UCIDA
UNITED COOK INLET DRIFT ASSOCIATION
P.O. Box 389 • Kenai, Alaska 99611 - 0389
(907) 283-3600 • FAX (907) 283-3306

October 19, 1994
By Telefax 276-7178

Mr. Jim Ayers
Executive Director
Exxon Valdez Oil Spill Trustee Council
645 "G" Street, Suite 401
Anchorage, AK 99501

included in TC summ

SUBJECT: Category 1 Projects, Kenai River sockeye salmon, FY

Dear Mr. Ayers,

United Cook Inlet Drift Association (UCIDA) represents the 585 salmon drift permit holders in Upper Cook Inlet. Some 350 permit holders are current members of our association. UCIDA is also active at the state and federal levels as a member of the Executive Committee of United Fishermen of Alaska (UFA).

I would like to relay UCIDA's strong support for the continuation of Trustee funding for Projects #95255 and #95258. It is with great consternation that we have recently learned that after several years of funding these projects, there appears to be some question in the eyes of the PAG (Mr. Rupe Andrews in particular) and the Chief Scientist as to the value of continuing these projects.

In support of our position, I would like to make the following points:

1) In 1992, the Trustees voted that as a matter of "policy", Kenai River sockeye salmon was to be considered a damaged resource, and that it was not necessary to consider the Valdez oil spill as the sole source of the damage and that the "population level" damage criteria preferred by the Chief Scientist was not to be the basis for declaring a resource "damaged".

2) The Interior Department attempted for several years to veto these projects along with others dealing with commercial fishery resources. The Kenai projects were eventually funded after the Trustees adopted the aforementioned "policy." Unfortunately, however, it took several years and a general collapse of pink salmon and herring stocks in Prince William Sound for other commercial resources to be recognized as "damaged".

3) I attended the P.I. workshop in Anchorage, where it was clearly stated that Kenai sockeye were damaged and that the monitoring schedule would be annual "until recovery objectives are met, and for two subsequent years after smolt productivity has returned to normal." It was also agreed that "at least seven years of monitoring will be necessary at Kenai and Akalura Lake to monitor productivity through returns of year-classes damaged by spill induced overescapements." (p. A-33, Invitation to Submit Restoration Projects for Fiscal Year 1995).

4) While some may well argue that ADF&G's forecasts were not perfect in 1992, it can not be contested that a continuing trend of decreasing productivity persists in the Kenai sockeye system. Further, the social and economic importance of Kenai River sockeye salmon is beyond question.

In conclusion, UCIDA urges you to recommend continued funding for Category 1 Kenai River sockeye projects #95255 and 95258. Further, we fully support project #95105 as a restoration measure aimed at examining the feasibility of the use of nutrients in the Kenai's glacial systems to aid fry survival. Finally, UCIDA frankly has not had time to examine the merits of project #95048. The battles with the Chief Scientist, environmental groups and federal Trustees are behind us and we look forward to closure - but not a premature closure - of these projects.

Sincerely,

Theo Matthews
Administrative Assistant

CC: Carl Rosier, ADF & G
John Sandor, ADEC

Craig Tillery, Dept of Law
Senator Ted Stevens
Senator Suzanne Little
Senator Judy Salo
Representative Gary Davis
Representative Gail Phillips
Representative Mike Navarre
UFA
KPFA
CDFU
Area K Seiners
Lower Cook Inlet Seiners
Alaska Sportfishing Association
Mary McBurney, PAG
Kenai Peninsula Borough Assembly

km

Bob - public comment

FAX TRANSMITTAL

DATE: 10/17/94

TO: Molly McCammon

FAX: 276-7178

FROM: CDFG

TEL: 424-3447

FAX: 424-3430

PAGES: 3

Molly - Thought you might be interested in seeing this.

Thanks, Thea Thomas

Cordova District Fishermen United
P.O. Box 939
Cordova, Alaska 99574
(907) 424-3447 FAX (907) 424-3430

October 17, 1994

Mr. James Ayers
Executive Director
Exxon Valdez Oil Spill Trustee Council
645 G Street
Anchorage, Alaska, 99501

Dear Mr. Ayers,

We realize that soon you will be making your recommendations to the Trustee Council for funding in 1995. We have reviewed the Draft 1995 Work Plan extensively, and would like to clarify once again the issues before the Trustee Council that we feel are critical to the resource users of Prince William Sound.

The Sound Ecosystem Assessment project continues to be of utmost importance to the Herring and Pink salmon fishermen of PWS. This research will provide the foundation to understanding the natural and man-caused variability in the sound. This information is necessary to determine and prioritize any future restoration programs. A critical component of the long term restoration of pink salmon is the identification and monitoring program(i.e. Coded Wire Tagging). CWT is a necessary tool for in-season management of hatchery and naturally spawning pink salmon to insure that injured non-recovering wild stocks are not further impacted. We strongly support an integrated funding program involving PWSAC, VFDA, ADFG and the Trustee Council. It is necessary to carry the Coded Wire Tag project(95320B) forward through 1995 and 1996 at full funding.

For the 1995 work plan, the scientific peer reviewers were very supportive of initiating a Thermal Mass Marking project(95320C). This method is technically superior to CWT as it is possible to mark all the fish. It is important to overlap the Coded Wire Tagging with the Thermal Marking as a check to the procedure. We understanding fully that continued funding of both the CWT for the next two years and the TMM requires the commitment from EVOSTC, PWSAC, VFDA and ADFG. The CDFU Board of Directors will continue our lobbying for CWT and TMM from these entities.

We would also like to address the collaborative proposal 95093 A,B an C. This joint proposal submitted by Prince William Sound Aquaculture Corporation and the Native Village of Eyak Tribal Council, with ADFG as the lead agency outlines direct restoration of Pink Salmon streams in PWS. The projects described in sections A & C, present an excellent opportunity to study oil impacted streams and the effects on straying and viability of Pink Salmon from these streams. Section B of this proposal involves changes in run timing and remote release of hatchery fish as a means of removing pressure from naturally spawning fish. This concept received support from the core peer reviewers. The restoration approach plan includes egg incubation, net pen rearing, hatchery rearing and fry transplant. These techniques are outlined in the EVOS Restoration Plan Final EIS as appropriate means for restoring injured pink salmon resources. PWSAC will be acting solely as the supplementation facility assisting in egg incubation. We understand that this project may require site-specific NEPA compliance and urge the Trustee Council to fund whatever environmental studies may be required. We would hope that at the very outside an Environmental Assessment would be all that is necessary and funded by the Trustee Council.

Please do not hesitate to call us if you have any questions.

Sincerely,
CORDOVA DISTRICT FISHERMEN UNITED

Thea Thomas, Board of Director

cc: B Botelho
P. Janik
C. Rosier
G. Frampton
S. Pennoyer
J. Sandor

Chugach Regional Resources Commission

Chenega Bay

Eyak

Nanwalek

Port Graham

Qutekcak Native Tribe

Tatitlek

Valdez Native Association

October 19, 1994

Mr. James R. Ayers, Executive Director
Exxon Valdez Oil Spill Trustee Council
645 G Street
Anchorage, Alaska 99501

Dear Mr. Ayers:

As a result of a discussion held during the quarterly Board of Directors meeting of the Chugach Regional Resource Commission, I am forwarding to you a copy of a resolution which was passed urging the Trustee Council to fund projects that will restore lost resources of importance to Native communities in the Chugach Region. As a preface to this resolution, I feel it important to inform you of some of the discussion surrounding its contents.

There was much debate on how best to express the frustration and even anger that is felt in the Native communities in Prince William Sound and Lower Cook Inlet over the difficulties being experienced in obtaining funding for restoration projects of interest to them. Although Trustee Council staff is making a much greater effort to communicate with the Native communities, there is still a bi gap between the encouragement and advice that is given at community meetings and the reception their project proposals receive at the Trustee Council level. Many of the proposals submitted by the Native communities this year were described as having "legal problems," that have not been further explained. This has caused many of the community leaders to throw up their hands in frustration and disgust.

There are many in the Native communities that still want to work with the Trustee Council and have hopes of seeing projects funded that will help mitigate the damage and loss of those resources that play such an important role in their lives. It was this combination of anger, frustration, and hope that produced the attached resolution.

The Chugach Natives certainly do not expect that every proposal they submit to the Trustee Council will get funded. On the other hand, they are continually frustrated with the fact that study upon study receives funding with

4201 Tudor Centre Drive, Suite 211, Anchorage, Alaska 99508, 907 / 562-6647, FAX 907 / 562-4939
A Tribal Organization Focusing on Natural Resource Issues Affecting the Chugach Region of Alaska

no clear benefit to the Native people directly affected by the oil spill. I do not think it unrealistic to expect that their needs and interests will be considered as an integral and important aspect of the natural resource restoration process in the oil spill area. As the review process of project proposals continues, I would sincerely hope that any problems found with the proposals submitted by the Native communities (including legal ones) be fully explained in an understandable manner and that an opportunity presented for these problems to be rectified.

As the end of the restoration process draws near and the funds diminish, the anxiety level in the Native communities rises. In the interest of all parties involved and in the interest of the restoration of the resource base upon which we are all dependent, it is hoped that a way can soon be found to fully bring the Chugach Natives into the Trustee Council restoration process. The Chugach Regional Resources Commission is available and willing to do whatever it can to expedite and foster this process. I look forward to hearing your comments on our concerns, and please feel free to contact us if we can be of service.

Sincerely,

Patty Brown-Schwalenberg
Executive Director

enc. 1
/pbs

RESOLUTION 94-1

CHUGACH REGIONAL RESOURCES COMMISSION

A resolution urging the Exxon Valdez Oil Spill Trustee Council to fund restoration projects that will help restore damaged natural resources that Native communities in the oil spill area depend on for their existence.

WHEREAS oil spilled from the Exxon Valdez severely damaged and/or depleted numerous marine resources upon which the Native communities in the oil spil area depend for their economic and social well being; and

WHEREAS the negative impact to the Native communities from these lost and damaged resources is increasing as times goes by; and

WHEREAS The Exxon Valdez Oil Spill Trustee Council was organized to oversee and direct the application of state and federal civil settlement moneys to restore or replace lost resources; and

WHEREAS the Native communities in the oil spill area have made a concerted effort, within the limited resources available to them, to make their needs known to the Trustee Council and to develop and recommend projects that would restore or replace these lost resources; and

WHEREAS the Native communities have had little success to date in obtaining funding from the Trustee Council for projects of interest to them; and

WHEREAS the funds made available for restoration work by the civil settlement are becoming depleted with little apparent benefit to those who were injured most by the effects of the oil spill or to the natural resources on which they depend;

NOW THEREFORE BE IT RESOLVED THAT

The Chugach Regional Resources Commission, a consortium of Native villages and associations in the Chugach region concerned with natural resource conservation, management and development, urges the Exxon Valdez Oil Spill Trustee Council, in the strongest possible terms, to fund the following project proposals. All these proposals are designed to restore resources of critical importance to the Native communities in the Chugach region of the oil spill area.

Project Number	Project Title	FY 95 Cost ($000)
95052	Community Involvement & Use of Traditional Knowledge	$230.5
95093 A, B & C	Restoration of PWS Natural Salmon Resources and Services Overview	$2,410.9
95123	Tatitlek Community Store	$300.0
95124 A&B	Tatitlek Mariculture Development	$514.5
95125	Tatitlek Sockeye Salmon Release	$39.0
95127	Tatitlek Coho Salmon Release	$39.0
95128	Teaching Subsistence Practices and Values	$69.0
95129	Tatitlek Fish & Game Processing Center and Smokery	$515.5
95130	Tatitlek Mental Health Center	$106.1
95131	Clam Restoration (Nanwalek, Port Graham, Tatitlek)	$224.0
95134	Chenega Bay Mariculture Development	$184.3
95135	Subsistence Harvest Support	$50.0
95136	Skin Sewing Crafts Restoration	$29.9
95138	Elders/Youth Conference	$85.5
95140	Subsistence Skills Program	$36.7
95272	Chenega Chinook Release	$47.2
		$4,882.1

ADOPTED this 18th day of October, 1994.

CERTIFICATION

I, the undersigned, Secretary of the Chugach Regional Resources Commission, hereby certify that the Board of Directors is composed of seven members, of whom all seven were present at a meeting held this 18th day of October, 1994, and that the foregoing resolution was adopted by the affirmative vote of all seven members.

ATTEST: Patrick Norman
Secretary

DATE: 10-18-94

HOMER SOCIETY OF NATURAL HISTORY
PRATT MUSEUM
3779 Bartlett Street
Homer, Alaska 99603
(907)235-8635

Accredited by the American Association of Museums

OCTOBER 14, 1994

JIM AYERS, DIRECTOR
EVOS TRUSTEE COUNCIL
645 G STREET, SUITE 402
ANCHORAGE, ALASKA 99501

DEAR MR. AYERS:

The 1995 Draft Work Plan Supplement (Volume I) seems replete with worthy projects. As a natural history museum concerned with marine conservation and education this institution is supportive of many of them. I am aware that the deadline for comments on the plan was October 3, but hope you might still accept a statement supporting specific projects.

I would like to urge implementation of two in particular: proposal 95013, Killer Whale Monitoring in Prince William Sound, and proposal 95014, Predation by Killer Whales in Prince William Sound.

For some years we at the museum have followed the ongoing research of the North Gulf Oceanic Society. It is our perception that it made a significant contribution to our understanding of these important marine mammals prior to the EVOS, and is now doubly vital as we attempt to understand the continuing impacts of that great catastrophe.

Proposal 95013 would extend and build upon an established and valuable research base. We understand that it is the least costly and broadest in scope of any proposal of its type. Work would be conducted by Alaskan scientists with almost 15 years of experience with Prince William Sound's orc

Proposal 95014 seems most innovative. Investigatin effects of prey switching by orcas could shed light array of subtle, secondary impacts to the marine ec from the EVOS. This could aid in developing strate encourage better recovery of prey species.

I hope that the Council will share our enthusiasm f proposals and provide the necessary funding to supp

This letter was added to to summary of other letters when provided to TC for 11/23 mtg

Sincerely,
BETSY PITZMAN, DIRECTOR
PRATT MUSEUM

Betsy Pitzman

HOMER SOCIETY OF NATURAL HISTORY
PRATT MUSEUM
3779 Bartlett Street
Homer, Alaska 99603
(907)235-8635

Accredited by the American Association of Museums

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Proposal 95014 seems most innovative. Investigating the effects of prey switching by orcas could shed light on an array of subtle, secondary impacts to the marine ecosystem from the EVOS. This could aid in developing strategies to encourage better recovery of prey species.

I hope that the Council will share our enthusiasm for these proposals and provide the necessary funding to support them.

Sincerely,
BETSY PITZMAN, DIRECTOR
PRATT MUSEUM

Betsy Pitzman

Cordova District Fishermen United
P.O. Box 939
Cordova, Alaska 99574
(907) 424-3447 FAX (907) 424-3430

original to replace fax copy.

October 17, 1994

Mr. James Ayers
Executive Director
Exxon Valdez Oil Spill Trustee Council
645 G Street
Anchorage, Alaska, 99501

Dear Mr. Ayers,

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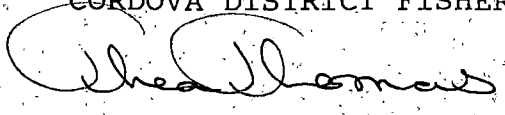
Please do not hesitate to call us if you have any questions.

Sincerely,
CORDOVA DISTRICT FISHERMEN UNITED



Thea Thomas, Board of Director

cc: B Botelho
P. Janik
C. Rosier
G. Frampton
S. Pennoyer
J. Sandor

Cordova District Fishermen United
P.O. Box 939
Cordova, Alaska 99574

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Mr. James Ayers
EVOS Executive Director
645 G Street
Anchorage, Alaska 99501

RECEIVED
OCT 19 1994
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

99501-3451 91

Oct 14, 1994

The correspondence following this sheet was copied, summarized and distributed at the 10/12-13/94 PAG mtg.

Mr. Jim Ayers, Director EVOS Trustee Council
645 G Street, Suite 402, Anchorage, AK 99501

22 September, 1994

Dear Mr. Ayers,

Please accept and share with other EVOS Trustees these comments on two issues: 1) support of Alaskan-based marine biology research and 2) closer scrutiny of the proposed IMS Infrastructure Improvement in Seward. I feel very strongly about both topics and hope you'll be receptive to considering my arguments.

I urge the Trustees to support Alaskan-based research such as that conducted by the North Gulf Oceanic Society (NGOS), specifically killer whale study proposals #95013 and #95014. Expertise of NGOS, in my opinion, is superior to that of federal agencies (NMML/NMFS). Costs of local research are lower than those associated with Outside agencies. Please be aware that fishermen, villagers, hatchery personnel, lodge owners and merchants living and working in the Sound know and trust NGOS from years of personal and professional contacts. I cannot stress strongly enough how important a history of trust is in contributing to consistent, quality research, year after year.

Killer whale whale research done by the North Gulf Oceanic Society has a long history, predating the oil spill. Their baseline data are extensive. I know these individuals. I can personally and professionally attest to their long term connection and committment to Prince William Sound. Their work is not just a contract job, it's their life. They care deeply about the Sound, spending much of the year there. They live in Alaska. And they do excellent work. To give contracts to competing Outside government agencies seems to me to be inappropriate. Please seriously consider funding their work as well as work by other Alaskan research groups. This seems the right thing to do.

Regarding the second issue, that of the Alaska SeaLife Center in Seward, I think existing IMS facilities in Kasitsna Bay should be improved if needed, rather than $37.5 million of EVOS funds poured into a $47.5 million venture. My personal opinion: monies should be prioritized highest in the area of critical habitat buyback, such as Chenega Native Corporation lands in the SW Sopund which are currently being surveyed for possible logging and/or buy-back potential. I hope the Trustees are being appraised of this situation.

While I agree that public education is vital, I fear yet another marineworld park attempting to duplicate that which already exists in the natural environment, an environment which would be wise to permanently protect via buyback purchases. Additionally, the University of Alaska owns appx. 1,000 acres of critical habitat in Jack Bay near Valdez, inc. lands around three creeks. One, Gregorioff Creek, is the area's most prolific pink salmon spawning stream. I'd advise you to seriously consider that area as well as the Chenega lands, all of which may be logged, subdivided or otherwise developed in the future.

Generally speaking, I question EVOS funds--especially those slated for restoration--being used to construct additional facilities when world-class facilities already exist in Kasitsna Bay, and when little critical habitat has been purchased to date.

I appreciate the time you spent reading my letter. I sincerely hope you'll consider those points raised in this letter, as they are so important to me and to many others. Thank you very much.

Sincerely,

John D. Lyle Box 83715 Fairbanks, Alaska 99708

John D. Lyle
Box 83715
Fairbanks, Alaska 99708

FAIRBANKS AK
PM
23 SEP
1994
99701

RECEIVED
SEP 26 1994
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

Mr. Jim Ayers,
Director, EVOS Trustee Council
645 G Street Suite 402
Anchorage, Alaska 99501

MARINE MAMMAL COMMISSION
1825 CONNECTICUT AVENUE, N.W. #512
WASHINGTON, DC 20009

16 September 1994

Mr. James R. Ayers
Director
EVOS Trustee Council
645 G Street, Suite 402
Anchorage, AK 99501

Dear Mr. Ayers:

I understand that Mr. Craig O. Matkin, of the North Gulf Oceanic Society, has submitted two proposals to the EVOS Trustee Council for FY 95 funding consideration. One proposal is to continue monitoring of killer whales in Prince William Sound, Alaska. The second is to continue field studies to document any changes in the diet of Prince William Sound killer whales since the Exxon Valdez oil spill and to estimate killer whale predation rates on harbor seals, salmon, and other species in Prince William Sound.

The Marine Mammal Commission contracted with Mr. Matkin in 1991 to prepare a report summarizing available information concerning the biology and management of killer whales in Alaska. A copy of the completed report is enclosed.

The report clearly illustrates Mr. Matkin's breadth of knowledge concerning killer whales and killer whale management problems in Alaska. I suspect that he may be uniquely qualified to do the research he has proposed.

This example of Mr. Matkin's work may help you to evaluate his proposals.

Sincerely,

Robert J. Hofman, Ph.D.
Scientific Program Director

Enclosure

cc: Mr. Steven Pennoyer

KILLER WHALE (*ORCINUS ORCA*) BIOLOGY AND MANAGEMENT IN ALASKA

by

Craig O. Matkin and Eva L. Saulitis

North Gulf Oceanic Society
P.O. Box 15244
Homer, Alaska 99603

Contract Number T75135023

Marine Mammal Commission
1825 Connecticut Avenue, N.W.
Washington, D.C. 20009

1994

September 22, 1994

Jim Ayers, Director
EVOS Trustee Council
645 G Street, Suite 402
Anchorage, AK 99501

Dear Mr. Ayers

I am writing to voice my support for funding the North Gulf Oceanic Society Killer Whale projects #95013 (Killer Whale Monitoring in Prince William Sound) and 94014 (Predation by Killer Whales in Prince William Sound).

This summer I was fortunate to have spent some time with Craig Matkin and some visiting Canadian Killer Whale researchers out near the NGOS whale camp in Prince William Sound. I work with Broadcast Services of Alaska a wildlife filming company and we were out there filming killer whales. The NGOS people were very helpful and gave us some very much appreciated advice and assistance.

Mr. Matkin is a long time Alaskan researcher and fisherman and has spent over 14 years researching the Killer Whales of Prince William Sound. While some may think that National Marine Fisheries Service would be best suited for this task (I used to work for them), in this case however you have a private Alaskan research group that has a very specialized expertise that is in a much better position to conduct the best research.

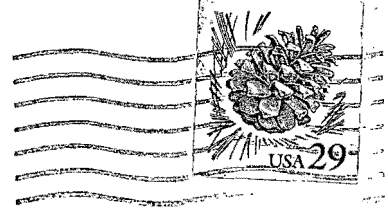
Please support these projects as they have a broader scope than the NMFS projects and cost much less.

Sincerely,

Paul A. McCollum
Business Manager
Broadcast Services of Alaska

Paul McCollum
P.O. Box 2016
Homer, AK 99603

ANCHORAGE AK
PM
23 SEP
1994
995



Mr. Jim Ayers
Director
EVOS Trustee Council
645 G Street, Suite 402

01

9-23-94

JIM AYERS, DIRECTOR
EVOS TRUSTEE COUNCIL
645 G STREET, SUITE 402
ANCHORAGE, ALASKA

Dear Mr. Ayres,

I have been a commercial fisherman in Prince William Sound since 1965. I have skippered my own seine boat since 1978. I feel very strongly about the damage that EXXON did to the PWS ecosystem. In the winter months I teach at the University of California Santa Cruz.

I am writing in support of your funding proposal 95013 Killer Whale Monitoring in Prince William Sound. Also Project 94014 is also worthy of your support also. I am familiar with past Killer Whale studies made by Mr. Matkin and his work is highly respected in the scientific community. His research group has already made significant contributions toward the understanding of how the resident and transient Killer Whale populations fit into the total PWS ecosystem and with continued funding he will be able to continue and expand those contributions. Mr. Matkin is an Alaskan resident and one of the most conscientious and thorough researchers that I know.

I understand that his proposals are in competition with the National Marine Mammal Laboratory proposals. I know for a fact that his proposal will cost less than the NMML proposal and his study will document all killer whales that use the sound and not just AB pod.

If I can offer any further information concerning Mr. Matkin and his work please do not hesitate to contact me.

Yours truly,

Robert H. Widmann Ed.D., Lecturer
University of California Santa Cruz

WIDMANN
4195 OLD SAN JOSE RD.
SOQUEL, CA 95073

SAN JOSE, CA 951
PM
24 SEP
1994

JIM AYERS, DIRECTOR
EVOS TRUSTEE COUNCIL
645 G ST. SUITE 402
ANCHORAGE, AK 99501

TEX EDWARDS
Po BOX 15014
FRITZ CREEK, AK, 99603
235-7334; FAX-7028

JIM AYERS
EVOS TRUSTEE COUNCIL

TO THE COUNCIL;

I AM WRITING IN SUPPORT OF PROPOSALS 95013 AND 94014: KILLER WHALE MONITORING IN PWS AND PREDATION BY KILLER WHALES IN PWS.

AS A LONG TIME ALASKAN I HAVE WORKED IN PWS SINCE '79: 6 YEARS ON THE VALDEZ PILOT BOATS AND THE LAST 8 YEARS SERVING AS MASTER OF THE "GLACIER QUEEN II" (A TOUR BOAT TRAVELING BETWEEN VALDEZ AND WHITTIER)

THE NORTH GULF OCEANIC SOCIETY HAS WORKED IN PWS FOR MORE THAN 14 YEARS: PRIOR TO, DURING, AND AFTER THE SPILL YEARS. THEY HAVE DEFINED THE ORCA POPULATION IN PWS; AND HAVE DEVELOPED EXCELLENT LINES OF COMMUNICATION WITH OTHER USER GROUPS - PROVIDING VALUABLE INFORMATION TO THE PUBLIC.

NGOS IS THE CLEAR CHOICE TO CONTINUE MONITORING AND STUDY PREDATION.

THANK YOU FOR YOUR THOUGHTFUL CONSIDERATION OF THESE PROPOSALS.

SINCERELY,

TEX EDWARDS
27 SEP 94

PO 15014
FC AK
99603

JIM AYERS, DIRECTOR
EVOS TRUSTEE COUNCIL
645 G STREET, SUITE 402
ANCHORAGE AK
99501

Jim Ayers, Director
EVOS Trustee Council
645 G. Street Suite 402
Anchorage, Alaska, 99501

9 26 94

Dear Mr. Ayers,

I write in support of Project 95013 "Killer Whale Monitoring" and 95014 "Killer Whale Predation" submitted to you by the North Gulf Oceanic Society. I have collaborated with Craig Matkin of that Society over the past 12 months. Our collaboration to date has included project design, permit application, and supply of extremely valuable biopsy samples. At all stages of our interaction I have found the organization to be professional, and deliver promised material in a timely manner. I am extremely excited about our ongoing collaboration, as Craig has given us the opportunity to study a critical part of the marine food web and its relationship to chemical exposure. He has been substantially more cooperative and forthcoming in this manner than many of the contacts I have attempted to make in the federal agency arena. His are worthwhile projects and NGOS is capable of completing the work. They have experience with biopsy sample techniques and they deliver what they promise.

If I can be of any further help in your consideration of their proposals please contact me,

Sincerely yours,

Michael J Moore

Michael J. Moore

Michael J. Moore Vet. M.B., Ph.D.
Biology Department, Woods Hole Oceanographic Institution
508 457 2000 x 3228 (phone), 508 457 2169 (fax), mmoore@whoi.edu (email)

WOODS HOLE OCEANOGRAPHIC INSTITUTION
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WOODS HOLE, MA 02543

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J Ayers
Evos Trustee Council
645 G. Street Suite 402
Anchorage AK 99501

Sept. 28, 1994

Jim Ayers, Director
EVOS Trustee Council
645 G St., Ste. #402
Anchorage AK 99501

Dear Mr. Ayers,

I would like to express my support for funding North Gulf Oceanic Society's proposal for Killer Whale research, Project 94014, in PWS.

Mr. Matkin has spent years studying both transient & resident orca pods and is highly skilled in his field. To have a person of his expertise conduct this study is not only more cost effective than the Marine Mammal Lab's proposal, but will probably result in a more accurate study.

Thank you,
Judy Lietzau

JUDY LIETZAU
PO BOX 2195

Sept. 28, 1994

Jim Ayers, Director
EVOS Trustee Council
645 G St., Ste. #402
Anchorage AK 99501

Dear Mr. Ayers,

I would like to express my support for funding North Gulf Oceanic Society's proposal for Killer Whale Research, Project 94014, in PWS.

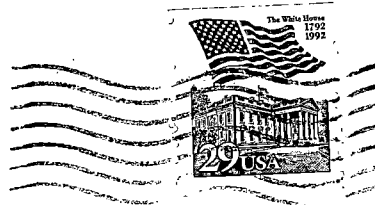
Mr. Matkin has spent years studying both transient & resident orca pods and is highly skilled in his field. To have a person of his expertise conduct this study is not only more cost effective than the Marine Mammal Lab's proposal, but will probably result in a more accurate study.

Thank you,
Judy Lietzau

JUDY LIETZAU
PO BOX 2195
CORDOVA AK 99574

Copper Delta Aero Service
Larry Lichrau, Owner
P.O. Box 2195
Cordova, AK 99574-2195

CORDOVA AK
SEP 28
99574



Jim Ayers, Director
EVOS Trustee Council
645 G St., Ste. #402
Anchorage AK 99501

Sept 28, 1994

Dear Truskee Council

Please support proposal 95013 Killer Whale Monitoring in Prince William Sound. This research would be conducted by Alaskan scientists who have studied the killer whales of PWS for over 14 years. It has a broader scale than the NMML proposal which would only look at AB pod and it will cost $28,000 less than the NMML project.

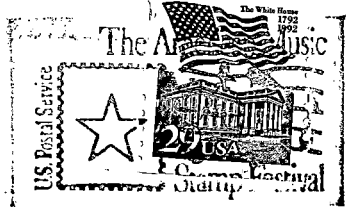
I would also like to re-enforce my strong desire (and most of the residents and users of the spill impacted areas) that the majority of settlement monies be used to acquire habitat in order to protect the marine environment of PWS and other spill impacted areas. Future generations of residents and users of the area will benifit most from habitat protection.

Sincerely

William Dunne

William Dunne
PO Box 15043
Fritz Creek AK 99603

Dunne
99603-6043



Jim Ayers, Director
EVOS Trustee Council
645 G St., Suite 402
Anchorage AK 99501

Vancouver Aquarium

Canada's Pacific National Aquarium, in Stanley Park, is a self-supporting, non-profit association dedicated to effecting the conservation of aquatic life through display and interpretation, education, research and direct action.

September 26, 1994

Mr. Jim Ayers
Director
EVOS Trustee Council
645 G Street, Suite 402
Anchorage, AK 99501

Dear Mr. Ayers,

I am writing regarding two project proposals concerning killer whales in Prince William Sound that have been submitted by the North Gulf Oceanic Society for consideration by the Trustee Council. These proposals are Project 95013 (Killer whale monitoring in PWS) and Project 94014 (Predation by killer whales in PWS).

In my opinion, these two proposed projects are of high merit and worthy of support. I am familiar with the nature of the research proposed, having undertaken similar field studies in British Columbia over the past 15 years, and am also familiar with the excellent work on killer whales that has been conducted by Craig Matkin and his group since the early 1980s. The two projects will help to identify trends in the population status of PWS killer whales, as well as provide important information on the feeding ecology of these animals.

I believe that the NGOS team is uniquely qualified to undertake these studies. They have an excellent track record of completing previous field research in the area, despite the rather challenging logistical problems that often arise in this remote region. The products of their research consistently rank among the best in field. Also, they have always been very free in sharing their data and ideas with others in the killer whale research community, which has helped to promote the understanding of the species and its conservation generally.

Thank you for allowing me to pass on my recommendations of these project proposals.

Yours sincerely,

John K.B. Ford, Ph.D.
Marine Mammal Scientist

and

Adjunct Professor, Department of Zoology and Fisheries Centre, University of British Columbia

Ford
Vancouver Aquarium
Canada's Pacific National Aquarium, in Stanley Park,
PO Box 3232, Vancouver, British Columbia, Canada V6B 3X8

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Mr. Jim Ayers
Director
EVOS Trustee Council
645 G St., Suite 402
Anchorage, AK 99501
— USA —

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TRUSTEE COUNCIL

Prince William Sound Conservation Alliance

P.O. Box 1697
Valdez, AK 99686
(907) 835-2799
Fax (907) 835-5395

P.O. Box 1185
Cordova, AK 99686
Phone & Fax
(907) 424-7466

September 28, 1994

Jim Ayers, Director
EVOS Trustee Council
645 G Street, Suite 402
Anchorage, AK 99501

Dear Jim,

The Prince William Sound Conservation Alliance would like to support Killer Whale research proposals submitted by private research groups. Specifically we would like to support proposal 95013, Killer Whale Monitoring in Prince William Sound. The Alaskans who will be conducting research under this proposal are professional scientists who have studied Killer Whales of Prince William Sound for over 14 years! This proposal will document all Killer Whales that use the Sound, not just one pod (which is what the National Marine Mammal Laboratory proposes limiting their study to).

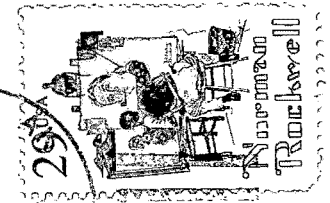
We would also like to support Project 94014, Predation by Killer Whales in Prince William Sound which is a more comprehensive study of the role of Killer Whales in the ecosystem proposed by the North Gulf Oceanic Society in conjunction with the Prince William Sound Science Center.

Thank you for your consideration of these valuable proposals.

Sincerely,

Bonnie S. Schwahn
Office Manager

Prince William Sound
Conservation Alliance
P.O. Box 1697
Valdez, AK 99686-1697



Jim Ayers, Director
EVOS Trustee Council
645 G. Street, Suite 402
Anchoarage, AK 99501

99501-3451 91

Jim Ayers, Director
EVOS Trustee Council
645 G Street, Suite 402
Anchorage, Alaska 99501

September 29, 1994

Dear Mr. Ayers,

I would like to voice my support for two research proposals which are before you now. I refer to Proposals 95013 - **Killer Whale Monitoring in Prince William Sound**, and 94014 - **Predation by Killer Whales in Prince William Sound.**

I was previously employed by the Prince William Sound Regional Citizens' Advisory Council as their environmental monitoring coordinator. It was my job to evaluate a multitude of research proposals and monitoring schemes. In my work with RCAC, as well as from my own personal experience in the Sound (I lived and fished in the Sound for 12 years), I can recommend the North Gulf Oceanic Society and Craig Matkin unreservedly. They have proven themselves scientists of the highest quality and have added a wealth of information to killer whale knowledge. The Prince William Sound Science Center also has top caliber scientists and are initiating some good solid research in the Sound.

I would ask that you support these two proposals. Proposal 95013 has a broader scope than the competing National Marine Mammal Laboratory proposal, and the latter is more expensive. A cooperative venture between the North Gulf Oceanic Society and the PWS Science Center would undoubtedly be productive and would lend support to two very good organizations. Thank you for your consideration.

Sincerely,

Dan Strickland

Dan Strickland
Box 9304-D
Palmer, Alaska 99645
(907) 745-1260

cc: Matkin/PWS Science Center

DAN & PAM STRICKLAND
HC 04, BOX 9304 D
PALMER AK 99645

ANCHORAGE AK 995
PM
03 OCT
1994

Jim Ayers, Director
EVOS Trustee Council
645 G Street, Suite 402
Anchorage, Alaska 99501

99501-3451 91

OCTOBER 2, 1994

Mr. Jim Ayers, Director
EVOS Trustees Council
645 G Street, Suite 402
Anchorage, Alaska 99501

Subject: Proposals 95013 and 95013, Killer Whale Monitoring in Prince William Sound

Dear Mr Ayers :

I am writing to voice my support for the proposals referenced above and submitted by the North Gulf Oceanic Society.

I believe the North Gulf Oceanic Society is uniquely qualified to conduct the studies contemplated by these proposals because of the many years they have spent studying killer whales in Prince William Sound. In addition, their proposal offers to do more for less money that the competing proposal by the National Marine Fisheries Service.

I am also persuaded that research conducted by a private sector organization with a fine reputation should be supported.

Sincerely yours,

Gary Williams
Box 608
Whittier, Alaska 99693

THE CITY OF WHITTIER
P. O. Box 608
Whittier, Alaska 99693

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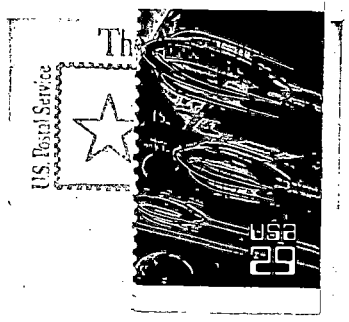
PM
03 OCT
1994



Mr. Jim Ayers, Director
EVOS Trustee Council
645 G Street, Suite 402
Anchorage AK 99501

DEAR SIM AYERS,

PLEASE SUPPORT PROPOSALS # 95013 & 95014. IT WOULD BE NICE TO HAVE QUALIFIED LOCAL PEOPLE WORKING LOCALLY. WE COULD EVEN SAVE MONEY ON THE DEAL!

THANK-YOU

MICHAEL FERANDO

53160 McNeil Canyon

Homer, AK 99603

Homer, AK 99603

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29 SEP
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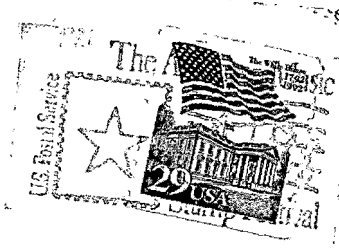

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SEP 29 1994
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TRUSTEE COUNCIL

JIM AYERS
EVOS TRUSTEE COUNCIL
645 G STREET, Suite 402
ANCHORAGE, AK
99501

White
40900 Birch Pk Dr.
Homer, AK 99603

THE POSTBOX COLLECTION

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TRUSTEE COUNCIL

Dear Jim Ayers,

Please support
Project 94014
Predation by Killer
Whales in Prince
William Sound.

Thank you,

Sincerely,
Lisa White

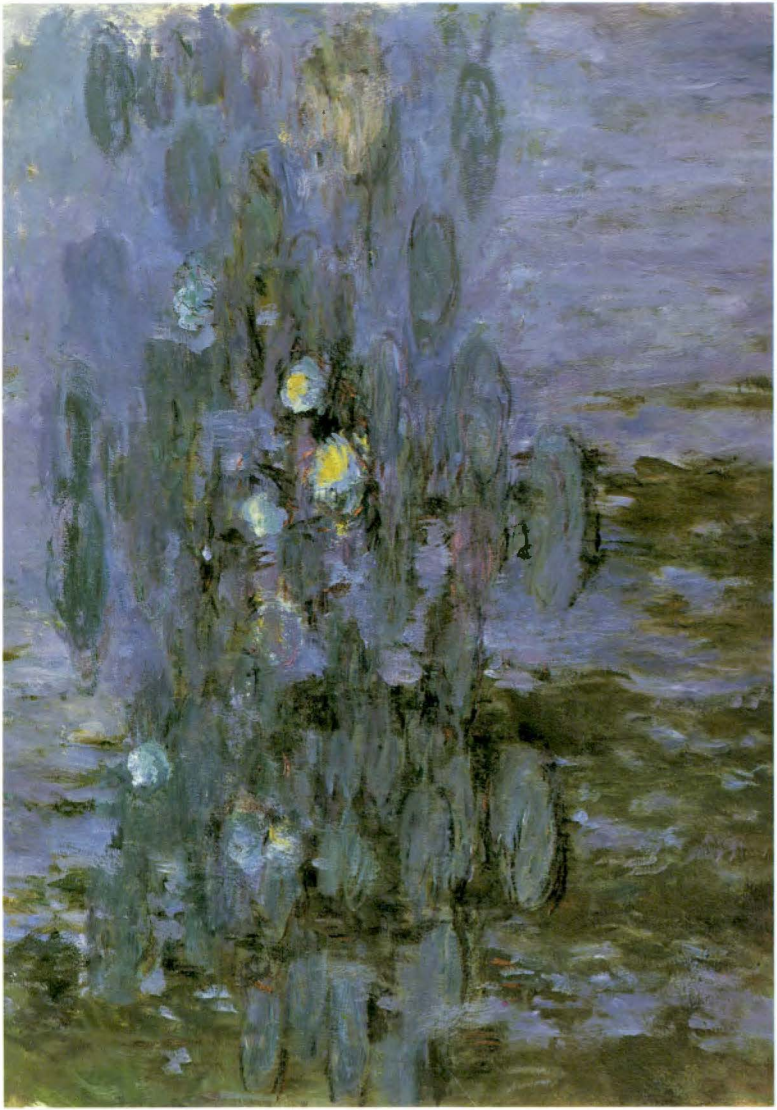
Claude Monet (1840-1926)
WATER LILIES, *c* 1915-17 (detail)
© Musée Marmottan, Paris

Jim Ayers

EVOS Trustee Council

645 G Street Suite 402

Anchorage, AK 99501



Mr. Ayers,

I would like to encourage you to support the proposals submitted to EVOS for Killer whale monitoring in Prince William Sound and the Killer whale predation study submitted to Prince William Sound Science Center by the North Gulf Oceanic Society. Independent Alaskan researchers need your support. As a humpback whale researcher in southeastern Alaska I find living near the species I study year-round gives me an insight into behaviors that others do not see when they "visit" for research purposes a few weeks or month each year. This group has a long-term research project ongoing that will dovetail perfectly with your goals. The proposals submitted by NGOS are also broader in scope and more cost effective than the "outside" proposals.

Thank you for allowing independent researchers to submit research proposals.

Jan Straley

JAN STRALEY
BOX 273
SITKA, ALASKA 99835

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99835

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SEP 26 1994
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TRUSTEE COUNCIL

Jim Ayers, Director
EVOS Trustees Council
645 G Street Suite 402
Anchorage AK 99501

Dear Jim Ayers,

Please support proposal 95013 Killer whale Monitoring in Prince William Sound.

The Alaskan researchers have studied the whales in Prince William Sound for over 14 years.

The research proposal has a broad scope and is cost efficient.

Thankyou Sincerely, Lisa White

Whip
40900 Birch Pk Dr.
Homer
AK 99603

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OCT 04 1994

SPILL

Jim Ayers
EVOS Trustee Council
645 G Street, Suite 402
Anchorage, AK 99501

To Trustee Council, 9/21/94

We strongly urge you to fund Proposal #5013 Killer Whale monitoring in Prince William Sound. We have been helping spot whales for years and reporting to Craig Matkin. Craig's proposal will document all the killer whales in the Sound and he is a professional who does cost effective studies. We believe it would be a travesty of justice to allow anyone other than Craig Matkin to do this study.

907-235-6671 Thank you, Rich & Sonja Corazza

Corazza
Box 1320
Homer, Ak.
99603

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1994

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SEP 22 1994
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TRUSTEE COUNCIL

Jim Ayers, Director
EVOS Trustee Council
645 G Street, Suite 402
Anchorage, AK. 99501

9/25/94

Dear Sirs:

I've read the proposals for Killer Whale research submitted to the Exxon Valdez Oil Spill Trustees for next year. I believe that our best interests would be served by support proposal 98013 because the researchers have much information and experience from previous. Why change researchers and loose the invaluable continuity of this project?

Sincerely,

Eric Knudtson

Knudson
PO Box 2094
Homer, AK 99603

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27 SEP
1994

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SEP 27 1994
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TRUSTEE COUNCIL

Jim Ayers
EVOS Trustee Council
645 G St, Suite 402
Anchorage, AK 99501

Sept. 25, 1994

Dear Mr. Ayers

I urge the EVOS Trustee Council to support proposal 95013, Killer Whale Monitoring in Prince William Sound. I feel it is important research and I favor this proposal over the NMML proposal since it will be conducted by local scientists who have been studying killer whales in PWS for many years, and who I feel are the most knowledgeable and qualified to be doing this work.

I also support proposal 94014, Predation by Killer whales in Prince William Sound.

Thankyou)
Liz Senear
Cordova, AK.

Seldovia
Box 7C
Seldovia Ak. 99574

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SEP 29 1994
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TRUSTEE COUNCIL

Jim Ayers
EVOS Trustees Council
645 G St Suite 402
Anchorage, Ak. 99501

Gustavus, AK 9/26/94

Dear Mr. Ayers,

I am writing to ask that you support proposals 95013 Killer Whale Monitoring in Prince William Sound and 94014 Predation by Killer Whales in Prince William Sound. The North Gulf Oceanic Society is a group of professional, well-respected scientists who have been conducting research in PWS since the early eighties. No one else knows the Sound better & has a better sense of the resources or the whales. Their proposals are broader in scope, less expensive and certain to be of greater use than projects proposed by other agencies.

Sincerely, Kristen A England

Ed Berg
Kenai NWR
PO Box x2139
Soldotna Ak 99669

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25 SEP
1994

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SEP 30 1994
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

Jim Ayers, Director
EVOS Trustee Council
645 G Street, Suite 402
Anchorage Ak 99501

10/1

Dear Mr. Ayers

I would like to support the North Gulf Oceanic Societys proposal 95013 Killer Whale Monitoring in Prince William Sound. The Societys 14 years of continuous work in the sound and the comphrehensive study of all killer whales in the Sound and their ability to do it a lower cost than the National Marine Mammal Laboratory make them the best choice for doing this work

Thank you

Dan McCauley

M. Gaulieu
Box 653
Whittier Ak
99693

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1994

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TRUSTEE COUNCIL

Jim Ayers, Director
EVOS Trustee Council
645 G. Street Suite 402
Anchorage Ak 99501

9/28/74

Dear Jim Ayers,

I am writing to support proposals 95103 and 94014 for studying killer whales in Prince William Sound.

These studies would be conducted by Alaska scientists with many years of whale research experience in the Sound. The studies would provide good baseline data about one of the key predators in this ecosystem. Such information could be very helpful for future management of marine mammals in the sound. Thank you kindly. Sincerely yours,

Ed Berg, Ecologist, Kenai Nat. Wildlife Refuge, USFWS

KIRSTEN ENGLUND
BOX 213
GUSTAVUS AK 99826

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30 SEP
1994

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OCT 03 1994
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TRUSTEE COUNCIL

JIM AYERS, DIRECTOR
EVOS TRUSTEE COUNCIL
645 G STREET, SUITE 402
ANCHORAGE AK 99501

Jim: 9-23-94

WE SUPPORT NORTH GULF OCEANIC SOCIETY'S PROPOSAL 95013 KILLER WHALE MONITORING IN PRINCE WILLIAM SOUND. They have OVER 14 years of studying ALL The ORCA'S IN The SOUND. WE ALSO SUPPORT Their PROJECT 94014 PREDATION BY KILLER WHALES IN PRINCE WILLIAM SOUND. N.G.O.S.' EXPERIENCE in The SOUND AND The RECORDS They have compiled place THEM FAR AHEAD of ANY OTHER GROUP INTERESTED IN The SOUND'S WHALES. We urge THAT N.G.O.S. PROPOSAL 95013 AND PROJECT 94014 BE GIVEN EVERY CONSIDERATION.

Thank you.

Peter & Marilynn McDOWELL

HONEY CHARTERS

HONEY CHARTERS
P.O. BOX 708
WHITTIER, AK 99693

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TRUSTEE COUNCIL

JIM AYERS, DIRECTOR
EVOS TRUSTEE COUNCIL
645 G STREET SUITE 402
ANCHORAGE, AK 99501

Nancy Lord
P.O. Box 558
Homer, Alaska 99603

9/29/94

Dear Jim and Trustees:

I'd like to lend my support to two killer whale research proposals — #95015 and #94014. I know the marine mammal research scientists involved and think highly of their experience and past work. I especially applaud the ecosystem approach of proposal #94014 since there are so many open questions about the relationships between predators and prey (including seabirds) in the Sound and Gulf of Alaska.

Sincerely, Nancy Lord

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1994

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TRUSTEE COUNCIL

Jim Ayers, Director
EVOS Trustee Council
645 G St., Suite 402
Anchorage, AK 99501

September 28, 1994

Dear Mr. Ayers,

I write to encourage the EVOS Trustee Council to approve 2 proposals involving whale research by the North Gulf Oceanic Society. Proposals 95013 and 94014 will both be conducted by scientists with long experience in the study areas, and with the pods who use those areas. They are Alaskans and work with private research groups already familiar with Prince William Sound. There is no question in my mind that experienced private research scientists can do more better and for less than either the National Marine Mammal Laboratory or the National Marine Fisheries Service. We need a broad (comprehensive) study done, as the North Gulf Oceanic Society proposes, and it is obvious that they will do a better job for a better price.

Thanks for this opportunity, and best wishes to the Trustee Council in these tough decisions!

Sincerely, Barbara Seaman (235-2986)

Seaman
P.O. Box RDO
Homer, AK 99603-8999

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1994

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SEP 30 1994
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TRUSTEE COUNCIL

Jim Ayers, Director
EVOS Trustee Council
645 G. St., Suite 402
Anchorage, AK. 99501

Dear Jim -

While I generally believe most remaining resources should be spent on land, project Proposals 95013 & 014 are particularly valuable & Orcas are ~~on~~ populations we have long time-series data that will help understand the significance of post-spill data. Also, as top predators w long life spans - these populations may supply important data on contaminants & their fate in the ecosystem & and lipid loads in the future.

Best -

Bob Childers
PO Box 203203
Anchorage AK 99520

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21 SEP
1994

Jim Agnos, Director
EVOS Trustee Council
645 G St Suite 402
Anchorage AK 99501

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NORTH GULF OCEANIC SOCIETY

P.O. BOX 15244
HOMER, ALASKA 99603
(907) 235-6590

Jim Ayers, Director
EVOS Trustee Council
645 G. Street Suite 402
Anchorage, Alaska 99501

September 29, 1994

Dear Mr Ayers,

Our group (NGOS) has submitted two proposals to the Trustee Council for consideration. We hope you will support them. These are Project 95013 Killer Whale Monitoring in Prince William Sound and Project 94014 Predation by Killer Whales in Prince William Sound: Feeding Behavior and Distribution of Predators and Prey. The two projects are complimentary and are both based on years of prior data collection.

First, I compare our killer whale monitoring project with a competitive project (Project 95092) submitted by the National Marine Mammal Laboratory (NMML).

Killer Whale Monitoring (NGOS) Project 95013	**Recovery Monitoring of Killer Whales (NMML) Project 95092**
Total Cost = $109.4K (FY95 and FY96)	**Total Cost = $137.2K** (FY95 and FY96)
Monitors AB pod, other major resident pods, and AT transient group	Monitors only AB pod
Examines changes in AB pod in comparison with other resident pods	Examines only AB pod
Provides computerized readout of each individual whale in each frame of exposed film (supplied with final report)	Provides no computerized database.
Final whale identifications by same biologist for past ten years. Accuracy has been demonstrated by rigorous cross checking by NMFS	Identification preformed by less experienced, untested personnel.
Continuation of long-term population studies started prior to the EVOS	Replaces NGOS project that existed prior to the EVOS

CI

Our monitoring program is cost effective and will provide a more detailed picture of the killer whale population. It is part of a pre- EVOS research program and will be analyzed with the benefit of uninterupted annual data from the past 11 years.

When Project 95013 and 95014 (Predation by Killer Whales) are coupled, the projects become an in depth examination of the killer whales' role in the Prince William Sound ecosystem. Project 95014 will provide hard data as well as models and projections that address such questions as how many whales eat how much of what prey and what is the impact this might have on the system. This is a strong first step in linking the chain of effects that may be responsible for some of the changes we have seen since the EVOS. In addition, the combination of the two projects will result in substantial cost savings (An FY95 savings of about 23K).

The long-term data base that exists on killer whale numbers, distribution, and feeding habits in Prince William Sound places us in a unique position. By incorporating the latest acoustic and genetic techniques, we can begin to construct an ecological profile for a difficult to study top marine predator.

Please support Projects 95013 and 95014. They are cost effective projects that will return a large amount of information for the dollars spent in study of a species and system damaged by the spill. Thank you for providing the opportunity for a non-agency group to submit research proposals to the Trustee Council.

Sincerely,

Craig O. Matkin, Director

NORTH GULF OCEANIC SOCIETY
P.O. BOX 15244
HOMER, ALASKA 99603

Jim Ayers, Director
EVOS Trustee Council
645 G Street
Suite 402
Anchorage, Alaska 99501

NORTH PACIFIC PROCESSORS, INC.

☐ HOME OFFICE: 2300 EASTLAKE AVE. EAST • SEATTLE, WASHINGTON 98102 • (206) 726-0000
P.O. BOX 31170 • SEATTLE, WASHINGTON 98103-1179
☒ PROCESSING PLANT, BOX 1040 • CORDOVA, ALASKA 99574 • (907) 424-7111

3 October 1994

Exxon Valdez Oil Spill Trustee Council
fax 276-7178

Attn.: Draft Fiscal Year 1995 Work Plan

North Pacific Processors, Inc. supports both project 95024 and 95093 and supports raising 95093 to category 1 as soon as possible.

Prince William Sound has been suffering from reduced wild stock returns as a result of the spill and now is the time to rebuild these runs.

Thank you in advance.

Ken Roemhildt, Supt.

Ken Roemhildt
Superintendent, North Pacific Processors, Inc.

Processors of Quality Alaska Seafoods

October 3, 1994

To The EVOS Trustees Council:

I am writing to support the integrated proposals, numbers 95093 and 95024, which address the restoration of Prince William Sound natural salmon stocks.

I have been an active member of the SEA Committee from its start, and have contributed a great number of hours working on and listening to proposals from all corners. Last fall, I attended the workshop held in Cordova, which addressed the scientific aspects of ecologic and economic restoration in Prince William Sound. As a member of the Prince William Sound Aquaculture (PWSAC) executive board, I have hoped that PWSAC could also contribute to a solid program for restoring the Sound after the 1989 oil spill.

The teamwork of PWSAC, the Native Village of Eyak Tribal Council, and the University of Alaska, as proposed in 95093 and 95024, could play a major role in successfully restoring the Sound's damaged fish stocks. Each player can contribute from its area of expertise: native Alaskans have the manpower and marine vessels, the University possesses the scientific experience, and PWSAC commands the skill for raising fish.

If just a few streams in the Sound could match the success PWSAC has had with its releases of coho salmon in Cordova and Whittier, all user groups of this area would benefit. PWSAC can use its expertise in nurturing fish stocks in combination with the talents of the other two groups to reestablish marine life that left Prince William Sound after the oil spill of 1989.

It's time for a project in the Sound that produces tangible, measurable results, one directed by a team committed to the area's ecological and economic health. We have had enough of the deadlocks caused by uninvolved parties who try to take control of our area's projects for their own economic benefit. Sport fishermen, subsistence fishers, native communities and commercial fishermen alike are tired of arguing and want to see some immediate, constructive action in Prince William Sound.

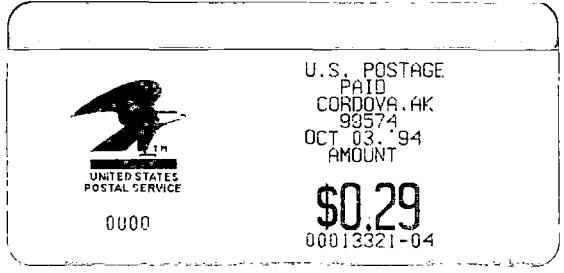
I am aware of the legal issues that surrounded PWSAC's proposal in fiscal 1994. However, if you want to convince me that this year's proposal 95093 falls into the same category, I suggest coming to Cordova with a ton of paper, a barrel of ink, and your lunch. I believe this proposal is critical for progress in restoring wild salmon stocks in Prince William Sound.

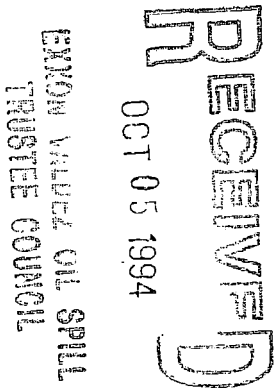
Sincerely,

Bud Perrine

Bud Perrine

Bud Perrine
P.O. Box 1141
Cordova, AK 99574





Exxon Valdez Oil Spill Trustee Council
645 G. Street
Anchorage, AK 99501

Attn: Draft Fiscal Year 1995 Work Plan

Silver Lining Seafoods
Cordova Plant
545 Railroad Ave.
P.O. Box 260
Cordova, Alaska 99574

Ph: (907) 424-5390 Fax: (907) 424-5395

September 29, 1994

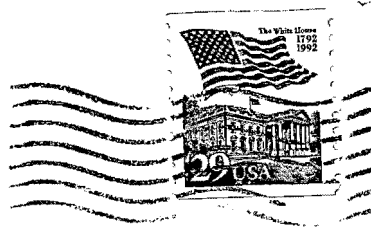
I William S. Gilbert as Plant Manager of Silver Lining Seafoods Cordova a division of Norquest Seafoods fully endorse and support the Prince William Sound natural Wild Stock restoration projects as outlined in the proposals #95093 and #95024.

These proposals when interegated and developed will assess and go a long way to rehabilitate the natural wild stocks in Prince William Sound which have suffered due to the EVOS. This is very important to the viability of the Prince William Sound region and will provide long term benefit to all the people and communities of Prince William Sound.

Sincerely,

William S. Gilbert
Plant Manager
Silver Lining Cordova

Silver Lining Seafoods
A Division of NorQuest Seafoods, Inc.
P.O. Box 260 • Cordova, AK 99574



Exxon Valdez Oil Spill Trustee Council
645 G. Street
Anchorage Alaska
99501

Attn: Draft Fiscal year 1995 Work Plan

September 30, 1994

Exxon Valdez Oil Spill Trustee Council
645 G Street
Anchorage, AK 99501

Re: Draft Fiscal Year 1995 Work Plan

Members of the EVOS Trustee Council:

I am writing in support of funding Proposal #95093 and #95024 concerning Prince William Sound (PWS) Natural Stock Salmon Resources and Enhancement of Wild Pink Salmon Stocks.

Prince William Sound Aquaculture Corporation has proposed restoration of salmon resources through a program of professional agency and local resident collaboration, integration of research, restoration and monitoring objectives. The integrated proposal involves a collaboration with University of Alaska Fairbanks School of Fisheries and Ocean Sciences, the Native Village of Eyak, and others.

It is time to begin active restoration of the salmon resources of the oil impacted areas which will provide knowledge and a sustainable resource for all the people and communities of PWS.

The Prince William Sound Aquaculture Corporation has the expertise in hatchery rearing and salmon management to successfully complete the proposed program. Please reclassify this project from Category 4 to Category 1 and vote to approve the program for funding.

Sincerely,

Ed Zeine

Ed Zeine
Chairman, Cordova Sporting Club

September 30, 1994

Exxon Valdez Oil Spill Trustee Council
645 G Street
Anchorage, AK 99501

Re: Draft Fiscal Year 1995 Work Plan

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Sincerely,

Ed Zeine

Ed Zeine
Chairman, Cordova Sporting Club

PRINCE WILLIAM SOUND
AQUACULTURE CORPORATION

POST OFFICE BOX 1110
CORDOVA, AK 99574-1110

CORDOVA ALASKA OCT -3'94 P.B.METER 2770669 U.S.POSTAGE .29

EVOS Trustee Council
645 G Street
Anchorage AK 99501

attn:
Draft FY95
Work Plan

October 1, 1994

TO: Members of Exxon Valdez Oil Spill Trustee Council

ATTN: Draft Fiscal Year 1995 Work Plan

VIA FAX: 276-7178

I am writing in support of EVOS Trustee Council funding for:
PROPOSAL # 95093, Restoration of PWS Natural Stock Salmon Resources and Services and
PROPOSAL # 95024, Enhancement of Wild Pink Salmon Stocks.

The Trustee Council has been supportive towards research funding for study of the PWS ecosystem and habitat protection and acquisition. So far there has been no funding for actual restoration of stocks damaged by the oil spill. Isn't funding such activities an important function of the Trustee Council? Proposal # 95093 is presently classed as Category 4 due to "legal issues" regarding the proposed use of settlement funds to support activities related to hatcheries. The important thing is to get restoration programs on line. Letting anti-hatchery sentiment derail # 95093 from Category 1 to Category 4 classification is foolish. We should be using all the tools available to us in restoration efforts. There is a lot of expertise available in the PWSAC hatchery system which should be taken advantage of. Reclassifing # 95093 to Category 1 status would the correct move to make.

Sincerely,

Emil D Nelson

Emil "Beaver" Nelson
F/V NUKA POINT
Box 130, Homer, AK 99603

Exxon Valdez Oil Spill 10/3/94
Trustee Council
645 G Street
Anchorage, Ak 99574

Re: Draft fiscal year 1995 Work Plan

Members of the EVOS Trustee Council

This letter is to state my support and to enlist yours for the Proposal Number 95093, Restoration of PWS Natural Stock Salmon Resources and Services, and Proposal Number 95024 in the Draft 1995 Work Plan.

These proposals are the best I've seen. They address what are among the worst of the observable consequences of the oil spill. They use the best available means to directly repair the damages. They can add substantially to the body of knowledge of impacts of oil spills on ecosystems, and of our practical ability to reverse these.

To me however, most import is that they are the best medicine for the effected fishing industry of P.W.S. and its dependant communities. Please give this proposal your fullest support. Thank You

Sincerely, Stuart L. Deal

Ocean Beauty Seafoods, Inc.

ST. ELIAS DIVISION

P.O. BOX 548 • CORDOVA, ALASKA 99574 • (907) 424-7171 • FAX (907) 424-5514
P.O. BOX 70739 • SEATTLE, WASHINGTON 98107 • (206) 285-6800 • FAX (206) 281-0820

September 30, 1994

Exxon Valdez Oil Spill Trustee Council
645 G Street
Anchorage, AK 99501

Re: Draft Fiscal Year 1995 Work Plan

Members of the EVOS Trustee Council:

I am writing in support of EVOS Trustee Council funding for **Proposal Number 95093, Restoration of PWS Natural Stock Salmon Resources and Services, and Proposal Number 95024,** in the Draft 1995 Work Plan.

Prince William Sound salmon fisheries are distressed. During the ten years prior to 1989, the average annual return of all salmon to the PWS management region was 22 million fish. Total natural and hatchery salmon returns dwindled to 10.5 million in 1992 and 7.0 million in 1993, then rebounded in 1994, in response to ecosystem changes that are now being investigated. The damaged salmon resources and the lost services provided by those resources have heavily impacted all user groups.

While the extent of short- and long-term damage to the Prince William Sound region depends on these natural salmon resources.

Please help the resources and the people of Prince William Sound recover. Thank you.

Sincerely,

OCEAN BEAUTY SEAFOODS- ST ELIAS DIVISION

Hap Symmonds

Hap Symmonds
Plant Manager

Katherine G Halgren
167 NW 73rd street
Seattle, WA. 98117-4850
October 3, 1994

Exxon Valdez Oil Spill Trustee Council
645 G Street
Anchorage, AK. 99501

RE: Comments Draft 1995 Work Plan

Members of the EVOS Trustee Council:

I applaud your approval September 1993 of Project 94320 for planning an Ecosystem Study in Prince William Sound. I hope you will continue your support by approving Proposal 95093, Restoration of PWS Natural Stock Salmon Resources and Services; and Proposal 95024, Enhancement of Wild Pink Salmon Stocks, in the Draft 1995 Work Plan.

Both wild and hatchery stocks have been recognized by the EVOS Trustee Council as injured and not recovering, and have been supportive through their funding of research towards understanding oil spill impacts to the resources, and the entire PWS/Gulf of Alaska ecosystem. I hope you will continue with significant restorative actions to aid the recovery process of the Sound's salmon.

The distressed fisheries have had an impact that reaches much further than one would imagine. The effects are felt by the fishermen, Commercial as well as Sport, Subsistence, and Personal Use. The communities, from the people who process the fish; to the suppliers of services, gear, and groceries; to the citizens whose cities have lost seafood processing companies due to bankruptcy; residents due to lack of employment opportunities; and revenues due to the dramatic drop in raw fish tax.

One hope the people have is that salmon enhancement will be able to restore and replace the lost resources. The proposed restoration program will provide not only knowledge and teams of developed local expertise in salmon restoration and conservation, but will also provide for a sustainable service for the people and communities of PWS. The program involves a collaboration with U of A Fairbanks School of Fisheries and Ocean Sciences, local residents, and the Native Village of Eyak, through their integrated proposal.

Please continue to support any proposed research to help better understand the salmon and the ecosystem of Prince William Sound, such as mass marking all hatchery salmon.

The most cost effective way to address residual oil is to leave it on the beaches. I believe its removal to encompasses more than Subsistence and Recreation Resources. I believe residual oil effects the birds both migrating and local, the terrestrial mammals, and marine life whenever there is a wind and tide similar to the one that originally put the oil on the beach. I would like the trustees to encourage future proposals that would remove or reduce residual oil when the technology becomes available.

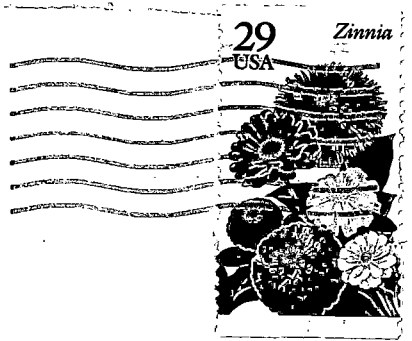
Thank You

Katherine G Halgren

Katherine G Halgren

98117-4850

AT SEATTLE WA 981
PM
3 OCT
1994



EVOS Trustee Council
645 G Street
Anchorage, AK. 99501

Katherine G Halgren
167 NW 73rd street
Seattle, WA. 98117-4850
October 3, 1994

Exxon Valdez Oil Spill Trustee Council
645 G Street
Anchorage, AK. 99501

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Thank You

Katherine G Halgren

Katherine G Halgren

9-30-94

BOX 1855
CORDOVA, AK. 99574

FAX # 276-7178

TO: EXXON VALDEZ TRUSTEE COUNCIL MEMBERS:

I URGE YOUR SUPPORT FOR PRINCE WM. SOUND PINK SALMON PROPOSALS #95093 AND 95024.

THE E.V.O.S. HAD AN INDISPUTABLE NEGATIVE EFFECT UPON P.W.S. PINK SALMON.

I AM GRATEFUL TO THE TRUSTEE COUNCIL FOR SUPPORTING THE RESEARCH COMPRISING THE S.E.A. PROJECT. HOWEVER, THESE PROPOSED PROJECTS GO BEYOND THE SCOPE OF THE SEA AND WOULD ATTEMPT TO ACTUALLY AID THE RESTORATION OF DAMAGED STOCKS. PLEASE BE AWARE THAT FUNDING FOR THESE PROJECTS WILL NOT BE USED BY THE HATCHERY TO CONDUCT NORMAL OPERATIONS. THE FOCUS IS CLEARLY UPON RESTORATION OF STOCKS FROM NATURAL STREAMS.

THESE ARE WHOLLY DEFENSIBLE AND NEEDED ADDITIONAL PROJECTS TO AID THE RECOVERY OF THE DAMAGED P.W.S. ECOSYSTEM.

SINCERELY,
Kenneth Adams

RESOLUTION

WHEREAS, stocks of salmon in Prince William Sound are recognized as having been injured by the Exxon Valdez oil spill, and are designated by the Exxon Valdez Oil Spill (EVOS) Trustee Council as "not recovering"; and,

WHEREAS, the fishermen and communities in Prince William Sound have been seriously impacted by the damaged natural salmon resources; and, WHEREAS, Cordova District Fishermen United (CDFU), the regional fishermen's organization, has encouraged regional organizations and expertise to develop programs to restore and monitor damaged natural salmon stocks; and,

WHEREAS, Prince William Sound Aquaculture Corporation, the Native Village of Eyak Tribal Council and the University of Alaska Fairbanks, School of Fisheries and Ocean Sciences have submitted collaborative proposals to the EVOS Trustee Council to restore natural salmon stocks in Prince William Sound through research and restoration activities using local residents, vessels and facilities; and

WHEREAS, the proposed restoration objectives are consistent with the Draft EVOS Restoration Plan and the Draft Environmental Impact Statement for the EVOS Restoration Plan; THEREFORE,

BE IT RESOLVED that the Board of Directors of the Cordova District Fishermen United support the following collaborative proposals, and request the EVOS Trustee Council to fund the research, restoration and monitoring activities as proposed therein:

PROPOSAL #95093: RESTORATION OF PWS NATURAL STOCK SALMON RESOURCES AND SERVICES: AN INTEGRATED APPROACH. Prince William Sound Aquaculture Corp.

PROPOSAL #95024: ENHANCEMENT OF WILD PINK SALMON STOCKS. Native Village of Eyak Tribal Council.

Donald McCune — 9-28-94

President, Cordova District Fishermen United

Signature — Date

Cordova District Fishermen United
P.O. Box 939
Cordova, Alaska 99574

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RECEIVED
SEP 30 1994
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

Exxon Valdez Oil Spill Trustee Council
645 G Street
Anchorage, AK 99501

Attn: Draft Fiscal Year 1995 Work Plan

October 27, 1994

EVOS Trustee Council
645 G Street
Anchorage, AK 99501

Dear Council Member,

Prince William Sound Aquaculture Corporation, the Native Village of Eyak Tribal Council, and the University of Alaska School of Fisheries and Ocean Sciences propose a collaborative and integrated program (Project # 95093-A, -B, -C) to restore natural spawning salmon stocks and services injured as a result of the oil spill.

Recent communications with agency representatives associated with the *EVOS* Trustee Council and staff at the *EVOS* office lead us to anticipate a recommendation will be placed before you to fund planning and permitting aspects of proposal 95093. In light of this information, the PWSAC Executive Committee of the Board approved the attached resolution which was forwarded to Executive Director Jim Ayers along with the October 25 cover letter to Mr. Ayers.

Two elements require focus:

1. PWSAC and collaborating partners support the recommendation concept to fund project planning and permitting;
2. PWSAC and collaborating parties condition their support on the *EVOS* Trustee Council revisiting for funding, in late winter or early spring, the projects as detailed and permitted so that field work on feasible project components can begin in 1995.

The recommendation as it has been currently presented is to allocate $100,000 for planning and permitting. We believe this is unrealistic considering **NEPA** complexity and costs. PWSAC projected $25,000 for each Environmental Assessment (EA). We project 8 EAs may be required for a total of $200,000. This is only our best estimate in that we have not been informed by parties of authority as to how many EAs will be required to permit the proposed work. A more realistic figure for planning and permitting is $250,000 to $300,000. A detailed budget for planning and permitting will be presented at the November 2 Trustee Council meeting.

I hope you will consider the actual planning and permitting requirements and not just approve a sum which appears to have been arbitrarily suggested and without input from the project proposers. This is very important.

Sincerely,

Dan Hull
Chairman

Corporate Office • Post Office Box 1110 • Cordova, Alaska 99574-1110
phone: 907/424-7511 * fax: 907/424-7514

Oct. 27,1994

To: Dr. Robert Spies, Chief Scientist,Exxon Valdez Oil Spill Trustee Council
From: Stephen C. Riedel

I have read your letter to Howard Ferren dated Oct. 22 and agree with the need for adequate funding for the planning and permitting process. What I can not accept is for PWSAC, The Village of Eyak, the University of Alaska, and involved Government agencies to work out an agreement on what can be done, how to do it, and to begin the permitting process only to find there are no funds available to start actual work until 1996. It will require a lot of work to come to a concensus on this project and all aspects may not be agreed upon by next spring. The parts of this project that can be agreed upon and have the necessary permits in place by spring meed to be funded for actual work in the summer of 1995.

If after the Nov. 1994 Trusteed Council meeting there is no mechanism in place to re-visit this project after the planning and permitting phase is completed, actual work in the field will not begin until the summer of 1996, over 7 years after the spill.

The Natives and Fishermen who make their entire living off the resources of Prince William Sound have waited long enough. It is the responsibility of the E.V.O.S. Trustee Council and involved Government Agencies to find solutions. Research, planning, and studies are not enough. We need restoration to begin now.

Stephen C. Riedel

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To Dr. Robert Spies	From Steve Riedel
Co. EVOS Trustee Council	Co.
Dept.	Phone # 424-3241
Fax # 276-7178	Fax #

October 25, 1994

Jim Ayers, Executive Director
EVOS Trustee Council
645 G Street
Anchorage, AK 99501

Mr. Ayers,

I am led to believe that a recommendation may be forth coming from you to the Trustee Council to fund planning and permitting for project #95093, subprojects -A, -B and -C. Discussions with Molly McCammon, Craig Tillary and James Brady, as well as a recent letter from Dr. Bob Spies, have underscored this possibility and the level of funding to be recommended.

This recommendation and subsequent planning/permitting funding in support of project #95093 will be a positive notification from the Trustee Council of intent to take a more active position in restoration of injured salmon resources and damaged services.

In support for this recommendation, the PWSAC Executive Committee provide the attached resolution. It is important to recognize the collaborative nature of the proposal, the conceptualized activities which are to be addressed, the fact that little actual direct restoration has taken place, and that planning and permitting can be accomplished before the 1995 field season. Therefore, it is vital that in adopting a recommendation for planning and permitting funding, that the Trustee Council decide to revisit #95093 in late winter/spring 1995, to make final funding decisions on work to be undertaken next summer.

With these thoughts in mind, I will look forward to a productive *EVOS* Trustee Council meeting November 2-3.

Sincerely,

Bud Perrine

Bud Perrine
Vice Chairman

cc Dr. Robert Spies

Corporate Office • Post Office Box 1110 • Cordova, Alaska 99574-1110
phone: 907/424-7511 * fax: 907/424-7514

Resolution 94-7EC

PRINCE WILLIAM SOUND AQUACULTURE CORPORATION

Position on EVOS Proposal #95093 Including Subprojects -A, -B, -C.

WHEREAS, PWSAC supports natural spawning stock salmon restoration and has proposed to the EVOS Trustee Council a collaborative proposal to restore natural spawning stock salmon in both oil damaged streams and streams important to subsistence users, and implement actions to reduce harvest pressure on injured stocks; and

WHEREAS, salmon stocks have been recognized as injured and services from those resources lost or damaged; and

WHEREAS, since 1989 little action has been taken to implement projects designed to directly restore these resources and services; and

WHEREAS, PWSAC has continued to respond to legal and scientific concerns in its proposal revisions; and

WHEREAS, PWSAC and project collaborators have full intention to implement project #95093 including subprojects A, B and C during the field season beginning May, 1995; and

WHEREAS, PWSAC believes the collaborative parties can complete all necessary planning and permitting prior to the 1995 field season, now

THEREFORE BE IT RESOLVED, that PWSAC supports the EVOS Trustee Council Executive Director and Chief Scientist recommendation to fund project #95093 planning and permitting, with the condition that the EVOS Trustee Council revisit the proposed projects prior to the field season and provide its decision on funding for FYY-95 at that time.

CERTIFICATION

I HEREBY CERTIFY, that I am the duly elected, qualified and acting Vice Chairman of the Prince William Sound Aquaculture Corporation, an Alaska corporation; that the foregoing is a full, true and correct copy of a resolution duly and legally adopted at a regular meeting of the Board of Directors Executive Committee on October 24, 1994 at which a quorum was present, and that such resolution is now in full force and effect and duly recorded in the minutes of the Board of Directors.

IN WITNESS WHEREOF, I have hereunto subscribed my name and affixed the seal of the Corporation this 25TH of October 1994.

Bud Fennimore
Vice Chairman

Corporate Office • Post Office Box 1110 • Cordova, Alaska 99574-1110
phone: 907/424-7511 * fax: 907/424-7514

September 30, 1994

Exxon Valdez Oil Spill Trustee Council
645 G Street
Anchorage, AK 99501

Re: Draft Fiscal Year 1995 Work Plan

Members of the EVOS Trustee Council:

The Board of Directors of the Prince William Sound Aquaculture Corporation unanimously approved the attached Resolution 94-3 GB at its fall meeting September 18, 1994. The resolution expresses the support of the members of the Board for the restoration of natural salmon resources in Prince William Sound through a program of professional agency and local resident collaboration.

Following the Exxon Valdez oil spill, salmon stocks in Prince William Sound have been recognized by the EVOS Trustee Council as injured and not recovering. The Trustee Council has been supportive through their funding of research towards understanding oil spill impacts to the resources, and the entire PWS-Gulf of Alaska ecosystem.

It is now time to take significant restorative actions to aid the recovery process of the Sound's salmon resources. The collaborative proposals supported by the attached resolution outline a multidisciplinary program for investigating salmon resources, enumerating stocks, and assessing stock condition and genetic identity. The program intends to take restorative action using methods among those described in the EVOS Restoration Plan Draft Environmental Impact Statement: hatchery rearing of wild stock eggs, netpen rearing of wild stocks, and relocation of hatchery runs.

We ask for your support of this collaborative program involving the University of Alaska Fairbanks School of Fisheries and Ocean Sciences, the Native Village of Eyak and local residents, in cooperation with PWSAC.

Best regards,

Bob Roys

Bob Roys
Interim President

(Hom)

Corporate Office • Post Office Box 1110 • Cordova, Alaska 99574-1110
phone: 907/424-7511 * fax: 907/424-7514

PRINCE WILLIAM SOUND AQUACULTURE CORPORATION

RESOLUTION 94-3 GB

1994 REVISED EVOS PROPOSAL

WHEREAS, stocks of salmon in Prince William Sound are recognized as injured by the *Exxon Valdez* oil spill in addition to the many stocks in PWS which are depressed and not recovering; and,

WHEREAS, Eyak Tribal Council, University of Alaska, and PWSAC propose to the *EVOS* Trustee Council to restore salmon stocks in PWS through research and restoration activities using local resource users, vessels and facilities through an integrated and coordinated collaboration program; and

WHEREAS, the proposed restoration objectives and strategies are consistent with the Draft *EVOS* Restoration Plan and Draft Environmental Impact Statement for the *Exxon Valdez* Oil Spill Restoration Plan; therefore,

BE IT RESOLVED: that the PWSAC Board of Directors supports the PWSAC salmon stock restoration proposal before the EVOS Trustee Council and encourages active public support for Trustee Council funding the research and restoration activities as proposed.

CERTIFICATION

I HEREBY CERTIFY, that I am the duly elected, qualified and acting Secretary of the Prince William Sound Aquaculture Corporation, an Alaska corporation; that the foregoing is a full, true and correct copy of a resolution duly and legally adopted at a regular meeting of the Board of Directors on Sept 18, 1994 at which a quorum was present, and that such resolution is now in full force and effect and duly recorded in the minutes of said Board of Directors.

IN WITNESS WHEREOF, I have hereunto subscribed my name and affixed the seal of the Corporation this 22 day of Sept., 1994.

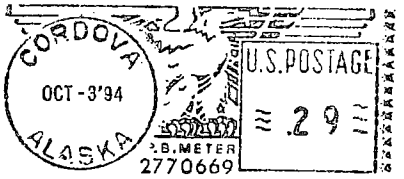
Edward Jeanie

Secretary

Corporate Office • Post Office Box 1110 • Cordova, Alaska 99574-1110
phone: 907/424-7511 * fax: 907/424-7514

PRINCE WILLIAM SOUND
AQUACULTURE CORPORATION

POST OFFICE BOX 1110
CORDOVA, AK 99574-1110



Exxon Valdez Oil Spill Trustee Council
645 G Street
Anchorage, AK 99501

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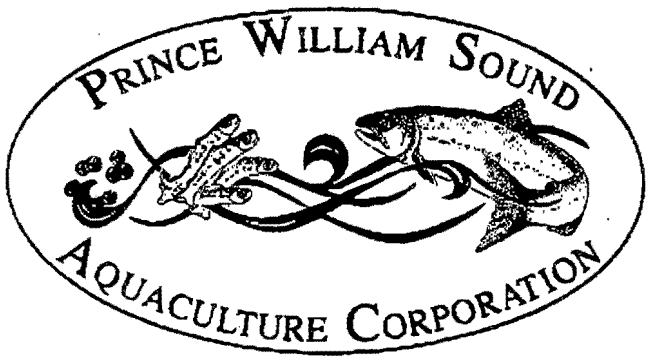

September 30, 1994

Exxon Valdez Oil Spill Trustee Council
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Best regards,

Bob Roys

Bob Roys
Interim President

(Hon.)

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phone: 907/424-7511 * fax: 907/424-7514

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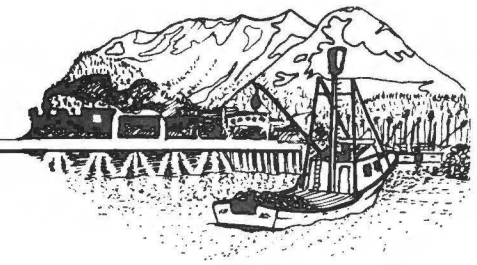
IN WITNESS WHEREOF, I have hereunto subscribed my name and affixed the seal of the Corporation this 22 day of Sept., 1994.

Secretary

Corporate Office • Post Office Box 1110 • Cordova, Alaska 99574-1110
phone: 907/424-7511 * fax: 907/424-7514

CITY OF CORDOVA



October 5, 1994

Exxon Valdez Oil Spill Trustee Council
645 G. Street
Anchorage, Alaska 99501

Attn: Draft Fiscal Year 1995 Work Plan
FAX: 276 7178

Re: Draft Fiscal Year 1995 Work Plan

Members of the EVOS Trustee Council:

Attached please find the City of Cordova's Resolution 10-94-55 which was approved by the City Council at their regular meeting held October 5, 1994. The Resolution supports the Proposal #95093, Restoration of PWS Natural Stock Salmon Resources and Services, and Proposal #95024, in the Draft 1995 Work Plan.

Prince William Sound salmon fisheries are distressed. During the ten years prior to 1989, the average annual return of all salmon to the PWS management region was 22 million fish. Total natural and hatchery salmon returns dwindled to 10.5 million in 1992 and 7 million in 1993, then rebounded in 1994, in response to ecosystem changes that are now being investigated. The damaged salmon resources and the lost services provided by those resources have heavily impacted all user groups.

While the extend of short- and long-term damage to the PWS ecosystem is still being assessed, it is more important than ever to the people of the Sound that these lost resources and services be restored and replaced through funding and implementation of these integrated proposals. The economic viability of the entire Prince William Sound region depends on these natural salmon resources. Please help the resources and the people of Prince William Sound recover. Thank you.

Sincerely,

W. S. Janke

Scott Janke
City Manager

Enclosure

original & copy already received?

602 Railroad Avenue P.O. Box 1210 Cordova, Alaska 99574 Telephone (907) 424-6200 Fax (907) 424-6000

CITY OF CORDOVA, ALASKA

RESOLUTION 10-94-55

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF CORDOVA, ALASKA SUPPORTING THE PRINCE WILLIAM SOUND AQUACULTURE CORPORATION (PWSAC) PROPOSAL #95093 AND THE NATIVE VILLAGE OF EYAK PROPOSAL #95024 BEFORE THE EVOS TRUSTEE COUNCIL

WHEREAS, stocks of salmon in Prince William Sound (PWS) are recognized as injured by the Exxon Valdez oil spill in addition to the many stocks in PWS which are depressed and not recovering; and

WHEREAS, the Native Village of Eyak, University of Alaska, and PWSAC propose to the EVOS Trustee Council to restore salmon stocks in PWS through research and restoration activities using local resource users, vessels and facilities through an integrated and coordinated collaboration program; and

WHEREAS, the proposed restoration objectives and strategies are consistent with the Draft EVOS Restoration Plan and Draft Environmental Impact Statement for the Exxon Valdez Oil Spill Restoration Plan;

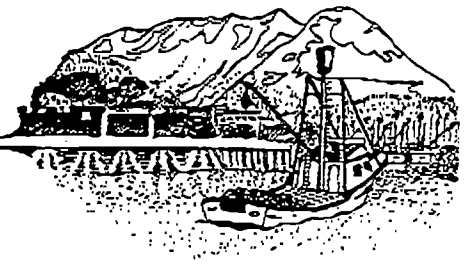
NOW, THEREFORE, BE IT RESOLVED that the City Council of the City of Cordova, Alaska, supports the PWS salmon stock restoration proposals #95093 and #95024 before the EVOS Trustee Council and request proposal #95093 be raised from Category 4 to Category 1 and encourages active public support for Trustee Council funding the research and restoration activities as proposed.

PASSED AND APPROVED THIS 5th DAY OF OCTOBER, 1994.

Margy K. Johnson
Mayor Margy K. Johnson

Lynda Plant
Lynda Plant, City Clerk

CITY OF CORDOVA



October 5, 1994

Exxon Valdez Oil Spill Trustee Council
645 G. Street
Anchorage, Alaska 99501

Attn: Draft Fiscal Year 1995 Work Plan
FAX: 276 7178

Re: Draft Fiscal Year 1995 Work Plan

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Sincerely,

W. S. Janke

Scott Janke
City Manager

Enclosure

CITY OF CORDOVA, ALASKA

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PASSED AND APPROVED THIS 5th DAY OF OCTOBER, 1994.

Margy K. Johnson
Mayor Margy K. Johnson

Lynda Plant
Lynda Plant, City Clerk

Exxon Valdez Oil Spill Trustee
Council Restoration Office
645 G Street
Anchorage, Alaska 99501

September 26, 1994

Dear EVOS Trustees:

I would like to support the Nanwalek/Port Graham/ Tatilek Clam Restoration Project (95131). The clam resources in the Prince William Sound and lower Cook Inlet are scarce. This project should help restore those populations and help enhance this subsistance resource.

Sincerely,

Jeff Hetrick
P.O. Box 7
Moose Pass, Alaska 99631

P.O. Box 7
Moose Pass, Ak
99631

MOOSE PASS AK
PM
SEP 29 1994
99631

USA 29

RECEIVED
SEP 30 1994
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

Exxon Valdez Oil Spill Trustee
Council Restoration Office
645 G street
Anchorage, Ak
99501

CHUGACH ALASKA CORPORATION

September 28, 1994

James Ayers
EVOS Trustee Council Restoration Office
645 G Street, Suite 401
Anchorage, Alaska 99501

Dear Mr. Ayers,

Prince William Sound Waste Management Plan

The Chugach Alaska Corporation, as one of the largest land owners in the Prince William Sound Area fully supports the PWS Economic Development Council's proposal to the EVOS Trustee Council for suitable funds to develop a Prince William Sound Waste Management Plan.

We have read the Economic Development Council's submission to you and are in full support of the contents, however the timing of the project should be compressed. Our own studies of the situation in PWS indicate that time is of the essence in the production of a plan and in the introduction of new facilities. Cordova's land fill is reaching a critical state and other communities are not far behind.

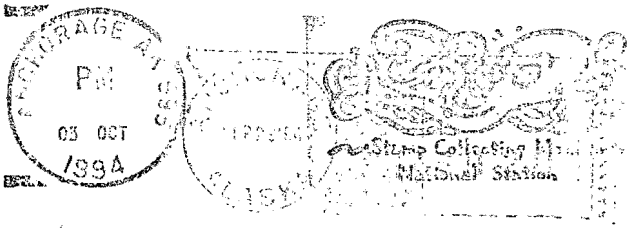
You support for this project will be most appreciated.

Yours,

Michael E Brown
President.

560 E. 34th Avenue, Suite 200 Anchorage, AK 99503-4196
(907) 563-8866 Fax (907) 563-8402

CHUGACH ALASKA CORPORATION



JAMES AYERS
EVOS TRUSTEE COUNCIL RESTORATION OFFICE
645 G STREET SUITE 401
ANCHRAGE AK 99501

560 E. 34th Avenue, Suite 200 Anchorage, AK 99503-4196

99501-3451 91

CITY OF CORDOVA

RESOLUTION 09-94-49

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF CORDOVA, ALASKA, SUPPORTING THE PRINCE WILLIAM SOUND ECONOMIC DEVELOPMENT COUNCIL SOLID WASTE PROPOSAL

WHEREAS, there exists a need to improve waste containment systems to mitigate the amount of oil and other waste effluent from entering port facilities and the adjoining waters of Prince William Sound; and

WHEREAS, existing landfills in Prince William Sound have limited life spans that necessitate the development of a comprehensive, regional plan; and

WHEREAS, a proposal was developed by the Prince William Sound Economic Development Council, working with the communities of Prince William Sound, the Alaska Department of Environmental Conservation, and other organizations to develop a three phase approach to resolving the waste stream problem in this region; and

WHEREAS, this project will reduce the impacts of solid waste to the communities of Prince William Sound from past impacts, providing restoration through a reduction in future pollution; and

WHEREAS, this proposal was presented to the Exxon Valdez Oil Spill Trustee Council and given a top priority ranking as a project for Fiscal Year 1995; and

NOW, THEREFORE, BE IT RESOLVED, by the City Council of the City of Cordova, Alaska, that the City of Cordova hereby supports the Prince William Sound Economic Development Council's proposal to systematically find, evaluate and pursue solutions to the region's solid and oily waste problems.

PASSED AND APPROVED THIS 21 **DAY OF SEPTEMBER, 1994.**

/s/ Mayor Margy Johnson
Mayor Margy K. Johnson

/s/ Lynda Plant
City Clerk Lynda Plant

OFFICE OF THE CITY CLERK
August 18, 1994

Mr. James Ayres, Executive Director
Exxon Valdez Oil Spill Trustee Council
645 G Street, Suite 401
Anchorage, Alaska 99501-3451

Dear Mr. Ayres:

At the regular meeting of August 15, 1994, the Valdez City Council passed by unanimous vote of those present Resolution #94-76 supporting the Prince William Sound Economic Development Council's proposal to systematically find, evaluate and pursue solutions to the region's solid and oily waste problems. A copy of that resolution is attached for your information.

Yours truly,

Jeanne Donald

Jeanne Donald, CMC/AAE
City Clerk

Attachment

cc: Paul Roetman, Prince William Sound Economic Development Council

P.O. BOX 307 • VALDEZ, ALASKA 99686
TELEPHONE (907) 835-4313 • TELEX 26-381 • TELECOPIER (907) 835-2992

CITY OF VALDEZ, ALASKA

RESOLUTION NO. 94-76

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF VALDEZ, ALASKA, SUPPORTING THE PRINCE WILLIAM SOUND ECONOMIC DEVELOPMENT COUNCIL SOLID WASTE PROPOSAL

WHEREAS, there exists a need to improve waste containment systems to mitigate the amount of oil and other waste effluent from entering port facilities and the adjoining waters of Prince William Sound; and

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WHEREAS, this project will reduce the impact of solid waste to the communities of Prince William Sound from past impacts, providing restoration through a reduction in future pollution; and

WHEREAS, this proposal was presented to the Exxon Valdez Oil Spill Trustee Council and given a top priority ranking as a project for Fiscal Year 1995;

NOW, THEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF VALDEZ, ALASKA, that the Valdez City Council hereby supports the Prince William Sound Economic Development Council's proposal to systematically find, evaluate and pursue solutions to the region's solid and oily waste problems.

PASSED AND APPROVED BY THE CITY COUNCIL OF THE CITY OF VALDEZ, ALASKA, this 15th day of August, 1994.

CITY OF VALDEZ, ALASKA

John L. Harris

CITY OF VALDEZ, ALASKA

ATTEST:

Jeanne D. Donald, City Clerk

Pacific Seabird Group

DEDICATED TO THE STUDY AND CONSERVATION OF PACIFIC SEABIRDS AND THEIR ENVIRONMENT

Craig S. Harrison
Vice Chair for Conservation
4001 North 9th Street #1801
Arlington, Virginia 22203

October 5, 1994

Molly McCammon
Exxon Valdez Oil Spill Trustee Council
645 G Street, Suite 401
Anchorage, Alaska 99501-3451

Re: Comments on Draft 1995 Work Plan

Dear Ms. McCammon:

This letter contains the Pacific Seabird Group's (PSG) comments on the draft 1995 Work Plan (August 1994). PSG is an international organization that was founded in 1972 to promote knowledge, study and conservation of Pacific seabirds. PSG draws its members from the entire Pacific Basin, and includes biologists who have research interests in Pacific seabirds, state and federal officials who manage seabird populations and refuges, and individuals with interests in marine conservation. PSG has hosted symposia on the biology and management of virtually every seabird species affected by the Exxon Valdez oil spill, and has sponsored symposia on the effects of the spill on seabirds.

I. Project 95038 (Symposium on Seabird Restoration)

We acknowledge our conflict of interest in viewing this symposium as PSG's highest priority in the 1995 Work Plan. Our proposed symposium is NOT designed to be a "low maintenance" meeting at which authors talk at one another, each reading to others a paper that may or may not be useful to seabird restoration. We envision a highly interactive meeting involving plenary sessions and sub-groups. We hope that the attendees will either reach consensus or form majority and minority views on the important issues and strategies for Alaskan seabird restoration. This symposium would allow North American biologists to discuss and debate seabird restoration and strategies in a focused environment for the first time. It will sponsor scientists from

U.K., New Zealand, Australia, Africa, Canada and Latin America who can provide North Americans with their experiences with seabird restoration.

PSG responds here to questions that have been raised regarding this proposal.

1. Could the symposium be held in conjunction with an annual PSG meeting? We believe that the symposium should be held in Alaska to attract local participants and interested observers who might ordinarily not attend a PSG meeting. PSG usually schedules its annual meeting between mid-January and mid-February. During the past 22 years, PSG's Executive Council has considered meeting in Alaska on several occasions. The Executive Council has always rejected that option because it believes that a winter meeting in Alaska would be poorly-attended. More recently, an Alaska meeting would interfere with our work on the conservation of marbled murrelets in the Pacific Northwest and our conservation initiatives in Baja California. We designed the proposal assuming that the symposium would be held in Alaska and to insure that participants could devote their full attention to this single issue. We will consider holding the symposium a few days before an annual PSG meeting if the Trustee Council prefers that PSG hold the symposium outside Alaska.

2. Can this be done cheaper?

Travel. Our estimate includes air fare, lodging and food for 25 scientists to participate in a 3-day symposium in Alaska discussing seabird restoration. Depending on actual rather than estimated expenses for travel (e.g., air fares are higher or lower than assumed), the number of sponsored scientists will vary. We assume that three of the scientists live in Anchorage, for whom no air fares will be needed.

Symposium (costs in $1,000):	
Room and board (25 X $470)	$11.8
Beyond North America air fares (8 X $1,000)	$8.0
West coast air fares (inc. Juneau, w.Canada) (8 X $500)	$4.0
East coast air fares (inc. eastern Canada) (6 X $800)	$4.8
Sub total	$28.6
P.I. Travel to Anchorage [one trip in FY96]:[1/]	
Air fare (2 X $500)	$1.0
Per diem (2 X $200)	$0.4
Sub total	$1.4
Total	$30.0

1/ The time and travel expense for these meetings is a requirement of the Trustee Council and not truly part of our proposal.

Contract Staff. This work will be conducted entirely by sub-contractors because PSG has no employees. We envision sub-contracts with at least two and possibly three highly qualified seabird biologists who will organize and run the symposium, conduct research and literature reviews, prepare discussion points, issue papers, conduct international conference calls and produce a final report. PSG might also hire a facilitator for the symposium. This assumes $35 K in contract expenses during FY95 and $9 K in contract expenses in FY96 to write a final report. At contract rates used by biological consultants to EVOS, this works out to less than 0.5 man-years, and assumes that sub-contractors will provide their own office space, equipment, and other overhead. We believe our proposal is parsimonious compared to most agency proposals.

3. Why not publish the proceedings? The proposal includes the preparation of a final report and left publication issues open. PSG has a distinguished record of professional publication,[2/] and we believe that this material would be appropriate for Biological Conservation, Restoration Ecology, PSG's own technical publication series, or other outlets. We believe that publication of the proceedings will require additional staff work to motivate authors to produce in a timely manner, direct the writing of papers to synthesize the material, provide honoraria and cover direct publication costs. We can negotiate with the Trustee Council regarding additional costs to publish the symposium.

II. Project 95041 (Introduced Predator Removal: Follow-up)

We strongly support a follow-up of FWS' efforts to remove introduced predators from Chernabura and Simeonof Islands during 1994. As we have stated repeatedly, the best means to restore Alaska's seabird populations would be to remove rats, foxes and other alien creatures from colonies and former colonies. The Canadian Wildlife Service has adopted this approach with regard to using oil spill restoration funds in British Columbia.

PSG is concerned that the Trustee Council has not extended this project for 1995 and beyond to include other islands. PSG reiterates its strong objection to limiting seabird restoration to the geographic area that the Trustee Council has identified as the spill area. We believe that far more effort and funds should be directed toward compensatory restoration of seabirds in areas that may be far from the spill area.

2/ Attachment 1 indicates that PSG has published 10 symposia in some of the most distinguished ornithological publicationss, and others are in planning stages.

III. Injured Seabirds

PSG expresses once again its objections to the Trustee Council's simplistic list of injured seabirds in the Summary of the 1995 Work Plan (Table 1). The overall goal of the draft Restoration Plan (we have not yet seen the final) is to restore all injured resources and services.[3/] We agree with the assessment of the Trustee Council that common murres, harlequin ducks, marbled murrelets and pigeon guillemots do not seem to be recovering and need restoration efforts.

We strongly believe, however, that the Trustee Council should also restore other bird species. We suggested with respect to the draft Restoration Plan that the Trustee Council add the categories "other seabirds" and "other sea ducks" to its list of "recovery unknown" resources.[4/] The draft Restoration Plan acknowledges that the current population status is "unknown" for the following seabirds that were collected dead in 1989: yellow-billed, Pacific, red-throated loon; red-necked and horned grebe; northern fulmar; sooty and short-tailed shearwater; double-crested, pelagic and red-faced cormorant; herring and mew gull; Arctic and Aleutian tern; Kittlitz's and ancient murrelet; Cassin's, least, parakeet and rhinoceros auklet; and horned and tufted puffin.[5/] The decline after the oil spill "varies by species" and cormorant, Arctic tern and tufted puffin clearly declined.[6/] The draft Restoration Plan also acknowledges that the current population status is "unknown" for the following species of sea ducks that were collected dead in 1989: Steller's, king and common eider; white-winged, surf and black scoter; oldsquaw; bufflehead; common and Barrow's goldeneye; and common and red-breasted merganser.[7/] Moreover, the Trustee Council entirely ignores 31 species of shorebirds, nine of which nest in and seven of which winter in the spill area.

We raised this issue repeatedly in our earlier comments and the DEIS (Table 1-1) concedes these injuries.[8/] The final EIS

3/ Draft Restoration Plan, p. 25.

4/ Restoration Plan, p. 30.

5/ Draft Restoration Plan, Appendix B, p. B-41.

6/ Appendix B, p. B-41.

7/ Appendix B, p. B-42.

8/ Letter to EVOS Trustee Council from PSG (August 6, 1993); PSG Comments of Draft 1994 Work Plan (January 21, 1994); PSG Comments on Draft Restoration Plan and Draft EIS (July 29, 1994).

states that this issue will be addressed in the Restoration Plan.[9/] According to the federal estimates published in 56 Federal Register 14687 (April 11, 1991), these "other" seabirds and "other sea ducks" totalled 14,000 dead birds. The Trustee Council estimates that "in general, the number of dead birds recovered probably represents only 10-15% of the total numbers of individuals killed."[10/] Simple mathematics indicates these losses were 90,000 to 140,000 birds, which the 1995 Work Plan continues to ignore.

As a reference point for this magnitude of injury to seabirds, the federal government recently settled the Apex Houston case in central California concerning a spill that may have damaged about 4,200 seabirds (the actual number being an unknown multiple of 4,200). The insurance company paid about $6 million to settle this claim. If Alaska seabirds are worth as much as California seabirds, the Trustee Council should spend at least $18 million of the trust funds to restore "other seabirds" and "other sea ducks."

IV. Agencies Should Not Be Funded for Work that they Normally Conduct

We agree with the Trustee Council's proposed Restoration Policy No. 9, which prohibits Government agencies from receiving restoration funds for work that they normally conduct. Apparently, Department of the Interior solicitors invoked this policy to assign one of PSG's proposals, Project No. 95042 (Five-year Plan to Remove Predators from Seabird Colonies), to category 4 because this work "is part of normal agency responsibility."[11/] PSG has identified numerous federal and state proposed projects in the 1995 Work Plan that are part of normal agency responsibility.

FWS' Project 95159 (Survey of Marine Seabirds and Sea Otters) proposes to spend $427,000 on activities that have been part of FWS' normal agency responsibilities since the agency began. We reach the same conclusion with regard to ADNR's Project 95007A (Monitoring Archeological Sites for Looting); the North Gulf Oceanic Society's Project 95013 (Killer Whale Monitoring); NOAA's Project 95092 (Recovery Monitoring of Killer Whales); NOAA's Project 95052 (Distribution, Abundance and Dispersal of Forage Fish); and ADF&G's Project No. 95064 (Monitoring Harbor Seals). PSG fails to see how these projects are any less "normal agency responsibility" than creating a plan

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9/ FEIS, chapter 5 p. 55.

10/ Draft Restoration Plan, p. B-16.

11/ Draft FY 95 Work Plan Summary, A-16.

to remove predators from seabird colonies, which would help implement the most effective means known to restore seabird populations.

We noted in our comments on the draft Restoration plan that monitoring is an area where the Trustee Council must make special efforts to guard against violating Policy No. 9. The Migratory Bird Treaty Act, Marine Mammal Protection Act, Magnuson Fishery Conservation and Management Act and other authorities assign legal responsibility to survey and monitor seabirds, marine mammals and fish to federal and state agencies. We can identify projects along these lines that have been conducted by federal and state agencies in PWS in the past. These projects should not be funded by the Trustee Council unless it has decided not to adopt Restoration Policy No. 9.

V. Work on Damaged Seabirds that Are Not Recovering

PSG generally supports projects that focus on birds that apparently are not recovering, including common murres (Projects 95021 and 95039), harlequin ducks (Projects 95005 and 95427), marbled murrelets (Project 95031), pigeon guillemots (Projects 95025C and 94173) and bald eagles (Projects 95029 and 95030).

Because bird populations may be depressed due to disruptions in food supplies, we support studies of the influence of forage fish and other prey on injured species (Projects 95019, 95023, 95025A, 95025F, 95033, 95118-BAA). We are especially pleased that the Trustee Council is finally focusing on sea ducks.

We agree with the comments in the draft work plan that many of the projects are similar, and should be coordinated and perhaps consolidated to insure the most effective use of the trust fund.

PSG thanks the Trustee Council for this opportunity to lend its expertise and views on these important issues.

Sincerely,

Craig S. Harrison

Enclosure

A brief chronology of the Pacific Seabird Group

Annual meeting		Symposia	Executive Council Chairs
1973–74	Bolinas, CA	Organizational meeting	
1974–75	Seattle, WA	Biology of the Alcids	J. Michael Scott
1975–76	Monterey, CA	Seabird Conservation on the California Coast	J. Michael Scott
1976–77	Monterey, CA	Shorebirds in the Marine Environment*	George Divoky
1977–78	Victoria, BC	Black-legged Kittiwake Reproduction	David Manuwal
1978–79	Monterey, CA	Food Availability and Reproductive Success Investigator Bias in Assessing Seabird Nesting Success	Dan Anderson
1979–80	Monterey, CA		Ralph Schreiber
1980–81	Tucson, AZ		Ralph Schreiber
1981–82	Seattle, WA	Feeding Ecology of Marine Waterfowl and Pelagic Birds* Seabird–Commercial Fisheries Interactions*	Kees Vermeer
1982–83	Honolulu, HI	Tropical Seabirds* Human Disturbance at Seabird Colonies	Harry Ohlendorf
1983–84	Monterey, CA		Craig Harrison
1984–85	Long Beach, CA	Biology of Terns	Judith Hand
1985–86	San Francisco, CA	Biology of Gulls* Bird Use of Man-Made vs. Natural Wetlands*	Dan Anderson
1986–87	La Paz, Mexico	Biology of Seabirds in the Gulf of California	Lora Leschner
1987–88	Monterey, CA	Alcids at Sea* Marbled Murrelet Management*	Ken Briggs
1988–89	Washington, DC	Wading-Bird Reproduction in 1988	Scott Hatch
1989–90	Victoria, BC	Status, Ecology, and Conservation of Marine Birds of the North Pacific*	Michael Fry
1990–91	Monterey, CA		Doug Siegel-Causey
1991–92	Charleston, OR		Malcolm Coulter
1992–93	Seattle, WA	*Exxon Valdez* Marbled Murrelets*	Palmer Sekora

* Published symposium

Craig S. Harrison
4001 North Ninth Street 1801
Arlington, VA 22203

WASHINGTON, DC 20013
PM
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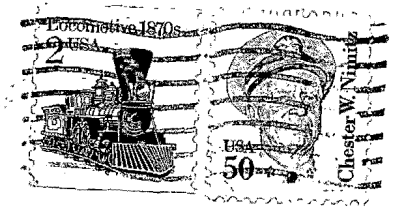
1994



Molly McCammon
Exxon Valdez Oil Spill Trustee Council
645 G Street, Suite 401
Anchorage, Alaska 99501-3451

99501-3451 91

Pacific Seabird Group

DEDICATED TO THE STUDY AND CONSERVATION OF PACIFIC SEABIRDS AND THEIR ENVIRONMENT

Craig S. Harrison
Vice Chair for Conservation
4001 North 9th Street #1801
Arlington, Virginia 22203

October 5, 1994

Molly McCammon
Exxon Valdez Oil Spill Trustee Council
645 G Street, Suite 401
Anchorage, Alaska 99501-3451

Re: Comments on Draft 1995 Work Plan

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I. Project 95038 (Symposium on Seabird Restoration)

We acknowledge our conflict of interest in viewing this symposium as PSG's highest priority in the 1995 Work Plan. Our proposed symposium is NOT designed to be a "low maintenance" meeting at which authors talk at one another, each reading to others a paper that may or may not be useful to seabird restoration. We envision a highly interactive meeting involving plenary sessions and sub-groups. We hope that the attendees will either reach consensus or form majority and minority views on the important issues and strategies for Alaskan seabird restoration. This symposium would allow North American biologists to discuss and debate seabird restoration and strategies in a focused environment for the first time. It will sponsor scientists from

U.K., New Zealand, Australia, Africa, Canada and Latin America who can provide North Americans with their experiences with seabird restoration.

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1. Could the symposium be held in conjunction with an annual PSG meeting? We believe that the symposium should be held in Alaska to attract local participants and interested observers who might ordinarily not attend a PSG meeting. PSG usually schedules its annual meeting between mid-January and mid-February. During the past 22 years, PSG's Executive Council has considered meeting in Alaska on several occasions. The Executive Council has always rejected that option because it believes that a winter meeting in Alaska would be poorly-attended. More recently, an Alaska meeting would interfere with our work on the conservation of marbled murrelets in the Pacific Northwest and our conservation initiatives in Baja California. We designed the proposal assuming that the symposium would be held in Alaska and to insure that participants could devote their full attention to this single issue. We will consider holding the symposium a few days before an annual PSG meeting if the Trustee Council prefers that PSG hold the symposium outside Alaska.

2. Can this be done cheaper?

Travel. Our estimate includes air fare, lodging and food for 25 scientists to participate in a 3-day symposium in Alaska discussing seabird restoration. Depending on actual rather than estimated expenses for travel (e.g., air fares are higher or lower than assumed), the number of sponsored scientists will vary. We assume that three of the scientists live in Anchorage, for whom no air fares will be needed.

Symposium (costs in $1,000):	
Room and board (25 X $470)	$11.8
Beyond North America air fares (8 X $1,000)	$8.0
West coast air fares (inc. Juneau, w.Canada) (8 X $500)	$4.0
East coast air fares (inc. eastern Canada) (6 X $800)	$4.8
Sub total	$28.6
P.I. Travel to Anchorage [one trip in FY96]:[1/]	
Air fare (2 X $500)	$1.0
Per diem (2 X $200)	$0.4
Sub total	$1.4
Total	$30.0

1/ The time and travel expense for these meetings is a requirement of the Trustee Council and not truly part of our proposal.

Contract Staff. This work will be conducted entirely by sub-contractors because PSG has no employees. We envision sub-contracts with at least two and possibly three highly qualified seabird biologists who will organize and run the symposium, conduct research and literature reviews, prepare discussion points, issue papers, conduct international conference calls and produce a final report. PSG might also hire a facilitator for the symposium. This assumes $35 K in contract expenses during FY95 and $9 K in contract expenses in FY96 to write a final report. At contract rates used by biological consultants to EVOS, this works out to less than 0.5 man-years, and assumes that sub-contractors will provide their own office space, equipment, and other overhead. We believe our proposal is parsimonious compared to most agency proposals.

3. Why not publish the proceedings? The proposal includes the preparation of a final report and left publication issues open. PSG has a distinguished record of professional publication,[2/] and we believe that this material would be appropriate for Biological Conservation, Restoration Ecology, PSG's own technical publication series, or other outlets. We believe that publication of the proceedings will require additional staff work to motivate authors to produce in a timely manner, direct the writing of papers to synthesize the material, provide honoraria and cover direct publication costs. We can negotiate with the Trustee Council regarding additional costs to publish the symposium.

II. Project 95041 (Introduced Predator Removal: Follow-up)

We strongly support a follow-up of FWS' efforts to remove introduced predators from Chernabura and Simeonof Islands during 1994. As we have stated repeatedly, the best means to restore Alaska's seabird populations would be to remove rats, foxes and other alien creatures from colonies and former colonies. The Canadian Wildlife Service has adopted this approach with regard to using oil spill restoration funds in British Columbia.

PSG is concerned that the Trustee Council has not extended this project for 1995 and beyond to include other islands. PSG reiterates its strong objection to limiting seabird restoration to the geographic area that the Trustee Council has identified as the spill area. We believe that far more effort and funds should be directed toward compensatory restoration of seabirds in areas that may be far from the spill area.

2/ Attachment 1 indicates that PSG has published 10 symposia in some of the most distinguished ornithological publicationss, and others are in planning stages.

III. Injured Seabirds

PSG expresses once again its objections to the Trustee Council's simplistic list of injured seabirds in the Summary of the 1995 Work Plan (Table 1). The overall goal of the draft Restoration Plan (we have not yet seen the final) is to restore all injured resources and services.[3/] We agree with the assessment of the Trustee Council that common murres, harlequin ducks, marbled murrelets and pigeon guillemots do not seem to be recovering and need restoration efforts.

We strongly believe, however, that the Trustee Council should also restore other bird species. We suggested with respect to the draft Restoration Plan that the Trustee Council add the categories "other seabirds" and "other sea ducks" to its list of "recovery unknown" resources.[4/] The draft Restoration Plan acknowledges that the current population status is "unknown" for the following seabirds that were collected dead in 1989: yellow-billed, Pacific, red-throated loon; red-necked and horned grebe; northern fulmar; sooty and short-tailed shearwater; double-crested, pelagic and red-faced cormorant; herring and mew gull; Arctic and Aleutian tern; Kittlitz's and ancient murrelet; Cassin's, least, parakeet and rhinoceros auklet; and horned and tufted puffin.[5/] The decline after the oil spill "varies by species" and cormorant, Arctic tern and tufted puffin clearly declined.[6/] The draft Restoration Plan also acknowledges that the current population status is "unknown" for the following species of sea ducks that were collected dead in 1989: Steller's, king and common eider; white-winged, surf and black scoter; oldsquaw; bufflehead; common and Barrow's goldeneye; and common and red-breasted merganser.[7/] Moreover, the Trustee Council entirely ignores 31 species of shorebirds, nine of which nest in and seven of which winter in the spill area.

We raised this issue repeatedly in our earlier comments and the DEIS (Table 1-1) concedes these injuries.[8/] The final EIS

3/ Draft Restoration Plan, p. 25.

4/ Restoration Plan, p. 30.

5/ Draft Restoration Plan, Appendix B, p. B-41.

6/ Appendix B, p. B-41.

7/ Appendix B, p. B-42.

8/ Letter to EVOS Trustee Council from PSG (August 6, 1993); PSG Comments of Draft 1994 Work Plan (January 21, 1994); PSG Comments on Draft Restoration Plan and Draft EIS (July 29, 1994).

states that this issue will be addressed in the Restoration Plan.[9] According to the federal estimates published in 56 Federal Register 14687 (April 11, 1991), these "other" seabirds and "other sea ducks" totalled 14,000 dead birds. The Trustee Council estimates that "in general, the number of dead birds recovered probably represents only 10-15% of the total numbers of individuals killed."[10] Simple mathematics indicates these losses were 90,000 to 140,000 birds, which the 1995 Work Plan continues to ignore.

As a reference point for this magnitude of injury to seabirds, the federal government recently settled the Apex Houston case in central California concerning a spill that may have damaged about 4,200 seabirds (the actual number being an unknown multiple of 4,200). The insurance company paid about $6 million to settle this claim. If Alaska seabirds are worth as much as California seabirds, the Trustee Council should spend at least $18 million of the trust funds to restore "other seabirds" and "other sea ducks."

IV. Agencies Should Not Be Funded for Work that they Normally Conduct

We agree with the Trustee Council's proposed Restoration Policy No. 9, which prohibits Government agencies from receiving restoration funds for work that they normally conduct. Apparently, Department of the Interior solicitors invoked this policy to assign one of PSG's proposals, Project No. 95042 (Five-year Plan to Remove Predators from Seabird Colonies), to category 4 because this work "is part of normal agency responsibility."[11] PSG has identified numerous federal and state proposed projects in the 1995 Work Plan that are part of normal agency responsibility.

FWS' Project 95159 (Survey of Marine Seabirds and Sea Otters) proposes to spend $427,000 on activities that have been part of FWS' normal agency responsibilities since the agency began. We reach the same conclusion with regard to ADNR's Project 95007A (Monitoring Archeological Sites for Looting); the North Gulf Oceanic Society's Project 95013 (Killer Whale Monitoring); NOAA's Project 95092 (Recovery Monitoring of Killer Whales); NOAA's Project 95052 (Distribution, Abundance and Dispersal of Forage Fish); and ADF&G's Project No. 95064 (Monitoring Harbor Seals). PSG fails to see how these projects are any less "normal agency responsibility" than creating a plan

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9/ FEIS, chapter 5 p. 55.

10/ Draft Restoration Plan, p. B-16.

11/ Draft FY 95 Work Plan Summary, A-16.

to remove predators from seabird colonies, which would help implement the most effective means known to restore seabird populations.

We noted in our comments on the draft Restoration plan that monitoring is an area where the Trustee Council must make special efforts to guard against violating Policy No. 9. The Migratory Bird Treaty Act, Marine Mammal Protection Act, Magnuson Fishery Conservation and Management Act and other authorities assign legal responsibility to survey and monitor seabirds, marine mammals and fish to federal and state agencies. We can identify projects along these lines that have been conducted by federal and state agencies in PWS in the past. These projects should not be funded by the Trustee Council unless it has decided not to adopt Restoration Policy No. 9.

V. Work on Damaged Seabirds that Are Not Recovering

PSG generally supports projects that focus on birds that apparently are not recovering, including common murres (Projects 95021 and 95039), harlequin ducks (Projects 95005 and 95427), marbled murrelets (Project 95031), pigeon guillemots (Projects 95025C and 94173) and bald eagles (Projects 95029 and 95030).

Because bird populations may be depressed due to disruptions in food supplies, we support studies of the influence of forage fish and other prey on injured species (Projects 95019, 95023, 95025A, 95025F, 95033, 95118-BAA). We are especially pleased that the Trustee Council is finally focusing on sea ducks.

We agree with the comments in the draft work plan that many of the projects are similar, and should be coordinated and perhaps consolidated to insure the most effective use of the trust fund.

PSG thanks the Trustee Council for this opportunity to lend its expertise and views on these important issues.

Sincerely,

Craig S. Harrison

Enclosure

A brief chronology of the Pacific Seabird Group

Annual meeting		Symposia	Executive Council Chairs
1973–74	Bolinas, CA	Organizational meeting	
1974–75	Seattle, WA	Biology of the Alcids	J. Michael Scott
1975–76	Monterey, CA	Seabird Conservation on the California Coast	J. Michael Scott
1976–77	Monterey, CA	Shorebirds in the Marine Environment*	George Divoky
1977–78	Victoria, BC	Black-legged Kittiwake Reproduction	David Manuwal
1978–79	Monterey, CA	Food Availability and Reproductive Success Investigator Bias in Assessing Seabird Nesting Success	Dan Anderson
1979–80	Monterey, CA		Ralph Schreiber
1980–81	Tucson, AZ		Ralph Schreiber
1981–82	Seattle, WA	Feeding Ecology of Marine Waterfowl and Pelagic Birds* Seabird–Commercial Fisheries Interactions*	Kees Vermeer
1982–83	Honolulu, HI	Tropical Seabirds* Human Disturbance at Seabird Colonies	Harry Ohlendorf
1983–84	Monterey, CA		Craig Harrison
1984–85	Long Beach, CA	Biology of Terns	Judith Hand
1985–86	San Francisco, CA	Biology of Gulls* Bird Use of Man-Made vs. Natural Wetlands*	Dan Anderson
1986–87	La Paz, Mexico	Biology of Seabirds in the Gulf of California	Lora Leschner
1987–88	Monterey, CA	Alcids at Sea* Marbled Murrelet Management*	Ken Briggs
1988–89	Washington, DC	Wading-Bird Reproduction in 1988	Scott Hatch
1989–90	Victoria, BC	Status, Ecology, and Conservation of Marine Birds of the North Pacific*	Michael Fry
1990–91	Monterey, CA		Doug Siegel-Causey
1991–92	Charleston, OR		Malcolm Coulter
1992–93	Seattle, WA	*Exxon Valdez* Marbled Murrelets*	Palmer Sekora

* Published symposium

TELECOPY INFORMATION

Hunton & Williams
P.O. Box 19230
Washington, DC 20036

Telecopy Number: (202)778-2201

TO: **Name:** James Ayers

Firm: Exxon Valdex Oil Spill Restoration Team

Location: Anchorage, Alaska

Telecopy Number: 907-276-7178

No. Pages 8 **Including Cover**

FROM: **Name:** Craig S. Harrison, Esq.

Extension: 202-778-2240

Special Instructions:

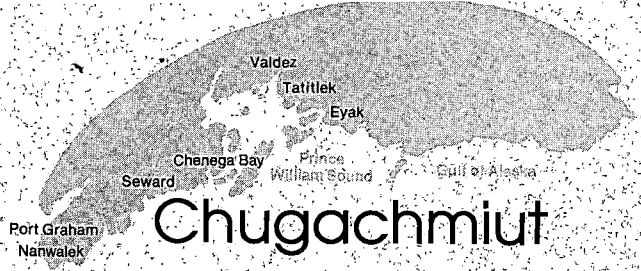
Operator: _____ **Date:** 10/05/94

Time: _____

Client/Matter Name: Firm

Client/Matter Number:

(For confirmation or assistance with problems, call 202/955-1611)



Chugachmiut

October 7, 1994

Mr. James Ayers, Executive Director
EVOS Restoration Office
645 G Street, Suite 401
Anchorage, Alaska 99501-3451

Dear Mr. Ayers:

This letter is to endorse the Prince William Sound Economic Development Council's proposal on Solid Waste Management. I would encourage that it be given serious consideration for funding.

Management of solid waste is a major problem in Prince William Sound, one which may prove to be as serious a threat, in the long run, to the health and well being of the Sound as are major oil spills. The problem is complex and difficult to solve and delaying it to another day will only complicate matters further. I am currently working with the villages of Tatitlek and Chenega Bay on this issue. However, all the communities and residents of the PWS area need to work collectively on the problem. I believe the PWSEDC proposal provides the means to do this. If funded I and the villages I mentioned will look forward to working cooperatively on this important project.

Please feel free to contact me if you have questions.

Sincerely,

Paul G. Jackson
Environmental Specialist

4201 Tudor Centre Dr., Suite 210 / Anchorage, AK 99508 / (907) 562-4155 / Fax (907) 563-2891
A Tribal Organization Serving the Chugach Native Peoples of Alaska

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"All of Ours"

Chugachmiut
4201 Tudor Centre Dr., Suite 210
Anchorage, Alaska 99508

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Mr. James Ayers, Executive Dir.
EVOS Restoration Office
645 G Street, Suite 401
Anchorage, Alaska 99501-3451

99501-3451 91

Sponsored by: City Manager

CITY OF WHITTIER, ALASKA
RESOLUTION 406-94
SUPPORTING THE PRINCE WILLIAM SOUND ECONOMIC DEVELOPMENT COUNCIL SOLID WASTE PROPOSAL

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF WHITTIER, ALASKA, SUPPORTING THE PRINCE WILLIAM SOUND ECONOMIC DEVELOPMENT COUNCIL SOLID WASTE PROPOSAL .

WHEREAS, there exists a need to improve waste containment systems to mitigate the amount of oil and other waste effluent from entering port facilities and the adjoining waters of Prince William Sound; and

WHEREAS, existing landfills in Prince William Sound have limited life spans that necessitate the development of a comprehensive, regional plan; and

WHEREAS, a proposal was developed by the Prince William Sound Economic Development Council, working with the communities of Prince William Sound, the Alaska Department of Environmental Conservation, and other organizations to develop a three phase comprehensive approach to resolving the waste stream problem in this region; and

WHEREAS, this project will reduce the impact of solid waste to the communities of Prince William Sound from past impacts, providing restoration through a reduction in future pollution; and

WHEREAS, this proposal was presented to the Exxon Valdez Oil Spill Trustee Council and given a top priority ranking as a project for Fiscal Year 1995;

NOW, THEREFORE the Whittier City Council Resolves:

THAT, the Whittier City Council hereby supports the Prince William Sound Economic Development Council's proposal to systematically find, evaluate and pursue solutions to the region's solid and oily waste problems.

PASSED AND APPROVED by a duly constituted quorum of the Whittier City Council this 3rd day of October, 1994.

Ben Butler

Ben Butler, Mayor

ATTEST:

Debra Burnham

Debra Burnham, City Clerk

AYES: 6
NOES: 0
ABSENT: 0
ABSTAIN: 0

406-94.res

THE CITY OF WHITTIER
P. O. Box 608
Whittier, Alaska 99693

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EVOS Trustees
645 G. ST.
Anchorage, AK 99501

ATTN: Jim Ayres

3 October 1994

To the Trustees Council:

I am writing to you with comments on projects described in the "Draft Fiscal Year 1995 Work Plan". I have read both the "Summary" and the project descriptions in "Supplement Volume I". "Supplement Volume II" was unavailable.

I am strongly in support of habitat acquisition and real restoration projects, that is, projects which physically work to restore species or habitat. Research and monitoring projects, while important because they help us understand the environment that controls species fluctuations, are of lesser importance. Listed below, by category, are projects I support, do not support, and am neutral on.

Research

Although I would rather see funding go to habitat protection and real restoration, I realize that many people want to find out what is limiting the recovery of species. I have listed below projects I support with that idea in mind.

Prince William Sound Systems Investigations

I support nearly all of these projects, including: 95320A, 95320E, 95320G, 95320H, 95320J, 95320M, 95320N, 95320Q, 95320S, 95320T, 95320U, and 95018.

I do not support:

95320Y Variation in local predation...

95065 PWSAC Pink Salmon Fry Mortality

95320K PWSAC Experimental Fry Release

The above three projects should be funded by PWSAC.

Marine Mammal Ecosystem Studies

Support:

95001 (Condition and Health of Harbor Seals) and 95117 (Harbor Seal Lipids) should be combined.

95014 (Killer Whale Feeding Behaviour) and 95073 (Impact of Killer Whales on Seals) should be combined.

95064 Monitoring, Habitat Use, Trophic Interactions of Harbor Seals

95320V Herring Predation by Humpbacks

Isotope Studies

Support:

95320I(1 and 2) Isotope tracers for fish, marine mammals, and birds

95114 Eelgrass Community structure

95320I (3) Purchase of Radio Mass Spectrometer

Do not Support:

95023 Food Web Relationships of Pelagic Species
Precluded by 95320I (1) and 95118-BAA

95121 Stable Isotope Ratios...
Precluded by 95329I(2)

Forage Fish Projects

Support:

95120-BAA Composition and Energetic Content...

95163 Abundance and distribution...

95057 Movement of Larval and Juvenile fish...

Concerning Bird/Forage Fish Projects,

Project 95118-BAA seems to cover the most ground for the least cost, looking at pigeon guillemots, puffins, and kittiwakes, thus precluding projects 95019, 95033, and 95173.

What 95118-BAA does not look at is radio tags. Could the radio tagging part of 95031, 95033, and 95173 be combined into one project?

The only good murre project appears to be 95021. I support this project because of the unique use of diving-time-depth measurements in researching forage fish for diving birds.

General Restoration

Stock Separation Projects

I realize that these projects could help restoration of injured species by ensuring that commercial and sport fishermen target only on uninjured stocks, however, in general, I do not support the financing of stock separation projects. Since the goal of stock separation is improved fisheries manangement, it would seem that they would fall under normal ADFG duties.

The stock separation projects are: 95255, 95137, 95051, 95320D, 95320B, 95320C, 95050, and 95165.

Fish and Shellfish Enhancement Projects

I strongly support the following projects:

95259 Restoration of Coghill Lake Reds

95139D Salmon Instream Habitat Restoration

95024 Enhancement of Wild Pink Salmon

95139A Spawning Channel--Port Dick Creek

95043A Cordova Cutthroat Trout Habitat

95043B Carry Forward: Cutthroat and Dolly Varden Rehabilitation

95105 Kenai River Ecosystem Pilot Study
This project, although it does not physically restore any species, works with that goal directly in mind.

95134 Chenega Bay Mariculture
I support this as replacing a resource. Seems to be a reasonable cost.

I do not support the following:

95079 Pink Salmon Restoration through Small-Scale Hatcheries
While this does attempt direct restoration, I believe it is very important to concentrate on restoring wild stock and re-creating natural runs.

95125 Tatitlek Sockeye Salmon Release
It is important to concentrate on rebuilding the natural stocks in the streams around Tatitlek. While I was not able to evaluate the full proposal (described in Supplement Volume II, which was unavailable), it appears to me that this project would not use broodstock from streams around Tatitlek.

95127 Tatitlek Coho Release
Do not support for reasons listed above.

95017 Port Graham Coho Restoration
This project, which basically expands a hatchery water supply, seems to have a very high cost per fish. Also, it does not work to establish natural runs in wild streams. This project should be pursued through Small Business Admin., etc.

I remain neutral on the following:

95131 Clam Restoration
While I support the idea, it seems to have a very high cost. Can this cost be reduced? Can the project be partially funded through other agencies?

95272 Chenega Chinook Release
Support the idea of creating natural runs in the Chenega area, but wonder why they are using broodstock from the hatchery at Esther instead of cultivating stock from streams around Chenega.

95069 Restoration of Salmon Stocks...
I support the idea, but believe project 95024 is more realistic and will accomplish more for a smaller cost. I believe project 95024 addresses many needs, including building up remnant salmon stocks in natural streams, using local knowledge and local labor, and following through with the project for a reasonable time (10 years) to make sure the goals are accomplished. Project 95069 addresses some of these issues, but I believe much of the work will go to biologists from outside the Prince William Sound area; also, the proposed bud-

get is quite high compared to 95024, and 95069 proposes to only follow the project for 2 years, which is not long enough to really establish the runs. Also, I like seeing actual subsistence users (the Eyak Corporation) involved in re-establishing the subsistence runs.

95093 PWSAC: Restoration of Pink Salmon Resources...
I think some of PWSAC's resources could be used for restoration of wild stocks. However, I think they would be more cost-effectively used if under the context of project 95024.

95124 Tatitlek Mariculture
I support this project as creating a resource. Can the cost be brought down somewhat?

95006 Paint River Pink Salmon Development
While this does create a resource, this project was proposed before the EVOS and has been quite controversial. Since the Paint River itself was not damaged, the Trustees may want to stay away from this controversy.

95112 Rockfish Restoration
Does not restore a resource, just studies it. Part of ADFG normal duties.

Subsistence Projects

I support the following:

95279 Subsistence Food Safety Testing
Since the food supply was safe before EVOS, this project should be funded by the Trustees. This project seems to be more cost effective than 95132.

I do not support:

95138 Elder/Youth Conference

95128 Teaching Subsistence

95136 Skin Sewing

95140 Subsistence Skills program
The above are all projects that could and should be passed from person to person, not through classes and conferences.

95132 Port Graham and Nanwalek Subsistence Baseline
Project 95279 seems to accomplish this for a much lower cost.

95133 English Bay River Red...
I support the concept. However, I have spoken with someone involved with this project, and it appears that the people of English Bay are not willing to work to make this project successful.

95123 Tatitlek Community Store

95129 Tatitlek Fish and Game Smoker

95130 Mental Health Center

95135 Subsistence Harvest Support
The above four projects should be pursued through different agencies.

I remain neutral on the following:

95244 Seals and Sea Otter Cooperative Subsistence Harvest
I seriously doubt that the number of seals and sea otters harvested has really affected the population. Also, seems like a count could be accomplished as part of USFWS duties.

Recreation Projects

I do not support any of the recreation projects. These projects include: 95002, 95016, 95053, 95080, 95082, 95084, and 95085. While some recreation may have been curtailed by the EVOS, increased recreation opportunities will best be accomplished through restoration projects. Also, it seems to me that spending money to bring more people into Prince William Sound will only increase the amount of time it will take for the Sound to be restored. As the Sound is restored, recreation will follow naturally.

Archaeological Resource

I support project 95007B (Archaeological Site Restoration) since the site was physically damaged by spill workers.

Protecting Resources by Reducing Marine Pollution

I support both projects under this category (Project 95115 Sound Waste Management and Project 95417 Waste Oil Disposal Facilities). Ensuring that more oily waste does not enter into the Sound will directly help recovery.

Other General Restoration Projects

I support the following:

95041 Introduced Predator Removal

95038 Symposium on Seabird Restoration
Predator removal seems to be the only project that directly helps to restore bird populations. I support the Symposium as a means to come up with more bird restoration ideas.

95266 PWS Shoreline Assessment...
Support, but cost seems quite high. Can it be brought down?

I do not support:

95042 Five year plan for predator removal
Would like to see 95041 assessed and go through with 95038 before implementing 95042.

95141 Afognak Island State Park Interim Support
Normal agency duties.

95116 Restoration of Intertidal Oiled Mussel Beds...
Agree with Trustees that this should be submitted as RFP.

Remain neutral on:

95052 Community Involvement...
Support the idea of bringing local people together with researchers, however, the cost seems high. Is there a way to accomplish this goal without creating another layer of bureaucracy?

95003 Area E Permit Buyback
This could definitely aid in restoring natural resources by removing the pressure of 25% of the commercial fishing fleet. While I support the concept, it is expensive.

Habitat Protection

I support the following projects:

95126 Habitat Protection and Acquisition Support

95505B Data Analysis for Stream Habitat

95058 Restoration Assistance to Private Landowners

95139C Montague Riparian Rehabilitation

95110-CLO Closeout: habitat protection and acquisition

I do not support the following:

95060 Spruce Bark Beetle Infestation Impacts...
I agree with the Trustees that this project should be funded by ADFG as part of normal agency responsibilities.

Monitoring

Have not had time to look through the monitoring projects.

Restoration Reserve

I am strongly in support of the Restoration Reserve (Project 95424).

I thank the Trustees Council for encouraging input and for making the draft work plan and project descriptions available to the public.

Sincerely,

Kendra Zamzow

Kendra Zamzow
Box 2514
Cordova, AK 99574

Box 2514
Cordova, AK 99574

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ATTN: Draft Fiscal Year 1995 Work Plan

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To [redacted] PHIL JANIK | From DAVID WERNER

Company | Company

Location | Location | Dept. Charge

Fax # 586-7840 | Telephone # | Fax # 424-3863 | Telephone # 424-5567

Comments

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OCT. 3, 1994

OIL SPILL TRUSTEE COUNCIL

GENTLEMEN, IN THE 1930's - 1940 SEA OTTERS WERE A RARE SIGHT IN P.W.S. THEIR POPULATION ESTAMATED AT ABOUT 12 PAIRS!

DURING THE 1920's THRU THE 1950's CORDOV WAS KNOW AS THE RAZOR CLAM CAPITOL OF THE WORLD! THERE WAS ABOUT A DOZEN CLAM CANNERI LOCALLY, MANY FAMILY OWNED. CRABING WAS ALS A LARGE PART OF CORDOVAS ECONOMY. MILLION OF POUNDS OF CRAB AND CLAMS WERE HARVESTED ANNUALLY AND SHIPPED OUT OF THE TERRITORY. BY THE LATE 1950's SEA OTTERS WER ON THE REBOUND BUT STILL SELDOM SEEN BY CORDOVANS. BY THE EARLY 1960's SEA OTTER STARTED APPEARING AROUND CORDOVA. IN 196 CORDOVAS CLAM BEDS WERE DEVASTATED BY THE "64" EARTHQUAKE. 50% TO 70% OF THESE

BEDS WERE CRUSHED OR DIED UP DUE TO THE UPLIFT. BECAUSE THE SEA OTTER WAS PROTECTED THERE WAS NO STOPPING ITS INTRUSION ONTO THE CORDOVA MUD FLATS AND IMMEADIATE AREAS. THEIR POPULATIONS INCREASED DRAMATICALLY WRECKING HAVOC ON THE REMAINING CLAM BED COMMERCIAL CLAMING WAS STOPPED. AS THE OTTERS MAIN FOOD SOURCE DWINDLED THEY TURNED TO FEEDING ON CRABS, ETC.

SOON COMMERCIAL CRABING WAS STOPPED. TODAY, 30 YEARS LATER, CRABING IS STILL CLOSED. THE CLAM BEDS ARE ALL BUT GONE AND THE LOCAL SEA OTTER POPULATION HAS SOARED TO AN ESTIMATED 4000 STRONG! CORDOVANS LIFE STYLE HAS CHANGED FOREVER. NO LONGER ARE CLAMS AND CRAB MEAT PART OF OUR EVERY DAY DIET! WE HAVE ALSO LOST MILLIONS OF DOLLARS ANNUALLY FROM THIS ONCE VIABLE AND SUSTAINABLE SOURCE.

THEREFORE, WE WOULD LIKE TO MAKE A PROPOSAL TO REVERSE THIS TRAGIC TREND.

PART I: WITH THE LOSS OF THOUSANDS OF SEA OTTER DUE TO THE OIL SPILL, WE PROPOSE TRANSFERRING ALL BUT ABOUT 300 SEA OTTERS FROM THE CORDOVA AREA TO THE CENTRAL AND SOUTHERN PORTIONS OF P.W.S.

PART II: RESTOCKING OUR RAZOR CLAM BEDS WITH STOCK FROM, SAY, TURNAGAIN ARM BEDS, AND RESTOCKING DUNGENESS CRAB, FROM, SAY, CAPE YAKATAGA AREAS.

THANK YOU FOR CONSIDERATION OF THIS PROPOSAL.

SINCERLY,

CORDOVAN OLD TIMERS

The National Outdoor Leadership School
P.O. Box 981, Palmer, Alaska 99645
(907) 745-4047

Don Ford
Alaska Branch Director

EVOS Trustee Council
645 G Street
Anchorage, Alaska 99501

October 1, 1994

Re: Fiscal Year 1995 Work Plan

Thank you for the opportunity to comment on the Fiscal Year 1995 EVOS Work Plan. Our concerns specifically relate to the Trustee Council's interpretation of the "Leave No Trace " education project #95002 and the "Recreation Impacts in Prince William Sound" research project #95077. Both of the proposed projects are designed to benefit Prince William Sound injured resources not the associated services.

In the comprehensive, balanced, ecosystem approach endorsed by the Trustees, the potential adverse affect of human impact can not be dismissed. Table 1 of the Draft 95 Work Plan Summary identifies wilderness areas as a resource for which scientific research has demonstrated a population level injury or a continuing sublethal effect as a result of the spill. Changes in the traditional recreation patterns and locations caused by the spill mean that formerly pristine or infrequently used areas are now receiving heavier use. Additionally, with increase notoriety as a result of the spill, more people are coming to the Sound. The effect of this increased and concentrated recreational use on Prince William Sound's Wilderness Study Area can be mitigated through education using common themes and valid research.

Secondly, while proposals for the acquisition of specific parcels of land are not the subject of this draft work plan, we continue to support habitat protection and acquisition as a vital restoration tool .

In particular, NOLS is concerned that the area in the Southwest part of Prince William Sound not be overlooked when making acquisitions. The area was the hardest hit of all the impact area, and has tremendous value for wilderness based tourism and damaged resources. We encourage the Trustees to acquire either title and surface/subsurface rights, or surface/subsurface rights with stipulations protecting from further development, of private lands in the following areas:

Dangerous Passage
East side of Knight Island
Bainbridge/Evans/LaTouche Islands
South end of Knight Island
Chenega Island

We appreciate your efforts in soliciting public input and look forward to the completion of the Final Restoration Plan.

Sincerely,

Don Ford
Director, NOLS Alaska

The National Outdoor
Leadership School
P.O. Box 981
Palmer, Alaska 99645

NOLS

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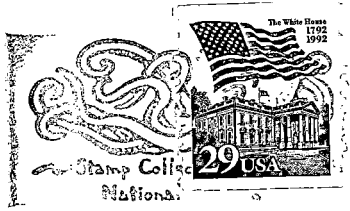
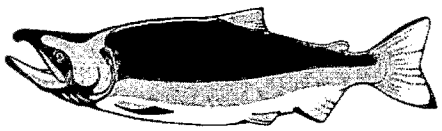
1994



RECEIVED
OCT 03 1994
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

Exxon Valdez Oil Spill Trustee Council
645 G Street
Anchorage, Alaska 99501

Attn: Draft Fiscal Year 1995 Work Plan



NERKA, Incorporated

PO Box 80165
Fairbanks, Alaska 99708
(907) 479-2476 September 26, 1994

Exxon Valdez Oil Spill Trustee Council
645 G Street
Anchorage, Alaska 99501

REGARDING: Draft Fiscal Year 1995 Work Plan

I have received the "Draft Fiscal Year 1995 Work Plan Summary" and would like to comment on our project No. 95079, "Pink Salmon Restoration through Small-Scale Hatcheries", which was rated in Category 4.

We are not aware of the legal ramifications of using a non-profit hatchery for aiding in salmon restoration, but presumably one aspect of an EIS would be to determine the impact of the hatchery on wild stocks. That is just the issue we plan on addressing, and propose an environmentally and genetically compatible system to enhance and increase the local pink salmon runs. Our project appears very similar to Numbers 95024 and 95069, which rate a Category 2. These projects emphasize incubation boxes, while we propose a small hatchery which would also simulate natural production and, in addition, incorporates a major research component to gain an understanding of hatchery-wild fish interaction. We use the term "hatchery" in a general sense, and might find it advantageous, with agency approval, to begin with incubation boxes building the wild stocks sufficient to justify a hatchery operation. All three projects appear very compatible from my review of the summary information, and all would contribute to restoration of wild pink salmon stocks in Prince William Sound.

Although the large hatcheries had good returns in 1994, from preliminary information the wild escapement was still poor. As of late August, we counted only 600 fish in the Perry Island South Bay streams -- extremely low for the even-year cycle, pointing up a continuing problem with our wild stocks and the need for additional research and restoration.

Jack M. Van Hyning

Jack M. Van Hyning
Box 80165
Fairbanks, AK 99708-0165

FAIRBANKS AK
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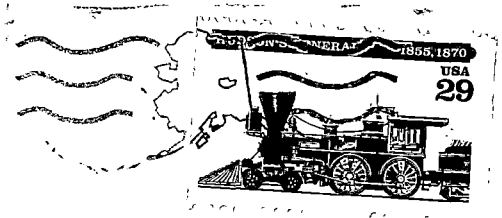

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SEP 28 1994
EXXON VALDEZ OIL SPILL
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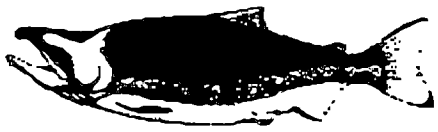
EXXON VALDEZ oil Spill Trustee Council
645 G St.
Anchorage, AK 99501



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Jack M. Van Hyning

Juneau Center
School of Fisheries and Ocean Sciences

University of Alaska Fairbanks
11120 Glacier Highway
Juneau, Alaska 99801

(907) 465-6441 Office
(907) 465-6447 FAX

September 28, 1994

To: EVOS Trustee Council
Fr: Michael S. Stekoll, Juneau Center School of Fisheries and Ocean Sciences, University of Alaska, Juneau, AK
Lawrence Deysher, Coastal Resources Associates, Inc., Vista, CA
Re: Proposed Project 95086A Coastal Habitat Intertidal Monitoring and Experimental Design Verification.

We are concerned that there is a misunderstanding of the purposes of the proposed experimental design verification as part of the above proposal. We have drafted a rationale for this aspect of the project and present it below.

Rationale for Experimental Design Verification of the Coastal Habitat Intertidal Monitoring Project

The optimal design for environmental impact monitoring requires that samples be taken at impacted and reference stations both before and after a disturbance event (Green, 1979; Stewart-Oaten et al, 1986). This process is a BACIP (Before-After, Control-Impact Pairs) design. It is very difficult, if not impossible, to obtain data for the "before" period at impact sites in unpredictable events such as an oil spill in Prince William Sound. Very few of the studies on the effects of the EVOS have been able to use this design due to the lack of pre-spill data. Therefore, the study design for the intertidal and subtidal injury assessments utilized sampling at pairs of oiled and reference sites for the after period to infer injury to biological resources. This process is an ACIP (After Control-Impact Pairs) design (Dean et al., 1993). Correct interpretation of the results produced from this design is based on the assumption that oiled and reference sites would not have differed if the oiled spill had not occurred.

The damage assessment studies for both intertidal and subtidal habitats have found consistent differences between oiled and control sites that have now persisted for 5 years. The percent cover of *Fucus* in the mid to upper intertidal of Prince William Sound, for example, has been consistently higher at control sites than at oiled sites. In subtidal habitats, *Musculus* density on eelgrass has been consistently higher at oiled sites. Without pre-spill data, it is difficult to establish whether these differences represent long term impacts of the spill, or whether they represent inherent differences among sites. For example, in the case of *Musculus* density, these types of inherent differences could

be due to subtle differences in the predominant wind and current conditions within the Sound that were responsible for bringing oil to the oiled and not to the control sites. These same wind and current conditions may also be responsible for bringing higher concentrations of *Musculus* larvae to the same beaches.

The assumption of this ACIP design that the oiled and control sites were the same before the spill has been criticized in peer reviews of publications we have written on the injury assessment data and has been recognized as a potential problem in defining damage and recovery in the "Invitation to Submit Restoration Proposals." There are essentially two ways to address this issue. First, long-term monitoring of resources could be conducted to determine if the resources at oiled and reference sites "converge" in the future. This approach suffers from the fact that convergence may take a long time, or may never occur if some alternate stable state has been achieved after the spill. State and Federal agencies, however, are faced with the decision to expend resources to restore these injured populations. These restoration resources could be best utilized if we had an immediate and conclusive answer to the question of damage assessed by the ACIP study design. An answer to this question could be obtained with an independent test of the process by which the control sites were matched with the controls. This independent test would demonstrate whether there were any inherent biases in the pairing process and whether the population differences we are still seeing are due to damage by the oil spill.

The site verification aspect of the proposal is a critical part of the entire Coastal Habitat project. Without this verification, results and conclusions from the data collected by the damage assessment of the nearshore must always be qualified by the prospect that oiled and control sites are inherently different.

MICHAEL S. STEKOLL
Juneau Center
School of Fisheries and Ocean Sciences
University of Alaska Fairbanks
11120 Glacier Highway
Juneau, Alaska 99801

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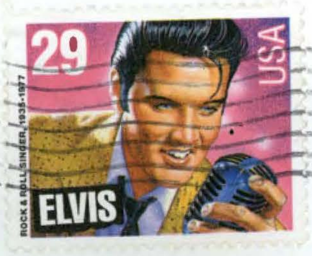

Exxon Valdez Oil Spill Trusteee Council
645 G Street
Anchorage, AK 99501
Attn: Draft Fiscal Year 1995 Work Plan

give a copy
of these to
Spies, then
add to wk
plan comments

School of Fisheries and Ocean Sciences

UNIVERSITY OF ALASKA FAIRBANKS
Fairbanks, Alaska 99775-1080

9 September 1994

To: Eric Myers
Alaska Dept. Fish and Game
EVOS Trustee Council
645 G Street, Suite 401
Anchorage, AK 99501-3451

From: Tom Kline
PWS Science Center
c/o IMS-SFOS
Univ. Alaska
Fairbanks, AK 99775
tel 907-474-5675
fax 907-474-7204

Re: FY95 p roposed project 95114 "Eelgrass community structure restoration assessment using stable isotope "

Per our tel
information
categorized
should ins
Additional
isotopes a
project as
Jewett's
genesis
relating
during disc

C. R. Spies
S. Jewett

Rebecca - This is the hard-copy original (w/ an attachment) of the letter I gave you earlier - a comment on the FY 95 Draft Work Plan ... Please file with the other one. (When we see how many we get, we'll decide what further analysis or processing is needed) Thank you ERK

Reprint on stable Botope research FYI

School of Fisheries and Ocean Sciences

UNIVERSITY OF ALASKA FAIRBANKS
Fairbanks, Alaska 99775-1080

9 September 1994

To: Eric Myers
Alaska Dept. Fish and Game
EVOS Trustee Council
645 G Street, Suite 401
Anchorage, AK 99501-3451

From: Tom Kline
PWS Science Center
c/o IMS-SFOS
Univ. Alaska
Fairbanks, AK 99775
tel 907-474-5675
fax 907-474-7204

Re: FY95 proposed project 95114 "Eelgrass community structure restoration assessment using stable isotope tracers"

Per our telephone conversation, I am sending the following information. In the Draft FY 1995 Work Plan, project 95114 is categorized in Appendix B on page B-16 as an intertidal project. It should instead be categorized as a subtidal project on page B-30. Additionally, project 95114 should be listed as a project using stable isotopes as the primary methodology on page 19 (chapter 2). This project as stated in the proposal is designed to piggy-back on Steve Jewett's project 95106 (by sharing research platform logistics). The genesis of 95114 (i.e., using stable isotopes to answer questions relating to recruitment of EVOS-affected subtidal species) came about during discussions while working on our other collaborations.

C. R. Spies
S. Jewett

Reprint on stable Botope research FYI

School of Fisheries and Ocean Sciences

UNIVERSITY OF ALASKA FAIRBANKS
Fairbanks, Alaska 99775-1080

9 September 1994

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To Eric Myers	From Tom Kline
Co. ADF&G - EVOS TC	Co.
Dept.	Phone # 474-5675
Fax # 276-7178	Fax # 474-7204

To: Eric Myers
Alaska Dept. Fish and Game
EVOS Trustee Council
645 G Street, Suite 401
Anchorage, AK 99501-3451

From: Tom Kline
PWS Science Center
c/o IMS-SFOS
Univ. Alaska
Fairbanks, AK 99775
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TRUSTEE COUNCIL
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SEP 08 1994

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C. R. Spies
S. Jewett

Am sending hard copy with a reprint also.

Recycling of Elements Transported Upstream by Runs of Pacific Salmon: II. $\delta^{15}N$ and $\delta^{13}C$ Evidence in the Kvichak River Watershed, Bristol Bay, Southwestern Alaska[1]

Thomas C. Kline, Jr., John J. Goering, Ole A. Mathisen, and Patrick H. Poe

School of Fisheries and Ocean Science, University of Alaska Fairbanks, AK 99775-1080, USA

and Patrick L. Parker and Richard S. Scalan

Marine Science Institute, University of Texas at Austin, Port Aransas, TX 78373, USA

Kline, T.C. Jr., J.J. Goering, O.A. Mathisen, P.H. Poe, P.L. Parker, and R.S. Scalan. 1993. Recycling of elements transported upstream by runs of Pacific salmon: II. $\delta^{15}N$ and $\delta^{13}C$ evidence in the Kvichak River watershed, Bristol Bay, southwestern Alaska. Can. J. Fish. Aquat. Sci. 50: 2350–2365.

Biota $\delta^{15}N$ and $\delta^{13}C$ values (deviations from recognized isotope standards) from Iliamna Lake (a major anadromous sockeye salmon (*Oncorhynchus nerka*) nursery lake supporting peak-year runs >10 million) and several other anadromous-salmon-free lakes in the Kvichak River watershed, Bristol Bay, southwestern Alaska, were compared to determine the significance of marine-derived nitrogen (MDN) delivered by returning adult salmon. Biota In Iliamna Lake had higher $\delta^{15}N$ compared with control lakes, verifying a mixing model correlating $\delta^{15}N$ with MDN. Periphyton $\delta^{15}N$ values reflected localized input from populations of spawning salmon. Juvenile sockeye MDN varied in response to escapement size, suggesting the importance of large escapements (>10 million) for maintaining a predominantly MDN lacustrine N pool. Other resident fishes showed shifts in $\delta^{15}N$ between years of high and low escapement. The dual-isotope approach, using $\delta^{15}N$ and $\delta^{13}C$ together, suggested that fish production is primarily dependent on limnetic primary and secondary production. The dual-isotope approach indicated that the coast range sculpin (*Cottus aleuticus*) was the only fish with an appreciable dietary component consisting of salmon eggs or emergent fry.

Les teneurs en $\delta^{15}N$ et $\delta^{13}C$ (écarts des étalons d'isotope reconnus) du biote du lac Iliamna (lac pépinière important pour le saumon rouge anadrome (*Oncorhynchus nerka*) qui connaît des remontes maximales de >10 millions) et plusieurs autres lacs ne contenant pas de saumons anadromes dans le bassin hydrographique de la rivière Kvichak (baie Bristol), dans le sud-ouest de l'Alaska, ont été comparées afin d'établir l'importance de l'azote d'origine marine apporté par des saumons adultes au moment de la remonte. Les teneurs en $\delta^{15}N$ du biote du lac Iliamna étaient plus élevées que celle de lacs témoins ce qui vérifie un modèle de brassage établissant une corrélation entre la teneur en $\delta^{15}N$ et l'azote d'origine marine. Les teneurs en $\delta^{15}N$ du périphyton reflétaient un apport localisé de populations de saumons reproducteurs. La teneur en azote d'origine marine chez les juvéniles de saumon rouge variait en fonction de la taille de l'échappée ce qui semble indiquer l'importance de grandes échappées (>10 millions) pour maintenir une réserve d'azote d'origine marin dans un lac. Les teneurs en $\delta^{15}N$ chez d'autres poissons résidants présentaient des variations entre les années à échappée élevé et faible. Le recours à ces deux isotopes, $\delta^{15}N$ et $\delta^{13}C$, semblait indiquer que la production de poisson dépend surtout de la production limnétique primaire et secondaire. L'approche par ces deux isotopes a montré que le chabot côtier (*Cottus aleuticus*) était le seul poisson dont le régime alimentaire comprenait une quantité appréciable d'oeufs de saumons ou d'alevins émergents.

Received May 21, 1991
Accepted May 31, 1993
(JB045)

Reçu le 21 mai 1991
Accepté le 31 mai 1993

Returning semelparous anadromous Pacific salmon, (*Oncorhynchus* spp.) have been shown by the measurement of the natural abundance of stable isotopes technique to be a significant nitrogen (N) source for Sashin Creek, a rapidly flushing southeastern Alaska stream (Kline et al. 1990). Ecological investigations based on the stable isotope biogeochemistry of biophilic elements hinge on the presence of an isotopic disparity between potential sources that can be detected at higher trophic levels (Wada and Hattori 1991). Biogenic N from returning anadromous Pacific salmon, virtually 100% marine in origin, has been shown to be isotopically distinguishable from terrestrial and freshwater N (most likely derived from fixation of atmospheric N_2) in Sashin Creek (Kline et al. 1990). Biota in the section of Sashin Creek available to spawners was found to be enriched with the heavy N isotope, ^{15}N, when compared with biota found in the section that was upstream of a 30-m waterfall (a barrier to anadromous salmon migration). The marine N isotopic signature was conserved through the process of decomposition and remineralization into Sashin Creek food webs. This was, in part, due to the large difference in $^{15}N/^{14}N$ in returning salmon compared with that in the terrestrial environment. Because environmental conditions that could lead to ^{15}N enrichment by ammonia volatilization (high NH_4^+ and high pH)

[1]Contribution No. 973, Institute of Marine Science, University of Alaska Fairbanks, Fairbanks, AK 99775-1080, USA.

ROGER, P.B. 1971. The ecology of two species of cottids in Iliamna Lake, Alaska, and their relation to sockeye salmon. M.S. thesis, University of Washington, Seattle, Wash. 80 p.

WADA, E., AND A. HATTORI. 1991. Nitrogen in the sea: forms, abundances, and rate processes. CRC Press, Boca Raton, Fla. 208 p.

WADA, E., H. MIZUTANI, AND M. MINAGAWA. 1991. The use of stable isotopes for food web analysis. Crit. Rev. Food Sci. Nutr. 30: 361–371.

WADA, E., M. TERAZAKI, Y. KABAYA, AND T. NEMOTO. 1987. ^{15}N and ^{13}C abundances in the Antarctic Ocean with emphasis on the biogeochemical structure of the food web. Deep-Sea Res. 34: 829–841.

WELCH, D.W., AND T.R. PARSONS. 1993. $\delta^{13}C$–$\delta^{15}N$ values as indicators of trophic position and competitive overlap for Pacific salmon (*Oncorhynchus* spp.). Fish. Oceanogr. 2: 11–23.

WILLIAMSON, F.S.L., AND L.J. PEYTON. 1962. Faunal relationships of birds in the Iliamna Lake area, Alaska. Biol. Univ. Pap. Alaska. No. 5: 72 p.

YOSIOKA, T., E. WADA, AND Y. SAIJO. 1989. Isotopic characterization of Lake Kizaki and Lake Suwa. Jpn. J. Limnol. 49: 119–128.

or denitrification (low O_2) are toxic to salmonid fishes, these processes are unlikely to occur where large populations of juvenile salmonids rear; hence, elevated ^{15}N can be ascribed to marine-derived N (MDN) input. The Sashin Creek study established the stable isotope abundance technique as a tracer of MDN in lotic Pacific salmon freshwater systems. This concept is extended in this study to a lentic system, Iliamna Lake, the primary sockeye (*Oncorhynchus nerka*) nursery lake in the Kvichak River system, where it has been previously established that salmon can be a major source of phosphorus (P) (Donaldson 1967).

It has been suggested that returning salmon can be a significant nutrient source to sockeye salmon nursery lakes (Juday et al. 1932; Barnaby 1944; Donaldson 1967; Krohkin 1967; Mathisen 1972; Koenings and Burkett 1987a) that are typically oligotrophic (Burgner et al. 1969; Hyatt and Stockner 1985). Nutrient release from fishes through excretion and decomposition has been identified as a top-down effect of fish on freshwater ecology (Northcote 1988). In the case of anadromous Pacific salmon, the terminal return migration can be viewed as an upstream vector of allochthonous nutrients from the marine environment. In this study, the use of variation in natural abundance of $^{15}N/^{14}N$ is applied to Iliamna Lake in the Kvichak River watershed, a major Alaskan sockeye-salmon-producing lake. Part of this study was similar to our Sashin Creek study in that control sites free of anadromous salmon were compared with sites within a spawning system. However, temporal and spatial variation in spawning density, longer residence time of salmon adults and carcasses, and the longer flushing time of the system were expected to add complexity. Of special significance was that the period of sampling, 1985–87, corresponded to a decline in the number of salmon returning to spawn in the Kvichak watershed. This made it possible to test the hypothesis that variation in escapement could result in significant changes in the nutrient budget important for the growth and survival of juvenile salmon.

The Kvichak System

The Kvichak River watershed has been the largest producer of sockeye salmon to the Bristol Bay, Alaska, sockeye fishery. Maturing sockeye salmon ascend the Kvichak River in late June – early July to spawn in Iliamna Lake and its tributaries. The annual escapement (enumerated by the Alaska Department of Fish and Game Commercial Fisheries Division and previous fisheries research agencies at a counting site on the Kvichak River just downstream from Iliamna Lake) has ranged from 225 000 to 24 million since World War II. The number of salmon returning to spawn has historically cycled with a 4- or 5-year period in the Kvichak system (Eggers and Rogers 1987). Several hypotheses have been developed to explain the occurrence of this so-called cyclic dominance in certain anadromous salmon systems (Foerster 1968; Mathisen 1972; Collie and Walters 1987; Eggers and Rogers 1987). Mathisen (1972) suggested that biogenic nutrient feedback from large escapements could play a role in maintaining the peak cycle years in the Kvichak system. Conversely the small escapements in off-years could not sustain or build up the off-year runs. Through simulation modeling, Eggers and Rogers (1987) showed that sockeye population cycling is intrinsic in the Kvichak system. Furthermore, they found that fishing is depensatory, amplifying the cycle and creating the strong peaks. Thus, one objective of this study was to determine whether a response, in terms of MDN related to the size of escapement, could be detected in juvenile salmon. If larger escapements result in a proportional increase of MDN in juvenile sockeye compared with smaller escapements, then it could be argued that other N sources are of less importance for large juvenile sockeye populations. By extension, the productivity of the ecosystem could be seen as being density dependent with respect to sockeye escapement. Thus, a system's sockeye production may be determined as much as by the number of decomposing carcasses as the number of eggs deposited into redds by the spawning adults because both are necessary for growth and survival of the progeny.

TABLE 1. Estimations of the N pool associated with the annual spawning migration to Iliamna Lake (escapement data from the Alaska Department of Fish and Game, King Salmon, Alaska) based on N composition of returning sockeye (Mathisen et al. 1988) and the dissolved N pool in the lake (from Poe 1980).

Datum	Number of salmon (10^6)	N pool (10^9g)
1983	3.6	0.3
1984	10.6	0.8
1985	7.2	0.5
1986	1.2	0.1
1987	6.1	0.5
1971–80 mean	6.2	0.5
1981–90 mean	5.1	0.4
N dissolved in Lake		4.8
Annual N flushed		0.7

N Mass Balance in Iliamna Lake

The N pool associated with the annual spawning migration is comparable in size with the dissolved N pool lost by flushing in Iliamna Lake, suggesting the importance of adult salmon N to the N budget (Table 1). Mathisen et al. (1988) estimated that each returning mature sockeye transports 73.2 g of N at point of entry into Iliamna lake. A relatively small number of salmon returning to spawn, e.g., 1 million, would result in an input of 7.32×10^7 g of N. In comparison, a large number, e.g., 15 million, would bring in 1.1×10^9 g of N. These values are comparable with the mean of the estimated total dissolved N pool (as $NO_3^- + NO_2^-$) in Iliamna Lake of 4.8×10^9 g of N (range 2.4×10^9 to 9.7×10^9 g), (Poe 1980). He included one estimate of the dissolved N pool in winter when most of the dissolved N should have been remineralized to NO_3^-. The winter estimate made in March 1976 was 9.7×10^9 g of N ($NO_3^- + NO_2^-$) based on the nutrient profile taken at the upper end of Iliamna Lake (Poe 1980). Assuming that the concentration of dissolved N in the lake outflow equals the mean for the lake, then the annual N loss through flushing, based on the 7.2-yr flushing time, is 0.7×10^9 g using the mean of Poe's (1980) dissolved N estimates, or 1.3×10^9 g using the winter 1976 estimate of the total dissolved N pool. The N input in a peak-year (e.g. 1984, Table 1) spawning migration is equivalent to 50–100% of the estimated annual N pool loss by flushing. This is in agreement with Donaldson's (1967) estimate that a peak-year input of marine P supplies >50% of the lake P pool. The emigration of sockeye smolts also removes N from the lake. However, the smolt biomass is about 1–2 orders of magnitude smaller than the adult immigration biomass, so the smolt component is small in terms of the N budget in a first-order analysis. However, they could be relatively important in small-escapement years if many smolts are emigrating. In these cases, smolt biomass could be equivalent to adult biomass. Thus, this nutrient loss would be barely maintained by new MDN input.

TABLE 2. Physical characteristics of Iliamna Lake, Alaska (from Poe 1980).

System characteristic	Dimension
Surface area	2622 km^2
Catchment basin[a]	20720 km^2
Volume	117 km^3
Maximum depth	393 m
Mean depth	44.1 m
Maximum length	125 km
Maximum width	65 km

[a] Includes Lake Clark with a catchment basin of 9583 km^2.

Estimations of the MDN input during the course of this study, averages for the two most recent decades, and dissolved N pool in Table 1 suggest that salmon N input can be the equivalent of the N pool loss through flushing and thus should be important in maintaining a steady-state nutrient pool in the lake. The above analysis, basically a mass-balance approach, only provides indirect evidence that returning salmon deliver significant quantities of nutrients important to freshwater ecosystems. The advantage of the natural stable isotope abundance technique is that the $^{15}N/^{14}N$ and $^{13}C/^{12}C$ signatures can be traced directly in ecosystem components, i.e., the biota, providing direct and quantitative evidence of the flow of nutrients from different sources. This paper is a continuation of the development of this technique in salmonid freshwater habitats that was initiated in Sashin Creek (Kline et al. 1990).

Timing of Events Related to Iliamna Lake N Pools

Because migrating salmon stop feeding prior to reentry into freshwater, all subsequent energy and nutritional requirements have to be internally derived from elements previously acquired from the marine environment. Elements lost through excretion, spawning, and eventually decomposition are thus marine derived.

Spawning commences in early August and continues until October. Although carcasses do not appear until mid-August, excretion by adult salmon during the final part of gametogenesis, in freshwater, is a potential source of dissolved nutrients (Mathisen et al. 1988). Comparison of the elemental composition of adults sampled upon entry into freshwater with newly spent salmon showed that a significant quantity (30%) of N is lost as excretion and gametes (Mathisen et al. 1988). Spawning occurs in small streams, rivers, and springs that drain into Iliamna Lake and several tributary lakes. Spawning also occurs at many lake beach sites. An ROV (remotely operated vehicle) survey of several Iliamna Lake beach spawning sites in early July, 1988 revealed the presence of incompletely decomposed sockeye carcasses at 20–50 m depth, suggesting the potential for nutrient input for a period of more than 8 mo beyond the termination of spawning.

Emergence of fry from the gravel occurs in the spring. Initial feeding occurs in the littoral zone of the nursery lakes. By August, all fry are in the limnetic zone where they forage on zooplankton until migrating out to sea as 1- or 2-yr-old smolts. Limnetic feeding in Iliamna Lake by sockeye fry (young-of-the-year) and yearlings (age 1+) is selective on the cladoceran *Bosmina* and the copepod *Cyclops*, respectively (Hoag 1972).

Characteristics of Iliamna Lake

Iliamna Lake (59°N, 155°W) is the largest freshwater body in Alaska (Table 2). The Iliamna Lake environment includes areas of both coastal and continental climates and is characterized by strong winds (Williamson and Peyton 1962). Summers are typically wet and winters are dry. Lake level fluctuates, with the peak occurring in September and declining to a minimum in April–May (Donaldson 1967; Poe 1980). Most of the flushing takes place during the summer and fall when ~20% of the lake volume drains out the Kvichak River during high water (Donaldson 1967). Strong winds maintain a deep mixed layer, with the result that the lake is poorly stratified. Iliamna Lake is usually ice covered from January to May (Poe 1980). A peak in the nutrient concentration profile just below the ice in March suggests a possible input from leaching of previous periphyton blooms exposed during low water and the effect of subice stratification (P.H. Poe and W.S. Reeburgh, unpublished data). Iliamna Lake is classified as oligotophic (Burgner et al. 1969). Limnetic summer primary productivity has been estimated as 142–213 mg $C \cdot m^{-2} \cdot d^{-1}$ (Low 1972). The human population in the area is <1000, so anthropogenic input of N is small (much of it is salmon derived, as salmon play a major part in the local nutrition).

The Kvichak system, in addition to being an important nursery for sockeye salmon, supports ~25 resident fish species (R. Russell, Alaska Department of Fish and Game, King Salmon, Alaska, personal communication). An aspect of this project was the comparison of $^{15}N/^{14}N$ in food webs of systems without anadromous salmon with those impacted by anadromous salmon (Kline et al. 1990). To this end, comparisons were made between isotopic signatures of fishes of the same species in both salmon and nonsalmon lakes. The following species in lakes of the Kvichak watershed were compared: coastrange sculpin (CRS) (*Cottus aleuticus*), threespine stickleback (3SP) (*Gasterosteus aculeatus*), ninespine stickleback (9SP) (*Pungitius pungitius*), rainbow trout (RBT) (*Oncorhynchus mykiss*), and Dolly Varden (DV) (*Salvelinus malma*). One Arctic Char (*Salvelinus alpinus*) sampled at Kakhonak Lake was included with the DV data. Identification of *Salvelinus* was based on gillraker count (McPhail and Lindsey 1970).

Materials and Methods

Sites

Sampling in the Kvichak River watershed was concentrated near the major sockeye spawning grounds in the eastern end of Iliamna Lake and in nearby nonsalmon control lakes. Iliamna Lake sampling was done at established stations (Donaldson 1967; Mathisen 1972; Poe 1980) and at additional selected sites (Fig. 1).

Five established littoral zone sampling stations (Mathisen 1972; Poe 1980) were supplemented by seven additional stations and sampled during most visits. Littoral stations were classified in relation to proximity to, and density of, beach spawning. Three stations located where large colonies of sockeye spawn (thousands of spawners) were classified as high density (HDN). Two stations adjacent to medium-sized (hundreds of spawners) or small colonies of spawners (<100 spawners), depending on year, were classified as low density (LDN). Four other stations >1 km away from spawning areas, but located where carcasses could drift in, were classified as drift sites (DRF). A spring-fed pond, Knutson Spring (KSP), used as a spawning site was sampled because of abundant blue-green algae. Another station, located

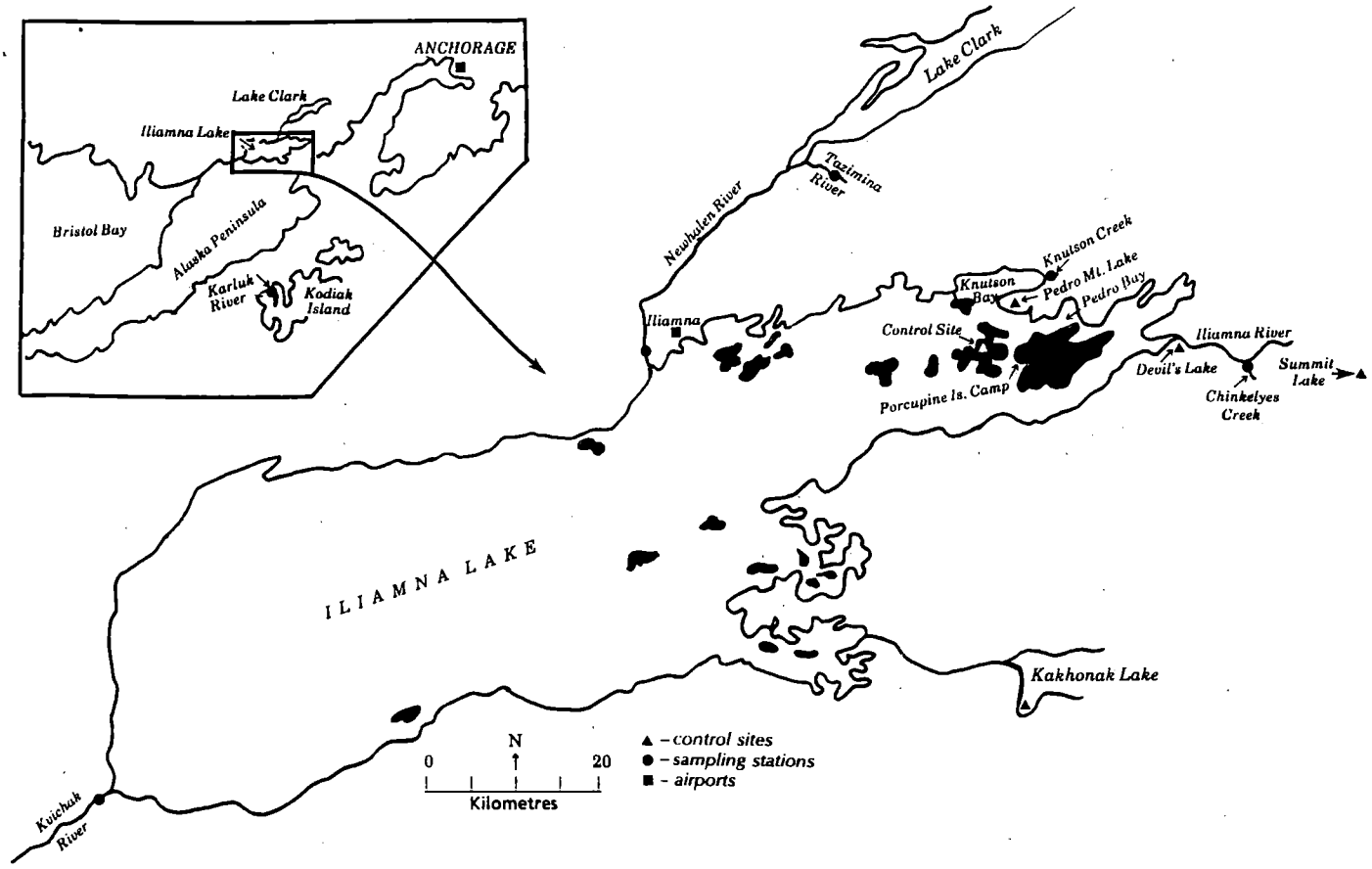

FIG. 1. Map of Iliamna Lake area showing geographical locations mentioned in text. Sites where adult salmon were sampled are indicated by circles. Knutson Spring is located adjacent to the mouth of Knutson Creek. Control sites are indicated by triangles. Towns with airports are indicated by squares. Islands within Iliamna Lake are black for clarification.

within the intricate channels of an island in the middle of Iliamna Lake, was classified as a control site within Iliamna Lake (Fig. 1). This control site, also used as a control in a previous periphyton study (Mathisen 1972), supplemented the non-anadromous salmon lakes that collectively were classified as controls (CTL).

Limnetic sampling was conducted at stations in Iliamna Lake established since the 1960s by the University of Washington Fisheries Research Institute. These included plankton tows at stations that are representative of the middle and upper portions of Iliamna Lake where many of the juvenile salmon rear, and tow-net sampling on established cruise tracks running through Knutson and Pedro bays in the northeastern part of the lake for limnetic fish (primarily juvenile sockeye salmon). Additional opportunistic sampling was also done at numerous locations in the watershed.

A small (~40 ha) salmon-free lake, located near the mouth of the Iliamna River, known as "Devil's Lake" by the residents of Pedro Bay, was established as a control site for repeated sampling throughout the course of this study. Other control lakes that had limited accessibility, Kakhonak Lake, Pedro Mountain Lake, and Summit Lake (Fig. 1), were sampled once each to extend the control lake $\delta^{15}N$ baseline. These control sites, although part of the Kvichak watershed, have no anadromous salmonids because of impassable waterfalls (Demory et al. 1964). Littoral zone samples collected in these lakes were compared with samples from the Iliamna Lake littoral stations classified as HDN, LDN, and DRF.

Sampling Schedule

RETURNS (Recycling of Elements Transported Upstream by Runs of Pacific Salmon) project sampling was conducted over a 2-yr period, 1985–86. A few samples were collected during a 1983–84 pilot study. A single visit in August of 1987 was made to sample a few Iliamna Lake sites using scuba to obtain subsurface littoral biota and to sample at Kakhonak Lake for fishes, periphyton, and plankton. Personnel of the Commercial Fisheries Division, Alaska Department of Fish and Game, collected smolts during their annual emigration studies at the outlet of Iliamna Lake. The multiyear sampling program at Iliamna Lake allowed for comparison of MDN among years that exhibited a large range in escapement (10.2, 7.2, and 1.2 million in 1984, 1985, and 1986, respectively). A visit made to Iliamna Lake in early July 1988 to conduct an ROV survey provided an opportunity to collect a few additional samples including adults from the Newhalen River. In 1988, we had the opportunity to sample adults from another system (Karluk River on Kodiak Island, see Fig. 1).

Field and Laboratory Methods

Collection and sample preservation methods (desiccation over silica gel or freezing at –20 °C) have been described by Kline et al. (1990). Monofilament gill nets, tow nets, baited minnow traps, and angling were used to sample resident fishes. Vertical and diagonal tows with 73-, 130- and 223-μm-mesh, 0.5-m-diameter nets were used to collect plankton. A slurp gun was used for sampling while scuba diving or snorkeling at littoral sites.

Migrating adult sockeye were seined from the Kvichak River (Mathisen et al. 1988). Fully mature (unspawned) and spawned-out salmon were collected in beach seines at spawning sites (Mathisen et al. 1988). Adult sockeye salmon samples were prepared in one of three ways for analyses. (1) Whole salmon homogenized for chemical analyses (Mathisen et al. 1988) were shipped frozen to Fairbanks and then freeze-dried like other samples (see above). (2) Individual carcasses were dissected in the field laboratory to remove selected tissues and organs. These small tissue and organ samples (~1 g wet weight) were frozen in the field prior to shipment to Fairbanks and treated like other samples. (3) Migrating adults from the Newhalen River in the Kvichak system and from the Karluk River on Kodiak Island were sampled to compare isotopic variation between and among sockeye salmon of these two runs. Based on conclusions drawn from the tissue samples, two specific tissues, muscle and whole gonad, were dissected and frozen as in (2) in the group (3) samples. The muscle tissue was dissected out of a transverse section located just behind the head. The group (3) samples consisted of all the sockeye salmon netted or trapped at the site at the time of sampling. The salmon collected for whole-fish analysis, group (1), were stratified by sex and ocean-age on site.

Laboratory preparation and mass spectrometry were performed as described by Kline et al. (1990). Selected samples were also analyzed at the University of Texas (Austin) Marine Science Institute, Port Aransas, Tex., using either a VG micromass 602E or Nuclide 6-60 RMS-26 stable isotope ratio mass spectrometer with similar preparation methods. Stable isotope ratios are reported relative to international standards (air for N and Pee Dee Belemnite (PDB) limestone for C) in standard delta notation:

$$(1)\quad \delta^{15}\mathrm{N}\ \text{or}\ \delta^{13}\mathrm{C} = \left(\frac{R_{\text{sample}}}{R_{\text{standard}}} - 1\right) \times 1000\ \text{per mil}$$

where $R = {}^{15}\mathrm{N}/{}^{14}\mathrm{N}$ or ${}^{13}\mathrm{C}/{}^{12}\mathrm{C}$ (after Craig 1957). The isotope standards have delta values of 0 by definition, i.e., $\delta^{15}\mathrm{N} = 0$ for atmospheric N_2. Naturally occurring $\delta^{15}\mathrm{N}$ and $\delta^{13}\mathrm{C}$ values observed in biota range from ~0 to ~+20 and from ~0 to ~−50, respectively. The negative $\delta^{13}\mathrm{C}$ values reflect the relative enrichment of $^{13}\mathrm{C}$ in limestone compared with biota.

Data Analysis

Estimating MDN

The $\delta^{15}\mathrm{N}$ values of biota are dependent on two factors: (1) the $\delta^{15}\mathrm{N}$ of the N source(s) and (2) the trophic level of the organism in question. These factors were combined in a mixing model to estimate MDN from $\delta^{15}\mathrm{N}$ values (Kline et al. 1990) which is expressed mathematically by equation (2):

$$(2)\quad \%\mathrm{MDN} = \frac{\mathrm{OBS} - \mathrm{TEM}_{\mathrm{TL}}}{\mathrm{MEM}_{\mathrm{TL}} - \mathrm{TEM}_{\mathrm{TL}}} \times 100\%$$

where OBS is the observed $\delta^{15}\mathrm{N}$ value, TEM is the $\delta^{15}\mathrm{N}$ terrestrial end member (the isotope signature of the terrestrial value in the mixing model), MEM is the corresponding $\delta^{15}\mathrm{N}$ marine end member (Kline et al. 1990), and TL is the trophic level. Primary producers are defined as TL = 1, and consumers are TL ≥ 2.

In the model, $\delta^{15}\mathrm{N}$ can lie between minimal and maximal values for a given TL corresponding to 0 and 100% MDN, i.e., the TEM and MEM. Thus, for a given TL the $\delta^{15}\mathrm{N}$ could range from the terrestrial end member value, $\mathrm{TEM}_{\mathrm{TL}}$, to the marine end member value, $\mathrm{MEM}_{\mathrm{TL}}$. The a priori N sources for salmon freshwater nurseries are atmospheric N_2 with a $\delta^{15}\mathrm{N} = 0$ by definition and salmon N with a $\delta^{15}\mathrm{N} = +11.2 \pm 1$ (Mathisen et al. 1988). The salmon-free control value of primary producers or TEM_1 was based on $\delta^{15}\mathrm{N}$ values for benthic algae (periphyton) collected at sites free of anadromous salmon. A TEM_1 value of 0 was thus based on empirical data (Kline et al. 1990). The MEM_1 value required the assumption that the localized periphyton blooms occurring at spawning sites were caused exclusively by the input of salmon-derived nutrients. In comparison, such blooms were not found in control lakes. This assumption was tested by sampling periphyton from separate spawning sites. An MEM_1 value of +7.0 per mil was initially based on periphyton growing at sites in a stream with a high concentration of salmon carcasses (Kline et al. 1990). One purpose of the control versus nursery lake comparisons of periphyton $\delta^{15}\mathrm{N}$ was the verification of these TEM_1 and MEM_1 values in a lentic system, as they were prerequisites for interpretation of data on higher TL biota $\delta^{15}\mathrm{N}$ using the mixing model, equation (2).

Use of the primary producers (TL = 1) end members of TEM = 0 and MEM = +7.0 (Kline et al. 1990) in this study was based on the $\delta^{15}\mathrm{N}$ values of periphyton in Iliamna Lake and the various control lakes. Estimation of higher TL end members was based on the well-established $\delta^{15}\mathrm{N}$ trophic enrichment, $\epsilon = 3.4$ (Minagawa and Wada 1984), where ϵ is the trophic enrichment factor. Thus the TEM_2 and MEM_2 (herbivores) were +3.4 and +10.4, respectively. Similarly the TEM_3 and MEM_3 (carnivores) were +6.8 and +13.8, respectively, and TEM_4 and MEM_4 (secondary carnivores) were +10.2 and 17.2, respectively. Mixing lines for integer TL generated by connecting the end members listed above can be shown graphically (Kline et al. 1990). One aspect of the $\delta^{15}\mathrm{N}$ mixing model is the constant slope or constant difference in end members, e.g., the difference between TEM_1 and MEM_1 is 7; thus, $\mathrm{MEM}_{\mathrm{TL}} - \mathrm{TEM}_{\mathrm{TL}} = 7$. The slope of 7 was derived using periphyton $\delta^{15}\mathrm{N}$ values because of their point-source response in $\delta^{15}\mathrm{N}$ to carcass abundance (Kline et al. 1990). Thus, equation (2) reduces to

$$(3)\quad \%\ \mathrm{MDN} = \frac{\mathrm{OBS} - \mathrm{TEM}_{\mathrm{TL}}}{7} \times 100\%$$

where $\mathrm{TEM}_{\mathrm{TL}}$ is the $\delta^{15}\mathrm{N}$ value from the control system. Equation (3) was used to estimate MDN of Iliamna Lake biota by comparison with values obtained for the same organisms in control systems.

The ϵ for $\delta^{15}\mathrm{N}$ may vary ±1.1 (Minagawa and Wada 1984); thus, the precision in estimating MDN based on estimating integer TL end members should decrease with increasing TL. Rather than assigning a priori TL to organisms and then determining their MDN in the model, it is possible to estimate TL from the $\delta^{15}\mathrm{N}$ data (Fry 1988) or to compare control and salmon systems directly. In order to make direct comparisons between controls and salmon systems, we assume that the TL for a given species in control and salmon systems is consistent. Thus, the control $\delta^{15}\mathrm{N}$ value for a given species (or defined subset, such as a certain size range) is used as the TEM in equation (3) for direct comparisons with salmon nursery systems. By assuming a consistent food chain length for a given species, accuracy is increased in estimating MDN because of similarity in the number of ϵ steps, probably making error systematic. Error when using estimated TL is likely to be proportional to TL because of the uncertainty of ϵ at each feeding step. Because of the subtraction

in equation (3) the net error due to TL in estimating MDN is ~0 if TL is constant. Verification of a consistent TL was based on the distribution of $\delta^{15}N$ data in histograms (Kline et al. 1990). Sockeye offspring do not occur in the control systems by definition (there are no landlocked sockeye or kokanee in this region (McPhail and Lindsey 1970)); therefore, a priori TL = 3 (zooplanktivores) was used to determine MDN. However, sockeye juveniles are stenometric zooplankton specialists and therefore should have less variability in their isotope chemistry. The observed variability should reflect variation in isotopic abundance due to source effect (MDN versus other sources) rather than variation in diet. Thus, sockeye juveniles are probably a better indicator of the effect of change in MDN in a system using the $\delta^{15}N$ technique than opportunistically-feeding species (probably all the other fishes) where diet is likely to change.

Multiple-isotope food web analysis

The multiple-isotope method can be used to elucidate the flow of matter in food webs when more than two different food sources exist, if any two sources differ in stable isotope abundance of a given element. In this study, there are three aquatic food sources for fishes. Two are autochthonous sources: benthic prodution in the littoral zone and planktonic production in the limnetic zone. Sockeye salmon carcasses (unremineralized), their eggs, and emergent fry (prior to feeding on freshwater production) are collectively an allochthonous third food source for fishes. Through consumption of carcasses, eggs, and fry, resident fishes can obtain the marine $\delta^{15}N$ signature directly. Thus, consumption of adult sockeye products had to be assessed as an alternative pathway for MDN utilization compared with remineralized MDN utilization in autochthonous food webs. Qualitative analysis of Sashin Creek fishes (Kline et al. 1990) indicated that eggs and fry were not a major component in fish diets in that system. A more intensive sampling effort in this study with several fish species in both spawning and control systems (compared with rainbow trout alone in Sashin Creek) permitted a quantitative analysis of MDN flow to fishes. The analytical protocol is graphically modeled in Fig. 2. The isotopic signature of a given sample, D, is a mixture of three potential sources of production and thus three food chains, distinguishable by a combination of $\delta^{13}C$ and $\delta^{15}N$. Isotopic signatures for a given sample (e.g., a length range for a given species) were estimated for each potential source based on TL and known fractionation factors (1.0 and 3.4 per TL for $\delta^{13}C$ and $\delta^{15}N$, respectively). For example, a fish consuming only food chain A would have a value of A' (the shift from A to A' reflecting the fractionation factors). Estimates of isotopic signatures for the same species-sample dependent on only B and C, B' and C', were derived in a similar manner although with a shorter food chain and hence, a different fractionation factor for C. A fish feeding exclusively on eggs and fry (a single isotopic signature assumed) would be isotopically enriched by only one trophic step compared with diets dependent on algal production that require several trophic steps. The one trophic step for feeding on eggs and fry is species independent; thus, C', the signature of a fish feeding on C (eggs and fry), is constant. Aé and Bé vary according to TL for a given fish. For the purposes of this study, it was assumed that the food chain length from A to A' and from B to B' was the same for a given fish species.

The points A, A', B, B', C, and C' were empirically derived. The $\delta^{13}C$ value used here for A was based on the mean value of periphyton collected during observed (Mathisen 1972) peak growth periods (August–October) at littoral sites classified LDN and HDN. A' was derived from A and was dependent on the TL

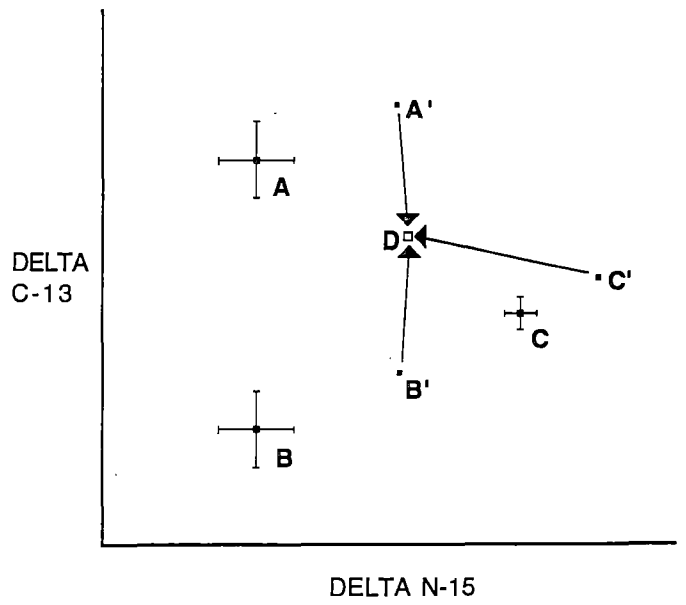

FIG. 2. Dual-isotope, three-source mixing model with variable trophic enrichments. Contribution of source A, B, or C was based on proximity of the observed isotopic signature D to end members A', B', and C'. A', B', and C' are end members corrected for trophic isotopic enrichment (e.g., a one-step trophic enrichment is 3.4 per mil for $\delta^{15}N$ and 1 per mil for $\delta^{13}C$; in the figure the two trophic steps linking A and A' and B and B' have twofold enrichments compared with the single trophic step linking C and C') dependent on length of food chain from sources A, B, and C, respectively.

of the organism in question (whose isotopic signature is indicated as D) and year because of a shift in MDN. The $\delta^{13}C$ value for A' equaled the sum of A (the mean periphyton $\delta^{13}C$) and the TL. The $\delta^{15}N$ for A corresponded to the primary producer $\delta^{15}N$ in the mixing model using the estimated mean % MDN for a particular year. This value was added to the product of TL and 3.4 to estimate the $\delta^{15}N$ of A'. The value for B and B' were similarly derived using the estimated mean $\delta^{13}C$ of phytoplankton instead of periphyton. Point C is the mean $\delta^{13}C$ and $\delta^{15}N$ of salmon eggs. Consumers of salmon eggs should be enriched in the heavy isotopes by exactly one trophic step. Therefore, C' was fixed and had a value corresponding to the mean $\delta^{13}C$ of salmon eggs + 1.0 and the mean $\delta^{15}N$ of salmon eggs + 3.4.

Estimation of the contribution of food chain A, B, or C in diet of D was based on the proximity of D to A', B', or C' and calculated by

$$(4)\quad \%\,X \text{ in diet} = \left(1 - \frac{(DA' + DB' + DC') - DX'}{DA' + DB' + DC'}\right) \times 100\%$$

where $X = A$, B, or C and DX' is the length of a line connecting D to X' (Fig. 2). The line lengths were determined using the isotope ratios as Cartesian points (X,Y).

Results

Extension of the natural stable isotope abundance methodology into a lentic system required an extensive isotopic analysis of the adult salmon and verification of isotopic contrasts in biota from lakes with and without anadromous salmon. Data on the salmon carcasses are presented first in the section titled Isotope Chemistry of Adult Sockeye Salmon, as these results form the

TABLE 3. Comparison of $\delta^{15}N$ and $\delta^{13}C$ of fresh and spawned-out whole adult sockeye salmon and individual mature adult salmon tissues (n = number of fish). Fresh salmon were from the Kvichak River near the Iliamna Lake outlet; spawned-out salmon were from the Tazimina River and Chinkelyes Creek. Tissues samples were taken from mature salmon collected at Knutson Creek (Fig. 1).

Sample	$\delta^{15}N$	SD	$\delta^{13}C$	SD
Whole salmon				
Fresh ($n = 4$)	+11.6	0.3	−22.1	0.9
Spawned-out ($n = 16$)	+12.3	0.9	−19.6	0.4
Tissues				
White muscle	+11.9	0.8	−20.7	0.3
Dark muscle	—		−22.2	0.2
Liver	+11.4	1.3	−22.1	0.4
Eggs	+12.3	0.1	−23.5	0.3

basis for the rest of the study. Second, the N isotope mixing model of Kline et al. (1990) is verified for use in the lacustrine environment by illustrating the dichotomy in $\delta^{15}N$ of biota from sockeye salmon nursery lakes (Iliamna Lake) and several non-anadromous-salmon lakes within the Kvichak watershed in Biota $\delta^{15}N$ in Iliamna Lake versus the Control Sites.

The third and fourth sections in this paper contain applications of the stable isotope abundance methodology. Because of the specialized nature of the juvenile sockeye diet, a shift in $\delta^{15}N$ in response to variation in marine N input shown in the third section, MDN in Juvenile Sockeye Salmon, provides the strongest evidence that MDN can be quantified by $\delta^{15}N$. The fourth section, Dietary Sources of MDN in Iliamna Lake consumers, uses both $\delta^{15}N$ and $\delta^{13}C$, estimated annual MDN (from the third section), and TL to reconstruct the food web structure of Iliamna resident fishes.

Isotope Chemistry of Adult Sockeye Salmon

Isotope chemistry of whole salmon

The 20 homogenized whole adult sockeye salmon carcasses analyzed here for $\delta^{15}N$ and $\delta^{13}C$ were previously analyzed for chemical constituents (Mathisen et al. 1988). These samples reflected chemical changes commensurate with utilization of internal matter during maturation and spawning in freshwater because adult salmon do not feed. Four of the adult salmon were collected in June 1985 on the Kvichak River near the Iliamna Lake outlet. These four fish were bright silver in color and had only slight development of the extended jaws or kype that characterize fully mature Pacific salmon. These were classified as fresh adult salmon for comparison with spawned-out salmon. The variability in $\delta^{15}N$ of fresh adult sockeye salmon was very small (Table 3). There was greater $\delta^{13}C$ variation (Table 3), although the SD was <1 per mil. The variation was due to slight differences in both sex and ocean age (up to 1.5 per mil difference in means, Kline 1991) that could be accounted for by differences in lipid storage because of the tendency of lipids to be depleted in ^{13}C (DeNiro and Epstein 1977; M. Hatano, K. Takahashi, and O.A. Mathisen, unpublished data).

Carcasses of 16 spawned-out salmon from two sites (Mathisen et al. 1988) were collected in September 1985. These samples, comprising two male and two female carcasses from both the 2- and 3-ocean-age group from each site, were analyzed for $\delta^{15}N$ and $\delta^{13}C$. Differences among spawned-out carcasses were small (Kline 1991). The females from one site and the males from the other had higher $\delta^{15}N$ values (difference in means were 1.0 and 1.3, respectively) compared with the opposite sex. There was very little variation in $\delta^{13}C$.

Differences in isotopic values between fresh and spawned-out adult salmon were not unexpected. During the 2- to 3-mo residence in the Iliamna system, adults lose an estimated 30% of N and 60% of C as excrement and gametes prior to death and decomposition (Mathisen et al. 1988). Statistical analysis suggested no relationship between spawning condition (either fresh or spawned-out and $\delta^{15}N$ (all $p \geq 0.22$, ANOVA). In contrast, spawning condition was highly significant as a factor affecting $\delta^{13}C$ ($p < 0.01$, ANOVA).

Although a greater $\delta^{15}N$ variability in spawned-out salmon compared with fresh salmon (Table 3) reduced statistical significance, the higher $\delta^{15}N$ in the spawned-out salmon suggests that the initial N fraction (30% of the original N pool) lost prior to decomposition could have a slightly lower $\delta^{15}N$. An estimate of +10 for the $\delta^{15}N$ of the 30% fraction can be made on the assumption of mass balance of the +11.6 value for the imported N pool and +12.3 for the 70% fraction remaining for release during decomposition as measured in the moribund spawned-out salmon. A fluctuation in $\delta^{15}N$ from ~+10 to +12.3 of the N released into freshwater from the time of entry into Iliamna Lake (early July) to decomposition (peak from September to October) had to be considered in the interpretation of $\delta^{15}N$ values, especially for those organisms capable of showing a rapid response to shifts in $\delta^{15}N$ of the N source, i.e., periphyton (Kline et al. 1990). However, this variation is small compared with the isotopic disparity of 7 per mil in the isotope model that represents source effect (marine versus terrestrial) on the observed $\delta^{15}N$ values of biota.

Small tissue samples

We established in the previous section that an isotopic shift occurs as adult sockeye salmon mature and eventually spawn in freshwater. It was necessary to study the variability in this pattern over time using large-scale field sampling. Because transporting large whole carcasses in remote areas is logistically difficult, we developed an alternative protocol whereby small subsamples of tissues could be isotopically analyzed.

Mizutani et al. (1991) stated that $\delta^{15}N$ and $\delta^{13}C$ in individual cormorant tissues are linearly correlated with diet. They found a consistent isotopic enrichment in the individual tissues in both N and C. Although no explanation was given for this relationship, they estimated that the mean $\delta^{15}N$ enrichment of individual tissues from diet was approximately +3 with a 4.0 range between different tissues. They found that the $\delta^{13}C$ enrichment between

TABLE 4. Comparisons of $\delta^{15}N$ and $\delta^{13}C$ in adult (bright, semi-mature, six fish per sex–site) sockeye salmon white muscle tissue from the Newhalen and Karluk rivers and gonad tissues from the Newhalen River.

	Newhalen River				Karluk River	
	Gonad	SD	Muscle	SD	Muscle	SD
$\delta^{15}N$						
Males	+11.8	0.2	+12.0	0.5	+11.0	0.6
Females	+11.6	0.3	+11.3	0.3	+11.4	0.5
$\delta^{13}C$						
Males	−19.6	0.7	−21.7	0.9	−21.0	0.6
Females	−23.4	0.3	−21.6	0.6	−20.2	0.5

individual tissues from diet was greater than the +1 that is generally accepted for enrichment between whole animals and their diet. The $\delta^{13}C$ enrichment range was 3.1 (no weighted mean was given). Because of the lack of consistency between tissues and diet, it is thus best to analyze whole organisms if the data are being used for ecological studies. If a smaller sample is more practical, then it must be established that the subsample taken is representative of the whole organism. Mature, pre-spawned sockeye were used for the tissue sample analysis (Table 3). White muscle tissue values were pooled when several different sections were sampled from within an individual fish because the $\delta^{15}N$ and $\delta^{13}C$ data within fish were found to be consistent. For example, the isotopic variation of white muscle within a fish was small enough (<1 per mil) to allow us to use subsamples in subsequent sampling of adult salmon. The white muscle tissue of mature salmon was slightly ^{13}C enriched compared with whole fresh salmon but ^{13}C depleted relative to whole spawned-out salmon (Table 3). These data and the more negative $\delta^{13}C$ of dark muscle and eggs are in accordance with the lipid content of these tissues and the expected depletion in ^{13}C of lipids (DeNiro and Epstein 1977). During the maturation process the salmon utilize stored energy in the form of lipids from the white muscle (M. Hatano et al., unpublished data); thus, a change in $\delta^{13}C$ was not unexpected. The significance of these results is that the eggs and spawned-out carcass tissue have distinguishable $\delta^{13}C$ for use in food web studies where differentiation of eggs from carcasses is important.

Adult isotopic variability

Small inter- and intraorganismal variations in sockeye stable isotope chemistry allowed sampling from only muscle and gonads. White muscle tissue $\delta^{15}N$ was considered representative of the whole carcass (Table 3). We also sampled eggs because they are a potential food source for resident fishes. Their distinct isotope signature (Table 3) allowed us to determine whether or not they were consumed by fishes.

Differences in $\delta^{15}N$ and $\delta^{13}C$ between muscle and eggs were suggested in the small tissue sample analysis. To better estimate the isotopic variability within a synoptically sampled salmon population (to avoid incorporating isotopic shifts during maturation), comparisons of muscle and gonads (ovaries and testes) were made where data (Table 4) were most comparable with the four fresh salmon sampled in 1985 (Table 3). Multifactorial ANOVAs were performed to determine the relationship of tissue variability (muscle versus gonad) and sex on isotope chemistry of adult salmon. Sex had a significant effect on $\delta^{15}N$ ($p < 0.05$, Table 4). Sex and sex–tissue interactions had a significant effect

TABLE 5. Comparison of periphyton $\delta^{15}N$ between controls and Iliamna Lake by site type (occurrence and density of spawning). Control sites included control lakes (CTL) and Knutson Spring (KSP). Periphyton in the latter consisted of blue-green algae. Sites affected by salmon are indicated as DRF, LDN, and HDN for drift input, low spawning density, and high spawning density, respectively. MDN based on isotope mixing model with 0 and +7 as the primary producer end members. The left column includes all data (collected throughout the year) whereas the right column includes only data from the period of salmon spawning.

	Annual			August–September		
Site type	$\delta^{15}N$	SD	%MDN	$\delta^{15}N$	SD	%MDN
Control sites						
CTL	−0.5	1.2	—	+0.0	1.3	—
KSP	+0.8	2.1	—	−1.6	1.0	—
Salmon site types						
DRF	+3.9	3.2	46	+6.3	3.4	90
LDN	+3.9	1.6	46	+3.6	1.8	51
HDN	+6.1	3.7	87	+6.6	4.2	94

on $\delta^{13}C$ ($p < 0.01$), with eggs and testes being, respectively, isotopically lighter and heavier than muscle (Table 4). The collective means of ovaries and testes $\delta^{13}C$ were the same as for muscle and so were insignificant when compared ($p > 0.4$). These results corroborate that the C isotopic shifts found in whole carcasses were due to gametogenesis.

Because the isotope chemistry of white muscle tissue (the bulk of the salmon carcass) was representative of whole carcasses, it was used for comparisons on a large scale. Extension of the isotopic mixing model to other systems requires that comparable end members exist (see Kline et al. 1990 for discussion on end members). This is verified here for the marine end member by comparison of the Newhalen River sample with the Karluk River (Kodiak Island) run. An opportunity to collect returning adult sockeye salmon from the Karluk River, Kodiak Island, Alaska, in addition to fish from the Newhalen River (Fig. 1) of the Kvichak system in 1988 enabled an intersystem isotopic comparison of returning adults (Table 4). The Karluk River salmon were sampled at the Alaska Department of Fish and Game weir located 1 km upstream from salt water. The chronological sequence of the Karluk sockeye spawning migration includes early-and late-run fish (Gard et al. 1987). The Karluk salmon, obtained in mid-August (1988) during the late run, were closer to spawning physiologically (more pronounced jaw, less external silvering, larger gonads), spatially (shorter migration), and temporally (earlier spawning time) than the Newhalen sample. Thus, the state of maturation was not the same in the two samples, although both populations were approaching maturation and had reared in the Gulf of Alaska for a comparable period. Nevertheless, the isotopic similarity of returning adults from two geographically distinct systems increases the potential for use of the stable isotope model with other anadromous Pacific salmon nursery systems. Two-factor (sex and system) ANOVAs were performed to test for differences in $\delta^{15}N$ and $\delta^{13}C$ in Newhalen and Karluk sockeye adult white muscle. Newhalen and Karluk male adult sockeye salmon differed in $\delta^{15}N$ by about 1 per mil whereas females were the same (sex–system interactions and system $p < 0.05$). Because the female $\delta^{15}N$ values were the same as the pooled mean, +11.4, and mean of the male $\delta^{15}N$ was +11.5, sex was an insignificant factor affecting $\delta^{15}N$ ($p = 0.6$). Newhalen and Karluk $\delta^{13}C$ values differed significantly by about

TABLE 6. Comparison of consumer time-integrated $\delta^{15}N$ between Iliamna Lake and control lakes. TL estimated on assumption of $\epsilon = +3.4$ and control primary producer $\delta^{15}N = 0$. MDN in Iliamna Lake based on assumption of same TL as controls. Fishes segregated by size when size was a statistically significant factor ($p < 0.01$, ANOVA) affecting $\delta^{15}N$. CRS = coastrange sculpin, DV = Dolly Varden, RBT = rainbow trout, 3SP = threespine stickleback, 9SP = ninespine stickleback, CFL = caddis fly larvae.

	Controls		Iliamna Lake	
Biota	$\delta^{15}N$	TL	$\delta^{15}N$	%MDN
Net plankton	+5.0	2.5	+6.8	73[a]
CRS <60 mm	+6.8	3.0	+11.2	63
CR ≥60 mm	+7.7	3.3	+12.5	69
DV	+9.2	3.7	+13.2	57
RBT <100 mm	+6.7	3.0	+12.8	88
RBT ≥100mm	+9.0	3.6	+13.6	66
3SP	+8.2[b]	3.4	+10.2	29
9SP	+6.5	2.9	+10.8	61
CFL	+1.3	1.4	+8.3[c]	86

[a] TL = 1.5 used to calculate MDN.
[b] Excludes Pedro Mountain Lake.
[c] Lower mode of bimodal distribution.

1 per mil (system $p < 0.01$). Sex and sex–system interactions did not affect $\delta^{13}C$ ($p \sim 0.2$). These results in combination with the muscle and gonad comparison are further evidence that $\delta^{13}C$ shifts were a result of gametogenesis, as fish of similar maturation level show no difference in muscle $\delta^{13}C$. The $\delta^{13}C$ variation in white muscle thus has potential use as a tool for quantification of the state of maturation or degree of lipid depletion in adult salmon.

Biota $\delta^{15}N$ in Iliamna Lake versus the Control Sites

Periphyton

Control site (CTL and KSP) periphyton had $\delta^{15}N$ near 0 (Table 5), consistent with Kline et al. (1990), thus justifying the continued use of $TEM_1 = 0$, the terrestrial end member in equations (2) and (3), for lake systems. The mixing model primary producer marine end member (MEM_1) or $\delta^{15}N$ value of a plant solely deriving its N from the salmon was assumed to be +7.0 (Kline et al. 1990). Salmon-influenced site periphyton $\delta^{15}N$ data are converted to %MDN in (Table 5) using these mixing model end member values.

%MDN estimations for periphyton growing at sites with different spawning densities ranged from ~50 to ~90% (Table 5). Low spawning density sites (LDN) had ~50% MDN with relatively small variation. High density sites (HDN) were high (~90% MDN) but with high variance among samplings. The mean values probably reflect the MDN input by averaging-out effects that cause variation in isotopic discrimination by algae and the potential variability in $\delta^{15}N$ of N released from salmon. The drift sites (DRF) varied considerably whether annual or just the spawning season was considered. reflecting the ephemeral nature of drift sites as carcasses can float in and out of the sites with vagaries in wind direction (typically east or west along axis of the lake). The $\delta^{15}N$ values thus suggest that littoral algae respond in a point-source manner to local N supply as determined by the presence of salmon carcasses. Marine N dominated (~90% MDN) as a N source at HDN spawning sites and areas where carcasses were washed up. The biogenic N signal persisted over all sampling times (virtually year-round) at HDN spawning sites (Table 5). The tendency for mean values to be ~50% MDN suggests a time-and-space integrated value for sites away from HDN spawning areas in the eastern portion of Iliamna Lake. Thus, MDN provides about half the N budget in these littoral areas.

Consumers

MDN was estimated in Iliamna Lake consumers by comparing the same organisms from control lakes within the Iliamna Lake catchment basin and by analysis of TL relative to periphyton TL which was assumed to be 1. Control lake consumer TL estimates were based on $\epsilon = +3.4$ (Minagawa and Wada 1984). Trophically, the lowest consumers examined were caddis fly larvae (CFL) and zooplankton. The low $\delta^{15}N$ in control CFL (Table 6) suggests a diet of $\delta^{15}N = -2.1$ (assuming $\epsilon = +3.4$), at the low end of the control periphyton $\delta^{15}N$ (Table 5). This may indicate the presence of micro- and meiofaunal consumers (bacteria, protozoans, and small invertebrates that could not be practically separated from algae) in the periphyton samples or selection of an isotopically light diet by control CFL. Iliamna Lake CFL $\delta^{15}N$ values were strongly bimodal. The higher mode ($\delta^{15}N = +13.2$) Iliamna Lake CFL were probably carnivores and thus not comparable with control CFL. The lower mode CFL, $\delta^{15}N = +8.3$, were assumed to be mostly herbivores and more comparable with control lake CFL (Table 6).

Net plankton $\delta^{15}N$, like the periphyton, may vary spatially and temporally because of localized input of MDN from decomposing carcasses, from excretion by adult salmon (Mathisen et al. 1988), and from N cycling per se. Additionally, plankton samples were an assemblage of both phytoplankton and zooplankton in varying ratios. Phytoplankton in Iliamna Lake consists largely of chain diatoms (e.g., *Fragilaria* and *Tabellaria*) that cannot be separated from the similarly sized zooplankters *Cyclops* and *Bosmina*. Thus, the plankton samples consist of organisms from several trophic levels which leads to further $\delta^{15}N$ variability because of trophic isotopic enrichment (Wada et al. 1991). Furthermore, control lake net plankton samples had few phytoplankton and comparatively more rotifers than samples from Iliamna Lake and thus, they were not as useful for control versus Iliamna Lake comparison as either periphyton or higher trophic levels (i.e., fishes). The $\delta^{15}N$ means of each of the four control lake plankton data sets were averaged together to obtain a control grand mean $\delta^{15}N = +5.0 \pm 0.9$ (SD). Assuming that the periphyton $\delta^{15}N = 0$ applies to the phytoplankton, then the control net plankton have an effective TL = 2.5 (calculated using a +3.4 per TL enrichment). The mean $\delta^{15}N$ of Iliamna plankton samples was +6.6 ± 1.3 (SD). Based on the greater proportion of phytoplankton, the effective TL for Iliamna net plankton was probably lower than the controls. Thus, TL = 1.5 and 2.0 were used to estimate net plankton MDN = 73 and 49%, respectively. A TL = 1.5 is probably closer to the true value assuming that the plankton should resemble fishes in MDN (Table 6). Although the difference in $\delta^{15}N$ means between Iliamna Lake and controls was only 1.6, a one-way ANOVA ($p < 0.05$) suggested a statistically significant difference.

TL of control fishes ranged from 2.9 to 3.7 (Table 6), appropriate to a food web scheme of insect consumption and piscivory. Control threespine sticklebacks (3SP) had a broad range of $\delta^{15}N$ values (Fig. 3). Pedro Mountain Lake 3SP $\delta^{15}N$ values (mean = +11.2 ± 1.4 (SD), N = 9 fish) were enriched by +5.7 compared with Pedro Mountain Lake net plankton $\delta^{15}N = 5.5 \pm 1.0$ (SD) equivalent to an enrichment by 1.7 trophic levels. Other control lake 3SP $\delta^{15}N$ values (mean = +8.2 ± 0.8 (SD), $n = 26$ fish) were

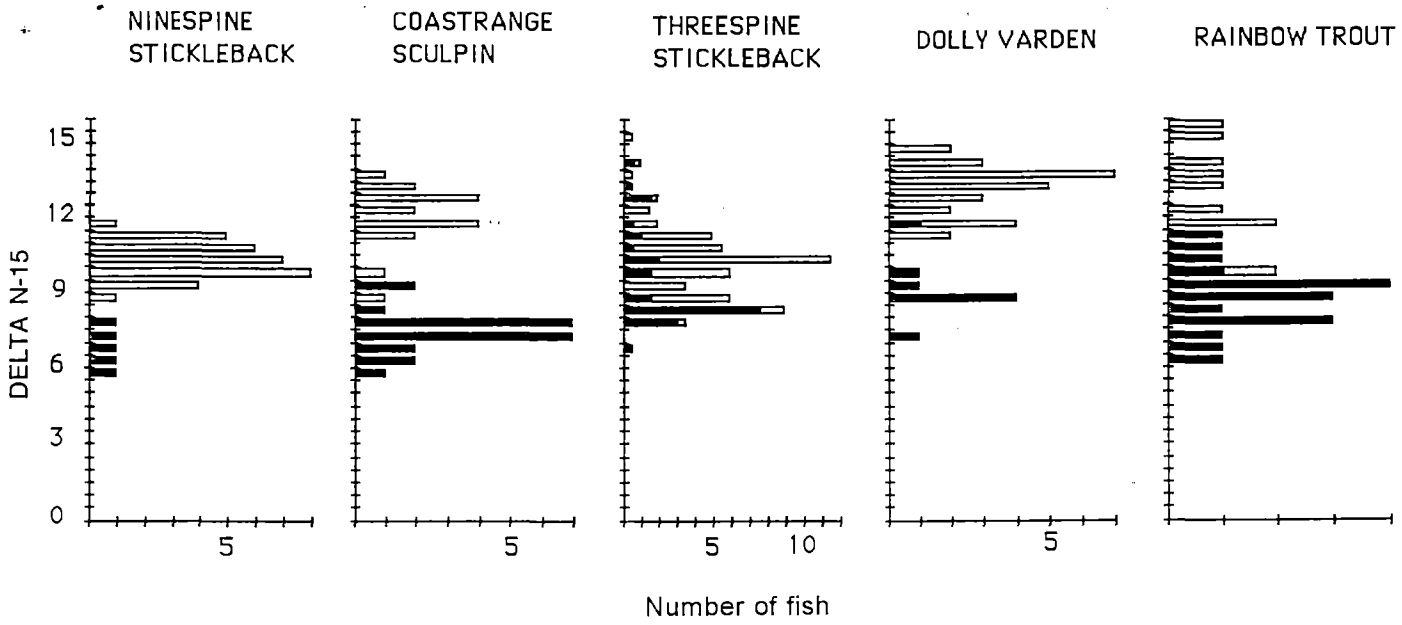

FIG. 3. $\delta^{15}N$ histograms of fishes sampled in Iliamna Lake (open bars) and control lakes (solid bars).

enriched from their net plankton ($\delta^{15}N = +5.0 \pm 0.9$) by +3.2, equivalent to 0.9 trophic level. The apparently longer food chain, as well as greater breadth in feeding niche as expressed in terms of the SD of the 3SP $\delta^{15}N$ mean, may be related to the fact that they were the only fish present in Pedro Mountain Lake (P.H. Poe, personal communication). Comparison of control lake and Iliamna Lake 3SP $\delta^{15}N$ was therefore made on 3SPs from control lakes other than Pedro Mountain Lake (Table 6). Iliamna coastrange sculpin (CRS) and rainbow trout (RBT) had large $\delta^{15}N$ ranges (Fig. 3) indicative of prey of several different TL. Fish $\delta^{15}N$ values may be dependent on size (Kline et al. 1990). Division of CRS and RBT into size classes (Table 6) was based on size frequency distribution and $\delta^{15}N$. These comparisons assumed that there was a correspondence in trophic shifts for similar sized fish in both type systems. The two estimates of MDN in CRS were similar, but in RBT were different (Table 6). The differences in mean $\delta^{15}N$ for the two size classes of CRS were similar in both control lakes and Iliamna Lake. However, the RBT intra-size-class $\delta^{15}N$ differences were 2.3 and 0.8 in control lakes and Iliamna Lake, respectively. Thus, RBT trophic structure may vary between controls and Iliamna Lake (RBT apparently occupy more than one TL in controls similar to the control section of Sashin Creek, Kline et al. 1990). If the mean $\delta^{15}N$ of Iliamna Lake RBT ($\delta^{15}N = +13.4$) is compared against either control lake size group, then estimations of MDN are 96 and 63% for TL =3.0 and 3.6, respectively. A TL = 3.6 may be more appropriate for Iliamna Lake RBT because 63% MDN is consistent with the other fishes. This assumes that all fishes should have a similar MDN component.

Dolly Varden (DV) and ninespine stickleback (9SP) $\delta^{15}N$ values were handled as unimodal due to a limited number of control samples for comparison (Fig. 3). Furthermore, the histograms of Iliamna Lake DV and 9SP have strong central tendencies. Comparison of mean $\delta^{15}N$ values suggests that these fishes are ~60% MDN.

Other than 3SP, Iliamna Lake fishes had similar estimations of MDN, 57–69%. These data suggest that returning salmon have a profound effect on the food webs supporting these fishes.

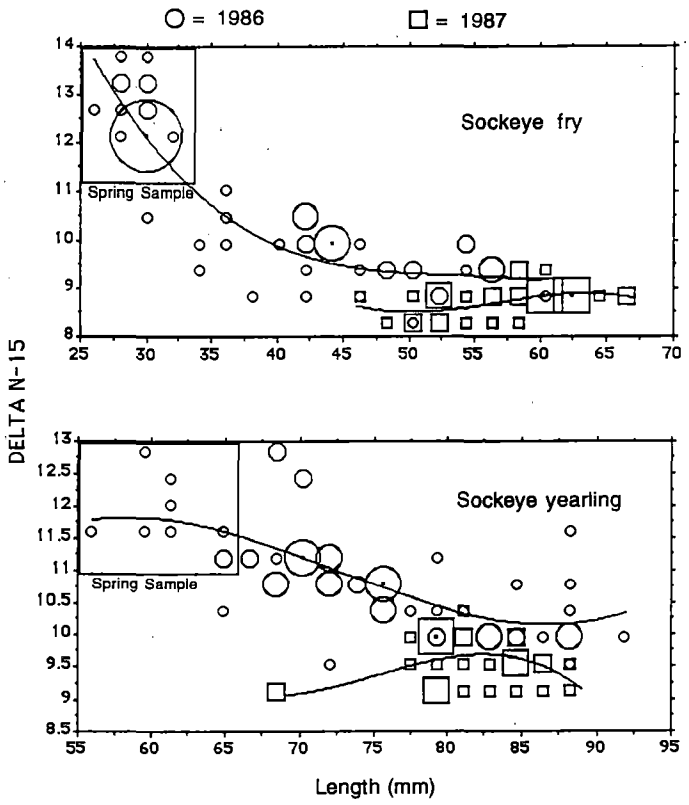

FIG. 4. $\delta^{15}N$ as a function of fork length in Iliamna Lake sockeye salmon fry and yearlings sampled in 1986 (circles) and 1987 (squares). Winter sampling of emergent fry and spring sampling of yearlings are indicated in the boxes. Other samples were collected in late August – early September. Size of symbols indicates the number of points in the size intervals. Curves were computer fitted to suggest shifts in $\delta^{15}N$ from spring to summer during growth.

MDN in Juvenile Sockeye Salmon

Juvenile sockeye did not occur in the control lakes, making it impossible to make direct $\delta^{15}N$ comparisons as for the other fishes. MDN estimation nonetheless had to be made because of

TABLE 7. Estimated MDN of Iliamna sockeye juveniles from three cohorts (year of spawning and size of escapement given) based on $\delta^{15}N$ and TL = 3. Spring 1985 smolts include 2. smolts from a 1982 cohort.

Brood year, brood size, and sampling period	Life history stage	$\delta^{15}N$	SD	*n*	%MDN
1983, 3.6 million					
Spring 1985	1. smolt	+9.1	1.2	5	33
Spring 1986	2. smolt	+9.8	0.6	13	43
1984, 10.2 million					
Spring 1986	1. smolt	+10.0	0.7	5	46
Spring 1986	Yearling	+11.8	0.5	9	71
Summer 1986	Yearling	+10.8	0.7	52	57
1985, 7.2 million					
Summer 1986	Fry >40 mm	+9.5	0.5	28	39
Summer 1987	Yearling	+9.5	0.4	30	39
1986, 1.2 million					
Summer 1987	Fry >40 mm	+8.7	0.3	32	27

the hypothesis of nutrient feedback from anadromous adults to offspring (e.g., Mathisen 1972) which is a central theme in this investigation. The variation in run size due to the cyclic nature of the Kvichak sockeye population (Mathisen and Poe 1981) during the years of sampling provided an opportunity to examine changes in MDN in response to changes in escapement as a test of the stable isotope approach for measuring this scale of change in the N biogeochemical cycle. Sample sizes sufficient for statistically valid results were provided by the University of Washington Fisheries Research Institute during fry surveys. A complication in the data analysis was that sockeye fry have an initial inventory of N that is 100% MDN (the egg and alevin stages; feeding commences upon emergence from the gravel). It was therefore necessary to follow changes in $\delta^{15}N$ to determine a minimal fry size for use in comparisons of fry that would have lost most of their initial marine N inventory (Fig 4). Minagawa and Wada (1984) found that following the loss of initial N inventory, the mussel *Mytilus edulis* had stable $\delta^{15}N$ values. Similarly, Iliamna Lake sockeye fry have consistent $\delta^{15}N$ values at lengths >~40–45 mm (Fig. 4). The $\delta^{15}N$ of >40-mm fry from 1986 and 1987 were statistically different ($p < 0.01$, ANOVA). The 1985 fry sampled as yearlings in June 1986 were ≤65 mm (boxed area in Fig. 4). This population when sampled later that summer (August–September) had shifted to a $\delta^{15}N$ that was 1 per mil lower (Fig. 4; Table 7). Between-year comparisons of yearlings were made with >65-mm fish because of uncertain factors that could have affected the earlier sample (e.g., residual N from 1985; internal N pool shift during winter due to remobilization). The 1986 and 1987 yearlings were distinctively different ($p < 0.01$, ANOVA). Thus, both fry and yearling sockeye showed shifts in $\delta^{15}N$ in concert with a decline in escapement from the previous fall. Time course comparison of the cohorts arising from four brood years (Table 7) suggests a strong feedback from escapement to the N pool supporting juvenile salmon food webs. The shift corresponds to a majority component of the N pool being derived from salmon after >10 million escapements and a minority component after ≤7 million escapements.

Dietary Sources of MDN in Iliamna Lake Consumers

Multiple stable isotope ratios are useful for the resolution of the relative contribution of more than two sources of production for consumers (Peterson and Howarth 1987; Kline et al. 1990). N and C isotopic signatures remain coupled during feeding processes but are decoupled during decomposition. Thus, $\delta^{13}C$ can be used as a secondary food web tracer of autochthonous production versus allochthonous marine production. Plant $\delta^{13}C$ gradients may arise in lakes because of respired C in the dissolved inorganic C (DIC) pool (Rau 1978; Quay et al. 1986; Herczeg 1987) and depletion of near-surface DIC by photosynthesis (LaZerte and Szalados 1982; Raven et al. 1982; Herczeg 1987). Limnetic production $\delta^{13}C$ values tend to be low (Rau 1980; Fry 1986; Yosioka et al. 1989). DIC depletion results in more positive (actually less negative) $\delta^{13}C$ in plants growing in shallow water, particularly in littoral areas. This dichotomy appears in Iliamna Lake where plankton $\delta^{13}C = -28.4$ (thus, fixing the $\delta^{13}C$ coordinate for point *B* in the three-point mixing model shown in Fig. 2) and periphyton (during peak growth in August–October at LDN and HDN sites) $\delta^{13}C = -10.5$ (the corresponding $\delta^{13}C$ coordinate for point A). The $\delta^{13}C$ of salmon eggs (point C) was at an intermediate value, –23.5. However, eggs and fry had very high $\delta^{15}N$ values (Table 3; Fig. 4). Thus, identification of egg and fry consumption in the three-point model is primarily resolved based on $\delta^{15}N$. Predators having a diet consisting of 100% eggs and fry would be expected to have $\delta^{15}N$ and $\delta^{13}C$ of +15.6 and –22.5, respectively, based on established ϵ (Fry and Sherr 1984; Minagawa and Wada 1984). These values, +15.6 and –22.5, form the coordinates for point C′ (Fig. 2). Such a high $\delta^{15}N$, i.e., +15.6, was not typical of any Iliamna Lake consumer (Table 6), suggesting that eggs and fry do not constitute a major portion of the diet in most consumers. It was, however, possible to estimate the relative contribution of salmon eggs and fry, littoral production, and limnetic production in the diets of Iliamna Lake consumers because of the existence of both $\delta^{13}C$ and $\delta^{15}N$ gradients. Isotopic signatures of diets derived from littoral and limnetic production, unlike direct consumption of salmon eggs and fry, depend on food chain "length" and thus required an assumption of consumer TL and primary producer $\delta^{15}N$ which fluctuated according to size of salmon N input. These isotope signatures were the derived *A′* and *B′* coordinates in Fig. 2. Because of the apparent decline in MDN through the course of the study, separate analyses were made on consumers based on year of sampling for large samples. The 3SP were also separated by the type of habitat where they were

TABLE 8. Estimated dietary source based on $\delta^{15}N$ and $\delta^{13}C$. Littoral and limnetic diet $\delta^{15}N$ end members based on 60 and 40% MDN in 1985–86 and 1987. Dietary $\delta^{13}C$ end members based on −10.5 (at sites of significant MDN, August–October) and −30.8 (based on $\epsilon = 1$ and TL (of net plankton) = 2.4) for limnetic and littoral primary producers, respectively. A diet derived from salmon eggs and emergent fry had an end member signature of +15.6 and −22.5 for $\delta^{15}N$ and $\delta^{13}C$, respectively, based on one trophic step. Diet composition based on proximity of actual values relative to three end members as shown in Fig. 2.

	$\delta^{15}N$, $\delta^{13}C$	%littoral	%limnetic	%eggs and fry
Threespine stickleback (*Gasterosteus aculeatus*)				
1986				
Limnetic	+11.1, −26.3	10	90	0
Littoral	+11.6, −24.1	18	71	11
1987				
Limnetic	+9.3, −26.3	10	90	0
Littoral	+9.9, −23.1	23	67	10
Ninespine stickleback (*Pungitius pungitius*)				
1986	+10.7, −24.4	22	78	0
1987	+9.9, −24.5	19	72	10
Coastrange sculpin (*Cottus aleuticus*)				
<60 mm				
1986	+12.1, −13.3	69	7	24
1987	+9.1, −12.7	79	21	0
≥60 mm				
1986	+12.5, −18.5	43	43	14
1987	+12.3, −17.7	42	24	34
Sockeye salmon (*Oncorhynchus nerka*)				
Fry >40 mm				
1986	+9.5, −26.0	14	86	0
1987	+8.7, −26.0	14	86	0
Yearling				
1986				
Littoral	+11.8, −27.7	5	95	0
Limnetic	+10.8, −27.7	5	95	0
Yearling				
1987	+9.5, −26.9	9	91	0
Rainbow trout (*Oncorhynchus mykiss*)				
1985–86	+13.1, −22.2	25	72	4
Dolly Varden (*Salvelinus malma*)				
1985–86	+13.2, −18.3	46	54	0

sampled because of significantly different $\delta^{13}C$ ($p < 0.01$, ANOVA) values between samples obtained from different habitats. Samples were also separated by size classes as previously noted. The $\delta^{13}C$ coordinate was calculated by adding the TL to the A and B $\delta^{13}C$ values discussed above. The $\delta^{15}N$ coordinates in A' and B' were equal to the product of the TL and isotopic fractionation factor of 3.4 that was added to the primary producer average value for the year. An overall importance for limnetic production is suggested by the dual-isotope analysis of fishes (Table 8). Littoral C and N sources were most significant for a benthic fish, CRS. The CRS also had the strongest indication of salmon eggs and fry in their diet, as was demonstrated by Roger (1971). The relative contribution of littoral production was small in the 3SP diet although greater for those sampled in the littoral zone. The 3SP diet source did not appear to shift in response to change in MDN.

Discussion

Basis for the Stable Isotope Method and Potential Sources of Variation in $\delta^{15}N$ in the Absence of Salmon

Two alternative N sources for Iliamna Lake exist, adult salmon (MDN) and the atmosphere. The premise in using $\delta^{15}N$ to trace MDN in anadromous sockeye salmon nursery lakes is that increased $\delta^{15}N$ values are due to (1) the trophic level of the biotic sample and (2) the N in the salmon carcasses. We assume that no other processes are significantly affecting $\delta^{15}N$. The exclusiveness of these two factors is also implied by the components of mixing model equations (2) and (3).

Ecosystems where N derived from N_2 fixation is important have low $\delta^{15}N$ reflecting the atmospheric N source (Minagawa and Wada 1984) because N_2 from the atmosphere has a $\delta^{15}N = 0$,

by definition. Similarly, we found low $\delta^{15}N$ in control primary producers because (1) there is no significant MDN input, (2) there is little isotopic fractionation during N_2 fixation, the a priori input of new N, and (3) these systems are oligotrophic and consequently show very little isotopic fractionation from the N source. Thus, $TEM_1 = 0$ (discussed extensively in Kline et al. 1990) where TEM_1 is the $\delta^{15}N$ value of trophic level one organisms based solely on atmospheric N_2 in the isotope mixing model (see equation (2)). We can probably eliminate biogeochemical processes, other than trophic level or the MDN source, that could potentially enrich ^{15}N. For example, there is empirical evidence that very large ^{15}N enrichment can occur through denitrification when the N source $\delta^{15}N = 0$ (Böttcher et al. 1990) and is suggested as a cause for elevated $\delta^{15}N$ in biota in Pyramid Lake, Nevada (Estep and Vigg 1985). Elevated ^{15}N occurs even though Pyramid Lake receives large quantities of atmospherically-derived N through pollution and is also known to have a large rate of N_2 fixation (Horne and Galat 1985). There are two factors that probably preclude denitrification from being a major factor affecting $\delta^{15}N$ in anadromous Pacific salmon habitats. (1) Denitrification occurs when dissolved O_2 is either low or absent. Because sockeye salmon are very sensitive to low O_2, they are not likely to inhabit lakes where denitrification is significant. (2) Anadromous sockeye salmon lakes must have an outlet to the sea. These lakes thus flush out, unlike terminal lakes that loose water by other means such as evaporation. Flushing of the system also reduces the opportunity for N recycling and concomitant shifts in isotopic composition of the dissolved N pool. The small range in $\delta^{15}N$ of ± 2 per mil seen in our control system periphyton in this as well as our Sashin Creek study (Kline et al. 1990) could be due to isotopic shifts in dissolved N due to small occurrences of ^{15}N-enriching biogeochemical processes such as denitrification, differences in isotopic discrimination between algal species, effect of growth rate on isotopic discrimination, or effects of using different inorganic N substrates by algae (Wada and Hattori 1991). Control periphyton $\delta^{15}N$ variation was thus assumed to represent variability due to isotopic fractionations arising from N cycling of originally atmospherically derived N as in Sashin Creek (Kline et al. 1990). The standard deviation of $\delta^{15}N$ for the collective control lake periphyton values was 1.2 per mil. However, this variance is small compared with the difference in $\delta^{15}N$ between atmospheric N_2 and salmon N. With a large enough sample, the central tendency in the data will suggest the $\delta^{15}N$ of the N source. Such is the case in our data sets collected in this study and in our previous study (Kline et al. 1990).

Variation in Adult Sockeye Salmon $\delta^{15}N$ and $\delta^{13}C$

Sockeye salmon return to spawn after 2 or 3 yrs in the ocean (Foerster 1968). Although no difference was found in the chemical composition relative to ocean-age (Mathisen et al. 1988), the 3-ocean-age salmon are larger in size, potentially having shifted feeding to a higher trophic level, thus affecting their isotopic signature because of trophic enrichment of ^{15}N (Minagawa and Wada 1984). Mathisen et al. (1988) found that about 30% of the N inventory in adult sockeye salmon at entry into Iliamna Lake is released into freshwater as excretion and gametes prior to decomposition. We tested for variation in $\delta^{15}N$ of adult salmon during their final phase of life to determine whether the marine $\delta^{15}N$ signature varied with time as a result of this N loss or because of ocean age. Three approaches were taken in examining the variability of $\delta^{15}N$ in returning adult salmon: (1) 20 homogenized whole carcasses previously analyzed for chemical composition (Mathisen et al. 1988) were analyzed for isotopic shifts of the whole fish during maturation by spawning site, sex, and ocean age, (2) small tissue samples from individual carcasses were compared for $\delta^{15}N$ and $\delta^{13}C$ to identify sources of isotopic variation, and (3) evaluation of variation of adult salmon $\delta^{15}N$ and $\delta^{13}C$ was made by comparison of standardized subsamples. The isotopic analyses of salmon carcasses suggested only small shifts in $\delta^{15}N$ during the maturation process and very little variability within a population of sockeye salmon at point-of-entry into the lacustrine environment. Our results suggest that a maximum shift of 2.3 per mil in $\delta^{15}N$ of the marine N input would result from the differential release of ^{15}N and ^{14}N during the time course of maturation, probably from remobilization of amino acids (Mommsen et al. 1980). Thus, the early marine N pool released through excrement and gametes could be as isotopically light as +10.0 and the N pool released by decomposition as isotopically heavy as +12.3. Mature eggs ($\delta^{15}N = +12.3$) have more positive $\delta^{15}N$ than developing eggs ($\delta^{15}N = +11.6$), corroborating the relationship between the low $\delta^{15}N$ of initial N lost through excretion and gametogenesis. However, the $\delta^{15}N$ value of $+11.5 \pm 0.5$ (SD) represented the natural variability of the returning adults and thus the total imported marine N pool. This value was more applicable to analysis of the total effect of salmon N on a time-integrated basis greater than the July–August maturation period, where the effects of differential release of ^{15}N and ^{14}N would be seen in Iliamna Lake. This value is also consistent with high-seas-caught juvenile and mature sockeye salmon from the northern Gulf of Alaska (Welch and Parsons 1993). The biochemical process during remobilization of the C pool during maturation appears to generate a significant shift in $\delta^{13}C$. A consistent fractionation between lipids and other constituents effected a difference in 2 per mil between salmon egg and carcass $\delta^{13}C$. This distinctive difference in egg and carcass $\delta^{13}C$ has potential for distinguishing their consumption by scavengers in future studies.

Relating $\delta^{15}N$ to MDN

With the $\delta^{15}N$ of N from the atmosphere = 0 (by definition), the $\delta^{15}N$ of N in primary producers (periphyton) arising from it also $= 0 \pm 1.2$, and the $\delta^{15}N$ of marine N $= +11.5 \pm 0.5$, a consistently large $\delta^{15}N$ range exists permitting $\delta^{15}N$ to be used to quantify MDN in freshwater habitats of anadromous Pacific salmon. The $\delta^{15}N$ data from this investigation and our previous study (Kline et al. 1990) suggest that MDN can be quantitatively traced into both lentic and lotic freshwater habitats of anadromous Pacific salmon. The relative variability of $\delta^{15}N$ in biota in control systems was small compared with the large difference between control and spawning habitat biota, suggesting that the isotopic signatures reflect MDN input. The greater variability of $\delta^{15}N$ of periphyton within spawning habitats seen in Iliamna Lake and Sashin Creek (Kline et al. 1990) is ascribed to the spatial and temporal heterogeneity of MDN input because of the close relationship of $\delta^{15}N$ with respect to local carcass abundance. The fractionation of the salmon N pool from +11.5 to +7 by primary producers appears to be consistent in lentic and lotic systems. As previously discussed (Kline et al. 1990), the greatest isotopic fractionation between inorganic N and primary producers occurs when the inorganic N concentration is high. The lowest $\delta^{15}N$ expected (i.e., maximum fractionation) from an alga using MDN exclusively is +5 (Kline et al. 1990). The higher $\delta^{15}N$ value of +7 used in our mixing models (Kline et al. 1990, Fig. 1)

and the equivalent, equation (3) here, is consistent with the moderately oligotrophic conditions of Iliamna Lake, i.e., measured $NO_3^- \sim 5$ μM (Mathisen et al. 1988). Because the greatest variation in $\delta^{15}N$ of periphyton occurred at carcass drift sites and high spawning density sites, the variation is ascribed to MDN input reflecting the inhomogeneous nature of carcass distribution and thus nutrient input. The mean $\delta^{15}N$ of ~+7 is thus the best estimate we can make for the primary producer marine end member ($MEM_{TL=1}$ in equations (2) and (3)) at this time. The mean $\delta^{15}N$ of oceanic N of +7 relative to atmospheric N_2 (Wada and Hattori 1991) parallels our observations of an isotopic enrichment of +7 for MDN versus terrestrial N in the biota in our studies. The analysis of consumer $\delta^{15}N$ data affirms the use of +7 as the primary producer marine end member. Because of the slower turnover time of chemical elements in fishes compared with primary producers, they, like other macrofauna, have isotope signatures that represent a time-integrated value of their diet (Wada et al. 1987). Although it is unlikely to find a freshwater-resident fish 100% dependent on MDN, eventually the accumulation of isotope data in connection with changes in MDN input via differences in escapements will provide a test of the mixing model through iterations with refinements in the end members. This will be shown best in the juvenile sockeye $\delta^{15}N$ data because of their specialized feeding behavior and consequent narrow $\delta^{15}N$ range at a given time.

The juvenile sockeye $\delta^{15}N$ data fluctuated within the range expected for a fixed TL = 3 and the resultant model constraints of +6.8 and +13.8 for 0 and 100% MDN, respectively. Preliminary sockeye fry data from a similar study conducted at Karluk Lake, Kodiak Island, suggest a higher dependence on MDN. Karluk sockeye fry range from +11.8 to +13.2 depending on escapement size, suggesting that anadromous salmon contribute 71–91% of the N pool, respectively (T.C. Kline et al., unpublished data). Karluk Lake is known for formerly having produced a large number of salmon for its size (Koenings and Burkett 1987b) and has been thought to be dependent on the nutrient loading derived from carcasses (Barnaby 1944). A further test to verify the $\delta^{15}N$ mixing model would be to measure the $\delta^{15}N$ of sockeye fry from a system with a small salmon run, which should have a low dependence of MDN, and therefore should have $\delta^{15}N$ values approaching +6.8. The high MDN estimated with $\delta^{15}N$ implies that marine-derived biogenic nutrients may be significant at lower escapements than estimated by mass balance of P, e.g., the 25 million spawners for 50% marine-derived P (Donaldson 1967).

Primary Pathway Transferring MDN into Lacustrine Food Webs

Our data suggest that the role of direct consumption of MDN as allochthonous marine organic matter (eggs and fry) is not very significant, collectively, in Iliamna Lake fishes. Thus, remineralized MDN, by autochthonous production supporting food webs, is the process whereby returning anadromous salmon effect nutrient flow in this freshwater ecosystem, providing strong evidence supporting the hypothesis of a biogenic nutrient feedback loop from adult to juvenile sockeye salmon through their freshwater forage (Mathisen 1972). Because sockeye forage has been identified as a limiting factor (Koenings and Burkett 1987b), the nutrient feedback loop may be an important regulatory process for controlling sockeye freshwater production.

Implications to Cyclic Dominance

Eggers and Rogers (1987) found that the Kvichak sockeye run has an inherent tendency to be cyclic in the absence of fishing. The fishing activity results in the amplification of the population cycling. They suggested that cycling results from interaction of offspring from peak and postpeak year classes. This can only occur during their lacustrine life history stage. Several mechanisms for this interaction can be postulated: competition, cannibalism, and predation. The first two mechanisms are a direct interaction, while the third mechanism is indirect and depends on the differential effects of predation with respect to age of fry. The stable isotope data suggest that predation on eggs and fry supplies only a small part of the diet of potential predators. Nevertheless, suggested year-to-year differences in consumption of fry by coastrange sculpin (Table 8) are in agreement with a differential predation hypothesis. Cannibalism of emerging fry is not supported by the isotope data of yearling sockeye. Yearling sockeye captured in the vicinity of where fry had recently emerged (littoral) had $\delta^{15}N$ and $\delta^{13}C$ of +11.8 and −27.7, respectively (Table 8), which are inconsistent with the expected values for a fry predator, +15.6 and −22.5, respectively. Evidence for competition for food (zooplankton) as a mechanism for intercohort interaction is the similarity in isotope signatures for concurrent broodlines of sockeye fry (Table 8), suggesting a common dietary source that is principally limnetic production. The rapid drop in MDN during 1986–87 following two successive strong runs of 1984–85 (Table 7) suggests that MDN is rapidly sequestered into the biomass of fry. The consumption of productivity by a strong cohort would be felt by the subsequent cohort if food resources were depleted. The "year-after effect" is in agreement with the conclusion of Eggers and Rogers (1987). Apparently the peak brood years are able to outcompete (in the Darwinian sense) the successive brood year, as is borne out by the relative poor survival of the postpeak cohort to smolt and recruitment to the fishery (Eggers and Rogers 1987). The postpeak year class in this study (1985) had an anomalously high survival rate of 2.4 returns per spawner (*R/S*), cf. <1 *R/S* that returned from the postpeak years 1961 and 1980 (data from the Commercial Fisheries Division, Alaska Department of Fish and Game, King Salmon, Alaska). A more definitive postpeak year class (e.g., *R/S* = 1.8, Eggers and Rogers 1987) might show more conclusive evidence of the mechanism(s) discussed above using stable isotope ratio data other than those found here.

Summary

The isotopic composition of juvenile Pacific salmon and other biota in freshwater habitats with anadromous salmon differs consistently from that in habitats without anadromous salmon (this study and Kline et al. 1990). The contrast in $\delta^{15}N$ is a "natural tracer" allowing us to use it as a proxy to quantify marine-derived biogenic nutrients transported to freshwater streams by the large terminal spawning migrations of Pacific salmon. Variation in $\delta^{15}N$ due to N cycling is significantly less than variation in $\delta^{15}N$ due to salmon N. The small-scale variations that are due to N cycling and, to a greater extent, the point-source variability in salmon carcass abundance are time integrated by consumers: fishes. Because of the specialized nature of sockeye salmon fry diet, their $\delta^{15}N$ was the best indicator of short-term (months) integrated variation in MDN in the lacustrine ecosystem, which was found to be dependent on size of escapement. MDN benefits lacustrine consumers primarily from limnetic food webs via remineralization.

Acknowledgements

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30 September 1994

Exxon Valdez Oil Spill Restoration Team
Jim Ayers, Executive Director
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Dear Mr. Ayers,

My comments on the Draft 1995 Work Plan are limited to 2 studies on bald eagles (95029 and 95030).

I was the project biologist for the bald eagle damage assessment study from 1989-93. I am thus intimately familiar with the previous bald eagle reproductive and population surveys; their methods, results, strengths, and limitations. The 2 eagle studies proposed in the 1995 Work Plan are replicates of previous surveys. Currently the productivity survey (95030) is a Category 1 study, whereas the population survey (95029) is Category 2. I have only one point I want to make:

<u>**The priority given to these 2 projects should be reversed**</u>.

I believe there are compelling reasons why the population survey should be Category 1:

1. The purpose of the proposed studies are to document population recovery (monitoring). When we conducted the damage assessment study, we estimated the time it will take the population to recover from the spill based on a population model that incorporated the best available, yet sometimes uncertain, parameters. Given that uncertainty, we could not predict with confidence the recovery time. Consequently, the model, and our projection about recovery time, needs confirmation. Frankly, the best way to document population recovery and monitor population status is to conduct a population survey (i.e., count the number of eagles in the same area we counted before). If reproduction or survival has been impaired significantly in the 6 years after the spill, it should be reflected by a decrease in population size. It is a direct measure of the population response, and estimates derived from the surveys are reasonably precise. Now six years after the spill, it is appropriate that such a survey be conducted.

2. The proposed reproductive survey of bald eagles will measure this years' reproductive performance only, but it will <u>not</u> document population recovery. Reproductive success of bald eagles varies widely, both annually and geographically, due to many factors (e.g., weather, seasonal food availability). This is well

documented for eagle populations in Alaska and elsewhere. The truth is, we don't know what constitutes "normal" reproductive rates for eagles in Prince William Sound. Reproductive studies were previously conducted there in only 2 years; 1989, when success was obviously impaired, and 1990, which we assume was normal although we have no way to substantiate that. Although reproductive surveys may be able to detect gross changes in reproductive rates (which I believe are unlikely for this population of eagles), they are not an effective method for long-term monitoring of bald eagle populations. Unless catastrophic, any change between 1990 and 1995 in the observed reproductive rates could be attributed simply to natural variation.

I urge you to seriously consider my comments and re-evaluate the priorities given to the proposed studies on bald eagles.

Feel free to contact me if you need additional information.

Sincerely,

Timothy D. Bowman

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September 30, 1994

James R. Ayers
Executive Director
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Dear Mr. Ayers and Members of the Trustee Council,

This is a response by LGL Alaska Research Associates, Inc. to your request for comments on the Draft Fiscal Year 1995 Work Plan which was prepared for the *Exxon Valdez* Oil Spill Trustee Council. Our comments are in several areas as noted in the following.

The Issue of Restoration ***Ideas*** versus Restoration ***Proposals***

In a document dated May 16, 1994, the Trustee Council invited interested parties to submit restoration projects for 1995. We were informed by Council staff that this announcement was the mechanism the Council intended to use to solicit ideas for restoration, and that the Council would categorize the restoration ideas it received from the public and agencies into two groups: those project ideas appropriate for agencies to accomplish and those project ideas that would be put out for competitive bid. It was clear to us that you were seeking ideas, not fleshed-out restoration proposals. We also understood that the next step in this process would involve a call for detailed restoration proposals which would identify agency track and competitive bid tasks.

Given this, we expected to see in your 1995 Draft Work Plan a dual listing of projects for which we, private sector researchers, could compete. There is no such differentiation in the Plan. Rather, we see explicit research projects, listed by priority, and no listing of projects that might be put out for bid. Most of the projects appear destined for state or federal agencies, which we believe is inconsistent with the U.S. General Accounting Office (GAO) report (GAO/RCED-93-206BR) recommendation "for more open competition for restoration projects,..." We are very disappointed that the Draft 1995 Work Plan appears to be a package of projects that will be funded, as is, with no stated competitive process.

We urge the Trustee Council to reexamine all projects in priority categories 1 and 2 and

consider offering some or all to competitive bid. Your own policy is to encourage competitive proposals (Policy 6, p. 13, Draft Restoration Plan). If you choose to do so, a nationwide Request for Proposals in the disciplines you intend to pursue as your restoration strategy undoubtedly will engender a large number of high quality proposals from scientists who are on the leading edge in their respective disciplines. We urge you to put a competitive process in place this year.

Specific Comments on Genetics Restoration Projects

There are four genetics projects listed in the draft work plan, all assigning the Alaska Department of Fish & Game as lead agency. Project 95191b is a continuation of an investigation of genetic damage to pink salmon. The experimental approach of exposing fish to oil seems unnecessary; wouldn't monitoring the wild population be more appropriate? If genetic damage is serious enough to be of concern, it should be detectable in wild fish. We would like to see the data generated by this project from prior years. Dr. John Bickham, a geneticist with LGL, proposed to ADF&G in 1991 that LGL use flow cytometry techniques to analyze whether genetic damage had occurred to fish populations in the affected areas. We note that, rather than contracting this work, ADF&G has developed in-house capabilities for flow cytometry, yet, to our knowledge, no reports nor papers published in the peer-reviewed literature are available on this study. Note that since 1991, Dr. Bickham has published papers on the use of flow cytometry for genetic toxicology studies of other species (see attached list). We recommend that the flow cytometry work be available for competitive bid.

Projects 95255 (Kenai River sockeye salmon genetics), 95165 (herring genetics), and 95320d (pink salmon genetics) all are of interest to the private sector, and we suggest that much of the work proposed could be accomplished through competitive bid processes. LGL, for example, has conducted several fish and marine mammal genetic stock identification studies. We have developed techniques for analysis of mitochondrial DNA, and recently nuclear DNA, markers in salmon and marine mammals, and have several papers published or in preparation (a list is attached). We do note that the Project 95255 proposal mentions contracting nuclear DNA marker development for sockeye. Funding for this subcontract ($20,000) is not much for modern molecular biology research, but we are interested in it. We also acknowledge the RFP from ADF&G for protein electrophoresis work on the pink salmon project; LGL doesn't do this sort of work and forwarded the RFP on to other firms that do.

We strongly recommend that restoration funds not be used to build molecular (DNA) genetics programs in government agencies when the equipment and personnel are already available in the private sector or universities. Some of these projects appear to justify fish stock identification, a normal agency function, as a restoration project in order to fund expansion of an agency in direct competition with nongovernment sources. We believe that the private sector could accomplish research and development and service work faster and more efficiently than government. For example, over the last three years, LGL has determined mitochondrial DNA genotypes for over 1,700 salmon and marine mammals for under $220,000 in total costs to clients. This included research and development, equipment, overhead, timely reports, *and publication of results*. This is only mtDNA work on aquatic species; we have many other projects with terrestrial animals

and with nuclear DNA. And as suggested in the GAO report, more open competition for restoration projects will improve the quality and timeliness of these projects.

Monitoring

For the past seven years, LGL has been the prime contractor to the oil and gas industry to conduct long-term comprehensive monitoring of the effects of oil and gas development on terrestrial, aquatic, and marine biotic resources in the Prudhoe Bay region of Arctic Alaska. We believe that our expertise and qualifications could be brought to the monitoring efforts planned by the Trustee Council. We request that the Trustee Council's monitoring program be re-cast into an issue-based, ongoing synthesis, integration, and assessment program. We believe that such a program could be efficiently conducted by our firm or perhaps other private sector groups.

In the early 1990s, LGL pioneered the process of issue-based monitoring of causeway effects on coastal fish populations and habitats in the central Alaskan Beaufort Sea. This process, of applied to the oil spill monitoring program, would involve:

- continuous **synthesis** of data and information toward understanding what information is necessary for resolution of key issues,

- **integration** of all restoration and monitoring studies into a holistic understanding of marine ecological processes in Prince William Sound, as they relate to natural and human-assisted restoration, and finally

- **assessment** of all available information in a structured process of hypothesis testing in order to resolve all important issues associated with the spill and its environmental perturbation.

We propose that the Trustee Council consider contracting with LGL to administer the monitoring effort for the *Exxon Valdez* oil spill affected area. Monitoring could proceed according to that described in Wilson and Gallaway (In Prep.), which is a manuscript describing the synthesis, integration, and assessment process (attached); this manuscript currently is under review for publication in a future symposium proceedings by the American Fisheries Society. Our recommended process would involve continued monitoring of the affected area and resources, but would be directed toward resolution of issues. The definition of these issues would be by consensus among the Trustee Council members, researchers, and the Principal Scientist. Such an approach would structure the monitoring program toward attaining a series of specific goals. This process would drive the restoration research efforts, guiding them toward collection of data or preparation of analyses that are necessary to determine when an appropriate level of restoration has been reached - at which time that phase of the restoration and monitoring effort could cease, and resources could be used elsewhere.

Obviously the Council cannot make such a sweeping decision without considerable investigation of LGL's qualifications and without gaining an adequate level of comfort with our approach. We propose to provide such documentation and consultation with

the Council and its staff at your earliest convenience. We believe that this will lead to a focused monitoring program that uses a scientifically-structured approach to resolving issues. LGL would subcontract some elements of this monitoring program, such as the archeological tasks. Other private sector or agency research groups would be contracted to assist with various facets of the environmental field data collection effort. Some of the marine mammal, terrestrial wildlife, bird, fish, and human uses tasks could be conducted with in-house experts in these disciplines.

I direct your attention to LGL's June 15, 1994 statement of interest to the Trustee Council in response to the Invitation to Submit Restoration Projects for Fiscal Year 1995. In that transmittal, I provided a detailed description of our firm and the expertise of our staff.

Accountability for Restoration Studies Conducted To Date

LGL is a company with extensive experience in Alaska, but with little familiarity with studies in Prince William Sound occasioned by the *Exxon Valdez* oil spill. Earlier this summer we sought information on the results of monitoring and restoration activities conducted since the spill occurred, in order to write an informed proposal for restoration project ideas to the Trustee Council. We were informed that reports or other published results of the studies conducted to date on the effects of the oil spill by state and federal agency researchers were not available. These studies have been ongoing since the event occurred in spring 1989 - over five years. Admittedly the study results were NRDA related and were tied up in the litigation process during those initial years after the spill. But since 1991 the process has been open, and we do not understand why monitoring and restoration study results haven't been, at the very least, presented in publicly-available Principal Investigator reports on file in the Trustee Council offices.

Our firm was placed in an impossible situation when considering responding to your call for restoration proposals: we had not done studies of the spill, and therefore had no inside knowledge of the various facets of work conducted to date, nor had we access to any publicly-available documentation of this work. We were informed by Council staff that the only mechanism to research a particular spill-related research or restoration issue was to contact current Principal Investigators, from whom we might be able to obtain progress reports. We assert that this is not an appropriate, accountable way of conducting a science-based restoration program.

We urge the Trustee Council not to fund any continuing or new restoration project until all past work conducted by that agency or individual research scientist or team has been released for public review in scientifically-acceptable form (e.g. a close-out final report that has withstood internal peer review and that has been cleared by the Trustee Council's Principal Scientist). Further, we recommend that all continuing and new restoration studies funded by the Council include a mandate, where appropriate, that one or more manuscripts be prepared from the 1994 (and previous years') studies that is suitable for publication in the peer-reviewed literature. By requiring publication, the Council has at least one measure of the scientific credibility and validity of the restoration studies it is funding. As a further consequence, researcher accountability will increase.

Administrative Overhead

We note that the Trustee Council proposes to fund its Executive Director's office, including public information and data management, at a rate that is 17 percent of the proposed 1994 research budget. We believe that spending almost 1 of every 5 dollars on administrative expenses is far too high and should be carefully examined for savings. Your own policy dictates that public information and administrative costs not exceed 5 percent of the overall restoration expenditures (p. 23, Draft Restoration Plan). Each agency, and suboffices within these agencies, also have their own administrative and information transfer expenses. We wonder if some duplication of services is occurring in this restoration program.

If you or your staff have questions or wish to discuss these matters further, please feel free to contact me.

Sincerely,
LGL ALASKA RESEARCH ASSOCIATES, INC.

William J. Wilson
Office Manager

cc: Dr. Benny Gallaway
Dr. Robert Spies

enclosures

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SYNTHESIS IN APPLIED FISH ECOLOGY: 20 YEARS' STUDIES ON EFFECTS OF CAUSEWAY DEVELOPMENT ON FISH POPULATIONS IN THE PRUDHOE BAY REGION, ALASKA

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ABSTRACT

Causeways in the form of gravel piers have been used in the Alaskan Arctic for access to offshore oil and gas fields and to facilitate movement of freight to the Prudhoe Bay development complex. For the past two decades, environmental monitoring has been required for these developments, and as a consequence a large data base has been developed on the marine habitats and fish populations of the nearshore Beaufort Sea. Impact assessment studies have been conducted for two specific causeways in the Alaskan Beaufort Sea, focusing on several fish species that are utilized in local commercial and subsistence fisheries. In recent years, fish monitoring programs associated with the West Dock and Endicott causeways have been required by the North Slope Borough and have been sponsored by industry. These studies have been reviewed by an independent and multi–disciplinary Science Advisory Committee (SAC) impaneled by the Borough. In 1991, the SAC and the Borough requested that a comprehensive synthesis of available information be undertaken to examine the nearly two decades of accumulated environmental data on the impacts of causeway development on arctic fish populations. This process also required integration of past monitoring reports and published papers into a definitive impact assessment. The synthesis effort was organized around four principal issues:

1) Causeway effects on migration of young–of–the–year Arctic cisco (Coregonus autumnalis),

2) Causeway effects on movements of other fish species,

3) Causeway–induced changes in nearshore hydrography and effects of those changes on fish populations, and

4) Causeway effects on fishery catches in the Colville River delta.

Resolution of each issue required answering multiple subsidiary questions, each requiring specific data analyses. The process of Synthesis, Integration, and Assessment is described in this paper.

INTRODUCTION

Oil and gas exploration and development activities have been continuous in northern Alaska since the 1960s. Environmental impacts of these development activities have been monitored almost continually since the discovery of the Prudhoe Bay oil field in 1968. Accompanying the development of hydrocarbon resources has been the construction of solid–fill causeways in the central Alaskan Beaufort Sea, and environmental concerns have been expressed over their impacts on nearshore hydrography and fish populations.

Two causeways (gravel-filled piers) have been developed in the region to date: West Dock and the Endicott Causeway (Figure 1). West Dock was constructed in 1974–75 to provide deep water access to barges delivering supplies and equipment to develop the Prudhoe Bay oil field. The structure was lengthened during early 1976 to provide emergency access to barges trapped in nearshore ice, and in 1981 was lengthened again for the installation of a water intake facility. The second and third segments are separated by a 15-m breach, located 2800 m offshore. The total length of the West Dock pier is approximately 4.3 km.

The Endicott oil field is located about 16 km northeast of Prudhoe Bay and in the delta of the Sagavanirktok River (Figure 1). The field contains oil reserves of approximately one billion barrels in place, about 350 million of which are recoverable. Development of the field required a 16–km–long gravel access road and an 8–km causeway connecting two manmade islands which support the oil production complex. The causeway was constructed in 1985 and included two breaches totaling 230 m.

Impact assessment research and long term monitoring of effects of these two causeways on the nearshore environment have been sporadic in the 1970s but more or less continuous since 1981. Under permit from the U.S. Army Corps of Engineers (USACE) and the North Slope Borough (NSB), environmental monitoring has been specifically mandated to include habitat and fish population studies. Various studies have been completed, but continued long term monitoring of the Endicott Causeway has been required by the Borough because of their concerns over impacts of the structure on fish populations important to residents of northern Alaska.

This paper focuses on the process of evaluating causeway impacts on fish populations of the Alaskan Arctic, and describes the historic monitoring efforts, data base, and analytical framework utilized to prepare a comprehensive synthesis of information for assessing impacts.

SCOPE AND HISTORY OF THE ISSUES

During the initial planning process for the Endicott Causeway, many environmental issues were raised. Four were concerns over impacts on fish populations:

(1) What would be the effects of the causeway and/or causeway–induced changes in circulation and hydrography on the migration of young–of–the–year Arctic cisco (C. autumnalis) from Canada to the Colville River of Alaska?

(2) What would be the effects of the causeway and/or causeway–induced changes in circulation and hydrography upon the nearshore migration corridor (from the shore to the 2–m isobath) used by most species and size groups of anadromous fish?

(3) How would the temperature/salinity characteristics of the nearshore habitat be altered by the circulation and hydrographic effects resulting from the causeway, and what ramifications would these changes have on the population level of broad whitefish (C. nasus) in the Sagavanirktok River?

(4) What would be the impact on the Colville River Arctic and least cisco (C. sardinella) fisheries?

These major issues of concern are restricted to the question of effects of coastal modification on physical and biological processes. The major issues are well documented, having been articulated in the early 1980s based upon monitoring the West Dock structure and comments presented in a series of public forums and resource agency meetings while the Endicott Development project was being planned. These issues provided the focus for the project environmental impact statement (EIS) and the monitoring program.

THE NEED FOR AN INFORMATION SYNTHESIS

Construction and operation permit stipulations imposed by the USACE and NSB for the Endicott Development Causeway mandated a marine ecological monitoring program. The purpose of the monitoring was to evaluate the predictions that had been made in the project EIS relative to the four major issues.

During 1985–1987, a joint oceanographic–fish monitoring program was conducted under the auspices of the USACE. During 1988–1990, separate oceanographic and fish monitoring programs were conducted for the USACE and NSB, respectively. The USACE oceanography program continued along the lines established by the 1985–1987 program and was concluded in 1990. BP Exploration (Alaska) Inc. (BPX), the operator of the Endicott Development, continued the oceanography program in 1991. The NSB fish monitoring program of 1988–1991 established a fish sampling and experimental studies program designed to address specific questions needing resolution. The NSB impaneled an independent Science Advisory Committee (SAC) to review and provide guidance to the program.

During the first years of SAC oversight, major emphasis was placed upon developing published papers addressing key questions so a synthesis of the understanding of the various elements of the research efforts eventually could be prepared based upon peer–reviewed literature. Prior to this effort, much of the scientific information on causeway effects was unpublished. Since many of the questions were of an oceanographic nature, the fish monitoring program also included oceanographic analyses and assessments (separate from the USACE program). Because the respective fish and oceanographic monitoring programs of 1988–1990 were separate, true integration and a consensus assessment were not achieved. Nevertheless, progress towards addressing the major issues was made by each of the review programs (SAC 1990a; SAC 1990b).

During 1991, the SAC stressed the overriding importance of a comprehensive synthesis of fish and oceanographic data, and a definitive assessment of impacts from the Endicott Causeway on fish and marine systems (SAC 1991). In the SAC's view, the most pressing need was to determine which impact issues, following six years of one of the most intensive monitoring studies ever conducted in North America, could be considered resolved, and what additional information was needed to complete a reasoned assessment. This view, that there was an immediate need for a comprehensive synthesis and assessment, was shared by the NSB, and by the operator of the development, BPX. Thus, major emphasis of the program was placed upon synthesis and integration of all existing data and information necessary to produce the most comprehensive assessment possible.

At this point, it is important to define the terms used in this process. The following paraphrases the SAC's concurrence on the definitions of Synthesis, Integration, and Assessment:

> SYNTHESIS: The process of building understanding from the separate elements and results of research and investigation.
>
> INTEGRATION: The act of combining elements of investigation into a whole; bringing results of unidisciplinary and multidisciplinary studies into a holistic explanation of phenomena; seeing how conclusions of the various task elements work together and what they mean in unison.
>
> ASSESSMENT: Appraising, evaluating, and coming to a conclusion; the final process of determining impacts, after synthesis and integration.

The objectives of the Synthesis, Integration, and Assessment program were based on the key issues:

1. To review and synthesize data relevant to assessing how the Endicott Development Causeway affects movement of young–of–the–year Arctic cisco from Canada to the Colville River of Alaska.

2. To review and synthesize data relevant to assessing how the causeway affects movement of other amphidromous fish (broad whitefish, least cisco, Dolly Varden charr (Salvelinus malma), and Arctic cisco age 1 and older).

3. To review and synthesize data relevant to assessing how temperature/salinity changes attributable to the causeway affect populations of amphidromous fish.

4. To review and synthesize data relevant to assessing whether observed variations in the Colville River Arctic cisco and least cisco fisheries are attributable to the causeways.

5. To identify areas in which additional data (if any) are needed to finalize the assessments noted above in Objectives 1–4.

All historic and recent data from the Prudhoe Bay region were included in the Synthesis, Integration, and Assessment program. Many investigations have been conducted in anticipation of, or to directly determine the, effects of industrial development on the marine environment of northern Alaska, particularly the Prudhoe Bay region. These studies have generated a large data base which, when used in conjunction with the more recent Endicott Causeway monitoring data base, comprise a record of oceanographic and fish observations in the Alaskan Beaufort Sea spanning the period 1954–present.

The data base includes data files on measurements of fish distribution and abundance, movement patterns, age and growth, food availability and feeding activities, and hydrographic conditions in the coastal zone. In addition to the archived data, numerous gray literature reports have been generated as well as dozens of peer–reviewed scientific articles and publications, including a major collection of ecological papers published by the University of Alaska Fairbanks (Norton 1989).

The NSB also requested that reports from all studies previously conducted—genetic stock structure studies, basic annual environmental monitoring studies, laboratory fish feeding

studies, and basic distribution, abundance and movement studies—be integrated into the comprehensive synthesis report. The report was to evaluate these various documents and data sets, and provide an assessment of how each of the original EIS issues has been resolved from all available data. That process of Synthesis, Integration, and Assessment is described below.

METHODS

Conceptual Approach

The conceptual design of the Synthesis, Integration, and Assessment effort is shown in Figure 2. The concerns about causeways relate to their effects on fish and fish habitat. These general concerns were divided into four "separate" issues (Panel A) which conform to the issues originally identified in the Endicott Project EIS. To resolve each issue required answering a series of key questions (Appendix 1) related to each issue based upon results of specific analyses (Panel B). Some of the questions are common to all the issues (effects of causeway–induced circulation changes) while others are specific to a single issue (has condition of broad whitefish exhibited a decline since construction of the Endicott Causeway in 1985?). Some of the questions required a response which was nothing more than descriptive information.

However, there were some points of contention regarding the interpretation of the descriptive data. In these instances, the relative merits of opposing points of view were evaluated by statistically testing well–structured hypotheses. Significant differences were stated with specified levels of confidence. If significant differences were not found, the results were evaluated in terms of the power of the test (what levels of difference could we have detected) and the possibility that a Type II error was being made. While there were relatively few general questions that fell in this category, there were many sub–questions that had to be addressed by formal hypothesis testing.

Once all the questions were addressed, there remained the task of integrating all the information to make a statement of conclusion regarding each issue. Statistical and simulation models were tools for achieving integration and providing the basis for the overall assessment concerning each issue. How models were used in concert with the synthesis information and results of analyses and hypothesis testing is perhaps best shown by an example which is presented in the next section.

The objectives of this approach were to definitively provide an up–to–date statement of conclusion regarding each of the four issues. The fifth and secondary objective was to define important data sets that should be obtained to complete a reasoned assessment. The "reasoned assessment" was judged by the SAC.

Addressing the Concerns and Issues

Originating with the emergency extension of West Dock in 1976, the use of causeways for coastal developments has elicited controversy about what effects these structures might have on fish habitat and, in turn, on fish stock health and size. These three areas (causeways, fish populations, and habitat) are the major concerns which were dealt with in the Synthesis, Integration, and Assessment effort. These three overlap considerably (see Panel A, Figure 2), although the areas of overlap are not necessarily proportional. This overlapping of issues, and the complexity thus generated, have led to a wide variety of opinions in the scientific community regarding the definition of impacts and the resolution of issues.

For example, the presence of causeways <u>per se</u> has been documented to directly block fish migrations under some circumstances (e.g. Gallaway et al. 1990). These circumstances involve

the natural encroachment of marine water against the tip of a causeway and the inability of migrating fish to move around the end of the structure because they are unwilling to swim into sublethally high salinity/low temperature water. "Blockage" of fish is not due simply to a physical barrier; rather other phenomena are involved. Blockage of fish migrations at these causeways results from the hydrographic changes induced by the effect of the structures on circulation. Often referred to as the "wake eddy" effect, high salinity/low temperature water occasionally is advected inshore downstream of the causeway (Colonell and Gallaway 1990) and fish are temporarily unable or unwilling to swim through the water mass.

To use the example given above, the symptom of causeway effects on fish is blockage of fish movement. Therefore, the approach needed to achieve effective mitigation must be based upon the mechanism producing the symptom. This is highly dependent upon the location of the causeway and the nature of the surrounding environment.

While is it clear that all causeways will have some effect on habitat, it does not necessarily follow that such changes will be detrimental to the fish. Fish species differ in terms of their habitat requirements and use patterns. And in the Arctic, the complexity and dynamics of coastal fish habitat conditions (Neill and Gallaway 1989) renders assessment of effects of habitat change a difficult challenge. What may be detrimental to one species or life history stage may be inconsequential to another. Conversely, a causeway at one location may have adverse impacts on a species, while at another location these impacts might not be significant. The mechanisms that account for these differences must be clearly identified if future causeways are to be evaluated objectively in terms of their likely impacts to fish populations and habitat. Further, the issues associated with a particular causeway must be focused on the fish species that are considered important and potentially affected under the site–specific circumstances.

Environmental monitoring programs and directed scientific studies of the causeways have gradually unraveled natural ecological processes and how causeways interact with these local and regional processes. Defining the issues of concern over causeways has been the key element of the environmental impact assessment process. We have attempted to guide our approach to synthesis and assessment by reliance on the original statement of issues found in the Endicott Development EIS. The next step in the program was to resolve each issue through a process of hypothesis testing.

Questions and Hypotheses

We devised a multi–stage approach to address each issue (Panel B, Figure 2). We began by identifying the pertinent questions for each issue. As suggested by the SAC, the questions were stated in a manner appropriate to a resource manager's needs and the questions were restricted to those which were considered necessary to resolve the issues. The questions, associated with the four specific issues surrounding the two Beaufort Sea causeways, are provided in Appendix 1. This list provided the measures that were used to determine when the program objectives had been met.

The next step was to formulate sets of testable hypotheses pertinent for each question and to document that there is an observational basis for each hypothesis; i.e., we demonstrated that specific data could be collected and analyzed to test each hypothesis (an example is provided in Table 1). This documentation served to focus effort on impacts that are truly possible and within the realm of probability rather than those which "could" occur given imaginary situations. Each hypothesis was coded to a specific question, itself coded to one of the four issues.

Each hypothesis (see example in Table 1) was stated in a testable fashion. For some, an explicitly–formulated statistical test was appropriate. For those, confidence limits were specified. If the results of the test suggested that the observed differences were not significant at the specified probability level, then appropriate power analysis was conducted to provide an explicit estimate of the maximum possible difference that could have escaped detection.

It was appropriate that some hypotheses would best be tested using model evaluations, especially some of the hypotheses concerning physical processes and physical/biological relationships. In these instances, an evaluation of the sensitivity of the model result to variation in any of the input parameters (assumed or measured) was provided.

Where necessary, the suitability of the model for testing a given hypothesis was evaluated. For example, various statistical models (Gazey–Staley or "Bayes", Schnabel, Schumaker–Eschmeyer) have been used to estimate population levels of some anadromous fish in the study area since 1988 for comparison to pre–causeway levels. All of these models, at least to some degree, include the assumption that the population is closed, although this is usually not the case. How seriously are the results compromised by invalidating this assumption? (See Gallaway et al. 1994, this symposium proceedings.) Comparison of the results from the models based upon the closed–population assumption to results obtained using an open–population model (Jolly–Seber) was suggested by the SAC, and an expanded fish tagging program was instituted in 1990 in order to strengthen the tests.

The results obtained for the least cisco population have enabled us to conduct the suggested comparison. The mean Bayes estimate (all three closed–population models gave similar results) suggested that 332,000 large least cisco were present in the Prudhoe Bay region during summer 1990. The mean daily Jolly-Seber estimate of the large least cisco population in Prudhoe Bay during the period 17 July (arrival date) to 29 July (initiation of the main return migration) was 301,000. Such results are encouraging given that historical data are available for use in closed–population models, but are not of the right type for use in open–population models.

Some hypotheses could be tested only qualitatively, and relied on weight–of–evidence evaluations for their acceptance or rejection. For example, the abundance of Arctic cisco in the Prudhoe Bay region was hypothesized to be related to wind patterns. Strong versus weak year classes could be defined qualitatively from the historical fyke net and fishery CPUE and age data, but the variance associated with some of these determinations could not be estimated. However, we found that classification of CPUE by age as either strong (represented by daily fyke net catches of 10's to 100's or 1000's of young–of–the–year Arctic cisco) or weak (daily catches <10) was convincing, without knowing the variance; the differences could be attributable to chance. However, when the pattern of strong versus weak year–class determinations was compared to a quantitative determination of wind patterns, marked correspondence was observed (Figure 3). Our judgment was that the variation in CPUE was more likely attributable to wind patterns than to random variation resulting from an imprecise measure of abundance. Such an approach was used when necessary, so that managers could distinguish the level to which the judgments of the scientists are based on pure gestalt versus documented evidence.

After evaluating each hypothesis, a basis for answering each question was established. The combination of hypothesis testing and responding to questions led to an assessment of each issue; i.e., a judgment of the degree to which each issue had been resolved (Panel B, Figure 2). This final step in the process was to draw a conclusion regarding impacts of the region's causeways on fish populations and habitats.

RESULTS AND DISCUSSION

The draft Synthesis, Integration, and Assessment was completed in 1992 and reviewed by the NSB and the SAC (1993). Appendix 2 provides a brief synopsis of the degree to which each issue may be considered resolved. The Synthesis, Integration, and Assessment process articulated specifically how causeways interact with natural ecological processes of the Alaskan Beaufort Sea, and quantified their effects on local fish populations. The four key issues are not fully resolved, but a basis for determining how each issue will be resolved has been established (SAC 1993).

The synthesis effort also has shown that the controversy regarding causeway effects on coastal habitat and fish populations in northern Alaska has largely resulted from a poor understanding of the biology of the fish in question as well as a poor understanding of the coastal oceanography. The initial approach followed by regulatory groups who had oversight responsibilities for evaluating the causeway developments had been to protect habitat based upon the premise that, if the habitat is reduced, declines in the fish populations will ultimately follow (Hachmeister et al. 1991). However, more issue-based, focused investigations have shown that the summer habitat is normally not at capacity because of the limiting features of winter habitat relative to summer habitat. Further, the net effect of causeways on summer habitat has been to increase locally the variability in temperature and salinity. However, the extremes are not affected and are within the limits naturally experienced by the fish. The fish are well adapted to contend with this type of environmental uncertainty (Johnson 1976, 1981, 1983; Craig 1989).

The synthesis process has also led us to believe that population parameters (e.g., population level and structure, and growth) are sensitive to habitat change and are well suited to address effects of habitat reduction. We concur with Robertson (1991) that impact predictions may be appropriately based on expected changes to habitat, but impact assessments are best made by study of the populations involved. However, long-term studies are necessary, particularly in the Arctic, to observe how the populations vary over time and to determine the key factors that govern the dynamics.

In essence, we believe that available information is adequate to determine that the effects of the Endicott Causeway on anadromous fish habitat and populations are likely not substantial.

CONCLUSION

Above we have described an approach to Synthesis, Integration, and Assessment of a large volume of scientific data and information available for evaluating the impacts of causeways on coastal marine habitat and fish populations in the central Alaskan Beaufort Sea. We recognize other methods to accomplish impact assessment. For example, we could have defined each key question and prepared a stand–alone report on it. Alternatively, a synthesis report could have been prepared that was organized by discipline, such as by trophic level (e.g., effects on coastal hydrography, primary productivity, epibenthic invertebrates, fish, and fisheries) or by fish species (e.g., effects on Arctic cisco, broad whitefish, etc.).

We chose our preferred approach based largely on the history of the causeway monitoring programs in the Alaskan Beaufort Sea. Since preparation of the Endicott Development EIS, federal and state agency concerns, and subsequently the field studies, have been issue–oriented. This "mindset" continues today, so it was logical to proceed with an issue–based synthesis. The SAC also indicated their preference for this approach.

The Endicott Development is the first continuous offshore producing field in the Arctic. As the sixth largest oil field in the U.S., the impacts of this development on fish and wildlife resources has been carefully monitored by regulatory agencies, conservation organizations, and the general public. The Synthesis, Integration, and Assessment serves as a key milestone in evaluating the impacts of the Endicott Development on coastal fish populations, and provides a framework for decision-making and a direction for future environmental studies in the North American Arctic and elsewhere where comprehensive long–term environmental impact assessments are required.

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Appendix 1. Questions answered during the process of Synthesis, Integration, and Assessment in order to resolve the four issues relevant to causeway impacts on Alaskan Beaufort Sea fish populations.

Issue 1: What would be the effects of the causeway and/or causeway-induced changes in circulation and hydrography on the migration of young-of-the-year Arctic cisco (C. autumnalis) from Canada to the Colville River of Alaska?

Question 1.1 What mechanisms govern the movement of young–of–the–year Arctic cisco from the Mackenzie River of Canada to habitats in Alaska?

Question 1.2 Is the movement restricted to the nearshore brackish water zone?

Question 1.3 What proportion of the Canadian source population(s) of Arctic cisco use the Colville River and adjacent coastal zone as overwintering and rearing habitat, respectively?

Question 1.4 Does the Endicott causeway cause the movements to be blocked in the Prudhoe Bay region, preventing the fish from reaching the Colville River?

Question 1.5 What is the fate of the young–of–the–year Arctic cisco that attempt to overwinter in the Sagavanirktok River and to what extent will survivors ultimately contribute to the fishery?

Question 1.6 Do the area causeways or their associated hydrographic conditions increase susceptibility to disease or other environmental stresses (e.g. storms, temperature change, etc.) in young–of–the–year Arctic cisco?

Question 1.7 If sufficient data are not available to answer the basic questions associated with Issue 1, what are the major areas in which additional data are needed?

Issue 2: What would be the effects of the causeway and/or causeway-induced changes in circulation and hydrography on the nearshore migration corridor (from the shore to the 2-m isobath) used by most species and size groups of anadromous fish?

Question 2.1 What are the mechanisms governing the movement of least cisco, Arctic cisco and broad whitefish from the Colville River eastward into the Prudhoe Bay region?

Question 2.2 When do these species arrive at the eastern end of Simpson Lagoon and do the conditions around West Dock result in blockage?

Question 2.3 What are the movement patterns of these species into and across Prudhoe Bay and beyond, and do the conditions around the Endicott Causeway lead to blockage?

Question 2.4 Do the species using the Prudhoe Bay region during summer show distributional responses that can be related to changes in temperature and salinity?

Question 2.5	Does the West Dock Causeway contribute to blockage or delay of fish moving westward?
Question 2.6	Do the catch patterns suggest that the Endicott Causeway or hydrographic conditions around the structure contribute to blockage or delay of the resident fish moving into the Sagavanirktok River?
Question 2.7	Do the area causeways or their associated hydrographic conditions increase susceptibility to disease or other environmental stresses (e.g. storms, temperature changes, etc.) in fish moving in and through the area?
Question 2.8	When and to what extent do fish of each species utilize breaches in the area causeways?
Question 2.9	If sufficient data are not available to answer the basic questions associated with Issue 2, what are the major areas in which additional data are needed?

Issue 3: How would the temperature/salinity characteristics of the nearshore habitat be altered by the circulation and hydrographic effects resulting from the causeway, and what ramifications would these changes have on the population level of broad whitefish (C. nasus) in the Sagavanirktok River?

Question 3.1	Have hydrographic and circulation effects from the Endicott Causeway exceeded the predictions of the EIS? In particular, does the causeway affect upwelling or otherwise cause shoreward incursion of a marine saltwater wedge into the delta?
Question 3.2	What temperature/salinity conditions can Arctic cisco and broad whitefish tolerate, and how do these tolerances compare to levels of causeway–induced changes in hydrography?
Question 3.3	Have there been any changes in abundance and age/size structure of broad whitefish or Arctic cisco that are attributable to the causeways?
Question 3.4	Are the fish exposed to the hydrographic effects from the causeway or do they avoid them?
Question 3.5	Is there a relationship between temperature/ salinity and growth and condition of Arctic cisco and broad whitefish; and, if so, what are the consequences of the causeway–induced hydrographic changes on these population characteristics?
Question 3.6	What are the population–level ramifications of adverse, sublethal effects on growth and condition of Arctic cisco and broad whitefish, and what is the time scale required before the effects would be manifested as a decrease in the populations?
Question 3.7	Is there a relationship between nearshore hydrography and the species composition of the fish community inhabiting nearshore habitat, and to what extent do the causeway–induced changes in hydrography alter composition of this community?

Question 3.8	If sufficient data are not available to answer the basic questions associated with Issue 3, what are the major areas in which additional data are needed?

Issue 4:	What would be the impact on the Colville River Arctic and least cisco fisheries?
Question 4.1	What stocks of Arctic cisco are important to the Colville River fisheries and what is their source?
Question 4.2	Has the size of the catchable stocks of Arctic and least ciscoes declined since construction of the causeways?
Question 4.3	Has the size/age structure, age at sexual maturity, or growth of the catchable stocks of Arctic and least ciscoes changed since construction of the causeways?
Question 4.4	Have there been changes in natural and/or fishing mortality rates of the catchable cisco stocks since construction of the area causeways?
Question 4.5	How sensitive are the source population(s) of Arctic cisco to impacts resulting from Alaskan causeways and/or harvest levels?
Question 4.6	If sufficient data are not available to answer the basic questions associated with Issue 4, what are the major areas in which additional data are needed?

Appendix 2. Synopsis of causeway impacts on fish populations of the central Alaskan Beaufort Sea based on the four key issues.

Issue 1.--Issue 1 concerned the potential effects of causeways on the dispersal of Arctic cisco from the Mackenzie River, Canada to the Colville River, Alaska.

Arctic cisco, predominantly from the Peel River tributary to the Mackenzie River of Canada, are transported to Alaska during their first year of life if winds are favorable. Winds are favorable on the order of 50% of the years. A substantial proportion of the population is likely affected when winds are favorable--on average about 30% or more of the population considering all years. The dispersal is largely a passive drift process (Gallaway et al. 1983; Gallaway et al. 1989), governed by the wind effect on currents. The effects of the regional causeways on circulation do not greatly affect the dispersals, and thermal trapping as described in the project EIS has not occurred.

The dependency of the fish during the dispersal on nearshore, brackish coastal waters for survival is not well documented. There is some indication that the fish do indeed occur in offshore waters, and data for older fish show that they can acclimate to marine salinities, at least under conditions of relatively warm temperature (> 3°C). Large numbers of the fish which do find refuge in the Sagavanirktok River typically survive, and overwinter there for up to two to three years following their initial recruitment. The number which overwinter there is determined by the number of fish which are transported this far west, and whether they are transported beyond the delta before the end of summer. Maximum numbers occur when the bulk of the fish are initially carried westward beyond the area, then subjected to a wind reversal carrying them back to the east into the Sagavanirktok River delta.

The area causeways do not appear to affect the numbers of fish which reach the Colville River. It should be stressed that large numbers can reach the Sagavanirktok River but not the Colville. Large numbers can be carried beyond the Sagavanirktok and then beyond the Colville River as well. Thus, abundance of young-of-the-year in the Prudhoe Bay region does not necessarily index abundance that will occur in the Colville River fisheries five to six years later.

The available evidence is adequate to conclude that the area causeways do not affect the dispersal of young-of-the-year Arctic cisco. Thus, while there are remaining uncertainties concerning the year-to-year composition of the Alaskan stock, the proportion of the source stocks involved, and the factors governing their abundance in Alaska, these do not bear directly on the issue of causeway effects. The issue of causeway effects on dispersal of young-of-the-year Arctic cisco is judged to be resolved.

Major modifications of the two area causeways are planned for 1993 when the breaches in the Endicott Causeway will be expanded by 200 m. A similar breaching expansion will occur in West Dock in 1994. These alterations will, to some extent, modify existing local water circulation patterns. While the effects of these modifications on circulation are expected to be minor in scale, continued monitoring will be conducted to document their effects on young-of-the-year Arctic cisco dispersal through the region.

Issue 2.--Issue 2 concerned the extent to which the causeways and their hydrographic effects influence the movements of anadromous fish other than young-of-the-year Arctic cisco.

Coregonid fish that use the Prudhoe Bay during summer overwinter in either the Colville River (Arctic cisco, least cisco, broad whitefish) or the Sagavanirktok River (Arctic cisco and broad whitefish). Small fish of each species do not disperse as far as large fish during the summer

feeding period. This is particularly true for small broad whitefish which do not venture away from the immediate vicinity of the mouths of their overwintering areas. Some small least cisco from the Colville River disperse as far east as West Dock, but in less than 40% of the years. Small Arctic cisco from the Colville River are difficult to distinguish from small Arctic cisco which overwinter in the Sagavanirktok River, but the dispersal range of small Arctic cisco from the Colville would not be expected to be much different than observed for least cisco. When small Colville River fish reach as far east as West Dock, they are periodically prevented from moving further eastward if regional upwelling has advected shelf bottom water to the vicinity of the causeway (Fechhelm et al. 1989). This phenomenon occurs infrequently at West Dock, and does not appear to influence movements eastward around the Endicott structure. Given these and other observations, we conclude that there are no appreciable effects of the Prudhoe Bay causeways on the summer feeding dispersal of small coregonid fish from the Colville River.

All the evidence is in agreement with the conclusion that migrations of large coregonid fish are not affected by either of the area causeways. There also is no evidence to support the contention that the fish moving through the Prudhoe Bay region are subjected to a higher exposure to stressful conditions than in other regions (see Bryan and Fechhelm 1994, this symposium proceedings).

Enlargement of the breaches in the two area causeways does not appear to be a required mitigation measure from a fish movement standpoint. The proposed enlargement of the existing breach at West Dock will not be effective in facilitating passage of anadromous fish because of its offshore location. To be effective, it should be located along the mainland shore. Future monitoring will likely focus on what effects the new breaching may have on localized hydrographic conditions around both causeways and on fish movement patterns in the vicinity of the causeways.

Issue 3.--The results of analyses under Issue 3 quantified the effects of the area causeways on habitat, and the resulting ramifications to fish populations. Whether habitat or population parameters should be used as the basis for impact assessment has generated the most controversy concerning effects from the area causeways. We have concluded that both are important, and use of one without considering the other can lead to erroneous conclusions and unjustified mitigation attempts.

The interaction between regional-scale oceanographic processes and causeways has been defined (Niedoroda and Colonell 1989, 1990), enabling quantification of the causeway effects on habitat variables that govern the well being of resident coregonid fish populations. The key habitat factor appears to be water temperature. Water temperature explains from 77 to 92% of the observed variance in growth of juvenile Arctic cisco and broad whitefish (Fechhelm et al. 1992a; Griffiths et al. 1992), the size classes of fish least able to move away from sub-optimal habitat conditions and, therefore, most at risk to causeway-induced hydrographic perturbations.

As little as 1°C reduction in temperature has been estimated to result in a 20% reduction in growth of juvenile broad whitefish (Fechhelm et al. 1992). In the nearshore area west of the Endicott Causeway, the causeway has reduced water temperature, on average, on the order of 0.5 to 0.7°C. While the fish still use this habitat, their movements reflect an avoidance response when adverse conditions occur. Because favorable habitat remains available, there have been no significant reductions in growth (Griffiths et al. 1992). Nevertheless, the results do show some potential habitat loss.

However, it also has been hypothesized for broad whitefish that the constraint of limited winter habitat may maintain the population below carrying capacity of the summer habitat (see

Gallaway et al. 1994, this symposium proceedings). If this were true, habitat reduction would not necessarily equate to a reduction in the population. Population size is probably governed by a density-dependent strategy used by the fish to cope with the constraint of limited winter habitat.

Pronounced causeway effects on fish habitat are restricted to the areas in the immediate vicinity of the causeways, and these areas are avoided by the fish (Gallaway et al. 1991). Such events occur on the order of one to five times during the summer with most occurring near the end of the summer after most of the fish have already departed the area. While significant reductions in temperature have occurred in more nearshore areas west of the Endicott Causeway, they are small and have not had significant effects on the populations.

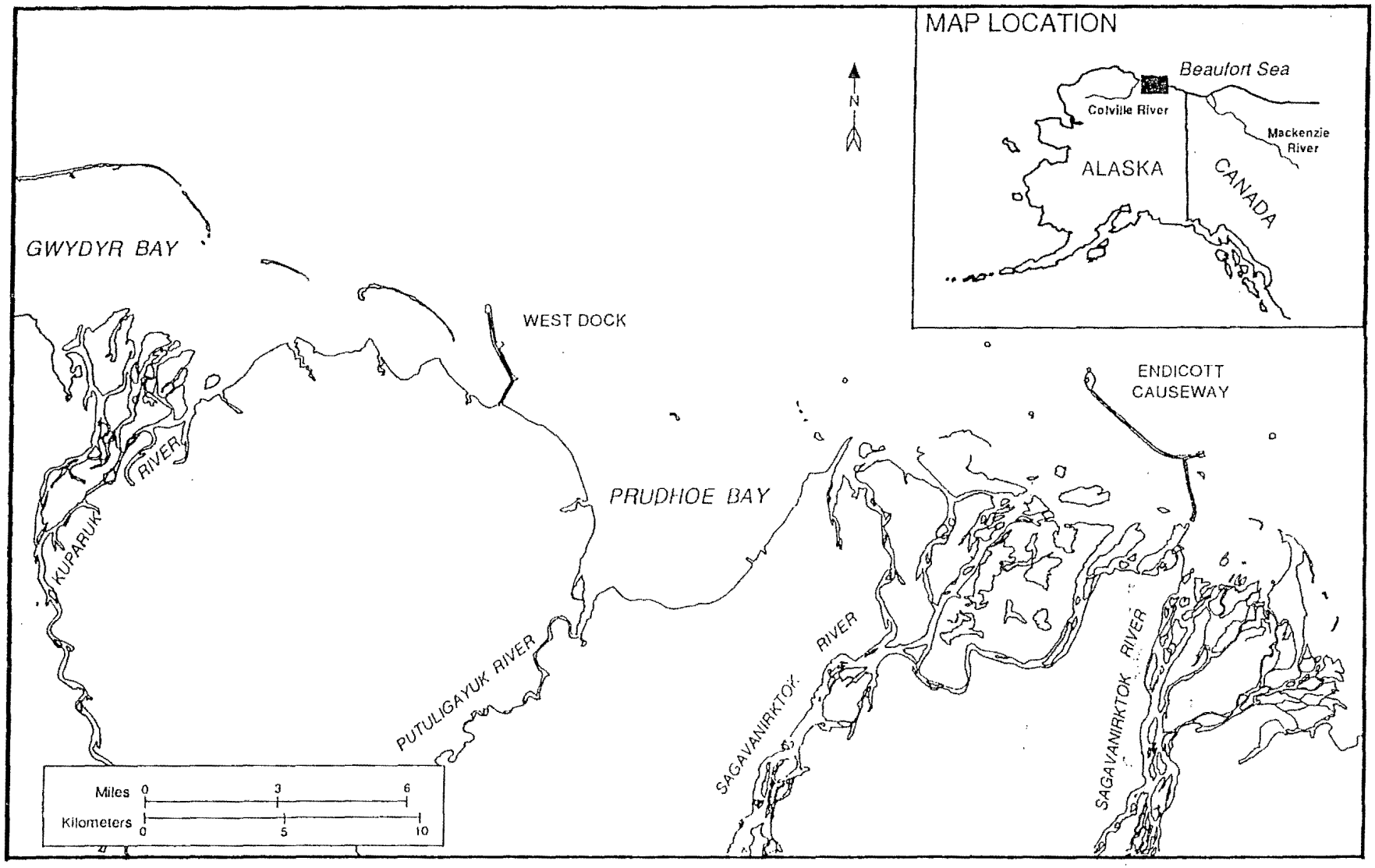
The decision to require additional breaching in the area causeways was based on the conclusion that the Endicott Causeway had resulted in adverse impacts on habitat and fish populations that had exceeded the predictions of the EIS (Hachmeister et al. 1991). This conclusion is erroneous based on the available evidence (Gallaway et al. 1991; Colonell et al. 1992). The requirement for additional breaching on this basis is therefore questionable. Continued monitoring will be required to determine if the additional breaching will mitigate the observed effects which are already generally less than those predicted in the project EIS.

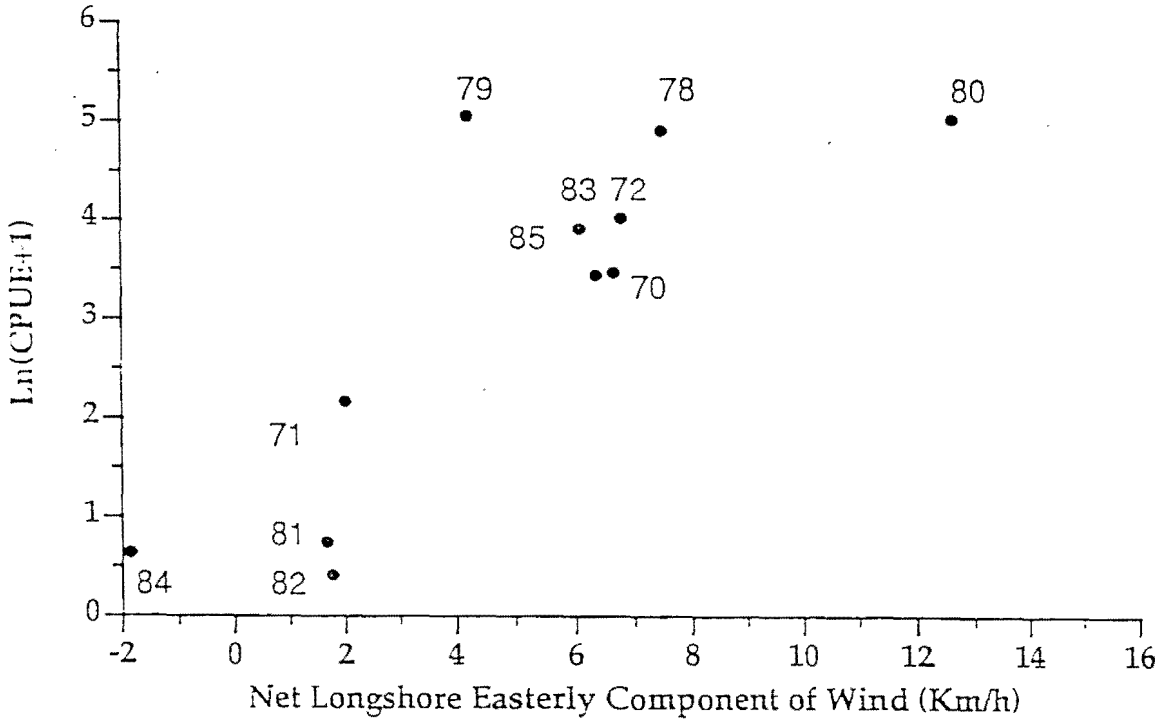
Issue 4.--The questions addressed under Issue 4 were asked to gain a better understanding of the dynamics of the fishery and the role of the area causeways on these dynamics.

The Colville River cisco fisheries predominantly harvest Arctic and least ciscoes along with smaller numbers of Bering cisco and broad whitefish. The harvested Arctic cisco are mainly representatives of the Peel River (Mackenzie River) population, with some contribution from the Arctic Red River (Mackenzie River) as well. Variation in fishing stock size results from variation in meteorological patterns. High stock levels occur in Alaska when westward transport is high and young-of-the-year are abundant. Under these conditions, a substantial portion of the source population appears to be transported to Alaska. We have not established any firm linkage between the area causeways and the success of the Alaskan fisheries. While we have not established any linkage between the causeways and fishery success, a key risk analysis remains to be conducted before a final conclusion is reached.

Table 1. An example of a group of analyses required to answer one question (see Appendix 1 for a list of all questions).

Question 1.1	What mechanisms govern the movement of young–of–the–year Arctic cisco from the Mackenzie River of Canada to habitats in Alaska?
Hypothesis 1.1.1.	There is no significant correlation between wind speed and direction and abundance of young–of–the–year Arctic cisco in Prudhoe Bay.
Analysis 1.1.1.	Correlation of winds to young–of–the–year abundance in Prudhoe Bay and coastal study sites between the Mackenzie River and Prudhoe Bay.
Hypothesis 1.1.2.	There is no significant association between time and distance travelled by young–of–the–year Arctic cisco and wind speed and direction.
Analysis 1.1.2	Graphical analysis showing level of association between elapsed time and distance travelled by young–of–the–year to wind speed and direction.
Hypothesis 1.1.3.	There is no significant association between historical year class contributions to the Colville fishery and the winds which occurred during the first year of each year class.
Analysis 1.1.3.	Graphical analysis showing level of association between year class contribution to fishery CPUE and historical wind patterns.
Hypothesis 1.1.4.	Abundance of young–of–the–year Arctic cisco in Prudhoe Bay cannot be described by simple regional scale diffusion/ transport models.
Analysis 1.1.4.	Develop regional scale diffusion/transport model based on physical processes alone and use to predict arrival times and strengths.


MAP LOCATION
Beaufort Sea
Colville River
Mackenzie River
ALASKA
CANADA
N
GWYDYR BAY
WEST DOCK
ENDICOTT CAUSEWAY
PRUDHOE BAY
KUPARUK RIVER
PUTULIGAYUK RIVER
SAGAVANIRKTOK RIVER
SAGAVANIRKTOK RIVER
Miles 0 3 6
Kilometers 0 5 10


Ln(CPUE+1)
Net Longshore Easterly Component of Wind (Km/h)
79
78
80
83
72
85
70
71
81
82
84
0
1
2
3
4
5
6
-2
0
2
4
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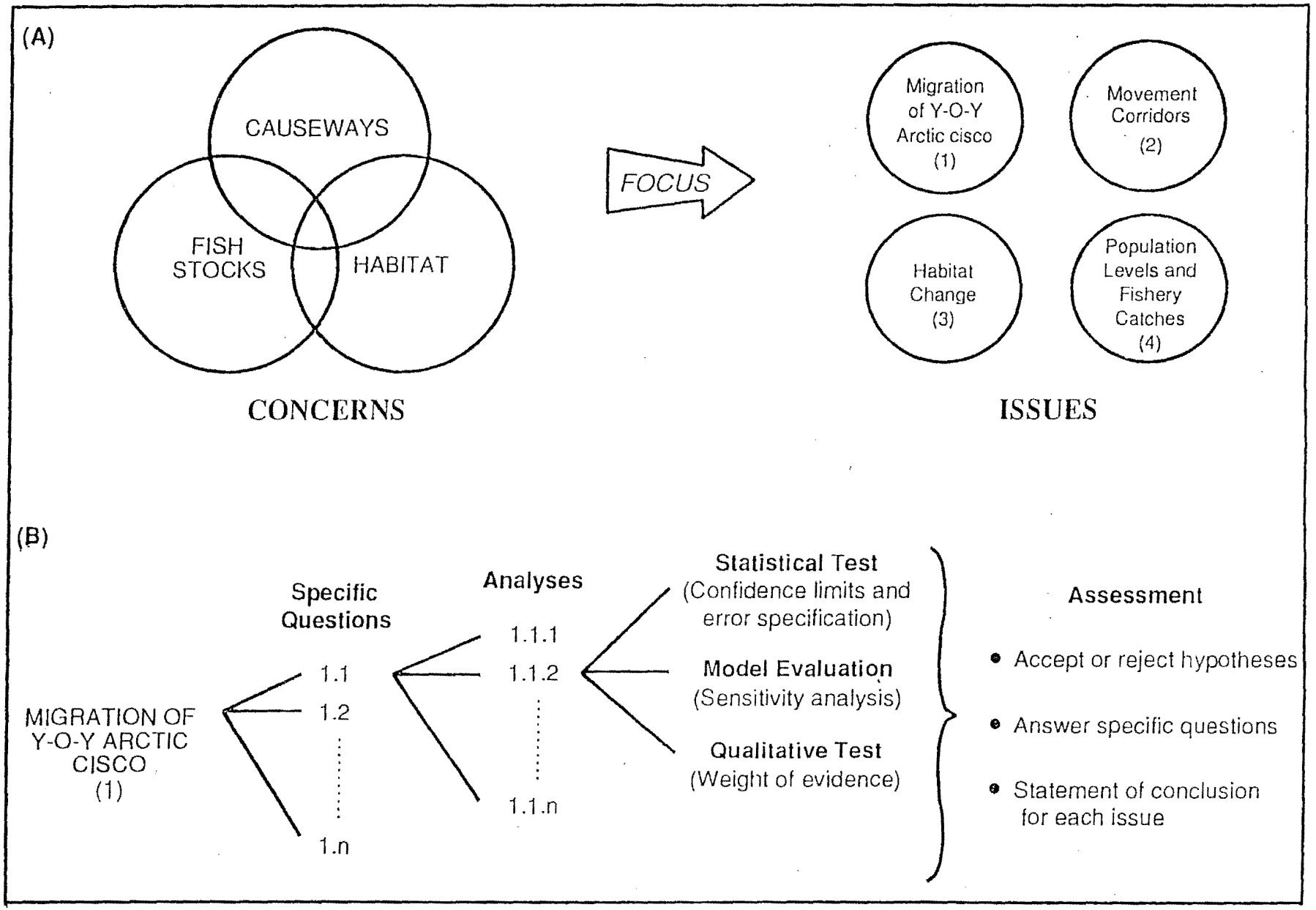
8
10
12
14
16


(A)
CAUSEWAYS
FISH STOCKS
HABITAT
CONCERNS
FOCUS
Migration of Y-O-Y Arctic cisco (1)
Movement Corridors (2)
Habitat Change (3)
Population Levels and Fishery Catches (4)
ISSUES
(B)
MIGRATION OF Y-O-Y ARCTIC CISCO (1)
Specific Questions
1.1
1.2
1.n
Analyses
1.1.1
1.1.2
1.1.n
Statistical Test (Confidence limits and error specification)
Model Evaluation (Sensitivity analysis)
Qualitative Test (Weight of evidence)
Assessment
Accept or reject hypotheses
Answer specific questions
Statement of conclusion for each issue

LGL ALASKA RESEARCH ASSOCIATES, INC.
Suite 101
4175 Tudor Centre Dr.
Anchorage, Alaska 99508
(907) 562-3339

To: James R. Ayers
Executive Director
Exxon Valdez Oil Spill Trustee Council
645 G Street
Anchorage, AK 99501

Please Copy

Need 3 Copies

Copies To: Molly Bo. Gus

Original: Rebecca

☐ Return to: _____

☐ File under: Wolfe Lawsuit

☐ _____

Post-it™ copy request pad 7670

Robert F. Chenier
P.O. Box 39055
Ninilchik, AK 99639

NINILCHIK, AK
SEP
8
1994
A.M.

***Exxon Valdez* Oil Spill Trustee Council**
645 G St., Suite 401
Anchorage, AK 99501-3451

91

9-7-94

Dear Sirs,

Please Check the facts on your "Research Proposals" Sept 1994 page 3-

Prince William Sound had one of the best pink salmon runs ever in 1994-

Sincerely,

Robert Chenier
P.O. Box 39055
NINILCHIK AK
99639

The Native Village of Eyak Tribal Council
P.O. Box 1388
Cordova, Alaska 99574-1388
(907) 424-7738 • Fax (907) 424-7739

FAX TRANSMITTAL ADDRESSED TO:

Exxon Valdez Oil Spill Trustee Council Members

FAX NUMBER TO: 276-7178

OPERATOR Bob Henrichs

IF ANY PROBLEMS WITH THIS FAX, PLEASE CONTACT THE ABOVE NUMBER IMMEDIATELY.

DATE: 10/31/94

PAGES INCLUDING COVER SHEET TOTAL 13

****

****

THANK YOU!

The Native Village of Eyak Tribal Council
P.O. Box 1388
Cordova, Alaska 99574 1388
(907) 424-7738 • Fax (907) 424-7739

October 28, 1994

John A. Sandor
Commisioner
Alaska Department Environmental Convervation
410 Willoughby Avenue, Room 105
Juneau, Alaska 99801-1795

Mr. Sandor

I writing this letter to request your support for our Joint Venture with Prince William Sound Aqua-Culture and the University of Alaska, projects 95093-A, 95093-B, & 95093-C, to restore oil damaged wild salmon stocks in Prince William Sound.

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If we are required to do more study, fund us $250,000-300,00, to get further study done and reconvene the Trustees Council in the spring to fund the full project, so we can start the actual restoration this next season. We have wasted enough time.

Sincerely yours

Bob Henrichs
President
Eyak Tribal Council
Native Village of Eyak

The Native Village of Eyak Tribal Council
P.O. Box 1388
Cordova, Alaska 99574-1388
(907) 424-7738 • Fax (907) 424-7739

October 28, 1994

Carl L. Rosier
Commisioner
Alaska Department of Fish and Game
1255 West 8th Street
Juneau, Alaska 99811-0300

Mr. Rosier

I writing this letter to request your support for our Joint Venture with Prince William Sound Aqua-Culture and the University of Alaska, projects 95093-A, 95093-B, & 95093-C, to restore oil damaged wild salmon stocks in Prince William Sound.

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Sincerely yours,

Bob Henrichs
President
Eyak Tribal Council
Native Village of Eyak

The Native Village of Eyak Tribal Council
P.O. Box 1388
Cordova, Alaska 99574-1388
(907) 424-7738 • Fax (907) 424 7739

October 28, 1994

Bruce M. Botelho
Attorney General
State of Alaska
123 4th Street
Dimond Courthouse 4th Floor
Juneau, Alaska 99811-0300

Mr. Botelho

I writing this letter to request your support for our Joint Venture with Prince William Sound Aqua-Culture and the University of Alaska, projects 95093-A, 95093-B, & 95093-C, to restore oil damaged wild salmon stocks in Prince William Sound.

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Bob Henrichs

Bob Henrichs
President
Eyak Tribal Council
Native Village of Eyak

The Native Village of Eyak Tribal Council
P.O. Box 1388
Cordova, Alaska 99574-1388
(907) 424-7738 • Fax (907) 424-7739

October 28, 1994

George T. Framton Jr.
Assistant Secretary for Fish, Wildlife & Parks
U.S. Department of The Interior
1849 C Street, N.W. 3156
Washington, D.C. 20240

Mr. Frampton

I writing this letter to request your support for our Joint Venture with Prince William Sound Aqua-Culture and the University of Alaska, projects 95093 A, 95093-B, & 95093-C, to restore oil damaged wild salmon stocks in Prince William Sound.

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Bob Henrichs
President
Eyak Tribal Council
Native Village of Eyak

The Native Village of Eyak Tribal Council
P.O. Box 1388
Cordova, Alaska 99574-1388
(907) 424-7738 • Fax (907) 424-7739

October 28, 1994

Steven Pennoyer
Director
U.S. Department of Commerce
National Marine Fisheries Service
709 West 9th Street, Room 453
Juneau, Alaska 99802-1668

Mr. Pennoyer

I writing this letter to request your support for our Joint Venture with Prince William Sound Aqua-Culture and the University of Alaska, projects 95093-A, 95093-B, & 95093-C, to restore oil damaged wild salmon stocks in Prince William Sound.

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Bob Henrichs

Bob Henrichs
President
Eyak Tribal Council
Native Village of Eyak

The Native Village of Eyak Tribal Council
P.O. Box 1388
Cordova, Alaska 99574-1388
(907) 424-7738 • Fax (907) 424-7739

October 28, 1994

Phil Janik
Regional Forester
U.S. Department of Agriculture
Forest Service
709 West 9th Street, Room 549
Juneau, Alaska 99802

Mr. Janik

I writing this letter to request your support for our Joint Venture with Prince William Sound Aqua Culture and the University of Alaska, projects 95093-A, 95093-B, & 95093-C, to restore oil damaged wild salmon stocks in Prince William Sound.

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Sincerely yours,

Bob Henrichs
President
Eyak Tribal Council
Native Village of Eyak

CHUGACH ALASKA CORPORATION

October 27, 1994

Mr. James R. Ayers, Executive Director
Exxon Valdez Oil Spill Trustee Council
645 G Street
Anchorage, AK 99501

Re: Funding of Alaska Native Community Projects

Dear Mr. Ayers:

It has come to my attention that Alaska Native restoration projects for which funding is deemed important to the communities of the Chugach Region have received little or no interest, assistance or satisfaction from the *Exxon Valdez* Oil Spill Council.

These restoration projects are of particular importance because of their relationship to the Alaska Native subsistence economy. As you must know, access to a healthy subsistence resource is as important to a rural community as the well-stocked markets are to the urban community.

The following list of projects deal directly with resource enhancement and/or replacement, and habitat restoration:

PROJECT NUMBER
95093 A – B – C
95124 A – B
95125
95127
95131
95134
95272

We at Chugach Alaska Corporation support and endorse the efforts of the communities of Eyak, Tatitlek, Chenega, Nanwalek and Port Graham and strongly urge the EVOS Trustee Council to consider and approve their proposed projects.

Please feel free to contact us for any further information or assistance regarding these proposals.

Sincerely,

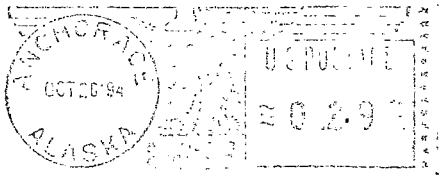
CHUGACH ALASKA CORPORATION

John A. Christensen Sr.
Chairman of the Board

JAC:jc

560 E. 34th Avenue, Suite 200 Anchorage, AK 99503-4196
(907) 563-8866 Fax (907) 563-8402

CHUGACH
ALASKA
CORPORATION



Mr. James R. Ayers, Executive Director
Exxon Valdez Oil Spill Trustee Council
645 G Street
Anchorage, AK 99501

560 E. 34th Avenue, Suite 200 Anchorage, AK 99503-4196

99501-3451 91

10/21/94

Dear Council members,

Please do not allow the "Alaska Sea Life Center" to become a reality. Marine mammals who survived the Valdez oil spill do not need to be harassed!

Sincerely,

L. Imperato

LYNN MORAN
343 East 6th Street Apt. 3B, New York, NY 10003

NEW YORK, NY 100
PM
21 OCT
1994

LOVE
29 USA

RECEIVED
OCT 27 1994
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

Exxon Valdez Oil Spill
Trustee Council
Restoration Office
645 6 Street
Anchorage, AK 99501

PRINCE WILLIAM SOUND AQUACULTURE CORPORATION

October 25, 1994

Jim Ayers, Executive Director
EVOS Trustee Council
645 G Street
Anchorage, AK 99501

Mr. Ayers,

I am led to believe that a recommendation may be forth coming from you to the Trustee Council to fund planning and permitting for project #95093, subprojects -A, -B and -C. Discussions with Molly McCammon, Craig Tillary and James Brady, as well as a recent letter from Dr. Bob Spies, have underscored this possibility and the level of funding to be recommended.

This recommendation and subsequent planning/permitting funding in support of project #95093 will be a positive notification from the Trustee Council of intent to take a more active position in restoration of injured salmon resources and damaged services.

additional FY95 work plan comments

In support for this recommendation, the PWSAC Executive Committee provide the attached resolution. It is important to recognize the collaborative nature of the proposal, the conceptual [illegible] activities which are to be addressed, the [illegible] actual direct restoration has taken place, and that planning and permitting [illegible] accomplished before the [illegible] field season. [illegible] endation for planning and permitting [illegible] 5093 in late winter/spring [illegible] taken next summer.

With [illegible] ee Council meeting [illegible]

Since[illegible]

Bud P[illegible]
Vice Chairman

cc Dr. Robert Spies

Post-It™ brand fax transmittal memo 7671 | # of pages ▸ 2

To Jim Ayers	From Houston Ferren
Co. EVOS Trustee Council	Co. PWSAC
Dept.	Phone # 424-7511
Fax # 276-7178	Fax # 424-7514

Corporate Office • Post Office Box 1110 • Cordova, Alaska 99574-1110
phone: 907/424-7511 * fax: 907/424-7514

PRINCE WILLIAM SOUND AQUACULTURE CORPORATION

October 25, 1994

Jim Ayers, Executive Director
EVOS Trustee Council
645 G Street
Anchorage, AK 99501

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This recommendation and subsequent planning/permitting funding in support of project #95093 will be a positive notification from the Trustee Council of intent to take a more active position in restoration of injured salmon resources and damaged services.

In support for this recommendation, the PWSAC Executive Committee provide the attached resolution. It is important to recognize the collaborative nature of the proposal, the conceptualized activities which are to be addressed, the fact that little actual direct restoration has taken place, and that planning and permitting can be accomplished before the 1995 field season. Therefore, it is vital that in adopting a recommendation for planning and permitting funding, that the Trustee Council decide to revisit #95093 in late winter/spring 1995, to make final funding decisions on work to be undertaken next summer.

With these thoughts in mind, I will look forward to a productive *EVOS* Trustee Council meeting November 2-3.

Sincerely,

Bud Perrine

Bud Perrine
Vice Chairman

cc Dr. Robert Spies

Post-It™ brand fax transmittal memo 7671 | # of pages ▸ 2

To Jim Ayers	From Houston Fenton
Co. EVOS Trustee Council	Co. PWSAC
Dept.	Phone # 424-7511
Fax # 276-7178	Fax # 424-7514

Corporate Office • Post Office Box 1110 • Cordova, Alaska 99574-1110
phone: 907/424-7511 * fax: 907/424-7514

Resolution 94-7EC

Position on EVOS Proposal #95093 Including Subprojects -A, -B, -C.

WHEREAS, PWSAC supports natural spawning stock salmon restoration and has proposed to the EVOS Trustee Council a collaborative proposal to restore natural spawning stock salmon in both oil damaged streams and streams important to subsistence users, and implement actions to reduce harvest pressure on injured stocks; and

WHEREAS, salmon stocks have been recognized as injured and services from those resources lost or damaged; and

WHEREAS, since 1989 little action has been taken to implement projects designed to directly restore these resources and services; and

WHEREAS, PWSAC has continued to respond to legal and scientific concerns in its proposal revisions; and

WHEREAS, PWSAC and project collaborators have full intention to implement project #95093 including subprojects A, B and C during the field season beginning May, 1995; and

WHEREAS, PWSAC believes the collaborative parties can complete all necessary planning and permitting prior to the 1995 field season, now

THEREFORE BE IT RESOLVED, that PWSAC supports the EVOS Trustee Council Executive Director and Chief Scientist recommendation to fund project #95093 planning and permitting, with the condition that the EVOS Trustee Council revisit the proposed projects prior to the field season and provide its decision on funding for FYY-95 at that time.

CERTIFICATION

I HEREBY CERTIFY, that I am the duly elected, qualified and acting Vice Chairman of the Prince William Sound Aquaculture Corporation, an Alaska corporation; that the foregoing is a full, true and correct copy of a resolution duly and legally adopted at a regular meeting of the Board of Directors Executive Committee on October 24, 1994 at which a quorum was present, and that such resolution is now in full force and effect and duly recorded in the minutes of the Board of Directors.

IN WITNESS WHEREOF, I have hereunto subscribed my name and affixed the seal of the Corporation this 25TH of October 1994.

Bud Fennimore

Vice Chairman

Corporate Office • Post Office Box 1110 • Cordova, Alaska 99574-1110
phone: 907/424-7511 * fax: 907/424-7514

HOMER SOCIETY OF NATURAL HISTORY
PRATT MUSEUM
3779 Bartlett Street
Homer, Alaska 99603
(907)235-8635

Accredited by the American Association of Museums

OCTOBER 14, 1994

JIM AYERS, DIRECTOR
EVOS TRUSTEE COUNCIL
645 G STREET, SUITE 402
ANCHORAGE, ALASKA 99501

DEAR MR. AYERS:

10/17/94 copies given to Bob-

The 1995 Supplement (Volume I) seems replete with a natural history museum concerned with nd education this institution is suppo. I am aware that the deadline for commen tober 3, but hope you might still accept g specific projects.

I would implementation of two in particular: proposal Killer Whale Monitoring in Prince William Sound, an proposal 95014, Predation by Killer Whales in Prince William Sound.

Tami add to wkplan comments

For some years we at the museum have followed the ongoing res of the North Gulf Oceanic Society. It is our pe ificant contribution to our un marine mammals prior to the EV we attempt to understand the co catastrophe.

Pr build upon an established and va erstand that it is the least c any proposal of its type. W an scientists with almost 15 y William Sound's orcas.

P ative. Investigating the e cas could shed light on an a cts to the marine ecosystem in developing strategies to rey species.

I hope that hare our enthusiasm for these proposals and provide the necessary funding to support them.

Sincerely,
BETSY PITZMAN, DIRECTOR
PRATT MUSEUM

Betsy Pitzman

HOMER SOCIETY OF NATURAL HISTORY
PRATT MUSEUM
3779 Bartlett Street
Homer, Alaska 99603
(907)235-8635

Accredited by the American Association of Museums

OCTOBER 14, 1994

JIM AYERS, DIRECTOR
EVOS TRUSTEE COUNCIL
645 G STREET, SUITE 402
ANCHORAGE, ALASKA 99501

DEAR MR. AYERS:

The 1995 Draft Work Plan Supplement (Volume I) seems replete with worthy projects. As a natural history museum concerned with marine conservation and education this institution is supportive of many of them. I am aware that the deadline for comments on the plan was October 3, but hope you might still accept a statement supporting specific projects.

I would like to urge implementation of two in particular: proposal 95013, Killer Whale Monitoring in Prince William Sound, and proposal 95014, Predation by Killer Whales in Prince William Sound.

For some years we at the museum have followed the ongoing research of the North Gulf Oceanic Society. It is our perception that it made a significant contribution to our understanding of these important marine mammals prior to the EVOS, and is now doubly vital as we attempt to understand the continuing impacts of that great catastrophe.

Proposal 95013 would extend and build upon an established and valuable research base. We understand that it is the least costly and broadest in scope of any proposal of its type. Work would be conducted by Alaskan scientists with almost 15 years of experience with Prince William Sound's orcas.

Proposal 95014 seems most innovative. Investigating the effects of prey switching by orcas could shed light on an array of subtle, secondary impacts to the marine ecosystem from the EVOS. This could aid in developing strategies to encourage better recovery of prey species.

I hope that the Council will share our enthusiasm for these proposals and provide the necessary funding to support them.

Sincerely,
BETSY PITZMAN, DIRECTOR
PRATT MUSEUM

HOMER SOCIETY OF NATURAL HISTORY
PRATT MUSEUM
3779 Bartlett Street
Homer, Alaska 99603

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TRUSTEE COUNCIL

JIM AYERS, DIRECTOR
EVOS TRUSTEE COUNCIL
645 G STREET, SUITE 402
ANCHORAGE, ALASKA 99501

Accredited by the American Association of Museums

Timothy D. Bowman
P.O. Box 112886
Anchorage, Alaska 99511
(907) 345-8851
27 September 1994

Exxon Valdez Oil Spill Trustee Council
645 G Street
Anchorage, Alaska 99501

Dear Trustees,

My comments on the draft 1995 Work Plan are limited to 2 studies on Bald Eagles (95029 and 95030). I was the project biologist for the Bald Eagle damage assessment study from 1989-93. I am thus intimately familiar with the previous bald eagle reproductive and population surveys; their methods, results, strengths, and limitations. The 2 eagle studies proposed in the 1995 Work Plan are replicates of previous surveys. Currently the productivity survey (95030) is a Category 1 study, whereas the population survey (95029) is Category 2. I have only one point I want to make:

<u>**The priority given to these 2 projects should be reversed**</u>.
I believe there are compelling reasons why the population survey should be Category 1:

1. The purpose of the proposed studies are to document population recovery (monitoring). When we conducted the damage assessment study, we estimated the time it will take the population to recover from the spill based on a population model that incorporated the best available, yet sometimes uncertain, parameters. Given that uncertainty, we could not predict with confidence the recovery time. Consequently, the model, and our projection about recovery time, needs confirmation. Frankly, the best way to document population recovery and monitor population status is to conduct a population survey (i.e., count the number of eagles in the same area we counted before). It is direct, and population estimates derived from the surveys are reasonably precise. Population estimates from 1982 and 1989-91 exist for comparison.

2. A one-year reproductive survey of bald eagles, conducted 6 years after the spill, will measure this years' reproductive performance, but will <u>not</u> document population recovery or provide information useful for long-term monitoring. Many factors (e.g., weather, seasonal food availability) influence the reproductive success of bald eagles, and reproductive performance varies widely annually and geographically. This is well documented for eagle populations in Alaska and elsewhere. The truth is, we don't know what constitutes "normal" reproductive rates for eagles in Prince William Sound. Reproductive studies were previously conducted in only 2 years; 1989, when success was obviously impaired, and 1990, which we assume was normal although we have no way to substantiate

that. Any change in observed reproductive rates, positive or negative, could be attributed simply to natural variation. The fact is, reproductive surveys are not an effective method to monitor bald eagle populations.

I urge you to seriously consider my comments and re-evaluate the priorities given to the proposed studies on bald eagles. I might point out, too, that the population survey is a more cost-effective study.

Feel free to contact me if you need additional information.

Sincerely,

Timothy D. Bowman

Tim Bowman
P.O. Box 112886
Anchorage, AK 99511

ANCHORAGE AK 995
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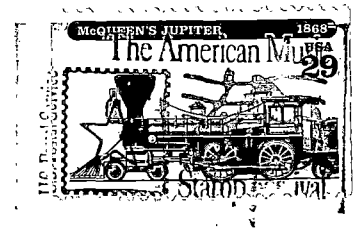
1994



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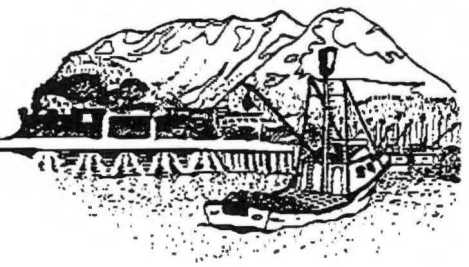
SEP 30 1994
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

Exxon Valdez Oil Spill Trustee Council
645 G Street
Anchorage, AK 99501

Attn: Draft Fiscal Year 1995 Work Plan

CITY OF CORDOVA



October 5, 1994

Exxon Valdez Oil Spill Trustee Council
645 G. Street
Anchorage, Alaska 99501

Attn: Draft Fiscal Year 1995 Work Plan
FAX: 276 7178

Re: Draft Fiscal Year 1995 Work Plan

Members of the EVOS Trustee Council:

Attached please find the City of Cordova's Resolution 10-94-55 which was approved by the City Council at their regular meeting held October 5, 1994. The Resolution supports the Proposal #95093, Restoration of PWS Natural Stock Salmon Resources and Services, and Proposal #95024, in the Draft 1995 Work Plan.

Prince William Sound salmon fisheries are distressed. During the ten years prior to 1989, the average annual return of all salmon to the PWS management region was 22 million fish. Total natural and hatchery salmon returns dwindled to 10.5 million in 1992 and 7 million in 1993, then rebounded in 1994, in response to ecosystem changes that are now being investigated. The damaged salmon resources and the lost services provided by those resources have heavily impacted all user groups.

While the extend of short- and long-term damage to the PWS ecosystem is still being assessed, it is more important than ever to the people of the Sound that these lost resources and services be restored and replaced through funding and implementation of these integrated proposals. The economic viability of the entire Prince William Sound region depends on these natural salmon resources. Please help the resources and the people of Prince William Sound recover. Thank you.

Sincerely,

W. S. Janke

Scott Janke
City Manager

Enclosure

add to public comments.

CITY OF CORDOVA, ALASKA

RESOLUTION 10-94-55

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF CORDOVA, ALASKA SUPPORTING THE PRINCE WILLIAM SOUND AQUACULTURE CORPORATION (PWSAC) PROPOSAL #95093 AND THE NATIVE VILLAGE OF EYAK PROPOSAL #95024 BEFORE THE EVOS TRUSTEE COUNCIL

WHEREAS, stocks of salmon in Prince William Sound (PWS) are recognized as injured by the Exxon Valdez oil spill in addition to the many stocks in PWS which are depressed and not recovering; and

WHEREAS, the Native Village of Eyak, University of Alaska, and PWSAC propose to the EVOS Trustee Council to restore salmon stocks in PWS through research and restoration activities using local resource users, vessels and facilities through an integrated and coordinated collaboration program; and

WHEREAS, the proposed restoration objectives and strategies are consistent with the Draft EVOS Restoration Plan and Draft Environmental Impact Statement for the Exxon Valdez Oil Spill Restoration Plan;

NOW, THEREFORE, BE IT RESOLVED that the City Council of the City of Cordova, Alaska, supports the PWS salmon stock restoration proposals #95093 and #95024 before the EVOS Trustee Council and request proposal #95093 be raised from Category 4 to Category 1 and encourages active public support for Trustee Council funding the research and restoration activities as proposed.

PASSED AND APPROVED THIS 5th DAY OF OCTOBER, 1994.

Margy K. Johnson
Mayor Margy K. Johnson

Lynda Plant
Lynda Plant, City Clerk