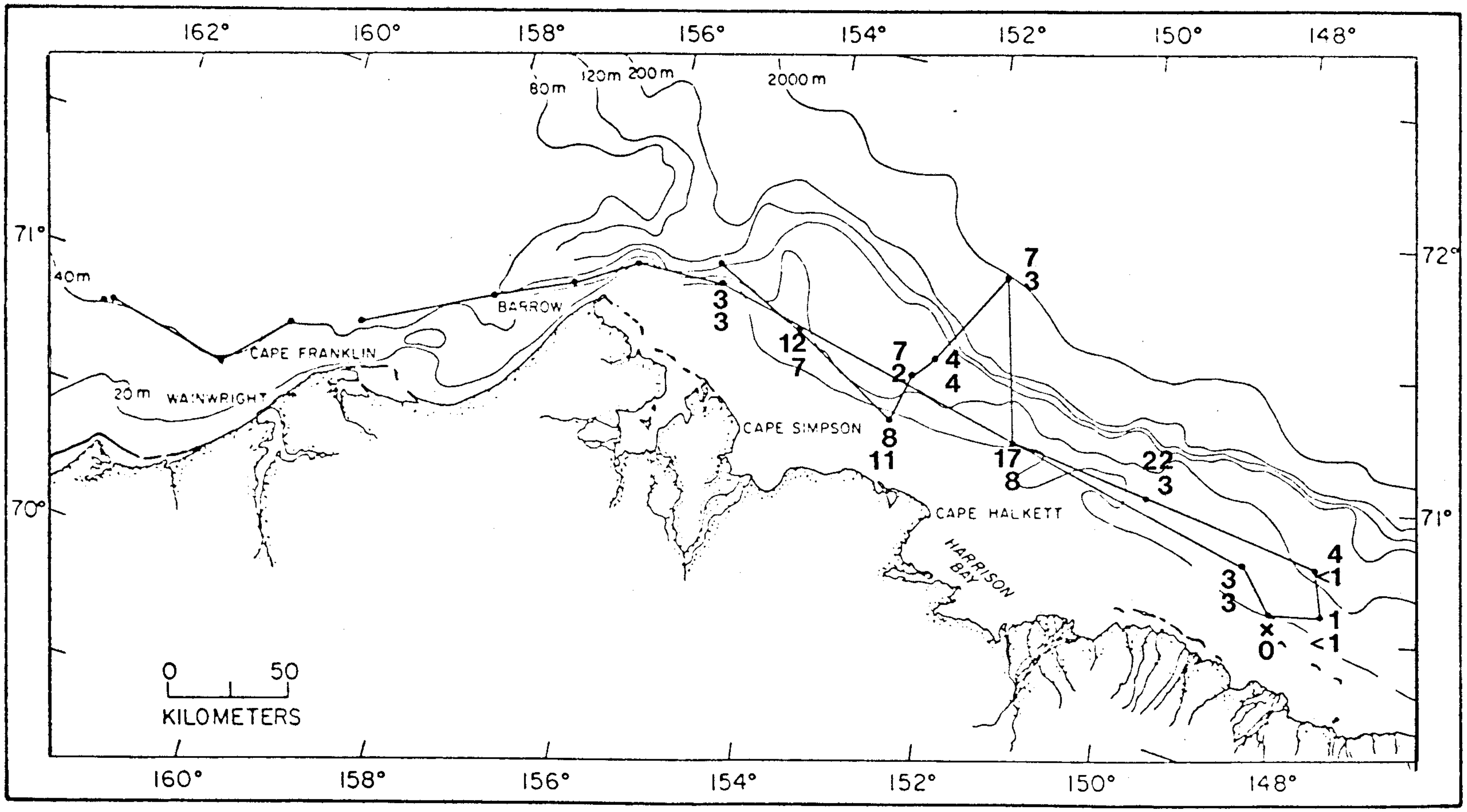

Fig. 33. Abundance of *Oikopleura* spp. (number m^2 x 10^2). Upper number represents 20-0 m haul; lower number represents 10-0 m haul. No 20-0 m haul was taken at station 15.

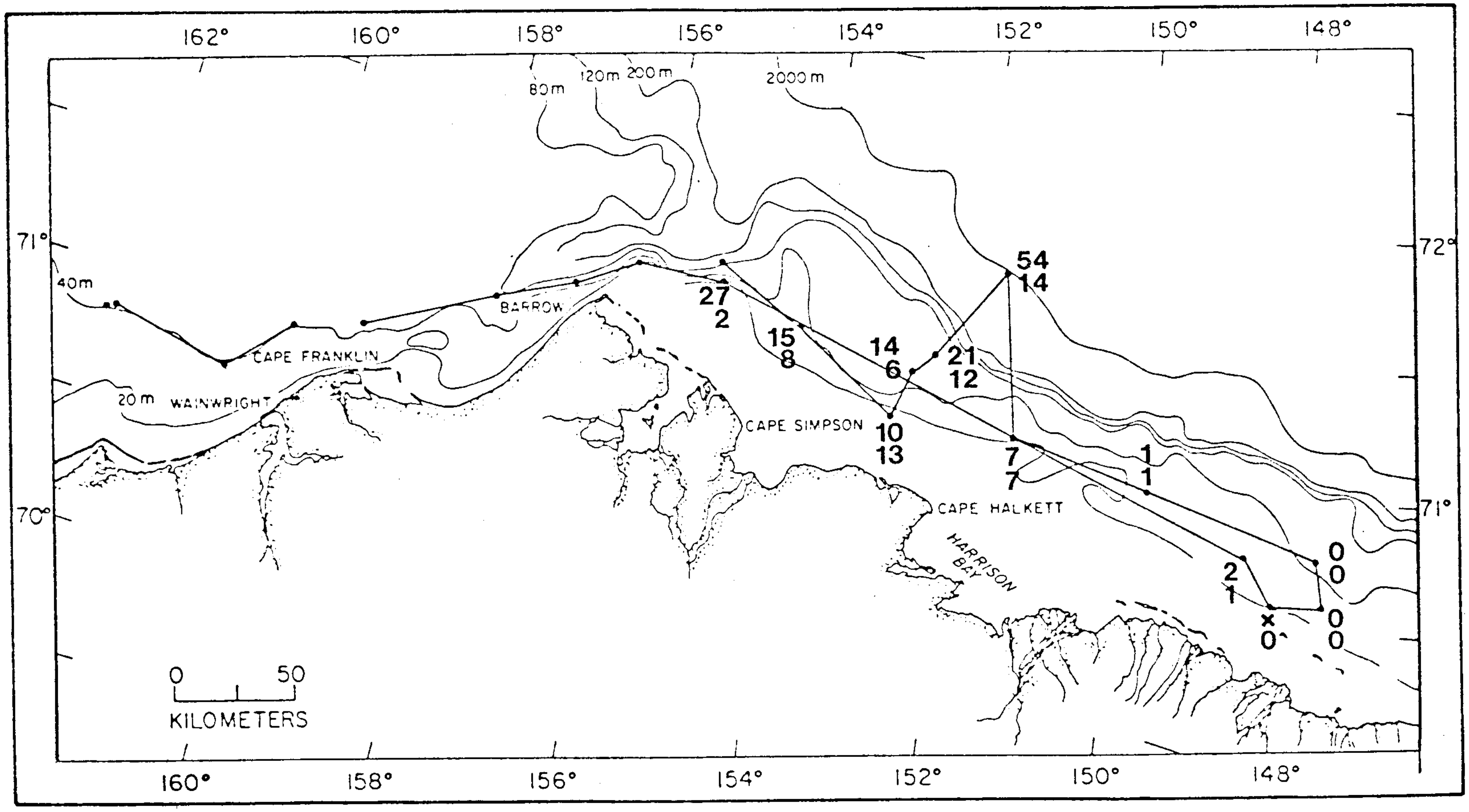

Fig. 34. Abundance of *Sagitta elegans* (number $m^2 \times 10^2$). Upper number represents 20-0 m haul; lower number represents 10-0 m haul. No 20-0 m haul was taken at station 15.

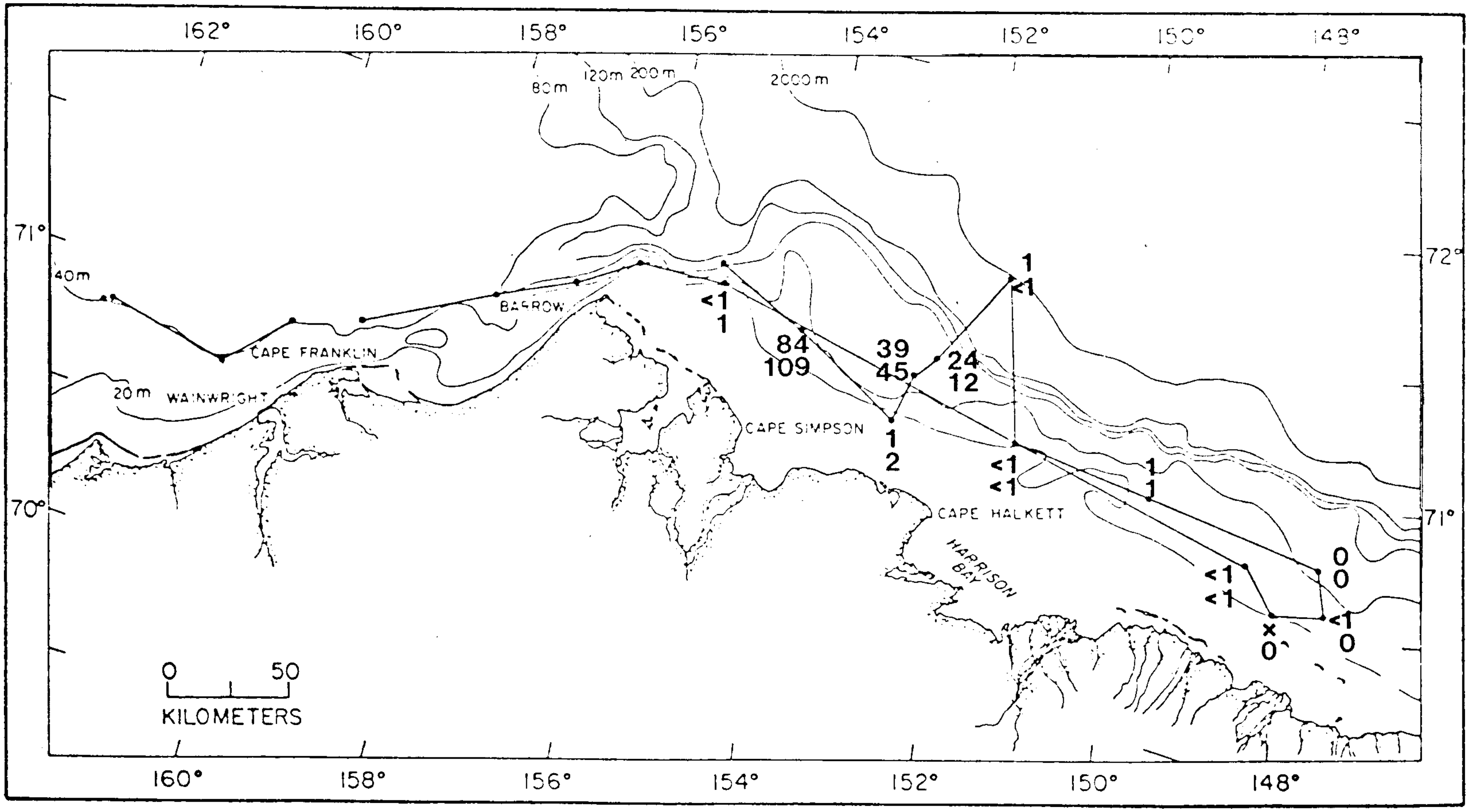

Fig. 35. Abundance of *Aglantha digitale* (number $m^2 \times 10^2$). Upper number represents 20-0 m haul; lower number represents 10-0 m haul. No 20-0 m haul was taken at station 15.

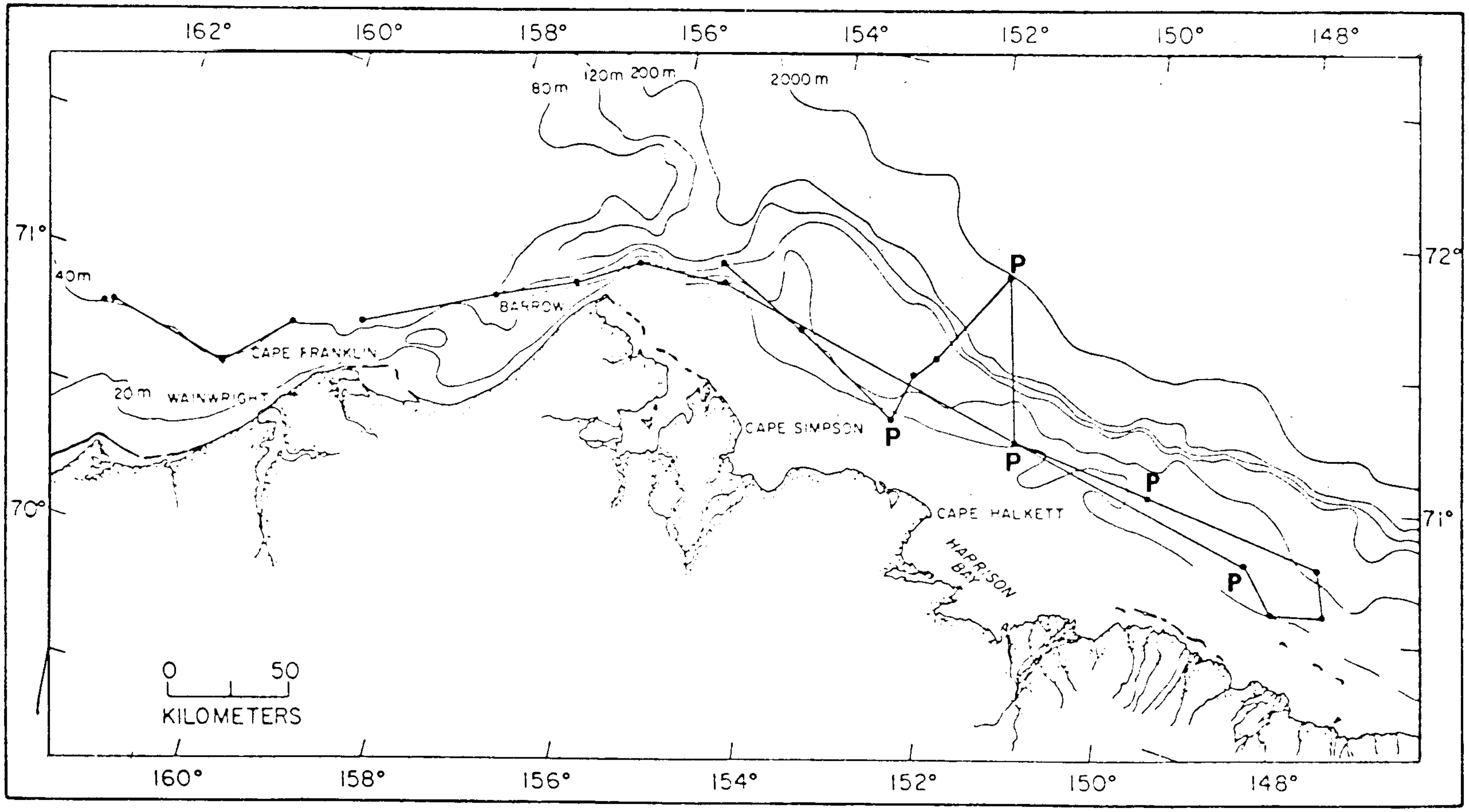

Fig. 36. Stations where *Perigonimus yoldia-arcticae* was present (P).

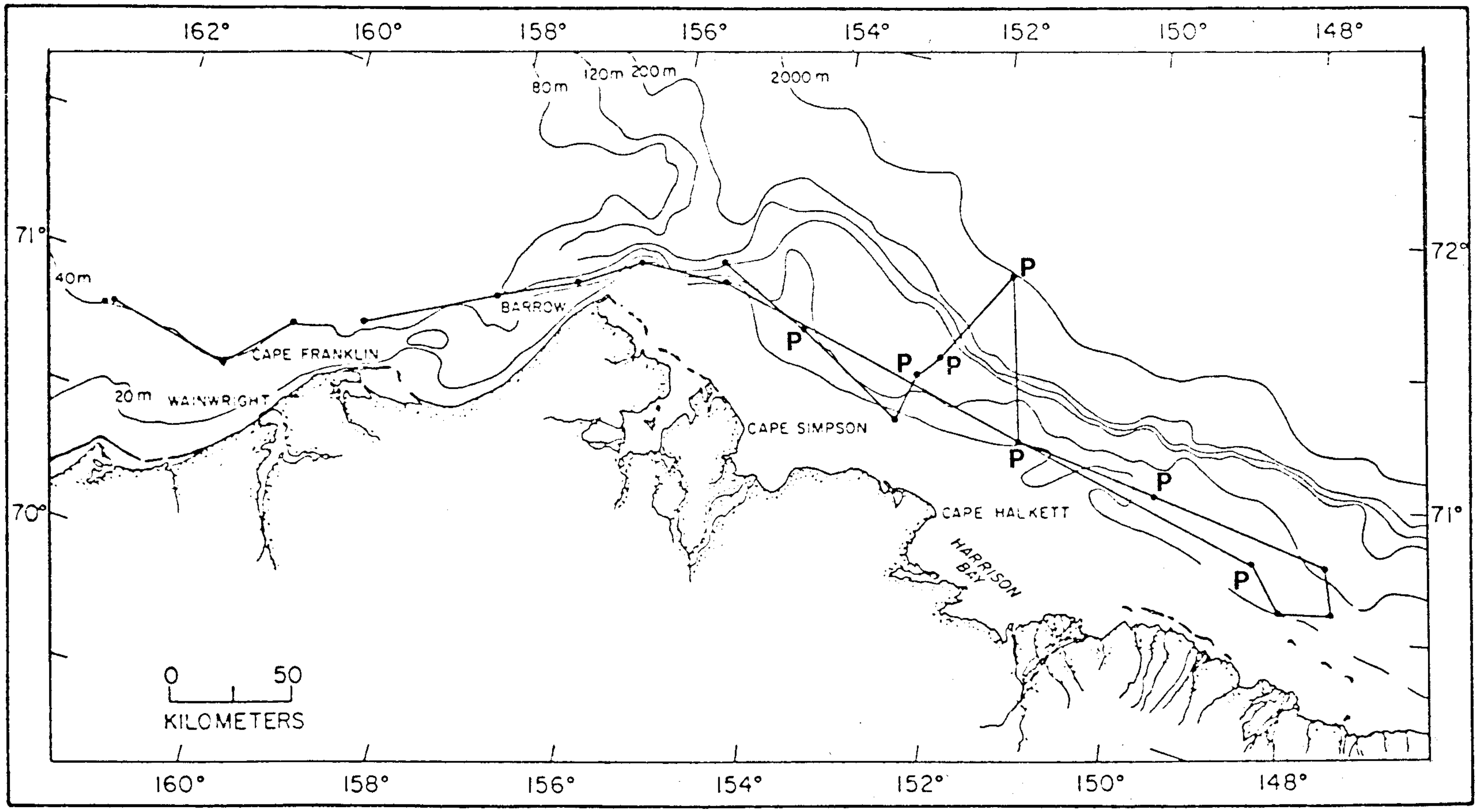

Fig. 37. Stations where *Rathkea octopunctata* was present (P).

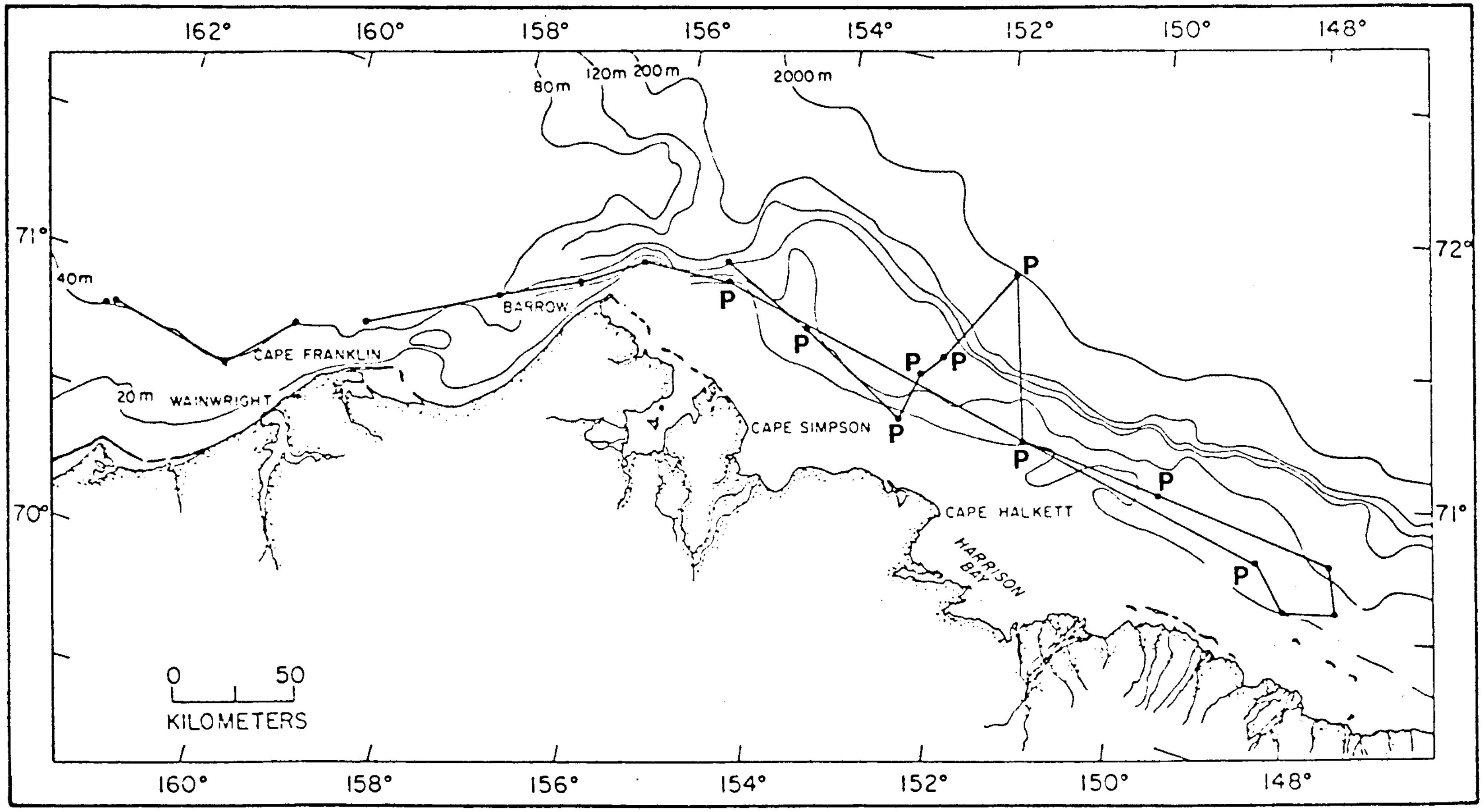

Fig. 38. Stations where *Cyanea capillata* was present (P).

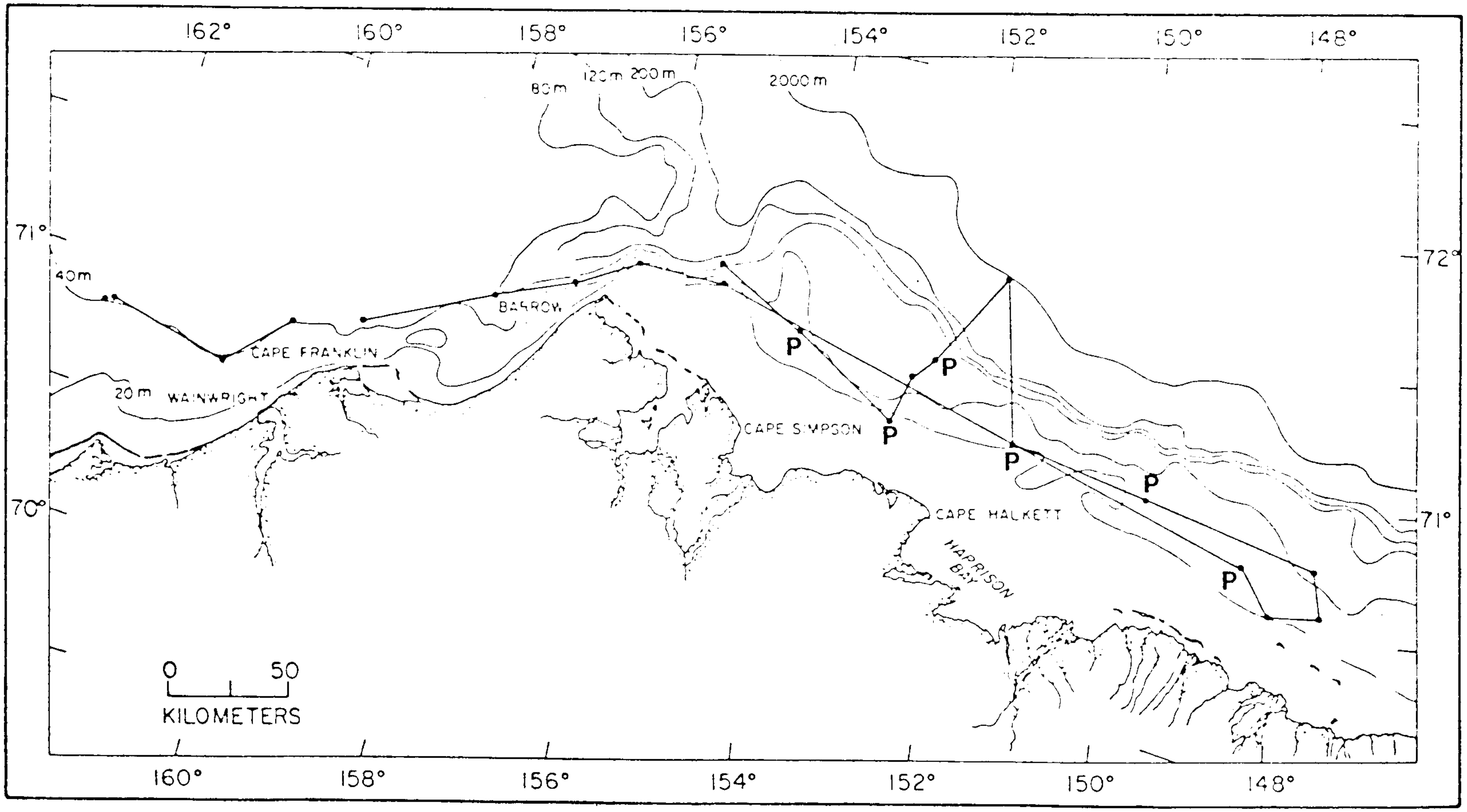

Fig. 39. Stations where *Boreogadus saida* was present (P).

Calanus cristatus Krøyer

This large copepod is abundant in the North Pacific and Bering Sea and is characteristically a bathypelagic species of cold waters (Brodskii 1950). It occurs in the Beaufort Sea as an expatriate from the Bering Sea. It was not present in vertical ring net hauls, but two stage V copepodites were collected in a bongo tow from 20 - 0 m at station 25.

Calanus glacialis Jaschnov

Calanus glacialis was one of three widespread, large, truly arctic calanoid species which occurred at all 12 stations (Fig. 17). Maximum abundances were found at station 19B for both 20 - 0 m and 10 - 0 m hauls. All developmental stages were present with stage II, III and IV copepodites generally most abundant. Adult females were present in small numbers. *Calanus glacialis* appears throughout the water column with large numbers present in the 200 - 0 m haul taken at station 21.

Calanus hyperboreus Krøyer

This large calanoid copepod is one of the dominant copepods of the Arctic Basin, and is usually found in large numbers in deeper water of the central Arctic. The species generally does not occur south of the northern Chukchi Sea (Brodskii 1950).

Calanus hyperboreus was observed at 6 stations, but did not appear in the western-most stations near the Pt. Barrow - Cape Simpson area (Fig. 18). Maximum abundances occurred at station 18 for 20 - 0 m and 10 - 0 m vertical net hauls. Specimens observed were stage I, II, III, and IV copepodites. No stage V copepodites or adult females were found.

Calanus plumchrus Marukawa

Calanus plumchrus is another expatriate member of the Beaufort Sea plankton community usually found in abundance in the Bering Sea. It has been reported in the Pt. Barrow area, but disappeared from the plankton community by mid-August (Redburn 1974). This species was found in 50 - 0 m vertical net hauls only at stations 23 and 24 (Fig. 19). Five stage V copepodites were taken at station 23 while 1 female and 2 stage V copepodites were collected at station 24.

Centropages abdominalis Sato

This copepod appeared in only one sample collected at station 24 in a 20 - 0 m vertical ring net haul. Only stage V copepodites were observed. *Centropages abdominalis* is a neritic species at times abundant in the North Pacific off western Canada, in the Bering Sea, and in the southern Chukchi Sea, and, therefore, is probably indicative of Bering Sea water in the Beaufort Sea.

Derjuginia tolli (Linko)

A neritic species of slightly less saline waters, *Derjuginia tolli* occurred at four stations predominately as stage III, IV, and V copepodites (Fig. 20). No adult females were taken. Maximum abundance was found at station 15 in a 10 - 0 m vertical net haul. The occurrence of this species at station 21 and in samples collected from AIDJEX, 1975, indicate that *Derjuginia tolli* is widely distributed and may show a greater tolerance to higher salinity water than other characteristically neritic species.

Eucalanus bungii bungii Johnson

Only two specimens of this species were collected. At station 21, one adult female was taken in a 100 - 0 m vertical ring net haul while one stage V copepodite was taken from a 50 - 0 m haul at station 24 (Fig. 21). *Eucalanus bungii bungii* is a large copepod expatriated from the Bering Sea.

Euchaeta glacialis Hansen

This large carnivorous copepod is characteristically a deep-water species found in greater abundances in offshore plankton. One adult female and five copepodites (stages IV and V) were taken in a 200 - 0 m vertical ring net haul at station 21. Stage IV copepodites were also present in a 20 - 0 m vertical ring net haul at station 17.

No specimens of *Euchaeta norvegica*, previously reported from this area (Johnson 1956) were collected in either vertical or double oblique net hauls.

Eurytemora richingsi Heron and Damkaer

An unexpected member of the inshore plankton of the Beaufort Sea is *Eurytemora richingsi*. This new species was previously found in three of 54 samples collected from Fletcher's Ice Island (T-3) from May to September, 1968 (Heron and Damkaer 1976). Most of these samples were collected at depths greater than 500 m.

In the *Glacier* samples, one adult female was collected in a double oblique bongo net haul from 20 - 0 m at station 25, providing additional information on the distribution and ecology of this species. Identification was confirmed by Gayle Heron.

Limnocalanus grimaldii (Guerne)

Occurring primarily in the upper 10 m of the water column, this neritic, less saline water species was present in samples from five stations (Fig. 22). Though abundant at eastern stations, it was absent from samples collected at station 15. Maximum abundances were found at station 18 for both 20 - 0 m and 10 - 0 m hauls. Abundances at other stations were much lower. Adult females and males were most numerous, while stage III, IV, and V copepodites were also collected.

Metridia longa (Lubbock)

Metridia longa is primarily a deep-water copepod characteristically found in large numbers offshore at depths between 175 and 300 m, except during winter months when it is found in the upper 50 m of the water column (Tidmarsh 1973). This species was collected at stations 17, 18, and 21, although at station 21 it was collected only in 100 - 0 m and 200 - 0 m vertical ring net hauls. Maximum abundance occurred in the 200 - 0 m hauls at station 21. *Metridia longa* occurred in the upper 10 m of the water column only at station 17, where stage I and II copepodites were collected. Stage IV and V copepodites were most abundant in the deep hauls at station 21. Few adult females were present.

Microcalanus pygmaeus (G. O. Sars)

Microcalanus pygmaeus was found in samples collected at the easternmost stations off Prudhoe Bay only (Fig. 23). Maximum abundances for both 20 - 0 m and 10 - 0 m vertical ring net hauls were found at station 17. Stage V copepodites were most abundant, although adult females and males were also numerous. Stage III copepodites were the youngest developmental stage collected. The species is usually abundant in the offshore waters of the central Arctic.

Oithona similis Claus

Oithona similis was the only cyclopoid copepod collected in the upper 20 m at all 12 stations (Fig. 24). At some stations, it was the most numerous copepod species, reaching a maximum abundance at station 13. The species was poorly represented in samples collected from station 14. All developmental copepodite stages were observed, with stage IV and V copepodites generally most numerous. Adult females were most numerous at station 17, although few were ovigerous. A few adult males were found in some samples.

Oncaea borealis G. O. Sars

This cyclopoid copepod was collected only in the 200 - 0 m vertical ring net haul at station 21. Only adult females were found. *Oncaea borealis* was collected in large numbers in the upper 150 m of the water column from AIDJEX, 1975, and is widespread throughout the Arctic (Sars 1900, 1903).

Pseudocalanus spp.

By far the most abundant copepod category, *Pseudocalanus* spp. was collected at all 12 stations (Fig. 25). Two species, possibly three, comprise this category, but were grouped together in view of current taxonomic revision of the genus and difficulty in identifying juveniles. *Pseudocalanus minutus* (Krøyer) appeared to be the most abundant species. However, *Pseudocalanus major* G. O. Sars, a larger form characteristic of less saline water, was numerous at stations 14, 15, 17, and 18. Johnson (1956) also recognized a larger form but made no attempt to distinguish it from *P. minutus*.

Maximum abundances for *Pseudocalanus* spp. were found at station 19B. Stage III and IV copepodites predominated in the Prudhoe Bay area, while stage IV and V copepodites were numerous in other areas. Other developmental stages, including adult males, were collected, but in fewer numbers. More adult females were found in deeper hauls from station 21, but none was ovigerous.

Scaphocalanus magnus (Scott)

A widespread species, *Scaphocalanus magnus* occurs primarily in water deeper than 50 m. Only two specimens, an adult female and a stage V copepodite, were collected in the 200 - 0 m haul at station 21.

Unidentified copepoda

Two species of calanoid copepods could not be identified. One species appeared to belong to the family Aetideidae and was especially prevalent at stations 15 and 18. Only stage III, IV, and V copepodites were collected. One species of cyclopoid copepod could not be identified because of small size and damaged specimens. Two species of harpacticoid copepods were collected, but no attempt was made to identify them to genus and species. Harpacticoids were collected from all stations except station 17.

Copepod nauplii

Copepod nauplii were collected at all stations with the exception of station 15. Maximum abundances were found at stations 13 and 19B. Most specimens collected were greater than 0.4 mm, although a large number of nauplii less than 4 mm were collected in samples containing large amounts of phytoplankton. This is in part reflected in those stations showing maximum abundances.

CIRRIPEDIA

Nauplii and cyprid larvae of *Balanus* spp. were abundant at most stations, often comprising the largest percentage of the total zooplankton in the upper 20 m, except at Prudhoe Bay where they were poorly represented (Fig. 26). Maximum abundances for nauplii were found at station 13, while maximum abundances for cyprids were found at station 26, two weeks later. Redburn (1974) suggested that the developmental period between nauplius and cypris stage in the Barrow area was 31 days.

Balanus crenatus Bruguière and *Balanus balanus* Linnaeus have been reported in the Barrow area with *B. crenatus* being the most abundant (MacGinitie 1955).

EUPHAUSIACEA

Three species of euphausids were collected during the two-week sampling period. Although few numbers were present in our samples, euphausids are apparently an important part of the diet of the marine birds and mammals of the area.

Thysanoessa inermis (Krøyer)

This species was the only euphausid caught in vertical ring net hauls. It was found at four stations, although never more than one individual was caught at a station (Fig. 27). Specimens collected were approximately 15 to 17 mm long. No specimens were collected in 10 - 0 m vertical net hauls. Johnson (1956) reported *T. inermis* at three stations in the Chukchi Sea, but not in the Beaufort Sea.

Thysanoessa raschii (M. Sars)

Thysanoessa raschii was caught only in a bongo tow from 20 - 0 m at station 25. Nine specimens were caught in the two nets, giving a concentration of 27/100 m^3. Specimens caught ranged from 14 to 17 mm in size. Johnson (1956) reported *T. raschii* to be the predominant euphausid of the area.

Thysanoessa longipes Brandt

One 14 mm specimen was collected in the 20 - 0 m double oblique bongo tow at station 25.

Thysanoessa spp. larvae

Thysanoessa spp. nauplii and calyptopid larvae were collected at stations 21, 23, 24, and 26, but were never very abundant.

OSTRACODA

Two species of ostracods were found. Johnson (1956) reported that ostracods of the area prefer deeper water.

Conchoecia borealis maxima Brady and Norman.

Ten specimens were collected at station 21 in the 200 - 0 m vertical ring net haul.

Philomedes globosus (Lilljeborg)

One specimen was collected in the 20 - 0 m vertical net tow at station 23.

CLADOCERA

One unidentified member of the family Polyphemidae was collected in the 20 - 0 m vertical ring net haul at station 25. This specimen was either *Podon leuckarti* G. O. Sars or *Evadne nordmanni* Loven, both of which are characteristically found inshore in less saline waters.

MYSIDACEA

Two species of mysids were collected although adults and larger juveniles were caught in the bongo net hauls only.

Mysis litoralis (Banner) and *Mysis oculata* (Fabricius) were present in bongo net hauls from stations 20 and 25. Small *Mysis* spp. juveniles were present in vertical ring net hauls from stations 20 and 21. No gravid females of either species were found.

DECAPODA

The decapods were divided into three categories: anomuran crab zoea, brachyuran crab zoea, and caridea or shrimp larvae. Decapod larvae were never very abundant relative to other zooplankton categories, but were generally widespread throughout the sampling area.

Anomuran zoea were represented primarily by members of the family Paguridae, although Redburn (1974) reported larvae of the king crab, *Paralithodes camtschatica* (family Lithodidae) near Pt. Barrow. Maximum abundances were found at station 13 in 20 - 0 m and 10 - 0 m hauls (Fig. 20). Anomuran zoea were absent from stations 15, 17, and 18 in the Prudhoe Bay area.

Brachyuran zoea were generally the most abundant decapods throughout the area, although relatively few were present in stations toward the east (Fig. 29). These zoea were represented primarily by members of the family Majidae and were probably the zoea of the snow crab, *Chionoecetes opilio* (O. Fabricius). No megalopa larval stages were found in the *Glacier*-76 samples.

Caridea, or shrimp larvae, were found at all stations except station 15 (Fig. 30). This category appeared to be primarily represented by members of the family Hippolytidae. Maximum abundances were found at stations 13 and 20. The large size, up to 10 mm, make these larvae prey for marine vertebrates in offshore areas where other prey are not available (Frost personal communication).

AMPHIPODA

Amphipods were grouped into two taxonomic categories, suborders Gammaridea and Hyperiidea. No attempt was made to identify specimens to genus and species.

Gammaridea

The gammarid amphipods were represented by three or four species, most of which occur in the top 10 m of the water column as under-ice organisms. Gammarid amphipods were collected at all 12 stations sampled, with maximum abundances found at station 20. No gravid females were collected.

Hyperiidea

Only one species was found representing this category. It was absent from all of the 10 - 0 m vertical net hauls, and was most abundant at station 14 in the 20 - 0 m vertical net haul.

POLYCHAETA

Pelagic larvae of polychaetes contributed a great deal to the meroplanktonic component of the zooplankton throughout the area, being second in importance to barnacle larvae. Polychaete larvae composed of trochophores, intermediate and late larval stages were present at all 12 stations, although in fewer numbers at the eastern stations (Fig. 31). Maximum abundances were found at station 26 for vertical net hauls.

Redburn (1974) reported that members of the families Phyllodocidae, Syllidae, and Polynoidae were abundant in the plankton off Pt. Barrow.

APPENDICULARIA

Fritellaria borealis Lohmann

One of two species found in the sampling area, *Fritellaria borealis* showed a widespread distribution, occurring at all stations except station 15 (Fig. 32). This small species showed maximum abundances at stations 13 and 21.

Oikopleura spp.

Questionable taxonomic characteristics resulted in grouping members of this larger appendicularian genus into one category. Although trunk lengths exceeded those of *Oikopleura labradoriensis* Lohmann, gastrointestinal characteristics did not match those of *Oikopleura vanhoeffeni* Lohmann.

Oikopleura spp. showed a widespread distribution, being absent only at station 15 (Fig. 33). Maximum abundances were found at stations 19B and 25. Most specimens collected were immature.

CHAETOGNATHA

Sagitta elegans Verrill

Sagitta elegans was the only chaetognath species collected during the sampling period. It was widely distributed throughout the area, although absent or sparse at those stations located near Prudhoe Bay (Fig. 34). Maximum abundances occurred at stations 13 and 21. Most specimens were immature, although mature specimens were always present. *Sagitta elegans* apparently did not occur at depths greater than 50 m at station 21.

CNIDARIA

Hydrozoa

Eight species of hydrozoa were collected in the sampling area, including one unidentified species. Only two species were present in appreciable numbers and were widespread in distribution.

Aeginopsis laurentii Brandt

A common circumpolar species, *Aeginopsis laurentii* was found in samples from only two stations. One 8 mm specimen was taken in a 10 - 0 m haul at station 18 while a 9 mm specimen was collected in a 20 - 0 m haul at station 20. *Aeginopsis laurentii* is a holoplanktonic hydrozoan spending its entire life in the plankton.

Aglantha digitale (Müller) var. *camtschatica* (Brandt)

This holoplanktonic species was by far the most numerous hydrozoan medusa. It occurred at 10 stations, primarily in the upper 10 m, although it was poorly represented in samples collected in the Prudhoe Bay area (Fig. 35). Maximum abundances were observed at station 26 for both 20 - 0 m and 10 - 0 m vertical net hauls. Stations 23, 24, and 26 showed large numbers of small, immature specimens, while at other stations, larger juveniles and mature specimens predominated.

Bougainvillia superciliaris (L. Agassiz)

This species was absent from all of the vertical ring net samples. One immature specimen was collected in a 10 - 0 m bongo net tow at station 20. Polyp colonies generally occur at depths of 1 to 17 m (Naumov 1960).

Corymorpha flammea Linko

Corymorpha flammea was poorly represented in the zooplankton of the area, occurring at only two stations. One immature medusa was collected at station 17 in a 20 - 0 m vertical haul, while another immature medusa was taken from the 100 - 0 m vertical haul at station 21.

Perigonimus yoldia-arcticae Birula

This hydrozoan medusa was found at five stations although in few numbers (Fig. 36). Maximum abundance was $7/m^2$ in a 20 - 0 m haul at station 14. At station 25, the species was taken in a bongo tow from 20 - 0 m.

Plotocnide borealis Wagner

A rare species, one immature medusa was collected in a vertical ring net haul from 10 - 0 m at station 19B. The polyp generation of this species is unknown (Naumov 1960).

Rathkea octopunctata (M. Sars)

This species was second in abundance to *Aglantha digitale* and was found in samples collected at seven stations (Fig. 34). Maximum abundances were found at stations 23 and 26. No mature specimens were found.

Unidentified hydrozoa

Included in this category are specimens too damaged to be identified. However, one immature specimen taken from a 50 - 0 m vertical ring net haul at station 21 might be *Coryne princeps* (Haeckel).

Scyphozoa

Cyanea capillata (Linnaeus)

Cyanea capillata was the only scyphozoan found in samples collected from the sampling area. The species was sparsely present at nine stations, and was absent in samples collected in the Prudhoe Bay area (Fig. 38). Maximum abundances were found at stations 4 and 6. Although capable of reaching 500 mm, specimens collected were 8 to 30 mm in diameter. The distribution of this species may be of some importance, as an association between it and the arctic cod *Boreogadus saida* has been suggested (Redburn 1974).

CTENOPHORA

Two species of ctenophores were found in samples collected from the area. However, one species remains unidentified because of the poor condition of preserved specimens. A quantitative analysis of the abundance of species of this phylum is difficult because of the poor preservation. Only complete or nearly complete specimens were counted.

Beroe cucumis Fabricius

Although present at four stations, *Beroe cucumis* was most abundant at station 14.

Unidentified ctenophores

Two unidentified ctenophores were found in vertical ring net samples collected at stations 21 and 23 and bongo net tows at stations 20 and 25.

MOLLUSCA

Spiratella helicina (Phipps)

This pteropod species was the most abundant and widespread representative of the Mollusca in the zooplankton population. It was present in samples collected from 10 stations. Maximum abundances were found at stations 17 and 18. Most specimens were small, generally < 0.5 mm, although larger pteropods, 1 to 2 mm, were also present.

Unidentified larvae

Two categories of molluscan larvae were distinguished: lamellibranch or bivalve larvae and gastropod veligers.

Lamellibranch larvae were abundant at times although primarily below 10 m. Maximum abundances were found at stations 13, 21, 23, and 24. Lamellibranch larvae were found at eight of the 12 stations sampled.

Gastropod veligers were present in samples collected from six stations. Maximum abundances were found at stations 24 and 26.

ECHINODERMATA

This phylum was represented in the zooplankton samples by plutei larval stages of ophiuroids (brittle stars) and echinoids (sea urchins). Bipinnaria larvae were also found. Echinoderm larvae were present in samples collected from 10 stations with maximum abundances occurring at station 18 where large numbers of ophioplutei were the only echinoderm larvae encountered.

PISCES

Three or possibly four species of fish larvae were encountered in the sampling area, two of which were found only in bongo net samples from station 20. No fish eggs were collected.

Boreogadus saida (Lepechin)

The arctic cod *Boreogadus saida* was the most abundant and widespread fish larva observed. It occurred in vertical ring net samples at stations 14 and 19B in 20 - 0 m hauls, and at stations 23 and 26 in 10 - 0 m hauls (Fig. 39). No more than one larva was caught in any one vertical net haul. Specimens ranged from 11 to 14 mm in length.

Boreogadus saida was also caught in bongo net tows at stations 20 and 25. Seven larvae ranging from 9 to 16 mm were caught in a double oblique haul from 10 - 0 m at station 20. Seven larvae, caught at station 25 in a double oblique haul from 20 - 0 m, ranged in size from 14 to 18 mm.

Lumpenus sp.

This fish larva was present only in the bongo net tow at station 20 where 4 larvae were caught in a 10 - 0 m haul. Larvae were 15 to 16 mm in length.

Unidentified Cyclopteridae

This species, probably *Liparis* sp., was caught in bongo net tows at stations 20 and 25. One 17 mm larva was caught in the 10 - 0 m haul at station 20, and a 28 mm specimen was collected in the 20 - 0 m haul at station 25.

Unidentified Gadidae

This category was represented at station 25 in vertical ring and bongo net hauls with one 19 mm larva collected in a 20 - 0 m ring net haul and two larvae, 21 and 24 mm, collected in the bongo net haul from 20 - 0 m. These fish larvae may be *Boreogadus saida*, although pigment patterns on these specimens do not match those described for this species.

VII. Discussion

A. Prudhoe Bay

Adverse ice conditions in the summer of 1975 prevented plankton sampling except for a fairly intensive program in September within Prudhoe Bay and in the lagoon area between Prudhoe Bay and the Midway Islands.

Carbon assimilation and chlorophyll *a* concentrations were generally variable throughout the study area except that higher values were usually found in deeper water, which agrees with the findings of Horner *et al.* (1974). Standing stock was also variable. *Chaetoceros furcellatus*, unidentified pennate diatoms, and unidentified flagellates were the most common organisms present. The pennate diatoms appeared to be species usually associated with the ice and comprising a large part of the ice algae community in spring. *Chaetoceros furcellatus* is also considered to be a spring species and frequently occurs with resting spores during ice breakup. Several species of the genus *Thalassiosira* were also present and are usually spring species. It appears that the phytoplankton community sampled in September 1975 consisted of species characteristic of the spring bloom that usually occurs about the time of ice breakup.

Other indications that the spring bloom was occurring in September were the relatively high nutrient concentrations, suggesting that the phytoplankton had not yet utilized the nutrients. The average nitrate plus nitrite concentration was about twice as high as that reported by Horner *et al.* (1974) for August 1972.

Horner *et al.* (1974) reported the presence of three phytoplankton communities within the Prudhoe Bay area. No such specific communities were found in this study. The most common taxa were distributed throughout the area and in the water column.

Annual variation in species composition, distribution and production in the shallow bay and the lagoon area inside the barrier islands in the Prudhoe Bay area is apparently a function of local weather and ice conditions along with available nutrient concentrations.

B. USCGC *Glacier*

1. Phytoplankton standing stock and productivity

Nearly all the species reported for the Chukchi and Beaufort seas (Bursa 1963, Horner 1969, Coyle 1974, Horner *et al.* 1974, Hsiao 1976) are common and widespread in north temperate and subarctic (as defined by Dunbar 1968) waters. Many species, especially pennate diatoms and flagellates, are only found in the epontic ice community in spring (Horner 1976) and are not listed in Table 6. Some species, including *Nitzschia frigida* Grunow and *Nitzschia grunowii* Hasle, are found in ice and in the water column. *Nitzschia frigida* is a dominant member of the ice community and is occasionally found in the water column, while *Nitzschia grunowii* is often a major component of the spring phytoplankton bloom in the water column.

Another major component of the spring bloom in the water column is *Porosira glacialis* (Grunow) Jørgensen, which was not common in the *Glacier*-76 samples. *Thalassiosira antarctica* Comber was present at stations 15, 17, and 18 near Prudhoe Bay. These two species have been tentatively called bipolar species by Hasle (1974) because they are found in extreme inshore waters or near ice in both polar regions. This distribution is difficult to explain, although Smayda (1958) suggested that bipolar distribution could be explained only if the species were cosmopolitan. Obviously more samples from low latitude oceanic areas must be examined before any decisions can be reached.

Chaetoceros furcellatus, *Ch. wighami*, included in *Chaetoceros* spp., and *Ch. septentrionalis* often occur in the water column either in spring or associated with ice. *Chaetoceros atlanticus*, *Ch. compressus*, *Ch. concavicornis*, *Ch. decipiens*, and *Ch. subsecundus* commonly occur in the Barrow area in summer.

Nitzschia closterium and *Leptocylindrus minimus* were abundant in Bering Sea water at stations 23 and 24. *Nitzschia closterium* is an ubiquitous species, commonly found in temperate and Arctic waters, and is always present in nearshore waters of the Chukchi and Beaufort Seas (Bursa 1963, Horner 1969, Horner *et al.* 1974). *Leptocylindrus minimus* is the only species in *Glacier*-76 samples that has not been reported previously from the Beaufort Sea. Its distribution is not well known, but it has been reported from the Bering Sea (Ohwada 1972, Motoda and Minoda 1974). It is possible that *L. minimus* has been present in other Beaufort Sea samples, but not recognized because of its small size and superficial resemblance to broken *Chaetoceros* spines. Its presence in Beaufort Sea water indicates that it is probably an expatriate.

The diatom *Eucampia zoodiacus* Ehrenberg occurred more frequently in *Glacier*-76 samples than in earlier collections, but its distribution was more restricted, occurring mainly at the inshore stations 15, 17, and 18 near Prudhoe Bay. In WEBSEC-73 samples from the Beaufort Sea, it was found from Pt. McIntyre to Flaxman Island, offshore as well as inshore.

Small flagellates are difficult to identify in preserved phytoplankton samples because of poor preservation, small size, scattered reference material, and the enumeration technique, i.e., use of the inverted microscope and settling chambers. No preservative currently available will work equally well on the wide variety of organisms in a phytoplankton sample. Formalin appears to be as good as any other preservative and does not require a bleaching step as does Lugol's iodine. Many of the smaller flagellates, those < 10 μm in diameter, require study under the transmission electron microscope before positive identification can be made. Most of these organisms, therefore, have been grouped into size classes based on the length and diameter of the cells. Where possible, they have been identified to family or phylum.

Dinoflagellates are also often difficult to identify in inverted microscope counting chambers, because they frequently settle at odd angles, so that identifying characteristics cannot be seen. This is especially true of species having relatively heavy thecae or spines, including species of *Peridinium* and *Ceratium*. Other forms, which are usually smaller in size, have very thin thecae and may be poorly preserved as are flagellates. Many of the smaller forms have probably not been described in the scientific literature, and they have been grouped as undetermined Pyrrophyta.

The lack of information on species distributions based on adequate taxonomic data makes it difficult to separate the phytoplankton into categories based on hydrography. Most of the species listed in Table 6 are considered to be neritic species, but many of them, including species of *Thalassiosira*, *Chaetoceros*, *Nitzschia*, and *Navicula*, have been reported from the central Arctic as well (Kawamura 1967).

Hasle (1976) discusses early attempts to group phytoplankton by habitat and points out some of the difficulties. She also resorts to simple terminology such as "warm water" or "cold water" assemblages.

Our use of a constant light incubator, while practical for the conditions under which we were working, gives relative production. The average light value used here, *ca.* 2100 lux, is somewhat lower than the light levels reported by Alexander *et al.* (1974) for 6 m near Barrow when no ice is present. Photosynthetic efficiency was probably not inhibited by the light levels we used.

The temperature in our incubator was usually 5 to 7° C higher than the *in situ* temperature. This might have enhanced photosynthetic rates somewhat, but the low light levels probably compensated for the higher temperatures.

Some estimates of annual production in the Chukchi and Beaufort Seas have been made, primarily from data collected in shallow nearshore areas (Coyle 1974, Horner *et al.* 1974, Alexander 1974, and Hsiao 1976). Coyle (1974) and Horner *et al.* (1974) based their figures on data collected in Prudhoe Bay and the lagoon area between the coast and the Midway Islands for the water column and on Barrow for the ice algae and benthic microalgae; therefore their estimates may be somewhat high. Total annual production within Prudhoe Bay was estimated to be < 10 g C $m^{-2} \cdot yr^{-1}$, and *ca.* 13 to 23 g C $m^{-2} \cdot yr^{-1}$ in the lagoon. Alexander (1974) estimated the annual production of the water column in Harrison Bay and Simpson Lagoon to be *ca.* 10 to 15 g C $m^{-2} \cdot yr^{-1}$.

Using the assumptions given below and Hsiao's (1976) average integrated productivity value of 28.14 mg C $m^{-2} \cdot yr^{-1}$ for inshore and offshore stations, annual production in the southern Beaufort Sea is about 8 g C $m^{-2} \cdot yr^{-1}$. In the eastern Canadian Arctic, Grainger (1971) reported annual production in excess of 40 g C $m^{-2} \cdot yr^{-1}$ from Frobisher Bay.

Estimates of annual production for the northeastern Chukchi Sea and western Beaufort Sea have been calculated using *Glacier*-76 data. The calculations assume 24 hr days in June and July, 20 hr days in August, and 15 hr days in September. It is also assumed that twice as much production occurs in June during the spring bloom as occurs later in the summer and that essentially no production occurs during other months. The ice algae and benthic microalgae have not been included in these estimates. In the northeastern Chukchi Sea, annual production is *ca.* 18 g C $m^{-2} \cdot yr^{-1}$, while in the western Beaufort Sea it is *ca.* 9 g C $m^{-2} \cdot yr^{-1}$.

2. Zooplankton

The zooplankton of the western Beaufort Sea may be grouped into 4 categories: species which are expatriates from the Bering and Chukchi Seas, species occurring throughout the Arctic Basin, species characteristically found in neritic, less saline environments, and species contributing meroplanktonic life history stages to the zooplankton. The abundance, distribution, and diversity of these categories is primarily a reflection of hydrographic conditions resulting from the clockwise circulation of the Polar Basin gyre, wind-driven upwelling, and from the easterly intrusion of warmer, more saline Bering Sea water.

The northward flow and subsequent easterly intrusion of Bering Sea water is not an unusual phenomenon in the western Beaufort Sea. Hufford (1973) has documented a warm, high salinity layer in 10 - 60 m of water in 10 of 16 years examined. This layer may extend as far east as 143° W. Hydrographic data during the summer of 1976 indicate an eastward extension of this layer to 151° 19.0' W (station 20).

Eastward extension of Bering Sea water is also indicated by the occurrence of expatriate copepod species *Calanus cristatus*, *Calanus plumchrus*, *Centropages abdominalis*, and *Eucalanus bungii bungii* (Johnson 1956). The cladocerans, *Evadne nordmanni* and *Podon leuckarti*, may also be expatriate species (Redburn 1974). These species were not found east of station 20, thus substantiating hydrographic data. The absence of these species at stations 13 and 26 may be due to the small volumes of water filtered relative to their abundance.

Other species reported by Johnson (1956) in the western Beaufort Sea as coastal expatriates from the south were *Acartia clausi*, *Eurytemora herdmani*, and *Tortanus discaudatus*. Redburn (1974) found these species only when surface temperatures exceeded 7° C. These species were not found during the 1976 sampling period, possibly because surface temperatures were always less than 7° C.

The majority of species occurring throughout the Arctic Basin were well represented in the inshore zooplankton of the western Beaufort Sea. Included in this category are *Calanus glacialis*, *Oithona similis*, *Thysanoessa* spp., *Fritellaria borealis*, *Oikopleura* spp., *Sagitta elegans*, and *Boreogadus saida*. Redburn (1974) suggested that distributions and abundances of these species are less directly affected by advective processes than they are by biological interactions and characteristics of these species, including predation, food requirements, natural death and sinking, and reproductive success.

Amphipods in this region are primarily under-ice organisms and therefore influenced by the presence or absence of ice. The widespread distribution of amphipods during the 1976 sampling period may be due to adverse ice conditions and little open water during that period.

There remains some question as to the distribution of *Eurytemora richingsi*, although its presence at station 25 and in deep hauls offshore makes it appear to be a widespread, though rare, species.

Other widely distributed species showed distributions and abundances which were affected by advective processes. Johnson (1956) suggested zooplankton distributions in the Beaufort Sea are influenced by the prevailing circulation in the Polar Basin in which clockwise circulation introduces cold central Arctic water from the north into the eastern Beaufort Sea. Using data collected in 1972, Hufford (1974) described the presence of a wind-driven, upwelling regime on the eastern half of the North Alaskan shelf which apparently is not a regular feature of the shelf circulation (Mountain 1974). English and Horner (1976) reported *Scaphocalanus magnus*, *Heterorhabdus norvegicus*, and *Gaidius tenuispinus* in WEBSEC-72 samples collected from 50 m off Barter Island (143° 45' W). These copepod species are characteristically deep water species in the central Arctic.

O'Brien and Hurlburt (1972) suggested that the upwelling regime proposed by Hufford (1974) should be accompanied by westward movement of water in the upwelling region, which will be in opposition to the easterly flow of Bering Sea water. The influence of this circulation regime is apparent in the Prudhoe Bay area, where copepods which are more abundant offshore or in deeper water, such as *Calanus hyperboreus*, *Euchaeta glacialis*, *Metridia longa*, and *Microcalanus pygmaeus*, were collected in 20 - 0 m net hauls in greatest abundance or only at stations in the Prudhoe Bay area in 1976.

Hand and Kan (1961) suggested a similar advective influence on the holoplanktonic hydrozoans *Aglantha digitale* and *Aeginopsis laurentii* collected in 1950 and 1951. These species were poorly represented in the Prudhoe Bay area during the sampling period in 1976.

Aglantha digitale, however, may show a response to the intrusion of Bering Sea water. Large numbers of this species were reported at the easterly front of intruding Bering Sea water in 1950. Hand and Kan (1961) suggested a downward movement of water at this front with an accumulation of *A. digitale* as a result of attempts by this species to remain close to the surface. During 1976, large numbers of *A. digitale* were collected at stations where Bering Sea water occurred. Whether this accumulation of individuals is a result of downwelling or is the result of recruitment of juvenile medusae into the plankton cannot be determined with present data, although the presence of large numbers of juvenile *A. digitale* at station 26 suggests recruitment.

Some species collected during 1976 are characteristically found in the Beaufort Sea and are neritic in nature. *Pseudocalanus* spp. is the largest representative of this category occurring throughout the sampling area, but absent from waters of the central Arctic. *Pseudocalanus minutus* and *Acartia longiremis* are characteristic of those species whose distributions and abundances in the inshore environment are more likely influenced by biological phenomena.

Pseudocalanus major, *Derjuginia tolli*, and *Limnocalanus grimaldii* are neritic species whose distribution and abundances are primarily influenced by the extent of lower salinity water resulting from runoff and melt water. *Pseudocalanus major* was restricted to the eastern stations during 1976, while *Derjuginia tolli* showed a wider distribution resulting from a higher tolerance to more saline waters.

In addition to the extent of less saline water, the distribution of *Limnocalanus grimaldii* is apparently influenced by advective processes. Johnson (1956) found *L. grimaldii* off the Colville River (*ca.* 150° 30' W) in 1950 when Bering Sea water extended to 143° W. English and Horner (1976) reported *L. grimaldii* in WEBSEC-72 samples collected off Barter Island (143° 45' W). In the 1976 samples, *L. grimaldii* was found only east of the Colville River. This distribution pattern suggests that *L. grimaldii* is a more eastern species, whose distribution in the western Beaufort Sea is restricted by the easterly flow of Bering Sea water.

Meroplanktonic life history stages of barnacles, polychaetes, hydrozoans, gastropods, and echinoderms comprised the largest part of the zooplankton in the western Beaufort Sea. Johnson (1956) suggested that meroplanktonic production was greater in the Chukchi and western Beaufort seas than in the eastern Beaufort Sea because of the larger area of shallow water in the western areas. Except for echinoderm larvae, meroplanktonic larval stages were most abundant at stations 13 and 26 during 1976.

Maximum abundances of barnacle larvae were found northwest of Pt. Barrow in 1950 and 1951, suggesting that a sizeable portion of barnacle larvae in the western Beaufort Sea may be due to advection (Johnson 1956).

This would seem a plausible hypothesis as barnacle larvae diminished in abundance at the easternmost stations.

Abundances of barnacle larvae collected at offshore stations were similar in 1951 and 1952, but were greater at inshore stations in 1976 Cypris larvae were more abundant in 1951, while nauplii were more abundant in 1976, although samples for both years were collected the last two weeks in August. This is probably due to the later release of meroplanktonic larval stages associated with adverse ice conditions in 1976.

Hand and Kan (1961) suggested that meroplanktonic hydrozoan medusae were advected into the western Beaufort Sea from the Chukchi Sea. During 1976, most meroplanktonic hydrozoans were not found in sufficient numbers to describe distributions and responses to advective processes. *Rathkea octopunctata*, however, was widespread in the western Beaufort Sea in 1976 and many small individuals were found suggesting a locally reproducing population.

VIII. Conclusions

Conclusions listed here, especially for the phytoplankton, must be considered preliminary because so few data are available.

A. Phytoplankton

1. Individual phytoplankton species have widespread distributions in the nearshore Beaufort Sea, but standing stocks of phytoplankton are variable and patchy.

2. Some apparently expatriate species occur when Bering Sea water is found in the Beaufort Sea.

3. Primary production is variable and patchy, with highest production occurring between 5 and 20 m and where diatoms are the most abundant organisms.

B. Zooplankton

1. Zooplankton species can be grouped into four categories:

   a. Expatriates from the Bering and Chukchi seas;
   b. Species occurring throughout the Arctic Basin;
   c. Species from less saline, nearshore areas;
   d. Species contributing meroplanktonic stages.

2. Distribution of some species or larval groups is patchy and is influenced by hydrography.

3. Expatriate species occur when Bering Sea water is found in the Beaufort Sea.

4. Meroplankton comprise a large part of the zooplankton in the western Bering Sea.

5. Species utilized as food by birds and mammals generally were not caught by our sampling gear. The presence of ice prevented use of horizontally-towed nets and larger, faster moving species are able to avoid vertically-towed nets.

IX. Needs for further study

Information currently available on the phytoplankton and zooplankton of the Beaufort Sea consists primarily of species distributions and abundances during the summer, usually August and early September, and usually west of Barter Island. This kind of information should be extended to include all seasons of the year and the area from Prudhoe Bay east at least to the Canadian border.

Essentially no data are available on life cycles of any phytoplankton or zooplankton species. A little information has been obtained from distribution and abundance surveys, but there have been no concerted efforts to determine life cycles of even the most common species.

No information is available on the vertical distribution of plankton species or on diel vertical migrations of zooplankton species in the Beaufort Sea.

No information is available on year-to-year variability of plankton populations, with the exception of the phytoplankton cycle in the nearshore water at Pt. Barrow.

There is very little information available on trophic dependencies. Some of the important food species for fish and mammals are amphipods, shrimps, euphausids, and Arctic cod, but distribution patterns, life cycles, and food habits of these organisms generally are not known. It is not known what role the ice algae play in the food web of the Beaufort Sea, although it has been suggested that this community lengthens the growing season by about two months (Horner 1976). In addition, Schell (personal communication) has suggested that the ice algae act as a nutrient pump, especially in water < 10 m deep, and that ice algae serve as food for grazers and also concentrate nutrients that will be released into the sediments or water column when the algal cells disintegrate, thus increasing the nutrient supply to benthic and planktonic microalgae.

Critical species or groups of species have not been identified. These critical species might be important food species, rare species that would be adversely affected by pollution, or abundant species.

Very little information is available on the effects of oil on plankton in the Arctic. Hsiao (1976) has shown that rates of primary production vary with type and concentration of oil, methods of preparation of oil-seawater mixtures, species composition of the plankton, and duration of exposure. Diatoms especially were inhibited by crude oils and mixtures of crude oils and Corexit (a compound used in oil spill clean-up). A slick of oil on the water surface would reduce light penetration, thus reducing photosynthesis and growth of phytoplankton. Organic pollutants might also contribute to changes in the species composition of the phytoplankton, changing the population from one composed of diatoms to one composed of microflagellates (Fisher 1976). This change in structure of the phytoplankton community could seriously affect other levels of the food chain. Some life cycle stages have been shown to be more sensitive to pollutants than other stages; in particular, larvae are often more susceptible than adults.

Environmental information should be collected at the same time as biological information. Knowledge of current regimes, for example, would help biologists determine dispersion patterns for plankton which could be important in repopulating an area after an oil spill.

X. Summary of 4th quarter operations

R.U. #359 had no field program during this quarter. Our activities consisted of finishing the laboratory analyses of samples, primarily sorting, counting, and identifying plankton samples, and working on data analysis for the final report.

XI. Bibliographies

Extensive bibliographies for phytoplankton and zooplankton have been compiled. All references have been checked, and key words identified; nearly all are available in the University of Washington library system, and UW call numbers are given along with the location in the UW library. Journal abbreviations are from the World List of Scientific Periodicals or follow the World List abbreviations for individual words where possible. Some publications have been written out in full to facilitate finding the reference. Bibliographic style generally follows the CBE Style Manual, third edition, American Institute of Biological Sciences, Washington, D. C. Foreign language references, journal abbreviations, library call numbers, and punctuation marks have been modified (use of capital letters, no umlauts, no degree signs, asterisks in place of quotation marks and apostrophes, etc.) to accommodate the computer.

Many of the references are taxonomic in nature and are not limited to Arctic taxa. The literature search has been designed to include references for the whole Arctic Ocean and peripheral waters, including the northern Bering Sea, Norwegian Sea, Denmark Strait, Baffin Bay, and Davis Strait, because it is impossible to separate the Beaufort Sea biologically from the rest of the Arctic.

The ichthyoplankton bibliography is not extensive and contains more references to adult fish than to larvae and juveniles. A more extensive bibliography for ichthyoplankton was done for R.U. #349 (English 1976). The present bibliography is limited primarily to the nearshore Beaufort Sea and streams entering into this area.

All three bibliographies are appended to this report, section XIV.

XII. Archived samples and unpublished data

Archived samples and unpublished data concerning zooplankton and phytoplankton are primarily from WEBSEC (Western Beaufort Sea Ecological Cruises) cruises sponsored by the U. S. Coast Guard from 1970 to 1973. Wing (1974) published the results of zooplankton collections made during the 1970 cruise in the eastern Chukchi Sea; Cobb and McConnell (unpubl. ms.) described the species composition, relative abundances, and distribution, of zooplankton from the 1971 cruise. Wing also collected zooplankton samples during the 1972 WEBSEC cruise. Some of these samples have been processed as part of the present OCSEAP project, and four tables included in our first annual report (R.U. #359), 1 April 1976 (English and Horner 1976), are reprinted here (Tables 17 to 20).

Horner collected phytoplankton standing stock and chlorophyll *a* samples during WEBSEC-73. All of the samples have been processed, but the results have not been published. Chlorophyll *a* and phytoplankton standing stock samples were collected in 1974 from Icy Cape to Barrow and from Barrow to Barter Island. The chlorophyll *a* samples have been analyzed, but the standing stock samples have not (Horner unpubl.).

Table 17. Number of fish larvae found in two WEBSEC-72 Isaacs-Kidd mid-water trawl samples

Station	Date	Depth (m)	Sample	Fish Larvae
009 (70°30.8'N, 144°27.0'W)	7 Aug 72	0	AB 72-157	29
		40	-159	15
		20	-160	0
010 (70°19.3'N, 144°46.5'W)	7 Aug 72	20	-163	26
		15	-164	38
		10	-165	59
		0	-166	272

Table 18. Fish eggs and larvae from two vertical net hauls

Station	Date	Depth (m)	Sample	Fish Larvae	Fish Eggs
005 (70°51.7'N, 143°45.4'W)	5 Aug 72	500	AB 72-137	0	1
		800	-138	0	1
010 (70°19.3'N, 144°46.5'W)	7 Aug 72	30	-161	1	0

Table 19. Copepods sorted from station 005, AB 72-132 (70°51.7'N, 143°45.4'W), 5 Aug 1972, 50 m. The total number of copepods was 1742.

Species	Stage	% Total
Calanus hyperboreus	VI ♀	38.80
	V	19.17
	IV	2.46
	III	0.40
	I	0.11
Calanus glacialis	VI ♀	14.12
	V	3.32
	IV	0.74
	III	1.32
	II	0.74
	I	0.11
Metridia longa	VI ♀	4.53
	VI ♂	1.03
	V ♀	2.58
	V ♂	0.80
	IV ♀	0.92
	IV ♂	0.45
Euchaeta glacialis	VI ♀	0.86
	V ♀	0.63
	V ♂	0.63
	IV ♀	0.11
	IV ♂	0.11
	III	0.06
	II	0.23
	I	0.05
Pseudocalanus minutus	VI ♀	3.20
Scaphocalanus magnus	VI ♀	0.28
	V ♀	0.17
	V ♂	0.06
	IV ♀	0.06
Heterorhabdus norvegicus	VI ♀	0.46
	VI ♂	0.22
Gaidius tenuispinus	VI ♀	0.11
	VI ♂	0.11
	V ♀	0.17
	V ♂	0.11
	IV ♀	0.06
Aetideopsis rostrata	VI ♀	0.29
Limnocalanus grimaldii	VI ♀	0.11
	VI ♂	0.06
	V ♀	0.06
	V ♂	0.06

Table 20. Copepods sorted from station 019, AB 72-199 (71°09.0'N, 146°29.0'W), 11 Aug 1972, 250 m. The total number of copepods was 265.

Species	Stage	% Total
Calanus hyperboreus	VI ♀	2.64
	V	4.15
	IV	0.75
	III	0.75
Calanus glacialis	VI ♀	4.15
	VI ♂	0.38
	V	3.01
	IV	9.81
	III	35.09
	II	8.30
	I	0.38
Metridia longa	VI ♀	3.01
	V ♀	7.17
	V ♂	7.92
Euchaeta glacialis	VI ♂	0.38
	V ♀	0.38
	IV ♀	0.38
	IV ♂	0.38
	III	0.38
Pseudocalanus minutus	VI ♀	12.83
	V	0.75
Scaphocalanus magnus	VI ♀	0.38

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XIV. Appendix: Bibliographies.

BIBLIOGRAPHY OF ARCTIC PHYTOPLANKTON INCLUDING REFERENCES TO

TAXONOMY, PRIMARY PRODUCTIVITY, CHLOROPHYLL CONCENTRATIONS, GEOGRAPHIC AND SEASONAL DISTRIBUTIONS, VERTICAL DISTRIBUTION, SPECIES COMPOSITION, STANDING STOCK, ECOLOGY, HYDROGRAPHY, NUTRIENTS, SAMPLING METHODS, HETEROTROPHY, MORPHOLOGY, CHEMICAL COMPOSITION, SEA ICE ALGAE, BENTHIC MICROALGAE

ALL REFERENCES HAVE BEEN VERIFIED; JOURNAL ABBREVIATIONS ARE FROM THE WORLD LIST OF SCIENTIFIC PERIODICALS; CALL NUMBERS ARE UNIVERSITY OF WASHINGTON NUMBERS; LOCATION IN THE UW LIBRARY SYSTEM IS GIVEN ACCORDING TO THE FOLLOWING ABBREVIATIONS:

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SR	SCIENCE READING ROOM MAIN LIBRARY
FO	FISHERIES OCEANOGRAPHY 151 OCEANOGRAPHY TEACHING BLDG

BIBLIOGRAPHIC STYLE GENERALLY FOLLOWS THE CBE STYLE MANUAL, THIRD EDITION (AMERICAN INSTITUTE OF BIOLOGICAL SCIENCES, WASHINGON, D. C.) FOREIGN LANGUAGE REFFRENCES, JOURNAL ABBREVIATIONS, AND LIBRARY CALL NUMBERS HAVE BEEN MODIFIED (USE OF CAPITAL LETTERS, NO UMLAUTS, ETC.) TO ACCOMMODATE THE COMPUTER. APOSTROPHES AND QUOTATION MARKS IN A REFERENCE ARE INDICATED BY *, QUESTION MARKS BY $, AND NUMBER BY ≠. * AT THE END OF A REFERENCE WHERE THE CALL NUMBER SHOULD BE, INDICATES THE REFERENCE IS NOT IN THE UW LIBRARY SYSTEM.

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SECTION 2

Offshore

Marine Ecosystems Studies at AIDJEX in the Southeast Beaufort Sea

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Gerald F. Hornof

Kevin D. Wyman

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I. Summary of objectives, conclusions, and implications with respect to OCS oil and gas development

The objective was to obtain a description of the plankton in the pelagic environment of the Beaufort Sea beyond the continental shelf during the summer season.

Nitrate depletion was observed in the upper 40-45 m in June and remained depleted throughout the summer. Within the same depth and time interval the phytoplankton population (estimated by chlorophyll *a*) was low, suggesting nutrient limitation. The disappearance of snow cover and formation of melt ponds resulted in a gradual increase in submarine light levels through July. Active growth of phytoplankton at the pycnocline (45 m) was observed. The highest chlorophyll *a* concentrations occurred at this depth in late July and early August. Graduated light experiments indicated the phytoplankton population was adapted to low light levels. The zooplankton population was sampled and vertical distribution for eight species on eight dates is presented.

The impact on the Beaufort Sea beyond the continental shelf from the development of coastal oil and gas reserves is difficult to assess. Apart from a major oil spill, only slight concentrations of oil and its by-products might be expected to reach this area by ocean and wind circulation. Their presence might directly alter the albedo, the thermoconductivity of the ice, and rates of ice growth. The sensitivity of the ecosystem to changes in these parameters is not known.

II. Introduction

A. General nature and scope of study

The oceanic waters of the Beaufort Sea are separated from the northern coasts of Alaska and Canada by a 60 - 100 mile wide continental shelf. Proceeding seaward from the coastline, the marine ecosystem changes from a neritic environment to an oceanic one. The sea surface also changes. Inshore, the presence of shorefast and drifting sea-ice is highly seasonal. Offshore, the pack-ice becomes more concentrated and perennial. The Beaufort Sea thus provides two extremes: a shallow water, seasonal ice environment, and a deep water, perennial ice environment.

The Outer Continental Shelf Environmental Assessment Program included several studies describing the shallow water, seasonal ice environment, including fisheries (Roguski R.U. #233), benthos (Carey R.U. #6, Broad R.U. #356), microbial activity (Morita R.U. #190), and marine plankton (English and Horner R.U. #359). These efforts were concentrated in the 1975-1976 field seasons and some are still in progress. An additional part of the marine plankton studies (English and Horner R.U. #359) was conducted during summer 1975 at the Arctic Ice Dynamics Joint Experiment (AIDJEX) main camp, Big Bear. The research took place within the perennial ice zone over deep water.

B. Specific objective

The objective of the biological oceanography program at AIDJEX was to develop an understanding of the seasonal changes in abundance and distribution of planktonic components of the marine pelagic ecosystem. Equipment and time limitations resulted in emphasis on the primary producer level though zooplankton was also sampled regularly.

The research program was designed to progress toward the ultimate goal of understanding the marine ecosystem well enough to formulate a predictive model (Fig. 1). We are presently in the descriptive phase.

C. Relevance to problems of petroleum development

The energy fixed by photosynthesis is transferred through herbivorous zooplankton to arctic cod, waterfowl, seals, whales, and polar bears. Some of these are important to the subsistence and economic welfare of coastal natives. An understanding of primary and secondary production dynamics is a prerequisite to assessment of the impacts of oil development in the Arctic Ocean periphery. No previous ecosystems studies have been made in the deep water perennial ice zone of the southeastern Beaufort Sea.

The fate and consequence of oil spilled in the Arctic are largely unknown. Biodegradation would be slow due to the extremely low water temperatures. It is possible that oil would be trapped between ice floes or within brine channels and eventually swept out into the

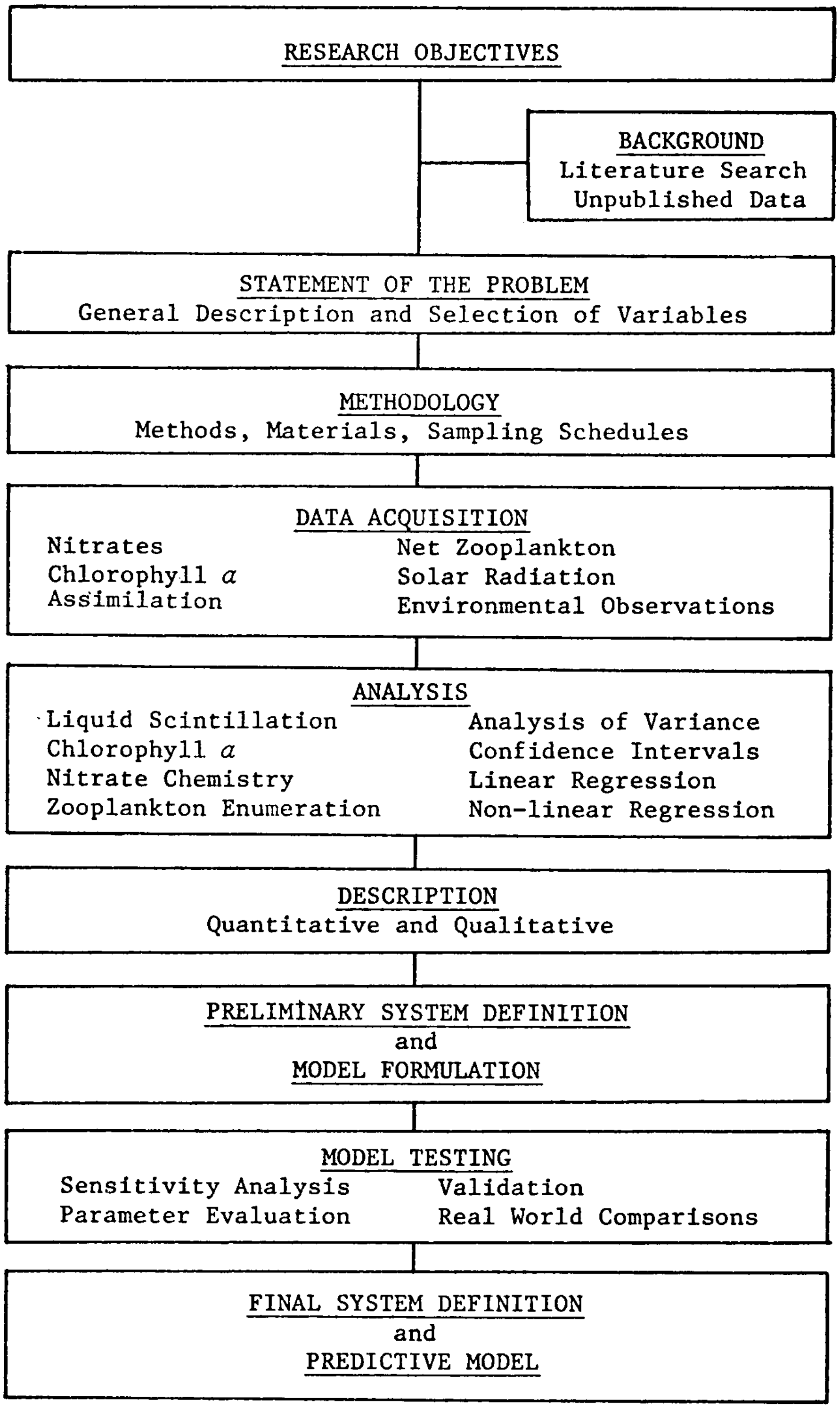

Fig. 1. Stages of the marine ecosystems studies at AIDJEX in the Southeast Beaufort Sea.

Pacific gyre of the Beaufort Sea. The oil could cause lowered albedos, reduction in thermoconductivity of the ice, and reduced rates of ice growth (Seelye Martin, seminar at UW, 22 May 1974). In addition, it could change the submarine light regime by reducing transmission properties of the overlying ice or open water areas. The sensitivity of the ecosystem to the latter type of perturbation will be tested in the modelling phase of this research.

III. Current state of knowledge

In the past 80 years, in excess of 40 expeditions and field programs have been staged in the Arctic Ocean or its periphery. Approximately 25 have yielded biological information (Table 1). Much of this information is descriptive in nature with only marginal efforts made to relate species to their environment or to each other (Shoemaker 1920, Farran 1936, Brodskii and Nikitin 1955, Barnard 1959, Hand and Kan 1961, Hülsemann 1963, Shirley 1966). Early attempts to associate higher levels of phytoplankton abundance with environmental factors emphasized the importance of light and temperature (Gran 1904, 1912). Later investigators discussed the effects of mixing and nutrient supply on phytoplankton development (Sverdrup 1929, Braarud 1935), and temperature and salinity on zooplankton distribution (Bigelow 1920, Bernstein 1932, Johnson 1956, Grainger 1965, Tibbs 1964).

Quantitative estimates of phytoplankton abundance, primary production, and zooplankton standing stocks and life cycles were made at the Soviet North Pole stations (Brodskii 1956) and the U. S. drift stations Alpha (English 1961, 1963; Johnson 1963 a, b), Bravo (Apollonio 1959, Grainger 1965), Arlis II (Kawamura 1967), and T-3 (Harding 1966, Hughes 1968, Hopkins 1969, English unpublished data). From these investigations emerged a general recognition of the components and processes of possible importance in determining changes in the marine ecosystem below the ice pack.

This understanding was based primarily on data collected in the central Arctic Ocean (north of 80° N) and in the western Beaufort Sea. With the exception of two studies on protozoa (Tibbs 1964) and medusae (Shirley 1966) at Arlis I, there is no published biological information for the oceanic perennial ice zone of the southeast Beaufort Sea where the AIDJEX platforms were located.

IV. Study area

The field program was conducted from 2 June to 1 October 1975 at the AIDJEX main camp, Big Bear. During this time, Big Bear drifted approximately 870 km in the southeast Beaufort Sea (Fig. 2). Sampling ended on 1 October when the main camp ice floe broke apart and camp members had to evacuate.

Table 1. Expeditions, years of field collections, authors and years of publications of marine biological studies in the Arctic Ocean

Expedition or Vessel	Dates	Papers Published
Fram	1893-1896	Sars 1900 Nansen 1902 Gran 1904 Gran 1912
Canadian Arctic	1913-1918	Shoemaker 1920 Willey 1920 Bigelow 1920
Maud	1922-1924	Sverdrup 1929
Sedov	1925-1929	Bernstein 1932
Øst	1929	Braarud 1935
Nautilus	1931	Farran 1936 Hardy 1936 Garstang and Georgeson 1936
NP-1	1937-1938	Shirshov 1938, 1944
Sedov	1937-1939	Bogorov 1938, 1939, 1946a, b Shirshov 1944 Usachev 1946
N-169	1941	Shirshov 1944
NP-2	1950-1951	Brodskii and Nikitin 1955
Burton Island	1950-1951	Johnson 1956 Hand and Kan 1961
M.V. *Cancolim II*	1951	Grainger 1965
NP-2,3,4,5	1954-1957	Brodskii 1956
T-3	1954-1955	Barnard 1959 Green 1959 Knox 1959 Mohr 1959 Hülsemann 1963
Bravo	1957-1958	Apollonio 1959 Grainger 1965

Table 1. (continued)

Expedition or Vessel	Dates	Papers Published
Alpha	1957-1958	English 1961, 1963 Johnson 1963a, b
Seadragon	1960	Grice 1962
Arlis I	1960-1961	Tibbs 1964 Shirley 1966
Polar Continental Shelf Project	1960-1961	Grainger 1965
M.V. *Salvelinus*	1960-1962	Grainger 1965
Arlis II	1964	Shirley 1966 Kawamura 1967 Minoda 1967
T-3	1964 1966-74	Harding 1966 Hopkins 1969 Hughes 1968 Scott 1969

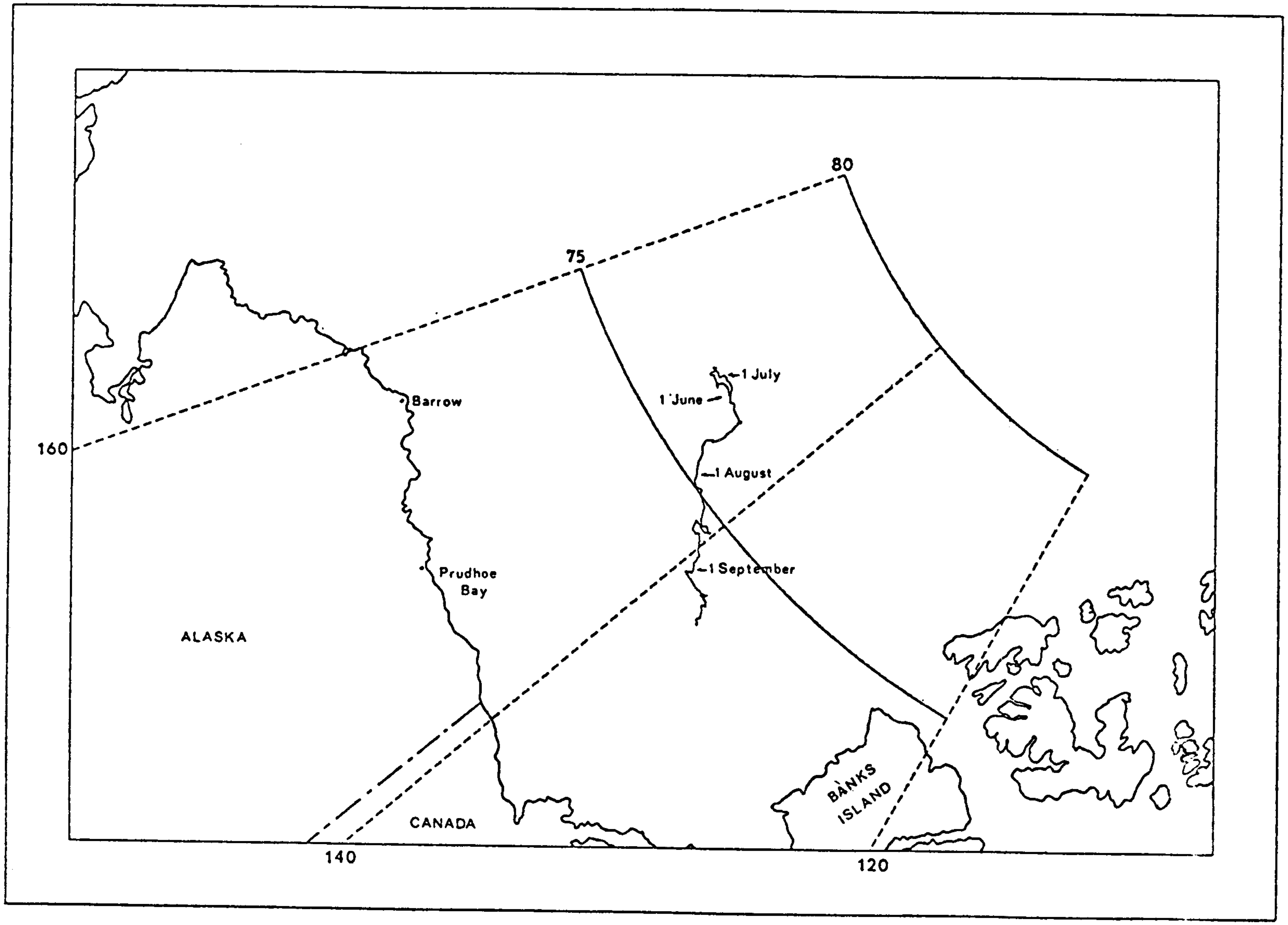

Fig. 2. Drift track of AIDJEX main camp, Big Bear, June through September 1975.

V. Rationale and methods of data collection

A. Rationale

We first formulated a general description of the ecosystem based on published and unpublished accounts. From this description, a suite of variables was selected to be measured in the field.

1. General description

Incoming solar radiation is low from October through February in the Arctic Ocean. Solar elevations and day length increase from late February until the summer solstice on 21 June. Although solar radiation also increases during this period, the amount that is transmitted to the water below the pack ice is very small. Maximum submarine radiation occurs in early to mid-July after the snow cover has melted and the ice surface is dominated by melt ponds which have a lower albedo than either snow or bare sea-ice.

Phytoplankton abundance in the water below the ice remains low throughout winter and spring. In response to higher levels of submarine radiation in late June and early July, phytoplankton biomass increases in the surface mixed layer (upper 25 - 50 m). The extent and duration of the development may depend on:

(1) availability of light, which is influenced by degree of melt, frequency of summer freeze-ups and snow storms, solar angle, day length, and timing of the first sustained autumn snowfall;

(2) availability of nutrients, which is influenced by initial spring nutrient concentrations, and their maintenance through turbulent mixing, convective overturn, and remineralization processes; and

(3) Losses of biomass from the phytoplankton population through sinking below the pycnocline, or from grazing by herbivorous zooplankton.

The major decrease in phytoplankton biomass usually occurs in the latter half of August, and low concentrations prevail throughout the ensuing dark period.

Though much is known about the species composition of the herbivorous zooplankton and their depth distribution, there are no studies showing the extent to which they interact with the phytoplankton populations. There is evidence from collections made in 1970-72 at T-3 (English, personal communication) of a general movement toward the surface from depths exceeding 100 - 200 m by *Calanus hyperboreus* early in the spring, and later by *C. glacialis*. The intensity with which they graze upon phytoplankton is not known.

2. Selection of variables

The biological variables selected for measurement included chlorophyll *a*, phytoplankton cell numbers, radiocarbon assimilation, and net zooplankton. Environmental variables included reactive nitrate, incoming solar radiation, ice surface melt conditions, air temperature, wind speed, island movement, and seawater temperature and salinity.

B. Methods

1. Field observations

Water samples were taken with a 5-ℓ PVC water bottle. Subsamples were drawn for the determination of nitrate concentration (50 ml), radiocarbon assimilation (125 ml), chlorophyll *a* concentration (4-ℓ), and phytoplankton cell counts (120 ml).

The analysis of nitrate concentration was done on station using the methods of Strickland and Parsons (1968).

To determine assimilation potential, paired light and dark subsamples were innoculated with a known amount of ^{14}C and incubated in a 0 - 1° C water bath under controlled fluorescent lighting. The maximum light intensity was 117 microeinsteins $\cdot m^{-2} \cdot s^{-1}$. In graduated light experiments, nine additional bottles were treated and fitted with metal screens. The screens were constructed to transmit 2, 4, 6, 8, 14, 16, 19, 49, or 74% of the total light available. All incubation periods were 6 hours. The subsamples were filtered through 25 mm Millipore HA (0.45 μm) filters, and the filters were placed in liquid scintillation vials. Radioactive uptake was measured using a Packard Tri-Carb Liquid Scintillation Spectrometer with Aquasol (New England Nuclear) as the scintillation cocktail.

The subsamples drawn to determine chlorophyll *a* concentration were filtered using 0.47 μm glass fiber filters treated with saturated $MgCO_3$ solution. The filters were frozen for later analysis (Strickland and Parsons 1968).

Subsamples designated for phytoplankton cell counts were fixed in 4% formalin.

Zooplankton was sampled with depth-to-surface vertical tows using a non-closing conical 1-m diameter ring net with 73 μm mesh. Samples were preserved in 4% buffered formalin. Large copepods were first sorted from the whole sample, counted, and identified. Small copepods and nauplii were sorted from a known volume of the sample. Copepods were counted and identified to species; nauplii were counted and separated into size classes ($<$ 0.3 mm and $>$ 0.3 mm). Zooplankton counts were adjusted to depth increment (0 - 50, 50 - 75, 75 - 150 m) and volume filtered by the 1-m ring net assuming 100% filtration efficiency.

Zooplankton and chlorophyll *a* samples were taken and assimilation potential was measured every 3 days (Table 2). The vertical zooplankton net tows were taken from 10, 20, 30, 40, 50, 75, 100, and 150 m to the surface. Chlorophyll *a* and assimilation potential were measured

Table 2. Sampling program at AIDJEX main camp during summer 1975

Variable	Type of Sampling	Depths	Frequency
Nitrate	Depth profile	10-70 m, 10 m intervals	3-6 day intervals
		46-64 m, 2 m intervals	Eight times
		80 and 100 m	Seven times
	Helicopter transect	10 and 20 m	Once
Chlorophyll *a*	Depth profile	3 m, 5-60 m, 5 m intervals	3 day intervals
		46-64 m, 2 m intervals, and 80 m, 100 m	3-6 day intervals
	Replications	5, 10, 20, 30 m	7-10 day intervals
	Helicopter transect	10 and 20 m	Once
Assimilation	Depth profile	3 m, 5-50 m, 5 m intervals, and 60 m	3 day intervals
	Replications	5, 10, 20, 30 m	7-10 day intervals
	Graduated light	5, 10, 20, 30 m	3 day intervals
	In situ	10 m	22 times
Zooplankton	Vertical tows	10, 20, 30, 40, 50, 75, 100, 150 m to surface	3 day intervals
Solar radiation	400 to 700 nm	1 m above ice surface	30 second intervals

at 12 depths from 3 to 60 m. Less frequently, chlorophyll *a* was measured at 12 depths from 46 to 100 m. Nitrates were measured in the upper 40 m every 3 to 6 days, and to 100 m less frequently. Graduated light experiments at 5, 10, 20, and 30 m were run every 3 days.

Ten replication experiments were run at four depths (5, 10, 20, and 30 m) every 7 to 10 days. In each experiment, four water samples were taken within 5 min from the same depth. Two subsamples for the determination of assimilation potential and one subsample for the determination of chlorophyll *a* were drawn from each water sample.

Twenty-two *in situ* assimilation experiments were conducted. For each experiment a water sample from 10 m was taken and 6 to 9 subsamples were drawn. These subsamples were innoculated with ^{14}C and separated into three groups of 2 or 3 bottles per group. Each group was taken to one of three prepared locations and lowered to 10 m. The first location was the center of a melt pond which was 4 m in diameter, with a freshwater depth of 25 cm covering ice 1.6 m thick. The second location was an area of bare ice, 2.3 m thick, and situated 80 m from the melt pond. The third location was a lead, 100 m wide, 50 m from locations one and two. The bottles were suspended at each site for six hours, and then processed as previously described. Due to mishaps, only 19 of the 22 experiments allow inter-site comparisons.

Chlorophyll *a* and nitrate were sampled on 3 and 4 August along helicopter transects from main camp to the two satellite camps, Caribou and Blue Fox. Distance covered was 75 miles. Samples from 10 and 20 m were taken every 7 - 10 miles.

Solar radiation (400 to 700 nm) was measured daily at 1 m above the ice surface using a quantum meter (Model LI-COR-185, Lambda Instruments Corp.). Melt conditions were logged daily and aerial photographs were taken by helicopter as scheduling and conditions permitted. Air temperature, wind speed, island movement, and seawater temperature and salinity were recorded by other research teams on AIDJEX.

2. Data analysis

Data analysis of chlorophyll *a* and assimilation potential measurements from depth profiles, replication experiments and *in situ* incubations has been completed (Table 3). All chlorophyll *a* and assimilation potential data were transformed by taking logarithms to the base 10 to make variances and means independent.

The ten assimilation measurements of each graduated light experiment were fitted to a curvilinear assimilation-light relation (Steele 1962):

$$P = P_{max} \cdot I_{rel}/I_k \cdot e^{1-I_{rel}/I_k} ,$$

where P is assimilation (mg C $m^{-3} \cdot hr^{-1}$); P_{max} is calculated maximum

Table 3. Summary of samples taken and analyzed

Type	Number Taken	Number Analyzed
Zooplankton	994	24
Phytoplankton Standing Stock	209	0
Chlorophyll *a*	1096	1096
Radiocarbon Assimilation	2941	2941
Nitrate	272	272

assimilation (mg C $m^{-3} \cdot hr^{-1}$); I_{rel} is light intensity expressed as a fraction of 117 microeinsteins $\cdot$ $m^{-2} \cdot s^{-1}$; and I_k is relative light intensity at which P_{max} occurred. The curve fitting procedure required substitution of paired assimilation and light measurements into the equation and iterative adjustment of P_{max} and I_k to minimize the sum of squared differences between calculated and observed P. Measured assimilations were then divided by the calculated P_{max} to allow relative comparison of curves from different depths and days.

Additional comparisons were made by calculating the initial slopes of the curves. First, light measurements were converted to W $\cdot$ m^{-2} using the relation 1 microeinsteins $\cdot$ $m^{-2} \cdot s^{-1}$ = 0.22 W $\cdot$ m^{-2} of photosynthetically active radiation (PAR), where 1 microeinstein = 6.02×10^{17} quanta, and 1 W = 2.77×10^{18} quanta $\cdot$ s^{-1} (Morel and Smith 1974). The initial slope (mg C $\cdot$ mg Chl $a^{-1} \cdot hr^{-1} \cdot (W \cdot m^{-2})^{-1}$) was calculated as the partial derivative of P from the fitted curve with respect to I_{rel} as I_{rel} approaches zero:

$$\text{Initial slope} = e \cdot P_{max} / (I_k \cdot I_m \cdot \text{Chl } a) ,$$

where I_m is full light intensity (W $\cdot$ m^{-2}); and Chl a is mg Chl a m^{-3}.

The assimilation number (mg C $\cdot$ mg Chl $a^{-1} \cdot hr^{-1}$) is the ratio of observed assimilation potential to chlorophyll *a* concentration. Assimilation numbers were calculated for all depth profiles and graduated light experiments. Since the means and variances of initial slopes and assimilation numbers were positively correlated, they were transformed by taking logarithms to the base 10 before further analysis.

Data for chlorophyll *a* and assimilation potential depth profiles, graduated light experiments, assimilation potential replication experiments, and zooplankton counts have been submitted in previous reports (Appendices). Data for nitrate determinations, chlorophyll *a* replications, *in situ* assimilations, and the helicopter transects are submitted in this report.

3. Variance analysis

The variability of chlorophyll *a*, assimilation potential, I_k, initial slope, and assimilation number arises from three levels. Each higher level contains variabilities associated with all lower levels in addition to that of the level itself. The first level, experimental error, includes variations in the physical or chemical treatment of the samples, and, for assimilation potential, light variations in the incubation chamber. The first level of error includes all variations introduced after the sample is brought to the surface. The second level of error is small-scale patchiness introduced from variations in measured properties over distances of less than several meters. This level has no temporal component. The third level of error includes the combined effects of temporal changes in the measured property, advective changes resulting from large scale patchiness (> 10's of meters), and differential motions of the ice with respect to the water.

The magnitudes of the two lowest levels of error were estimated using results of replication experiments for chlorophyll *a* and assimilation. A one-way analysis of variance was done on replicated chlorophyll *a* subsamples from a single depth. For each depth there were 10 experiments of four replicates each. The resulting mean square error (MSE) is an estimate of the combined variability of experimental and small-scale patchiness error. A nested one-way analysis of variance was done on assimilation potential measurements from a single depth. For each depth there were 10 experiments with 4 water samples per experiment and 2 replicate observations per water sample. The resulting MSE estimates experimental error.

The third or highest level of error was estimated for chlorophyll *a*, assimilation potential, assimilation numbers, I_k, and initial slope. This was done by dividing the 4-month sampling period into equal time intervals and pooling observations within each interval. Five-day intervals were selected for chlorophyll *a*, assimilation potential, and assimilation numbers, and two-day intervals were selected for I_k and initial slopes. All chlorophyll *a* measurements made from a single depth in the same time interval were pooled, including samples from depth profiles and graduated light experiments. Measurements of assimilation potential were pooled similarly. Initial slopes and I_k values were pooled from the four sampled depths (5, 10, 20 and 30 m). Assimilation numbers from all samples in the upper 30 m were pooled.

One-way analyses of variance were done on the grouped data to determine the within group mean square error (MSE). The MSE term is an estimate of the combined effects of variation due to experimental, small-scale patchiness, spatial, and temporal errors. Ninety-five percent confidence intervals (CI) about cell means for chlorophyll *a*, assimilation potential, I_k, and initial slope were calculated as:

$$CI = \overline{X} \times/\div \text{ antilog } (t_{0.05,df} \cdot (MSE/n)^{1/2}) ,$$

where $\overline{X}$ equals the geometric mean, n equals the number of samples in a time cell, and df equals the within group degrees of freedom. Confidence intervals for assimilation numbers were determined as:

$$CI = \overline{X} \pm t_{0.05,df} \cdot (MSE/n)^{1/2} ,$$

where $\overline{X}$ equals the arithmetic mean. Sample size (n) was typically 3 or 4 for chlorophyll *a* and assimilation potential, 4 for I_k and initial slope, and 7 for assimilation number.

A one-way analysis of variance was done on each *in situ* assimilation experiment for which an inter-site comparison was available. There were 2 or 3 sites, with 2 or 3 replicates for each site.

The zooplankton counts have not been analyzed statistically. Solar radiation measurements and phytoplankton standing stock samples have not been analyzed.

VI. Results

A. Nitrate

Nitrate concentrations were below detectable limits in the upper 40 m throughout the summer (Table 4). Samples taken during the helicopter transects showed that nitrate depletion in the upper 20 m was widespread (Table 5). At the bottom of the pycnocline, 48 to 52 m, nitrate was undetectable until early September. Trace amounts (< 1.0 μg at ℓ^{-1}) were measured at 42 m by late September. Concentrations increased with depth across the pycnocline at 50 to 60 m. Nitrate at 100 m was >10.0 μg at ℓ^{-1}. At 1.0 μg at ℓ^{-1} concentrations, experimental error results in the correct value being within ± 0.05 μg at ℓ^{-1} of the measured value (Strickland and Parsons 1968).

B. Chlorophyll *a*

Chlorophyll *a* concentrations in the upper 40 to 45 m were about 0.10 mg m^{-3} in early June. Chlorophyll *a* in this depth range declined in late June and remained below 0.03 mg m^{-3} throughout July and August. Similar low chlorophyll *a* concentrations were found along the helicopter transect (Table 5). Concentrations increased in the upper 40 to 45 m in late September (Figs. 3 and 4). During July and August, a major increase in chlorophyll *a* occurred in the pycnocline at 58 to 64 m. At mid-summer the concentrations in this depth range were above 0.25 mg m^{-3}, but declined thereafter. Chlorophyll *a* below 70 m remained less than 0.10 mg m^{-3}.

The total chlorophyll *a* integrated over the upper 100 m showed two peaks (Fig. 5). The first, of about 6.0 mg m^{-3}, occurred in early June due to increased chlorophyll *a* in the upper 40 m. Following a decline to less than 2.0 mg m^{-3} in late June, a second peak of about 6.8 mg m^{-3} occurred in early August due to the chlorophyll *a* increase at the pycnocline.

A one-way analysis of variance performed on the transformed chlorophyll *a* data pooled into 5-day intervals indicates that at the 4 depths analyzed, there is a highly significant ($P < 0.01$) variance component added between time periods (Appendix B). The variability of the chlorophyll *a* concentrations pooled into individual time periods is 20 to 31% of the total variability. The 95% confidence intervals about 5-day means extend from about 71 to 140% of the means (Fig. 6). The analysis of variance performed on the chlorophyll *a* replications indicate that the combined effects of experimental and small-scale patchiness

Table 4. Nitrate concentrations (μg at ℓ^{-1}) measured at AIDJEX Main Camp Big Bear

Depth (m)	JUN					JUL						AUG						SEP			
	11	17	20	23	29	5	7	11	17	23	29	4	10	16	22	28	30	6	12	22	27
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42																	0.0	0.0	0.0	0.1	0.1
44																	0.0	0.0	0.0	0.0	0.2
46		0.0							0.0				0.0				0.0	0.0	0.4	0.4	0.7
48									0.0				0.0				0.2	0.0	0.4	0.4	1.1
50		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5	0.0	0.8	1.0	1.9
52								0.0	0.0				0.3				1.2	0.2	1.3	1.4	3.0
54								0.1	0.2				0.5				1.9	0.3	1.8	2.1	3.3
56						0.0	0.1	0.2	0.4	0.0	0.0	0.0	0.8				2.6	0.9	1.9	2.4	3.6
58									0.4				1.2				2.4	1.3	2.1	2.1	4.3
60		1.3	0.2	0.6	1.3	0.0	0.3	0.4	1.1	0.2	0.1	2.4	0.9	0.5	1.2	1.7	3.0	1.9	2.1	3.4	5.6
62									0.9				1.9				3.4	3.7	3.4	5.0	5.4
64						0.3	0.6	2.4	1.4				2.4				3.7	5.8	2.8	4.4	6.4
70		6.3			3.5	2.8	2.6	4.7	4.5	2.4	4.0	6.6	3.6			3.0	5.8	6.5			
80					7.4		5.8	8.4	6.6				7.0				10.1	10.2	10.2	9.6	10.8
100					11.0				10.5				12.2				13.5	14.8	14.3		13.3

Table 5. Nitrate and chlorophyll *a* measured at two depths during helicopter transects

Camp		Caribou					Big Bear				Blue Fox
Mileage		+35	+27	+18	+10	+4	0	+12	+22	+32	+42
Nitrate (μg at ℓ^{-1})	10 m	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	20 m	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Chl *a* (mg m^{-3})	10 m	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02
	20 m	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.01	0.02	0.02

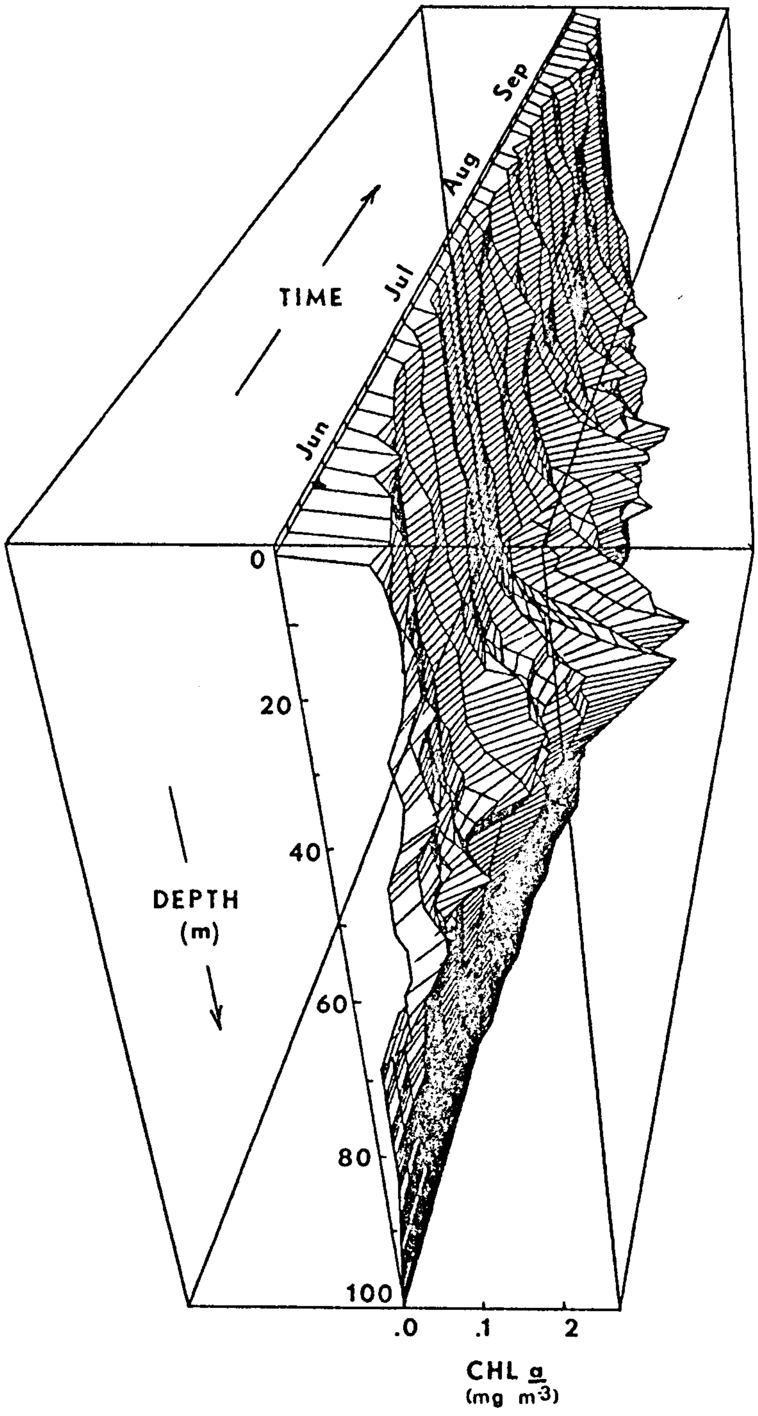

Fig. 3. Three dimensional plot of chlorophyll *a* at 0-100 m, June through September.

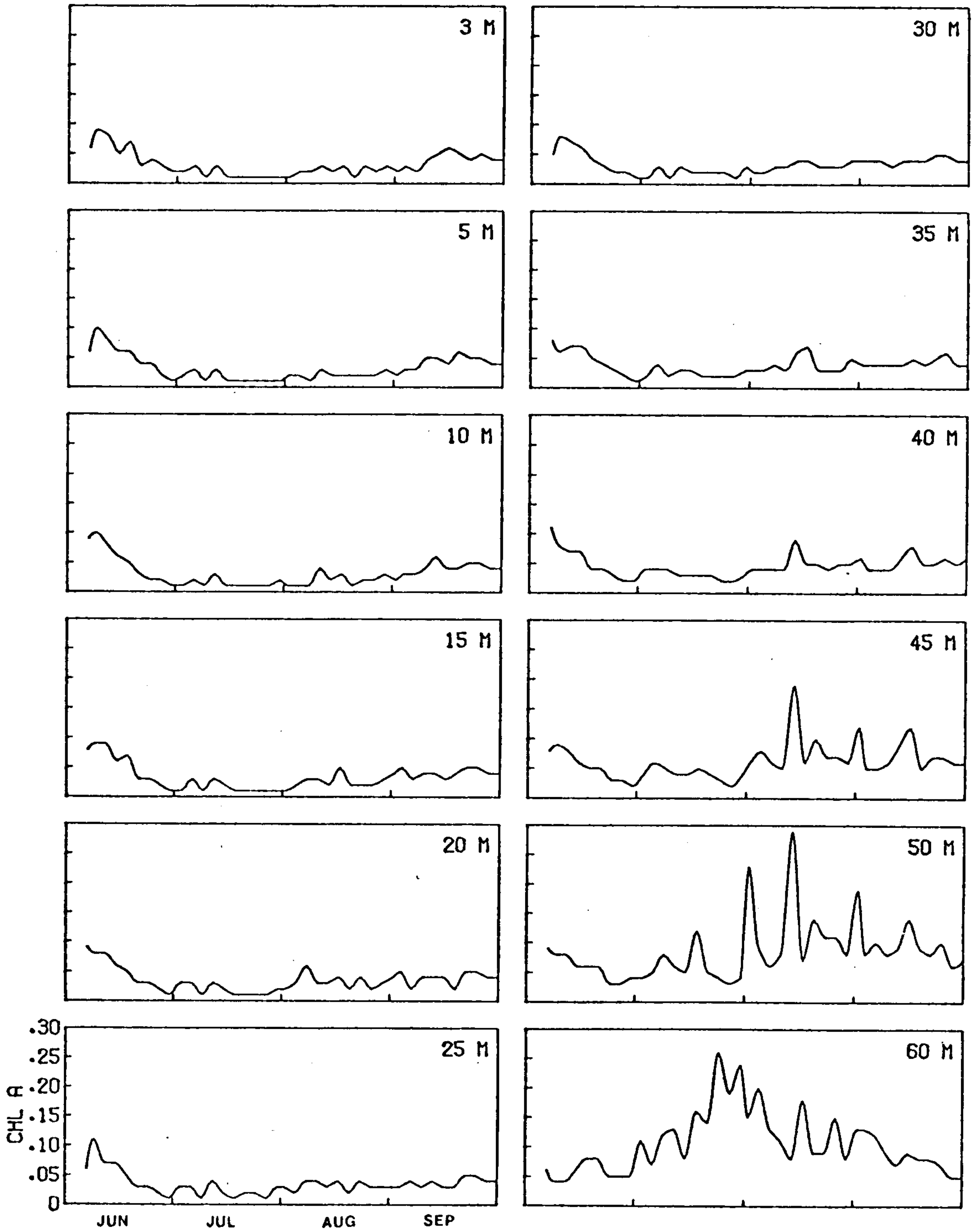

Fig. 4. Chlorophyll *a* (mg m^{-3}) over time at 12 depths.

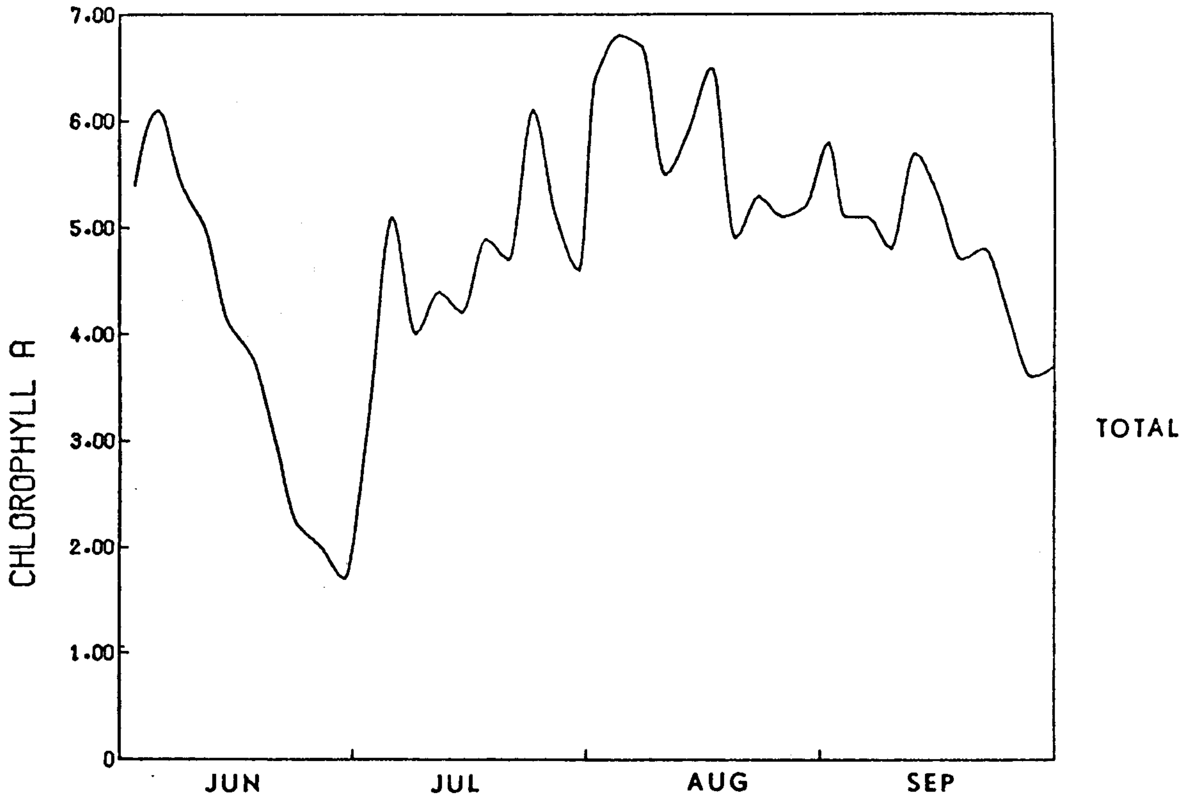

Fig. 5. Chlorophyll *a* (mg m^{-2}) integrated over the upper 100 m.

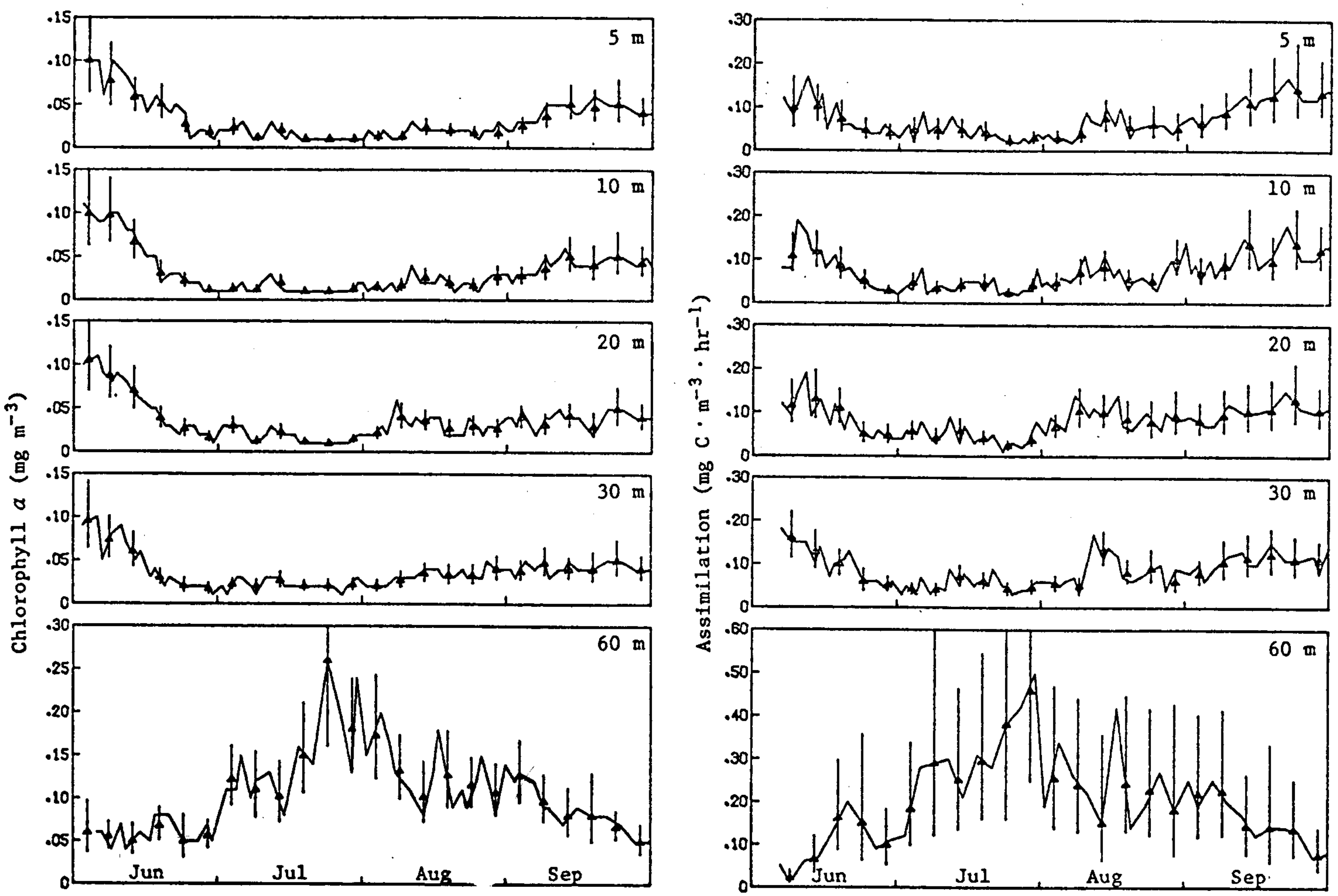

Fig. 6. Chlorophyll *a* and assimilation potential measured at five depths, with 5-day geometric means and confidence intervals.

error was only 5 to 14% of the variability of chlorophyll *a* concentrations pooled within 5-day intervals (Table 6 and Appendix B).

C. Assimilation potential

The assimilation potential of the upper 40 to 45 m was 0.1 - 0.2 mg C $m^{-3} \cdot hr^{-1}$ in early June (Fig. 7). The potential in this depth range declined in late June and remained below 0.1 mg C $m^{-3} \cdot hr^{-1}$ until late September, when it increased slightly. The major increase in assimilation potential occurred at the pycnocline in late July and early August (Fig. 8). Values of 0.48 - 0.50 mg C $m^{-3} \cdot hr^{-1}$ were measured during this period. Assimilation potential decreased at these depths through the rest of the summer.

The analysis of variance performed on the transformed assimilation potential data pooled into 5-day intervals indicates that at the 4 depths analyzed, there is a highly significant ($P < 0.01$) variance component between time periods (Appendix A). The variability of the assimilation potential pooled within each time interval is 33 to 41% of the total variability. The 95% confidence intervals of 5-day means extend from about 68 to 147% of the mean (Fig. 6).

The nested analysis of variance performed on the assimilation potential replications indicates there is a significant ($P < 0.05$) component of variance added between water bottle samples (Appendix A). The variability due to experimental error was about 35-57% of that found among samples pooled within 5-day intervals. The variability due to small-scale patchiness errors was less than that due to experimental error. The combined effect of experimental and small-scale patchiness error is 47 - 90% of the variability of assimilation potential pooled within 5-day intervals.

D. Assimilation number

Assimilation numbers ranged from < 1.0 to 8.3 mg C·mg Chl $a^{-1} \cdot hr^{-1}$. Values were generally higher in July and August than in early or late summer (Fig. 11). The 95% confidence intervals about the means of the 5-day periods extend from about 80 to 125% of the mean. The regression of assimilation potential on chlorophyll *a* was highly significant ($P < 0.01$, $r = 0.90$) and resulted in a slope of 1.73 mg C·mg Chl $a^{-1} \cdot hr^{-1}$ for samples combined from 20, 40, and 60 m (Fig. 9).

E. Graduated light experiments

The curvilinear relation of assimilation versus light (Steele 1962) was fitted to 120 graduated light data sets (Fig. 10). I_k, converted from relative to absolute light intensity ($W \cdot cm^{-2}$PAR) was 1.0 - 4.0 x 10^{-3} $W \cdot cm^2$ (Fig. 11). Values were highest in August. The 95% confidence interval about the mean of the 2-day periods was the mean ± 0.8 x 10^{-3} $W \cdot cm^2$.

Table 6. Chlorophyll *a* (mg m^{-3} x 100) measured during the replication experiments at four depths on 10 days

Date	Depth (m) 5				10				20				30			
0703	1.7	1.6	1.6	1.9	1.2	1.3	1.2	1.8	3.2	2.8	2.7	2.4	2.8	3.3	3.2	3.3
0712	2.1	2.2	2.4	2.7	1.5	1.8	1.5	1.5	2.3	2.3	2.1	2.1	2.6	3.6	3.3	2.9
0721	1.4	1.5	1.3	1.3	1.1	1.2	1.6	1.0	1.2	1.2	1.3	1.4	2.2	2.2	1.9	2.1
0731	1.3	1.4	1.3	1.3	1.7	1.8	1.7	1.6	1.8	1.8	1.7	1.8	3.0	2.9	2.8	2.9
0809	2.5	2.3	2.5	2.6	2.2	2.4	2.3	2.4	4.4	4.5	4.2	4.1	3.4	3.4	3.2	3.6
0818	1.4	1.7	1.6	1.4	1.8	1.5	1.4	1.5	2.0	2.6	2.2	2.2	3.2	2.9	3.0	2.8
0827	2.5	2.2	2.3	2.0	2.5	2.6	2.4	2.6	3.3	3.2	3.4	3.9	5.4	5.1	5.0	3.6
0905	3.4	3.3	3.3	3.8	3.0	3.2	3.1	3.3	3.6	3.8	3.9	4.3	5.6	4.4	4.8	4.4
0914	3.6	3.4	4.2	3.9	4.1	4.2	4.4	5.0	3.8	3.4	3.6	3.6	5.0	5.4	5.2	5.3
0929	4.4	4.2	5.3	4.2	5.1	5.4	5.1	5.1	3.9	4.1	4.0	4.4	4.0	3.8	3.6	3.5

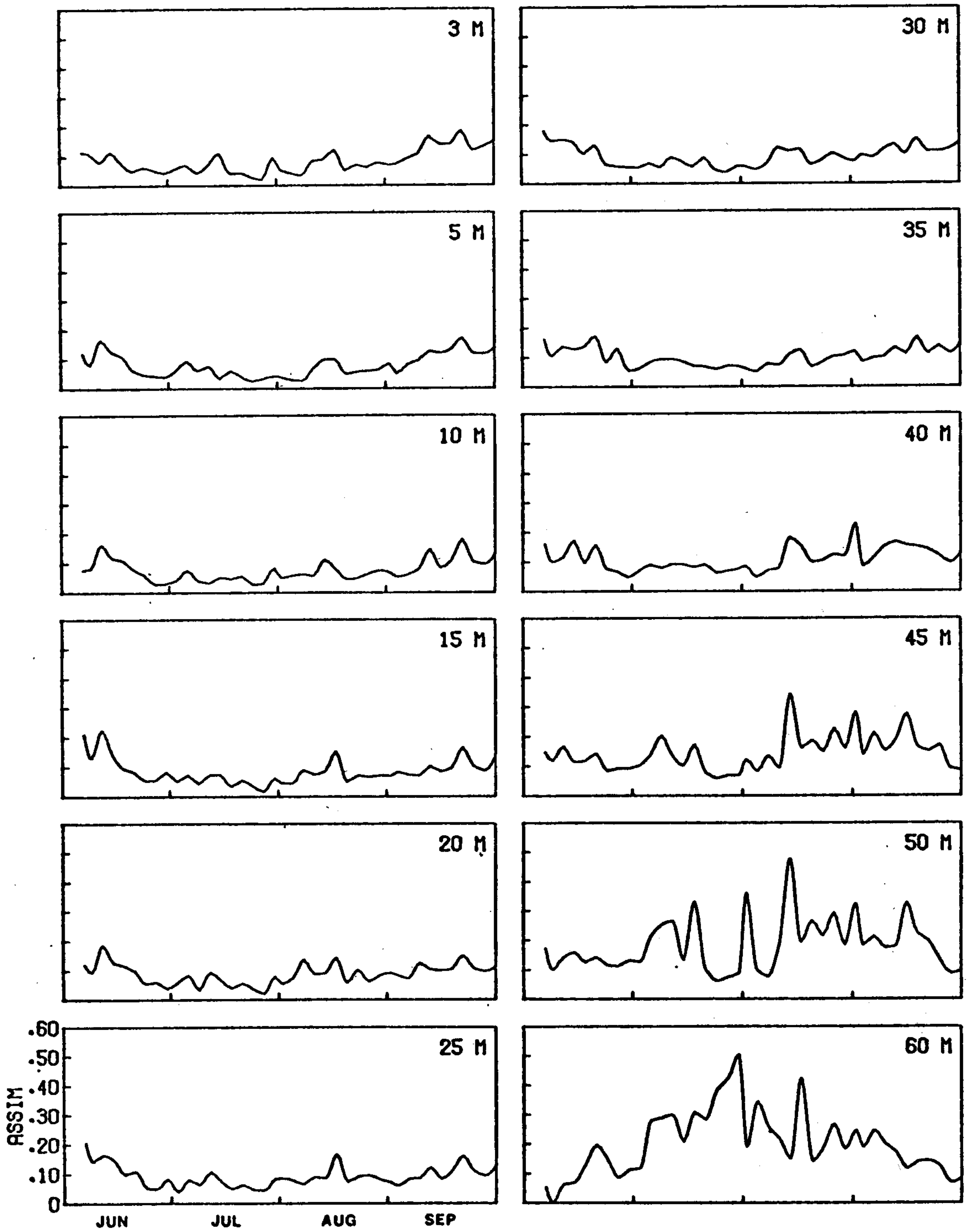

Fig. 7. Assimilation potential (mg C $m^{-3} \cdot hr^{-1}$) over time at 12 depths.

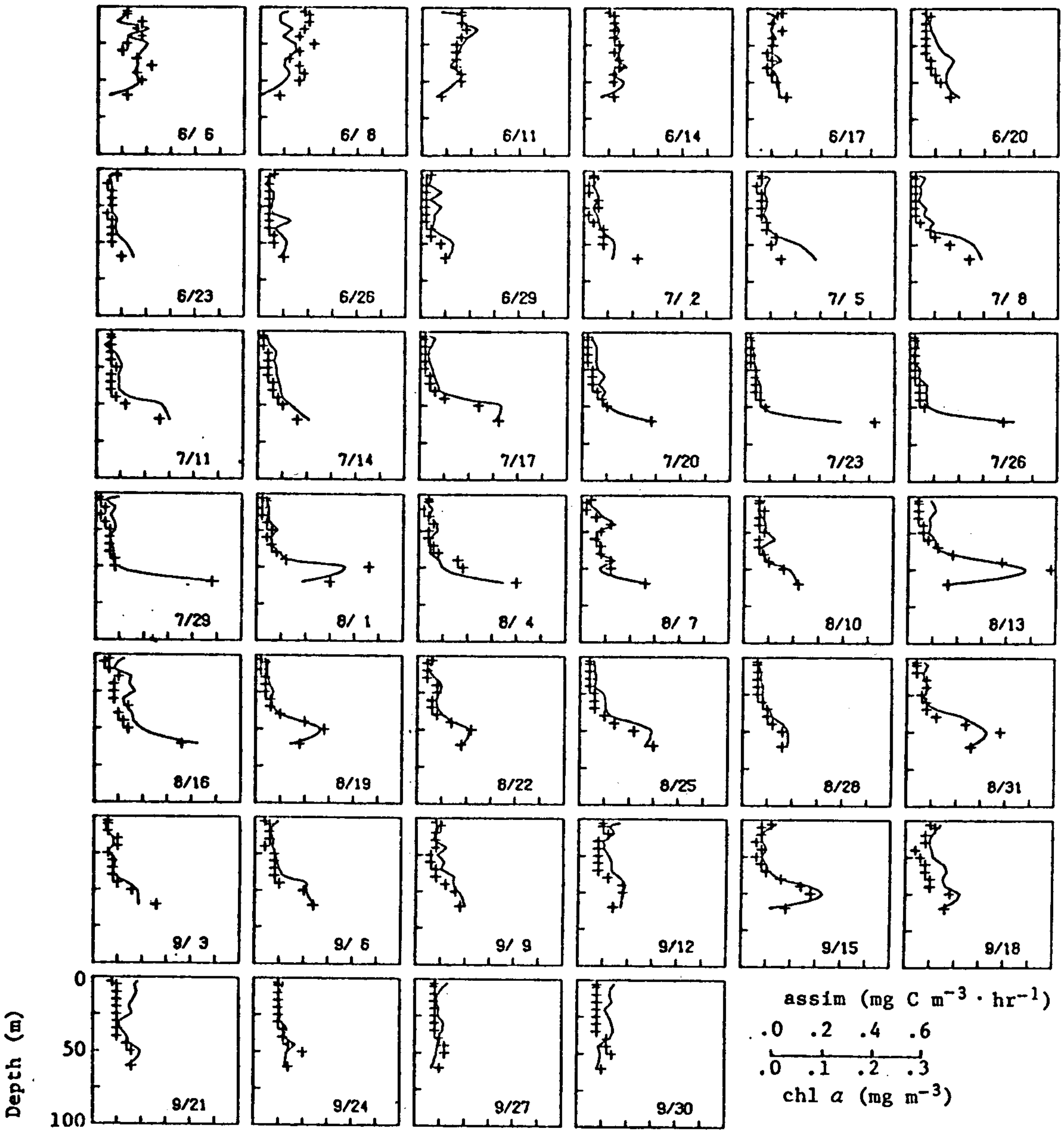

Fig. 8. Chlorophyll *a* depth profiles overlaid on assimilation potential depth profiles. (+) chl *a* (-) assim.

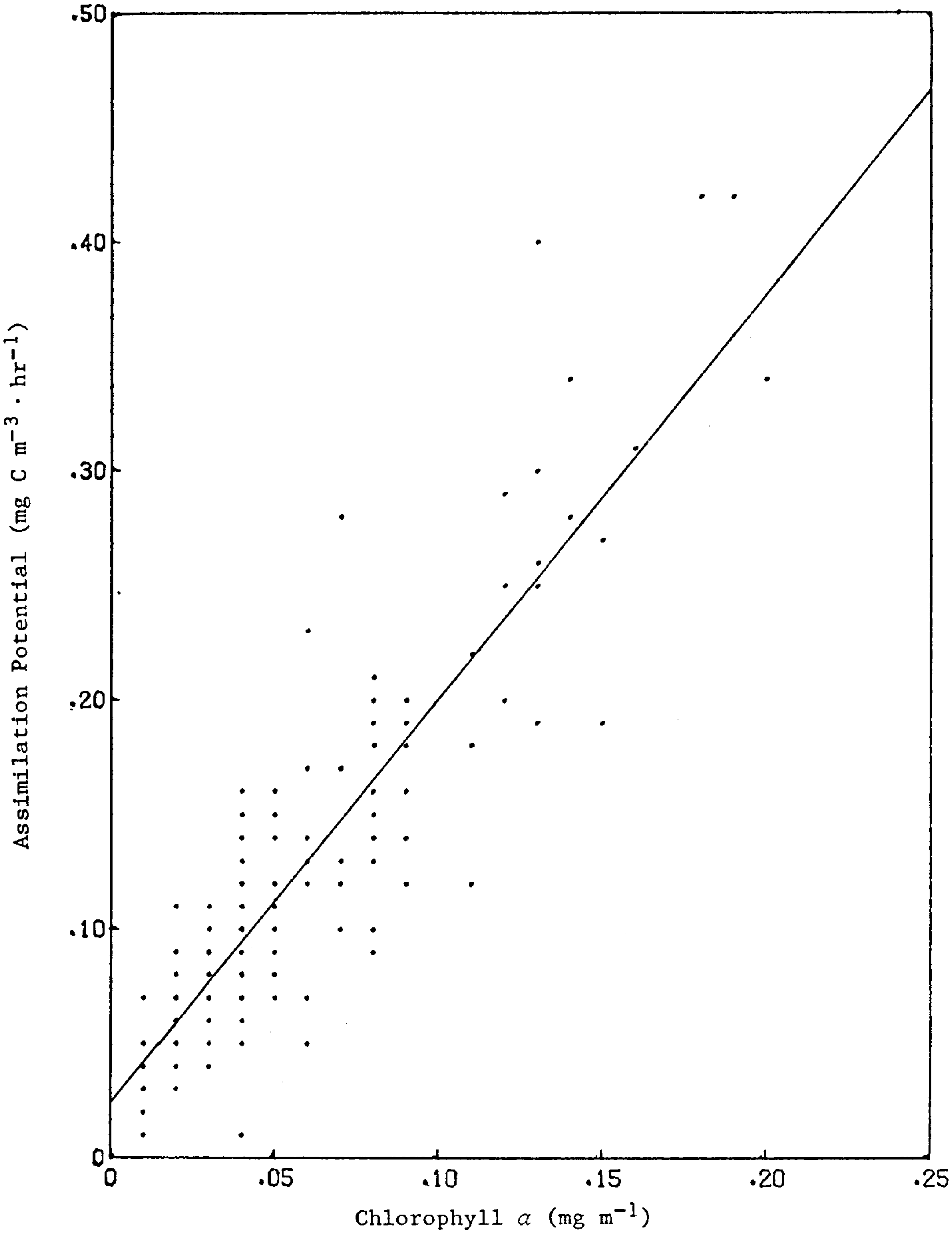

Fig. 9. Assimilation potential versus chlorophyll *a* measured at 20, 40 and 60 m. The regression line equation is: assim. = 1.73 Chl *a* + 0.026.

Fig. 10. Relative assimilation (P_r) versus relative light (I_r) for observations from graduated light experiments at five depths. Month and day are indicated to the left. The last five graphs are from 60 m.

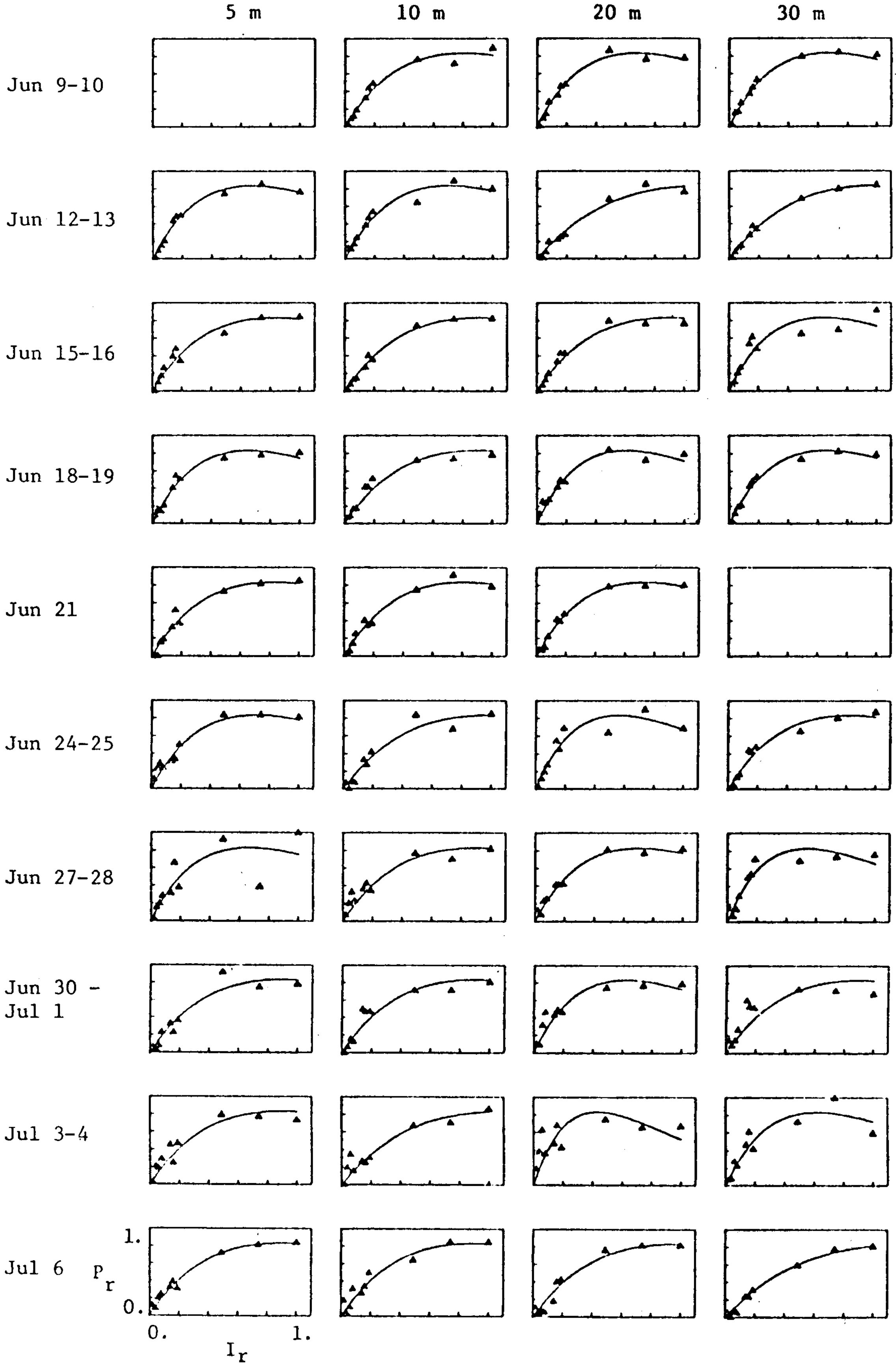
5 m
10 m
20 m
30 m
Jun 9-10
Jun 12-13
Jun 15-16
Jun 18-19
Jun 21
Jun 24-25
Jun 27-28
Jun 30 -
Jul 1
Jul 3-4
Jul 6
1.
P r
0.
0.
1.
I r

Fig. 10.

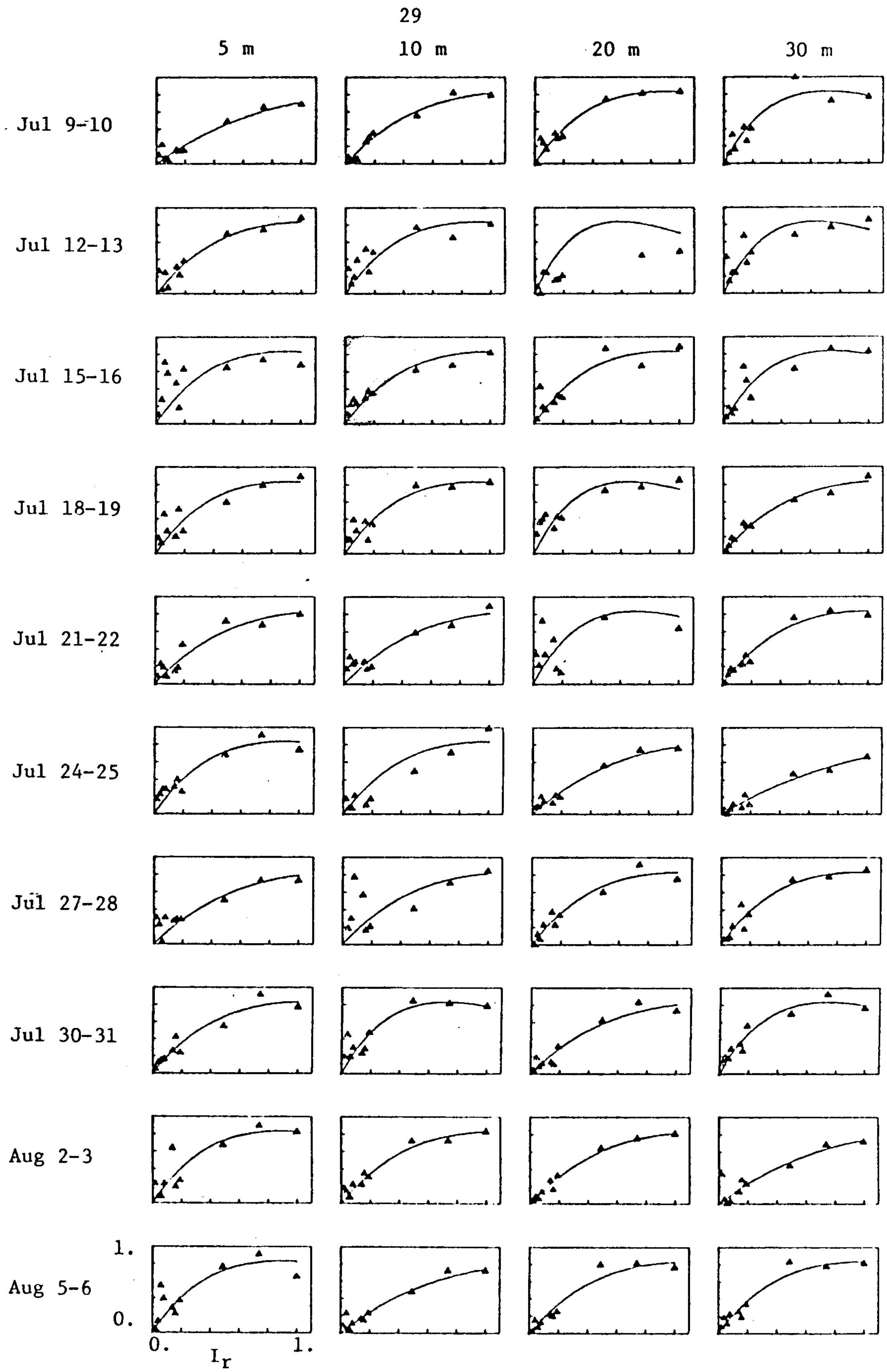

Fig. 10. (continued)

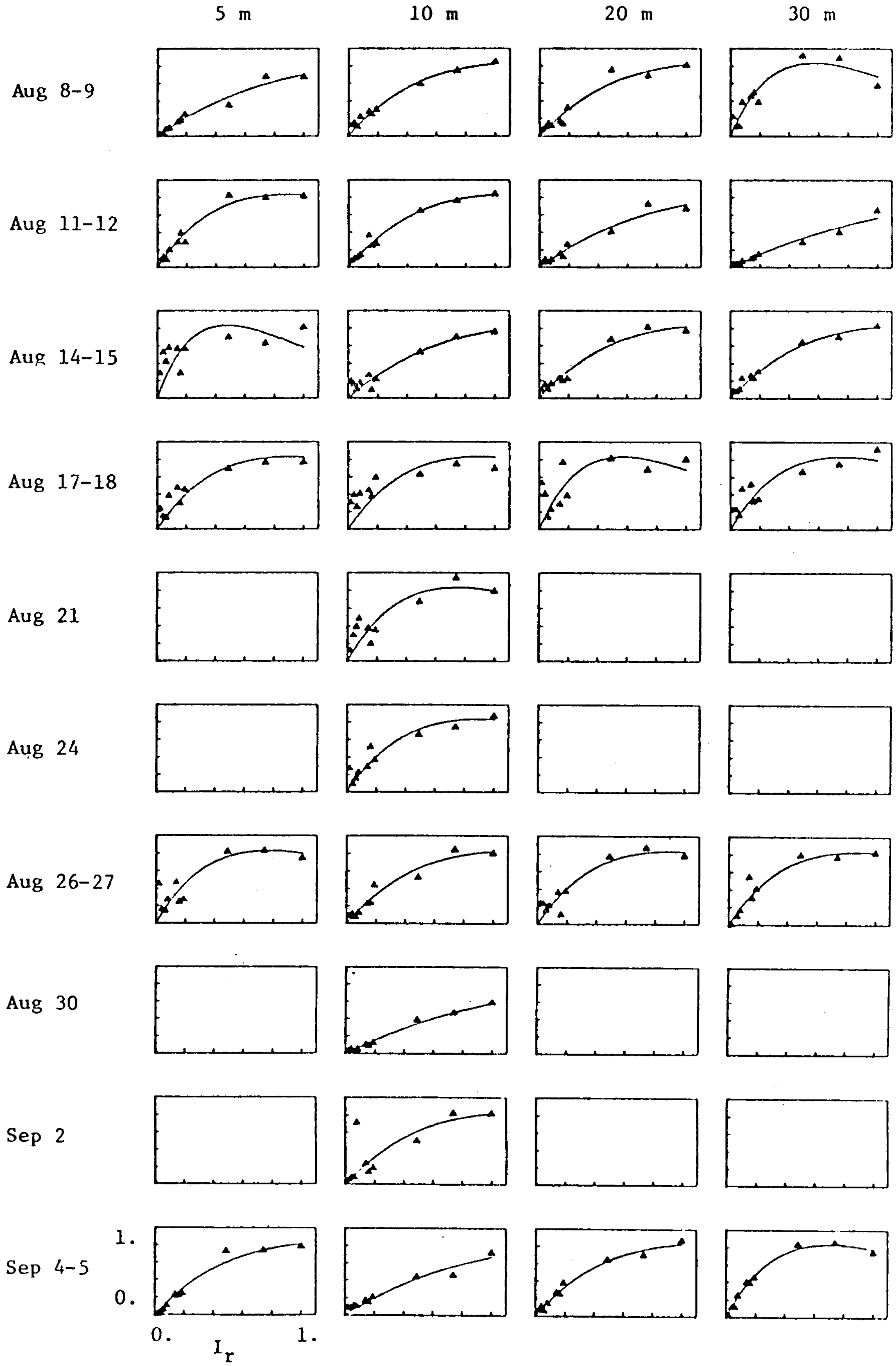

Fig. 10. (continued)

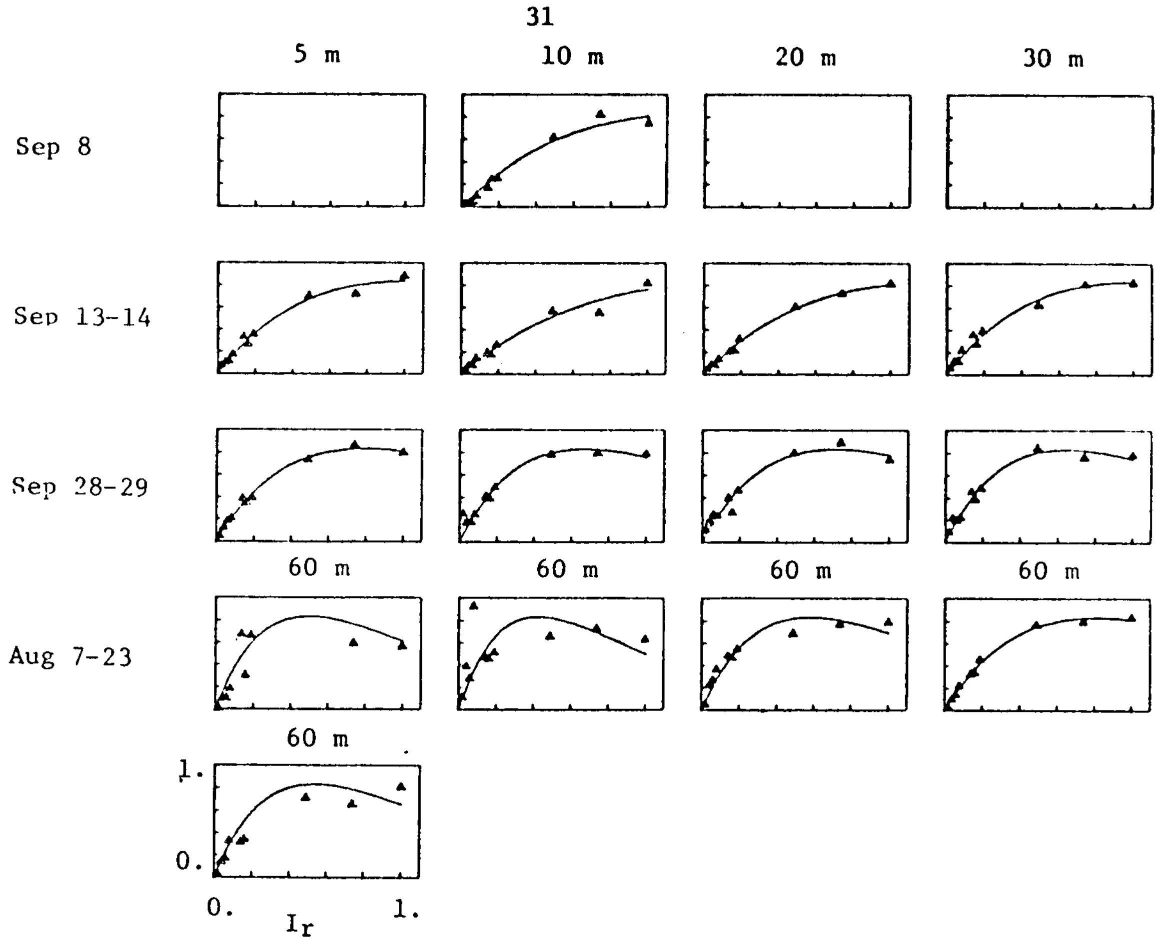

Fig. 10. (continued)

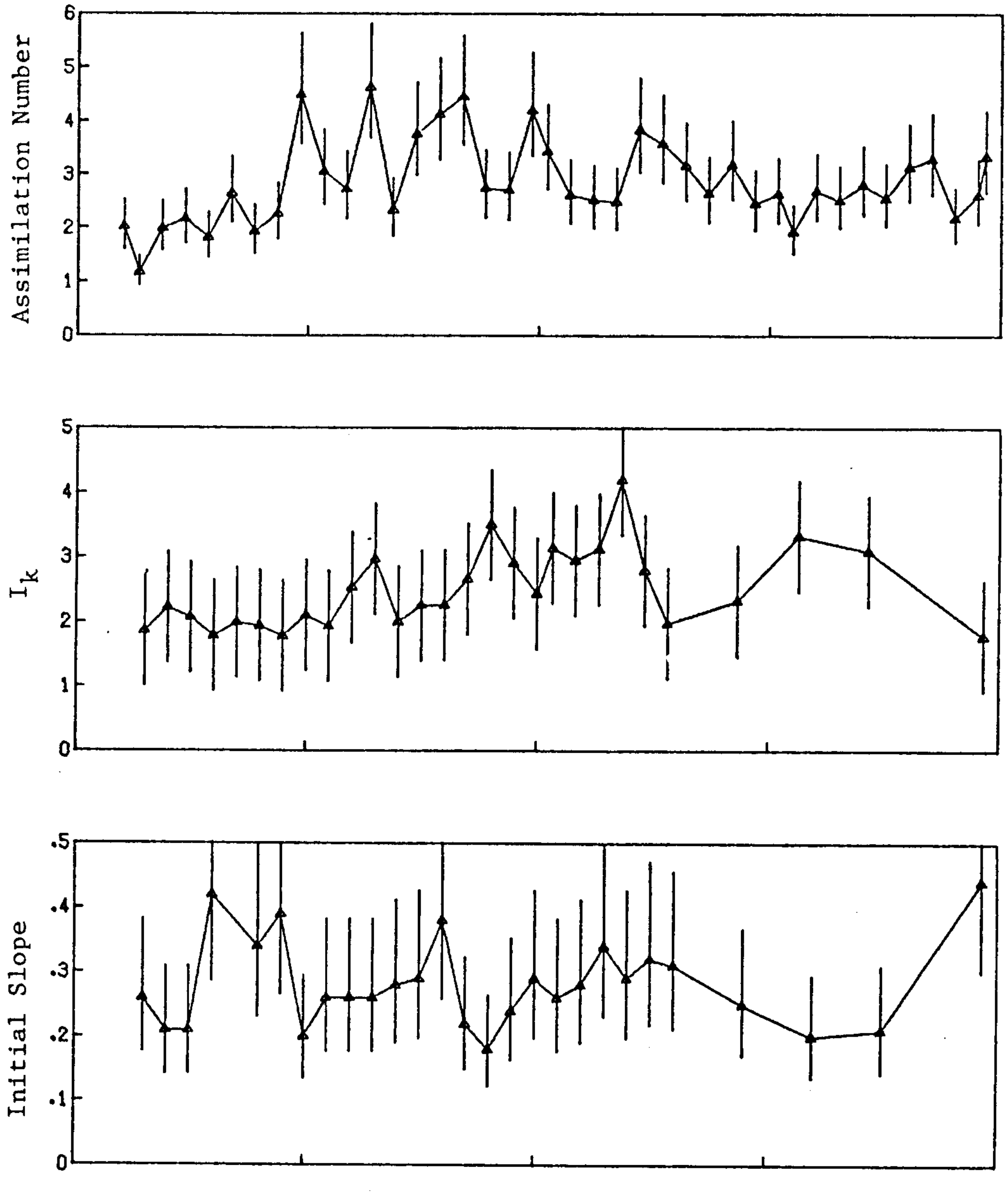

Fig. 11. Assimilation number (mg C·mg Chl a^{-1} · hr^{-1}), I_k (W · cm^{-2} x 10^{-3}), and initial slope (mg C·mg Chl a^{-1} · (W · $m^{-2})^{-1}$ · hr^{-1}) over time with means and confidence intervals.

Initial slopes ranged from 0.10 to 0.69 mg C mg Chl $a^{-1} \cdot (W \cdot m^{-2})^{-1} \cdot hr^{-1}$ (Fig. 11). Slopes were highest in the second half of June and at the end of summer. The 95% confidence intervals about the mean of the 2-day periods extend from about 68-147% of the geometric mean.

A slight photoinhibition at high light was noted in some experiments (e.g., 5 m on 12-13 June, Fig. 10).

F. *In situ* assimilation

In situ assimilation, averaging the 2 or 3 replicate observations per site, ranged from 0.005 mg C $m^{-3} \cdot hr^{-1}$ below bare-ice drafted with snow on 28 July, to 0.076 mg C $m^{-3} \cdot hr^{-1}$ below a melt pond skimmed with ice and some slushy snow on 14 August (Table 7). There was a significant ($P < 0.05$) variance component added between sites in only 6 of the 19 experiments where inter-site comparison was possible. *In situ* assimilation was generally the same for the pond and lead sites. Assimilation at the ice site was usually less than at the other sites.

G. Zooplankton

Twenty-two copepod species were identified (Table 8). The smaller species, *Microcalanus pygmaeus*, *Oithona similis*, and *Oncaea borealis*, were more abundant (Table 9). *Calanus glacialis* and *Euchaeta glacialis* were least abundant. Nauplii were much more abundant than adults. Males were rarely encountered except in *Oithona similis* and *Oncaea borealis*.

Calanus hyperboreus adult females were present in the upper 75 m all summer (Fig. 12). Stage I appeared in mid-July and was present in the upper 75 m until mid-August. Stage II appeared in mid-August and remained until mid-September. Stage III was most abundant in September. Stages IV and V were present throughout the summer in the upper 50 m.

Calanus glacialis adult females were most abundant in July (Fig. 13). Stage I appeared in mid-July, and stages II and III appeared in early September and mid-August. Stage IV (possibly individuals that overwintered) was present in June and early July. Stage V was most abundant in July, though present all summer.

Euchaeta glacialis adult females were present after mid-July (Fig. 14). Stage II was present in early summer, mainly in the 50 to 75 m stratum. Stages III and IV were abundant in August and September. Stage V was present from late June onward. Except for stages II and III, this species was generally below the mixed layer (0 - 50 m).

Metridia longa adult females and males were present all summer (Fig. 15). Stage III was present mainly in September. Stages IV and V were present all summer. The species was generally below 75 m.

Table 7. Surface characteristics of the melt pond, lead, and bare ice sites during *in situ* incubations, and the associated average assimilation (mg C $\cdot$ m^{-3} $\cdot$ hr^{-1}). An asterisk denotes a significant ($P < 0.05$) added variance component between sites.

	Pond		Lead		Ice	
Date	Character	Assim.	Character	Assim.	Character	Assim.
0722	Skim ice	0.010	Open	0.009	Snow veneer, bright white	0.006
0723	Open	0.007	Open	0.011	Snow veneer, bright white	0.013
*0725	Open	0.007	Open	0.011	Melting greyish ice	0.008
0726	Skim ice	0.008	Ice bergs but open	0.009	Snow veneer, bright white	0.008
*0728	Ice and snow	0.008	Open	0.007	Snow drifts	0.005
*0729	Snow, ice and slush	0.043	Ice bergs but open	0.021	Fresh snow, 6-7 cm	0.034
0801	2 cm ice, 1/3 snow covered	0.042	Open	0.024	Fresh snow, 5-6 cm	
0803	Split by lead		Ice raft	0.014	Frost and snow, 4-5 cm	0.012
*0807	New pond, skim ice	0.022	50% mush	0.030	Snow, 2-5 cm	0.021
0809	Snow drifted		Open	0.039	Wind-blown snow, greyish	0.036
0811	Clear, some ice chunks	0.051	Open	0.047	Snow veneer	0.040
0812	Open	0.044	Open	0.052	Bright white, frosty	0.049
0813	Open	0.025	Open	0.030	Snow frosted	0.026
0814	Skim ice, some slush-snow	0.076	Open	0.061	Snow frosted	0.052

Table 7. (continued)

Date	Pond		Lead		Ice	
	Character	Assim.	Character	Assim.	Character	Assim.
0815	Skim ice, grey slush	0.033	Open	0.040	Snowy, melting	0.032
0816	Open	0.066	Open	0.050	Melting	0.053
0818	Skim ice	0.030	Skim ice	0.026	Frosted	0.020
*0821	4 cm ice	0.030	2 cm ice	0.025	Melting, grey	0.025
*0824	Blue ice	0.019	Open	0.024	Frosty white	0.021
0902	Drifted snow		Open	0.053	Drifted snow	
0908	Drifted snow		Ice and snow	0.059	Drifted snow	
0914	Drifted snow		Mush, drifted snow	0.053	Drifted snow	

Table 8. Copepods identified in samples taken at AIDJEX

Aetidiopsis multiserrata
Calanus glacialis
Calanus hyperboreus
Chiridius obtusifrons
Derjuginia tolli
Euchaeta glacialis
Gaidius brevispinus
Gaidius tenuispinus
Heterorhabdus compactus
Heterorhabdus norvegicus
Lubbockia glacialis
Metridia longa
Microcalanus pygmaeus
Microcalanus sp.
Oithona similis
Oncaea borealis
Oncaea notopus
Scaphocalanus magnus
Scolecithricella minor
Spinocalanus longicornis
Spinocalanus sp.
Temorites brevis
unidentified copepoda

Table 9. Maximum numbers of animals per 100 m^3 for species and stages collected at AIDJEX

Species	♀	♂	V	IV	III	II	I
Calanus hyperboreus	417	0	143	99	832	239	109
Calanus glacialis	69	2	38	5	20	41	76
Euchaeta glacialis	41	2	41	10	90	36	0
Metridia longa	239	5	265	66	132		
Microcalanus pygmaeus	4455	0	10182	15273	31818	38818	27364
Oithona similis	7000	1273	7318	3500	3818	7000	20682
Oncaea borealis	5091	21636	*Oncaea* spp. juveniles ← 39773 →				
Oncaea notopus	1061	0					
Nauplii - small	371148						
Nauplii - large	9866						
Nauplii - total	373545						

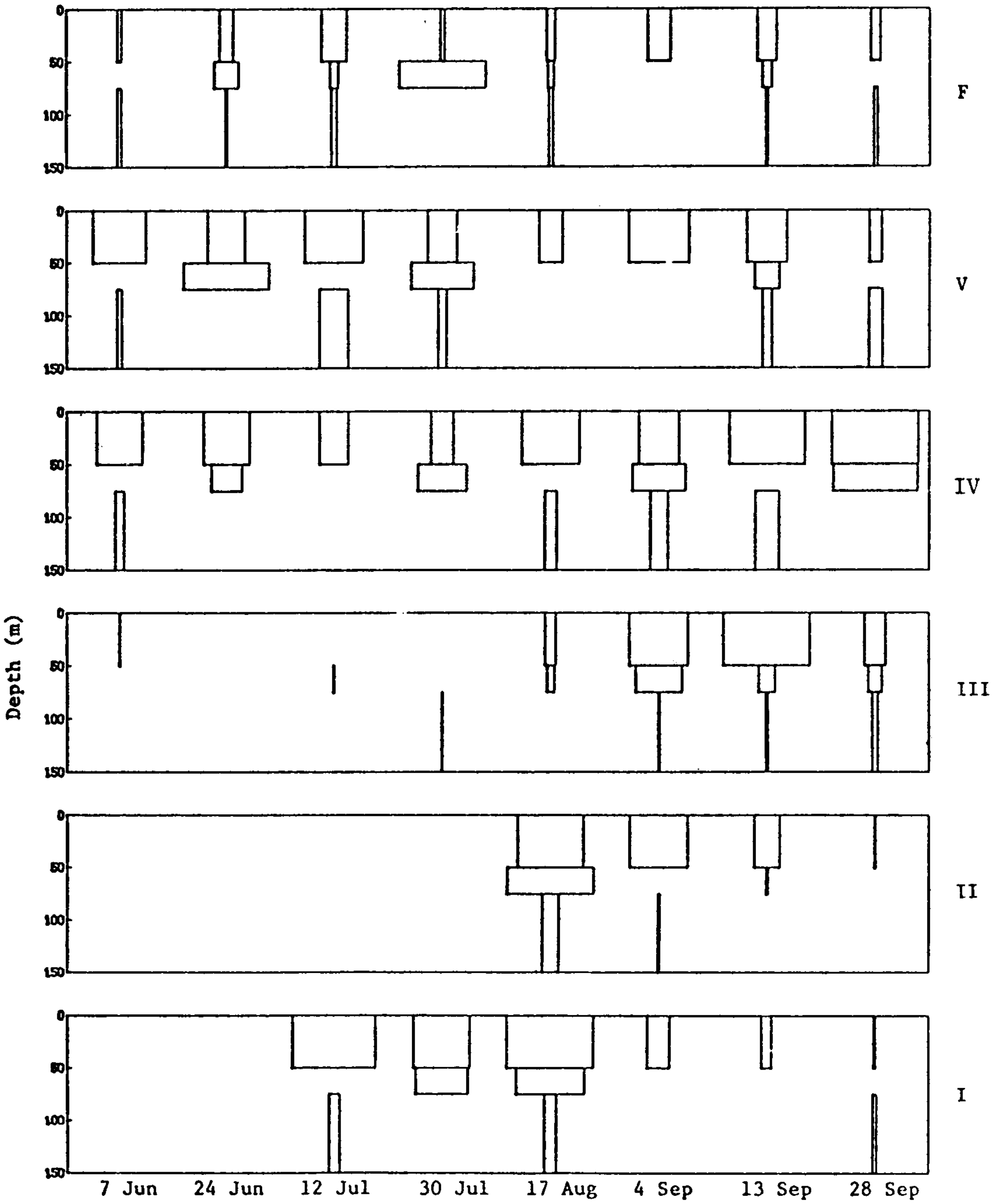

Fig. 12. Relative abundance of *Calanus hyperboreus*, females and stages I to V, for 3 depth intervals and 8 dates. The width of rectangles indicates the relative abundance at depths and dates within life history stages.

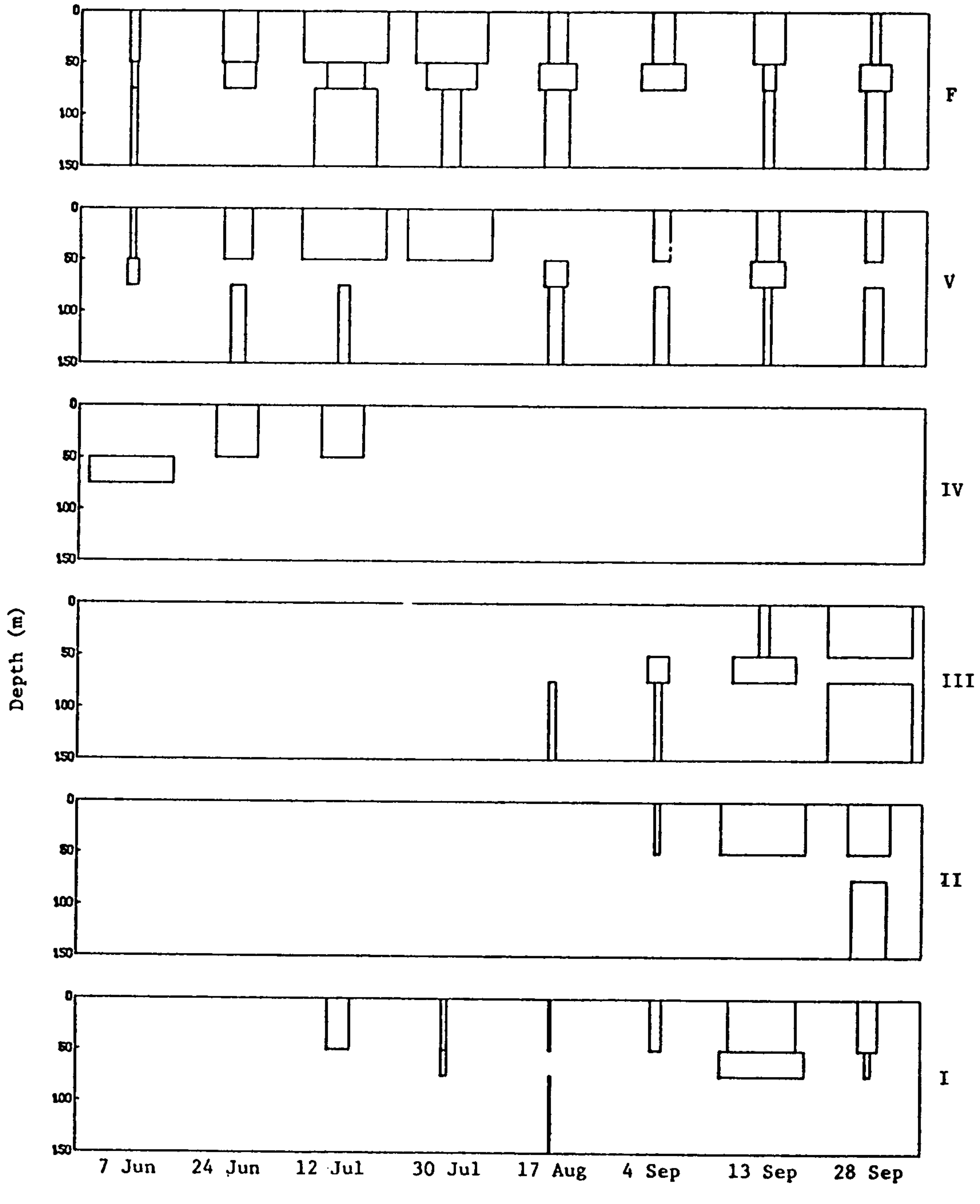

Fig. 13. Relative abundance of *Calanus glacialis*, females and stages I to V, for 3 depth intervals and 8 dates. The width of rectangles indicates the relative abundance at depths and dates within life history stages.

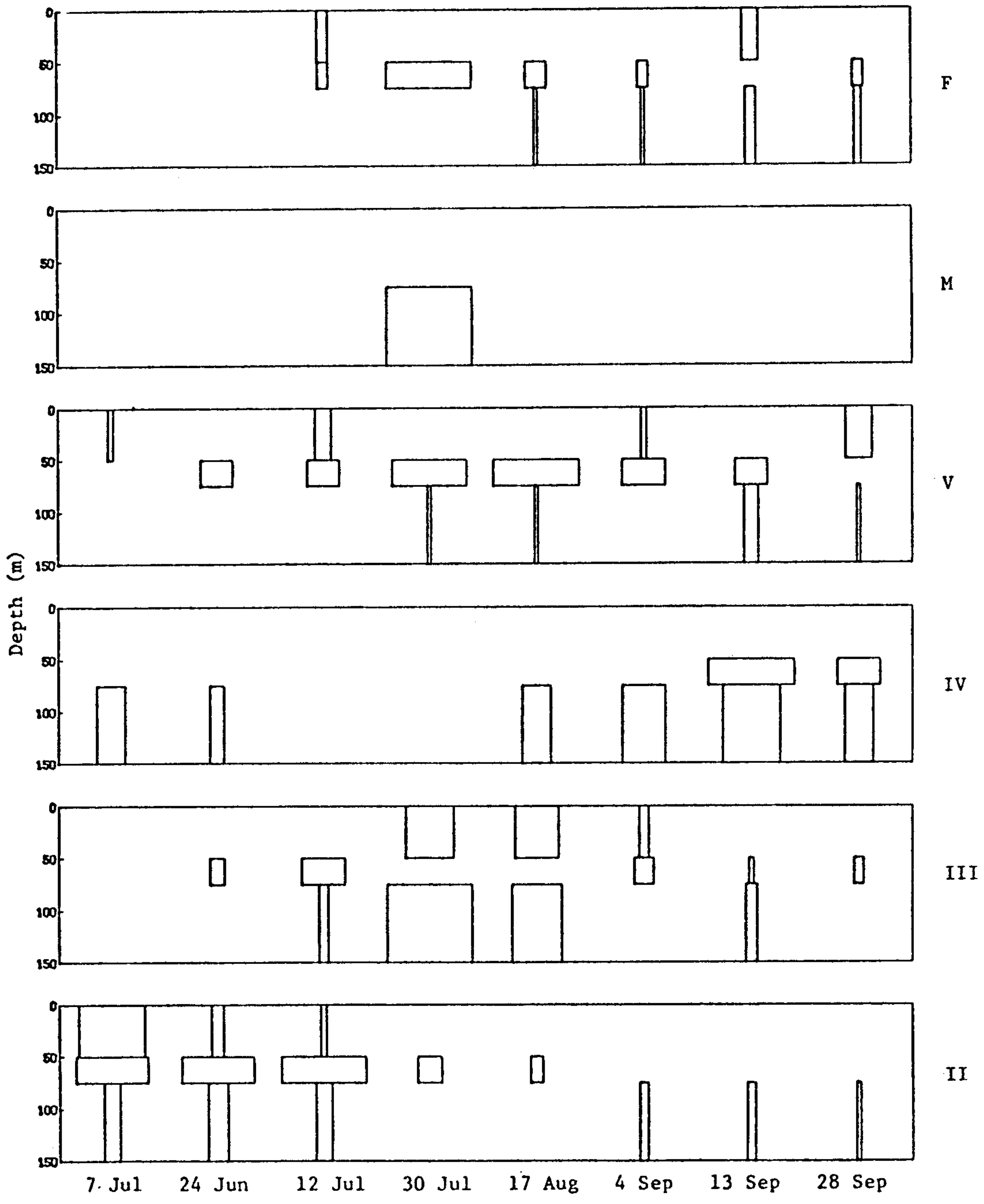

Fig. 14. Relative abundance of *Euchaeta glacialis*, females, males, and stages II to V, for 3 depth intervals and 8 dates. The width of rectangles indicates the relative abundance at depths and dates within life history stages.

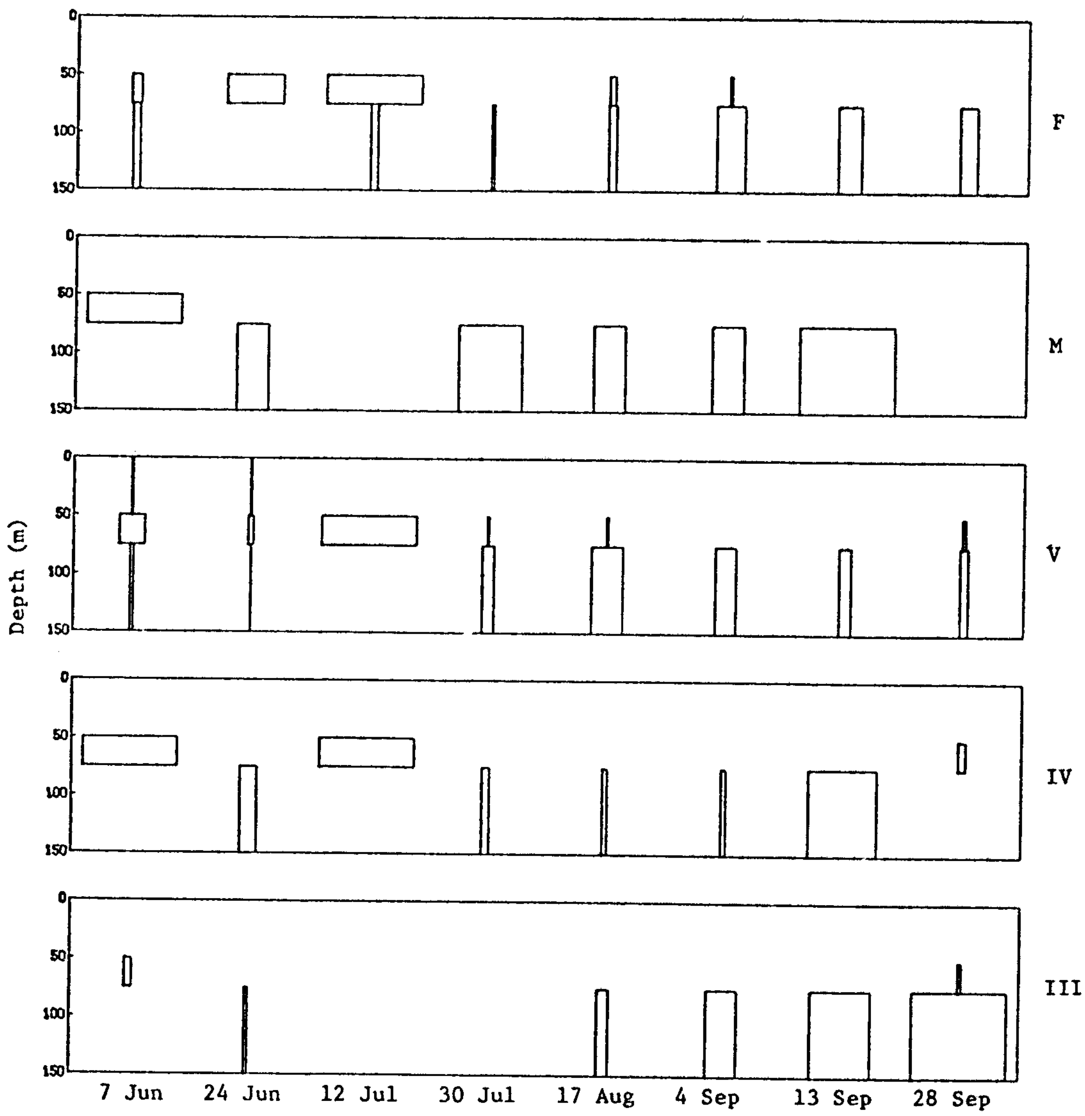

Fig. 15. Relative abundance of *Metridia longa*, females, males, and stages III to IV, for 3 depth intervals and 8 dates. The width of rectangles indicates the relative abundance at depths and dates within life history stages.

Microcalanus pygmaeus adult females were present, usually below 50 m, all summer (Fig. 16). Stages I through V were present all summer and generally remained above 50 m. Stage I was in greatest abundance in late June, stage II in late July, and stages III and IV in mid-September.

Oithona similis adult females and males were most abundant in the 50 to 75 m stratum, whereas the juveniles were generally in the upper 50 m (Fig. 17). Stages I through V were present all summer.

Oncaea borealis adult females and males were present all summer, the females being somewhat deeper than the males (Fig. 18), *Oncaea notopus* females were abundant in early summer and remained deep (Fig. 18). *Oncaea* spp. juveniles were present in the upper 50 m all summer.

Large and small copepod nauplii were present all summer and mainly associated with the upper mixed layer (Fig. 19). In general, the juveniles and nauplii were in the upper 75 m. There was a pattern of development shared in common by *Calanus hyperboreus*, *C. glacialis*, and *Microcalanus pygmaeus*, wherein the juveniles passed from stage I through stage III during the summer. *Euchaeta glacialis* juveniles passed from stage II through stage IV during the summer.

H. Environmental observations

Air temperatures increased and remained near the freezing point about 22 June (Fig. 20). In late July, temperatures temporarily decreased, snow accumulated, and pond surfaces froze. These conditions lasted until late August when a brief rainy period caused a slight melting of the surface. The autumn snow began to increase in September as temperatures decreased. Though there was a brief rise in temperature to near freezing in the first half of September, snow continued to accumulate.

Observed changes in the ice cover can be delineated roughly into eight periods:

1-22 June: pre-melt, crusty, snowy, bright white surface

22 June - 1 July: heavy melting, melt ponds increasing, intermittent rains

2-9 July: maximum meltwater (40 to 60%), intermittent snow

10-15 July: pond drainage, increased leads, intermittent snow

16-25 July: little change, grey ice, pond surfaces frozen, some snow

26 July - 19 August: heavy snow accumulation, ponds drifted over, bare ice covered with snow

20-20 August: brief rain, warm melt period, grey ice, slight melt water accumulation

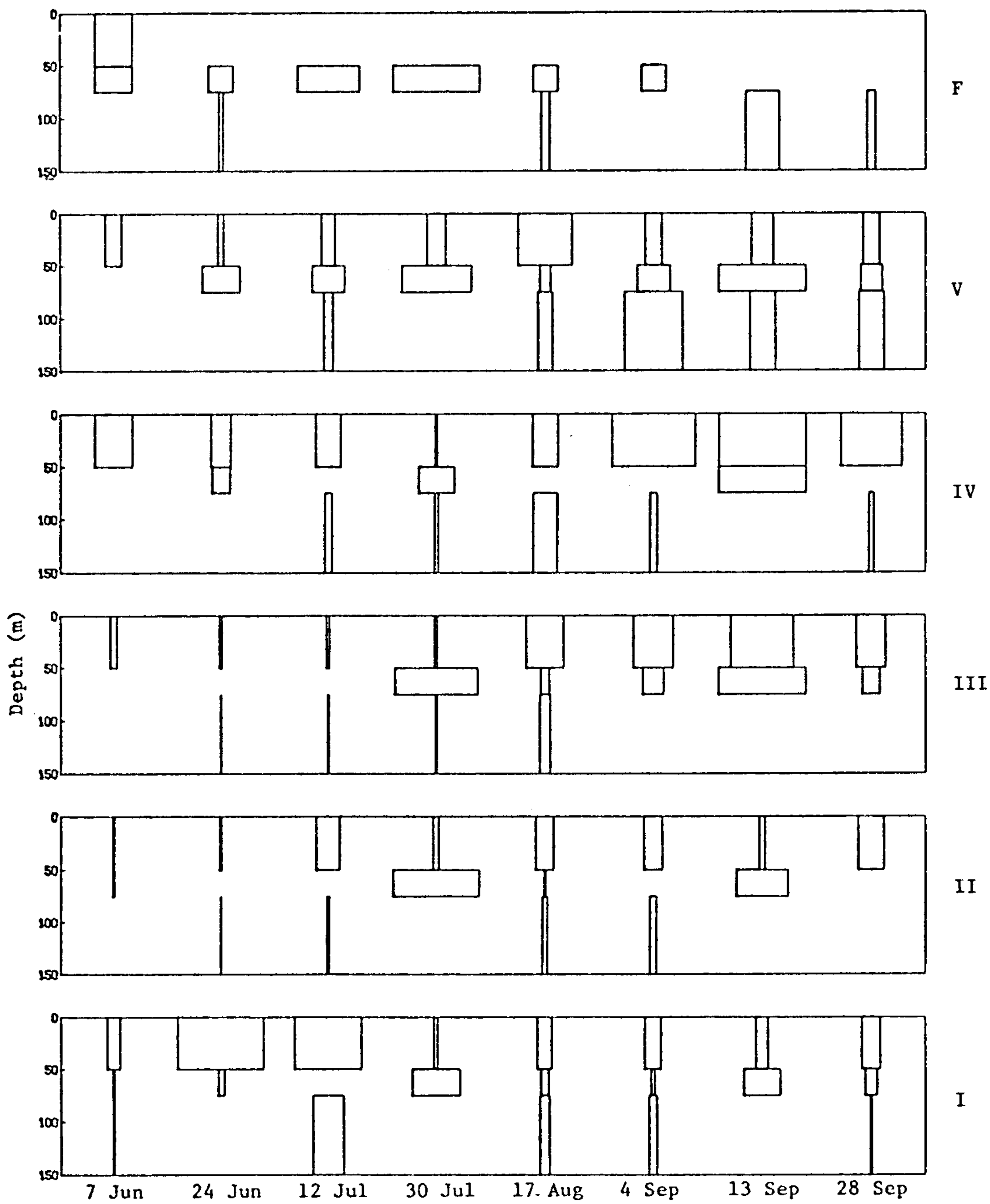

Fig. 16. Relative abundance of *Microcalanus pygmaeus*, females and stages I to V, for 3 depth intervals and 8 dates. The width of rectangles indicates the relative abundance at depths and dates within life history stages.

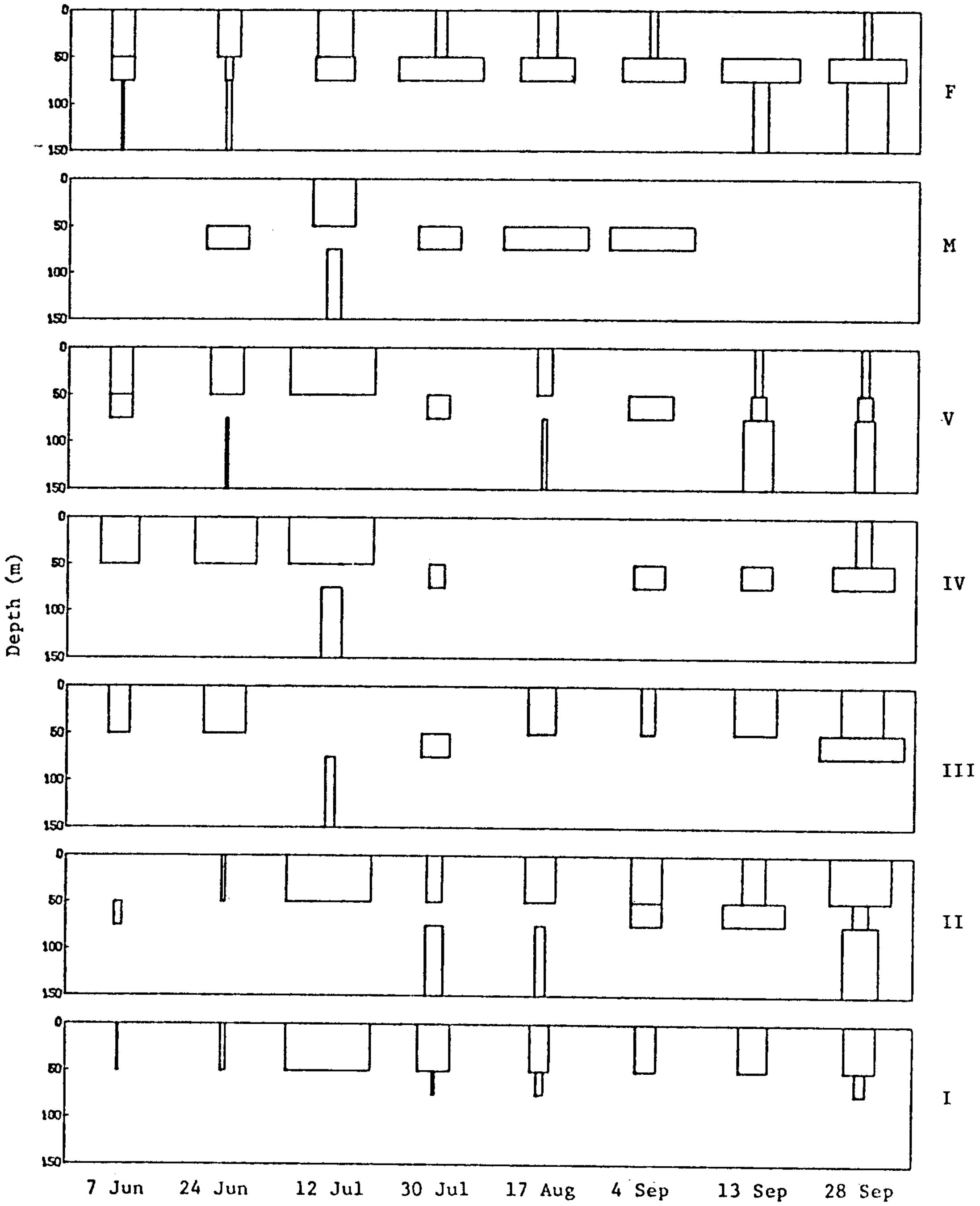

Fig. 17. Relative abundance of *Oithona similis*, females, males, and stages I to V, for 3 depth intervals and 8 dates. The width of rectangles indicates the relative abundance at depths and dates within life history stages.

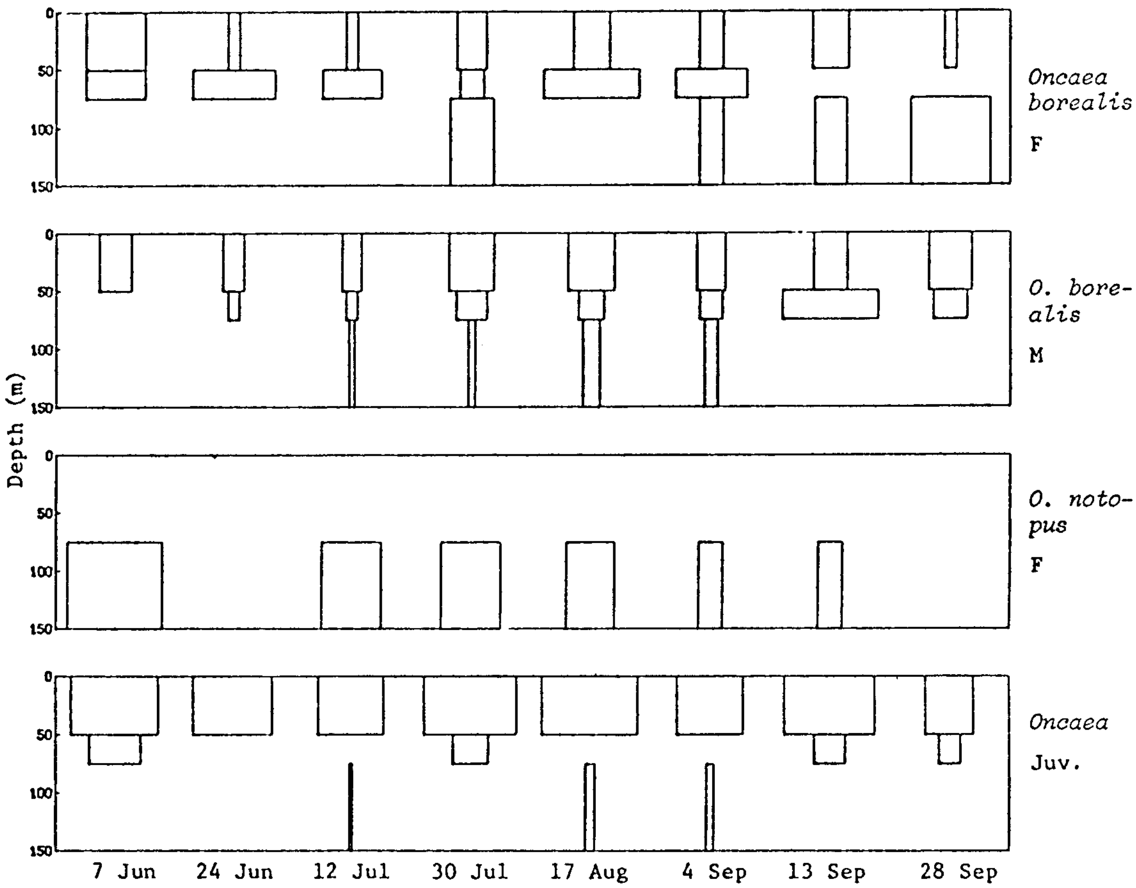

Fig. 18. Relative abundance of *Oncaea borealis*, females and males; *O. notopus*, females; and *Oncaea* spp. copepodite stages, for 3 depth intervals and 8 dates. The width of rectangles indicates the relative ıbundance at depths and dates within life history stages.

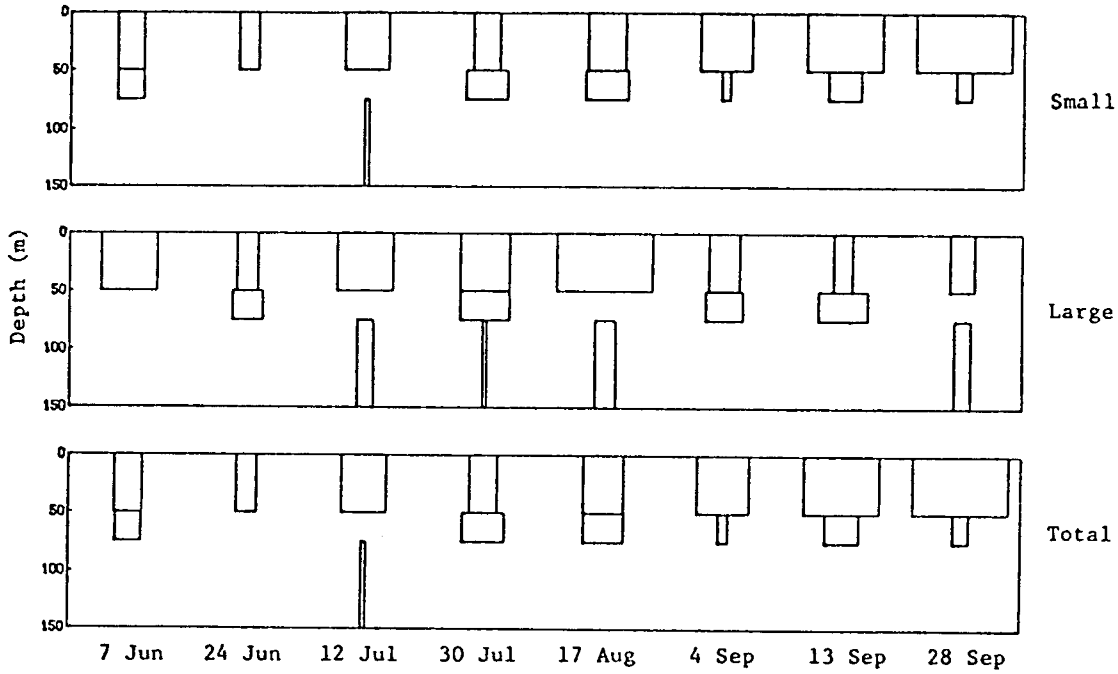

Fig. 19. Relative abundance of small, large, and total copepod nauplii, for 3 depth intervals and 8 dates. The width of rectangles indicates the relative abundance at depths and dates within life history stages.

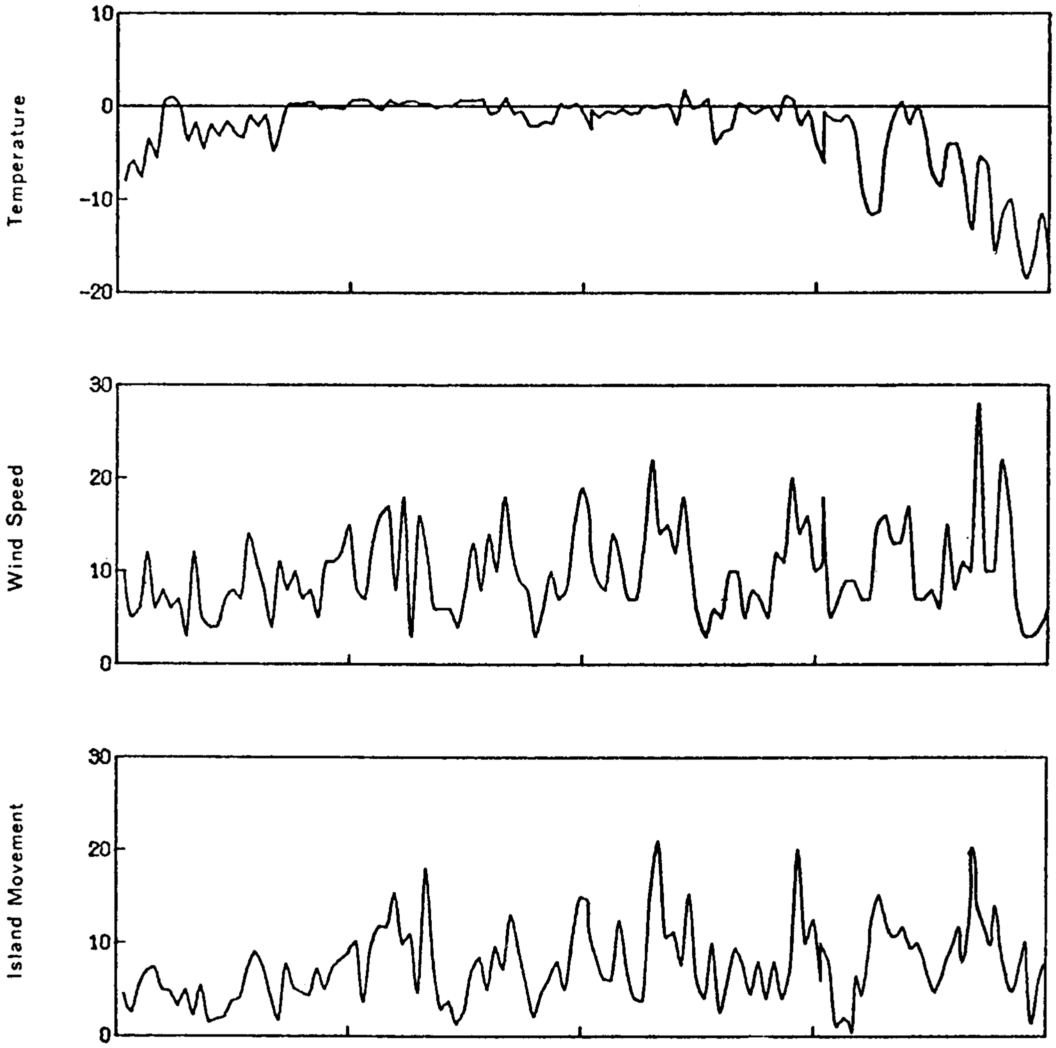

Fig. 20. Air temperature (^{o}C), wind speed (knots), and island movement ($km \cdot day^{-1}$) recorded at AIDJEX main camp.

30 August - 30 September: final snow build-up, ponds and bare ice all snow-covered

Wind speed was rarely greater than 20 knots (Fig. 20). There were roughly seven periods of sustained high winds ($>$ 12 to 13 knots). The initial and longest period was in late June and early July. The highest winds were recorded in late September. The response time of the ice movement (Fig. 20) to the increased winds was on the order of hours.

A sharp salinity increase marked the base of the mixed layer. There were small incremental steps in salinity within the mixed layer itself. From June through mid-July, the bottom of the mixed layer was generally at 50 to 60 m. At present, we do not have the temperature and salinity data for the remainder of the summer. The depth of the subsurface chlorophyll *a* maximum during July and August was at 55 to 60 m. Nitrate concentrations increased substantially at these depths. We inferred from these two variables that the sharp increase in density remained at about 50 to 60 m all summer long, though there were varying degrees of shallower density stratification.

VII. Discussion

Our observations commenced on 2 June and ended on 30 September. Experience on Fletcher's Ice Island, T-3, has shown this time interval to encompass the annual active growth of phytoplankton in the ice-covered areas of the Arctic Ocean. The initial chlorophyll *a* concentrations in the upper 40 m in June 1975 were 0.06 to 0.11 mg m^{-3}. In early June at T-3, chlorophyll *a* in the upper 40 m averaged 0.10 mg m^{-3} in 1968, 0.05 mg m^{-3} in 1971, 0.09 mg m^{-3} in 1972, and 0.02 mg m^{-3} in 1973. Though these initial concentrations were comparable, the pattern of development during late June and July was markedly different at AIDJEX compared to T-3. The 1975 summer increase in phytoplankton occurred at the pycnocline (50 to 60 m). On T-3, the active growth occurred in the upper 40 m, and maximum concentrations were found in late July. In 1975, phytoplankton in the mixed layer declined in late June and remained low until September.

A major difference between T-3 and AIDJEX was the nutrient regime. Our first measurements of nitrate were not made until 11 June. At that time and until mid-September, there was no detectable nitrate in the upper 40 m. June nitrate concentrations on T-3 averaged about 0.5 - 3.0 μg at ℓ^{-1}. Conceivably, nitrate mixed into the upper 40 to 50 m through turbulence and convective processes during the winter was depleted during the initial spring phytoplankton activity. Whether there were ever any substantial concentrations of nitrate prior to June is unknown.

We propose that the growth of phytoplankton at the pycnocline effectively limited the flux of nutrients across the density gradient into the mixed layer and that this lack of nutrients severely curtailed the phytoplankton development that would normally have occurred above 40 m. Visual microscopic examination of *Thalassiosira* and *Chaetoceros* spp. cells lend support to this argument. During mid-summer, cells taken from the upper 50 m were very pale in color compared to those in the pycnocline. Toward the end of summer, as nitrate spread into the upper 50 m, chlorophyll *a* increased and the cells were golden brown and healthy.

The development of phytoplankton at the pycnocline was stimulated by changes in the surface of the pack ice allowing greater transmission of incident radiation to the waters below. The most rapid increase in chlorophyll *a* was during the late June ablation of snow and the development of melt ponds and frequent rainy periods during July. During this period the average surface albedo generally declines to about 50 to 60% (Weller and Holmgren 1974). Considering the floe ice to average 3 m in thickness (Maykut and Untersteiner 1971) and have an absorption coefficient of 1.1 m^{-1} (Weller 1968), the radiation at the ice-water interface is about 1 to 2% of the radiation incident on the ice. Using 0.04 m^{-1} for the absorption coefficient of water (Smith 1973), the light at 50 to 60 m depth is only 0.1 to 0.2% of the incident radiation.

The phytoplankton populations seemed particularly well adapted to these low light intensities. This conclusion is supported by the values of I_k, initial slope and assimilation number. The I_k's determined for 1975 were 2.0 to 2.5 x 10^{-3} $W \cdot cm^{-2}$. Ryther (1956) reported values, converted to $W \cdot cm^{-2}$ PAR (1 ft-c natural sunlight = 4.6 x 10^{-6} $W \cdot cm^{-2}$ PAR, Strickland 1958), of 4.6 x 10^{-3} $W \cdot cm^{-2}$ for diatoms and 11.0 x 10^{-3} $W \cdot cm^{-2}$ for dinoflagellates. Initial slopes for 1975 were generally 0.20 to 0.30 mg C·mg Chl $a^{-1} \cdot hr^{-1} \cdot (W \cdot m^{-2})^{-1}$. Platt (1969) reported initial slopes for coastal populations of 0.01 to 0.20, and Parsons and Takahashi (1973) reported slopes of 0.09 to 0.10 for Arctic and Antarctic waters. Assimilation numbers for 1975 were mainly 2.0 to 4.0 mg C· mg Chl $a^{-1} \cdot hr^{-1}$. These are comparable to values reported by Parsons and Takahashi (1973). The above indicates that the phytoplankton populations observed in 1975 were able to use low light intensities with high efficiency.

The best period for growth was during July. On 26 July, lowered temperatures put skim ice on ponds and snow rapidly accumulated. The ponds were rapidly covered with drifted snow. This period of lowered submarine light levels lasted until about 20 August. Then, for about a week, warmer temperatures and some rain caused the ice surface to melt and turn greyish. There was a slight accumulation of melt water, but most ponds remained snow-filled.

Chlorophyll *a* abundance at the pycnocline did not increase in the second half of August. Sun elevations were low and days short this time of year. Through September, phytoplankton abundance at depth declined. Nutrients not utilized at the pycnocline were spread into the mixed layer during periods of higher winds, contributing to the brief fall increase in phytoplankton above 30 m.

The pattern of early summer and late fall development of phytoplankton in the mixed layer, coupled with a mid-summer development in the pycnocline, resulted in generally high amounts of total chlorophyll *a* throughout the summer. Only in late June did any substantial decrease occur.

The sampling done by helicopter enroute to the satellite camps indicates observations at main camp may be representative of a broad geographic area. At mid-summer, the chlorophyll *a* values were low and nitrate not dectected over this 75-mile transect. This indicates that nutrients may be limiting over large areas. The results further suggest that the variability in observations due to short term island movement may be small.

The zooplankton counts show that the juveniles of several of the copepods advanced through 3 to 4 stages during the summer. This period of higher food abundance was probably important to the survival of the cohort. Unfortunately, our sampling program was constrained in time and space, and changes due to migration in and out of the sample space cannot be assessed. Nor can conclusions be drawn about the survival in the fall or over-wintering process.

VIII. Conclusions

A. The phytoplankton populations in the upper 40 m remained low during summer and were probably nutrient-limited. Nitrate was not detected in this depth range through July and August.

B. The period of increased submarine light was confined to late June through July. This was also the period when active growth of phytoplankton occurred at the pycnocline. This growth inhibited nutrient transfer to the mixed layer.

C. Phytoplankton was low and nitrate was not detected in the mixed layer over a large area.

D. Graduated light experiments indicated the phytoplankton were well adapted to low light intensities. In comparison to other oceanic areas, I_k was low, initial slope was high, and assimilation numbers were average.

E. Statistical analysis of chlorophyll *a* and assimilation potential indicated that the combined effects of variability due to experimental and small-scale patchiness errors was a much higher proportion of the variability within 5-day intervals for assimilation than for chlorophyll *a*.

F. Though the surface conditions associated with the three *in situ* incubation sites were very different, a significant difference between assimilation measured at the different sites could only be shown in 32% of the experiments.

G. Eight species of copepods, *Calanus hyperboreus, C. glacialis, Euchaeta glacialis, Metridia longa, Microcalanus pygmaeus, Oncaea borealis, O. notopus,* and *Oithona similis,* were the most abundant calanoids out of 22 species identified.

H. Smaller species of copepods, *Microcalanus pygmaeus, Oithona similis,* and *Oncaea borealis*, were more abundant than larger copepods. Nauplii were more abundant than adults. Males of all species were rarely encountered except in *Oithona similis* and *Oncaea borealis*.

I. In general, juveniles and nauplii were in the upper 75 m.

J. Juveniles of *Calanus hyperboreus, C. glacialis,* and *Microcalanus pygmaeus* passed from stage I through stage III during the summer. *Euchaeta glacialis* juveniles passed from stage II through stage IV during the summer.

IX. Recommendations

A longer time series is required for this region to allow the assessment of trophic dependencies and seasonal changes of the vertical distributions of zooplankton. A sequence of zooplankton samples throughout the year, to depths of 300 m, could be enumerated to species and stages within species to elucidate the over-wintering process, and determine survival rates and the critical periods of development.

Herbivore development may depend on the depth and timing of increased phytoplankton activity. Therefore it is important to know if significant yearly differences occur in the cycle of phytoplankton abundance due to summer melt patterns, nutrient fluxes, mixing, or other environmental factors. The continued evaluation of the changes in the character of the pack ice surface, as well as the nutrient regime and mixing processes in the mixed layer, would allow assessment of important driving forces of the marine ecosystem. It should include a synoptic sampling program in order to assess small and large scale patchiness.

If no platform could be put in the perennial ice zone, it would still be very useful to make helicopter or aircraft transects from the edge of the ice northward. These could be made bi-weekly, if not more frequently, throughout the summer, to evaluate the development of chlorophyll *a* and nutrients. These transects, along with icebreaker transects from the coast to the edge of the pack ice, would furnish information useful to determining geographic differences in the dynamics of the marine ecosystem, especially those associated with the transition from the coastal shelf systems to the deep oceanic type.

Sampling of the various environmental properties as well as the phytoplankton and zooplankton populations at close intervals in time and depth would allow the variability in these dimensions to be assessed. This assessment would allow a more efficient field program to be formulated.

Only with the estimation of variability inherent in the environment and several complete time series of samples will we be in a position to attempt an evaluation of short and long term changes that may be attributable to resource development on the outer shelf.

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Table 1. Analysis of variance of the transformed radiocarbon assimilation potentials pooled into 5-day time cells at 4 depths

Depth	Source	Pooled DF	SS	MS	F
5 m	Between time cells	22	3.090	0.140	5.0*
	Within time cells	44	1.242	0.028	
	Total	66	4.332		
10 m	Between time cells	22	3.408	0.155	7.3*
	Within time cells	50	1.067	0.021	
	Total	72	4.475		
20 m	Between time cells	22	2.678	0.122	5.3*
	Within time cells	45	1.027	0.023	
	Total	67	3.705		
30 m	Between time cells	22	2.273	0.103	7.1*
	Within time cells	44	0.644	0.015	
	Total	66	2.917		

* $P < 0.01$ $F_{0.01}\ (22,44) \simeq 2.24$ $F_{0.01}\ (22,50) \simeq 2.22$

Table 2. Analysis of variance of the transformed radiocarbon assimilation potentials at 4 depths for 10 replication experiments

Depth	Source	Replication DF	SS	MS	F
5 m	Between days	9	6.561	0.729	48.0*
	Among water bottles	30	0.456	0.015	1.3
	Within water bottles	40	0.464	0.012	
	Total	79	7.481		
10 m	Between days	9	7.290	0.810	61.4*
	Among water bottles	30	0.397	0.013	1.8**
	Within water bottles	40	0.298	0.008	
	Total	79	7.985		
20 m	Between days	9	5.011	0.557	17.1*
	Among water bottles	30	0.977	0.033	2.6**
	Within water bottles	40	0.499	0.013	
	Total	79	6.488		
30 m	Between days	9	0.957	0.106	4.2*
	Among water bottles	30	0.767	0.026	5.1*
	Within water bottles	40	0.202	0.005	
	Total	79	1.926		

* $P < 0.01$ $F_{0.01}(30,40) \simeq 2.20$ $F_{0.01}(9, 30) \simeq 3.06$

** $P < 0.05$ $F_{0.05}(9,30) \simeq 2.21$ $F_{0.05}(30,40) \simeq 1.74$

Table 3. Depth series ^{14}C assimilation experiments

Explanation of Table Values:

1.	Date:	Month, day, year of experiment
2.	Standard:	Total activity (microcuries) added to water sampled
3.	Time:	Duration (hours) of incubation
4.	Eff:	Liquid scintillation external standard (e.g. 13) and resultant percentage counting efficiency (e.g. 75.6)
5.	Depth:	Depth (m) of water sampled
6.	Light:	Light intensity (microeinsteins $m^{-2}sec^{-1}$) in incubation box during experiment
7.	Assim:	Light, dark, and net assimilation ($mgCm^{-3}hr^{-1}$)
8.	Chl *a*:	Measured chlorophyll *a* (mg m^3) of incubated water sample
9.	Normalized:	Assimilation normalized on chlorophyll and assimilation normalized on light intensity

DATE 6/ 6/75 STANDARD 7.70 MC/AMP TIME 6.0 HR EFF 13/75.6

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.12	.01	.11	.06	1.91	.00099
5	118	.13	.01	.12	.06	1.98	.00101
10	120	.09	.01	.08	.09	.85	.00064
15	121	.22	.01	.21	.08	2.62	.00173
20	120	.13	.01	.12	.09	1.32	.00099
25	119	.21	.01	.20	.06	3.41	.00172
30	110	.19	.01	.18	.05	3.60	.00164
35	112	.17	.01	.16	.08	2.03	.00145
40	114	.17	.01	.16	.11	1.47	.00142
45	116	.16	.01	.15	.08	1.85	.00127
50	117	.18	.01	.17	.09	1.92	.00147
60	116	.06	.01	.05	.06	.83	.00043

DATE 6/ 8/75 STANDARD 7.70 MC/AMP TIME 6.0 HR EFF 13/75.6

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.12	.01	.11	.09	1.23	.00096
5	118	.09	.01	.08	.10	.80	.00068
10	120	.09	.01	.08	.10	.80	.00067
15	121	.14	.01	.13	.09	1.46	.00108
20	120	.10	.01	.09	.08	1.16	.00077
25	119	.15	.01	.14	.11	1.29	.00120
30	110	.16	.01	.15	.08	1.84	.00134
35	112	.11	.01	.10	.06	1.75	.00094
40	114	.12	.02	.10	.08	1.25	.00087
45	116	.13	.01	.12	.09	1.34	.00104
50	117	.11	.01	.10	.08	1.25	.00086
60	116	.01	.01	.00	.04	.02	.00001

DATE 6/11/75 STANDARD 7.70 MC/AMP TIME 6.0 HR EFF 13/75.6

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.10	.02	.08	.08	.99	.00069
5	118	.18	.02	.17	.08	2.09	.00142
10	120	.18	.01	.16	.08	2.05	.00137
15	121	.24	.01	.23	.09	2.50	.00186
20	120	.20	.01	.19	.08	2.34	.00156
25	119	.18	.01	.17	.07	2.36	.00139
30	110	.17	.02	.15	.07	2.14	.00136
35	112	.16	.02	.14	.07	1.95	.00122
40	114	.13	.01	.12	.07	1.64	.00101
45	116	.19	.02	.17	.08	2.09	.00144
50	117	.15	.01	.14	.08	1.77	.00121
60	116	.07	.01	.06	.04	1.59	.00055

Table 3 (cont.)

DATE 6/14/75 STANDARD 7.70 MC/AMP TIME 6.0 HR EFF 14/75.9

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.13	.02	.11	.05	2.29	.00099
5	118	.14	.01	.13	.06	2.09	.00106
10	120	.13	.01	.12	.06	1.93	.00097
15	121	.15	.01	.14	.06	2.35	.00117
20	120	.14	.01	.13	.06	2.11	.00106
25	119	.16	.01	.15	.07	2.09	.00123
30	110	.16	.01	.14	.06	2.37	.00129
35	112	.15	.02	.13	.07	1.84	.00115
40	114	.18	.01	.17	.07	2.47	.00151
45	116	.13	.01	.11	.06	1.91	.00099
50	117	.17	.01	.16	.06	2.67	.00137
60	116	.08	.01	.07	.06	1.15	.00060

DATE 6/17/75 STANDARD 7.70 MC/AMP TIME 6.0 HR EFF 36/74.3

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.09	.01	.08	.07	1.10	.00066
5	118	.12	.02	.11	.06	1.81	.00092
10	120	.12	.01	.11	.05	2.16	.00090
15	121	.11	.01	.09	.07	1.34	.00078
20	120	.13	.01	.12	.05	2.33	.00097
25	119	.12	.02	.10	.05	1.97	.00093
30	110	.12	.02	.10	.04	2.53	.00092
35	112	.15	.01	.14	.05	2.75	.00123
40	114	.11	.01	.10	.04	2.38	.00084
45	116	.13	.01	.12	.05	2.38	.00103
50	117	.14	.01	.13	.06	2.09	.00107
60	116	.14	.01	.13	.08	1.62	.00112

DATE 6/20/75 STANDARD 7.70 MC/AMP TIME 6.0 HR EFF 33/75.7

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.07	.02	.05	.03	1.63	.00042
5	118	.08	.02	.06	.04	1.55	.00053
10	120	.09	.02	.08	.03	2.54	.00063
15	121	.09	.01	.08	.03	2.76	.00068
20	120	.11	.01	.10	.03	3.25	.00081
25	119	.12	.01	.11	.03	3.63	.00092
30	110	.15	.02	.13	.03	4.41	.00120
35	112	.18	.01	.17	.04	4.34	.00155
40	114	.17	.01	.16	.04	3.94	.00138
45	116	.16	.01	.14	.05	2.87	.00124
50	117	.16	.01	.14	.06	2.39	.00123
60	116	.21	.01	.20	.08	2.45	.00169

Table 3 (cont.)

DATE 6/23/75 STANDARD 7.70 MC/AMP TIME 5.8 HR EFF 27/78.4

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.08	.02	.06	.04	1.55	.00054
5	118	.07	.02	.05	.04	1.18	.00040
10	120	.07	.02	.06	.02	2.90	.00048
15	121	.07	.02	.06	.03	1.85	.00046
20	120	.07	.02	.05	.03	1.78	.00045
25	119	.06	.01	.05	.03	1.76	.00044
30	110	.07	.01	.06	.02	3.24	.00059
35	112	.09	.01	.08	.03	2.74	.00073
40	114	.09	.01	.07	.03	2.49	.00066
45	116	.10	.01	.08	.03	2.80	.00073
50	117	.13	.01	.12	.03	3.85	.00099
60	116	.16	.01	.15	.05	2.97	.00128

DATE 6/26/75 STANDARD 7.70 MC/AMP TIME 6.0 HR EFF 25/79.3

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.07	.02	.05	.03	1.76	.00046
5	118	.05	.01	.04	.02	2.11	.00036
10	120	.04	.02	.03	.02	1.40	.00023
15	121	.07	.01	.06	.02	2.78	.00046
20	120	.07	.02	.06	.02	2.97	.00049
25	119	.06	.01	.05	.02	2.39	.00040
30	110	.07	.01	.06	.02	2.90	.00053
35	112	.14	.01	.13	.02	6.51	.00116
40	114	.08	.01	.07	.02	3.29	.00058
45	116	.10	.01	.09	.03	3.06	.00079
50	117	.12	.01	.11	.03	3.76	.00097
60	116	.10	.01	.09	.05	1.70	.00073

DATE 6/29/75 STANDARD 7.70 MC/AMP TIME 6.0 HR EFF 24/78.6

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.06	.02	.04	.02	2.12	.00037
5	118	.05	.01	.04	.01	3.99	.00034
10	120	.05	.02	.03	.01	3.09	.00026
15	121	.10	.01	.08	.01	8.37	.00069
20	120	.06	.02	.04	.01	3.67	.00031
25	119	.09	.01	.08	.01	8.24	.00069
30	110	.07	.02	.06	.01	5.53	.00050
35	112	.07	.01	.05	.01	5.41	.00048
40	114	.07	.02	.05	.02	2.35	.00041
45	116	.11	.01	.09	.02	4.63	.00080
50	117	.15	.01	.13	.04	3.30	.00113
60	116	.12	.01	.11	.05	2.26	.00097

Table 3 (cont.)

DATE 7/ 2/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 14/75.9

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.08	.02	.06	.02	2.84	.00049
5	118	.07	.01	.06	.02	3.11	.00053
10	120	.05	.01	.04	.01	4.04	.00034
15	121	.06	.01	.05	.01	5.27	.00044
20	120	.07	.01	.06	.03	1.92	.00048
25	119	.05	.01	.04	.03	1.30	.00033
30	110	.07	.01	.05	.01	5.40	.00049
35	112	.07	.01	.06	.02	3.11	.00056
40	114	.08	.01	.07	.04	1.76	.00062
45	116	.11	.01	.10	.04	2.57	.00088
50	117	.14	.01	.13	.04	3.16	.00108
60	116	.13	.01	.12	.11	1.07	.00101

DATE 7/ 5/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 35/74.8

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.09	.02	.07	.03	2.38	.00062
5	118	.11	.01	.09	.03	3.10	.00079
10	120	.09	.02	.08	.02	3.75	.00063
15	121	.09	.02	.07	.03	2.45	.00061
20	120	.10	.01	.08	.03	2.75	.00069
25	119	.10	.02	.08	.03	2.64	.00067
30	110	.08	.01	.07	.03	2.32	.00063
35	112	.10	.01	.08	.04	2.11	.00075
40	114	.11	.02	.09	.04	2.23	.00076
45	116	.16	.02	.14	.06	2.31	.00120
50	117	.23	.01	.21	.05	4.26	.00182
60	116	.29	.01	.28	.07	3.98	.00240

DATE 7/ 8/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 34/75.2

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.06	.02	.04	.01	4.13	.00036
5	118	.08	.02	.06	.01	5.99	.00051
10	120	.06	.02	.04	.01	3.92	.00033
15	121	.06	.02	.04	.01	4.40	.00036
20	120	.05	.02	.03	.01	3.16	.00026
25	119	.08	.01	.06	.01	6.21	.00052
30	110	.07	.01	.05	.01	5.45	.00050
35	112	.11	.01	.09	.02	4.71	.00094
40	114	.09	.02	.08	.04	1.96	.00069
45	116	.22	.01	.20	.05	4.06	.00175
50	117	.27	.02	.25	.08	3.18	.00217
60	116	.30	.01	.29	.12	2.40	.00248

Table 3 (cont.)

DATE 7/11/75 STANDARD 7.50 MC/AMP TIME 6.5 HR EFF 33/75.7

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.09	.02	.07	.03	2.32	.00060
5	118	.09	.02	.08	.03	2.53	.00064
10	120	.05	.02	.03	.03	1.06	.00026
15	121	.09	.02	.07	.03	2.47	.00061
20	120	.11	.02	.09	.03	3.10	.00078
25	119	.12	.02	.11	.04	2.64	.00089
30	110	.10	.01	.09	.03	3.00	.00082
35	112	.11	.01	.09	.03	3.12	.00084
40	114	.11	.02	.09	.03	3.08	.00081
45	116	.16	.02	.14	.04	3.40	.00117
50	117	.28	.02	.27	.06	4.45	.00228
60	116	.31	.02	.30	.13	2.30	.00258

DATE 7/14/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 28/77.9

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.05	.01	.04	.01	3.52	.00030
5	118	.05	.01	.04	.01	3.53	.00030
10	120	.06	.01	.05	.01	5.06	.00042
15	121	.09	.01	.07	.02	3.70	.00061
20	120	.08	.01	.07	.02	3.30	.00055
25	119	.09	.02	.07	.02	3.66	.00062
30	110	.09	.01	.08	.02	3.76	.00068
35	112	.10	.01	.09	.03	2.84	.00076
40	114	.10	.01	.09	.03	3.05	.00080
45	116	.12	.02	.10	.04	2.51	.00086
50	117	.14	.01	.13	.05	2.63	.00113
60	116	.22	.01	.21	.08	2.58	.00178

DATE 7/17/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 29/77.5

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.06	.02	.04	.01	4.07	.00035
5	118	.07	.01	.06	.01	5.96	.00051
10	120	.06	.01	.05	.01	4.56	.00038
15	121	.05	.01	.03	.01	3.42	.00028
20	120	.05	.01	.04	.01	3.82	.00032
25	119	.07	.02	.05	.01	4.89	.00041
30	110	.07	.01	.06	.02	2.85	.00052
35	112	.08	.01	.07	.02	3.52	.00063
40	114	.10	.02	.08	.03	2.71	.00071
45	116	.19	.01	.17	.05	3.46	.00149
50	117	.35	.01	.33	.12	2.77	.00284
60	116	.32	.01	.31	.16	1.92	.00265

Table 3 (cont.)

DATE 7/20/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 32/76.1

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.06	.02	.04	.01	4.12	.00036
5	118	.06	.02	.04	.01	4.12	.00035
10	120	.07	.01	.06	.01	5.54	.00046
15	121	.07	.01	.06	.01	5.62	.00046
20	120	.07	.01	.05	.01	5.44	.00045
25	119	.08	.01	.06	.02	3.13	.00053
30	110	.10	.01	.09	.02	4.43	.00081
35	112	.08	.01	.07	.02	3.38	.00060
40	114	.11	.01	.09	.03	3.06	.00080
45	116	.09	.01	.08	.04	1.95	.00067
50	117	.11	.01	.10	.05	1.98	.00085
60	116	.29	.01	.28	.14	2.01	.00242

DATE 7/23/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 35/74.8

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.04	.02	.03	.01	2.74	.00024
5	118	.04	.01	.02	.01	2.47	.00021
10	120	.04	.01	.03	.01	2.81	.00023
15	121	.05	.02	.04	.01	3.51	.00029
20	120	.06	.02	.03	.01	3.46	.00029
25	119	.06	.01	.04	.02	2.25	.00038
30	110	.06	.02	.05	.02	2.28	.00042
35	112	.08	.02	.06	.02	2.99	.00053
40	114	.08	.01	.06	.02	3.13	.00055
45	116	.08	.02	.06	.03	1.97	.00051
50	117	.07	.01	.06	.04	1.50	.00051
60	116	.39	.01	.38	.26	1.47	.00329

DATE 7/26/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 32/76.1

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.04	.02	.02	.01	1.95	.00017
5	118	.05	.01	.03	.01	3.42	.00029
10	120	.04	.01	.03	.01	3.02	.00025
15	121	.04	.02	.02	.01	1.68	.00014
20	120	.04	.02	.02	.01	1.97	.00016
25	119	.06	.01	.04	.01	4.42	.00037
30	110	.06	.02	.04	.01	3.67	.00033
35	112	.08	.01	.07	.02	3.51	.00063
40	114	.08	.01	.07	.02	3.44	.00060
45	116	.08	.01	.07	.02	3.48	.00060
50	117	.09	.02	.07	.03	2.45	.00063
60	116	.43	.01	.42	.19	2.22	.00364

Table 3 (cont.)

DATE 7/29/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 30/77.0

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.12	.02	.10	.01	9.59	.00083
5	118	.06	.02	.04	.01	4.22	.00036
10	120	.10	.01	.08	.02	4.11	.00069
15	121	.08	.01	.06	.01	6.30	.00052
20	120	.09	.01	.08	.02	3.94	.00066
25	119	.10	.01	.09	.03	2.80	.00071
30	110	.07	.01	.06	.03	2.01	.00055
35	112	.08	.01	.07	.03	2.30	.00062
40	114	.09	.01	.08	.03	2.52	.00066
45	116	.09	.02	.07	.04	1.73	.00060
50	117	.10	.01	.09	.04	2.15	.00074
60	116	.52	.02	.50	.24	2.10	.00435

DATE 8/ 1/75 STANDARD 6.95 MC/AMP TIME 5.0 HR EFF 24/78.6

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.07	.02	.05	.01	5.45	.00047
5	118	.05	.01	.04	.02	1.99	.00034
10	120	.07	.02	.05	.01	4.96	.00041
15	121	.06	.02	.05	.01	4.63	.00038
20	120	.08	.03	.05	.02	2.66	.00044
25	119	.11	.02	.09	.03	2.87	.00072
30	110	.08	.02	.06	.02	2.95	.00054
35	112	.08	.02	.06	.03	2.06	.00055
40	114	.10	.01	.09	.04	2.15	.00075
45	116	.14	.01	.12	.06	2.06	.00107
50	117	.38	.02	.36	.23	1.57	.00309
60	116	.20	.02	.19	.15	1.25	.00162

DATE 8/ 4/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 19/77.3

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.06	.02	.04	.02	2.03	.00035
5	118	.05	.02	.03	.02	1.43	.00024
10	120	.08	.02	.06	.01	5.64	.00047
15	121	.06	.01	.04	.02	2.25	.00037
20	120	.09	.02	.07	.03	2.45	.00061
25	119	.09	.02	.08	.02	3.84	.00065
30	110	.06	.01	.05	.02	2.36	.00043
35	112	.06	.01	.05	.03	1.65	.00044
40	114	.06	.01	.05	.04	1.15	.00040
45	116	.10	.02	.08	.08	1.03	.00071
50	117	.11	.02	.10	.09	1.07	.00082
60	116	.36	.01	.34	.20	1.72	.00297

Table 3 (cont.)

DATE 8/ 7/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 36/74.3

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.05	.02	.03	.02	1.65	.00028
5	118	.05	.02	.03	.01	2.60	.00022
10	120	.07	.01	.06	.01	6.16	.00051
15	121	.11	.02	.09	.03	2.99	.00074
20	120	.15	.01	.14	.06	2.27	.00113
25	119	.08	.01	.07	.04	1.63	.00055
30	110	.09	.02	.07	.03	2.23	.00061
35	112	.10	.02	.08	.04	1.95	.00070
40	114	.09	.02	.07	.04	1.78	.00063
45	116	.15	.01	.14	.06	2.28	.00118
50	117	.09	.01	.08	.06	1.27	.00065
60	116	.28	.01	.27	.13	2.07	.00232

DATE 8/10/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 31/76.6

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.11	.02	.08	.03	2.81	.00073
5	118	.08	.02	.07	.03	2.21	.00056
10	120	.08	.02	.06	.04	1.39	.00046
15	121	.09	.01	.08	.03	2.52	.00062
20	120	.10	.02	.09	.03	2.89	.00072
25	119	.11	.02	.09	.04	2.24	.00075
30	110	.14	.02	.12	.03	4.11	.00112
35	112	.09	.02	.07	.03	2.39	.00064
40	114	.09	.02	.08	.04	1.93	.00068
45	116	.11	.01	.09	.05	1.86	.00090
50	117	.20	.02	.18	.08	2.28	.00156
60	116	.23	.02	.22	.11	1.96	.00186

DATE 8/10/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 32/76.1

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
46	116	.10	.02	.08	.07	1.17	.00071
48	118	.20	.02	.18	.10	1.77	.00150
50	120	.19	.02	.18	.11	1.61	.00148
52	121	.24	.02	.22	.10	2.22	.00183
54	120	.25	.02	.23	.10	2.26	.00189
56	119	.23	.02	.21	.10	2.13	.00179
58	110	.19	.01	.18	.08	2.24	.00163
60	112	.17	.01	.16	.09	1.79	.00144
62	114	.16	.01	.14	.09	1.57	.00124
64	116	.15	.01	.14	.10	1.37	.00119
80	117	.07	.01	.06	.06	1.02	.00052
100	116	.04	.01	.02	.04	.60	.00021

Table 3 (cont.)

DATE 8/13/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 28/77.9

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.11	.02	.09	.02	4.47	.00077
5	118	.12	.02	.10	.02	4.93	.00084
10	120	.13	.02	.11	.02	5.54	.00092
15	121	.11	.02	.09	.02	4.27	.00071
20	120	.11	.02	.09	.03	2.99	.00075
25	119	.10	.02	.08	.03	2.82	.00071
30	110	.13	.02	.11	.04	2.77	.00101
35	112	.13	.02	.11	.06	1.83	.00098
40	114	.20	.01	.18	.09	2.03	.00160
45	116	.36	.02	.34	.19	1.81	.00296
50	117	.50	.02	.49	.29	1.65	.00409
60	116	.17	.02	.15	.08	1.87	.00129

DATE 8/16/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 28/77.9

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.14	.02	.12	.03	4.04	.00105
5	118	.12	.02	.10	.02	5.00	.00085
10	120	.10	.02	.08	.03	2.72	.00068
15	121	.17	.02	.15	.05	3.05	.00126
20	120	.16	.02	.14	.04	3.57	.00119
25	119	.19	.02	.17	.04	4.18	.00141
30	110	.13	.01	.12	.04	2.96	.00108
35	112	.14	.01	.13	.07	1.81	.00113
40	114	.17	.02	.16	.05	3.12	.00137
45	116	.18	.02	.16	.06	2.67	.00138
50	117	.21	.02	.19	.07	2.74	.00164
60	116	.44	.02	.42	.18	2.36	.00366

DATE 8/19/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 24/75.2

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.07	.02	.05	.01	5.08	.00044
5	118	.07	.02	.05	.02	2.50	.00042
10	120	.07	.02	.05	.01	4.53	.00038
15	121	.07	.02	.05	.02	2.54	.00042
20	120	.08	.02	.06	.02	2.81	.00047
25	119	.09	.02	.07	.02	3.60	.00060
30	110	.08	.01	.06	.03	2.14	.00058
35	112	.08	.02	.07	.03	2.26	.00061
40	114	.11	.01	.10	.05	1.98	.00087
45	116	.20	.01	.19	.10	1.88	.00162
50	117	.28	.02	.27	.14	1.91	.00223
60	116	.16	.01	.14	.09	1.58	.00123

Table 3 (cont.)

DATE 8/22/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 33/75.7

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.09	.02	.07	.03	2.35	.00061
5	118	.07	.02	.06	.02	2.85	.00048
10	120	.07	.02	.05	.02	2.41	.00040
15	121	.09	.02	.07	.02	3.59	.00059
20	120	.12	.02	.10	.04	2.53	.00084
25	119	.11	.02	.09	.04	2.29	.00077
30	110	.10	.02	.08	.03	2.64	.00072
35	112	.10	.01	.08	.03	2.75	.00074
40	114	.12	.01	.10	.04	2.61	.00091
45	116	.16	.01	.15	.07	2.13	.00129
50	117	.24	.02	.21	.11	1.95	.00184
60	116	.20	.01	.19	.09	2.07	.00161

DATE 8/25/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 31/76.6

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.08	.02	.06	.02	3.11	.00054
5	118	.08	.02	.06	.02	3.01	.00051
10	120	.08	.02	.06	.02	3.15	.00052
15	121	.09	.02	.07	.02	3.32	.00055
20	120	.08	.02	.06	.02	3.06	.00051
25	119	.11	.02	.10	.03	3.20	.00081
30	110	.12	.02	.10	.03	3.44	.00094
35	112	.12	.02	.10	.03	3.46	.00093
40	114	.14	.02	.12	.05	2.46	.00108
45	116	.24	.02	.23	.07	3.24	.00195
50	117	.31	.02	.29	.11	2.66	.00251
60	116	.29	.02	.27	.15	1.78	.00230

DATE 8/28/75 STANDARD 7.55 MC/AMP TIME 6.1 HR EFF 36/74.3

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.10	.02	.08	.03	2.62	.00068
5	118	.08	.02	.06	.03	2.13	.00054
10	120	.09	.02	.07	.03	2.48	.00062
15	121	.09	.02	.07	.03	2.39	.00059
20	120	.10	.02	.08	.03	2.75	.00069
25	119	.10	.02	.08	.03	2.68	.00068
30	110	.10	.02	.09	.04	2.17	.00079
35	112	.12	.01	.11	.05	2.14	.00095
40	114	.14	.02	.12	.05	2.36	.00103
45	116	.18	.02	.16	.06	2.67	.00138
50	117	.20	.02	.18	.08	2.30	.00157
60	116	.20	.01	.18	.08	2.27	.00157

Table 3 (cont.)

DATE 8/31/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 21/77.8

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.09	.02	.07	.02	3.49	.00060
5	118	.10	.02	.08	.02	4.24	.00072
10	120	.09	.02	.07	.02	3.39	.00057
15	121	.09	.02	.07	.04	1.74	.00058
20	120	.11	.02	.09	.04	2.28	.00076
25	119	.09	.02	.07	.03	2.33	.00059
30	110	.09	.01	.08	.04	1.89	.00069
35	112	.14	.02	.12	.04	3.03	.00108
40	114	.24	.02	.23	.06	3.80	.00200
45	116	.30	.02	.28	.12	2.36	.00244
50	117	.34	.02	.33	.19	1.71	.00278
60	116	.26	.02	.25	.13	1.89	.00212

DATE 9/ 3/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 21/77.8

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.09	.02	.07	.03	2.46	.00064
5	118	.07	.02	.05	.03	1.67	.00043
10	120	.07	.02	.05	.03	1.74	.00043
15	121	.10	.02	.08	.05	1.67	.00069
20	120	.10	.02	.08	.05	1.66	.00069
25	119	.08	.02	.06	.03	1.96	.00049
30	110	.11	.02	.10	.04	2.44	.00089
35	112	.10	.01	.08	.04	2.09	.00075
40	114	.10	.01	.08	.04	2.11	.00074
45	116	.15	.02	.14	.05	2.77	.00119
50	117	.20	.02	.18	.08	2.28	.00156
60	116	.21	.02	.19	.13	1.44	.00162

DATE 9/ 6/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 15/76.2

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.10	.01	.09	.02	4.60	.00079
5	118	.10	.01	.08	.03	2.71	.00069
10	120	.08	.02	.06	.03	2.02	.00051
15	121	.09	.01	.07	.03	2.46	.00061
20	120	.09	.01	.07	.02	3.56	.00059
25	119	.10	.02	.08	.04	2.08	.00070
30	110	.10	.01	.09	.04	2.22	.00081
35	112	.11	.01	.10	.04	2.44	.00087
40	114	.13	.01	.11	.04	2.83	.00099
45	116	.23	.01	.21	.05	4.27	.00194
50	117	.23	.02	.21	.10	2.13	.00182
60	116	.27	.02	.25	.12	2.05	.00212

Table 3 (cont.)

DATE 9/ 9/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 26/78.8

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.12	.02	.11	.04	2.70	.00093
5	118	.11	.02	.10	.05	1.92	.00081
10	120	.10	.02	.08	.04	2.00	.00067
15	121	.09	.02	.07	.04	1.77	.00059
20	120	.14	.02	.12	.04	3.12	.00104
25	119	.11	.02	.09	.03	2.87	.00072
30	110	.13	.01	.12	.03	3.84	.00105
35	112	.12	.02	.10	.04	2.56	.00091
40	114	.17	.02	.15	.04	3.86	.00135
45	116	.17	.02	.15	.06	2.54	.00131
50	117	.19	.01	.18	.08	2.20	.00150
60	116	.22	.02	.20	.09	2.22	.00172

DATE 9/12/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 24/78.6

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.19	.02	.17	.05	3.32	.00143
5	118	.15	.02	.13	.05	2.53	.00107
10	120	.17	.02	.15	.06	2.44	.00122
15	121	.12	.02	.10	.04	2.55	.00084
20	120	.12	.02	.10	.04	2.60	.00087
25	119	.14	.02	.12	.04	3.05	.00103
30	110	.15	.01	.13	.04	3.33	.00121
35	112	.15	.01	.13	.04	3.32	.00119
40	114	.18	.02	.17	.06	2.80	.00147
45	116	.21	.02	.19	.09	2.12	.00165
50	117	.20	.02	.18	.09	2.00	.00154
60	116	.19	.02	.17	.07	2.47	.00149

DATE 9/15/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 15/76.2

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.16	.02	.14	.06	2.32	.00120
5	118	.13	.01	.12	.04	3.00	.00102
10	120	.10	.02	.08	.04	2.05	.00068
15	121	.11	.02	.09	.03	2.84	.00070
20	120	.12	.02	.10	.04	2.51	.00084
25	119	.10	.02	.08	.03	2.78	.00070
30	110	.11	.01	.10	.04	2.49	.00091
35	112	.12	.01	.11	.05	2.23	.00100
40	114	.17	.01	.16	.08	1.95	.00137
45	116	.29	.01	.28	.12	2.30	.00238
50	117	.34	.01	.33	.14	2.34	.00280
60	116	.13	.01	.12	.09	1.29	.00100

Table 3 (cont.)

DATE 9/18/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 15/76.2

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.16	.02	.14	.05	2.80	.00121
5	118	.15	.02	.13	.06	2.22	.00113
10	120	.12	.02	.11	.04	2.70	.00090
15	121	.12	.02	.10	.04	2.43	.00080
20	120	.12	.01	.11	.02	5.26	.00088
25	119	.13	.02	.11	.03	3.69	.00093
30	110	.17	.01	.15	.04	3.80	.00138
35	112	.18	.01	.17	.04	4.20	.00150
40	114	.17	.02	.15	.05	3.03	.00133
45	116	.18	.01	.16	.05	3.29	.00142
50	117	.24	.02	.22	.09	2.48	.00191
60	116	.16	.02	.14	.08	1.77	.00122

DATE 9/21/75 STANDARD 7.55 MC/AMP TIME 6.3 HR EFF 14/75.9

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.21	.02	.19	.04	4.66	.00161
5	118	.19	.02	.17	.05	3.44	.00146
10	120	.20	.02	.18	.05	3.62	.00151
15	121	.19	.02	.17	.05	3.34	.00138
20	120	.17	.02	.15	.05	3.02	.00126
25	119	.18	.01	.16	.05	3.23	.00136
30	110	.13	.02	.11	.05	2.20	.00100
35	112	.12	.01	.11	.05	2.25	.00100
40	114	.15	.01	.14	.05	2.82	.00124
45	116	.16	.01	.15	.07	2.16	.00130
50	117	.21	.02	.20	.08	2.46	.00168
60	116	.15	.01	.14	.08	1.80	.00124

DATE 9/24/75 STANDARD 7.55 MC/AMP TIME 6.5 HR EFF 13/75.6

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.14	.02	.12	.05	2.39	.00103
5	118	.14	.02	.12	.05	2.39	.00101
10	120	.12	.02	.10	.05	2.06	.00086
15	121	.12	.02	.10	.05	2.04	.00084
20	120	.13	.02	.11	.05	2.14	.00089
25	119	.12	.02	.11	.05	2.15	.00091
30	110	.13	.02	.11	.05	2.19	.00099
35	112	.15	.01	.14	.06	2.31	.00124
40	114	.14	.02	.12	.06	2.00	.00105
45	116	.19	.01	.17	.07	2.46	.00149
50	117	.15	.01	.14	.10	1.36	.00116
60	116	.14	.01	.13	.07	1.81	.00109

Table 3 (cont.)

DATE 9/27/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 13/75.6

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.15	.02	.13	.04	3.30	.00114
5	118	.13	.02	.12	.04	2.93	.00099
10	120	.12	.02	.10	.04	2.38	.00079
15	121	.10	.01	.09	.04	2.18	.00072
20	120	.11	.01	.10	.04	2.43	.00081
25	119	.11	.01	.09	.04	2.35	.00079
30	110	.13	.01	.12	.04	2.91	.00106
35	112	.12	.01	.11	.04	2.84	.00102
40	114	.11	.01	.10	.05	1.92	.00084
45	116	.10	.01	.09	.06	1.53	.00079
50	117	.10	.01	.09	.06	1.47	.00075
60	116	.09	.02	.07	.05	1.36	.00059

DATE 9/30/75 STANDARD 6.35 MC/AMP TIME 6.0 HR EFF 23/78.3

DEPTH (M)	LIGHT (ME/M2/S)	ASSIM (MGC/M3/HR) L	D	N	CHL A (MG/M3)	NORMALIZED A/C	A/L
3	116	.16	.01	.15	.04	3.74	.00129
5	118	.15	.01	.14	.04	3.47	.00117
10	120	.14	.01	.13	.04	3.27	.00109
15	121	.15	.01	.14	.04	3.50	.00116
20	120	.14	.02	.11	.04	2.81	.00094
25	119	.14	.01	.13	.04	3.22	.00108
30	110	.15	.01	.14	.04	3.48	.00127
35	112	.16	.01	.15	.04	3.66	.00131
40	114	.15	.02	.13	.06	2.17	.00114
45	116	.10	.01	.09	.06	1.44	.00074
50	117	.11	.02	.09	.07	1.35	.00081
60	116	.09	.01	.08	.05	1.63	.00070

Table 4. Results of replicated ^{14}C assimilation experiments

Explanation of Table Values:

1.	Date:	Month, day, year of experiment
2.	Standard:	Total activity (microcuries) added to water sample
3.	Time:	Duration (hours) of incubation
4.	Eff:	Liquid scintillation external standard (e.g. 14) and resultant percentage counting efficiency (e.g. 75.9)
5.	Depth:	Depth (m) of water sampled
6.	Replicate assimilation:	Light, dark, and net assimilation ($mgCm^{-3}hr^{-1}$) for 8 experiments on water samples from same depth. (Darks were not replicated.)
7.	Mean net assimilation	Mean of 8 experiments ($mgCm^{-3}hr^{-1}$)
8.	Standard deviation:	Pertains to above 8 data values
9.	Standard error:	Pertains to mean of above 8 data values $\sqrt{\text{Std dev}/8}$
10.	Coefficient of variation:	Pertains to above 8 data values, the mean divided by standard deviation times 100%

Table 4 (cont.)

DATE 7/ 3/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 14/75.9

DEPTH 5 M REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.038	.038	.044	.037	.029	.047	.042	.036
DARK	.014	.014	.014	.014	.014	.014	.014	.014
NET	.025	.024	.031	.023	.015	.033	.029	.023

MEAN NET ASSIMILATION .0252 MGC/M3/HR
STANDARD DEVIATION .0056 MGC/M3/HR
STANDARD ERROR (N=8) .0020 MGC/M3/HR
COEFFICIENT OF VARIATION 22.10

DATE 7/ 3/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 14/75.9

DEPTH 10 M REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.044	.035	.039	.040	.034	.036	.042	.052
DARK	.013	.013	.013	.013	.013	.013	.013	.013
NET	.031	.022	.026	.027	.021	.023	.029	.039

MEAN NET ASSIMILATION .0273 MGC/M3/HR
STANDARD DEVIATION .0059 MGC/M3/HR
STANDARD ERROR (N=8) .0021 MGC/M3/HR
COEFFICIENT OF VARIATION 21.76

DATE 7/ 4/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 35/74.8

DEPTH 20 M REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.063	.062	.022	.061	.056	.059	.060	.068
DARK	.014	.014	.014	.014	.014	.014	.014	.014
NET	.049	.048	.008	.047	.042	.045	.047	.054

MEAN NET ASSIMILATION .0424 MGC/M3/HR
STANDARD DEVIATION .0142 MGC/M3/HR
STANDARD ERROR (N=8) .0050 MGC/M3/HR
COEFFICIENT OF VARIATION 33.51

DATE 7/ 4/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 35/74.8

DEPTH 30 M REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.043	.051	.074	.072	.053	.052	.085	.080
DARK	.014	.014	.014	.014	.014	.014	.014	.014
NET	.029	.038	.060	.058	.040	.038	.071	.066

MEAN NET ASSIMILATION .0500 MGC/M3/HR
STANDARD DEVIATION .0156 MGC/M3/HR
STANDARD ERROR (N=8) .0055 MGC/M3/HR
COEFFICIENT OF VARIATION 31.22

Table 4 (cont.)

DATE 7/12/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 29/77.5

DEPTH 5 M REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.078	.060	.050	.048	.048	.040	.062	.054
DARK	.017	.017	.017	.017	.017	.017	.017	.017
NET	.061	.044	.034	.031	.031	.023	.046	.038

MEAN NET ASSIMILATION .0385 MGC/M3/HR
STANDARD DEVIATION .0115 MGC/M3/HR
STANDARD ERROR (N=8) .0041 MGC/M3/HR
COEFFICIENT OF VARIATION 30.00

DATE 7/12/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 29/77.5

DEPTH 10 M REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.043	.035	.036	.042	.035	.036	.046	.049
DARK	.015	.015	.015	.015	.015	.015	.015	.015
NET	.028	.020	.021	.027	.020	.021	.031	.034

MEAN NET ASSIMILATION .0254 MGC/M3/HR
STANDARD DEVIATION .0055 MGC/M3/HR
STANDARD ERROR (N=8) .0019 MGC/M3/HR
COEFFICIENT OF VARIATION 21.65

DATE 7/13/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 28/77.9

DEPTH 20 M REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.045	.043	.050	.051	.059	.055	.057	.055
DARK	.018	.018	.018	.018	.018	.018	.018	.018
NET	.027	.025	.032	.033	.041	.037	.039	.037

MEAN NET ASSIMILATION .0339 MGC/M3/HR
STANDARD DEVIATION .0055 MGC/M3/HR
STANDARD ERROR (N=8) .0019 MGC/M3/HR
COEFFICIENT OF VARIATION 16.09

DATE 7/13/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 29/77.5

DEPTH 30 M REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.068	.078	.069	.058	.094	.101	.054	.056
DARK	.015	.015	.015	.015	.015	.015	.015	.015
NET	.053	.064	.054	.043	.080	.086	.040	.041

MEAN NET ASSIMILATION .0576 MGC/M3/HR
STANDARD DEVIATION .0178 MGC/M3/HR
STANDARD ERROR (N=8) .0063 MGC/M3/HR
COEFFICIENT OF VARIATION 30.91

Table 4 (cont.)

DATE 7/21/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 30/77.0

DEPTH 5 M REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.039	.031	.041	.041	.037	.036	.048	.043
DARK	.013	.013	.013	.013	.013	.013	.013	.013
NET	.026	.017	.027	.027	.023	.023	.035	.030

MEAN NET ASSIMILATION .0261 MGC/M3/HR
STANDARD DEVIATION .0052 MGC/M3/HR
STANDARD ERROR (N=8) .0018 MGC/M3/HR
COEFFICIENT OF VARIATION 19.87

DATE 7/21/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 35/74.8

DEPTH 10 M REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.035	.038	.031	.033	.031	.037	.033	.039
DARK	.013	.013	.013	.013	.013	.013	.013	.013
NET	.022	.025	.018	.020	.018	.024	.020	.026

MEAN NET ASSIMILATION .0216 MGC/M3/HR
STANDARD DEVIATION .0032 MGC/M3/HR
STANDARD ERROR (N=8) .0011 MGC/M3/HR
COEFFICIENT OF VARIATION 14.65

DATE 7/22/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 30/77.0

DEPTH 20 M REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.025	.025	.035	.032	.052	.036	.044	.046
DARK	.013	.013	.013	.013	.013	.013	.013	.013
NET	.011	.012	.021	.019	.039	.023	.030	.033

MEAN NET ASSIMILATION .0235 MGC/M3/HR
STANDARD DEVIATION .0098 MGC/M3/HR
STANDARD ERROR (N=8) .0035 MGC/M3/HR
COEFFICIENT OF VARIATION 41.63

DATE 7/22/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 30/77.0

DEPTH 30 M REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.062	.057	.070	.058	.078	.050	.080	.099
DARK	.015	.015	.015	.015	.015	.015	.015	.015
NET	.047	.042	.055	.043	.063	.035	.065	.084

MEAN NET ASSIMILATION .0544 MGC/M3/HR
STANDARD DEVIATION .0160 MGC/M3/HR
STANDARD ERROR (N=8) .0057 MGC/M3/HR
COEFFICIENT OF VARIATION 29.43

Table 4 (cont.)

DATE 7/30/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 23/78.3

DEPTH 5 M REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.044	.036	.042	.055	.022	.050	.058	.045
DARK	.014	.014	.014	.014	.014	.014	.014	.014
NET	.030	.022	.027	.041	.008	.036	.044	.031

MEAN NET ASSIMILATION .0298 MGC/M3/HR
STANDARD DEVIATION .0115 MGC/M3/HR
STANDARD ERROR (N=8) .0041 MGC/M3/HR
COEFFICIENT OF VARIATION 38.59

DATE 7/30/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 24/78.6

DEPTH 10 M REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.056	.039	.051	.065	.101	.061	.048	.041
DARK	.015	.015	.015	.015	.015	.015	.015	.015
NET	.041	.024	.036	.049	.086	.046	.033	.026

MEAN NET ASSIMILATION .0424 MGC/M3/HR
STANDARD DEVIATION .0195 MGC/M3/HR
STANDARD ERROR (N=8) .0069 MGC/M3/HR
COEFFICIENT OF VARIATION 46.02

DATE 7/31/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 29/77.5

DEPTH 20 M REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.074	.053	.136	.076	.138	.159	.172	.197
DARK	.015	.015	.015	.015	.015	.015	.015	.015
NET	.058	.037	.120	.061	.123	.143	.157	.182

MEAN NET ASSIMILATION .1102 MGC/M3/HR
STANDARD DEVIATION .0522 MGC/M3/HR
STANDARD ERROR (N=8) .0185 MGC/M3/HR
COEFFICIENT OF VARIATION 47.41

DATE 7/31/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 23/78.3

DEPTH 30 M REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.061	.083	.071	.055	.088	.059	.084	.078
DARK	.012	.012	.012	.012	.012	.012	.012	.012
NET	.049	.071	.059	.042	.075	.047	.072	.066

MEAN NET ASSIMILATION .0601 MGC/M3/HR
STANDARD DEVIATION .0128 MGC/M3/HR
STANDARD ERROR (N=8) .0045 MGC/M3/HR
COEFFICIENT OF VARIATION 21.32

Table 4 (cont.)

DATE 8/ 9/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 32/76.1

DEPTH 5 M REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.106	.098	.083	.097	.111	.116	.088	.105
DARK	.014	.014	.014	.014	.014	.014	.014	.014
NET	.093	.085	.070	.083	.097	.102	.075	.091

MEAN NET ASSIMILATION .0869 MGC/M3/HR
STANDARD DEVIATION .0111 MGC/M3/HR
STANDARD ERROR (N=8) .0039 MGC/M3/HR
COEFFICIENT OF VARIATION 12.74

DATE 8/ 9/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 32/76.1

DEPTH 10 M REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.127	.086	.098	.097	.105	.105	.088	.069
DARK	.015	.015	.015	.015	.015	.015	.015	.015
NET	.112	.071	.083	.082	.090	.090	.073	.054

MEAN NET ASSIMILATION .0817 MGC/M3/HR
STANDARD DEVIATION .0169 MGC/M3/HR
STANDARD ERROR (N=8) .0060 MGC/M3/HR
COEFFICIENT OF VARIATION 20.69

DATE 8/ 8/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 34/75.2

DEPTH 20 M REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.147	.127	.182	.137	.171	.190	.196	.172
DARK	.015	.015	.015	.015	.015	.015	.015	.015
NET	.133	.112	.168	.122	.157	.175	.181	.158

MEAN NET ASSIMILATION .1507 MGC/M3/HR
STANDARD DEVIATION .0254 MGC/M3/HR
STANDARD ERROR (N=8) .0090 MGC/M3/HR
COEFFICIENT OF VARIATION 16.84

DATE 8/ 8/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 32/76.1

DEPTH 30 M REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.047	.058	.044	.052	.104	.103	.076	.061
DARK	.016	.016	.016	.016	.016	.016	.016	.016
NET	.032	.043	.029	.036	.089	.087	.061	.046

MEAN NET ASSIMILATION .0527 MGC/M3/HR
STANDARD DEVIATION .0238 MGC/M3/HR
STANDARD ERROR (N=8) .0084 MGC/M3/HR
COEFFICIENT OF VARIATION 45.16

Table 4 (cont.)

DATE 8/18/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 33/75.7

DEPTH 5 M REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.049	.054	.071	.052	.057	.060	.065	.057
DARK	.014	.014	.014	.014	.014	.014	.014	.014
NET	.035	.040	.057	.038	.043	.046	.051	.042

MEAN NET ASSIMILATION .0441 MGC/M3/HR
STANDARD DEVIATION .0071 MGC/M3/HR
STANDARD ERROR (N=8) .0025 MGC/M3/HR
COEFFICIENT OF VARIATION 16.19

DATE 8/18/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 33/75.7

DEPTH 10 M REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.042	.041	.040	.030	.044	.042	.054	.050
DARK	.015	.015	.015	.015	.015	.015	.015	.015
NET	.028	.026	.026	.015	.030	.028	.039	.035

MEAN NET ASSIMILATION .0282 MGC/M3/HR
STANDARD DEVIATION .0071 MGC/M3/HR
STANDARD ERROR (N=8) .0025 MGC/M3/HR
COEFFICIENT OF VARIATION 25.32

DATE 8/17/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 33/75.7

DEPTH 20 M REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.085	.066	.071	.078	.075	.096	.098	.094
DARK	.016	.016	.016	.016	.016	.016	.016	.016
NET	.069	.050	.054	.062	.059	.079	.082	.077

MEAN NET ASSIMILATION .0666 MGC/M3/HR
STANDARD DEVIATION .0121 MGC/M3/HR
STANDARD ERROR (N=8) .0043 MGC/M3/HR
COEFFICIENT OF VARIATION 18.21

DATE 8/17/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 33/75.7

DEPTH 30 M REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.088	.068	.075	.079	.084	.095	.111	.075
DARK	.018	.018	.018	.018	.018	.018	.018	.018
NET	.070	.050	.056	.061	.065	.077	.093	.057

MEAN NET ASSIMILATION .0662 MGC/M3/HR
STANDARD DEVIATION .0138 MGC/M3/HR
STANDARD ERROR (N=8) .0049 MGC/M3/HR
COEFFICIENT OF VARIATION 20.84

Table 4 (cont.)

DATE 8/27/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 36/74.3

DEPTH 5 M REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.054	.062	.076	.061	.062	.056	.073	.070
DARK	.018	.018	.018	.018	.018	.018	.018	.018
NET	.036	.044	.059	.044	.044	.038	.055	.053

MEAN NET ASSIMILATION .0467 MGC/M3/HR
STANDARD DEVIATION .0091 MGC/M3/HR
STANDARD ERROR (N=8) .0029 MGC/M3/HR
COEFFICIENT OF VARIATION 17.27

DATE 8/27/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 36/74.3

DEPTH 10 M REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.113	.123	.126	.117	.156	.117	.147	.111
DARK	.017	.017	.017	.017	.017	.017	.017	.017
NET	.096	.106	.109	.100	.139	.100	.130	.094

MEAN NET ASSIMILATION .1092 MGC/M3/HR
STANDARD DEVIATION .0166 MGC/M3/HR
STANDARD ERROR (N=8) .0059 MGC/M3/HR
COEFFICIENT OF VARIATION 15.18

DATE 8/26/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 31/76.6

DEPTH 20 M REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.121	.081	.122	.102	.117	.128	.112	.131
DARK	.020	.020	.020	.020	.020	.020	.020	.020
NET	.101	.062	.102	.082	.097	.108	.092	.111

MEAN NET ASSIMILATION .0944 MGC/M3/HR
STANDARD DEVIATION .0160 MGC/M3/HR
STANDARD ERROR (N=8) .0057 MGC/M3/HR
COEFFICIENT OF VARIATION 16.96

DATE 8/26/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 36/74.3

DEPTH 30 M REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.065	.060	.107	.092	.083	.092	.107	.091
DARK	.015	.015	.015	.015	.015	.015	.015	.015
NET	.050	.045	.092	.077	.068	.078	.092	.076

MEAN NET ASSIMILATION .0722 MGC/M3/HR
STANDARD DEVIATION .0173 MGC/M3/HR
STANDARD ERROR (N=8) .0061 MGC/M3/HR
COEFFICIENT OF VARIATION 23.97

Table 4 (cont.)

DATE 9/ 5/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 15/76.2

DEPTH 5 M — REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.095	.098	.110	.135	.191	.127	.135	.127
DARK	.015	.015	.015	.015	.015	.015	.015	.015
NET	.080	.083	.095	.120	.176	.112	.120	.113

MEAN NET ASSIMILATION .1123 MGC/M3/HR
STANDARD DEVIATION .0301 MGC/M3/HR
STANDARD ERROR (N=8) .0106 MGC/M3/HR
COEFFICIENT OF VARIATION 26.78

DATE 9/ 5/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 15/76.2

DEPTH 10 M — REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.116	.125	.101	.088	.096	.121	.084	.088
DARK	.013	.013	.013	.013	.013	.013	.013	.013
NET	.103	.113	.089	.075	.083	.109	.071	.075

MEAN NET ASSIMILATION .0898 MGC/M3/HR
STANDARD DEVIATION .0163 MGC/M3/HR
STANDARD ERROR (N=8) .0058 MGC/M3/HR
COEFFICIENT OF VARIATION 18.17

DATE 9/ 4/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 21/77.8

DEPTH 20 M — REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.086	.070	.085	.096	.078	.083	.104	.091
DARK	.015	.015	.015	.015	.015	.015	.015	.015
NET	.071	.055	.070	.081	.063	.068	.089	.076

MEAN NET ASSIMILATION .0718 MGC/M3/HR
STANDARD DEVIATION .0103 MGC/M3/HR
STANDARD ERROR (N=8) .0036 MGC/M3/HR
COEFFICIENT OF VARIATION 14.37

DATE 9/ 4/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 19/77.3

DEPTH 30 M — REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.073	.068	.108	.110	.100	.118	.109	.102
DARK	.015	.015	.015	.015	.015	.015	.015	.015
NET	.058	.053	.093	.095	.085	.102	.094	.087

MEAN NET ASSIMILATION .0836 MGC/M3/HR
STANDARD DEVIATION .0181 MGC/M3/HR
STANDARD ERROR (N=8) .0064 MGC/M3/HR
COEFFICIENT OF VARIATION 21.68

Table 4 (cont.)

DATE 9/14/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 15/76.2

DEPTH 5 M REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.109	.124	.133	.196	.170	.127	.193	.171
DARK	.013	.013	.013	.013	.013	.013	.013	.013
NET	.096	.111	.120	.183	.157	.113	.179	.158

MEAN NET ASSIMILATION .1395 MGC/M3/HR
STANDARD DEVIATION .0335 MGC/M3/HR
STANDARD ERROR (N=8) .0119 MGC/M3/HR
COEFFICIENT OF VARIATION 24.03

DATE 9/14/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 15/76.2

DEPTH 10 M REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.131	.080	.114	.115	.100	.184	.111	.110
DARK	.013	.013	.013	.013	.013	.013	.013	.013
NET	.118	.067	.101	.101	.087	.171	.097	.097

MEAN NET ASSIMILATION .1047 MGC/M3/HR
STANDARD DEVIATION .0303 MGC/M3/HR
STANDARD ERROR (N=8) .0107 MGC/M3/HR
COEFFICIENT OF VARIATION 28.97

DATE 9/13/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 13/75.6

DEPTH 20 M REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.109	.121	.096	.097	.097	.107	.106	.101
DARK	.013	.013	.013	.013	.013	.013	.013	.013
NET	.095	.107	.083	.083	.083	.094	.093	.088

MEAN NET ASSIMILATION .0907 MGC/M3/HR
STANDARD DEVIATION .0084 MGC/M3/HR
STANDARD ERROR (N=8) .0030 MGC/M3/HR
COEFFICIENT OF VARIATION 9.31

DATE 9/13/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 13/75.6

DEPTH 30 M REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.113	.125	.107	.114	.100	.117	.093	.096
DARK	.014	.014	.014	.014	.014	.014	.014	.014
NET	.099	.111	.093	.100	.086	.103	.078	.082

MEAN NET ASSIMILATION .0938 MGC/M3/HR
STANDARD DEVIATION .0111 MGC/M3/HR
STANDARD ERROR (N=8) .0039 MGC/M3/HR
COEFFICIENT OF VARIATION 11.86

Table 4 (cont.)

DATE 9/29/75 STANDARD 6.35 MC/AMP TIME 6.0 HR EFF 23/78.3

DEPTH 5 M REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.159	.173	.136	.129	.166	.164	.167	.160
DARK	.015	.015	.015	.015	.015	.015	.015	.015
NET	.143	.158	.120	.113	.151	.149	.152	.145

MEAN NET ASSIMILATION .1413 MGC/M3/HR
STANDARD DEVIATION .0160 MGC/M3/HR
STANDARD ERROR (N=8) .0056 MGC/M3/HR
COEFFICIENT OF VARIATION 11.29

DATE 9/29/75 STANDARD 6.35 MC/AMP TIME 6.0 HR EFF 23/78.3

DEPTH 10 M REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.145	.145	.164	.165	.166	.167	.172	.164
DARK	.011	.011	.011	.011	.011	.011	.011	.011
NET	.134	.134	.153	.154	.155	.156	.161	.153

MEAN NET ASSIMILATION .1501 MGC/M3/HR
STANDARD DEVIATION .0102 MGC/M3/HR
STANDARD ERROR (N=8) .0036 MGC/M3/HR
COEFFICIENT OF VARIATION 6.82

DATE 9/28/75 STANDARD 6.35 MC/AMP TIME 6.0 HR EFF 10/74.8

DEPTH 20 M REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.115	.123	.124	.140	.119	.135	.144	.097
DARK	.013	.013	.013	.013	.013	.013	.013	.013
NET	.102	.110	.111	.127	.106	.123	.131	.084

MEAN NET ASSIMILATION .1117 MGC/M3/HR
STANDARD DEVIATION .0152 MGC/M3/HR
STANDARD ERROR (N=8) .0054 MGC/M3/HR
COEFFICIENT OF VARIATION 13.64

DATE 9/28/75 STANDARD 6.35 MC/AMP TIME 6.0 HR EFF 11/75.1

DEPTH 30 M REPLICATED ASSIMILATION (MGC/M3/HR)

LIGHT	.098	.098	.096	.117	.125	.104	.162	.122
DARK	.014	.014	.014	.014	.014	.014	.014	.014
NET	.084	.084	.083	.104	.112	.091	.149	.108

MEAN NET ASSIMILATION .1018 MGC/M3/HR
STANDARD DEVIATION .0221 MGC/M3/HR
STANDARD ERROR (N=8) .0078 MGC/M3/HR
COEFFICIENT OF VARIATION 21.74

Table 5. Results of graduated light series ^{14}C assimilation experiments

Explanation of Table Values:

1.	Date:	Month, day, year of experiment
2.	Standard:	Total activities (microcuries) added to water sample
3.	Time:	Duration (hours) of incubation
4.	Eff:	Liquid scintillation external standard (e.g. 12) and resultant percentage counting efficienc (e.g. 75.4)
5.	Depth:	Depth (m) of water sample
6.	Dark Assim:	Dark bottle assimilation ($mgCm^{-3}hr^{-1}$)
7.	Light:	Light intensity (microeinsteins $m^{-2}sec^{-1}$) in incubation box during experiment
8.	Max:	Light intensity expressed as percentage of maximum light in box (i.e., % of 117 microeinsteins $m^{-2}sec^{-1}$)
9.	Assim:	Light, net assimilation ($mgCm^{-3}hr^{-1}$) and net assimilation normalized on, and expressed as a percentage of, the maximum net assimilation that occurred during the experiment
10.	Normalized:	Net assimilation normalized on light intensity

Table 5 (cont.)

DATE 6/ 9/75 STANDARD 7.70 MC/AMP TIME 6.0 HR EFF 12/75.4

DEPTH 10 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.01	3	.00268
5.0	4	.03	.02	10	.00362
7.0	6	.04	.02	13	.00345
10.0	8	.05	.04	21	.00396
17.0	14	.08	.07	37	.00407
19.0	16	.10	.09	49	.00484
22.0	19	.12	.10	55	.00473
57.0	49	.17	.16	86	.00285
87.0	74	.16	.15	80	.00175
117.0	100	.20	.19	100	.00162

DATE 6/ 9/75 STANDARD 7.70 MC/AMP TIME 6.0 HR EFF 13/75.6

DEPTH 20 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.01	.00	1	.00067
5.0	4	.03	.02	10	.00308
7.0	6	.04	.02	16	.00353
10.0	8	.06	.05	32	.00488
17.0	14	.07	.06	41	.00362
19.0	16	.09	.08	52	.00415
22.0	19	.09	.08	55	.00374
57.0	49	.16	.15	100	.00264
87.0	74	.15	.13	88	.00153
117.0	100	.15	.14	90	.00115

DATE 6/10/75 STANDARD 7.70 MC/AMP TIME 6.0 HR EFF 14/75.9

DEPTH 30 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.00	2	.00167
5.0	4	.04	.03	18	.00546
7.0	6	.04	.03	20	.00428
10.0	8	.06	.05	32	.00480
17.0	14	.08	.07	44	.00392
19.0	16	.09	.08	52	.00417
22.0	19	.11	.09	63	.00430
57.0	49	.15	.14	94	.00250
87.0	74	.16	.15	100	.00174
117.0	100	.16	.15	96	.00125

Table 5 (cont.)

DATE 6/13/75 STANDARD 7.70 MC/AMP TIME 6.0 HR EFF 13/75.6

DEPTH 5 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.01	.00	1	.00067
5.0	4	.02	.01	11	.00241
7.0	6	.03	.02	17	.00277
10.0	8	.04	.03	24	.00267
17.0	14	.07	.06	51	.00334
19.0	16	.08	.06	57	.00338
22.0	19	.08	.07	59	.00298
57.0	49	.11	.10	88	.00172
87.0	74	.12	.11	100	.00128
117.0	100	.11	.10	90	.00086

DATE 6/12/75 STANDARD 7.70 MC/AMP TIME 6.0 HR EFF 13/75.6

DEPTH 10 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.03	.02	14	.00936
5.0	4	.03	.02	13	.00348
7.0	6	.04	.03	18	.00363
10.0	8	.05	.04	27	.00368
17.0	14	.07	.06	43	.00350
19.0	16	.08	.07	53	.00384
22.0	19	.10	.08	61	.00380
57.0	49	.11	.10	72	.00175
87.0	74	.15	.14	100	.00158
117.0	100	.14	.12	90	.00106

DATE 6/12/75 STANDARD 7.70 MC/AMP TIME 6.0 HR EFF 14/75.9

DEPTH 20 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.01	.00	3	.00133
5.0	4	.01	.00	1	.00013
7.0	6	.02	.01	9	.00133
10.0	8	.04	.02	23	.00240
17.0	14	.04	.03	25	.00157
19.0	16	.04	.03	29	.00161
22.0	19	.05	.03	32	.00154
57.0	49	.10	.08	80	.00146
87.0	74	.12	.10	100	.00120
117.0	100	.11	.09	90	.00080

Table 5 (cont.)

DATE 6/13/75 STANDARD 7.70 MC/AMP TIME 6.0 HR EFF 14/75.9

DEPTH 30 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.01	.00	1	.00067
5.0	4	.02	.01	9	.00187
7.0	6	.03	.01	14	.00209
10.0	8	.03	.02	18	.00187
17.0	14	.04	.03	32	.00196
19.0	16	.06	.05	45	.00242
22.0	19	.05	.04	41	.00191
57.0	49	.10	.08	82	.00148
87.0	74	.11	.10	95	.00113
117.0	100	.11	.10	100	.00088

DATE 6/15/75 STANDARD 7.70 MC/AMP TIME 6.0 HR EFF 14/75.9

DEPTH 5 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.01	.00	0	.00000
5.0	4	.01	.01	11	.00107
7.0	6	.02	.01	20	.00133
10.0	8	.02	.01	31	.00147
17.0	14	.03	.02	46	.00129
19.0	16	.04	.03	56	.00140
22.0	19	.03	.02	41	.00088
57.0	49	.05	.04	77	.00064
87.0	74	.06	.05	99	.00054
117.0	100	.06	.05	100	.00040

DATE 6/15/75 STANDARD 7.70 MC/AMP TIME 6.0 HR EFF 14/75.9

DEPTH 10 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.01	.00	2	.00067
5.0	4	.02	.01	9	.00147
7.0	6	.02	.01	15	.00181
10.0	8	.03	.01	18	.00147
17.0	14	.04	.03	33	.00157
19.0	16	.05	.04	49	.00210
22.0	19	.05	.04	43	.00161
57.0	49	.09	.07	90	.00130
87.0	74	.09	.08	99	.00093
117.0	100	.09	.08	100	.00070

Table 5 (cont.)

DATE 6/16/75 STANDARD 7.70 MC/AMP TIME 6.0 HR EFF 15/76.2

DEPTH 20 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.01	.00	0	.00000
5.0	4	.02	.01	8	.00120
7.0	6	.02	.01	15	.00161
10.0	8	.03	.02	25	.00179
17.0	14	.04	.03	42	.00180
19.0	16	.05	.04	54	.00206
22.0	19	.05	.04	54	.00178
57.0	49	.09	.07	100	.00128
87.0	74	.08	.07	96	.00081
117.0	100	.08	.07	96	.00060

DATE 6/16/75 STANDARD 7.70 MC/AMP TIME 6.0 HR EFF 35/74.8

DEPTH 30 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.01	8	.00271
5.0	4	.02	.01	12	.00162
7.0	6	.03	.02	22	.00222
10.0	8	.03	.02	29	.00203
17.0	14	.05	.04	58	.00239
19.0	16	.06	.05	67	.00246
22.0	19	.05	.04	52	.00166
57.0	49	.06	.05	71	.00087
87.0	74	.07	.05	76	.00061
117.0	100	.08	.07	100	.00060

DATE 6/18/75 STANDARD 7.70 MC/AMP TIME 6.0 HR EFF 35/74.8

DEPTH 5 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.01	12	.00338
5.0	4	.02	.01	20	.00230
7.0	6	.02	.01	17	.00145
10.0	8	.03	.01	26	.00149
17.0	14	.04	.03	50	.00171
19.0	16	.05	.04	67	.00206
22.0	19	.05	.04	63	.00166
57.0	49	.07	.05	92	.00094
87.0	74	.07	.06	97	.00065
117.0	100	.07	.06	100	.00050

Table 5 (cont.)

DATE 6/18/75 STANDARD 7.70 MC/AMP TIME 6.0 HR EFF 35/74.8

DEPTH 10 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.01	9	.00304
5.0	4	.02	.01	12	.00162
7.0	6	.03	.01	21	.00213
10.0	8	.03	.02	22	.00156
17.0	14	.05	.04	53	.00219
19.0	16	.05	.04	53	.00196
22.0	19	.06	.05	65	.00209
57.0	49	.08	.06	92	.00114
87.0	74	.08	.07	94	.00076
117.0	100	.08	.07	100	.00060

DATE 6/19/75 STANDARD 7.70 MC/AMP TIME 6.0 HR EFF 35/74.8

DEPTH 20 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.01	13	.00406
5.0	4	.03	.02	30	.00365
7.0	6	.03	.02	28	.00242
10.0	8	.03	.02	33	.00196
17.0	14	.04	.03	49	.00175
19.0	16	.05	.04	60	.00189
22.0	19	.05	.03	56	.00154
57.0	49	.07	.06	100	.00106
87.0	74	.06	.05	87	.00060
117.0	100	.07	.05	94	.00049

DATE 6/19/75 STANDARD 7.70 MC/AMP TIME 6.0 HR EFF 34/75.2

DEPTH 30 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.00	3	.00168
5.0	4	.03	.02	14	.00336
7.0	6	.04	.03	23	.00384
10.0	8	.04	.03	26	.00309
17.0	14	.07	.06	52	.00364
19.0	16	.08	.07	59	.00368
22.0	19	.09	.08	65	.00351
57.0	49	.12	.11	90	.00186
87.0	74	.13	.12	100	.00136
117.0	100	.13	.11	96	.00097

Table 5 (cont.)

DATE 6/21/75 STANDARD 7.70 MC/AMP TIME 6.0 HR EFF 27/78.4

DEPTH 5 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.01	.00	1	.00032
5.0	4	.01	.00	0	.00000
7.0	6	.02	.01	18	.00129
10.0	8	.02	.01	22	.00110
17.0	14	.03	.02	38	.00114
19.0	16	.04	.03	61	.00163
22.0	19	.04	.02	43	.00100
57.0	49	.06	.04	86	.00077
87.0	74	.06	.05	96	.00056
117.0	100	.06	.05	100	.00044

DATE 6/22/75 STANDARD 7.70 MC/AMP TIME 6.0 HR EFF 27/78.4

DEPTH 10 M DARK ASSIM .02 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.00	3	.00097
5.0	4	.02	.00	6	.00077
7.0	6	.03	.01	15	.00138
10.0	8	.03	.02	28	.00174
17.0	14	.04	.03	44	.00163
19.0	16	.04	.02	38	.00126
22.0	19	.04	.03	41	.00117
57.0	49	.07	.05	82	.00091
87.0	74	.08	.06	100	.00073
117.0	100	.07	.05	86	.00046

DATE 6/22/75 STANDARD 7.70 MC/AMP TIME 6.0 HR EFF 27/78.4

DEPTH 20 M DARK ASSIM .02 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.01	9	.00258
5.0	4	.02	.00	8	.00090
7.0	6	.02	.01	12	.00101
10.0	8	.03	.02	27	.00155
17.0	14	.05	.03	52	.00175
19.0	16	.04	.03	49	.00149
22.0	19	.05	.03	60	.00155
57.0	49	.07	.06	98	.00098
87.0	74	.07	.05	99	.00065
117.0	100	.07	.06	100	.00049

Table 5 (cont.)

DATE 6/24/75 STANDARD 7.70 MC/AMP TIME 6.0 HR FFF 27/78.4

DEPTH 5 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.01	13	.00258
5.0	4	.03	.01	27	.00219
7.0	6	.03	.01	34	.00194
10.0	8	.03	.01	27	.00110
17.0	14	.03	.01	37	.00087
19.0	16	.03	.02	40	.00085
22.0	19	.04	.02	60	.00109
57.0	49	.05	.04	100	.00070
87.0	74	.05	.04	100	.00046
117.0	100	.05	.04	97	.00033

DATE 6/24/75 STANDARD 7.70 MC/AMP TIME 6.0 HR FFF 27/78.4

DEPTH 10 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.00	8	.00161
5.0	4	.01	.00	0	.00000
7.0	6	.02	.00	10	.00055
10.0	8	.02	.00	8	.00032
17.0	14	.03	.01	39	.00087
19.0	16	.03	.01	32	.00065
22.0	19	.03	.02	49	.00085
57.0	49	.05	.04	98	.00066
87.0	74	.04	.03	80	.00035
117.0	100	.05	.04	100	.00033

DATE 6/25/75 STANDARD 7.70 MC/AMP TIME 6.0 HR FFF 27/78.4

DEPTH 20 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.00	3	.00065
5.0	4	.02	.01	13	.00129
7.0	6	.02	.01	21	.00147
10.0	8	.03	.01	30	.00148
17.0	14	.04	.03	61	.00175
19.0	16	.04	.02	50	.00129
22.0	19	.05	.04	76	.00170
57.0	49	.05	.03	71	.00061
87.0	74	.06	.05	100	.00056
117.0	100	.05	.04	76	.00032

Table 5 (cont.)

DATE 6/25/75 STANDARD 7.70 MC/AMP TIME 6.0 HR EFF 24/78.6

DEPTH 30 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.01	.00	1	.00032
5.0	4	.02	.00	5	.00064
7.0	6	.02	.01	15	.00129
10.0	8	.03	.01	19	.00116
17.0	14	.04	.03	51	.00178
19.0	16	.04	.03	48	.00152
22.0	19	.05	.03	55	.00149
57.0	49	.06	.05	75	.00079
87.0	74	.07	.06	92	.00064
117.0	100	.07	.06	100	.00051

DATE 6/27/75 STANDARD 7.70 MC/AMP TIME 6.0 HR EFF 24/78.6

DEPTH 5 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.01	.00	2	.00064
5.0	4	.02	.01	15	.00180
7.0	6	.03	.01	19	.00165
10.0	8	.03	.02	28	.00167
17.0	14	.03	.02	31	.00110
19.0	16	.05	.04	66	.00207
22.0	19	.04	.02	38	.00102
57.0	49	.07	.06	92	.00097
87.0	74	.04	.02	39	.00027
117.0	100	.07	.06	100	.00051

DATE 6/27/75 STANDARD 7.70 MC/AMP TIME 6.0 HR EFF 24/78.6

DEPTH 10 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.00	8	.00129
5.0	4	.02	.01	24	.00154
7.0	6	.03	.01	40	.00184
10.0	8	.02	.01	28	.00090
17.0	14	.03	.01	44	.00083
19.0	16	.03	.02	52	.00088
22.0	19	.03	.01	42	.00061
57.0	49	.04	.03	94	.00053
87.0	74	.04	.03	86	.00032
117.0	100	.05	.03	100	.00028

Table 5 (cont.)

DATE 6/28/75 STANDARD 7.70 MC/AMP TIME 6.0 HR EFF 24/78.6

DEPTH 20 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.01	15	.00322
5.0	4	.02	.00	9	.00077
7.0	6	.03	.01	28	.00175
10.0	8	.03	.01	31	.00135
17.0	14	.04	.02	50	.00129
19.0	16	.04	.02	50	.00115
22.0	19	.04	.02	51	.00102
57.0	49	.06	.04	99	.00076
87.0	74	.05	.04	94	.00047
117.0	100	.06	.04	100	.00037

DATE 6/28/75 STANDARD 7.70 MC/AMP TIME 6.0 HR EFF 24/78.6

DEPTH 30 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.01	20	.00386
5.0	4	.02	.00	8	.00064
7.0	6	.02	.01	18	.00101
10.0	8	.03	.01	38	.00148
17.0	14	.04	.03	66	.00151
19.0	16	.04	.03	70	.00146
22.0	19	.05	.04	93	.00167
57.0	49	.05	.04	90	.00062
87.0	74	.05	.04	97	.00044
117.0	100	.05	.04	100	.00034

DATE 6/30/75 STANDARD 7.70 MC/AMP TIME 6.0 HR EFF 14/75.9

DEPTH 5 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.00	6	.00100
5.0	4	.01	.00	4	.00027
7.0	6	.02	.00	8	.00038
10.0	8	.02	.01	25	.00080
17.0	14	.02	.01	35	.00067
19.0	16	.02	.01	25	.00042
22.0	19	.03	.01	40	.00058
57.0	49	.05	.03	100	.00056
87.0	74	.04	.03	81	.00030
117.0	100	.04	.03	85	.00023

Table 5 (cont.)

DATE 6/30/75 STANDARD 7.70 MC/AMP TIME 6.0 HR EFF 14/75.9

DEPTH 10 M DARK ASSIM .01 MG/M3/HR

LIGHT		ASSIM (MGC/M3/HR)			NORMALIZED
(MF/M2/S)	MAX	L	N	MAX	A/L
2.0	2	.01	.00	0	.00000
5.0	4	.01	.00	8	.00027
7.0	6	.01	.00	19	.00048
10.0	8	.01	.00	15	.00027
17.0	14	.02	.01	62	.00063
19.0	16	.02	.01	58	.00053
22.0	19	.02	.01	58	.00045
57.0	49	.03	.02	88	.00027
87.0	74	.03	.02	88	.00018
117.0	100	.03	.02	100	.00015

DATE 7/ 1/75 STANDARD 7.70 MC/AMP TIME 6.0 HR EFF 14/75.9

DEPTH 20 M DARK ASSIM .01 MG/M3/HR

LIGHT		ASSIM (MGC/M3/HR)			NORMALIZED
(MF/M2/S)	MAX	L	N	MAX	A/L
2.0	2	.02	.00	13	.00233
5.0	4	.02	.00	11	.00080
7.0	6	.03	.01	40	.00200
10.0	8	.03	.02	58	.00207
17.0	14	.03	.02	55	.00114
19.0	16	.04	.02	62	.00116
22.0	19	.03	.02	58	.00094
57.0	49	.05	.03	94	.00058
87.0	74	.05	.03	98	.00040
117.0	100	.05	.04	100	.00030

DATE 7/ 1/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 14/75.9

DEPTH 30 M DARK ASSIM .01 MG/M3/HR

LIGHT		ASSIM (MGC/M3/HR)			NORMALIZED
(MF/M2/S)	MAX	L	N	MAX	A/L
2.0	2	.02	.01	20	.00274
5.0	4	.01	.00	12	.00068
7.0	6	.02	.01	20	.00078
10.0	8	.02	.01	37	.00103
17.0	14	.03	.02	83	.00137
19.0	16	.03	.02	73	.00108
22.0	19	.03	.02	71	.00090
57.0	49	.04	.03	100	.00049
87.0	74	.04	.03	98	.00031
117.0	100	.04	.03	93	.00022

Table 5 (cont.)

DATE 7/ 3/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 14/75.9

DEPTH 5 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.01	.00	3	.00034
5.0	4	.02	.01	26	.00137
7.0	6	.02	.01	23	.00088
10.0	8	.02	.01	36	.00096
17.0	14	.03	.02	56	.00089
19.0	16	.02	.01	31	.00043
22.0	19	.03	.02	59	.00072
57.0	49	.04	.03	100	.00047
87.0	74	.04	.03	97	.00030
117.0	100	.04	.02	92	.00021

DATE 7/ 3/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 14/75.9

DEPTH 10 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.01	.00	0	.00000
5.0	4	.02	.01	22	.00137
7.0	6	.03	.01	40	.00176
10.0	8	.02	.01	18	.00055
17.0	14	.02	.01	31	.00056
19.0	16	.02	.01	29	.00047
22.0	19	.02	.01	36	.00050
57.0	49	.04	.02	78	.00042
87.0	74	.04	.03	82	.00029
117.0	100	.04	.03	100	.00026

DATE 7/ 4/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 35/74.8

DEPTH 20 M DARK ASSIM .02 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.03	.01	25	.00625
5.0	4	.04	.03	51	.00514
7.0	6	.06	.04	84	.00605
10.0	8	.04	.02	48	.00243
17.0	14	.05	.03	63	.00188
19.0	16	.06	.05	90	.00241
22.0	19	.05	.03	58	.00133
57.0	49	.07	.05	100	.00089
87.0	74	.06	.04	88	.00051
117.0	100	.06	.05	89	.00039

Table 5 (cont.)

DATE 7/ 4/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 34/75.2

DEPTH 30 M DARK ASSIM .02 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.00	6	.00138
5.0	4	.02	.00	8	.00069
7.0	6	.03	.01	27	.00168
10.0	8	.03	.01	23	.00097
17.0	14	.04	.02	47	.00118
19.0	16	.04	.03	61	.00138
22.0	19	.04	.02	42	.00082
57.0	49	.05	.03	73	.00054
87.0	74	.06	.04	100	.00049
117.0	100	.04	.03	60	.00022

DATE 7/ 6/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 34/75.2

DEPTH 5 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.01	14	.00310
5.0	4	.02	.00	10	.00083
7.0	6	.02	.01	24	.00147
10.0	8	.03	.01	29	.00124
17.0	14	.03	.02	38	.00097
19.0	16	.03	.02	46	.00105
22.0	19	.03	.02	37	.00072
57.0	49	.05	.04	86	.00065
87.0	74	.06	.04	97	.00048
117.0	100	.06	.04	100	.00037

DATE 7/ 6/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 34/75.2

DEPTH 10 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.00	21	.00241
5.0	4	.01	.00	3	.00014
7.0	6	.02	.00	12	.00039
10.0	8	.02	.01	35	.00083
17.0	14	.02	.01	30	.00040
19.0	16	.02	.01	39	.00047
22.0	19	.03	.01	58	.00059
57.0	49	.03	.02	76	.00030
87.0	74	.04	.02	100	.00026
117.0	100	.04	.02	100	.00019

Table 5 (cont.)

DATE 7/ 7/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 34/75.2

DEPTH 20 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) I	N	MAX	NORMALIZED A/L
2.0	2	.02	.01	13	.00275
5.0	4	.02	.00	5	.00041
7.0	6	.02	.00	8	.00049
10.0	8	.02	.00	7	.00028
17.0	14	.02	.01	22	.00053
19.0	16	.03	.02	48	.00105
22.0	19	.04	.02	52	.00097
57.0	49	.05	.04	93	.00068
87.0	74	.06	.04	100	.00047
117.0	100	.06	.04	100	.00035

DATE 7/ 7/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 33/75.7

DEPTH 30 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) I	N	MAX	NORMALIZED A/L
2.0	2	.01	.00	7	.00103
5.0	4	.01	.00	0	.00000
7.0	6	.02	.00	9	.00039
10.0	8	.01	.00	7	.00021
17.0	14	.02	.01	29	.00052
19.0	16	.02	.01	29	.00047
22.0	19	.02	.01	38	.00053
57.0	49	.03	.02	73	.00040
87.0	74	.04	.03	96	.00034
117.0	100	.04	.03	100	.00026

DATE 7/ 9/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 32/76.1

DEPTH 5 M DARK ASSIM .02 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) I	N	MAX	NORMALIZED A/L
2.0	2	.02	.01	14	.00307
5.0	4	.03	.01	32	.00273
7.0	6	.02	.00	8	.00049
10.0	8	.02	.00	6	.00027
17.0	14	.03	.01	22	.00056
19.0	16	.03	.01	21	.00047
22.0	19	.03	.01	22	.00043
57.0	49	.05	.03	71	.00054
87.0	74	.06	.04	95	.00047
117.0	100	.06	.04	100	.00037

Table 5 (cont.)

DATE 7/ 9/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 33/75.7

DEPTH 10 M DARK ASSIM .02 MG/M3/HR

LIGHT (MF/M2/S)	% MAX	ASSIM (MGC/M3/HR) L	N	% MAX	NORMALIZED A/L
2.0	2	.02	.00	9	.00206
5.0	4	.02	.00	5	.00041
7.0	6	.02	.00	6	.00039
10.0	8	.02	.00	6	.00027
17.0	14	.03	.01	31	.00081
19.0	16	.03	.02	37	.00087
22.0	19	.03	.02	43	.00087
57.0	49	.05	.03	68	.00053
87.0	74	.06	.04	100	.00051
117.0	100	.06	.04	97	.00037

DATE 7/10/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 33/75.7

DEPTH 20 M DARK ASSIM .02 MG/M3/HR

LIGHT (MF/M2/S)	% MAX	ASSIM (MGC/M3/HR) L	N	% MAX	NORMALIZED A/L
2.0	2	.02	.00	0	.00000
5.0	4	.04	.02	34	.00412
7.0	6	.03	.02	28	.00235
10.0	8	.03	.01	20	.00117
17.0	14	.04	.02	41	.00145
19.0	16	.04	.02	34	.00108
22.0	19	.04	.02	38	.00103
57.0	49	.07	.05	90	.00094
87.0	74	.08	.06	98	.00067
117.0	100	.08	.06	100	.00051

DATE 7/10/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 32/76.1

DEPTH 30 M DARK ASSIM .02 MG/M3/HR

LIGHT (MF/M2/S)	% MAX	ASSIM (MGC/M3/HR) L	N	% MAX	NORMALIZED A/L
2.0	2	.02	.00	0	.00000
5.0	4	.02	.01	11	.00109
7.0	6	.03	.02	33	.00224
10.0	8	.03	.01	16	.00075
17.0	14	.04	.02	41	.00116
19.0	16	.03	.01	26	.00065
22.0	19	.04	.02	40	.00087
57.0	49	.07	.05	100	.00084
87.0	74	.05	.03	73	.00040
117.0	100	.05	.04	77	.00031

Table 5 (cont.)

DATE 7/12/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 29/77.5

DEPTH 5 M DARK ASSIM .02 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.03	.02	30	.00905
5.0	4	.02	.00	5	.00067
7.0	6	.03	.02	27	.00239
10.0	8	.02	.00	5	.00047
17.0	14	.04	.02	35	.00126
19.0	16	.03	.01	24	.00078
22.0	19	.04	.03	43	.00119
57.0	49	.07	.05	79	.00085
87.0	74	.07	.05	85	.00059
117.0	100	.08	.06	100	.00052

DATE 7/12/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 29/77.5

DEPTH 10 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.01	36	.00503
5.0	4	.02	.00	14	.00080
7.0	6	.02	.01	24	.00096
10.0	8	.03	.01	48	.00134
17.0	14	.03	.02	64	.00106
19.0	16	.02	.01	31	.00046
22.0	19	.03	.02	60	.00076
57.0	49	.04	.03	95	.00047
87.0	74	.04	.02	81	.00026
117.0	100	.04	.03	100	.00024

DATE 7/13/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 29/77.9

DEPTH 20 M DARK ASSIM .02 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.00	4	.00233
5.0	4	.02	.00	0	.00000
7.0	6	.03	.01	13	.00200
10.0	8	.03	.01	13	.00140
17.0	14	.03	.01	8	.00051
19.0	16	.03	.01	8	.00049
22.0	19	.03	.01	11	.00055
57.0	49	.13	.11	100	.00194
87.0	74	.04	.03	23	.00029
117.0	100	.05	.03	25	.00024

Table 5 (cont.)

DATE 7/13/75 STANDARD 7.50 MC/AMP TIME 6.0 HR FFF 29/77.5

DEPTH 30 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.04	.03	49	.01307
5.0	4	.02	.01	16	.00174
7.0	6	.02	.01	28	.00211
10.0	8	.03	.01	28	.00147
17.0	14	.06	.04	78	.00244
19.0	16	.04	.02	42	.00116
22.0	19	.04	.03	56	.00134
57.0	49	.06	.04	80	.00074
87.0	74	.06	.05	90	.00055
117.0	100	.07	.05	100	.00045

DATE 7/15/75 STANDARD 7.50 MC/AMP TIME 6.0 HR FFF 28/77.9

DEPTH 5 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.00	13	.00200
5.0	4	.03	.01	37	.00227
7.0	6	.04	.03	96	.00419
10.0	8	.04	.02	78	.00240
17.0	14	.03	.02	63	.00114
19.0	16	.02	.01	24	.00039
22.0	19	.04	.03	85	.00118
57.0	49	.04	.03	87	.00047
87.0	74	.04	.03	100	.00035
117.0	100	.04	.03	91	.00024

DATE 7/15/75 STANDARD 7.50 MC/AMP TIME 6.0 HR FFF 29/77.5

DEPTH 10 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.01	12	.00302
5.0	4	.03	.01	26	.00255
7.0	6	.03	.02	34	.00239
10.0	8	.03	.01	27	.00134
17.0	14	.03	.02	36	.00103
19.0	16	.04	.02	45	.00116
22.0	19	.03	.02	42	.00094
57.0	49	.05	.04	75	.00065
87.0	74	.05	.04	82	.00046
117.0	100	.06	.05	100	.00042

Table 5 (cont.)

DATE 7/16/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 29/77.5

DEPTH 20 M DARK ASSIM .02 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.00	6	.00101
5.0	4	.04	.02	48	.00335
7.0	6	.03	.01	21	.00105
10.0	8	.02	.01	17	.00060
17.0	14	.03	.01	27	.00055
19.0	16	.03	.01	37	.00067
22.0	19	.03	.01	35	.00055
57.0	49	.05	.03	98	.00060
87.0	74	.04	.03	75	.00030
117.0	100	.05	.03	100	.00030

DATE 7/16/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 29/77.5

DEPTH 30 M DARK ASSIM .02 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.00	8	.00201
5.0	4	.03	.01	29	.00201
7.0	6	.02	.01	12	.00086
10.0	8	.03	.01	19	.00094
17.0	14	.05	.04	76	.00221
19.0	16	.05	.03	57	.00148
22.0	19	.03	.02	34	.00076
57.0	49	.05	.04	73	.00063
87.0	74	.07	.05	100	.00057
117.0	100	.07	.05	96	.00041

DATE 7/19/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 29/77.5

DEPTH 5 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.01	20	.00299
5.0	4	.02	.00	13	.00080
7.0	6	.03	.02	51	.00213
10.0	8	.02	.01	29	.00086
17.0	14	.02	.01	22	.00039
19.0	16	.03	.02	58	.00091
22.0	19	.02	.01	29	.00039
57.0	49	.03	.02	67	.00035
87.0	74	.04	.03	89	.00031
117.0	100	.04	.03	100	.00026

Table 5 (cont.)

DATE 7/18/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 29/77.5

DEPTH 10 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) I	M	MAX	NORMALIZED A/L
2.0	2	.02	.01	19	.00299
5.0	4	.02	.01	19	.00119
7.0	6	.03	.01	47	.00209
10.0	8	.02	.01	32	.00100
17.0	14	.03	.01	45	.00082
19.0	16	.02	.01	19	.00031
22.0	19	.03	.01	40	.00057
57.0	49	.04	.03	96	.00052
87.0	74	.04	.03	94	.00034
117.0	100	.05	.03	100	.00027

DATE 7/19/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 29/77.5

DEPTH 20 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) I	M	MAX	NORMALIZED A/L
2.0	2	.03	.01	27	.00568
5.0	4	.03	.02	42	.00361
7.0	6	.03	.02	47	.00286
10.0	8	.04	.02	53	.00227
17.0	14	.03	.01	34	.00086
19.0	16	.04	.02	50	.00113
22.0	19	.04	.02	48	.00094
57.0	49	.05	.04	86	.00064
87.0	74	.05	.04	91	.00045
117.0	100	.06	.04	100	.00037

DATE 7/19/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 30/77.0

DEPTH 30 M DARK ASSIM .02 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) I	M	MAX	NORMALIZED A/L
2.0	2	.02	.00	4	.00101
5.0	4	.02	.01	10	.00108
7.0	6	.03	.01	20	.00154
10.0	8	.03	.01	18	.00094
17.0	14	.04	.02	39	.00123
19.0	16	.04	.02	35	.00099
22.0	19	.04	.02	35	.00086
57.0	49	.06	.04	70	.00065
87.0	74	.06	.04	78	.00048
117.0	100	.07	.05	100	.00046

Table 5 (cont.)

DATE 7/21/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 30/77.0

DEPTH 5 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.00	10	.00134
5.0	4	.02	.01	28	.00147
7.0	6	.02	.01	23	.00086
10.0	8	.02	.00	10	.00027
17.0	14	.02	.00	18	.00027
19.0	16	.02	.01	23	.00032
22.0	19	.03	.01	56	.00067
57.0	49	.04	.02	90	.00041
87.0	74	.04	.02	85	.00025
117.0	100	.04	.03	100	.00022

DATE 7/21/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 30/77.0

DEPTH 10 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.00	19	.00200
5.0	4	.02	.01	34	.00147
7.0	6	.02	.01	25	.00076
10.0	8	.02	.01	28	.00060
17.0	14.	.02	.01	28	.00035
19.0	16	.02	.00	19	.00021
22.0	19	.02	.00	22	.00021
57.0	49	.03	.01	66	.00025
87.0	74	.03	.02	75	.00018
117.0	100	.03	.02	100	.00018

DATE 7/22/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 30/77.0

DEPTH 20 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.01	32	.00268
5.0	4	.02	.00	20	.00067
7.0	6	.03	.01	68	.00163
10.0	8	.02	.01	32	.00054
17.0	14	.02	.01	48	.00047
19.0	16	.02	.00	16	.00014
22.0	19	.02	.00	12	.00009
57.0	49	.03	.01	72	.00021
87.0	74	.03	.02	100	.00019
117.0	100	.02	.01	60	.00009

Table 5 (cont.)

DATE 7/22/75 STANDARD 7.50 MC/AMP TIME 6.0 HR FFF 31/75.6

DEPTH 30 M DARK ASSIM .02 MG/M3/HR

LIGHT (MF/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.00	1	.00034
5.0	4	.02	.01	12	.00122
7.0	6	.03	.01	20	.00145
10.0	8	.02	.01	18	.00088
17.0	14	.03	.01	26	.00076
19.0	16	.04	.02	39	.00104
22.0	19	.03	.01	30	.00068
57.0	49	.06	.05	91	.00080
87.0	74	.07	.05	100	.00058
117.0	100	.06	.05	93	.00040

DATE 7/25/75 STANDARD 7.50 MC/AMP TIME 6.0 HR FFF 34/75.2

DEPTH 5 M DARK ASSIM .02 MG/M3/HR

LIGHT (MF/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.00	19	.00204
5.0	4	.02	.01	25	.00109
7.0	6	.02	.01	31	.00097
10.0	8	.02	.01	31	.00068
17.0	14	.02	.01	34	.00044
19.0	16	.03	.01	44	.00050
22.0	19	.02	.01	28	.00028
57.0	49	.03	.02	75	.00029
87.0	74	.04	.02	100	.00025
117.0	100	.03	.02	81	.00015

DATE 7/25/75 STANDARD 7.50 MC/AMP TIME 6.0 HR FFF 35/74.8

DEPTH 10 M DARK ASSIM .01 MG/M3/HR

LIGHT (MF/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.00	17	.00171
5.0	4	.02	.00	7	.00027
7.0	6	.02	.00	7	.00020
10.0	8	.02	.00	20	.00041
17.0	14	.03	.02	100	.00121
19.0	16	.02	.00	10	.00011
22.0	19	.02	.00	17	.00016
57.0	49	.02	.01	47	.00017
87.0	74	.03	.01	67	.00016
117.0	100	.03	.02	93	.00016

Table 5 (cont.)

DATE 7/24/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 35/74.8

DEPTH 20 M DARK ASSIM .02 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.00	10	.00138
5.0	4	.02	.00	12	.00069
7.0	6	.02	.01	25	.00108
10.0	8	.02	.01	19	.00055
17.0	14	.02	.00	17	.00028
19.0	16	.02	.01	29	.00044
22.0	19	.02	.01	26	.00034
57.0	49	.04	.02	74	.00038
87.0	74	.04	.03	98	.00033
117.0	100	.05	.03	100	.00025

DATE 7/24/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 35/74.8

DEPTH 30 M DARK ASSIM .02 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.00	6	.00138
5.0	4	.02	.00	0	.00000
7.0	6	.02	.00	8	.00040
10.0	8	.02	.01	17	.00055
17.0	14	.02	.00	10	.00020
19.0	16	.03	.01	33	.00058
22.0	19	.02	.01	17	.00025
57.0	49	.04	.02	71	.00041
87.0	74	.04	.03	77	.00029
117.0	100	.05	.03	100	.00028

DATE 7/27/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 30/77.0

DEPTH 5 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.01	42	.00497
5.0	4	.02	.01	31	.00146
7.0	6	.01	.00	3	.00009
10.0	8	.02	.01	42	.00099
17.0	14	.02	.01	36	.00051
19.0	16	.02	.01	39	.00049
22.0	19	.02	.01	39	.00042
57.0	49	.03	.02	69	.00029
87.0	74	.04	.02	100	.00027
117.0	100	.04	.02	100	.00020

Table 5 (cont.)

DATE 7/28/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 31/76.6

DEPTH 10 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.01	-.00	-5	-.00072
5.0	4	.02	.01	22	.00115
7.0	6	.02	.01	35	.00134
10.0	8	.04	.02	92	.00245
17.0	14	.03	.02	68	.00106
19.0	16	.02	.01	19	.00027
22.0	19	.02	.01	24	.00029
57.0	49	.03	.01	49	.00023
87.0	74	.04	.02	84	.00026
117.0	100	.04	.03	100	.00023

DATE 7/27/75 STANDARD 7.50 MC/AMP TIME 6.0 HR EFF 31/76.6

DEPTH 20 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.01	.00	0	.00000
5.0	4	.02	.00	12	.00081
7.0	6	.02	.00	6	.00029
10.0	8	.02	.01	24	.00081
17.0	14	.03	.01	41	.00079
19.0	16	.02	.01	24	.00043
22.0	19	.03	.01	37	.00055
57.0	49	.04	.02	65	.00038
87.0	74	.05	.03	100	.00038
117.0	100	.04	.03	82	.00023

DATE 7/27/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 31/76.6

DEPTH 30 M DARK ASSIM .02 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.00	7	.00146
5.0	4	.02	.00	7	.00058
7.0	6	.02	.00	9	.00052
10.0	8	.03	.01	24	.00095
17.0	14	.04	.02	54	.00124
19.0	16	.02	.01	20	.00042
22.0	19	.03	.02	41	.00073
57.0	49	.05	.03	87	.00060
87.0	74	.05	.04	91	.00041
117.0	100	.06	.04	100	.00034

Table 5 (cont.)

DATE 7/30/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 23/78.3

DEPTH 5 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.00	6	.00106
5.0	4	.02	.00	14	.00099
7.0	6	.02	.01	16	.00080
10.0	8	.02	.01	18	.00063
17.0	14	.02	.01	28	.00058
19.0	16	.03	.02	46	.00085
22.0	19	.02	.01	26	.00042
57.0	49	.04	.02	60	.00037
87.0	74	.05	.04	100	.00040
117.0	100	.04	.03	84	.00025

DATE 7/30/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 24/78.6

DEPTH 10 M DARK ASSIM .02 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.03	.01	23	.00491
5.0	4	.04	.02	53	.00463
7.0	6	.03	.01	23	.00140
10.0	8	.03	.02	35	.00154
17.0	14	.03	.01	27	.00070
19.0	16	.03	.01	34	.00078
22.0	19	.04	.02	56	.00112
57.0	49	.06	.04	100	.00076
87.0	74	.06	.04	97	.00048
117.0	100	.06	.04	94	.00035

DATE 7/31/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 29/77.5

DEPTH 20 M DARK ASSIM .02 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.00	5	.00180
5.0	4	.03	.01	22	.00288
7.0	6	.02	.01	10	.00093
10.0	8	.02	.01	14	.00094
17.0	14	.03	.01	16	.00064
19.0	16	.02	.01	13	.00046
22.0	19	.04	.03	38	.00115
57.0	49	.06	.05	75	.00087
87.0	74	.08	.07	100	.00076
117.0	100	.07	.06	88	.00050

Table 5 (cont.)

DATE 7/31/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 20/77.5

DEPTH 30 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	M	MAX	NORMALIZED A/L
2.0	2	.02	.01	14	.00399
5.0	4	.03	.01	21	.00247
7.0	6	.02	.01	19	.00155
10.0	8	.03	.02	31	.00181
17.0	14	.03	.02	37	.00128
19.0	16	.03	.02	28	.00088
22.0	19	.05	.04	60	.00162
57.0	49	.06	.04	75	.00078
87.0	74	.07	.06	100	.00068
117.0	100	.06	.05	83	.00042

DATE 8/ 3/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 20/77.5

DEPTH 5 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	M	MAX	NORMALIZED A/L
2.0	2	.02	.00	25	.00213
5.0	4	.01	.00	8	.00028
7.0	6	.01	.00	8	.00020
10.0	8	.02	.00	25	.00043
17.0	14	.02	.01	71	.00071
19.0	16	.02	.00	21	.00019
22.0	19	.02	.00	29	.00023
57.0	49	.03	.01	75	.00022
87.0	74	.03	.02	100	.00020
117.0	100	.03	.02	92	.00013

DATE 8/ 3/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 20/77.5

DEPTH 10 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	M	MAX	NORMALIZED A/L
2.0	2	.02	.01	21	.00284
5.0	4	.02	.00	16	.00085
7.0	6	.02	.00	8	.00030
10.0	8	.02	.01	26	.00071
17.0	14	.02	.01	26	.00042
19.0	16	.03	.01	42	.00060
22.0	19	.02	.01	37	.00045
57.0	49	.04	.02	87	.00041
87.0	74	.04	.02	87	.00027
117.0	100	.04	.03	100	.00023

Table 5 (cont.)

DATE 8/ 2/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 23/76.3

DEPTH 20 M DARK ASSIM .02 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.00	5	.00246
5.0	4	.03	.01	11	.00197
7.0	6	.02	.01	7	.00090
10.0	8	.03	.01	16	.00148
17.0	14	.05	.03	33	.00178
19.0	16	.03	.02	20	.00096
22.0	19	.05	.04	41	.00170
57.0	49	.09	.07	79	.00126
87.0	74	.10	.08	93	.00097
117.0	100	.11	.09	100	.00078

DATE 8/ 2/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 22/78.1

DEPTH 30 M DARK ASSIM .02 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.04	.03	48	.01472
5.0	4	.02	.00	7	.00086
7.0	6	.02	.00	0	.00000
10.0	8	.02	.00	5	.00029
17.0	14	.03	.01	19	.00068
19.0	16	.04	.02	38	.00125
22.0	19	.03	.02	31	.00088
57.0	49	.05	.04	62	.00067
87.0	74	.07	.06	95	.00068
117.0	100	.08	.06	100	.00053

DATE 8/ 6/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 36/74.3

DEPTH 5 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.01	.00	5	.00074
5.0	4	.02	.00	14	.00089
7.0	6	.03	.02	60	.00264
10.0	8	.03	.01	43	.00133
17.0	14	.02	.01	31	.00057
19.0	16	.02	.01	24	.00039
22.0	19	.03	.01	40	.00057
57.0	49	.04	.03	83	.00045
87.0	74	.04	.03	100	.00036
117.0	100	.03	.02	71	.00019

Table 5 (cont.)

DATE 8/ 6/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 21/77.8

DEPTH 10 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.01	11	.00283
5.0	4	.03	.02	32	.00326
7.0	6	.01	.00	5	.00040
10.0	8	.02	.01	15	.00078
17.0	14	.02	.01	23	.00071
19.0	16	.02	.01	21	.00056
22.0	19	.03	.02	32	.00074
57.0	49	.05	.03	66	.00060
87.0	74	.06	.05	100	.00059
117.0	100	.06	.05	100	.00044

DATE 8/ 5/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 20/77.5

DEPTH 20 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.00	2	.00072
5.0	4	.03	.01	18	.00229
7.0	6	.02	.01	8	.00072
10.0	8	.02	.01	15	.00093
17.0	14	.03	.02	27	.00101
19.0	16	.03	.02	24	.00079
22.0	19	.03	.02	31	.00088
57.0	49	.08	.06	98	.00108
87.0	74	.08	.06	100	.00072
117.0	100	.07	.06	94	.00051

DATE 8/ 5/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 20/77.5

DEPTH 30 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.01	9	.00255
5.0	4	.03	.01	22	.00247
7.0	6	.02	.01	13	.00104
10.0	8	.03	.01	26	.00146
17.0	14	.03	.02	29	.00098
19.0	16	.03	.01	22	.00065
22.0	19	.04	.02	40	.00103
57.0	49	.07	.06	100	.00100
87.0	74	.07	.05	94	.00061
117.0	100	.07	.06	97	.00047

Table 5 (cont.)

DATE 8/ 9/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 32/76.1

DEPTH 5 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.00	3	.00145
5.0	4	.02	.00	5	.00087
7.0	6	.02	.01	12	.00155
10.0	8	.03	.01	13	.00123
17.0	14	.03	.02	22	.00124
19.0	16	.04	.02	25	.00130
22.0	19	.05	.03	36	.00155
57.0	49	.06	.05	52	.00085
87.0	74	.11	.09	100	.00107
117.0	100	.11	.09	99	.00079

DATE 8/ 9/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 32/76.1

DEPTH 10 M DARK ASSIM .02 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.03	.02	14	.00796
5.0	4	.03	.02	17	.00376
7.0	6	.03	.01	12	.00197
10.0	8	.04	.03	25	.00282
17.0	14	.05	.04	32	.00213
19.0	16	.05	.03	29	.00168
22.0	19	.05	.04	35	.00178
57.0	49	.09	.08	69	.00136
87.0	74	.11	.10	88	.00112
117.0	100	.13	.11	100	.00095

DATE 8/ 8/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 35/74.8

DEPTH 20 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.03	.01	9	.00590
5.0	4	.03	.02	12	.00324
7.0	6	.04	.02	17	.00326
10.0	8	.03	.02	14	.00192
17.0	14	.04	.03	20	.00160
19.0	16	.04	.02	17	.00116
22.0	19	.07	.05	39	.00238
57.0	49	.14	.12	93	.00217
87.0	74	.13	.11	84	.00129
117.0	100	.15	.13	100	.00114

Table 5 (cont.)

DATE 8/ 8/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 32/76.1

DEPTH 30 M DARK ASSIM .02 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.03	.01	23	.00591
5.0	4	.02	.01	12	.00118
7.0	6	.02	.01	12	.00084
10.0	8	.04	.02	42	.00214
17.0	14	.04	.03	49	.00148
19.0	16	.04	.03	54	.00144
22.0	19	.04	.02	42	.00097
57.0	49	.07	.05	100	.00089
87.0	74	.06	.05	97	.00057
117.0	100	.05	.03	62	.00027

DATE 8/ 7/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 34/75.2

DEPTH 60 M DARK ASSIM .02 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.00	1	.00154
5.0	4	.06	.05	9	.00969
7.0	6	.06	.05	9	.00681
10.0	8	.10	.09	16	.00877
17.0	14	.34	.32	58	.01892
19.0	16	.16	.15	26	.00765
22.0	19	.33	.32	57	.01437
57.0	49	.57	.55	100	.00966
87.0	74	.30	.28	52	.00327
117.0	100	.29	.27	49	.00233

DATE 8/12/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 28/77.9

DEPTH 5 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.01	10	.00284
5.0	4	.02	.01	14	.00170
7.0	6	.02	.01	11	.00091
10.0	8	.03	.01	24	.00142
17.0	14	.04	.02	35	.00121
19.0	16	.04	.03	48	.00149
22.0	19	.04	.02	35	.00094
57.0	49	.07	.06	100	.00105
87.0	74	.07	.06	96	.00066
117.0	100	.07	.06	99	.00050

Table 5 (cont.)

DATE 8/12/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 28/77.9

DEPTH 10 M DARK ASSIM .02 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	M	MAX	NORMALIZED A/L
2.0	2	.03	.01	9	.00355
5.0	4	.03	.01	12	.00185
7.0	6	.03	.01	14	.00162
10.0	8	.03	.01	17	.00135
17.0	14	.05	.03	43	.00205
19.0	16	.04	.02	29	.00123
22.0	19	.05	.03	32	.00116
57.0	49	.08	.06	77	.00108
87.0	74	.09	.07	91	.00084
117.0	100	.10	.08	100	.00069

DATE 8/11/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 29/77.5

DEPTH 20 M DARK ASSIM .02 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	M	MAX	NORMALIZED A/L
2.0	2	.02	.01	7	.00393
5.0	4	.03	.01	13	.00286
7.0	6	.02	.01	7	.00112
10.0	8	.03	.01	12	.00136
17.0	14	.04	.02	22	.00147
19.0	16	.04	.02	17	.00101
22.0	19	.06	.04	36	.00188
57.0	49	.08	.06	56	.00113
87.0	74	.13	.11	100	.00131
117.0	100	.12	.11	93	.00091

DATE 8/11/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 29/77.5

DEPTH 30 M DARK ASSIM .02 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	M	MAX	NORMALIZED A/L
2.0	2	.03	.01	5	.00435
5.0	4	.03	.01	6	.00203
7.0	6	.03	.01	6	.00135
10.0	8	.04	.02	11	.00181
17.0	14	.04	.02	15	.00145
19.0	16	.05	.03	17	.00149
22.0	19	.06	.04	23	.00172
57.0	49	.09	.07	43	.00127
87.0	74	.12	.10	61	.00118
117.0	100	.19	.17	100	.00143

Table 5 (cont.)

DATE 8/15/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 28/77.9

DEPTH 5 M DARK ASSIM .02 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.04	.02	35	.01007
5.0	4	.06	.04	65	.00733
7.0	6	.05	.03	52	.00421
10.0	8	.06	.04	71	.00403
17.0	14	.06	.04	70	.00233
19.0	16	.04	.02	35	.00106
22.0	19	.06	.04	70	.00180
57.0	49	.07	.05	86	.00086
87.0	74	.06	.04	77	.00050
117.0	100	.08	.06	100	.00049

DATE 8/15/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 27/78.4

DEPTH 10 M DARK ASSIM .02 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.04	.02	25	.00751
5.0	4	.03	.01	20	.00243
7.0	6	.03	.01	13	.00112
10.0	8	.03	.01	23	.00136
17.0	14	.04	.02	35	.00122
19.0	16	.03	.01	12	.00038
22.0	19	.04	.02	27	.00075
57.0	49	.06	.04	69	.00073
87.0	74	.08	.06	92	.00063
117.0	100	.08	.06	100	.00051

DATE 8/14/75 STANDARD 6.95 MC/AMP TIME 6.2 HR EFF 27/78.4

DEPTH 20 M DARK ASSIM .02 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.03	.01	11	.00553
5.0	4	.04	.02	18	.00387
7.0	6	.03	.01	12	.00178
10.0	8	.04	.02	20	.00208
17.0	14	.05	.03	28	.00175
19.0	16	.04	.02	24	.00131
22.0	19	.05	.03	27	.00129
57.0	49	.11	.09	83	.00153
87.0	74	.12	.11	100	.00121
117.0	100	.12	.10	95	.00085

Table 5 (cont.)

DATE 8/14/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 28/77.9

DEPTH 30 M DARK ASSIM .02 MG/M3/HR

LIGHT		ASSIM (MGC/M3/HR)			NORMALIZED
(ME/M2/S)	MAX	L	N	MAX	A/L
2.0	2	.03	.01	10	.00683
5.0	4	.03	.01	9	.00244
7.0	6	.04	.02	12	.00236
10.0	8	.06	.04	27	.00374
17.0	14	.06	.04	32	.00254
19.0	16	.06	.04	27	.00197
22.0	19	.07	.05	37	.00229
57.0	49	.13	.10	77	.00184
87.0	74	.14	.11	84	.00131
117.0	100	.16	.14	100	.00117

DATE 8/16/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 34/75.2

DEPTH 60 M DARK ASSIM .02 MG/M3/HR

LIGHT		ASSIM (MGC/M3/HR)			NORMALIZED
(ME/M2/S)	MAX	L	N	MAX	A/L
2.0	2	.09	.07	12	.03616
5.0	4	.26	.25	42	.04908
7.0	6	.20	.18	31	.02572
10.0	8	.61	.59	100	.05886
17.0	14	.32	.30	51	.01774
19.0	16	.31	.29	49	.01527
22.0	19	.35	.33	56	.01497
57.0	49	.44	.42	71	.00734
87.0	74	.48	.46	79	.00531
117.0	100	.42	.40	69	.00345

DATE 8/18/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 33/75.7

DEPTH 5 M DARK ASSIM .01 MG/M3/HR

LIGHT		ASSIM (MGC/M3/HR)			NORMALIZED
(ME/M2/S)	MAX	L	N	MAX	A/L
2.0	2	.02	.01	31	.00538
5.0	4	.02	.01	19	.00135
7.0	6	.02	.01	17	.00086
10.0	8	.03	.02	50	.00175
17.0	14	.04	.02	62	.00127
19.0	16	.03	.01	38	.00071
22.0	19	.03	.02	60	.00095
57.0	49	.05	.03	90	.00055
87.0	74	.05	.03	100	.00040
117.0	100	.05	.03	100	.00030

Table 5 (cont.)

DATE 8/18/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 33/75.7

DEPTH 10 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.03	.01	41	.00605
5.0	4	.03	.02	52	.00309
7.0	6	.02	.01	34	.00144
10.0	8	.03	.02	55	.00161
17.0	14	.03	.02	59	.00103
13.0	16	.03	.01	50	.00078
22.0	19	.04	.02	80	.00107
57.0	49	.04	.02	84	.00044
87.0	74	.04	.03	100	.00034
117.0	100	.04	.03	93	.00024

DATE 8/17/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 35/74.8

DEPTH 20 M DARK ASSIM .02 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.06	.05	65	.02315
5.0	4	.05	.03	49	.00694
7.0	6	.03	.01	17	.00175
10.0	8	.04	.02	28	.00197
17.0	14	.04	.03	36	.00148
19.0	16	.08	.07	94	.00351
22.0	19	.05	.03	47	.00152
57.0	49	.09	.07	100	.00124
87.0	74	.08	.06	84	.00068
117.0	100	.09	.07	98	.00059

DATE 8/17/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 33/75.7

DEPTH 30 M DARK ASSIM .02 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.04	.02	24	.00849
5.0	4	.04	.02	25	.00353
7.0	6	.03	.01	17	.00175
10.0	8	.05	.04	50	.00353
17.0	14	.06	.04	56	.00232
19.0	16	.04	.02	35	.00129
22.0	19	.04	.03	38	.00120
57.0	49	.07	.05	72	.00088
87.0	74	.08	.06	82	.00066
117.0	100	.09	.07	100	.00060

Table 5 (cont.)

DATE 8/20/75 STANDARD 6.95 MC/AMP TIME 6.0 HR EFF 34/75.2

DEPTH 60 M DARK ASSIM .02 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.03	.01	6	.00579
5.0	4	.07	.05	28	.01050
7.0	6	.08	.06	34	.00915
10.0	8	.11	.09	46	.00864
17.0	14	.14	.12	62	.00686
19.0	16	.13	.11	60	.00589
22.0	19	.15	.13	70	.00593
57.0	49	.18	.16	87	.00286
87.0	74	.20	.18	98	.00210
117.0	100	.21	.19	100	.00160

DATE 8/21/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 33/75.7

DEPTH 10 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.01	13	.00436
5.0	4	.03	.02	32	.00429
7.0	6	.04	.03	42	.00402
10.0	8	.05	.03	51	.00349
17.0	14	.04	.03	40	.00158
19.0	16	.03	.01	21	.00074
22.0	19	.04	.03	38	.00116
57.0	49	.06	.05	71	.00085
87.0	74	.08	.07	100	.00078
117.0	100	.07	.06	84	.00049

DATE 8/23/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 32/76.1

DEPTH 60 M DARK ASSIM .02 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.03	.01	3	.00593
5.0	4	.06	.04	12	.00837
7.0	6	.08	.06	17	.00847
10.0	8	.11	.09	27	.00907
17.0	14	.16	.13	39	.00788
19.0	16	.16	.14	41	.00738
22.0	19	.21	.19	55	.00850
57.0	49	.34	.32	92	.00553
87.0	74	.35	.33	96	.00375
117.0	100	.36	.34	100	.00292

Table 5 (cont.)

DATE 8/26/75 STANDARD 7.55 MC/AMP TIME 7.1 HR EFF 31/76.6

DEPTH 10 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.01	32	.00506
5.0	4	.02	.00	11	.00067
7.0	6	.02	.01	18	.00080
10.0	8	.02	.01	26	.00084
17.0	14	.02	.01	33	.00063
19.0	16	.03	.02	60	.00101
22.0	19	.03	.01	42	.00061
57.0	49	.04	.02	75	.00042
87.0	74	.04	.03	86	.00032
117.0	100	.05	.03	100	.00027

DATE 8/27/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 35/74.8

DEPTH 5 M DARK ASSIM .02 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.04	.02	54	.01086
5.0	4	.03	.01	19	.00149
7.0	6	.02	.01	17	.00097
10.0	8	.03	.01	32	.00129
17.0	14	.04	.02	56	.00132
19.0	16	.03	.01	29	.00061
22.0	19	.03	.01	32	.00059
57.0	49	.06	.04	98	.00069
87.0	74	.06	.04	100	.00046
117.0	100	.05	.04	90	.00031

DATE 8/27/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 36/74.3

DEPTH 10 M DARK ASSIM .02 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.03	.01	10	.00512
5.0	4	.03	.01	13	.00259
7.0	6	.03	.01	9	.00127
10.0	8	.03	.01	14	.00143
17.0	14	.04	.03	27	.00157
19.0	16	.05	.03	29	.00151
22.0	19	.07	.05	52	.00239
57.0	49	.08	.06	63	.00110
87.0	74	.12	.10	100	.00115
117.0	100	.11	.10	95	.00082

Table 5 (cont.)

DATE 8/26/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 31/76.6

DEPTH 20 M DARK ASSIM .02 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.05	.03	27	.01524
5.0	4	.05	.03	27	.00610
7.0	6	.04	.02	18	.00293
10.0	8	.05	.03	24	.00272
17.0	14	.07	.05	42	.00277
19.0	16	.03	.01	12	.00073
22.0	19	.07	.05	43	.00223
57.0	49	.12	.10	89	.00177
87.0	74	.13	.11	100	.00130
117.0	100	.12	.10	89	.00087

DATE 8/26/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 31/76.6

DEPTH 30 M DARK ASSIM .02 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.00	0	.00000
7.0	6	.03	.00	11	.00068
10.0	8	.03	.01	19	.00081
17.0	14	.05	.03	66	.00163
19.0	16	.04	.02	37	.00082
22.0	19	.04	.02	50	.00095
57.0	49	.06	.04	97	.00071
87.0	74	.06	.04	94	.00045
117.0	100	.06	.04	100	.00036

DATE 8/30/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 35/74.8

DEPTH 10 M DARK ASSIM .02 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.03	.01	6	.00407
5.0	4	.03	.01	9	.00244
7.0	6	.02	.01	5	.00087
10.0	8	.03	.01	9	.00115
17.0	14	.04	.02	18	.00144
19.0	16	.04	.02	16	.00111
22.0	19	.05	.03	21	.00130
57.0	49	.11	.09	66	.00156
87.0	74	.12	.11	80	.00124
117.0	100	.15	.14	100	.00115

Table 5 (cont.)

DATE 9/ 2/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 21/77.8

DEPTH 10 M DARK ASSIM .02 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.01	6	.00261
5.0	4	.02	.01	10	.00170
7.0	6	.02	.01	10	.00121
10.0	8	.09	.08	86	.00750
17.0	14	.04	.03	29	.00150
19.0	16	.03	.02	17	.00079
22.0	19	.04	.02	23	.00092
57.0	49	.07	.05	61	.00093
87.0	74	.10	.09	100	.00100
117.0	100	.10	.09	99	.00074

DATE 9/ 5/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 15/76.2

DEPTH 5 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.01	.00	0	.00000
5.0	4	.02	.00	2	.00027
7.0	6	.02	.01	7	.00076
10.0	8	.03	.01	13	.00107
17.0	14	.04	.02	29	.00137
19.0	16	.04	.02	27	.00112
22.0	19	.04	.02	31	.00112
57.0	49	.09	.07	93	.00131
87.0	74	.09	.08	94	.00087
117.0	100	.09	.08	100	.00068

DATE 9/ 5/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 15/76.2

DEPTH 10 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.03	.01	13	.00666
5.0	4	.02	.01	11	.00226
7.0	6	.03	.02	15	.00228
10.0	8	.03	.01	14	.00147
17.0	14	.04	.02	24	.00145
19.0	16	.03	.02	21	.00112
22.0	19	.04	.03	28	.00133
57.0	49	.08	.06	61	.00110
87.0	74	.08	.07	63	.00075
117.0	100	.12	.10	100	.00088

Table 5 (cont.)

DATE 9/ 4/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 21/77.8

DEPTH 20 M DARK ASSIM .02 MG/M3/HR

LIGHT		ASSIM (MGC/M3/HR)			NORMALIZED
(ME/M2/S)	MAX	L	N	MAX	A/L
2.0	2	.02	.01	7	.00261
5.0	4	.02	.01	13	.00183
7.0	6	.02	.00	6	.00065
10.0	8	.03	.01	17	.00117
17.0	14	.04	.02	30	.00127
19.0	16	.04	.02	29	.00110
22.0	19	.05	.03	43	.00139
57.0	49	.07	.05	74	.00093
87.0	74	.07	.06	81	.00066
117.0	100	.09	.07	100	.00061

DATE 9/ 4/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 20/77.5

DEPTH 30 M DARK ASSIM .02 MG/M3/HR

LIGHT		ASSIM (MGC/M3/HR)			NORMALIZED
(ME/M2/S)	MAX	L	N	MAX	A/L
2.0	2	.02	.00	2	.00065
5.0	4	.02	.01	13	.00170
7.0	6	.02	.01	13	.00122
10.0	8	.03	.02	29	.00190
17.0	14	.05	.03	47	.00181
19.0	16	.05	.03	46	.00158
22.0	19	.05	.03	52	.00158
57.0	49	.08	.06	98	.00114
87.0	74	.08	.07	100	.00076
117.0	100	.07	.06	87	.00049

DATE 9/ 8/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 16/76.4

DEPTH 10 M DARK ASSIM .01 MG/M3/HR

LIGHT		ASSIM (MGC/M3/HR)			NORMALIZED
(ME/M2/S)	MAX	L	N	MAX	A/L
2.0	2	.02	.00	4	.00199
5.0	4	.02	.01	5	.00106
7.0	6	.02	.01	6	.00095
10.0	8	.03	.01	12	.00126
17.0	14	.04	.02	20	.00129
19.0	16	.05	.03	30	.00171
22.0	19	.05	.03	31	.00151
57.0	49	.09	.08	75	.00142
87.0	74	.12	.11	100	.00124
117.0	100	.11	.10	90	.00083

Table 5 (cont.)

DATE 9/11/75 STANDARD 7.55 MC/AMP TIME 6.0 HR FFF 26/78.8

DEPTH 60 M DARK ASSIM .02 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.01	3	.00374
5.0	4	.05	.03	13	.00598
7.0	6	.05	.04	16	.00525
10.0	8	.09	.07	32	.00707
17.0	14	.09	.07	30	.00400
19.0	16	.09	.07	33	.00387
22.0	19	.24	.22	100	.01017
57.0	49	.17	.15	69	.00270
87.0	74	.16	.14	63	.00163
117.0	100	.19	.17	78	.00149

DATE 9/14/75 STANDARD 7.55 MC/AMP TIME 6.0 HR FFF 15/76.2

DEPTH 5 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.01	8	.00400
5.0	4	.02	.01	12	.00226
7.0	6	.03	.01	13	.00181
10.0	8	.03	.02	19	.00187
17.0	14	.05	.04	38	.00216
19.0	16	.04	.03	30	.00151
22.0	19	.05	.04	40	.00176
57.0	49	.09	.08	80	.00134
87.0	74	.09	.08	82	.00090
117.0	100	.11	.10	100	.00082

DATE 9/14/75 STANDARD 7.55 MC/AMP TIME 6.0 HR FFF 16/76.4

DEPTH 10 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.01	5	.00266
5.0	4	.03	.01	10	.00239
7.0	6	.03	.01	10	.00171
10.0	8	.03	.02	18	.00206
17.0	14	.04	.03	24	.00164
19.0	16	.04	.03	21	.00133
22.0	19	.05	.04	32	.00172
57.0	49	.10	.08	70	.00144
87.0	74	.09	.08	68	.00092
117.0	100	.13	.12	100	.00100

Table 5 (cont.)

DATE 9/13/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 13/75.6

DEPTH 20 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	M	MAX	NORMALIZED A/L
2.0	2	.02	.01	6	.00268
5.0	4	.02	.01	11	.00215
7.0	6	.02	.01	11	.00144
10.0	8	.03	.02	17	.00161
17.0	14	.04	.02	25	.00142
19.0	16	.04	.03	27	.00134
22.0	19	.05	.04	39	.00168
57.0	49	.08	.07	75	.00125
87.0	74	.10	.08	89	.00097
117.0	100	.11	.10	100	.00081

DATE 9/13/75 STANDARD 7.55 MC/AMP TIME 6.0 HR EFF 13/75.6

DEPTH 30 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	M	MAX	NORMALIZED A/L
2.0	2	.02	.01	7	.00369
5.0	4	.03	.01	14	.00282
7.0	6	.03	.01	15	.00211
10.0	8	.04	.03	27	.00262
17.0	14	.06	.04	44	.00253
19.0	16	.05	.03	33	.00173
22.0	19	.06	.05	48	.00213
57.0	49	.09	.08	76	.00132
87.0	74	.11	.10	99	.00112
117.0	100	.11	.10	100	.00084

DATE 9/29/75 STANDARD 6.35 MC/AMP TIME 6.0 HR EFF 23/78.3

DEPTH 5 M DARK ASSIM .02 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	M	MAX	NORMALIZED A/L
2.0	2	.02	.01	6	.00462
5.0	4	.04	.02	14	.00447
7.0	6	.05	.03	21	.00473
10.0	8	.05	.04	24	.00370
17.0	14	.08	.07	45	.00408
19.0	16	.08	.06	40	.00328
22.0	19	.09	.07	46	.00322
57.0	49	.15	.13	85	.00231
87.0	74	.17	.15	100	.00178
117.0	100	.16	.14	93	.00122

Table 5 (cont.)

DATE 9/29/75 STANDARD 6.35 MC/AMP TIME 6.0 HR EFF 23/78.3

DEPTH 10 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.05	.04	31	.02118
5.0	4	.04	.03	22	.00585
7.0	6	.04	.03	22	.00429
10.0	8	.05	.04	31	.00416
17.0	14	.08	.07	51	.00408
19.0	16	.08	.07	49	.00353
22.0	19	.09	.08	61	.00378
57.0	49	.14	.13	98	.00234
87.0	74	.15	.14	100	.00156
117.0	100	.14	.13	99	.00115

DATE 9/28/75 STANDARD 6.35 MC/AMP TIME 6.0 HR EFF 10/74.8

DEPTH 20 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.03	.02	12	.00766
5.0	4	.04	.02	20	.00500
7.0	6	.05	.03	28	.00495
10.0	8	.05	.03	26	.00322
17.0	14	.07	.05	44	.00322
19.0	16	.05	.04	30	.00195
22.0	19	.08	.06	52	.00293
57.0	49	.12	.11	90	.00194
87.0	74	.14	.12	100	.00142
117.0	100	.12	.10	83	.00088

DATE 9/28/75 STANDARD 6.35 MC/AMP TIME 6.0 HR EFF 11/75.1

DEPTH 30 M DARK ASSIM .01 MG/M3/HR

LIGHT (ME/M2/S)	MAX	ASSIM (MGC/M3/HR) L	N	MAX	NORMALIZED A/L
2.0	2	.02	.01	11	.00482
5.0	4	.04	.02	25	.00466
7.0	6	.03	.02	23	.00298
10.0	8	.04	.02	26	.00241
17.0	14	.06	.05	54	.00288
19.0	16	.06	.04	46	.00220
22.0	19	.07	.05	57	.00237
57.0	49	.11	.09	100	.00161
87.0	74	.10	.08	89	.00094
117.0	100	.10	.08	92	.00072

Table 1. Analysis of variance of transformed chlorophyll *a* concentrations pooled into 5-day time cells at 4 depths

Depth	Source	Pooled DF	SS	MS	F
5 m	Between time cells	23	5.574	0.242	12.9*
	Within time cells	51	0.954	0.019	
	Total	74	6.528		
10 m	Between time cells	23	6.153	0.268	14.1*
	Within time cells	53	1.004	0.019	
	Total	76	7.157		
20 m	Between time cells	23	4.539	0.197	13.1*
	Within time cells	53	0.800	0.015	
	Total	76	5.339		
30 m	Between time cells	23	2.591	0.113	8.0*
	Within time cells	51	0.720	0.014	
	Total	74	3.312		

* $P < 0.01$ $F_{0.01}$ $(23,51) \simeq 2.18$ $F_{0.01}$ $(23,53) \simeq 2.15$

Table 2. Analysis of variance of transformed chlorophyll *a* concentrations for 10 replication experiments at 4 depths

		Replication			
Depth	Source	DF	SS	MS	F
5 m	Between days	9	1.280	0.142	106.1*
	Within days	30	0.040	0.001	
	Total	39	1.320		
10 m	Between days	9	1.712	0.190	88.3*
	Within days	30	0.065	0.002	
	Total	39	1.776		
	Between days	9	1.116	0.124	120.1*
	Within days	30	0.031	0.001	
	Total	39	1.147		
30 m	Between days	9	0.531	0.059	35.2*
	Within days	30	0.050	0.002	
	Total	39	0.581		

* $P < 0.01$ $F_{0.01}(9,30) \approx 3.06$

Table 3. Chlorophyll *a* concentrations measured at AIDJEX main camp

CHLOROPHYLL A (MG/M^3) FOR JUNE 1975

DEPTH (M)	2	5	8	11	14	17	20	23	26	29 DAY
3	.09	.10	.09	.08	.05	.07	.03	.04	.03	.02
5	.10	.10	.10	.08	.06	.06	.04	.04	.02	.01
10	.11	.09	.10	.08	.06	.05	.03	.02	.02	.01
15	.11	.11	.09	.09	.06	.07	.03	.03	.02	.01
20	.10	.11	.08	.08	.06	.05	.03	.03	.02	.01
25	.08	.09	.11	.07	.07	.05	.03	.03	.02	.01
30	.09	.10	.08	.07	.06	.04	.03	.02	.02	.01
35	.08	.11	.06	.07	.07	.05	.04	.03	.02	.01
40	.06	.08	.08	.07	.07	.04	.04	.03	.02	.02
45	.06	.08	.09	.08	.06	.05	.05	.03	.03	.02
46				.07		.06				.02
48				.09		.05				.03
50	.07	.10	.08	.07	.06	.06	.06	.03	.03	.03
52				.06		.08				.03
54				.05		.09				.04
56				.05		.11				.04
58				.04		.08				.08
60		.06	.04	.04	.06	.05	.08	.05	.05	.07
62				.04		.06				.05
64				.04		.04				.03
80				.02		.00				.01
100				.00		.00				.00

Table 3. (continued)

CHLOROPHYLL A (MG/M^3) FOR JULY 1975

DEPTH (M)	2	5	8	11	14	17	20	23	26	29 DAY
3	.02	.03	.01	.03	.01	.01	.01	.01	.01	.01
5	.02	.03	.01	.03	.01	.01	.01	.01	.01	.01
10	.01	.02	.01	.03	.01	.01	.01	.01	.01	.02
15	.01	.03	.01	.03	.02	.01	.01	.01	.01	.01
20	.03	.03	.01	.03	.02	.01	.01	.01	.01	.02
25	.03	.03	.01	.04	.02	.01	.02	.02	.01	.03
30	.01	.03	.01	.03	.02	.02	.02	.02	.01	.03
35	.02	.04	.02	.03	.03	.02	.02	.02	.02	.03
40	.04	.04	.04	.03	.03	.03	.03	.02	.02	.03
45	.04	.06	.05	.04	.04	.05	.04	.03	.02	.04
46		.10		.04		.06				.02
48		.11		.06		.07				.02
50	.04	.11	.08	.06	.05	.09	.05	.04	.03	.02
52		.11		.09		.10				.02
54		.13		.09		.10				.04
56		.12		.11		.13				.07
58		.11		.08		.12				.12
60	.11	.11	.12	.09	.08	.12	.14	.26	.19	.13
62		.12		.10		.13				.13
64		.12		.09		.14				.10
80		.03		.04		.05				.07
100		.01		.01		.02				.03

Table 3. (continued)

CHLOROPHYLL A (MG/M^3) FOR AUGUST 1975

DEPTH (M)	1	4	7	10	13	16	19	22	25	28	31 DAY
3	.01	.02	.02	.03	.02	.03	.01	.03	.02	.03	.02
5	.02	.02	.01	.03	.02	.02	.02	.02	.02	.03	.02
10	.01	.01	.01	.04	.02	.03	.01	.02	.02		.02
15	.01	.02	.03	.03	.02	.05	.02	.02	.02	.03	.04
20	.02	.03	.06	.03	.03	.04	.02	.04	.02	.03	.04
25	.03	.02	.04	.04	.03	.04	.02	.04	.03	.03	.03
30	.02	.02	.03	.03	.04	.04	.03	.03	.03	.04	.04
35	.03	.03	.04	.03	.06	.07	.03	.03	.03	.05	.04
40	.04	.04	.04	.04	.09	.05	.05	.04	.05	.05	.06
45	.06	.08	.06	.05	.19	.06	.10	.07	.07	.06	.12
46	.04		.06	.07	.19	.08	.07	.05	.08	.10	.07
48	.07		.05	.10	.14	.07	.10	.09	.08	.12	.09
50	.06	.09	.08	.11	.17	.10	.13	.12	.09	.11	.10
52	.08		.12	.10	.17	.10	.16	.14		.12	.11
54	.07		.12	.10	.14	.11	.16	.14	.12	.10	.18
56	.11		.10	.10	.14	.18	.15	.14	.14	.08	.17
58	.14		.14	.08	.09	.14	.10	.11	.12	.09	.14
60	.17	.20	.16	.09	.08	.13	.08	.11	.12	.11	.14
62	.26		.15	.09	.07	.14	.08	.10	.10	.09	.11
64	.24		.14	.10	.06	.12	.06	.10	.10	.07	.08
80	.05		.08	.06	.04	.06	.04	.04	.04	.05	.05
100	.03		.05	.04	.02	.04	.03	.03	.03	.02	.02

Table 3. (continued)

CHLOROPHYLL A (MG/M) FOR SEPTEMBER 1975

DEPTH (M)	3	6	9	12	15	18	21	24	27	30 DAY
3	.03	.02	.04	.05	.06	.05	.04	.05	.04	.04
5		.03	.05	.05	.04	.06	.05	.05	.04	.04
10	.03	.03	.04	.06	.04	.04	.05	.05	.04	.04
15	.05	.03	.04	.04	.03	.04	.05	.05	.04	.04
20	.05	.02	.04	.04	.04	.02	.05	.05	.04	.04
25	.03	.04	.03	.04	.03	.03	.05	.05	.04	.04
30	.04	.04	.03	.04	.04	.04	.05	.05	.04	.04
35	.04	.04	.04	.04	.05	.04	.05	.06	.04	.04
40	.04	.04	.04	.06	.08	.05	.05	.06	.05	.06
45	.05	.05	.06	.09	.12	.05	.07	.07	.06	.06
46	.05	.06	.06	.10	.08		.07	.08	.06	.06
48	.04	.07	.07	.08	.08		.07	.08	.07	.06
50	.06	.07	.07	.10	.08	.09	.08	.07	.06	.05
52	.10	.08	.08	.12	.08		.08	.06	.05	.05
54	.10	.09	.08	.12	.08		.07	.07	.05	.05
56	.12	.11	.09	.11	.08		.08	.05	.05	.06
58	.11	.12	.10	.11	.08		.07	.05	.05	.04
60	.12	.12	.09	.10	.08	.08	.07	.05	.05	.06
62	.12	.12	.07	.10	.07		.06	.04	.04	.05
64	.12	.11	.08	.09	.06		.06	.04	.03	.04
80	.03	.04	.04	.04	.05		.03	.02	.02	.02
100	.02	.02	.02	.02	.03		.02	.01	.02	.02

Table 1. Numbers of adult females and copepodite stages I-V for *Calanus hyperboreus*, *C. glacialis*, and *Euchaeta glacialis* as sampled by 150-0 m net hauls 8 times during summer 1975

	June		July		August	September		
Stage \ Date	7	24	12	30	17	4	13	28
				Calanus hyperboreus				
Females	20	54	71	73	20	35	54	26
V	39	44	47	47	7	34	43	14
IV	22	16	3	14	23	42	48	57
III	0	0	0	0	43	319	371	138
II	0	0	0	0	115	32	8	0
I	0	0	0	0	5	0	0	0
				Calanus glacialis				
Females	7	16	63	40	24	7	17	17
V	1	7	10	13	6	6	9	8
IV	1	1	0	0	0	0	0	0
III	0	0	0	1	1	2	4	19
II	0	0	0	0	30	24	17	17
I	0	0	43	25	67	7	27	11
				Euchaeta glacialis				
Females	0	0	2	5	3	2	5	3
V	0	3	6	8	9	5	7	5
IV	2	1	0	0	2	3	6	3
III	0	3	15	65	39	8	8	2
II	21	13	12	2	1	2	2	1
I	0	0	0	0	0	0	0	0

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ICHTHYOPLANKTON OF THE EASTERN BERING SEA

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I. SUMMARY OF OBJECTIVES, CONCLUSIONS AND IMPLICATIONS WITH RESPECT TO OCS OIL AND GAS DEVELOPMENT

The objective of RU-380, as set forth in our work statement, was to conduct a preliminary, present-day assessment of the pollock eggs and larvae in a portion of the Bering Sea during spring of 1976.

Briefly, the assessment showed that pollock eggs and larvae were present in an area generally between the 75 to 1,000 m isobaths along the outer edge of the continental shelf and the continental slope from the Alaska Peninsula to as far northward as sampling was conducted, about 268 km (145 nautical miles) northwest of the Pribilof Islands. Within this area, eggs and larvae were most abundant between the Alaska Peninsula and the Pribilof Islands, though the peak abundance of eggs and of larvae did not occur at the same station.

With respect to vertical distribution, pollock eggs were much more abundant in the upper one meter of the water than below that depth. However, larvae were taken at more stations and in greater numbers below the upper one meter of the water column. Larvae and eggs of 14 other families were caught and these could be identified as belonging to 19 genera or species plus 19 unnamed types given arbitrary letter designations within the families.

The implications of this assessment with respect to oil and gas development are that environmental changes or catastrophes caused by such activity in the area between the Alaska Peninsula and the Pribilof Islands, and occurring during spring, would be potentially damaging to a major part of the pollock eggs and larvae in the eastern Bering Sea. Environmental changes limited to the surface layer would be most damaging to pollock eggs, and changes extending to deeper layers would have a greater effect on pollock larvae.

II. INTRODUCTION

A. General Nature and Scope of Study

The general scope of this survey, conducted by the Northwest and Alaska Fisheries Center (NWAFC), was to identify critical regions inhabited by eggs and larvae of commercially valuable fish in the eastern Bering Sea. Because of limited allocations of vessel time and money, the study could be of only limited scope and restricted to study of a single species during a single time period; thus, only limited results could be expected, and it is not possible to extrapolate the data to other species or time periods.

B. Specific Objective

The specific objective of this study was to conduct a preliminary present-day assessment of the pollock eggs and larvae in a portion of the southeastern Bering Sea during the spring of 1976.

C. Relevance to Problems of Petroleum Development

Pollock constitute the largest commercial fishery in the eastern Bering Sea, roughly 90% of the fish catch. Limited historical data (Musienko, 1963; Serobaba, 1968) indicate that the major spawning ground of this species largely overlaps the St. George Basin, one of the important areas to be considered in the development of petroleum resources of the Bering Sea. Since egg and larval stages of fish may be damaged by changes in the environment caused by petroleum developmental activities, it was felt essential to assess this part of the biota.

III. CURRENT STATE OF KNOWLEDGE

Information concerning ichthyoplankton in the Bering Sea is sparse, and based mainly on investigations carried out by Soviet and Japanese scientists.

Until inception of the Outer Continental Shelf Environmental Assessment Program (OCSEAP) there were very few investigations of ichthyoplankton in the eastern Bering Sea by marine biologists of the United States. In some instances, if not in most, analyses of collections made by U.S. scientists have not typically resulted in scientific publications, but generally have been summarized in the form of "in-house" processed reports that have limited distribution.

Publications concerning many of the collections made by Japanese fishery scientists are in the form of station and cruise summaries with a listing of eggs and larvae captured at various locations (Faculty of Fisheries, Hokkaido University, 1957-1970). Most of these reports cover collections made only during the summer. Kashkina (1970) included much of the above Japanese data in a report on the distribution of fish eggs and larvae in the Bering Sea during the summer season.

In addition to Kashkina (1970), Soviet scientists have published other articles concerned specifically with distribution and abundance of eggs and larvae of particular species or families of fish (pollock - Serobaba 1968, 1971, 1974; yellowfin sole - Fadeev 1970; Kashkina 1965b). There are only two available reports by U.S. scientists concerning ichthyoplankton in the Bering Sea, one by Aron (1960) and the other an unpublished "in-house" report by Dunn and Naplin(1973) reporting on collections made in 1971. These reports show that pollock spawn during the spring, generally from about March to June, in an area of the outer continental shelf or upper continental slope, with the greatest concentrations of eggs and larvae close to Unimak Pass. Some of the reports do not clearly indicate the methods used in making collections nor the methods and units used to standardize actual numbers collected, and interpretation of these results is difficult or impossible.

IV. STUDY AREA

The area within which the study was conducted was south of latitude 60°N extending close to the Alaska Peninsula, and from the eastern part of Bristol Bay in the vicinity of longitude 159°W extending westward to about the 200 m depth contour. Figure 1 shows the total area included in the survey, the station pattern, and order in which the stations were occupied, and Table 1 lists pertinent station data.

V. SOURCES, METHODS AND RATIONALE OF DATA COLLECTION

A. Station Pattern

Collection of plankton was not a primary mission during either of the two portions of this survey, and so station position and order of occupancy were dictated by the needs of other projects. The station pattern was that used for a survey of benthic organisms, RU-303. Order of occupancy was controlled by the schedule of a demersal fish survey conducted between 25 April and 12 May 1976, and by the requirements of the benthic survey between 18 to 31 May 1976. During both periods an additional constraint controlling order of occupancy was the presence of ice. Certain areas which were covered by ice during one time period would be free of ice at a later time and accessible to sampling. As a result of these factors, order of occupancy was quite haphazard and adjacent stations were separated in time by as much as 27 days (station 6 on 2 May and station 48 on 29 May; distance about 56 km). This was an extreme example but many stations were separated by as much as a week from the closest adjacent station. Because of this, interpretation of results is more difficult than if station occupancy had been more orderly.

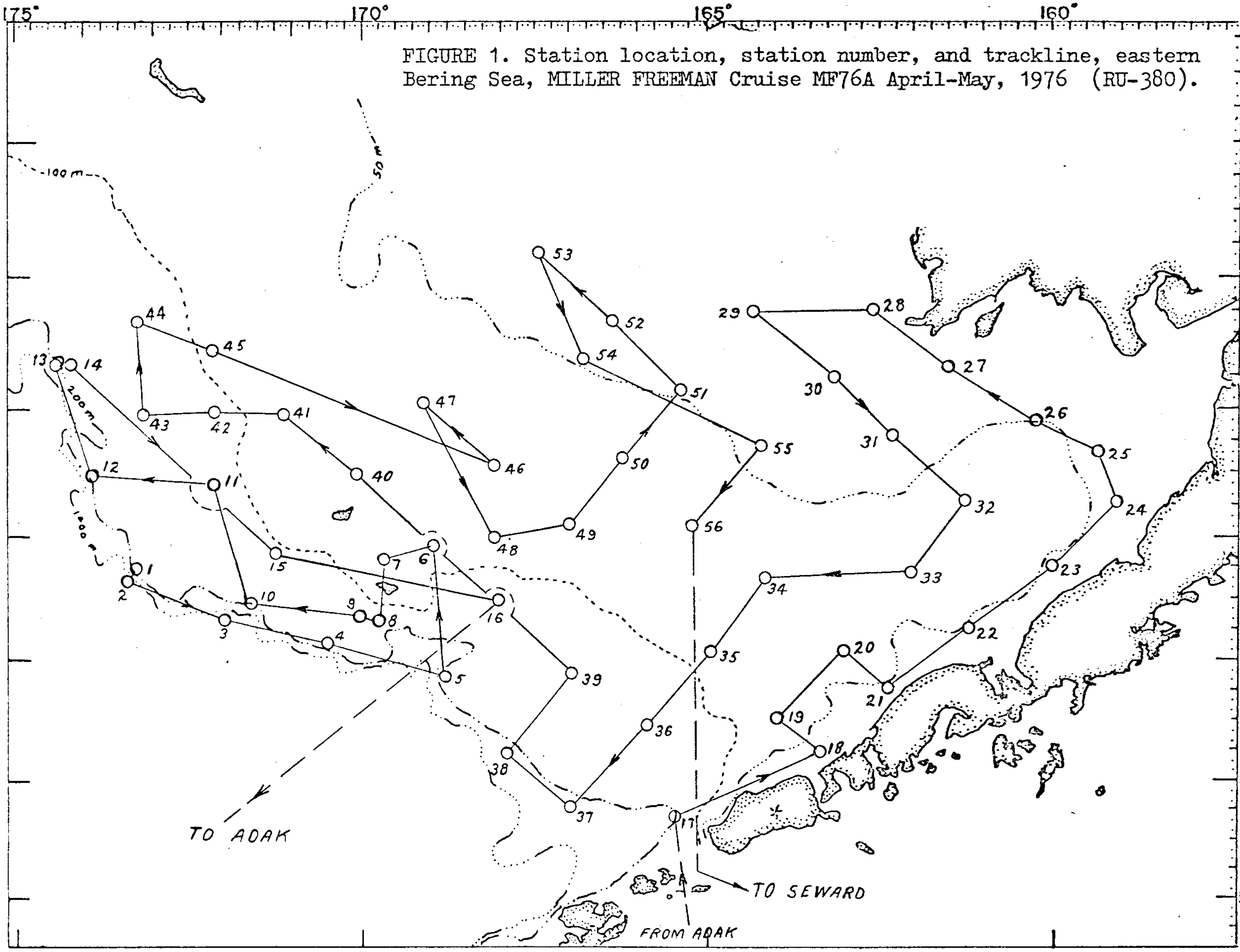

FIGURE 1. Station location, station number, and trackline, eastern Bering Sea, MILLER FREEMAN Cruise MF76A April-May, 1976 (RU-380).

TABLE 1

STATION DATA FROM CRUISE MF 76A, MILLER FREEMAN, 26 April-31 May, 1976

Sta. No.	Position Lat. N. ° '		Long. W. ° '		Day/Time[1/]	Temperature[2/] Surf.	Bot.	Depth (m) Bot.	Net	SHF(A)[3/]	SHF(B)[4/]
						APRIL, 1976					
1	56	44.8	173	16.0	26/2333	0.5	2.2	148	139	6.079	4.361
2	56	41.0	173	19.0	27/0102	1.1	3.7	450+	213	5.916	2.772
3	56	21.2	171	57.3	27/2146	2.8	3.6	450	206	5.508	2.671
4	56	07.8	170	23.2	29/1043	1.3	2.2	139	97	4.113	4.245
						MAY, 1976					
5	55	52.3	168	44.9	01/1106	2.2	3.0	154	134	4.720	3.528
6	56	58.1	168	59.2	02/0830	0.0	3.0	85	64	4.009	6.294
7	56	49.7	169	39.0	04/1007	-0.3	-0.4	73	65	4.501	6.903
8	56	21.0	169	40.0	05/0857	1.4	3.6	155	127	4.807	3.776
9	56	25.3	169	56.8	05/1205	0.8	3.0	106	88	4.637	5.275
10	56	29.8	171	34.1	06/1327	0.8	3.0	154	120	4.822	4.029
11	57	25.0	172	04.9	07/0830	1.7	1.7	115	106	4.112	3.897
12	57	30.3	173	50.4	08/0954	0.0	1.9	140	123	5.012	4.085
13	58	18.3	174	19.0	09/0728	2.0	2.5	154	133	4.741	3.565
14	58	20.3	174	09.8	09/1000	1.9	2.0	137	106	5.104	4.815
15	56	55.3	170	56.2	11/0142	0.0	0.3	110	93	4.255	4.580
16	56	31.2	167	55.0	12/0851	0.7	3.3	117	96	5.171	5.381
17	54	42.3	165	25.9	20/0724	3.0	3.4	220	146	5.867	4.024
18	55	16.9	163	20.3	20/1445	1.6	1.8	46	34	5.000	14.618
19	55	31.6	163	55.3	20/1817	2.4	1.9	90	85	5.254	6.188
20	56	08.5	162	55.6	21/0140	0.5	-0.3	85	66	6.100	9.260
21	55	49.6	162	20.3	21/0443	1.4	0.8	46	34	5.529	16.504
22	56	16.8	161	02.3	21/1237	0.4	0.6	54	32	4.443	13.886
23	56	44.9	159	56.2	21/2213	1.0	-0.5	51	35	3.813	10.958
24	57	20.3	158	58.9	22/0511	-0.7	-0.4	48	26	4.506	17.467
25	57	40.6	159	13.7	22/1317			49	42	5.438	13.073
26	57	55.3	160	07.9	22/1709	0.3	0.5	55	35	4.253	12.327
27	58	20.5	161	22.5	22/2230	2.0	1.9	35	27	5.014	18.299
28	58	45.5	162	29.1	23/0336	0.6	0.7	46	35	7.012	20.191
29	58	46.1	164	14.7	23/0903	0.3	1.6	37	27	4.849	18.299
30	58	17.0	163	12.7	23/1347	0.3	0.3	38	36	7.328	20.597
31	57	49.3	162	13.9	23/1936	1.3	1.6	46	32	4.594	14.268
32	57	18.2	161	07.4	24/0109	0.2	-0.9	66	60	8.255	13.841
33	56	44.4	161	59.1	24/0648	4.0	-1.3	71	55	6.213	11.275
34	56	41.8	164	00.3	25/0045	0.8	-1.2	78	66	6.102	9.274
35	56	05.1	164	52.6	25/0553	1.5	-0.1	97	74	5.678	7.725

Sta. No.	Position Lat. N. ° '		Long W. ° '		Day/Time[1/]	Temperature[2/] Surf.	Bot.	Depth (m) Bot.	Net	SHF(A)[3/]	SHF(B)[4/]
					MAY, 1976 (Cont'd)						
36	55	29.0	165	50.8	25/1110			122	61	4.458	7.297
37	54	52.0	166	50.3	25/1652	3.3	3.3	197	172	6.093	3.545
38	55	20.3	167	47.5	25/2217	3.6	3.1	172	141	7.064	5.016
39	55	57.9	166	52.9	26/0342	3.9		135	115	6.884	5.973
40	57	29.0	170	00.0	27/0128	0.2	1.0	68	58	6.751	11.640
41	57	59.8	171	09.0	27/0746	-0.4	-0.5	90	76	6.195	8.108
42	57	59.4	172	02.5	27/1318	0.8	0.7	107	100	7.083	7.060
43	57	56.7	173	04.5	27/1715	1.0	1.6	115	93	5.707	6.143
44	58	40.6	173	08.0	28/0133	0.4	1.5	117	107	6.210	5.825
45	58	27.2	172	07.4	28/0626	0.5	0.5	104	87	6.998	8.057
46	57	34.6	168	01.1	28/2133	1.4	-1.9	73	63	5.178	8.232
47	58	04.6	169	03.3	29/0329	0.7	-1.1	73	62	5.777	9.287
48	57	00.5	168	02.1	29/1147	0.8	-0.2	82	64	5.890	9.260
49	57	06.5	166	57.9	29/1656	0.7	-1.4	77	65	6.376	9.778
50	57	39.3	166	06.8	29/2221	0.2	-1.2	68	61	5.564	9.182
51	58	07.9	165	15.8	30/0323	0.2	0.0	48	43	6.015	14.021
52	58	40.6	166	16.0	30/0825	0.1	0.2	41	38	7.052	18.803
53	59	10.8	167	20.9	30/1353	0.4	1.5	40	36	6.303	17.650
54	58	25.5	166	44.8	30/2218	0.2	0.3	48	41	4.367	10.757
55	57	43.8	164	10.5	31/1017	0.3	-0.1	52	47	5.555	11.746
56	57	09.1	165	06.1	31/1814	0.5	-0.3	71	66	6.552	9.996

1/ Day and time GMT

2/ Degrees C

3/ SHF(A) converts actual catch to numbers beneath 10 square meters of sea surface. (SHF = Standard Haul Factor; sampling depth 200 m or less)

4/ SHF(B) converts actual catch to numbers per 1000 cubic meters of water.

B. Nets and Collecting Methods

Plankton was collected following general procedures established by the National Marine Fisheries Service MARMAP Field Group for use of bongo and neuston nets. Minor modifications were made in equipment specifications and towing procedures.

Two types of samples were collected, (A) an integrated tow from the surface to near bottom, or to 200 m in deep water, using bongo nets, and (B) a surface sample from the upper 0.25 m by means of a neuston net.

Bongo net frames, constructed of aluminum, were 60 cm inside diameter rather than 61 cm as suggested by MARMAP. One net was constructed of 0.505 mm mesh (=505-bongo) and the other of 0.333 mm mesh (=333-bongo). Both had a 1:10 mouth area to open mesh area ratio, somewhat larger than that used for standard MARMAP tows, and this was done to permit more efficient filtering of water with a high phytoplankton content. Cod ends were socks attached by the method described by Kramer et al., (1972, p.9). A close estimate of volume of water filtered was obtained by means of a hydrodynamically shaped, calibrated, mechanical flowmeter with digital read-out mounted in the center of the mouth of each net.

During the tow, depressing force was provided by a spherical weight, a 10-inch metal trawl net float filled with lead to a weight of 45.4 kg.

The neuston net, of MARMAP design, was a simple pipe frame 1.0 x 0.5 m inside dimensions constructed of 3.2 cm i.d. aluminum pipe with a simple cylindro-conical net with 0.47 mm mesh laced to the frame. The collection sock was similar to that described for the bongo net.

Wire angle was measured with a telemetering inclinometer having one indicator visible to the tow observer on deck and a second indicator in the wheelhouse visible to the helmsman. The wheelhouse indicator showed only deviation from a zero point which was set to correspond to a wire angle of 45°, and this permitted maintenance of the desired wire angle through close control of the vessel speed.

Bongo nets were towed over a double oblique path from the surface to within about 5 m of bottom or a maximum of 200 m depth. Desired ship speed during tows was 2.0 knots, but actual speed probably varied between 1.5 and 2.5 knots because there was no means of accurately measuring speed.

With the vessel underway at about 2.0 knots, the bongo array was lowered to the desired depth at a rate of 50 m of wire per minute, held at that depth for 30 seconds to permit stabilization of the nets and the wire angle, and then retrieved at a rate of 20 meters of wire per minute. During retrieval wire angle was maintained as closely as possible to 45° by close control of vessel speed. After the nets were out of the water they were rinsed thoroughly to concentrate the catch in the sock and the plankton was preserved in 5% formalin buffered with sodium tetraborate (50 ml 100% formalin, 20 ml saturated sodium tetraborate in a 1 quart jar of plankton). The neuston net was lowered to the surface of the water while the vessel was underway at about 1.5 knots and enough wire paid out so that the net frame was submersed about one-half its depth, i.e. about 0.25 m. In order to position the net away from the side of the vessel it was usually necessary to make a slow turn to starboard, the side from which the net was towed. Duration of tow was 10 minutes after the net frame reached the desired depth. Collections were handled in the same manner as were the bongo collections.

An XBT was dropped at each station and the surface and bottom temperatures were read from the trace.

C. Standardization

Procedures used to standardize data were adapted from those used in the California Cooperative Oceanic Fisheries Investigations (Kramer et al., 1972).

Standardization of catches was based upon two different measures, (A) numbers per standard volume per meter of depth sampled, usually referred to as numbers per unit surface area, and (B) numbers per standard volume.

When sampling encompasses the vertical distribution of eggs and larvae in water column, then numbers per unit of water strained per unit of depth sampled will give a better representation of total numbers present than will numbers per unit volume. This method, which derives a Standard Haul Factor (SHF), was used to describe abundance of eggs and larvae caught with the 505-bongo net. The computations are described by Kramer et al., (1972, p. 31). In this study, catch was adjusted to number per 10 square meters surface area (No./10 m^2).

The above method could not be used to compare bongo and neuston catches because neuston nets do not sample the entire vertical distribution of eggs and larvae. In order to compare catches from these two different nets, the catch was adjusted to number per 1000 cubic meters of water. Kramer et al., (1972, p. 35) gives the procedure for nets equipped with flowmeters (as were the bongo nets used in this survey). The neuston net was not equipped with a flowmeter so the following assumptions were made in order to estimate the volume of water strained during a tow:

1. Vessel speed on all tows was 1.5 knots or 46.2 m/minute;
2. The net mouth was submerged to a depth of 0.25 m giving a cross-sectional mouth area of 0.25 m^2.

With these assumptions the net filtered a calculated 115 m^3 per 10-minute tow.

D. Sorting and Identification

Measurement of volume of plankton, identification and counting of major taxa of non-fish zooplankton, and removal of fish eggs and fish larvae from samples, were done through a contract with Texas Instruments, Inc. of Dallas, Texas. Before shipment to the contractor 15 samples, or about 10% of the total, were sorted for fish eggs and larvae at the NWAFC, the eggs and larvae counted, and then returned to their respective samples. These pre-sorted samples then provided an independent measure of quality control and served as a means of evaluating thoroughness of sorting by the contractor. After receiving results from an initial sorting, discrepancies were found in the analyses of control samples previously sorted at NWAFC. As a consequence the contractor employed higher magnification than had been used during the initial sorting and resorted all 505-Bongo and neuston net samples. These counts resulted in agreement with the pre-sorted control samples.

E. Identification

Fish eggs and larvae were identified by ichthyoplanktologists at the NWAFC. About 99% of the actual catch of larvae was identified to at least the family level, 74% to genus, and 68% to species. The 1% which could not be identified to family consisted mainly of badly damaged specimens. Identification of eggs was somewhat simplified by the fact that many species of fish with planktonic larvae have demersal eggs (e.g., Cottidae) so there were fewer types of eggs than of larvae. About 92% of the total actual catch of eggs was identified to species with the remaining 8% made up of 1 genus, 4 unidentified types, and some damaged eggs which were not assigned to either a species genus or a type.

F. Definitions

Length of specimens is standard length, measured from anterior margin of the snout to tip of the notocord, or to the posterior margin of the hypural in larger specimens.

Volume of plankton is the displacement volume as described in Kramer et al., (1972).

Common and scientific names of fish mentioned in this report are listed in Table 2 , and are those recommended by the American Fisheries Society (Bailey et al., 1970).

VI. RESULTS

During the survey, samples were collected at 56 stations (Figure 1) with three samples collected at each station, viz. a neuston net sample, a 505-bongo net sample and a 333-bongo net sample, or a total of 168 samples. Fish eggs and fish larvae were sorted and identified from 112 of these, the neuston and the 505-bongo samples. Combined actual catches of larvae totaled 2,939 of which 2,347 (80%) were caught in the bongo net and 592 (20%) in the neuston net. Of 43,288 eggs collected, 35,688 (82%) were caught in the neuston net and 7,600 (18%) in the 505-bongo net. Fish eggs were present in all neuston collections (2 to 10,655 per sample), but only 54 (96%) of the 505-bongo samples (1 to 2454 per sample). Larvae were present in 29 (52%) of the neuston samples (1 to 68 per sample) and in 44 (79%) of the 505-bongo samples (1 to 202 per sample).

Larvae from 15 familes were identified in the combined bongo and neuston catches. All of these familes were present in the 505-bongo collections, but only 9 of the families were found in the neuston samples. Within the 15 families, 19 genera or species were identified, with an additional 19 types assigned a letter designation within the family. Further study may permit

TABLE 2 LIST OF SCIENTIFIC AND COMMON NAMES

CLUPEIDAE	
Clupea harengus pallasi	Pacific Herring
OSMERIDAE	Smelts
Mallotus villosus	Capelin
BATHYLAGIDAE	Deepsea Smelt
Bathylagus pacificus	Slender Blacksmelt
Bathylagus schmidti	Northern Smoothtongue
MYCTOPHIDAE	Lanternfishes
Protomyctophum thompsoni	Bigeye Lanternfish
GADIDAE	Codfishes
Gadus macrocephalus	Pacific Cod
Theragra chalcogramma	Walleye Pollock or Pollock
ZOARCIDAE	Eelpouts
SCORPAENIDAE	Scorpionfishes
Sebastes sp.	Rockfishes
HEXAGRAMMIDAE	Greenlings
Hexagrammos sp.	Greenling
Pleurogrammus monopterygius	Atka Mackerel
COTTIDAE	Sculpins
Hemilepidotus sp.	Irish Lords
Triglops sp.	Ribbed Sculpins
AGONIDAE	Poachers
CYCLOPTERIDAE	Lumpfishes, Snailfishes
BATHYMASTERIDAE	Ronquils
Ronquilus jordani	Northern Ronquil
STICHAEIDAE	Pricklebacks
Lumpenus maculatus	Daubed Shanny
PHOLIDAE	Gunnels
AMMODYTIDAE	Sand Lances
Ammodytes hexapterus	Pacific Sand Lance
PLEURONECTIDAE 1/	Righteye Flounders
Atheresthes	Arrowtooth Flounders
Atheresthes evermanni	Kamchatka Flounder
Atheresthes stomias	Arrowtooth Flounder

TABLE 2 (con't)

Hippoglossoides	Flathead Soles
Hippoglossoides elassodon	Flathead Sole
Hippoglossoides robustus	Bering Flounder
Hippoglossus stenolepis	Pacific Halibut
Limanda aspera	Yellowfin Sole
Pleuronectes quadrituberculatus	Alaska Plaice or Plaice
Reinhardtius hippoglossoides	Greenland Halibut

1/ For convenience in this report, the genus Atheresthes will be referred to as arrowtooth flounders, and the genus Hippoglossoides as flathead soles.

assigning at least a type designation to larvae in the family Cyclopteridae.

Eggs of 2 species and 1 genus were identified in the combined neuston and 505-bongo catches, as well as 4 arbitrary types.

Actual catch, standardized catch, and percent composition for each net by species or type are shown in Table 3 for both larvae and eggs. In the combined neuston and 505-bongo catches 8 families made up 98% of the larvae, with 53% contributed by a single species, the walleye pollock. Eggs of 2 families made up 95% of the total actual catch, and eggs of walleye pollock accounted for 75% of the total.

Surface water temperature (Figure 2) ranged from -0.7 to +3.9°C., and bottom temperature (Figure 3) from -1.9 to +3.7°C. The warmer temperatures were in the area between Unimak Island and the Pribilof Islands.

VII. DISCUSSION

Three families--cod, flounders, and salmon support the major commercial fisheries for fin-fish in the eastern Bering Sea, and because salmon are anadromous, their larvae or fry are seldom taken in the course of plankton sampling in the open ocean. Cod and flounders are thus the two most commercially valuable marine fish in the Bering Sea. Larvae of cod and flounders together accounted numerically for 65% of the 505-bongo and 29% of the neuston catches, whereas eggs of these two families accounted for 97% of the 505-bongo and 95% of the neuston catches.

A. Walleye Pollock

Walleye pollock, provided 53% of all larvae and 75% of the eggs taken in the combined catch of the two nets. Pollock larvae were found only over the outer continental shelf where water depth was greater than 68 meters, none was captured inshore of this isobath (Figures 4 and 5). In bongo catches, centers of abundance were found in two

TABLE 3

ICHTHYOPLANKTON, EASTERN BERING SEA, APRIL-MAY, 1976, CATCH BY TAXA

TAXA 1/	505-BONGO NET			NEUSTON NET		
	Actual No.	No./10 m^2	% 2/	Actual No.	No./1000 m^3	% 2/
LARVAE						
OSMERIDAE (3)						
Mallotus villosus	2	10	0.1	0		
Unidentified Species	1	5	+	0		
BATHYLAGIDAE (18)						
Bathylagus pacificus	15	81	0.7	0		
Bathylagus schmidti	3	16	0.1	0		
MYCTOPHIDAE (1)						
Protomyctophum thompsoni	1	5	+	0		
GADIDAE (1,596)						
Gadus macrocephalus	3	17	0.1	1	9	0.2
Theragra chalcogramma	1,416	7,485	61.2	133	1,157	22.5
Unidentified Species	4	20	0.2	39	339	6.6
ZOARCIDAE (1)						
Zoarcidae A	1	7	0.1	0		
SCORPAENIDAE (68)						
Sebastes sp.	54	315	2.6	14	122	2.4
HEXAGRAMMIDAE (61)						
Hexagrammos sp.	3	17	0.1	54	470	9.1
Pleurogrammus monopterygius	0			2	17	0.3
Unidentified Species	0			2	17	0.3
COTTIDAE (511)						
Hemilepidotus sp.	3	18	0.1	3	26	0.5
Triglops sp.	4	20	0.2	1	9	0.2
Cottidae A	13	63	0.5	0		
Cottidae B	185	1,041	8.5	288	2,504	48.6
Cottidae C	1	4	+	0		
Cottidae D	1	5	+	0		
Cottidae E	3	13	0.1	0		
Cottidae F	2	12	0.1	0		
Cottidae G	0			1	9	0.2
Cottidae H	1	6	+	0		
Cottidae J	2	10	0.1	0		
Cottidae K	1	5	+	0		
Unidentified Species	2	9	0.1	1	9	0.2

TABLE 3 (con't)

ICHTHYOPLANKTON, EASTERN BERING SEA, APRIL-MAY, 1976, CATCH BY TAXA

TAXA 1/	505-BONGO NET			NEUSTON NET		
	Actual No.	No./10 m^2	% 2/	Actual No.	No./1000 m^3	% 2/
LARVAE (con't)						
AGONIDAE (9)						
Agonidae A	5	27	0.2	0		
Agonidae B	2	12	0.1	0		
Agonidae C	2	11	0.1	0		
CYCLOPTERIDAE (149)						
Unidentified Species	148	678	5.6	1	9	0.2
BATHYMASTERIDAE (8)						
Ronquilus jordani	0			2	17	0.3
Bathymasteridae A	3	18	0.2	3	26	0.5
STICHAEIDAE (149)						
Lumpenus maculatus	135	682	5.6	2	17	0.3
Stichaeidae A	8	38	0.3	3	26	0.5
Stichaeidae B	1	5	+	0		
PHOLIDAE (3)						
Pholidae A	1	5	+	0		
Pholidae B	2	10	0.1	0		
AMMODYTIDAE (246)						
Ammodytes hexapterus	218	1,029	8.4	28	244	4.7
PLEURONECTIDAE (94)						
Atheresthes sp.	44	227	1.9	2	17	0.3
Hippoglossus stenolepis	3	16	0.1	0		
Reinhardtius hippoglossoides	39	204	1.7	0		
Unidentified Species	6	34	0.3	0		
TELEOSTEI (21)						
Unidentified Species	9	44	0.4	12	104	2.0
TOTAL LARVAE (2,939)	2,347	12,224		592	5,131	

TABLE 3 (con't)

ICHTHYOPLANKTON, EASTERN BERING SEA, APRIL-MAY, 1976, CATCH BY TAXA

TAXA 1/	505-BONGO NET			NEUSTON NET		
	Actual No.	No./ 10 m^2	% 2/	Actual No.	No./ 1000 m^3	% 2/
EGGS						
GADIDAE (32,445)						
Theragra chalcogramma	6,326	36,089	71.3	26,119	227,240	73.4
PLEURONECTIDAE (8,666)						
Hippoglossoides sp.	146	1,104	2.2	1,355	11,787	3.8
Pleuronectes quadrituberculatus	912	10,202	20.2	6,253	54,403	17.3
TELEOSTEI (2,177)						
Teleostei E	18	204	0.4	90	810	0.3
Teleostei F	164	2,808	5.5	1,468	12,972	4.2
Teleostei I	0			1	9	+
Teleostei L	0			2	17	+
Teleostei Not Typed	34	208	0.4	400	3,793	1.1
TOTAL EGGS (43,288)	7,600	50,615		35,688	311,031	

1/ Number in parenthesis after each family name is the combined actual catch for both nets.

2/ The symbol + indicates a percentage less than 0.05.

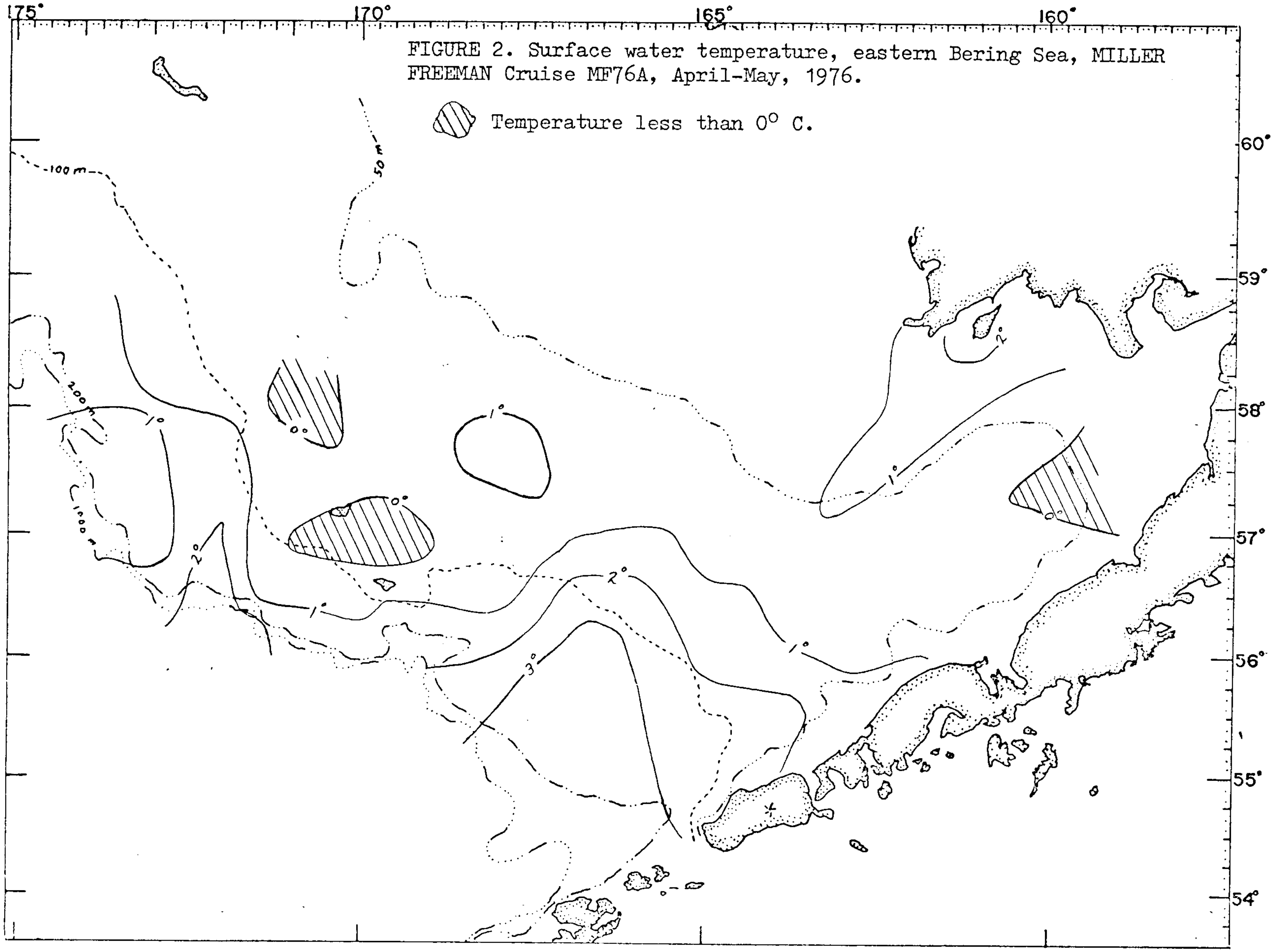

FIGURE 2. Surface water temperature, eastern Bering Sea, MILLER FREEMAN Cruise MF76A, April-May, 1976.

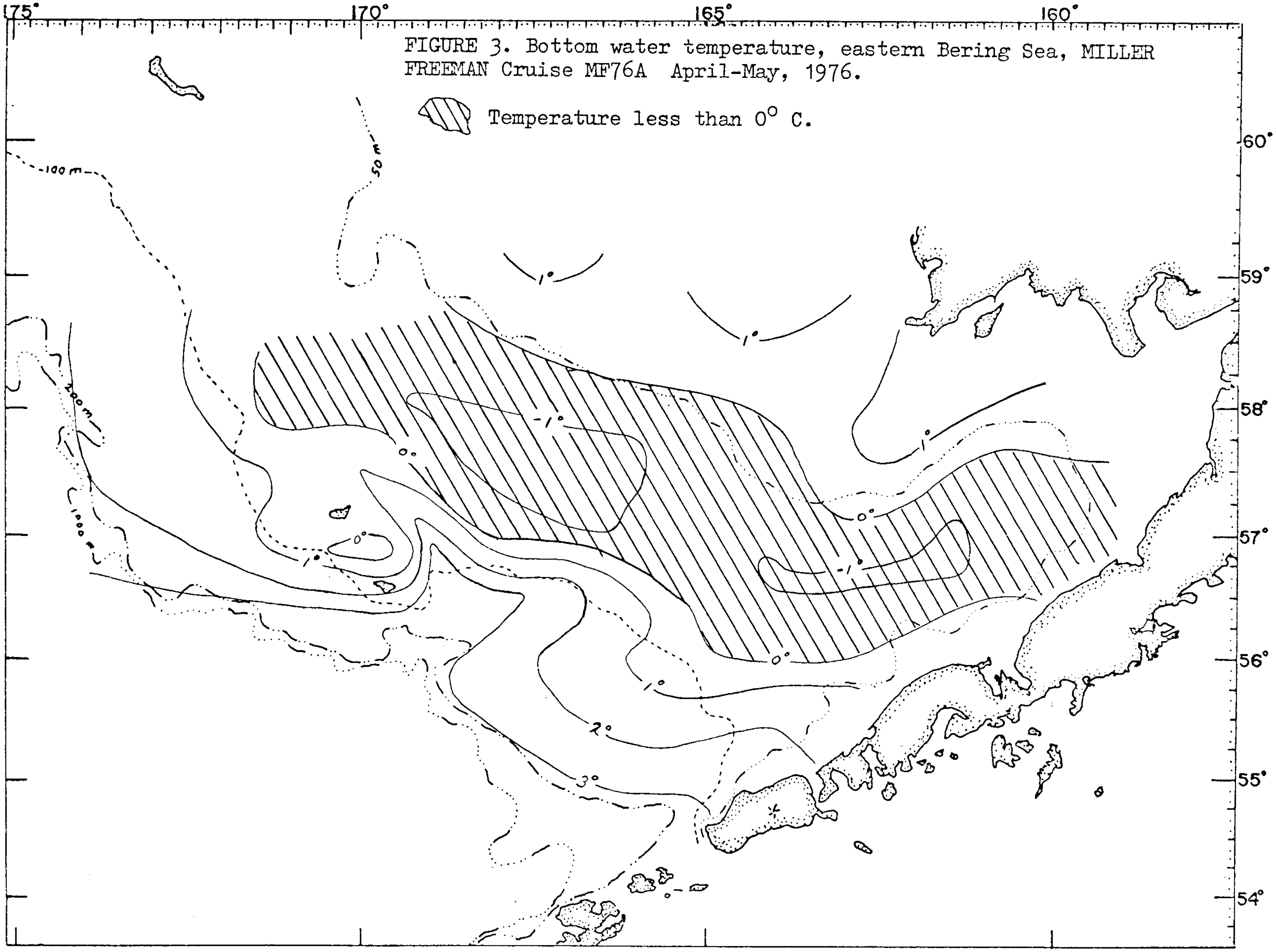

FIGURE 3. Bottom water temperature, eastern Bering Sea, MILLER FREEMAN Cruise MF76A April-May, 1976.

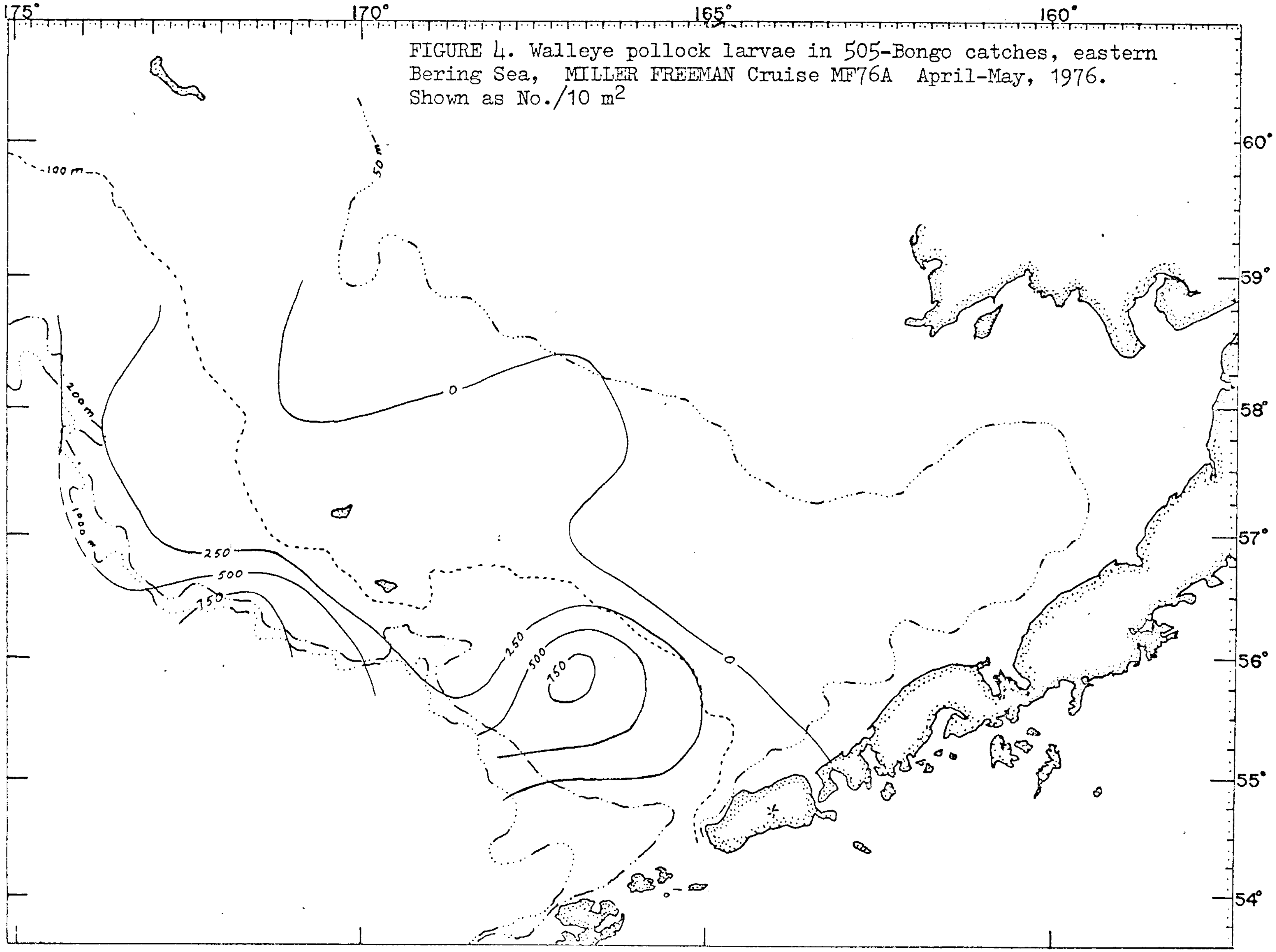

FIGURE 4. Walleye pollock larvae in 505-Bongo catches, eastern Bering Sea, MILLER FREEMAN Cruise MF76A April-May, 1976. Shown as No./10 m^2

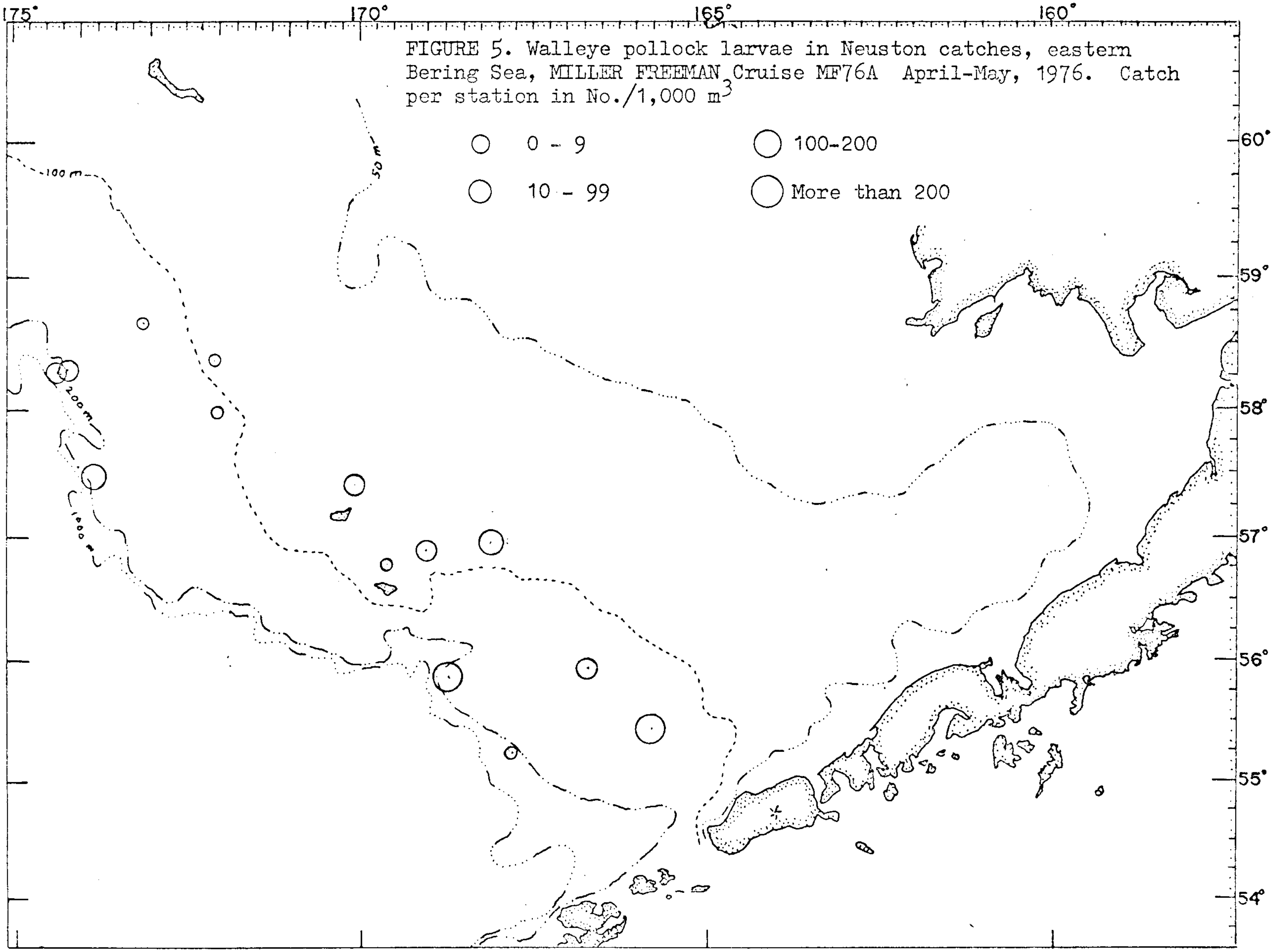

FIGURE 5. Walleye pollock larvae in Neuston catches, eastern Bering Sea, MILLER FREEMAN Cruise MF76A April-May, 1976. Catch per station in No./1,000 m^3

locations, one about 150 km west-southwest from St. George Island (Station 3, 27 April), and the other about 180 km northwest of Unimak Island (Station 39, 26 May). Abundance was generally high along a narrow band located between the 100 and 200 m isobaths extending from near Unimak Island northwestward to west of the Pribilof Islands. Pollock larvae were not abundant near the surface, judging from the low numbers caught in the upper 0.25 m by the neuston net. When compared on the basis of No./1000m^3 (see Section V, Standardization) it can be seen that surface catches by the neuston net at a given locality were only about half of those of the bongo catches, which combined a very short towing time in the upper meter of water (about 4.5 seconds) with an extended towing time below that depth (generally longer than 5 minutes). Further, although neuston and bongo samples containing pollock larvae covered about the same area, only 14 of 56 neuston samples contained pollock larvae as compared with 27 of 56 bongo samples.

Pollock eggs were distributed in the same general pattern as the larvae and were present in 39 of 56 neuston samples, and 34 of 56 bongo samples. Both the neuston and the 505-bongo samples showed a major center of abundance about 90 km east of St. George Island (Station 16, 12 May) and a secondary center of high abundance about 55 km north of Unimak Island (Station 19, 20 May) (Figures 6 and 7).

In contrast to predominantly subsurface distribution of larvae, pollock eggs were 5 to 10 times more abundant in the surface neuston than in the subsurface bongo collections. However, considering the short sampling time of the bongo net in the upper one meter of water (about 4.5 seconds) it is apparent that the major portion of eggs in the bongo net tows came from below the upper one meter, indicating a distribution not confined to the surface layer.

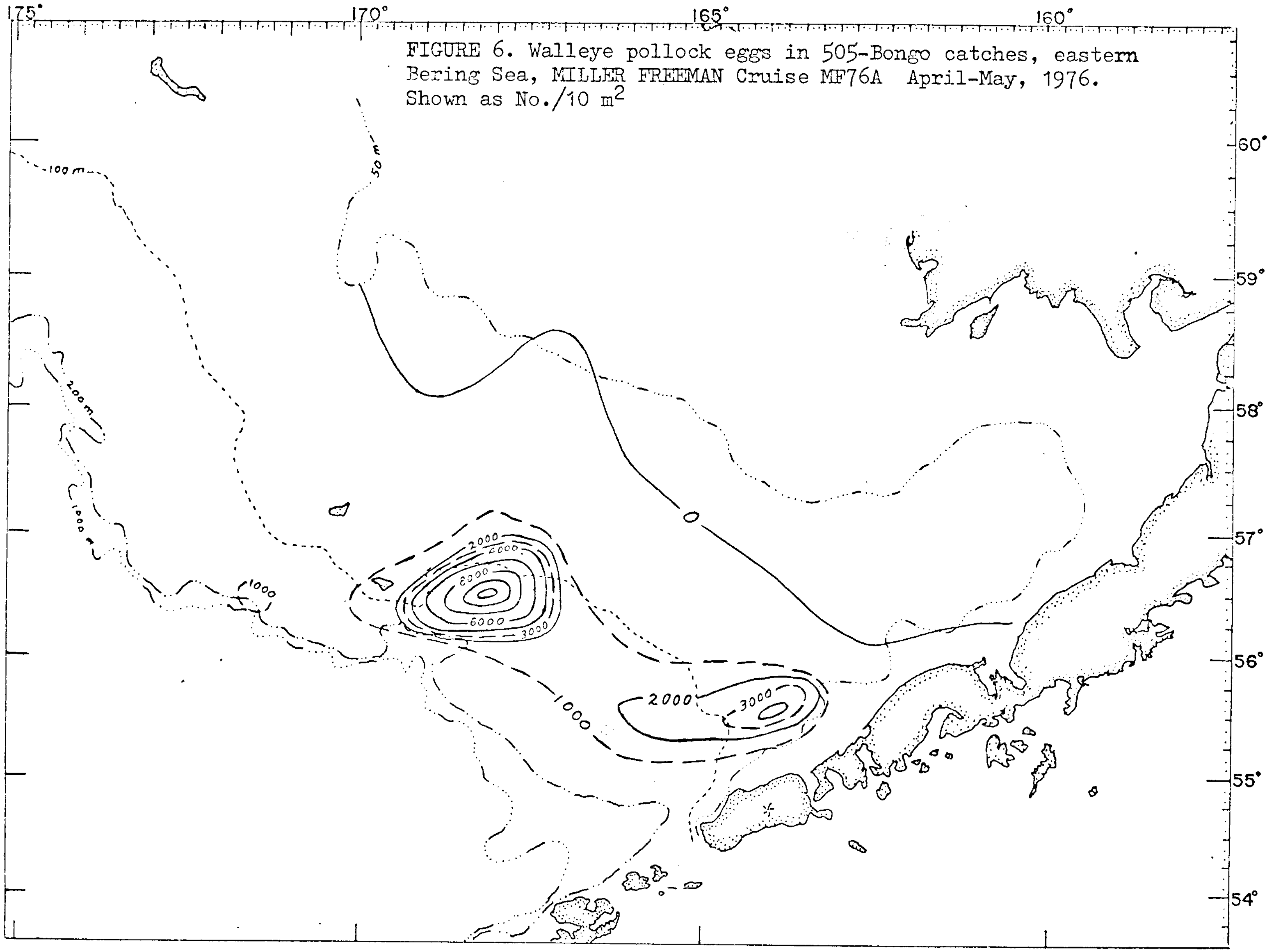

FIGURE 6. Walleye pollock eggs in 505-Bongo catches, eastern Bering Sea, MILLER FREEMAN Cruise MF76A April-May, 1976. Shown as No./10 m^2

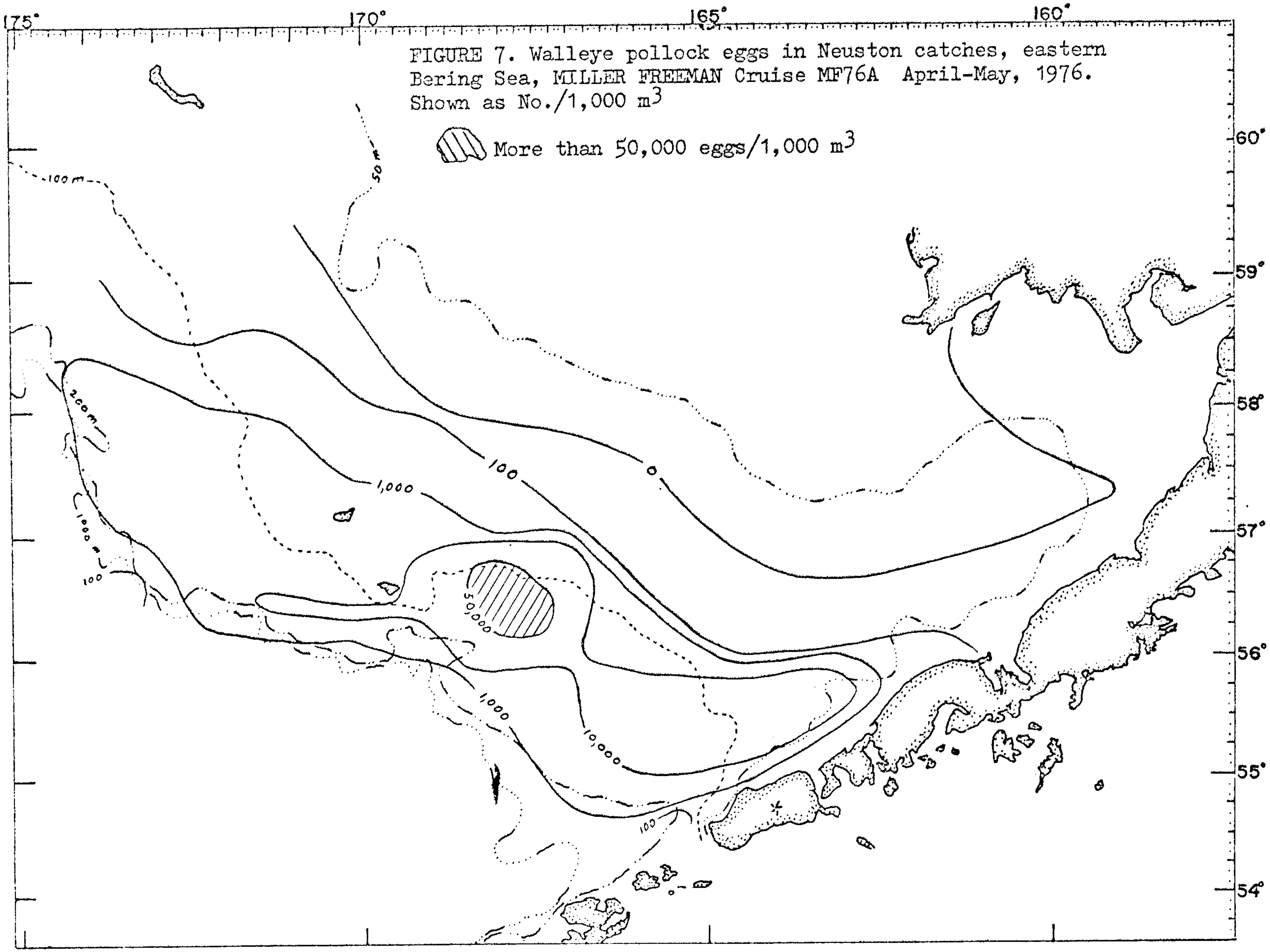

FIGURE 7. Walleye pollock eggs in Neuston catches, eastern Bering Sea, MILLER FREEMAN Cruise MF76A April-May, 1976. Shown as No./1,000 m^3

The distribution of pollock eggs was slightly more wide-spread at the surface than in subsurface layer waters, though the numbers of eggs caught in the neuston net outside of the distribution shown by the bongo catches was very small. The most noticeable area in which eggs were caught only in neuston samples was a line of stations along the Alaska Peninsula (Sta. Nos. 17-26) (Figure 1), but at these stations the catch was only one or two eggs per station.

The presence of large numbers of pollock eggs and larvae probably reflects the time at which the survey was made as much as it does the abundance of adults. Had the survey been conducted later in the year, during summer for instance, it is likely that pollock would have been present in low numbers while eggs and/or larvae of another species, e.g., yellowfin sole (Limanda aspera) would have been dominant. Also, the center of abundance of the dominant species would have been other than that shown by pollock eggs and larvae. In order to adequately sample some flatfish, e.g., Pacific halibut, it would be necessary to carry out a survey during the winter.

B. Comparison with Previous Studies of Pollock

Musienko (1963) and Serobaba (1968) showed the distribution of pollock eggs in June-September 1958 to March 1959, and from March to July 1965, respectively. Dunn and Naplin (1973) reported the presence of pollock eggs and/or larvae at 3 stations in the southern Bering Sea during May-June 1971, and Cooney (1976) reported only that the species was present in plankton collections gathered during May-June and August 1975.

The March 1959 survey described by Musienko (1963) and the March-May 1965 survey described by Serobaba (1968) were extensive enough to delineate the major pollock spawning areas, though part of the distribution shown for 1959 may be caused by the station pattern. Those parts of both surveys made during March 1959 and March-June 1965 show fair agreement with the distribution found during the present survey, i.e., April to May 1976. Boundaries of the area in which eggs and larvae were found differed for all surveys, as did centers of abundance. In March 1959, egg distribution was not as wide-spread as in 1963 or 1976 (partly due to station pattern), while north of the Pribilof Islands in 1963 egg distribution was more restricted than in 1976 or 1959. Greatest abundance in 1963 was found near Unimak Pass and near the north side of Unimak Island, while in 1959 it was farther offshore towards the Pribilof Islands and in 1976 was slightly south and east of the Pribilof Islands. Comparison of these three surveys, i.e., 1959, 1965 and 1976 show that there is general agreement as to total spawning area, but the center of abundance was in a different locality in each year.

Maximum number of eggs in March 1959 was 598/m^2, in March 1965 more than 2,000/m^2, and in April-May 1976 the maximum was 1,268/m^2. Another measure of the abundance of pollock eggs is the number collected in 10-minute surface tows, and such tows in 1959 collected a maximum of 2,653 eggs, up to 6,500 eggs in 1965, and a maximum of 10,418 pollock eggs in May 1976 at Station 16 just east of the Pribilof Island (Figure 1). With respect to larvae, published reports fail to mention the presence of any substantial numbers of pollock larvae in the eastern Bering Sea. In March 1959 larvae were collected at only 3 stations (Musienko, 1963; Figure 3) with a maximum of 60/m^2 at a station about 185 km north of Samalga Pass in the Aleutian Islands. However, the depth given (149-350 m) does not agree with the charted depth (ca. 1,500 m) for the position shown on Musienko's Figure 3. Serobaba (1968; Figure 2) shows larvae collected during June-July 1965 at 8 of 85 stations, and only 1 or 2 larvae per station. Although Serobaba reported extensive collection of pollock eggs during March no mention was made in the report of the presence of larvae though it is unlikely that they were absent at that time of year. Part of the apparent absence of larvae in the two Soviet surveys may relate to their use of vertical net hauls, a type that generally captures few larval fish.

Dunn and Naplin (1973) reported collection of 13 larval pollock at 3 stations between 26 May and 8 June 1971, all 3 being west of the 1976 survey area and over water depths of 1200 to 3400 m.

Although Japanese biologists have collected plankton in the Bering Sea for many years, none of their collections of larval fish in the eastern Bering Sea has been made before about June 10th in any year (Faculty of Fisheries, Hokkaido University 1957-1970). During 12 years of collecting, between 1955 and 1969, they reported larval pollock during June only 32 times. The majority of these were from a band about 375 km wide north of the Alaska Peninsula and Aleutian Islands. On only 4 occasions during the 12 years did they capture more than 50 pollock larvae per collection, and these were at 2 locations in 1967, and 1 each in 1968 and 1969.

Thus, the collections made in April-May 1976 are more extensive in terms of larval pollock than any of those previously reported, and can be used to identify distribution and centers of abundance over the upper continental slope and outer continental shelf. It is apparent, however, from examination of other surveys that there may be significant pollock spawning over deep water west of the area surveyed in 1976. Distribution of pollock eggs and larve in this area can be determined only by means of a systematic survey westward to at least 175°W south of 58°N.

B. Information on Flounders

During April and May 1976, larvae and eggs of righteye flounders were second most abundant of the commercially valuable finfish. Larvae of the following families of non-commercial fish were more abundant than flounders and these were: Cottidae, Ammodytidae, Stichaeidae, and Cyclopteridae.

Identification of flatfish larvae to species is more feasible than for some other families of fish in the Bering Sea, generally because many have been described in literature. Flatfish eggs and larvae collected during the present survey included 5 groups which could be identified to either genus or species. Where two species of a genus have overlapping ranges as adults and where adequate descriptions of the larvae are not available, no attempt was made to carry identification to species. In this category are the arrowtooth flounders (Atheresthes) with two species, A. stomias, the arrowtooth flounder, a predominantly eastern Bering Sea fish, and A. evermanni, the Kamchatka flounder, a predominantly western Bering Sea fish, with ranges overlapping in the vicinity of the Pribilof Islands.

The flathead soles (Hippoglossoides), depending upon the author, are considered to contain either two species, or one species with two sub-species in the eastern Bering Sea. If there are considered to be two species, then these are H. elassodon, the flathead sole, and H. robustus, the Bering flounder. In our collections this group is represented only by eggs, and are classified only to genus.

The most numerous flatfish larvae in the catches were arrowtooth flounder (Atheresthes sp.) (46 specimens) and they occurred at 13 stations (Figure 8). All but 2 were caught with bongo nets, indicating perhaps a preference for subsurface waters. Arrowtooth flounder larvae were taken from near Unimak Pass

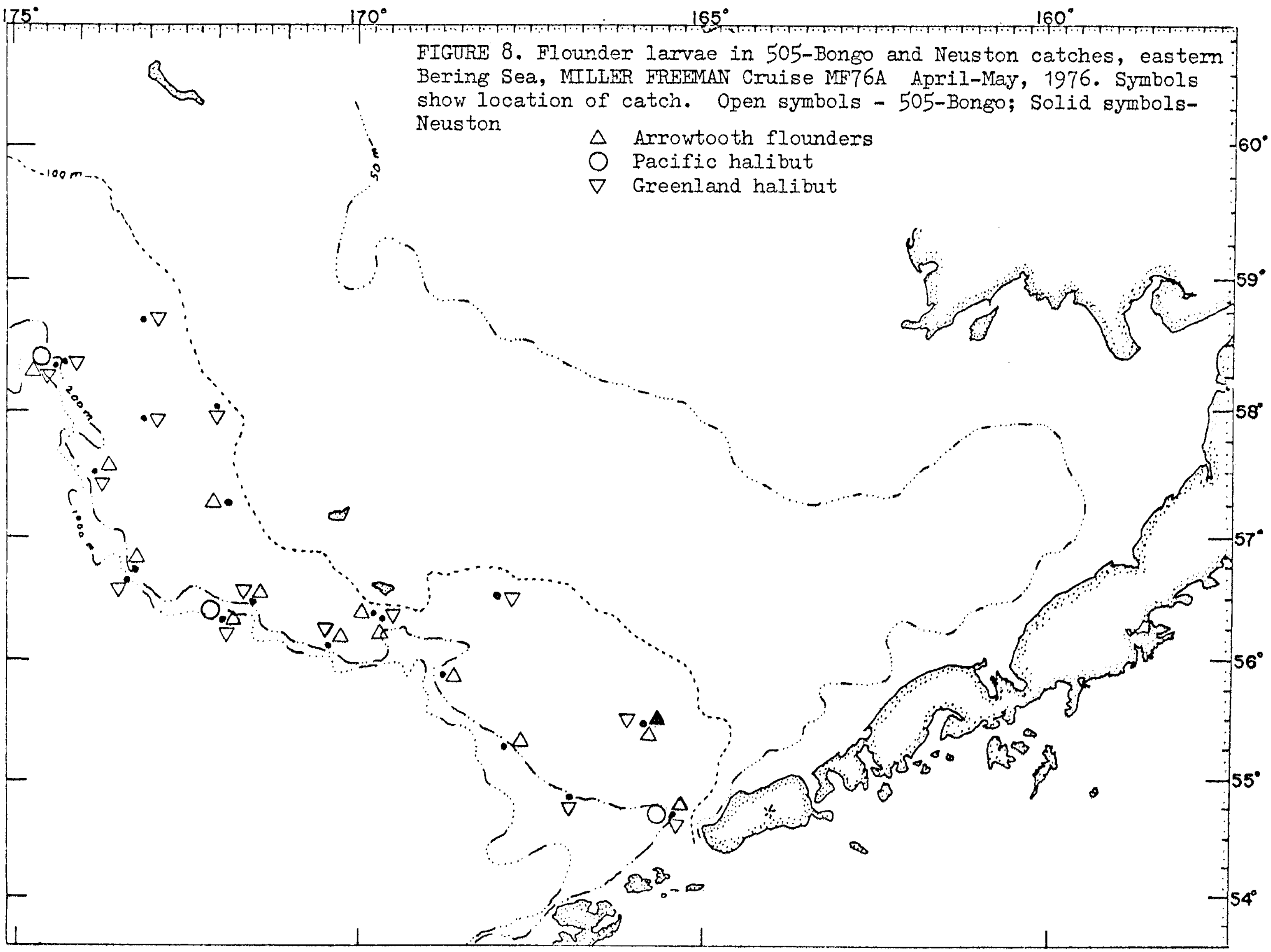

FIGURE 8. Flounder larvae in 505-Bongo and Neuston catches, eastern Bering Sea, MILLER FREEMAN Cruise MF76A April-May, 1976. Symbols show location of catch. Open symbols - 505-Bongo; Solid symbols-Neuston

(Station 17) to about 230 km northwest of St. Paul Island, all stations between the 100 and 500 m isobaths. Within this area there did not appear to be any real trend in abundance, though the largest catch was made at one of the more southerly stations. No eggs of this genus were caught.

Larvae of Greenland halibut (R. hippoglossoides) were second most abundant in the total catch of flatfish. Their distribution extended into shallower water than larvae of arrowtooth flounder and all were caught with the bongo nets at stations near the 200 m isobath from near Unimak Pass to the most northwesterly station. No eggs identifiable to this species were caught.

The only other flatfish larvae identified were 3 specimens of Pacific halibut caught at 3 stations (3, 13, 17) along the other edge of the survey area. Though the number is small, it is worthy of mention because there are few reports of halibut larvae in the eastern Bering Sea. Dunlop et al., (1964) recorded the collection of 10 larvae caught at 4 of 10 one-hour tows near Unimak Pass (in the vicinity of Station 17), and Musienko (1963) reported 2 halibut larvae caught west of the Pribilof Islands. The latter report is suspect in that the position and depth given do not agree with the charted depth at that position. More recently Cooney (1976) listed Pacific halibut in catches for a 2 meter Tucker trawl, but did not state if they were juveniles or larvae, nor the location of catch. The 3 larvae caught in this survey were taken with bongo nets. No halibut eggs were identified in our collections.

Eggs of flathead sole (Hippoglossoides sp.) are quite fragile and easily broken during capture and processing. What at first were classed as small larvae were later identified as late stage embryos which had been released from ruptured eggs. In the tabulations in this report all flathead sole are considered to be egg stages.

Flathead sole eggs were captured in bongo nets at 13 stations and in neuston nets at 20 stations, all in a band extending from Unimak Island to the most northwesterly stations, and situated in water depths between 50 and 200 m. Within this area there seemed to be two centers of abundance, one northwest and the other southeast of the Pribilof Islands, especially noticeable in the neuston catches (Figure 9).

Egg diameter is one criterion used to differentiate eggs of the two forms of *Hippoglossoides* in the eastern Bering Sea (Pertseva-Ostroumova, 1961), but Alderdice and Forrester (1974) suggest that diameter per se may be affected by environmental as well as genetic factors and may not be entirely reliable for taxonomic purposes. It is interesting to note that most eggs from stations southeast of the Pribilof Islands were of large size and could be equated to those of the flathead sole (*H. elassodon*), while those to the northwest of the Pribilof Islands were of smaller size and might be considered by Pertseva-Ostroumova (1961) to be those of the Bering flounder (*H. robustus*). However, examination of water temperature shows warmer water present in the southeastern area where the larger diameter eggs occurred, and colder temperatures to the northwest where the smaller diameter eggs occurred.

Eggs identified as those of Alaska plaice (*P. quadrituberculatus*) were second most abundant of all eggs caught, both in the neuston and in the bongo catches.

Eggs of plaice were caught in the bongo net at 34 stations and in the neuston net at 36 stations, and this placed it second in frequency of occurrence. The distribution of this species was more widespread than that of any other species and covered most of the survey area except for a few stations along the Alaska Peninsula. This corresponds fairly well with the

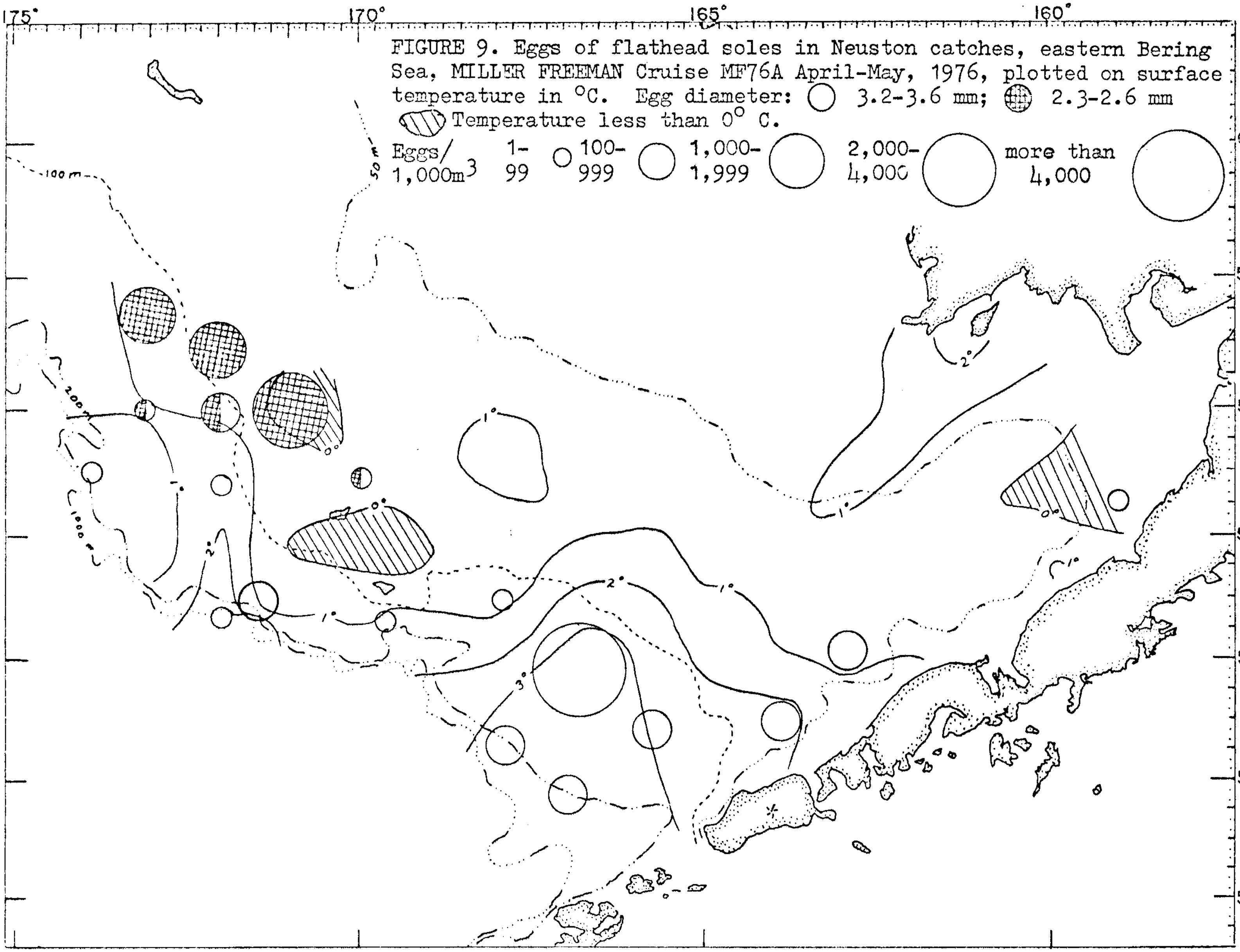

FIGURE 9. Eggs of flathead soles in Neuston catches, eastern Bering Sea, MILLER FREEMAN Cruise MF76A April-May, 1976, plotted on surface temperature in °C. Egg diameter: ○ 3.2-3.6 mm; ⊕ 2.3-2.6 mm ▨ Temperature less than 0° C.

distribution of adults shown by a trawl survey made during the preceding fall (Kaimmer et al., 1976). Centers of abundance shown by the combined neuston and bongo catches were situated near the Alaska Peninsula (Station 21), south of Nunivak Island (Station 53) and north of the Pribilof Islands (Station 41). There was also a large portion of the central survey area in which the abundance of Alaska plaice eggs was moderately high (Figure 10).

It is interesting to note that while eggs of Alaska plaice were abundant, no larvae were caught that could be identified as of this species. This, combined with the presence of several very ripe female plaice in demersal fish trawls taken during the benthis survey, may indicate that spawning by this species had only just begun. During the first leg of the cruise (April 26 to May 12) samples from only 3 of 16 stations contained eggs of Alaska plaice, while during the second leg (May 20-31) 35 of 40 stations produced eggs of this species. Further, most of the eggs were in early stages of development with very few late stage eggs. There is little information on occurrence of eggs and larvae of this species in the eastern Bering Sea. Kashkina (1970) reported eggs at only one station and larvae at one other station during June-July, 1962. Musienko (1970) lists spawning dates for the western Bering Sea as beginning in May and extending to mid-June. On the basis of the above information it seems likely that large scale spawning by this species began about mid-May during 1976.

VIII. CONCLUSIONS

The following preliminary conclusions can be made regarding fish eggs and fish larvae from the eastern Bering Sea:

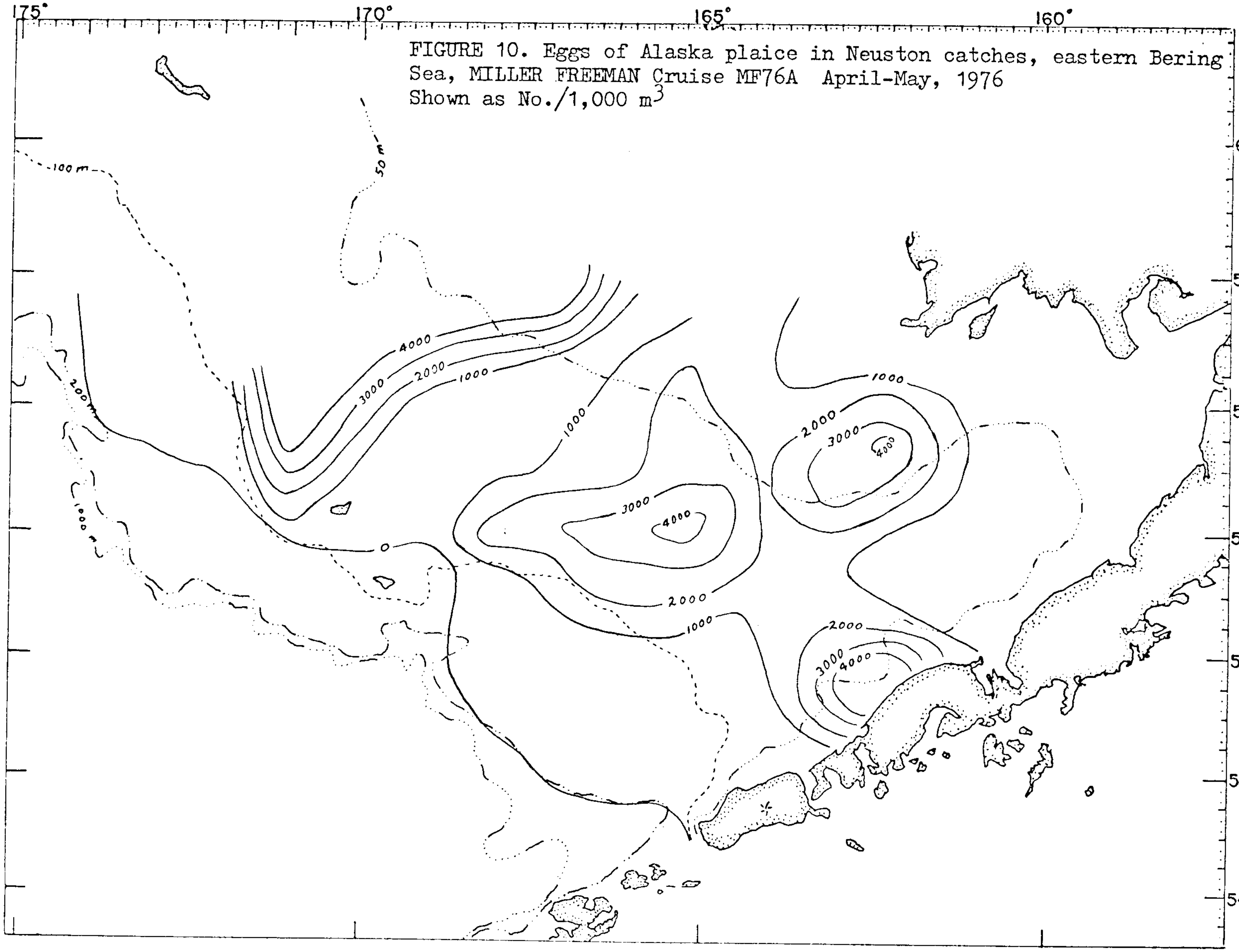

FIGURE 10. Eggs of Alaska plaice in Neuston catches, eastern Bering Sea, MILLER FREEMAN Cruise MF76A April-May, 1976
Shown as No./1,000 m^3

1. There was evidence of high spawning activity for three species of commercially valuable fin-fish, walleye pollock, Alaska plaice, and flathead sole. Spawning by walleye pollock had begun before the sampling period, as shown by the presence of both eggs and larvae in our catches. Spawning by Alaska plaice and flathead sole had probably just begun, as shown by the presence of eggs but not of larvae.
2. Although pollock eggs are most abundant in the upper 0.25 m of water, they are present in significant numbers below that depth. Pollock larvae, on the other hand, are more abundant in sub-surface waters below 0.25 m than in the immediate surface waters.
3. Spawning by 3 other flatfish, Pacific halibut, Greenland halibut, and arrowtooth flounder had been completed prior to the sampling period, indicated by the presence of advanced larvae and the absence of eggs in our samples.
4. During April-May the most numerous pelagic eggs and larvae are those of walleye pollock. The next most numerous eggs were of Alaska plaice and flathead sole. The next most numerous larvae were those of sculpins and sand lances.
5. It is not possible with a single survey to show the peak spawning periods or the time span covered by any one species of fish. Historical records from Soviet surveys provide the only measure of time-span covered by the spawning of one species caught in the present survey, i.e., walleye pollock.
6. Geographic distribution and centers of gross abundance of eggs and larvae of several species of fish can be shown for a particular time of year by a survey such as the one carried out in April-May 1976.

7. A survey during April-May does not provide any information on the distribution of larvae or eggs of other valuable, or potentially valuable, fish--for example, yellowfin sole, Pacific herring, smelts, or Atka mackerel. In order to obtain such information surveys would have to be conducted at different times of the year.

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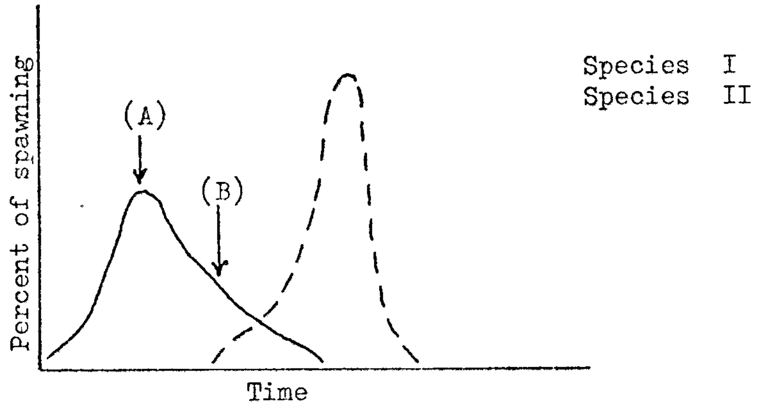
IX. NEED FOR FURTHER STUDY

As pointed out earlier (see Section VIII. CONCLUSIONS) surveys made during a short time period provide only limited results. Estimates of annual production of eggs of any species must be based on good knowledge of the spawning cycles of the fish to be studied. To illustrate this point, consider two arbitrary species, I and II, in the figure shown below. If sampling takes place at time (A) it is evident that estimates of eggs produced will be different than if sampling were at time (B), and overall estimates of potential damage to eggs of species I by man-induced environmental changes might be quite distorted. Further, sampling at either time (A) or (B) would produce no information about species II. It is therefore vital to know the duration of spawning, the shape of the spawning cycle with respect to time, and the season in which spawning occurs.



Pollock is presently the most important commercial fin-fish in the Bering Sea, but other species are of value and conceivably could supersede pollock in the future. Estimates of the annual production of eggs and larvae of the other species would require sampling at other times of the year than spring. Yellowfin sole, Pacific herring, and capelin may spawn in late spring through summer, while Pacific halibut and Greenland halibut spawn during winter. Knowledge of the time and extent of spawning for several species of economically and ecologically important fish in the Bering Sea is a basic factor in evaluating environmental damage which may occur at different times of the year.

A schedule of sampling at about monthly intervals over a one year period would provide base-line information which then could be used to plan monitoring studies necessary to evaluate environmental damage, or to plan more detailed studies of a particular species of fish. Allocation of a week to ten days of vessel time per month in the eastern Bering Sea would be necessary to carry out such a study, and to determine peak spawning times, sampling must be done during one continuous year. It is likely that any NOAA vessel operating in the area, if equipped with suitable nets and winches, could carry out the sampling in a satisfactory manner.

X. SUMMARY OF 4th QUARTER OPERATIONS

A. Ship or Laboratory Activities

1. Vessel activities were limited to loading supplies and equipment aboard the MILLER FREEMAN during January for use during the next quarter.

2. Scientific personnel working on RU-380 were:

Kenneth D. Waldron	NMFS	Co-principal Investigator (part-time)
Beverly Vinter	NMFS	Ichthyoplankton Specialist (part-time)
Donald M. Fisk	NMFS	Technician (part-time)

3. Methods

Laboratory activities consisted of analysis of data, preparation of figures and tabular summaries and preparation of the Annual Report. Invitations for bids to sort plankton to be collected during April and May, 1977, were sent out, and in March the bid was awarded to Texas Instruments, Inc. of Dallas, Texas, the same firm which sorted the samples collected during 1976. New flowmeters were calibrated for use during the forthcoming cruise.

4. Sample localities -- Not applicable.

5. Data collected or analyzed

   a. Number of samples -- None

   b. Analyses -- See above

   c. Miles of trackline -- None

6. Milestone chart and data submission schedules (Attached)

Submission of data on magnetic tape may be delayed by about three weeks due to delays in renewing card punching contracts for the Northwest and Alaska Fisheries Center's Data Management Division.

B. Problems Encountered and Recommended Changes

Charts provided by OCSEAP do not cover our entire survey area, and so it was necessary to utilize a standard Mercator projection chart for resentation of data in the Annual Report.

A recommended change would be to use standard Mercator charts for showing data collected at sea. Charts used aboard ship for navigational purposes are a Mercator projection and use of a different projection makes it more difficult than necessary when transferring data from vessel charts to OCSEAP charts. If it is necessary to retain the present projection used for OCSEAP charts, then they should be expanded to cover a wider range of longitude westwards.

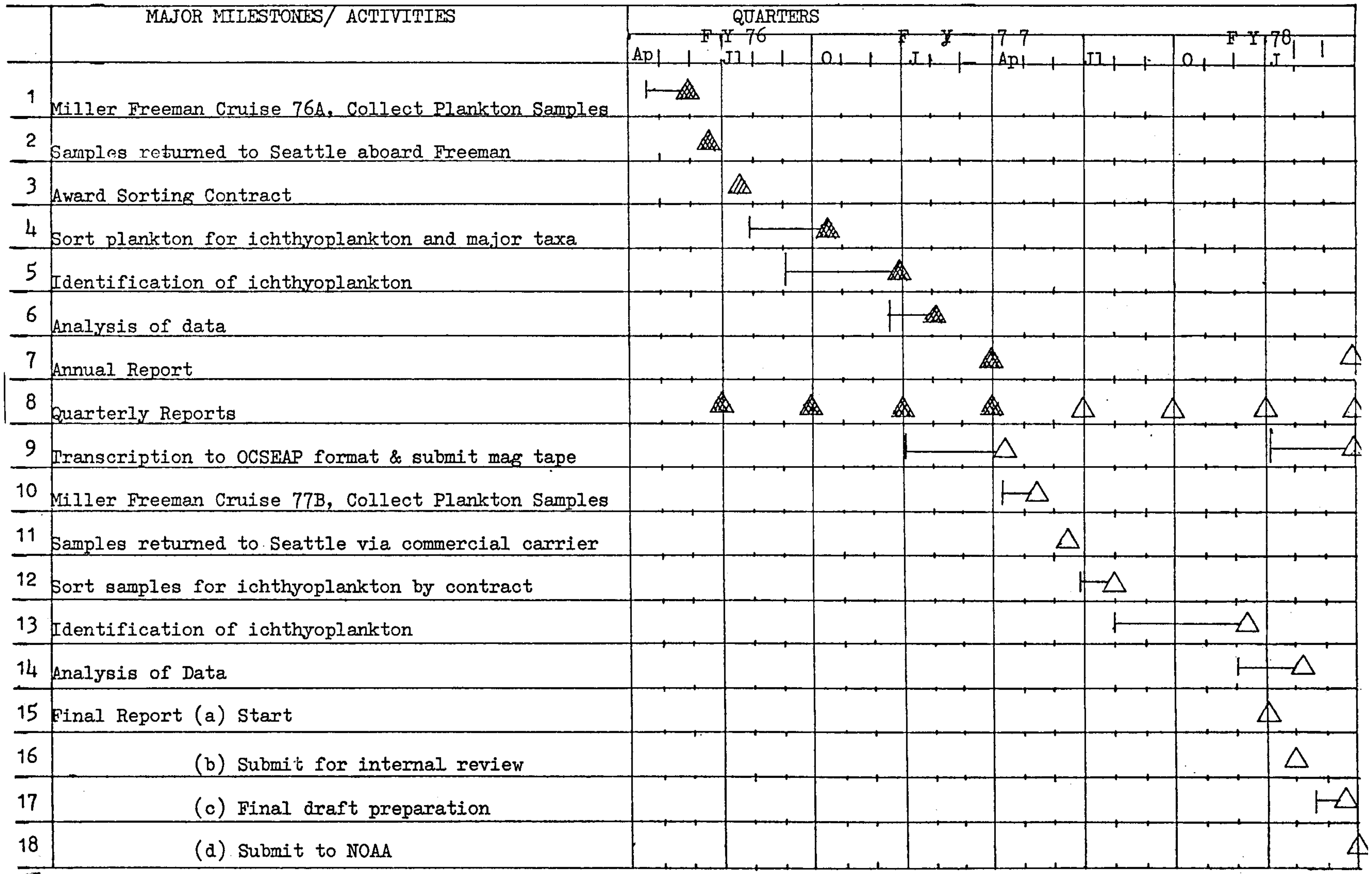
C. Estimate of Funds Expended

As of 25 March 1977 an estimated $32,000 have been expended.

MILESTONE CHART

PROJECT RU-380 Ichthyoplankton, Eastern Bering Sea - NWFC DATE 25 March 1977

PRINCIPAL INVESTIGATORS Dr. F. Favorite and Mr. K. Waldron



Milestone: Start ├── Estimated Completion △ Actual Completion ▲

Appendix Table A

CATCH BY STATION SHOWING SPECIES CAUGHT AND RANGE IN LENGTH OF LARVAE

Station	Taxa	Bongo Number Caught	Bongo Length (mm)	Neuston Number Caught	Neuston Length (mm)
1	T. chalcogramma	48L	5.7-6.0		
	A. hexapterus	1L	6.2		
	Atheresthes sp.	2L	4.2-8.8		
	T. chalcogramma	46E		32E	
2	B. schmidti	1L	10.2		
	T. chalcogramma	71L	3.0-6.0		
	Sebastes sp.	1L	5.8		
	Hemilepidotus sp.	1L	10.5		
	R. hippoglossoides	3L	18.7		
	Teleostei	1L	?		
	T. chalcogramma	24E		9E	
3	B. pacificus	8L	7.9		
	B. schmidti	1L	30.6		
	T. chalcogramma	160L	5.0-7.0		
	Sebastes sp.	1L	7.7		
	Hemilepidotus sp.	1L	13.3		
	Atheresthes sp.	2L	3.3-7.8		
	H. stenolepis	1L	14.2		
	R. hippoglossoides	6L	20.1		
	T. chalcogramma	39E		395E	
	Hippoglossoides sp.			1E	
4	T. chalcogramma	149L	6.0-8.0		
	P. monopterygius			1L	23.0
	Cyclopteridae	37L	5.5-8.3		
	Stichaeidae A	1L	14.5		
	Atheresthes sp.	6L	3.3-8.0		
	R. hippoglossoides	4L	18.0		
	T. chalcogramma	68E		25E	
5	B. pacificus	1L	8.3		
	T. chalcogramma	30L	5.0-8.0	23L	6.0-7.0
	Triglops sp.			1L	8.3
	Atheresthes sp.	1L	4.2		
	Teleostei			2L	3.2-3.5
	T. chalcogramma	29E		88E	
6	T. chalcogramma	18L	6.0	2L	6.3
	Cottidae C	1L	9.2		
	Cyclopteridae	2L	6.0-10.9		
	Teleostei			1L	?
	T. chalcogramma	127E		349E	
	Teleostei F	1E			

Station	Taxa	Bongo Number Caught	Bongo Length (mm)	Neuston Number Caught	Neuston Length (mm)
7	T. chalcogramma	10L	6.4	1L	6.5
	Cottidae A	8L	9.4		
	Cottidae D	1L	8.5		
	Cottidae E	2L	9.0		
	Cyclopteridae	22L	5.4-10.7		
	Stichaeidae A	2L	13.6		
	Teleostei	1L	3.7		
	T. chalcogramma	134E		422E	
8	Osmeridae	1L	11.0		
	T. chalcogramma	4L	6.0-7.0		
	Hexagrammos sp.			12L	18.0-24.0
	Cyclopteridae	4L	5.4-8.7		
	Atheresthes sp.	1L	3.5		
	R. hippoglossoides	2L	19.6-21.3		
	Teleostei	4L	4.5-?		
	T. chalcogramma	260E		328E	
	Hippoglossoides sp.			2E	
9	Sebastes sp.	1L	5.0		
	Cottidae A	1L	9.4		
	Cottidae J	1L	5.7		
	Cyclopteridae	35L	4.6-8.8		
	Stichaeidae A	1L	12.8		
	Atheresthes sp.	1L	3.7		
	T. chalcogramma	268E		1,193E	
	Teleostei	2E			
10	B. pacificus	1L	8.2		
	T. chalcogramma	165L	5.5-8.3		
	Sebastes sp.	1L	6.2		
	Hexagrammos sp.			5L	19.0-28.0
	Cyclopteridae	29L	5.8-10.2		
	Stichaeidae A	3L	15.6		
	Atheresthes sp.	2L	3.4-7.5		
	R. hippoglossoides	1L	20.0		
	T. chalcogramma	288E		1,431E	
	Hippoglossoides sp.			15E	
11	T. chalcogramma	22L	6.5-8.0		
	L. maculatus	4L	10.5-11.9		
	Atheresthes sp.	1L	4.5		
	Teleostei	1L	?		
	T. chalcogramma	106E		475E	
	Hippoglossoides sp.	1E		2E	
	Teleostei	4E			
12	P. thompsoni	1L	8.8		
	T. chalcogramma	74L	5.4-7.3	13L	6.0-7.0

Station	Taxa	Bongo Number Caught	Bongo Length (mm)	Neuston Number Caught	Neuston Length (mm)
12 (con't)	Agonidae C	1L	7.5		
	Atheresthes sp.	5L	3.4-8.3		
	R. hippoglossoides	1L	21.3		
	Pleuronectidae	1L	3.4		
	T. chalcogramma	98E		386E	
	Hippoglossoides sp.			1E	
	P. quadrituberculatus	3E			
13	B. pacificus	3L	8.0		
	B. schmidti	1L	9.6		
	T. chalcogramma	126L	6.0-8.0	11L	3.0-6.0
	Sebastes sp.	11L	4.2-6.7	1L	5.0
	Cyclopteridae	2L	4.0-5.4		
	Atheresthes sp.	2L	8.5-8.8		
	H. stenolepis	1L	14.6		
	R. hippoglossoides	2L	20.4		
	T. chalcogramma	42E		94E	
14	T. chalcogramma	89L	5.0-8.0	6L	5.0
	Gadidae	3L	3.0-7.0		
	Sebastes sp.	3L	6.8	2L	6.0
	Hexagrammos sp.			1L	27.0
	Hemilepidotus sp.			1L	13.5
	Cottidae J	1L	5.4		
	Cyclopteridae	3L	5.4		
	R. hippoglossoides	11L	16.5-22.0		
	Teleostei	1L	?		
	T. chalcogramma	41E		130E	
15	T. chalcogramma	20L	6.6		
	Gadidae			2L	4.0
	Hexagrammos sp.	1L	27.7		
	Cyclopteridae	6L	6.0-8.5		
	L. maculatus	19L	12.0-13.0		
	T. chalcogramma	112E		481E	
	P. quadrituberculatus	2E			
16	T. chalcogramma	6L	3.5-5.8		
	Hexagrammos sp.	1L	28.0	2L	26.0-30.0
	R. jordani			2L	35.0-38.0
	R. hippoglossoides	1L	21.0		
	Teleostei			1L	3.4
	T. chalcogramma	2,452E		10,418E	
	Hippoglossoides sp.	10E		6E	
	P. quadrituberculatus	10E		11E	
	Teleostei E			1E	
	Teleostei	3E		219E	
17	T. chalcogramma	9L	4.4-10.0		
	Sebastes sp.	4L	5.4-5.8	8L	4.5-7.2

Station	Taxa	Bongo Number Caught	Bongo Length (mm)	Neuston Number Caught	Neuston Length (mm)
17 (con't)	*Hexagrammos* sp.			8L	9.0-18.2
	Cottidae A	3L	9.6-10.0		
	Agonidae A	2L	8.3-10.0		
	Agonidae B	2L	5.4-10.0		
	Stichaeidae A	1L	18.1	1L	22.1
	A. hexapterus	1L	9.5		
	Atheresthes sp.	2L	9.4		
	H. stenolepis	1L	15.3		
	R. hippoglossoides	2L	19.0-21.0		
	Teleostei			1L	2.8
	T. chalcogramma	55E		84E	
	Teleostei	3E			
18	*M. villosus*	2L	29.7-44.5		
	Gadidae	1L	5.0		
	Hexagrammos sp.			1L	9.7
	Triglops sp.	2L	15.3-17.0		
	Cottidae B			1L	9.2
	Agonidae A	1L	9.5		
	Stichaeidae B	1L	14.9		
	A. hexapterus	45L	5.0-10.0	13L	4.7-7.5
	T. chalcogramma	8E		20E	
	P. quadrituberculatus	25E		74E	
	Teleostei E			2E	
19	*Hexagrammos* sp.			1L	25.0
	Pholidae A	1L	17.4		
	A. hexapterus	2L	6.7		
	T. chalcogramma	767E		4,777E	
	Hippoglossoides sp.	8E		18E	
	P. quadrituberculatus	7E		28E	
	Teleostei E			2E	
	Teleostei			2E	
20	*T. chalcogramma*			12E	
	Hippoglossoides sp.			16E	
	P. quadrituberculatus	71E		251E	
	Teleostei E	11E		22E	
	Teleostei F	1E		17E	
21	*Triglops* sp.	1L	10.9		
	Cyclopteridae	1L	5.8		
	A. hexapterus	27L	4.4-8.0		
	T. chalcogramma	6E		51E	
	Hippoglossoides sp.			8E	
	P. quadrituberculatus	93E		867E	
	Teleostei E	1E		10E	
	Teleostei F	1E		3E	
	Teleostei L			1E	
	Teleostei			1E	

Station	Taxa	Bongo Number Caught	Bongo Length (mm)	Neuston Number Caught	Neuston Length (mm)
22	Hexagrammos sp.			4L	20.0-37.0
	T. chalcogramma			1E	
	P. quadrituberculatus	3E		16E	
	Teleostei E	1E			
	Teleostei F	3E		3E	
23	A. hexapterus	68L	5.6-7.0		
	T. chalcogramma			1E	
	Teleostei F			1E	
24	Hippoglossoides sp.			1E	
	Teleostei E			1E	
25	T. chalcogramma			2E	
	P. quadrituberculatus	1E		3E	
	Teleostei F			5E	
26	Triglops sp.	1L	10.6		
	Cottidae B	3L	7.5		
	Cottidae E	1L	7.5		
	T. chalcogramma			1E	
	P. quadrituberculatus	3E		10E	
	Teleostei E			1E	
27	Cottidae K	1L	9.8		
	Agonidae A	2L	8.9		
	L. maculatus	95L	19.5-20.5		
	Pholidae B	2L	11.5		
	A. hexapterus	60L	6.0-6.7	9L	5.0-5.5
	P. quadrituberculatus			1E	
	Teleostei F	86E		309E	
28	L. maculatus	9L	12.5-17.9		
	P. quadrituberculatus			4E	
	Teleostei F	9E		200E	
29	Gadidae			1L	5.0
	L. maculatus			1L	16.4
	P. quadrituberculatus	8E		166E	
	Teleostei E			1E	
	Teleostei F	6E		96E	
30	P. quadrituberculatus	6E		44E	
	Teleostei F	3E		33E	
31	Cottidae B	1L	9.2		
	P. quadrituberculatus	12E		492E	
	Teleostei F	5E		89E	

Station	Taxa	Bongo Number Caught	Bongo Length (mm)	Neuston Number Caught	Neuston Length (mm)
32	P. quadrituberculatus	3E		89E	
	Teleostei E			4E	
	Teleostei F	1E		24E	
	Teleostei	1E			
33	P. quadrituberculatus	4E		53E	
	Teleostei F	1E		27E	
34	P. quadrituberculatus	19E		186E	
	Teleostei F			3E	
35	L. maculatus	2L	11.2		
	T. chalcogramma	4E		2E	
	P. quadrituberculatus	3E		17E	
36	T. chalcogramma	108L	3.5-10.0	40L	5.0-10.0
	Gadidae			4L	5.0-7.0
	Sebastes sp.			1L	6.9
	Hexagrammos sp.			3L	20.0-29.0
	Hemilepidotus sp.			2L	9.7-15.1
	Cottidae A	1L	9.2		
	Cottidae	2L	9.5-9.6	1L	9.1
	L. maculatus	2L	13.4-13.8	1L	27.0
	Stichaeidae A			1L	18.9
	A. hexapterus	10L	6.9-12.5	6L	6.6-10.0
	Atheresthes sp.	11L	3.9-9.7	2L	4.6-5.0
	R. hippoglossoides	1L	21.1		
	Teleostei			4L	2.0-3.0
	T. chalcogramma	499E		2,811E	
	Hippoglossoides sp.	8E		39E	
	P. quadrituberculatus			3E	
	Teleostei	8E			
37	B. pacificus	1L	7.9		
	T. chalcogramma	3L	9.2-13.9		
	Sebastes sp.	24L	4.1-8.0	1L	6.2
	Hexagrammos sp.			14L	22.0-29.0
	P. monopterygius			1L	27.0
	Hexagrammidae			2L	10.0-13.0
	Hemilepiditus sp.	1L	7.5		
	Cottidae G			1L	10.7
	Agonidae C	1L	8.7		
	Cyclopteridae	1L	4.5		
	Bathymasteridae A	3L	5.8-7.0	3L	5.5-7.0
	Stichaeidae A			1L	17.7
	R. hippoglossoides	1L	18.7		
	Pleuronectidae	1L	3.2		
	T. chalcogramma	16E		233E	
	Hippoglossoides sp.	1E		29E	

Station	Taxa	Bongo Number Caught	Bongo Length (mm)	Neuston Number Caught	Neuston Length (mm)
37 (con't)	Teleostei I			1E	
	Teleostei			1E	
38	B. pacificus	1L	8.3		
	T. chalcogramma	78L	4.5-10.0	1L	5.8
	Sebastes sp.	8L	5.0-7.1	1L	5.5
	Hexagrammos sp.	1L	19.7	3L	10.0-10.7
	Atheresthes sp.	8L	5.0-10.0		
	Pleuronectidae	1L	?		
	T. chalcogramma	3E		57E	
	Hippoglossoides sp.	1E		29E	
	Teleostei	2E		2E	
39	T. chalcogramma	127L	4.2-10.8	8L	2.5-5.0
	A. hexapterus	1L	10.2		
	Pleuronectidae	3L	4.2		
	Teleostei			3L	?
	T. chalcogramma	238E		1,260E	
	Hippoglossoides sp.	4E		483E	
	P. quadrituberculatus			6E	
	Teleostei	6E		140E	
40	T. chalcogramma	1L	6.6	10L	4.0
	L. maculatus	1L	11.0		
	A. hexapterus	3L	4.8-5.2		
	T. chalcogramma	26E		68E	
	Hippoglossoides sp.	3E		9E	
	P. quadrituberculatus	7E		69E	
	Teleostei F	1E			
	Teleostei			6E	
41	T. chalcogramma	31E		28E	
	Hippoglossoides sp.	34E		279E	
	P. quadrituberculatus	116E		706E	
	Teleostei E			21E	
	Teleostei F	1E		180E	
	Teleostei			15E	
42	T. chalcogramma	1L	5.0	1L	7.5
	Zoarcidae A	1L	37.0		
	L. maculatus	1L	12.1		
	R. hippoglossoides	1L	23.0		
	T. chalcogramma	110E		104E	
	Hippoglossoides sp.	2E		33E	
	P. quadrituberculatus	32E		110E	
43	T. chalcogramma	10L	6.5-8.0		
	Cottidae H	1L	10.0		
	L. maculatus	1L	10.7		

Station	Taxa	Bongo Number Caught	Bongo Length (mm)	Neuston Number Caught	Neuston Length (mm)
43 (con't)	*R. hippoglossoides*	2L	21.3		
	T. chalcogramma	81E		245E	
	Hippoglossoides sp.	2E		3E	
	P. quadrituberculatus	3E		5E	
	Teleostei	3E		6E	
44	*T. chalcogramma*	43L	6.7-8.3	1L	7.5
	Cyclopteridae	2L	6.0-7.3		
	R. hippoglossoides	1L	18.0		
	T. chalcogramma	62E		3E	
	Hippoglossoides sp.	3E		159E	
	P. quadrituberculatus	2E		25E	
	Teleostei			4E	
45	*T. chalcogramma*	2L	5.5-7.1	1L	6.0
	T. chalcogramma	8E		14E	
	Hippoglossoides sp.	69E		222E	
	P. quadrituberculatus	52E		96E	
	Teleostei E			1E	
	Teleostei F	2E		3E	
	Teleostei	1E		2E	
46	*T. chalcogramma*	1L	5.0		
	Cyclopteridae	1L	6.4		
	T. chalcogramma	5E		4E	
	P. quadrituberculatus	13E		85E	
	Teleostei E			3E	
	Teleostei			1E	
47	*G. macrocephalus*	1L	5.1		
	Cottidae B	2L	9.2		
	L. maculatus	1L	9.2		
	P. quadrituberculatus	11E		7E	
	Teleostei E			1E	
48	*T. chalcogramma*	41L	3.0-5.8	15L	3.0-4.5
	Gadidae			32L	3.5-5.0
	T. chalcogramma	266E		81E	
	P. quadrituberculatus	82E		299E	
	Teleostei E	2E		3E	
	Teleostei F			1E	
	Teleostei	1E			
49	Cyclopteridae	1L	6.6		
	T. chalcogramma	7E		4E	
	P. quadrituberculatus	46E		348E	
	Teleostei E			3E	
	Teleostei L			1E	

Station	Taxa	Bongo Number Caught	Bongo Length (mm)	Neuston Number Caught	Neuston Length (mm)
50	G. macrocephalus	2L	5.0-5.4		
	P. quadrituberculatus	32E		180E	
	Teleostei E			3E	
51	Cottidae B	56L	7.5-9.0		
	Cottidae F	2L	8.3		
	Cyclopteridae	1L	5.8		
	P. quadrituberculatus	31E		279E	
	Teleostei E			1E	
	Teleostei F	3E		17E	
52	Cottidae B	1L	9.2		
	P. quadrituberculatus	30E		55E	
	Teleostei E	1E		3E	
	Teleostei F	3E		19E	
53	G. macrocephalus			1L	5.0
	Cyclopteridae			1L	3.9
	P. quadrituberculatus	33E		888E	
	Teleostei E	1E		10E	
	Teleostei F	25E		429E	
	Teleostei			1E	
54	Cottidae B	8L	8.0-8.5		
	P. quadrituberculatus	8E		32E	
	Teleostei F	7E		2E	
55	Cottidae B	114L	6.5-9.5	68L	8.0-8.5
	Cyclopteridae	1L	5.4		
	Teleostei	1L	?		
	P. quadrituberculatus	109E		223E	
	Teleostei E	1E			
	Teleostei F	5E		6E	
56	Cottidae B			219L	8.0-9.0
	P. quadrituberculatus	32E		525E	
	Teleostei F			1E	

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Lower Cook Inlet Meroplankton

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I. Summary

The objective was to obtain a reconnaissance level survey of eggs and larvae of fishes and shellfishes of economic importance in Lower Cook Inlet. The conclusions include the observations that the abundance of those early life history stages varies greatly in time and space because spawning is both seasonal and localized. The implications with respect to OCS oil and gas development are that potential resource use conflicts with fisheries harvests are serious and that we lack quantitative ecosystem observations for model input to decide whether changes in harvests can best be attributed to oil and gas development or to fishing activities.

II. Introduction

A. General nature and scope of study

This study was planned as a reconnaissance level survey of early life history stages of fishes, shrimps, and crabs in Lower Cook Inlet. The study was intended to obtain observations in several seasons within 1 year.

B. Specific objectives

The specific objective of this study was to use standard MARMAP methods to obtain density distribution maps within seasons of eggs and larvae of fishes and shellfishes of major economic significance in Lower Cook Inlet.

C. Relevance to problems of petroleum development

Quantitative assessments of spatial and temporal variability of distributions and abundance of economically important fishes and shellfishes are of direct relevance to problems of petroleum development in Lower Cook Inlet. The resource use conflict in Lower Cook Inlet is between petroleum development and major fisheries harvests important to man's welfare. Spawning areas are close to OCS lease areas.

Lower Cook Inlet is a managed ecosystem and the present emphasis of rules and regulations is to optimize harvests of fishes and shellfishes. Petroleum development is a relatively new parameter for the ecosystem managers to consider. Opinions of probable oil-related damage to the harvests range from no discernible effect to total catastrophe. There is no *a priori* predictive model available to support any shade of opinion. An understanding of the critical upper trophic levels of the ecosystem in Lower Cook Inlet can be obtained by time series observations of the fisheries and by fishery-independent observations.

The biology and dynamics of the harvested populations can be described quantitatively by methods already in existence. Studies of early life history stages are the most important fishery-independent observations: (1) the earliest life history stages allow an assessment of the magnitude of the spawning population, and (2) later, pre-recruit, life history stages allow an assessment of year class strength before exploitation by the fishery. A standard program of fisheries catch statistics and market sampling can provide the input data for the established ecological models of the dynamics of exploited populations.

A sustained program for collection and timely analysis of quantitative benchmark data can illuminate the questions certain to arise from resource conflict in Lower Cook Inlet. The program must contain studies based on sound sampling design and analyses which allow computation of confidence interval estimates.

Studies of early life history stages of fishes and shellfishes can suggest and confirm patterns of water movements in Lower Cook Inlet. The planktonic forms which are released into the water by aggregations of spawning adults can be sampled to follow distributions over space and over time by identifying the successive developmental stages of the organisms. These studies can add substantially to understanding paths of petroleum and to determine which populations are at risk.

Since there is no reasonable possibility of being able to study all populations in the Lower Cook Inlet ecosystem, concentrating effort on the important harvested species seems appropriate. Those harvested species are most relevant to the problem of resource use conflict associated with petroleum development in Lower Cook Inlet. The multiplicity of species and the magnitude of the harvest in relatively restricted geographic areas probably singles out Lower Cook Inlet as the most critical area of potential resource use conflict in the entire Outer Continental Shelf area of responsibility.

III. Current state of knowledge

The current state of knowledge has been compiled in an annotated review of the literature (Tables 1-3). These references are predominantly used for the identification of fish eggs and larvae (Table 1), crabs (Table 2), and shrimps (Table 3).

IV. Study area

Station locations are shown in Figure 1.

Table 1. Annotated literature review; fish eggs and larvae

References	Area of Study	Nature of Study	Specific Features of Interest
Ahlstrom, 1972	California	Distribution of *Bathylagus stilbius*, *Stenobrachius leucopsarus*, and four non-Alaskan species in the California Current Region	Illustrations of planktonic larvae.
Ahlstrom and Moser, 1975	California	Distribution of flatfishes in the California Current Region	Brief descriptions of planktonic eggs and larvae, figures.
Bell and St. Pierre, 1970	North Pacific	Eggs and larvae of *Hippoglossus hippoglossus stenolepis*	Descriptions of eggs and larvae, figures, life history, and commercial fisheries.
Blackburn, 1973	Puget Sound, Washington	Ichthyoplankton survey of Skagit Bay	Species list, key to elongate fishes (Ammodytidae, Bathymasteridae, Clupeidae, Engraulidae, Osmeridae, Pholidae, and Stichaeidae), descriptions of larvae for elongate and non-elongate fishes (Cottidae, Hexagrammidae, and Pleuronectidae), figures.
Budd, 1940	Monterey Bay, California	Development of eggs and early larvae of *Parophrys vetulus*, *Pleuronichthys decurrens*, *Pleuronichthys coenosus*, and three non-Alaskan species	Descriptions of eggs and larvae, figures. Eggs and larvae from the plankton.

Table 1. (continued)

References	Area of Study	Nature of Study	Specific Features of Interest
Delacy, Hitz, and Dryfoos, 1964	Puget Sound, Washington coast	Reproduction of several *Sebastes* species	Descriptions of ovarian eggs, larval descriptions, figures of nine species, and life history. Eggs and larvae from the plankton.
Efremenko and Lisovenko, 1972	Gulf of Alaska	Intraovarian and pelagic larvae of some Alaskan *Sebastes* species	Descriptions of intraovarian and pelagic larvae, figures. Larvae from the plankton.
English, 1976	Alaskan waters	Pelagic fish eggs and larvae, shrimp and crab larvae	Keys in table form, figures.
Fraser and Hansen, eds., 1967	North Atlantic	Larvae of Ammodytidae	Keys and descriptions of larvae, figures.
Gorbunova, 1954	NW Pacific Ocean and Bering Sea	Reproduction and development of *Theragra chalcogramma*	Life history, descriptions of eggs, larvae, and juveniles; brief sections describing larvae and juveniles of *Gadus morhua macrocephalus*, *Eleginus gracilis*, and *Boreogadus saida*; figures.
Gorbunova, 1962	NW Pacific Ocean (?)	Spawning and development of Hexagrammidae	Text in Russian, English abstract; descriptions of embryonic and larval development for *Pleurogrammus monopterygius*, *Hexagrammos octogrammus*, *Hexagrammos lagocephalus*; descriptions of larvae for *Hexagrammos stelleri*, *Hexagrammos decagrammus* , *and Hexagrammos superciliosus*; larval key and figures.

Table 1. (continued)

References	Area of Study	Nature of Study	Specific Features of Interest
Hickman, 1959	Puget Sound, Washington	Larval development of *Psettichthys melanostictus*	Descriptions of larvae and early juveniles, figures. Larvae from the plankton.
Kobayashi, 1961	Okhotsk Sea, North Pacific	Larvae and young of *Ptilichthys goodei*	Text in Japanese, English summaries of descriptions of larvae and young, figures.
Miller, 1969	San Juan Is., Washington	Life history of *Hippoglossoides elassodon*	Life history, descriptions of egg and larval development, and photographs. Eggs artificially spawned and from the plankton, raised in the lab.
Morris, 1956	Monterey Bay, California	Early larvae of four *Sebastes* species: *S. goodei*, *S. jordani*, *S. paucispinus*, and *S. saxicola*	Descriptions of larvae and figures. Larvae raised in the lab.
Moser, 1967	Southern California	Reproduction and development of *Sebastes paucispinis* and comparison with other rockfishes	Descriptions of ovarian eggs and intraovarian and planktonic larvae, figures of larvae and early juveniles. Larvae from the plankton.
Moser, 1974	Southern California	Development and distribution of larvae and juveniles of *Sebastolobus*	Descriptions of larvae and juveniles, figures. Larvae from the plankton.

Table 1. (continued)

References	Area of Study	Nature of Study	Specific Features of Interest
Moser and Ahlstrom, 1974	World-wide	Systematic investigations of larval stages of Myctophidae	Descriptions of larvae, figures. Larvae from the plankton.
O'Connell, 1953	California	Life history of *Scorpaenichthys marmoratus*	Life history, descriptions of unfertilized egg, larvae, and young; figures. Artificially spawned eggs, larvae from the plankton.
Orcutt, 1950	Monterey Bay, California	Life history of *Platichthys stellatus*	Descriptions of eggs, larvae, and young; figures, life history and commercial fishery. Eggs artificially spawned and reared in the lab.
Quast and Hall, 1972	Alaska	List of fishes of Alaska	Species lists, distributions, and references.
Richardson and DeHart, 1975	Oregon coast	Larvae, young, and adults of *Ptilichthys goodei*	Descriptions of larvae, young, and adults; figure of larva. Larvae from the plankton.
Saville, 1964	North Atlantic	Eggs and larvae of Clupeoidae	Keys to eggs and larvae, descriptions and figures of larvae.
Templeman, 1948	Newfoundland	Life history of *Mallotus villosus*	Life history, descriptions of eggs and larvae; figures of larvae. Larvae from the plankton.

Table 2. Annotated literature review; crabs

References	Area of Study	Nature of Study	Specific Features of Interest
Hart, 1935	Nanaimo, British Columbia	Larvae of *Lophopanopeus bellus bellus*, *Hemigrapsis nudis* and *H. oregonensis*	Descriptions of larval stages, and figures of crabs with larvae similar to commercially important species.
Hart, 1960	Nanaimo, British Columbia	Larvae of *Oregonia gracilis* and *Hyas lyratus*	Descriptions of larval stages, and figures of crabs with larvae similar to commercially important species.
Hart, 1971	British Columbia	Key to planktonic larvae of families of decapod Crustacea	Figures.
Haynes, 1973	Bristol Bay, Alaska	Larvae of *Chionoecetes bairdi* and *C. opilio*	Descriptions of prezoeae and first stage, figures. Larvae raised at sea and preserved.
Hoffman, 1968	Auke Bay, Alaska	Larvae of *Paralithodes platypus*	Descriptions of larval stages and figures. Larvae raised in the lab.
Karinen and Rice, 1974	Auke Bay, Alaska	Effects of oil on Tanner crabs	Most significant effect of oil on crabs was the autotomy of limbs, or death in high concentrations.
Kurata, 1956	Hokkaido, Japan	Larvae of *Paralithodes brevipes*	Text in Japanese, brief English summaries of larval stages, figures. Larvae similar to commercially important species.

Table 2. (continued)

References	Area of Study	Nature of Study	Specific Features of Interest
Kurata, 1963a	Hokkaido, Japan	Larvae of *Erimacrus isenbeckii* and *Telmessus cheiragonus*	Text in Japanese, brief English summaries of larval stages, figures. Larvae similar to commercially important species.
Kurata, 1963b	Hokkaido, Japan	Larvae of *Chionoecetes opilio elongatus* and *Hyas Coaretatus alutaceus*	Text in Japanese, brief English summaries of larval stages, figures. Larvae similar to commercially important species.
Kurata, 1964	Hokkaido, Japan	Larvae of *Paralithodes camtschatica*, *P. brevipes* and *P. platypus*	Text in Japanese, brief English summaries of larval stages, figures.
Lough, 1975	Newport Bay, Oregon	Keys to larvae of *Cancer magister*, *C. productus* and *C. oregonensis*	Includes keys to families, and species of crabs with larvae similar to commercially important species.
Marukawa, 1933	Japanese waters	Descriptions of adult, biology and fishery	Illustrations of larval stages but no descriptions.
Motoh, 1973	Sea of Japan	Larvae of *Chionoecetes opilio*	Descriptions of larval stages, figures. Larvae raised in the lab.
Poole, 1966	Eureka, California	Larvae of *Cancer magister*	Descriptions of larval stages, figures. Larvae raised in the lab.
Sato and Tanaka, 1949	Hokkaido, Japan	Larvae of *Paralithodes camtschatica*	Descriptions of larval stages, figures. Larvae raised in the lab.

Table 2. (continued)

References	Area of Study	Nature of Study	Specific Features of Interest
Trask, 1970	Humboldt Bay, California	Larvae of *Cancer productus*	Descriptions of larval stages, figures and comparison with *Cancer magister* larvae. Larvae raised in the lab.

Table 3. Annotated literature review; shrimps

References	Area of Study	Nature of Study	Specific Features of Interest
Alaska Dept. of Fish and Game, 1975	Kachemak Bay, Alaska	Circulation, ecology, commercial fishing, potential impact of oil spill, conservation of renewable energy resources	*Pandalus borealis*, *P. goniurus*, *P. hypsinotus* and *Pandalopsis dispar* were the four species of shrimp caught commercially with the first two comprising 93% of trawl catches. *Pandalus hypsinotus* comprises 90% of pot catches. King crab, Tanner crab and Dungeness crab caught commercially.
Barr, 1970	Lower Cook Inlet Kenai Peninsula and Kodiak Is.	Commercial species of Alaskan shrimp	Key to species, life history, figures, domestic and foreign fisheries.
Berkeley, 1930	Nanaimo, British Columbia	Larvae of *Pandalopsis dispar*, *Pandalus borealis*, *P. danae*, *P. hypsinotus*, *P. platyceros*	Descriptions of larval stages, and adults, figures, key to species. First stage larva raised in the lab, later stages from plankton.
Greenwood, 1959	Lower Cook Inlet, Shelikof Strait, and Kodiak Is., Alaska	Exploratory research	*Pandalus borealis*, *Pandalopsis dispar* and *Pandalus hypsinotus* were 3 most abundant commercially important shrimp.
Haynes, 1976	Kasitsna Bay, Alaska	Larvae of *Pandalus hypsinotus*	Descriptions of larval stages, figures and comparison of zoeal stages by other authors. Larvae raised in the lab.

Table 3. (continued)

References	Area of Study	Nature of Study	Specific Features of Interest
Ivanov, 1965	Russian waters	Larvae of *Pandalus tridens*, *Eualus macilentus*, *E. barbatus*, *Spirontocaris spina*, *Lebbeus groenlandicus*	First stage illustrated, text in Russian.
Ivanov, 1971	Russian waters	Larva of *Pandalus goniurus*	First stage illustrated, text in Russian.
Kurata, 1964	Hokkaido, Japan	Larvae of *Pandalus borealis*, *P. hypsinotus* and *Pandalopsis coccinata*	Text in Japanese, brief English summaries of larval stages, figures.
Lee, 1969	Puget Sound, Washington	Larvae of *Pandalus jordani*	Descriptions of larval stages, figures and comparison of zoeal stages by Modin and Cox, 1967. Larvae raised in the lab.
Modin and Cox, 1967	Crescent City, California	Larvae of *Pandalus jordani*	Descriptions of larval stages and figures. Larvae raised in the lab.
Needler, 1938	Nanaimo, British Columbia	Larvae of *Pandalus stenolepis*	Descriptions of larval stages and figures. 1st and 2nd stages raised in the lab, 2nd to 7th from the plankton.

Table 3. (continued)

References	Area of Study	Nature of Study	Specific Features of Interest
Price and Chew, 1972	Dabob Bay, Washington	Larvae of *Pandalus platyceros*	Descriptions of larval stages and figures. Larvae raised in the lab.
Rathbun, 1904	Arctic Alaska to Southern California	Adult decapod crustaceans	Descriptions, figures, keys and distributions.
Ronholt, 1963	Southern Alaskan waters	Exploratory research	*Pandalus borealis*, *Pandalopsis dispar* *Pandalus hypsinotus* were the 3 most abundant commercially important shrimp in the Lower Cook Inlet area.

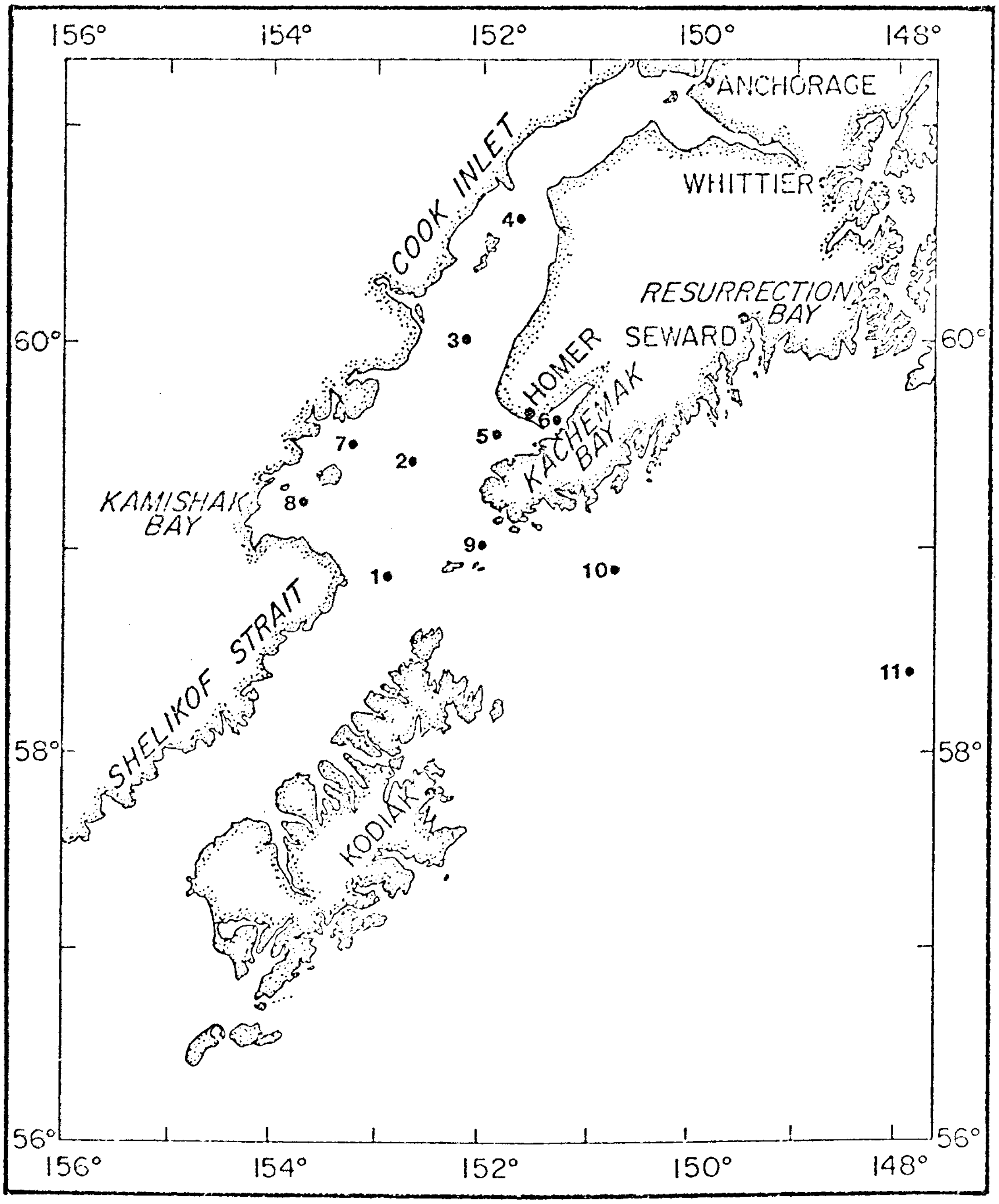

Fig. 1. Station locations, Cook Inlet area.

V. Sources, methods and rationale of data collection

A. Field activities

1. 06-13 April 1976 *Discoverer* RP-4-DI-76A, Leg III

2. 05-09 May 1976 *Discoverer* RP-4-DI-76A, Leg V

3. 22-30 May 1976 *Discoverer* RP-4-DI-76A, Leg VII

4. 08-15 July 1976 *Acona* RP-4-AC-231, Leg II

5. 24-31 August 1976 *Surveyor* RP-4-SU-76B, Leg II

6. 17-29 October 1976 *Miller Freeman* RP-4-MF-76B, Leg III

7. 21-26 February 1977 *Discoverer* RP-4-DI-77A, Leg I

B. Methods

All stations were located in Lower Cook Inlet, the open Gulf of Alaska, or Prince William Sound (Fig. 1). During Leg III, the *Discoverer* cruise, the proposed station 12 was not occupied. Station 6 in Kachemak Bay was occupied for 26 hours, station 11 in the open Gulf for 8 hours, and station 13 in Prince William Sound for 21 hours. Stations 2 and 5 were occupied twice, the second occupation being designated 2a and 5a. The stations designated 4a and 11a were PMEL vertical zooplankton stations. Station 4a was occupied at local midnight and 11a at local apparent noon. The remaining stations were occupied on the average for 3 to 4 hours each. The seas were calm with overcast skies, snow, and rain; 15-knot winds prevailed.

During Leg V, the *Discoverer* cruise, station 6 in Kachemak Bay was occupied for 9.5 hours. Station 5 was occupied twice, the second occupation designated as 5a. This station 5 was located further north than station 5 of Leg III. This was an attempt to sample a gyre reported by the Alaska Department of Fish and Game to be an Alaskan king crab nursery. The station designated 8a was a PMEL vertical zooplankton station occupied at local midnight. All other stations were occupied once for approximately 2 to 3 hours, with the exception of station 10. This station was occupied briefly due to adverse sea conditions. Seas ranged from calm to 20 feet with winds as high as 50 knots. The weather varied from rain and snow to clear.

During Leg VII, the *Discoverer* cruise, station 9 was abandoned before any samples were taken due to adverse sea conditions. Station 6 in Kachemak Bay was occupied for 24 hours, and station 11 in the open Gulf for 12 hours. The remaining stations were occupied for an average of 1 to 2 hours each. The seas varied from calm to 7 feet, with winds up to 40 knots. The weather was mostly clear or partly cloudy, and occasionally overcast with some rain.

During Leg II, the *Acona* cruise, all the stations were not sampled in order, due to adverse sea conditions at the beginning of the cruise. Station 6 in Kachemak Bay was occupied for 24 hours, and station 11 in the open Gulf for 22 hours. All the remaining stations were occupied for an average of 1 to 2 hours each. The weather was mostly overcast and cool.

During Leg II, the *Surveyor* cruise, station 6 in Kachemak Bay was occupied for 20 hours and station 11 in the Gulf of Alaska for 10 hours. An average of 1 or 2 hours was spent at each of the remaining stations. Station 3 was occupied twice. However, the second occupation was only for the purpose of collecting primary productivity samples. The weather was mostly overcast and cool.

During Leg III, the *Miller Freeman* cruise, station 10 in the Gulf of Alaska was not sampled due to adverse sea conditions. Station 11, also located in the Gulf of Alaska, was not sampled due to the shortage of cruise time available. The stations were not sampled in order, having to fit in with the other scientific programs and the cruise time available. All UW stations were occupied for an average of 0.5 to 1 hr depending on the length of the bongo tow and the weather. The weather was variable from fair to snowing. The temperature ranged between 50° to -15°F. We encountered calm to 10 ft seas and 5 to 60 kt winds. The inclement weather was a problem and caused the loss of 2 working days and slowed down operations considerably on other days.

The summary of methods for Leg I, the *Discoverer* cruise, is summarized in Section X.

The acoustic surveys were conducted using a Ross 200A Fine Line Echosounder system operating with a frequency of 105 kHz. A towed 10° transducer mounted in a 2 foot V-fin depressor was used during Leg III until the housing was destroyed during the towing operation. Thereafter and during Leg V, the transducer was lowered approximately 2 m below the surface whenever the vessel was stopped. During Leg VII, a transducer that was smaller in diameter, had a wider beam and was slightly more efficient than the Ross transducer used during the previous cruises, was mounted in a V-fin depressor. It was lowered over the side while on station, and towed during the net hauls and on one transect between stations 5a and 6. Transceiver problems ended the use of the echosounder system at station 6 during Leg VII. The incoming signal was recorded on a paper chart marked with station number, date, time (GMT), and other pertinent information. If a layer was present during Legs III and V, the incoming signal was recorded on magnetic tape for later digitizing and analysis at the University of Washington. Magnetic tape records were made at stations 4, 5a, and 6 during Leg VII. Emphasis was placed on the 0 to 50 fm range but depths to 200 fms were examined as well. Of particular interest were layers of zooplankton, ichthyoplankton, or nekton.

The *Acona*'s hull-mounted transducer was used for sonic recording on Leg II. During the *Surveyor* cruise, Leg II, the ship's hull-mounted transducer was only used while underway. The UW's 10° transducer was lowered approximately one meter below the surface while on station. On both cruises the paper chart was marked with station number, date, time (local and GMT), and other pertinent information. Acoustic scattering layers were of particular interest. Depth ranges of 0-50, 50-100, 100-150 and 150-200 fm were recorded, with the 0-50 fm depth range being particularly emphasized. The incoming signal was also recorded on magnetic tape for at least 5 minutes at every station for later digitizing and analysis at the University of Washington.

During Leg III, the *Miller Freeman* cruise, the 10° Ross transducer, mounted in a plywood towed body, was lowered approximately 2 m below the surface while on station. The incoming signals were recorded on a paper chart marked with station number, date, time (GMT), and other pertinent information. Acoustic scattering layers were of particular interest. The incoming signal was recorded on magnetic tape for at least 5 min at every station for later digitizing and analysis at the University of Washington.

A summary of the acoustic survey for Leg I, the *Discoverer* cruise, is summarized in Section X.

Zooplankton and ichthyoplankton were sampled during all cruises with a bongo net in a double oblique tow. The bongo net consisted of a double-mouthed frame (each mouth with an inside diameter of 60 cm and a mouth area of 0.2827 m^2) made of fiber glass and weighing 95 lbs (a 100 lb weight was also attached to this net). A 505 μm mesh net with an open area ratio (OAR) of 8:1 and a 333 μm mesh net, 8:1 OAR, were attached to the frame. A TSK flowmeter was mounted in the mouth of each net to determine the volume of water filtered. A bathykymograph (BKG) was attached to the frame to determine the depth of tow. Double oblique tows required deployment at 50 m/min, a 30 sec soaking time, and retrieval at 20 m/min. A towing speed of 3-4½ knots was typical. The sampling depth for double oblique tows was usually 200 m following standard MARMAP procedures. In shallower water, the net was placed as close to the bottom as possible without endangering the net. Several subtractive hauls were made at stations that showed a strong acoustic scattering layer to help determine the composition of that layer.

Zooplankton and ichthyoplankton were sampled with a nonclosing 1-m NIO net in horizontal or double oblique tows, or a Miller net in a horizontal tow during the Leg III *Discoverer* cruise only. One tow with the 1-m NIO net was made during Leg V.

The 1-m NIO net had an open area ratio (OAR) of 4:1 with 571-μm mesh. A bathykymograph (BKG) was attached to determine depth and a TSK flowmeter was mounted on the top bar to determine the volume of water filtered. The mouth area when fishing is 1 m. Double oblique tows required deployment at 50 m/min, a 30-sec soaking time, and retrieval at 20 m/min. Horizontal tows were made by deploying and retrieving at approximately 50 m/min with an appreciably longer time spent fishing at depth. Horizontal tows were used for sampling layers seen with the echosounder. The initial fishing depth of the net was determined by the product of the cosine of the wire angle and the amount of wire out. The actual depth was determined with a

BKG. A towing speed of 2-3 knots was attempted for the NIO net, while the Miller nets were towed at 12 knots

Nekton capable of avoiding the smaller nets were, in part, sampled with 3-m and 5 x 6-m NIO nets during the Leg III, *Discoverer* cruise, only.

Samples were placed in 500 or 1000-ml bottles and preserved with a stock solution of formalin, propylene glycol, propylene phenoxetol and sea water in a 2:8 ratio. The solution was changed and the sample represerved 24 hr later. A label was filled out and inserted in the jar. The jar was capped and sealed with plastic electrical tape for storage.

The number and kinds of net hauls are given in Tables 4-12.

VI. Results

A. *Discoverer*, Leg III

The original intention was to have a continuous acoustic survey utilizing the transducer mounted in a towed body. After the destruction of the towed body between stations 1 and 2, the transducer was lowered whenever the vessel was stopped. Twelve of the 13 stations were surveyed with a total of 2,609 minutes of chart records and 120 minutes of magnetic records. Sampling with bongo nets and 1-m NIC nets revealed large numbers of copepods normally invisible to the echosounder. Larger fish could be seen below 160 m during the day with an upward shift toward night.

Both the 1-m NIO net and the bongo net were successful in catching ichthyoplankton and confirmed what the acoustic system was detecting at stations 6 and 13. Large quantities of zooplankton were collected when the layers were sampled.

The 5 x 6-m and 3-m NIO nets were somewhat more difficult to use because of their size and the returns were relatively small. The 5 x 6-m NIO net caught some shrimp and smelt between stations 3 and 4 in Cook Inlet during the day while the 3-m NIO net and the bongo net caught myctophids at night at station 11 in the open Gulf.

The fish eggs and larvae have been sorted and identified from these samples (Tables 13-18). Crabs and shrimps are identified and summarized (Tables 19-22).

B. *Discoverer*, Leg V

Twelve stations were surveyed acoustically with a total of 732 minutes of chart records and 66 minutes of magnetic records. Station 10 was not surveyed due to high sea and wind conditions. Fish were evident at every station with apparent high concentrations at stations 1, 3, and 6. Records from stations 9 and 11 were of poor quality due to increasing seas and excessive maneuvering of the ship in an effort to maintain position. There may be a scattering layer at station 9.

Table 4. UW Haul Summary Sheet, *Discoverer*, Leg III, 06-13 April 1976

Bongo Tows

Date (1976) (GMT)	Time (GMT)	Station	Haul	Latitude (N)	Longitude (W)	Depth (m)	Volume Filtered (m^3)	Mesh Size (µm) 505	Mesh Size (µm) 333
7 Apr	0844	1	1	58° 53.0'	152° 52.0'	125	350	1	1
7 Apr	1620	2	2	59' 23.0'	152° 38.6'	[2]	79	1	1
7 Apr	2239	3	2	59° 58.0'	152° 11.0'	[1]	106	1	1
8 Apr	0440	4	1	60° 40.5'	151° 35.0'	[1]	95	1	1
8 Apr	1520	5	3	59° 31.4'	151° 45.2'	[1]	272	1	1
8 Apr	1635	6	1	59° 36.5'	151° 19.0'	[1]	208	1	1
9 Apr	0155	6	5	59° 36.5'	151° 19.0'	[1]	353	1	1
10 Apr	0810	7	1	59° 29.9'	153° 10.0'	90	64	1	1
10 Apr	1536	9	2	59° 01.7'	151° 57.7'	[1]	612	1	1
10 Apr	2134	10	1	58° 51.1'	150° 39.5'	110	359	1	1
11 Apr	1307	11	2	58° 26.0'	148° 06.0'	130	365	1	1
12 Apr	0355	13	2	60° 41.5'	147° 40.9'	190	657	1	1
12 Apr	1448	13	4	60° 41.5'	147° 40.9'	310	1186	1	1

[1] BKG spring not calibrated

[2] BKG not used

Table 5. UW Haul Summary Sheet, *Discoverer*, Leg III, 06-13 April 1976

1-m NIO Tows

Date (1976) (GMT)	Time (GMT)	Station	Haul	Latitude (N)	Longitude (W)	Depth (m)	Tow Type	Volume Filtered (m^3)	Mesh Size 581 μm
7 Apr	0926	1	2	58° 53.0'	152° 52.0'	[1]	DO	--	1
7 Apr	1639	2	3	59° 23.0'	152° 36.6'	[1]	DO	536	1
7 Apr	2217	3	1	59° 58.0'	152° 11.0'	80	DO	413	1
8 Apr	0456	4	2	60° 40.5'	151° 35.0'	30	DO	456	1
8 Apr	1507	5	2	59° 31.4'	151° 45.2'	38	DO	659	1
8 Apr	1650	6	2	59° 36.5'	151° 19.0'	75	DO	481	1
9 Apr	0115	6	4	59° 36.5'	151° 19.0'	[1]	DO	975	1
9 Apr	0210	6	6	59° 36.5'	151° 19.0'	53	HZ	2920	1
9 Apr	1657	6	7	59° 36.5'	151° 19.0'	[1]	HZ	1079	1
9 Apr	1828	6	8	59° 36.5'	151° 19.0'	65	HZ	--	1
10 Apr	1515	9	1	59° 01.7'	151° 57.7'	[1]	HZ	--	1
10 Apr	2243	10	2	58° 51.1'	150° 39.5'	100	DO	1634	1
12 Apr	0224	13	1	60° 41.5'	147° 40.9'	20	HZ	~1100	1
12 Apr	0632	13	3	60° 41.5'	147° 40.9'	[1]	DO	723	1
12 Apr	1640	13	5	60° 41.5'	147° 40.9'	10	HZ	877	1

* Tow type: HZ - horizontal
DO - double oblique

[1] BKG not calibrated

Table 6. UW Haul Summary Sheet, *Discoverer*, Leg III, 06-13 April 1976

Miscellaneous Net Tows

Date (1976) (GMT)	Time (GMT)	Station	Haul	Latitude (N)	Longitude (W)	Depth (m)	Net	Tow Type	Duration (sec)
7 Apr	2310	3	3	59° 58.0'	152° 11.0'	50	5 x 6-m NIO	DO	5700
10 Apr	1607	9	3	59° 01.7'	151° 57.7'	0	Miller	HZ	1800
11 Apr	0631	11	1	58° 26.0'	148° 06.0'	35	3-m NIO	HZ	4560

Note: Ship speed for 5 x 6 m and 3 m NIO nets varied from 3 to 4 knots, dropping to dead slow for retrieval. Ship speed was approximately 12 knots for the Miller net.

Table 7. UW Haul Summary Sheet, *Discoverer*, Leg V, 05-09 May 1976

Bongo Tows

Date (1976) (GMT)	Time (GMT)	Station	Haul	Latitude (N)	Longitude (W)	Depth (m)	Volume Filtered (m^3)	Jars from Mesh Size (μm) 505	333
6 May	1325	1	1	58° 52.5'	152° 47.4'	170	605	1	1
6 May	1552	2	1	59° 22.9'	152° 39.5'	53	242	1	1
6 May	2117	3	1	59° 59.4'	152° 11.0'	65	280	1	1
7 May	0259	4	1	60° 40.0'	151° 37.7'	65	260	1	1
7 May	1030	5	2	59° 34.8'	151° 47.8'	20	244	1	1
7 May	1312	6	1	59° 37.1'	151° 19.0'	75	182	1	1
7 May	1709	6	2	59° 37.1'	151° 19.0'	70	263	1	1
8 May	0020	5a	1	59° 34.6'	151° 47.3'	25†	116	1	1
8 May	0402	7	1	59° 30.0'	153° 10.0'	35	--	1	1
8 May	0734	8	1	59° 14.2'	153° 40.3'	32†	116	1	1
8 May	1315	9	1	59° 02.0'	151° 58.6'	130	546	1	1
9 May	0145	11	1	58° 23.3'	148° 02.0'	195	795	1	1

†estimated by wire angle
BKG not used

Table 8. UW Haul Summary Sheet, *Discoverer*, Leg V, 05-09 May 1976

1-m NIO Tows

Date (1976) (GMT)	Time (GMT)	Station	Haul	Latitude (N)	Longitude (W)	Depth (m)	Volume Filtered (m^3)	Mesh Size (μm)
7 May	1757	6	3	59° 37.1'	151° 17.0'	40	724	571

Table 9. UW Haul Summary Sheet, *Discoverer*, Leg VI, 22-30 May 1976

Bongo Tows

Date (1976) (GMT)	Time (GMT)	Station	Haul	Latitude (N)	Longitude (W)	Depth (m)	Volume Filtered (m^3)	Mesh Size (μm) 505	333
24 May	0732	1	1	58° 52.6'	152° 47.0'	105	652	1	1
25 May	1150	2	1	59° 23.6'	152° 38.1	40	216	1	1
25 May	1607	3	1	59° 59.5'	152° 11.5'	58	170	1	1
25 May	2217	4	1	60° 41.5'	151° 37.5'	40	252	1	1
26 May	0541	5a	2	59° 34.6'	151° 47.0'	45	149	1	1
26 May	0835	6	1	59° 36.6'	151° 19.1'	90	221	1	1
26 May	1928	6	3	59° 36.6'	151° 19.1'	67	212	1	1
27 May	0056	6	4	59° 36.6'	151° 19.1'	51	174	1	1
27 May	0708	6	7	59° 36.6'	151° 19.1'	50	193	1	1
27 May	1300	7	1	59° 29.4'	153° 09.6'	36	156	1	1
27 May	1701	8	1	59° 13.6'	153° 37.6'	32	87	1	1
30 May	1813	10	1	58° 51.9'	150° 40.3'	90	348	1	1
30 May	0253	11	1	58° 23.9'	148° 05.5'	103	797	1	1
30 May	0813	11	2	58° 23.9'	148° 05.5'	265	764	1	1

Table 10. UW Haul Summary Sheet, *Acona*, Leg II, 08-15 July 1976

Bongo Tows

Date (1976) (GMT)	Time (GMT)	Station	Haul	Latitude (N)	Longitude (W)	Depth (m)	Volume Filtered† (m^3)	Jars from mesh size (μm) 505	333
12 July	1619	1	1	58° 53.0'	152° 48.0'	150	616	4	3
12 July	1133	2	1	59° 23.0'	152° 40.0'	30	245	1	3
10 July	0901	3	1	60° 00.0'	152° 10.0'	83	207	1	1
10 July	1556	4	1	60° 38.1'	151° 38.5'	60	297	1	1
11 July	0018	5	1	59° 35.0'	151° 48.0'	28	168	1	1
		6	1	59° 37.0'	151° 19.0'		ABORT		
11 July	1009	6	2	59° 37.0'	151° 19.0'	27	108	1	1
11 July	1031	6	3	59° 37.0'	151° 19.0'	73	283	1	1
11 July	2051	6	4	59° 37.0'	151° 19.0'	17	272	1	1
11 July	2113	6	5	59° 37.0'	151° 19.0'	45	373	1	1
10 July	0405	7	1	59° 30.0'	153° 10.0'	20	209	1	1
10 July	0010	8	1	59° 14.0'	151° 40.0'	23	221	1	1
13 July	0548	9	1	59° 02.0'	151° 58.0'	200	732	3	4
13 July	1230	10	1	58° 52.1'	150° 48.7'	104	958	4	4
13 July	2243	11	1	58° 24.0'	148° 02.0'	207	880	2	2
14 July	0835	11	2	58° 24.0'	148° 02.0'	206	956	2	3

† averaged

Table 11. UW Haul Summary Sheet, *Surveyor*, Leg II, 24-31 August 1976

Bongo Tows

Date (1976) (GMT)	Time (GMT)	Station	Haul	Latitude (N)	Longitude (W)	Depth (m)	Volume Filtered† (m^3)	Jars from mesh size (μm) 505	333
25 Aug	0840	1	1	58° 53.2'	152° 46.2'	162	476	2	3
25 Aug	1206	2	1	59° 22.1'	152° 40.0'	70	--	1	1
25 Aug	1952	3	1	59° 59.5'	152° 11.0'	48	217	2	1
26 Aug	0400	4	1	60° 42.1'	151° 36.5'	90	322	1	1
26 Aug	1040	5	1	59° 34.9'	151° 50.6'	30	277	1	1
26 Aug	2203	6	1	59° 36.5'	151° 17.7'	40	488	1	1
27 Aug	1000	6	2	59° 36.5'	151° 17.7'	50	370	1	1
28 Aug	0650	7	1	59° 30.1'	153° 07.7'	48	1190	2	1
28 Aug	0330	8	1	59° 14.3'	153° 40.5'	34	33	1	1
28 Aug	1832	9	1	59° 02.2'	151° 58.6'	100	1387	2	1
28 Aug	1919	9	2	59° 02.2'	151° 58.6'	115	1989	2	3
29 Aug	0459	10	1	58° 51.5'	150° 40.2'	135	1907	1	1
29 Aug	1922	11	1	58° 24.4'	148° 06.2'	270	3645	1	1
31 Aug	0600	13	1	60° 41.2'	147° 40.7'	165	848	4	2
30 Aug	0559	14	1	59° 24.9'	149° 05.0'	170	468	2	2

† averaged

Table 12. UW Haul Summary Sheet, *Miller Freeman*, Leg III, 17-29 October 1976

Bongo Tows

(1976) (GMT)	Time (GMT)	Station	Haul	Latitude (N)	Longitude (W)	Depth (m)	Volume Filtered† (m^3)	Jars from mesh size (μm) 505	333
19 Oct	0400	1	1	58° 54.3'	152° 51.1'	172	243.6	1	1
19 Oct	2057	2	1	59° 24.3'	152° 41.5'	- - - - - - -	ABORT	- - - - - - - -	
28 Oct	0845	2	2	59° 22.8'	152° 40.8'	66	129.8	1	-
23 Oct	1935	3	1	60° 00.8'	152° 13.6'	57	115.2	1	1
24 Oct	1004	4	1	60° 38.4'	151° 39.0'	50	161.7	1	1
23 Oct	1006	5	1	59° 35.1'	151° 49.2'	32	110.2	1	1
22 Oct	1758	6	1	59° 36.7'	151° 16.8'	75	162.4	1	1
21 Oct	0907	7	1	59° 29.9'	153° 10.0'	31	44.9	1	1
22 Oct	0403	8	1	59° 15.9'	153° 41.8'	27	152.6	1	1
28 Oct	1244	9	1	59° 02.6'	151° 59.4'	199	706.0	1	1

† averaged

Table 13. Number of Fish Eggs and Larvae at each Station

Lower Cook Inlet Bongo Tows, *Discoverer*, Leg III, 6-13 April 1976

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae
7 Apr	0844	1	1	333	0	4
7 Apr	0844	1	1	505	1	3
7 Apr	1620	2	2	333	0	0
7 Apr	1620	2	2	505	0	0
7 Apr	2239	3	2	333	1	3
7 Apr	2239	3	2	505	2	1
8 Apr	0440	4	1	333	0	0
8 Apr	0440	4	1	505	0	0
8 Apr	1520	5	3	333	0	1
8 Apr	1520	5	3	505	4	5
8 Apr	1635	6	1	333	5	3
8 Apr	1635	6	1	505	0	3
9 Apr	0155	6	5	333	15	7
9 Apr	0155	6	5	505	12	7
10 Apr	0810	7	1	333	16	1
10 Apr	0810	7	1	505	16	2
10 Apr	1536	9	2	333	1	16
10 Apr	1536	9	2	505	2	13
10 Apr	2134	10	1	333	1	2
10 Apr	2134	10	1	505	1	1
11 Apr	1307	11	2	333	1	13
11 Apr	1307	11	2	505	8	8
12 Apr	0355	13	2	333	512	4156
12 Apr	0355	13	2	505	504	3680
12 Apr	1448	13	4	333	2622	8056
12 Apr	1448	13	4	505	3336	8112

1-m NIO Tows (571 μm mesh size)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Eggs	Fish or Larvae
7 Apr	0916	1	2	0	2
7 Apr	1639	2	3	0	2
7 Apr	2217	3	1	1	9

Table 13. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Eggs	Fish or Larvae
8 Apr	0456	4	2	0	1
8 Apr	1507	5	2	2	13
8 Apr	1650	6	2	7	16
9 Apr	0115	6	4	12	24
9 Apr	0210	6	6	28	107
9 Apr	1657	6	7	6	17
9 Apr	1828	6	8	21	14
10 Apr	1515	9	1	1	10
10 Apr	2243	10	2	2	4
12 Apr	0224	13	1	396	5880
12 Apr	0632	13	3	115,200	69
12 Apr	1640	13	5	456	5040

Miscellaneous Net Tows

Date (1976) (GMT)	Time (GMT)	Station	Haul	Net	Eggs	Fish or Larvae
7 Apr	2310	3	3	5 x 6-m NIO	--	195
10 Apr	1607	9	3	Miller	0	0
11 Apr	0631	11	1	3-m NIO	0	109

Table 14. Summary of taxonomic categories of fish eggs, larvae, young and adults found in Bongo, 1-m, 3-m, and 5 x 6-m NIO net samples collected on the Lower Cook Inlet *Discoverer* cruise, Leg III, 6-13 April 1976

A total of 44 samples contained 123,192 fish eggs and 35,601 fish and larvae that were examined. The fish were distributed into 11 families, 15 genera and 12 species. The eggs are distributed into 4 size categories.

Family Ammodytidae

189 larvae sandlance[1] *Ammodytes hexapterus* Pallas

Family Bathylagidae

2745 larvae northern smoothtongue *Bathylagus stilbius* (Gilbert)

Family Cottidae

1 adult marbled sculpin *Oligocottus rimensis* (Greeley)
1 larva genus? species?

Family Gadidae

32,083 larvae Alaska pollock *Theragra chalcogramma* (Pallas)
1 young Pacific tomcod *Microgadus proximus* (Girard)
125 larvae genus? species?

Family Liparidae

2 young marbled snailfish *Liparis dennyi* Jordan and Starks

Family Myctophidae

29 larvae smallfin lanternfish *Stenobrachius leucopsarus* (Eigenmann and Eigenmann)
125 young smallfin lanternfish *Stenobrachius leucopsarus* (Eigenmann and Eigenmann)
11 larvae lanternfish genus? species?

Family Osmeridae

17 larvae capelin *Mallotus villosus* Müller
3 larvae longfin smelt *Spirinchus thaleichthys* (Ayres)
189 young longfin smelt *Spirinchus thaleichthys* (Ayres)
1 adult candlefish *Thaleichthys pacificus* (Richardson)
1 young genus? species?

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[1] The common name is presented for the first time for each species; thereafter only the scientific name is recorded.

Table 14. (continued)

Family Pleuronectidae

1 larva Pacific halibut *Hippoglossus stenolepis* Schmidt

Family Scorpaenidae

18 larvae rockfishes *Sebastes* sp.

Family Stichaeidae

2 larvae cockscomb *Anoplarchus* sp.
1 larva prickleback *Lumpenus* sp.

Family Zoarcidae

8 young pallid eelpout *Lycodapus mandibularis* Gilbert

56 larvae unidentified

123,192 eggs categorized (see Table 15. List of Possible Fish for Egg Size Categories):

16	eggs < 1 mm	(0.74-0.88 mm)
121,419	eggs ∿ 1 mm	(0.90-1.28 mm)
1,635	eggs ∿ 2 mm	(1.30-2.54 mm)
122	eggs ∿ 3 mm	(2.56-3.90 mm)

Table 15. List of possible fish for egg size categories

< 1 mm category (0.74-0.88 mm)

Limanda aspera
Limanda proboscidea

∿ 1 mm category (0.90-1.28 mm)

Gadus macrocephalus
Isopsetta isolepis
Parophrys vetulus
Platichthys stellatus
Psettichthys melanostictus

∿ 2 mm category (1.30-2.54 mm)

Eopsetta jordani
Glyptocephalus zachirus
Lyopsetta exilis
Microstomus pacificus
Pleuronichthys coenosus
Pleuronichthys decurrens
Theragra chalcogramma

∿ 2 mm category (2.56-3.90 mm)

Hippoglossoides elassodon
Hippoglossoides robustus
Hippoglossus stenolepis

Table 16. Identification of Fish Eggs and Larvae by Station

Cook Inlet Bongo Tows, *Discoverer*, Leg III, 06-13 April 1976

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
7 Apr	0844	1	1	333	0[a]	4[a]	1 larva 8.2 mm[b] *Ammodytes hexapterus* 2 larvae 31, 44 mm *Mallotus villosus* 1 larva 4.5 mm *Stenobrachius leucopsarus*
7 Apr	0844	1	1	505	1	3	1 egg ∿ 2 mm (1.44 mm) 2 larvae 6.7, 7.7 mm *Ammodytes hexapterus* 1 larva 45 mm *Mallotus villosus*
7 Apr	2239	3	2	333	1	3	1 egg ∿ 1 mm (1.14 mm) 3 larvae 7.0 mm *Ammodytes hexapterus*
7 Apr	2239	3	2	505	2	1	2 eggs ∿ 1 mm (1.10 mm) 1 larva 7.0 mm *Ammodytes hexapterus*

[a] All specimens are classified into four main categories: eggs include all stages of eggs prior to hatching; larvae include newly hatched and all stages prior to metamorphosis; young include fish after metamorphosis to acquisition of adult fin rays and adult body configuration; adults include fish that are sexually mature.

[b] Eggs are measured to the nearest hundredths of a millimeter in diameter. Fish or larvae, if less than 10 mm in length, are measured to the nearest tenth of a millimeter under a microscope using a calibrated micrometer eye piece. If 10 mm or greater in length, the fish or larvae are measured by a metric ruler to the nearest millimeter. When there are more than three eggs, fish or larvae, the largest and the smallest are measured. Larvae are measured by standard length.

Table 16. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
8 Apr	1520	5	3	333	0	1	1 larva 9.0 mm *Sebastes* sp.
8 Apr	1520	5	3	505	4	5	4 eggs ∿ 1 mm (1.10 mm) 1 larva 7.0 mm damaged, probably *Ammodytes hexapterus* 4 larvae 8.0-9.0 mm *Sebastes* sp.
8 Apr	1635	6	1	333	5	3	5 eggs ∿ 1 mm (1.03 mm) 2 larvae 4.8, 5.6 mm *Ammodytes hexapterus* 1 larva 14 mm Myctophidae
8 Apr	1635	6	1	505	0	3	2 larvae 4.8, 6.1 mm *Ammodytes hexapterus* 1 larva 28 mm *Mallotus villosus*
9 Apr	0155	6	5	333	15	7	14 eggs ∿ 1 mm (1.03 mm) 1 egg ∿ 2 mm (1.36 mm) 6 larvae 6.0-8.0 mm *Ammodytes hexapterus* 1 larva 16 mm Myctophidae
9 Apr	0155	6	5	505	12	7	11 eggs ∿ 1 mm (1.10 mm) 1 egg ∿ 2 mm (1.40 mm) 6 larvae 4.8-7.5 mm *Ammodytes hexapterus* 1 larva 18 mm Myctophidae

Table 16. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
10 Apr	0810	7	1	333	16	1	16 eggs ∿ 1 mm (1.03 mm) 1 larva 5.0 mm *Ammodytes hexapterus*
10 Apr	0810	7	1	505	16	2	16 eggs ∿ 1 mm (1.03 mm) 2 larvae 6.0 mm *Ammodytes hexapterus*
10 Apr	1536	9	2	333	1	16	1 egg ∿ 1 mm (1.10 mm) 1 larva 6.0 mm *Ammodytes hexapterus* 3 larvae 35, 42, 45 mm *Mallotus villosus* 7 larvae approximately 4 mm *Theragra chalcogramma* 5 larvae 3.2-7.0 mm elongate, damaged and unidentified
10 Apr	1536	9	2	505	2	13	2 eggs ∿ 2 mm (1.44 mm) 1 larva 9.0 mm *Bathylagus stilbius* 3 larvae 40-43 mm *Mallotus villosus* 5 larvae 4.0-4.4 mm *Theragra chalcogramma* 4 larvae 4.0-6.0 mm unidentified
10 Apr	2134	10	1	333	1	2	1 egg ∿ 1 mm (1.20 mm) 1 larva 5.0 mm Myctophidae 1 larva 5.0 mm with 2 dorsal bands, unidentified

Table 16. (continued)

Date (1976 (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
10 Apr	2134	10	1	505	1	1	1 egg ∿ 1 mm (1.20 mm)
							1 larva 4.0 mm *Ammodytes hexapterus*
11 Apr	1307	11	2	333	1	13	1 egg ∿ 1 mm (egg not measured)
							4 larvae 6.0 mm *Stenobrachius leucopsarus*
							9 young 19-36 mm *Stenobrachius leucopsarus*
11 Apr	1307	11	2	505	8	8	8 eggs < 1 mm (0.70-0.98 mm)
							1 larva 13 mm *Hippoglossus stenolepis*
							7 young 21-50 mm *Stenobrachius leucopsarus*
12 Apr	0355	13	2	333	512	4156[c]	500 eggs ∿ 2 mm (1.24-1.56 mm)
							12 eggs ∿ 3 mm (2.40-3.10 mm)
							748 larvae 7.2-10 mm *Bathylagus stilbius*
							3320 larvae approx. 5-6 mm *Theragra chalcogramma*
							84 larvae 5.0-5.4 mm Gadidae
							4 larvae 10 mm unidentified
12 Apr	0355	13	2	505	504[d]	3680[d]	480 eggs ∿ 1 mm (1.20-1.30 mm)

[c] Approximately ¼ of the sample was sorted for fish eggs and larvae; 123 eggs and 1037 larvae were identified.
[d] Approximately ½ of the sample was sorted for fish eggs and larvae; 252 eggs and 1840 larvae were identified.

Table 16. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
12 Apr	0355	13	2	505	504	3680	18 eggs ∿ 2 mm (1.68-1.80 mm)
							6 eggs ∿ 3 mm (2.44-3.10 mm)
							2 larvae 7.0 mm *Anoplarchus* sp.
							648 larvae 7.0-11 mm *Bathylagus stilbius*
							3030 larvae 4.0-8.0 mm *Theragra chalcogramma*
12 Apr	1448	13	4	333	2622[e]	8056[e]	2546 eggs ∿ 1 mm (1.20-1.30 mm)
							76 eggs ∿ 2 mm (1.90-2.00 mm)
							532 larvae 8.0-10 mm *Bathylagus stilbius*
							7524 larvae 4.0-6.0 mm extensively damaged *Theragra chalcogramma*
12 Apr	1448	13	4	505	3336[f]	8112[f]	3048 eggs ∿ 1 mm (1.20-1.35 mm)
							264 eggs ∿ 2 mm (1.60-1.75 mm)
							24 eggs ∿ 3 mm (2.72-3.00 mm)
							816 larvae 5.6-10 mm *Bathylagus stilbius*
							8 young 115 mm *Lycodapus mandibularis*

[e] Total sample had 9-32 oz. jars; settling volume for whole sample was 4.8 liters. Approximately 126 ml was taken from one jar to sort for fish eggs and larvae. The count was 69 eggs and 212 larvae for 1/38 of the sample.

[f] Approximately 1/8 of the sample was sorted for fish eggs and larvae; 417 eggs and 1014 larvae were identified.

Table 16. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
12 Apr	1448	13	4	505	3336	8112	7272 larvae 3.0-5.6 mm *Theragra chalcogramma*
							16 larvae 6.0, 11 mm unidentified

Table 17. Identification of Fish Eggs and Larvae by Station
1-m NIO Tows (571 μm mesh size), *Discoverer*, Leg III

Date (1976) (GMT)	Time (GMT)	Station	Haul	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
7 Apr	0916	1	2	0	2	2 larvae 5.0, 7.0 mm *Ammodytes hexapterus*
7 Apr	1639	2	3	0	2	1 larva 5.0 mm *Ammodytes hexapterus*
						1 larva 9.0 mm *Sebastes* sp.
7 Apr	2217	3	1	1	9	1 egg ∿ 1 mm (1.10 mm)
						9 larvae 7.0 mm *Ammodytes hexapterus*
8 Apr	0456	4	2	0	1	1 larva 6.0 mm *Ammodytes hexapterus*
8 Apr	1507	5	2	2	13	2 eggs ∿ 1 mm (1.10 mm)
						5 larvae 5.0-6.0 mm *Ammodytes hexapterus*
						2 larvae 28, 31 mm *Mallotus villosus*
						2 larvae 8.0 mm *Sebastes* sp.
						4 larvae 11-14 mm Myctophidae
8 Apr	1650	6	2	7	16	7 eggs ∿ 1 mm (1.03 mm)
						15 larvae 4.4-6.8 mm *Ammodytes hexapterus*
						1 larva 18 mm Myctophidae
9 Apr	0115	6	4	12	24	8 eggs ∿ 1 mm (1.10 mm)
						4 eggs ∿ 2 mm (1.40 mm)

Table 17. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
9 Apr	0115	6	4	12	24	20 larvae 4.0-7.2 mm *Ammodytes hexapterus*
						4 larvae 32-40 mm *Mallotus villosus*
9 Apr	0210	6	6	28	107	28 eggs ∿ 1 mm (1.03-1.10 mm)
						79 larvae 5.0-6.0 mm *Ammodytes hexapterus*, many damaged
						3 larvae 25, 25, 28 mm *Spirinchus thaleichthys*
						22 larvae 10-16 mm *Stenobrachius leucopsarus*
						1 larva 17 mm *Lumpenus* sp.
						1 larva 5.6 mm Cottidae
						1 larva 13 mm unidentified
9 Apr	1657	6	7	6	17	5 eggs ∿ 1 mm (1.03 mm)
						1 egg ∿ 2 mm (1.40 mm)
						15 larvae 5.6-7.2 mm *Ammodytes hexapterus*
						2 larvae 16 mm *Stenobrachius leucopsarus*
9 Apr	1828	6	8	21	14	19 eggs ∿ 1 mm (1.03 mm)
						2 eggs ∿ 2 mm (1.40 mm)
						13 larvae 5.0-6.0 mm *Ammodytes hexapterus*, some badly damaged
						1 larva 30 mm *Mallotus villosus*

Table 17. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
10 Apr	1515	9	1	1	10	1 egg ∿ 1 mm (1.10 mm) 9 larvae 5.0-10 mm *Sebastes* sp. 1 larva damaged Myctophidae
10 Apr	2243	10	2	2	4	1 egg ∿ 1 mm (0.96 mm) 1 egg ∿ 2 mm (1.40 mm) 1 larva 11 mm *Sebastes* sp. 1 larva 4.4 mm *Theragra chalcogramma* 1 larva 3.4 mm Myctophidae 1 larva 6.0 mm with two dorsal bars unidentified (similar to larva in st. #10, haul 1).
12 Apr	0224	13	1	396[a]	5880[a]	8 eggs < 1 mm (0.80 mm) 340 eggs ∿ 2 mm (1.32-1.40 mm) 48 eggs ∿ 3 mm (2.95-3.95 mm) 5880 larvae 5.0-6.0 mm *Theragra chalcogramma*
12 Apr	0632	13	3	115,200[b]	69	115,200 eggs ∿ 1 mm (1.20-1.30 mm) with one 0.16 mm oil globule

[a] Approximately ¼ of the sample was sorted for fish eggs and larvae; 99 eggs and 1470 larvae were identified.

[b] Total sample included three one-gallon jars, two of the three jars were broken in transit. Settling volume for one jar was 2.4 liters. Sample jar was hand shaken and approx. 116 ml settled volume, approx. 1/60 of the sample, was sorted. The count was 1920 eggs.

Table 17. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
12 Apr	0632	13	3	155,200	69	4 larvae 4.0-5.0 mm *Theragra chalcogramma*
						41 larvae 4.8-5.8 mm Gadidae (some damaged larvae)
						1 larva 4.5 mm unidentified (non-elongate)
						1 larva 2.1 mm unidentified (very early embryo that escaped from a ruptured egg)
						22 larvae unidentified due to extensive damage (non-elongate)
12 Apr	1640	13	5	456[c]	5040[c]	424 eggs ∿ 2 mm (1.28-1.36 mm)
						32 eggs ∿ 3 mm (3.00-3.60 mm)
						5040 larvae 4.8-5.5 mm *Theragra chalcogramma*

[c] Approximately 1/8 of the sample was sorted for fish eggs and larvae; 57 eggs and 630 larvae were identified.

Table 18. Identification of Fish and Larvae by Station

Gulf of Alaska Miscellaneous Net Tows, *Discoverer*, Leg III

Date (1976) (GMT)	Time (GMT)	Station	Haul	Depth (m)	Net	Fish or Larvae	Identification of Fish or Larvae
7 Apr	2310	3	3	50	5 x 6-m NIO	195	2 young 65 mm *Liparis dennyi*
							1 young 90 mm *Microgadus proximus*
							1 adult 65 mm *Oligocottus rimensis*
							189 young 46-106 mm *Spirinchus thaleichthys*
							1 adult 185 mm *Thaleichthys pacificus*
							1 young 53 mm Osmeridae
11 Apr	0631	11	1	35	3-m NIO	109	109 young *Stenobrachius leucopsarus*

Table 19. Summary of taxonomic categories of commercially important crab and shrimp larvae found in Bongo, 1-m, 3-m, and 5 x 6-m NIO net samples collected on the Lower Cook Inlet, *Discoverer* cruise, Leg III, 6-13 April 1976

A total of 44 samples contained 311 crab zoea and 28 megalopae, distributed into 3 families, 3 genera, and 2 species. The 44 samples contained 1702 adult shrimp and 1200 zoea, distributed into 1 family, 2 genera, and 5 species.

Section Anomura

Family Lithodidae

47 zoea king crab[1] *Paralithodes camtschatica* (Tilesius)

131 zoea unidentified, non-commercially important anomurans

Section Brachyura

Family Cancridae

2 zoea unidentified non-commercially important *Cancer* spp.

Family Majidae

25 zoea tanner crab *Chionoecetes opilio* (O. Fabricius)
28 megalopae *Chionoecetes* spp.

106 zoea unidentified, non-commercially important brachyurans

Section Caridea

Family Pandalidae

40 zoea sidestripe shrimp *Pandalopsis dispar* Rathbun
402 zoea northern pink shrimp *Pandalus borealis* Kröyer
15 zoea humpy shrimp *Pandalus goniurus* Stimpson
1 adult *Pandalus goniurus*
2 zoea *Pandalus montagui tridens* Rathbun
1 zoea *Pandalus stenolepis* Rathbun
3 zoea *Pandalus* spp., damaged

737 zoea unidentified hippolytids
1701 adult non-commercially important shrimp

[1] The common name is presented for the first time for each species; thereafter only the scientific name is recorded.

Table 20. Identification of Shrimp and Crab Larvae by Station
Lower Cook Inlet Bongo Tows, *Discoverer*, Leg III, 06-13 April 1976

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
7 Apr	0844	1	1	333		6	unidentified anomurans
7 Apr	0844	1	1	505		2	unidentified anomurans
7 Apr	1620	2	2	333		0	
7 Apr	1620	2	2	505		0	
7 Apr	2239	3	2	333		0	
7 Apr	2239	3	2	505		0	
8 Apr	0440	4	1	333		0	
8 Apr	0440	4	1	505		0	
8 Apr	1520	5	3	333		0	
8 Apr	1520	5	3	505	IV	1	*Cancer oregonensis*
8 Apr	1635	6	1	333	I	3	*Paralithodes camtschatica*
						2	unidentified anomurans
8 Apr	1635	6	1	505	I	1	*Paralithodes camtschatica*
						1	unidentified anomuran
9 Apr	0155	6	5	333	I	3	*Paralithodes camtschatica*

Table 20. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (µm)	Stage	Total	Identification of Larvae
9 Apr	0155	6	5	333		14	unidentified anomurans
					I	2	*Pandalus borealis*
					I	1	*P. goniurus*
9 Apr	0155	6	5	505	II	1	*Paralithodes camtschatica*
						13	unidentified anomurans
					I	1	*Pandalopsis dispar*
10 Apr	0810	7	1	333		0	
10 Apr	0810	7	1	505	Adult	1	*Pandalus goniurus*
10 Apr	1536	9	2	333	Megalopa	2	*Chionoecetes* sp.
					I	1	*Pandalopsis dispar*
10 Apr	1536	9	2	505	I	1	*Pandalus montagui tridens*
10 Apr	2134	10	1	333	Megalopa	1	*Chionoecetes* sp.
10 Apr	2134	10	1	505		0	
11 Apr	1307	11	2	333	Megalopa	5	*Chionoecetes* sp.
						1	unidentified brachyuran
					Adult	1	*Sergestes* sp.
11 Apr	1307	11	2	505	Megalopa	2	*Chionoecetes* sp.
12 Apr	0355	13	2	333	I	10	*Chionoecetes opilio*
					Megalopa	1	*Chionoecetes* sp.
						28	unidentified anomurans

Table 20. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
12 Apr	0355	13	2	333		5	unidentified brachyurans
					I	4	*Pandalopsis dispar*
					I	79	*Pandalus borealis*
					II	2	*P. borealis*
					I	1	*P. goniurus*
					I	1	*P. stenolepis*
						36	unidentified hippolytids
12 Apr	0355	13	2	505		12	unidentified anomurans
						3	unidentified brachyurans
					I	3	*Pandalopsis dispar*
					I	53	*Pandalus borealis*
					II	4	*P. borealis*
					I	3	*P. goniurus*
						111	unidentified hippolytids
12 Apr	1448	13	4	333	I	9	*Chionoecetes opilio*
						14	unidentified anomurans
						4	unidentified brachyurans
					I	15	*Pandalopsis dispar*
					I	22	*Pandalus borealis*
					II	2	*P. borealis*
						205	unidentified hippolytids
					Adult	7	*Pasiphaea* sp.
12 Apr	1448	13	4	505		5	unidentified anomurans
						5	unidentified brachyurans
					I	9	*Pandalopsis dispar*

Table 20. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
12 Apr	1448	13	4	505	I	18	*Pandalus borealis*
					II	5	*P. borealis*
						147	unidentified hippolytids
					Adult	9	*Pasiphaea* sp.

Table 21. Identification of Shrimp and Crab Larvae by Station
Lower Cook Inlet 1-m NIO Net Tows

Date (1976) (GMT)	Time (GMT)	Station	Haul	Stage	Total	Identification of Larvae
7 Apr	0916	1	2		0	
7 Apr	1639	2	3		0	
7 Apr	2217	3	1	Adult	7	*Crangon franciscorum angustimana* (2 gravid females)
8 Apr	0456	4	2		0	
8 Apr	1507	5	2	I	1	*Pandalopsis dispar*
				I	9	*Pandalus borealis*
8 Apr	1650	6	2		2	unidentified anomurans
					19	unidentified brachyurans
				I	2	*Pandalus borealis*
				I	1	*P. goniurus*
					6	unidentified hippolytids
9 Apr	0115	6	4	I	19	*Paralithodes camtschatica*
					6	unidentified anomuran
					38	unidentified brachyurans
				I	3	*Pandalus goniurus*
					9	unidentified hippolytids
9 Apr	0210	6	6	Megalopa	1	*Chionoecetes* sp.
				I	21	*Paralithodes camtschatica*
					4	unidentified anomurans

Table 21. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Stage	Total	Identification of Larvae
9 Apr	0210	6	6		14	unidentified brachyurans
9 Apr	1657	6	7		0	
9 Apr	1828	6	8		9	unidentified brachyrans
				I	1	*Pandalus borealis*
				I	2	*P. goniurus*
					5	unidentified hippolytids
10 Apr	1515	9	1	Megalopa	11	*Chionoecetes* sp.
					1	unidentified hippolytids
10 Apr	2243	10	2	Megalopa	5	*Chionoecetes* sp.
					1	unidentified anomuran
12 Apr	0224	13	1	II	1	unidentified *Cancer* sp.
				I	6	*Chionoecetes opilio*
				I	2	*Paralithodes camtschatica*
					20	unidentified anomurans
					8	unidentified brachyurans
				I	3	*Pandalopsis dispar*
				I	154	*Pandalus borealis*
				II	4	*P. borealis*
				I	1	*P. goniurus*
				I	1	*P. montagui tridens*
					121	unidentified hippolytids

Table 21. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Stage	Total	Identification of Larvae
12 Apr	0632	13	3		1	unidentified anomuran
				I	2	*Pandalopsis dispar*
				I	33	*Pandalus borealis*
				I	3	unidentified *Pandalus* sp., damaged
					15	unidentified hippolytids
12 Apr	1640	13	5	I	1	*Pandalopsis dispar*
				I	12	*Pandalus borealis*
				I	3	*P. goniurus*
					81	unidentified hippolytids

Table 22. Identification of Shrimp and Crab Larvae by Station

Lower Cook Inlet Misc. Net Tows

Date (1976) (GMT)	Time (GMT)	Station	Haul	Net	Stage	Total	Identification of Larvae
7 Apr	2310	3	3	5 x 6-m NIO	Adult	1	*Crangon alaskensis*
					Adult	1629	*Crangon franciscorum angustimana*
					Adult	1	*Eualus suckleyi*
					Adult	777	*Boreomysis* sp.
10 Apr	1607	9	3	Miller		0	
11 Apr	0631	11	1	3-m NIO	Adult	46	*Sergestes* sp.

Phytoplankton was present in every bongo net sample. At times the quantity was sufficient to partially clog the nets. Noticeable amounts of ichthyoplankton were caught in the bongo nets at stations 1, 5, and 6. Two bongo samples at station 6 appeared to be predominantly ichthyoplankton. These samples were obtained at approximately 0830 (ADT). Zoea were apparent, particularly during the second occupation of station 5 located in the vicinity of the gyre reported by the Alaska Department of Fish and Game. Other stations yielded some euphausids, large shrimp, and copepods, usually in concentrations too small to make any appreciable trace on the Ross echosounder chart record.

The 1-m NIO net sample at station 6 was not obviously different from the bongo net samples taken at that station.

The fish eggs and larvae have been sorted and identified from these samples (Tables 23-26). Crabs and shrimps are identified from stations 1, 2, 5, 6, and 9 only (Tables 27-28).

C. *Discoverer*, Leg VII

The new V-fin depressor and transducer were tested while underway for station 1. They were deployed over the starboard side of the ship utilizing the outboard towing device. To test the effect of interference generated by the ship's propeller on the Ross system and the stability of the V-fin depressor, the ship's speed was slowly increased to 8 knots and then to 10 knots. At all times only the port propeller was in use to help reduce interference. The V-fin depressor towed well at all speeds and did not need any adjustment. The chart recorder showed some interference that increased with the speed of the ship. A total of 1,137 minutes of chart records was made. Only the recordings at station 5a and the transect between stations 5a and 6, a total of 180 minutes, will be usable due to internal interference in the Ross system. Fifteen minutes of magnetic tape records were made.

The fish eggs and larvae have been sorted and identified for all stations except station 11 (Tables 29-31). Crabs and shrimps are identified from stations 1, 2, 5, and 6 only (Tables 32-33).

D. *Acona*, Leg II

The *Acona*'s hull-mounted transducer in conjunction with our Ross recording system, was in operation continuously while the vessel was underway. This gave a sonic chart record of a transect up Cook Inlet, a cross-sectional sonic view of Cook Inlet, and a transect out to the Gulf of Alaska station and then back into Kodiak. The interference lines on the chart record were from the Ross fathometer on the bridge. A total of 9330 minutes of chart records was made, 3663 minutes of which were recorded on station. 103 minutes of magnetic tape records were made.

The fish eggs and larvae have been sorted and identified for all stations except stations 4, 6, 7, 8, and 11 (Tables 34-36). Crabs and shrimps have not yet been identified.

Table 23. Number of fish eggs and larvae at each station Lower Cook Inlet, *Discoverer*, Leg V, 05-09 May 1976

Bongo Tows

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae
6 May	1325	1	1	333	42	34
6 May	1325	1	1	505	28	33
6 May	1552	2	1	333	0	26
6 May	1552	2	1	505	3	13
6 May	2117	3	1	333	41	12
6 May	2117	3	1	505	37	14
7 May	0259	4	1	333	0	3
7 May	0259	4	1	505	0	2
7 May	1030	5	2	333	40	119
7 May	1030	5	2	505	136	852
7 May	1312	6	1	333	992	290
7 May	1312	6	1	505	1616	326
7 May	1709	6	2	333	1296	352
7 May	1709	6	2	505	364	236
8 May	0020	5a	1	333	48	182
8 May	0020	5a	1	505	50	162
8 May	0402	7	1	333	54	4
8 May	0402	7	1	505	60	8
8 May	0734	8	1	333	360	17
8 May	0734	8	1	505	353	20
8 May	1315	9	1	333	22	18
8 May	1315	9	1	505	21	17
9 May	0145	11	1	333	11	44
9 May	0145	11	1	505	11	24

1-m NIO Tows

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae
7 May	1757	6	3	571	1096	352

Table 24. Summary of taxonomic categories of fish eggs, larvae, young and adults found in Bongo and 1-m NIO net samples collected on Lower Cook Inlet, *Discoverer* cruise, Leg V, 05-09 May 1976

A total of 25 samples were collected. The fish are distributed into 15 families, 17 genera and 11 species. The eggs are distributed into 4 size categories.

Family Agonidae

24 larvae genus? species?

Family Ammodytidae

1370 larvae sandlance[1] *Ammodytes hexapterus* Pallas

Family Bathymasteridae

4 larvae blacksmelt *Bathylagus* spp.?
18 larvae genus? species?

Family Cottidae

3 larvae cabezon *Scorpaenichthys marmoratus* (Ayres)
118 larvae genus? species?

Family Cyclopteridae

12 larvae genus? species?

Family Gadidae

20 larvae Alaska pollock *Theragra chalcogramma* (Pallas)
74 larvae genus? species?

Family Liparidae

1 larva snailfish *Liparis* sp.

Family Myctophidae

21 larvae northern lampfish *Stenobrachius Leucopsarus* (Eigenmann and Eigenmann)
6 larvae genus? species?

Family Osmeridae

11 larvae capelin *Mallotus villosus* (Müller)

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[1] The common name is presented for the first time for each species; thereafter only the scientific name is recorded.

Table 24. (continued)

Family Osmeridae

4 larvae longfin smelt *Spirinchus thaleichthys* (Ayres)
11 larvae genus? species?

Family Pholidae

4 larvae penpoint gunnel *Apodichthys flavidus* Girard
4 larvae gunnel *Pholis* sp.
78 larvae genus? species?

Family Pleuronectidae

1 larva sole *Hippoglossoides* sp.
10 larvae butter sole *Isopsetta isolepis* (Lockington)
4 larvae rock sole *Lepidopsetta bilineata* (Ayres)?
11 larvae slender sole *Lyopsetta exilis* (Jordan and Gilbert)

Family Scorpaenidae

16 larvae rockfish *Sebastes* sp.
3 larvae genus? species?

Family Stichaeidae

10 larvae cockscomb *Anoplarchus* sp.
1137 larvae prickleback *Lumpenus* spp.
2 larvae rock prickleback *Xiphister mucosus* (Girard)

Family Tetragonuridae

1 larva genus? species?

176 larvae unidentified

6675 eggs categorized (see Table 15. List of possible fish for egg size categories):

12 eggs $<$ 1 mm (0.74-0.88 mm)
6526 eggs $\sim$ 1 mm (0.90-1.28 mm)
64 eggs $\sim$ 2 mm (1.30-2.54 mm)
81 eggs $\sim$ 3 mm (2.56-3.90 mm)
2 eggs unidentified, damaged

Table 25. Identification of Fish Eggs and Larvae by Station

Lower Cook Inlet Bongo Tows, *Discoverer*, Leg V, 05-09 May 1976

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
6 May	1325	1	1	333	42[a]	34[a]	2 eggs ∿ 2 mm (1.60 mm)[b]
							38 eggs ∿ 3 mm (2.90-3.20 mm)
							2 eggs damaged unidentified
							4 larvae 32, 42 mm *Mallotus villosus*
							2 larvae 9.7 mm *Sebastes* sp.
							8 larvae 4.4 mm *Stenobrachius leucopsarus*
							8 larvae 3.6-5.2 mm *Theragra chalcogramma*
							6 larvae 5.5 mm Myctophidae
							2 larvae 10 mm unidentified (elongate)
							4 larvae unidentified due to extensive damage

[a] All specimens are classified into four main categories: eggs include all stages of eggs prior to hatching; larvae include newly hatched and all stages prior to metamorphosis; young include fish after metamorphosis to acquisition of adult fin rays and adult body configuration; adults include fish that are sexually mature. Approximately ½ of sample was sorted for fish eggs and larvae; 21 eggs and 17 larvae were identified.

[b] Eggs are measured to the nearest hundredths of a millimeter in diameter. Fish or larvae, if less than 10 mm in length, are measured to the nearest tenth of a millimeter under a microscope using a calibrated micrometer eye piece. If 10 mm or greater in length, the fish or larvae are measured by a metric ruler to the nearest millimeter. When there are more than three eggs, fish or larvae, the largest and the smallest are measured. Larvae are measured by standard length.

Table 25. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
6 May	1325	1	1	505	28	33	3 eggs ∿ 1 mm (1.28 mm)
							25 eggs ∿ 3 mm (2.97-3.52 mm) (23 whole eggs, 2 yolksac embryos without membrane)
							4 larvae 7.2-54 mm *Mallotus villosus*
							7 larvae 4.0-4.7 mm *Stenobrachius leucopsarus*
							4 larvae 3.6-5.2 mm *Theragra chalcogramma*
							8 larvae 6.0-7.0 mm Bathymasteridae
							2 larvae 8.8, 11 Gadidae
							4 larvae 4.1-7.1 mm Gadidae
							1 larva 8.0 mm Scorpaenidae
							4 larvae 5.0 mm damaged, unidentified
6 May	1552	2	1	333	0	26	4 larvae 7.7-18 mm *Sebastes* sp.
							2 larvae 6.0 mm *Stenobrachius leucopsarus*
							2 larvae 3.8 mm *Theragra chalcogramma*
							2 larvae 5.6-18 mm Bathymasteridae
							1 larva 5.6 mm Cottidae
							5 larvae 3.8-5.0 mm Gadidae
							9 larvae 7.7-8.1 mm Osmeridae
							1 larva 6.0 mm Scorpaenidae

Table 25. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
6 May	1552	2	1	505	3	13	1 egg < 1 mm (0.93 mm)
							2 eggs ∿ 2 mm (1.68 mm)
							5 larvae 7.0-9.0 mm *Ammodytes hexapterus*
							2 larvae 4.8 mm *Sebastes* sp.
							2 larvae 3.8, 4.0 mm *Theragra chalcogramma*
							3 larvae 4.0 mm Gadidae
							1 larva 5.6 mm Scorpaenidae
6 May	2117	3	1	333	41	12	36 eggs ∿ 1 mm (0.97-1.10 mm)
							5 eggs ∿ 2 mm (1.33-1.50 mm)
							9 larvae 4.8-6.0 mm *Ammodytes hexapterus*
							2 larvae 3.6, 4.0 mm Cottidae
							1 larva 4.8 mm damaged, unidentified
6 May	2117	3	1	505	37	14	33 eggs ∿ 1 mm (0.93-1.10 mm)
							4 eggs ∿ 2 mm (1.30-1.40 mm)
							13 larvae 4.4-7.7 mm *Ammodytes hexapterus*
							1 larva 4.0 mm Cottidae
7 May	0259	4	1	333	0	3	1 larva 4.4 mm Cottidae
							1 larva ∿ 5 mm damaged Gadidae
							1 larva > 6 mm extensively damaged, elongate, unidentified

Table 25. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
7 May	0259	4	1	505	0	2	2 larvae 5.2 mm *Ammodytes hexapterus*
7 May	1030	5	2	333	40	119	36 eggs ∿ 1 mm (0.96-1.20 mm)
							4 eggs ∿ 2 mm (1.76-1.91 mm)
							63 larvae 5.0-10 mm *Ammodytes hexapterus*
							1 larva 9.0 mm *Liparis* sp.
							24 larvae 12-23 mm *Lumpenus* spp.
							1 larva 40 mm *Mallotus villosus*
							1 larva 10 mm *Scorpaenichthys marmoratus*
							3 larvae 9.0 mm Agonidae
							2 larvae 9.0-10 mm Cottidae
							1 larva 10 mm Cottidae
							20 larvae 10-15 mm Pholidae
							1 larva 10 mm Tetragonuridae
							2 larvae 5.0 mm unidentified
7 May	1030	5	2	505	136[c]	852[c]	124 eggs ∿ 1 mm (0.96-1.20 mm)
							12 eggs ∿ 2 mm (1.52-1.92 mm)
							486 larvae 6.0-10 mm *Ammodytes hexapterus*
							134 larvae 12-24 mm *Lumpenus* spp.
							2 larvae 43 mm *Mallotus villosus*

[c] Approximately ½ of sample was sorted for fish eggs and larvae; 68 eggs and 436 larvae were identified.

Table 25. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
7 May	1030	5	2	505	136	852	2 larvae 10 mm *Scorpaenichthys marmoratus*
							4 larvae 9.3 mm *Sebastes* sp.
							4 larvae ∿ 29 mm *Spirinchus thaleichthys*
							4 larvae 4.8 mm *Theragra chalcogramma*
							16 larvae 8.1-10 mm Agonidae
							8 larvae Bathymasteridae
							10 larvae 9.0-12 mm Cottidae
							18 larvae 3.7-5.1 mm Cottidae
							18 larvae 4.0-8.5 mm Cottidae
							38 larvae 4.8-6.2 mm Cottidae
							8 larvae 8.0-12 mm Cottidae
							12 larvae 3.2-4.0 mm Gadidae
							76 larvae 9.0-11 mm Pholidae
							4 larvae 9.0, 10 mm unidentified
							8 larvae unidentified
8 May	0020	5a	1	333	48	182	45 eggs ∿ 1 mm (0.96-1.03 mm)
							3 eggs ∿ 2 mm (1.28-1.36)
							159 larvae 7.0-10 mm *Ammodytes hexapterus*
							12 larvae 12-24 mm *Lumpenus* spp.

Table 25. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
8 May	0020	5a	1	333	48	182	3 larvae 3.7, 3.8, 4.8 mm *Isopsetta isolepis*
							1 larva 8.2 mm Agonidae
							5 larvae 4.7-9.6 mm Cottidae
							1 larva 7.9 mm Cottidae
							1 larva unidentified due to extensive damage (elongate)
8 May	0020	5a	1	505	50	162	48 eggs ∿ 1 mm (0.91-1.10 mm)
							2 eggs ∿ 2 mm (1.30, 1.69 mm)
							143 larvae 5.7-8.5 mm *Ammodytes hexapterus*
							6 larvae 4.0-5.9 mm *Isopsetta isolepis*
							6 larvae 12-21 mm *Lumpenus* spp.
							6 larvae 5.0-8.4 mm Cottidae
							1 larva 7.4 mm Cottidae
7 May	1312	6	1	333	992[d]	290[d]	992 eggs ∿ 1 mm (0.96-1.10 mm)
							84 larvae 4.0-6.3 mm *Ammodytes hexapterus*
							184 larvae 9.0-14 mm *Lumpenus* spp.

[d] Approximately ½ of sample was sorted for fish eggs and larvae; 496 eggs and 145 larvae were identified.

Table 25. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
7 May	1312	6	1	333	992	290	2 larvae 4.4 mm *Sebastes* sp.
							2 larvae 20 mm *Xiphister mucosus*
							18 larvae unidentified due to extensive damage (elongate)
7 May	1312	6	1	505	1616[e]	326[e]	1616 eggs ∿ 1 mm (0.98-1.10 mm)
							96 larvae 4.3-7.7 mm *Ammodytes hexapterus*
							184 larvae 9.0-18 mm *Lumpenus* spp.
							4 larvae 8.1-9.5 mm *Pholis* sp.
							2 larvae 30 mm Osmeridae
							40 larvae unidentified due to extensive damage (elongate)
7 May	1709	6	2	333	1296[f]	352[f]	1280 eggs ∿ 1 mm (0.96-1.08 mm)
							16 eggs ∿ 2 mm (1.40-1.83 mm)
							92 larvae 5.1-8.3 mm *Ammodytes hexapterus*
							220 larvae 9.7-17 mm *Lumpenus* spp.
							4 larvae 4.2 mm Cottidae

[e] Approximately ½ of sample sorted for fish eggs and larvae; 808 eggs and 163 larvae were identified

[f] Approximately 1/8 of sample sorted for fish eggs and 1/4 of sample sorted for larvae; 162 eggs and 88 larvae were identified.

Table 25. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
7 May	1709	6	2	333	1296	352	12 larvae 3.3-3.7 mm Cyclopteridae 24 larvae unidentified due to extensive damage (elongate)
7 May	1709	6	2	505	364[g]	236[g]	362 eggs ∿ 1 mm (0.96-1.10 mm) 2 eggs ∿ 2 mm (1.95 mm) 44 larvae 4.4-7.3 mm *Ammodytes hexapterus* 4 larvae 8.2-9.5 mm *Apodichthys flavidus* 154 larvae 9.6-21 mm *Lumpenus* spp. 34 larvae unidentified due to extensive damage (elongate)
8 May	0402	7	1	333	54[h]	4[h]	54 eggs ∿ 1 mm (1.00-1.20 mm) 2 larvae 8.4 mm *Ammodytes hexapterus* 2 larvae 10 mm *Lumpenus* sp.
8 May	0402	7	1	505	60[i]	8[i]	56 eggs ∿ 1 mm (1.06-1.24 mm) 4 eggs ∿ 2 mm (1.36 mm) 8 larvae unidentified due to extensive damage (1 elongate and 1 non-elongate)

[g] Approximately ½ of sample was sorted for fish eggs and larvae; 182 eggs and 118 larvae were identified.

[h] Approximately ½ of sample was sorted for fish eggs and larvae; 27 eggs and 2 larvae were identified.

[i] Approximately ¼ of sample was sorted for fish eggs and larvae; 15 eggs and 2 larvae were identified.

Table 25. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
8 May	0734	8	1	333	360[j]	17	358 eggs ∿ 1 mm (0.92-1.30 mm)
							2 eggs ∿ 2 mm (1.36 mm)
							17 larvae 6.9-9.0 mm *Ammodytes hexapterus*
8 May	0734	8	1	505	353	20	346 eggs ∿ 1 mm (0.94-1.24 mm)
							7 eggs ∿ 2 mm (1.34-1.64 mm)
							18 larvae 3.4-4.5 mm *Ammodytes hexapterus*
							1 larva 9.7 mm *Lumpenus* sp.
							1 larva 3.7 mm *Lepidopsetta bilineata* (?)
8 May	1315	9	1	333	22	18	11 eggs ∿ 1 mm (0.94-1.16 mm)
							1 egg ∿ 2 mm (1.40 mm)
							10 eggs ∿ 3 mm (2.80-3.84 mm)
							4 larvae 5.8-6.0 mm *Anoplarchus* sp.
							2 larvae 3.3, 3.9 mm *Lepidopsetta bilineata*
							2 larvae 5.1, 6.3 mm Cottidae
							1 larva 4.4 mm Gadidae
							1 larva 5.3 mm unidentified (intense body pigment)
							8 larvae unidentified due to extensive damage (all elongate)

[j] Approximately ½ of sample was sorted for fish eggs; 180 eggs were identified.

Table 25. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
8 May	1315	9	1	505	21	17	12 eggs ∿ 1 mm (0.94-1.20 mm)
							1 egg ∿ 2 mm (1.60 mm)
							8 eggs ∿ 3 mm (2.97-3.56 mm)
							3 larvae 4.6, 5.5, 9.5 mm *Ammodytes hexapterus*
							6 larvae 5.0-6.2 mm *Anoplarchus* sp.
							1 larva 3.5 mm *Isopsetta isolepis*
							1 larva 11 mm *Lumpenus* sp.
							1 larva damaged, Gadidae
							5 larvae unidentified due to extensive damage (all elongate)
9 May	0145	11	1	333	11	44	11 eggs < 1 mm (0.67-0.83 mm)
							3 larvae 7.9, 11, 21 mm *Bathylagus* spp. (?)
							1 larva 29 mm *Lumpenus* sp.
							4 larvae 3.4-4.1 mm *Stenobrachius leucopsarus*
							32 larvae 3.4-4.4 mm Gadidae
							1 larva 8.8 mm unidentified (elongate)
							2 larvae 3.7, 6.0 mm unidentified (non-elongate)
							1 larva 12 mm unidentified (w/large ellipsoidal eyes extending to the articulation of the jaws)

Table 25. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
9 May	0145	11	1	505	11	24	11 eggs ∿ 2 mm (1.36-2.56 mm) 1 larva 7.4 mm *Bathylagus* sp. (?) 1 larva 3.3 mm *Lepidopsetta bilineata* (?) 2 larvae 5.5, 6.1 mm *Sebastes* sp. 13 larvae 3.5-4.6 mm Gadidae 7 larvae unidentified due to extensive damage (all elongate)

Table 26. Identification of Fish Eggs and Larvae by Station
Lower Cook Inlet 1-m NIO Tows, *Discoverer*, Leg V, 05-09 May 1976

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
7 May	1757	6	3	571	1096	352	1096 eggs ∿ 1 mm (0.96-1.10 mm)
							134 larvae 5.6-9.4 mm *Ammodytes hexapterus*
							214 larvae 12-22 mm *Lumpenus* spp.
							4 larvae 7.1-8.3 mm Agonidae

Table 27. Summary of taxonomic categories of commercially important crab and shrimp larvae found in bongo net samples collected on the Lower Cook Inlet, *Discoverer* cruise, Leg V, 05-09 May 1976

A total of 25 samples were taken, 4 samples have been analyzed for crab larvae. They contained 654 crab zoea and 6 megalopae, distributed into 3 families, 3 genera and 1 species. Eleven samples were analyzed for shrimp larvae. They contained 1 adult shrimp and 9296 zoea, distributed into 1 family, 2 genera and 6 species.

Section Anomura

Family Lithodidae

33 zoea king crab[1] *Paralithodes camtschatica* (Tilesius)

316 zoea unidentified, non-commercially important anomurans

Section Brachyura

Family Cancridae

7 zoea unidentified, non-commercially important *Cancer* sp.

Family Majidae

6 megalopae tanner crab *Chionoecetes* spp.

298 zoea unidentified, non-commercially important brachyurans

Section Caridea

Family Pandalidae

2 zoea side-stripe shrimp *Pandalopsis dispar* Rathbun
1938 zoea northern pink shrimp *Pandalus borealis* Kröyer
6002 zoea humpy shrimp *Pandalus goniurus* Stimpson
1 adult *Pandalus goniurus*
12 zoea coon-stripe shrimp *Pandalus hypsinotus* Brandt
463 zoea *Pandalus montagui tridens* Rathbun
43 zoea *Pandalus stenolepis* Rathbun
2 zoea *Pandalus* spp., damaged

834 zoea unidentified hippolytids

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[1] The common name is presented for the first time for each species; thereafter only the scientific name is recorded.

Table 28. Identification of Shrimp and Crab Larvae by Station

Lower Cook Inlet Bongo Tows, *Discoverer*, Leg V, 05-09 May 1976

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
6 May	1325	1	1	333	I	3	*Cancer productus*
						123	unidentified anomurans
						115	unidentified brachyurans
					I	9	*Pandalus borealis*
					II	8	*P. borealis*
					I	39	*P. montagui tridens*
					I	4	*P. stenolepis*
						247	unidentified hippolytids
6 May	1325	1	1	505	I	4	*Cancer productus*
					Megalopa	2	*Chionoecetes* sp.
						122	unidentified anomurans
						88	unidentified brachyurans
					I	18	*Pandalus borealis*
					II	10	*P. borealis*
					I	85	*P. montagui tridens*
					I	3	*P. stenolepis*
						295	unidentified hippolytids
6 May	1552	2	1	505	I	1	*Pandalus borealis*
					II	1	*P. borealis*
					I	1	*P. montagui tridens*
					I	2	*P. stenolepis*

Table 28. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
7 May	1030	5	2[a]	333	I	408	*Pandalus borealis*
					II	64	*P. borealis*
					I	1416	*P. goniurus*
					II	152	*P. goniurus*
					I	8	*P. hypsinotus*
7 May	1030	5	2[a]	505	I	720	*P. borealis*
					II	192	*P. borealis*
					I	2976	*P. goniurus*
					II	640	*P. goniurus*
8 May	0020	5a	1[b]	333	I	80	*P. borealis*
					II	44	*P. borealis*
					I	480	*P. goniurus*
					II	76	*P. goniurus*
					I	4	*P. hypsinotus*
					I	4	*P. montagui tridens*
8 May	0020	5a	1[b]	505	I	120	*P. borealis*
					II	24	*P. borealis*
					I	592	*P. goniurus*
					II	84	*P. goniurus*

[a] Approximately 1/8 of the sample was sorted for larvae; totals given are for entire sample.

[b] Approximately ¼ of the sample was sorted for larvae; totals given are for entire sample.

Table 28. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
7 May	1312	6	1[c]	333	II	2	*Pandalopsis dispar*
					I	142	*Pandalus borealis*
					II	8	*P. borealis*
					I	412	*P. goniurus*
7 May	1312	6	1[c]	505	I	140	*P. borealis*
					II	2	*P. borealis*
					I	560	*P. goniurus*
					I	2	*P. hypsinotus*
8 May	1315	9	1	333	I	14	*Paralithodes camtschatica*
						33	unidentified anomurans
						61	unidentified brachyurans
					I	30	*Pandalus borealis*
					II	22	*P. borealis*
					I	13	*P. goniurus*
					Adult	1	*P. goniurus*
					I	188	*P. montagui tridens*
					I	22	*P. stenolepis*
						165	unidentified hippolytids
8 May	1315	9	1	505	Megalopa	4	*Chionoecetes* sp.
					I	19	*Paralithodes camtschatica*
						38	unidentified anomurans
						34	unidentified brachyurans

[c] Approximately ½ of the sample was sorted for larvae; totals given are for entire sample.

Table 28. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
8 May	1315	9	1	505	I	28	*Pandalus borealis*
					II	9	*P. borealis*
					I	17	*P. goniurus*
					I	231	*P. montagui tridens*
					I	10	*P. stenolepis*
					II	2	*P. stenolepis*
					II	2	unidentified *Pandalus* sp., damaged
						127	unidentified hippolytids

Table 29. Number of fish eggs and larvae at each station

Lower Cook Inlet Bongo Tows, *Discoverer*, Leg VII, 22-30 May 1976

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae
24 May	0732	1	1	333	68	122
24 May	0732	1	1	505	46	97
25 May	1150	2	1	333	11	59
25 May	1150	2	1	505	6	58
25 May	1607	3	1	333	85	7
25 May	1607	3	1	505	86	8
25 May	2217	4	1	333	3	4
25 May	2217	4	1	505	1	2
26 May	0541	5a	2	333	28	70
26 May	0541	5a	2	505	85	167
26 May	0835	6	1	333	648	27
26 May	0835	6	1	505	684	29
26 May	1928	6	3	333	380	36
26 May	1928	6	3	505	242	29
27 May	0056	6	4	333	169	84
27 May	0056	6	4	505	181	79
27 May	0708	6	7	333	17	70
27 May	0708	6	7	505	37	76
27 May	1300	7	1	333	692	67
27 May	1300	7	1	505	656	52
27 May	1701	8	1	333	189	27
27 May	1701	8	1	505	256	22
30 May	1813	10	1	333	22	121
30 May	1813	10	1	505	18	57
30 May	0253	11	1	333		
30 May	0253	11	1	505		
30 May	0813	11	2	333		
30 May	0813	11	2	505		

Table 30. Summary of taxonomic categories of fish eggs, larvae, young, and adults found in Bongo net samples collect on Lower Cook Inlet, *Discoverer* cruise, Leg VII, 22-30 May 1976

A total of 28 samples were collected. Samples from station 11 have yet to be analyzed. The fish are distributed into 14 families, 19 genera, and 10 species. The eggs are distributed into 4 size categories.

Family Agonidae

14 larvae genus? species?

Family Ammodytidae

358 larvae sandlance[1] *Ammodytes hexapterus*
1 adult *Ammodytes hexapterus*

Family Bathymasteridae

1 larva blacksmelt *Bathylagus* sp.
4 larvae genus? species?

Family Cottidae

1 larva northern sculpin *Icelinus borealis* Gilbert ?
3 larvae sculpin *Myoxocephalus* sp. (2 uncertain)
43 larvae genus? species?

Family Cyclopteridae

52 larvae genus? species?

Family Gadidae

3 larvae cod *Gadus* sp.
3 larvae Alaska pollock *Theragra chalcogramma* (Pallas)
4 larvae genus? species?

Family Hexagrammidae

2 young greenling *Hexagrammos* sp.

Family Gonostomidae

2 larvae bristlemouth *Cyclothone* sp.?

Family Osmeridae

6 larvae capelin *Mallotus villosus* (Müller)
1 larva genus? species?

[1] The common name is presented for the first time for each species; thereafter only the scientific name is recorded.

Table 30. (continued)

Family Myctophidae

11 larvae smallfin lanternfish *Stenobrachius leucopsarus* (Eigenmann and Eigenmann)

Family Pholidae

3 larvae penpoint gunnel *Apodichthys flavidus* Girard
16 larvae genus? species?

Family Pleuronectidae

54 larvae sole *Hippoglossoides* sp.
33 larvae butter sole *Isopsetta isolepis* (Lockington)
8 larvae rock sole *Lepidopsetta bilineata* (Ayres) (5 undertain)
3 larvae slender sole *Lyopsetta exilis* (Jordan and Gilbert)

Family Ptilichthydae

1 larva quillfish *Ptilichthys goodei* Bean

Family Scorpaenidae

3 larvae rockfish *Sebastes* sp.

Family Stichaeidae

29 larvae cockscomb *Anoplarchus* sp.
150 larvae prickleback *Lumpenus* spp.
1 young prickleback *Lumpenus* sp.

560 larvae unidentified

4610 eggs categorized (see Table 15. List of possible fish for egg size categories):

144 eggs < 1 mm (0.74-0.88 mm)
4288 eggs ∿ 1 mm (0.90-1.28 mm)
50 eggs ∿ 2 mm (1.30-2.54 mm)
128 eggs ∿ 3 mm (2.56-3.90 mm)

Table 31. Identification of Fish Eggs and Larvae by Station
Lower Cook Inlet Bongo Tows, *Discoverer*, Leg VII, 22-30 May 1976

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
24 May	0732	1	1	333	68[a]	122[a]	1 egg ∿ 2 mm (2.16 mm)[b] 67 eggs ∿ 3 mm (2.74-3.60 mm) 7 larvae 4.7-6.5 mm *Ammodytes hexapterus* 2 larvae 8.1, 8.7 mm *Anoplarchus* sp. 1 larva 5.4 mm *Cyclothone* sp. (?) 31 larvae 4.3-6.9 mm *Hippoglossoides* sp. 4 larvae 6.8-8.7 mm *Lepidopsetta bilineata* (?) 3 larvae 3.6, 4.2, 5.2 mm *Lyopsetta exilis* 1 larva 36 mm *Ptilichthys goodei* 1 larva 3.3 mm *Icelinus borealis*

[a] All specimens are classified into four main categories: eggs include all stages of eggs prior to hatching; larvae include newly hatched and all stages prior to metamorphosis; young include fish after metamorphosis to acquisition of adult fin rays and adult body configuration; adults include fish that are sexually mature.

[b] Eggs are measured to the nearest hundredths of a millimeter in diameter. Fish or larvae, if less than 10 mm in length, are measured to the nearest tenth of a millimeter under a microscope using a calibrated micrometer eye piece. If 10 mm or greater in length, the fish or larvae are measured by a metric ruler to the nearest millimeter. When there are more than three eggs, fish or larvae, the largest and the smallest are measured. Larvae are measured by standard length.

Table 31. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
24 May	0732	1	1	333	68	122	2 larvae 8.9, 9.9 mm *Myoxocephalus* sp.
							1 larva 7.7 mm Cottidae
							2 larvae 4.4, 4.2 mm Gadidae
							64 larvae 3.9-6.7 mm unidentified (elongate)
							1 larva 5.8 mm unidentified (non-elongate)
							2 larvae unidentified due to extensive damage (1 elongate and 1 non-elongate)
24 May	0732	1	1	505	46	97	1 egg ∿ 2 mm (2.08 mm)
							45 eggs ∿ 3 mm (2.74-3.60 mm)
							4 larvae 8.8-14 mm *Ammodytes hexapterus*
							2 larvae 8.0, 8.5 mm *Anoplarchus* sp.
							1 larva 4.3 mm *Cyclothone* sp. (?)
							3 larvae 5.3, 7.4, 9.0 mm *Gadus* sp.
							18 larvae 4.0-5.6 mm *Hippoglossoides* sp.
							1 larva 8.0 mm *Lepidopsetta bilineata* (?)
							1 larva 4.1 mm Cottidae (*Myoxocephalus* sp. - ?)
							1 larva 6.4 mm Cottidae ("Cottid 2" from Blackburn 1973)

Table 31. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
24 May	0732	1	1	505	46	97	3 larvae 3.8, 3.9, 5.0 mm Cottidae
							1 larva 4.8 mm Cyclopteridae
							1 larva 5.5 mm Gadidae
							56 larvae 5.5-6.4 mm unidentified (elongate)
							1 larva 8.9 mm unidentified (non-elongate)
							4 larvae unidentified due to extensive damage
25 May	1150	2	1	333	11	59	7 eggs ∿ 1 mm (0.94-1.02 mm)
							3 eggs ∿ 2 mm (1.34, 1.34, 1.40 mm)
							1 egg ∿ 3 mm (3.12 mm)
							16 larvae 7.4-13 mm *Ammodytes hexapterus*
							3 larvae 14, 17, 18 mm *Apodichthys flavidus*
							5 larvae 5.5-11 mm *Anoplarchus* sp.
							1 larva 6.7 mm Bathymasteridae
							1 larva 6.5 mm *Theragra chalcogramma*
							8 larvae 4.9-6.5 mm *Isopsetta isolepis*
							17 larvae 4.1-9.1 mm Cyclopteridae
							8 larvae unidentified due to extensive damage (elongate)

Table 31. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
25 May	1150	2	1	505	6	58	6 eggs ∿ 1 mm (0.93-1.00 mm)
							17 larvae 6.8-13 mm *Ammodytes hexapterus*
							2 larvae 5.6, 18 mm *Lumpenus* spp.
							3 larvae 5.5, 9.3, 9.5 mm *Anoplarchus* sp.
							3 larvae 6.6, 6.7, 7.2 mm Bathymasteridae
							1 larva 9.4 mm *Theragra chalcogramma*
							1 larva 5.9 mm *Sebastes* sp.
							2 larvae 6.9, 7.1 mm Cottidae
							2 larvae 5.8, 6.4 mm Cottidae
							1 larva 8.3 mm Cottidae
							14 larvae 4.8-7.8 mm Cyclopteridae
							2 larvae 5.2, 5.5 mm *Isopsetta isolepis*
							1 larva 4.4 mm *Hippoglossoides* sp.
							1 larva 4.7 mm unidentified (very intensely pigmented larva)
							8 larvae unidentified due to extensive damage
25 May	1607	3	1	333	85	7	80 eggs ∿ 1 mm (0.96-1.24 mm)
							5 eggs ∿ 2 mm (1.30-1.50 mm)

Table 31. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
25 May	1607	3	1	333	85	7	1 larva 13 mm *Ammodytes hexapterus* 5 larvae 3.4-4.0 mm Cottidae 1 larva unidentified due to extensive damage
25 May	1607	3	1	505	86	8	85 eggs ∿ 1 mm (0.90-1.20 mm) 1 egg ∿ 2 mm (1.54 mm) 1 larva 6.2 mm *Ammodytes hexapterus* 1 larva 5.9 mm *Theragra chalcogramma* 5 larvae 3.4-4.0 mm Cottidae 1 larva 5.5 mm unidentified (non-elongate)
25 May	2217	4	1	333	3	4	2 eggs ∿ 1 mm (1.10-1.16 mm) 1 egg ∿ 2 mm (1.70 mm) 4 larvae 3.8-4.1 mm *Ammodytes hexapterus*
25 May	2217	4	1	505	1	2	1 egg ∿ 1 mm (1.10 mm) 2 larvae 5.1, 6.3 mm *Ammodytes hexapterus*
26 May	0541	5a	2	333	28	70	26 eggs ∿ 1 mm (0.93-1.02 mm) 1 egg ∿ 2 mm (1.36 mm) 1 egg ∿ 3 mm (3.28 mm)

Table 31. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
26 May	0541	5a	2	333	28	70	38 larvae 5.2-11 mm *Ammodytes hexapterus*
							2 larvae 15, 24 mm *Lumpenus* sp.
							5 larvae 4.7-5.9 mm *Anoplarchus* sp.
							6 larvae 10-17 mm Pholidae
							5 larvae 2.8-5.5 mm *Isopsetta isolepis*
							2 larvae 4.4, 4.5 mm *Hippoglossoides* sp.
							1 larva 3.4 mm Cottidae
							3 larvae 3.7, 4.3, 5.4 mm Cyclopteridae
							2 larvae 1.9, 2.3 mm unidentified (yolk sac absorption has already occurred)
							6 larvae unidentified due to extensive damage (5 elongate, 1 other)
26 May	0541	5a	2	505	85	167	1 egg < 1 mm (0.79 mm)
							80 eggs ∿ 1 mm (0.91-1.06 mm)
							3 eggs ∿ 2 mm (1.34-1.38 mm)
							1 egg ∿ 3 mm (2.56 mm)
							69 larvae 5.5-17 mm *Ammodytes hexapterus*
							4 larvae 19-24 mm *Lumpenus* sp.
							8 larvae 4.7-7.0 mm *Anoplarchus* sp.

Table 31. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
26 May	0541	5a	2	505	85	167	8 larvae 9.6-18 mm Pholidae
							18 larvae 2.1-6.7 mm *Isopsetta isolepis*
							2 larvae 5.3, 6.1 mm *Hippoglossoides* sp.
							1 larva 7.1 mm Cottidae
							3 larvae 3.0, 4.3, 4.7 mm Cyclopteridae
							2 larvae 2.3, 3.4 mm unidentified
							1 larva 6.8 mm unidentified (2 rows of scutes on each side of body; spines on head)
							51 larvae unidentified due to extensive damage (45 elongate, 6 others)
26 May	0835	6	1	333	648[c]	27	4 eggs < 1 mm (0.86 mm)
							644 eggs ∿ 1 mm (0.94-1.10 mm)
							1 adult 73 mm *Ammodytes hexapterus*
							2 larvae 29, 30 mm *Lumpenus* sp.
							1 larva 13 mm Agonidae
							23 larvae unidentified due to extensive damage (22 elongate, 1 non-elongate)

[c]Approximately one-fourth of the sample sorted for fish eggs; 162 eggs were identified.

Table 31. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
26 May	0835	6	1	505	684[d]	29	4 eggs < 1 mm (0.86 mm)
							680 eggs ∿ 1 mm (0.90-1.06 mm)
							1 larva 7.3 mm *Anoplarchus* sp.
							8 larvae 15-29 mm *Lumpenus* spp.
							1 larva 18 mm Pholidae
							1 larva 19 mm unidentified (non-elongate)
							18 larvae unidentified due to extensive damage (elongate)
26 May	1928	6	3	333	380[e]	36	378 eggs ∿ 1 mm (0.90-1.06 mm)
							2 eggs ∿ 2 mm (1.34 mm)
							13 larvae 5.1-9.0 mm *Ammodytes hexapterus*
							13 larvae 20-28 mm *Lumpenus* sp.
							1 larva 35 mm *Mallotus villosus*
							1 larva 8.0 mm Cottidae
							2 larvae 4.2, 6.3 mm Cyclopteridae
							6 larvae unidentified due to extensive damage (elongate)

[d] Approximately one-fourth of the sample sorted for fish eggs; 171 eggs were identified.

[e] Approximately one-half of the sample sorted for fish eggs; 190 eggs were identified.

Table 31. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
26 May	1928	6	3	505	242[f]	29	2 eggs < 1 mm (0.84 mm)
							237 eggs ∿ 1 mm (0.94-1.06 mm)
							2 eggs ∿ 2 mm (1.36 mm)
							13 larvae 5.9-13 mm *Ammodytes hexapterus*
							7 larvae 13-23 mm *Lumpenus* spp.
							2 larvae 5.5, 6.3 mm *Mallotus villosus*
							3 larvae 3.8, 4.8, 5.8 mm Cyclopteridae
							1 larva 6.7 mm Osmeridae
							2 larvae 2.9, 3.2 mm unidentified (non-elongate)
							1 larva unidentified due to extensive damage (elongate)
27 May	0056	6	4	333	169	84	168 eggs ∿ 1 mm (0.94-1.16 mm)
							1 egg ∿ 2 mm (1.40 mm)
							42 larvae 6.5-12 mm *Ammodytes hexapterus*
							1 larva 6.7 mm *Anoplarchus* sp.
							11 larvae 17-30 mm *Lumpenus* spp.
							3 larvae 5.3, 5.9, 6.4 mm *Mallotus villosus*

[f] Approximately one-half of the sample sorted for fish eggs; 121 eggs were identified.

Table 31. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
27 May	0056	6	4	333	169	84	2 larvae 4.7, 5.5 mm Cottidae ("Cottid 6" from Blackburn 1973) 3 larvae 3.4, 4.4, 5.2 mm Cyclopteridae 7 larvae 2.5-3.3 mm unidentified (non-elongate) 15 larvae unidentified due to extensive damage (elongate)
27 May	0056	6	4	505	181	79	180 eggs ∿ 1 mm (0.94-1.10 mm) 1 egg ∿ 2 mm (1.40 mm) 49 larvae 6.2-14 mm *Ammodytes hexapterus* 11 larvae 16-23 mm *Lumpenus* spp. 1 larva 6.1 mm Cottidae 1 larva 3.9 mm Cyclopteridae 1 larva 3.8 mm Gadidae 6 larvae 2.0-3.3 mm unidentified (non-elongate) 10 larvae unidentified due to extensive damage (elongate)
27 May	0708	6	7	333	17	70	16 eggs ∿ 1 mm (0.94-1.10 mm) 1 egg ∿ 2 mm (1.40 mm)

Table 31. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
27 May	0708	6	7	333	17	70	18 larvae 2.9-4.9 mm *Ammodytes hexapterus* 37 larvae 15-29 mm *Lumpenus* spp. 1 young 58 mm *Lumpenus* sp. 2 larvae 6.5, 6.7 mm Cottidae ("Cottid 6" from Blackburn 1973) 1 young 21 mm Cottidae 1 larva 7.5 mm Cyclopteridae 1 larva 19 mm Pholidae 1 larva 5.6 mm unidentified (non-elongate) 8 larvae unidentified due to extensive damage (elongate)
27 May	0708	6	7	505	37	76	36 eggs ∿ 1 mm (0.94-1.16 mm) 1 egg ∿ 2 mm (1.40 mm) 36 larvae 4.4-13 mm *Ammodytes hexapterus* 2 larvae 3.2 mm *Lepidopsetta bilineata* 28 larvae 16-29 mm *Lumpenus* spp. 4 larvae 5.1-5.8 mm Cottidae ("Cottid 6" from Blackburn 1973) 1 larva 2.8 mm unidentified (non-elongate) 5 larvae unidentified due to extensive damage (elongate)

Table 31. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
27 May	1300	7	1	333	692[g]	67	20 eggs < 1 mm (0.84-0.86 mm)
							668 eggs ∿ 1 mm (0.90-1.10 mm)
							4 eggs ∿ 2 mm (1.30 mm)
							16 larvae 5.9-10 mm *Ammodytes hexapterus*
							1 larva 8.0 mm *Anoplarchus* sp.
							2 young 33, 36 mm *Hexagrammos* sp.
							17 larvae 10-17 mm *Lumpenus* spp.
							8 larvae 6.4-8.4 mm Agonidae
							1 larva 4.7 mm Cyclopteridae
							22 larvae unidentified due to extensive damage (elongate)
27 May	1300	7	1	505	656[h]	52	36 eggs < 1 mm (0.82-0.86 mm)
							620 eggs ∿ 1 mm (0.90-1.10 mm)
							7 larvae 6.3-7.9 mm *Ammodytes hexapterus*
							7 larvae 10-20 mm *Lumpenus* spp.
							5 larvae 7.2-8.1 mm Agonidae
							2 larvae 4.0, 5.5 mm Cyclopteridae
							31 larvae unidentified due to extensive damage (elongate)

[g] Approximately one-fourth of the sample sorted for fish eggs; 173 eggs were identified.

[h] Approximately one-fourth of the sample sorted for fish eggs; 164 eggs were identified.

Table 31. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
27 May	1701	8	1	333	189	27	38 eggs < 1 mm (0.80-0.88 mm)
							150 eggs ∿ 1 mm (0.90-1.14 mm)
							1 egg ∿ 2 mm (1.40 mm)
							2 larvae 9.6, 10 mm *Ammodytes hexapterus*
							1 larva 8.3 mm *Lepidopsetta bilineata*
							1 larva 9.6 mm *Lumpenus* sp.
							4 larvae 5.6-5.9 mm Cottidae ("Cottid 6" from Blackburn 1973)
							1 larva 4.9 mm Cyclopteridae
							5 larvae 2.5-3.2 mm unidentified (non-elongate)
							13 larvae unidentified due to extensive damage (7 elongate, 6 non-elongate)
27 May	1701	8	1	505	256[i]	22	36 eggs < 1 mm (0.80-0.86 mm)
							220 eggs ∿ 1 mm (0.90-1.14 mm)
							3 larvae 11, 11, 13 mm *Ammodytes hexapterus*
							1 larva 6.7 mm *Anoplarchus* sp.
							6 larvae 5.0-5.4 mm Cottidae ("Cottid 6" from Blackburn 1973)

[i] Approximately one-half of the sample sorted for fish eggs; 128 eggs were identified.

Table 31. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
27 May	1701	8	1	505	256	22	1 larva 9.3 mm Cottidae
							1 larva 3.2 mm unidentified (non-elongate)
							10 larvae unidentified due to extensive damage (9 elongate, 1 non-elongate)
30 May	1813	10	1	333	22	121	1 egg < 1 mm (0.84 mm)
							2 eggs ∿ 1 mm (0.90-0.94 mm)
							9 eggs ∿ 2 mm (1.26-2.26 mm)
							10 eggs ∿ 3 mm (3.06-3.80 mm)
							1 larva 14 mm *Bathylagus* sp.
							1 larva 4.3 mm *Sebastes* sp.
							8 larvae 3.7-5.5 mm *Stenobrachius leucopsarus*
							101 larvae 4.2-6.1 mm unidentified (elongate)
							10 larvae unidentified due to extensive damage (elongate)
30 May	1813	10	1	505	18	57	2 eggs < 1 mm (0.74-0.84 mm)
							1 egg ∿ 1 mm (0.96 mm)
							12 eggs ∿ 2 mm (1.50-2.54 mm)
							3 eggs ∿ 3 mm (2.70-3.90 mm)

Table 31. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
30 May	1813	10	1	505	18	57	1 larva 3.7 mm *Sebastes* sp.
							3 larvae 3.7, 4.2, 5.2 mm *Stenobrachius leucopsarus*
							44 larvae 4.4-6.5 mm unidentified (elongate)
							9 larvae unidentified due to extensive damage (7 elongate, 2 non-elongate)

Table 32. Summary of taxonomic categories of commercially important crab and shrimp larvae found in Bongo net samples collected on the Lower Cook Inlet, *Discoverer* cruise, Leg VII, 22-30 May 1976

A total of 28 samples were collected, 13 have been analyzed for shrimp larvae only. They contained 1 adult and 771 zoea, distributed into 1 family, 2 genera and 6 species.

Section Caridea

Family Pandalidae

1 zoea sidestripe shrimp[1] *Pandalopsis dispar* Rathbun
13 zoea northern pink shrimp *Pandalus borealis* Kröyer
150 zoea *Pandalus goniurus* Stimpson
37 zoea humpy shrimp *Pandalus hypsinotus* Brandt
55 zoea *Pandalus montagui tridens* Rathbun
6 zoea *Pandalus stenolepis* Rathbun
2 zoea *Pandalus* spp., damaged

507 zoea unidentified hippolytids
1 adult non-commercially important shrimp

[1] The common name is presented for the first time for each species; thereafter only the scientific name is recorded.

Table 33. Identification of Shrimp and Crab Larvae by Station

Lower Cook Inlet Bongo Tows, *Discoverer*, Leg VII, 22-30 May 1976

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
24 May	0732	1	1	505	II	1	*Pandalopsis dispar*
					II	7	*Pandalus borealis*
					III	40	*P. borealis*
					II	1	*P. goniurus*
					I	9	*P. montagui tridens*
					II	44	*P. montagui tridens*
					III	2	*P. montagui tridens*
					I	3	*P. stenolepis*
					II	3	*P. stenolepis*
						507	unidentified hippolytids
					Adult	1	unidentified *Eualus* sp.
25 May	1150	2	1	333	I	1	*Pandalus borealis*
					III	1	*P. goniurus*
25 May	1150	2	1	505		0	
25 May	0541	5a	2	333	I	30	*P. borealis*
					III	3	*P. borealis*
					I	1	*P. goniurus*
					II	60	*P. goniurus*
					III	36	*P. goniurus*
26 May	0541	5a	2	505	II	3	*P. borealis*
					III	1	*P. borealis*
					IV	3	*P. borealis*
					I	3	*P. goniurus*

Table 33. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
26 May	0541	5a	2	505	II	37	*Pandalus goniurus*
					III	19	*P. goniurus*
					I	1	*P. hypsinotus*
26 May	0835	6	1	333	IV	2	*P. goniurus* ?
26 May	0835	6	1	505	II	1	*P. borealis*
					I	3	*P. goniurus*
					II	3	*P. goniurus*
26 May	1928	6	3	333	III	3	*P. borealis*
					I	3	*P. goniurus*
26 May	1928	6	3	505	I	1	*P. borealis*
					II	1	*P. borealis*
					I	4	*P. goniurus*
					II	4	*P. goniurus*
					III	1	*P. goniurus*
27 May	0056	6	4	333	I	4	*P. borealis*
					II	1	*P. borealis*
					III	1	*P. borealis*
					I	2	*P. goniurus*
					II	1	*P. goniurus*
					III	2	*P. goniurus*
					I	9	*P. hypsinotus*
					II	3	*P. hypsinotus*

Table 33. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (µm)	Stage	Total	Identification of Larvae
27 May	0708	6	7	333	III	1	*Pandalus borealis*
					I	1	*P. goniurus*
					III	2	*P. goniurus*
					I	15	*P. hypsinotus*
					II	8	*P. hypsinotus*
						2	unidentified *Pandalus* sp., damaged
27 May	0708	6	7	505	III	1	*P. goniurus*
					III	1	*P. hypsinotus* ?

Table 34. Number of fish eggs and larvae at each station

Lower Cook Inlet Bongo Tows, *Acona*, Leg II, 08-15 July 1976

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae
13 July	0119	1	1	333	1	1116
13 July	0119	1	1	505	3	1584
12 July	1133	2	1	333	24	1272
12 July	1133	2	1	505	16	1312
10 July	0901	3	1	333	1	150
10 July	0901	3	1	505	1	101
10 July	1556	4	1	333		
10 July	1556	4	1	505		
11 July	0018	5	1	333	63	744
11 July	0018	5	1	505	169	668
11 July	1009	6	2	333	123	33
11 July	1009	6	2	505	68	40
11 July	1031	6	3	333	104	37
11 July	1031	6	3	505	112	37
11 July	2051	6	4	333	164	
11 July	2051	6	4	505	816	
11 July	2113	6	5	333		
11 July	2113	6	5	505		
10 July	0405	7	1	333	330	
10 July	0405	7	1			
11 July	0010	8	1	333		
11 July	0010	8	1	505	920	
13 July	0548	9	1	333	2	119
13 July	0548	9	1	505	7	217
13 July	1230	10	1	333	4	302
13 July	1230	10	1	505	2	413
13 July	2243	11	1	333		
13 July	2243	11	1	505		
14 July	0835	11	2	333		
14 July	0835	11	2	505		

Table 35. Summary of taxonomic categories of fish eggs, larvae, young and adults found in Bongo net samples collected on Lower Cook Inlet, *Acona* cruise, Leg II, 08-15 July 1976

A total of 30 samples were collected. A few of the samples have yet to be sorted (see Table 34). Thus far the fish are distributed into 12 families, 15 genera, and 9 species. Eggs are distributed into 4 size categories.

Family Agonidae

1 young sturgeon poacher[1] *Agonus acipenserinus* (Tilesius)

Family Bathymasteridae

1 larva genus? species?

Family Clupeidae

1 larva Pacific herring *Clupea harengus pallasi* Valenciennes

Family Cottidae

67 larvae genus? species?
1 larvae northern sculpin *Icelinus borealis* Gilbert
1 young *Icelinus borealis*

Family Cyclopteridae

82 larvae genus? species?

Family Gadidae

4 larvae cod *Gadus* sp.
3 larva genus? species?

Family Myctophidae

17 larvae smallfin lanternfish *Stenobrachius leucopsarus* (Eigenmann and Eigenmann)
1 larva genus? species?

Family Osmeridae

4149 larvae capelin *Mallotus villosus* (Müller)
2668 larvae genus? species?

Family Pholidae

84 larvae genus? species?

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[1] The common name is presented for the first time for each species; thereafter only the scientific name is recorded.

Table 35. (continued)

Family Pleuronectidae

71 larvae sole *Hippoglossoides* sp.
8 larvae rock sole *Lepidopsetta bilineata* (Ayres)
1 young starry flounder *Platichthys stellatus* (Pallas) ?
2 larvae sand sole *Psettichthys melanostictus* Girard
18 larvae rex sole *Glyptocephalus zachirus* Lockington
3 larvae genus? species?

Family Scorpaenidae

24 larve rockfish *Sebastes* sp.
11 larvae thornyhead *Sebastolobus* sp.

Family Stichaeidae

52 larvae prickleback *Lumpenus* spp.
21 larvae cockscomb *Anoplarchus* sp.

856 larvae unidentified

2930 eggs categorized (see Table 15. List of possible fish for egg size categories).

2708 eggs < 1 mm (0.74-0.88 mm)
215 eggs ∿ 1 mm (0.90-1.28 mm)
3 eggs ∿ 2 mm (1.30-2.54 mm)
4 eggs ∿ 3 mm (2.56-3.90 mm)

Table 36. Identification of Fish Eggs and Larvae by Station

Lower Cook Inlet Bongo Tows, *Acona*, Leg II, 08-15 July 1976

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
13 July	0119	1	1	333	1[a]	1116[a]	1 egg < 1 mm (0.71 mm)[b]
							16 larvae 8.4-14 mm *Hippoglossoides* sp.
							912 larvae 3.1-12 mm *Mallotus villosus*
							4 larvae 6.7 mm Cottidae ("Cottid 2" from Blackburn 1973)
							180 larvae 3.4-16 mm Osmeridae
							4 larvae 3.0 mm unidentified (non-elongate)
13 July	0119	1	1	505	3	1584[c]	2 eggs < 1 mm (0.71-0.87 mm)
							1 egg ∿ 1 mm (0.93 mm)

[a] All specimens are classified into four main categories: eggs include all stages of eggs prior to hatching; larvae include newly hatched and all stages prior to metamorphosis; young include fish after metamorphosis to acquisition of adult fin rays and adult body configuration; adults include fish that are sexually mature. Approximately ¼ of the sample was sorted for fish larvae; 279 larvae were identified.

[b] Eggs are measured to the nearest hundredths of a millimeter in diameter. Fish or larvae, if less than 10 mm in length, are measured to the nearest tenth of a millimeter under a microscope using a calibrated micrometer eye piece. If 10 mm or greater in length, the fish or larvae are measured by a metric ruler to the nearest millimeter. When there are more than three eggs, fish or larvae, the largest and the smallest are measured. Larvae are measured by standard length.

[c] Approximately 1/8 of the sample was sorted for fish larvae; 198 larvae were identified.

Table 36. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
13 July	0119	1	1	505	3	1584	1088 larvae 3.7-12 mm *Mallotus villosus*
							496 larvae 3.2-15 mm Osmeridae
12 July	1133	2	1	333	24[d]	1272[d]	24 ∿ 1 mm (0.90-0.96 mm)
							8 larvae 7.1 mm *Lepidopsetta bilineata*
							536 larvae 6.2-11 mm *Mallotus villosus*
							8 larvae 8.6 mm Cottidae
							16 larvae 6.5-6.7 mm Cyclopteridae
							520 larvae 6.4-14 mm Osmeridae
							24 larvae 10-17 mm Pholidae
							160 larvae unidentified due to extensive damage (elongate)
12 July	1133	2	1	505	16[e]	1312[e]	16 eggs ∿ 1 mm (0.94 mm)
							16 larvae 5.9 mm *Hippoglossoides*
							496 larvae 7.5-11 mm *Mallotus villosus*
							32 larvae 6.7-7.6 mm Cottidae
							48 larvae 9.1-10 mm Cyclopteridae
							416 larvae 6.9-11 mm Osmeridae

[d] Approximately 1/8 of the sample was sorted for fish eggs and larvae; 3 eggs and 159 larvae were identified.
[e] Approximately 1/16 of the sample was sorted for fish eggs and larvae; 1 egg and 82 larvae were identified.

Table 36. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
12 July	1133	2	1	505	16	1312	32 larvae 11-23 mm Pholidae
							16 larvae 3.8 mm unidentified (non-elongate)
							16 larvae 3.8 mm unidentified (non-elongate)
							240 larvae unidentified due to extensive damage (elongate)
10 July	0901	3	1	333	1	150	1 egg ∿ 2 mm (1.40 mm)
							1 larva 42 mm *Lumpenus* sp.
							91 larvae 4.9-11 mm *Mallotus villosus*
							6 larvae 13-14 mm Cyclopteridae
							3 larvae 11, 13, 15 mm Cyclopteridae
							4 larvae 7.1-10 mm Osmeridae
							5 larvae 20-30 mm Pholidae
							40 larvae unidentified due to extensive damage (elongate)
10 July	0901	3	1	505	1	101	1 egg < 1 mm (0.84 mm)
							1 young 20 mm *Agonus acipenserinus*
							2 larvae 48, 51 mm *Lumpenus* sp.
							60 larvae 5.3-12 mm *Mallotus villosus*
							1 larvae 8.7 mm Cottidae ("Cottid 5" from Blackburn 1973)

Table 36. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
10 July	0901	3	1	505	1	101	2 larvae 13, 15 mm Cyclopteridae
							5 larvae 6.7-8.1 mm Osmeridae
							2 larvae 18, 22 mm Pholidae
							3 larvae 4.4, 4.5, 4.9 mm unidentified (elongate)
							25 larvae unidentified due to extensive damage (elongate)
11 July	0018	5	1	333	63[f]	744[f]	51 eggs < 1 mm (0.74-0.84 mm)
							12 eggs ∿ 1 mm (0.90-0.94 mm)
							12 larvae 11-13 mm *Anoplarchus* sp.
							360 larvae 4.7-12 mm *Mallotus villosus*
							4 larvae 4.4 mm Cottidae ("Cottid 6" from Blackburn 1973)
							276 larvae 4.6-13 mm Osmeridae
							12 larvae 14-27 mm Pholidae
							12 larvae 4.5-8.5 mm unidentified (elongate)
							24 larvae 3.5-5.2 mm unidentified (non-elongate)
							8 larvae 6.9 mm unidentified (non-elongate)
							36 larvae unidentified due to extensive damage (elongate)

[f] Approximately ¼ of the sample was sorted for fish eggs and larvae; 16 eggs and 186 larvae were identified.

Table 36. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
11 July	0018	5	1	505	169	668[g]	133 eggs < 1 mm (0.74-0.88 mm)
							36 eggs ∿ 1 mm (0.90-1.00 mm)
							8 larvae 11-12 mm *Anoplarchus* sp.
							4 larvae 5.9 mm *Gadus* sp.
							4 larvae 8.8 mm *Hippoglossoides* sp.
							312 larvae 5.9-12 mm *Mallotus villosus*
							4 larvae 6.0 mm Cottidae ("Cottid 5" from Blackburn 1973)
							4 larvae 3.5 mm Cyclopteridae
							176 larvae 5.2-13 mm Osmeridae
							8 larvae 16-19 mm Pholidae
							24 larvae 4.8-7.7 mm unidentified (elongate)
							12 larvae 3.8-5.4 mm unidentified (non-elongate)
							4 larvae 6.8 mm unidentified (non-elongate)
							108 larvae unidentified due to extensive damage (elongate)

[g] Approximately ¼ of the sample was sorted for larvae; 167 larvae were identified.

Table 36. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
11 July	1009	6	2	333	123	33	123 eggs < 1 mm (0.74-0.86 mm)
							2 larvae 7.0, 8.0 mm *Hippoglossoides* sp.
							13 larvae 38-52 mm *Lumpenus* spp.
							2 larvae 4.2, 9.5 mm *Mallotus villosus*
							1 larva 9.2 mm Cottidae ("Cottid 5" from Blackburn 1973)
							11 larvae 4.4-8.9 mm unidentified (elongate)
							1 larva 2.0 mm unidentified (appears to be a very early embryo that escaped from a ruptured egg)
							3 larvae unidentified due to extensive damage (all elongate)
11 July	1009	6	2	505	68	40	67 eggs < 1 mm (0.76-0.86 mm)
							1 egg ∿ 1 mm (1.14 mm)
							1 larva 17 mm *Clupea harengus pallasi*
							15 larvae 36-42 mm *Lumpenus* sp.
							4 larvae 5.6-9.3 mm *Mallotus villosus*
							1 young 17 mm *Platichthys stellatus*(?)
							3 larvae 5.2, 6.3, 6.8 mm Cottidae ("Cottid 5" from Blackburn 1973)

Table 36. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
11 July	1009	6	2	505	68	40	1 larvae 32 mm Pholidae 13 larvae 4.5-8.2 mm unidentified (elongate) 2 larvae unidentified due to extensive damage (elongate)
11 July	1031	6	3	333	104	37	103 eggs < 1 mm (0.74-0.86 mm) 1 egg ∿ 1 mm (1.04 mm) 3 larvae 7.1, 7.2, 10 mm *Hippoglossoides* sp. 11 larvae 37-45 mm *Lumpenus* spp. 6 larvae 5.2-15 mm *Mallotus villosus* 1 larva 8.6 mm *Psettichthys melanostictus* 1 larva 8.0 mm Cottidae ("Cottid 5" from Blackburn 1973) 1 larva 6.3 mm Cottidae 12 larvae 4.9-9.1 mm unidentified (elongate) 1 larva 3.5 mm unidentified (non-elongate) 1 larva 2.2 mm unidentified (non-elongate)
11 July	1031	6	3	505	112	37	111 eggs < 1 mm (0.76-0.90 mm) 1 egg ∿ 1 mm (1.00 mm) 1 larva 14 mm *Anoplarchus* sp.

Table 36. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
11 July	1031	6	3	505	112	37	10 larvae 37-41 mm *Lumpenus* sp.
							5 larvae 6.9-14 mm *Mallotus villosus*
							1 larva 8.8 mm Cottidae ("Cottid 5" from Blackburn 1973)
							1 larva 4.5 mm Cottidae ("Cottid 6" from Blackburn 1973)
							1 larva 10 mm Cottidae
							14 larvae 5.7-9.4 mm unidentified (elongate)
							4 larvae unidentified due to extensive damage (elongate)
11 July	2051	6	4	333	164[h]		164 eggs < 1 mm (0.76-0.90 mm)
11 July	2051	6	4	505	816[i]		808 eggs < 1 mm (0.76-0.86 mm)
							8 eggs ∿ 1 mm (1.00 mm)
10 July	0405	7	1	333	330		278 eggs < 1 mm (0.74-0.87 mm)
							52 eggs ∿ 1 mm (0.90-1.04 mm)
10 July	0010	8	1	505	920[j]		864 eggs < 1 mm (0.76-0.86 mm)
							56 eggs ∿ 1 mm (0.90-1.04 mm)

[h] Approximately ¼ of the sample was sorted for eggs; 41 eggs were identified

[i] Approximately ¼ of the sample was sorted for eggs; 204 eggs were identified.

[j] Approximately 1/8 of the sample was sorted for eggs; 115 eggs were identified.

Table 36. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
13 July	0548	9	1	333	2	119	1 egg < 1 mm (0.73 mm)
							1 egg $\sim$ 2 mm (1.97 mm)
							1 larva 9.6 mm *Glyptocephalus zachirus*
							1 larva 13 mm *Hippoglossoides* sp.
							1 larva 3.0 mm *Icelinus borealis*
							57 larvae 4.2-13 mm *Mallotus villosus*
							1 larva 4.6 mm *Sebastes* sp.
							1 larva 3.6 mm Cottidae ("Cottid 6" from Blackburn 1973)
							1 larva 8.7 mm Cyclopteridae
							1 larva 21 mm Gadidae
							52 larvae 4.1-16 mm Osmeridae
							3 larvae unidentified due to extensive damage (elongate)
13 July	0548	9	1	505	7	217	1 egg < 1 mm (0.77 mm)
							5 eggs $\sim$ 1 mm (1.00-1.20 mm)
							1 egg $\sim$ 3 mm (lost)
							1 larva 12 mm *Glyptocephalus zachirus*
							7 larvae 8.2-15 mm *Hippoglossoides* sp.
							1 young 12 mm *Icelinus borealis*

Table 36. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
13 July	0548	9	1	505	7	217	65 larvae 5.3-16 mm *Mallotus villosus*
							1 larva 12 mm Bathymasteridae
							1 larva 7.7 mm Cottidae ("Cottid 6" from Blackburn 1973)
							2 larvae 6.4, 9.7 mm Cyclopteridae
							2 larvae 22, 29 mm Gadidae
							106 larvae 5.9-18 mm Osmeridae
							31 larvae unidentified due to extensive damage (elongate)
13 July	1230	10	1	333	4	302	1 egg ∿ 2 mm (2.00 mm)
							3 eggs ∿ 3 mm (2.84, 3.04, 3.24 mm)
							6 larvae 9.5-19 mm *Glyptocephalus zachirus*
							9 larvae 7.2-18 mm *Hippoglossoides* sp.
							67 larvae 6.1-15 mm *Mallotus villosus*
							1 larva 8.8 mm *Psettichthys melanostictus*
							9 larvae 6.6-9.7 mm *Sebastes* sp.
							4 larvae 2.4-2.8 mm *Sebastolobus* sp.
							10 larvae 5.1-6.1 mm *Stenobrachius leucopsarus*
							1 larva 9.1 mm Myctophidae

Table 36. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (µm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
13 July	1230	10	1	333	4	302	186 larvae 7.6-19 mm Osmeridae
							2 larvae 6.6, 6.7 mm Pleuronectidae
							5 larvae 5.7-10 mm unidentified (elongate)
							2 larvae unidentified due to extensive damage (elongate)
13 July	1230	10	1	505	2	413	2 eggs ∿ 1 mm (lost)
							10 larvae 5.1-17 mm *Glyptocephalus zachirus*
							13 larvae 5.9-20 mm *Hippoglossoides* sp.
							88 larvae 8.1-18 mm *Mallotus villosus*
							14 larvae 3.3-7.0 mm *Sebastes* sp.
							7 larvae 2.2-3.1 mm *Sebastolobus* sp.
							7 larvae 5.1-7.1 mm *Stenobrachius leucopsarus*
							251 larvae 9.1-19 mm Osmeridae
							1 larva 8.1 mm Pleuronectidae
							6 larvae 6.0-8.9 mm unidentified (elongate)
							16 larvae unidentified due to extensive damage (elongate)

E. *Surveyor*, Leg II

The *Surveyor*'s hull-mounted transducer was in continual use while underway to give a sonic chart record of transects up Cook Inlet (sta 1-4), across Cook Inlet (sta 6, 3, 8), out to the Gulf of Alaska (sta 7, 9, 10, 11). Approximately 9,431 minutes of chart records and 70 minutes of magnetic tape records were made.

The fish eggs and larvae have been sorted and identified for all stations except stations 3, 4, 6, 7, 8, and 11 (Tables 37-39). Crabs and shrimps have not yet been identified.

F. *Miller Freeman*, Leg III

Nine stations were surveyed acousti ally with a total of 60 min of chart records and 45 min of magnetic tapes. The chart recorder revealed large numbers of target organisms in the water column at all stations.

The fish eggs and larvae have been counted for all stations (Table 40) but identified for stations 1 and 9 only (Table 41).

G. *Discoverer*, Leg I

Results are summarized in Section X.

Figures 2 through 6 show the four size categories of fish eggs (in Table 15) that were caught at each station for the following cruises:

07-10 April 1976	*Discoverer*, Leg III
06-07 May 1976	*Discoverer*, Leg V
24-27 May 1976	*Discoverer*, Leg VII
10-13 July 1976	*Acona*, Leg II
25-28 August 1976	*Surveyor*, Leg II
18-28 October 1976	*Miller Freeman*, Leg III

VII. Discussion

The field sampling phase of the reconnaissance level survey of early life history stages of fishes and shellfishes in Lower Cook Inlet has covered several seasons within 1 year. The analysis of the data completed to date demonstrates that eggs and larvae of the economically important fish and shellfish populations of the area do occur in the water column and can be sampled with standard MARMAP methods.

The fish eggs have been more completely analyzed than the other groups and can serve as the basis for a discussion which can be expected to be representative of all groups. The spatial and temporal variability for all fish eggs is large (Fig. 6). The variability for the several size-groups of eggs is even more pronounced (Fig. 2 to 5).

Table 37. Number of fish eggs and larvae at each station

Lower Cook Inlet Bongo Tows, *Surveyor*, Leg II, 24-31 August 1976

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae
25 Aug	0840	1	1	333	0	125
25 Aug	0840	1	1	505	0	772
25 Aug	1206	2	1	333	0	109
25 Aug	1206	2	1	505	0	128
25 Aug	1952	3	1	333		
25 Aug	1952	3	1	505	0	
26 Aug	0400	4	1	333		
26 Aug	0400	4	1	505		
26 Aug	1040	5	1	333	34	476
26 Aug	1040	5	1	505	25	536
26 Aug	2203	6	1	333	21	856
26 Aug	2203	6	1	505	17	332
27 Aug	1000	6	2	333		
27 Aug	1000	6	2	505	48	1568
28 Aug	0650	7	1	333	0	
28 Aug	0650	7	1	505		
28 Aug	0330	8	1	333		
28 Aug	0330	8	1	505	0	
28 Aug	1832	9	1	333	2	21
28 Aug	1832	9	1	505	1	17
28 Aug	1919	9	2	333	0	218
28 Aug	1919	9	2	505	1	207
29 Aug	0459	10	1	333	0	39
29 Aug	0459	10	1	505	1	55
29 Aug	1922	11	1	333		
29 Aug	1922	11	1	505		

Table 38. Summary of taxonomic categories of fish eggs, larvae, young and adults found in Bongo net samples collected on Lower Cook Inlet, *Surveyor* cruise, Leg II, 24-31 August 1976

A total of 26 samples were collected. A few of the samples have been analyzed (see Table 39). Thus far the fish are distributed into 7 families, 7 genera, and 3 species. Eggs are distributed into 3 size categories.

Family Bathylagidae

1 larva smoothtongue[1] *Bathylagus* sp.

Family Bathymasteridae

3 larvae genus? species?

Family Cottidae

9 larvae genus? species?

Family Osmeridae

420 larvae capelin *Mallotus villosus* Müller
721 larvae genus? species?

Family Pleuronectidae

7 larvae sole *Hippoglossoides* sp.
1 larvae sand sole *Psettichthys melanostictus* Girard

Family Ptilichthyidae

1 young quillfish *Ptilichthys goodei* Bean

Family Scorpaenidae

57 larvae rockfish *Sebastes* sp.
1 larva thornyhead *Sebastolobus* sp.

233 larvae unidentified

56 eggs categorized (see Table 15. List of possible fish for egg size categories):

52 eggs < 1 mm (0.74-0.88 mm)
1 egg ∿ 1 mm (0.90-1.28 mm)
3 eggs ∿ 3 mm (2.56-3.90 mm)

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[1] The common name is presented for the first time for each species; thereafter only the scientific name is recorded.

Table 39. Identification of Fish Eggs and Larvae by Station
Lower Cook Inlet Bongo Tows, *Surveyor*, Leg II, 24-31 August 1976

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
25 Aug	0840	1	1	333	0[a]	125[a]	26 larvae 4.7-12 mm[b] *Mallotus villosus*
							2 larvae 3.4, 4.0 mm *Sebastes* sp.
							88 larvae 4.7-31 mm Osmeridae
							9 larvae unidentified due to extensive damage (elongate)
25 Aug	0840	1	1	505	0	772[c]	176 larvae 4.7-11 mm *Mallotus villosus*
							12 larvae 3.6-4.1 mm *Sebastes* sp.
							4 larvae 8.2 mm Cottidae ("Cottid 6" from Blackburn 1973)
							420 larvae 5.8-33 mm Osmeridae
							4 larvae 8.4 mm unidentified (elongate)
							156 larvae unidentified due to extensive damage (elongate)

[a] All specimens are classified into four main categories: eggs include all stages of eggs prior to hatching; larvae include newly hatched and all stages prior to metamorphosis; young include fish after metamorphosis to acquisition of adult fin rays and adult body configuration; adults include fish that are sexually mature.

[b] Eggs are measured to the nearest hundredths of a millimeter in diameter. Fish or larvae, if less than 10 mm in length, are measured to the nearest tenth of a millimeter under a microscope using a calibrated micrometer eye piece. If 10 mm or greater in length, the fish or larvae are measured by a metric ruler to the nearest millimeter. When there are more than three eggs, fish or larvae, the largest and the smallest are measured. Larvae are measured by standard length.

[c] Approximately ¼ of the sample was sorted for larvae; 193 larvae were identified.

Table 39. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
25 Aug	1206	2	1	333	0		
25 Aug	1206	2	1	505	0		
25 Aug	1952	3	1	505	0		
26 Aug	1040	5	1	333	34		33 eggs < 1 mm (0.74-0.88 mm)
							1 egg ∿ 1 mm (not measured)
26 Aug	2203	6	1	505	17		17 eggs < 1 mm (0.76-0.84 mm)
28 Aug	0650	7	1	333	0		
28 Aug	0330	8	1	505	0		
28 Aug	1832	9	1	333	2	21	2 eggs ∿ 3 mm (2.88, 3.59 mm)
							6 larvae 5.1-15 mm *Mallotus villosus*
							3 larvae 3.5, 3.8, 3.9 mm *Sebastes* sp.
							3 larvae 9.1, 11, 15 mm Bathymasteridae
							9 larvae 10-26 mm Osmeridae
28 Aug	1832	9	1	505	1	17	1 egg 1 mm (0.87 mm)
							1 larva 4.8 mm *Hippoglossoides* sp.
							5 larvae 6.1-14 mm *Mallotus villosus*

Table 39. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Larvae	Identification of Fish Eggs and Larvae
28 Aug	1832	9	1	505	1	17	3 larvae 3.7, 3.8, 4.0 mm *Sebastes* sp.
							1 larva 3.2 mm Cottidae ("Cottid 6" from Blackburn 1973)
							2 larvae 5.1, 11 mm Osmeridae
							1 larva 7.9 mm unidentified (non-elongate)
							4 larvae unidentified due to extensive damage (elongate)
28 Aug	1919	9	2	333	0	218	1 larva 19 mm *Bathylagus* sp.
							3 larvae 4.3, 5.8, 21 mm *Hippoglossoides* sp.
							55 larvae 3.9-14 mm *Mallotus villosus*
							1 young 152 mm *Ptilichthys goodei*
							18 larvae 3.0-3.9 mm *Sebastes* sp.
							1 larva 7.1 mm Cottidae ("Cottid 6" from Blackburn 1973)
							84 larvae 4.2-24 mm Osmeridae
							1 larva 7.0 mm unidentified (elongate)
							54 larvae unidentified due to extensive damage (elongate)
28 Aug	1919	9	2	505	1	207	1 egg ∿ 3 mm (3.39 mm)
							3 larvae 3.2, 4.8, 5.6 mm *Hippoglossoides* sp.

Table 39. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
28 Aug	1919	9	2	505	1	207	108 larvae 4.2-18 mm *Mallotus villosus*
							1 larva 9.4 mm *Psettichthys melanostictus*
							19 larvae 3.0-4.1 mm *Sebastes* sp.
							1 larva 5.2 mm *Sebastolobus* sp.
							2 larvae 4.4, 7.0 mm Cottidae ("Cottid 6" from Blackburn 1973)
							71 larvae 4.5-28 mm Osmeridae
							1 larva 4.2 mm unidentified (non-elongate)
							1 larva unidentified due to extensive damage (elongate)
29 Aug	0459	10	1	333	0	39	19 larvae 9.1-13 mm *Mallotus villosus*
							1 larva 8.5 mm Cottidae ("Cottid 6" from Blackburn 1973)
							19 larvae 7.0-19 mm Osmeridae
29 Aug	0459	10	1	505	1	55	1 egg < 1 mm (0.74 mm)
							25 larvae 8.7-12 mm *Mallotus villosus*
							28 larvae 8.3-23 mm Osmeridae
							2 larvae unidentified due to extensive damage (elongate)

Table 40. Number of Fish Eggs and Larvae at each Station

Lower Cook Inlet Bongo Tows, *Miller Freeman*, Leg III
17-29 October 1976

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae
19 Oct.	0400	1	1	333	0	13
19 Oct.	0400	1	1	505	0	15
28 Oct.	0845	2	2	333	No sample:	cod end of net broke
28 Oct.	0845	2	2	505	0	6
23 Oct.	1935	3	1	333	0	0
23 Oct.	1935	3	1	505	0	1
24 Oct.	1004	4	1	333	0	1
24 Oct.	1004	4	1	505	0	0
23 Oct.	1006	5	1	333	0	3
23 Oct.	1006	5	1	505	0	5
22 Oct.	1758	6	1	333	0	0
22 Oct.	1758	6	1	505	0	0
21 Oct.	0907	7	1	333	0	1
21 Oct.	0907	7	1	505	0	0
21 Oct.	0403	8	1	333	0	9
21 Oct.	0403	8	1	505	0	2
28 Oct.	1244	9	1	333	0	0
28 Oct.	1244	9	1	505	0	12

Note: Larvae from stations 1 and 9 have been identified (Table 41). All others are sorter's counts and have yet to be analyzed.

Table 41. Identification of Fish Eggs and Larvae by Station

Lower Cook Inlet Bongo Tows, *Miller Freeman*, Leg III, 17-29 October 1976

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
19 Oct.	0400	1	1	333	0[a]	13[a]	3 larvae 5.9, 13, 23 mm[b] *Mallotus villosus*
							10 larvae 5.0-5.9 mm *Sebastes* sp.
19 Oct.	0400	1	1	505	0	15	1 adult 28 mm *Gasterosteus aculeatus*
							2 larvae 15, 24 mm *Mallotus villosus*
							10 larvae 5.0-5.6 mm *Sebastes* sp.
							1 larva 4.5 mm Cyclopteridae
							1 larva 18 mm Osmeridae
28 Oct.	1244	9	1	505	0	12	9 larvae 4.3-6.4 mm *Sebastes* sp.
							3 larvae 15, 18, 23 mm Osmeridae

[a] All specimens are classified into four main categories: eggs include all stages of eggs prior to hatching; larvae include newly hatched and all stages prior to metamorphosis; young include fish after metamorphosis to acquisition of adult fin rays and adult body configuration; adults include fish that are sexually mature.

[b] Eggs are measured to the nearest hundredths of a millimeter in diameter. Fish or larvae, if less than 10 mm in length, are measured to the nearest tenth of a millimeter under a microscope using a calibrated micrometer eye piece. If 10 mm or greater in length, the fish or larvae are measured by a metric ruler to the nearest millimeter. When there are more than three eggs, fish or larvae, the largest and the smallest are measured. Larvae are measured by standard length.

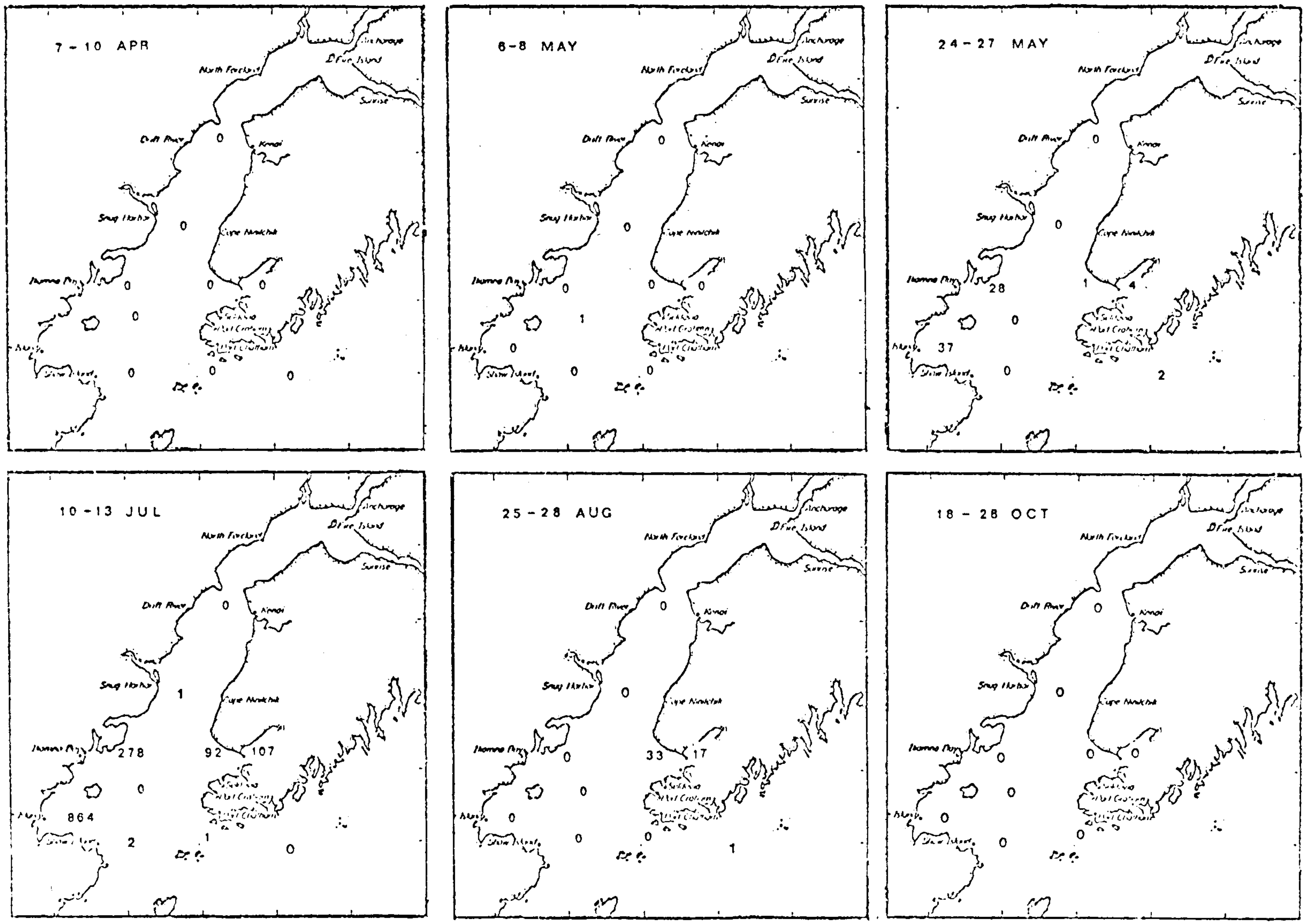

Fig. 2. Small fish eggs per bongo net tow at 10 stations for 6 cruises.

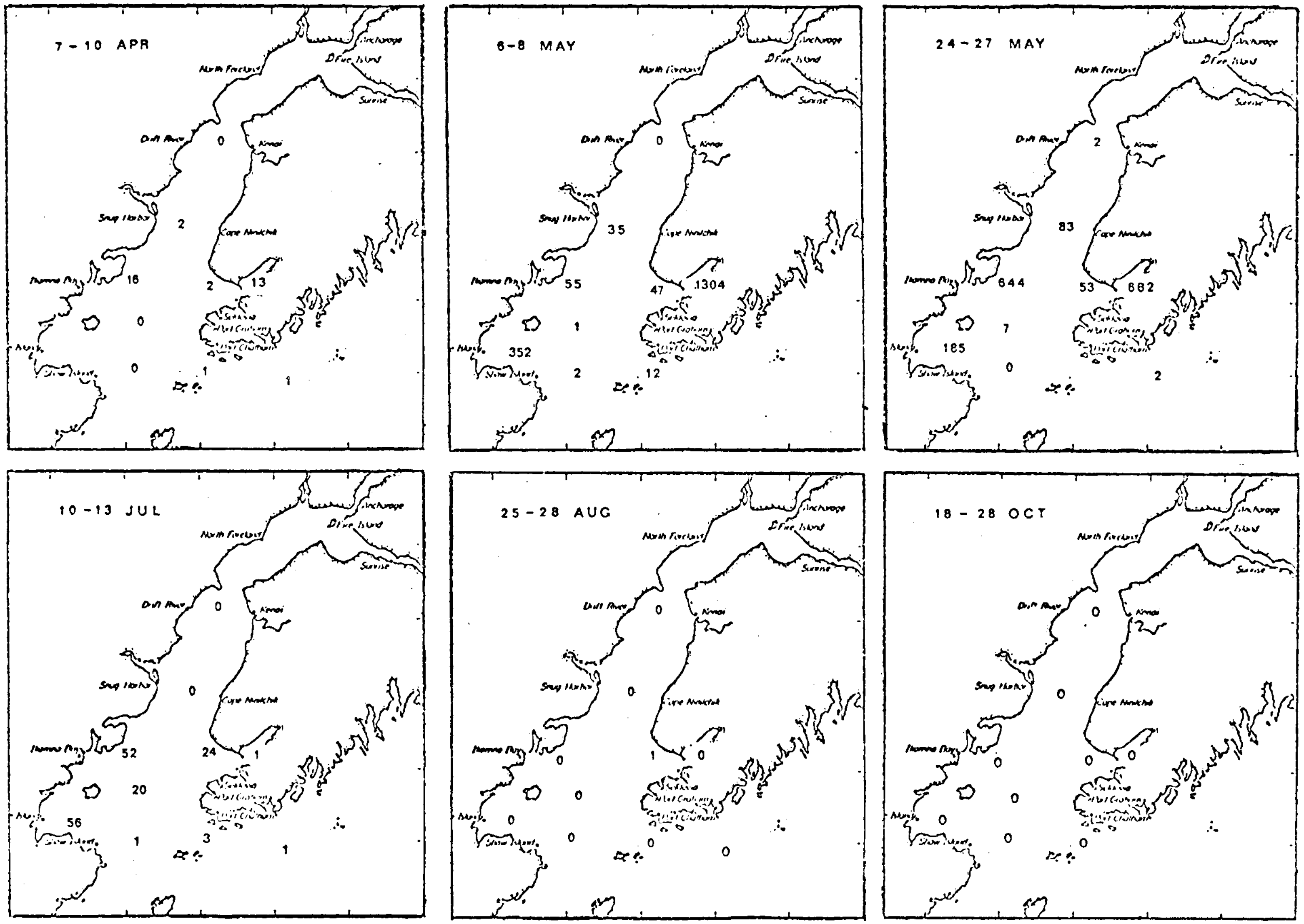

Fig. 3. 1-mm fish eggs per bongo net tow at 10 stations for 6 cruises.

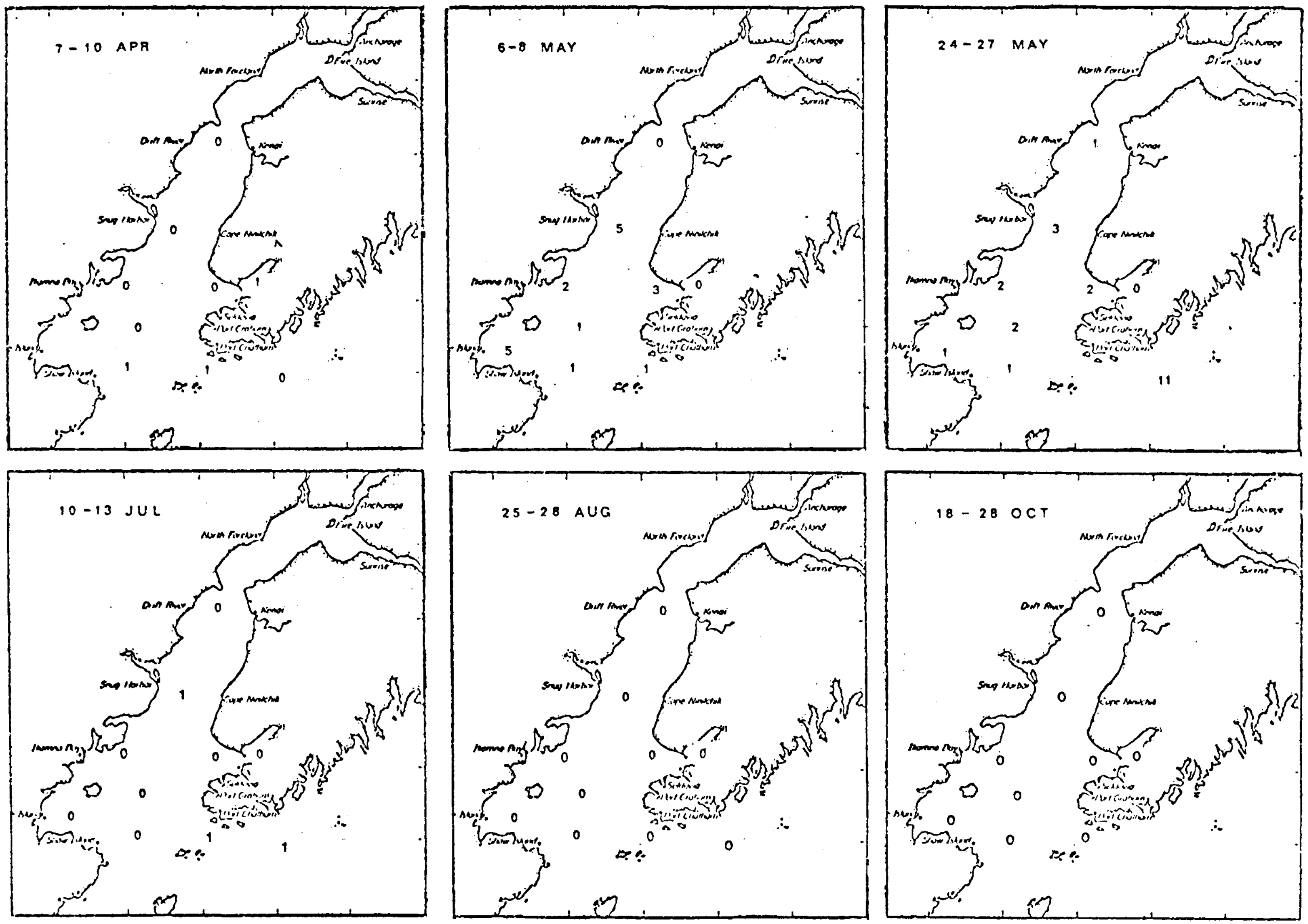

Fig. 4. Intermediate fish eggs per bongo net tow at 10 stations for 6 cruises.

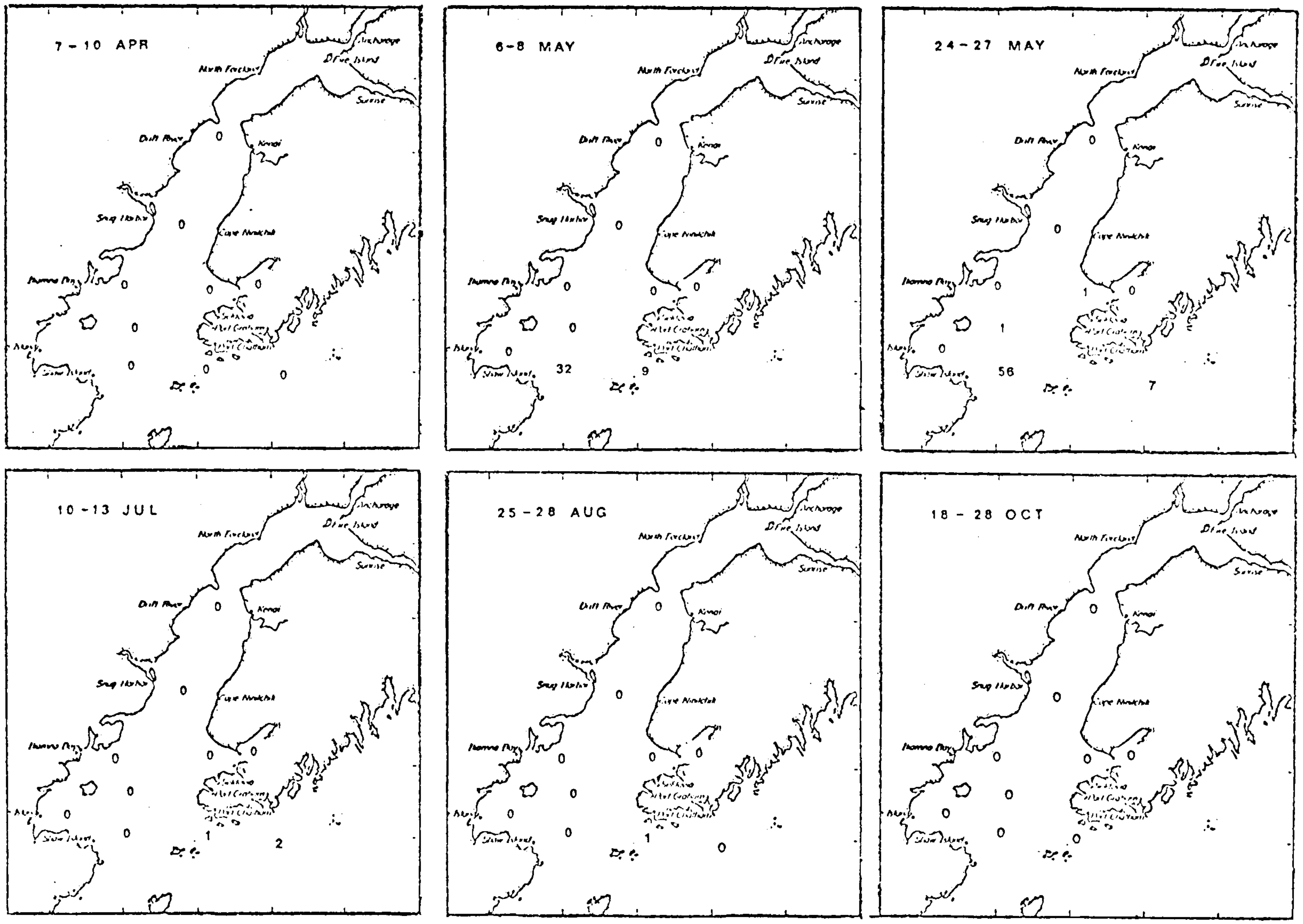

Fig. 5. Large fish eggs per bongo net tow at 10 stations for 6 cruises.

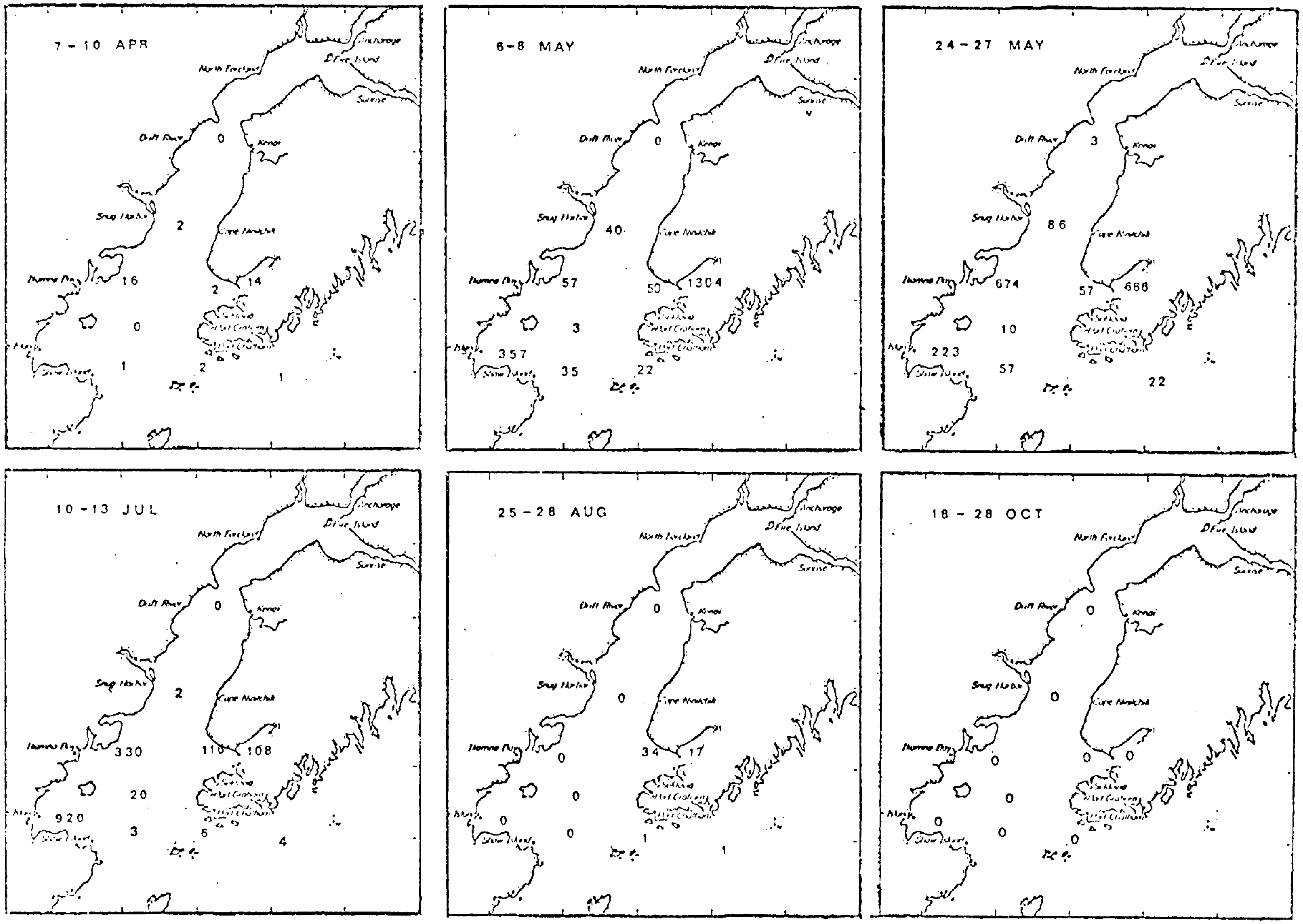

Fig. 6. Total fish eggs per bongo net tow at 10 stations for 6 cruises.

The fish eggs are repeatedly most abundant in Kachemak Bay and Kamîshak Bay. Eggs are least abundant to the north in Cook Inlet and tend to be very scarce in the center of the inlet between Kachemak Bay and Kamishak Bay. That location is near the null area described by the physical oceanographers. A more intensive program of sampling eggs and larvae could provide information on the biological importance of the null area. The distribution of abundance of the eggs suggests discrete spawning centers on the east and west sides of the inlet, rather than a drift into the inlet or counterclockwise around its lower reaches. The highest abundance of fish eggs in these samples was inside the Homer Spit in Kachemak Bay, suggesting that area as especially critical to harvested resources in the ecosystem.

The time between cruises was so long that usually only a single life history stage of shrimps or crabs was observed. A more intensive time series would be needed to assess growth rates, mortalities, year class strength, and other important population parameters. The multiplicity of species extends the period within each year when observations are necessary.

This study could now usefully be extended from the reconnaissance level to the benchmark level. Quantitative benchmark data will be needed to resolve questions of resource use conflict that are certain to persist in Lower Cook Inlet as long as petroleum development continues.

VIII. Conclusions

Reasonably firm:

Early life history stages of economically important fish and shellfish populations in Lower Cook Inlet were sampled with standard MARMAP methods.

The temporal and spatial variability of distributions is large because spawning is seasonal and localized.

The time series sampling has been too diffuse to sample all life history stages of the several species.

A benchmark level program is appropriate for Lower Cook Inlet.

Tentative:

Fish eggs are most abundant inside Homer Spit in Kachemak Bay.

Kachemak Bay and Kamishak Bay are locations of spawning aggregations of fishes and shellfish.

Advection of early life history stages into Lower Cook Inlet is relatively unimportant.

Preliminary:

All early life history stages of all important fishes and shellfishes harvested in Lower Cook Inlet occur there in the appropriate season.

Unit stocks of at least several species occur in both Kachemak Bay on the east side and Kamishak Bay on the west side of Lower Cook Inlet.

The distribution of abundance of fish eggs in space lends support to the physical oceanographers' decription of water movements in Lower Cook Inlet.

IX. Need for further study

My opinion of the needs for further study has evolved from the Lower Cook Inlet and Kodiak synthesis meetings and from my experience in resource use conflicts in other areas. I believe that the harvested fish and shellfish resources in the Lower Cook Inlet ecosystem should be documented by OCSEAP independently of fisheries management agencies, utilizing management-developed data insofar as appropriate. Fisheries catch statistics and market sampling can be used and supplemented. Fisheries-independent measures such as egg and larva surveys, echo surveys, and experimental fishing will be essential.

An explicit commitment from BLM to obtain quantitative benchmark data and to monitor against those benchmarks should go far to meet local and state concerns in an emotional and poorly understood resource use conflict. An intensive study at the benchmark level may not be possible in many geographic regions, but Lower Cook Inlet appears to be the most important regions per unit area within the Outer Continental Shelf program.

The data collected by fisheries management agencies should be assembled, analyzed, and described. Supplemental catch statistics and market sampling should be instituted. A time-series sampling of early life history stages of fishes and shellfishes adequate to catch all stages should be undertaken. Consideration should be given to trophodynamic studies at least adequate to ascertain food web relationships of economically important fishes and shellfishes. Additional sampling adequate to detect major changes in food supplies probably approaches the limit of funding available for the study I envision.

This study is needed for informed management decisions in the managed ecosystem of Lower Cook Inlet. The levels of harvest of economically important fishes and shellfishes are likely to change primarily because of fishing effort--those changes can be documented and placed in perspective with the end products and deliverables from this study.

X. Summary of 4th quarter operations

A. Ship or laboratory activities

1. Ship schedule

Discoverer RP-4-DI-77A, Leg I
Lower Cook Inlet, 21-26 February 1977

2. Scientific party

Kendra Daly, Assistant Oceanographer
Clarence Pautzke, graduate student

Department of Oceanography
University of Washington
Seattle, WA 98195

3. Methods

The acoustic surveys were conducted using a Ross 200A Fine Line Echosounder system operating with a frequency of 105 kHz. A 10° beam Ross transducer, mounted in a plywood towed body, was lowered 2 m below the surface while on station. The incoming signal was recorded on a paper chart marked with station number, date, time (GMT) and other pertinent information. The incoming signal was also recorded on magnetic tape for later digitizing and analysis at the University of Washington.

The bongo net consisted of a double-mouthed frame (each mouth with an inside diameter of 60 cm and a mouth area of 0.2827 m^2) made of fiber glass and weighing 95 lb. A 100 lb weight was attached below the frame. A 505 μm mesh net, with an open area ration (OAR) of 8:1 and a 333 μm net, 8:1 OAR, were attached to the frame. A TSK flowmeter was mounted in the mouth of each net to estimate the volume of water filtered. A bathykymograph (BKG) was attached to the frame to determine the depth of the tow. The double oblique tows required deployment at 50 m/min, a 30 sec soaking time, and retrieval at 20 m/min, with the wire angle kept as close to 45° as possible. The net was placed as close to the bottom as possible without endangering the net.

Samples were placed in 1000 ml bottles and preserved with a stock solution of formalin, propylene glycol, propylene phenoxetal and sea water in a 2:8 volume ratio. The solution was changed and the sample represerved 24 hr later.

Stations 5 and 6, in Kachemak Bay, were occupied 4 times and station 2, in Lower Cook Inlet, was occupied 3 times. Station 8 was abandoned due to bad weather, then reoccupied. The remaining stations were occupied once for an average of 0.5 to 1 hr.

4. Sample localities

All eleven stations were located in Lower Cook Inlet or the Gulf of Alaska (Fig. 7, Table 42).

5. Data collected

a. Net hauls are given in Table 43.

A total of 36 samples were taken. Ichthyoplankton was caught at 9 stations, shrimp larvae were caught at 5 stations and crab larvae were caught only at station 6.

b. Eleven stations were surveyed acoustically with a total of 169 min of chart records and 80 min of magnetic tapes. The chart recorder revealed target organisms in the water columns at all stations.

c. The cruise track was approximately 1500 km in length.

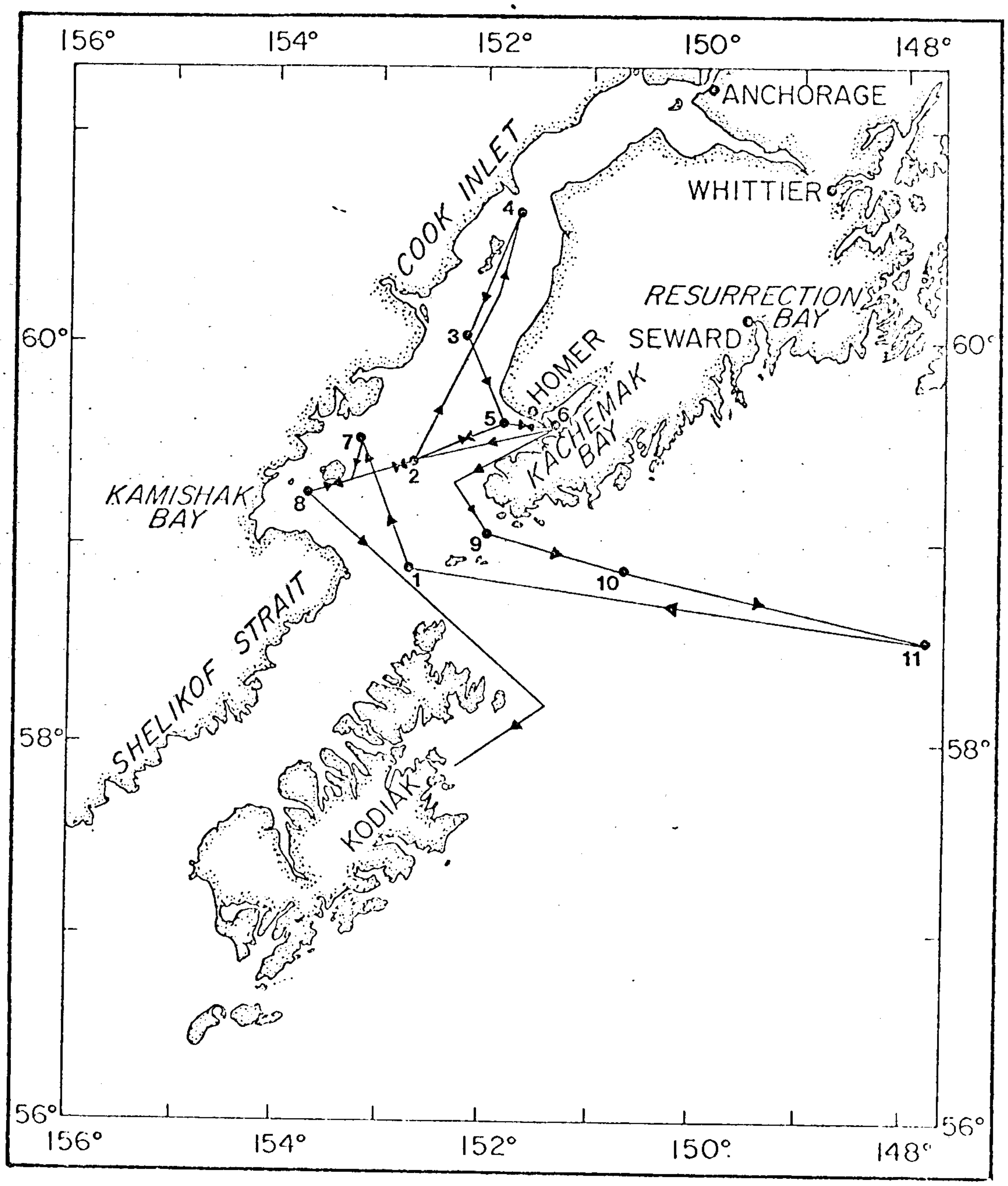

Fig. 7. Station sampling order, *Discoverer*, Leg I, 21-26 February 1977.

Table 42. Station locations, *Discoverer*, Leg I, 21-26 February, 1977

Station	Haul	Latitude (N)	Longitude (W)	Chart Depth (m)	Location
1	1	58° 54.4'	152° 48.9'	177	Shelikof Strait
2	1	59° 23.1'	152° 39.5'	68	Lower Cook Inlet
2	2	59° 22.6'	152° 40.1'	ABORT	
2	3	59° 22.3'	152° 38.2'	49	Lower Cook Inlet
3	1	59° 59.3'	152° 12.0'	75	Lower Cook Inlet
4	1	60° 41.7'	151° 37.2'	100	Cook Inlet
5	1	59° 34.4'	151° 49.8'	40	Outer Kachemak Bay
5	2	59° 34.7'	151° 49.2'	35	Outer Kachemak Bay
5	3	59° 34.8'	151° 48.0'	35	Outer Kachemak Bay
5	4	59° 34.6'	151° 48.6'	35	Outer Kachemak Bay
6	1	59° 36.6'	151° 17.8'	80	Inner Kachemak Bay
6	2	59° 36.75'	151° 16.3'	76	Inner Kachemak Bay
6	3	59° 36.7'	151° 15.8'	82	Inner Kachemak Bay
6	4	59° 36.7'	151° 17.7'	78	Inner Kachemak Bay
7	1	59° 18.0'	153° 08.0'	58	Kamishak Bay
8	1	59° 14.1'	153° 41.4'	ABORT	
8	2	59° 15.8'	153° 31.0'	ABORT	
8	3	59° 15.7'	153° 30.5'	33	Kamishak Bay
9	1	59° 00.7'	151° 59.2'	188	Lower Cook Inlet
10	1	58° 52.2'	150° 40.2'	129	Gulf of Alaska
11	1	58° 22.0'	148° 02.7'	1400	Gulf of Alaska

Table 43. UW Haul Summary Sheet, *Discoverer*, Leg I, 21-26 February 1977

Bongo Tows

(1976) (GMT)	Time (GMT)	Station	Haul	Latitude (N)	Longitude (W)	Depth (m)	Volume Filtered† (m^3)	Jars from mesh size (μm) 505	333
24 Feb	1331	1	1	58° 54.4'	152° 48.9'	105	736.7	1	1
22 Feb	0736	2	1	59° 23.1'	152° 39.5'	68	222.7	1	1
24 Feb	2137	2	2	59° 22.6'	152° 40.1'		ABORT		
25 Feb	2340	2	3	59° 22.3'	152° 38.2'	38	106.5	1	1
22 Feb	2108	3	1	59° 59.3'	152° 12.0'	35	241.1	1	1
22 Feb	1723	4	1	60° 41.7'	151° 37.2'	60	260.6	1	1
22 Feb	0447	5	1	59° 34.4'	151° 49.8'	40	139.1	1	1
23 Feb	0415	5	2	59° 34.7'	151° 49.2'	22	98.3	1	1
25 Feb	0031	5	3	59° 34.8'	151° 48.0'	30	157.7	1	1
25 Feb	0745	5	4	59° 34.6'	151° 48.6'	26	170.2	1	1
22 Feb	0050	6	1	59° 36.6'	151° 17.8'	70	361.8	1	1
23 Feb	0645	6	2	59° 36.75	151° 16.3'	70	396.9	1	1
25 Feb	0035	6	3	59° 36.7'	151° 15.8'	50	267.4	1	1
25 Feb	1039	6	4	59° 36.7'	151° 17.7'	30	327.9	1	1
24 Feb	1604	7	1	59° 18.0'	153° 08.0'	58	118.7	1	1
24 Feb	1807	8	1	59° 14.1'	153° 41.4'		ABORT		
26 Feb	0416	8	2	59° 15.8'	153° 31.0'		ABORT		
26 Feb	0429	8	3	59° 15.7'	153° 30.5'	30	75.3	1	1
23 Feb	1055	9	1	59° 00.7'	151° 59.2'	188	481.4	1	1
23 Feb	1501	10	1	58° 52.2'	150° 48.2'	110	307.1	1	1
23 Feb	2137	11	1	58° 22.0'	148° 02.7'	180	862.4	1	1

† averaged

6. MILESTONE CHART

a. Updated Schedules

Activity/Milestone/Data Management	APR	JUL	OCT	JAN
1. Annual Report	Δ			
2. Submit April 76 cruise data	Δ			
3. Submit May 76 cruise data		Δ		
4. Quarterly Report 3		Δ		
5. Submit July 76 cruise data		Δ		
6. Submit August and October 76 cruise data			Δ	
7. Submit February 77 cruise data			Δ	
8. Final Report			Δ	

b. Slippages

The schedule has slipped since our last estimate because we changed our priorities to prepare for the Kodiak synthesis meeting and because great quantities of phytoplankton in the samples have slowed the sorting more than we anticipated.

B. Problems encountered

The transducer suffered some damage while occupying station 5 on 24 February, was repaired by the *Discoverer*'s electronic technicians, and ready for use on 25 February. A back-up transducer would have obviated the possibility of wasting expensive operational time due to irreparable damage or loss while immersed in the water.

C. Estimate of funds expended

We estimate that 63% of the budgeted funds have been expended.

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