FINAL REPORT

TO: U.S. Fish and Wildlife Service
Regional Office - Alaska
1011 East Tudor Road
Anchorage, AK 99503

CONTRACT NO: 14-16-0007-81-5216 Ammended

ANALYSIS OF REPRODUCTIVE ORGANS AND STOMACH CONTENTS FROM WALRUSES TAKEN IN THE ALASKAN NATIVE HARVEST, SPRING 1980

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Institute of Marine Science
25 March 1982

Contract Administrator
U. S. Fish and Wildlife Service/CGS
1011 East Tudor Road
Anchorage, AK 99503

Re: Contract 14-16-0007-81-5216

Dear Sir or Madame:

Pursuant to the specifications of the above contract between the U. S. Fish and Wildlife Service and the Institute of Marine Science, University of Alaska-Fairbanks, I enclose herewith the original and three copies of the final narrative report of our "Analysis of Reproductive Organs and Stomach Contents from Walruses Taken in the Alaskan Native Harvest, Spring 1980." Appended to the report is a listing of specific findings in each specimen, as regards reproductive status (Appendix I) and the kinds and quantities of food items in the stomach content samples (Appendix II).

All of the sectioned ovaries and selected examples of the food items from the stomach contents have been retained in storage (in formalin) for future reference, should you or others have any questions about our interpretations of them or need to refer to them for other purposes, in the future.

Sincerely,

Francis H. Fay
Associate Professor
of Marine Science

enclosures

cc: Jim Baker, USFWS

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ABSTRACT

During the spring harvest of walruses by Alaskan Eskimos in 1980, reproductive tracts and/or pairs of ovaries were collected from a sample of 279 females, and aliquots of stomach contents were obtained from 105 males and females. These were analyzed and the results compared with those from samples obtained in previous years for the purpose of assessing the relative status of the population, which is believed to be at, or near, the carrying capacity of its environment. The findings in the reproductive tracts suggest that the percentage of females conceiving (bearing a fetus) has declined from about 38 to 30% in recent years, and that their rate of success in carrying the fetus to full-term has declined from about 95 to 73% per year, mainly due to abortion and premature birth. Findings from the stomach contents suggest that walruses in the St. Lawrence Island to Bering Strait region, although still primarily feeding on bivalve mollusks, have shifted their diet appreciably toward the taking of other types of invertebrate prey and fishes, since 1975. Furthermore, the unit weights of nearly all food items have declined by about 50%, suggesting that the age composition of the prey populations has been changed, presumably by the walrus' predation pressure. Whereas the male and female walruses previously selected different kinds and sizes of prey, they now appear to be competing for virtually the same resources. Complimentary data on population composition and fatness of individuals confirm that the productivity of the population has declined significantly in recent years, and that the food supply is either much less abundant or less nutritious than it was earlier.

INTRODUCTION

The Pacific walrus, *Odobenus rosmarus divergens* Illiger, inhabits the Bering and Chukchi Seas between western Alaska and eastern Siberia, where it has been harvested in small numbers by the indigenous people for several thousand years. The dependence of those people on the walrus as a subsistence resource remains strong today, and for that reason the governments of the United States and the Soviet Union protect and manage the walrus primarily for native use.

Management of the Pacific walrus requires that both nations maintain continuous surveillance of the numerical status and biological characteristics of the walrus population, including the quantity and quality of the harvests by man. For history has shown that this resource is highly susceptible to depletion by over-harvesting (Fay, 1957), and that it has been recovering in recent years from such depletion (Krylov, 1968; Fay and Kelly, 1980). One aspect of management surveillance is the collection of biological samples from harvested animals, with which to assess their current reproductive status and performance, as well as their age composition, physical condition, and feeding habits. Collections of that type were made by Fish and Wildlife Service personnel in 1980, during the spring walrus harvests at native villages in the St. Lawrence Island to Bering Strait region. This was done with the assistance and cooperation of the villagers, under the aegis of the Eskimo Walrus Commission.

The following is a report on analyses of some of the materials collected from the walruses taken during the 1980 spring harvest. Those materials included 105 samples of stomach contents from animals taken at Little Diomede, Wales, Nome, Savoonga, and Gambell, and reproductive organs from 283 females taken at Diomede, Nome and Gambell.

The materials were preserved and labelled in the field by the FWS personnel and were stored for about one year before being made available to us in June 1981. After their arrival in Fairbanks, they were stored for about 2 months in 10% formalin in a refrigerated space, before the analyses were begun.

METHODS

Reproductive Tracts

The reproductive tracts from Gambell and Nome were received as preserved (in 10% formalin), labelled (with accession number and date), pairs of ovaries with all or part of the adjacent uterine horns still attached. Those from Diomede were pairs of ovaries alone. Before processing, these were soaked in fresh water for a few hours to remove some of the formalin and to soften the tissues for easier handling. Insofar as possible, each ovary per pair was identified as "right" or "left", or if this was not feasible, as "A" or "B". The right (or "A") ovary was then sectioned serially in 1- to 2-mm-thick longitudinal slices with a sharp knife, and inspected visually, before the adjacent uterine horn (if available) was hemisected longitudinally. Then the same process was repeated with the left (or "B") ovary and horn. The reasons for this sequence were: (1) if an ovary was found to contain a new corpus luteum of pregnancy, the adjacent horn could be opened very carefully, so that it could be searched for the associated embryo without damaging it, and (2) for the sake of maintaining the correct relationship between structures in each ovary and its adjacent uterine horn, the right and left organs were handled separately. The latter is important for interpreting the individual animal's reproductive history.

Each sectioned ovary and uterine horn was inspected visually, and all features relevant for interpretation of reproductive history and status were recorded. For the ovaries, these records included the kinds and dimensions of the vesicular follicles, corpora lutea, and corpora albicantia; for the uteri, they included the width and color of any placental scars, presence of embryos, blood, or mucous in the lumen, condition of the endometrium, and when appropriate, the outside diameter of the horns.

The features in the ovaries and uteri provide a long-term, semi-permanent record of reproductive performance, but both caution and experience are needed for their interpretation. Our identifications of those features were based on the following criteria (Harrison and Weir, 1977; Fay, 1982):

Ripening follicles.- In nearly all ovaries of adult and subadult walruses, some vesicular follicles can be seen in the creamy-brown cortical layer. These follicles vary considerably in size, in relation to the reproductive status of the animal. "Healthy," ripening follicles have the appearance of more or less spherical cysts, filled with a slightly opaque liquor which, with formalin fixation, has a soft, gelatinous texture. In anestrous animals, these usually are up to 5 mm in diameter; in estrous animals, one or more of the follicles enlarges further to as much as 25 to 30 mm. In the present study, for an index of reproductive condition, we routinely measured only the largest follicle in each ovary.

Degenerate follicles.- These are similar to the foregoing, except that the follicular liquor is very milky, often with a yellowish to pinkish coloration. With formalin fixation, the liquor becomes rather firm and "cheesy." Degenerate follicles often are very large and occur most frequently in post-estrous animals.

Corpus luteum of new pregnancy.- These were identifield by their nearly spherical shape, large size (17 to 34 mm in diameter), softness (i.e., lack of fibrous tissue), usually irregular perimeter, bright yellowish color (sometimes with a pinkish center), and fresh ovulation scar in the adjacent tunic of the ovary, through which the ovum was released. Pregnancy was confirmed in a few cases by the presence of a newly implanted embryo in the adjacent horn of the uterus. In most cases, however, we were unable to confirm that the animal was pregnant because, either the uterine horns were not collected (Diomede sample), or the unimplanted blastocyst was too small to be seen with the naked eye. Implantation generally takes place in June or early July, at least one month later than the time when this series of specimens was taken.

Accessory corpus luteum.- The accessory corpora were identical in color and texture to the corpus luteum of pregnancy, with which they occurred in the same or opposite ovary. They were, however, much smaller (1 to 12 mm) and lacked the ovulation scar (i.e., the ovum had not been released).

Corpus atreticum.- Like the foregoing, these were mostly small and lacked an ovulation scar. They differed in that, where they occurred with a corpus luteum of new pregnancy, their development was not in concert with the latter. That is, they showed signs of incomplete development or degenerative retrogression, usually with extensive invasion by reddish-brown thecal tissue and some tough, fibrous scar tissue.

Corpus luteum of false pregnancy.- When first formed, these may be identical to and indistinguishable from a corpus luteum of new pregnancy, including the presence of an ovulation scar. If so, we may have misidentified some of the latter in cases where pregnancy could not be confirmed by the presence of an implanted embryo. Our basis for identification of a corpus luteum of false pregnancy was its being degeneratively out of phase with the corpora lutea of new pregnancy. That is, even though an ovum had been released and a corpus luteum had formed, that corpus already was showing retrogressive changes, like those in the corpora atretica, presumably because the ovum had not been fertilized or the blastocyst had died or been expelled.

Corpus luteum of term pregnancy.- The corpus luteum at term usually was very large (25-40 mm), very firm (from fibrous invasion), and subspherical, with a smooth, regular border. Generally, one-third to one-half of the corpus was whitish fibrous tissue, often arranged in a stellate pattern, and the remaining patches of lutein cells tended to be more orange than yellowish. The adjacent uterine horn was very large and thick-walled; the opposite horn was much smaller, its endometrium was intensely vesiculate, and its lumen usually contained a large amount of mucous, sometimes mixed with blood.

Corpus luteum/albicans, postpartum.- Following the birth of the calf (or abortion of the fetus), the corpus luteum gradually shrinks in size, its lutein cells are depleted, and it eventually becomes a mass of whitish scar tissue -- the corpus albicans. This process requires about 3 to 6 months. Early in that period, some thecal invasion also takes place, imparting a somewhat brownish color to the waning patches of lutein cells. The uterus, at the same time shrinks to its former size (which takes about 2 months), and the placental lesion gradually heals. Based on these changes, the time of birth (or abortion) can be estimated by back-calculation from the date when the animal was taken.

Corpus albicans.- Each corpus luteum, whether of pregnancy or not, eventually becomes a corpus albicans. These scars vary greatly in size, structure, and appearance, probably in part because of their different origins and different ages. They also vary greatly in duration, some apparently disappearing within 2 to 4 years, whereas others may persist for 15 to 20 years. We presume that the larger, more persistent ones are those derived from corpora lutea of pregnancy, and this is borne out by their correlation with placental scars for at least the first few years. Although we did count and measure all corpora albicantia, we did not accept any as firm evidence of previous pregnancy without the corroborating evidence from a placental scar in the adjacent uterine horn.

Placental scars.- The broad, zonal placenta of the walrus encircles the fetus in utero and, at birth, tears free from the uterine wall, leaving a raw, bloody lesion in the endometrium and an associated hematic contusion in the underlying tissues. The lesion evidently heals within a month, becoming a "placental scar," dark reddish-brown in color from the residue of hemoglobin and its derivitives in the tissues. Gradually, over a period of 4 to 5 years, the pigments are removed or fade, and the scar becomes successively paler, then disappears.

In the preserved uteri from the Gambell and Nome samples, the scars were separable into seven distinct types:

1. "Scar" broad (up to 30 cm wide), rough, dark brown and bloody, found in animals at full term pregnancy or having recently (within 30 days) given birth. Both uterine horns were greatly enlarged, and the

endometrium of the non-pregnant horn, in particular, was extremely vesiculate. In the ovary adjacent to the largest horn (with the scar) was a corpus luteum of term pregnancy.

2. Scar smooth to slightly rough, dark brown to reddish-brown, 1.5 to 4 cm wide (N =13, mean ± SE = 2.43 ± 0.24 cm). The uterine horns ranged from normal non-pregnant size up to 7 cm in diameter. Usually both horns contained some free blood in the lumen, and the endometrium of both was moderately to highly vesiculate. In the ovary adjacent to the horn with the scar was a corpus with structure and appearance intermediate between the corpus luteum of term pregnancy and the corpus albicans. From the diameter of the horn with the scar and the retrogressive state of the corpus luteum-albicans, these were judged to have aborted or given birth 40 to more than 60 days earlier, well before the normal mid-April to mid-June calving season.

3. Scar orange-brown, smooth to slightly rough, 1.5 to 3.5 cm wide (N = 28, mean ± SE = 2.60 ± 0.08 cm); uterine horn of normal progestational size with no free blood or vesiculation of the endometrium. In the adjacent ovary were one or more corpora albicantia, usually one of which was considerably larger and more rounded than the others, presumably having developed most recently from retrogession of the corpus luteum of term pregnancy associated with the scar. These scars were judged to be about 1 year old (i.e., from term pregnancy in 1979).

4. Scar bright to dull orange, smooth, 1.8 to 3.3 cm wide (N = 28, mean ± SE = 2.31 ± 0.06 cm); uterine horns of progestational size, with no free blood or vesiculation. In the adjacent ovary were one or more corpora albicantia, usually one of which was slightly larger than the

others, more dense, and more rounded to oval. These scars were judged to be 2 years old (term pregnancy in 1978).

5. Scar pale orange, smooth, 1.3 to 3.5 cm wide (N = 22, mean ± SE = 2.07 ± 0.11 cm); uterine horns of progestational size, with no free blood or vesiculation. In the adjacent ovary were one or more corpora albicantia, sometimes one of which was slightly larger than the others, more dense, and more regular in outline. These scars were believed to be 3 years old (term pregnancy in 1977).
6. Scar usually very faint, with patchy coloration of endometrium but a distinct pale orange band in the circular muscular layer beneath it, 1.2 to 3.3 cm wide (N = 18, mean ± SE = 1.67 ± 0.09 cm). One or more irregularly shaped corpora albicantia were in the adjacent ovary, sometimes one of which was slightly larger and more dense than the others. These scars were believed to be 4 years old (term pregnancy in 1976).
7. No distinct coloration of the endometrium, but scar evident as very pale yellowish to orange band or blotches in the circular muscle beneath it. Where measureable, these ranged in width from 0.9 to 2.3 cm (N = 15, mean ± SE = 1.45 ± 0.11 cm). The adjacent ovary contained one or more irregularly shaped corpora albicantia, sometimes one of which was slightly larger or more dense than the others. These scars were believed to be about 5 years old (term pregnancy in 1975).

Numerous other uteri contained no evident placental scars or pigment in the uterine wall, though most had a number of corpora albicantia in their ovaries. These animals were judged not to have been pregnant for a least 5 years.

Stomach Contents

The samples of stomach contents apparently also had been preserved in 10% formalin, although the fixation of a few was extremely poor, as if they had not been immersed long enough or in a strong enough solution. Each sample was in a separate, nylon "paint strainer" bag, labelled with accession number, date, and (in most cases) the sex of the animal. Most of these were subsamples (aliquots) taken from larger volumes, after they were thoroughly mixed. In only a few instances, however, was total volume or weight stated on the label.

Of the 105 stomach content samples, 15 were from Little Diomede, 11 from Wales, 3 from Nome, 25 from Savoonga, and 51 were from Gambell. Five of the 11 samples from Wales (WL-3, 5, 31a,31b, 32) were improperly preserved (or not preserved at all), and one contained only gravel (DWL-2). Three of the 51 from Gambell consisted only of congealed blood and gravel (GW-110, 124, 150); one contained only gravel (GW-34): Those ten samples were discarded; the remaining 95 were analyzed in the same manner and with the same equipment used by Fay *et al.* (1977) for analysis of the samples from the spring 1975 harvest in the same region.

First, each sample was placed in a bucket of fresh water to dilute the formalin and separate the pieces, most of which had congealed together into a more or less solid mass. After decanting some of the liquid, the larger solid parts were removed by hand and sorted into taxonomic groups. The remaining particulate material was then decanted from the sediments (sand and gravel) and poured through a 2-mm-mesh sieve. The materials caught in the sieve also were then sorted into taxonomic groups, insofar as possible.

Then, the number of individual prey represented in each taxonomic group was counted, and after the excess water had been drained and blotted from it, each group was weighed to the nearest gram. Each taxon was identified to the lowest possible nomenclatural level (usually to genus), based on comparison with reference specimens in the University of Alaska's marine collections. Since walruses usually do not ingest whole gastropods and bivalve mollusks, our identifications of those mullusks were based mainly on the soft parts (feet and siphons) or, in the case of the gastropods, on the attached operculum.

For each sample, we recorded the accession number, date, sex (when given), and the name, number of individuals, and total weight for each taxon of prey. Also recorded were the weights of molluscan shell fragments, bottom sediments, and unidentifiable organic digesta.

RESULTS

Reproductive Tracts

Of the 177 specimens provided from Gambell and Nome, 166 consisted of all or part of both uterine horns with attached ovaries, 7 consisted of only one uterine horn and ovary, and 4 were simply pieces of meat, fat, and vascular tissue having no relationship to the reproductive organs (Appendix I). These had been well labelled and well preserved, and 170 of them were sufficiently complete for diagnosis of current reproductive status of the animals from which they were taken. The 106 specimens from Diomede consisted of pairs of ovaries alone, unfortunately with no information on uterine size or placental scars.

Four of the 167 diagnostic specimens from Gambell were nulliparous, immature individuals, as were four of the 106 from Diomede. The remaining 163 from Gambell, 3 from Nome, and 102 from Diomede were from females of breeding age ("adults"), as indicated by the fact that they had at least one corpus (luteum or albicans) in their ovaries. The following analysis is based on the findings in those adults.

Current Reproductive Status

Gambell.- Of the 163 adult females from Gambell, 36 (22%) were in full-term pregnancy or had given birth to a calf within the normal mid-April to mid-June calving period. This was evident from the fact that both uterine horns were greatly enlarged and thickened, and that one of the attached ovaries contained a corpus luteum of the type typical of term pregnancy or recent parturition. Because only a small part of the pregnant horn of the uterus was provided, however, we were unable to diagnose in most instances whether the fetus was still in utero or had recently been born. Only where the parturient horn obviously was reduced in size from term pregnancy dimensions were we able to confirm that birth had taken place not long before the animal was killed. Thirty-four (94%) of these term to postpartum females were accompanied by a newborn calf; two (6%) apparently had lost their calves, at or soon after birth (K. Lourie, unpublished data). Loss of some calves during the natal period is not unusual in Pacific walruses (Fay, 1982), and the proportions indicated by these data are comparable with previous findings.

Another 13 animals (8%) which had conceived in 1979 had given birth to their calves unusually early in 1980 or had aborted the fetus during the winter, before the gestation was completed. This was indicated in each case by the fact that (a) a recent (brown or reddish brown) placental scar was present in the uterus, (b) the uterine horn with the placental scar had contracted to or nearly to its normal non-pregnant size, and (c) the associated corpus luteum-albicans was more fibrous and consolidated than those of animals known to have given birth within the normal mid-April to mid-June calving period. At least 9 of these females were not accompanied by a calf, indicating that their calves or abortuses had not survived; the fate of the other four is unknown (no data). One which apparently had aborted very early in the winter had ovulated again in a postabortum estrus and had been fertilized, as indicated by its large, normally functional corpus luteum of new pregnancy. Two others, which contained ripening follicles 9 to 11 mm in diameter, apparently were about to ovulate. The remaining ten were not in estrus and had not ovulated in the current year.

In addition to the one animal which had aborted early in pregnancy and had become pregnant again in the current year, 67 others (41%) also were newly pregnant. Of those, 62 had ovulated only once in the current year and become fertilized successfully, as indicated by the presence of a single, large corpus luteum of new pregnancy. Five others had ovulated twice and had been fertilized successfully at the second ovulation, as indicated by the presence of a small, retrogressive corpus luteum of false pregnancy and a large, normally developed, new corpus luteum of pregnancy. Two had one or more small, accessory corpora lutea, in addition to the large primary one. The uteri of most of these newly pregnant animals were not enlarged and did not contain any macroscopically visible embryos, although we assume that a microscopic blastocyst was present in each. Only three, taken on 27-28 May, contained visible embryos in an early stage of nidation (implantation). In those, the uterus was slightly swollen at the implantation site. Their embryos were elliptical blastocysts, about 6-7 mm long and 4-5 mm in diameter, which apparently had not yet reached the "primitive streak" stage of organization.

The remaining 47 animals (29%) were classified as "barren", in as much as they had not been pregnant within the past year and were not likely to become pregnant in the current year. Although six of them appeared to be in estrus (with ripening follicles 8 to 14 mm in diameter), these probably would not have been fertilized successfully, since rutting males are scarce after April (Fay, 1982). Nine of these barren females apparently had been in estrus earlier, during the normal, mid-winter mating season but had not ovulated successfully, as indicated by the presence of a corpus atreticum in their ovaries.

At least two (4.3%) of the newly pregnant females were accompanied by newborn calves, which they apparently had taken in fosterage. At least four other calves were in the company of barren females. Several instances of fosterage of calves that were lost or abandoned by the mother were reported previously by Burns (1965), Eley (1978), and Fay (1982), hence this does not appear to be unusual.

Nome.- Each of the three specimens taken in the vicinity of Nome was a multiparous adult in new pregnancy. In two of these, pregnancy was assumed on the basis of the presence of a large, new corpus luteum in one of the ovaries; in the third, pregnancy was confirmed by the presence of an unattached blastocyst about 5 mm long in the adjacent uterine horn (20 May).

Diomede.- Of the 102 adult females from Diomede, 15 (15%) were in term pregnancy or had given birth within the normal calving period in 1980. Eight others (8%) had aborted during the winter or had given birth unusually early, as indicated by the contracted, fibrous condition of the corpus luteum/albicans in one of their ovaries. Two of these eight apparently had aborted early enough to permit ovulation again in the current mating season, for they were newly pregnant. One other was coming into estrus again when taken, for she had a 10-mm, ripening follicle in one ovary. The other five were neither in estrus nor had they ovulated earlier.

In addition to the two animals which had aborted early and become pregnant again, 61 others (60%) were newly pregnant (i.e. had a new corpus luteum of pregnancy). Of these, 58 had ovulated once in 1980 and been fertilized successfully; 5 had ovulated twice, the first resulting in failure and the second, success.

The remaining 18 animals (17%) were barren. Two of them had ovulated earlier but had not been fertilized; these two and five others were in estrus at the time when they were taken. Had these estrous animals survived, they probably would not have been bred in 1980 anyway, due to the scarcity of rutting bulls that late (May) in the year.

Comparative Findings

In the past, the walrus hunters at Gambell were highly selective in their spring harvests of females, preferentially taking those with newborn calves whenever possible (Fay, 1958; Burns, 1965). This was done traditionally because the flesh of the calves was cherished as dried meat for summer use, and the hides were needed for preparation of rawhide lines. As a result, about 80% of the spring harvest of females each year was made up of those which recently had given birth, about 15% was made up of newly pregnant animals, and the remaining 5% was barren (Table 1). In the 1980 spring harvest, however, cows recently bearing made up only about 20%, and the remainder was about evenly divided between newly pregnant and barren animals. This was a marked change in the composition of the harvest. To the best of our knowledge, it was not due to any change in selection; rather, it apparently was due to a change in availability of postpartum females.

At Diomede, the selection by the hunters since the 1950's has been for the animals with the largest tusks, and this has not changed in recent

Table 1. Comparative proportions of births, new pregnancies, and unproductive animals in spring harvest samples of adult females walruses from Gambell and Diomede, 1952-1980.

Location and years	Sample size	% Bearing new calf	% Newly pregnant	% Aborted, early birth, or barren	Source
Gambell					
1952-61	93	83	11	6	F. H. Fay, unpubl. data
1962-64	109	80	15	5	J. J. Burns, unpubl. data
1965	114	89	7	4	J. J. Burns, unpubl. data
1966-75	49	76	20	4	F. H. Fay, unpubl. data
1980	163	22	42	36	This study
Diomede					
1952-58	47	47	38	15	K. W. Kenyon, J. W. Brooks, unpubl. data
1962-64	61	51	31	18	J. J. Burns, unpubl. data
1965	49	33	33	14	J. J. Burns, unpubl. data
1966-68	35	48	26	26	J. J. Burns, unpubl. data
1980	102	15	62	23	This study

years. About 50% of the harvests of females there in the past were made up of those having recently given birth to a calf, about 30% were of newly pregnant animals, and the remainder were barren (Table 1). In 1980, however, the proportion of females recently bearing was down to about 15%, with the remainder made up of newly pregnant and barren cows. Again, this was a marked change, comparable to that at Gambell, in that there was a reduction in the number of postpartum cows taken to about one-fourth of the former proportion. This suggests that post partum cows were equally scarce in both localities.

Of the 217 females from Gambell, Nome, and Diomede which were potentially capable of breeding in 1980 (i.e., were not in term pregnancy and had not recently given birth), 134 (62%) apparently had been bred and 83 (38%) were barren. The respective proportions of these classes in previous years, based on a comparable sample of 206 specimens, were 68 and 32% (Fay, 1982). Although this comparison suggests that the pregnancy rate of the population may have declined in recent years, a difference of this magnitude in samples of this size is not significant; it could occur by chance with greater than 10% probability ($X_1^2 = 1.54$).

Current Reproductive Performance

The reproductive efficiency of the female depends not only on the frequency and proper timing of estrus but also on her ability to achieve fertilization of the shed ovum, implantation of the blastocyst, gestation of the fetus to full-term, and birth and nurture of the calf. The rate of success in achieving each of these steps varies considerably with the age of the walrus, being highest at 8 to 15 years of age and lowest in the youngest and oldest breeders (Fay, 1982).

The percentage of ovulations resulting in unsuccessful fertilization or death of the blastocyst in this 1980 series appears to have been about the same or slightly higher than was found in earlier samples. Of 153 ovulations which had taken place in the 1980 breeding season, 133 (87%) probably were fertilized successfully, as indicated by the presence of a normal-appearing, new corpus luteum of pregnancy in the ovaries. The other 20 (13%) were not successfully fertilized, as indicated by the presence of a degenerating corpus of false pregnancy. In comparable samples taken in the 1950's and 1960's, the percentage of ovulations in which reproductive failure took place as a result of unsuccessful fertilization, death of the blastocyst, or failure of the blastocyst to implant was about 12% (Fay, 1982). Because most of the cases of successful fertilization in this 1980 series had not yet reached the stage of implantation, in which some further failures could be expected, the actual rate of failure between ovulation and conception (implantation) in 1980 may have been somewhat higher but not greater than 14 or 15%, (assuming that embryonic mortality takes place at about 1% per month).

Comparative rates of success and failure in gestation (i.e., from conception to birth) were derived most reliably from the 1980 Gambell and Nome samples, because these provided the most complete record from both ovarian features and placental scars. These indicated that, of at least 49 females conceiving in 1979, 36 (73%) had successfully completed the full pregnancy and given birth to a calf in the normal spring season. Most of those calves probably were born alive, though judging from past performance, a few (about 2%) could have been born dead (Fay, 1982). The remaining 13 animals (25%) that conceived in 1979 evidently had either given birth unusually early or had aborted the fetus prematurely. In 10 of those specimens, the uterus already had contracted to the normal pro-gestational (non-pregnant) size, indicating that birth or abortion had taken place during the winter, not later than mid-March. In 3, the uterine size suggested birth or abortion in late March to the first days of April. Although some prematurely born calves apparently can survive (Burns, 1965; Fay, 1982), most of them probably expire. Two abortuses which were sighted on the ice during the walrus research cruise of the ZRS *Zvyagino* in early March 1981, were dead or dying; no other newborn calves were seen among more than 6,000 females sighted during that cruise (F. H. Fay, unpublished data).

According to our interpretation of features in the ovaries alone of the animals in the 1980 Diomede sample, at least 21 had conceived in 1979, and 15 (71%) of those had completed the full term of pregnancy. This was indicated by the presence in their ovaries of a large corpus luteum, still containing about 50% or more luteal tissue and corresponding in appearance to those in the Gambell and Nome specimens which were known to have given birth or were carrying a term fetus. The other 6 specimens (29%) apparently had aborted the fetus during the winter or had given birth to it unusually early in 1980. In these specimens, the corpus luteum/albicans contained very little luteal tissue and had contracted markedly in size.

The proportion of incomplete gestations indicated by these two samples differs to a very highly significant degree from findings in the 1950's and 1960's. In those years, the proportion of conceptions ending in gestational failure due to abortion, premature birth, and fetal death was only about 5% (Fay, 1982), in contrast to the 27% average indicated for abortion and pre-mature birth alone in the combined 1980 samples.

This type of decline in reproductive success could be due to many factors, one of which could be a change in age composition of the harvest, for the individual's reproductive performance varies greatly with age, being highest from about 8 to 15 years and substantially lower in earlier and later ages (Fay, 1982). That a change in the age composition of the harvest did take place in 1980 is indicated by the higher numbers of corpora (lutea and albicantia) in this series of ovaries than in any previous samples. The number of corpora per individual is roughly equivalent to the number of times the individual has ovulated; hence, it tends to increase with age (Burns, 1965; Krylov, 1966). In 1980, the modal number of corpora per individual from both Gambell and Diomede was about 5 or 6 and the maxima were 14 and 16, respectively. In comparable samples from the 1950's to mid-1960's, the modes were about 2 or 3 and the maxima 9 and 11 (Fig. 1). These differences are not large but do suggest that the model ages of the animals taken in both localities in 1980 were at least 4 to 5 years older than in the earlier harvests.

Past Reproductive Performance

Because the placental scars persist in the uterus for several years and change in color in a consistent manner, the past reproductive performance of each individual can be determined in part from the presence and character of those scars. Confidence in interpretation of them, however, diminishes with the age of the scars, and the presence of old scars may be masked by newer ones in the same location. This second interpretive problem can be circumvented by including in the sample only those animals in which there is no possibility of such masking. For example, to estimate from the present (1980) series the proportion of animals which conceived in 1978 and carried a fetus to or nearly to term in 1979, the sample would

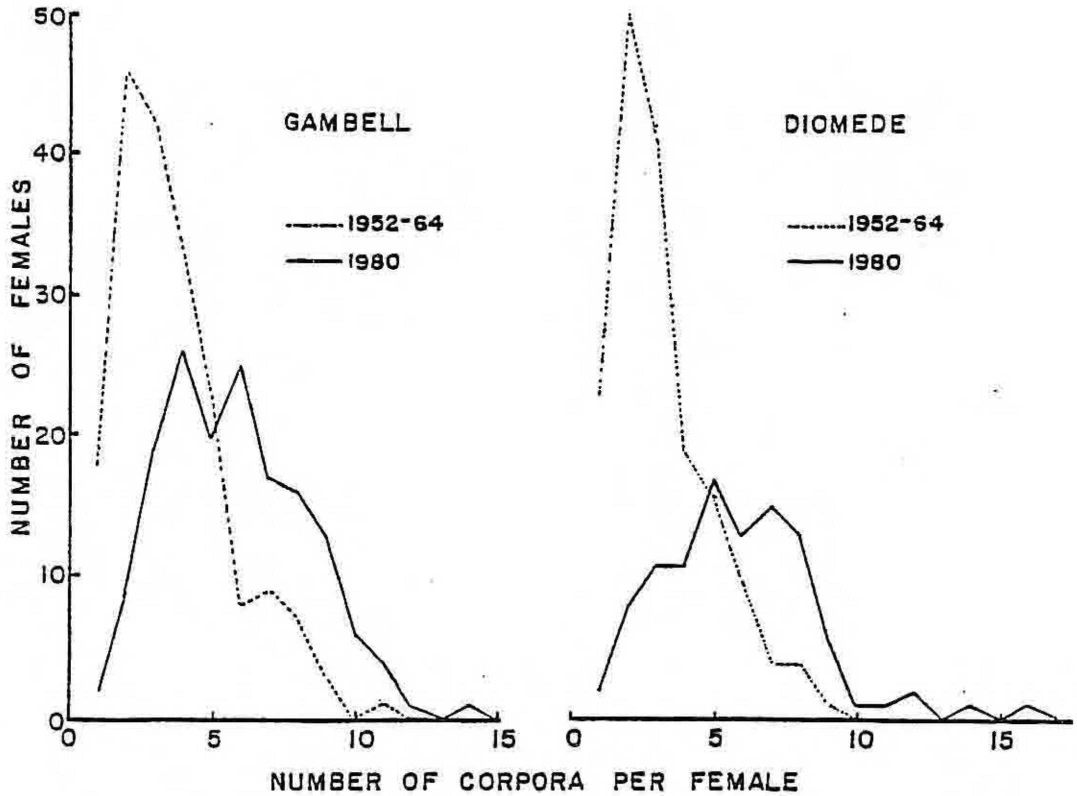

Figure 1. Frequency of occurrence of numbers of ovarian corpora (lutea and albicantia, combined) per female in samples of walruses taken in the spring harvests at Gambell and Little Diomede. Results from the 1980 harvests (this study) are compared with those from the same localities in 1952-64 (J. W. Brooks, J. J. Burns, F. H. Fay, and K. W. Kenyon, unpublished data).

include only those animals having placental scars that were 1 year old or older; for estimation of the proportion conceived in 1977 and carrying to term in 1978, the sample would include only those with scars 2 years old and older, etc. Because there is no possibility of the hunter's selection having any biasing effect on this historical record (Fay, 1982), each such sample can be regarded as random and representative of the population at large.

The results of this analysis (Table 2) suggest that the conception rate (percentage per year of animals carrying a fetus to or nearly to term) at least since 1977 has been about 30%, whereas it was about 38% per year in the 1950's and 1960's (Fay, 1982). The difference is large and suggests that the conception rate in the population may have declined significantly in recent years.

Stomach Contents

The 95 samples of stomach contents which were suitable for analysis comprised about 132.6 kg, of which 117.8 kg were organic matter and 14.8 kg were inorganic sediments (sand and gravel). Since most of the samples were 2 to 3 liter aliquots drawn from much larger volumes, these weights are not representative of the total quantity of food and sediments in the 95 stomachs, though they are representative of the proportions of prey. Some 25,000 individual prey were identified in the samples, and these represented at least 44 genera of benthic organisms from 11 phyla (Table 3). The diversity of prey from each locality was proportional to the number of samples, as might be expected. The greatest diversity (35 genera) was at Gambell, from which the most samples (47) were obtained; the lowest diversity (9 genera)

Table 2. Pregnancy rates indicated for the past five years by placental scars in the uteri of female walruses taken in the 1980 spring harvest at Gambell and Nome.

	Year of birth				
Specimens	1975	1976	1977	1978	1979
Sample size	18	36	50	72	103
No. pregnant	2	18	14	22	31
% pregnant	11.1	50	28.0	30.6	30.1

Table 3. Diversity and frequency of occurrence of prey taxa represented in the stomach contents of walruses taken in each locality, spring 1980.

Taxon	Diomede (N=15)	Wales (N=5)	Nome (N=3)	Savoonga (N=25)	Gambell (N=47)
Coelenterata					
Bryozoa (unidentified)	0	0	0	0	1
Anthozoa (unidentified)	3	0	0	2	6
Annelida					
Nephythys	9	1	0	8	3
Lumbrinereis	1	0	0	1	0
* *Arenicola*	0	1	0	0	2
* *Brada*	0	0	0	0	4
* *Phyllodoce*	1	0	0	0	0
Pectinaria	0	0	0	1	0
Unidentified	1	0	0	2	1
Sipunculida					
Golfingia	7	0	0	9	3
Echiurida					
Echiurus	5	2	0	13	15
Priapulida					
Priapulus	6	0	0	20	27
Mollusca					
Neptunea	8	3	2	14	31
Buccinum	9	1	0	10	24
Natica	6	0	2	14	21
Polinices	8	1	2	19	34
Margarites	1	0	0	1	1
* *Epitonium*	1	0	0	2	0
Solariella	0	0	0	0	3
* *Onchidiopsis*	0	0	0	2	0
Serripes	13	0	1	24	35
Clinocardium	0	0	0	2	0
Mya	14	5	2	25	35
Spisula	1	0	0	0	2

Table 3. Continued

Taxon	Diomede	Wales	Nome	Savoonga	Gambell
Tellina/Macoma	6	1	0	9	12
Hiatella	3	0	0	8	0
Astarte	0	0	0	0	2
Yoldia	2	0	0	2	4
Thyasira	1	0	0	0	1
Liocyma	0	0	0	1	2
Octopus	5	0	0	0	1
Crustacea					
Anonyx	1	0	0	0	3
Hippomedon	0	0	0	0	1
* *Protomedia*	0	0	0	0	1
* *Byblis*	1	0	0	0	0
Argis	0	0	2	11	16
Pagurus	1	0	0	3	7
Hyas	1	0	1	5	26
Echinodermata					
Cucumaria	1	0	0	1	0
Thyonidium	7	2	0	8	15
Urochordata					
Pelonaia	1	0	1	0	5
Unidentified	0	0	0	0	3
Vertebrata					
* *Ammodytes*	0	0	0	1	1

* Not recorded previously as food of Pacific walrus.

was at Nome, from which only 3 samples were obtained. A tabulation of findings in each sample from each locality is presented in Appendix II.

Included in the weight of organic matter were about 3 kg of fragmented digesta not identifiable to taxon, and 135 g of molluscan shell fragments, most of which were identifiable to genus. Loose periostracum from siphons of *Mya* spp. and *Hiatella* was included in the respective total weights for each of those genera, as were the shell fragments. Not included in either the total numbers or weights were 1,594 gastropod operculae and 6 octopus beaks, weighing about 320 g. These were recorded only as "trace" occurrences, inasmuch as such indigestible hard parts apparently are retained in the stomach for some time after the fleshy parts have been digested.

About two-thirds or more of the identified prey in the samples from each locality were bivalve mollusks, predominantly *Mya* spp. Where the samples were little affected by digestion, it was clear that the entire fleshy portion of each bivalve had been eaten (i.e., excluding only the shells). This was in contrast to earlier reports (Vibe, 1950; Fay *et al.*, 1977), which indicated that walruses eat only the large, muscular parts (foot, siphon), leaving the remainder of the soft parts along with the shell. The undigested gastropods also included essentially all of the soft parts, together with the firmly attached operculum; only the shell had not been eaten.

As in previous studies (Brooks, 1954; Fay *et al.*, 1977), the samples obtained from male walruses showed somewhat lower diversity of prey than did those from females, but the difference was not significant. Also, the unit weights of the prey taken by the males tended to be somewhat greater than of those taken by the females.

Regional Comparison

The 20 samples from Little Diomede and Wales contained about 35.2 kg of food and 2.3 kg of sediments. By far, the largest proportion of the 4,185 individual prey were mollusks (gastropods, bivalves, and cephalopods), which made up about 84% of their number and 92% of their weight. More than 3,000 of the identified prey were bivalves (clams and cockles), principally of the genera *Mya, Serripes, Macoma,* and *Tellina*. In terms of weight, *Mya* predominated, making up more than 66% of the identifiable animal remains. Of the non-molluscan prey, polychaete, sipunculid, and echiurid worms were most abundant and made up about 8% by weight of the identified prey.

The three samples from the Nome area were not adequately representative of walrus feeding habits there, but they did resemble earlier samples in that none contained any measurable amount of bottom sediments, and cockles of the genus *Serripes* predominated. In both numbers and weight, mollusks made up about 98% of the prey, and *Serripes* comprised more than 67% of the total weight of identified organisms. *Mya* was second in abundance, making up 30% of the total weight. The principal non-molluscan prey were crangonid shrimps and crabs, which made up 1.3% of the total weight.

The 25 samples from Savoonga contained 10,437 prey and had a total weight of 37.1 kg, of which about 10% was sand and gravel and the rest was animal matter. At least 29 taxa of prey were represented. Mollusks were by far the most abundant, making up about 97% of the number and 94% of the total weight of identifiable organisms. Dominant among these in terms of numbers were clams of the genera *Hiatella* and *Mya* of which about 9,000 individuals were present. By weight, however, *Mya* and *Serrripes* dominated, amounting to 42 and 35%, respectively, of the total identified prey. Among the non-molluscan prey, priapulids and crustaceans were most abundant, making up more than 3% of the weight of identified organisms. Notable was the presence of 22 anemones and one fish (sand lance, *Ammodytes hexapterus*), neither of which had been recorded previously as walrus food in this locality.

Finally, the 47 analyzable samples from Gambell contained 9,092 individual prey and made up more than 53 kg, of which 44.4 kg (84%) was animal matter. At least 35 taxa were represented; the most abundant of these were mollusks. In this area, however, the mollusks made up only about 69% of the number and 82% of the total weight of identifiable prey. Of these, bivalves of the genera *Mya* and *Astarte* were most numerous, comprising nearly 4,000 individuals. *Mya* predominated by weight, making up about 60% of the total identifiable prey. Of the non-molluscan prey, polychaetes, echiurids, and crustaceans were most abundant, making up about 27% of the number and 15% of the weight of identified prey. As at Savoonga, fishes (sand lance) and anemones were found for the first time.

Comparison With 1975 Results

As a whole, the findings in these samples did not appear to be markedly different from those in a comparable series obtained from most of the same localities in the spring of 1975 (Fay *et al.*, 1977). The proportion of the ingesta made up by bivalve mollusks was very high in both years, and the proportions by other prey were mostly very low (Table 4). There was, however, a tendency toward increased utilization of nearly all of the non-bivalve taxa, especially the gastropods (snails and whelks) and crustaceans (mainly crangonid shrimps). Large increases were indicated also in the use of anemones and echiurid worms, and there were small increases in use of

Table 4. Comparative percentages by weight of prey taxa in stomach contents of walruses taken in spring harvests at four localities in 1975 and 1980.

Location	Diomede		Nome		Savoonga		Gambell		
Year	1975	1980	1975	1980	1975	1980	1975	1980	Trend
Sample Size	71	15	7	3	14	25	13	47	
Anthozoa	0.0	0.1	0.0	0.0	0.0	0.5	0.0	0.3	+++
Polychaeta	0.6	1.7	tr	0.0	0.1	0.5	1.0	1.6	++
Sipunculida	0.6	3.3	0.0	0.0	0.1	0.6	0.3	tr	-
Echiurida	tr	0.3	0.0	0.0	0.2	0.2	tr	5.4	++
Priapulida	0.2	0.8	0.4	0.0	0.4	2.2	0.8	0.8	+
Gastropoda	1.1	2.8	0.7	0.9	0.3	2.7	1.1	3.7	++++
Bivalvia	84.0	85.8	73.5	97.5	80.6	79.9	65.2	61.7	
Cephalopoda	tr	0.2	0.0	0.0	0.0	0.0	tr	tr	+
Crustacea	tr	0.1	tr	1.3	0.3	0.6	3.3	5.2	++++
Holothuroidea	0.4	0.6	0.0	0.0	0.7	0.7	2.7	0.8	
Urochordata	0.0	tr	0.0	0.3	0.0	0.0	0.0	0.1	+++
Fishes	0.0	0.0	0.0	0.0	0.0	tr	0.0	0.2	++
Mammals	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
Sediments	2.0	3.5	0.2	0.0	0.7	10.4	2.0	16.3	++

tunicates and fishes. Furthermore, 10 genera of these "alternate" (non-bivalve) prey in the 1980 samples had been recorded rarely or not at all in the 1975 and earlier samples. These included at least two genera of anthozoan polyps (anemones), three polychaetes (*Brada, Arenicola,* and *Phyllodoce*), two gastropods (*Epitonium* and *Onchidiopsis*), two amphipods (*Protomedia* and *Byblis*), and one fish (*Ammodytes*). Anemones had been found previously in only one non-quantitative sample from Bering Strait (Fay *et al.*, 1977), and fishes were found only twice before in stomach contents of walruses taken in the western Chukchi Sea (Krylov, 1971). Indication of increased reliance on fishes as prey in recent years was evident also from the marked increase in occurrence of parasitic nematodes (Table 5), the intermediate hosts of which are primarily gadoid fishes (Margolis, 1977).

Taking into consideration the known disparities between males and females in feeding habits (Brooks, 1954; Fay *et al.*, 1977), the differences between years were even more apparent (Table 6). The tendency was toward decreased use of bivalves and increased use of all other types of prey. Such changes were evident particularly in the samples from females, in which the use of alternate prey apparently increased from about 5% by weight in 1975 to about 24% in 1980; in the males an increase from about 4 to 9% was indicated. Of the bivalves, the females apparently were feeding most intensively in 1975 on the smaller genera, such as *Hiatella, Astarte, Yoldia,* and *Macoma/Tellina* (about 56% by weight), whereas they were taking them much less often in 1980 (2.4% by weight) and were concentrating more on the larger genera (*Serripes* and *Mya*). The males apparently continued to rely on the large clams and cockles primarily, but their use of those as well as of the smaller genera appeared to have declined slightly. Those changes suggest that

Table 5. Comparative frequency of occurrence and numbers of anasakid nematodes ("cod worms") parasitizing the stomach of walruses taken in the Bering Strait region over the past two decades.*

Year	No. of walruses	Anasakid nematodes Frequency (%)	Number per walrus Range	Number per walrus Mean	Source
1964-66	95	1.0	5	-	Yurakhno and Treschev, 1972
1975	107	6.5	1 - 20	6.0	L. M. Shults, pers. commun.
1980	95	15.8	1 - 61	15.2	This study

* Since these parasites are acquired by pinnipeds through ingestion of fishes, their comparative frequency of occurrence and relative abundance are indicative of degree of piscivory.

Table 6. Comparative percentage composition by weight of stomach contents from male and female walruses taken in the Bering Strait region in spring 1975 and 1980.

	From males		From females	
	1975	1980	1975	1980
Anemones	0.0	0.2	0.0	0.4
Worms*	1.4	4.3	2.4	15.8
Snails/whelks	1.1	1.4	2.0	3.4
Bivalves (total)	96.2	91.5	95.0	76.4
Large†	91.2	86.9	39.5	74.0
Small‡	5.0	3.6	55.5	2.4
Crustaceans	0.5	2.5	0.06	3.3
Sea cucumbers	0.7	0.9	0.5	0.6
Tunicates	0.004	0.03	0.0	0.1
Fishes	0.0	0.1	0.0	0.0

* Polychaetes, sipunculids, echiurids, and priapulids.

† *Serripes, Clinocardium, Mya,* and *Spisula.*

‡ *Hiatella, Astarte, Macoma, Tellina, Yoldia, Thyasira,* and *Liocyma.*

the males and females in 1980 were much more competitive with each other for the same genera of prey than they had been 5 years earlier in this region. This was indicated also by the comparative sizes of individual prey in their stomach contents.

Whereas in 1975, the overall average unit weight (g/individual) of the prey in the samples from males tended to be about 5 times larger than from the females (Fay *et al.*, 1977), the average unit weights were nearly equal in both sexes in the 1980 samples (Table 7). This overall change was dominated by the bivalves but was evident in nearly all of the other taxa, as well. Although it may not be accurately reflected in Table 7, because of problems in weighting the data from small, uneven samples, the overall downward trend certainly is real. Even though the males continued to rely primarily on the large types of bivalves in 1980, they apparently were not taking as many of the very large, mature individuals but were tending to utilize the smaller, younger ones, about half as large as those taken in 1975. Conversely, the females, which apparently had relied mainly on the smaller genera in 1975, were taking many more of the larger bivalves in 1980, comparable in size to those taken by the males.

DISCUSSION

Since the late 1950's, the Pacific walrus population appears to have been recovering from a greatly depleted state. That depletion was brought about by the Soviet Union's overharvests during the 1930's to 1950's. The magnitude of those harvests (about 140,000 animals) was comparable to those taken by the Yankee whalers in the late 19th century (Krylov, 1968; Bockstoce and Botkin, in press). By the 1950's, the population probably was at its

Table 7. Comparative unit weights (g/individual) of prey in the stomach contents of walruses taken in the Bering Strait region in spring 1975 and 1980.

Prey type	From males				From females			
	1975		1980		1975		1980	
	No.	Unit wt.	No.	Unit wt.	No.	Unit wt.	No.	Unit wt.
Polychaetes	302	12.8	220	2.4	104	5.6	568	1.8
Sipunculids	941	3.3	170	2.4	135	3.0	200	4.0
Echiurids	67	6.6	286	4.8	13	7.8	811	3.3
Priapulids	196	8.1	140	7.9	42	11.2	63	6.6
Gastropods	1,717	3.8	375	3.1	618	2.1	370	2.9
Bivalves								
Cardiids*	3,961	21.8	935	18.4	675	6.2	304	18.8
Myacids†	20,182	22.8	7,349	6.7	1,193	17.9	1,444	9.9
Hiatella	22,586	1.4	4,467	0.5	26,377	1.3	0	--
Tellinids	136	2.5	1,389	0.3	1,230	1.1	963	0.5
Other small clams	188	0.5	44	0.7	735	0.3	1,219	0.2
Shrimps	71	3.0	426	4.0	4	0.5	345	2.7
Crabs	363	7.5	163	1.8	9	4.0	46	2.7
Holothureans	221	21.0	53	13.4	19	18.2	18	9.6
Overall	50,931	11.8	16,017	4.8	31,155	2.1	7,413	4.2

* Excluding samples from Nome, where cardiids appear to be uniformly of much smaller size than elsewhere and were sampled only from males in 1975 and only from females in 1980.

† Includes *Mya truncata*, *M. arenaria*, and other large *Mya*-like clams as yet unidentified.

lowest numerical level in history (Fay, 1982), and it is from that low point that it has been recovering in recent years.

Results of repeated aerial censuses of the population since 1958 have indicated rapid increase in numbers, possibly from a low of less than 100,000 to more than 200,000 animals by 1980 (Kenyon, 1960, 1972; Fedoseev, 1962; Krylov, 1968; Estes and Gol'tsev, in press; A. W. Johnson, pers. comm.). This trend of increase has been indicated also by the population's gradual reoccupation of most of its former range in both Soviet and American waters (Gol'tsev, 1968; Fay, 1982; Estes and Gol'tsev, in press; J. J. Burns, pers. comm.). To date, practically all former hauling grounds that were used by the population in historic times have been reoccupied, with the exception of the Pribilof Islands.

Beginning about 1977 or 78, the native walrus hunters of western Alaska (particularly at Gambell) complained about the scarcity of newborn calves and the leanness of the adults, and they reported that the animal's feeding habitats also had changed in some degree. Those observations, coupled with a mass mortality of walruses at St. Lawrence and the Punuk Islands in the autumn of 1978, led the hunters to suspect that the population had overshot the carrying capacity of its environment and was likely to decline again, this time from natural causes (Fay and Kelly, 1980). Conversely, on theoretical grounds (Estes, 1978), one would not predict a major post-saturation decline in numbers for a long-lived, *K*-selected species such as the walrus. Instead, the population would be expected to come gradually into balance with its environmental limitations rather than to overshoot that mark, for the walrus has the lowest reproductive rate of any pinniped, and this population still is cropped annually to a considerable degree.

Other pinnipeds (e.g., the southern elephant seal: Ling and Bryden, 1981), under similar circumstances of re-expansion into an environment that was almost unexploited for many years, seem not to have responded in a "peak-and-crash" mode, even when fully protected.

The real status of the Pacific walrus population at present is uncertain. If it has reached or is approaching an upper limit, the adjustments required to bring it into balance with its food supply and other environmental parameters should be detectable and quantitatively definable (see Eberhardt and Siniff, 1977; Siniff *et al.*, 1978). These should appear as declines in birth rate, calf survival, or both, coupled with increasing age at first pregnancy. If there has been a decline in productivity, then the age composition of the population should be changing, with decrease in the proportion of young and increase in proportion of old-aged animals. If it has increased to the point of impacting its own food supply, then the animals in general should be getting leaner and growing more slowly, and there should be some significant changes in their diet, possibly with a shift in emphasis from bivalve mollusks (clams and cockles) to other kinds of benthic organisms. Also the size of the prey should be diminishing as the larger, older organisms are depleted. Conversely, if the status of the population has not changed since the last major collection of biological samples was taken in 1975, then none of the above "adjustments" should be evident, for no changes had been detected up to that time, since the first collections in 1952.

Our findings in the present study, compared with those from earlier years, do indicate that some changes relatable to stabilization or decline of the population were underway in 1980 and that some had begun as early as 1977. The changes indicated by the reproductive organs were:

1. The conception rate of adult females decreased from about 38% prior to the 1970's, down to about 30% per year in 1977-79 (and, possibly, in 1980).

2. The percentage of gestations that resulted in normal births declined from about 95% in the 1950's to early 1970's, to about 73% in 1979-80, mainly as a result of increased abortion and premature birth.

3. The percentage of postpartum females available to the hunters at Gambell and Diomede during the spring harvest in 1980 was down 75% from previous levels in the 1950's to early 1970's.

4. The females taken in the 1980 harvests at Gambell and Diomede appear to have been considerably older than those taken in previous years, suggesting that the population now contains a much higher proportion of old animals than it did earlier.

A reduction in conception rate could be due in part to the increased proportion of old females, for productivity of walruses declines in old age (Burns, 1965; Krylov, 1966). This may not account, however, for the increase in percentage of abortions and premature births, since the older females in the past tended to have higher success in gestation than did the younger ones (Fay, 1982). That is, the overall decline in reproductive performance may have been influenced by some other factors, in addition to old age.

No significant changes were evident in (a) the percentage of ovulations resulting in fertilization of the ovum, or (b) the percentage of postpartum females that lacked a calf.

Unfortunately, because we were not provided with the teeth of the specimens for age determination, we were unable to compare the age at first pregnancy.

The stomach contents of animals taken in the 1980 harvest were similar to those obtained in 1975, which was the only other large, quantitative sample available for comparison. Bivalve mollusks predominated, and the prey eaten by females tended to be smaller and slightly more diverse than those eaten by the males. The 1980 samples differed from those taken in 1975, however, in several ways:

1. The proportion of the diet made up of bivalves (clams and cockles) was substantially lower in both sexes in 1980, and this difference was reflected by increased abundance of non-bivalve prey, especially anemones, echiurid worm, snails, and shrimps.

2. At least 10 genera of alternate (non-bivalve) prey which had not been utilized in 1975 were represented in the 1980 sample. These included fishes, which appear to have been increasing in importance since the 1960's, judging from the parasitological evidence.

3. The average size of nearly all types of prey was about 50% smaller than in the 1975 sample.

4. The males in 1980 were tending to take much smaller bivalves than in 1975, whereas those taken by the females tended to be somewhat larger.

5. The females in 1980 had shifted their primary predation to the bivalves of larger growth form (i.e., *Serripes* and *Mya*), whereas they had relied more on those of smaller growth form (*Hiatella, Macoma, Tellina*) in 1975.

6. In both sexes, the proportion of the ingesta made up of benthic sediments (sand and gravel) was significantly higher in 1980 than in 1975).

The principal implications of these findings are that bivalves in general were less abundant in the St. Lawrence Island to Bering Strait region in 1980 than they had been in 1975. Those of smaller growth form, in particular, appear to have been scarce. Furthermore, both the bivalves and the populations of "alternate" prey evidently were made up of much lower proportions of large, mature individuals and higher proportions of small, younger ones than they were in 1975. All such changes could be attributed to depletion of the food supply by the walruses themselves or, perhaps, by some other factors as yet unknown. Conceivably, the much higher proportion of sediments in the 1980 sample also was related to the increased use of alternate prey or to an increased expenditure of effort in finding and consuming the smaller bivalves. With a 50% decrease in size of the prey, at least twice as much effort would be required to obtain a comparable volume of food per day.

The tendency for the males and females to be preying on more similar genera and sizes of bivalves in 1980 than in 1975, suggests that the sexes are now in more direct competition with each other for the available food than they were a few years ago. This may apply only in the Bering Strait region, for they appear to partition the resources of other regions by geographical segregation of sexes and by seasonal segregation of their feeding schedules (Fay, 1982; P. M. Hayton, unpublished data).

Data from other recent studies of the Pacific walrus population also have indicated reduced productivity and a depleted food supply. For example, the proportion of adult females accompanied by calves in the Chukchi Sea amounted to only about 5% in the summer of 1981 (Fay, 1981b), whereas earlier estimates by Soviet investigators had indicated the proportion to be between 11 and 34% (Krylov, 1968; A. A. Kibal'chich, unpublished data). The proportions of 1-, 2-, 3-, and 4-5-year-old young in the 1981 sample also were very low, indictating that birth and/or postnatal survival rates have been depressed, at least since 1976-77.

That the food supply of the Pacific walrus population has been depleted in recent years is suggested by a general decline in fatness by about 50% in both the males and the females. Whereas the thickness of sternal blubber of adults taken in 1958-73 ranged from about 3 to 10 cm (Fay and Kelly, 1980), the same measurement on adults taken during 1980-81 ranged from 0.5 to 7.5 cm (Smith, 1980; Fay, 1981a). The change appears to be highly significant and suggests to us that the walruses today are either obtaining much less food than before or are working much harder to get it (or both).

In our analyses of the stomach contents from the animals taken in the 1980 spring harvests, as well as from several collected in the southeastern Bering Sea in 1981 (Fay, 1981a; Fay and Lowry, 1981) we found remarkably high proportions of tiny clam meats, weighing no more than 0.1 to 0.2 g; many were even smaller. We had not encountered such minute specimens in any previous samples, up to 1975. We suspect that the energetic cost of seeking and consuming such tiny prey by a 1,000 kg predator may exceed the return.

The results of the analyses reported here, when considered in relation with the recent aerial census (1980), composition counts, and other biological parameters, suggest to us that the Pacific walrus population already has reached or exceeded the carrying capacity of its environment and that it may be levelling off or about to decline to some degree, to achieve a balance primarily with its food supply. The possibility of a decline in numbers cannot be dismissed summarily, for the walrus is rather different from other pinnipeds, in that it is a benthic grazer, apparently dependent on a few general of sedentary bivalves which require as many years to reach reproductive maturity (5-8 years: Peterson, 1978; Hughes and Bourne, 1981) as do the walruses themselves. Although bivalves make up a rather large proportion of the benthic biomass, they are among the least productive organisms on the bottom. The probability of the walrus' overexploiting such a food source seems high, even considering the walrus' reduced productivity at present. That they have already depressed the food supply in the Bering Strait region is suggested by this analysis. How far they will go in depleting it further is not predictable but can be determined by further sampling.

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APPENDIX I

FINDINGS IN REPRODUCTIVE TRACTS OF FEMALE WALRUSES TAKEN IN HARVESTS NEAR NATIVE COMMUNITIES IN THE BERING STRAIT REGION, SPRING 1980.

The following is a list of principal findings in the ovaries and uteri of reproductive tracts provided from the 1980 spring harvest of walruses taken in the vicinity of Gambell, Nome, and Little Diomede Island. Corpora lutea in the ovaries were classified as follows: N = Corpus luteum of new pregnancy; F = Corpus luteum of false pregnancy; T = Corpus luteum of term pregnancy; C = Corpus atreticum; A = Accessory corpus luteum; and X = Corpus luteum/albicans from abortion or premature birth of the fetus. See "METHODS" for diagnostic characters of each. Absence of these is indicated by a dash in the "corpus luteum type" column.

The number of corpora albicantia is the total for both ovaries. Where indicated as number "+?", only one ovary was available, hence the total probably was greater than the number found in the one ovary.

The age of each placental scar was based on the criteria given in "METHODS". For those less than 1 year old, the age estimate was based in part also on the dimensions of the involuting uterus. Where indicated as unknown ("unk"), the uterine horn was not available for diagnosis. For animals in term pregnancy or recently postpartum, the scar is indicated as "New", whether or not the uterine horn was available for inspection. In many young adults, including several of those with one or more corpora albicantia in their ovaries, the uterine horns were comparable with those of the immature animals in being very slender (1.5 cm) with no traces of placental scars. Hence, they were judged not to have been pregnant previously; this is indicated by a dash in the "Age latest placental scar" column. Older animals with no evident scars but with much strouter (2.5-3 cm) uterine horns and numerous corpora albicantia were judged to have been pregnant ">5" years earlier.

The diameter of the largest healthy follicle (i.e., not including degenerate follicles) is the largest for the pair of ovaries. Where the follicle was irregular or oval in outline, the size given is the best estimate of the diameter of it as a sphere.

Information on presence ("Yes") or absence ("No") of the calf with the female was extracted from field data sheets prepared by K. Lourie during the collections at Gambell. This information was based on reports from the walrus hunters. Where no information was given or there was uncertainty as to which of several females was accompanied by the calf, this is indicated as "unk".

Non-pregnant animals having one or more healthy follicles 8 or 9 mm in diameter or larger were regarded as being "Estrous". This is tantamount to being "Barren", since the probability of fertilization of an ovum in May or later appears to be near zero (Fay, 1982). A few of the animals at "Term" or "Postpartum" also had such large follicles, for there is a postpartum estrus, ordinarily not resulting in pregnancy (Fay, 1982). Animals were regarded as being in "New pregnancy" if they had an ostensibly normally developed corpus luteum with ovulation scar in one ovary. We suspect that some of these may have been misidentified; that is, some may have been corpora of "False pregnancy", since several also had large, ripening follicles indicative of continuing estrus. Animals were considered to have "Aborted" where the condition of their uterine horns and/or corpus luteum/albicans was indicative of birth of the fetus at a time well before the normal calving season.

Specimens from Gambell area, 11-28 May 1980
(Collected by K. Lourie)

No.	Date	Corpus luteum type	No. of corpora albicanta	Age latest placental scar (yrs)	Diameter largest follicle (mm)	With calf	Remarks
5	5/11	N	3	1	1	unk	New pregnancy
6	"	-	11	unk	3	unk	Barren
7	"	-	8	>5	5	unk	Barren
8	"	-	2	1	6	unk	Barren
9	"	F,N	4	3	4	unk	New pregnancy
10	"	T	4	New	3	No	Term or postpart
12	"	X	0	>0.1	9	No	Aborted; Estrous
13	"	N	7	2	1	No	New pregnancy
14	"	T	4	New	4	Yes	Postpartum
15	5/12	T	6	New	3	Yes	Postpartum
16a	"	N	1	2	3	No	New pregnancy
16b	"	T	2	New	2	Yes	Postpartum
18	"	N	3	2	<1	No	New pregnancy
19	"	X,C	7	>0.2	3	No	Aborted
22	"	N	7	4	2	unk	New pregnancy
23	"	N	4	1	4	unk	New pregnancy
24	"	-	4	1	4	unk	Barren
25	5/11	-	6	1	1	unk	Barren
26	"	N	5	unk	2	unk	New pregnancy
27	"	T	3	New	4	Yes	Postpartum
28	5/12	Meat, fat, and vascular tissues only.					
29	"	C	9	>5	10	unk	Estrous

Gambell, Continued

No.	Date	Corpus luteum type	No. of corpora albicanta	Age latest placental scar (yrs)	Diameter largest follicle (mm)	With calf	Remarks
30	5/12	-	3	1	6	Yes	Barren
31	5/11	N	6	2	2	No	New pregnancy
34	5/14	T	1	New	1	Yes	Postpartum
35	"	T	3	New	3	Yes	Postpartum
36	unk	-	0	-	5	unk	Immature
37	5/14	-	7	2	14	unk	Estrous
43	"	N	5	3	1	No	New pregnancy
44	"	X	4	>0.2	6	No	Aborted
45	"	N	4	4	1	No	New pregnancy
46	5/15	N	8	2	3	No	New pregnancy
47	5/14	N	6	2	3	No	New pregnancy
52	"	X	3	>0.1	4	No	Aborted
53	"	X	3	>0.2	1	No	Aborted
54	"	N	1	-	3	No	New pregnancy
55	"	N	3	1	2	No	New pregnancy
56	"	N	7	1	6	No	New pregnancy
57	"	N	8	2	7	No	New pregnancy
60	"	N	2	-	4	No	New pregnancy
63	5/15	N	5	3	<1	No	New pregnancy
64	"	N	2	1	3	No	New pregnancy
65	"	T	4	New	3	Yes	Postpartum
66	"	N	4	2	9	No	New pregnancy

Specimens from Gambell area, 11-28 May 1980
(Collected by K. Lourie)

No.	Date	Corpus luteum type	No. of corpora albicanta	Age latest placental scar (yrs)	Diameter largest follicle (mm)	With calf	Remarks
5	5/11	N	3	1	1	unk	New pregnancy
6	"	-	11	unk	3	unk	Barren
7	"	-	8	>5	5	unk	Barren
8	"	-	2	1	6	unk	Barren
9	"	F,N	4	3	4	unk	New pregnancy
10	"	T	4	New	3	No	Term or postpart
12	"	X	0	>0.1	9	No	Aborted; Estrous
13	"	N	7	2	1	No	New pregnancy
14	"	T	4	New	4	Yes	Postpartum
15	5/12	T	6	New	3	Yes	Postpartum
16a	"	N	1	2	3	No	New pregnancy
16b	"	T	2	New	2	Yes	Postpartum
18	"	N	3	2	<1	No	New pregnancy
19	"	X,C	7	>0.2	3	No	Aborted
22	"	N	7	4	2	unk	New pregnancy
23	"	N	4	1	4	unk	New pregnancy
24	"	-	4	1	4	unk	Barren
25	5/11	-	6	1	1	unk	Barren
26	"	N	5	unk	2	unk	New pregnancy
27	"	T	3	New	4	Yes	Postpartum
28	5/12	Meat, fat, and vascular tissues only.					
29	"	C	9	>5	10	unk	Estrous

Specimens from Gambell area, 11-28 May 1980
(Collected by K. Lourie)

No.	Date	Corpus luteum type	No. of corpora albicanta	Age latest placental scar (yrs)	Diameter largest follicle (mm)	With calf	Remarks
5	5/11	N	3	1	1	unk	New pregnancy
6	"	-	11	unk	3	unk	Barren
7	"	-	8	>5	5	unk	Barren
8	"	-	2	1	6	unk	Barren
9	"	F,N	4	3	4	unk	New pregnancy
10	"	T	4	New	3	No	Term or postpart
12	"	X	0	>0.1	9	No	Aborted; Estrous
13	"	N	7	2	1	No	New pregnancy
14	"	T	4	New	4	Yes	Postpartum
15	5/12	T	6	New	3	Yes	Postpartum
16a	"	N	1	2	3	No	New pregnancy
16b	"	T	2	New	2	Yes	Postpartum
18	"	N	3	2	<1	No	New pregnancy
19	"	X,C	7	>0.2	3	No	Aborted
22	"	N	7	4	2	unk	New pregnancy
23	"	N	4	1	4	unk	New pregnancy
24	"	-	4	1	4	unk	Barren
25	5/11	-	6	1	1	unk	Barren
26	"	N	5	unk	2	unk	New pregnancy
27	"	T	3	New	4	Yes	Postpartum
28	5/12	Meat, fat, and vascular tissues only.					
29	"	C	9	>5	10	unk	Estrous

Gambell, Continued

No.	Date	Corpus luteum type	No. of corpora albicanta	Age latest placental scar (yrs)	Diameter largest follicle (mm)	With calf	Remarks
30	5/12	-	3	1	6	Yes	Barren
31	5/11	N	6	2	2	No	New pregnancy
34	5/14	T	1	New	1	Yes	Postpartum
35	"	T	3	New	3	Yes	Postpartum
36	unk	-	0	-	5	unk	Immature
37	5/14	-	7	2	14	unk	Estrous
43	"	N	5	3	1	No	New pregnancy
44	"	X	4	>0.2	6	No	Aborted
45	"	N	4	4	1	No	New pregnancy
46	5/15	N	8	2	3	No	New pregnancy
47	5/14	N	6	2	3	No	New pregnancy
52	"	X	3	>0.1	4	No	Aborted
53	"	X	3	>0.2	1	No	Aborted
54	"	N	1	-	3	No	New pregnancy
55	"	N	3	1	2	No	New pregnancy
56	"	N	7	1	6	No	New pregnancy
57	"	N	8	2	7	No	New pregnancy
60	"	N	2	-	4	No	New pregnancy
63	5/15	N	5	3	<1	No	New pregnancy
64	"	N	2	1	3	No	New pregnancy
65	"	T	4	New	3	Yes	Postpartum
66	"	N	4	2	9	No	New pregnancy

Gambell, continued

No.	Date	Corpus luteum type	No. of corpora albicanta	Age latest placental scar (yrs)	Diameter largest follicle (mm)	With calf	Remarks
67	5/15	F,N	9	1	8	No	New pregnancy
68	"	F,N	1	3	4	No	New pregnancy
69	"	-	6	4	5	No	Barren
70	"	-	6	1	4	No	Barren
72	"	N	2	-	3	unk	New pregnancy
73	"	F,N	7	5	<1	unk	New pregnancy
74	"	N	8	>5	3	unk	New pregnancy
75	"	N	8	4	6	No	New pregnancy
76	"	N	0	-	3	No	New pregnancy
77	"	X	3	>0.2	3	No	Aborted
78	"	N	4	4	4	unk	New pregnancy
79	"	N	4	4	3	No	New pregnancy
80	"	T	2	New	4	Fetus	Term pregnancy
81	"	-	9	4	3	No	Barren
82	"	F,N	6	>5	4	No	New pregnancy
83	"	F,N	1	-	10	No	New pregnancy
84	"	N	4	2	2	No	New pregnancy
85	"	T	3	New	3	Yes	Postpartum
94	5/11	C,C,C,C,C	6	4	12	unk	Estrous
95	5/15	N,A	8	4	3	No	New pregnancy
96	"	X	3	>0.2	3	No	Aborted
97	"	T	1+?	New	4	Yes	Postpartum

Gambell, continued

No.	Date	Corpus luteum type	No. of corpora albicanta	Age latest placental scar (yrs)	Diameter largest follicle (mm)	With calf	Remarks
98	5/16	-	5	3	2	No	Barren
99	"	F	4	3	2	unk	Barren; False preg
100	"	T	1	New	2	Yes	Postpartum
101	"	N	4	2	2	No	New pregnancy
102	"	unk	3+?	unk	1	No	New preg. or Barren
103	"	N	4	2	3	No	New pregnancy
104	"	-	7	2	<1	No	Barren
105	"	N	9	4	<1	Yes	New pregnancy
106	5/15	-	8	>5	2	No	Barren
107	"	X,N	6	>0.2	1	No	Aborted; New preg.
108	"	-	4	4	7	Yes	Barren
109	5/19	-	6	1	2	unk	Barren
110	"	N	7	3	10	unk	New pregnancy
111	"	T	4	New	5	Yes	Postpartum
112	"	N	4	2	3	No	New pregnancy
113	"	-	3	3	7	No	Barren
114	"	N	1	-	1	No	New pregnancy
115	"	-	6	1	9	No	Estrous
117	"	-	0	-	3	unk	Immature
118	"	N	7	>5	3	No	New pregnancy
119	"	-	6	1	<1	No	Barren

Gambell, continued

No.	Date	Corpus luteum type	No. of corpora albicanta	Age latest placental scar (yrs)	Diameter largest follicle (mm)	With calf	Remarks
120	5/19	N	2	-	7	No	New pregnancy
121	"	N	4	2	2	No	New pregnancy
123	"	-	4	2	5	No	Barren
124	"	N	3	2	3	No	New pregnancy
125	"	-	6	>5	4	No	Barren
126	"	N	5+?	unk	<1	No	New pregnancy
127	"	T	3	New	3	Yes	Postpartum
128	"	T	2	New	6	Yes	Postpartum
129	"	X	5	>0.1	6	unk	Aborted
130	"	N	5	4	4	unk	New pregnancy
131	"	N	5	>5	2	unk	New pregnancy
132	"	-	0	-	5	unk	Immature
133	"	-	8	4	1	unk	Barren
134	5/20	F	13	3	2	Yes	Barren; False preg.
135	"	-	4	1	<1	No	Barren
136	"	-	12	1	<1	No	Barren
137	"	N,A	6	2	6	No	New pregnancy
140	"	unk	2+?	unk	3	Yes	New preg. or Barren
141	"	T	5+?	New	5	Yes	Postpartum
142	"	N	4	3	8	No	New pregnancy
143	"	F	8	1	7	No	Barren; False preg.

Gambell, continued

No.	Date	Corpus luteum type	No. of corpora albicanta	Age latest placental scar (yrs)	Diameter largest follicle (mm)	With calf	Remarks
147	5/20	N	2	-	2	No	New pregnancy
148	"	T	3+?	New	3	Yes	Postpartum
149	"	unk	1+?	unk	1	No	New prèg. or Barren
150	"	N	3	1	2	Yes	New pregnancy
151	"	-	4	3	6	Yes	Barren
152	"	F	1	3	3	unk	Barren; False preg.
153	"	-	7	1	<1	unk	Barren
154	"	T	5	New	4	Yes	Postpartum
155	"	T	3	New	2	Yes	Postpartum
156	"	N	3	1	5	unk	New pregnancy
158	"	-	6	1	10	unk	Estrous
159	"	-	4	1	4	unk	Barren
160	"	T	4	New	5	Yes	Postpartum
161	"	-	8	3	3	unk	Barren
162	"	-	7	>5	5	unk	Barren
163	"	F	5	2	11	No	Estrous
165	"	-	7	1	2	No	Barren
166	"	-	8	4	4	unk	Barren
168	"	-	8	1	<1	unk	Barren
169	"	C	10	>5	1	unk	Barren
175	"	-	2	1	4	No	Barren

Gambell, continued

No.	Date	Corpus luteum type	No. of corpora albicanta	Age latest placental scar (yrs)	Diameter largest follicle (mm)	With calf	Remarks
178	5/21	N	5	-	<1	No	New pregnancy
179	"	F	7	>5	1	No	Barren; False preg.
180	"	T	2	New	2	Yes	Postpartum
181	"	T	6	New	3	Yes	Postpartum
182	5/22	N	2	-	2	unk	New pregnancy
184	"	T	5	New	4	Yes	Postpartum
187	"	X	8	>0.2	2	No	Aborted
189	"	T	6	New	3	Yes	Postpartum
194	5/24	T	2	New	2	Yes	Postpartum
197	5/26	T	2	New	<1	Yes	Postpartum
198	"	T	1	New	5	No	Postpartum
204	"	T	2	New	1	Yes	Postpartum
205	"	-	4	1	8	No	Estrous
206	"	Meat, fat, and vascular tissues only.					
212	5/27	N	5	>5	2	No	New pregnancy
213	"	N	9	>5	3	No	New pregnancy
214	"	N	6	2	3	No	New pregnancy
215	"	N	3	-	2	No	New pregnancy
216	"	-	8	>5	3	No	Barren
217	"	-	10	>5	3	No	Barren
218	"	T	2	New	4	Yes	Postpartum
219	"	T	5	New	1	Yes	Postpartum

Gambell, continued

No.	Date	Corpus luteum type	No. of corpora albicanta	Age latest placental scar (yrs)	Diameter largest follicle (mm)	With calf	Remarks
220	5/27	N	8	5	4	No	New pregnancy
221	"	N	6	4	2	unk	New pregnancy
222	"	T	5	New	<1	Yes	Postpartum
224	"	T	6	New	4	Yes	Postpartum
225	"	T	9	New	9	Yes	Postpartum
226	"	N	8	1	2	unk	New pregnancy
227	"	N	5	1	3	unk	New pregnancy
228	"	-	4	2	3	unk	Barren
229	"	X	6	>0.2	5	unk	Aborted
311	"	N	5	1	3	unk	New pregnancy
312	"	N	2	4	5	unk	New pregnancy
313	"	T	8	New	5	Yes	Postpartum
314	"	X	4	>0.2	2	No	Aborted
318	"	-	9	2	3	No	Barren
319	5/28	N	6	1	3	unk	New pregnancy
320	"	Meat, fat, and vascular tissues only.					
321	"	-	0	-	4	unk	Immature
322	"	N	6	4	3	unk	New pregnancy
333	"	T	3	New	2	Yes	Postpartum
334	"	X	5	>0.2	4	unk	Aborted
343	5/27	N	3	1	1	No	New pregnancy
344	"	T	6	New	1	Yes	Postpartum

Specimens from Nome area, 14-22 May 1980
(Collected by Scott Schliebe)

No.	Date	Corpus luteum type	No. of corpora albicanta	Age latest placental scar (yrs)	Diameter largest follicle (mm)	With calf	Remarks
1	5/14	Visceral fat only - not reproductive organs					
2	5/15	F,N	7	4	3	unk	New pregnancy
6	5/18	N	7	>5	3	unk	New pregnancy
8	5/20	N	6	3	2	unk	New pregnancy

Specimens from Little Diomede area, 10 May-11 June 1980
(Collected by Tim Smith)

1	5/10	-	3	unk	3	unk	Barren
2	5/11	N,A,A,A	8	unk	3	unk	New pregnancy
3	"	T	1	unk	2	unk	Postpartum
4	"	F,N	4	unk	3	unk	New pregnancy
5	"	C,N	3	unk	7	unk	New pregnancy
6	"	N	8	unk	3	unk	New pregnancy
7	"	T	3	New	4	unk	Term or Postpartum
8	"	N	8	unk	2	unk	New pregnancy
39	5/13	C	3	unk	4	unk	Barren
40	"	-	0	-	5	unk	Immature
41	5/11	F,N	3	unk	2	unk	New pregnancy
42	5/15	-	6	unk	4	unk	Barren
45	5/13	N	2	unk	4	unk	New pregnancy
81	5/26	-	4	unk	9	unk	Estrous

Diomede, continued

No.	Date	Corpus luteum type	No. of corpora albicanta	Age latest placental scar (yrs)	Diameter largest follicle (mm)	With calf	Remarks
84	5/26	-	6	unk	2	unk	Barren
85	"	T	1	New	4	unk	Term or postpartum
86	"	X	4	unk	2	unk	Abort or early birth
87	"	X	6	unk	4	unk	Abort or early birth
88	"	N	2	unk	3	unk	New pregnancy
90	"	N	7	unk	6	unk	New pregnancy
91	"	N	1	unk	3	unk	New pregnancy
92	"	C,N	6	unk	4	unk	New pregnancy
115	5/27	T	6	New	5	unk	Postpartum
116	"	N	4	unk	3	unk	New pregnancy
117	"	N	6	unk	2	unk	New pregnancy
118	"	N	4	unk	3	unk	New pregnancy
119	"	N	4	unk	4	unk	New pregnancy
120	"	N	4	unk	<1	unk	New pregnancy
121	"	N	7	unk	4	unk	New pregnancy
122	"	-	8	unk	11	unk	Estrous
125	"	N	3	unk	2	unk	New pregnancy
126	"	N	7	unk	1	unk	New pregnancy
138	"	F,N	1	unk	6	unk	New pregnancy
139	"	N	10	unk	5	unk	New pregnancy
140	"	N	7	unk	3	unk	New pregnancy

Diomede, continued

No.	Date	Corpus luteum type	No. of corpora albicanta	Age latest placental scar (yrs)	Diameter largest follicle (mm)	With calf	Remarks
141	5/27	N	4	unk	3	unk	New pregnancy
142	"	-	0	-	3	unk	Immature
143	"	T	1	New	<1	unk	Postpartum
144	"	T	6	New	2	unk	Term or Postpartum
145	"	T	5	New	3	unk	Term or Postpartum
146	"	C	6	unk	10	unk	Estrous
147	"	N	3	unk	2	unk	New pregnancy
148	"	N	0	-	1	unk	New pregnancy
149	"	N	8	unk	8	unk	New pregnancy
150	"	T	5	New	3	unk	Term or Postpartum
151	"	N	7	unk	4	unk	New pregnancy
152	"	N,A,A	4	unk	<1	unk	New pregnancy
153	"	C,C	8	unk	3	unk	Barren
154	"	X,N	3	unk	1	unk	Abort; New preg.
155	"	N	4	unk	7	unk	New pregnancy
156	"	-	8	unk	2	unk	Barren
157	"	-	3	unk	1	unk	Barren
158	"	T	4	New	6	unk	Postpartum
159	"	N	6	unk	2	unk	New pregnancy
160	"	F,N	0	-	2	unk	New pregnancy
161	"	N	3	unk	4	unk	New pregnancy
162	"	T	4	New	2	unk	Term or Postpartum

Diomede, continued

No.	Date	Corpus luteum type	No. of corpora albicanta	Age latest placental scar (yrs)	Diameter largest follicle (mm)	With calf	Remarks
163	5/27	N	3	unk	5	unk	New pregnancy
164	"	N	8	unk	2	unk	New pregnancy
165	"	N	7	unk	<1	unk	New pregnancy
166	"	N	3	unk	4	unk	New pregnancy
167	"	N	2	unk	3	unk	New pregnancy
168	"	N	1	unk	10	unk	New pregnancy
169	"	T	2	New	4	unk	Term or Postpartum
170	"	N	2	unk	4	unk	New pregnancy
171	"	X	4	unk	6	unk	Aborted
172	"	N	15	unk	9	unk	New pregnancy
173	"	X,N	4	unk	<1	unk	Abort; New preg.
174	"	-	0	-	5	unk	Immature
195	"	-	0	-	7	unk	Immature
207	"	T	2	New	2	unk	Term or Postpartur
208	"	-	2	unk	<1	unk	Barren
209a	"	N	5	unk	3	unk	New pregnancy
209b	"	N	6	unk	2	unk	New pregnancy
210	"	N	5	unk	2	unk	New pregnancy
215	"	T	6	New	2	unk	Postpartum
228	"	C,C,C,C	3	unk	23	unk	Estrous
229	"	N	2	unk	4	unk	New pregnancy
230	"	N	3	unk	5	unk	New pregnancy

Diomede, continued

No.	Date	Corpus luteum type	No. of corpora albicanta	Age latest placental scar (yrs)	Diameter largest follicle (mm)	With calf	Remarks
231	5/27	N	3	unk	3	unk	New pregnancy
232	"	N	5	unk	2	unk	New pregnancy
233	"	N	0	-	3	unk	New pregnancy
234	"	T	2	New	11	unk	Term pregnancy
235	"	N	4	unk	5	unk	New pregnancy
236	"	N	6	unk	2	unk	New pregnancy
237	"	N	4	unk	4	unk	New pregnancy
238	"	C,N	7	unk	6	unk	New pregnancy
239	"	X	3	unk	5	unk	Aborted
240	"	F,C,N	5	unk	1	unk	New pregnancy
241	"	N	5	unk	2	unk	New pregnancy
242	"	F	6	unk	11	unk	Estrous
243	"	T	7	New	3	unk	Term or Postpartum
244	"	-	8	unk	15	unk	Estrous
245	"	N	4	unk	6	unk	New pregnancy
246	"	F	8	unk	13	unk	Estrous
247	"	N	4	unk	4	unk	New pregnancy
248	"	C,C	0	-	<1	unk	Barren
250a	"	N	6	unk	3	unk	New pregnancy
250b	"	N	11	unk	5	unk	New pregnancy
251	"	C	13	unk	4	unk	Barren
252a	"	N	7	unk	5	unk	New pregnancy

Diomede, continued

No.	Date	Corpus luteum type	No. of corpora albicanta	Age latest placental scar (yrs)	Diameter largest follicle (mm)	With calf	Remarks
252b	5/27	X	5	unk	3	unk	Aborted
254	"	N	6	unk	3	unk	New pregnancy
255	"	C,N	4	unk	4	unk	New pregnancy
257	"	X	5	unk	10	unk	Abort; Estrous
302	6/11	-	7	unk	5	unk	Barren

APPENDIX II

TAXONOMIC COMPOSITION, NUMBERS OF INDIVIDUALS, AND WEIGHTS OF PREY IDENTIFIED IN STOMACH CONTENTS OF WALRUSES FROM THE BERING STRAIT REGION, SPRING 1980.

The following is a list of numbers and weights of prey taxa found in aliquots of stomach contents of each of the 95 walruses whose food samples were adequate for analysis. For each walrus, the number of individual prey ("No.") is the maximum identifiable with certainty. All weights ("Wt.") are in grams. Insofar as possible, each type of prey was identified to genus; otherwise, identification to higher taxonomic rank was possible. Where only the indigestible hard parts of an organism were present, presumably left from an earlier meal, these were indicated only as trace occurrence ("tr"). Most of these were operculae from gastropods (snails). In many instances there were several gastropod feet which lacked the diagnostic operculum, hence were not certainly identifiable to genus. These are indicated as "Gastropoda unidentified". The last category "Sediments" includes only the inorganic materials (sand and gravel).

Findings in stomach content samples of
Specimens from Gambell area, 11-27 May 1980 (Coll. by K. Lourie)

Field No. / Sex / Taxon	GW-9 ♀ No.	GW-9 ♀ Wt.	GW-16 ♀ No.	GW-16 ♀ Wt.	GW-22 ♀ No.	GW-22 ♀ Wt.	GW-51 ♂ No.	GW-51 ♂ Wt.	GW-61 ♂ No.	GW-61 ♂ Wt.
Anemone	2	1	-	-	5	26	-	-	-	-
Bryozoan	-	-	-	-	-	-	-	-	-	-
Nephthys	4	16	-	-	-	-	-	-	-	-
Arenicola	25	164	-	-	-	-	-	-	-	-
Brada	-	-	-	-	-	-	-	-	-	-
Polych. unid.	-	-	-	-	-	-	-	-	-	-
Golfingia	-	-	2	2	1	6	-	-	-	-
Echiurus	199	622	-	-	45	253	-	-	-	-
Priapulus	2	5	-	-	1	1	1	4	2	11
Neptunea	tr	tr	2	2	11	25	tr	tr	-	-
Buccinum	tr	tr	tr	tr	-	-	-	-	-	-
Natica	1	1	-	-	-	-	tr	tr	-	-
Polinices	1	3	tr	tr	1	1	tr	tr	-	-
Margarites	-	-	-	-	-	-	-	-	-	-
Solariella	-	-	tr	tr	-	-	-	-	-	-
Gastrop. unid.	14	18	-	-	-	-	-	-	1	4
Serripes	4	48	-	-	34	292	-	-	19	537
Mya	261	931	1	4	41	371	12	16	150	1492
Spisula	-	-	-	-	-	-	-	-	-	-
Tellinidae	130	30	-	-	2	2	-	-	-	-
Astarte	-	-	-	-	-	-	tr	tr	-	-
Yoldia	2	1	-	-	-	-	-	-	-	-
Thyasira	-	-	-	-	1	1	-	-	-	-
Liocyma	-	-	-	-	-	-	-	-	-	-
Bivalve frags.	-	-	-	-	-	-	-	440	-	120
Octopus	-	-	-	-	-	-	-	-	-	-
Anonyx	-	-	-	-	-	-	-	-	-	-
Hippomedon	-	-	-	-	-	-	-	-	-	-
Protomedia	-	-	-	-	-	-	-	-	-	-
Argis	-	-	-	-	-	-	-	-	-	-
Crangonidae	-	-	-	-	2	4	-	-	-	-
Hyas	-	-	-	-	4	30	12	14	-	-
Pagurus	-	-	-	-	-	-	-	-	-	-
Crustacean	-	-	-	32	-	-	-	-	-	-
Thyonidium	-	-	-	-	1	36	2	35	1	4
Pelonaia	-	-	-	-	-	-	-	-	-	-
Tunicate	-	-	-	-	1	3	-	-	-	-
Ammodytes	-	-	-	-	-	-	-	-	-	-
Animal frags.	-	-	-	-	-	140	-	-	-	-
Wood frags.	-	-	-	-	-	-	-	-	-	-
Sediments	-	0	-	980	-	325	-	1725	-	15
Totals	645	1840	5	1020	150	1516	27	2234	173	2183

Gambell, continued

Taxon \ Field No. / Sex	GW-62 ♂		GW-71 ♂		GW-106 ♀		GW-112 ♀		GW-113 ♀	
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
Anemone	-	-	-	-	-	-	-	-	-	-
Bryozoan	-	-	-	-	-	-	-	-	-	-
Nephthys	-	-	-	-	-	-	-	-	-	-
Arenicola	-	-	-	-	-	-	-	-	-	-
Brada	-	-	-	-	-	-	500	60	-	-
Polych. unid.	-	-	-	-	-	-	-	-	-	-
Golfingia	-	-	-	-	-	-	-	-	-	-
Echiurus	-	-	-	-	-	-	6	4	tr	tr
Priapulus	2	15	1	2	-	-	5	25	8	64
Neptunea	tr	tr	1	1	-	-	tr	tr	tr	tr
Buccinum	tr	tr	-	-	-	-	tr	tr	tr	tr
Natica	tr	tr	-	-	-	-	3	4	tr	tr
Polinices	tr	tr	tr	tr	1	1	6	8	tr	tr
Margarites	-	-	-	-	-	-	-	-	-	-
Solariella	-	-	-	-	-	-	-	-	-	-
Gastrop. unid.	5	5	2	6	-	-	3	4	26	42
Serripes	11	185	17	603	5	50	3	7	3	17
Mya	66	969	64	1146	18	314	3	7	23	112
Spisula	-	-	-	-	-	-	-	-	-	-
Tellinidae	-	-	-	-	-	-	2	1	-	-
Astarte	-	-	-	-	-	-	-	-	-	-
Yoldia	-	-	-	-	-	-	-	-	-	-
Thyasira	-	-	-	-	-	-	-	-	-	-
Liocyma	-	-	-	-	-	-	-	-	-	-
Bivalve frags.	-	47	-	206	-	32	-	-	-	-
Octopus	-	-	-	-	-	-	-	-	-	-
Anonyx	-	-	-	-	-	-	-	-	-	-
Hippomedon	-	-	-	-	-	-	-	-	-	-
Protomedia	-	-	-	-	-	-	-	-	-	-
Argis	-	-	-	-	-	-	-	-	-	-
Crangonidae	-	-	-	-	1	1	175	387	20	27
Hyas	-	-	1	1	7	14	1	2	-	-
Pagurus	-	-	1	1	-	-	-	-	-	-
Crustacean	-	-	-	-	-	-	-	-	-	-
Thyonidium	-	-	1	5	-	-	-	-	-	-
Pelonaia	-	-	-	-	-	-	-	-	2	1
Tunicate	1	5	-	-	-	-	2	7	-	-
Ammodytes	-	-	-	-	-	-	-	-	-	-
Animal frags.	-	-	-	-	-	-	-	-	-	280
Wood frags.	-	-	-	-	-	-	-	-	-	-
Sediments	-	30	-	0	-	1360	-	0	-	0
Totals	85	1256	88	1971	32	1772	709	516	82	543

Gambell, continued

Taxon \ Field No. / Sex	GW-119 ♀ No.	GW-119 ♀ Wt.	GW-121 ♀ No.	GW-121 ♀ Wt.	GW-122 ♂ No.	GW-122 ♂ Wt.	GW-125 ♀ No.	GW-125 ♀ Wt.	GW-126 ♀ No.	GW-126 ♀ Wt.
Anemone	-	-	-	-	-	-	-	-	-	-
Bryozoan	-	-	-	-	-	-	-	-	-	-
Nephthys	-	-	-	-	-	-	-	-	-	-
Arenicola	-	-	-	-	-	-	-	-	20	196
Brada	35	183	-	-	-	-	-	-	-	-
Polych. unid.	-	-	-	-	-	-	-	-	-	-
Golfingia	-	-	-	-	-	-	-	-	-	-
Echiurus	88	335	3	6	-	-	116	74	69	261
Priapulus	2	3	6	16	-	-	3	7	5	30
Neptunea	tr	tr	-	-	3	4	-	-	2	4
Buccinum	-	-	-	-	tr	tr	-	-	1	2
Natica	1	6	tr	tr	-	-	-	-	1	5
Polinices	-	-	2	4	-	-	2	6	3	9
Margarites	-	-	-	-	tr	tr	-	-	-	-
Solariella	-	-	-	-	-	-	-	-	-	-
Gastrop. unid.	1	7	17	28	30	55	-	-	21	30
Serripes	8	68	-	-	-	-	10	45	4	46
Mya	1	3	95	479	-	-	-	-	34	138
Spisula	-	-	-	-	-	-	-	-	-	-
Tellinidae	217	50	1	1	-	-	-	-	147	37
Astarte	-	-	-	-	-	-	-	-	-	-
Yoldia	20	8	-	-	-	-	-	-	21	7
Thyasira	-	-	-	-	-	-	-	-	-	-
Liocyma	-	-	6	9	-	-	-	-	-	-
Bivalve frags.	-	-	-	31	-	-	-	-	-	-
Octopus	-	-	-	-	-	-	-	-	-	-
Anonyx	-	-	-	-	-	-	-	-	-	-
Hippomedon	-	-	-	-	-	-	-	-	-	-
Protomedia	-	-	-	-	-	-	-	-	-	-
Argis	-	-	-	-	-	-	-	-	-	-
Crangonidae	-	-	-	-	31	93	-	-	9	10
Hyas	-	-	-	-	1	1	2	5	-	-
Pagurus	-	-	-	-	-	-	-	-	-	-
Crustacean	-	-	-	-	-	-	-	-	-	-
Thyonidium	-	-	-	-	-	-	-	-	-	-
Pelonaia	-	-	-	-	-	-	-	-	-	-
Tunicate	-	-	-	-	-	-	-	-	-	-
Ammodytes	-	-	-	-	-	-	-	-	-	-
Animal frags.	-	60	-	-	-	202	-	38	-	67
Wood frags.	-	-	-	-	-	-	-	-	-	-
Sediments	-	120	-	130	-	-	-	246	-	100
Totals	364	846	130	704	65	355	133	421	337	942

Gambell, continued

Field No. / Sex / Taxon	GW-148 ♀		GW-156 ♀		GW-163 ♀		GW-164 ♂		GW-167 ♂	
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
Anemone	-	-	2	15	-	-	-	-	-	-
Bryozoan	-	-	-	-	-	-	-	-	-	-
Nephthys	-	-	-	-	-	-	-	-	-	-
Arenicola	-	-	-	-	-	-	-	-	-	-
Brada	-	-	-	-	-	-	-	-	-	-
Polych. unid.	-	-	-	-	-	-	-	-	-	-
Golfingia	-	-	-	-	-	-	-	-	-	-
Echiurus	104	414	-	-	-	-	-	-	-	-
Priapulus	-	-	-	-	-	-	-	-	-	-
Neptunea	2	8	-	-	4	6	1	2	41	78
Buccinum	tr	tr	-	-	1	1	tr	tr	4	12
Natica	1	3	-	-	34	50	1	1	12	17
Polinices	1	2	-	-	4	4	4	3	-	-
Margarites	-	-	-	-	-	-	-	-	-	-
Solariella	-	-	-	-	-	-	-	-	-	-
Gastrop. unid.	2	2	-	-	27	50	1	17	44	138
Serripes	14	125	-	-	4	39	-	-	9	45
Mya	114	665	10	149	15	83	244	1364	-	-
Spisula	-	-	-	-	-	-	-	-	-	-
Tellinidae	11	2	-	-	-	-	4	1	-	-
Astarte	-	-	-	-	-	-	-	-	-	-
Yoldia	-	-	-	-	-	-	-	-	-	-
Thyasira	-	-	-	-	-	-	-	-	-	-
Liocyma	-	-	-	-	-	-	-	-	-	-
Bivalve frags.	-	-	-	23	-	-	-	32	-	-
Octopus	-	-	-	-	-	-	-	-	-	-
Anonyx	-	-	-	-	-	-	-	-	2	4
Hippomedon	-	-	-	-	-	-	-	-	-	-
Protomedia	-	-	-	-	-	-	-	-	-	-
Argis	-	-	-	-	-	-	-	-	298	1252
Crangonidae	-	-	-	-	111	415	-	-	-	-
Hyas	-	-	5	5	-	-	2	1	8	50
Pagurus	-	-	1	3	-	-	-	-	8	11
Crustacean	1	1	-	-	-	-	-	-	-	-
Thyonidium	-	-	1	6	-	-	-	-	-	-
Pelonaia	-	-	-	-	-	-	-	-	-	-
Tunicate	-	-	-	-	-	-	-	-	-	-
Ammodytes	-	-	-	-	-	-	-	-	-	-
Animal frags.	-	100	-	-	-	18	-	-	-	-
Wood frags.	-	-	-	-	-	-	-	-	-	-
Sediments	-	140	-	438	-	0	-	320	-	0
Totals	250	1464	19	639	200	666	257	1741	426	1607

Gambell, continued

Taxon \ Field No. / Sex	GW-168 ♀ No.	GW-168 ♀ Wt.	GW-169 ♀ No.	GW-169 ♀ Wt.	GW-170 ♂ No.	GW-170 ♂ Wt.	GW-171 ♂ No.	GW-171 ♂ Wt.	GW-172 ♂ No.	GW-172 ♂ Wt.
Anemone	-	-	-	-	-	-	-	-	-	-
Bryozoan	-	-	-	-	-	-	-	-	-	-
Nephthys	-	-	-	-	-	-	-	-	-	-
Arenicola	-	-	-	-	-	-	-	-	-	-
Brada	-	-	4	5	-	-	-	-	100	15
Polych. unid.	-	-	30	178	-	-	-	-	-	-
Golfingia	-	-	-	-	-	-	-	-	-	-
Echiurus	-	-	88	335	79	258	5	28	-	-
Priapulus	12	82	2	3	8	42	1	3	2	6
Neptunea	1	1	tr	tr	-	-	-	-	3	4
Buccinum	tr	tr	-	-	-	-	-	-	1	2
Natica	27	76	1	6	tr	tr	-	-	-	-
Polinices	1	2	1	3	7	10	1	2	3	7
Margarites	-	-	-	-	-	-	-	-	-	-
Solariella	-	-	-	-	-	-	-	-	-	-
Gastrop. unid.	85	109	1	7	16	23	-	-	8	10
Serripes	-	-	8	68	3	32	2	13	2	25
Mya	-	-	1	3	104	500	12	88	266	1292
Spisula	-	-	-	-	-	-	-	-	-	-
Tellinidae	-	-	217	50	-	-	-	-	-	-
Astarte	-	-	-	-	-	-	-	-	-	-
Yoldia	-	-	20	8	-	-	-	-	-	-
Thyasira	-	-	-	-	-	-	-	-	-	-
Liocyma	-	-	-	-	-	-	-	-	-	-
Bivalve frags.	-	-	-	-	-	-	-	-	-	-
Octopus	-	-	-	-	-	-	-	-	-	-
Anonyx	-	-	-	-	-	-	-	-	-	-
Hippomedon	-	-	-	-	-	-	-	-	-	-
Protomedia	-	-	-	-	-	-	-	-	-	-
Argis	-	-	-	-	-	-	-	-	-	-
Crangonidae	-	-	-	-	-	-	-	-	2	5
Hyas	-	-	-	-	1	1	-	-	1	2
Pagurus	-	-	-	-	-	-	-	-	-	-
Crustacean	-	-	-	-	-	-	-	-	-	-
Thyonidium	-	-	-	-	-	-	-	-	-	-
Pelonaia	-	-	-	-	-	-	-	-	6	10
Tunicate	-	-	-	-	-	-	-	-	-	-
Ammodytes	-	-	-	-	-	-	-	-	-	-
Animal frags.	-	37	-	60	-	50	-	10	-	63
Wood frags.	-	-	-	-	-	2	-	-	-	-
Sediments	-	15	-	120	-	160	-	0	-	75
Totals	126	322	373	846	218	1078	21	145	394	1516

Gambell, continued

Field No. / Sex / Taxon	GW-174 ♂ No.	GW-174 ♂ Wt.	GW-176 ♂ No.	GW-176 ♂ Wt.	GW-177 ♂ No.	GW-177 ♂ Wt.	GW-178 ♀ No.	GW-178 ♀ Wt.	GW-183 ♂ No.	GW-183 ♂ Wt.
Anemone	-	-	-	-	4	21	3	5	-	-
Bryozoan	-	-	-	-	1	2	-	-	-	-
Nephthys	-	-	-	-	-	-	-	-	-	-
Arenicola	-	-	-	-	-	-	-	-	-	-
Brada	-	-	-	-	-	-	-	-	-	-
Polych. unid.	-	-	-	-	-	-	-	-	-	-
Golfingia	-	-	-	-	-	-	-	-	-	-
Echiurus	-	-	8	59	74	222	-	-	-	-
Priapulus	-	-	-	-	3	18	3	30	-	-
Neptunea	5	20	-	-	16	31	-	-	-	-
Buccinum	tr	tr	-	-	tr	tr	1	3	-	-
Natica	3	3	-	-	16	20	-	-	-	-
Polinices	tr	tr	-	-	3	6	3	5	-	-
Margarites	-	-	-	-	-	-	-	-	-	-
Solariella	-	-	-	-	-	-	-	-	-	-
Gastrop. unid.	8	15	-	-	78	120	4	8	-	-
Serripes	-	-	1	18	4	34	2	25	-	-
Mya	190	1710	-	-	40	166	26	80	39	439
Spisula	-	-	-	-	-	-	-	-	-	-
Tellinidae	-	-	-	-	-	-	16	5	-	-
Astarte	-	-	-	-	-	-	-	-	-	-
Yoldia	-	-	-	-	-	-	-	-	-	-
Thyasira	-	-	-	-	-	-	-	-	-	-
Liocyma	-	-	-	-	-	-	-	-	-	-
Bivalve frags.	-	17	-	-	-	-	-	-	-	3
Octopus	-	-	-	-	-	-	-	-	-	-
Anonyx	2	1	-	-	-	-	-	-	-	-
Hippomedon	-	-	-	-	-	-	-	-	-	-
Protomedia	-	-	-	-	-	-	-	-	-	-
Argis	-	-	-	-	-	-	-	-	-	-
Crangonidae	-	-	-	-	-	-	1	1	-	-
Hyas	-	-	-	-	1	4	-	-	-	-
Pagurus	-	-	-	-	-	-	-	-	-	-
Crustacean	-	-	-	-	-	-	-	-	-	-
Thyonidium	-	-	-	-	-	-	-	-	1	13
Pelonaia	-	-	-	-	-	-	-	-	-	-
Tunicate	-	-	-	-	-	-	-	-	-	-
Ammodytes	-	-	-	-	-	-	-	-	-	-
Animal frags.	-	-	-	-	-	113	-	10	-	-
Wood frags.	-	-	-	-	-	-	-	-	-	-
Sediments	-	5	-	0	-	250	-	10	-	0
Totals	208	1771	9	77	240	1007	59	182	40	455

Gambell, continued

Field No. / Sex / Taxon	GW-185 ♂ No.	GW-185 ♂ Wt.	GW-186 ♂ No.	GW-186 ♂ Wt.	GW-195 ♂ No.	GW-195 ♂ Wt.	GW-198 ♀ No.	GW-198 ♀ Wt.	GW-199 ♂ No.	GW-199 ♂ Wt.
Anemone	-	-	-	-	-	-	15	70	-	-
Bryozoan	-	-	-	-	-	-	-	-	-	-
Nephthys	-	-	-	-	-	-	1	5	-	-
Arenicola	-	-	-	-	-	-	-	-	-	-
Brada	-	-	-	-	-	-	-	-	-	-
Polych. unid.	-	-	-	-	-	-	-	-	-	-
Golfingia	-	-	-	-	-	-	3	8	-	-
Echiurus	-	-	-	-	-	-	2	12	-	-
Priapulus	-	-	4	10	-	-	-	-	-	-
Neptunea	4	17	8	27	-	-	140	340	-	-
Buccinum	-	-	tr	tr	tr	tr	38	81	tr	tr
Natica	-	-	-	-	-	-	2	2	-	-
Polinices	-	-	1	1	-	-	2	3	1	7
Margarites	-	-	-	-	-	-	-	-	-	-
Solariella	-	-	-	-	-	-	-	-	-	-
Gastrop. unid.	-	-	-	-	-	-	112	163	1	2
Serripes	34	549	4	27	12	223	2	20	10	145
Mya	103	1241	83	992	79	1265	3	16	63	1292
Spisula	-	-	-	-	-	-	-	-	-	-
Tellinidae	-	-	-	-	-	-	-	-	1	2
Astarte	-	-	-	-	-	-	1157	248	-	-
Yoldia	-	-	-	-	-	-	-	-	-	-
Thyasira	-	-	-	-	-	-	-	-	-	-
Liocyma	-	-	-	-	-	-	tr	tr	-	-
Bivalve frags.	-	115	-	21	-	118	-	20	-	89
Octopus	-	-	-	-	-	-	-	-	-	-
Anonyx	-	-	-	-	-	-	3	6	-	-
Hippomedon	-	-	-	-	-	-	-	-	-	-
Protomedia	-	-	-	-	-	-	1	1	-	-
Argis	-	-	-	-	-	-	-	-	-	-
Crangonidae	-	-	3	6	3	10	4	20	-	-
Hyas	1	7	3	19	11	28	5	7	-	-
Pagurus	-	-	-	-	1	1	7	9	-	-
Crustacean	-	-	-	-	-	-	-	-	-	-
Thyonidium	-	-	2	13	1	3	-	-	7	180
Pelonaia	-	-	-	-	-	-	-	-	-	-
Tunicate	-	-	-	-	-	-	-	-	-	-
Ammodytes	-	-	-	-	-	-	-	-	-	-
Animal frags.	-	-	-	-	-	-	-	218	-	-
Wood frags.	-	-	-	-	-	-	-	-	-	-
Sediments	-	0	-	753	-	25	-	20	-	0
Totals	142	1929	108	1869	107	1673	1497	1269	83	1717

Gambell, continued

Taxon \ Field No. / Sex	GW-200 ♂		GW-201 ♂		GW-202 ♂		GW-203 ♂		GW-229 ♀	
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
Anemone	-	-	-	-	-	-	-	-	-	-
Bryozoan	-	-	-	-	-	-	-	-	-	-
Nephthys	2	2	-	-	-	-	-	-	-	-
Arenicola	-	-	-	-	-	-	-	-	-	-
Brada	-	-	-	-	-	-	-	-	-	-
Polych. unid.	-	-	-	-	-	-	-	-	-	-
Golfingia	-	-	-	-	-	-	-	-	-	-
Echiurus	-	-	-	-	-	-	-	-	-	-
Priapulus	1	4	-	-	1	2	-	-	2	2
Neptunea	-	-	1	1	1	1	13	26	9	19
Buccinum	-	-	tr	tr	-	-	-	-	tr	tr
Natica	2	3	-	-	-	-	-	-	tr	tr
Polinices	tr	tr	tr	tr	1	2	1	1	tr	tr
Margarites	-	-	-	-	-	-	-	-	-	-
Solariella	-	-	-	-	-	-	-	-	tr	tr
Gastrop. unid.	-	-	-	-	-	-	12	19	5	20
Serripes	1	8	1	20	6	86	5	83	1	8
Mya	-	-	93	1734	42	355	22	327	30	639
Spisula	308	963	-	-	-	-	-	-	-	-
Tellinidae	1	5	-	-	-	-	-	-	-	-
Astarte	-	-	-	-	-	-	-	-	-	-
Yoldia	-	-	-	-	-	-	-	-	-	-
Thyasira	-	-	-	-	-	-	-	-	-	-
Liocyma	-	-	-	-	-	-	-	-	-	-
Bivalve frags.	-	-	-	75	-	30	-	25	-	122
Octopus	-	-	-	-	-	-	-	-	tr	tr
Anonyx	-	-	-	-	-	-	-	-	-	-
Hippomedon	1	1	-	-	-	-	-	-	-	-
Protomedia	-	-	-	-	-	-	-	-	-	-
Argis	-	-	-	-	16	45	-	-	-	-
Crangonidae	-	-	-	-	-	-	-	-	-	-
Hyas	-	-	10	10	7	10	6	15	15	30
Pagurus	-	-	2	1	-	-	-	-	2	3
Crustacean	-	-	-	-	-	-	-	-	-	-
Thyonidium	-	-	2	28	1	1	1	11	5	50
Pelonaia	-	-	2	3	-	-	-	-	-	-
Tunicate	-	-	-	-	-	-	-	-	-	-
Ammodytes	160	100	-	-	-	-	-	-	-	-
Animal frags.	-	158	-	-	-	-	-	-	-	-
Wood frags.	-	-	-	-	-	-	-	-	-	-
Sediments	-	300	-	50	-	15	-	30	-	130
Totals	476	1544	111	1922	75	547	60	537	69	1023

Gambell, continued

Taxon \ Sex \ Field No.	GW-303 ♂ No.	GW-303 ♂ Wt.	GW-304 ♂ No.	GW-304 ♂ Wt.	GW-308 ♂ No.	GW-308 ♂ Wt.	GW-309 ♂ No.	GW-309 ♂ Wt.	GW-310 ♂ No.	GW-310 ♂ Wt.
Anemone	-	-	-	-	-	-	-	-	-	-
Bryozoan	-	-	-	-	-	-	-	-	-	-
Nephthys	-	-	-	-	-	-	-	-	-	-
Arenicola	-	-	-	-	-	-	-	-	-	-
Brada	-	-	-	-	-	-	-	-	-	-
Polych. unid.	-	-	-	-	-	-	-	-	-	-
Golfingia	-	-	-	-	-	-	-	-	-	-
Echiurus	-	-	-	-	-	-	-	-	-	-
Priapulus	-	-	1	10	1	3	3	22	7	23
Neptunea	-	-	-	-	1	1	1	1	-	-
Buccinum	-	-	-	-	tr	tr	-	-	-	-
Natica	tr	tr	-	-	-	-	-	-	-	-
Polinices	1	2	tr	tr	-	-	-	-	-	-
Margarites	-	-	-	-	-	-	-	-	-	-
Solariella	-	-	-	-	tr	tr	-	-	-	-
Gastrop. unid.	2	5	-	-	-	-	-	-	-	-
Serripes	1	9	33	525	-	-	5	46	7	78
Mya	-	-	94	1341	81	1315	48	367	61	1320
Spisula	43	137	-	-	-	-	-	-	-	-
Tellinidae	-	-	-	-	-	-	-	-	-	-
Astarte	-	-	-	-	-	-	-	-	-	-
Yoldia	-	-	-	-	-	-	-	-	-	-
Thyasira	-	-	-	-	-	-	-	-	-	-
Liocyma	-	-	-	-	-	-	-	-	-	-
Bivalve frags.	-	32	-	212	-	-	-	-	-	-
Octopus	-	-	-	-	-	-	-	-	-	-
Anonyx	-	-	-	-	-	-	-	-	-	-
Hippomedon	-	-	-	-	-	-	-	-	-	-
Protomedia	-	-	-	-	-	-	-	-	-	-
Argis	-	-	-	-	-	-	-	-	-	-
Crangonidae	-	-	29	121	1	4	-	-	-	-
Hyas	-	-	2	18	28	23	-	-	2	1
Pagurus	-	-	-	-	-	-	-	-	-	-
Crustacean	-	-	-	-	-	-	-	-	-	-
Thyonidium	-	-	1	5	-	-	1	11	-	-
Pelonaia	-	-	1	1	-	-	-	-	-	-
Tunicate	-	-	-	-	-	-	-	-	-	-
Ammodytes	-	-	-	-	-	-	-	-	-	-
Animal frags.	-	-	-	-	-	186	-	40	-	177
Wood frags.	-	-	-	-	-	-	-	-	-	-
Sediments	-	250	-	100	-	10	-	320	-	60
Totals	47	435	161	2333	112	1542	58	807	77	1659

Gambell, concluded

Taxon \ Field No. / Sex	GW-337 ♂ No.	GW-337 ♂ Wt.	GW-344 ♀ No.	GW-344 ♀ Wt.	Summary: Frequency of occurrence (/47)	Totals: Individuals No.	Individuals (%)	Weight Grams	Weight (%)
Anemone	-	-	-	-	6	31	0.3	138	0.3
Bryozoan	-	-	-	-	1	1	-	2	-
Nephthys	-	-	-	-	3	7	0.1	23	-
Arenicola	-	-	-	-	2	45	0.5	360	0.7
Brada	-	-	-	-	4	639	7.0	263	0.5
Polych. unid.	-	-	-	-	1	30	0.3	178	0.3
Golfingia	-	-	-	-	3	6	0.1	16	-
Echiurus	-	-	-	-	15	886	9.7	2883	5.4
Priapulus	-	-	-	-	27	89	1.0	443	0.8
Neptunea	tr	tr	tr	tr	31	270	3.0	619	1.2
Buccinum	-	-	tr	tr	24	46	0.5	101	0.2
Natica	-	-	-	-	21	105	1.2	197	0.4
Polinices	-	-	-	-	34	52	0.6	95	0.2
Margarites	-	-	-	-	1	tr	-	tr	-
Solariella	-	-	-	-	3	tr	-	tr	-
Gastrop. unid.	2	8	8	36		536	5.9	951	1.8
Serripes	-	-	-	-	35	289	3.2	4149	7.8
Mya	21	335	7	166	41	2660	29.2	25226	47.6
Spisula	-	-	-	-	2	351	3.9	1100	2.1
Tellinidae	-	-	-	-	12	749	8.2	186	0.4
Astarte	-	-	-	-	2	1157	12.7	248	0.5
Yoldia	-	-	-	-	4	43	0.5	16	-
Thyasira	-	-	-	-	1	1	-	1	-
Liocyma	-	-	-	-	2	6	0.1	9	-
Bivalve frags.	-	-	-	-		-	-	1810	3.4
Octopus	-	-	-	-	1	tr	-	tr	-
Anonyx	-	-	-	-	3	7	0.1	11	-
Hippomedon	-	-	-	-	1	1	-	1	-
Protomedia	-	-	-	-	1	1	-	1	-
Argis	-	-	-	-	1	314	3.4	1297	2.4
Crangonidae	-	-	-	-	15	392	4.3	1104	2.1
Hyas	3	5	1	1	26	140	1.5	304	0.6
Pagurus	-	-	-	-	7	22	0.2	29	0.1
Crustacean	-	-	-	-		-	-	33	0.1
Thyonidium	-	-	-	-	15	28	0.3	401	0.8
Pelonaia	3	3	-	-	5	14	0.2	18	-
Tunicate	-	-	-	-	3	4	-	15	-
Ammodytes	-	-	-	-	1	160	1.8	100	0.2
Animal frags.	-	8	-	10		-	-	2046	3.[illegible]
Wood frags.	-	-	-	-	1	-	-	2	-
Sediments	-	0	-	40	34	-	-	8667	16.[illegible]
Totals	29	359	16	253		9,092		53,048	

Findings in stomach content samples of
Specimens from Savoonga area, 15 May - 3 June 1980

Field No. / Sex / Taxon	SW-1 ♂		SW-2 ♂		SW-11 ♂		SW-17 ♂		SW-19	
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
Anemone	12	70	10	105	-	-	-	-	-	-
Nephthys	3	41	2	6	-	-	-	-	1	1
Lumbrinereis	-	-	-	-	-	-	-	-	-	-
Pectinaria	-	-	-	-	-	-	-	-	-	-
Polychaete unid.	-	-	-	-	4	1	1	2	-	-
Golfingia	-	-	-	-	-	-	-	-	23	94
Echiurus	1	2	-	-	-	-	tr	tr	2	10
Priapulus	5	24	4	27	6	38	1	2	4	38
Neptunea	14	78	25	185	-	-	-	-	-	-
Buccinum	-	-	1	2	-	-	-	-	-	-
Natica	-	-	-	-	-	-	4	3	-	-
Polinices	6	17	1	2	1	2	3	2	1	2
Epitoneum	-	-	-	-	-	-	-	-	-	-
Cochlidiopsis	-	-	-	-	-	-	-	-	-	-
Margarites	-	-	-	-	-	-	-	-	-	-
Gastropod unid.	8	16	5	10	-	-	-	-	-	-
Serripes	2	12	-	-	16	528	8	114	9	205
Clinocardium	2	2	1	1	-	-	-	-	-	-
Mya	9	193	2	3	42	699	820	1537	385	752
Macoma/Tellina	67	28	114	54	3	5	-	-	1	2
Hiatella	-	-	-	-	-	-	-	-	103	39
Yoldia	4	3	1	1	-	-	-	-	-	-
Liocyma	-	-	-	-	-	-	-	-	-	-
Bivalve frags.	-	-	-	-	-	-	-	-	-	-
Crangonidae	-	-	-	-	-	-	2	10	-	-
Hyas	-	-	-	-	-	-	-	-	-	-
Pagurus	-	-	1	1	-	-	-	-	-	-
Cucumaria	-	-	-	-	-	-	-	-	-	-
Thyonidium	1	2	-	-	-	-	-	-	2	48
Ammodytes	-	-	-	-	-	-	-	-	-	-
Animal frags.	-	-	-	50	-	292	-	58	-	-
Sediments	-	235	-	15	-	0	-	0	-	450
Totals	134	723	167	462	72	1565	839	1728	531	1641

Savoonga, continued

Taxon \ Field No. / Sex	SW-20 ♂ No.	SW-20 ♂ Wt.	SW-58 ♂ No.	SW-58 ♂ Wt.	SW-59 No.	SW-59 Wt.	SW-60 ♂ No.	SW-60 ♂ Wt.	SW-61 No.	SW-61 Wt.
Anemone	-	-	-	-	-	-	-	-	-	-
Nephthys	-	-	-	-	-	-	1	1	2	20
Lumbrinereis	-	-	-	-	-	-	-	-	-	-
Pectinaria	-	-	-	-	-	-	-	-	-	-
Polychaete unid.	-	-	-	-	-	-	-	-	-	-
Golfingia	10	20	-	-	-	-	1	2	3	13
Echiurus	1	3	-	-	-	-	1	9	2	6
Priapulus	-	-	6	35	1	10	4	25	-	-
Neptunea	-	-	tr	tr	1	1	2	10	-	-
Buccinum	1	2	tr	tr	-	-	-	-	-	-
Natica	4	5	-	-	-	-	-	-	2	5
Polinices	1	2	5	5	tr	tr	6	10	-	-
Epitoneum	-	-	-	-	-	-	-	-	-	-
Cachidiopsis	-	-	tr	tr	-	-	-	-	-	-
Margarites	-	-	-	-	-	-	-	-	1	1
Gastropod unid.	1	1	10	11	-	-	4	40	1	2
Serripes	8	53	30	810	14	361	38	802	4	112
Clinocardium	-	-	-	-	-	-	-	-	-	-
Mya	394	637	23	195	117	1087	64	652	593	997
Macoma/Tellina	3	8	-	-	-	-	-	-	-	-
Hiatella	1291	875	-	-	-	-	-	-	781	371
Yoldia	-	-	-	-	-	-	-	-	-	-
Liocyma	-	-	-	-	-	-	-	-	-	-
Bivalve frags.	-	-	-	65	-	56	-	92	-	60
Crangonidae	-	-	-	-	-	-	1	1	-	-
Hyas	-	-	-	-	19	36	1	3	-	-
Pagurus	-	-	-	-	-	-	-	-	1	3
Cucumaria	1	3	-	-	-	-	-	-	-	-
Thyonidium	-	-	-	-	5	57	-	-	-	-
Ammodytes	-	-	-	-	-	-	-	-	-	-
Animal frags.	-	-	-	-	-	-	-	-	-	-
Sediments	-	50	-	30	-	87	-	0	-	370
Totals	1715	1659	74	1151	157	1695	123	1647	1390	1960

Savoonga, continued

Taxon \ Field No. / Sex	SW-62 ♂		SW-116 ♂		SW-180 ♂		SW-186 ♂		SW-187 ♂	
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
Anemone	-	-	-	-	-	-	-	-	-	-
Nephthys	7	105	1	2	-	-	-	-	-	-
Lumbrinereis	2	2	-	-	-	-	-	-	-	-
Pectinaria	1	1	-	-	-	-	-	-	-	-
Polychaete unid.	-	-	-	-	-	-	-	-	-	-
Golfingia	10	51	1	3	-	-	10	21	1	3
Echiurus	-	-	-	-	-	-	1	16	1	10
Priapulus	1	23	-	-	2	28	1	2	2	16
Neptunea	10	59	-	-	-	-	-	-	-	-
Buccinum	6	53	-	-	-	-	-	-	-	-
Natica	-	-	-	-	3	2	-	-	1	2
Polinices	-	-	3	6	-	-	-	-	1	3
Epitoneum	-	-	-	-	-	-	-	-	-	-
Onchidiopsis	-	-	tr	tr	-	-	-	-	-	-
Margarites	-	-	-	-	-	-	-	-	-	-
Gastropod unid.	1	6	-	-	5	5	-	-	1	2
Serripes	23	782	63	1315	4	21	10	146	3	111
Clinocardium	-	-	-	-	-	-	-	-	-	-
Mya	38	628	13	288	159	141	785	1254	367	907
Macoma/Tellina	-	-	1	5	-	-	2	3	1	2
Hiatella	-	-	-	-	1272	727	375	157	175	70
Yoldia	-	-	-	-	-	-	-	-	-	-
Liocyma	-	-	-	-	-	-	-	-	-	-
Bivalve frags.	-	97	-	7	-	48	-	45	-	40
Crangonidae	17	107	1	3	1	1	-	-	1	1
Hyas	-	-	-	-	-	-	-	-	1	1
Pagurus	-	-	-	-	-	-	-	-	-	-
Cucumaria	-	-	-	-	-	-	-	-	-	-
Thyonidium	-	-	-	-	1	2	2	30	3	43
Ammodytes	-	-	-	-	-	-	-	-	-	-
Animal frags.	-	142	-	-	-	-	-	-	-	-
Sediments	-	0	-	3	-	730	-	120	-	355
Totals	116	2038	83	1632	1447	1705	1186	1794	558	1566

Savoonga, continued

Taxon \ Field No. / Sex	SW-188		SW-191 ♂		SW-192 ♂		SW-195 ♂		SW-196 ♂	
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
Anemone	-	-	-	-	-	-	-	-	-	-
Nephthys	-	-	-	-	-	-	-	-	-	-
Lumbrinereis	-	-	-	-	-	-	-	-	-	-
Pectinaria	-	-	-	-	-	-	-	-	-	-
Polychaete unid.	-	-	-	-	-	-	-	-	-	-
Golfingia	-	-	-	-	-	-	-	-	-	-
Echiurus	1	7	-	-	-	-	-	-	-	-
Priapulus	-	-	5	42	-	-	4	30	36	336
Neptunea	-	-	7	47	-	-	tr	tr	3	13
Buccinum	-	-	tr	tr	-	-	-	-	3	4
Natica	3	3	tr	tr	2	3	tr	tr	1	1
Polinices	1	1	2	1	tr	tr	tr	tr	1	1
Epitoneum	-	-	-	-	-	-	-	-	-	-
Cachidiopsis	-	-	-	-	-	-	-	-	-	-
Margarites	-	-	-	-	-	-	-	-	-	-
Gastropod unid.	1	1	5	8	2	2	-	-	4	4
Serripes	3	20	48	930	49	931	25	684	11	166
Clinocardium	-	-	-	-	-	-	-	-	-	-
Mya	275	655	32	454	34	573	12	131	70	302
Macoma/Tellina	-	-	-	-	13	10	-	-	-	-
Hiatella	202	71	-	-	-	-	-	-	-	-
Yoldia	-	-	-	-	-	-	-	-	-	-
Liocyma	-	-	-	-	-	-	-	-	1	1
Bivalve frags.	-	24	-	305	-	130	-	162	-	226
Crangonidae	-	-	8	29	3	7	-	-	2	2
Hyas	-	-	-	-	-	-	1	1	-	-
Pagurus	-	-	-	-	-	-	-	-	-	-
Cucumaria	-	-	-	-	-	-	-	-	-	-
Thyonidium	4	50	-	-	-	-	-	-	-	-
Ammodytes	-	-	1	5	-	-	-	-	-	-
Animal frags.	-	-	-	-	-	-	-	79	-	5
Sediments	-	520	-	46	-	50	-	0	-	0
Totals	490	1352	108	1867	103	1706	42	1087	132	1061

Savoonga, continued

Field No. / Sex / Taxon	SW-197 ♂		SW-200 ♂		SW-201 ♂		SW-203a ♂		SW-203b ♂	
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
Anemone	-	-	-	-	-	-	-	-	-	-
Nephthys	-	-	-	-	1	5	-	-	-	-
Lumbrinereis	-	-	-	-	-	-	-	-	-	-
Pectinaria	-	-	-	-	-	-	-	-	-	-
Polychaete unid.	-	-	-	-	-	-	-	-	-	-
Golfingia	1	2	-	-	-	-	-	-	-	-
Echiurus	4	10	1	4	4	3	-	-	3	3
Priapulus	5	42	3	28	2	14	3	36	3	30
Neptunea	tr	tr	2	104	6	15	10	60	10	25
Buccinum	-	-	4	17	tr	tr	tr	tr	tr	tr
Natica	-	-	3	5	1	1	1	3	4	3
Polinices	1	1	3	5	2	1	-	-	-	-
Epitoneum	-	-	-	-	tr	tr	tr	tr	-	-
Cnchidiopsis	-	-	-	-	-	-	-	-	-	-
Margarites	-	-	-	-	-	-	-	-	-	-
Gastropod unid.	1	1	-	-	18	45	10	12	23	100
Serripes	12	135	55	811	60	839	34	619	59	908
Clinocardium	-	-	-	-	-	-	-	-	-	-
Mya	328	565	44	198	50	341	31	292	42	221
Macoma/Tellina	-	-	-	-	-	-	-	-	-	-
Hiatella	89	46	-	-	-	-	-	-	-	-
Yoldia	-	-	-	-	-	-	-	-	-	-
Liocyma	-	-	-	-	-	-	-	-	-	-
Bivalve frags.	-	-	-	343	-	155	-	114	-	123
Crangonidae	1	3	-	-	-	-	6	6	-	-
Hyas	-	-	-	-	-	-	1	1	-	-
Pagurus	-	-	-	-	-	-	18	17	-	-
Cucumaria	-	-	-	-	-	-	-	-	-	-
Thyonidium	-	-	-	-	-	-	1	10	-	-
Ammodytes	-	-	-	-	-	-	-	-	-	-
Animal frags.	-	-	-	-	-	-	-	-	-	-
Sediments	-	585	-	-	-	17	-	162	-	20
Totals	442	1390	125	1515	144	1436	115	1332	144	1433

Savoonga, concluded

Taxon	Frequency of occur-rense (/25)	Summary Totals Individuals No.	(%)	Weight Grams	(%)
Anemone	2	22	0.2	175	0.5
Nephthys	8	18	0.2	181	0.5
Lumbrinereis	1	2	-	1	-
Pectinaria	1	1	-	1	-
Polychaete unid.	2	5	-	3	-
Golfingia	9	60	0.6	209	0.6
Echiurus	13	22	0.2	83	0.2
Priapulus	20	98	0.9	836	2.2
Neptunea	14	100	1.0	587	1.6
Succinum	10	15	0.1	60	0.2
Natica	14	29	0.3	36	0.1
Polinices	19	38	0.4	61	0.2
Epitoneum	2	tr	-	tr	-
Onchidiopsis	2	tr	-	tr	-
Margarites	1	1	-	1	-
Gastropod unid.		100	1.0	266	0.7
Serripes	24	588	5.6	11,415	30.7
Clinocardium	2	3	-	3	-
Mya	25	4,729	45.3	13,702	36.9
Macoma/Tellina	9	205	2.0	117	0.3
Hiatella	8	4,288	41.1	2,356	6.3
Yoldia	2	5	-	4	-
Liocyma	1	1	-	1	-
Bivalve frags.		-	-	2,092	5.6
Crangonidae	11	43	0.4	170	0.5
Hyas	5	23	0.2	42	0.1
Pagurus	3	20	0.2	21	0.1
Cucumaria	1	1	-	3	-
Thyonidium	8	19	0.2	242	0.6
Ammodytes	1	1	-	5	-
Animal frags.		-	-	626	1.7
Sediments	18	-	-	3,845	10.4
Totals		10,437		37,145	

Findings in stomach content samples of specimens from the Nome area, 14-18 May 1980.

Field No. / Sex / Taxon	NW-1 ♀ No.	NW-1 ♀ Wt.	NW-2 ♀ No.	NW-2 ♀ Wt.	NW-6 ♀ No.	NW-6 ♀ Wt.	Summary: Freq. occur. (/3)	Totals: Individuals No.	Individuals (%)	Weight Grams	Weight (%)
Neptunea	-	-	tr	tr	tr	tr	2	tr	-	tr	-
Natica	-	-	1	1	1	2	2	2	0.2	3	0.1
Polinices	-	-	2	2	tr	tr	2	2	0.2	2	-
Gastropoda	-	-	7	15	9	24	2	16	1.3	39	0.8
Serripes	1059	3184	-	-	-	-	1	1059	84.6	3184	67.4
Mya	-	-	118	1098	25	325	2	143	11.4	1423	30.1
Crangonidae	2	6	-	-	20	50	2	22	1.8	56	1.2
Hyas	-	-	-	-	1	5	1	1	0.1	5	0.1
Pelonaia	-	-	-	-	7	12	1	7	0.6	12	0.2
Sediments	-	0	-	0	-	0	0	-	-	0	-
Totals	1061	3190	128	1116	63	418		1,252		4,724	

Findings in stomach content samples of specimens from the Wales area, 26 May-3 June 1980.

Taxon \ Field No. / Sex	DWL-1 ♂		DWL-2 ♀		WLW-4 ♂		WLW-30 ♂		WLW-37 ♂	
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
Nephthys	-	-	-	-	-	-	-	-	1	1
Arenicola	-	-	-	-	-	-	-	-	4	22
Echiurus	-	-	-	-	-	-	96	713	84	318
Neptunea	1	2	-	-	1	1	-	-	tr	tr
Buccinum	-	-	-	-	-	-	-	-	tr	tr
Polinices	-	-	-	-	-	-	-	-	1	4
Gastropoda	2	4	-	-	2	4	-	-	2	5
Mya	57	2064	60	850	37	1418	30	704	8	59
Macoma/Tellina	-	-	-	-	-	-	-	-	130	95
Thyonidium	1	15	2	40	-	-	-	-	-	-
Animal frags.	-	12	-	70	-	22	-	30	-	50
Sediments	-	360	-	0	-	0	-	260	-	600
Totals	61	2457	62	960	40	1445	126	1707	230	1154

Wales, concluded

	Summary				
	Frequency of occurrence (/5)	Totals			
		Individuals		Weight	
		No.	(%)	Grams	(%)
Nephthys	1	1	0.2	1	-
Arenicola	1	4	0.8	22	0.3
Echiurus	2	180	34.7	1,031	13.3
Neptunea	3	2	0.4	3	-
Buccinum	1	tr	-	tr	-
Polinices	1	1	0.2	4	-
Gastropoda		6	1.2	13	0.2
Mya	5	192	37.0	5,095	66.0
Macoma/Tellina	1	130	25.0	95	1.2
Thyonidium	2	3	0.6	55	0.7
Animal frags.		-	-	184	2.4
Sediments	3	-	-	1,220	15.8
Totals		519		7,723	

Findings in stomach content samples of
specimens from Little Diomede area, 11 May - 11 June 1980 (Coll. T. Smith)

Field No. / Sex / Taxon	DW-3 ♀		DW-7 ♀		DW-8 ♀		DW-9 ♀		DW-25 ♂	
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
Anemone	-	-	-	-	-	-	-	-	-	-
Nephthys	1	1	-	-	-	-	-	-	2	1
Lumbrinereis	-	-	-	-	-	-	-	-	-	-
Phyllodoce	-	-	-	-	-	-	-	-	-	-
Polychaete unid.	-	-	-	-	-	-	-	-	-	-
Golfingia	-	-	24	122	-	-	-	-	12	17
Echiurus	-	-	3	14	-	-	-	-	1	9
Priapulus	-	-	2	19	3	14	-	-	3	50
Neptunea	-	-	20	234	tr	tr	-	-	6	51
Buccinum	tr	tr	2	17	tr	tr	2	10	tr	tr
Natica	-	-	tr	tr	tr	tr	-	-	1	1
Polinices	tr	tr	1	1	tr	tr	-	-	4	3
Epitonium	-	-	-	-	-	-	-	-	-	-
Margarites	-	-	-	-	-	-	-	-	-	-
Gastropoda	37	82	43	136	1	4	-	-	12	23
Serripes	53	711	44	1261	2	32	3	38	3	47
Mya	58	573	134	1468	57	1319	163	3220	97	2646
Spisula	-	-	-	-	-	-	11	50	-	-
Macoma/Tellina	-	-	-	-	-	-	1	1	-	-
Hiatella	-	-	-	-	-	-	-	-	151	69
Yoldia	-	-	-	-	-	-	-	-	-	-
Thyasira	-	-	-	-	-	-	-	-	-	-
Bivalve frags.	-	321	-	122	-	62	-	0	-	50
Octopus	1	14	1	20	-	-	-	-	-	-
Anonyx	-	-	-	-	-	-	-	-	-	-
Byblis	-	-	-	-	-	-	-	-	-	-
Hyas	-	-	-	-	-	-	2	12	-	-
Pagurus	-	-	1	2	-	-	-	-	-	-
Cucumaria	-	-	-	-	-	-	-	-	-	-
Thyonidium	2	10	1	10	-	-	-	-	-	-
Pelonaia	-	-	-	-	-	-	-	-	-	-
Animal frags.	2	12	2	8	-	-	-	-	-	-
Sediments	-	0	-	50	-	241	-	164	-	75
Totals	154	1724	278	3484	63	1672	182	3495	292	3042

Diomede, continued

Field No. / Sex / Taxon	DW-84 ♀		DW-206 ♂		DW-258 ♀		DW-276 ♂		DW-277 ♂	
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
Anemone	1	18	-	-	3	1	-	-	-	-
Nephthys	12	116	-	-	2	5	-	-	1	4
Lumbrinereis	-	-	-	-	-	-	-	-	-	-
Phyllodoce	-	-	-	-	-	-	-	-	-	-
Polychaete unid.	-	-	-	-	-	-	-	-	-	-
Golfingia	163	636	-	-	-	-	-	-	97	174
Echiurus	-	-	-	-	-	-	-	-	-	-
Priapulus	5	73	-	-	-	-	-	-	1	50
Neptunea	7	75	-	-	2	4	2	8	-	-
Buccinum	tr	tr	-	-	tr	tr	tr	tr	-	-
Natica	-	-	-	-	6	1	-	-	-	-
Polinices	tr	tr	-	-	7	2	1	1	-	-
Epitonium	-	-	-	-	tr	tr	-	-	-	-
Margarites	-	-	-	-	tr	tr	-	-	-	-
Gastropoda unid.	18	47	1	2	9	14	17	22	4	7
Serripes	33	714	-	-	36	400	29	687	2	36
Mya	35	625	50	810	25	83	65	1387	135	3180
Spisula	-	-	-	-	-	-	-	-	-	-
Macoma/Tellina	-	-	-	-	1	1	-	-	-	-
Hiatella	-	-	-	-	-	-	-	-	27	26
Yoldia	-	-	-	-	12	5	-	-	-	-
Thyasira	-	-	-	-	-	-	-	-	-	-
Bivalve frags.	-	0	-	0	-	47	-	146	-	0
Octopus	tr	tr	-	-	-	-	tr	tr	-	-
Anonyx	-	-	-	-	-	-	-	-	-	-
Byblis	-	-	-	-	-	-	-	-	-	-
Hyas	-	-	-	-	-	-	-	-	-	-
Pagurus	-	-	-	-	-	-	-	-	-	-
Cucumaria	-	-	-	-	-	-	-	-	-	-
Thyonidium	-	-	-	-	1	6	-	-	1	10
Pelonaia	-	-	-	-	1	1	-	-	-	-
Animal frags.	-	200	-	0	-	6	-	0	-	10
Sediments	-	0	-	70	-	0	-	175	-	72
Totals	274	2504	51	882	105	576	114	2426	268	3569

Diomede, continued

Taxon \ Field No. / Sex	DW-278 ♂		DW-279 ♂		DW-282 ♀		DW-303 ♀		DW-304 ♀	
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
Anemone	3	7	-	-	-	-	-	-	-	-
Nephthys	74	307	-	-	1	3	7	64	1	3
Lumbrinereis	5	6	-	-	-	-	-	-	-	-
Phyllodoce	4	5	-	-	-	-	-	-	-	-
Polychaete unid.	5	5	-	-	-	-	-	-	-	-
Golfingia	-	-	1	8	3	12	4	19	-	-
Echiurus	1	3	-	-	1	5	6	58	-	-
Priapulus	-	-	-	-	2	40	-	-	-	-
Neptunea	-	-	1	3	4	31	-	-	-	-
Buccinum	-	-	1	7	-	-	-	-	-	-
Natica	tr	tr	tr	tr	-	-	-	-	-	-
Polinices	15	20	-	-	-	-	-	-	-	-
Epitonium	-	-	-	-	-	-	-	-	-	-
Margarites	-	-	-	-	-	-	-	-	-	-
Gastropoda unid.	5	9	3	3	4	13	-	-	7	17
Serripes	101	1140	22	567	4	140	-	-	27	291
Mya	6	26	210	1242	23	1296	-	-	11	130
Spisula	-	-	-	-	-	-	-	-	-	-
Macoma/Tellina	1177	281	-	-	1	4	43	128	45	65
Hiatella	1	1	-	-	-	-	-	-	-	-
Yoldia	38	25	-	-	-	-	-	-	-	-
Thyasira	tr	tr	-	-	-	-	-	-	-	-
Bivalve frags.	-	132	-	48	-	0	-	0	-	53
Octopus	-	-	-	-	-	-	1	15	-	-
Anonyx	-	-	1	2	-	-	-	-	-	-
Byblis	-	-	1	1	-	-	-	-	-	-
Hyas	-	-	-	-	-	-	-	-	-	-
Pagurus	-	-	-	-	-	-	-	-	-	-
Cucumaria	5	22	-	-	-	-	-	-	-	-
Thyonidium	-	-	3	71	1	9	-	-	6	46
Pelonaia	-	-	-	-	-	-	-	-	-	-
Animal frags.	-	0	-	0	-	0	-	20	-	0
Sediments	-	15	-	106	-	0	-	62	-	10
Totals	1440	2004	243	2058	44	1553	61	366	97	615

Diomede, concluded

Taxon	Summary: Frequency of occurrence (/15)	Totals: Individuals No.	Individuals (%)	Weight Grams	Weight (%)
Anemone	3	7	0.2	26	0.1
Nephthys	9	101	2.8	504	1.7
Lumbrinereis	1	5	0.1	6	-
Phyllodoce	1	4	0.1	5	-
Polychaete unid.	1	5	0.1	5	-
Golfingia	7	304	8.3	988	3.3
Echiurus	5	12	0.3	89	0.3
Priapulus	6	16	0.4	246	0.8
Neptunea	8	42	1.1	406	1.4
Buccinum	9	5	0.1	34	0.1
Natica	6	7	0.2	2	-
Polinices	8	33	0.9	22	0.1
Epitonium	1	tr	-	tr	-
Margarites	1	tr	-	tr	-
Gastropoda unid.		161	4.4	379	1.3
Serripes	13	359	9.8	6,064	20.2
Mya	14	1,069	29.2	18,005	60.1
Spisula	1	11	0.3	50	0.2
Macoma/Tellina	6	1,268	35.1	480	1.6
Hiatella	3	179	4.9	96	0.3
Yoldia	2	50	1.4	30	0.1
Thyasira	1	tr	-	tr	-
Bivalve frags.		-	-	981	3.3
Octopus	5	3	0.1	49	0.2
Anonyx	1	1	-	2	-
Byblis	1	1	-	1	-
Hyas	1	2	-	12	-
Pagurus	1	1	-	2	-
Cucumaria	1	5	0.1	22	0.1
Thyonidium	7	15	0.4	162	0.5
Pelonaia	1	1	-	1	-
Animal frags.		4	0.1	256	0.8
Sediments	11	-	-	1,040	3.5
Totals		3,666		29,970	