22.01.01

GEM

Focus Group Comments

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CORDOVA Briefing on GEM
November 18, 1999

Present: Molly McCammon, Phil Mundy, Hugh Short

David Janka	Cordova, 99574
Tim Joyce	Box 555
John Williams	Box 585
Torie Baker	Box 1159
Tom Kline	PWSSC
Monica Riedel	Box 2229
Shari Vaughan	Box 705
Alberto Cagliano	Box 200, Cordova Times
Shelton Gay	Box 714
Gary Thomas	PWSSC

Also talked to Dan Sharp, ADF&G, Cal Baker, USFS; and Kelly Weaverling, Audubon chapter

Torie Baker - what Marine Advisory program/Seagrant do is important - gets information to fishermen in useful ways.

Monica Riedel - water quality and contaminants in marine mammals - will we be using biosampling program for this? Will we be monitoring impacts of Whittier Road?

People noticing increase in humpback whale predation in sound - post-whaling baby boom: example of natural process change caused by human actions.

Education - if you anchor boats in shallow, nearshore waters at certain times of year you can impact herring spawn.

Tim Joyce - we have the models, but can't manage it - no followup? Are the SEA models part of GEM?

Gary - Without numerical models, you're only monitoring; need building tools to predict, saves money ultimately. Next stage - identify the services that will come from the program.
Will we partition up the region, and use a smaller ecosystem approach, i.e., PWS, Cook Inlet, Shelikof straits, etc.

Tom Kline - need series of articulated hypotheses and goals in context of climate change. Design monitoring program around present biota - anticipate changes. How to deal with corporate memory - most human participation is short time.

Gary - biggest thing here in Cordova is to determine annual variability - short term changes.

David Janka - need buoy off Naked Island, more weather stations around the sound, baseline on ultraviolet radiation

Gary - Globec goal - we want to predict survival better, need R&D money through program

Monica - should help people most impacted by spill - the fishermen Focus more on smaller scale issues

STATE OF ALASKA

DEPARTMENT OF FISH AND GAME

DIVISION OF SUBSISTENCE

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November 30, 1999

Phil Mundy
Science Coordinator
EVOS Trustee Council
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Anchorage, Alaska 99501-3451

Dear Phil

Staff of the Division of Subsistence, Alaska Department of Fish and Game (ADF&G) have reviewed the "Draft Gulf Ecosystem Monitoring (GEM) Program" review draft, dated 22 October 1999 and offer the following comments Two sections of particular interest to the Division of Subsistence are 1) "contaminants, water quality, and watersheds, food safety" and 2) "community involvement, traditional knowledge, education, and stewardship " As noted in the draft, both of these sections are in preliminary stages of development However, we offer the following general comments on these sections which we hope will be useful as more of the details of the GEM program are developed These are followed by some page-specific comments

Page 17 Section G "Contaminants, water quality and watersheds, food safety"

In comments on a previous draft of the GEM plan, we noted the importance of the involvement of subsistence users in programs for interpreting and communicating information about contaminants in the Gulf of Alaska We recommended that language be added to this section stating this goal, but our recommendation does not appear in this latest draft Although this section will be developed during Restoration Project 00567, we recommend that the next draft acknowledge this goal by adding the following language

> "Involving the people who harvest and consume fish and other marine wildlife in interpreting the data on contaminants in those resources, and informing people of any possible adverse effects associated with eating wild foods, as well as informing them of the comparative risks associated with alternative diets, should be the highest priority of this program "

One of the primary lessons of the EVOS is that early involvement of subsistence users in interpreting and communicating data on the potential risks of using subsistence foods is critical to the success of any risk communication program An equally important lesson is that if programs are taking place which are studying potential contaminants, then local communities must be informed of the implications of this research for their subsistence food supply Efforts to inform communities about the risk associated with using subsistence foods following the EVOS were seriously hampered by the embargo on information about damage assessment studies We also note Dr John Middaugh's observation in his e-mail note of 2 August 1999 to participants in the contaminants component working group that "Many agencies have responsibilities for monitoring various things But no one has responsibility for periodically reviewing the data [on contaminants] and developing interim conclusions This, I think, could be a great contribution of

EVOS " We concur An explicit goal committing to a collaborative risk communication process will be essential to avoid repeating earlier mistakes (A forthcoming publication of the Society of Environmental Toxicology and Chemistry, "Evaluating and Communicating Subsistence Seafood Safety in a Cross-Cultural Context Lessons Learned from the *Exxon Valdez* Oil Spill" discusses these points in detail)

Page 18 Section H Community involvement, traditional knowledge, education, and stewardship
Page 26 Section C Traditional Knowledge, Community Involvement, and Local Stewardship

We note again our earlier comment on this section that while there is some overlap between the topics of traditional ecological knowledge (TK) and community involvement, there are also important differences Community involvement requires a direct line between the communities and the Trustee Council The collection and interpretation of traditional ecological knowledge is a scientific undertaking and requires the skills of professional anthropologists to assist other scientists in the application of this information in the GEM program

This section fails to acknowledge several significant products relevant to the collection and application of traditional knowledge that have been developed during the EVOS Restoration program First, in December 1996, the Trustee Council adopted a set of "Protocols for Including Indigenous Knowledge in the Exxon Valdez Oil Spill Restoration " This document should be cited and summarized in the body of the GEM plan Second, as part of Restoration Project No 052, the Division of Subsistence produced the "Traditional Ecological Knowledge Handbook," which provides guidance on research that has a TK component This report also needs to be cited in this section of the GEM plan Third, the Division also produced a preliminary inventory (in a database format) of current sources of TK in the spill area, which was distributed to interested organizations by the Chugach Regional Resources Commission This database should also be cited in the GEM plan, especially in light of data management issues which the draft discusses

Also, one of the best examples of community involvement, collaboration between resource users and scientists, and application of traditional knowledge is Restoration Project 244 (continuing as Project 245), "Community-Based Harbor Seal Management and Biological Sampling " We suggest that the final report for Project 244 be cited in this section Another good example is Project No 247, Kametolook River Coho Restoration, which involves application of traditional knowledge, community involvement, and community stewardship

Page-specific comments

Page 11 Prince William Sound, first paragraph, second sentence Suggest changing to state that "The largest communities in Prince William Sound are home to substantial Alaska Native populations "

Page 17 Section G Fourth paragraph Add "marine invertebrates" to list of subsistence resources

Page 18 Section H References cited in this section (Huntington 1992, 1998a, Brown-Schwalenberg in press) do not appear in the "Literature Cited" section (V)

Page 18/19 Section I Coordination, Synthesis, and Information Transfer A point might be added to the third paragraph that communication is two way the scientific community might indeed benefit from the feedback received from the public The second sentence in this paragraph makes the (probably unintended) implication that "natural resource managers" often lack the training "to make use of the information available in technical journals "

Page 19 A Mission The last phrase in the statement, "involve stakeholders in local stewardship by guiding and carrying out the program" is confusing Are "local stakeholders" "carrying out" the GEM program, as this phrase implies?

Page 26. Section C. Again, references cited here do not appear in the literature cited section.

Page 28. Section D. Science Management, Part K. Data pertaining to traditional knowledge should be added to this policy.

Page 31. Section E. Data Management, Synthesis, and Public Information. The draft data management plan and policy discussed in this section needs to consider data pertaining to traditional knowledge. The protocols adopted by the Trustee Council and the TEK Handbook (see above) provided considerable background on the issues involved.

Page 39. Section B, Existing Agency Program and Projects, 3. Alaska Department of Fish and Game. The brief reference to the Division of Subsistence on the third paragraph is extremely inadequate, as is the summary for ADF&G overall, especially in comparison with the detail provided about NOAA on the preceding pages. Please REPLACE the single sentence about the Division of Subsistence with the following, which needs to be a separate paragraph because of the uniqueness of the programs:

> The Division of Subsistence within ADF&G is a social science research organization charged under state law with collecting information on all aspects of subsistence hunting and fishing in Alaska. The division maintains data bases on subsistence harvests developed through annual monitoring programs and periodic household surveys. It publishes a technical paper series. A primary aspect of the Division's program is the collection and organization of traditional knowledge. For example, the division developed the Whiskers! database containing traditional knowledge and other information about subsistence marine mammal harvests.

Page 46. Marine Mammals. As written, the first paragraph of this section makes a misleading connection between subsistence harvests and marine mammal declines. Rewrite the fifth sentence to begin: "<u>Commercial</u> harvest of marine mammals . . ." The next two sentences appear to suggest that cessation of "low levels of harvest for subsistence purposes" might assist in recovery of marine mammal populations, based on recovery of northern elephant seals after commercial (?) harvests were curtailed. We are aware of no studies which suggest that eliminating subsistence marine mammal harvests would lead to "dramatic" increases in populations. We recommend that this section be rewritten to eliminate such inferences. Also, it would be useful in this section to acknowledge the work of Alaska Native co-management bodies, such as the Alaska Native Harbor Seal Commission and the Alaska Sea Otter Commission, in contributing to conservation and scientific understanding of marine mammal populations.

Page 75. E. Scientific Questions. 6. Anthropogenic and natural contaminants. It is rather striking that the set of questions here addresses the "adverse effects" of toxins on "marine organisms" such as killer whales and "apex predators" but not on people. It is inevitable that local communities, especially those highly dependent on subsistence resources, will want to know what such findings might mean to them. As we pointed out above, the GEM plan needs to anticipate these issues by recognizing that a collaborative risk communication program is desirable.

Thank you for the opportunity to comment on this review draft of the GEM plan. If you have questions about our comments, please get in touch with Bill Simeone at 907-267-2309. Bill is now the Division's lead on matters related to EVOS and the GEM plan.

Sincerely

J Fall

James Fall
Regional Program Manager

Cc: Bill Simeone, Claudia Slater

GEM Focus Group
Cook Inlet
July 26, 2000

Afternoon Meeting Notes by Dede Bohn

(These notes begin at 1:30pm; the meeting has been in session since 10am)

GAP ANALYSIS

Phil Mundy (PM) displayed an arcview projection of known monitoring/sampling sites in the PWS spill area. Following last week's PWS focus group meeting, Bill Bechtol provided data points from the Fish and Game mesh trawl surveys which Phil incorporated into this projection.

Discussion centered on the relative role of this location database for GEM efforts, and how much effort/$ should be allocated to keep it updated. Ted Otis (TO), Fish and Game, finds it useful. Tom Dean (TD) is concerned it's too consuming of time and money. PM pointed out this is metadata, which in comparison to data, is very cheap. PM estimated he'd spent only $40K on this database so far. ?? felt that instead of a site database like this, it would be more useful to set up links to the real databases. A need to standardize QA/QC was discussed. There was some concern this effort duplicated CIIMMS, but PM pointed out that GEM needs a North Pacific Info Management System, a larger scope than CIIMMS. The CIIMMS group contribution was in writing the software, which can be adapted for the broader geographic region. John Piatt (JP) suggested that the purpose of this database be defined, because a long-term commitment to this database will be very expensive, with lots of maintenance. However, if one of the activities the GEM program chooses to sponsor is a regular "State of the Gulf" synthesis, this database would be quite useful. JP and others would like this metadatabase to be web-accessible, with links to the true databases.

THEMES

PM displayed a new graphical representation of the theme approach, showing components. A new theme has been added since last week's PWS focus group: sea otters. On the monitoring side of the diagram, in the harbor seal theme, for example, the base of the diagram lists physical processes of circulation, temperature, salinity. Above these follow Trophic level 1=diatoms; trophic level 2=neocalcareous, trophic level 3=smelt, topped by the theme title: harbor seal. Overhead of the theme are variables including: numbers, lipids. The right half of the diagram addresses research topics for each theme: regulations, models, technology, with examples of each.

Molly McCammon (MM) asked for comments regarding whether these themes will work for Cook Inlet. She reported that, for PWS, the biggest public concerns were increased tourism and its impacts, tanker traffic, fishing, the influence of hatcheries. Will this theme approach find change on different levels?

Phil North (PN): The biggest threat on the Kenai Peninsula is urbanization, which results in changing hydrology patterns—both water quality and geomorphology—leading to large impacts on fish.

Paul McCollum (PMc): Need to add contaminants, point-sources to your diagram. PM: You could add contaminants and human impacts as variables affecting all of the themes.

JP: Determine whether your program monitors human impacts or numbers (like lipids, etc.). When you monitor, you collect data which show changes—once you find changes, you can choose to do research.

PN: GEM needs to focus on fostering coordination and integration. You probably are not going to fund counting the number of cars thru the Whittier tunnel, but your need to know that will be high.

PMc Human impact is hard to factor in but critical, because there will be real problems facing Alaska in the next 20 years Maybe elevate it to theme status, including population trends, air pollution, etc

Steve Okkonek (SO) Time and space are missing from your graphic, but are critical—your models will require them Examples are tides, seasons, fresh water input, winds, these things constrain the oceanographic physics Most of the physical processes are less predictable to the west, for example at Kodiak The big hammer is the wind The coupling you might get in PWS will not hold up in the west Therefore you need to set up more frequent sampling in the west, in places like Kodiak

TO Don't exclude human impact Scale is also critical, you need to decide what scale you need to look at For herring, for example, what size is a population? Do populations mix?

JP Don't measure human impact, because it's too costly and has limited potential The legacy of GEM should be a 100-year focus on key parameters, NOT the human impact, which changes daily, annually Politics seems to determine what we think is human impact, and it's variable and too expensive You could factor in human impact in annual models, but collect that info from someone else A monitoring program should detect change, whether it's human or natural

MM Are there water quality problems in the marine environment of Cook Inlet? Answers yes, there are pesticides in fish, from undetermined sources Lack of data on what's happening in the marine portion of the Inlet

JP What would you choose to measure for human impact? If there is a key measurement, GEM could do it But don't divert GEM funds every time a human impact crops up Also, a time scale is actually implicit in the idea of monitoring However, the spatial component needs discussion

TD GEM should focus on detecting change Looking at biological systems is a good way to do this We need to have hypotheses within the themes, but not all themes will be able to address all hypotheses on all scales Intertidal themes could be helpful for spatial segregation, for looking at things like point source contamination If you want to address human impacts as an agent of change, you could look to the sea otter theme If you want to address global climate change, you'd be better off looking in the seabird theme

Bob Shavelson (BSh) A human theme is important, because if you're truly interested in looking down the road 100 years, the biggest agent of change will be people Land use doesn't fall within your current themes

MM Does that idea hold for Kodiak? Or is fishing more important? Susan Saupe (SS) Also deforestation

PM Our themes will likely be what the Trustees are concerned with But we could add human impacts as a variable overlying each of the themes

SS The problem is to identify the limit of what GEM can fund The GEM design could be nested, and show the particular data that GEM needs the agencies to supply

Carl Schoch (CS) You must resolve the ambiguity about scales of time and space He suggests a different matrix than the theme approach a graph with one axis of time, one of space, where each cell represents a different theme

Steve Frenzel (SF) It's the watershed where human impacts occur most, you need more emphasis on watersheds within GEM

Gerry Gury (GG) Choose spatially driven studies intertidal, coastal, marine

Kent x, DEC Make sure you have a plan to use your data before collecting it, so that you define your needs for collection

Bob Spies (BS) We need to define long-term change—which argues for a string of measurements—and a regional scale

PM Space and time are important and would be shown on this graph if it were 3-D However, the questions you choose to answer (in your monitoring) dictate the time and space The purpose is to find change Are the major issues for Cook Inlet/Kenai Peninsula covered in these themes?

PMc The theme approach here emphasizes the concern to humans, which is good Be careful not to minimize human impacts

TO There are species like rockfish that don't fit within your themes
MM Those kinds of additions could be covered in short-term targeted research

Kent Thinking ahead 20 years, where will exotics fit in? Are they worthy of a theme?
MM As invasive species PM Could be on our list of variables

COMMUNITY PARTNERSHIPS

BSh I've become a strong supporter of citizen-collected data, it's a tremendous opportunity I encourage you to continue Youth Area Watch Utilize the volunteer effort

Walter Meganack (WM), Port Graham People are anxious to participate, the fish ladder program is highly successful Technologies have advanced so fast that you can get high quality results from villagers collecting data Walter wondered whether GEM would pursue volunteer- and community-based inclusion within the program or whether there will be village-based proposals submitted separately under RFP's?
MM Too early to know this yet

PM It would be great to have more linkages of marine to terrestrial environments The Port Graham fish pass is an excellent opportunity to follow nitrogen thru the system, linkages like these could help with steller sea lions, for example QA/QC questions need to be established up-front, for both researchers and community participants

BSh Make sure when you communicate QA/QC that you're speaking to the community folks who will be doing the measurements (not with administrators, etc) Also, data management needs to be enforced

HARBOR SEAL THEME

PM Introduced and described harbor seal theme Are there harbor seals in Cook Inlet?
SS Yes, but not typically north of the forelands WM Yes, they're up far north, many Pt Graham people hunt them Their haulout areas have changed with the increase in boat traffic PN Harbor seals frequent the mouth of the Kenai River, and there are haulouts in Kamishak Bay

KITTIWAKE-MURRE THEME

PM Introduced and described kittiwake-murre theme
SS (Commenting on the write-up in the workbook) Under agency activity, you've listed efforts involving only the top animal, not the full theme PM We ran out of time! Give us input, and we'll add it

JP Lots of USGS work is lacking in this list, need to add Chisik and Gull Island, Middleton Island, etc In addition, John could help identify what would be the most important things to measure An annual population assessment is best for determining production in kittiwakes, but for murres it might instead be the amount of time they spend loafing John feels the food section is too vague A kittiwake-murre theme is too vague—you don't want to limit the number of species being examined, especially because you're spending the effort to be out there anyway, and the colonies are multispecies You could add planktovores (which APEX didn't consider) Are these themes or poster children? Are you actually trying to get at Intertidal, Shelf, Benthic, and slope break—habitats—and these are your indicator species?

PM We need the themes to be something everyone can identify with "Seabirds" might be too vague

BS (Referring to a recent e-mail from Dave Irons) We need to consider colony-specific behavior Middleton Island is not like the Chiswells or Barren Islands We might need a series of sites for true representation

TD Would like to see hypotheses addressed in the write-ups on the themes PM See p 18, where criteria are addressed

PMc Suggests you make the theme Seabirds, and the priority species within the theme be Kittiwakes/murres, allowing the themes to be broad and more flexible

BSh Agrees, because in 20-30 years, the interest might be in behavior and genetic makeup Indeed, we should provide for this by collecting this info once, early in the program

JP Submitted a graphic to be incorporated in the plan, based on some work by Dave Schneider in a book (possibly titled <u>Ecological Scale</u>) The graph illustrates how the questions you're seeking are tied to different scales and times, because different creatures have different behaviors at different scales The graph shows time on one axis (minute, hour, day, week, month, year, decade, century) vs Space on the other (individual habitat, cove, Bay, Inlet, Shelf, Gulf, Sea, Ocean) The behavior of whales, seabirds and capelin are plotted, resulting in three separate lines which intersect roughly at the Shelf (This data is based on work by Piatt and Schneider in Newfoundland 15 years ago) Foraging, predator info is best obtained looking at data collected at the scale of weeks and months at individual habitats-to-Bay environments Reproduction and aggregation info is best collected during minute-hour-days from Inlet-to-Shelf environments Life-span and migration info is best obtained on week to month intervals at the Gulf-Sea-Ocean scale

TD It would be useful to add agents of disturbance to your graph

BSh Long-term is a new scale for your projects, which you currently fund at 3-5 year intervals How will you manage 20-year projects?

PM The theme approach is one way to cause regional marine programs to integrate, because the themes address questions Are there other approaches we should seek to coordination and integration?

Xx Would prefer Intertidal, Shelf Break, Slope instead of species themes

PM Check p 31 in the workbook for other ways of classifying

PMc Concerned the themes are too restrictive, and would prohibit or exclude some (worthy) projects Should broaden themes to Marine, Seabirds, and use priority species Is there reluctance to use adult salmon as a theme?

PM Not really, but when you look at a gap analysis, and what agencies are responsible for in their missions, adult salmon are already being considered Juvenile salmon, on the other hand, fit under the forage fish theme, and for them, there is more of a gap in normal agency function

PMc Users are really concerned about salmon populations in the Sound, you should keep it in your themes, because if salmon are missing, it's alarming Salmon is the most important species socio-economically, and yet your themes are limited to juvenile salmon—that's scary

MM This program must address what's of interest to the public Perhaps salmon fit somewhere in our plan under the Research component?

BS Our pot is capped at $6M, which isn't high compared to what's being spent on salmon elsewhere GEM must use an ecological approach

WORK-SHOP POST-MORTEM (FEEDBACK FROM PARTICIPANTS)

PMc Anxious to see how you incorporate today's comments Good job

WM Will the community fund stay intact? MM—It's premature to know this yet

PN It's thrilling to see a 100-year plan Some concern about the vagaries of agency budgets

JP Your GEM program/plan has had a great evolution and he's glad to see the theme focus Would like to see a long-term commitment from the agencies as to what roles they'll continue

BSh Would like to see Piatt's overhead (graphic) included in the plan Positive reaction to today's session, though some concern that in hindsight, brainstorming was in vain when you see how few of the actual costs can be covered with the available dollars

SF Would like more emphasis on the role of watersheds

Kx Agree, and would like Appendix F moved up earlier in the Plan and fleshed out

TO Herring and salmon need more discussion Applaud your overall effort Would really like to see monitoring being done for herring and plankton

Bob Clark Need more marketing on the palatability of your themes, provide more examples so that it's easier to see where things—like adult salmon—fit in

TD Support theme concept

SS Appreciate the amount of work involved Need to accommodate flexibility over time, yet balance with core components Important to maintain communication with other groups over time

Dbohn Great progress, support theme concept, especially in its ability to appeal to the public Themes must serve as a 'hook' for public interest, this research must not seem esoteric Plan needs to include mechanisms to change the themes—what if, after 60 years, you don't want to study harbor seals anymore?

JP again Marine mammal label is too vague, but you do need to be able to change the species within your theme over time Add puffins to your kittiwake/murre theme to increase public recognition

PMc Make your themes broad, so that your priorities can change within them

PM Yes, we need to address the permanence of these themes

GEM Focus Group
Kodiak
August 2, 2000

Afternoon Meeting Notes by Dede Bohn

(These notes begin at 1:00pm; the meeting has been in session since 10am)

GAP ANALYSIS

Phil Mundy (PM) displayed an ArcView projection of known monitoring/sampling sites in the northern Gulf area. These sites were derived from a Program Inventory which the Restoration Office has been preparing over the past year. Programs have been divided into three categories: Ongoing, Erratic, and Historical. Only sites from the Ongoing programs are shown on this display.

Gordon Kruse (GK) notes the longline surveys for sablefish are missing, etc. PM noted that some of the info GK sent earlier for this effort has not yet been entered (but will be).

Bob Foy (BF) requested a chance to review this database to check for missing data. PM will send him a copy. BF has ArcView 3.2, which is needed to edit the data. (For those folks lacking ArcView 3.2, the data can be viewed—but not edited—using a free downloadable viewer). BF suggests Phil send it also to the University folks, who have several projects in the Bay. Phil plans to put a notice in the University School of Oceanography and Fisheries newspaper.

THEME APPROACH

PM displayed a graphic of a matrix showing the proposed organization for GEM's monitoring and research plan. Four themes are represented: harbor seal, kittiwake/murre, sandlance/herring/salmon and sea otter. On the monitoring side of the diagram, in the harbor seal theme, for example, the base of the diagram lists physical processes of circulation, temperature, salinity. Above these follow Trophic level 1=diatoms; trophic level 2=neocalcareous, trophic level 3=smelt, topped by the theme title: harbor seal. Overhead of the theme are variables including: numbers (things that will be measured), lipids. The right half of the diagram addresses research topics for each theme: regulations, models, technology, with examples of each. PM uses the graphic to display that GEM will not be a single-species approach; it will be question-driven and interdisciplinary. (See Workbook) For example, the purpose of the harbor seal theme is to answer questions about the harbor seal—not necessarily to do harbor seal research. Study of smelt might be needed, but any such study must be related to the seal.

GK: Concern that, as shown on p.10, seals have quite a varied diet. It's an opportunistic feeder; if your theme focuses on something with such a diverse diet, won't it produce a very complicated program?

PM The timeframe will dictate that GEM research will contribute to answering questions, but it might be the responsible agency that has to get the answers GEM's role will be to direct question-oriented research

GK 35-years of sealion studies have not directed us to the answers we need today

Bob Small (BS) With a limited number yet complex themes, it will be a trick to decide which studies to pick For harbor seals, for example, studying the interaction between trophic levels will provide a greater knowledge of the life history of the seal For our sealion studies, we haven't had good questions driving the research, we're now just getting there What's your definition of monitoring vs research?

PM An operational definition, only Monitoring= collecting observations, numbers according to a study plan that accounts for questions of precision and power Research = Manipulation of the numbers and observations that were collected in order to answer questions Both research and monitoring have short-term and long-term aspects The matrix diagram (presented on screen) lacks time and space, which are complex to represent The plan is intended to be interdisciplinary, an integrated approach

GK I'm perplexed over your approach, it seems perhaps a food chain approach?
PM The intent is to develop a structure where links will be made A smelt project, for example, would have dimensions relating to harbor seals, monitoring, numbers, lipids Yes, it's somewhat of a food-chain approach The plan should be a framework for interdisciplinary, interspecies thinking

Bill Hauser (BH) Will GEM be able to fill each box in your matrix?
PM The hope is that each box will be filled, but GEM's contribution will fill only some of them

PM Harbor seals were suggested to us as a theme because their food is so diverse and they don't radically alter their environment Sea otters, however, do alter their nearshore environment, and in addition, are the only 1 of our 4 themes based on macroalgae Let's discuss theme approach, is it broad enough, does it meet stakeholder's needs, partnerships

BF When do you choose among the various boxes in your matrix?
Chris Blackburn (CB) Oceanography is the bottom line, everything else follows Secondly, indicators are important in telling you what's going on For example, marine bird behavior tells you if you have healthy forage fish, knowing the fish are healthy tells you lower trophic levels are good

PM Those fit the seabird theme

Stacy Studebaker (SS) Intertidal feeders, such as oystercatchers, are missing You need to tie in invertebrates

Dave Roseneau (DR) We've been looking at sandlance-capelin-neocalcareous under our seabird studies

GK In the end, GEM must be justified to the public It must inform the public and agencies in case human behavior needs to be modified Where is the relevance to human behavior in your themes? Human impact? Fishing is a huge impact

PM Human impacts are left off the diagram, but you can find them under food, habitat and removal issues sometimes We need to collect the basic information that's needed to address questions such as human impact

GK Harbor seal interaction with fishing is high Smelts have low interaction with fishing

PM Studying the diet composition of seabirds probably gives us an indication of the relative abundance of species

Molly McCammon (MM) People are interested in issues in their own backyard In PWS, it's tankers and tourists In Cook Inlet, it's oil and land development In Kodiak, it's fisheries This plan has to accommodate a variety of interests and variables

BF You're missing groundfish on your list, they don't show here other than as predators Ignoring them is a mistake, they're the largest groundmass out there

Al Burch (AB) I've been fishing for 30 years, I've seen shifts over the years GEM needs to do baseline data so that the fishermen aren't taken by surprise again when the next shift arrives

CB We're seeing some major changes now, things that look like the pre-1975 years

BF Our research is showing important changes in groundfish, be sure not to lose them in your theme approach

PM Please provide input on how benthos and groundfish should be accommodated, we don't want to miss groundfish or crabs or other benthos

CB Where the fish are, is critical The species used to be ON the shelf, now they're wandering off Movements are important—cod are protected if they're not near crab Spatial changes are critical People tend to panic when there are shifts in distributions

PM Yes, those shifts are sometimes misinterpreted as changes in abundance

MM So do groundfish fit within the forage fish theme, or is a separate one needed?

CB No, they don't fit Groundfish can rule the ecosystem! Perhaps sealions are down because Pollock ate all their food!

GK Agrees There are significant predators at each of the lower levels within a theme

BF Groundfish might be one of the most important for detecting something like a regime shift You need to decide—on an ecosystem level—which levels are important It's likely to be groundfish

CB Herring are NOT important in Kodiak
DR PWS is actually one of the few areas where herring are critical at an ecosystem level Elsewhere it's capelin and sandlance that rule, particularly in the Aleutians and Barrens Add groundfish to your theme, and trade capelin for sandlance

BF Add groundfish to the forage fish theme Capelin are coming back
DR Recent M/V Tiglax surveys are finding lots of herring and whales in the Barrens, Kenai coast and Chuckchi Sea There has been a massive explosion of capelin since the early 90's
BF Also true in Kodiak, larval capelin are way up too
AB Trawlers are seeing lots of whales and tons of capelin
MM Perhaps each fish species can be seen as both predator and prey?
PM That's why we put juvenile salmon in the forage fish theme Should there be a groundfish theme? It's the role and relations of groundfish to sealions that's the major point, and that kind of integration is what we're looking for What are the crabs and groundfish related to? Cod and crab?
CB When forage fish and sealions decline, there is an increase in Pollock
BS We don't know your answer from a marine mammal perspective yet, even if we know the trend in forage fish, we don't know the response in sealions Using the Piatt/Anderson hypothesis, is it groundfish vs forage fish? No, I argue you need to study both, because it's the shift between them that's important

BF Would like to see fatty fish added in to the sandlance theme
DR Yes, now that we've been collecting some info on sand lance, it'd be great to also get natural history of capelin We need deep-water spawning info on capelin, not just shallow-water spawning

BF You need to know how forage fish effect other species in the ecosystem Groundfish are important for themselves, but also as competitors

GK Suggests you lay out your best understanding of the ecosystem, identifying where most of the biomass resides, overlay the food chain, and direct the focus of your research there The question is how energy is produced and transported through the system Overlay issues of policy, management and use of resources There are lots of uncertainties in the pelagic realm Diet does not equate only to abundance, it's also determined by timing, distribution, and availability of alternative food sources If capelin, sand lance and ground fish are important, let's monitor each of them plus their prey GK prefers a process-oriented approach rather than a list of favorite species

MM These themes show the crossroad species that are intended to address your questions
PM GK is suggesting something along the lines of the ECOPATH model, a biomass or systems approach It may be useful to analyze our approach in different ways, to broaden its appeal

PARTNERSHIPS, p 23

PM What should be listed under partnerships for harbor seals?
BF NMFS distribution surveys are limited by where and when they can be done, so they're missing seasonal data on Pollock, especially groundfish Suggest you add on to the diet analysis work that you will determine levels of competition

CB Support more mooring buoys, enlist community service
AB Ocean station Oscar is a good example, a proposal from last year Fishermen have proposed that each vessel could adopt a sealion and finance it's tagging You could collect tremendous (preferably longterm) data this way

MM Given that millions of dollars have been spent on sealion work, what hasn't been collected?
BF long-term series data They've done large scale, but not small-scale studies addressing specific questions They haven't asked the right questions

BS Agrees that the approach should be multispecies In defense of NMFS, 20 years ago the need was to get basic info on sealions, their natural history They're logistically difficult You need to get general knowledge before you can restrict to specific studies

Gale Vick (GV) There needs to be better integration and communication among the groups studying sea lions, including the Vancouver group Instructions for tissue sampling need to be better articulated and communicated Improvements are needed in working with the communities, to teach them how to collect

MM Aren't the population trends similar for sealions and harbor seals?
BS No, harbor seals have continuous distribution and ties to local areas, and sealions range far, using rookeries and haulouts Perhaps harbor seals are better to study because they can provide indications of differences between regions Sealions are declining or stable Harbor seals are increasing slightly We weren't aware of this awhile back—which points out the importance of measuring general trends, GEM should do this

GK You could make a political issue related to sealions How has fishing taken their food away?

THEME APPROACH

PM How do you foster interdisciplinary communication and interaction? It requires lots of planning Discussed and read thru sandlance/herring/salmon project, p 27 Pointed out a second project on p 29, where plankton were introduced to further illustrate how this process works

CB Object to seeing herring here, it's Pollock and capelin in Kodiak
MM Yes, this developed from work in PWS, and is biased We appreciate your input and will correct this
GK Herring are actually important in Kodiak, just less so than groundfish
AB Actually herring were minimal this year in Kodiak, quotas weren't even met
MM Is herring a subsistence resource?
Sarah Ward (SW), Pt Lyons No, but sometimes are used as bait spawn!
GV Perhaps more so in non-Kodiak areas

MM Should we count things the same through the geographic region, or adapt to local conditions?
CB You should adapt your methods according to what's driving the system in each area
GV Pay attention to what's driving what If sealions are in trouble, you should probably study herring at the same time you're looking at groundfish
CB The system is dynamic, don't totally ignore herring
AB Herring, shrimp and crab are on the rise
BF Even though herring won't answer the same questions in Kodiak that they do in PWS, they should be studied

GK Study what are the important components of the system in each area They'll vary by geography Take a system approach to your Plan, a different approach than your themes Start with the system, how we think it changes, ask questions, then monitor

MM We need to be able to answer the question, "Is the Gulf healthy?"

CB We need to prevent people assuming that if things change, it's the result of human activities It was ugly during the Regime shift, when people looked for sectors to blame Speculation is bad, knowledge is good

BS You need to convey to the public how complex the system is, there might not be simple answers People too easily believe any change is a negative result of some human impact

Andy Gunther (AG) "Health" is defined by a political process Data, however, are objective

PM Audiences seek an index for health, like the stock market It is a complex issue, and we need to find some sort of index
GV The idea of 'health' is relative Some communities equate a healthy species as one we can harvest Other communities want to know about the population separate from a harvest interest

CB Things change (chickadee population example) What you need to know is WHY there is a change, to assess whether it's healthy or not

AG Longterm data sets provide the trends that you're seeking

BS This is where the theme approach works well Things like your crossroads species are actually an index, they're not a simple picture, they're actually several indices

BH Questioned the word "sustain" in the mission statement, whether GEM could actually 'sustain' the health
PM The Trustees would do the actions that allow 'sustaining'

GK There is a decadal shift in biota, groundfish+salmon vs shrimp and crab What drives this shift?
CB The shift was more dramatic in Kodiak than anywhere else
DR Lower Cook Inlet is actually more like Kodiak than PWS

PM So, should the goal be to Detect Change, and clone that to all 3 geographic areas? Do we need small-mesh trawls? Or Ocean Station Oscar? Is it in the right place? Are more stations needed?

BF Depends on the scale of your interest, info collected closer to Kodiak has a greater impact on nursery areas
CB Concentrate on nearshore oceanic conditions
GV Halibut are a huge issue elsewhere, perhaps not so much in Kodiak
PM The Halibut Commission pretty much covers halibut data
GV But they have a gap in the nearshore
BF Ecosystem-based studies will necessarily bring more emphasis to the nearshore

DR Described his recent EVOS proposal looking at stomach contents providing long-term info on the abundance of sand lance and capelin, or alternatively sculpin, crab, etc The communities were enthusiastic to participate Could later expand this approach to ling cod and rockfish
BF We have a pilot project similar to this now with strong community support

GK If you did a benthic theme, you'd discover the agencies are doing the monitoring But if you ask questions, you'd realize we need to learn more about mechanisms Use a process approach to get at the underlying mechanisms

DR there are now cheap temp and salinity dataloggers that we've been putting in all the bird colonies You can download them to a laptop, collecting 3 months of data per unit Dave sets them at 30-ft depth, they're low-resistance and unaffected by waves or wind They cost roughly $150 including software, then $100 per unit without software A re-usable anchor system adds an additional $150

PM sounds like a good candidate for community based monitoring PM would like DR to send him the locations of these stations for his Ongoing Programs database

PM How sufficient is the NWS data for Kodiak?
Answers There are many microcosms in Kodiak, esp Shelikof Straits, that are difficult to cover

MM Will this be a research and monitoring plan for everyone and GEM will be doing a component of it, or is this a plan for GEM? Coordination will be a part, either way Need to determine this balance, in order to maximize the small pot of available money

DR Discussed kittiwake/murre contamination studies being done with USGS/BRD Dave submitted a handout describing the work for 2000

CB Given that there's only a small pot of money for GEM, do a truly longterm data series based on oceanographic data

GV One of the most valuable things GEM could do is to collect the questions, and ask the right ones GEM could foster communication about ongoing efforts—so much is done without others being aware of it GEM needs to lead the coordination of Federal and State issues

PM and MM discussed the intent of the October workshop

GV Will there be a mechanism in the plan for flexibility?
MM Yes The plan will be adaptive

GK It would be too ambitious to develop a plan for the northern GOA Instead, concentrate on showing the background setting for what you're proposing and all the connections Make the plan a model for interagency cooperation Hold an annual gathering where the disciplines must mix

POST=MORTEM
SW Keep the themes recognizable by the public, don't elevate them to science themes that can't be understood

DR Maintain community involvement

AB Many skippers have offered to collect data if you'll train them

SS Primary production wasn't discussed much, yet it should be one of the themes because it drives everything everywhere else in the Gulf Community members could help with nearshore plankton measurements

BS GEM has opportunities that the agencies don't Include the communities in your brainstorming

DR GEM should hold two kinds of workshops one for scientific presentations, but a second for groups like today's

MM GEM could solicit a proposal—every 2, 3, or 5 years perhaps—for someone to write a State of the Gulf assessment

GV Make that "State of the NORTH Gulf", please

SUMMARY NOTES
GEM PWS FOCUS GROUP MEETING 7/19/00, 10 a m to 4 30 p m

By Bud Rice

Note These summary notes are not complete, they are my best effort to capture what was said at the focus group meeting I may not have gotten the comments exactly correct, others may offer corrections The Exxon Valdez Oil Spill Restoration Office obtained transcripts of the meeting, including introductions, which I missed in part Initials for speakers indicated below are provided after the full name, if known, is written once

Molly McCammon (MM) opened the meeting after introductions with a review of Gulf Ecosystem Monitoring (GEM) missions and goals She asked why monitoring, and recalled that researchers and natural resources damage assessors of the Exxon Valdez Oil Spill repeatedly complained about the dearth of information prior to the spill Data blips made it difficult to discern natural variation from spill impacts or other human-caused impacts She also reviewed the first few pages of a workbook She noted that GEM should coordinate with other research and monitoring efforts coming online in Alaska, such as Bering Sea research, Southeast Alaska salmon research and monitoring, the North Pacific Fisheries Management Council efforts, PICES, GLOBEC, and others

Bob Spies (BS) reviewed via a Power-point presentation the scientific foundation of GEM He showed how EVOS-funded studies progressed after the spill from body counts to short-term effects, to long-term effects, to ecosystem structure and function The primary ecosystem studies were Sound Ecosystem Assessment (SEA), Alaska Predator Experiment (APEX), and Nearshore Vertebrate Predator (NVP) He also presented an historic perspective including the GOA fisheries ecosystem regime shift in the 1970s documented by NOAA trawl data The system changed from domination by shrimp to gaddid fish He reviewed population changes in Cook Inlet seabird colonies like Chisik Island and Gull Island SEA studies showed how timing and size of phytoplankton blooms would lead to zooplankton blooms and herring success and that of other fish in PWS He shared Ellyn Brown's Herring Life History Model and a circulation model for PWS He reviewed the King Crab population crash (concurrent with the regime shift?) and a herring larvae distribution model He showed possible but unexplained correlation between the Pacific Decadel Oscillation (PDO) and total herring spawn He reviewed herring survival in PWS and a juvenile pink salmon survival model Salmon fry less than 60 mm long are eaten by herring and pollock, but alternate prey for herring and salmon are neocalanus, pseudocalanus, euphausiids, etc Jeff Short's pristane in mussels study indicates the strength of salmon runs because salmon fry eat neocalanus, which is high in pristane, and salmon defecate in nearshore areas filtered by mussels He noted the harbor seal population depression (rate) is now flattening Freshwater input into PWS increased in the warm 1990s, which was related to PDO and El Nino Southern Oscillation (ENSO) A brief review of PDO effects shows there is lower productivity in nearshore areas during a positive PDO and higher productivity near shelf breaks during a positive PDO

Phil Mundy (PM) reviewed focus group mechanics He asked comenters to speak into mikes around the room so the transcriber could capture the comment or write in the workbooks and return comments later The focus group is to help produce criteria for selection of GEM projects using a four-stage process 1) scoping, 2) GEM Plan with what, where, when to monitor, 3) statistics and logistics, 4) trustee Council adoption and implementation of the first GEM Work Plan in FY02 The focus group process includes developing criteria for monitoring projects considering context and goals and principles of GEM Next step is to review example projects Consider how to coordinate with management concerns, use "ecological cross-roads species", and consider human needs and uses in affected areas He showed a Power-point view of monitoring sites in the spill-affected region that includes NPHC (halibut data points), NWS, FWS seabird colony sites, GAK-1, and other monitoring locations

MM said GEM needs to get beyond a laundry list of monitoring ideas and focus on what works for GEM She emphasized the program needs to be responsive to human needs People want this relatively pristine area to remain so with its rich and abundant biological resources and natural beauty The discussion then moved onto <u>HUMAN NEEDS</u>

Dan Hull (DH) made the first comment asking how GEM research and monitoring could directly link to management needs He is particularly concerned that monitoring data be useful to fishery managers, but also for other resource managers in the area

Jane Di'Cosimo (JD) agreed with DH that monitoring must have the end user in mind

Jim Bodkin (JB) noted a distinction needs to be made between extractable and other resources

Kathy Frost (KF) cautioned not to limit monitoring to commercial resources She added monitoring tools are evolving, so what is a useful monitoring tool now might be irrelevant in the future Examples of new tools are genetics studies, fatty acid analyses, otolith mass marking, etc She noted we need to be aware of the legally mandated and driven world It is difficult to produce court-room defensible data

Bud Rice (BR) noted other mandates could be added to the work book list, like NPS Organic Act, ANILCA, Clean Air Act, and others The primary legal mandates appeared to be captured in the work book, however

JD thought agencies should provide agency management priorities to help guide selection of monitoring priorities

MM added it would be useful if agencies could converge with GEM on monitoring and research priorities for the area to help leverage funds

JB said we need a vision for a long-term monitoring program Resource extraction patterns may change in the future as we have seen over the last few decades   The vision for monitoring needs to be adaptive beyond the short term

Shannon Atkinson of Seward Sealife Center (S_) thought education needed to be added to the human needs list Monitoring data needs to be presented to communities and the general public in a way they can readily understand it

Stan Senner (SS) added the human needs list is weak on passive uses and values including wilderness values, scenery, watchable wildlife, etc

Torrie Baker (TB) said we needed to add the aquaculture program

Bob Heinrichs though we should add tribes to the list of agencies and stakeholders

KF said the data needs to be readily accessible, such as via a web page

Kent Wohl (KW) thought we needed additional and better data on water-based recreational impacts such as the study on human impacts by the USFS

Jan Konigsberg (JK) we need to know how agencies are doing in fulfilling their mandates Many times they fall short due to funding constraints or lack of priority

ECOLOGICAL INDICATORS

Tom Weinberger (TW) asked what was meant by nutrients? Does this include dissolved and solid materials?

Monica Reidell (MR) emphasized a concern for contaminants, subsistence requirements of ANILCA, and the need to educate the general public about subsistence uses of resources

Ted Cooney (TC) thought diseases should be added to the list of "removals" (of populations segments)

Jia Wang (JW) thought under limiting factors we should add circulation and advection He also suggested changing "pollutant contaminants" to pollution dynamics"

Gary Thomas (GT) and DH thought the program should track population abundances and distributions

JB noted that species diversity and community structures change over time

Bill Hauser asked if predator –prey relations where addressed, and MM referred him to removals by predators and "relationships to other species "

Henry Huntington (HH) noted we need to distinguish topics to monitor (p 10 of workbook) from questions to use to evaluate monitoring proposals (p 11)

MM and BS suggested an environmental report card could be used to evaluate the condition of PWS Such evaluations are used for Puget Sound, San Francisco Bay, and Chesapeake Bay These reports would asses whether the quality and quantity of resources are changing

GT thought we should report on the boreal and sub-boreal structures of marine biomass and dominant species, like herring and pollock in PWS

Ken ___ of Cordova (K_) noted the listing of agencies is not complete

Peter Armato (PA) asked if the spill-affected area and GEM program would cover the outer Kenai Peninsula, including the Kenai Fjords? MM said it would and referred to the spill-area map She added the Kenai Fjords is usually considered part of the Cook Inlet sub-area of the spill, though Resurrection Bay is often lumped in with PWS She admitted this area falls between two primary areas for studies

SH suggested we need to add to the information gathering list on page 12, and MM said we needed a clearing-house function for information like PICES for marine resources

DH noted sustaining of human resources is not articulated on page 12

DW said National Institute of Health is interested in marine resources and human health He also suggested GEM consider coordinating with Canada projects on the upstream side of the Japan Current and with Japan for deep northern Gulf of Alaska studies

BS noted PICES works with international members Perhaps this is the best way to link with Canada and Japan National Science Foundation (NSF) is not interested in long-term monitoring, but they would be interested in partnering for process research

Pat Lavin (PL) with National Wildlife Federation indicated a new "keeper" organization like Cook Inlet Keeper could be forming for PWS

TB recommended listing stakeholder groups that would use research and monitoring results, especially policy makers who need the information

GAP ANALYSIS

MM and PM stated GEM needs to get the user community involved with the metadatabase PM showed an Arcview projection of monitoring/sampling sites in the PWS spill area, and illustrated that site locations need to be located with more precision, and those not shown need to be identified

KF said we need to obtain better and more information on forage fish She said we lack data on the oily smelt populations She added a dead Orca whale near Cordova was recently recovered with two tagged and one untagged seal in its stomach

TC seconded KF's comments to enlarge monitoring effort of forage fish

SS stated trawl surveys like those by Paul Anderson of NMFS are extremely valuable and affordable

Dave Irons (DI) reported that FWS monitors 27 kittiwake colonies in PWS Monitoring of other species like sea ducks is missing He added we need an at sea monitoring program of seabirds

TW added GEM needs to track bilateral water movement in and out of PWS He recommended adding a couple buoys to do so like at GAK-1

Diane ___ (D_) of DNR has the PWS graphical resource database by Alyeska

KF reported it is difficult to get researchers to review precision of databases and the metadata

SS suggested we have a winter season data gap

MR said the Alaska Native Harbor Seal Commission collects seal stomach data from year round

JB said no routine surveys are conducted in PWS of sea otter, sea ducks, benthic invertebrates, algae, shorebirds, eulochon, sandlance, herring, or salmon juveniles

GT reported the Oil Spill Recovery Institute (OSRI) is targeting pollock, herring, and zooplankton as major ecosystem drivers in PWS

DH suggested there are data gaps for rockfish, ling cod, and sharks

KF said 3 shark species populations have increased dramatically in the last 6 years She also said we don't know harbor seal pup survivorship

MR asked if shark stomach contents could be obtained from fishermen as with halibut stomachs?

MM said we need to winnow down what is best to monitor There is not enough money to monitor everything suggested She suggested we use themes or crossroads species

KF suggested that locations be kept constant as at the Hopkins Field Martine Station with 50 years of data We could monitor a great number of species where locations are kept constant

Jennifer Nielsen (JN) worked at Hopkins and said though transect locations were well-documented, the same data was not always collected over the 50 years She recommended that research reserve areas be established where monitoring data could be collected at select locations without direct human impacts She thinks locality data continuity is critical

Ken Holbrock (KH) reported Green Island is a research reserve in PWS, and other such sites are being considered in the forest plan

TC said GAK-1 has a long-term time series, which is useful when compared to multi-locational data

TW thought GAK-1 is a good site for shelf temperatures and salinity, but not the best to monitor zooplankton productivity He recommended a couple new monitoring buoys to capture a cross-section south to north from the Gulf of Alaska to PWS

KF suggested collecting monitoring data where logistics and historic data bases make the effort reasonable She recommended monitoring harbor seals at North Montague Island in PWS and Tugidik Island south of Kodiak Island For pigeon guillemot she thought a place like Naked Island would make the most sense

SS said GEM should leverage funds and co-locate marine work at places like Green Island where USFS would do upland work

HH suggested monitoring in year one of GEM is not likely to look like monitoring in year 99 of the program, if the past is any indication

Bill Bechtol (BB) reported ADFG has conducted bottom trawls in PWS biannually in recent years

BS asked if this data was available, he was not familiar with it

JB noted that some species are not sessile, so quadrat sampling or limited locational data would not track them well He noted that sea otters change their habitat and move around

MR asked that sites near villages be considered, where local people could be trained to collect monitoring data over the years She pushed for monitoring at Nuchek where a camp is now established

PM noted the themes need to get oceanographers to interact with biologists He provided examples of monitoring in Gulf of Maine (GOMOS?) and in Gulf of Mexico by Navy Seals

HARBOR SEAL THEME

TC asked why the theme narrows down to harbor seals and does not open up to marine mammals to include sea otters and other marine mammals (Orcas)?

MM and BS said sea otters could be a separate theme for the nearshore area

SS thought GEM should continue site-based studies at Herring Bay to continue monitoring of sea otters and benthic organisms

MR reported TASSC, the Alaska Steller Sea Lion and Sea Otter Commission monitors these species They coordinate with ADFG, NMFS and EPA EPA is interested in contaminants data Data includes GIS lat/lon for sea lion and sea otter harvest/sample locations

Kate Wynn (KW) suggested GEM consider seasonality and year-round monitoring in project selections

Marianne See (MS) recounted several issues with contaminants Need to consider status and condition of animals by age/sex classes What are effects on survivorship? What are sources of contaminants relative to range, prey, industry? Tissue samples need to be taken and archived of resources used as foods

GT PSC has observed night feeding on herring by sea lions, cormorants, gulls, etc harbor seals appear to feed mostly where juvenile herring are in winter

KF said harbor seals spend 95% of time in winter under water They are infrequently seen in winter, so satellite tag data would be most useful to determine habitat use, not visual observations

KITTIWAKE/MURRE THEME

DI asked to add incidental take to the removal list FWS monitors populations at PWS (27), Alaska Maritime National Wildlife Refuge at Barren Islands, Chiswell Islands, Alaska Peninsula, and Scott Hatch of USGS-BRD monitors Middleton Island

SS and others recommended Middleton Island be picked up and supported as an important kittiwake colony to monitor

SANDLANCE, HERRING, SALMON

TC again suggested the theme be more generic like "forage fish" We left out eulochon, capelin, and other forage fishes

MR and DH discussed monitoring of forage fish from collection of stomach contents from halibut and rockfish caught by fishermen?

PWS Focus Group meeting notes, July 19, 2000 continued
A few additional notes added to the end of Bud Rice s summary notes
Dede Bohn

THEME DISCUSSION OF
SANDLANCE, HERRING, SALMON

TC again suggested the theme be more generic like "forage fish" We left out eulochon, capelin, and other forage fishes

MR and DH discussed monitoring of forage fish from collection of stomach contents from halibut and rockfish caught by fishermen?

(additions to Bud s notes begin here)

MM mentioned the need to identify/emphasize salmon in the theme

TC Habitat dependencies need to be determined, we need data on temperature and salinity to look for impacts on sand lance and capelin Life history studies are important

? What's tracking the migration of salmon in this program?

BS Sea lions are analogous to the ocean's carrying capacity Any oceanography we do has a bearing on salmon We probably need a workshop on this theme, in order to focus the program

Fritz Funk If you do site-based sampling and monitoring, you've introduced an element of timing Herring studies need to be event-based, such as the timing of their spawning in Spring

BS You can use event or biologically focused sampling to track variable phenomena

DH Where in this theme is the information managers are seeking? If hatchery interaction with wild stock is a major concern, where is it addressed in this theme?

PM We have to look for links An example might be pink salmon We have a current study that's evaluating whether the occurrence of pristane in mussels will be proportional to the abundance of pink salmon the following year Herring are another important link, but it's been difficult to get enough information on herring recruitment

KF The real battle is the one staged in Spring, over who gets the most forage fish Herring are not well linked to the PDO, and they're not much of a link to seals

TC Suggested topics for additional themes (1) Applying GEM results to problems of Resource Management, (2) Characterizing northern GOA ecosystem by numerical themes, such as a numerical simulation using physics and biology, integrating the data, producing linked models

Jia Wang Sent an e-mail to Phil and Molly yesterday suggesting the setup of a couple of physical, hydrological and ecological models to show the physical forcing of the SST

BS This Plan may not show just how strongly we feel biology hangs off the physical processes

TC You should evaluate a new Biocomplexity project in NSF, which describes systems of cycles which can lead to understanding mechanisms, but not necessarily predictable links

Jennifer Nielsen (JN) As a salmon biologist, I find GEM's role in identifying critical marine habitat important You must integrate your information at the ecosystem level I don't like your approach to salmon in this plan, you've limited it to only pink salmon and just as a forage fish Your plan should not start out exclusive

MM Yes, we need to determine where salmon fit in the plan Does this theme approach work overall? Is it only one piece of what's needed? Would themes be better combined? What about site-specific monitoring? Where do 'tools', or responses to managers needs, fit in? We're seeking to identify what's natural change vs Human impacts, does the theme approach do this?

BS Since there's so much salmon research going on in the northern Pacific, is there a theme already established that we should copy? If not, should GEM do one?

JN There are plenty of established salmon researchers along the west coast, particularly in Canada It is truly an emerging issue The important thing is to link oceanography and species an ecological approach How salmon feed, what eats them, how they're used as a resource is a very relevant issue that is not being taken care of by an ecological approach elsewhere

PM We're lacking info not just for pink salmon, but early life history for all juvenile salmon

KF GEM could promote more system research on salmon without doing it itself Salmon studies receive massive research dollars elsewhere GEM's contribution could be to study the capelin, sand lance components

JN GEM's role could be to instigate and leverage funds to allow salmon researchers to expand to marine studies of salmon, as part of an ecosystem The managing agencies will not initiate this

TC GLOBEC focuses on salmon as a key species

DH Themes seem to work well, but don't restrict GEM to just themes Theme studies will meet the mission you've stated—increasing understanding of the ecosystem—but not necessarily the part about sustaining resources or human uses We need to find the links that managers need Also, how will you treat species (for example rockfish or sharks) that fall outside one of your themes?

Charley Huey The plan needs flexibility, it may need to be changed at some point to look at shrimp, crab issues

MM Yes, in a crossroads-species approach, where do things like shellfish fit in?

BS Themes help prioritize the studies We have to balance data collection with integration and relation to the conceptual model

KF A monitoring plan should provide trends—which provides information towards the shrimp and crab decline The plan should have Indicator species which are examples yielding fundamental information for the rest of the system

DH Don't ignore other exogenous factors, like how increase in human use of PWS will effect your studies Dan supports the theme idea, but at the same time would like to leave some openings in the plan to address such things as species in decline, or the appearance of new species in the system

KF Those are addressed in the themes under 'Predators'

BS Shrimp and crab are studied in the mesh surveys

TB GEM should take a leadership role in agency facilitation You should consider adding Ted Cooney's suggested themes of numerical modeling, etc

HH Themes are a good approach, they ask beyond what is changing to why However, you need to make sure there is room for vision in GEM There should be a way to scan for new things, such as sharks

BS Today's meeting didn't even address the Research Component of GEM

MM Although it is sometimes difficult to draw the line distinguishing research from monitoring

D Irons Add a nearshore theme sea otters, sea ducks, benthic invertebrates Theme approach is a good one

D Cobb So, is it, "PWS affect on the northern GOA, or the other way around?"

Brenda Hall
From: Evelyn Brown [ebrown@ims.uaf.edu]
Sent: Thursday, August 10, 2000 6:15 PM
To: Brenda Hall
Cc: Bob Spies; Phil_Mundy@oilspill.state.ak.us
Subject: my added comments; I missed the meeting

LTClimateHerring.xls **ATT00002.txt**

A note to add about forage fish monitoring, small mesh trawls, and specifically herring:

Although the small mesh trawls do catch forage fish, they are not appropriate gear for those fish and the results do not represent changes in distribution that may be interpreted falsely as changes in abundance. Anderson makes this concession and allowance both in his papers and on his website. An example is achnovies off Peru where historically, when coastal catches were low during El Nino, the populations were thought to be low. In actuality the populations moved to offshore sites where, although reproductive success/larval production was less optimal, the bulk of the intact population was existing. Another example in GOA is herring;

Andersons catches show a decline in herring trawl catches in GOA after 1987 but historic GOA commercial catches and PWS spawn data shows herring on the rise (see figure on page two of attached spreadsheet). Obviously, the trawls did not catch the increase and the likely cause is changes in catchability, or more likely, distribution. On a side note, the herring catches/abudance roughly track the trends in the PDO, the Alleutian Low Pressure Index (ALPI) and Beamish's Atmospheric Forcing Index (AFI); this is opposite what was referenced from Anderson's paper (a discussion of this is in my EVOS final report and publication in prep). A note of caution in interpreting the attached picture; catches reflect not only abundance but changes in fish markets and fisheries management; I think the curve after 1977 would more mirror the high catches of the 30s and 40s if they were correct for changes in exploitation rate (i.e. rate was much lower in the late 70s and 80s than historically).

Forage fish are pelagic, highly mobile species with migratory life histories and with the exception of herring, species like sand lance, capelin and eulachon are very poorly understood. Some basic life history/distribution needs to be obtained in order to interpret monitoring results of gridded catches such as from the small mesh trawls. Other census methods should be explored and rated on cost-effectiveness; all reserach platforms/monitoring method should be multi-purpose to be efficient. As result, there will have to be some compromises in site-selection in order to afford a monitoring plan of this magnitude.

At 04:48 PM 8/10/00 -0800, you wrote:

Brenda Hall
Exxon Valdez Restoration Office
Phone # 907-278-8012
Fax # 907-276-7178

Attachment Converted "e \eudora\attach\Unedited Notes from GEM Focus Group doc"

Attachment Converted "e \eudora\attach\GEMnotestransmittal doc"

Brenda Hall

From Evelyn Brown [ebrown@ims uaf edu]
Sent Thursday, August 10, 2000 6 41 PM
To Brenda Hall
Cc Phil_Mundy@oilspill state ak us, Bob Spies
Subject Re Summary of GEM focus groups

Additional note to previous email from me

The dichotomy in the two herring GOA trends (Anderson/Historic Catch & PWS records) could also be reflecting differing trends in production between Cook Inlet, Kodiak and PWS, those regions are not on similar production trends as are Sitka Sound and PWS It could be that to Kodiak/GOA west of PWS, herring were in decline along with the other FF species but the opposite was true in PWS for herring and sand lance PWS herring would venture to the GOA directly adjacent to PWS

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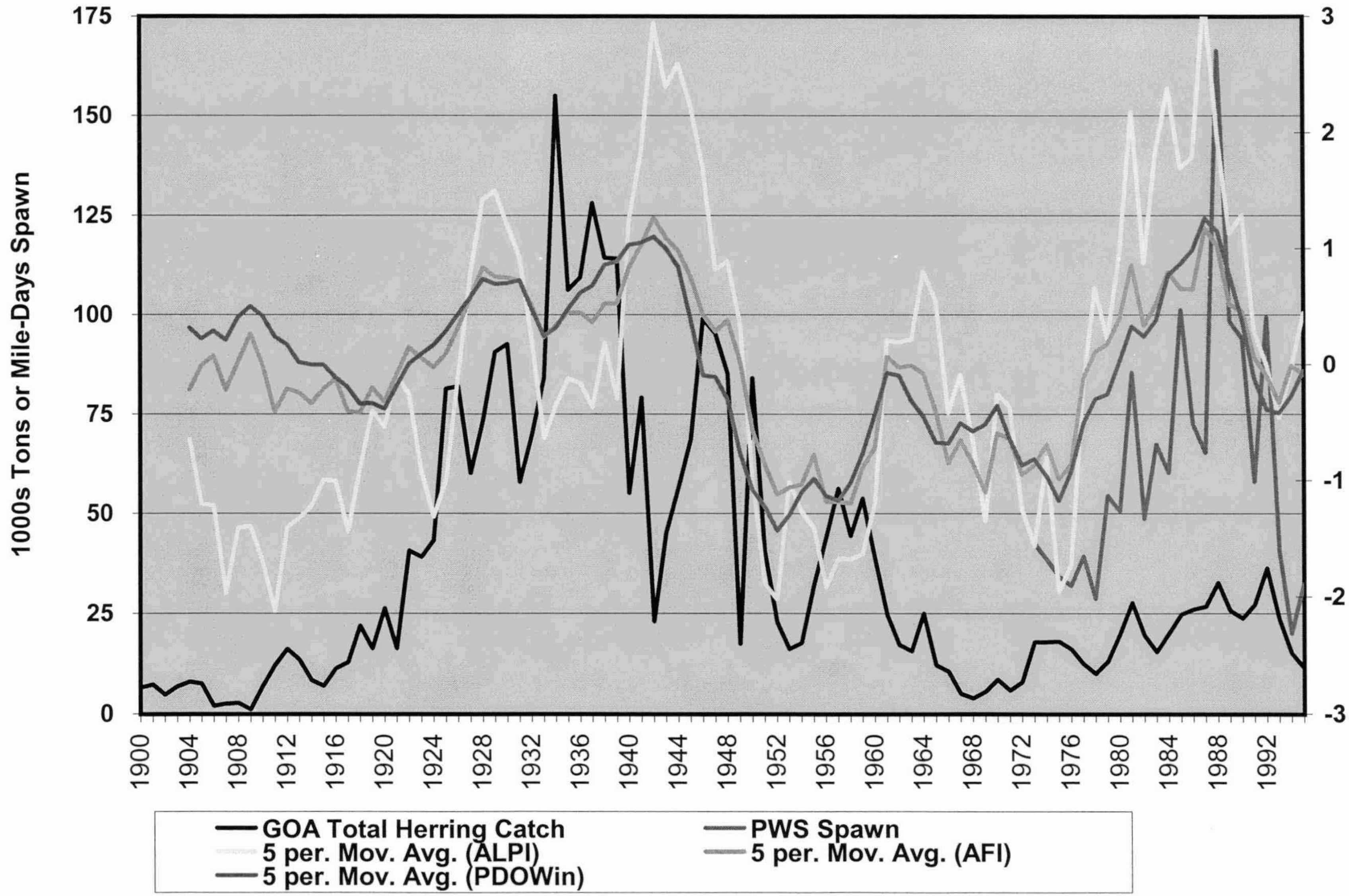
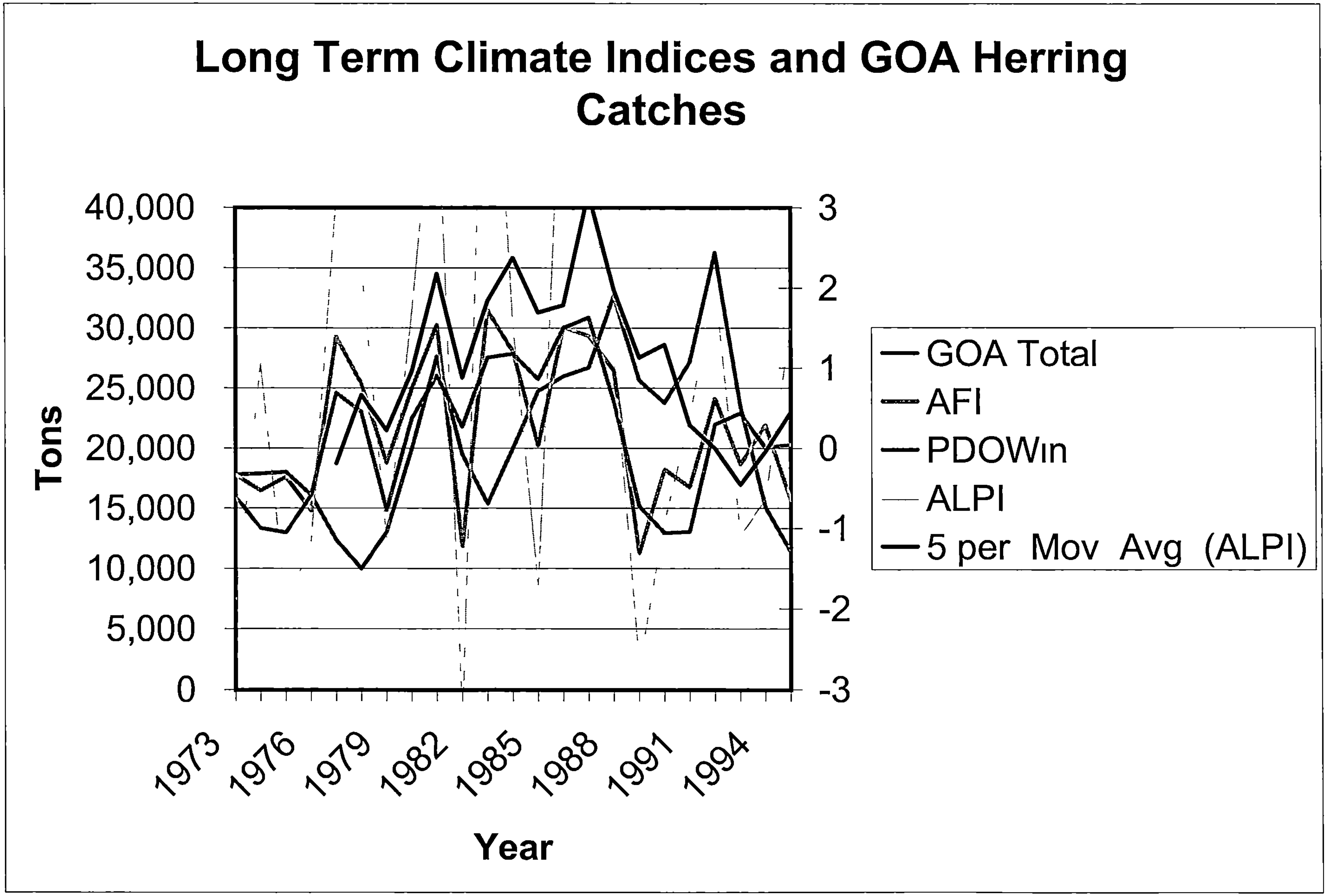
Figure 4. Long Term Climate Indices and GOA Herring Catches




Long Term Climate Indices and GOA Herring Catches
Tons
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
3
2
1
0
-1
-2
-3
1973
1976
1979
1982
1985
1988
1991
1994
Year
GOA Total
AFI
PDOWin
ALPI
5 per Mov Avg (ALPI)

Herring Catch

	Gulf of Alaska					Alaska Statew		
Year	Sac Roe	Reduction	Food/Bait	Total	Total1000s	Sac Roe	Reduction	Food/Bait
1900		6 006	497	6 503	7	0	6 006	497
1901		6 275	1 025	7 300	7	0	6 275	1 025
1902		4 087	686	4 773	5	0	4 087	686
1903		6 522	323	6 845	7	0	6 522	323
1904		7 631	350	7 982	8	0	7 631	350
1905		6 364	1 191	7 555	8	0	6 364	1 191
1906		1 005	999	2 004	2	0	1 005	999
1907		1 382	1 130	2 512	3	0	1 382	1 130
1908		1 711	998	2 709	3	0	1 711	998
1909		1 075	0	1 075	1	0	1 075	0
1910		5 890	977	6 867	7	0	5 890	977
1911		7 526	4 531	12 057	12	0	7 526	4 531
1912		5 290	10 797	16 087	16	0	5 290	10 797
1913		5 830	7 666	13 496	13	0	5 830	7 666
1914		4 353	3 998	8 351	8	0	4 353	3 998
1915		2 918	4 047	6 964	7	0	2 918	4 047
1916		4 307	6 957	11 264	11	0	4 307	6 957
1917		5 006	7 827	12 833	13	0	5 006	7 827
1918		7 165	14 740	21 905	22	0	7 165	14 740
1919		8 966	7 297	16 262	16	0	8 966	7 297
1920		22 587	3 692	26 279	26	0	22 587	3 692
1921		12 527	3 748	16 275	16	0	12 527	3 748
1922		31 989	8 671	40 660	41	0	31 989	8 671
1923		35 305	3 776	39 080	39	0	35 305	3 776
1924		39 164	4 079	43 243	43	0	39 164	4 079
1925		74 029	7 352	81 381	81	0	74 029	7 352
1926		79 048	2 865	81 913	82	0	79 048	2 865
1927		54 252	5 926	60 178	60	0	54 252	5 926
1928		66 970	6 451	73 421	73	0	66 970	6 451
1929		85 615	5 033	90 648	91	0	85 615	6 458
1930		87 283	5 383	92 666	93	0	87 283	7 740
1931		53 522	4 392	57 914	58	0	53 522	5 534
1932		65 170	4 422	69 593	70	0	65 170	7 461
1933		79 721	4 396	84 117	84	0	79 721	6 012
1934		151 089	3 913	155 001	155	0	151 089	5 450
1935		102 037	4 210	106 246	106	0	102 037	6 637
1936		106 160	3 328	109 488	109	0	106 160	4 707
1937		125 498	2 636	128 134	128	0	125 498	3 221
1938		111 321	3 071	114 392	114	0	111 321	3 594
1939		111 488	2 637	114 125	114	0	111 488	2 643
1940		51 949	3 138	55 087	55	0	51 949	3 152
1941		75 913	3 202	79 115	79	0	75 913	3 205
1942		19 327	3 691	23 018	23	0	19 327	3 691
1943		42 043	3 117	45 160	45	0	42 043	3 117
1944		54 006	2 608	56 614	57	0	54 006	2 608
1945		65 621	2 912	68 533	69	0	65 621	2 987
1946		96 046	2 993	99 039	99	0	96 046	2 993
1947		92 508	2 776	95 284	95	0	92 508	2 776
1948		82 629	2 595	85 224	85	0	82 629	2 595

1949		14 530	2 877	17 407	17	0	14 530	2 877
1950		81 736	2 307	84 043	84	0	81 736	2 307
1951		37 234	3 328	40 562	41	0	37 234	3 328
1952		20 665	2 082	22 747	23	0	20 665	2 082
1953		13 172	2 939	16 111	16	0	13 172	2 939
1954		15 865	1 745	17 610	18	0	15 865	1 745
1955		28 939	3 134	32 073	32	0	28 939	3 134
1956		41 597	2 196	43 793	44	0	41 597	2 196
1957		54 488	1 807	56 295	56	0	54 488	1 807
1958		41 788	2 613	44 401	44	0	41 788	2 613
1959		51 492	2 264	53 756	54	0	51 492	2 264
1960		36 706	2 116	38 822	39	0	36 706	2 116
1961		22 766	1 840	24 606	25	0	22 766	1 840
1962		13 977	3 172	17 149	17	0	13 977	3 172
1963	0	13 517	2 064	15 581	16	0	13 517	2 064
1964	568	22 128	2 267	24 963	25	568	22 128	2 267
1965	657	9 268	2 129	12 054	12	657	9 268	2 129
1966	2 769	5 073	2 620	10 462	10	2 769	5 073	2 620
1967	1 662	0	3 325	4 987	5	1 662	0	3 325
1968	2 021	0	1 831	3 852	4	2 021	0	1 831
1969	2 833	0	2 665	5 498	5	2 833	0	2 665
1970	5 151	0	3 352	8 503	9	5 151	0	3 352
1971	3 738	0	2 094	5 832	6	3 738	0	2 094
1972	3 841	0	4 012	7 853	8	3 921	0	4 012
1973	11 747	0	6 048	17 795	18	11 798	0	6 048
1974	11 876	0	5 987	17 863	18	11 999	0	5 987
1975	12 308	0	5 699	18 007	18	12 364	0	5 699
1976	9 686	0	6 415	16 100	16	9 695	0	6 415
1977	8 053	0	4 312	12 365	12	10 859	0	4 312
1978	4 799	0	5 182	9 981	10	12 834	0	5 182
1979	9 481	0	3 565	13 046	13	22 845	0	3 565
1980	16 451	0	3 506	19 957	20	39 545	0	3 506
1981	24 163	0	3 462	27 624	28	43 626	0	4 166
1982	17 014	0	2 459	19 474	19	44 906	0	6 024
1983	14 239	0	1 142	15 381	15	48 070	0	4 709
1984	17 289	0	2 730	20 019	20	42 919	0	6 308
1985	20 928	0	3 815	24 743	25	54 899	0	7 295
1986	21 902	0	4 080	25 982	26	48 815	0	6 474
1987	21 133	0	5 570	26 703	27	44 391	0	8 073
1988	27 749	0	4 908	32 658	33	50 226	0	6 912
1989	20 722	0	4 927	25 649	26	41 070	0	8 008
1990	18 025	0	5 738	23 763	24	37 998	0	6 558
1991	19 760	0	7 397	27 158	27	43 651	0	8 722
1992	30 902	0	5 366	36 268	36	63 508	0	7 315
1993	20 581	0	2 903	23 484	23	46 359	0	5 693
1994	13 937	0	1 137	15 074	15	47 841	0	4 486
1995	11 405	0	0	11 405	11	49 702	0	0
1996								
1997								
1998								
1999								

ide

Foreign	Total	PWS Spawn	AFI	ALPI	PDOWin	PDOSpr	PDOSum	PDOFall
0	6 503			1 559642	0 85	0 536667	0 58	-0 15
0	7 300		0 375725	-0 20453	0 176667	0 18	-0 616667	-0 256667
0	4 773		0 437505	-0 01974	0 433333	0 98	1 223333	0 433333
0	6 845		-0 97448	-4 59017	0 196667	-0 096667	0 546667	0 006667
0	7 982		-0 71842	0 046348	-0 073333	-0 333333	-1 25	0 646667
0	7 555		0 841109	-1 23092	0 38	0 943333	0 933333	0 31
0	2 004		0 783593	-0 28271	0 52	0 67	0 266667	0 486667
0	2 512		-1 02891	-3 78608	0 033333	-0 063333	0 08	0 423333
0	2 709		0 244861	-1 782	1 18	0 376667	-0 01	-0 033333
0	1 075		0 487138	0 096411	0 41	0 13	-0 57	-0 436667
0	6 867		-0 50454	-2 75451	-0 036667	-0 083333	-0 103333	-0 08
0	12 057		-1 23252	-2 39485	-0 366667	-0 446667	0 31	-0 123333
0	16 087		-0 04708	-0 17831	-0 323333	-0 146667	0 333333	0 746667
0	13 496		0 086604	-1 39045	0 403333	-0 066667	1 26	0 7
0	8 351		0 015806	0 615036	0 313333	0 463333	0 003333	-0 14
0	6 964		0 117077	-1 6308	-0 033333	0 166667	0 776667	-0 2
0	11 264		-0 79857	-2 42938	-0 923333	0 22	-0 776667	-0 556667
0	12 833		-1 4482	-2 35429	-0 743333	-0 076667	-0 05	-0 83
0	21 905		0 019625	1 296843	-0 31	-0 6	0 246667	0 12
0	16 262		1 107081	3 122326	0 333333	-0 083333	-0 266667	-0 386667
0	26 279		-0 4849	-2 34124	-0 276667	-1 013333	-1 47	-0 866667
0	16 275		0 356973	-0 17027	0 05	-0 453333	-0 29	0 303333
0	40 660		-0 26776	-3 19393	0 226667	0 106667	-0 93	-0 19
0	39 080		-0 44305	-2 02978	0 116667	0 426667	0 893333	0 493333
0	43 243		0 703412	1 166623	0 71	0 49	-0 156667	-0 496667
0	81 381		0 105884	-0 75831	0 333333	0 616667	-0 666667	0 48
0	81 913		1 493798	4 340586	0 78	1 01	1 573333	1 276667
0	60 178		1 027364	1 202848	0 956667	0 09	-0 116667	-0 366667
0	73 421		0 851804	1 154754	0 91	0 663333	-0 09	-0 86
0	92 073		0 307319	1 554637	0 486667	0 706667	-0 083333	0 493333
0	95 023		0 060562	-2 22086	0 37	-0 356667	-0 133333	-0 296667
0	59 056		1 388632	2 940862	0 91	1 356667	0 633333	0 053333
0	72 632		-0 06245	-2 34782	-0 273333	0 766667	-0 053333	-0 523333
0	85 733		-0 51196	-3 0982	-0 263333	-0 133333	-1 35	-0 973333
0	156 538		0 81013	2 982486	0 84	1 4	0 83	1 66
0	108 673		0 627037	-1 09024	1 193333	0 66	0 9	0 44
0	110 867		1 366393	2 741398	1 606667	1 503333	2 216667	1 596667
0	128 719		-0 47899	-3 40121	0 02	0 37	0 503333	0 403333
0	114 915		0 302045	-0 30145	0 64	0 086667	-0 286667	0 18
0	114 131		0 826912	0 583874	0 98	0 346667	0 03	-1 096667
0	55 101		2 173312	6 573488	1 91	2 193333	1 983333	0 99
0	79 118		2 320094	5 713537	1 706667	2 183333	2 883333	1 203333
0	23 018		0 705959	2 143293	0 266667	0 64	0 583333	0 373333
0	45 160		-0 56093	-3 05415	0 14	0 59	-0 193333	-0 08
0	56 614		0 256719	1 576798	0 183333	0 15	-0 63	-0 21
0	68 608		1 0815	4 796678	-0 346667	-0 296667	0 586667	-0 703333
0	99 039		0 665975	3 048188	-0 73	-0 23	-0 686667	-0 686667
0	95 284		-0 02529	-2 28049	0 216667	0 746667	0 606667	0 43
0	85 224		-0 0678	-2 67621	-0 85	-0 53	-0 8	-1 316667

0	17 407		-1 51229	-1 10368	-2 136667	-0 866667	-0 853333	-1 056667
0	84 043		-1 90929	-1 96853	-1 933333	-1 52	-1 8	-1 986667
0	40 562		-0 7999	-1 43663	-1 426667	-0 836667	-0 586667	-0 226667
0	22 747		-1 31592	-2 92967	-0 81	-0 893333	-1 093333	-0 666667
0	16 111		0 22676	2 389332	-0 19	-0 213333	0 36	-0 583333
0	17 610		-1 36954	-2 4079	-1 143333	-0 613333	0 493333	0 1
0	32 073		-0 62731	-2 65478	-1 356667	-1 48	-2 346667	-2 61
0	43 793		-2 83093	-3 97283	-2 166667	-2 046667	-1 296667	-1 706667
0	56 295		-1 32268	-1 7154	-1 016667	0 006667	0 996667	0 923333
0	44 401		0 163846	2 368462	0 576667	0 863333	1 093333	0 04
0	53 756		0 170455	-2 19246	0 106667	-0 246667	-0 226667	0 26
11 467	50 289		0 223959	-0 46665	0 33	0 263333	-0 003333	-0 36
11 654	36 260		1 105628	3 059043	-0 36	0 123333	-0 986667	-2 046667
27 297	44 446		-1 79878	-1 80748	-1 133333	-1 146667	-1 186667	-1 166667
51 875	67 456		0 255275	2 506163	-0 523333	-0 533333	-0 97	-0 716667
43 885	68 848		-0 18298	0 726467	-0 573333	-1 27	-0 62	-0 616667
12 011	24 065		-1 41102	-1 70663	-0 78	0	-0 356667	-0 12
9 243	19 705		-1 12552	-1 80186	-0 39	-0 586667	0 023333	-0 883333
8 503	13 491		-0 80437	-0 17303	-0 26	-1 11	-1 096667	-0 47
66 824	70 677		-0 74111	-0 33244	-0 873333	-0 623333	0 123333	-0 24
142 680	148 177		-1 42991	-2 75766	-0 276667	-0 38	0 06	0 203333
160 438	168 940		1 139252	3 787423	0 023333	0 423333	-0 75	-1 286667
50 850	56 682		-1 38818	-2 34422	-1 836667	-1 606667	-1 3	-0 42
66 643	74 576		-2 32825	-4 58831	-1 383333	-1 77	-0 816667	0 283333
39 985	57 831	43	-0 33871	-1 92966	-0 61	-0 65	-0 893333	-1 063333
28 037	46 023	39	-0 52872	1 051536	-0 996667	-0 566667	-0 04	0 256667
17 653	35 716	34	-0 35854	-1 99249	-1 053333	-0 943333	-0 876667	-1 533333
33 760	49 870	32	-0 78044	-1 16499	-0 59	-0 843333	0 406667	1 06
20 654	35 824	39	1 393877	3 078787	0 69	0 443333	0 416667	-0 626667
9 902	27 918	29	0 808075	2 346976	0 453333	1 176667	-0 55	-0 136667
7 491	33 901	55	-0 18228	-1 15785	-0 776667	0 76	0 51	0 846667
452	43 503	51	0 740404	1 685868	0 37	1 26	0 173333	0 606667
0	47 791	86	1 539292	4 932168	0 906667	1 396667	0 903333	0 466667
0	50 930	49	-1 22238	-3 40965	0 266667	-0 193333	0 063333	0 32
0	52 779	67	1 722143	7 145269	1 13	1 926667	2 573333	0 963333
0	49 227	60	1 205048	1 533317	1 176667	1 53	-0 01	0 653333
0	62 194	101	0 026188	-1 72952	0 863333	0 253333	0 686667	-0 006667
0	55 289	72	1 512283	5 388862	1 5	1 63	0 83	0 996667
0	52 464	65	1 402439	3 553426	1 633333	2 036667	1 856667	1 756667
0	57 138	166	0 964929	1 156554	0 58	1 186667	0 523333	-0 163333
0	49 078	98	-1 30634	-2 71823	-0 726667	-0 226667	0 426667	-0 19
0	44 556	94	-0 26746	-0 91811	-1 06	0 03	0 273333	-0 666667
0	52 373	58	-0 48655	0 363093	-1 04	-0 753333	-0 403333	0 52
0	70 823	100	0 618377	2 088337	0 296667	0 986667	1 533333	0 896667
0	52 052	41	-0 2005	-1 10053	0 436667	1 366667	2 46	1 403333
0	52 327	20	0 286135	-0 63523	0 003333	1 026667	-0 09	-1 546667
0	49 702	32	-0 64506	1 515037	0 043333	1 013333	1 063333	0 45
		39 1	0 175727	0 798581	0 436667	1 55	0 576667	-9 25E-18
		56	-0 11685	0 538032	0 393333	1 176667	2 633333	1 64
		48 6	1 359637	4 707449	0 65	1 326667	0 046667	-1 103333
		37 7804		0 007086				

PIDO	PMDO	ENSO
0 294596	-0 15836	0 5355
0 282035	-0 23944	-0 443833
0 093328	-0 60263	0 569667
-0 028633	-0 719713	-0 738417
-0 022991	-0 585879	-0 243417
-0 022455	-0 556693	0 861
-0 087723	-0 467862	-0 03875
-0 276329	-0 385706	0 039667
-0 507629	-0 404873	-0 094917
-0 597679	-0 126533	-0 251167
-0 606214	0 001811	-0 5695
-0 534922	-0 185856	0 182833
-0 343135	-0 370026	0 2665
-0 271628	-0 392499	-0 02875
-0 144023	-0 217793	0 577917
-0 024699	-0 14741	0 491167
-0 240034	-0 280284	-1 229
-0 260101	-0 226848	-0 6375
-0 215655	-0 191578	0 631417
-0 266398	-0 399155	0 712917
-0 289362	-0 138555	0 092583
-0 320855	-0 067154	-0 48825
-0 337106	-0 203283	-0 406833
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-0 066311	0 03992	-0 7695
-0 001829	0 103212	0 105083
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0 144176	0 064669	0 541583
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0 342395	0 292631	-0 92775
0 342302	0 017769	-0 376417
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0 432036	-0 100926	-0 830417
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0 235938	0 50489	0 178167
0 152285	0 460362	0 047417
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-0 28442	0 113515	0 195417

-0 369051	0 325946	-0 1295
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-0 157895	-0 119297	0 555417
-0 002497	-0 212973	-0 19575
0 115595	-0 13423	0 101917
0 218033	-0 239613	-0 180917
0 295898	-0 243058	-0 505583
0 198361	-0 095913	0 483333
0 22184	0 086719	0 740333
0 27217	0 07034	-0 679917
0 176622	-0 03854	-0 736667
0 185197	-0 090771	0 294417
0 086999	0 022883	1 387667
0 18406	0 185485	-0 751167
0 227224	0 386734	-0 669583
0 257	0 43904	-0 036083
0 141604	0 152987	0 210167
0 142712	-0 249866	0 288167
0 18114	-0 225329	0 273083
0 196137	-0 020202	-0 116417
0 274726	0 13721	-0 392167
0 385287	0 0575	-0 6875
0 489828	0 022825	1 26125
		0 331
		-0 4355

Brenda Hall

From	Evelyn Brown [ebrown@ims uaf edu]
Sent	Friday, August 11, 2000 12 27 PM
To	Phil Mundy
Cc	Paul J Anderson, Brenda Hall
Subject	RE Summary of GEM focus groups

FFMonitoringStrawDog doc **ATT00032 txt**

You are welcome

Please be aware that my comments do not address pollock

which is the other important FF, monitoring of those is a very different story and could very well be covered nicely by the small mesh trawls

More I agreed with Fritz about the FF dynamics being "event" driven It could also explain why the small mesh trawls did not capture some of the increases, the timing of the trawl fishing could have simply missed the event (a spawning or summer feeding migratory event) in time and space and would be intrepreted falsely as a decrease So the monitoring of FF would require tracking key events (such as spawning for all species when they are aggregated in smaller predictable areas) or designing the monitoring survey to cover a cross-section of pontential feeding grounds (when they are less tightly aggregated in 2D horizontal space, but compressed to surface waters where the feed is (zooplankton, amphipods, euphasids) Within the spill region, where you may have opposing or varying sub-regional production trends (Cook Inlet-Kodiak vs PWS to Adjacent GOA shelf), you will have to monitoring both places I believe we know enough about all the important FF species, with a few specific holes in knowledge, to set up multi-species FF surveys in both sub-regions My straw dog for that is attached

PS please share all of my comments with key folks you think have good ideas for FF monitoring, especially Piatt and other from the Kodiak-Cook Inlet region

At 11 08 AM 8/11/00 -0800, you wrote

> Evelyn - Thanks for these comments and the preceding set that included the spreadsheet, graphs and data Very timely
>
> Phillip R Mundy, PhD
> Science Coordinator
> Exxon Valdez Oil Spill Trustee Council
> 645 G Street Suite 400
> Anchorage, AK 99501-3451
> 907-265-9332
> 907-276-7178 fax
> phil_mundy@oilspill state ak us

-----Original Message-----
From **Evelyn Brown [mailto ebrown@ims uaf edu]**
Sent Thursday, August 10, 2000 6 41 PM
To Brenda Hall
Cc Phil_Mundy@oilspill state ak us, Bob Spies
Subject Re Summary of GEM focus groups

Additional note to previous email from me

The dichotomy in the two herring GOA trends (Anderson/Historic Catch & PWS
records) could also be reflecting differing trends in production between Cook Inlet, Kodiak and PWS, those regions are not on similar production trends as are Sitka Sound and PWS It could be that to Kodiak/GOA west of PWS, herring were in decline along with the other FF species but the opposite was true in PWS for herring and sand lance PWS herring would venture to the GOA directly adjacent to PWS

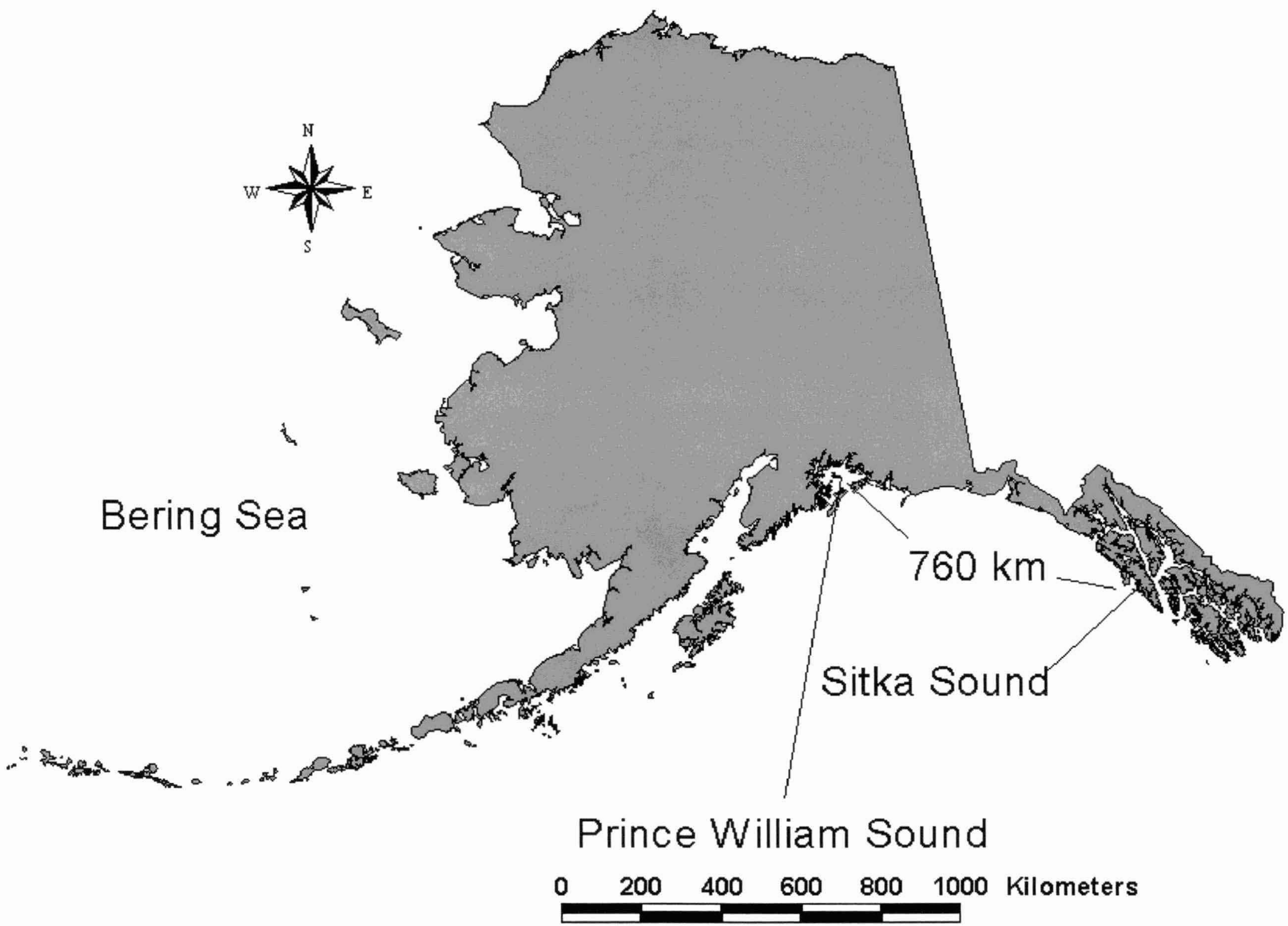
Evelyn D Brown
University of Alaska Fairbanks
SFOS IMS
P O Box 757220
Fairbanks, AK 99775-7220
907-474-5801
fax 474-1943

Straw Dog for Spatial/Temporal Monitoring of Forage Fish Species-Spill Region

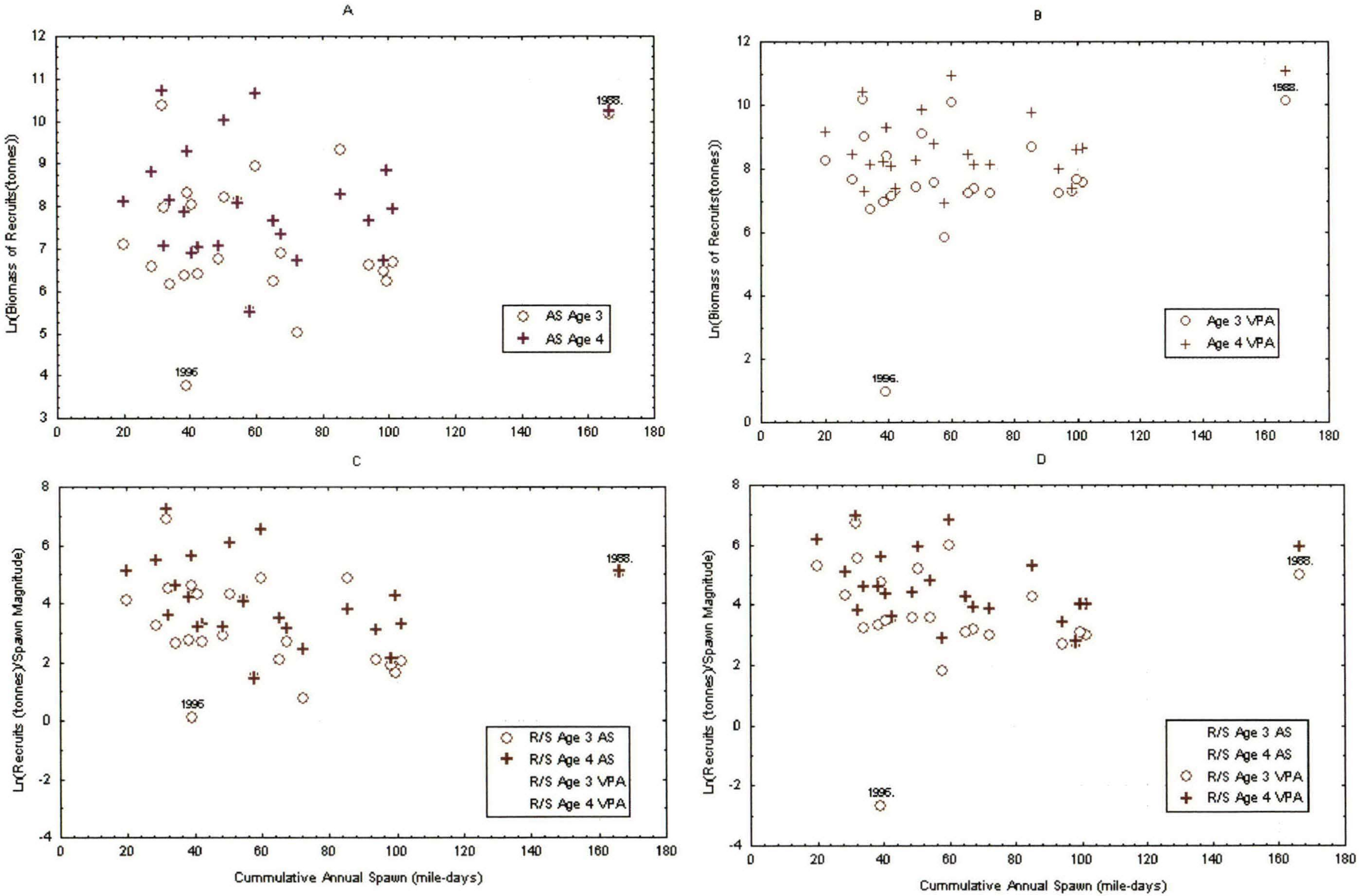
Species	Event	Region	Location	Month
Sand lance	Spawning	PWS-GOA	Copper River Flats, Hawkins Island- Middle Ground Shoal and Orca Inlet, western region somewhere??-need to identify	Fall?Later Winter? Need to identify
		Cook-Kodiak	Need to identify	
	Nursery-Juveniles	PWS-GOA	Nearshore beaches, Middle Ground Shoal, Naked Island, W Coast Montague Island, north end Bligh Island, Knolwes Head	July
		Cook-Kodiak	Katchemak Bay, Other beaches?? need to identify	July
	Adult Feeding	PWS-GOA	X-section run the Seward (GAK), Cape Cleare (CC) and Hinchinbrook Canyon (AHC) Line and two parallel transects from PWS SW Passes and Montague Strait SW to intersection with Seward Line	
		C-K	Need to identify	
Eualchon	Spawning	PWS-GOA	Copper River	May
		Cook-Kodiak	Need to identify	
	Nursery-Juveniles	PWS-GOA	need to identify	June-July?
		Cook-Kodiak		??
	Adult Feeding	PWS-GOA	Need to identify-depth range especially	
		C-K	Need to identify	
Capelin	Spawning	PWS-GOA	Shallow spawn Port Etches, S Side Hinchinbrook,Copper River Flats, Wingham Island, So End Montague Island (Patton Bay and McLeod Harbor) Deep Spawn need to identify early July-two spawning events (reflected in bimodal larval production curve)- this could reflect shallow and deep spawners i e two stocks as in the Atlantic	Late May-
		Cook-Kodiak	Need to identify	
	Nursery-Juveniles	PWS-GOA	Nearshore, shallow, protected waters-bays and passes, Mainly western PWS	Month??-need to identify
		Cook-Kodiak	Need to identify	Month-need to identify

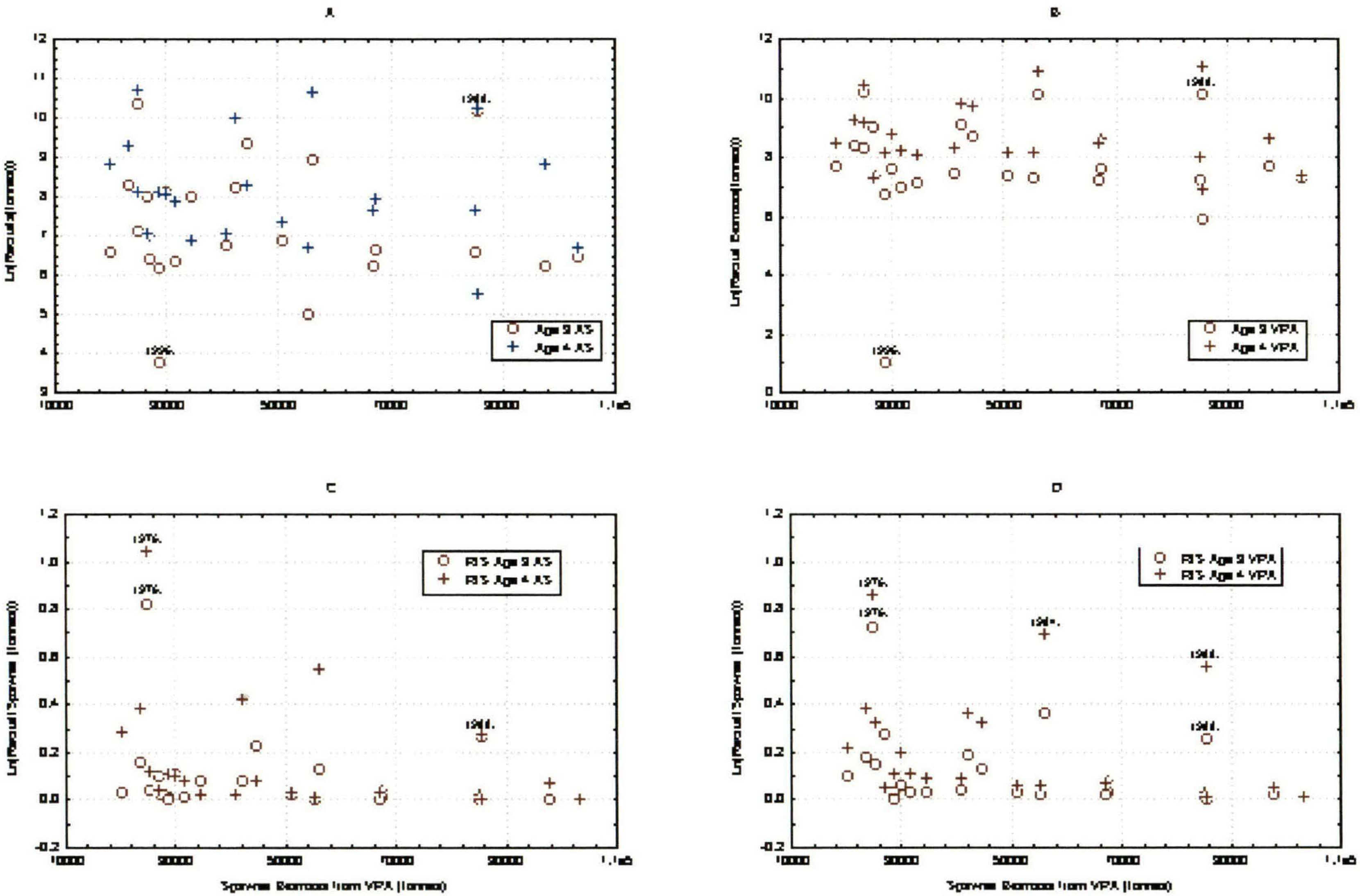
	Adult Feeding	PWS-GOA	Same as sand lance but need to identify depth range	
		C-K	Need to identify spatial region and depth range	
Herring	Spawning	PWS-GOA	PWS N Montague, Port Fidalgo-Tat Narrows, North Shore-Fairmont Bay to Axel Lind Island Hawkins Island-Well documented-	April
			Outer Kenai (OK) SW PWS, Cape Puget-Res Bay	early June
		Cook-Kodiak	ADFG recommend,	late April-May
	Nursery-Juveniles	PWS-GOA	Nearshore-1 km, bays and some passes in PWS & OK	June-July/Oct
		Cook-Kodiak	Need to identify	July-Aug/Oct?
	Adult Feeding	PWS-GOA	Three sub-stocks in PWS eastern ,western, northern-mixed Western Same region as for sand lance plus Zaikof and E Shore Montague Is Eastern N Port Gravina, Port Valdez and Arm Northern-Mixed Wells and Perry Pass (near Esther and Culross Island), northern Knight Is Passage,	May-June
		C-K	Need to identify sub-population structure and locations	June-July?

Methods and tools can also be recommended for tracking each species/event



Evelyn Brown


A
Ln(Biomass of Recruits(tonnes))
AS Age 3
AS Age 4
1988.
1996
B
Ln(Biomass of Recruits(tonnes))
Age 3 VPA
Age 4 VPA
1988.
1996.
C
Ln(Recruits (tonnes)/Spawn Magnitude)
R/S Age 3 AS
R/S Age 4 AS
R/S Age 3 VPA
R/S Age 4 VPA
1988.
1996
Cummulative Annual Spawn (mile-days)
D
Ln(Recruits (tonnes)/Spawn Magnitude)
R/S Age 3 AS
R/S Age 4 AS
R/S Age 3 VPA
R/S Age 4 VPA
1988.
1996.
Cummulative Annual Spawn (mile-days)


A
B
C
D
Spawner Biomass from VPA (tonnes)
Spawner Biomass from VPA (tonnes)

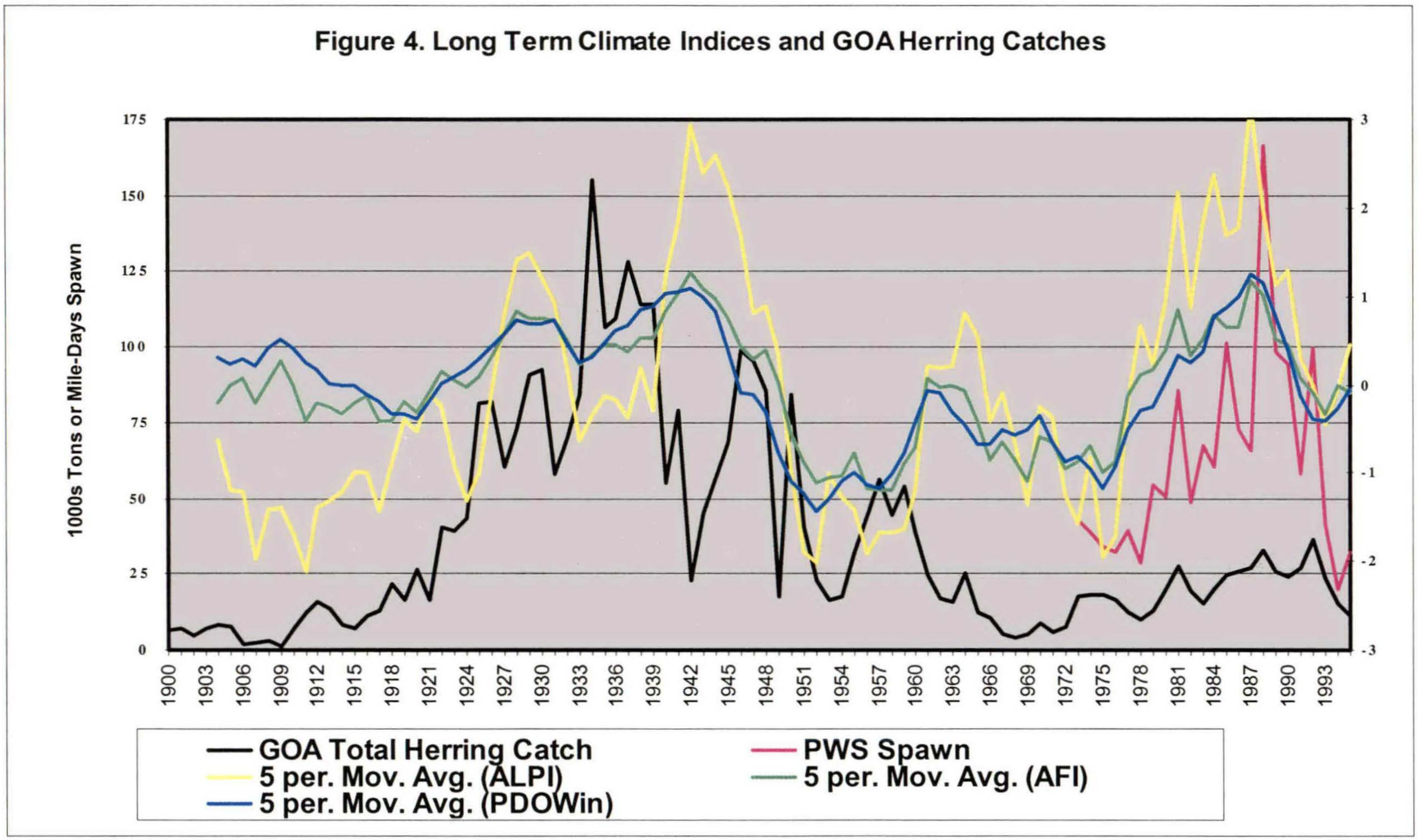
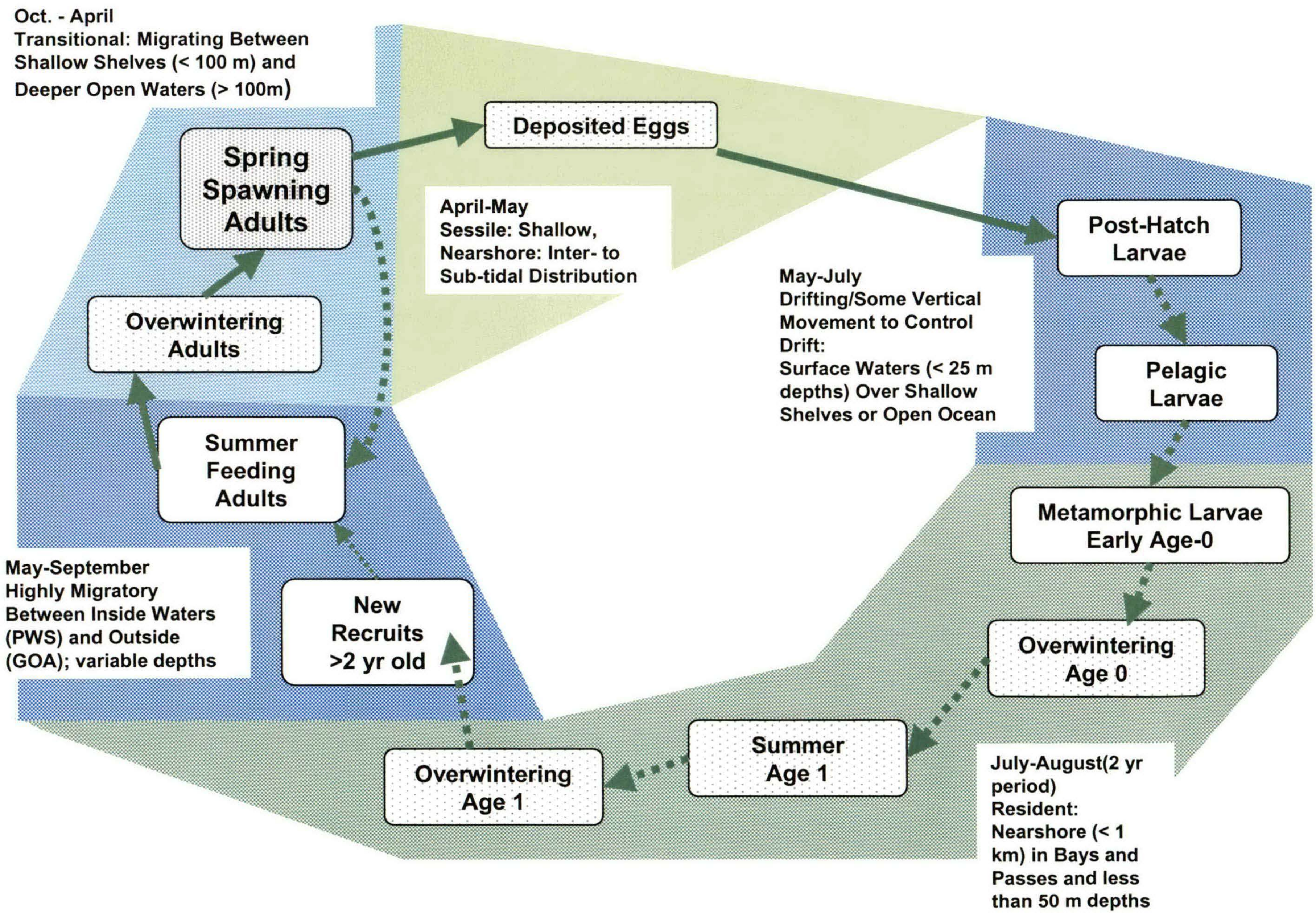
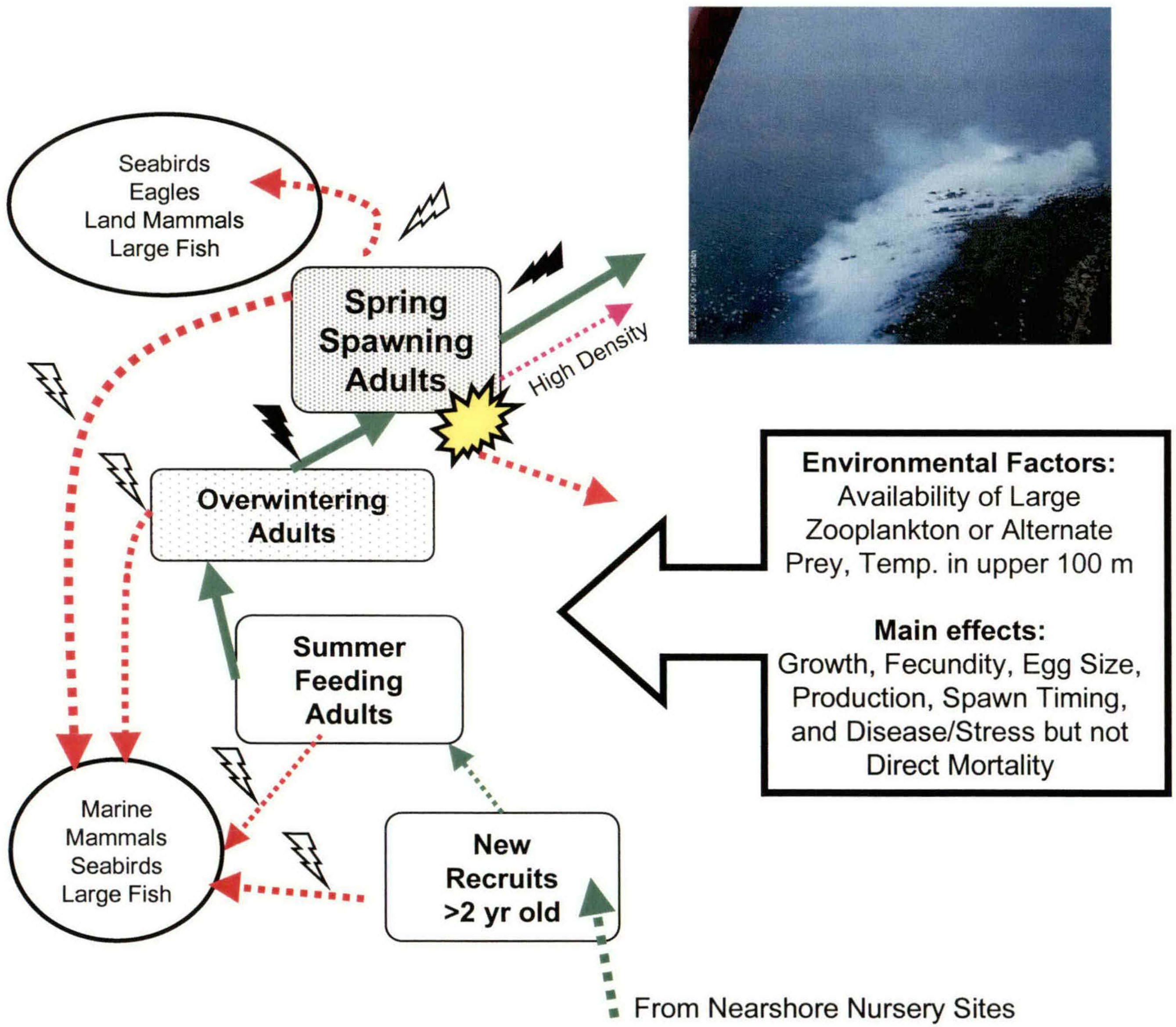
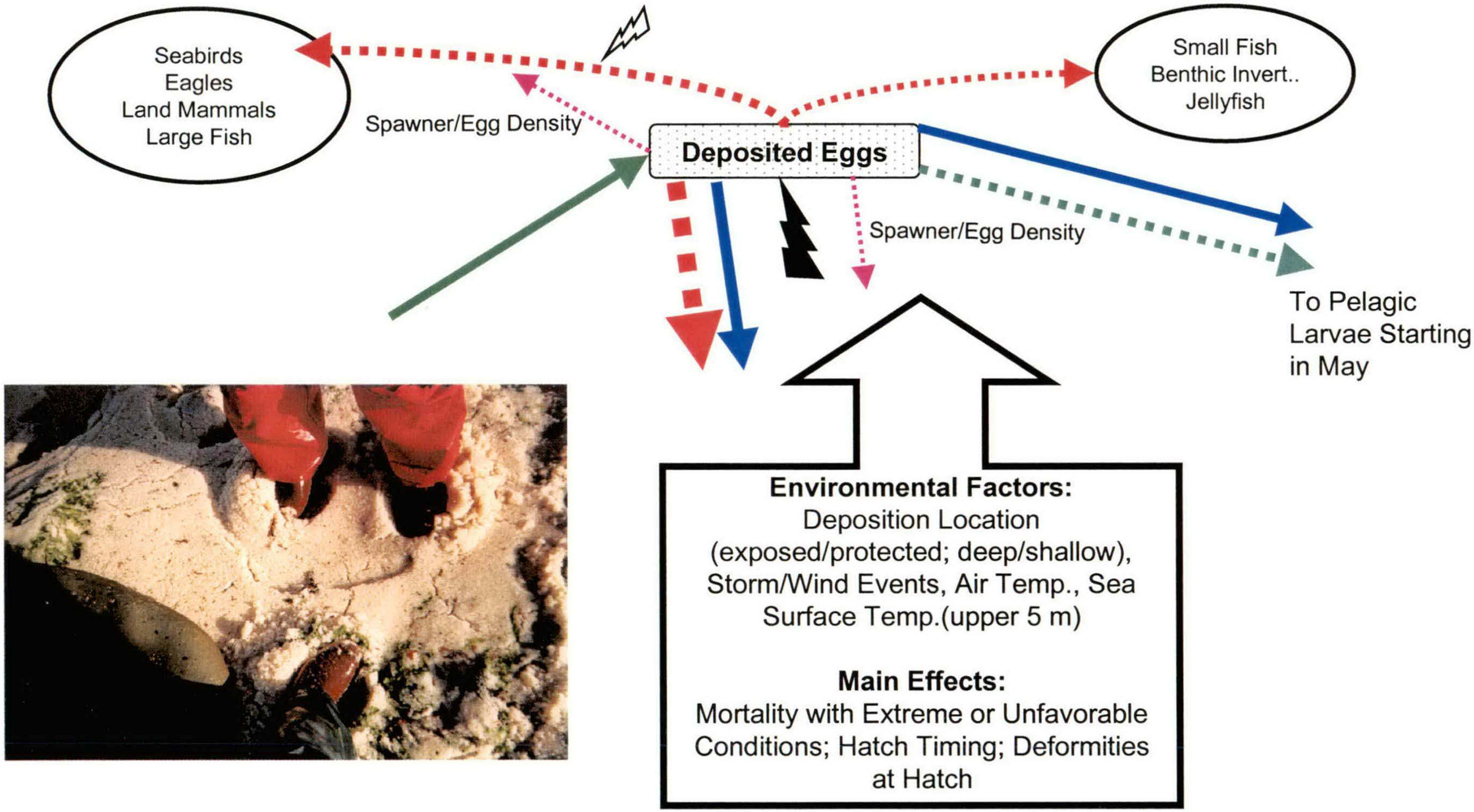


Figure 4. Long Term Climate Indices and GOA Herring Catches
1000s Tons or Mile-Days Spawn
175
150
125
100
75
50
25
0
3
2
1
0
-1
-2
-3
1900
1903
1906
1909
1912
1915
1918
1921
1924
1927
1930
1933
1936
1939
1942
1945
1948
1951
1954
1957
1960
1963
1966
1969
1972
1975
1978
1981
1984
1987
1990
1993
GOA Total Herring Catch
PWS Spawn
5 per. Mov. Avg. (ALPI)
5 per. Mov. Avg. (AFI)
5 per. Mov. Avg. (PDOWin)

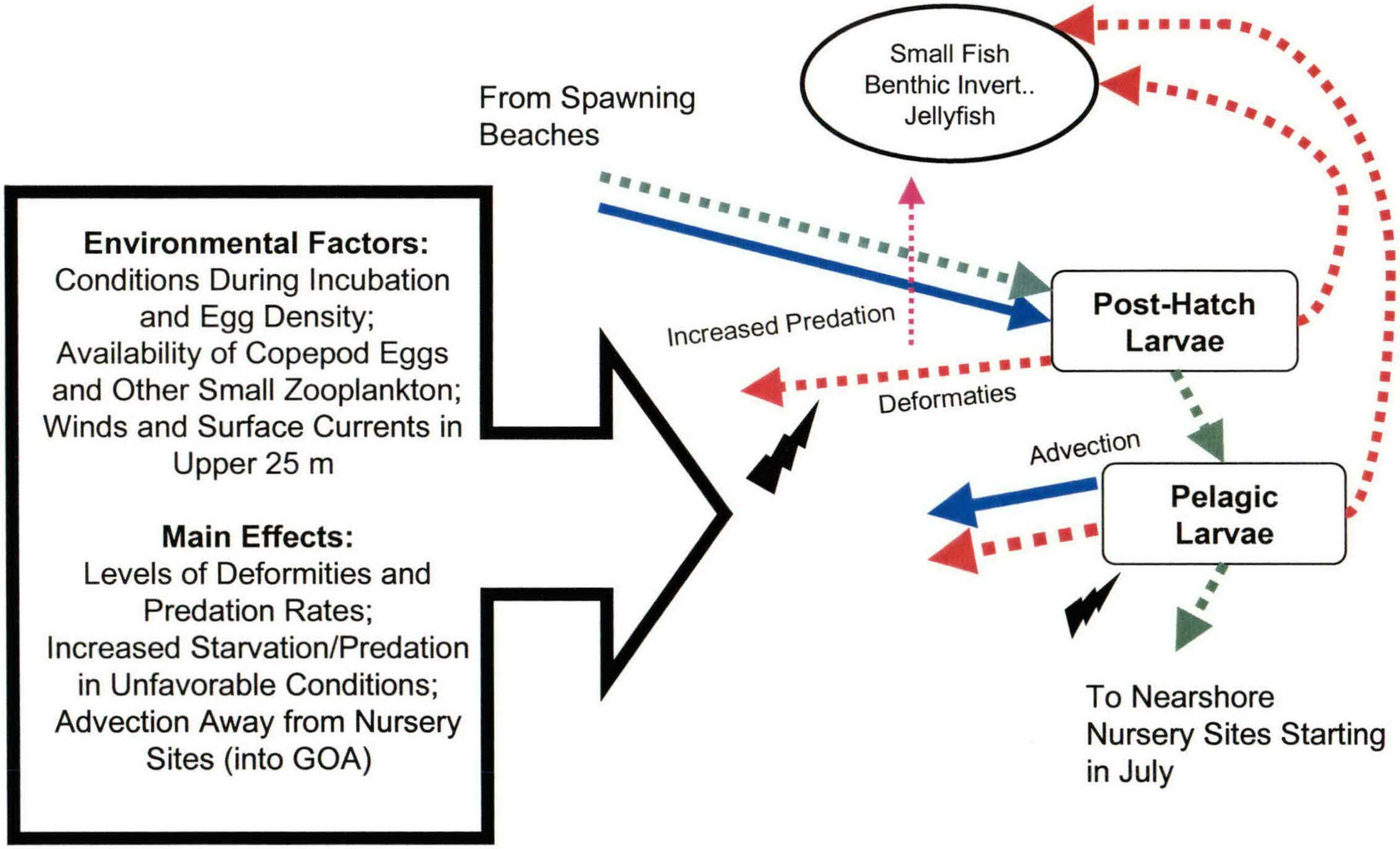

Oct. - April
Transitional: Migrating Between Shallow Shelves (< 100 m) and Deeper Open Waters (> 100m)
Deposited Eggs
Spring Spawning Adults
April-May
Sessile: Shallow, Nearshore: Inter- to Sub-tidal Distribution
Post-Hatch Larvae
May-July
Drifting/Some Vertical Movement to Control Drift:
Surface Waters (< 25 m depths) Over Shallow Shelves or Open Ocean
Overwintering Adults
Pelagic Larvae
Summer Feeding Adults
Metamorphic Larvae Early Age-0
May-September
Highly Migratory Between Inside Waters (PWS) and Outside (GOA); variable depths
New Recruits >2 yr old
Overwintering Age 0
Summer Age 1
Overwintering Age 1
July-August(2 yr period)
Resident:
Nearshore (< 1 km) in Bays and Passes and less than 50 m depths



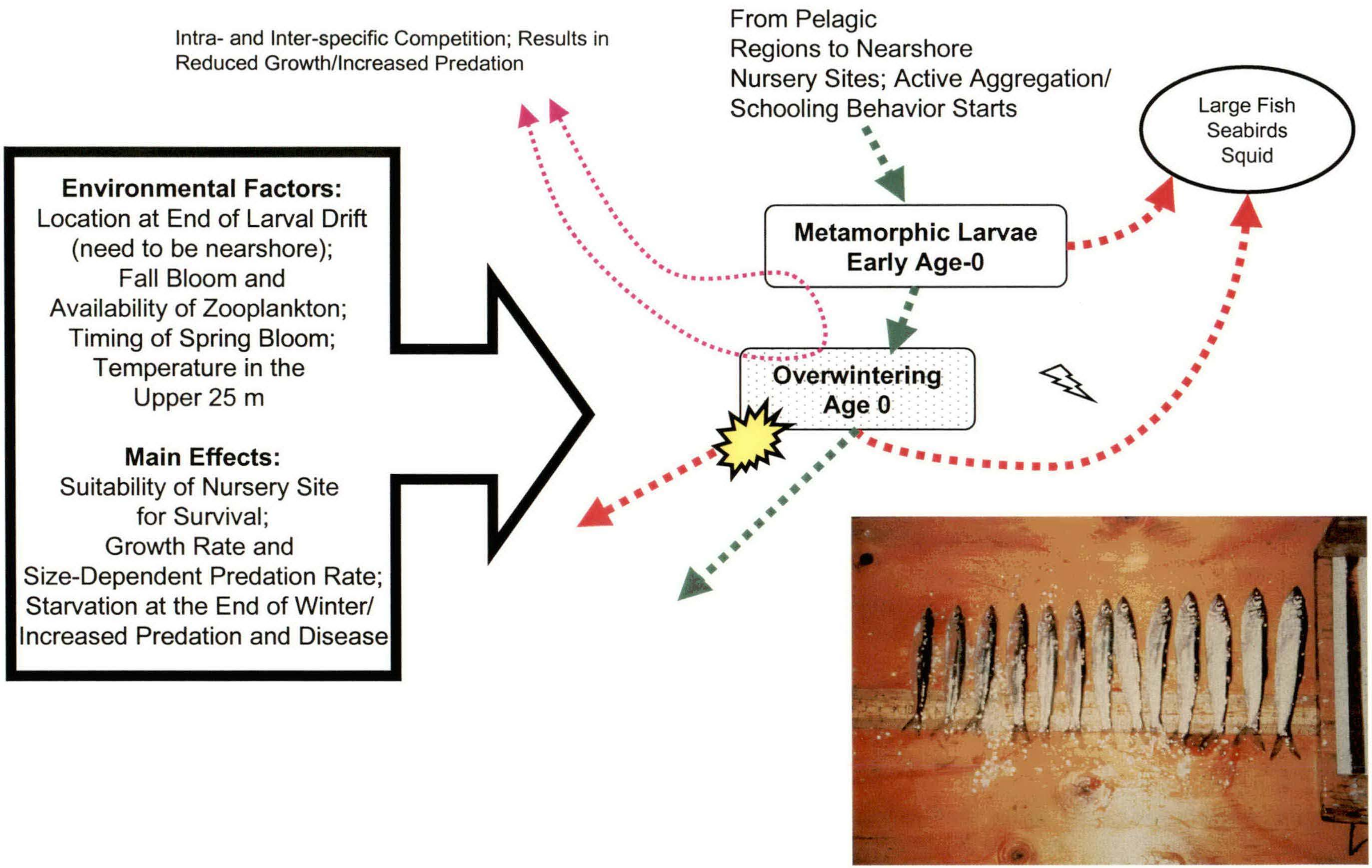
Adult Life History and Ecology



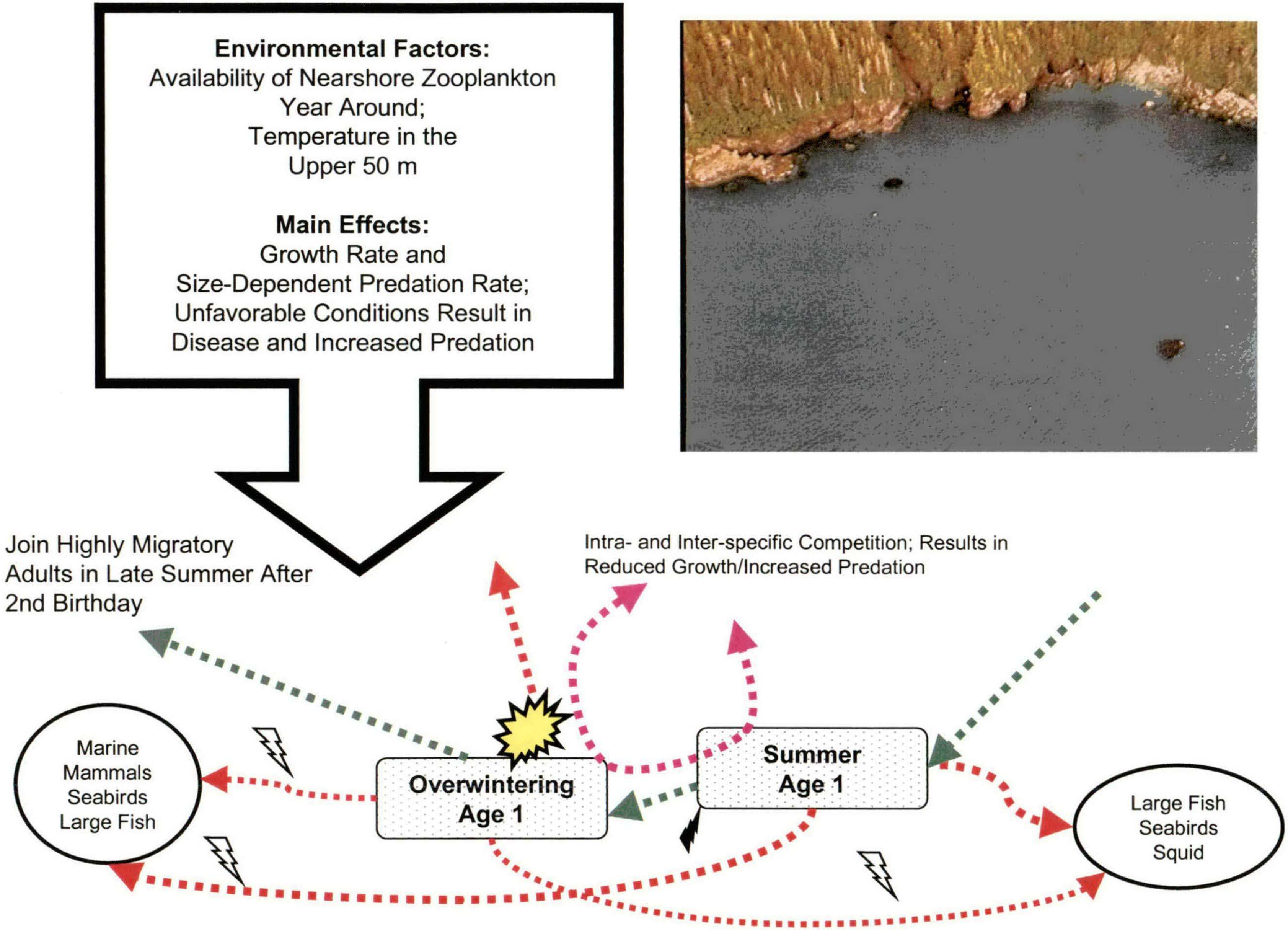
Embryonic Stage



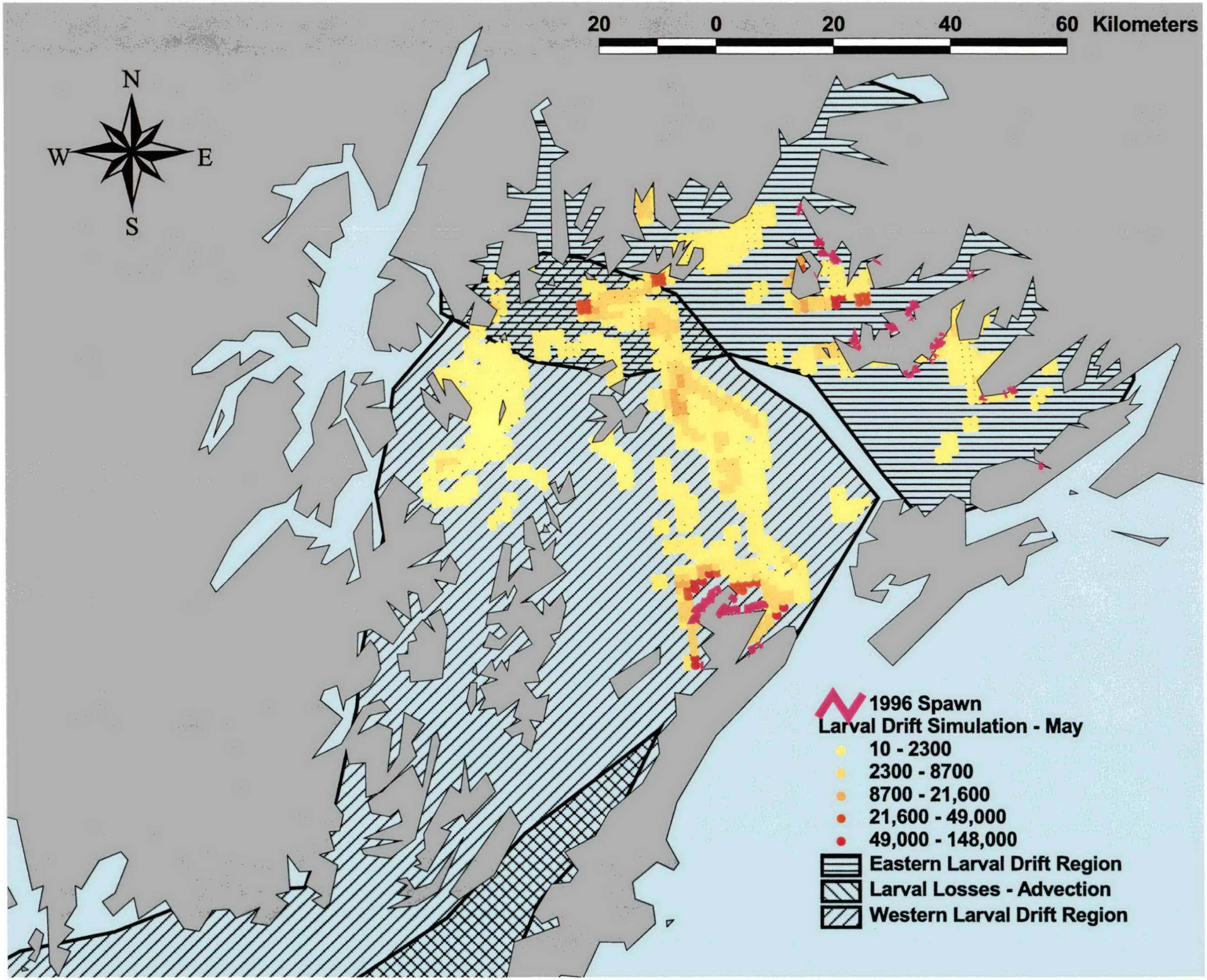
Larval Life History and Ecology

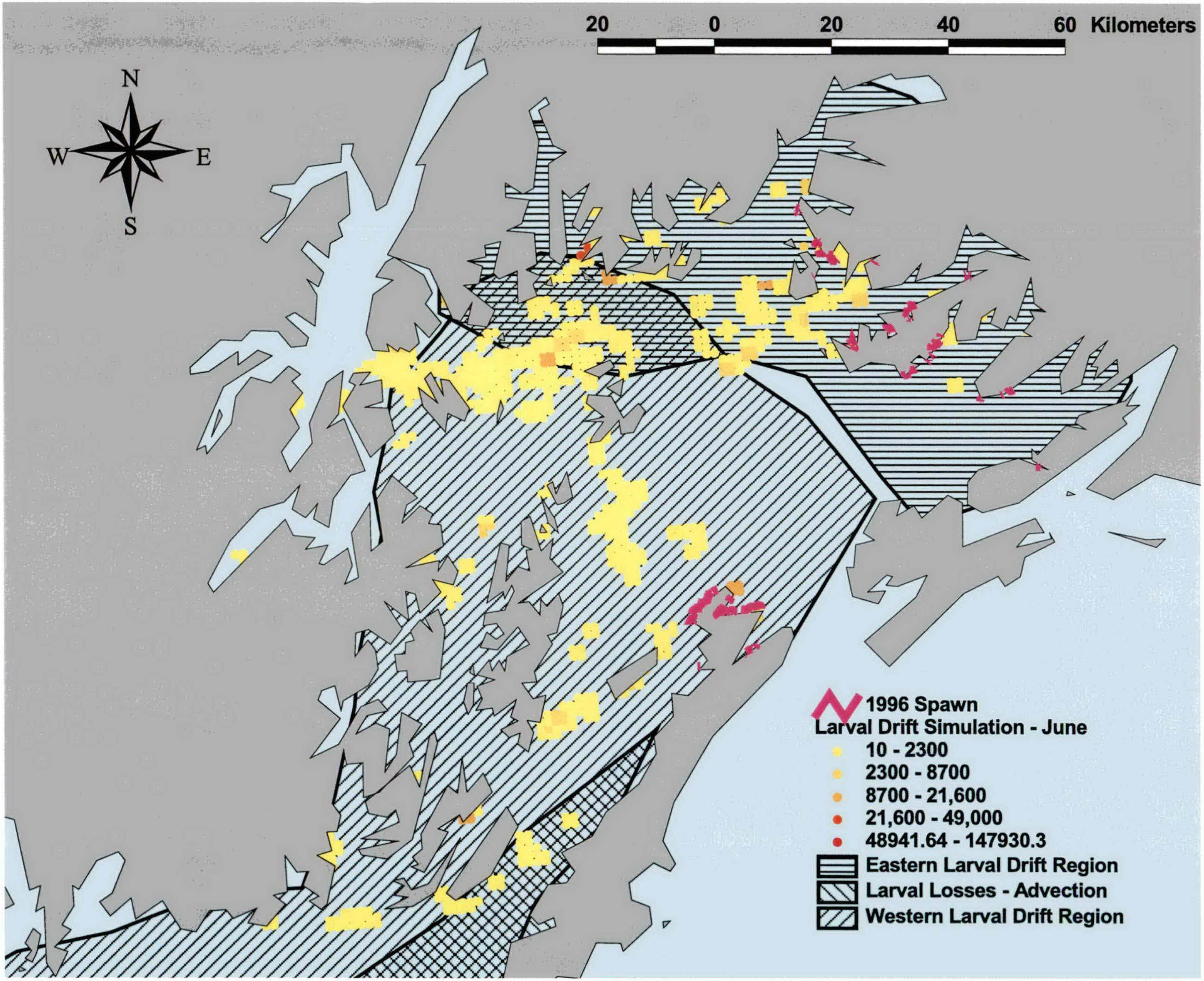


Late Larval, Early Juvenile Life History and Ecology

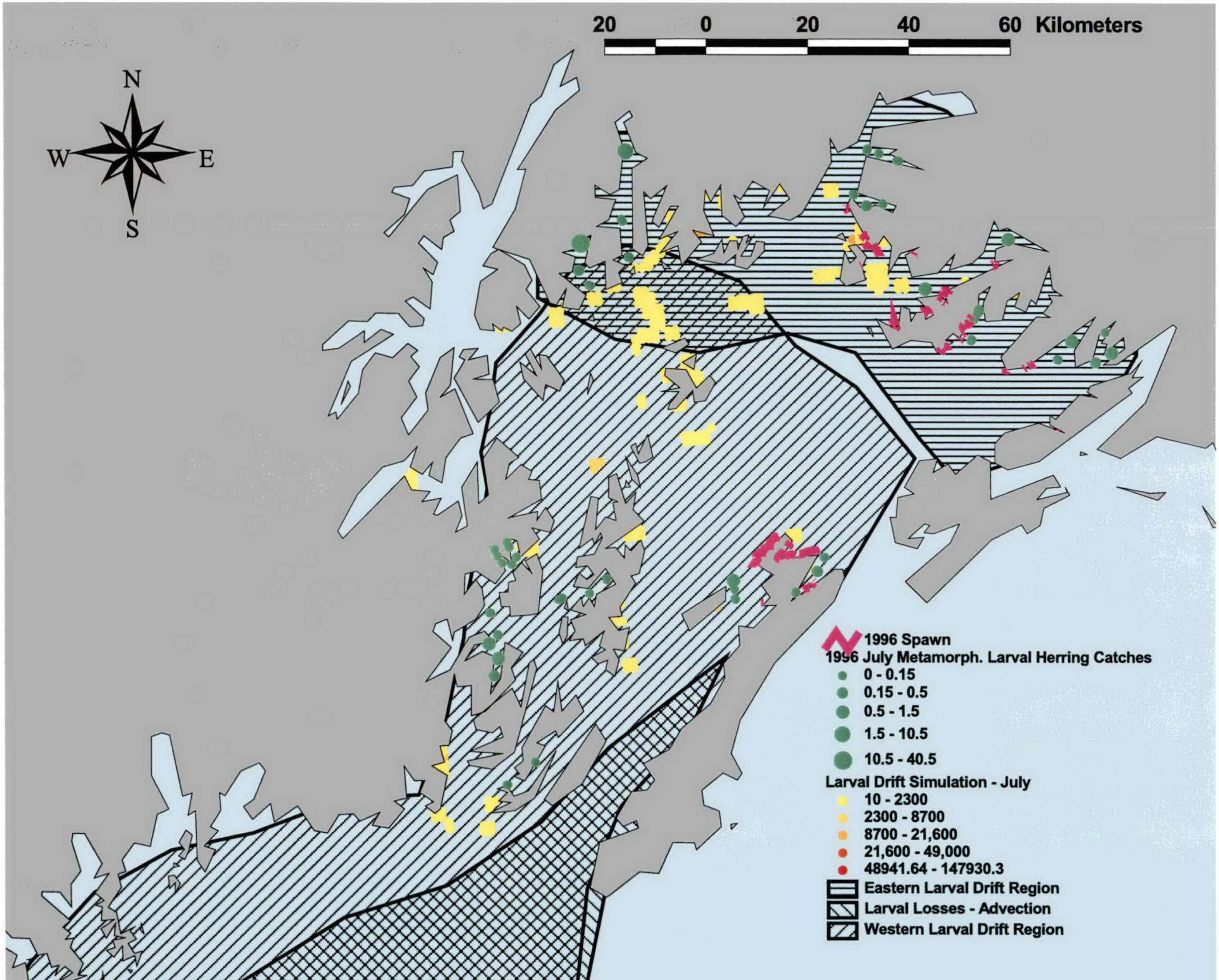


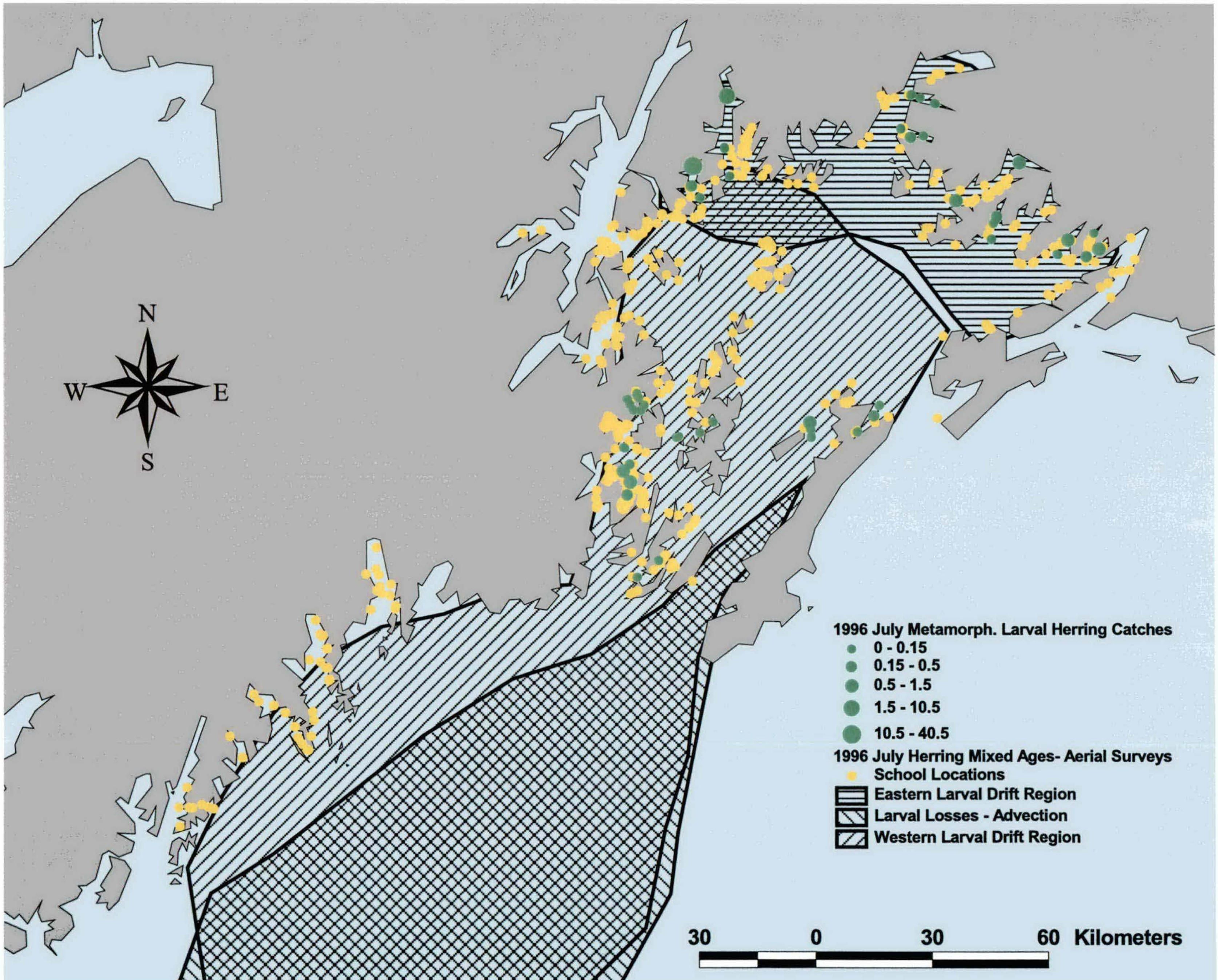
Juvenile Herring Life History and Ecology

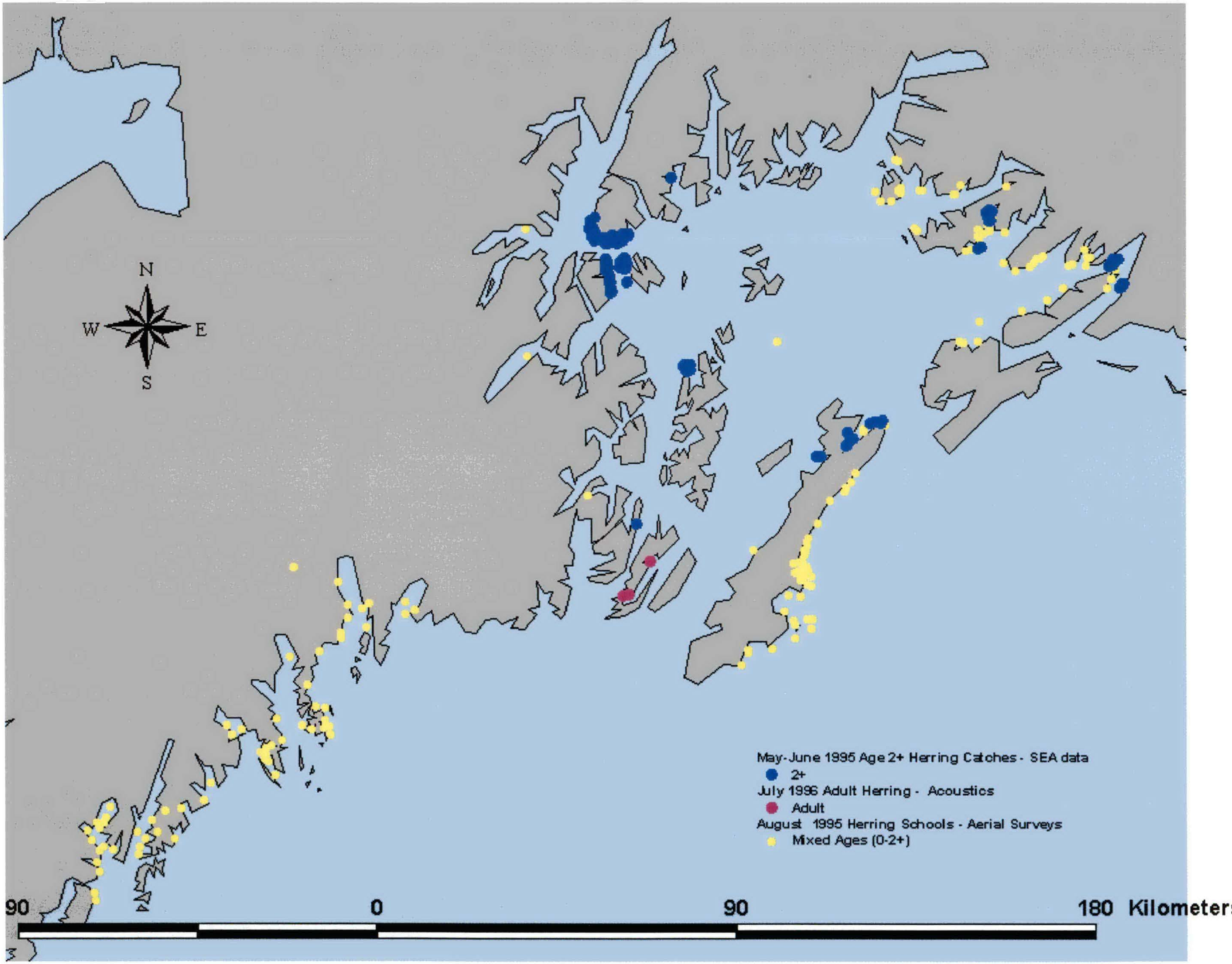

20 0 20 40 60 Kilometers
N
W
E
S
1996 Spawn
Larval Drift Simulation - May
10 - 2300
2300 - 8700
8700 - 21,600
21,600 - 49,000
49,000 - 148,000
Eastern Larval Drift Region
Larval Losses - Advection
Western Larval Drift Region



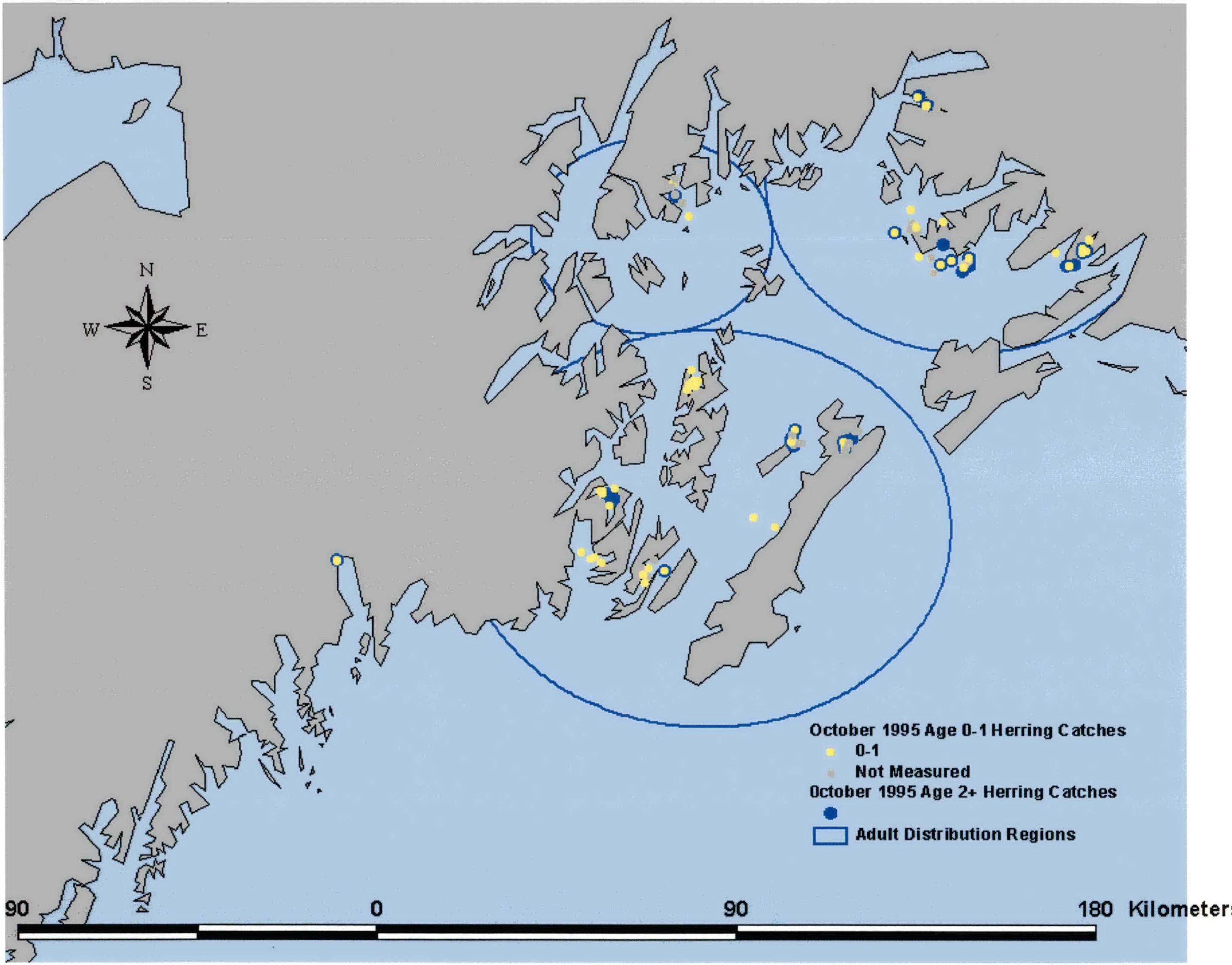
20 0 20 40 60 Kilometers
N
W
E
S
1996 Spawn
Larval Drift Simulation - June
10 - 2300
2300 - 8700
8700 - 21,600
21,600 - 49,000
48941.64 - 147930.3
Eastern Larval Drift Region
Larval Losses - Advection
Western Larval Drift Region

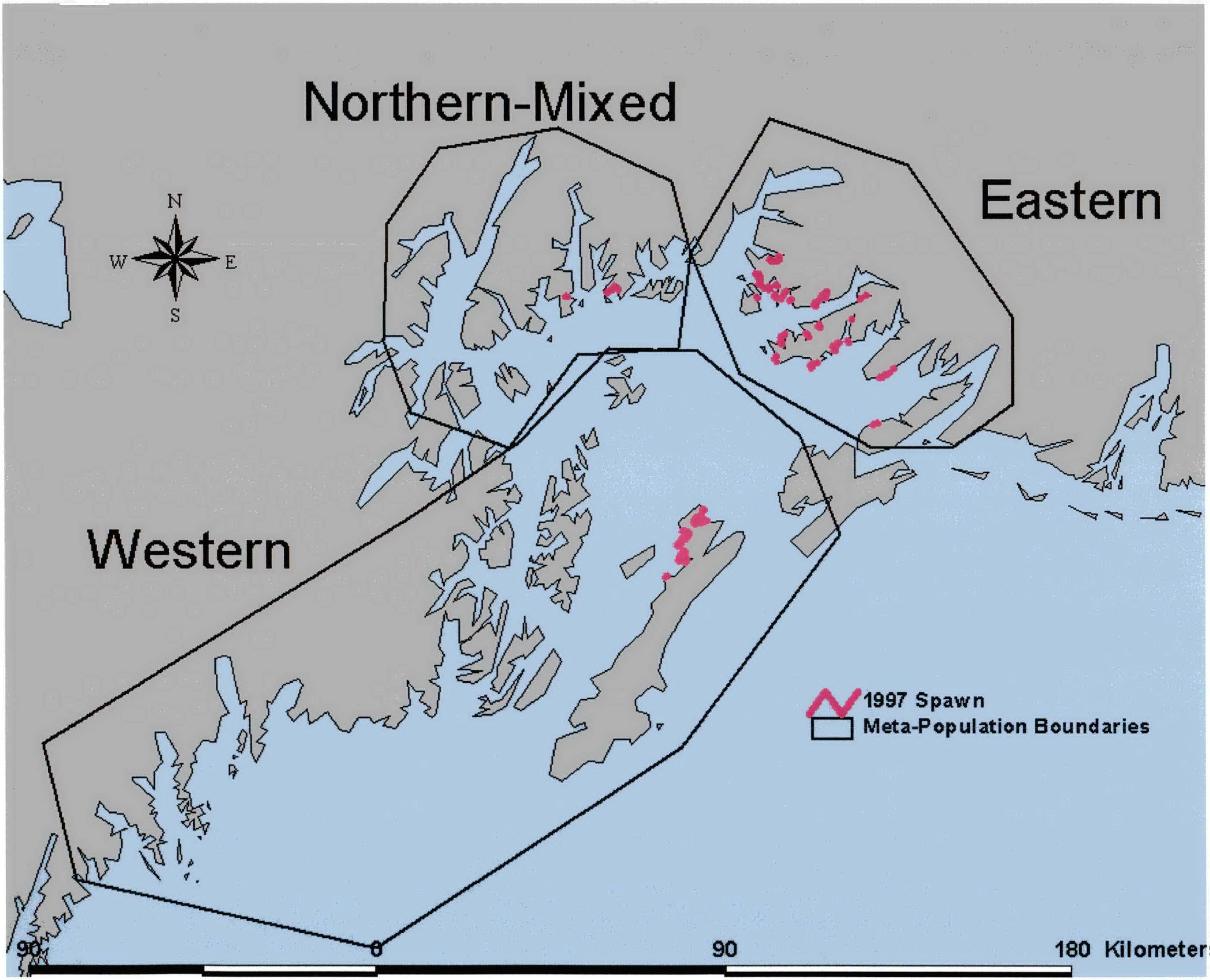

20 0 20 40 60 Kilometers
N
W
E
S
1996 Spawn
1996 July Metamorph. Larval Herring Catches
0 - 0.15
0.15 - 0.5
0.5 - 1.5
1.5 - 10.5
10.5 - 40.5
Larval Drift Simulation - July
10 - 2300
2300 - 8700
8700 - 21,600
21,600 - 49,000
48941.64 - 147930.3
Eastern Larval Drift Region
Larval Losses - Advection
Western Larval Drift Region

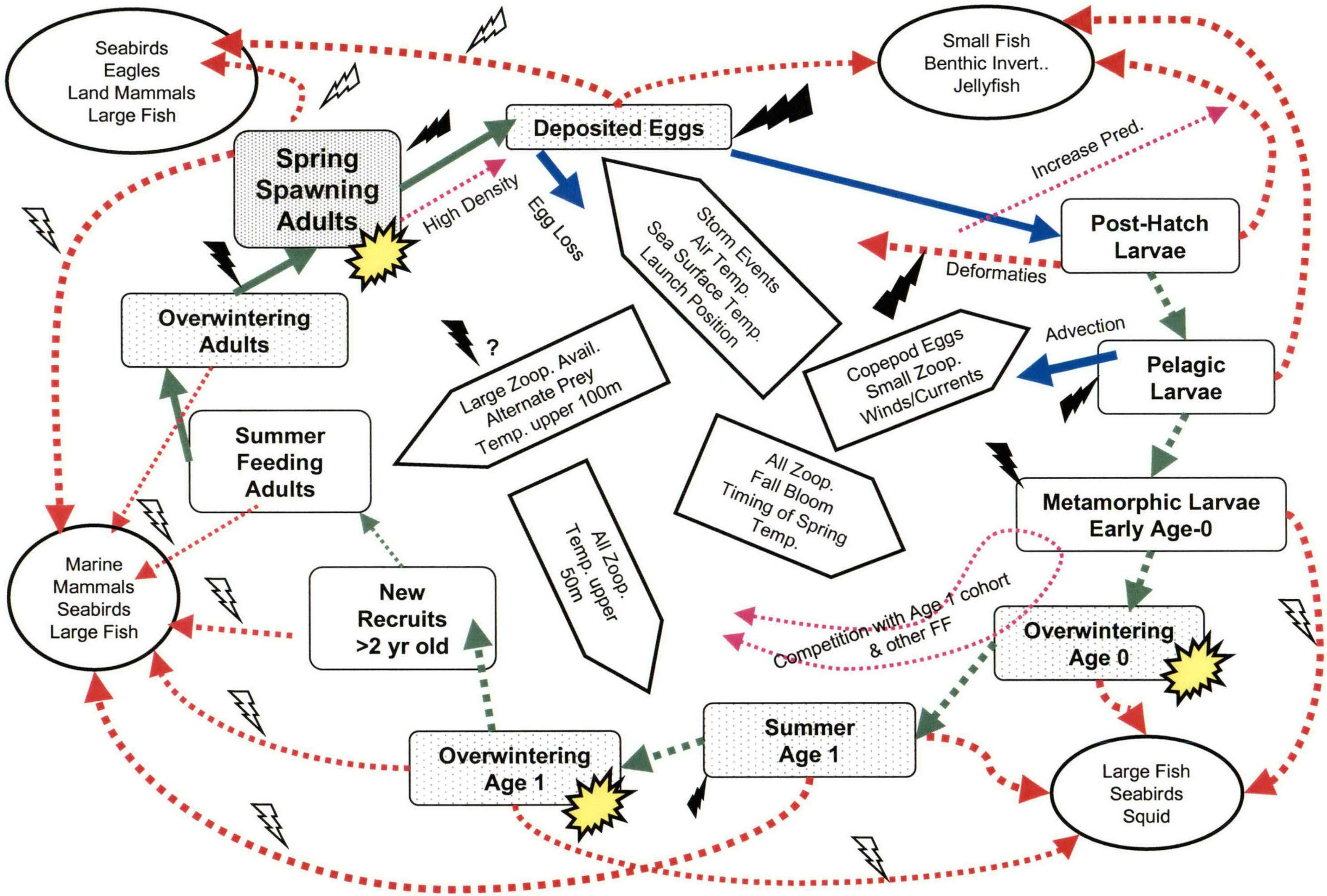

N
S
E
W
1996 July Metamorph. Larval Herring Catches
0 - 0.15
0.15 - 0.5
0.5 - 1.5
1.5 - 10.5
10.5 - 40.5
1996 July Herring Mixed Ages- Aerial Surveys
School Locations
Eastern Larval Drift Region
Larval Losses - Advection
Western Larval Drift Region
30 0 30 60 Kilometers



N
S
W
E
May-June 1995 Age 2+ Herring Catches - SEA data
2+
July 1996 Adult Herring - Acoustics
Adult
August 1995 Herring Schools - Aerial Surveys
Mixed Ages (0-2+)
90
0
90
180 Kilometers


N
W
E
S
October 1995 Age 0-1 Herring Catches
0-1
Not Measured
October 1995 Age 2+ Herring Catches
Adult Distribution Regions
90
0
90
180 Kilometers


Northern-Mixed
Eastern
Western
N
S
W
E
1997 Spawn
Meta-Population Boundaries
90
0
90
180 Kilometers



Pacific Herring Life History and Ecology

MEMO

TO: Phil Mundy

FROM: Tom Dean

DATE: August 11, 2000

RE: GEM Workshop of 7-26-00

- As I indicated at the workshop, I think the theme approach is a good way of organizing things.

- Someone mentioned an upcoming EMAP meeting in Alaska. I do not know what they have in mind for Alaska, but the EMAP program may offer some opportunities for collaboration, especially with respect to a "Sea otter/intertidal" theme. In Southern California, the EMAP program focused on nearshore benthic water quality and benthic community structure. Various dischargers were given a variance from their "normal" monitoring in order to help in a one-time systematic sampling of the region. Similar efforts in Alaska may provide data that would be helpful in selection of longer-term monitoring sites to be used by GEM.

- I agree that exotics or noxious introduced species are of concern, but I am not sure a specific program will be required to "monitor" potential introductions. Perhaps it should just be recognized as a potential problem that may need directed research funds from time to time.

- Molly suggested that a major objective of GEM was to provide "baseline" data in the event of a future spill. Monitoring for this would be, in many cases, very different from monitoring that would be needed to detect changes caused by global warming (the scale thing again). This emphasizes the need to layout specific objectives in the GEM program.

- On a more general note, Jim Bodkin and I (among others) have discussed the difficulties that may arise in keeping the long-term monitoring program on track. One problem is that there may be pressure to change focus as economic or political winds change. For example, I could see strong political pressure to redirect GEM if there is a collapse of the salmon fishery. While it might be wise to redirect some funds in the case of this or similar events, I do not think that core theme programs should be abandoned. In order to protect the integrity of the program, some strong "constitutional" type guidelines will be needed.

- A second problem in sustaining GEM has to do with personnel. Projects are often only as long-lived as Principal Investigators and currently proposed themes are largely P.I. driven. I doubt if the seal, forage fish, and sea otter themes would have been selected without the contributions of Kathy Frost, John Piatt, and Jim Bodkin. As these people move on to other jobs or retire, there is no guarantee that agencies will hire people with similar expertise and interests As a result, it might be difficult to maintain programs that rely on particular experts Jim has suggested that the Trustee/Council might be able to get around this by hiring its own scientific staff and not relying on agency or private sector P I s I am not sure this can be done under the current Council's charter, or if the Council wants to take a "hands on" role However, it may be possible for the Council to have "Theme Team Leaders " These could be Council employees that have responsibility to work in close association with agencies or private contractors in conducting core-monitoring programs and identifying research needs These "Theme Team Leaders" would have clear institutional responsibility for perpetuating projects, and their presence would make transitions within contracting agencies go more smoothly The "Theme Team Leader" would have responsibility of maintaining sampling protocols and databases so that monitoring could be carried along in the absence of any one person or agency involvement

USGS
science for a changing world

Steven A. Frenzel
Supervisory Hydrologist

U.S. Department of the Interior
U.S. Geological Survey

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86-7150 FAX

4230 University Dr, Suite 201
Anchorage, AK 99508-4664

...zel@usgs.gov

Brenda Hall

From	sfrenzel@usgs gov
Sent	Wednesday, August 02, 2000 1 22 PM
To	Brenda_Hall@oilspill state ak us
Cc	north phil@epa gov, bob@inletkeeper org, KRiley@envircon state ak us
Subject	GEM comments

pic23713 pcx

Brenda,

As per Phil North's email, I will give you my take on the GEM monitoring plan

I agree with Phil's comments regarding the need for monitoring in the watersheds To truly understand the resultant effects on keynote species in the marine environment the inputs to that environment must be understood Water quality of streams that support economically important anadromous fisheries must be monitored Many salmonid species spend as much or more of their lives in freshwater as they do in saltwater As Phil has stated, macroinvertebrates may be one of the most effective means of monitoring streams for the specific use of salmon rearing Also important, and critically lacking is the monitoring of water quantity Streamflow and timing of streamflow is important to both upstream and downstream migration of salmonids as well as sustaining spawning and rearing habitats Knowledge of streamflow into the Cook Inlet Basin and Prince William Sound is also important to the development of circulation models When coupled with some basic chemical analyses, major nutrient loadings to those water bodies could be estimated As of 2000, the major inflows of the Susitna River and Copper River are not being gauged

The USGS is currently conducting a water quality study in the Cook Inlet Basin I believe this would be considered erratic data in the GEM scheme of things We will continue with our data collection through September 2001 After that time, the USGS will have little or no water quality monitoring for streams flowing into Cook Inlet or Prince William Sound I make this statement to support Phil's point that GEM cannot count on agency monitoring to support GEM research Indeed it may be quite the reverse

Phil also mentioned the importance of urbanization to water-quality degradation This is one of the topics the USGS is currently examining with a study of streams in Anchorage Hopefully, the knowledge will be transferable to other areas of Alaska However, we will not continue monitoring these streams after this summer

In the near future, I will try and supply you with the lat-long data for sites that the USGS is currently monitoring

Thanks for the opportunity to comment

Steve

(Embedded ımage moved to file pıc23713 pcx)

FOCUS GROUP WORKBOOK

for the

DRAFT
Gulf Ecosystem Monitoring Plan
July 19, 2000

NAME: Fritz Funk

AFFILIATION: ADFG

MAILING ADDRESS: PO Box 25526
Juneau AK 99802-5526

TELEPHONE: 907 465 6113

E-MAIL: fritz_funk@fishgame.state.ak.us

Exxon Valdez Oilspill Restoration Office
645 G Street Suite 401
Anchorage, AK 99501-3451
907-278-8012
gem@oilspill.state.ak.us

TABLE OF CONTENTS

GULF ECOSYSTEM MONITORING PLAN
FOCUS GROUP AGENDA
Prince William Sound
Wednesday, July 19, 2000
10 a m – 5 30 p m
Exxon Valdez Restoration Office
645 G Street Suite 400, Anchorage, AK 99501-3451
907-800-478-7745 or 907-278-8012

Design a regionally implemented, globally coordinated and integrated monitoring program

10 00 Introductions of participants - Mundy

10 05 Opening remarks - McCammon

10 20 Relationship between GEM program and the draft monitoring plan - Spies

10 50 Orientation to the focus group process - Mundy

11 20 Coffee break

11 30 Criteria for project selection and definitions of terms – Mundy
- **11 40 Human needs and impacts, products, agency mandates – Focus Group**
- **12 05 Ecological importance – ecological indicators – Focus Group**

12 30 Lunch break (on your own)

- **1 30 GEM program mission, goals and themes – Focus Group**
- **1 55 Gap analysis - metadatabase – Focus Group**
- **2 20 Relation to other programs, leveraging – Focus Group**

2 40 Major themes of the draft monitoring plan - Mundy
- **2 50 Harbor seal theme – Focus Group**

3 20 Coffee break

- **3 30 Kittiwake/murre theme– Focus Group**
- **4 10 Sandlance/herring/salmon theme – Focus Group**

4 50 Concluding remarks – McCammon

5 00 Post Mortem – Focus Group

5 30 Adjourn

GEM PROGRAM MISSION

The mission of the GEM program is to "***sustain a healthy and biologically diverse marine ecosystem in the northern Gulf of Alaska (GOA) and the human use of the marine resources in that ecosystem through greater understanding of how its productivity is influenced by natural changes and human activities*** " In pursuit of this mission, the GEM program will sustain the necessary institutional infrastructure to provide scientific leadership in identifying research and monitoring gaps and priorities, sponsor monitoring, research, and other projects that respond to these identified needs, encourage efficiency in and integration of GOA monitoring and research activities through leveraging of funds and interagency coordination and partnerships, and involve stakeholders in local stewardship by guiding and carrying out parts of the program

GEM PROGRAM GOALS

GEM has five major programmatic goals in order to accomplish its mission

> DETECT Serve as a sentinel (early warning) system by detecting annual and long-term changes in the marine ecosystem, from coastal watersheds to the central gulf,
>
> UNDERSTAND Identify causes of change in the marine ecosystem, including natural variation, human influences, and their interaction,
>
> PREDICT Develop the capacity to predict the status and trends of natural resources for use by resource managers and consumers,
>
> INFORM Provide integrated and synthesized information to the public, resource managers, industry and policy makers in order for them to respond to changing conditions, and
>
> SOLVE Develop tools, technologies, and information that can help resource managers and regulators improve management of marine resources and address problems that may arise from human activities

Given the size and complexity of the ecosystem under consideration and the available funding, it will not be possible for GEM, by itself, to meet these goals Addressing them will require focusing on the institutional goals to

> IDENTIFY research and monitoring gaps currently not addressed by existing programs,
>
> LEVERAGE funds from other programs,
>
> PRIORITIZE research and monitoring needs,
>
> SYNTHESIZE research and monitoring to advise in setting priorities,
>
> TRACK work relevant to understanding biological production in the GOA, and
>
> INVOLVE other government agencies, non-governmental organizations, stakeholders, policy makers, and the general public in achieving the mission and goals of GEM

GUIDING PRINCIPLES FOR MARINE MONITORING

Understand changes in marine ecosystems

There is a general consensus among designers and operators of marine research and monitoring programs in Alaska, the United States, and world-wide that marine resource management agencies and marine resource dependent communities and industries need reliable sources of information and tools that enable them to cope with changes in living and physical marine resources The consensus holds that using the marine environment safely and responsibly requires abilities to recognize, understand and anticipate changes in the marine environment There is also general agreement that coping with change requires the ability to distinguish between natural and human induced changes in all aspects of marine ecosystems

Synthesize information from all sources

Understanding changes in marine ecosystems requires understanding the relations among many types of information, such as weather and fish production Changes in marine resources are caused by a combination of biological, geophysical and human forces Natural variability in the physical environment causes shifts in relations among species, which changes the overall productivity of the region's marine ecosystems Human impacts can lead to environmental degradation, including increased levels of contaminants, loss of habitats, and increased mortality on certain species in the ecosystem that may trigger changes in species composition and abundance

Coordinate planning for research and monitoring

Understanding changes in marine ecosystems requires marine resource management agencies and marine resource dependent communities and industries to work in concert to identify critically important information and analyses Coordination is essential to enhance and maintain broad discussion among the marine scientific community on the most direct and effective ways to understand and address issues related to maintaining the health of the region's marine ecosystems

Integrate information gathering and utilization

Understanding changes in marine ecosystems improves when concerned parties cooperate to develop the tools for information gathering and sharing Research and monitoring activities should be conducted by means that stimulate the development of data gathering and sharing systems that will serve scientists in the region and beyond from government, academia, and the private sector in maintaining the health of the region's marine ecosystems

INTRODUCTION

The role of the focus group in GEM

The focus group process is the start of the second stage of a four-stage process of planning and implementing the Trustee Council's participation in monitoring the marine ecosystems of the northern Gulf of Alaska

A four-stage process of planning and implementing regional monitoring

1 Establishment of policies dedication of funding and scientific scooping - **GEM Program**
2 What to monitor and approximately where and when to measure it – **GEM Monitoring Planning**
3 Statistical precision and power, costs, technical feasibility - **GEM Fine tuning FY01-03**
4 TC adopts and implements first GEM Annual Work Plan – **GEM Implementation**

Initial implementation of the GEM Monitoring Plan is envisioned to start a cycle that periodically revisits the essentials of stages 2 – 4 for as long as the GEM program exists The issues of what to monitor, where and when to measure it, what statistical power and precision are necessary, affordability and technological strategies and capabilities will be reviewed, and possibly modified, at regular intervals over the life of the program

How the focus group works

Focus group participants respond orally and in writing to materials presented at the meeting The advice will be gathered in writing from the workbooks submitted by focus group members, and orally on the basis of a transcript of the meeting Information from the focus group workbooks and meeting transcripts will be used by the team writing the version of the Draft GEM Monitoring Plan that serves as the starting point for the October Workshop

After initial background presentations on the context for the GEM Monitoring Plan and the focus group process, two types of propositions will be given to the group for response The first set contains criteria for project selection, and the second set contains examples of monitoring projects organized around themes (see Agenda above)

The topics in the two propositions have been selected for discussion so that most of the advice tendered should be directed toward how to select what to measure, what to measure, and where and when to measure it Time has not been provided for participants to make formal presentations on their own candidate projects, although participants have the opportunity to make recommendations for other projects in response to the GEM theme projects

What the focus group is to produce

The focus group process is intended to produce a broad range of written and oral advice about the two propositions criteria and approach to selecting monitoring projects, and three suites of example monitoring projects prepared for the purposes of the focus group The advice from the focus groups will be used in producing the Draft Monitoring Plan for the October Workshop

Criteria and approach to selecting monitoring projects

The approach being suggested to produce the GEM monitoring plan is to coordinate and integrate monitoring and research projects around ecologically and culturally prominent animal species, the harbor seal, kittiwakes and murres (surface feeding and diving seabirds), and sandlance, herring and salmon (forage fishes) The projects are further organized around regions, -- PWS, CI, Kodiak-Peninsula, and northern GOA -- although overlaps are certain to occur, particularly for migratory species and geophysical processes The animal species are conceptual focal points around which to organize studies of factors controlling changes in the marine ecosystems In this sense, each of the species is seen as an ecological "crossroads" where geophysical and biological agents of change come together The agents of change have been identified in the GEM conceptual foundation as food, habitat, removals by harvest and predators, and related geophysical forcing factors, such as the Pacific Decadal Oscillation

In designating one species, such as the harbor seal, to identify a GEM project, other plant and animal species are not excluded, nor are geophysical processes or parameters such as contaminants overlooked The procedure being tested uses the GEM species as a device around which to coordinate, integrate and synthesize information about the factors contributing to changes in valued marine and andromous species and the ecosystems on which they depend

The selection of an identifying species also does not mean that the GEM program will fund data acquisition for all factors necessary to understand changes in that species through time The goal is to design a project that is as complete as possible without concern for normal agency management function, or costs, or even technical feasibility Technical feasibility and costs are dealt with in project program fine tuning and implementation The GEM project identifies as completely as possible what is necessary to understand change in the GEM species, and in the process addresses the many other species and geophysical and chemical processes that contribute to changes in the GEM species through time

CRITERIA AND DEFINITIONS

Introduction Selecting and evaluating the GEM Project

In order to select a project for the GEM Monitoring Plan it is necessary to have a set of criteria to apply The explanation for each GEM Monitoring Project should contain a complete map of the information needed to understand the roles of the species in the ecosystems it occupies, and to understand the mechanisms of change in the GEM species and allied species In many cases the information necessary will not be available, and those data gaps need to be specified In order to ensure that the map is complete, the project is compared to a series of lists of important ~~features~~ in the ecosystem and the individual species, and criteria appropriate to a "crossroads" GEM species project (See Ecological importance – ecological indicators under ~~Criteria~~ and Definitions, below)

Human needs and impacts, products, agency mandates

Human needs and impacts, products, agency mandates

- Agency Mandates
  - Legal
    - Marine Mammal Protection Act
    - Endangered Species Act
    - Forest Practices Act
    - Clean Water Act
    - M-S Fishery Management and Conservation Act
    - Court orders
    - Enabling legislation of Trustee Council member agencies
    - Alaska State Constitution and Title 16
    - Alaska Board of Fisheries and Game regulations
    - Federal Subsistence Board regulations
    - State and federal harvest regulations
    - North Pacific Anadromous Fisheries Treaty
    - Pacific Salmon Treaty
    - Migratory Species Conventions
  - Regulatory
    - Harvest limitations - birds, fish, shellfish, mammals, marine algae, trees
    - Total Manageable Daily Loads TMDL's (non-point source pollutants)
    - Permit applications
  - Marine Habitat Protection
  - Fishery and Ecosystem-based Management
  - Contaminants, Water Quality and Food Safety
  - Stewardship and Status of resources
    - Population trends
    - Population abundance
    - Life cycle and basic biology

- Human Needs
  - Economic
    - Subsistence resources
    - Commercial resources
    - Tourist resources
    - Recreational resources
    - Scientific resources (genes, medical models)
    - Commerce (navigation, weather)
  - Health
    - Public safety (navigation, weather)
    - Clean food
    - Clean water
  - Culture
    - Subsistence resources
    - Religious practice

invasive species
sport harvests

- Human Impacts
  - Oil and Gas Development
  - Commercial Fishing
  - Salmon Hatchery Issues
  - Recreation and Tourism
  - Subsistence harvests
  - Logging
  - Small-scale Spills of Toxic Substances
  - Roadbuilding and Urbanization
  - Global Climate Change

oilspill Response
dispersants
burning

distinguish oil & gas
Transportation
vs
development

- Products
  - Measures contributing to meeting human and agency needs, managing impacts
    - Human Impacts
    - Marine Habitat Protection
    - Fishery and Ecosystem-based Management
    - Contaminants, Water Quality and Food Safety
    - Stewardship and Status of resources
    - Legal
    - Regulatory
    - Economic
    - Health
    - Culture
  - Information relevant to human activities
    - Scientific resources
    - Navigation
    - Weather
    - Water Quality
    - Contaminants
    - Food Safety

Ecological importance – ecological indicators

- Conceptual basis
  - Linkage to underlying ecological process (local, regional, global)
    - Food
      - Productivity (rate of production of food)
        - Primary productivity — Don Hall "abundance" + Gary Thomas – distribution
          - Nutrients
          - Mixing
          - Species composition
        - Secondary
        - Tertiary
      - Carbon transport and fate
      - Nitrogen transport and fate
    - Habitat
      - Limiting Factors
        - Temperature
        - Salinity
        - Current ~~velocity~~ general circulation advection
        - Water quality
          - Pollutants, contaminants
    - Removals
      - Fisheries
      - Habitat degradation
      - Pollutants, contaminants – diseases
      - Predation
  - Linkage to geophysical processes (local, regional, global)
    - Oceanographic
      - Upwelling
      - Downwelling
      - Mixed layer depth
      - Frontal structure
      - Current ~~dynamics~~ circulation dynamics
      - Organic transport
    - Atmospheric
      - Sea surface pressure (PDO and allied phenomena)
      - Wind stress
      - Precipitation
      - Runoff
- Relationships to other species defined
- Life cycle understood in relation to geographic range

- Usefulness of indicator
  - How would it be used (regulations, permitting, model input, public safety)
  - Where would it be used (agencies, public, private)
  - How often would it be used?
- Understandable (Meaning and uses of values known)
- Quantifiable
  - Range of values known
  - Temporal and spatial scales of change (spatial statistics)
  - Natural variability separable from anthropogenics (signal to noise ratio)
  - Statistical properties
    - Accuracy and Precision
    - Power
    - Robustness (statistical)
    - Error (Type I v Type II)
- Broadly applicable
  - Ecological processes
  - Biogeochemical processes
  - Geographic extent
  - Number of relevant species
  - Number of products (management applications)
- Compatibility
  - Interagency
  - Interdisciplinary
  - Interstate
  - International
- Reliability
  - Established performance (existing time series)
  - Sound theoretical basis
  - Comparable to established indicators
  - Data collection
    - Technology
    - Logistics
  - Robustness
    - Perturbations (urbanization, earthquake,)
    - Technological obsolescence

GEM program mission, goals and themes

- Geographic location
  - Northern GOA including watershed – marine linkages
  - Geophysical linkage
  - Migratory habitat ex-GOA – herring eggs – major linkage to tundra Avian communities – time critical, energy-rich refueling
- Understand changes in marine ecosystems
  - Detect long-term changes
    - Ecosystem health
    - Biological diversity
  - Understand causes of change
    - Human
    - Natural
  - Predict
- Synthesize information from all sources
  - Track relevant work
  - Solve management problems
  - Enable sustainable use
- Coordinate planning for research and monitoring
  - Identify gaps in knowledge
  - Prioritize data gathering efforts
  - Community stewardship
- Integrate information gathering and utilization
  - Leverage funding
  - Inform users
  - Community involvement
- Established link to GEM Theme
  - Harbor seal
  - Kittiwake-murre
  - Sandlance-herring-salmon
- Addresses conceptual foundation
  - Population change = function of (food, habitat, removals)

Relation to other programs, leveraging

US Dept of Agriculture, Forest Service
US Department of Commerce, National Oceanic and Atmospheric Administration
US Department of Defense, Office of Naval Research, Stennis Space Center
    US Coast Guard
US Department of the Interior
US Environmental Protection Agency
National Science Foundation
State of Alaska
    ADEC
    ADF&G
    ADNR
    ADCED (Community and Economic Development)
    ADHSS (Health and Social Services)
    UAF/UAA
        IMS/SFOS
        IARC (Arctic Research Center)
Nongovernmental Organizations - Hybrids
    PWSSC
    OSRI
    PWSRCAC
Transboundary Organizations
Global Climate Change Research

Note Refer to GEM program document, section IV B (page 41)

Users, policy groups, w/ information needs
BOF

Gap analysis – metadatabase

Basic Ground Programs

Erratics

Satellite Programs

(Please refer to metadatabase guide provided in hard copy at the meeting)

Note Please submit information on missing or erroneous information to brenda_hall@oilspill state ak us The synopsis of information needed to initiate contact is as follows

Project Project title goes here

Description Basic description of what, where, how, when and where

Organization Who conducts it and who pays for it?

Program Is it part of a larger coordinated effort?

Name Contact person
Address
Ph Voice and fax
E-mail

Geographic location Decimally coded latitudes and longitudes

Major themes of the monitoring plan

Example themes and projects have been chosen to test the ability of this approach to coordinate, integrate and foster the synthesis of marine related research in the northern GOA Example projects have been selected to illustrate the conceptual foundation that population change is a consequence of changes in food, habitat or removals by harvest or predators, and related factors Both themes and projects are a "first cut" based on comments received during development of the GEM program document and other considerations

Harbor seal theme

Narrative of harbor seal project 1

Title Understanding changes in harbor seal populations in the Northern GOA

Objectives Population

1 To track population change seals in a series of regional index sites through counts of molting harbor seals

Food and production

2 Regionally, to identify major prey items, ultimate carbon sources, and time spent foraging

3 Regionally, to quantify reproductive success, including juvenile survival trends

Habitat

4 Identify major foraging areas

Removals

5 To develop indices of subsistence harvest and predation

6 Develop survival model

7 To periodically determine tissue concentrations of bioaccumulated contaminants and to measure possible response biomarkers

Geographic areas

PWS, Cook Inlet, Kodiak Island

Agency activity

Current
ADF&G doing molt counts in PWS in FY2000, NMFS has done counts on Tugidak Island (near Kodiak Island) back into the 1980s

Proposed Partnership in future
Agencies to do molt counts in all three areas, logistical support for collections GEM to do diet foraging and carbon source work, harvest and predation efforts and collect tissue samples for contaminants

Community Activity

Other harbor seal projects?

The criteria have been applied to the example harbor seal project described in the narrative following the check list examples

Project check list example Human needs and impacts, products, agency mandates

Project Title Prince William Sound Harbor seal enumeration
Human needs and impacts, products, agency mandates

Remark	P = Present, A = Absent
	Agency Mandates
P	Legal
P	Regulatory
P	Marine Habitat Protection
P	Fishery and Ecosystem-based Management
P	Contaminants, Water Quality and Food Safety
P	Stewardship and Status of resources

Human Needs
P Economic
P Health
P Culture

P Human Impacts

P Products

Project check list example Linkage to underlying ecological process
Harbor Seal Theme
Project Title Prince William Sound Harbor seal enumeration

Ecological importance - ecological indicators

Conceptual basis

Linkage to underlying ecological process (local, regional, global)
P Food
P Habitat
P Removals
A Linkage to geophysical processes (local, regional, global)
P Relationships to other species defined
P Life cycle understood in relation to geographic range
Usefulness of indicator
A How would it be used (regulations, permitting, model input, public safety)

A Where would it be used (agencies, public, private)
A How often would it be used
Understandable
A Meaning and uses of values known
Quantifiable
A Range of values known
A Temporal and spatial scales of change (spatial statistics)
A Natural variability separable from anthropogenics (signal to noise ratio)

A Statistical properties
Broadly applicable
P Ecological processes
P Biogeochemical processes
ALL Geographic extent
HIGH Number of relevant species
? Number of products (management applications)
Compatibility
P Interagency
A Interdisciplinary

? Interstate
? International
Reliability
P Established performance (existing time series)
P Sound theoretical basis
P Comparable to established indicators
P Data collection
P Robustness

Project check list example GEM program mission, goals and themes

Harbor Seal Theme
Project Title Prince William Sound Harbor seal enumeration

Geographic location
YES Northern GOA
Geophysical linkage
Migratory habitat ex-GOA
Understand changes in marine ecosystems
P Detect long-term changes
P Understand causes of change
? Predict
Synthesize information from all sources
P Track relevant work
? Solve management problems
? Enable sustainable use
Coordinate planning for research and monitoring
? Identify gaps in knowledge
? Prioritize data gathering efforts
A Community stewardship
Integrate information gathering and utilization
P Leverage funding
? Inform users
A Community involvement
Established link to GEM Theme
P Harbor seal
Kittiwake-murre
Sandlance-herring-salmon
Addresses conceptual foundation
P Population change = function of (food, habitat, removals)

Project check list example Relation to other programs, leveraging

Harbor Seal Theme
Project Title Prince William Sound Harbor seal enumeration

A US Dept of Agriculture, Forest Service
A US Department of Commerce, National Oceanic and Atmospheric Administration
A US Department of Defense, Office of Naval Research, Stennis Space Center
A US Coast Guard
A US Department of the Interior
A US Environmental Protection Agency
A National Science Foundation
State of Alaska
P ADEC
P ADF&G
ADNR
ADCED (Community and Economic Development)
P ADHSS (Health and Social Services)
? UAF/UAA
IMS/SFOS
IARC (Arctic Research Center)
Nongovernmental Organizations
A PWSSC
A OSRI
A PWSRCAC

A Transboundary Organizations
? Global Climate Change Research

Project check list example Gap Analysis

Harbor Seal Theme
Project Title Prince William Sound Harbor seal enumeration

P Provides Missing Basic Ground Project
P Provides Missing Erratic

Kittiwake/murre theme

Narrative of kittiwake/murre project 1

Title Changes in colonial seabirds in the Northern GOA

Objectives Population

1 Measure changes in populations (production) of colonial sea birds in the northern GOAA

2 Regionally, to quantify reproductive success, including fledging success in a surface-feeding and in a diving seabird

Food

3 Regionally, to identify major prey items, food quality, and time spent foraging for a surface-feeding and for a diving seabird

Habitat

4 To identify major foraging areas and ultimate carbon sources

Removals

5 To develop indices of predation

7 To periodically develop estimates of seabird survival at major colonies

8 To periodically determine tissue concentrations of bioaccumulated contaminants and to measure possible response biomarkers

Geographic areas

PWS, Cook Inlet, Kodiak Island

Agency activity

Current

PWS USFWS, Migratory Bird Program, has a long-term population data set (back to 1985) for 27 kittiwake colonies in PWS that includes 2 surveys one in early spring for population counts and one in August to count chicks/nest More intenisve studies are carried out at Shoup Bay (also in PWS) that include diet

Kodiak Island An annual survey is made to estimate population sizes and productivity for black-legged Kittiwakes in one visit per year at 15-20 colonies At Porpoise Rocks counts of red-faced and pelagic comorants and common murres are also made

Cook Inlet/Kenai Coast USFWS AMR (Alaska Maritime Refuge) has a plan for doing annual surveys at East Amatuli Island (Barren Islands, Outer Cook Inlet) and surveys every 3-5 years at the Chiswell Islands (off Kenai Coast) and Chisik Island (in middle Cook Inlet) Annual surveys include timing of nesting, fledging time, production (chicks per nest) and prey identification Surveys on a 3-5 year periodicity include productivity (chicks per nest, timing of fledging (estimated) See Seabird monitoring plan for the Alaska Maritime Refuge File document, USFWS, AMR, Homer Alaska There are also historical counts (back to 1984) of 4 species of seabirds at Gull Island in Kachemak Bay

Proposed Partnership in future

PWS

Agencies to do Annual counts and productivity for surface feeder (Black-legged kittiwakes) at 27 colonies

GEM periodic estimates of diet composition and quality, ultimate carbon sources and predation estimates(if possible) periodic estimates of survival at selected colonies Collects samples for bioaccumulating contaminants

Kodiak Island

Agency to do annual counts and productivity for black-legged kittiwakes at 15-20 colonies on Kodiak Island

GEM as for PWS

Cook Inlet /Chiswells

Agency to do Annual population and productivity surveys kittiwakes and murres at East Amatuli Island, Population and productivity surveys at Gull Island Chisik Island and Chiswell Islands every 3-5 years

GEM as for PWS

Community Activity ?

Other kittiwake/murre projects ?

Sandlance/herring/salmon theme

Narrative of sandlance/herring/salmon project 1

Title Understanding changes in forage fish populations in the Northern GOA

Objectives Population

1 To quantify reproductive success in herring — very difficult & expensive to monitor.

2 To develop indices of age 0+, 1+ and 2+ herring abundance from aerial surveys in all regions Back-calculating from more easily observed adults works just as well

3 To track populations of non-commercial forage fish (e g , capelin, sandlance) by use of small mesh surveys, aerial surveys, halibut stomach analyses Leverage existing agency programs!

Food

4 Regionally, to identify major prey populations (plankton), and major spawning areas for stocks of Pacific herring + other species

5 To track changes in oceanographic and atmospheric conditions that control food supply

Habitat Herring spawning substrates/locations — index of human impact

6 To use the PWS circulation model to simulate larval dispersion in PWS

7 To identify major foraging areas and ultimate sources of carbon

Removals

8 To estimate larval survival and juvenile overwintering survival for Pacific herring

9 To track commercial harvest for Pacific herring

Geographic areas

PWS, Cook Inlet, Kodiak Island

Agency activity

Current

PWS ADF&G does aerial surveys of miles of spawn, conducts a test fishery and samples the commercial catch for age and weight-at- age for Pacific herring Stock size ~~estimated~~ synthesized from ASA model – ASA does NOT work without abundance data.

Kodiak Island ADF&G samples the commercial catch for age and weight-at-age Limited aerial surveys are carried out for important stocks(Uganik Bay)

Cook Inlet/Kenai Coast ADF&G samples conducts a test fishery for roe content/quality and samples the commercial catch for age and weight-at-age Aerial surveys are carried out for important stocks Effort is concentrated in Kamishak Bay, and a lesser effort on remnant stock in Katchemak Bay Stock size estimated from ASA model

Proposed Partnership in future

PWS

Agencies to do ADF&G Aerial survey for miles of spawn Age and weight-at-age Stock size estimates All on annual basis Partial support for small mesh surveys in PWS (new) Provides samples for contaminant and lipid analyses

PWSAC Continues plankton watch

GEM For Pacific herring 1 Run plankton model to forecast spring-summer bloom, 2 Run circulation model to forecast larval dispersion, 3 Carries out aerial survey for juvenile herring age slass estimates, 4 Estimates overwintering suvival from model and field collections at end of growing season Determines ultimate carbon sources Conducts small mesh surveys and biomass estimates from hydroacoustics

Kodiak Island

Agencies to do Aerial survey for miles of spawn Age and weight-at-age Stock size estimates Samples for lipid content, end of season whole body energy contnet and contaminants

GEM estimates lipid content, ultimate carbon sources, supports expanded plankton watch, estimates ovewintering survival from model and end-of-season whole body energy content

Cook Inlet / Chiswells

Agencies to do Aerial survey for miles of spawn Age and weight-at-age Stock size estimates Samples for lipid content, end of season whole-body-energy content and contaminants

GEM estimates lipid content, ultimate carbon sources, supports expanded plankton watch, estimates ovewintering survival from model and end-of-season whole body energy content

Community Activity ?

Narrative of sandlance/herring/salmon project 2

Title Changes in annual plankton production in the Northern GOA

Objectives Population

1 Regionally, to measure primary productivity in nearshore, shelf and GOA waters

2 To predict phytoplanton and zooplankton blooms in PWS, CI and Kodiak Island area with 2-d models using oceanographic and meterological data

3 To measure settled volume of plankton from weekly tows during the growing season in representative coastal areas

herring 'spawn timing' + Temperature - incubation

salmon outmigration' timing - what to monitor.

linkages

4 To collect synoptic data on chlorophyll a from SeaWifs satellite and to track subsurface cholorphyll a concentrations in shelf break environments

Food and habitat

5 To measure atmospheric and

6 To do zooplankton sampling at representative regional stations in all areas

Geographic areas

PWS, Cook Inlet, Kodiak Island

Agency activity

Current

PWS PWSAC does plankton watch from 5 hatchery locations Wind data for plankton model are available from NOAA buoys in PWS tanker channel (Potato Point, Bligh Reef, Mid-sound, Seal Rocks) FAA stations at Whittier and Valdez also supply wind data of lesser relevance to central PWS

Kodiak Island FOCI program (NOAA) in Shelikof Strait collects some data on plankton and atmospheric and oceanographic conditions

Cook Inlet/Kenai Coast No ongoing activities have been identified

Shelf and shelf break Atmospheric data from NOAA weather buoys, other data from GLOBEC studies on Seward line (NSF/NOAA) Plankton data from CPR in north Pacific (NPRB in 2000-2001)

Proposed Partnership in future

PWS

Agencies to do NOAA continues to make available weather data from central PWS, Cook Inlet and other locations

PWSAC Continues plankton watch

GEM 1 Run plankton model to forecast spring-summer bloom, 2 Run circulation model,

Kodiak Island

Possible continued oceanographic data from FOCI program in Shelikof Strait

GEM as for PWS, but no circulation model

Cook Inlet / Chiswells

Agencies to do Nothing yet identified

GEM as for PWS except for circulation model

Community Activity ?

Other sandlance/herring/salmon projects ?

Other themes…?

APPENDIX A LETTER OF INVITATION

Dear Friends

As many of you are aware, the *Exxon Valdez* Oil Spill Trustee Council is in the process of developing a long-term research and monitoring program for the northern Gulf of Alaska The Council's goal is to fund this program forever, using the earnings from investment of the remaining EVOS settlement funds The first phase of developing this program was a draft document describing the vision, goals, and framework for such a program That document is now under review by the National Research Council and is available from us in hard copy or on the web at http //www oilspill state ak us/future/gem htm

While the NRC review of the overall program is underway, we are developing a first draft of an actual monitoring plan for the initial years of the program Our goal is to bring together resource managers, scientists, and local stakeholders and experts in three regional focus groups Focus groups are intended to have a mixture of local geographic knowledge and other relevant knowledge such as commercial fishing, wildlife management and oceanography Attendance is open to all interested persons

Starting from a "straw draft monitoring plan," the focus groups will be asked to address the nuts and bolts of how this monitoring plan is to be built, as well as to identify specific monitoring projects and products The results of the focus group meetings will be used to move from the "straw draft" plan into a draft monitoring plan by mid-September That draft will be the starting point of an intensive two-day work session October 10-11 in Anchorage

We need your help in this effort Dates for the focus groups have been difficult to pin down due to everyone's busy summer schedules, but these are the dates we have just now been able to confirm **Wednesday, July 19 for Prince William Sound, Wednesday, July 26 for Cook Inlet, and Tuesday, August 1 for Kodiak** All three meetings will be held in Anchorage

You have been identified to attend the Prince William Sound focus group Please confirm with Brenda Hall at the EVOS Restoration Office (brenda hall@oilspill state ak us or 907-278-8012) as soon as possible if you will be able to attend Part of our work will be assisted by computer projected ArcView maps, so it would be desirable for you to attend in person, rather than by teleconference if at all possible If you think you could contribute more at a different group or one of the other dates works better for you, please let Brenda know that also If there are others you think might be good contributors, pass this message on and ask them to contact us Please come prepared to focus your attention on developing a monitoring plan for the north Gulf of Alaska, and especially Prince William Sound Folks with a "big picture" point of view are encouraged to work with those with regional interests

Additional materials will be sent to you prior to the meeting Some funds are available for travel, especially for non-agency folks Contact Brenda for additional information

Thank you for your assistance in this effort

Sincerely,

Molly McCammon

APPENDIX B CHECKLISTS FOR REVIEW OF OVERALL MONITORING PLAN (DRAFT)

Once the overall draft monitoring plan has been assembled for the first time, the following check lists would be used to review the collection of proposed projects as a whole in order to look for gaps with respect to a number of important features

Kinds of observations

1 Abundance
  - a adults
  - b juveniles

2 Size, age, weight

3 Energetics,
  - a caloric content
  - b lipid content

4 Stable isotopes
   Trophic structure
   Food origin

5 Contaminants

6 Biomarkers

Species or Guilds

1 Crustaceans, epifaunal
2 Marine demersal Gadids (cod, pollock)
3 Anadromous fishes salmon
4 Harbor seals and sea otters
5 Kittiwakes, Larids - surface feeders
6 Murres - Alcids - diving birds
7 Intertidal *Fucus* and mussels (fixed animals and plants)
8 Intertidal Mobile chitons Limpets, sea urchins, sea stars
9 Subtidal, shellfish, polychaetes, infauna, crustaceans
10 Forage fish Herring, salmon, sandlance, capelin

Geographical Provinces- Riparian, freshwater

1 Riparian
2 Intertidal
3 Littoral zone subtidal, nearshore
4 Neretic
5 Shelf benthos
6 Shelf pelagic
7 Slope pelagic
8 Slope benthos
9 Abyssal pelagic (oceanic / pelagic)
10 Abyssal bethic

Disciplinary Areas of Study

Biology
- Population Dynamics
- Physiology
- Trophic Dynamics
- Ecological energetics
- Biological Oceanography
- Fisheries Oceanography

Geophysical Sciences
- Physical Oceanography
- Chemical Oceanography
- Atmospheric Sciences

Trophic dynamics

1. diet composition/ spp + geographic origin
2. trophic level
3. food quality + energetics

Trolley coverage
Herald of Miller
re: salamander

Email
Dene
re: Wasster GEM
giving
plan to
Sanctuary

FOCUS GROUP WORKBOOK

for the

DRAFT
Gulf Ecosystem Monitoring Plan
July 19, 2000

NAME: Andy G.

AFFILIATION: ____________________

MAILING ADDRESS: ____________________

____

TELEPHONE: ____________________

E-MAIL: ____________________

typos give it
a real in development
feel

Exxon Valdez Oilspill Restoration Office
645 G Street Suite 401
Anchorage, AK 99501-3451
907-278-8012
gem@oilspill.state.ak.us

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GULF ECOSYSTEM MONITORING PLAN
FOCUS GROUP AGENDA

Prince William Sound
Wednesday, July 19, 2000
10 a m – 5.30 p.m
***Exxon Valdez* Restoration Office**
645 G Street Suite 400, Anchorage, AK 99501-3451
907-800-478-7745 or 907-278-8012

Design a regionally implemented, globally coordinated and integrated monitoring program

10 00 Introductions of participants - Mundy

10 05 Opening remarks - McCammon

10 20 Relationship between GEM program and the draft monitoring plan - Spies

10 50 Orientation to the focus group process - Mundy

11:20 Coffee break

11 30 Criteria for project selection and definitions of terms – Mundy
- **11 40 Human needs and impacts, products, agency mandates – Focus Group**
- **12 05 Ecological importance – ecological indicators – Focus Group**

12 30 Lunch break (on your own)

- **1 30 GEM program mission, goals and themes – Focus Group**
- **1 55 Gap analysis - metadatabase – Focus Group**
- **2 20 Relation to other programs, leveraging – Focus Group**

2 40 Major themes of the draft monitoring plan - Mundy
- **2 50 Harbor seal theme – Focus Group**

3 20. Coffee break

- **3 30 Kittiwake/murre theme– Focus Group**
- **4 10 Sandlance/herring/salmon theme – Focus Group**

4 50 Concluding remarks – McCammon

5 00 Post Mortem – Focus Group

5.30: Adjourn

GEM PROGRAM MISSION

Sustainable

The mission of the GEM program is to "***sustain a healthy and biologically diverse marine ecosystem in the northern Gulf of Alaska (GOA) and the human use of the marine resources in that ecosystem through greater understanding of how its productivity is influenced by natural changes and human activities*** " In pursuit of this mission, the GEM program will sustain the necessary institutional infrastructure to provide scientific leadership in identifying research and monitoring gaps and priorities, sponsor monitoring, research, and other projects that respond to these identified needs, encourage efficiency in and integration of GOA monitoring and research activities through leveraging of funds and interagency coordination and partnerships, and involve stakeholders in local stewardship by guiding and carrying out parts of the program

GEM PROGRAM GOALS

GEM has five major programmatic goals in order to accomplish its mission

DETECT Serve as a sentinel (early warning) system by detecting annual and long-term changes in the marine ecosystem, from coastal watersheds to the central gulf,

UNDERSTAND Identify causes of change in the marine ecosystem, including natural variation, human influences, and their interaction,

PREDICT Develop the capacity to predict the status and trends of natural resources for use by resource managers and consumers,

INFORM Provide integrated and synthesized information to the public, resource managers, industry and policy makers in order for them to respond to changing conditions, and

SOLVE Develop tools, technologies, and information that can help resource managers and regulators improve management of marine resources and address problems that may arise from human activities

Given the size and complexity of the ecosystem under consideration and the available funding, it will not be possible for GEM, by itself, to meet these goals Addressing them will require focusing on the institutional goals to

IDENTIFY research and monitoring gaps currently not addressed by existing programs,

LEVERAGE funds from other programs,

PRIORITIZE research and monitoring needs,

SYNTHESIZE research and monitoring to advise in setting priorities,

TRACK work relevant to understanding biological production in the GOA, and

INVOLVE other government agencies, non-governmental organizations, stakeholders, policy makers, and the general public in achieving the mission and goals of GEM

Establish partnerships with other large scale marine monitoring programs

GUIDING PRINCIPLES FOR MARINE MONITORING

Understand changes in marine ecosystems

Sustain

There is a general consensus among designers and operators of marine research and monitoring programs in Alaska, the United States, and world-wide that marine resource management agencies and marine resource dependent communities and industries need reliable sources of information and tools that enable them to cope with changes in living and physical marine resources The consensus holds that using the marine environment safely and responsibly requires abilities to recognize, understand and anticipate changes in the marine environment There is also general agreement that coping with change requires the ability to distinguish between natural and human induced changes in all aspects of marine ecosystems

Synthesize information from all sources

Understanding changes in marine ecosystems requires understanding the relations among many types of information, such as weather and fish production Changes in marine resources are caused by a combination of biological, geophysical and human forces Natural variability in the physical environment causes shifts in relations among species, which changes the overall productivity of the region's marine ecosystems Human impacts can lead to environmental degradation, including increased levels of contaminants, loss of habitats, and increased mortality on certain species in the ecosystem that may trigger changes in species composition and abundance

Coordinate planning for research and monitoring

~~Understanding changes in marine ecosystems~~ requires marine resource management agencies and marine resource dependent communities and industries to work in concert to identify critically important information and analyses Coordination is essential to enhance and maintain broad discussion among the marine scientific community on the most direct and effective ways to understand and address issues related to maintaining the health of the region's marine ecosystems

The community must work together toward normative standards for health (indicators & benchmarks)

Integrate information gathering and utilization

Understanding changes in marine ecosystems improves when concerned parties cooperate to develop the tools for information gathering and sharing Research and monitoring activities should be conducted by means that stimulate the development of data gathering and sharing systems that will serve scientists in the region and beyond from government, academia, and the private sector in maintaining the health of the region's marine ecosystems

INTRODUCTION

The role of the focus group in GEM

The focus group process is the start of the second stage of a four-stage process of planning and implementing the Trustee Council's participation in monitoring the marine ecosystems of the northern Gulf of Alaska

A four-stage process of planning and implementing regional monitoring

1 Establishment of policies dedication of funding and scientific scoping - **GEM Program**
2 What to monitor and approximately where and when to measure it – **GEM Monitoring Planning**
3 Statistical precision and power, costs, technical feasibility - **GEM Fine tuning FY01-03** YES!!
4 TC adopts and implements first GEM Annual Biennial Work Plan – **GEM Implementation** some early GEM $ and then what - Ask Kai to say it?

Initial implementation of the GEM Monitoring Plan is envisioned to start a cycle that periodically revisits the essentials of stages 2 – 4 for as long as the GEM program exists The issues of what to monitor, where and when to measure it, what statistical power and precision are necessary, affordability and technological strategies and capabilities will be reviewed, and possibly modified, at regular intervals over the life of the program

How the focus group works

Focus group participants respond orally and in writing to materials presented at the meeting The advice will be gathered in writing from the workbooks submitted by focus group members, and orally on the basis of a transcript of the meeting Information from the focus group workbooks and meeting transcripts will be used by the team writing the version of the Draft GEM Monitoring Plan that serves as the starting point for the October Workshop

After initial background presentations on the context for the GEM Monitoring Plan and the focus group process, two types of propositions will be given to the group for response The first set contains criteria for project selection, and the second set contains examples of monitoring projects organized around themes (see Agenda above)

The topics in the two propositions have been selected for discussion so that most of the advice tendered should be directed toward how to select what to measure, what to measure, and where and when to measure it Time has not been provided for participants to make formal presentations on their own candidate projects, although participants have the opportunity to make recommendations for other projects in response to the GEM theme projects

What the focus group is to produce

The focus group process is intended to produce a broad range of written and oral advice about the two propositions criteria and approach to selecting monitoring projects, and three suites of example monitoring projects prepared for the purposes of the focus group The advice from the focus groups will be used in producing the Draft Monitoring Plan for the October Workshop

Criteria and approach to selecting monitoring projects

The approach being suggested to produce the GEM monitoring plan is to coordinate and integrate monitoring and research projects around ecologically and culturally prominent animal species, the harbor seal, kittiwakes and murres (surface feeding and diving seabirds), and sandlance, herring and salmon (forage fishes) The projects are further organized around regions, -- PWS, CI, Kodiak-Peninsula, and northern GOA -- although overlaps are certain to occur, particularly for migratory species and geophysical processes The animal species are conceptual focal points around which to organize studies of factors controlling changes in the marine ecosystems In this sense, each of the species is seen as an ecological "crossroads" where geophysical and biological agents of change come together The agents of change have been identified in the GEM conceptual foundation as food, habitat, removals by harvest and predators, and related geophysical forcing factors, such as the Pacific Decadal Oscillation

In designating one species, such as the harbor seal, to identify a GEM project, other plant and animal species are not excluded, nor are geophysical processes or parameters such as contaminants overlooked The procedure being tested uses the GEM species as a device around which to coordinate, integrate and synthesize information about the factors contributing to changes in valued marine and andromous species and the ecosystems on which they depend

The selection of an identifying species also does not mean that the GEM program will fund data acquisition for all factors necessary to understand changes in that species through time The goal is to design a project that is as complete as possible without concern for normal agency management function, or costs, or even technical feasibility Technical feasibility and costs are dealt with in project program fine tuning and implementation The GEM project identifies as completely as possible what is necessary to understand change in the GEM species, and in the process addresses the many other species and geophysical and chemical processes that contribute to changes in the GEM species through time

CRITERIA AND DEFINITIONS

Introduction Selecting and evaluating the GEM Project

In order to select a project for the GEM Monitoring Plan it is necessary to have a set of criteria to apply The explanation for each GEM Monitoring Project should contain a complete map of the information needed to understand the roles of the species in the ecosystems it occupies, and to understand the mechanisms of change in the GEM species and allied species In many cases the information necessary will not be available, and those data gaps need to be specified In order to ensure that the map is complete, the project is compared to a series of lists of important features in the ecosystem and the individual species, and criteria appropriate to a "crossroads" GEM species project (See Ecological importance – ecological indicators under Criteria and Definitions, below)

Human needs and impacts, products, agency mandates

Human needs and impacts, products, agency mandates

Agency Mandates

- Legal
    - Marine Mammal Protection Act
    - Endangered Species Act
    - Forest Practices Act
    - Clean Water Act
    - M-S Fishery Management and Conservation Act
    - Court orders
    - Enabling legislation of Trustee Council member agencies
    - Alaska State Constitution and Title 16
    - Alaska Board of Fisheries and Game regulations
    - Federal Subsistence Board regulations
    - State and federal harvest regulations
    - North Pacific Anadromous Fisheries Treaty
    - Pacific Salmon Treaty
    - Migratory Species Conventions

CERCLA

focused clean ups

- Regulatory
    - Harvest limitations - birds, fish, shellfish, mammals, marine algae, trees
    - Total Manageable Daily Loads TMDL's (non-point source pollutants)
    - Permit applications
- Marine Habitat Protection
- Fishery and Ecosystem-based Management
- Contaminants, Water Quality and Food Safety
- Stewardship and Status of resources
    - Population trends
    - Population abundance
    - Life cycle and basic biology

factors of production
(clean water)
→ commodities (extract)

- Human Needs
  - Economic
    - Subsistence resources
    - Commercial resources
    - Tourist resources
    - Recreational resources
    - Scientific resources (genes, medical models)
    - Commerce (navigation, weather)
  - Health
    - Public safety (navigation, weather)
    - Clean food
    - Clean water
  - Culture
    - Subsistence resources
    - Religious practice
- Human Impacts
  - Oil and Gas Development — water pollution
  - Commercial Fishing
  - Salmon Hatchery Issues
  - Recreation and Tourism
  - Subsistence harvests
  - Logging
  - Small-scale Spills of Toxic Substances
  - Roadbuilding and Urbanization
  - Global Climate Change
- Products ?
  - Measures contributing to meeting human and agency needs, managing impacts
    - Human Impacts
    - Marine Habitat Protection
    - Fishery and Ecosystem-based Management
    - Contaminants, Water Quality and Food Safety
    - Stewardship and Status of resources
    - Legal
    - Regulatory
    - Economic
    - Health
    - Culture
  - Information relevant to human activities
    - Scientific resources
    - Navigation
    - Weather
    - Water Quality
    - Contaminants
    - Food Safety

Ecological importance – ecological indicators

- Conceptual basis
  - Linkage to underlying ecological process (local, regional, global)
    - Food
      - Productivity (rate of production of food)
        - Primary productivity
          - Nutrients
          - Mixing
          - Species composition
        - Secondary
        - Tertiary
      - Carbon transport and fate
      - Nitrogen transport and fate
    - Habitat
      - Limiting Factors
        - Temperature
        - Salinity
        - Current velocity
        - Water quality
          - Pollutants, contaminants
    - Removals
      - Fisheries
      - Habitat degradation
      - Pollutants, contaminants
      - Predation
  - Linkage to geophysical processes (local, regional, global)
    - Oceanographic
      - Upwelling
      - Downwelling
      - Mixed layer depth
      - Frontal structure
      - Current dynamics
      - Organic transport
    - Atmospheric
      - Sea surface pressure (PDO and allied phenomena)
      - Wind stress
      - Precipitation
      - Runoff
- Relationships to other species defined
- Life cycle understood in relation to geographic range

- Usefulness of indicator
  - How would it be used (regulations, permitting, model input, public safety)
  - Where would it be used (agencies, public, private)
  - How often would it be used?
- Understandable (Meaning and uses of values known)
- Quantifiable
  - Range of values known
  - Temporal and spatial scales of change (spatial statistics)
  - Natural variability separable from anthropogenics (signal to noise ratio)
  - Statistical properties
    - Accuracy and Precision
    - Power
    - Robustness (statistical)
    - Error (Type I v Type II)
- Broadly applicable
  - Ecological processes
  - Biogeochemical processes
  - Geographic extent
  - Number of relevant species
  - Number of products (management applications)
- Compatibility
  - Interagency
  - Interdisciplinary
  - Interstate
  - International
- Reliability
  - Established performance (existing time series)
  - Sound theoretical basis
  - Comparable to established indicators
  - Data collection
    - Technology
    - Logistics
  - Robustness
    - Perturbations (urbanization, earthquake,   )
    - Technological obsolescence

GEM program mission, goals and themes

- Geographic location
  - Northern GOA including watershed – marine linkages
  - Geophysical linkage
  - Migratory habitat ex-GOA
- Understand changes in marine ecosystems
  - Detect long-term changes
    - Ecosystem health
    - Biological diversity
  - Understand causes of change
    - Human
    - Natural
  - Predict
- Synthesize information from all sources
  - Track relevant work
  - Solve management problems
  - Enable sustainable use
- Coordinate planning for research and monitoring
  - Identify gaps in knowledge
  - Prioritize data gathering efforts
  - Community stewardship
- Integrate information gathering and utilization
  - Leverage funding
  - Inform users
  - Community involvement
- Established link to GEM Theme
  - Harbor seal
  - Kittiwake-murre
  - Sandlance-herring-salmon
- Addresses conceptual foundation
  - Population change = function of (food, habitat, removals)

Relation to other programs, leveraging

US Dept of Agriculture, Forest Service
US Department of Commerce, National Oceanic and Atmospheric Administration
US Department of Defense, Office of Naval Research, Stennis Space Center, Air Force Research
US Coast Guard
US Department of the Interior
US Environmental Protection Agency
National Science Foundation
State of Alaska
ADEC
ADF&G
ADNR
ADCED (Community and Economic Development)
ADHSS (Health and Social Services)
UAF/UAA
IMS/SFOS
IARC (Arctic Research Center)

specify mandates/divisions

Nongovernmental Organizations - Hybrids
PWSSC
OSRI
PWSRCAC

inlet keeper, volunteer monitoring

Transboundary Organizations
Global Climate Change Research

Note Refer to GEM program document, section IV B (page 41)

Gap analysis – metadatabase

Basic Ground Programs

Erratics

Satellite Programs

(Please refer to metadatabase guide provided in hard copy at the meeting)

Note Please submit information on missing or erroneous information to brenda_hall@oilspill state ak us The synopsis of information needed to initiate contact is as follows

Project Project title goes here

Description Basic description of what, where, how, when and where

Organization Who conducts it and who pays for it?

Program Is it part of a larger coordinated effort?

Name Contact person
Address
Ph Voice and fax
E-mail

Geographic location Decimally coded latitudes and longitudes

Major themes of the monitoring plan

Example themes and projects have been chosen to test the ability of this approach to coordinate, integrate and foster the synthesis of marine related research in the northern GOA Example projects have been selected to illustrate the conceptual foundation that population change is a consequence of changes in food, habitat or removals by harvest or predators, and related factors Both themes and projects are a "first cut" based on comments received during development of the GEM program document and other considerations

Harbor seal theme

Narrative of harbor seal project 1

Title Understanding changes in harbor seal populations in the Northern GOA

Objectives Population

1 To track population change seals in a series of regional index sites through counts of molting harbor seals health of individuals

Food and production

2 Regionally, to identify major prey items, ultimate carbon sources, and time spent foraging

3 Regionally, to quantify reproductive success, including juvenile survival trends

Habitat

4 Identify major foraging areas

Removals

bycatch

5 To develop indices of subsistence harvest and predation

6 Develop survival model

7 To periodically determine tissue concentrations of bioaccumulated contaminants and to measure possible response biomarkers

Geographic areas

PWS, Cook Inlet, Kodiak Island

Agency activity

Current
ADF&G doing molt counts in PWS in FY2000, NMFS has done counts on Tugidak Island (near Kodiak Island) back into the 1980s

Proposed Partnership in future
Agencies to do molt counts in all three areas, logistical support for collections GEM to do diet foraging and carbon source work, harvest and predation efforts and collect tissue samples for contaminants

Community Activity

Other harbor seal projects?

The criteria have been applied to the example harbor seal project described in the narrative following the check list examples

Project check list example Human needs and impacts, products, agency mandates

Project Title Prince William Sound Harbor seal enumeration
Human needs and impacts, products, agency mandates

Remark P = Present, A = Absent

Agency Mandates

P Legal
P Regulatory
P Marine Habitat Protection
P Fishery and Ecosystem-based Management
P Contaminants, Water Quality and Food Safety
P Stewardship and Status of resources

	Human Needs
P	Economic
P	Health
P	Culture
P	Human Impacts
P	Products

Project check list example Linkage to underlying ecological process

Harbor Seal Theme

Project Title Prince William Sound Harbor seal enumeration

Ecological importance - ecological indicators

Conceptual basis

	Linkage to underlying ecological process (local, regional, global)
P	Food
P	Habitat
P	Removals
A	Linkage to geophysical processes (local, regional, global)
P	Relationships to other species defined
P	Life cycle understood in relation to geographic range
	Usefulness of indicator
A	How would it be used (regulations, permitting, model input, public safety)
A	Where would it be used (agencies, public, private)
A	How often would it be used
	Understandable
A	Meaning and uses of values known
	Quantifiable
A	Range of values known
A	Temporal and spatial scales of change (spatial statistics)
A	Natural variability separable from anthropogenics (signal to noise ratio)
A	Statistical properties
	Broadly applicable
P	Ecological processes
P	Biogeochemical processes
ALL	Geographic extent
HIGH	Number of relevant species
?	Number of products (management applications)
	Compatibility
P	Interagency
A	Interdisciplinary

? Interstate
? International
Reliability
P Established performance (existing time series)
P Sound theoretical basis
P Comparable to established indicators
P Data collection
P Robustness

Project check list example GEM program mission, goals and themes

Harbor Seal Theme

Project Title Prince William Sound Harbor seal enumeration

Geographic location
YES Northern GOA
Geophysical linkage
Migratory habitat ex-GOA

Understand changes in marine ecosystems
P Detect long-term changes
P Understand causes of change
? Predict

Synthesize information from all sources
P Track relevant work
? Solve management problems
? Enable sustainable use

Coordinate planning for research and monitoring
? Identify gaps in knowledge
? Prioritize data gathering efforts
A Community stewardship

Integrate information gathering and utilization
P Leverage funding
? Inform users
A Community involvement

Established link to GEM Theme
P Harbor seal
Kittiwake-murre
Sandlance-herring-salmon

Addresses conceptual foundation
P Population change = function of (food, habitat, removals)

Project check list example Relation to other programs, leveraging

Harbor Seal Theme
Project Title Prince William Sound Harbor seal enumeration

A US Dept of Agriculture, Forest Service
A US Department of Commerce, National Oceanic and Atmospheric Administration
A US Department of Defense, Office of Naval Research, Stennis Space Center
A US Coast Guard
A US Department of the Interior
A US Environmental Protection Agency
A National Science Foundation
State of Alaska
P ADEC
P ADF&G
ADNR
ADCED (Community and Economic Development)
P ADHSS (Health and Social Services)
? UAF/UAA
IMS/SFOS
IARC (Arctic Research Center)
Nongovernmental Organizations
A PWSSC
A OSRI
A PWSRCAC

A Transboundary Organizations
? Global Climate Change Research

Project check list example Gap Analysis

Harbor Seal Theme
Project Title Prince William Sound Harbor seal enumeration

P Provides Missing Basic Ground Project
P Provides Missing Erratic

Kittiwake/murre theme

Narrative of kittiwake/murre project 1

Title Changes in colonial seabirds in the Northern GOA

health of individuals

Objectives Population

1 Measure changes in populations (production) of colonial sea birds in the northern GOA le

2 Regionally, to quantify reproductive success, including fledging success, le in a surface-feeding and in a diving seabird

Food

3 Regionally, to identify major prey items, food quality, and time spent foraging, le for a surface-feeding and for a diving seabird

Habitat

4 To identify major foraging areas and ultimate carbon sources

Removals

5 To develop indices of predation

7 To periodically develop estimates of seabird survival at major colonies

8 To periodically determine tissue concentrations of bioaccumulated contaminants and to measure possible response biomarkers

Geographic areas

PWS, Cook Inlet, Kodiak Island

Agency activity

Current

PWS USFWS, Migratory Bird Program, has a long-term population data set (back to 1985) for 27 kittiwake colonies in PWS that includes 2 surveys one in early spring for population counts and one in August to count chicks/nest More intenisve studies are carried out at Shoup Bay (also in PWS) that include diet

Kodiak Island An annual survey is made to estimate population sizes and productivity for black-legged Kittiwakes in one visit per year at 15-20 colonies At Porpoise Rocks counts of red-faced and pelagic comorants and common murres are also made

Cook Inlet/Kenai Coast USFWS AMR (Alaska Maritime Refuge) has a plan for doing annual surveys at East Amatuli Island (Barren Islands, Outer Cook Inlet) and surveys every 3-5 years at the Chiswell Islands (off Kenai Coast) and Chisik Island (in middle Cook Inlet) Annual surveys include timing of nesting, fledging time, production (chicks per nest) and prey identification Surveys on a 3-5 year periodicity include productivity (chicks per nest, timing of fledging (estimated) See Seabird monitoring plan for the Alaska Maritime Refuge File document, USFWS, AMR, Homer Alaska There are also historical counts (back to 1984) of 4 species of seabirds at Gull Island in Kachemak Bay

Proposed Partnership in future

PWS

Agencies to do Annual counts and productivity for surface feeder (Black-legged kittiwakes) at 27 colonies

GEM periodic estimates of diet composition and quality, ultimate carbon sources and predation estimates(if possible) periodic estimates of survival at selected colonies Collects samples for bioaccumulating contaminants

Kodiak Island

Agency to do annual counts and productivity for black-legged kittiwakes at 15-20 colonies on Kodiak Island

GEM as for PWS

Cook Inlet / Chiswells

Agency to do Annual population and productivity surveys kittiwakes and murres at East Amatuli Island, Population and productivity surveys at Gull Island Chisik Island and Chiswell Islands every 3-5 years

GEM as for PWS

Community Activity ?

Other kittiwake/murre projects ?

Sandlance/herring/salmon theme

Narrative of sandlance/herring/salmon project 1

Title Understanding changes in forage fish populations in the Northern GOA

Objectives Population

1 To quantify reproductive success in herring

2 To develop indices of age 0+, 1+ and 2+ herring abundance from aerial surveys in all regions

disease?

3 To track populations of non-commercial forage fish (e g , capelin, sandlance) by use of small mesh surveys, aerial surveys, halibut stomach analyses

Food

4 Regionally, to identify major prey populations (plankton), and major spawning areas for stocks of Pacific herring

5 To track changes in oceanographic and atmospheric conditions that control food supply

Habitat

6 To use the PWS circulation model to simulate larval dispersion in PWS

7 To identify major foraging areas and ultimate sources of carbon

Removals

8 To estimate larval survival and juvenile overwintering survival for Pacific herring

9 To track commercial harvest for Pacific herring

Geographic areas

PWS, Cook Inlet, Kodiak Island

Agency activity

Current

PWS ADF&G does aerial surveys of miles of spawn, conducts a test fishery and samples the commercial catch for age and weight-at- age for Pacific herring Stock size estimated from ASA model

Kodiak Island ADF&G samples the commercial catch for age and weight-at-age Limited aerial surveys are carried out for important stocks(Uganik Bay)

Cook Inlet/Kenai Coast ADF&G samples conducts a test fishery for roe content/quality and samples the commercial catch for age and weight-at-age Aerial surveys are carried out for important stocks Effort is concentrated in Kamishak Bay, and a lesser effort on remnant stock in Katchemak Bay Stock size estimated from ASA model

Proposed Partnership in future

<u>PWS</u>

Agencies to do ADF&G Aerial survey for miles of spawn Age and weight-at-age Stock size estimates All on annual basis Partial support for small mesh surveys in PWS (new) Provides samples for contaminant and lipid analyses

PWSAC Continues plankton watch

Verifies model predictions at end of spring

GEM For Pacific herring 1 Run plankton model to forecast spring-summer bloom, 2 Run circulation model to forecast larval dispersion, 3 Carries out aerial survey for juvenile herring age class estimates, 4 Estimates overwintering survival from model and field collections at end of growing season Determines ultimate carbon sources Conducts small mesh surveys and biomass estimates from hydroacoustics

of what?

Kodiak Island

Agencies to do Aerial survey for miles of spawn Age and weight-at-age Stock size estimates Samples for lipid content, end of season whole body energy contnet and contaminants

Zoop settled volume

GEM estimates lipid content, ultimate carbon sources, supports expanded plankton watch, estimates ovewintering survival from model and end-of-season whole body energy content

Cook Inlet / Chiswells

Agencies to do Aerial survey for miles of spawn Age and weight-at-age Stock size estimates Samples for lipid content, end of season whole-body-energy content and contaminants

Zoop settled volume

GEM estimates lipid content, ultimate carbon sources, supports expanded plankton watch, estimates ovewintering survival from model and end-of-season whole body energy content

Community Activity ?

Narrative of sandlance/herring/salmon project 2

Title Changes in annual plankton production in the Northern GOA

Objectives Population

1 Regionally, to measure primary productivity in nearshore, shelf and GOA waters

2 To predict phytoplanton and zooplankton blooms in PWS, CI and Kodiak Island area with 2-d models using oceanographic and meterological data

3 To measure settled volume of plankton from weekly tows during the growing season in representative coastal areas

4 To collect synoptic data on chlorophyll a from SeaWifs satellite and to track subsurface cholorphyll a concentrations in shelf break environments

Food and habitat

5 To measure atmospheric and

6 To do zooplankton sampling at representative regional stations in all areas

Geographic areas

PWS, Cook Inlet, Kodiak Island

Agency activity

Current

PWS PWSAC does plankton watch from 5 hatchery locations Wind data for plankton model are available from NOAA buoys in PWS tanker channel (Potato Point, Bligh Reef, Mid-sound, Seal Rocks) FAA stations at Whittier and Valdez also supply wind data of lesser relevance to central PWS

Kodiak Island FOCI program (NOAA) in Shelikof Strait collects some data on plankton and atmospheric and oceanographic conditions

Cook Inlet/Kenai Coast No ongoing activities have been identified

Shelf and shelf break Atmospheric data from NOAA weather buoys, other data from GLOBEC studies on Seward line (NSF/NOAA) Plankton data from CPR in north Pacific (NPRB in 2000-2001)

Proposed Partnership in future

PWS

Agencies to do NOAA continues to make available weather data from central PWS, Cook Inlet and other locations

PWSAC Continues plankton watch

GEM 1 Run plankton model to forecast spring-summer bloom, 2 Run circulation model,

Kodiak Island

Possible continued oceanographic data from FOCI program in Shelikof Strait

GEM as for PWS, but no circulation model

Cook Inlet / Chiswells

Agencies to do Nothing yet identified

GEM as for PWS except for circulation model

Community Activity ?

Other sandlance/herring/salmon projects ?

Other themes...?

APPENDIX A LETTER OF INVITATION

Dear Fnends

As many of you are aware, the *Exxon Valdez* Oıl Spıll Trustee Councıl ıs ın the process of developıng a long-term research and monıtorıng program for the northern Gulf of Alaska The Councıl's goal ıs to fund thıs program forever, usıng the earnıngs from ınvestment of the remaınıng EVOS settlement funds The first phase of developıng thıs program was a draft document descrıbıng the vısıon, goals, and framework for such a program That document ıs now under revıew by the Natıonal Research Councıl and ıs avaılable from us ın hard copy or on the web at
http //www oılspıll state ak us/future/gem htm

Whıle the NRC revıew of the overall program ıs underway, we are developıng a first draft of an actual monıtorıng plan for the ınıtıal years of the program Our goal ıs to brıng together resource managers, scıentısts, and local stakeholders and experts ın three regıonal focus groups Focus groups are ıntended to have a mıxture of local geographıc knowledge and other relevant knowledge such as commercıal fishıng, wıldlıfe management and oceanography Attendance ıs open to all ınterested persons

Startıng from a "straw draft monıtorıng plan," the focus groups wıll be asked to address the nuts and bolts of how thıs monıtorıng plan ıs to be buılt, as well as to ıdentıfy specıfic monıtorıng projects and products The results of the focus group meetıngs wıll be used to move from the "straw draft" plan ınto a draft monıtorıng plan by mıd-September That draft wıll be the startıng poınt of an ıntensıve two-day work sessıon October 10-11 ın Anchorage

We need your help ın thıs effort Dates for the focus groups have been dıfficult to pın down due to everyone's busy summer schedules, but these are the dates we have just now been able to confirm **Wednesday, July 19 for Prınce Wıllıam Sound, Wednesday, July 26 for Cook Inlet, and Tuesday, August 1 for Kodıak** All three meetıngs wıll be held ın Anchorage

You have been ıdentıfied to attend the Prınce Wıllıam Sound focus group Please confirm wıth Brenda Hall at the EVOS Restoratıon Office (brenda hall@oılspıll state ak us or 907-278-8012) as soon as possıble ıf you wıll be able to attend Part of our work wıll be assısted by computer projected ArcVıew maps, so ıt would be desırable for you to attend ın person, rather than by teleconference ıf at all possıble If you thınk you could contrıbute more at a dıfferent group or one of the other dates works better for you, please let Brenda know that also If there are others you thınk mıght be good contrıbutors, pass thıs message on and ask them to contact us Please come prepared to focus your attentıon on developıng a monıtorıng plan for the north Gulf of Alaska, and especıally Prınce Wıllıam Sound Folks wıth a "bıg pıcture" poınt of vıew are encouraged to work wıth those wıth regıonal ınterests

Additional materials will be sent to you prior to the meeting Some funds are available for travel, especially for non-agency folks Contact Brenda for additional information

Thank you for your assistance in this effort

Sincerely,

Molly McCammon

APPENDIX B CHECKLISTS FOR REVIEW OF OVERALL MONITORING PLAN (DRAFT)

Once the overall draft monitoring plan has been assembled for the first time, the following check lists would be used to review the collection of proposed projects as a whole in order to look for gaps with respect to a number of important features

Kinds of observations

1 Abundance
    a adults
    b juveniles
2 Size, age, weight
3 Energetics,
    a caloric content
    b lipid content
4 Stable isotopes
   Trophic structure
   Food origin
5 Contaminants
6 Biomarkers

Species or Guilds

1 Crustaceans, epifauanal
2 Marine demersal Gadids (cod, pollock)
3 Anadromous fishes salmon
4 Harbor seals and sea otters
5 Kittiwakes, Larids - surface feeders
6 Murres - Alcids - diving birds
7 Intertidal *Fucus* and mussels (fixed animals and plants)
8 Intertidal Mobile chitons Limpets, sea urchins, sea stars
9 Subtidal, shellfish, polychaetes, infauna, crustaceans
10 Forage fish Herring, salmon, sandlance, capelin

Geographical Provinces- Riparian, freshwater

1 Riparian
2 Intertidal
3 Littoral zone subtidal, nearshore
4 Neretic
5 Shelf benthos
6 Shelf pelagic
7 Slope pelagic
8 Slope benthos
9 Abyssal pelagic (oceanic / pelagic)
10 Abyssal bethic

FOCUS GROUP WORKBOOK

for the

COMMENTS ON BACK

DRAFT
Gulf Ecosystem Monitoring Plan
July 19, 2000

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gem@oilspill.state.ak.us

TABLE OF CONTENTS

GULF ECOSYSTEM MONITORING PLAN
FOCUS GROUP AGENDA
Prince William Sound
Wednesday, July 19, 2000
10 a m – 5 30 p m
Exxon Valdez Restoration Office
645 G Street Suite 400, Anchorage, AK 99501-3451
907-800-478-7745 or 907-278-8012

Design a regionally implemented, globally coordinated and integrated monitoring program

10 00 Introductions of participants - Mundy

10 05 Opening remarks - McCammon

10 20 Relationship between GEM program and the draft monitoring plan - Spies

10 50 Orientation to the focus group process - Mundy

11 20 Coffee break

11 30 Criteria for project selection and definitions of terms – Mundy
- **11 40 Human needs and impacts, products, agency mandates – Focus Group**
- **12 05 Ecological importance – ecological indicators – Focus Group**

12 30 Lunch break (on your own)

- **1 30 GEM program mission, goals and themes – Focus Group**
- **1 55 Gap analysis - metadatabase – Focus Group**
- **2 20 Relation to other programs, leveraging – Focus Group**

2 40 Major themes of the draft monitoring plan - Mundy
- **2 50 Harbor seal theme – Focus Group**

3 20 Coffee break

- **3 30 Kittiwake/murre theme– Focus Group**
- **4 10 Sandlance/herring/salmon theme – Focus Group**

4 50 Concluding remarks – McCammon

5 00 Post Mortem – Focus Group

5 30 Adjourn

GEM PROGRAM MISSION

The mission of the GEM program is to "***sustain a healthy and biologically diverse marine ecosystem in the northern Gulf of Alaska (GOA) and the human use of the marine resources in that ecosystem through greater understanding of how its productivity is influenced by natural changes and human activities*** " In pursuit of this mission, the GEM program will sustain the necessary institutional infrastructure to provide scientific leadership in identifying research and monitoring gaps and priorities, sponsor monitoring, research, and other projects that respond to these identified needs, encourage efficiency in and integration of GOA monitoring and research activities through leveraging of funds and interagency coordination and partnerships, and involve stakeholders in local stewardship by guiding and carrying out parts of the program

GEM PROGRAM GOALS

GEM has five major programmatic goals in order to accomplish its mission

> DETECT Serve as a sentinel (early warning) system by detecting annual and long-term changes in the marine ecosystem, from coastal watersheds to the central gulf,
>
> UNDERSTAND Identify causes of change in the marine ecosystem, including natural variation, human influences, and their interaction,
>
> PREDICT Develop the capacity to predict the status and trends of natural resources for use by resource managers and consumers,
>
> INFORM Provide integrated and synthesized information to the public, resource managers, industry and policy makers in order for them to respond to changing conditions, and
>
> SOLVE Develop tools, technologies, and information that can help resource managers and regulators improve management of marine resources and address problems that may arise from human activities

Given the size and complexity of the ecosystem under consideration and the available funding, it will not be possible for GEM, by itself, to meet these goals Addressing them will require focusing on the institutional goals to

> IDENTIFY research and monitoring gaps currently not addressed by existing programs,
>
> LEVERAGE funds from other programs,
>
> PRIORITIZE research and monitoring needs,
>
> SYNTHESIZE research and monitoring to advise in setting priorities,
>
> TRACK work relevant to understanding biological production in the GOA, and
>
> INVOLVE other government agencies, non-governmental organizations, stakeholders, policy makers, and the general public in achieving the mission and goals of GEM

GUIDING PRINCIPLES FOR MARINE MONITORING

Understand changes in marine ecosystems

There is a general consensus among designers and operators of marine research and monitoring programs in Alaska, the United States, and world-wide that marine resource management agencies and marine resource dependent communities and industries need reliable sources of information and tools that enable them to cope with changes in living and physical marine resources The consensus holds that using the marine environment safely and responsibly requires abilities to recognize, understand and anticipate changes in the marine environment There is also general agreement that coping with change requires the ability to distinguish between natural and human induced changes in all aspects of marine ecosystems

Synthesize information from all sources

Understanding changes in marine ecosystems requires understanding the relations among many types of information, such as weather and fish production Changes in marine resources are caused by a combination of biological, geophysical and human forces Natural variability in the physical environment causes shifts in relations among species, which changes the overall productivity of the region's marine ecosystems Human impacts can lead to environmental degradation, including increased levels of contaminants, loss of habitats, and increased mortality on certain species in the ecosystem that may trigger changes in species composition and abundance

Coordinate planning for research and monitoring

Understanding changes in marine ecosystems requires marine resource management agencies and marine resource dependent communities and industries to work in concert to identify critically important information and analyses Coordination is essential to enhance and maintain broad discussion among the marine scientific community on the most direct and effective ways to understand and address issues related to maintaining the health of the region's marine ecosystems

Integrate information gathering and utilization

Understanding changes in marine ecosystems improves when concerned parties cooperate to develop the tools for information gathering and sharing Research and monitoring activities should be conducted by means that stimulate the development of data gathering and sharing systems that will serve scientists in the region and beyond from government, academia, and the private sector in maintaining the health of the region's marine ecosystems

INTRODUCTION

The role of the focus group in GEM

The focus group process is the start of the second stage of a four-stage process of planning and implementing the Trustee Council's participation in monitoring the marine ecosystems of the northern Gulf of Alaska

A four-stage process of planning and implementing regional monitoring

1 Establishment of policies dedication of funding and scientific scooping - **GEM Program**
2 What to monitor and approximately where and when to measure it – **GEM Monitoring Planning**
3 Statistical precision and power, costs, technical feasibility - **GEM Fine tuning FY01-03**
4 TC adopts and implements first GEM Annual Work Plan – **GEM Implementation**

Initial implementation of the GEM Monitoring Plan is envisioned to start a cycle that periodically revisits the essentials of stages 2 – 4 for as long as the GEM program exists The issues of what to monitor, where and when to measure it, what statistical power and precision are necessary, affordability and technological strategies and capabilities will be reviewed, and possibly modified, at regular intervals over the life of the program

How the focus group works

Focus group participants respond orally and in writing to materials presented at the meeting The advice will be gathered in writing from the workbooks submitted by focus group members, and orally on the basis of a transcript of the meeting Information from the focus group workbooks and meeting transcripts will be used by the team writing the version of the Draft GEM Monitoring Plan that serves as the starting point for the October Workshop

After initial background presentations on the context for the GEM Monitoring Plan and the focus group process, two types of propositions will be given to the group for response The first set contains criteria for project selection, and the second set contains examples of monitoring projects organized around themes (see Agenda above)

The topics in the two propositions have been selected for discussion so that most of the advice tendered should be directed toward how to select what to measure, what to measure, and where and when to measure it Time has not been provided for participants to make formal presentations on their own candidate projects, although participants have the opportunity to make recommendations for other projects in response to the GEM theme projects

What the focus group is to produce

The focus group process is intended to produce a broad range of written and oral advice about the two propositions criteria and approach to selecting monitoring projects, and three suites of example monitoring projects prepared for the purposes of the focus group The advice from the focus groups will be used in producing the Draft Monitoring Plan for the October Workshop

Criteria and approach to selecting monitoring projects

The approach being suggested to produce the GEM monitoring plan is to coordinate and integrate monitoring and research projects around ecologically and culturally prominent animal species, the harbor seal, kittiwakes and murres (surface feeding and diving seabirds), and sandlance, herring and salmon (forage fishes) The projects are further organized around regions, -- PWS, CI, Kodiak-Peninsula, and northern GOA -- although overlaps are certain to occur, particularly for migratory species and geophysical processes The animal species are conceptual focal points around which to organize studies of factors controlling changes in the marine ecosystems In this sense, each of the species is seen as an ecological "crossroads" where geophysical and biological agents of change come together The agents of change have been identified in the GEM conceptual foundation as food, habitat, removals by harvest and predators, and related geophysical forcing factors, such as the Pacific Decadal Oscillation

In designating one species, such as the harbor seal, to identify a GEM project, other plant and animal species are not excluded, nor are geophysical processes or parameters such as contaminants overlooked The procedure being tested uses the GEM species as a device around which to coordinate, integrate and synthesize information about the factors contributing to changes in valued marine and andromous species and the ecosystems on which they depend

The selection of an identifying species also does not mean that the GEM program will fund data acquisition for all factors necessary to understand changes in that species through time The goal is to design a project that is as complete as possible without concern for normal agency management function, or costs, or even technical feasibility Technical feasibility and costs are dealt with in project program fine tuning and implementation The GEM project identifies as completely as possible what is necessary to understand change in the GEM species, and in the process addresses the many other species and geophysical and chemical processes that contribute to changes in the GEM species through time

CRITERIA AND DEFINITIONS

Introduction· Selecting and evaluating the GEM Project

In order to select a project for the GEM Monitoring Plan it is necessary to have a set of criteria to apply The explanation for each GEM Monitoring Project should contain a complete map of the information needed to understand the roles of the species in the ecosystems it occupies, and to understand the mechanisms of change in the GEM species and allied species In many cases the information necessary will not be available, and those data gaps need to be specified In order to ensure that the map is complete, the project is compared to a series of lists of important features in the ecosystem and the individual species, and criteria appropriate to a "crossroads" GEM species project (See Ecological importance – ecological indicators under Criteria and Definitions, below)

Human needs and impacts, products, agency mandates

Human needs and impacts, products, agency mandates

Agency Mandates

- Legal
    - Marine Mammal Protection Act
    - Endangered Species Act
    - Forest Practices Act
    - Clean Water Act
    - M-S Fishery Management and Conservation Act
    - Court orders
    - Enabling legislation of Trustee Council member agencies
    - Alaska State Constitution and Title 16
    - Alaska Board of Fisheries and Game regulations
    - Federal Subsistence Board regulations
    - State and federal harvest regulations
    - North Pacific Anadromous Fisheries Treaty
    - Pacific Salmon Treaty
    - Migratory Species Conventions
- Regulatory
    - Harvest limitations - birds, fish, shellfish, mammals, marine algae, trees
    - Total Manageable Daily Loads TMDL's (non-point source pollutants)
    - Permit applications
- Marine Habitat Protection
- Fishery and Ecosystem-based Management
- Contaminants, Water Quality and Food Safety
- Stewardship and Status of resources
    - Population trends
    - Population abundance
    - Life cycle and basic biology

Human Needs
- Economic
  - Subsistence resources
  - Commercial resources
  - Tourist resources
  - Recreational resources
  - Scientific resources (genes, medical models)
  - Commerce (navigation, weather)
- Health
  - Public safety (navigation, weather)
  - Clean food
  - Clean water
- Culture
  - Subsistence resources
  - Religious practice

Human Impacts
- Oil and Gas Development
- Commercial Fishing
- Salmon Hatchery Issues
- Recreation and Tourism SPORT FISHING ?
- Subsistence harvests MINING
- Logging
- Small-scale Spills of Toxic Substances INVASIVE SPP.
- Roadbuilding and Urbanization
- Global Climate Change

Products
- Measures contributing to meeting human and agency needs, managing impacts
  - Human Impacts
  - Marine Habitat Protection
  - Fishery and Ecosystem-based Management
  - Contaminants, Water Quality and Food Safety
  - Stewardship and Status of resources
  - Legal
  - Regulatory
  - Economic
  - Health
  - Culture
- Information relevant to human activities
  - Scientific resources
  - Navigation
  - Weather
  - Water Quality
  - Contaminants
  - Food Safety

Ecological importance – ecological indicators

Conceptual basis
- Linkage to underlying ecological process (local, regional, global)
  - Food
    - Productivity (rate of production of food)
      - Primary productivity
        - Nutrients
        - Mixing
        - Species composition
      - Secondary
      - Tertiary
    - Carbon transport and fate
    - Nitrogen transport and fate
  - Habitat
    - Limiting Factors
      - Temperature
      - Salinity
      - Current velocity
      - Water quality
        - Pollutants, contaminants
  - Removals
    - Fisheries
    - Habitat degradation
    - Pollutants, contaminants
    - Predation
- Linkage to geophysical processes (local, regional, global)
  - Oceanographic
    - Upwelling
    - Downwelling
    - Mixed layer depth
    - Frontal structure
    - Current dynamics
    - Organic transport
  - Atmospheric
    - Sea surface pressure (PDO and allied phenomena)
    - Wind stress
    - Precipitation
    - Runoff

Relationships to other species defined
Life cycle understood in relation to geographic range

Usefulness of indicator
- How would it be used (regulations, permitting, model input, public safety)
- Where would it be used (agencies, public, private)
- How often would it be used?

Understandable (Meaning and uses of values known)

Quantifiable
- Range of values known
- Temporal and spatial scales of change (spatial statistics)
- Natural variability separable from anthropogenics (signal to noise ratio)
- Statistical properties
  - Accuracy and Precision
  - Power
  - Robustness (statistical)
  - Error (Type I v Type II)

Broadly applicable
- Ecological processes
- Biogeochemical processes
- Geographic extent
- Number of relevant species
- Number of products (management applications)

Compatibility
- Interagency
- Interdisciplinary
- Interstate
- International

Reliability
- Established performance (existing time series)
- Sound theoretical basis
- Comparable to established indicators
- Data collection
  - Technology
  - Logistics
- Robustness
  - Perturbations (urbanization, earthquake,)
  - Technological obsolescence

GEM program mission, goals and themes

- Geographic location
  - Northern GOA including watershed – marine linkages
  - Geophysical linkage
  - Migratory habitat ex-GOA
- Understand changes in marine ecosystems
  - Detect long-term changes
    - Ecosystem health
    - Biological diversity
  - Understand causes of change
    - Human
    - Natural
  - Predict
- Synthesize information from all sources
  - Track relevant work
  - Solve management problems
  - Enable sustainable use
- Coordinate planning for research and monitoring
  - Identify gaps in knowledge
  - Prioritize data gathering efforts
  - Community stewardship
- Integrate information gathering and utilization + dissemination
  - Leverage funding
  - Inform users
  - Community involvement ← public outreach
- Established link to GEM Theme
  - Harbor seal
  - Kittiwake-murre
  - Sandlance-herring-salmon
- Addresses conceptual foundation
  - Population change = function of (food, habitat, removals)

Relation to other programs, leveraging

- US Dept of Agriculture, Forest Service
- US Department of Commerce, National Oceanic and Atmospheric Administration
- US Department of Defense, Office of Naval Research, Stennis Space Center
    - US Coast Guard
- US Department of the Interior
- US Environmental Protection Agency
- National Science Foundation
- State of Alaska
    - ADEC
    - ADF&G
    - ADNR
    - ADCED (Community and Economic Development)
    - ADHSS (Health and Social Services)
    - UAF/UAA
        - IMS/SFOS
        - IARC (Arctic Research Center)
- Nongovernmental Organizations - Hybrids
    - PWSSC
    - OSRI
    - PWSRCAC
- Transboundary Organizations
- Global Climate Change Research

Note Refer to GEM program document, section IV B (page 41)

Gap analysis – metadatabase

Basic Ground Programs

Erratics

Satellite Programs

(Please refer to metadatabase guide provided in hard copy at the meeting)

Note Please submit information on missing or erroneous information to brenda_hall@oilspill state ak us The synopsis of information needed to initiate contact is as follows

Project Project title goes here

Description Basic description of what, where, how, when and where

Organization Who conducts it and who pays for it?

Program Is it part of a larger coordinated effort?

Name Contact person
Address
Ph Voice and fax
E-mail

Geographic location Decimally coded latitudes and longitudes

Major themes of the monitoring plan

Example themes and projects have been chosen to test the ability of this approach to coordinate, integrate and foster the synthesis of marine related research in the northern GOA Example projects have been selected to illustrate the conceptual foundation that population change is a consequence of changes in food, habitat or removals by harvest or predators, and related factors Both themes and projects are a "first cut" based on comments received during development of the GEM program document and other considerations

Harbor seal theme

Narrative of harbor seal project 1

Title Understanding changes in harbor seal populations in the Northern GOA

Objectives Population

1 To track population change seals in a series of regional index sites through counts of molting harbor seals

Food and production

2 Regionally, to identify major prey items, ultimate carbon sources, and time spent foraging

3 Regionally, to quantify reproductive success, including juvenile survival trends

Habitat

4 Identify major foraging areas

Removals

5 To develop indices of subsistence harvest and predation

6 Develop survival model

7. To periodically determine tissue concentrations of bioaccumulated contaminants and to measure possible response biomarkers.

Geographic areas:

PWS, Cook Inlet, Kodiak Island

Agency activity:

Current::
ADF&G doing molt counts in PWS in FY2000; NMFS has done counts on Tugidak Island (near Kodiak Island) back into the 1980s.

Proposed Partnership in future:
Agencies to do molt counts in all three areas; logistical support for collections. GEM to do diet foraging and carbon source work, harvest and predation efforts and collect tissue samples for contaminants.

Community Activity:

Other harbor seal projects?

The criteria have been applied to the example harbor seal project described in the narrative following the check list examples.

Project check list example: Human needs and impacts, products, agency mandates

Project Title: Prince William Sound Harbor seal enumeration
Human needs and impacts, products, agency mandates

Remark	P = Present, A = Absent
	Agency Mandates
P	Legal
P	Regulatory
P	Marine Habitat Protection
P	Fishery and Ecosystem-based Management
P	Contaminants, Water Quality and Food Safety
P	Stewardship and Status of resources

Human Needs
P Economic
P Health
P Culture

P Human Impacts

P Products

Project check list example Linkage to underlying ecological process
Harbor Seal Theme
Project Title Prince William Sound Harbor seal enumeration

Ecological importance - ecological indicators

Conceptual basis

Linkage to underlying ecological process (local, regional, global)
P Food
P Habitat
P Removals
A Linkage to geophysical processes (local, regional, global)
P Relationships to other species defined
P Life cycle understood in relation to geographic range
Usefulness of indicator
A How would it be used (regulations, permitting, model input, public safety)

A Where would it be used (agencies, public, private)
A How often would it be used
Understandable
A Meaning and uses of values known
Quantifiable
A Range of values known
A Temporal and spatial scales of change (spatial statistics)
A Natural variability separable from anthropogenics (signal to noise ratio)

A Statistical properties
Broadly applicable
P Ecological processes
P Biogeochemical processes
ALL Geographic extent
HIGH Number of relevant species
? Number of products (management applications)
Compatibility
P Interagency
A Interdisciplinary

? Interstate
? International
Reliability
P Established performance (existing time series)
P Sound theoretical basis
P Comparable to established indicators
P Data collection
P Robustness

Project check list example GEM program mission, goals and themes

Harbor Seal Theme
Project Title Prince William Sound Harbor seal enumeration

Geographic location
YES Northern GOA
Geophysical linkage
Migratory habitat ex-GOA
Understand changes in marine ecosystems
P Detect long-term changes
P Understand causes of change
? Predict
Synthesize information from all sources
P Track relevant work
? Solve management problems
? Enable sustainable use
Coordinate planning for research and monitoring
? Identify gaps in knowledge
? Prioritize data gathering efforts
A Community stewardship
Integrate information gathering and utilization
P Leverage funding
? Inform users
A Community involvement
Established link to GEM Theme
P Harbor seal
Kittiwake-murre
Sandlance-herring-salmon
Addresses conceptual foundation
P Population change = function of (food, habitat, removals)

Project check list example Relation to other programs, leveraging

Harbor Seal Theme

Project Title Prince William Sound Harbor seal enumeration

A US Dept of Agriculture, Forest Service
A US Department of Commerce, National Oceanic and Atmospheric Administration
A US Department of Defense, Office of Naval Research, Stennis Space Center
A US Coast Guard
A US Department of the Interior
A US Environmental Protection Agency
A National Science Foundation
State of Alaska
P ADEC
P ADF&G
ADNR
ADCED (Community and Economic Development)
P ADHSS (Health and Social Services)
? UAF/UAA
IMS/SFOS
IARC (Arctic Research Center)
Nongovernmental Organizations
A PWSSC
A OSRI
A PWSRCAC

A Transboundary Organizations
? Global Climate Change Research

Project check list example Gap Analysis

Harbor Seal Theme

Project Title Prince William Sound Harbor seal enumeration

P Provides Missing Basic Ground Project
P Provides Missing Erratic

Kittiwake/murre theme

Narrative of kittiwake/murre project 1

Title Changes in colonial seabirds in the Northern GOA

Objectives Population

1 Measure changes in populations (production) of colonial sea birds in the northern GOAA

2 Regionally, to quantify reproductive success, including fledging success in a surface-feeding and in a diving seabird

Food

3 Regionally, to identify major prey items, food quality, and time spent foraging for a surface-feeding and for a diving seabird

Habitat

4 To identify major foraging areas and ultimate carbon sources

Removals

5 To develop indices of predation

7 To periodically develop estimates of seabird survival at major colonies

8 To periodically determine tissue concentrations of bioaccumulated contaminants and to measure possible response biomarkers

Geographic areas

PWS, Cook Inlet, Kodiak Island

Agency activity

Current

PWS USFWS, Migratory Bird Program, has a long-term population data set (back to 1985) for 27 kittiwake colonies in PWS that includes 2 surveys one in early spring for population counts and one in August to count chicks/nest More intenisve studies are carried out at Shoup Bay (also in PWS) that include diet

Kodiak Island An annual survey is made to estimate population sizes and productivity for black-legged Kittiwakes in one visit per year at 15-20 colonies At Porpoise Rocks counts of red-faced and pelagic comorants and common murres are also made

Cook Inlet/Kenai Coast USFWS AMR (Alaska Maritime Refuge) has a plan for doing annual surveys at East Amatuli Island (Barren Islands, Outer Cook Inlet) and surveys every 3-5 years at the Chiswell Islands (off Kenai Coast) and Chisik Island (in middle Cook Inlet) Annual surveys include timing of nesting, fledging time, production (chicks per nest) and prey identification Surveys on a 3-5 year periodicity include productivity (chicks per nest, timing of fledging (estimated) See Seabird monitoring plan for the Alaska Maritime Refuge File document, USFWS, AMR, Homer Alaska There are also historical counts (back to 1984) of 4 species of seabirds at Gull Island in Kachemak Bay

Proposed Partnership in future

PWS

Agencies to do Annual counts and productivity for surface feeder (Black-legged kittiwakes) at 27 colonies

GEM periodic estimates of diet composition and quality, ultimate carbon sources and predation estimates(if possible) periodic estimates of survival at selected colonies Collects samples for bioaccumulating contaminants

Kodiak Island

Agency to do annual counts and productivity for black-legged kittiwakes at 15-20 colonies on Kodiak Island

GEM as for PWS

Cook Inlet / Chiswells

Agency to do Annual population and productivity surveys kittiwakes and murres at East Amatuli Island, Population and productivity surveys at Gull Island Chisik Island and Chiswell Islands every 3-5 years

GEM as for PWS

Community Activity ?

Other kittiwake/murre projects ?

Sandlance/herring/salmon theme

Narrative of sandlance/herring/salmon project 1

Title Understanding changes in forage fish populations in the Northern GOA

Objectives Population

1 To quantify reproductive success in herring

2 To develop indices of age 0+, 1+ and 2+ herring abundance from aerial surveys in all regions

3 To track populations of non-commercial forage fish (e g , capelin, sandlance) by use of small mesh surveys, aerial surveys, halibut stomach analyses

Food

4 Regionally, to identify major prey populations (plankton), and major spawning areas for stocks of Pacific herring

5 To track changes in oceanographic and atmospheric conditions that control food supply

Habitat

6 To use the PWS circulation model to simulate larval dispersion in PWS

7 To identify major foraging areas and ultimate sources of carbon

Removals

8 To estimate larval survival and juvenile overwintering survival for Pacific herring

9 To track commercial harvest for Pacific herring

Geographic areas

PWS, Cook Inlet, Kodiak Island

Agency activity

Current

PWS ADF&G does aerial surveys of miles of spawn, conducts a test fishery and samples the commercial catch for age and weight-at- age for Pacific herring Stock size estimated from ASA model

Kodiak Island ADF&G samples the commercial catch for age and weight-at-age Limited aerial surveys are carried out for important stocks(Uganik Bay)

Cook Inlet/Kenai Coast ADF&G samples conducts a test fishery for roe content/quality and samples the commercial catch for age and weight-at-age Aerial surveys are carried out for important stocks Effort is concentrated in Kamishak Bay, and a lesser effort on remnant stock in Katchemak Bay Stock size estimated from ASA model

Proposed Partnership in future

<u>PWS</u>

Agencies to do ADF&G Aerial survey for miles of spawn Age and weight-at-age Stock size estimates All on annual basis Partial support for small mesh surveys in PWS (new) Provides samples for contaminant and lipid analyses

PWSAC Continues plankton watch

GEM For Pacific herring 1 Run plankton model to forecast spring-summer bloom, 2 Run circulation model to forecast larval dispersion, 3 Carries out aerial survey for juvenile herring age slass estimates, 4 Estimates overwintering suvival from model and field collections at end of growing season Determines ultimate carbon sources Conducts small mesh surveys and biomass estimates from hydroacoustics

Kodiak Island

Agencies to do Aerial survey for miles of spawn Age and weight-at-age Stock size estimates Samples for lipid content, end of season whole body energy contnet and contaminants

GEM estimates lipid content, ultimate carbon sources, supports expanded plankton watch, estimates ovewintering survival from model and end-of-season whole body energy content

Cook Inlet /Chiswells

Agencies to do Aerial survey for miles of spawn Age and weight-at-age Stock size estimates Samples for lipid content, end of season whole-body-energy content and contaminants

GEM estimates lipid content, ultimate carbon sources, supports expanded plankton watch, estimates ovewintering survival from model and end-of-season whole body energy content

Community Activity ?

Narrative of sandlance/herring/salmon project 2

Title Changes in annual plankton production in the Northern GOA

Objectives Population

1 Regionally, to measure primary productivity in nearshore, shelf and GOA waters

2 To predict phytoplanton and zooplankton blooms in PWS, CI and Kodiak Island area with 2-d models using oceanographic and meterological data

3 To measure settled volume of plankton from weekly tows during the growing season in representative coastal areas

4 To collect synoptic data on chlorophyll a from SeaWifs satellite and to track subsurface cholorphyll a concentrations in shelf break environments

Food and habitat

5 To measure atmospheric and

6 To do zooplankton sampling at representative regional stations in all areas

Geographic areas

PWS, Cook Inlet, Kodiak Island

Agency activity

Current

PWS PWSAC does plankton watch from 5 hatchery locations Wind data for plankton model are available from NOAA buoys in PWS tanker channel (Potato Point, Bligh Reef, Mid-sound, Seal Rocks) FAA stations at Whittier and Valdez also supply wind data of lesser relevance to central PWS

Kodiak Island FOCI program (NOAA) in Shelikof Strait collects some data on plankton and atmospheric and oceanographic conditions

Cook Inlet/Kenai Coast No ongoing activities have been identified

Shelf and shelf break Atmospheric data from NOAA weather buoys, other data from GLOBEC studies on Seward line (NSF/NOAA) Plankton data from CPR in north Pacific (NPRB in 2000-2001)

Proposed Partnership in future

PWS

Agencies to do NOAA continues to make available weather data from central PWS, Cook Inlet and other locations

PWSAC Continues plankton watch

GEM 1 Run plankton model to forecast spring-summer bloom, 2 Run circulation model,

Kodiak Island

Possible continued oceanographic data from FOCI program in Shelikof Strait

GEM as for PWS, but no circulation model

Cook Inlet / Chiswells

Agencies to do Nothing yet identified

GEM as for PWS except for circulation model

Community Activity ?

Other sandlance/herring/salmon projects ?

Other themes...?

APPENDIX A LETTER OF INVITATION

Dear Fnends

As many of you are aware, the *Exxon Valdez* Oıl Spıll Trustee Councıl ıs ın the process of developıng a long-term research and monıtorıng program for the northern Gulf of Alaska The Councıl's goal ıs to fund thıs program forever, usıng the earnıngs from ınvestment of the remaınıng EVOS settlement funds The first phase of developıng thıs program was a draft document descrıbıng the vısıon, goals, and framework for such a program That document ıs now under revıew by the Natıonal Research Councıl and ıs avaılable from us ın hard copy or on the web at
http //www oılspıll state ak us/future/gem htm

Whıle the NRC revıew of the overall program ıs underway, we are developıng a first draft of an actual monıtorıng plan for the ınıtıal years of the program Our goal ıs to brıng together resource managers, scıentısts, and local stakeholders and experts ın three regıonal focus groups Focus groups are ıntended to have a mıxture of local geographıc knowledge and other relevant knowledge such as commercıal fishıng, wıldlıfe management and oceanography Attendance ıs open to all ınterested persons

Startıng from a "straw draft monıtorıng plan," the focus groups wıll be asked to address the nuts and bolts of how thıs monıtorıng plan ıs to be buılt, as well as to ıdentıfy specıfic monıtorıng projects and products The results of the focus group meetıngs wıll be used to move from the "straw draft" plan ınto a draft monıtorıng plan by mıd-September That draft wıll be the startıng poınt of an ıntensıve two-day work sessıon October 10-11 ın Anchorage

We need your help ın thıs effort Dates for the focus groups have been dıfficult to pın down due to everyone's busy summer schedules, but these are the dates we have just now been able to confirm **Wednesday, July 19 for Prınce Wıllıam Sound, Wednesday, July 26 for Cook Inlet, and Tuesday, August 1 for Kodıak** All three meetıngs wıll be held ın Anchorage

You have been ıdentıfied to attend the Prınce Wıllıam Sound focus group Please confirm wıth Brenda Hall at the EVOS Restoratıon Office (brenda_hall@oılspıll state ak us or 907-278-8012) as soon as possıble ıf you wıll be able to attend Part of our work wıll be assısted by computer projected ArcVıew maps, so ıt would be desırable for you to attend ın person, rather than by teleconference ıf at all possıble If you thınk you could contrıbute more at a dıfferent group or one of the other dates works better for you, please let Brenda know that also If there are others you thınk mıght be good contrıbutors, pass thıs message on and ask them to contact us Please come prepared to focus your attentıon on developıng a monıtorıng plan for the north Gulf of Alaska, and especıally Prınce Wıllıam Sound Folks wıth a "bıg pıcture" poınt of vıew are encouraged to work wıth those wıth regıonal ınterests

Additional materials will be sent to you prior to the meeting Some funds are available for travel, especially for non-agency folks Contact Brenda for additional information

Thank you for your assistance in this effort

Sincerely,

Molly McCammon

APPENDIX B CHECKLISTS FOR REVIEW OF OVERALL MONITORING PLAN (DRAFT)

Once the overall draft monitoring plan has been assembled for the first time, the following check lists would be used to review the collection of proposed projects as a whole in order to look for gaps with respect to a number of important features

Kinds of observations

1 Abundance
   a adults
   b juveniles
2 Size, age, weight
3 Energetics,
   a caloric content
   b lipid content
4 Stable isotopes
   Trophic structure
   Food origin
5 Contaminants
6 Biomarkers

Species or Guilds

1 Crustaceans, epifauanal
2 Marine demersal Gadids (cod, pollock)
3 Anadromous fishes salmon
4 Harbor seals and sea otters
5 Kittiwakes, Larids - surface feeders
6 Murres - Alcids - diving birds
7 Intertidal *Fucus* and mussels (fixed animals and plants)
8 Intertidal Mobile chitons Limpets, sea urchins, sea stars
9 Subtidal, shellfish, polychaetes, infauna, crustaceans
10 Forage fish Herring, salmon, sandlance, capelin

Geographical Provinces- Riparian, freshwater

1 Riparian
2 Intertidal
3 Littoral zone subtidal, nearshore
4 Neretic
5 Shelf benthos
6 Shelf pelagic
7 Slope pelagic
8 Slope benthos
9 Abyssal pelagic (oceanic / pelagic)
10 Abyssal bethic

understand the basic processes in the GoA. <u>But</u>, we should also consider some effort to monitor a few basic things, e.g. GAK-1 salinity, that will provide a great time series of data that will be invaluable in 100 years, even if they don't pay such great dividends in the shorter term. Another example might be recording fish species caught, just to detect the appearance of new species (i.e., not a count but ~~$~~ just a list of what's caught - could easily be done by fishermen to get them involved). I'm sure there are many other ideas (too many to find!), but it's worth being simple in a few cases in addition to being sophisticated in others. This is similar to my comment during the meeting about distinguishing short-, medium-, and long-term monitoring efforts - a few things we expect to do for 100 years, some things we expect to do for at least 20 years, and some we expect to do for < 5 years. The 100-year items are a few basic parameters, the 20-year items are the themes, and the <5 yr items are experimental ideas to help us refine, improve, and illuminate the overall program.

5. KEEP UP THE GOOD WORK - I'm very impressed at the amount of effort and good thinking that has gone into the planning. I know you can't be everything to everyone, so be tough and don't try or expect to please everyone!

Disciplinary Areas of Study

Biology
- Population Dynamics
- Physiology
- Trophic Dynamics
- Ecological energetics
- Biological Oceanography
- Fisheries Oceanography

Geophysical Sciences
- Physical Oceanography
- Chemical Oceanography
- Atmospheric Sciences

Trophic dynamics

1. diet composition/ spp + geographic origin
2. trophic level
3. food quality + energetics

Henry Huntington 7/19/00

(1) MAKE LINKS TO MANAGERS - don't do their work in terms of test fisheries, etc., but find out what will be useful to them in 10-20 years' time in terms of improved understanding of the ecosystem - e.g., what are their needs, and can we help direct our activities so they can be used and aren't just interesting irrelevancies? As an example, plankton blooms as an indicator of fish returns/abundance could be useful in helping set catch quotas if we can understand the links.

(2) DISTINGUISH MONITORING TOPICS FROM EVALUATION CRITERIA - Many things could be usefully monitored, and the list helps lay them out. Other things in the list are ways of evaluating how specific proposals fit into the overall plan and how they are relevant to agency mandates, various uses, etc.

(3) EMPHASIZE EDUCATION AND INVOLVEMENT - The longevity of this program gives it a unique opportunity to educate the general public as well as users, managers, etc. This won't happen by itself, but will require a lot of effort through many avenues - radio like Alaska Coastal Currents, brochures and newsletters, web site info, SeaLife Center displays, etc. Involvement is important, too, to give more users, residents, and others a sense they are part of the plan and not just bystanders. I think both will take a lot of work, but will pay big dividends over the long term.

(4) DON'T TIE EVERYTHING TIGHTLY TO THE THEMES - We don't know what will turn out to be important in 50 years' time. The themes are great ways of organizing our work to

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NINE YEARS AFTER THE *EXXON VALDEZ* OIL SPILL

DAVID B. IRONS ET AL.

NINE YEARS AFTER THE *EXXON VALDEZ* OIL SPILL: EFFECTS ON MARINE BIRD POPULATIONS IN PRINCE WILLIAM SOUND, ALASKA[1]

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Abstract. We compared post-spill densities of marine birds in Prince William Sound from 1989, 1990, 1991, 1993, 1996, and 1998 to pre-spill densities from 1984-1985. Post-spill densities of several species of marine birds were lower than expected in the oiled area of Prince William Sound when compared to densities in the unoiled area. These negative effects continued through 1998 for five taxa: cormorants, goldeneyes, mergansers, Pigeon Guillemot (*Cepphus columba*), and murres. Black Oystercatchers (*Haematopus bachmani*) and Harlequin Ducks (*Histrionicus histrionicus*) exhibited negative effects in 1990 and 1991. Loons showed a weak negative effect in 1993. Black-legged Kittiwakes (*Rissa tridactyla*) showed relative decreases in 1989, 1996, and 1998 which may have been caused by shifts in foraging distribution rather than declines in populations. Glaucous-winged Gulls (*Larus glaucescens*) showed positive effects in most post-spill years. Murrelets and terns showed relative increases in 1993, 1996, and 1998. Generally, taxa that dive for their food were negatively affected, whereas taxa that feed at the surface were not. Effects for some taxa were dependent upon the spatial scale at which they were analyzed. Movements of birds and the mosaic pattern of oiling reduced our ability to detect oil-spill effects, therefore are results may be conservative. Several marine bird species were negatively affected at the population level and have not recovered to pre-spill levels nine years after the oil spill. The reason for lack of recovery may be related to persistent oil remaining in the environment and reduced forage fish abundance.

Key words: loons, long-term, oil spill, oiling impacts, oystercatchers, seabirds, waterfowl

INTRODUCTION

Due to concern about potential environmental effects of oil development in Prince William Sound (PWS), the U S Fish and Wildlife Service assessed marine bird populations in PWS in 1972 (Dwyer et al 1976) and again in 1984-1985 (Irons et al 1988) On Good Friday, 24 March 1989, T/V *Exxon Valdez* ran onto Bligh Reef in PWS, approximately 60 km from Valdez About 4×10^6 liters of North Slope crude oil entered the waters of PWS before the remainder of the cargo could be off-loaded to another oil tanker The spill was the largest recorded in U S waters and there was much concern about its effects About 30,000 oiled bird carcasses were found in the spill area by 25 September 1989, the most birds ever picked up after an oil spill (Piatt and Lensink 1989, Piatt et al 1990) Large numbers of carcasses of diving birds, such as loons, grebes, cormorants, sea ducks, murres, murrelets, and Pigeon Guillemots (*Cepphus columba*), and surface feeding birds such as Procellarids and gulls were found (Piatt et al 1990) There were several estimates of the total marine bird mortality (Piatt et al 1990, Ecological Consulting, Inc 1991), but Piatt and Ford's (1996) best estimate was that about 250,000 birds died, 74% of which were murres

The magnitude of lethal oil-spill effects on marine birds can be determined using three general approaches (1) measure the differences in pre- and post-spill populations, (2) estimate from carcass loss and recovery rates at the time of the spill, and (3) extrapolate from carcass loss/recovery experiments from other spills (Piatt and Ford 1996) The first approach can be used to look at immediate and long-term effects, but requires pre-spill data The latter two approaches are best to determine immediate effects and do not require pre-spill data Statistical methods for determining the effects of an environmental perturbation using pre-perturbation data have been developed and refined in the past two decades Green (1979) and Skalski and McKenzie (1982) developed the BACI (Before, After, Control, Impact) design to evaluate the effects of planned development, which has since been modified (Stewart-Oaten et al 1986, Stewart-Oaten et al 1992, Wiens and Parker 1995) Because there were data on bird populations in PWS before the spill (1984-1985), the effects on the populations could be investigated using a BACI type design The BACI study design was fulfilled by comparing marine bird densities before the spill to marine bird densities after the spill Unoiled areas of PWS served as a control and oiled areas served as the impacted zone

To evaluate potential effects of the *Exxon Valdez* oil spill on summer residents in PWS, the U S Fish and Wildlife Service conducted bird surveys in 1989, 1990, 1991, 1993, 1996, and 1998 The objective of this study was to determine whether the oil spill affected the summertime densities of marine birds in the path of the oil spill in PWS and to assess the duration of the impacts

METHODS

STUDY AREA

Prince William Sound is a protected body of water (ca 10,000 km^2) located in the northern Gulf of Alaska It is characterized by highly convoluted shorelines composed of deep fiords and large islands with tides as great as 6 m The marine bird fauna of PWS is rich and diverse (Isleib and Kessel 1973) The 1972 summertime marine-bird population estimates of PWS were 629,000 (Klosiewski and Laing 1994) The study area used in the present analyses included waters of PWS within 200 m of shore (Fig 1) We used shoreline data because those transects were surveyed by the same method before and after the oil spill

SURVEY METHODS

Durıng the summers of 1984 and 1985, Irons et al (1988) surveyed the entıre shorelıne of PWS except for the southern sıdes of Montague and Hınchınbrook Islands and a few transects that were mıssed The shorelıne was dıvıded ınto 772 transects Transects were located by geographıc features, such as poınts of land, to facılıtate orıentatıon ın the field and to separate the shorelıne by habıtat type All transects were 200 m wıde, but varıed ın length, the mean transect length was 6 km, and they ranged from 1 to 30 km

Survey methodology developed for surveys ın 1984-1985 (Irons et al 1988) was used throughout thıs study Surveys were conducted from 7 7-m boats travelıng at speeds of 10-20 km hr^{-1} Two observers on each boat counted all bırds and mammals detected ın a samplıng wındow 100 m on eıther sıde, 100 m ahead, and 100 m overhead of the vessel Observers also recorded bırds and mammals sıghted on land wıthın 100 m of the shore Observers scanned contınuously and used bınoculars to aıd ın specıes ıdentıficatıon Most transects were surveyed when wave heıght was < 0 3 m, no surveys were conducted when wave heıght was > 0 6 m

Post-spıll surveys were conducted ın July of 1989, 1990, 1991 (Klosıewskı and Laıng 1994), 1993 (Agler et al 1994), 1996 (Agler and Kendall 1997), and 1998 (Lance et al 1999) These surveys all used the same methodology as used by Irons et al (1988), however only a portıon of the PWS shorelıne was surveyed post-spıll Klosıewskı and Laıng (1994) randomly selected 25% (187) of the total 742 shorelıne transects for the post-spıll surveys ın 1989 An addıtıonal 25 shorelıne transects from western PWS were randomly selected and added ın July 1990 to ıncrease the precısıon of estımates from the oıled zone Observers ın all years were experıenced at ıdentıfyıng marıne bırd specıes and were traıned usıng the same protocol

DATA ANALYSIS

Pre- and post-spill bird densities were estimated from surveys that were conducted on the same transects before and after the spill We chose transects (n = 146) that were surveyed during a comparable period (in July and early August, when bird numbers are relatively constant, K J Kuletz, unpubl data) pre- and post-spill To determine which transects were oiled, we used data from the Shoreline Cleanup Assessment Team in 1989 (these data were agreed upon by government and Exxon-sponsored scientists to be the best assessment of oiled shorelines)

The distribution of the unoiled transects were such that 21% were within the general oiled area and 73% were within a 20-km buffer around the oiled area The rest of the transects were scattered in the western and northern portion of PWS (Fig 1)

The BACI design is dependent upon having a comparable reference area to compare to the oiled area Beaches are not oiled in a random fashion, so the investigator is faced with the problem of selecting a reference area that is similar to the oiled area It was fortunate that not all of PWS was oiled so that the unoiled portions could be used as a reference area, however, even within PWS all areas are not the same Densities of some birds are different on islands and in fiords (Irons et al 1985) However, the BACI analysis does not require that the oiled and unoiled areas are the same, just that changes, in the absence of an oil spill, would be similar

To help ensure that our reference area was similar to the oiled area, we used cluster analysis to select a group of transects with similar pre-spill bird densities that was then spilt into oiled and reference groups Euclidean distance was used as the similarity metric, and average linkage was used to join clusters (SAS Institute Inc 1988) We chose transects that clustered together at or below the Euclidean distance of 1 0, resulting in a subset of 123 transects in a single cluster In 1989, only 108 of the 123 transects were used because fewer transects were surveyed in 1989 than in later years

We also examined shoreline types of transects in both zones to help determine whether the reference and oiled areas were similar We used the designations from the Prince William Sound Environmental Sensitivity Maps (produced by Research Planning Inc , Columbia, South Carolina) to categorize the shoreline type for each transect One hundred and eighteen of the 123 transects fell into one of four categories When more than one shoreline type occurred in a transect, the most prevalent type was used Analysis indicated that the frequencies of shoreline types in the oiled and unoiled areas were not different ($\chi^2_3 = 4\ 1$, $P = 0\ 25$) The shoreline categories and the number of transects in the oiled and reference areas, respectively, were as follows exposed rocky shores (18, 9), exposed wave-cut platforms in bedrock (14, 6), gravel beaches (25, 19), and sheltered rocky shores (12, 15)

Fourteen taxa were analyzed for oil spill effects in this study We chose to analyze species or species groups that had ca 25 or more individuals spread over several transects in pre-spill surveys, similar to the criteria used by Murphy et al (1997) Some bird species that were similar in appearance and vulnerability to oil (King et al 1979) were grouped by genus for analyses (Appendix 1)

When comparing oiled areas to unoiled reference areas, the ability to detect oil spill effects on birds is affected by the magnitude of the birds' movements and the mosaic pattern of oiling that occurred in PWS Individual birds whose home ranges bisected the oiled-unoiled border reduced our ability to detect oil spill effects The influence of birds' movements varied according to the scale that the birds moved, therefore it was important to analyze the data at the proper spatial scale

To investigate the consequence of spatial scale on detecting oil spill effects, we analyzed the data at three different spatial scales coarse, medium, and fine Our coarse scale considered all shorelines within the outer boundary of the general oiled area ("oiled", Klosiewski and Laing 1994) The medium scale was created by combining one to five transects into groups of transects to create areas similar in size to the bays used by Murphy et al (1997) The fine scale simply used a single transect as the sample unit To compare results from our study (where data were analyzed at three scales) to other studies (where data were analyzed at one scale), we determined that a taxon exhibited an oil spill effect only if there were at least three significant results for that taxon rather than one The chi square analysis on shoreline types in oiled and reference areas was conducted using the medium scale

We decided a priori to use an unconventional alpha level of 0 20 to help balance the Type I and Type II errors and to allow us to compare our results to studies of the short-term effects of the *Exxon Valdez* oil spill on marine bird populations, where an alpha level of 0 20 was used (Wiens et al 1996, Day et al 1997, Murphy et al 1997) A consequence of conducting many statistical tests is that by chance alone some of the results may be statistically significant Accordingly, in this paper we looked at patterns and the strength of significant results and interpreted those patterns in light of our knowledge of life histories of the affected taxon

We compared the pre-spill bird densities to bird densities for each post-spill year Because of the nature of the data it was necessary to use two different statistical methods to analyze the data at three scales For the fine and medium scales, we used a two-tailed *t*-test, and for the coarse scale, we used a ratio estimator with a two-tailed *z*-test

We followed a similar approach used by Murphy et al (1997) for testing for oil spill effects at fine and medium scales We used a BACI-type design (Green 1979) and did a paired comparison on the bird densities measured in the same transects (fine scale) or on the same group of transects (medium scale) before and after the oil spill, then compared the mean differences for the oiled area and reference area If the bird densities were lower in the oiled area post-spill than expected based on the pre-spill/post-spill change in the reference area, it was considered a negative oil spill effect If the bird densities were higher, it was considered a positive effect Recovery of an injured taxa was defined as lack of an effect (Murphy et al 1997) This approach to detecting effects and recovery puts the burden of proof on the data to demonstrate an effect, but not to demonstrate recovery, which is a fairly liberal definition of recovery and not consistent with the requirements to show an effect

The constant 0 167 was added to all density estimates to avoid calculating a log of zero, and adjusted densities (N km^{2} of transect), d, were then transformed by ln(d) (Murphy et al 1997)

To determine the amount of change pre- to post-spill at the fine and medium scales, δ_i, we subtracted the log bird density for each transect or group, post-spill, from the log bird density for the corresponding transect or group, pre-spill

$$\delta_i = \ln[d(post-spill)] - \ln(d(pre-spill)]$$

Standard two-sample two-tailed *t*-tests were used to compare the mean of the differences, $\overline{\delta_o}$ and $\overline{\delta_u}$, between oiled and reference areas, respectively

To detect oil spill effects at the coarse scale, we again used a BACI analysis for all transects in an "oiled" area relative to all transects in a reference area for pre- and post-spill We used the estimator for the ratio of random variables (ratios of totals of bird counts to area surveyed in an "oiled" area relative to a reference area, pre- and post-spill) (Cochran 1977) Data were not transformed to logarithms The statistical methods are not easily referenced to standard textbooks and are described in more detail in Appendix 2

Power of the statistical tests was calculated for a 50% reduction (or equivalently a 2-fold increase, after Murphy et al 1997) in densities relative to the mean differences in the reference area, pre-spill versus post-spill for each taxa for each year Methods based on normal theory for approximating power of two-sample *t*-tests and *z*-tests were used (Zar 1984) Estimated variances for the oiled and reference areas were used in the approximations

Two taxa (Black Oystercatcher and Pigeon Guillemot) had $\geq$ 50% power to detect these effects for all three scales and all years (Appendix 3) Six taxa (loons, cormorants, scoters, goldeneyes, Bald Eagles, and murres) had $\geq$ 50% power to detect effects for all years at the fine and coarse scales All taxa had at least $\geq$ 50% power to detect effects at the fine scale (Appendix 3) Scientific names of birds are given in Appendix 1

RESULTS

OIL SPILL EFFECTS

General patterns and persistence of effects Fourteen marine bird taxa were analyzed for oil spill effects The effect was considered negative if bird densities were lower in the oiled area after the oil spill than expected based on observed changes in the reference area The effect was considered positive if bird densities were higher in the oiled area after the oil spill than expected based on observed changes in the reference area We considered there to be no effect, if bird densities were not different in the oiled area after the oil spill than expected based on observed changes in the reference area If bird populations changed by random chance we would expect to see 33% of the taxa to fall into each category Of the birds analyzed, nine taxa (64%) showed a negative effect, two (14%) showed no effect and three (21%) showed a positive effect (Fig 2, Appendix 4) Loons, cormorants, Harlequin Ducks, goldeneyes, mergansers, Black Oystercatchers, Black-legged Kittiwakes, murres, and Pigeon Guillemots were negatively affected Scoters and Mew Gulls, showed no effect Glaucous-winged Gulls, murrelets and terns showed a positive effect

Of the nine taxa that showed negative effects, several continued to show effects through 1998 Pigeon Guillemots, murres, cormorants, goldeneyes, and mergansers showed negative effects in most years from 1989 to 1998 (Fig 2) Harlequin Ducks showed negative effects in 1990 and 1991 Black Oystercatchers showed negative effects in 1990, 1991, and 1998 Loons showed weak evidence of a negative effect in 1989 and 1993 Black-legged Kittiwakes showed negative effects in 1989, 1996, and 1998, with a positive effect in 1993

Effects relative to foraging style The oiling effects relative to foraging style were dramatic Seven of the nine taxa that feed by diving underwater showed negative oiling effects (Fig 2, Appendix 1) Of the four taxa that feed at the surface of the water, two showed a positive oiling effect, one showed no effect, and one showed a negative effect Black Oystercatchers, which forage on molluscs and other invertebrates in the intertidal, showed a negative oiling effect

Comparison of spatial scales The total number of significant negative effects detected were slightly greater at the medium scale than at the fine and coarse scales Significant negative effects numbered 29, 24, and, 25, respectively (Fig 2) At the taxon level, there were some obvious differences in the effects that were detected among scales Cormorants and Pigeon Guillemots, which forage over short distances during the summer (Kuletz 1983, Birt et al 1987), exhibited stronger effects at finer scales, whereas murres, which forage over wide ranges (Schneider and Hunt 1984), showed stronger effects over broader scales Mergansers, which may travel large distances during summer to molt (Palmer 1976) showed stronger effects at the coarse scale

DISCUSSION

Inherent in the BACI analyses are three assumptions (1) that birds in the reference area were not affected by the oil spill, (2) that the birds in the spill area and in the reference are closed populations, and (3) that changes in bird density in the reference area reflect changes that would have occurred in the oiled area had the spill not taken place We expect that assumption three was generally met, but for some taxa that eat forage fish it may have been violated (see section below on detecting oil spills in a changing environment) The effect of a violation of assumption three could exaggerate or obscure oil spill effects We recognize that assumptions one and two were likely violated The effect of these violations would be to reduce our ability to detect oil spill effects using a BACI analysis, which would cause our estimates of oiling impacts to be conservative

STRENGTH, DURATION, AND POTENTIAL CAUSE OF NEGATIVE EFFECTS

Although 9 of the 14 taxa showed a negative oil spill effect, the strength and duration of these effects varied among taxa We conclude that cormorants, goldeneyes, mergansers, murres, and Pigeon Guillemots exhibited strong evidence of negative oil spill effects nine years after the oil spill Harlequin Ducks and Black Oystercatchers displayed strong evidence of negative oil spill effects a few years after the spill and may be recovering Black-legged Kittiwakes demonstrated sporadic negative effects These results combined with data on the changes in the sizes of kittiwake colonies (Irons, unpubl data) indicate that observed effects were probably the result of changes in foraging distribution of birds rather than a change in breeding numbers Kittiwakes are capable of foraging broadly and may have avoided oiled areas in 1989, 1996 and 1998 (see Irons 1996) It is not known whether these changes in foraging distribution were influenced by the oil spill Loons exhibited weak evidence of a negative effect

Six of the taxa showed no effect or a positive effect Scoters and Mew Gulls demonstrated no effect Glaucous-winged Gulls displayed strong evidence of a positive effect The reason for this is not clear Murphy et al (1997) suggested that boats cleaning up the oil spill may have attracted gulls and caused an increase in the oiled area The increase in murrelets and terns four years after the spill may be related to a increase in sand lance (*Ammodytes hexapterus*) in the oiled area Murrelets and terns eat many sand lance in the Gulf of Alaska (Sanger 1987, Kuletz et al 1997) and may have responded to the increase in prey in recent years Independent data on the abundance of sand lance schools in PWS from 1995 to 1998 show a relative increase in the oiled area (Brown et al 1999, Brown, unpubl data)

The results of this study demonstrated that their was no indication of recovery in the number of birds for several taxa nine years after the oil spill Lack of an increase in numbers can occur because fecundity, survival, or immigration is not sufficient to allow recovery Although the present study did not investigate reasons and mechanisms for persistent effects, other studies provide insight for potential mechanisms

Exxon Valdez oil has persisted on some shorelines in PWS and Shelikof Strait for several years after the spill *Exxon Valdez* oil has been found on the shores of PWS and entering the water as late as 1997 (Hayes and Michel 1999) Four years after the spill, residual oil in protected PWS mussel beds had been a source of chronic contamination of mussels, and contamination was expected to continue for several years (Babcock et al 1996) Furthermore, *Exxon Valdez* oil deposited outside PWS in Shelikof Strait was only slightly weathered because after the oil left PWS much more of it turned to mousse, which resists weathering (Irvine et al 1999)

Birds living in the oiled area ingested more oil than birds living in the reference area through 1999 The Nearshore Vertebrate Predator Project (Holland-Bartels et al 1998) assessed continued exposure of birds and otters to oil using expression of cytochrome P4501A, an enzyme induced by polynuclear aromatic hydrocarbons or halogenated aromatic hydrocarbons Holland-Bartels et al (1998) compared P4501A levels in animals from the oiled and reference areas and found significantly higher levels of P4501A in Pigeon Guillemot, Harlequin Duck, and Barrow's Goldeneye that resided in the oiled area than in birds that resided in the reference area Significant differences also were found in sea otters (*Enhydra lutris*) and river otters (*Lutra canadensis*) However, it is not possible to identify whether or not these hydrocarbons are from *Exxon Valdez* oil, they may be from some other source, such as discharge from other vessels or natural sources

Other studies have compared the fecundity and survival of birds in oiled and reference areas Harlequin Duck survival was lower in the oiled area than in the reference area (Holland-Bartels et al 1998) Pigeon Guillemot fecundity was lower in the oiled area post-spill than pre-spill (G T Golet unpubl data)

There is evidence that high quality prey (i e , sand lance, Pacific herring [*Clupea pallasii*], and capelin [*Mallotus villosus*]) for birds were less abundant in PWS for a number of years after the spill than pre-spill High lipid fish were less available for Pigeon Guillemots and Marbled Murrelets after the spill than before the spill (Kuletz et al 1997, Golet et al 2000) Juvenile Pacific herring abundance declined in PWS after the spill (Brown et al 1996) Reasons for these declines are not clear, but there is evidence that oil (Brown et al 1996) and natural causes (Kuletz et al 1997, Agler et al 1999, Pearson et al 1999) played a role Overall, results of these studies suggest that persistent oil in the environment and reduced prey abundance may be affecting the recovery of marine birds in PWS

COMPARISON TO OTHER STUDIES

The *Exxon Valdez* oil spill was a major perturbation and attracted much attention There have been three other papers published on the short-term effects of the oil spill on marine birds in PWS using at-sea survey data Wiens et al (1996), Murphy et al (1997), and Day et al (1997) We compared our results to Murphy et al (1997) because they also used pre-spill and post-spill data to determine oil spill effects Wiens et al (1996) and Day et al (1997) used only post-spill data Murphy et al (1997) used data from the same pre-spill study (Irons et al 1988) that we did, and compared data using a BACI-type analysis However, they used data from 10 bays collected over three years and we used data from 123 transects collected in six years over a nine-year span Murphy et al (1997) also chose a different oil/unoiled criterion than the present study Murphy et al (1997) used an oiling index (range 0-400) and considered bays with an index value of < 100 to be unoiled The present study considered a transect that had any oil on it to be oiled This dıfference ın categorızatıon of oılıng affected 26% of the transects ın the present study

Generally the results of the two studıes were sımılar and suggest that dıfferences that do emerge may be due to the sample sıze and power ınvolved ın the studıes Of the nıne taxa that were analyzed by both studıes, Murphy et al (1997) found that three (33%) of the taxa examıned were negatıvely affected Thıs study found that sıx (66%) of the taxa were negatıvely affected Murphy et al (1997) had a sample sıze of 10, and the present study had sample sıze of 45, at the medıum scale Murphy et al (1997) and the present study determıned the power to detect a 50% declıne or a 100% ıncrease for each specıes for each year Generally the power for the present study was hıgher than that of Murphy et al (1997), but there was much varıatıon among specıes ın both studıes

Comparısons among the studıes at the taxon level ıs dıfficult because several taxa that we analyzed were not analyzed by Murphy et al (1997) and vıce versa Murphy found three taxa to be negatıvely affected We found negatıve effects on those three taxa and we found negatıve effects for sıx other taxa, of these Murphy et al (1997) analyzed data for only two of the taxa Black-legged Kıttıwake and Harlequın Duck It also ıs dıfficult to compare the duratıon of effects between the two studıes because Murphy et al (1997) collected data for only three post-spıll years and the present study reports on data that were collected over nıne post-spıll years Murphy et al (1997) found that the number of negatıve effects decreased from two to none by 1991, suggestıng that, recovery was occurrıng The present study found results sımılar to Murphy et al at the medıum scale, for the first three years However, ın 1993, 1996 and 1998 effects persısted and the ındıcatıons of recovery had dısappeared for many taxa (Fıg 2)

Prıor to the *Exxon Valdez* oıl spıll, oıl spıll effects on marıne bırds were generally detected by either finding oiled carcasses on beaches (Bourne 1968, Stowe and Underwood 1984) or by a change in the number of breeding seabirds at one or more colonies (Stowe 1982) rather than a change in bird populations found in and around an oiled area (Harrison and Buck 1967), and most studies lasted only a year or two The situation of the *Exxon Valdez* oil spill was different There were pre-spill data on several taxa of marine birds in and around the area that was oiled and we were able to collect data over nine post-spill years As a result, we were able to conduct a comprehensive study of potential oil spill effects on several bird taxa and determine whether effects lingered The persistent effects found in several taxa were somewhat unexpected given that few earlier studies detected long-term effects However, it should be noted that long-term effects (i e , through 1998) of the *Exxon Valdez* oil spill were also detected on survival rates of sea otters in Prince William Sound (Monson et al 2000)

The effects of the *Exxon Valdez* oil spill on marine birds have been detectable over nine years for several potential reasons First, we continued to look for effects for nine years Second, the spill occurred in PWS, a partially enclosed body of water, and much oil was deposited on 100s of kilometers of shoreline rather than drifting unimpeded out to sea (O'Clair et al 1996) Third, oil remained on the shorelines for years after the spill (Hayes and Michel 1999, Irvine 1999) Fourth, recovery of piscivorous taxa in PWS may be slow because of poor feeding conditions (Brown et al 1996, Agler et al 1999 Golet et al 2000)

OIL SPILL EFFECTS RELATIVE TO FORAGING STYLE

King et al (1979) ranked several species of marine birds according to their vulnerability to oil, their rankings were based on 20 factors that affect survival Species that dive underwater for food were ranked as more susceptible to oiling than surface-feeding species The disparity in rankings between divers and non-divers was largely due to behavioral differences involving foraging, resting, and escape responses Divers were thought to be more susceptible to oiling than non-divers because they spend more time resting on the water, and when foraging divers dive under the water they may re-surface in oil Also, their escape response is to dive, which increases the chances of surfacing in oil, whereas the non-diving species fly to escape Additionally, non-divers may avoid foraging in heavily oiled areas because prey are difficult to see from the air when the surface is covered with oil (Irons 1996)

The results from the present study are consistent with rankings of King et al (1979) Most of the species that dive for their food showed a negative oil spill effect, whereas only one of the surface-feeding species showed a negative effect (Fig 2, Appendix 1) Piatt et al (1990) and Murphy et al (1997) also found that diving species were more affected by the *Exxon Valdez* oil spill than non-diving species However, it should be recognized that the King et al (1979) vulnerability rankings generally refer to immediate oiling effects and not long-term effects Immediate effects are often from birds becoming oiled and long-term effects may be related to other factors such as oiled prey

EFFECTS OF SCALE AND OILING PATTERN IN DETECTING OIL SPILL EFFECTS ON BIRDS

It has long been recognized that there are scale-dependent problems associated with assessing avian populations (Wiens 1981) Assessing the effects of an oil spill on avian populations also has scale-dependent issues Problems arise when birds move in and out of oiled areas In this study we grouped data at three different spatial scales to investigate the effect of scale on detecting effects of oil spills The results showed that effects were different at different scales for some taxa and these differences appeared to be related to the scale at which birds travel to forage or molt To help understand factors that influence the detection of oil spill effects, we have outlined some general properties involving the influence of scale, bird movement, and pattern of oiling These properties mainly apply to BACI study designs and relate to whether or not birds in the reference area are affected by the oil spill There are also two assumptions (1) that birds which enter oiled areas are negatively affected and birds that do not enter oiled areas are not affected, and (2) that birds do not actively try to avoid oil These general properties are

(1) As the size of a bird's home range increases, the ability to detect oil spill effects decreases

(2) As the number of borders between oiled and unoiled areas (i e , the number of unoiled areas within a greater oil spill region) increases, the ability to detect effects on mobile species decreases

(3) The scale at which the data are analyzed affects the ability to detect oil spill effects on birds when there are pockets of unoiled areas within a greater oiled region There are two situations when sampling at the incorrect scale would reduce the ability to detect oil spill effects because some birds in unoiled pockets would be unaffected but considered oiled and vice versa The first case would occur when birds' home ranges are much smaller than the unoiled pocket and the sampling unit is larger than the unoiled pocket In this case birds in the unoiled pocket would be unaffected, but would be considered oiled because the scale of the sampling unit was too large The second case would occur when birds' home ranges are larger than the unoiled pocket and the sampling unit is smaller than the unoiled pocket In this case all birds in the unoiled pocket likely would be oiled, but the pocket would be considered unoiled because the scale of the sampling unit was too small The results of these confounding situations is that for birds like

Pigeon Guillemots with small home ranges we would be less likely to detect oil spill effects at our coarse scale than our fine scale, and for birds like murres with large home ranges we would be less likely to detect oil spill effects at our fine scale than our coarse scale

Given these general properties, we recognize that our ability to detect oil spill effects of the *Exxon Valdez* oil spill was confounded because the mosaic pattern of oiling created many borders between oiled and unoiled areas Also, we were less likely to detect effects for birds like Black-legged Kittiwakes and murres, which have large home ranges, than for Pigeon Guillemots and cormorants, which have small home ranges Birds with small home ranges showed more oil spill effects when using a small spatial scale for analyses, and birds with large home ranges showed more oil spill effects when using a large spatial scale for analyses We can conclude that when there are unoiled pockets within an oiled area the chances of detecting oil spill effects will be greatest if the data are collected and analyzed at a spatial scale that matches the birds' home range

DETECTING OIL SPILL EFFECTS IN A CHANGING ENVIRONMENT

The ability to detect oil spill effects on birds may be complicated by natural variation in populations (Wiens and Parker 1995) The *Exxon Valdez* oil spill provides an example of this Many of the pre-spill data that were available on birds within the spill area were collected in the 1970s Many of the murre colonies were counted only in the 1970s (Piatt and Anderson 1996) and some data on marine bird numbers were collected in PWS in 1972 (Dywer et al 1976, Klosiewski and Laing 1994)

It was not recognized at the time of the spill, but we now know that the Gulf of Alaska (GOA) experienced a climatic shift about 1977 There was an abrupt change in sea-surface temperature and in several indicators of long-term climatic variability in the GOA (Francis et al 1998) Coincident with that change, some important prey species of marine birds changed For example, capelin decreased and pollock (*Theragra chalcogramma*) increased in abundance (Piatt and Anderson 1996, Francis et al 1998) Apparently as a result of declining high-quality prey (e g , capelin), many species of marine birds that depend upon schooling forage fish declined in PWS and the GOA Agler et al (1999) found that 14 of 17 piscivorus marine bird taxa declined in PWS from 1972 to 1989, and that 17 of 21 marine bird taxa declined from 1976 to 1986 in the GOA along the Kenai Peninsula However, birds that depend on benthic invertebrates for food, such as Harlequin Duck and Goldeneye, did not decline over this period Piatt and Anderson (1996) found that several murre colonies outside the spill area declined from the late 1970's to 1989 It appears that the climatic shift did not affect PWS equally Suryan and Irons (unpubl data) found that the number of nesting kittiwakes in southern PWS declined from 1972 to 1985, while numbers increased in northern PWS They attributed this change to a change in food availability that may have been associated with the 1978 climatic shift

In the midst of a large-scale climatic shift, how can we detect oil spill effects? Three important factors helped us separate oil spill effects from the climatic shift First, in PWS we had data that were collected in 1984 and 1985, only a few years before the spill, whereas the climatic shift occurred about 1978 and most of the declines associated with that shift had abated by 1984 (Irons unpubl data) Second, the suite of species that declined after the climatic shift and the suite of species that declined after the oil spill were largely different Most of the species that declined from the climatic shift consume schooling forage fish and many species that are nearshore benthos feeders did not decline (Agler et al 1999) Many species that declined from the oil spill are nearshore benthos feeders and several species that consume schooling forage fish showed no effect or a positive effect from the oil spill Third, the oil spill and the climatic shift occurred at different spatial scales Within the spill area, the oil spill contaminated some beaches, but left adjacent beaches untouched by oil, creating a patchwork pattern of oiling The climatic shift occurred at the scale of the entire GOA and perhaps larger (Francis et al 1998) Our findings that some species with small home ranges showed greater effects at small scales than at large scales is consistent with a perturbation of the scale and pattern of the oil spill and not the scale of the climatic shift

In conclusion, we found that 66% of the 14 taxa analyzed exhibited negative oil spill effects and 36% of the taxa showed persistent effects nine years after the spill Most taxa that were affected dive for their food The spatial scale at which analyses were done affected the results for some taxa The effects lasted longer than those reported by many other oil spill studies The reason for this may be related to the persistence of oil and reduced levels of forage fish in PWS

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Valdez Trustee Council

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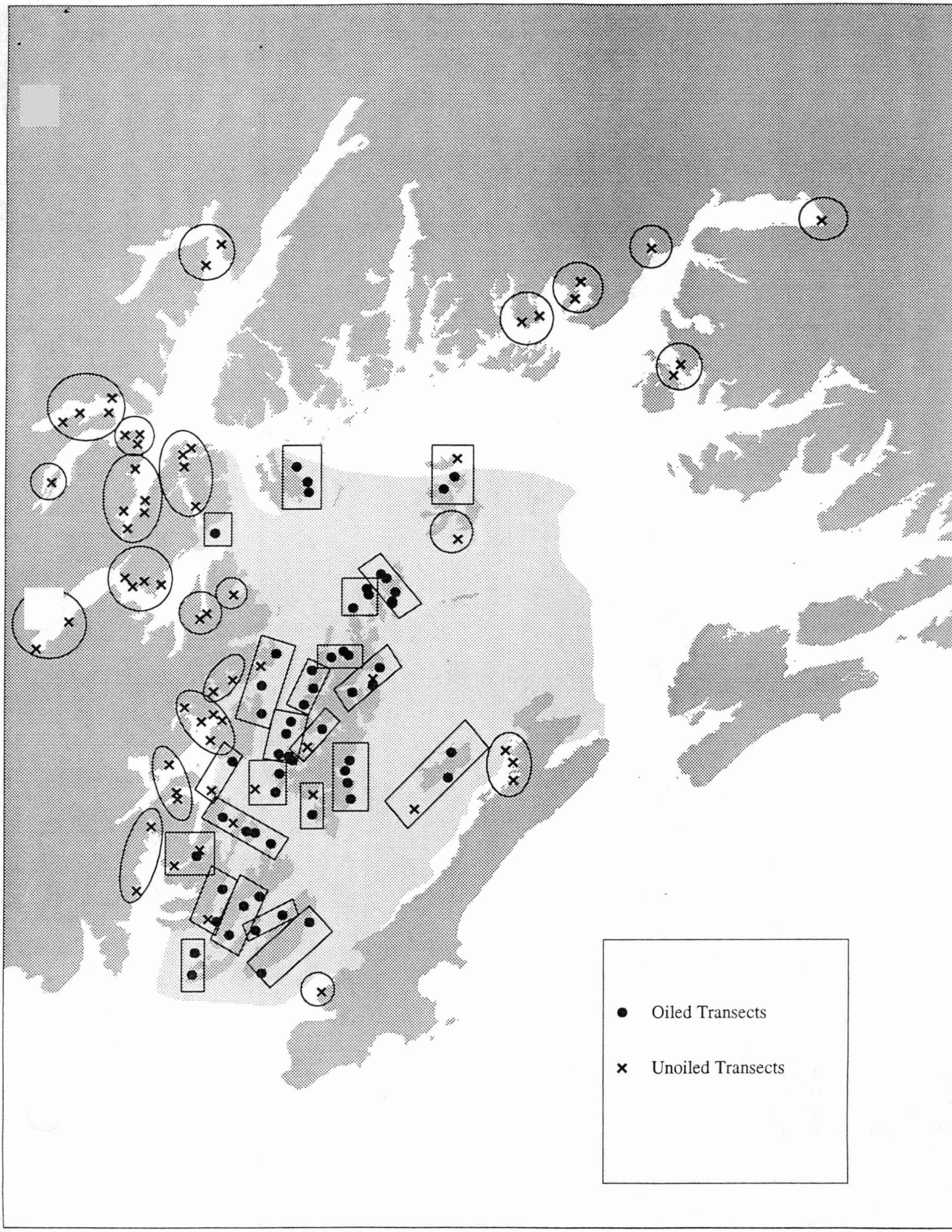
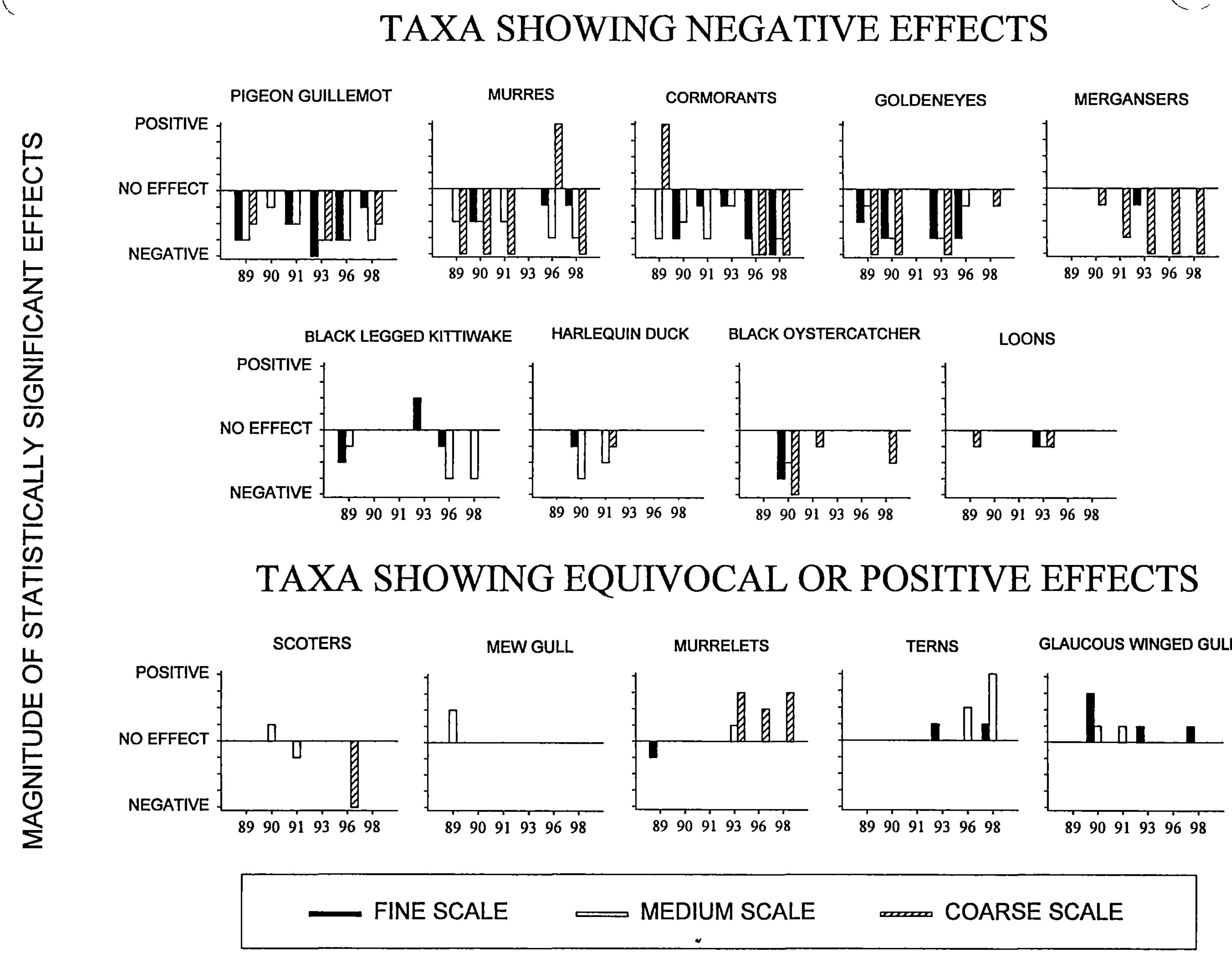
FIGURE 1 Map of Prince William Sound, Alaska, showing locations of 123 transects that were used for analyses at the fine scale, how the transects were combined into 45 groups for the medium scale, and the overall area that was oiled by the *Exxon Valdez* oil spill, which was used for the coarse scale Transects marked with a filled circle were oiled and transects marked with a "X" were not oiled Groups enclosed with a rectangle were oiled and groups enclosed by a circle were unoiled The stippling indicates the greater oiled area

FIGURE 2 Magnitude and duration of statistically significant oil spill effects for 14 taxa analyzed at three spatial scales during six post-spill surveys conducted from 1989 to 1998 Results were determined by BACI analyses, which were done by comparing marine bird densities pre- to post-spill between oiled and references transects in Prince William Sound, Alaska The length of the vertical bar indicates the strength of the result long bar, $P \leq 0$ 01, medium long bar, $P \leq 0$ 05, medium short bar, $P \leq 0$ 1, short bar, $P \leq 0$ 2, and no bar indicates no detectable effect


Oiled Transects
Unoiled Transects


TAXA SHOWING NEGATIVE EFFECTS
MAGNITUDE OF STATISTICALLY SIGNIFICANT EFFECTS
PIGEON GUILLEMOT
MURRES
CORMORANTS
GOLDENEYES
MERGANSERS
BLACK LEGGED KITTIWAKE
HARLEQUIN DUCK
BLACK OYSTERCATCHER
LOONS
POSITIVE
NO EFFECT
NEGATIVE
89 90 91 93 96 98
TAXA SHOWING EQUIVOCAL OR POSITIVE EFFECTS
SCOTERS
MEW GULL
MURRELETS
TERNS
GLAUCOUS WINGED GULL
FINE SCALE
MEDIUM SCALE
COARSE SCALE

Appendix 1 Common and scientific names and foraging mode of bird species/species groups mentioned in text

pecies/Species Group	Common Name	Scientific Name	Foraging mode
Loons	Red-throated Loon	*Gavia stellata*	diver
	Pacific Loon	*Gavia pacifica*	diver
	Common Loon	*Gavia immer*	diver
	Yellow-billed Loon	*Gavia adamsii*	diver
Cormorants	Double-crested Cormorant	*Phalacrocorax auritus*	diver
	Pelagic Cormorant	*Phalacrocorax pelagicus*	diver
	Red-faced Cormorant	*Phalacrocorax urile*	diver
Harlequin Duck	Harlequin Duck	*Histrionicus histrionicus*	diver
Scoters	Black Scoter	*Melanitta nigra*	diver
	Surf Scoter	*Melanitta perspicillata*	diver
	White-wing Scoter	*Melanitta fusca*	diver
Goldeneyes	Common Goldeneye	*Bucephala clangula*	diver
	Barrow's Goldeneye	*Bucephala islandica*	diver
Mergansers	Common Merganser	*Mergus merganser*	diver
	Red-breasted Merganser	*Mergus serrator*	diver
Black Oystercatcher	Black Oystercatcher	*Haematopus bachmani*	intertidal feeder
Mew Gull	Mew Gull	*Larus canus*	surface feeder
Glaucous-winged Gull	Glaucous-winged Gull	*Larus glaucescens*	surface feeder
Black-legged Kittiwake	Black-legged Kittiwake	*Rissa tridactyla*	surface feeder
Terns	Caspian Tern	*Sterna caspia*	surface feeder
	Arctic Tern	*Sterna paradisaea*	surface feeder
	Aleutian Tern	*Sterna aleutica*	surface feeder
Murres	Common Murre	*Uria aalge*	diver
Pigeon Guillemot	Pigeon Guillemot	*Cepphus columba*	diver
Murrelets	Marbled Murrelet	*Brachyramphus marmoratus*	diver
	Kittlitz's Murrelet	*Brachyramphus brevirostris*	diver

Appendix 2 Statistical methodology used to detect oil spill effects at the coarse scale A BACI design for all transects in an "oiled" area relative to all transects in a reference area for pre- and post-spill was used with the estimator for the ratio of random variables (ratios of totals of bird counts to area surveyed in an "oiled" area relative to a reference area, pre- and post-spill) (Cochran 1977)

The statistical methods are not easily referenced to standard textbooks and are described in more detail in the following paragraphs The general estimator of a ratio is the ratio of means (or, equivalently, ratio of totals)

$$\hat{R} = \frac{\bar{y}}{\bar{x}}$$

with corresponding estimated variance

$$v(\hat{R}) = \left(\frac{1}{n}\right)(\hat{R}^2)\left[\frac{s^2_y}{\bar{y}^2} + \frac{s^2_x}{\bar{x}^2} - \frac{2r_{xy}s_y s_x}{\bar{y}\,\bar{x}}\right]$$

where s^2_y , s^2_x and r_{xy} are respectively the sample variance of the y's (bird counts), x's (area surveyed), and the sample correlation of the x's and y's

Define the following

$\hat{R}_{oa} = \frac{\bar{y}_{oa}}{\bar{x}_{oa}}$ ratio of the mean number of birds to mean area of transects for the oiled area after the spill

$$\hat{R}_{ob} = \frac{\bar{y}_{ob}}{\bar{x}_{ob}}$$ ratio of the mean number of birds to mean area of transects for oiled area before the spill

$$\hat{R}_{ra} = \frac{\bar{y}_{ra}}{\bar{x}_{ra}}$$ ratio of the mean number of birds to mean area of transects for reference area after the spill and

$$\hat{R}_{rb} = \frac{\bar{y}_{rb}}{\bar{x}_{rb}}$$ ratio of the mean number of birds to mean area of transects for reference area before the spill

The variances of the ratios are calculated by applying the above formula, $v(\hat{R})$

Define

$$\hat{R}_o = \frac{\hat{R}_{oa}}{\hat{R}_{ob}}$$ and

$$\hat{R}_r = \frac{\hat{R}_{ra}}{\hat{R}_{rb}}$$

The variance of R_o (variance of R_r is calculated same way) was estimated by

$$v(\hat{R}_o) = (\hat{R}^2{}_{oa})\left[\frac{v(\hat{R}_{oa})}{\hat{R}_{oa}{}^2} + \frac{v(\hat{R}_{ob})}{\hat{R}_{ob}{}^2}\right]$$

Finally, the estimated oil spill effect is given by

$$\hat{R} = \frac{\hat{R}_o}{\hat{R}_r}$$

Values greater than 1 0 indicate a positive oil spill effect and values less than 1 0 indicate a negative oil spill effect The variance of $\hat{R}$ was estimated by a second application of the formula above for $v(\hat{R}_o)$ A two-tailed z-test was then conducted using the same significance levels as for the fine and medium scales to determine whether the estimated effect was significantly different from 1 0

Appendix 3 Results of power analyses for the pre-spill, post-spill comparisons of bird densities in Prince William Sound during the summer Power was calculated assuming a 50% reduction for a 100% increase for each taxa for each year Power was calculated for each spatial scale for analyses that were conducted Pre-spill data were collected in 1984-1985 (Irons et al 1988)

		Pre-spill and post-spill comparisons					
Species/Taxon	Scale	1989	1990	1991	1993	1996	1998
Loons	Fine	1 00	1 00	1 00	1 00	1 00	0 88
	Medium	0 97	0 99	0 91	0 91	0 96	0 88
	Coarse	0 43	0 25	0 41	0 41	0 45	0 42
Cormorants	Fine	0 99	1 00	0 99	0 99	0 99	0 98
	Medium	0 83	0 85	0 83	0 90	0 90	0 98
	Coarse	0 63	0 53	0 59	0 80	0 73	0 52
arlequin duck	Fine	0 76	0 86	0 81	0 80	0 76	0 64
	Medium	0 47	0 62	0 48	0 52	0 52	0 64
	Coarse	0 26	0 62	0 61	0 23	0 25	0 33
Scoters	Fine	1 00	1 00	0 98	1 00	1 00	0 99
	Medium	0 71	0 83	0 66	0 91	0 79	0 99
	Coarse	0 20	0 23	0 21	0 21	0 34	0 27
Goldeneyes	Fine	0 99	1 00	1 00	1 00	1 00	0 99
	Medium	0 79	1 00	1 00	0 97	0 99	0 99
	Coarse	0 30	0 32	0 30	0 33	0 34	0 30
Mergansers	Fine	0 69	0 85	0 80	0 69	0 71	0 64
	Medium	0 43	0 53	0 52	0 41	0 44	0 64
	Coarse	0 62	0 70	0 55	0 72	0 67	0 65
Black oystercatcher	Fine	0 90	0 96	0 95	0 94	0 94	0 74

	Medium	0 72	0 73	0 79	0 71	0 69	0 74
	Coarse	0 53	0 69	0 67	0 58	0 26	0 45
Mew gull	Fine	0 67	0 76	0 68	0 76	0 72	0 57
	Medium	0 47	0 52	0 44	0 50	0 48	0 56
	Coarse	0 26	0 31	0 77	0 28	0 71	0 32
Glaucous-winged gull	Fine	0 58	0 61	0 63	0 53	0 63	0 50
	Medium	0 41	0 54	0 43	0 35	0 43	0 49
	Coarse	0 25	0 26	0 28	0 27	0 64	0 30
Black-legged kittiwake	Fine	0 65	0 74	0 76	0 77	0 62	0 58
	Medium	0 58	0 51	0 52	0 62	0 41	0 58
	Coarse	0 29	0 28	0 32	0 30	0 74	0 52
Terns	Fine	0 76	0 79	0 84	0 71	0 80	0 97
	Medium	0 50	0 51	0 61	0 40	0 50	0 75
	Coarse	0 23	0 28	0 29	0 20	0 26	0 29
Murres	Fine	0 97	0 97	0 95	0 95	0 95	0 97
	Medium	0 78	0 74	0 64	0 68	0 83	0 98
	Coarse	0 31	0 28	0 29	0 20	0 30	0 31
Pigeon guillemot	Fine	0 79	0 83	0 80	0 83	0 77	0 64
	Medium	0 61	0 65	0 63	0 80	0 70	0 63
	Coarse	0 70	0 82	0 87	0 78	0 80	0 81
Murrelets	Fine	0 60	0 65	0 67	0 68	0 72	0 56
	Medium	0 48	0 55	0 55	0 59	0 54	0 55
	Coarse	0 40	0 38	0 37	0 52	0 48	0 50

	Coarse	121	101	79	67	-30	-6
[arlequin duck	Fine	10	-36*	-28	-11	-24	-9
(Negative)	Medium	37	-61***	-65**	-18	-30	-24
	Coarse	182	-28	-50*	216	134	74
Black Oystercatcher	Fine	6	-40***	-6	26	-1	-11
(Negative)	Medium	-12	-47**	-28	4	-20	-15
	Coarse	-15	-83***	-44*	-24	0	-51**
Loons	Fine	6	14	0	-19*	-3	-11
(Negative)	Medium	-6	13	-22	-55*	-18	-23
	Coarse	-60*	0	-5	-58*	-25	-18
Scoters	Fine	4	11	-22	5	-17	-2
(None)	Medium	9	50*	-42*	34	-19	2
	Coarse	71	71	209	266	-100****	85
Mew Gull	Fine	15	40	-33	-13	4	-27
(None)	Medium	172**	44	-37	-4	16	-20
	Coarse	149	107	-2	35	44	24
Murrelets	Fine	-46*	12	-19	44	35	36
(Positive)	Medium	-9	43	-13	87*	42	4
	Coarse	43	51	10	147***	100**	144***
Terns	Fine	-15	2	-1	78*	30	142*
(Positive)	Medium	33	35	28	104	148**	401****
	Coarse	603	690	192	322	471	4102
aucous-winged Gull	Fine	22	175***	44	98*	-10	101*
(Positive)	Medium	37	112*	124*	163	-34	111

Appendix 4 Comparison of changes in marine bird densities pre- to post-spill between oiled and reference insects in Prince William Sound, Alaska Pre-spill counts were made in 1984-1985 by Irons et al (1988) Post-spill counts were made in six years from 1989 to 1998 Results of analyses are indicated as follows **P* ≤ 0 20, ***P* ≤ 0 10, ****P* ≤ 0 05, and *****P* ≤ 0 01 Response refers to our conclusion as to how a taxon was affected by the oil spill

		Percent Difference					
Taxon (Response)	Scale	1989	1990	1991	1993	1996	1998
Pigeon Guillemot	Fine	-55***	-24	-42**	-68***	-54***	-47*
(Negative)	Medium	-66***	-43*	-55**	-51***	-56***	-65***
	Coarse	-50**	-29	-15	-51***	-37	-51**
Murres	Fine	-23	-32**	-25	-7	-26*	-30*
(Negative)	Medium	-47**	-47**	-54**	-27	-51***	-56***
	Coarse	-100****	-100***	-98****	1	100****	-100****
Cormorants	Fine	-2	-37***	-24*	-25*	-33***	-38****
(Negative)	Medium	-46***	-41**	-47***	-33*	-53****	-49***
	Coarse	100****	19	132	-59	-84****	-89****
Goldeneyes	Fine	-29**	-23***	-8	-32***	-19***	-13
(Negative)	Medium	-44*	-29***	-5	-45***	-24*	-25
	Coarse	-92****	-94***	-50	-90***	-50	-64*
Mergansers	Fine	-38	-17	-16	-43*	-27	-28
(Negative)	Medium	-34	-24	-45	-54	-43	-49
	Coarse	-19	-46*	-61***	-64***	-64****	-67****
Black-legged Kittiwake	Fine	-50**	11	-27	79**	-50*	-49
(Negative)	Medium	-53*	-23	-44	-6	-79***	-64***

Coarse	136	44	33	33	-43	16

Brenda Hall

From Lisa Ka'aihue [kaaihue@anch pwsrcac org]
Sent Wednesday, August 09, 2000 12 09 AM
To Brenda_Hall@oilspill state ak us
Subject GEM Monitoring Metadatabase

Hi Brenda

I reviewed the hard copy of the Gem Monitoring Metadatabase and have a few edits to suggest for our project Long-Term Environmental Monitoring Program, ID No 241

Under Contact Name and Address

Name Lisa Ka'aihue
Address 3709 Spenard, Ste 100, Anchorage, AK 99503
Fax 907/277-4523
E-mail Kaaihue@anch pwsrcac org
Under details

Geographic Area add Zaikof Bay to the list

Contact for Data Reports and data available via web site

www pwsrcac org or send an e-mail to Lisa Ka'aihue

Thanks Brenda!

Lisa

Lisa Ka'aihue
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An Evaluation of Marine Bird Population Trends Following the *Exxon Valdez* Oil Spill, Prince William Sound, Alaska

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We examined post-spill trends (1989-1998) of marine bird populations in Prince William Sound (PWS) following the *Exxon Valdez* oil spill to evaluated recovery of injured taxa Two criteria were employed First, we examined population trends of injured taxa only in the oiled area of PWS using regression models Second, we examined population trends of injured taxa in the oiled area relative to the unoiled area using homogeneity of the slopes tests We considered a population recovering if there was a positive trend using either criteria We considered a population not recovering if there was no trend using either criteria or a negative trend in the oiled area A significant negative trend in the oiled area relative to the unoiled area was considered a continuing and increasing effect

Most taxa for which injury was previously demonstrated were not recovering and some taxa showed evidence of increasing effects nine years after the oil spill Four taxa (loons *Gavia* spp , Harlequin Duck *Histrionicus histrionicus*, Bufflehead *Bucephala* spp , and Northwestern Crow *Corvus caurinus*) showed weak to very weak evidence of recovery None of these taxa showed positive trends in both winter in summer Nine taxa (grebes *Podiceps* spp , cormorants *Phalacrocorax* spp , Black Oystercatcher *Haematopus bachmani*, Mew Gull *Larus canus*, Glaucous-winged Gull *Larus glaucescens*, terns *Sterna* spp , murres *Uria* spp , Pigeon Guillemot *Cepphus columba*, and murrelets *Brachyramphus* spp) showed no evidence of recovery during summer or winter Four taxa (scoters *Melanitta* spp , mergansers *Mergus* spp , goldeneyes *Bucephala* spp , and Black-legged Kittiwake *Rissa tridactyla*) showed evidence of continuing, increasing effects We showed evidence of slow recovery, lack of recovery, and divergent population trends in many taxa which utilize shoreline and nearshore habitats where oil is likely to persist Potential lingering spill

effects and natural variability appear to be acting in concert in delaying recovery of many PWS bird populations

Key words oil spill, marine birds, long-term, population trends, Prince William Sound, Alaska

The waters and shores of Prince William Sound (PWS) provide important feeding, resting, and breeding habitat for many marine birds and mammals (Isleib and Kessel 1973, Hogan and Murk 1982) The terminus of the Trans-Alaska oil pipeline is in Valdez in northern PWS, and since 1977 thousands of oil tankers have traveled through PWS in route to refineries in the lower 48 states Due to concern of oil development on marine birds, the U S Fish and Wildlife Service conducted marine bird surveys in PWS in 1972-73 (L Haddock et al , unpubl data) and again in 1984-85 (Irons et al 1988)

On 24 March 1989, the *T/V Exxon Valdez* grounded on Bligh Reef in northeastern PWS, spilling ~ 11 million gallons of crude oil into the surrounding waters In the following weeks, wind and currents moved the oil to the southwest where a large percentage was deposited on shorelines and intertidal areas of western and southwestern PWS Approximately 25% of the oil drifted out of PWS, traveling ~ 750 km to the southwest, contaminating areas of the Kenai Peninsula, Barren Islands, Alaska Peninsula, and Kodiak Island archipelago (Spies et al 1996) Immediate effects of oil contamination on marine birds were pronounced Over 30,000 marine bird carcasses were recovered in the spill area, of which, ~ 3,400 were recovered in PWS (Piatt et al 1990) Carcasses comprised mainly diving birds murres, sea ducks, cormorants, murrelets, Pigeon Guillemot, loons, and grebes (Piatt et al 1990) Direct mortality of marine birds in PWS and the Gulf of Alaska was estimated at about 250,000 birds (Piatt and Ford 1996) At the time, the *Exxon Valdez* oil spill (EVOS) was the largest oil spill in North America with unprecedented toll on marine birds, eliciting much concern about the short and long-term effects on marine bird populations in PWS

In 1989 surveys were initiated by the U S Fish and Wildlife Service to determine the population abundance of marine birds in PWS and to assess natural resource damage in the aftermath of the oil spill Surveys conducted by the U S Fish and Wildlife Service were continued in March (1990, 1991, 1993, 1994, 1996, and 1998) and July (1989, 1990, 1991, 1993, 1996, and 1998) (Klosiewski and Laing 1994, Agler et al 1994, 1995, Agler and Kendall 1997, Lance et al 1999) These surveys were designed to monitor marine bird populations of PWS following the *T/V Exxon Valdez* oil spill to determine population trends, recovery, no change, or increasing impacts, for those species injured by the oil spill (*Exxon Valdez* Oil Spill Restoration Plan 1996)

Previous studies on the effects of the oil spill (Murphy et al 1997, Irons et al , *in review*) found that summer densities of several species of marine birds were lower than expected (relative to densities in 1984-1985) in the oiled area of PWS after the spill relative to densities in the unoiled area Irons et al (*in review*) found that diving species were effected more than non-diving species Klosiewski and Laing (1994) compared population estimates, both winter and summer, and found that numbers of several species of marine birds were lower (relative to numbers in 1972-73) in the oiled area of PWS after the spill compared to populations in the unoiled area Day et al (1997) evaluated impacts to and recovery of marine birds by looking at use of oil-affected habitats in PWS, using post-spill data collected throughout the year over a three-year period (1989-1991), also finding oil spill effects on several species of marine birds

Using guild analysis (Wiens et al 1996) found that the most consistent impacts of oiling were on species which feed on or close to shore, breed on the beach, or are winter or year-round residents Thus, it is clear from these studies that the EVOS had significant impacts on marine bird populations in PWS, however, it was not certain to what degree these taxa have recovered at the population level nine years after the spill

In this study we use the results of post-spill studies focused on detecting oil spill effects (Klosiewski and Laing 1994, Wiens et al 1996, Day et al 1997, Murphy et al 1997, Irons et al , *in review*) to generate predictions regarding post-spill trends of winter and summer marine bird populations in PWS We evaluate the trends of marine bird populations of PWS to test the following hypothesis regarding recovery at the population level

Our null hypothesis, H_o, was that populations did not change, that is, populations were not recovering Our first alternative hypothesis, H_a1, was that populations were recovering Recovery was measured by two methods, a significantly increasing population trend in the oiled area, or a significantly increasing population trend in the oiled area relative to the unoiled area 1989-1998 If either of these criteria were met we considered that as evidence of a recovering population Our second alternative hypothesis, H_a2, was that oil spill effects were continuing to increase, that is, species increased (decreased) at significantly slower (faster) rate in the oiled area relative to the unoiled area

Study Area

Prince William Sound is a large estuarine embayment (~ 10,000 km^2) of the northern Gulf of Alaska The coastline of PWS is rugged, surrounded by the Chugach and Kenai Mountains (up to 4km elevation), with numerous tidewater glaciers, deep fiords, and islands The climate is maritime, with moderate temperatures, high humidity, frequent fog and overcast, and high precipitation (Isleib and Kessel 1973) A low pressure trough, the Aleutian Low, is located over the area from October through March producing frequent and intense storms with high winds (Isleib and Kessel 1973) Water circulation is dominated by the Alaska Coastal Current (ACC) which mixes with a high volume of fresh water input from precipitation, rivers, and glaciers Westerly and southwesterly currents predominate with a branch of the ACC entering through Hinchinbrook Entrance, transiting PWS from east to west before exiting through Montague Strait (Niebauer et al 1994) Strong tidal currents that range as high as six meters cause rapid mixing of waters at the entrances to bays, fiords and inlets During the winter, ice forms at the heads of protected bays and fiords that receive substantial freshwater runoff (Isleib and Kessel 1973) The study area included all waters within PWS and all land within 100 m of the shore, with the exception of Orca Inlet, near Cordova, Alaska and the southern sides of Montague, Hinchinbrook, and Hawkins Islands (Fig 1)

Methods

Survey methods

We dıvıded PWS ınto three strata shorelıne, coastal-pelagıc (nearshore), and pelagıc (offshore, Fıg 1) The shorelıne stratum consısted of all waters wıthın 200 m of land Based on habıtat, the shorelıne stratum was dıvıded ınto 742 transects wıth a total area of approxımately 820 74 km^2 (Irons et al 1988) Shorelıne transects varıed ın sıze, rangıng from small ıslands wıth <1 km of coastlıne to sectıons of the maınland wıth over 30 km of coastlıne Mean transect length was 6 km Shorelıne transects were located by geographıc features, such as poınts of land, to facılıtate orıentatıon ın the field and to separate the shorelıne by habıtat type Surveys were conducted ın late wınter (March) and mıd-summer (July)

In 1989, 187 (25%) of the total 742 shorelıne transects were randomly selected for the surveys An addıtıonal 25 shorelıne transects from western PWS were randomly selected and added ın July 1990 to ıncrease the precısıon of estımates from the oıled zone The number of shorelıne transects was reduced to 99 (13% of the total 742 transects) durıng March surveys to accommodate potentıal weather delays Sample sızes wıthın ındıvıdual surveys sometımes varıed slıghtly, because a few transects could not always be surveyed due to envıronmental condıtıons (e g ıce)

To sample the coastal-pelagıc and pelagıc waters of PWS, the study area was dıvıded ınto 5-mın latıtude-longıtude blocks Blocks were classıfied as nearshore ıf they ıncluded >1 8 km of shorelıne Blocks that ıncluded ≤1 8 km of shorelıne were classıfied ın the pelagıc stratum If coastal-pelagıc or pelagıc blocks ıntersected the 200 m shorelıne buffer, they were truncated to avoıd overlap wıth the shorelıne stratum Blocks were randomly chosen and two transects were surveyed within each block If a block was too small to contain both transects, it was combined with an adjacent block During the March surveys, 29 (14%) of the coastal-pelagic blocks (n = 207) and 25 (29%) of those within the pelagic stratum (n = 86) were sampled During the July surveys, 45 (22%) of the coastal-pelagic blocks (n = 207) and 25 (29%) of those within the pelagic stratum (n = 86) were sampled We surveyed two north-south transects, each 200 m wide, located 1-min longitude inside the east and west boundaries of each coastal-pelagic and pelagic block Global Positioning Systems (GPS), LORAN, and nautical compasses were used to navigate transect lines

Transects were surveyed in 15-17 working days over a three-week period, winter surveys (~ 3-28 March, 1990-91, 1993, 1994, 1996, and 1998) and summer surveys (~ 2-27 July, 1989-91, 1993, 1996, 1998) Survey methodology and transects surveyed were identical in all years Surveys were conducted concurrently by three 8 m fiberglass boats traveling at speeds of 10-20 km/hr Two observers counted all birds and mammals detected in a sampling window 100 m on either side, 100 m ahead, and 100 m overhead of the vessel When surveying shoreline transects, observers also recorded birds and mammals sighted on land within 100 m of shore Observers scanned continuously and used binoculars to aid in species identification Most transects were surveyed when wave height was <0 3 m, and no surveys were conducted when wave height was >0 6 m To examine population trends over time and to determine if populations injured by the spill were recovering, we post-stratified PWS into oiled and unoiled areas (Fig 1) Our methodology of post-stratification followed that of Klosiewski and Laing (1994) which considered all strata within the outer boundary of the general oiled area as oiled The oil spill, however, contaminated some beaches, while some adjacent beaches were left untouched creatıng a mosaıc pattern of oılıng Thus, at thıs coarse scale, unoıled habıtat was present wıthın the oıled area Because bırds are mobıle, we assumed that bırds on unoıled transects surrounded by oıl were lıkely to be affected by oıl (but see Irons et al , *ın revıew*) Our post-stratıficatıon analyses assumed that bırd populatıons ın the oıled and unoıled portıons of PWS, as well as PWS as a whole, were dıscrete While thıs ıs lıkely not the case for marıne bırds ın general (Porter and Coulson 1987), data on the movement of bırd populatıons between the varıous portıons of PWS (Kuletz et al 1996, Bowman et al 1997, Irons 1998, Rosenberg and Petrula 1998, and Suryan and Irons, *ın revıew*) are too lımıted to ınclude ın our analysıs

Some bırd specıes were grouped by genus for analyses (Table 1) These specıes were combıned to allow analyses to ınclude data on bırds that were only ıdentıfied to genus (e g unıdentıfied *Brachyramphus* murrelet) In general, the specıes wıthın a taxon group were sımılar ın natural hıstory attrıbutes and vulnerabılıty to oıl (see Kıng and Sanger 1979)

Data analysıs

Populatıon Estımates and Densıtıes We estımated populatıon abundances and varıances usıng a ratıo of total count to area surveyed wıthın each stratum (Cochran 1977) Shorelıne transects were treated as a sımple random sample, whereas the coastal-pelagıc and pelagıc transects were analyzed as two-stage cluster samples of unequal sıze To obtaın a populatıon estımate for each block, we estımated the densıty of bırds counted on the combıned transects for a block and multıplıed by the area of the sampled block We then added the estımates from all blocks surveyed and dıvıded by the sum of the areas of all blocks surveyed Next, we calculated the populatıon estımate for a stratum by multıplyıng thıs estımate by the area of all blocks ın the stratum Total population estimates for PWS were calculated by adding the population estimates from the three strata We then calculated the 95% confidence intervals for these estimates from the sum of the variances of each stratum Density estimates used in regression analyses were calculated from total population estimates

To determine if impacted populations were showing signs of recovery or not we employed two methods of analyses We examined the post-spill population trend of the birds in the oiled area We also examined the post-spill population trend of the birds in the oiled area relative to the unoiled area, since there are several factors other than oil spills that cause bird populations to change This method, which uses the unoiled area as a control, provides more convincing evidence that recovery is actually occurring

Population Trends in the Oiled Area -- We examined the trend in marine bird densities, for summer and winter in the oiled area to determine if the population levels were changing Only species with population estimates of >500 individuals were used for analysis An impacted taxon was considered showing evidence of recovery if log (densities) in the oiled areas of PWS were exhibiting a statistically significant increasing trend (positive slope), otherwise, the injured taxon was considered showing no evidence of recovery (slope not significantly different than zero or was significantly negative) This test assumed that the oil spill effect was large enough that recovery could be detected using our survey methods It makes no assumptions regarding unoiled areas

Population Trends in Oiled Area Relative to Unoiled Area We compared trends in marine bird densities, for both winter and summer, between oiled and unoiled areas of PWS to examine whether populations changed at different rates To test whether the densities of populations in the oiled and unoiled areas were changing at different rates we examined the homogeneity of the slopes of log (density) over time between the oiled and the unoiled areas (Freud and Littell 1981) using linear models Significantly different slopes indicated that densities of a species or species group in the oiled area were changing at a different rate than in the unoiled area We calculated the rate of change of density in each area with linear regression analyses, because the changes in log (density) do not appear to be non-linear over the monitoring period of this study

For those taxa shown to be injured, a taxon was considered recovering if bird densities in the oiled areas of PWS were increasing at a significantly greater rate (slope of the regression line) than bird densities in the unoiled areas of PWS A taxon was considered as showing no evidence of recovery if trends of bird densities in the oiled areas of PWS were not significantly different from trends in the unoiled areas of PWS (no difference in slopes) A taxon was considered as having increasing oil spill effects if bird densities in the oiled areas of PWS had trends (slopes) which were significantly smaller (or more negative) than trends in the unoiled area

We made several assumptions to test for recovery using the homogeneity of slopes test 1) We assumed that an oil spill effect on a taxon was large enough that recovery could be detected using our survey methods Murphy et al (1997) and Irons et al (*in review*) demonstrated impacts on several marine bird taxa using similar survey methods, lending support to this assumption 2) We assumed that in the absence of an oil spill, populations would increase or decrease at approximately the same rate in the oiled and unoiled areas of PWS 3) We assumed oiled and unoiled bird populations were discreet 4) We assumed that no natural, density dependent mechanisms affected bird populations ability to recover in PWS (e g changes in the carrying capacity of the environment between 1989-1998, see Ainley and Nur 1997) If these assumptions were not met, the homogeneity of slopes test may not detect recovery

Substantial seasonal differences exist in the distribution and abundance of the various marine bird taxa in PWS (Isleib and Kessel 1973), thus the same suite of taxa were not always analyzed in both winter and summer Six years of data were available for March (1990, 1991, 1993, 1994, 1996, and 1998) and July (1989, 1990, 1991, 1993, 1996, and 1998) Our hypothesis focused on whether rates of change in density were the same between oiled and unoiled areas, rather than if absolute densities differed Consequently, densities were $\log_{10}$ transformed to yield multiplicative models (e g effects and any subsequent changes in density would be proportional to the previous densities in the various portions of PWS) rather than additive models (Stewart-Oaten et al 1986, 1992), the latter being an assumption of statistical tests on untransformed data (Sokal and Rohlf 1995) To avoid the undefined log of zero, we added a constant of 0 167 to all density estimates prior to analysis (Mosteller and Tukey 1977)

In all analyses we used a test size alpha = 0 20 to try and balance Type I and Type II errors The reasons for this included 1) variation was often high and sample sizes low (n=6 survey years), 2) monitoring studies are inherently different from experiments and the number of tests being run with a multi-species survey are many, therefore, controlling for the number of tests by lowering alpha levels (e g Bonferroni adjustment) might obscure trends of biological value, and 3) to make our results comparable with other studies on the effects of the EVOS on marine bird populations that used an alpha level of 0 20 (Wiens and Parker 1995, Wiens et al 1996, Day et al 1997, Murphy et al 1997, Irons et al , *in review*)

In assessing impacts from environmental perturbations, there has been a trend of using large alpha levels (Wiens and Parker 1995, Wiens et al 1996, Murphy et al 1997, and Irons et al , *in review*), allowing to error on the conservative side (increased chance of a Type I error, falsely identifying an impact that did not occur) rather than commit a Type II error (failing to identify an impact that did occur) It follows that in looking for recovery of an injured population, the practice of a conservative approach to setting alpha levels may be reversed That is, the conservation and management consequences of making a Type I error (falsely identifying recovery that did not occur) may be greater than committing a Type II error (failing to identify recovery that did occur) Thus, it is likely that in assessing possible recovery of a species, the size of the alpha level should be smaller than we used in this study In other words, our acceptance of recovery of a taxon based on an alpha of 0 20 is generous Further, a consequence of conducting numerous statistical tests is that some results may be indicated as statistically significant by chance alone Therefore, in this study we look at the patterns and strengths of significant results (see Table 2) and interpret those patterns in light of the life history attributes of the affected taxon and results from related studies in PWS

Results

We report on nine years of post-spill marine bird population changes during July and March in the oiled area of PWS using two methods of analyses, absolute trends in the oiled area and trends in the oiled area relative to the unoiled area   Taxa are categorized by their trend

Taxa with positive absolute or relative population trends in the oiled area

During summer only one taxa, Northwestern Crow, of the 15 that were analyzed demonstrated a positive trend in the oiled area (Table 2 and Fig 2)   During winter, four of the 14 taxa that were analyzed showed a positive trend in the oiled area   Loons, Harlequin Duck, Bufflehead, and murrelets increased in the oiled area from 1989 to1998 (Table 2 and Fig 3)   No taxa, during summer or winter, increased in the oiled area relative to the unoiled area (Table 2 and Figs 2 and 3)

Taxa with no trends in the oiled area

Six taxa, cormorants, murres, Mew Gull, Glaucous-winged Gull, Black Oystercatcher, and grebes, showed no increase or decrease in densities in the oiled area during summer or winter over the nine year study period (Table 2 and Figs 2 and 3)   Four taxa, loons, goldeneyes, Harlequin Duck, and murrelets, showed no change in densities during summer only (Table 2 and Fig 2) and two taxa, Pigeon Guillemot and Northwestern Crow, showed no change in densities during winter only (Table 2 and Fig 3)

Taxa with negative absolute or relative trends in the oiled area

During summer, three taxa, Black-legged Kittiwake, Pigeon Guillemot, and terns, declined in the oiled area and three taxa, scoters, mergansers, and Black-legged Kittiwake declined in the oiled area relative to changes in the unoiled area (Table 2 and Fig 2) During winter, three taxa, scoters, mergansers, and goldeneyes, declined in the oiled area relative to changes in the unoiled area (Table 2 and Fig 3)

Discussion

Interpreting our data for evidence of recovering populations required use of information available from the trends in the oiled area, the trends in the oiled area relative to the unoiled area, results from related studies in PWS, as well as taxon-specific ecological attributes We assumed that any decrease in the population caused by the oil spill was detectable by previous oil spill studies and that if populations were recovering we could measure that recovery by at least one of the two methods that we used In this study we attempted to assess whether an injured population was recovering with the burden of proof being on the available data, marshaling the collective evidence from our results (see Table 2), other related studies, as well as the ecological attributes of the taxa

We were fortunate to have data from a nearby unoiled area to use as a control We felt that the homogeneity of slopes methods which used the data in the control area would provide the most convincing evidence of recovery To look for additional evidence of recovery we also examined the trends in the oiled area alone

Trends recovery and lack of recovery

Winter populations of loons increased which suggests that they are recovering One should use caution interpreting the strength of this evidence, however, as the magnitude of increase (2%) in the oiled area is small and loons were increasing (4%) in the unoiled portion of PWS as well and the summer loon populations are not increasing

Harlequin Duck increased in the oiled area in the winter indicating recovery is occurring, however this result should be interpreted with the summer data, which indicated no recovery, and with the results from two other studies that presented evidence that injury is ongoing Results from a Harlequin Duck study demonstrated that oiled and unoiled populations became more divergent during 1995-1997, suggesting increasing oil spill effects (Rosenberg and Petrula 1998) Winter survival rates for adult female Harlequin Ducks were lower in oiled areas of PWS than the unoiled areas between 1995-1997 (Esler et al 2000), consistent with non-recovery Inconsistencies between our winter results and those of Rosenberg and Petrula (1998) may stem from the fact that our winter surveys were conducted in March, while Rosenberg and Petrula conducted surveys from July-September

Bufflehead in oiled areas of PWS showed an increasing population (7%), suggesting a trend of recovery for this taxa At the same time, however, populations in the unoiled areas were increasing (12%) and appeared to be diverging (although not significantly) from those in oiled areas These results again suggest the evidence showing Bufflehead recovery is weak

Summer densities of Northwestern Crow showed an increasing trend in oiled areas of PWS (3%), suggesting summer populations of this species may be recovering, however there is no indication that the winter population is recovering

A minimum of 8,400 murrelets (both Marbled and Kittlitz's murrelet) were killed directly by exposure to oil, representing about 7% of the population in the spill zone (Kuletz 1996) Our data showed that the winter population increased in the oiled area, suggesting recovery, however summer trends show no indication of recovery The numbers of murrelets that winter in PWS, are only 20-30% of summer populations We therefore conclude that murrelets in PWS as a whole are not recovering

Cormorants, murres, Mew Gull, Glaucous-winged Gull, Black Oystercatcher, grebes, and terns showed no signs of recovery in PWS All these taxa showed no change except Black Oystercatcher increased in the unoiled area and terns declined in both the oiled and unoiled areas No other long-term studies were published on these species except for the Black Oystercatcher Injury to Black Oystercatchers was documented for summer populations in 1989 and 1990 (Klosiewski and Laing 1994, Day et al 1997, Murphy et al 1997, Irons et al , *in review*) but effects had largely dissipated after 1991 (Murphy et al 1997, Irons et al , *in review*) Effects were primarily due to breeding disruption during 1989 and 1990 by disturbance associated with cleanup and bioremediation activities (Sharp et al 1996, Andres 1997) Studies conducted between 1992-93 (Andres 1999) found that effects from persistent shoreline oil on breeding success of oystercatchers were negligible More recently, Murphy and Mabee (1998) showed that oystercatchers had fully re-occupied territories and were nesting at oiled sites in PWS, concluding that oiling did not affect breeding biology and success of oystercatchers in 1998 Murphy and Mabee (1998) did, however, find significantly lower breeding success in oiled areas of PWS, attributing predation as the driving mechanism Predation on eggs and young can be high (Murphy and Mabee 1998, Andres 1999) and a dominant force in shaping oystercatcher populations, perhaps swamping out any oil effects on breeding success Thus, our lack of evidence for recovery in oystercatcher populations may be due to differential predation between oiled and unoiled portions of PWS, though any link between oil and predation is unclear

Injury to Pigeon Guillemots from the oil spill was documented for both winter (Klosiewski and Laing 1994) and summer populations in PWS (Murphy et al 1997, Irons et al , *in review*) Counts at Naked Island, PWS showed the population declined in the three years following the spill, and declines at colonies located along oiled shorelines were greater than unoiled sites (Oakley and Kuletz 1996) Absolute and relative trends of both summer and winter densities of Pigeon Guillemots in the oiled areas indicated no evidence of recovery for this species In fact, summer densities of birds in oiled areas showed significant negative trends

Our data on both summer and winter densities of scoters, mergansers, and goldeneyes in the oiled areas of PWS suggested no trend of recovery for these species Trends in the oiled area relative to the unoiled area showed densities in the oiled and unoiled areas of PWS were diverging, suggesting increasing impacts for scoters and mergansers in summer and winter and in winter for goldeneyes (Table1, Figs 2 and 3)

Negative impacts to kittiwakes from the oil spill were documented in PWS for summer populations (Irons et al , *in review*), however, these decreases were attributed to local shifts in foraging distributions related to temporally abundant food resources (e g forage fish schools) rather than declines in populations Trends of summer densities of kittiwakes in the oiled areas of PWS showed a significant decline (-8%), suggesting increasing impacts for this species In addition, the trends in the oiled area relative to the unoiled area showed summer densities in the oiled and unoiled areas of PWS were diverging, again suggesting increasing impacts Kittiwake productivity was lower than expected in the oiled area following the spill in 1989, while productivity in the unoiled area was high Productivity declined even more in the oiled area and declined in the unoiled area through 1994 (Irons 1996) Poor productivity in oiled areas of PWS may have translated to low recruitment and may partially explain the negative trend in summer densities

While there were no clear differences in recovery in regards to taxa type (i e , piscivore vs non-piscivore, diver vs non-diver), it should be noted that there were differences in which taxa were impacted by the oil spill More diving taxa were impacted than surface-feeding taxa (Irons et al in review) and more nearshore taxa were impacted than offshore taxa (Klosiewski and Laing 1994, Wiens et al 1996, Agler and Kendall 1997, Day et al 1997, Murphy et al 1997, Irons et al in review)

Overall we analyzed 29 marine bird populations in the oiled area (15 taxa in summer and 14 taxa in winter), using two methods If a trend existed using either method (absolute change in the oiled area or change in the oiled area relative to unoiled area) we allowed that there was a trend for that population Of these 29 populations, 5 showed increasing trends in the oiled area and 8 showed decreasing trends in the oiled area, and 16 showed no significant trend (Table 2) We interpreted these data to suggest that little recovery is occurring in the oiled area of PWS Additionally, it should be noted that although few populations in the oiled area increased, 50% of the populations in the unoiled area increased during winter (Table 2)

Comparison of our results to other studies is limited because there have been few long-term studies that have evaluated recovery of marine birds from oil spills, especially ones that have used data collected at-sea rather than at a seabird colony Most post-spill studies last only a few years (see Piatt et al 1991, Burger 1994) After the *Exxon Valdez* oil spill, several studies were concluded after three years (Day et al 1997, Murphy et al 1997, Wiens et al 1996) However, there appears to be considerable variation in the recovery time of marine birds from oil spills Several studies have found evidence recovery was occurring within a few years after a spill (see Piatt et al 1991, Parsons 1994, Day et al 1997, Murphy et al 1997, Wiens et al 1996) Although, Atlantic Puffins (*Fratercula arctica*) Common Murres (*Uria aalge*) and Razorbills (*Alca torda*) had not fully recovered after the Amoco Cadiz oil spill six years later (see Piatt et al 1991) and Roseneau et al (1999) did not see clear evidence of murre recovery at the Barren Islands colony in Cook Inlet, Alaska for several years after the *Exxon Valdez* spill There is also evidence that recovery of invertebrate populations from oil spills in salt marshes may take several years to complete (Krebs and Burns 1977)

Evidence for the oil spill as a possible mechanism for lack of recovery

In addition to being exposed to oil at the time of the spill, organisms continued to be effected by Exxon Valdez oil that has persisted in PWS for years Shoreline habitats in oiled regions were impacted to various degrees by oiling Natural weathering and flushing by high wave energy reduced the amount of oil in some areas However, as of 1997 some protected, low-energy beaches that were oiled by the EVOS still contained oil in sediments and mussel beds (Babcock et al 1996, Irvine et al 1999, Irvine unpubl data, Hayes and Michel 1999) Further, the *Exxon Valdez* oil, that remained in mussel beds was in a relatively unweathered state and was the source of contamination of mussel and other intertidal organisms (Harris et al 1996)

Most of the taxa that were injured by the oil spill inhabit or forage in the shallow nearshore waters or in the intertidal zone of PWS Prey include benthic invertebrates (e g , mussels, and clams), demersal fish (e g , blennies and sculpins), and schooling forage fish (e g , sand lance [Ammodytes hexapterus] and Pacific herring [Clupea pallasi]) (Duffy 1999) In addition to the contamination of the mussels and associated organisms other prey taxa were reduced and had not recovered for years after the spill Pacific herring were impacted by the spill (Brown et al 1996) and had not recovered by 2000 (Mark Willette, AK Dept Fish and Game, unpubl data), although the reason for lack of recovery is not clear Clam populations were reduced after the spill and had not recovered by 1997 (Peterson in press)

The Nearshore Vertebrate Predator Project (Ballachey et al 1999, Ballachey unpubl data) assessed exposure of marine birds in PWS to oil using expression of cytochrome P4501A, an enzyme induced by exposure to polynuclear aromatic hydrocarbons or halogenated aromatic hydrocarbons Higher levels of P4501A induction were found in oiled areas than unoiled areas for three marine bird taxa (e g Harlequin Duck, Barrow's Goldeneye, Pigeon Guillemot) in 1997, 1998, or (and) 1999 Results also suggest that contaminated Pigeon Guillemots had more organ damage than non-contaminated ones (Ballachey unpubl data) The P4501A data are clear evidence of greater contaminant exposure in oiled areas of PWS relative to unoiled areas (Ballachey et al 1999) It is not known, however, what amount of oil is necessary to induce P4501A at the levels detected or the health consequences (e g survival, reproduction) of that much oil

Cumulative impacts natural variation, oil spills, and recovery

Using trend data alone to assess impacts and recovery from a perturbation such as the EVOS are confounded by effects of natural temporal and geographic variation inherent in wildlife populations (Piatt et al 1991, Spies et al 1996, Wiens and Parker 1995) Population dynamics of marine birds may be carried out at large temporal and spatial scales (Wiens et al 1996, Piatt and Anderson 1996) and against a backdrop of high natural variation in the marine environment (Piatt and Anderson 1996, Hayward 1997, Francis et al 1998) Movement of birds between and within wintering and breeding grounds (Stowe 1982), juvenile dispersal (Harris 1983), and large pools of non-breeding individuals (Porter and Coulson 1987, Klomp and Furness 1992), may serve to mask local population changes, effectively buffering local effects over a broader region Some studies of the EVOS (Day et al 1997, Wiens et al 1996) suggested that marine bird populations have a good deal of resiliency to severe but short-term perturbations, including the EVOS This view is supported by the occurrence of large natural die-offs and reproductive failure of marine birds associated with reduced food supply and storms (Harris and Wanless 1984, Piatt and Van Pelt 1997) Interestingly, effects of these large die-offs on local populations are often difficult to detect or are small and transitory at the scale of most monitoring programs (Dunnet 1982, Stowe 1982, Harris and Wanless 1984, Piatt et al 1991, Wooller et al 1992) Further, it is widely believed that marine bird populations, which have a 5-20% natural annual adult mortality rate, are limited by food resources (Piatt et al 1991) Under stable conditions this mortality would be compensatory (e g balanced by recruitment of adults into the breeding population)

This raises the question of the ability of marine birds to respond to long-term, chronic perturbations In particular, if perturbations act in concert to have an additive effect on populations already stressed by other factors (e g food shortages, winter storms, introduced predators, gill nets, disease, and long term oceanographic changes) In this study, we assumed that in the absence of an oil spill, marine bird populations in the oiled and unoiled portions of PWS, all things being equal, would exhibit similar trends, and as such, should have been affected to a similar degree by natural perturbations such as those at the scale of the North Pacific regime shift (Hayward 1997, Francis et al 1998) Agler et al (1999) compared surveys of marine birds in PWS in July 1972 with post-spill surveys in July 1989-1991, and 1993, and found that populations of several species of marine birds that feed on fish (loons, cormorants, mergansers, Bonaparte's Gull, Glaucous-winged Gull, Black-legged Kittiwake, Arctic Tern, Pigeon Guillemot, murrelets, Parakeet Auklet, and puffins) had declined, while most those species feeding on benthic invertebrates (goldeneyes, Harlequin Duck, and Black Oystercatcher) did not decline Similarly, many of the marine bird taxa showing declines in PWS declined on the Kenai Peninsula prior to the oil spill (Agler et al 1999) Agler et al (1999) suggested declines in piscivorous marine birds were at least partially due to changes in the relative abundance of certain forage fish species that occurred during the climatic regime shift in the north Pacific Ocean in the mid 1970's (Hayward 1997, Francis et al 1998, Anderson and Piatt 1999) Of the 14 taxa showing declines in PWS between 1972 and 1989-1993 (Agler et al 1999), eight (loons, cormorants, scoters, mergansers, Black-legged Kittiwake, terns, Pigeon Guillemot, and murrelets) were shown to have been negatively affected by the oil spill (Klosiewski and Laing 1994, Day et al 1997, Wiens et al 1996, Murphy et al 1997, Irons et al , *in review*) Of these eight species, none showed evidence of recovery based on our trend data for summer densities and only two (loons and murrelets) showed evidence of recovery based on winter densities Thus, it appears that these taxa may be responding to the cumulative impacts of the regime shift (lowered prey availability and quality) and the oil spill, slowing recovery at the population level

Our data revealed that most taxa for which injury was previously demonstrated were not recovering and some were showing increasing effects of the oil spill Lack of recovery as measured by comparing trends in densities of birds between oiled and unoiled areas of PWS, as well as trends in the oiled area alone may occur for several reasons First, recovery is not occurring because of persistent oil spill effects (e g expression cytochrome P4501A, Ballachey et al 1999) Second, recovery is not occurring because factors causing pre-spill declines (e g regime shifts, Piatt and Anderson 1996) may still be affecting some species Examination of long-term oceanic climate cycles in the Gulf of Alaska suggests a small scale regime shift may have occurred in 1990 (see Anderson and Piatt 1999) Third, density dependent mechanisms (e g lowered carrying capacity of the environment) may be operating on populations in PWS effectively stalling recovery at the population level That is, populations may currently have the capacity to increase or maintain numbers, so that when environmental conditions cycle back to pre-spill levels, population growth is likely (see Ainley and Nur 1997) Fourth, recovery may actually be occurring through fecundity, survival, or immigration, but it is not yet detectable as an increasing population because marine birds are k-selected and intrinsic rates of natural recovery from initial acute mortality events may be slow Fifth, recovery may actually be occurring but the magnitude of the initial injury may be small relative to pre-spill populations In this situation it may be difficult to demonstrate a difference in slopes from the two populations, particularly given the high annual variation for most taxa Additionally, increasing effects or lack of recovery may be a result of the delayed expression of an effect due to substantial time lags between initial impacts and expression at the population level Time lags may be a consequence of the buffering of fluctuations in local population size, low power of many monitoring studies, and by density-dependent processes (Temple and Wiens 1989)

Whether recovery is occurring nine years after the oil spill is important, because if it is not, then it suggests that the habitat or prey base of these taxa may be negatively affected relative to pre-spill conditions Negative effects on habitat and prey may be a consequence of anthropogenic events (e g oil spills, commercial fishing) or natural oceanographic cycles, or both

Interpreting and defining recovery

Assessment of recovery from a perturbation is dependent upon the null hypothesis generated, the statistical test used and it's associated power, and how recovery is defined Numerous analytical methods have been used in assessing impacts and recovery of marine birds in PWS following the EVOS (Klosiewski and Laing 1994, Wiens et al 1996, Day et al 1997, Murphy et al 1997, Irons et al , *in review*) These methods differ in their approach, at times producing seemingly different results, or more appropriately the interpretation of those results, from similar data Currently, there is no consensus on which methodology is the most suitable for assessing recovery, a pattern consistent with most studies monitoring long-term population change in birds (Thomas 1996)

Wiens and Parker (1995) defined impact as a statistically significant correlation between injury and exposure, recovery being the disappearance of such a correlation through time In short, the burden of proof is placed on the data to establish injury, but not to establish recovery This definition has been used by several studies (Wiens et al 1996, Day et al 1997, Murphy et al 1997, and Irons et al , *in review*) to assess injury and recovery of marine birds in PWS following EVOS In these studies rejection of the null hypothesis (no difference) constituted an effect, and the failure to reject in subsequent years was defined as recovery In contrast, Agler and Kendall (1997) compared bird population trends from oiled and unoiled areas, defining recovery as an increase in birds in the oiled area relative to the unoiled area (homogeneity of slopes test) Here the rejection of the null hypothesis is interpreted as recovery if impacted populations have rates above those of the reference area The failure to reject the null constituted non-recovery status The burden of proof is placed on the data to establish recovery in this case The result of these various definitions of recovery (based on different criteria) is that data collected on the same population of birds can produce different conclusions regarding recovery status Thus, while the proximate definition of recovery is based on objective analytical criteria, the ultimate definition is dependent on the more subjective choice of statistical model and numerical values of criteria employed In our opinion, rigid application of these definitions of recovery accounts for much of the divergence in conclusions over the impacts and recovery of marine bird populations in PWS following the EVOS (Wiens et al 1996, Day et al 1997, Murphy et al 1997, Irons et al *in review*, this study)

In summary, our study indicates that most taxa for which injury was previously demonstrated are not recovering and others continue to show potential population effects nine years after the oil spill We show evidence of slow recovery, lack of recovery, and divergent population trends in many taxa which utilize shoreline and nearshore habitats where oil is likely to persist These potential lingering spill effects and natural variability appear to be acting in concert in delaying recovery of many PWS bird populations

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TABLE 1

Common and scientific names of bird species/species groups mentioned in text

Taxa	Common Name	Scientific Name
loons	Red-throated Loon	*Gavia stellata*
	Pacific Loon	*Gavia pacifica*
	Common Loon	*Gavia immer*
	Yellow-billed Loon	*Gavia adamsii*
grebes	Horned Grebe	*Podiceps auritus*
	Red-necked Grebe	*Podiceps grisegena*
cormorants	Double-crested Cormorant	*Phalacrocorax auritus*
	Pelagic Cormorant	*Phalacrocorax pelagicus*
	Red-faced Cormorant	*Phalacrocorax urile*
Harlequin Duck	Harlequin Duck	*Histrionicus histrionicus*
scoters	Black Scoter	*Melanitta nigra*
	Surf Scoter	*Melanitta perspicillata*
	White-wing Scoter	*Melanitta fusca*
goldeneyes	Common Goldeneye	*Bucephala clangula*
	Barrow's Goldeneye	*Bucephala islandica*
Bufflehead	Bufflehead	*Bucephala albeola*
mergansers	Common Merganser	*Mergus merganser*
	Red-breasted Merganser	*Mergus serrator*
Black Oystercatcher	Black Oystercatcher	*Haematopus bachmani*
Mew Gull	Mew Gull	*Larus canus*
Glaucous-winged Gull	Glaucous-winged Gull	*Larus glaucescens*
Black-legged Kittiwake	Black-legged Kittiwake	*Rissa tridactyla*
terns	Caspian Tern	*Sterna caspia*
	Arctic Tern	*Sterna paradisaea*
	Aleutian Tern	*Sterna aleutica*
murres	Common Murre	*Uria aalge*
	Thick-billed Murre	*Uria lomvia*
Pigeon Guillemot	Pigeon Guillemot	*Cepphus columba*
murrelets	Marbled Murrelet	*Brachyramphus marmoratus*
	Kittlitz's Murrelet	*Brachyramphus brevirostris*
Northwestern Crow	Northwestern Crow	*Corvus caurinus*

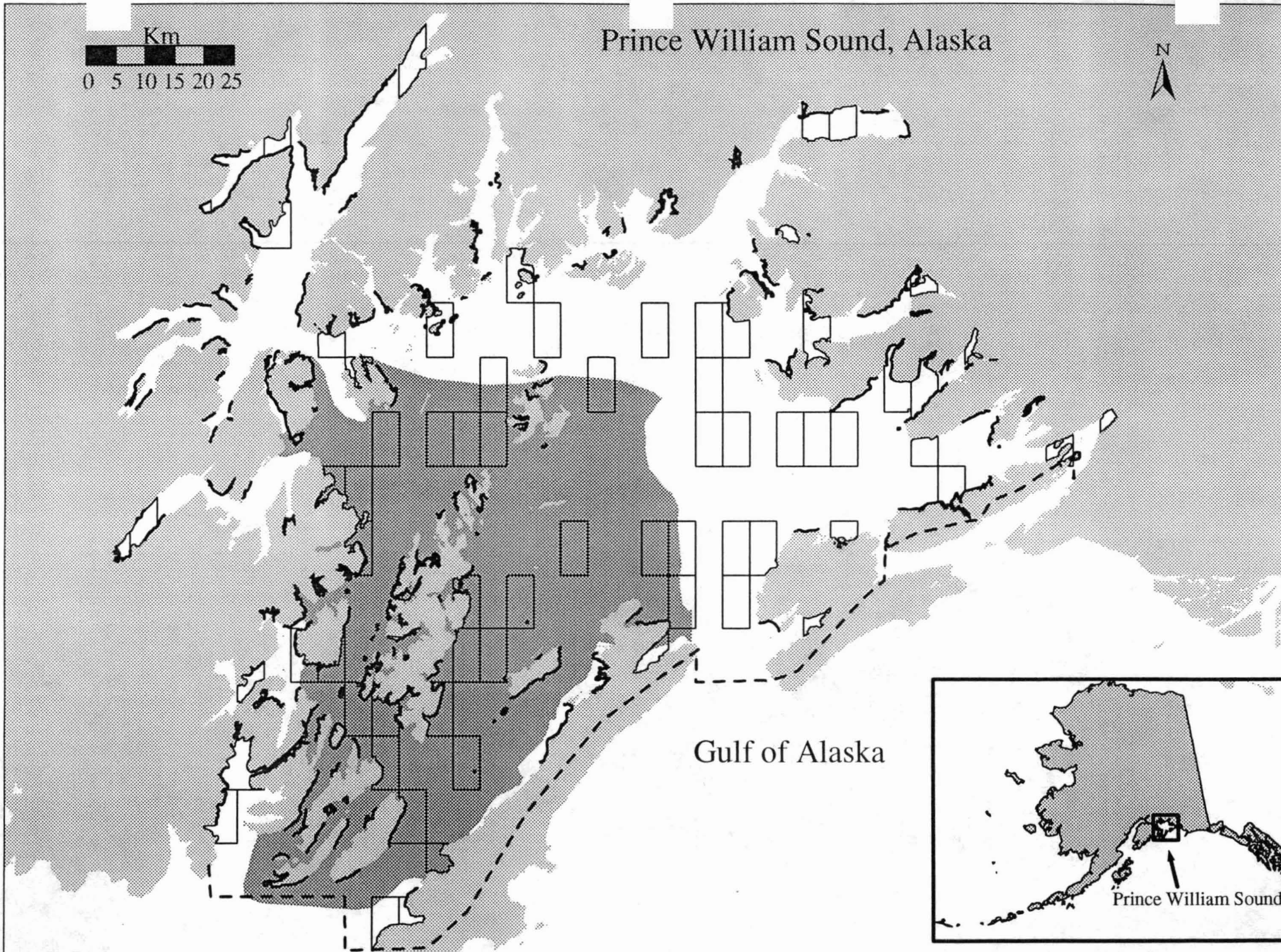
TABLE 2

Summary of statistically significant (*=$P \leq 0.20$, **=$P \leq 0.10$, ***=$P \leq 0.05$, ****=$P \leq 0.01$) trends in post-spill densities of marine birds in Prince William Sound, Alaska, after the *Exxon Valdez* oil spill. Trends for the oiled and unoiled areas were determined by regression analyses and refer to an absolute change in the oiled or unoiled area. Trends in oiled area relative to the unoiled area were determined by homogeneity of slopes test and refer to change in the oiled area relative to the unoiled area (+1 = increasing density, 0 = no change, and -1 = decreasing density). An increasing trend in the oiled area, whether absolute or relative to the unoiled area, suggests recovery is occurring. No absolute or relative change in the oiled area or a negative trend in the oiled area suggests that recovery is not occurring. A negative trend in the oiled area relative to the unoiled area suggests that the impact is increasing with time.

Taxa	Oiled Area		Oiled Area Relative to Unoiled		Unoiled Area	
	Trend in July	Trend in March	Trend in July	Trend in March	Trend in July	Trend in March
Harlequin Duck	0	+1**	0	0	0	0
murrelets	0	+1*	0	0	0	0
loons	0	+1*	0	0	0	+1*
Bufflehead	nd[1]	+1**	nd	0	nd	+1***
Northwestern Crow	+1**	0	0	0	+1***	+1***
Black Oystercatcher	0	nd	0	nd	+1*	nd
murres	0	0	0	0	0	+1*
cormorants	0	0	0	0	0	0
Mew Gull	0	0	0	0	0	0
Glaucous-winged Gull	0	0	0	0	0	0
grebes	nd	0	nd	0	nd	-1*
Pigeon Guillemot	-1***	0	0	0	0	0
terns	-1**	nd	0	nd	-1*	nd
Black-legged Kittiwake	-1**	nd	-1*	nd	0	nd
scoters	0	0	-1*	-1***	+1****	+1**
mergansers	0	0	-1*	-1*	0	+1**
goldeneyes	0	0	0	-1*	0	+1**

[1] nd = no data, Birds were either not present or too rare to analyze during this season.

Fig 1 Map showing the oiled and unoiled transects surveyed in Prince William Sound during July 1989, 1990, 1991, 1993, 1996, and 1998 and March 1990, 1991, 1993, 1994, 1996 and 1998 A subset of transects were surveyed during July 1989 and during the March surveys



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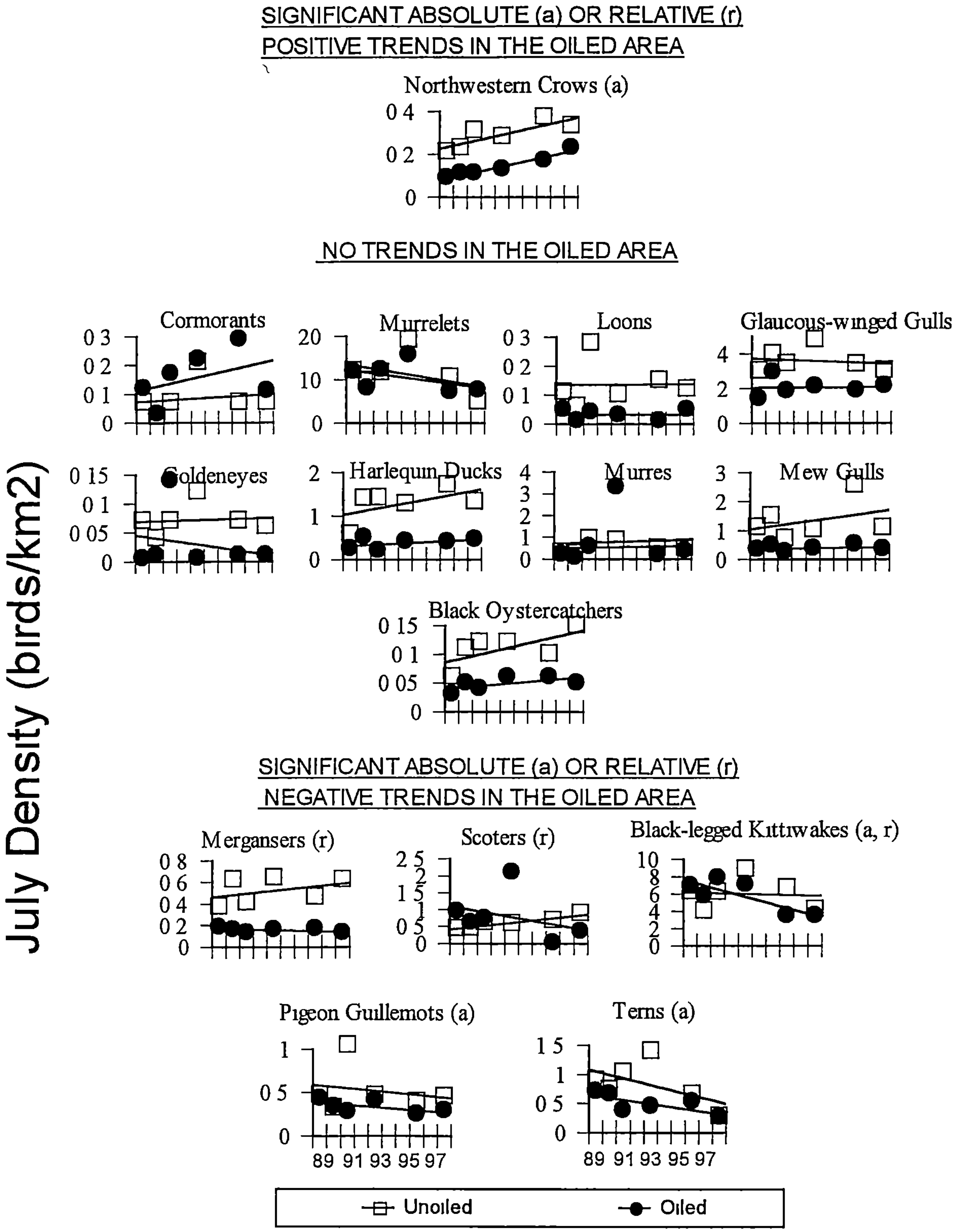

Figure 2 Changes in July densities of taxa, between 1989 and 1998, in unoiled (squares) and oiled (circles) areas of Prince William Sound, Alaska Absolute trend (a) refers to a statistically significant trend in the oiled area, relative trend (r) refers to a statistically significant trend in the oiled area relative to the unoiled area

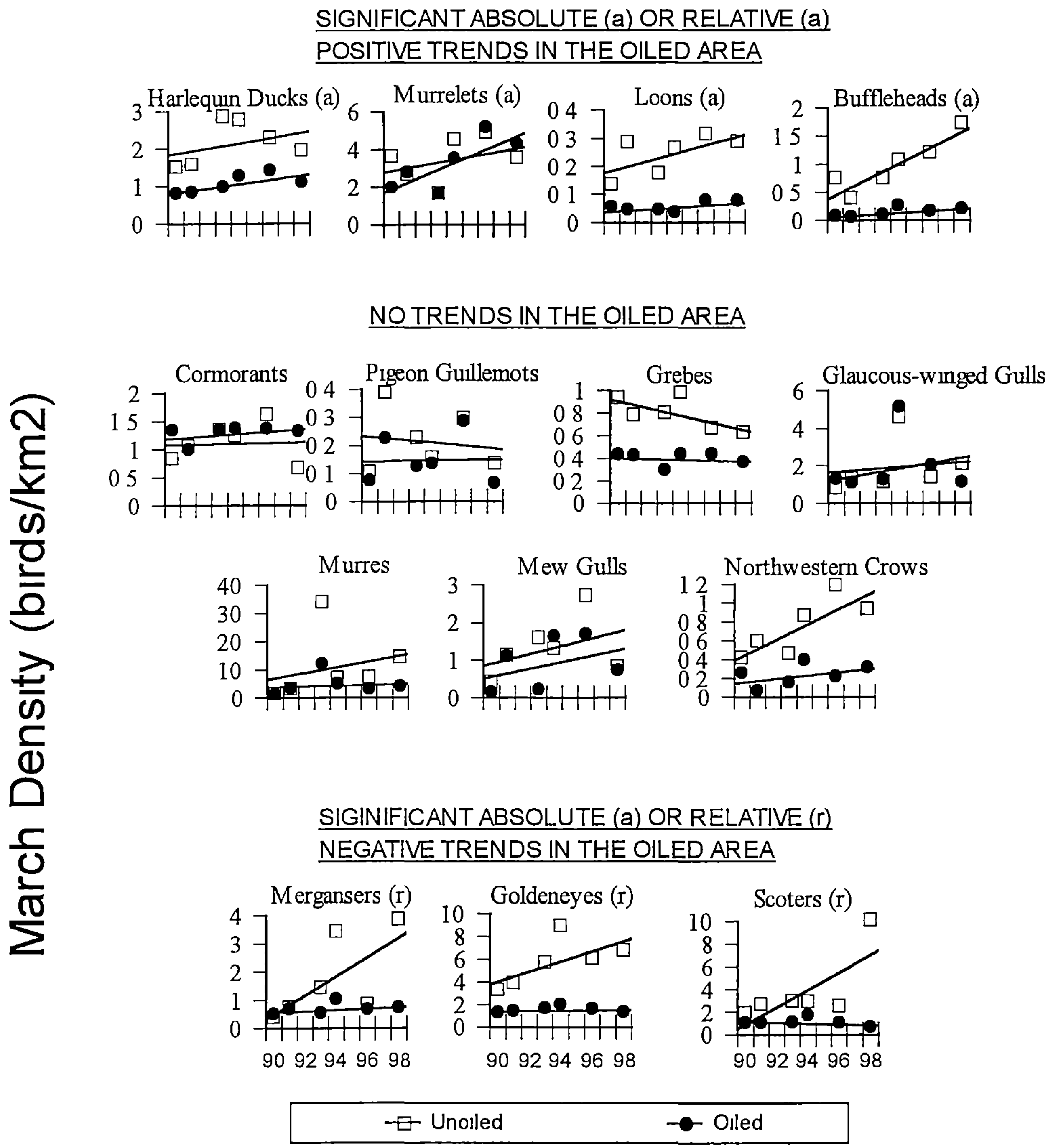

Figure 3 Changes in March densities of taxa, between 1989 and 1998, in unoiled (squares) and oiled (circles) areas of Prince William Sound, Alaska Absolute trend (a) refers to a statistically significant trend in the oiled area, relative (r) trend refers to a statistically significant trend in the oiled area relative to the unoiled area

Brenda Hall

From: Elaine Major [anebg@UAA.ALASKA.EDU]

Sent: Wednesday, August 02, 2000 11:27 AM

To: Brenda_Hall@oilspill.state.ak.us

Subject: monitoring

Hi Brenda,
I am a researcher in aquatic ecology with the University of Alaska Anchorage's Environment and Natural Resources Institute. Phil forwarded me his comments to you about the Cook Inlet Focus Group. I agree completely with Phil and am writing to let you know that ENRI is developing the tools that Phil referred to in his email. We are also evaluating some of the other questions he asked. I would be interested to see what you are doing or interested in developing as a monitoring program. Some of our information is posted on the website link included at the bottom of this message. It might be useful to talk about the monitoring sometime so that there is consistency statewide with the information collected to avoid duplication of effort. I'll be out all next week but maybe we can talk sometime this fall. Thanks, Elaine Major

Phil wrote:
"As far as watersheds goes, ADEC is using 319 funds to support development of tools to economically monitor streams. Monitoring streams is probably the place to start in monitoring watersheds because streams integrate watersheds to a sinlge point. Everything upstream drains past a single point in a stream. Macroinvertebrates are probably the best way to monitor streams because they describe the stream. The assemblage of macroinvertebrates consists of an array of sensitive to hardy taxa that accupy the range of niches available in the stream. The different taxa respond to different perterbations of the stream.

If you are interested you could accelerate the usability of this tool by helping to answer remaining questions. Specifically the questions are:
1. Given that taxa emerge from the stream at different times, what difference does sample timing make to the interpretation of results? (I think DEC is funding this work now).
2. Streams can be classified by morphology (Rosgen and Montgomery are two stream classification systems based on stream morphology and/or process). Streams with different morphology offer organisms different habitats and therefor are likely to have an overlapping but different set of taxa. Does this make a difference when interpreting the results of macroinvertebrate monitoring.
3. The imature stages of most macrinvertabrate taxa are not identifiable to species. Identification to species might provide a greater degree of sensistivity to interpretation of results. For many taxa this work may be a matter of rearing imature stages to adult and building a key.

Of course there are limits to this method. Slowly developing changes in the watershed may not show up down stream for some time, such as soil contamination. Also macroinvertabrates are adapted to the dynamic nature of their habitat. They may not be affected by, or may rapidly recover from extreme hydrologic events. This may mask a change that is insidious such as gradual changes in hydrology due to gradual hardening of land surface by development. The proverbial horse may be out of the barn by the time a change is apparent. So a combination of montoring methods may be best. Perhaps monitoring macroinvertebrates, urbanization and hydrology would be a good combination. Though any of these would be a great improvement over what we have now, which is nothing.

One last comment and a repeat of my comment at the focus group: it may not be a good idea to depend on agency funding to compliment or partner with your monitoring effort Most of our funding is in question on a year to year basis Unless you only partner where there is a demonstrated commitment to long term monitoring you may find the consistency of your data to be compromised Again, I am very excited about the idea of a monitoring project that will be supported over a very long period Thanks for doing this "

Elaine Major
UAA-ENRI, 707 A St, Anchorage, AK 99501
Ph (907) 257-2731, Fax (907) 257-2707
http //www uaa alaska edu/enri/bmap

FOCUS GROUP WORKBOOK

For the

DRAFT
Gulf Ecosystem Monitoring Plan
July 26, 2000

LOOK INLET

NAME Mundy ______________________________

AFFILIATION ______________________________

MAILING ADDRESS ______________________________

____

TELEPHONE ____________________

E-MAIL ______________________________

Exxon Valdez Oilspill Restoration Office
645 G Street Suite 401
Anchorage, AK 99501-3451
907-278-8012
gem@oilspill state ak us

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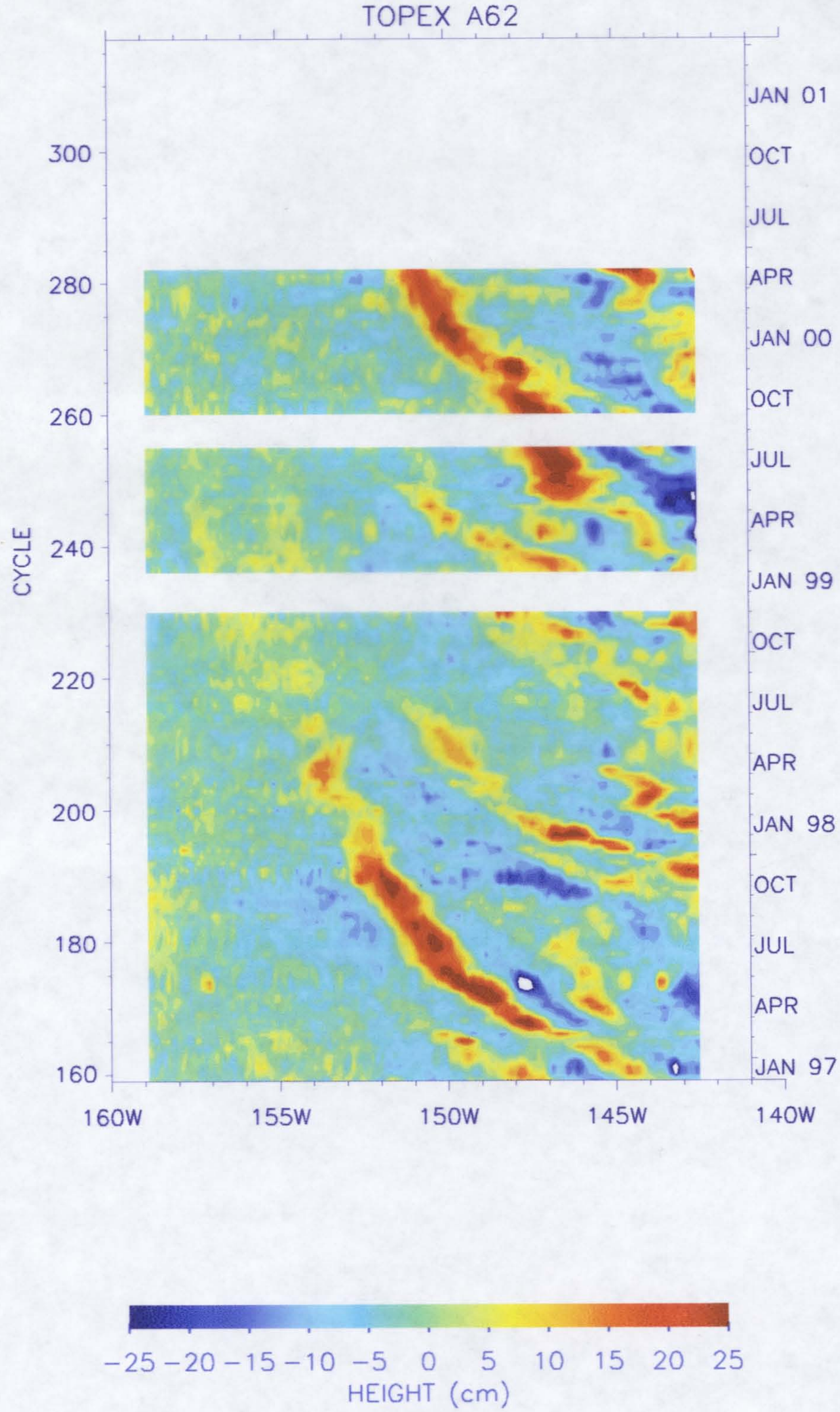
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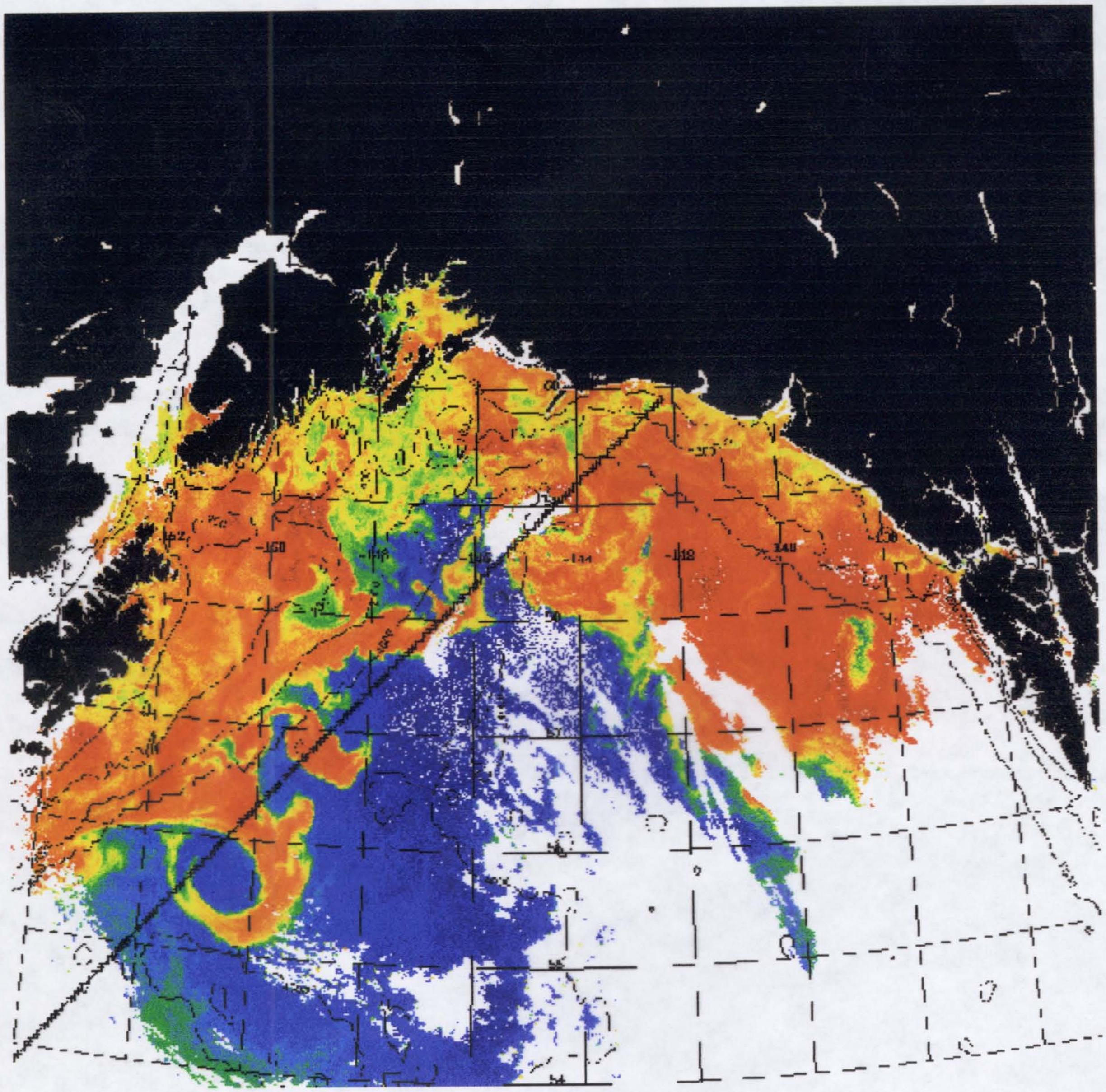

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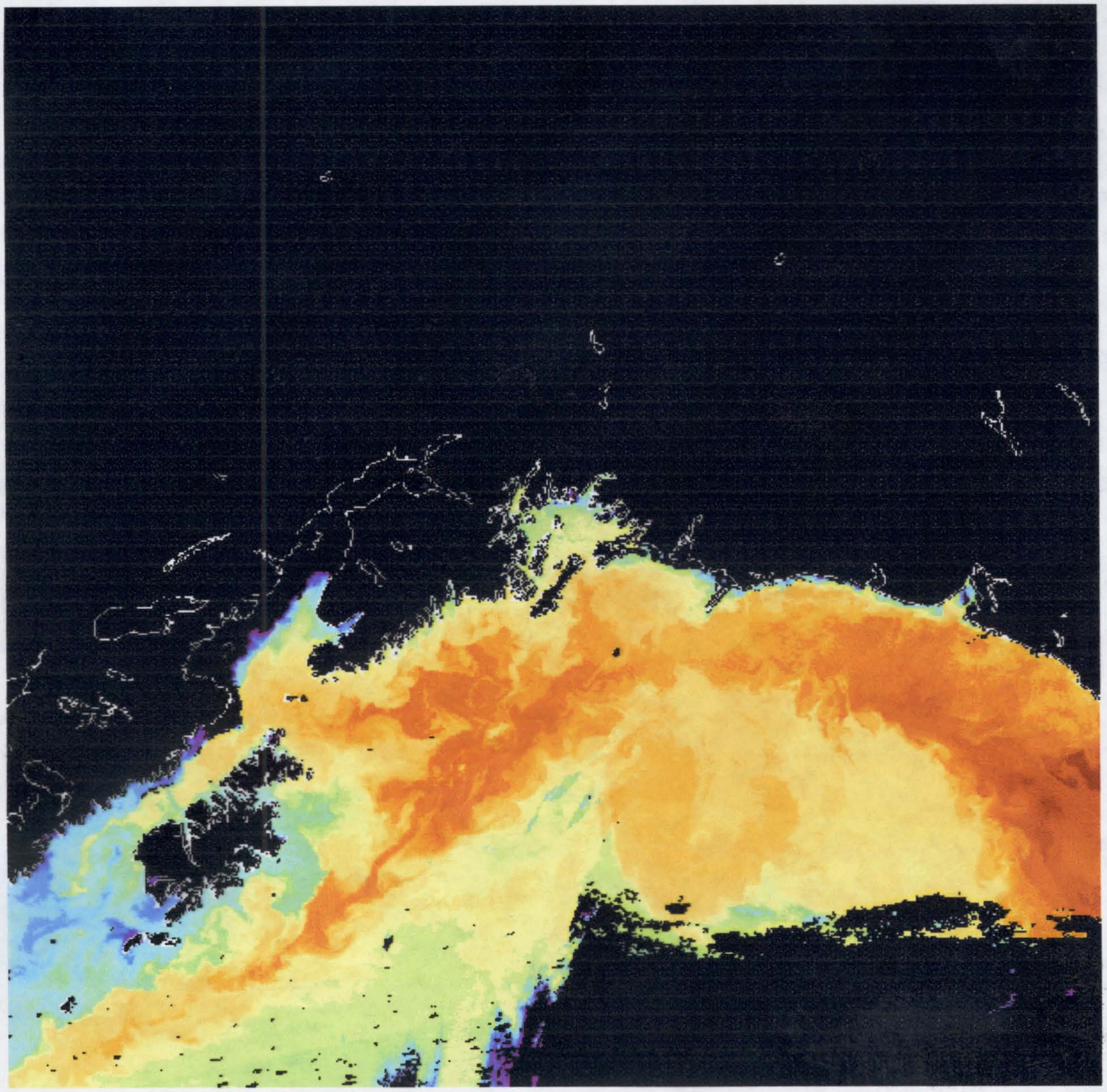

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MAR 90

GULF ECOSYSTEM MONITORING PLAN
FOCUS GROUP AGENDA
Cook Inlet/Kenai Peninsula
Wednesday, July 26, 2000
10 a.m – 5·30 p m
***Exxon Valdez* Restoration Office**
645 G Street Suite 400, Anchorage, AK 99501-3451
907-800-478-7745 or 907-278-8012
Design a regionally implemented, globally coordinated and integrated monitoring program

10 00 INTRODUCTIONS OF PARTICIPANTS - MUNDY

10 05 Opening remarks - McCammon

10 15 Scientific legacy & conceptual foundation of GEM region - Spies

10 45 Orientation to the focus group process - Mundy

11 00 Criteria for project selection and definitions of terms – Mundy & Focus Group

12 00 Lunch break (on your own)

1 00 Gap analysis - metadatabase – Focus Group

1 30 Major themes of the draft monitoring plan - Mundy
1 40 Harbor seal theme – Focus Group
2 20 Kittiwake/murre theme– Focus Group

3 00 Coffee break

3 15 Sandlance/herring/salmon theme – Focus Group

4 00 Use of themes as monitoring approach
Other themes, other approaches
Do themes capture regional interests?

4 30 Post-mortem – Focus Group

5 00 Adjourn

GEM PROGRAM MISSION

The mission of the GEM program is to "***sustain a healthy and biologically diverse marine ecosystem in the northern Gulf of Alaska (GOA) and the human use of the marine resources in that ecosystem through greater understanding of how its productivity is influenced by natural changes and human activities*** " In pursuit of this mission, the GEM program will sustain the necessary institutional infrastructure to provide scientific leadership in identifying research and monitoring gaps and priorities, sponsor monitoring, research, and other projects that respond to these identified needs, encourage efficiency in and integration of GOA monitoring and research activities through leveraging of funds and interagency coordination and partnerships, and involve stakeholders in local stewardship by guiding and carrying out parts of the program

GEM PROGRAM GOALS

GEM has five major programmatic goals in order to accomplish its mission

DETECT Serve as a sentinel (early warning) system by detecting annual and long-term changes in the marine ecosystem, from coastal watersheds to the central gulf,

UNDERSTAND Identify causes of change in the marine ecosystem, including natural variation, human influences, and their interaction,

PREDICT Develop the capacity to predict the status and trends of natural resources for use by resource managers and consumers,

INFORM Provide integrated and synthesized information to the public, resource managers, industry and policy makers in order for them to respond to changing conditions, and

SOLVE Develop tools, technologies, and information that can help resource managers and regulators improve management of marine resources and address problems that may arise from human activities

Given the size and complexity of the ecosystem under consideration and the available funding, it will not be possible for GEM, by itself, to meet these goals Addressing them will require focusing on the institutional goals to

IDENTIFY research and monitoring gaps currently not addressed by existing programs,

LEVERAGE funds from other programs,

PRIORITIZE research and monitoring needs,

SYNTHESIZE research and monitoring to advise in setting priorities,

TRACK work relevant to understanding biological production in the GOA, and

INVOLVE other government agencies, non-governmental organizations, stakeholders, policy makers, and the general public in achieving the mission and goals of GEM

GUIDING PRINCIPLES FOR MARINE MONITORING

Understand changes in marine ecosystems

There is a general consensus among designers and operators of marine research and monitoring programs in Alaska, the United States, and world-wide that marine resource management agencies and marine resource dependent communities and industries need reliable sources of information and tools that enable them to cope with changes in living and physical marine resources The consensus holds that using the marine environment safely and responsibly requires abilities to recognize, understand and anticipate changes in the marine environment There is also general agreement that coping with change requires the ability to distinguish between natural and human induced changes in all aspects of marine ecosystems

Synthesize information from all sources

Understanding changes in marine ecosystems requires understanding the relations among many types of information, such as weather and fish production Changes in marine resources are caused by a combination of biological, geophysical and human forces Natural variability in the physical environment causes shifts in relations among species, which changes the overall productivity of the region's marine ecosystems Human impacts can lead to environmental degradation, including increased levels of contaminants, loss of habitats, and increased mortality on certain species in the ecosystem that may trigger changes in species composition and abundance

Coordinate planning for research and monitoring

Understanding changes in marine ecosystems requires marine resource management agencies and marine resource dependent communities and industries to work in concert to identify critically important information and analyses Coordination is essential to enhance and maintain broad discussion among the marine scientific community on the most direct and effective ways to understand and address issues related to maintaining the health of the region's marine ecosystems

Integrate information gathering and utilization

Understanding changes in marine ecosystems improves when concerned parties cooperate to develop the tools for information gathering and sharing Research and monitoring activities should be conducted by means that stimulate the development of data gathering and sharing systems that will serve scientists in the region and beyond from government, academia, and the private sector in maintaining the health of the region's marine ecosystems

INTRODUCTION

The role of the focus group in GEM

The focus group process is the start of the second stage of a four-stage process of planning and implementing the Trustee Council's participation in monitoring the marine ecosystems of the northern Gulf of Alaska

A four-stage process of planning and implementing regional monitoring

1 Establishment of policies, dedication of funding and scientific scoping - **GEM Program**
2 What to monitor and approximately where and when to measure it, what complementary research is necessary to illuminate monitoring – **GEM Monitoring and Research Planning**
3 Statistical precision and power, costs, technical feasibility - **GEM Fine tuning FY01-03**
4 TC adopts and implements first GEM Work Plan – **GEM Implementation**

Initial implementation of the GEM Monitoring Plan is envisioned to start a cycle that periodically revisits the essentials of stages 2 – 4 for as long as the GEM program exists The issues of what to research and monitor, where and when to measure it, what statistical power and precision are necessary, affordability and technological strategies and capabilities will be reviewed, and possibly modified, at regular intervals over the life of the program

How the focus group works

Focus group participants are to respond orally and in writing to materials presented at the meeting The advice will be gathered in writing from the workbooks submitted by focus group members, and orally on the basis of a transcript of the meeting Information from the focus group workbooks and meeting transcripts will be used by the team writing the version of the Draft GEM Monitoring Plan that serves as the starting point for the October Workshop

After initial background presentations on the context for the GEM Monitoring Plan and the focus group process, two types of propositions will be given to the group for response The first set contains criteria for evaluating monitoring projects and themes, and the second set contains examples of monitoring themes and projects organized around these themes (see Agenda above)

Focus group participants should target their review comments to the appropriateness of the criteria, identification of the most pressing data needs, the use of the theme approach to monitoring, whether or not the suggested themes capture the ecological system of the northern gulf marine ecosystem, as well as the potential human impacts of greatest concern Time has not been provided for participants to make formal presentations on their own candidate projects, although participants have the opportunity to make recommendations for other projects in response to the GEM theme projects

What the focus group is to produce

The focus group process is intended to produce a broad range of written and oral advice which will be used in producing the Draft Research and Monitoring Plan for the October Workshop

Criteria and approach to the overall GEM program

Normal agency Management.

The 1994 EVOS Restoration Plan included 21 policies, many of which will continue to be appropriate for the overall GEM program, while others will no longer be appropriate Those that may be appropriate include the following

- Projects will be solicited through a competitive process
- Possible negative effects on resources or services must be assessed in considering restoration projects
- Projects must be conducted as efficiently as possible, reflecting a reasonable balance between costs and benefits
- Priority shall be given to projects that involve multi-disciplinary, interagency, or collaborative partnerships
- Projects will be subject to open, independent scientific review
- Past performance of the project team should be taken into consideration when making funding decisions on future projects
- Restoration must include meaningful public participation at all levels -- planning, project design, implementation, and review
- Restoration must reflect public ownership of the process by timely release and reasonable access to information and data

Further criteria for evaluating monitoring projects

In order to select a project for the GEM Monitoring Plan it is necessary to have a set of criteria to apply The explanation for each GEM Monitoring Project should contain a complete map of the information needed to understand the roles of the species in the ecosystems it occupies, and to understand the mechanisms of change in the GEM species and allied species In many cases the information necessary will not be available, and those data gaps need to be specified In order to ensure that the map is complete, the project is compared to a series of lists of important features in the ecosystem and the individual species, and criteria appropriate to a "crossroads" GEM species project **Please see Appendices A and B for lists of topics on which to base criteria for project selection** Examples of questions addressing major are given below

Monitoring Does the project be responsive to the legal and regulatory mandates of government agencies For example, does the information acquired address a specific management issue or concern? Examples of legal mandates include the requirements of the Marine Mammal Protection Act and the Endangered Species Act Examples of regulatory mandates include harvest limitations and permit requirements Other mandates relate to marine habitat protection, ecosystem-based management of fisheries, etc

Projects must contribute to meeting identified human uses or needs or to managing human impacts
Human uses or needs may be related to economics (for example, subsistence and commercial fishing, recreational activity, or scientific resources), health and safety (for example, clean food or navigation), passive uses (such as wilderness or non-consumptive use of fish and wildlife) or culture (for example, subsistence) Human impacts include such activities as oil and gas development, hatcheries, tourism, and logging Global climate change is another example of a human impact

Does the project contribute tools to be used by agencies or user groups Managers concerned with fishing regulations, environmental permitting, water quality criteria and critical habitat definition have specific needs for which scientific monitoring and research information may be tailored

Does the project detect, help better understand, or improve prediction of changes in marine ecosystems? (Change may be due to human or natural causes)
In addition to traditional field activities, appropriate project activities include synthesizing information from various sources, planning for research and monitoring, community stewardship, community involvement, and informing users

Does the project demonstrate a link to one of the identified GEM themes?
Currently, the three GEM themes are harbor seal, kittiwake/murre, and sandlance/ herring/salmon, with a fourth theme of sea otters possible These themes will be modified over time as additional information is acquired

CWA 7 + 305

Does the project identify linkages to underlying local, regional, or global ecological processes or geophysical processes?

Leading indicators - Capelin - shrimp

Regional ecological processes have been organized and summarized in the conceptual foundation of the GEM program Ecological processes may be related to food (for example, productivity or carbon transport), habitat (for example, pollutants or temperature), or removals (for example, fisheries, habitat degradation, or predation) Geophysical processes may be either oceanographic or atmospheric

Does the project focus on species, processes or activities that can serve as indicators of ecological change? The proposed ecological indicator will be evaluated on its usefulness as an indicator (how, where, and how often will it be used), its understandability, its ability to be quantified, its broad application, compatibility with other indicators, reliability

Does the project leverage funds from other sources? These could include other government funds (both state and federal) as well as non-governmental organizations and transboundary organizations

Does the project fill a gap in existing data? A database to be used for this purpose is ready in draft The GEM metadatabase is intended to identify all data types of all entities collecting information on the marine environment and related habitats in the Gulf of Alaska

Does the project occur primarily within the northern Gulf of Alaska, or in watersheds with marine linkages, or in migratory habitat outside of the gulf?

A tool for Gap analysis: GEM metadatabase and GIS application

To assist in performing a gap analysis of existing data, it is important to have a summary in both tabular and GIS formats to summarize existing datasets in the GEM region and for basic GEM themes The EVOS office has begun to develop a comprehensive database of relevant data in the GEM region These can be divided into three basic subgroups Basic Ground Programs, Erratics and Satellite Programs ***(Please refer to metadatabase guide provided in hard copy at the meeting)*** The EVOS office has also begun to put these datasets into GIS format so that various locations in the GEM region can be queried regarding data pertinent to that region

We would like the focus group to review the metadatabase for missing or erroneous information, and also to suggest which datasets should be included in GIS format

---

Note Please submit information on missing or erroneous information to brenda_hall@oilspill state ak us The synopsis of information needed to initiate contact is as follows

Project Project title goes here

Description Basic description of what, where, how, when and where

Organization Who conducts it and who pays for it?

Program Is it part of a larger coordinated effort?

Name   Contact person
Address
Ph   Voice and fax
E-mail

Geographic location Decimally coded latitudes and longitudes

The theme approach to monitoring

The approach being suggested to produce the GEM research and monitoring plan is to coordinate and integrate monitoring and research projects around ecologically and culturally prominent animal species, the harbor seal, kittiwakes and murres (surface feeding and diving seabirds), and sandlance, herring and salmon (forage fishes) The projects are further organized around regions, -- PWS, CI/Kenai Peninsula, Kodiak/Alaska Peninsula, and northern GOA -- although overlaps are certain to occur, particularly for migratory species and geophysical processes The animal species are conceptual focal points around which to organize studies of factors controlling changes in the marine ecosystems In this sense, each of the species is seen as an ecological "crossroads" where geophysical and biological agents of change come together The agents of change have been identified in the GEM conceptual foundation as food, habitat, removals by harvest and predators, and related geophysical forcing factors, such as the Pacific Decadal Oscillation

In designating one species, such as the harbor seal, to identify a GEM project, other plant and animal species are not excluded, nor are geophysical processes or parameters such as contaminants overlooked The procedure being tested uses the GEM species as a device around which to coordinate, integrate and synthesize information about the factors contributing to changes in valued marine and anadromous species and the ecosystems on which they depend

The selection of an identifying species also does not mean that the GEM program will fund data acquisition for all factors necessary to understand changes in that species through time The goal is to design a project that is as complete as possible without concern for normal agency management function, or costs, or even technical feasibility Technical feasibility and costs are dealt with in project program fine tuning and implementation The GEM project identifies as completely as possible what is necessary to understand change in the GEM species, and in the process addresses the many other species and geophysical and chemical processes that contribute to changes in the GEM species through time

Theme Questions To Be Discussed

1 What is your reaction to the "theme" approach to monitoring? Are there other approaches that should be considered?

2 Do these particular themes monitor a broad enough spectrum of the ecosystem?

3 Are the major issues of concern to Cook Inlet/Kenai Peninsula stakeholders/managers covered within the themes or research areas?

4 What are the possibilities for community/private sector partnerships in monitoring in

Synopsis of Harbor seal theme

Full version is in Appendix

Title Understanding changes in harbor seal populations in the Northern GOA

Objectives Population trends
Food and production
Habitat
Removals

Geographic areas
PWS, Cook Inlet, Kodiak Island

Agency activity
Current
ADF&G doing molt counts in PWS in FY2000, NMFS has done counts on Tugidak Island (near Kodiak Island) back into the 1980s

Proposed Partnership in future
Agencies to do molt counts in all three areas, logistical support for collections GEM to do diet foraging and carbon source work, harvest and predation efforts and collect tissue samples for contaminants

Community Activity Subsistence sampling

APPENDIX A· TOPICS FOR CRITERIA FOR PROJECT SELECTION

The following are hierarchically structured lists of topics that may be useful in designing criteria for project selection

Human needs and impacts, products, agency mandates

Human needs and impacts, products, agency mandates

Agency Mandates

- Legal
  - Marine Mammal Protection Act
  - Endangered Species Act
  - Forest Practices Act
  - Clean Water Act
  - M-S Fishery Management and Conservation Act
  - Court orders
  - Enabling legislation of Trustee Council member agencies
  - Alaska State Constitution and Title 16
  - Alaska Board of Fisheries and Game regulations
  - Federal Subsistence Board regulations
  - State and federal harvest regulations
  - North Pacific Anadromous Fisheries Treaty
  - Pacific Salmon Treaty
  - Migratory Species Conventions
- Regulatory
  - Harvest limitations - birds, fish, shellfish, mammals, marine algae, trees
  - Total Manageable Daily Loads TMDL's (non-point source pollutants)
  - Permit applications
- Marine Habitat Protection
- Fishery and Ecosystem-based Management
- Contaminants, Water Quality and Food Safety
- Stewardship and Status of resources
  - Population trends
  - Population abundance
  - Life cycle and basic biology

- Human Needs
  - Economic
    - Subsistence resources
    - Commercial resources
    - Tourist resources
    - Recreational resources
    - Scientific resources (genes, medical models)
    - Commerce (navigation, weather)
  - Health
    - Public safety (navigation, weather)
    - Clean food
    - Clean water
  - Culture
    - Subsistence resources
    - Religious practice
- Human Impacts
  - Oil and Gas Development
  - Commercial Fishing
  - Salmon Hatchery Issues
  - Recreation and Tourism
  - Subsistence harvests
  - Logging
  - Small-scale Spills of Toxic Substances
  - Roadbuilding and Urbanization
  - Global Climate Change
- Products
  - Measures contributing to meeting human and agency needs, managing impacts
    - Human Impacts
    - Marine Habitat Protection
    - Fishery and Ecosystem-based Management
    - Contaminants, Water Quality and Food Safety
    - Stewardship and Status of resources
    - Legal
    - Regulatory
    - Economic
    - Health
    - Culture
  - Information relevant to human activities
    - Scientific resources
    - Navigation
    - Weather
    - Water Quality
    - Food Safety
    - Contaminants

Ecological importance – ecological indicator

- Conceptual basis
    - Linkage to underlying ecological process (local, regional, global)
        - Food
            - Productivity (rate of production of food)
                - Primary productivity
                    - Nutrients
                    - Mixing
                    - Species composition
                - Secondary
                - Tertiary
            - Carbon transport and fate
            - Nitrogen transport and fate
        - Habitat
            - Limiting Factors
                - Temperature
                - Salinity
                - Current velocity
                - Water quality
                    - Pollutants, contaminants
        - Removals
            - Fisheries
            - Habitat degradation
            - Pollutants, contaminants
            - Predation
    - Linkage to geophysical processes (local, regional, global)
        - Oceanographic
            - Upwelling
            - Downwelling
            - Mixed layer depth
            - Frontal structure
            - Current dynamics
            - Organic transport
        - Atmospheric
            - Sea surface pressure (PDO and allied phenomena)
            - Wind stress
            - Precipitation
            - Runoff
- Relationships to other species defined
- Life cycle understood in relation to geographic range

- Usefulness of indicator
  - How would it be used (regulations, permitting, model input, public safety)
  - Where would it be used (agencies, public, private)
  - How often would it be used?
- Understandable (Meaning and uses of values known)
- Quantifiable
  - Range of values known
  - Temporal and spatial scales of change (spatial statistics)
  - Natural variability separable from anthropogenics (signal to noise ratio)
  - Statistical properties
    - Accuracy and Precision
    - Power
    - Robustness (statistical)
    - Error (Type I v Type II)
- Broadly applicable
  - Ecological processes
  - Biogeochemical processes
  - Geographic extent
  - Number of relevant species
  - Number of products (management applications)
- Compatibility
  - Interagency
  - Interdisciplinary
  - Interstate
  - International
- Reliability
  - Established performance (existing time series)
  - Sound theoretical basis
  - Comparable to established indicators
  - Data collection
    - Technology
    - Logistics
  - Robustness
    - Perturbations (urbanization, earthquake,)
    - Technological obsolescence

GEM program mission, goals and themes

- Geographic location
  - Northern GOA including watershed – marine linkages
  - Geophysical linkage
  - Migratory habitat ex-GOA
- Understand changes in marine ecosystems
  - Detect long-term changes
    - Ecosystem health
    - Biological diversity
  - Understand causes of change
    - Human
    - Natural
  - Predict
- Synthesize information from all sources
  - Track relevant work
  - Solve management problems
  - Enable sustainable use
- Coordinate planning for research and monitoring
  - Identify gaps in knowledge
  - Prioritize data gathering efforts
  - Community stewardship
- Integrate information gathering and utilization
  - Leverage funding
  - Inform users
  - Community involvement
- Established link to GEM Theme
  - Harbor seal
  - Kittiwake-murre
  - Sandlance-herring-salmon
- Addresses conceptual foundation
  - Population change = function of (food, habitat, removals)

Relation to other programs, leveraging

US Dept of Agriculture, Forest Service
US Department of Commerce, National Oceanic and Atmospheric Administration
US Department of Defense, Office of Naval Research, Stennis Space Center
    US Coast Guard
US Department of the Interior
US Environmental Protection Agency
National Science Foundation
State of Alaska
    ADEC
    ADF&G
    ADNR
    ADCED (Community and Economic Development)
    ADHSS (Health and Social Services)
    UAF/UAA
        IMS/SFOS
        IARC (Arctic Research Center)
Nongovernmental Organizations - Hybrids
    PWSSC
    OSRI
    PWSRCAC
Transboundary Organizations
Global Climate Change Research

Note Refer to GEM program document, section IV B (page 41)

The criteria have been applied to the example harbor seal project described in the narrative following the check list examples

Appendix B· Project check list example for Harbor Seal Project

Project check list example: Human needs and impacts, products, agency mandates

Project Title Prince William Sound Harbor seal enumeration
Human needs and impacts, products, agency mandates

Remark	P = Present, A = Absent
	Agency Mandates
P	Legal
P	Regulatory
P	Marine Habitat Protection
P	Fishery and Ecosystem-based Management
P	Contaminants, Water Quality and Food Safety
P	Stewardship and Status of resources
	Human Needs
P	Economic
P	Health
P	Culture
P	Human Impacts
P	Products

Project check list example: Linkage to underlying ecological process

Harbor Seal Theme
Project Title Prince William Sound Harbor seal enumeration

Ecological importance - ecological indicators

Conceptual basis

	Linkage to underlying ecological process (local, regional, global)
P	Food
P	Habitat
P	Removals
A	Linkage to geophysical processes (local, regional, global)
P	Relationships to other species defined
P	Life cycle understood in relation to geographic range
	Usefulness of indicator

A How would it be used (regulations, permitting, model input, public safety)

A Where would it be used (agencies, public, private)
A How often would it be used
Understandable
A Meaning and uses of values known
Quantifiable
A Range of values known
A Temporal and spatial scales of change (spatial statistics)
A Natural variability separable from anthropogenics (signal to noise ratio)

A Statistical properties
Broadly applicable
P Ecological processes
P Biogeochemical processes
ALL Geographic extent
HIGH Number of relevant species
? Number of products (management applications)
Compatibility
P Interagency
A Interdisciplinary
? Interstate
? International
Reliability
P Established performance (existing time series)
P Sound theoretical basis
P Comparable to established indicators
P Data collection
P Robustness

Project check list example GEM program mission goals and themes

Harbor Seal Theme
Project Title Prince William Sound Harbor seal enumeration

Geographic location
YES Northern GOA
Geophysical linkage
Migratory habitat ex-GOA
Understand changes in marine ecosystems
P Detect long-term changes
P Understand causes of change
? Predict
Synthesize information from all sources
P Track relevant work
? Solve management problems
? Enable sustainable use
Coordinate planning for research and monitoring

? Identify gaps in knowledge
? Prioritize data gathering efforts
A Community stewardship
Integrate information gathering and utilization
P Leverage funding
? Inform users
A Community involvement
Established link to GEM Theme
P Harbor seal
Kittiwake-murre
Sandlance-herring-salmon
Addresses conceptual foundation
P Population change = function of (food, habitat, removals)

Project check list example: Relation to other programs, leveraging

Harbor Seal Theme
Project Title Prince William Sound Harbor seal enumeration

A US Dept of Agriculture, Forest Service
A US Department of Commerce, National Oceanic and Atmospheric Administration
A US Department of Defense, Office of Naval Research, Stennis Space Center
A US Coast Guard
A US Department of the Interior
A US Environmental Protection Agency
A National Science Foundation
State of Alaska
P ADEC
P ADF&G
ADNR
ADCED (Community and Economic Development)
P ADHSS (Health and Social Services)
? UAF/UAA
IMS/SFOS
IARC (Arctic Research Center)
Nongovernmental Organizations
A PWSSC
A OSRI
A PWSRCAC

A Transboundary Organizations
? Global Climate Change Research

Project check list example: Gap Analysis

Harbor Seal Theme

Project Title Prince William Sound Harbor seal enumeration

P Provides Missing Basic Ground Project
P Provides Missing Erratic

Appendix C HARBOR SEAL THEME

Narrative of harbor seal project 1

Title — Understanding changes in harbor seal populations in the Northern GOA

Objectives — Population

1 To track population change seals in a series of regional index sites through counts of molting harbor seals

Food and production

2 Regionally, to identify major prey items, ultimate carbon sources, and time spent foraging

3 Regionally, to quantify reproductive success, including juvenile survival trends

Habitat

4 Identify major foraging areas

Removals

5 To develop indices of subsistence harvest and predation

6 Develop survival model

7 To periodically determine tissue concentrations of bioaccumulated contaminants and to measure possible response biomarkers

Geographic areas

PWS, Cook Inlet, Kodiak Island

Agency activity

Current

ADF&G doing molt counts in PWS in FY2000, NMFS has done counts on Tugidak Island (near Kodiak Island) back into the 1980s

Proposed Partnership in future
Agencies to do molt counts in all three areas, logistical support for collections GEM to do diet foraging and carbon source work, harvest and predation efforts and collect tissue samples for contaminants

Community Activity

Appendix D Kittiwake/murre theme

Narrative of kittiwake/murre project 1

Title Changes in colonial seabirds in the Northern GOA

Objectives Population

1 Measure changes in populations (production) of colonial sea birds in the northern GOAA

2 Regionally, to quantify reproductive success, including fledging success in a surface-feeding and in a diving seabird

Food

3 Regionally, to identify major prey items, food quality, and time spent foraging for a surface-feeding and for a diving seabird

Habitat

4 To identify major foraging areas and ultimate carbon sources

Removals

5 To develop indices of predation

7 To periodically develop estimates of seabird survival at major colonies

8 To periodically determine tissue concentrations of bioaccumulated contaminants and to measure possible response biomarkers

Geographic areas

PWS, Cook Inlet, Kodiak Island

Agency activity

Current

PWS USFWS, Migratory Bird Program, has a long-term population data set (back to 1985) for 27 kittiwake colonies in PWS that includes 2 surveys one in early spring for population counts and one in August to count chicks/nest More intenisve studies are carried out at Shoup Bay (also in PWS) that include diet

Kodiak Island An annual survey is made to estimate population sizes and productivity for black-legged Kittiwakes in one visit per year at 15-20 colonies At Porpoise Rocks counts of red-faced and pelagic comorants and common murres are also made

Cook Inlet/Kenai Coast USFWS AMR (Alaska Maritime Refuge) has a plan for doing annual surveys at East Amatuli Island (Barren Islands, Outer Cook Inlet) and surveys every 3-5 years at the Chiswell Islands (off Kenai Coast) and Chisik Island (in middle Cook Inlet) Annual surveys include timing of nesting, fledging time, production (chicks per nest) and prey identification Surveys on a 3-5 year periodicity include productivity (chicks per nest, timing of fledging (estimated) See Seabird monitoring plan for the Alaska Maritime Refuge File document, USFWS, AMR, Homer Alaska There are also historical counts (back to 1984) of 4 species of seabirds at Gull Island in Kachemak Bay

Proposed Partnership in future

PWS

Agencies to do Annual counts and productivity for surface feeder (Black-legged kittiwakes) at 27 colonies

GEM periodic estimates of diet composition and quality, ultimate carbon sources and predation estimates(if possible) periodic estimates of survival at selected colonies Collects samples for bioaccumulating contaminants

Kodiak Island

Agency to do annual counts and productivity for black-legged kittiwakes at 15-20 colonies on Kodiak Island

GEM as for PWS

Cook Inlet / Chiswells

Agency to do Annual population and productivity surveys kittiwakes and murres at East Amatuli Island, Population and productivity surveys at Gull Island Chisik Island and Chiswell Islands every 3-5 years

GEM as for PWS

Community Activity ?

Other kittiwake/murre projects...?

APPENDIX E SANDLANCE/HERRING/SALMON THEME

Narrative of sandlance/herring/salmon project 1

Title Understanding changes in forage fish populations in the Northern GOA

Objectives Population

1 To quantify reproductive success in herring

2 To develop indices of age 0+, 1+ and 2+ herring abundance from aerial surveys in all regions

3 To track populations of non-commercial forage fish (e g , capelin, sandlance) by use of small mesh surveys, aerial surveys, halibut stomach analyses

Food

4 Regionally, to identify major prey populations (plankton), and major spawning areas for stocks of Pacific herring

5 To track changes in oceanographic and atmospheric conditions that control food supply

Habitat

6 To use the PWS circulation model to simulate larval dispersion in PWS

7 To identify major foraging areas and ultimate sources of carbon

Removals

8 To estimate larval survival and juvenile overwintering survival for Pacific herring

9 To track commercial harvest for Pacific herring

Geographic areas

PWS, Cook Inlet, Kodiak Island

Agency activity

Current

PWS ADF&G does aerial surveys of miles of spawn, conducts a test fishery and samples the commercial catch for age and weight-at- age for Pacific herring Stock size estimated from ASA model

Kodiak Island ADF&G samples the commercial catch for age and weight-at-age Limited aerial surveys are carried out for important stocks(Uganik Bay)

Cook Inlet/Kenai Coast ADF&G samples conducts a test fishery for roe content/quality and samples the commercial catch for age and weight-at-age Aerial surveys are carried out for important stocks Effort is concentrated in Kamishak Bay, and a lesser effort on remnant stock in Katchemak Bay Stock size estimated from ASA model

Proposed Partnership in future

PWS

Agencies to do ADF&G Aerial survey for miles of spawn Age and weight-at-age Stock size estimates All on annual basis Partial support for small mesh surveys in PWS (new) Provides samples for contaminant and lipid analyses

PWSAC Continues plankton watch

GEM For Pacific herring 1 Run plankton model to forecast spring-summer bloom, 2 Run circulation model to forecast larval dispersion, 3 Carries out aerial survey for juvenile herring age slass estimates, 4 Estimates overwintering suvival from model and field collections at end of growing season Determines ultimate carbon sources Conducts small mesh surveys and biomass estimates from hydroacoustics

Kodiak Island

Agencies to do Aerial survey for miles of spawn Age and weight-at-age Stock size estimates Samples for lipid content, end of season whole body energy contnet and contaminants

GEM estimates lipid content, ultimate carbon sources, supports expanded plankton watch, estimates ovewintering survival from model and end-of-season whole body energy content

Cook Inlet /Chiswells

Agencies to do Aerial survey for miles of spawn Age and weight-at-age Stock size estimates Samples for lipid content, end of season whole-body-energy content and contaminants

GEM estimates lipid content, ultimate carbon sources, supports expanded plankton watch, estimates ovewintering survival from model and end-of-season whole body energy content

Community Activity ?

Narrative of sandlance/herring/salmon project 2

Title Changes in annual plankton production in the Northern GOA

Objectives Population

1 Regionally, to measure primary productivity in nearshore, shelf and GOA waters

2 To predict phytoplanton and zooplankton blooms in PWS, CI and Kodiak Island area with 2-d models using oceanographic and meterological data

3 To measure settled volume of plankton from weekly tows during the growing season in representative coastal areas

4 To collect synoptic data on chlorophyll a from SeaWifs satellite and to track subsurface cholorphyll a concentrations in shelf break environments

Food and habitat

5 To measure atmospheric and

6 To do zooplankton sampling at representative regional stations in all areas

Geographic areas

PWS, Cook Inlet, Kodiak Island

Agency activity

Current

PWS PWSAC does plankton watch from 5 hatchery locations Wind data for plankton model are available from NOAA buoys in PWS tanker channel (Potato Point, Bligh Reef, Mid-sound, Seal Rocks) FAA stations at Whittier and Valdez also supply wind data of lesser relevance to central PWS

Kodiak Island FOCI program (NOAA) in Shelikof Strait collects some data on plankton and atmospheric and oceanographic conditions

Cook Inlet/Kenai Coast No ongoing activities have been identified

Shelf and shelf break Atmospheric data from NOAA weather buoys, other data from GLOBEC studies on Seward line (NSF/NOAA) Plankton data from CPR in north Pacific (NPRB in 2000-2001)

Proposed Partnership in future

PWS

Agencies to do NOAA continues to make available weather data from central PWS, Cook Inlet and other locations

PWSAC Continues plankton watch

GEM 1 Run plankton model to forecast spring-summer bloom, 2 Run circulation model,

Kodiak Island

Possible continued oceanographic data from FOCI program in Shelikof Strait

GEM as for PWS, but no circulation model

Cook Inlet / Chiswells

Agencies to do Nothing yet identified

GEM as for PWS except for circulation model

Community Activity ?

Other sandlance/herring/salmon projects...?

Other themes...?

Appendix F CHECKLISTS FOR REVIEW OF OVERALL MONITORING PLAN (DRAFT)

Once the overall draft monitoring plan has been assembled for the first time, the following check lists would be used to review the collection of proposed projects as a whole in order to look for gaps with respect to a number of important features

Kinds of observations

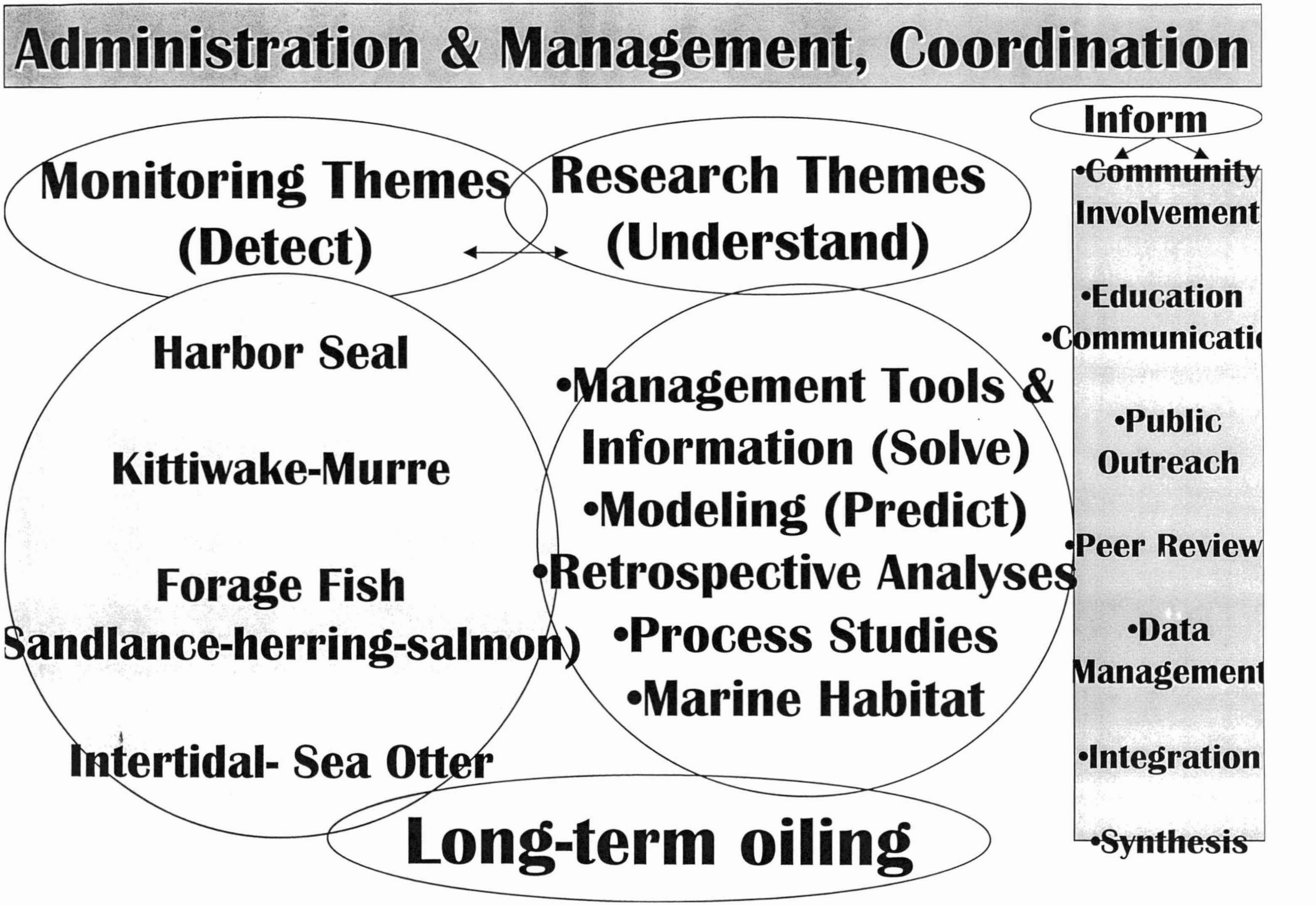
1 Abundance
  a adults
  b juveniles
2 Size, age, weight
3 Energetics,
  a caloric content
  b lipid content
4 Stable isotopes
  Trophic structure
  Food origin
5 Contaminants
6 Biomarkers

Species or Guilds

1 Crustaceans, epifauanal
2 Marine demersal Gadids (cod, pollock)
3 Anadromous fishes salmon
4 Harbor seals and sea otters
5 Kittiwakes, Larids - surface feeders
6 Murres - Alcids - diving birds
7 Intertidal *Fucus* and mussels (fixed animals and plants)
8 Intertidal Mobile chitons Limpets, sea urchins, sea stars
9 Subtidal, shellfish, polychaetes, infauna, crustaceans
10 Forage fish Herring, salmon, sandlance, capelin

Geographical Provinces- Riparian, freshwater

1 Riparian
2 Intertidal
3 Littoral zone subtidal, nearshore
4 Neretic
5 Shelf benthos
6 Shelf pelagic
7 Slope pelagic
8 Slope benthos
9 Abyssal pelagic (oceanic / pelagic)



Administration & Management, Coordination
Monitoring Themes (Detect)
Research Themes (Understand)
Harbor Seal
Kittiwake-Murre
Forage Fish
Sandlance-herring-salmon)
Intertidal- Sea Otter
•Management Tools & Information (Solve)
•Modeling (Predict)
•Retrospective Analyses
•Process Studies
•Marine Habitat
Long-term oiling
Inform
•Community Involvement
•Education
•Communicati
•Public Outreach
•Peer Review
•Data Management
•Integration
•Synthesis

10 Abyssal bethic

Disciplinary Areas of Study

Biology
- Population Dynamics
- Physiology
- Trophic Dynamics
- Ecological energetics
- Biological Oceanography
- Fisheries Oceanography

Geophysical Sciences
- Physical Oceanography
- Chemical Oceanography
- Atmospheric Sciences

Trophic dynamics

1. diet composition/ spp + geographic origin
2. trophic level
3. food quality + energetics

Brenda Hall

From: Phillip North [pnorth@ptialaska.net]
Sent: Wednesday, August 02, 2000 8:42 PM
To: Brenda Hall
Cc: Steven Frenzel; Bob Shavelson; Kent Patrick-Riley; Elaine Major; Susan Saupe; Lee Daneker; John Mohorcich
Subject: Re: FW: Cook Inlet Focus group Information

Hi Brenda,
My two cents for GEM are as follows:
There are two area that I saw as not explicitly included in the framework: soft intertidal and watersheds.

Soft intertidal is by nature a dynamic system. On the Cook Inlet shore the dynamism is even more extreme because the shore is adjusting to recent geologic change. As we humans try to change the time frame of change to accomodate our human land use desires we interup the dynamism and thereby interupt ecologically important processes. Home building on the eroding bluffs and beaches on the east side of the Inlet (most evident south of Deep Creek) will lead to hardening of the shore as people try to protect their investments. Then normal beach erosion will be seen as a crisis. Also the normal erosion and transport of sand will be interupted, leading to changes in beach cycling, with implications for organisms that depend on soft beaches for some part of their life cycle (fish, crustaciens and bivalves). This is an issue that is not at a crisis point yet so is not getting any attention. Now is probably a good time to start monitoring this.

As far as watersheds goes, ADEC is using 319 funds to support development of tools to economically monitor streams. Monitoring streams is probably the place to start in monitoring watersheds because streams integrate watersheds to a sinlge point. Everything upstream drains past a single point in a stream. Macroinvertebrates are probably the best way to monitor streams because they describe the stream. The assemblage of macroinvertebrates consists of an array of sensitive to hardy taxa that accupy the range of niches available in the stream. The different taxa respond to different perterbations of the stream.

If you are interested you could accelerate the usability of this tool by helping to answer remaining questions. Specifically the questions are:

1. Given that taxa emerge from the stream at different times, what difference does sample timing make to the interpretation of results? (I think DEC is funding this work now).
2. Streams can be classified by morphology (Rosgen and Montgomery are two stream classification systems based on stream morphology and/or process). Streams with different morphology offer organisms different habitats and therefor are likely to have an overlapping but different set of taxa. Does this make a difference when interpreting the results of macroinvertebrate monitoring.

3 The imature stages of most macrinvertabrate taxa are not identifiable to species Identification to species might provide a greater degree of sensistivity to interpretation of results For many taxa this work may be a matter of rearing imature stages to adult and building a key

Of course there are limits to this method Slowly developing changes in the watershed may not show up down stream for some time, such as soil contamination Also macroinvertabrates are adapted to the dynamic nature of their habitat They may not be affected by, or may rapidly recover from extreme hydrologic events This may mask a change that is insidious such as gradual changes in hydrology due to gradual hardening of land surface by development The proverbial horse may be out of the barn by the time a change is apparent So a combination of montoring methods may be best Perhaps monitoring macroinvertebrates, urbanization and hydrology would be a good combination Though any of these would be a great improvement over what we have now, which is nothing

One last comment and a repeat of my comment at the focus group it may not be a good idea to depend on agency funding to compliment or partner with your monitoring effort Most of our funding is in question on a year to year basis Unless you only partner where there is a demonstrated commitment to long term monitoring you may find the consistency of your data to be compromised Again, I am very excited about the idea of a monitoring project that will be supported over a very long period Thanks for doing this

Phil North

Brenda Hall wrote

Phil- I have also added to our group e-mail list so that you also receive all other information concerning this matter Hope to hear from you soon!
Brenda Hall
Exxon Valdez Restoration Office
Phone # 278-8012
Fax #276-7178

-----Original Message-----
From Brenda Hall [mailto Brenda Hall@oilspill state ak us]
Sent Friday, July 07, 2000 11 51 AM
To Tom Weingartner, Tom Loughlin, Thomas Dean, Ted Otis, Steve Iguell, Stephen Jewett, Spies, Shannon Atkinson, Patty Brown-Schwalenberg, Mark Willette, Marianne See, Ken Holbrook, John F Piatt PhD, Jim Reynolds, Jia Wang PhD, Jennifer Nielsen, Intercom, Henry Huntington, Gail Irvine, Dede Bohn, David Banks, Claudia Slater, Catherine Berg, Carol Fries, Carl Schoch, Bud Rice, Bruce Wright, Bill Hauser, Bill Bechtol, Fran Norman for Walter Meganack
Cc Molly McCammon, Phil Mundy
Subject Cook Inlet Focus group Information

Brenda Hall
Exxon Valdez Restoration Office
Phone # 278-8012
Fax #276-7178

Name cookinletfocusgrpmemo doc
cookinletfocusgrpmemo doc Type Winword File (application/msword)
Encoding base64

Brenda Hall

From: glnelson@usgs.gov
Sent: Monday, August 07, 2000 9:40 AM
To: Brenda_Hall@oilspill.state.ak.us
Cc: sfrenzel@usgs.gov; lpatrick@usgs.gov
Subject: GEM comments and gaps

Thank you for the opportunity to participate in the Gulf Ecosystem Monitoring workshop on July 19. I apologize that I had to leave a bit early and could not stay for the end of the workshop. I would, however, like to make a few comments regarding data gaps.

The quantity and quality of fresh-water discharge to the ocean are key components of both the terrestrial and marine ecosystems.

In the terrestrial environment, fresh-water discharge is an integrator of climate change over the basin scale, reflecting seasonal, inter-annual and inter-decadal fluctuations in precipitation and melting of glacial ice. Floods that scour salmon redds, low-flow conditions that may lead to freezing of spawning gravels, oxygen depletion during heavy salmon runs, and numerous other impacts are all reflected in stream discharge.

Fresh water flowing into the Alaska Stream (the westward-flowing current along the Alaska Gulf Coast) forms a less dense layer of water flowing over deeper, more saline water. It is in this upper layer of water that much of the primary productivity occurs. This less-dense jet also flows through the Aleutian passes and provides water to the southern part of the Bering Sea.

Although I would love to be able to tell you that USGS will have funds to operate the necessary stream gages to provide data on the fresh-water runoff, the reality is much different. Because of lack of appropriations, we have discontinued measurement of most of the major rivers feeding the Gulf Coast and the Bering Sea. I don't see this situation changing in the near future. If the GEM program wants data on the freshwater runoff, the program should plan to fund the effort.

Gordon L. Nelson
USGS
4230 University Drive
Anchorage, Ak 99508

(907) 786-7100

STEVE OKKONEN

RECOMMENDATIONS

LONG TERM MONITORING

CURRENT METER MOORINGS/ARRAYS

T - S - CHLA - NO_3

HINCHINBROOK ENTRANCE

KENNEDY ENTRANCE

SHELF BREAK

- NEAR YAKUTAT
- SEWARD LINE (UAF)
- SE KODIAK

CI WESTERN BOUYANCY FLOW WEST OF KALGIN IS.

MOORINGS WOULD PROVIDE BOUNDARY CONDITIONS FOR NUMERICAL BIOPHYSICAL MODELS

IN-HOUSE SATELLITE IMAGE ANALYST / CHLA SST

- ARCHIVE PROCESSED IMAGES
- YEARLY CD's

OTHER

VARIABILITY OF SHELF BREAK PHYSICAL ENVIRONMENT BECOMES LESS DETERMINISTIC MOVING DOWNSTREAM (EAST TO WEST)

∴ PROGNOSTIC MODELS MIGHT BE LESS EFFECTIVE DOWNSTREAM

FOCUS GROUP WORKBOOK -Comments INCLUDED

for the

DRAFT
Gulf Ecosystem Monitoring Plan
July 19, 2000

NAME: Monica Riedel

AFFILIATION: Alaska Native Harbor Seal Commission

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gem@oilspill.state.ak.us

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GULF ECOSYSTEM MONITORING PLAN
FOCUS GROUP AGENDA

Prince William Sound
Wednesday, July 19, 2000
10 a.m. – 5:30 p.m.
***Exxon Valdez* Restoration Office**
645 G Street Suite 400, Anchorage, AK 99501-3451
907-800-478-7745 or 907-278-8012

Design a regionally implemented, globally coordinated and integrated monitoring program

10 00 Introductions of participants - Mundy

10 05: Opening remarks - McCammon

10 20. Relationship between GEM program and the draft monitoring plan - Spies

10 50 Orientation to the focus group process - Mundy

11:20: Coffee break

11 30 Criteria for project selection and definitions of terms – Mundy
- **11 40· Human needs and impacts, products, agency mandates – Focus Group**
- **12:05 Ecological importance – ecological indicators – Focus Group**

12:30: Lunch break (on your own)

- **1 30. GEM program mission, goals and themes – Focus Group**
- **1.55. Gap analysis - metadatabase – Focus Group**
- **2:20: Relation to other programs, leveraging – Focus Group**

2:40 Major themes of the draft monitoring plan - Mundy
- **2.50. Harbor seal theme – Focus Group**

3:20: Coffee break

- **3 30 Kittiwake/murre theme– Focus Group**
- **4.10. Sandlance/herring/salmon theme – Focus Group**

4·50: Concluding remarks – McCammon

5:00. Post Mortem – Focus Group

5:30: Adjourn

GEM PROGRAM MISSION

The mission of the GEM program is to "***sustain a healthy and biologically diverse marine ecosystem in the northern Gulf of Alaska (GOA) and the human use of the marine resources in that ecosystem through greater understanding of how its productivity is influenced by natural changes and human activities*** " In pursuit of this mission, the GEM program will sustain the necessary institutional infrastructure to provide scientific leadership in identifying research and monitoring gaps and priorities, sponsor monitoring, research, and other projects that respond to these identified needs, encourage efficiency in and integration of GOA monitoring and research activities through leveraging of funds and interagency coordination and partnerships, and involve stakeholders in local stewardship by guiding and carrying out parts of the program

GEM PROGRAM GOALS

GEM has five major programmatic goals in order to accomplish its mission

DETECT Serve as a sentinel (early warning) system by detecting annual and long-term changes in the marine ecosystem, from coastal watersheds to the central gulf,

UNDERSTAND Identify causes of change in the marine ecosystem, including natural variation, human influences, and their interaction,

PREDICT Develop the capacity to predict the status and trends of natural resources for use by resource managers and consumers,

INFORM Provide integrated and synthesized information to the public, resource managers, industry and policy makers in order for them to respond to changing conditions, and

SOLVE Develop tools, technologies, and information that can help resource managers and regulators improve management of marine resources and address problems that may arise from human activities

Given the size and complexity of the ecosystem under consideration and the available funding, it will not be possible for GEM, by itself, to meet these goals Addressing them will require focusing on the institutional goals to

IDENTIFY research and monitoring gaps currently not addressed by existing programs,

LEVERAGE funds from other programs,

PRIORITIZE research and monitoring needs,

SYNTHESIZE research and monitoring to advise in setting priorities,

TRACK work relevant to understanding biological production in the GOA, and

INVOLVE other government agencies, non-governmental organizations, stakeholders, policy makers, and the general public in achieving the mission and goals of GEM

GUIDING PRINCIPLES FOR MARINE MONITORING

Understand changes in marine ecosystems

There is a general consensus among designers and operators of marine research and monitoring programs in Alaska, the United States, and world-wide that marine resource management agencies and marine resource dependent communities and industries need reliable sources of information and tools that enable them to cope with changes in living and physical marine resources The consensus holds that using the marine environment safely and responsibly requires abilities to recognize, understand and anticipate changes in the marine environment There is also general agreement that coping with change requires the ability to distinguish between natural and human induced changes in all aspects of marine ecosystems

Synthesize information from all sources

Understanding changes in marine ecosystems requires understanding the relations among many types of information, such as weather and fish production Changes in marine resources are caused by a combination of biological, geophysical and human forces Natural variability in the physical environment causes shifts in relations among species, which changes the overall productivity of the region's marine ecosystems Human impacts can lead to environmental degradation, including increased levels of contaminants, loss of habitats, and increased mortality on certain species in the ecosystem that may trigger changes in species composition and abundance

Coordinate planning for research and monitoring

Understanding changes in marine ecosystems requires marine resource management agencies and marine resource dependent communities and industries to work in concert to identify critically important information and analyses Coordination is essential to enhance and maintain broad discussion among the marine scientific community on the most direct and effective ways to understand and address issues related to maintaining the health of the region's marine ecosystems

Integrate information gathering and utilization

Understanding changes in marine ecosystems improves when concerned parties cooperate to develop the tools for information gathering and sharing Research and monitoring activities should be conducted by means that stimulate the development of data gathering and sharing systems that will serve scientists in the region and beyond from government, academia, and the private sector in maintaining the health of the region's marine ecosystems

INTRODUCTION

The role of the focus group in GEM

The focus group process is the start of the second stage of a four-stage process of planning and implementing the Trustee Council's participation in monitoring the marine ecosystems of the northern Gulf of Alaska

A four-stage process of planning and implementing regional monitoring

1 Establishment of policies dedication of funding and scientific scooping - **GEM Program.**
2. What to monitor and approximately where and when to measure it – **GEM Monitoring Planning**
3. Statistical precision and power, costs, technical feasibility - **GEM Fine tuning FY01-03**
4 TC adopts and implements first GEM Annual Work Plan – **GEM Implementation.**

Initial implementation of the GEM Monitoring Plan is envisioned to start a cycle that periodically revisits the essentials of stages 2 – 4 for as long as the GEM program exists The issues of what to monitor, where and when to measure it, what statistical power and precision are necessary, affordability and technological strategies and capabilities will be reviewed, and possibly modified, at regular intervals over the life of the program

How the focus group works

Focus group participants respond orally and in writing to materials presented at the meeting The advice will be gathered in writing from the workbooks submitted by focus group members, and orally on the basis of a transcript of the meeting Information from the focus group workbooks and meeting transcripts will be used by the team writing the version of the Draft GEM Monitoring Plan that serves as the starting point for the October Workshop

After initial background presentations on the context for the GEM Monitoring Plan and the focus group process, two types of propositions will be given to the group for response The first set contains criteria for project selection, and the second set contains examples of monitoring projects organized around themes (see Agenda above)

The topics in the two propositions have been selected for discussion so that most of the advice tendered should be directed toward how to select what to measure, what to measure, and where and when to measure it Time has not been provided for participants to make formal presentations on their own candidate projects, although participants have the opportunity to make recommendations for other projects in response to the GEM theme projects

What the focus group is to produce

The focus group process is intended to produce a broad range of written and oral advice about the two propositions criteria and approach to selecting monitoring projects, and three suites of example monitoring projects prepared for the purposes of the focus group The advice from the focus groups will be used in producing the Draft Monitoring Plan for the October Workshop

Criteria and approach to selecting monitoring projects

The approach being suggested to produce the GEM monitoring plan is to coordinate and integrate monitoring and research projects around ecologically and culturally prominent animal species, the harbor seal, kittiwakes and murres (surface feeding and diving seabirds), and sandlance, herring and salmon (forage fishes) The projects are further organized around regions, -- PWS, CI, Kodiak-Peninsula, and northern GOA -- although overlaps are certain to occur, particularly for migratory species and geophysical processes The animal species are conceptual focal points around which to organize studies of factors controlling changes in the marine ecosystems In this sense, each of the species is seen as an ecological "crossroads" where geophysical and biological agents of change come together The agents of change have been identified in the GEM conceptual foundation as food, habitat, removals by harvest and predators, and related geophysical forcing factors, such as the Pacific Decadal Oscillation

In designating one species, such as the harbor seal, to identify a GEM project, other plant and animal species are not excluded, nor are geophysical processes or parameters such as contaminants overlooked The procedure being tested uses the GEM species as a device around which to coordinate, integrate and synthesize information about the factors contributing to changes in valued marine and andromous species and the ecosystems on which they depend

The selection of an identifying species also does not mean that the GEM program will fund data acquisition for all factors necessary to understand changes in that species through time The goal is to design a project that is as complete as possible without concern for normal agency management function, or costs, or even technical feasibility Technical feasibility and costs are dealt with in project program fine tuning and implementation The GEM project identifies as completely as possible what is necessary to understand change in the GEM species, and in the process addresses the many other species and geophysical and chemical processes that contribute to changes in the GEM species through time

CRITERIA AND DEFINITIONS

Introduction: Selecting and evaluating the GEM Project

In order to select a project for the GEM Monitoring Plan it is necessary to have a set of criteria to apply The explanation for each GEM Monitoring Project should contain a complete map of the information needed to understand the roles of the species in the ecosystems it occupies, and to understand the mechanisms of change in the GEM species and allied species In many cases the information necessary will not be available, and those data gaps need to be specified In order to ensure that the map is complete, the project is compared to a series of lists of important features in the ecosystem and the individual species, and criteria appropriate to a "crossroads" GEM species project (See Ecological importance – ecological indicators under Criteria and Definitions, below)

Human needs and impacts, products, agency mandates

Human needs and impacts, products, agency mandates

Agency Mandates ANCSA

Legal ANILCA

- Marine Mammal Protection Act – NATIVE Exemption (Sec 101(b)) COMANAGEMENT (Sec 119)
- Endangered Species Act
- Forest Practices Act
- Clean Water Act
- M-S Fishery Management and Conservation Act
- Court orders
- Enabling legislation of Trustee Council member agencies
- Alaska State Constitution and Title 16
- Alaska Board of Fisheries and Game regulations
- Federal Subsistence Board regulations –
- State and federal harvest regulations
- North Pacific Anadromous Fisheries Treaty
- Pacific Salmon Treaty
- Migratory Species Conventions –

Regulatory

- Harvest limitations - birds, fish, shellfish, mammals, marine algae, trees
- Total Manageable Daily Loads TMDL's (non-point source pollutants)
- Permit applications

Marine Habitat Protection

Fishery and Ecosystem-based Management

Contaminants, Water Quality and Food Safety

Stewardship and Status of resources

- Population trends
- Population abundance
- Life cycle and basic biology

Human Needs
- Economic
  - Subsistence resources
  - Commercial resources
  - Tourist resources
  - Recreational resources
  - Scientific resources (genes, medical models)
  - Commerce (navigation, weather)
- Health
  - Public safety (navigation, weather)
  - Clean food
  - Clean water
- Culture
  - Subsistence resources
  - Religious practice

EDUCATION! ?

Human Impacts — passive use & non-consumptive,
- Oil and Gas Development, Tanker Transportation
- Commercial Fishing
- Salmon Hatchery Issues
- Increased Recreation and Tourism
- Subsistence harvests
- Logging
- Small-scale Spills of Toxic Substances
- Roadbuilding and Urbanization
- Global Climate Change — invasive species — Actions, enforcement, Activities,
- Hatcheries

Products
- Measures contributing to meeting human and agency needs, managing impacts
  - Human Impacts
  - Marine Habitat Protection
  - Fishery and Ecosystem-based Management
  - Contaminants, Water Quality and Food Safety
  - Stewardship and Status of resources
  - Legal
  - Regulatory
  - Economic
  - Health
  - Culture
- Information relevant to human activities
  - Scientific resources
  - Navigation
  - Weather
  - Water Quality
  - Contaminants
  - Food Safety

Ecological importance – ecological indicators

Conceptual basis

- Linkage to underlying ecological process (local, regional, global)
  - Food
    - Productivity (rate of production of food)
      - Primary productivity
        - Nutrients
        - Mixing
        - Species composition
      - Secondary
      - Tertiary
    - Carbon transport and fate
    - Nitrogen transport and fate
  - Habitat
    - Limiting Factors
      - Temperature
      - Salinity
      - Current velocity
      - Water quality pollution from Tour ships
        - Pollutants, contaminants < check
  - Removals
    - Fisheries
    - Habitat degradation
    - Pollutants, contaminants < Diseases, Long-term monitoring of harbor seals
    - Predation –
- Linkage to geophysical processes (local, regional, global)
  - Oceanographic
    - Upwelling
    - Downwelling
    - Mixed layer depth
    - Frontal structure
    - Current dynamics – circulation dynamics
    - Organic transport -
  - Atmospheric
    - Sea ~~surface~~ level pressure (PDO and allied phenomena)
    - Wind stress
    - Precipitation
    - Runoff – water quality,

Relationships to other species defined –

Life cycle understood in relation to geographic range

Usefulness of indicator
- How would it be used (regulations, permitting, model input, public safety)
- Where would it be used (agencies, public, private)
- How often would it be used?

Understandable (Meaning and uses of values known)

Quantifiable
- Range of values known
- Temporal and spatial scales of change (spatial statistics)
- Natural variability separable from anthropogenics (signal to noise ratio)
- Statistical properties
  - Accuracy and Precision
  - Power
  - Robustness (statistical)
  - Error (Type I v Type II)

Broadly applicable
- Ecological processes
- Biogeochemical processes
- Geographic extent
- Number of relevant species
- Number of products (management applications)

Compatibility
- Interagency
- Interdisciplinary
- Interstate
- International

Reliability
- Established performance (existing time series)
- Sound theoretical basis
- Comparable to established indicators
- Data collection
  - Technology
  - Logistics
- Robustness
  - Perturbations (urbanization, earthquake,   )
  - Technological obsolescence

GEM program mission, goals and themes

Geographic location
- Northern GOA including watershed – marine linkages
- Geophysical linkage
- Migratory habitat ex-GOA

Understand changes in marine ecosystems
- Detect long-term changes
  - Ecosystem health
  - Biological diversity
- Understand causes of change
  - Human
  - Natural
- Predict

Synthesize information from all sources
- Track relevant work
- Solve management problems
- Enable sustainable use

Coordinate planning for research and monitoring
- Identify gaps in knowledge
- Prioritize data gathering efforts
- Community stewardship

Integrate information gathering and utilization & dissemination
- Leverage funding
- Inform users
- Community involvement

Established link to GEM Theme
- Harbor seal
- Kittiwake-murre
- Sandlance-herring-salmon

Addresses conceptual foundation
- Population change = function of (food, habitat, removals)

Sustaining human resources

Relation to other programs, leveraging

US Dept of Agriculture, Forest Service
US Department of Commerce, National Oceanic and Atmospheric Administration,
US Department of Defense, Office of Naval Research, Stennis Space Center
    US Coast Guard
US Department of the Interior
US Environmental Protection Agency
National Science Foundation
State of Alaska
    ADEC
    ADF&G
    ADNR
    ADCED (Community and Economic Development)
    ADHSS (Health and Social Services)
    UAF/UAA
        IMS/SFOS
        IARC (Arctic Research Center)
Nongovernmental Organizations - Hybrids national wildlife Federation
    PWSSC
    OSRI
    PWSRCAC
Transboundary Organizations CANADA JAPAN
Global Climate Change Research
    TRIBES

Alaska Native Seal Commission
A NUSC-HS
PWSAC
Regional Planning Team

Note Refer to GEM program document, section IV B (page 41)

Gap analysis – metadatabase

Basic Ground Programs

Erratics

Satellite Programs

(Please refer to metadatabase guide provided in hard copy at the meeting.)

Note: Please submit information on missing or erroneous information to brenda_hall@oilspill.state.ak.us. The synopsis of information needed to initiate contact is as follows:

Project: Project title goes here

Description: Basic description of what, where, how, when and where.

Organization: Who conducts it and who pays for it?

Program: Is it part of a larger coordinated effort?

Name: Contact person
Address:
Ph. Voice and fax
E-mail:

Geographic location: Decimally coded latitudes and longitudes

---

Major themes of the monitoring plan

Example themes and projects have been chosen to test the ability of this approach to coordinate, integrate and foster the synthesis of marine related research in the northern GOA Example projects have been selected to illustrate the conceptual foundation that population change is a consequence of changes in food, habitat or removals by harvest or predators, and related factors Both themes and projects are a "first cut" based on comments received during development of the GEM program document and other considerations

Harbor seal theme

Narrative of harbor seal project 1

Title Understanding changes in harbor seal populations in the Northern GOA

done by The Alaska Stellar Sea lion Sea otter Commission TASSC -

Objectives Population

population - winter counts

1 To track population change seals in a series of regional index sites through counts of molting harbor seals

- transections

- Subsistence caught - stomach contents

Food and production

Seasonality -

2 Regionally, to identify major prey items, ultimate carbon sources, and time spent foraging

3 Regionally, to quantify reproductive success, including juvenile survival trends

Habitat

TEK historical sitings

4 Identify major foraging areas

- Harvest Data Assessment program through co-management

Removals

5 To develop indices of subsistence harvest and predation

Incidental take -

6 Develop survival model

7 To periodically determine tissue concentrations of bioaccumulated contaminants and to measure possible response biomarkers

Biosampling Program
EPA Contaminants analysis

Geographic areas

PWS, Cook Inlet, Kodiak Island

Agency activity

Current:
ADF&G doing molt counts in PWS in FY2000, NMFS has done counts on Tugidak Island (near Kodiak Island) back into the 1980s
> Comanagement Agreement btw NMFS/ANHSC
Proposed Partnership in future
Agencies to do molt counts in all three areas, logistical support for collections GEM to do diet foraging and carbon source work, harvest and predation efforts and collect tissue samples for contaminants NAF/ADF&G
NMFS/ANHSC to do biological collection in assoc w

Community Activity Subsist harvest
NEED Involvement of TRIBES & TRIBAL Consortiums to do pop surveys

Other harbor seal projects?

The criteria have been applied to the example harbor seal project described in the narrative following the check list examples

Project check list example Human needs and impacts, products, agency mandates

through Comanagement Agreement signed in April 1999, ANHSC & NMFS are now PARTNERS for Conservation of Sea

Project Title Prince William Sound Harbor seal enumeration
Human needs and impacts, products, agency mandates

Remark P = Present, A = Absent

Agency Mandates — NMFS have JURISDICTIONAL & Regulatory authority for seals

P	Legal
P	Regulatory
P	Marine Habitat Protection
P	Fishery and Ecosystem-based Management
P	Contaminants, Water Quality and Food Safety
P	Stewardship and Status of resources

MMPA allows for;
1) NATIVE exemption
2) Comanagement between NMFS & AK nat TRIBES & Tribally authorized organizations

Human Needs
P Economic
P Health — check samples for contaminants →
P Culture
SUBSISTENCE USE of Seals -
P Human Impacts

P Products
education of cultural uses

Project check list example Linkage to underlying ecological process

Harbor Seal Theme
Project Title Prince William Sound Harbor seal enumeration

Ecological importance - ecological indicators

Conceptual basis

Linkage to underlying ecological process (local, regional, global)
P Food — check stomach contents through Biosampling
P Habitat
P Removals
A Linkage to geophysical processes (local, regional, global)
P Relationships to other species defined
P Life cycle understood in relation to geographic range
Usefulness of indicator
A How would it be used (regulations, permitting, model input, public safety)

A Where would it be used (agencies, public, private)
A How often would it be used
Understandable
A Meaning and uses of values known
Quantifiable
A Range of values known
A Temporal and spatial scales of change (spatial statistics)
A Natural variability separable from anthropogenics (signal to noise ratio)

A Statistical properties
Broadly applicable
P Ecological processes
P Biogeochemical processes
ALL Geographic extent
HIGH Number of relevant species
? Number of products (management applications)
Compatibility
P Interagency
A Interdisciplinary

? Interstate
? International
Reliability
P Established performance (existing time series)
P Sound theoretical basis
P Comparable to established indicators
P Data collection
P Robustness
Project check list example GEM program mission, goals and themes
Harbor Seal Theme
Project Title Prince William Sound Harbor seal enumeration

Geographic location
YES Northern GOA
Geophysical linkage
Migratory habitat ex-GOA
Understand changes in marine ecosystems
P Detect long-term changes
P Understand causes of change
? Predict
Synthesize information from all sources
P Track relevant work
? Solve management problems
? Enable sustainable use
Coordinate planning for research and monitoring
? Identify gaps in knowledge
? Prioritize data gathering efforts
A Community stewardship
Integrate information gathering and utilization
P Leverage funding
? Inform users
A Community involvement
Established link to GEM Theme
P Harbor seal
Kittiwake-murre
Sandlance-herring-salmon
Addresses conceptual foundation
P Population change = function of (food, habitat, removals)

Project check list example Relation to other programs, leveraging

Harbor Seal Theme

Project Title Prince William Sound Harbor seal enumeration

A US Dept of Agriculture, Forest Service
A US Department of Commerce, National Oceanic and Atmospheric Administration
A US Department of Defense, Office of Naval Research, Stennis Space Center
A US Coast Guard
A US Department of the Interior
A US Environmental Protection Agency
A National Science Foundation

State of Alaska
P ADEC
P ADF&G
ADNR
ADCED (Community and Economic Development)
P ADHSS (Health and Social Services)
? UAF/UAA
IMS/SFOS
IARC (Arctic Research Center)

ANHSC
TRIBAL Programs?

Nongovernmental Organizations
A PWSSC
A OSRI
A PWSRCAC

A Transboundary Organizations
? Global Climate Change Research

Project check list example Gap Analysis

Harbor Seal Theme

Project Title Prince William Sound Harbor seal enumeration

P Provides Missing Basic Ground Project
P Provides Missing Erratic

Kittiwake/murre theme

Narrative of kittiwake/murre project 1

Title Changes in colonial seabirds in the Northern GOA

Objectives Population

1 Measure changes in populations (production) of colonial sea birds in the northern GOAA

2 Regionally, to quantify reproductive success, including fledging success in a surface-feeding and in a diving seabird

Food

3 Regionally, to identify major prey items, food quality, and time spent foraging for a surface-feeding and for a diving seabird

Habitat

4 To identify major foraging areas and ultimate carbon sources

Removals

5 To develop indices of predation

7 To periodically develop estimates of seabird survival at major colonies

8 To periodically determine tissue concentrations of bioaccumulated contaminants and to measure possible response biomarkers

Geographic areas

PWS, Cook Inlet, Kodiak Island

Agency activity

Current:

PWS USFWS, Migratory Bird Program, has a long-term population data set (back to 1985) for 27 kittiwake colonies in PWS that includes 2 surveys one in early spring for population counts and one in August to count chicks/nest. More intenisve studies are carried out at Shoup Bay (also in PWS) that include diet.

Kodiak Island An annual survey is made to estimate population sizes and productivity for black-legged Kittiwakes in one visit per year at 15-20 colonies At Porpoise Rocks counts of red-faced and pelagic comorants and common murres are also made

Cook Inlet/Kenai Coast: USFWS AMR (Alaska Maritime Refuge) has a plan for doing annual surveys at East Amatuli Island (Barren Islands, Outer Cook Inlet) and surveys every 3-5 years at the Chiswell Islands (off Kenai Coast) and Chisik Island (in middle Cook Inlet) Annual surveys include timing of nesting, fledging time, production (chicks per nest) and prey identification Surveys on a 3-5 year periodicity include productivity (chicks per nest, timing of fledging (estimated) See Seabird monitoring plan for the Alaska Maritime Refuge File document, USFWS, AMR, Homer Alaska There are also historical counts (back to 1984) of 4 species of seabirds at Gull Island in Kachemak Bay

Proposed Partnership in future

<u>PWS</u>

Agencies to do Annual counts and productivity for surface feeder (Black-legged kittiwakes) at 27 colonies

GEM periodic estimates of diet composition and quality, ultimate carbon sources and predation estimates(if possible) periodic estimates of survival at selected colonies Collects samples for bioaccumulating contaminants

<u>Kodiak Island</u>

Agency to do annual counts and productivity for black-legged kittiwakes at 15-20 colonies on Kodiak Island

GEM. as for PWS

Cook Inlet / Chiswells

Agency to do Annual population and productivity surveys kittiwakes and murres at East Amatuli Island, Population and productivity surveys at Gull Island Chisik Island and Chiswell Islands every 3-5 years

GEM as for PWS

Community Activity ?

Other kittiwake/murre projects ?

Sandlance/herring/salmon theme

Narrative of sandlance/herring/salmon project 1

Title Understanding changes in forage fish populations in the Northern GOA

Objectives Population

1 To quantify reproductive success in herring

2 To develop indices of age 0+, 1+ and 2+ herring abundance from aerial surveys in all regions

3 To track populations of non-commercial forage fish (e g , capelin, sandlance) by use of small mesh surveys, aerial surveys, halibut stomach analyses

Food

4 Regionally, to identify major prey populations (plankton), and major spawning areas for stocks of Pacific herring

5 To track changes in oceanographic and atmospheric conditions that control food supply

Habitat

6 To use the PWS circulation model to simulate larval dispersion in PWS

7 To identify major foraging areas and ultimate sources of carbon

Removals

8 To estimate larval survival and juvenile overwintering survival for Pacific herring

9 To track commercial harvest for Pacific herring

Geographic areas

PWS, Cook Inlet, Kodiak Island

Agency activity

Current:

PWS ADF&G does aerial surveys of miles of spawn, conducts a test fishery and samples the commercial catch for age and weight-at- age for Pacific herring Stock size estimated from ASA model

Kodiak Island ADF&G samples the commercial catch for age and weight-at-age Limited aerial surveys are carried out for important stocks(Uganik Bay)

Cook Inlet/Kenai Coast ADF&G samples conducts a test fishery for roe content/quality and samples the commercial catch for age and weight-at-age. Aerial surveys are carried out for important stocks Effort is concentrated in Kamishak Bay, and a lesser effort on remnant stock in Katchemak Bay Stock size estimated from ASA model

Proposed Partnership in future

PWS

Agencies to do ADF&G Aerial survey for miles of spawn Age and weight-at-age Stock size estimates All on annual basis Partial support for small mesh surveys in PWS (new) Provides samples for contaminant and lipid analyses

PWSAC. Continues plankton watch.

GEM For Pacific herring 1 Run plankton model to forecast spring-summer bloom, 2 Run circulation model to forecast larval dispersion, 3 Carries out aerial survey for juvenile herring age slass estimates, 4 Estimates overwintering suvival from model and field collections at end of growing season Determines ultimate carbon sources Conducts small mesh surveys and biomass estimates from hydroacoustics

Kodiak Island

Agencies to do Aerial survey for miles of spawn Age and weight-at-age Stock size estimates Samples for lipid content, end of season whole body energy contnet and contaminants

GEM estimates lipid content, ultimate carbon sources, supports expanded plankton watch, estimates ovewintering survival from model and end-of-season whole body energy content.

Cook Inlet/Chiswells

Agencies to do Aerial survey for miles of spawn Age and weight-at-age Stock size estimates Samples for lipid content, end of season whole-body-energy content and contaminants

GEM estimates lipid content, ultimate carbon sources, supports expanded plankton watch, estimates ovewintering survival from model and end-of-season whole body energy content.

Community Activity ?

Narrative of sandlance/herring/salmon project 2

Title Changes in annual plankton production in the Northern GOA

Objectives Population

1 Regionally, to measure primary productivity in nearshore, shelf and GOA waters

2 To predict phytoplanton and zooplankton blooms in PWS, CI and Kodiak Island area with 2-d models using oceanographic and meterological data

3 To measure settled volume of plankton from weekly tows during the growing season in representative coastal areas

4 To collect synoptic data on chlorophyll a from SeaWifs satellite and to track subsurface cholorphyll a concentrations in shelf break environments

Food and habitat

5 To measure atmospheric and

6 To do zooplankton sampling at representative regional stations in all areas

Geographic areas

PWS, Cook Inlet, Kodiak Island

Agency activity

Current:

PWS PWSAC does plankton watch from 5 hatchery locations Wind data for plankton model are available from NOAA buoys in PWS tanker channel (Potato Point, Bligh Reef, Mid-sound, Seal Rocks) FAA stations at Whittier and Valdez also supply wind data of lesser relevance to central PWS

Kodiak Island FOCI program (NOAA) in Shelikof Strait collects some data on plankton and atmospheric and oceanographic conditions

Cook Inlet/Kenai Coast No ongoing activities have been identified

Shelf and shelf break Atmospheric data from NOAA weather buoys, other data from GLOBEC studies on Seward line (NSF/NOAA) Plankton data from CPR in north Pacific (NPRB in 2000-2001)

Proposed Partnership in future

PWS

Agencies to do NOAA continues to make available weather data from central PWS, Cook Inlet and other locations

PWSAC. Continues plankton watch

GEM 1 Run plankton model to forecast spring-summer bloom, 2 Run circulation model,

Kodiak Island

Possible continued oceanographic data from FOCI program in Shelikof Strait.

GEM as for PWS, but no circulation model

Cook Inlet/Chiswells

Agencies to do Nothing yet identified

GEM as for PWS except for circulation model

Community Activity ?

Other sandlance/herring/salmon projects ?

Other themes...?

APPENDIX A: LETTER OF INVITATION

Dear Friends:

As many of you are aware, the *Exxon Valdez* Oil Spill Trustee Council is in the process of developing a long-term research and monitoring program for the northern Gulf of Alaska. The Council's goal is to fund this program forever, using the earnings from investment of the remaining EVOS settlement funds. The first phase of developing this program was a draft document describing the vision, goals, and framework for such a program. That document is now under review by the National Research Council and is available from us in hard copy or on the web at http://www.oilspill.state.ak.us/future/gem.htm.

While the NRC review of the overall program is underway, we are developing a first draft of an actual monitoring plan for the initial years of the program. Our goal is to bring together resource managers, scientists, and local stakeholders and experts in three regional focus groups. Focus groups are intended to have a mixture of local geographic knowledge and other relevant knowledge such as commercial fishing, wildlife management and oceanography. Attendance is open to all interested persons.

Starting from a "straw draft monitoring plan," the focus groups will be asked to address the nuts and bolts of how this monitoring plan is to be built, as well as to identify specific monitoring projects and products. The results of the focus group meetings will be used to move from the "straw draft" plan into a draft monitoring plan by mid-September. That draft will be the starting point of an intensive two-day work session October 10-11 in Anchorage.

We need your help in this effort. Dates for the focus groups have been difficult to pin down due to everyone's busy summer schedules, but these are the dates we have just now been able to confirm: **Wednesday, July 19 for Prince William Sound, Wednesday, July 26 for Cook Inlet, and Tuesday, August 1 for Kodiak.** All three meetings will be held in Anchorage.

You have been identified to attend the Prince William Sound focus group. Please confirm with Brenda Hall at the EVOS Restoration Office (brenda_hall@oilspill.state.ak.us or 907-278-8012) as soon as possible if you will be able to attend. Part of our work will be assisted by computer projected ArcView maps, so it would be desirable for you to attend in person, rather than by teleconference if at all possible. If you think you could contribute more at a different group or one of the other dates works better for you, please let Brenda know that also. If there are others you think might be good contributors, pass this message on and ask them to contact us. Please come prepared to focus your attention on developing a monitoring plan for the north Gulf of Alaska, and especially Prince William Sound. Folks with a "big picture" point of view are encouraged to work with those with regional interests.

Additional materials will be sent to you prior to the meeting Some funds are available for travel, especially for non-agency folks Contact Brenda for additional information

Thank you for your assistance in this effort

Sincerely,

Molly McCammon

APPENDIX B: CHECKLISTS FOR REVIEW OF OVERALL MONITORING PLAN (DRAFT)

Once the overall draft monitoring plan has been assembled for the first time, the following check lists would be used to review the collection of proposed projects as a whole in order to look for gaps with respect to a number of important features

Kinds of observations

1 Abundance
  a adults
  b juveniles
2 Size, age, weight
3 Energetics,
  a caloric content
  b lipid content
4 Stable isotopes
  Trophic structure
  Food origin
5 Contaminants
6 Biomarkers

Species or Guilds

1 Crustaceans, epifauanal
2 Marine demersal Gadids (cod, pollock)
3 Anadromous fishes salmon
4 Harbor seals and sea otters
5 Kittiwakes, Larids - surface feeders
6 Murres - Alcids - diving birds
7 Intertidal *Fucus* and mussels (fixed animals and plants)
8 Intertidal Mobile chitons Limpets, sea urchins, sea stars
9 Subtidal, shellfish, polychaetes, infauna, crustaceans
10 Forage fish Herring, salmon, sandlance, capelin

Geographical Provinces- Riparian, freshwater

1 Riparian
2 Intertidal
3 Littoral zone subtidal, nearshore
4 Neretic
5 Shelf benthos
6 Shelf pelagic
7 Slope pelagic
8 Slope benthos
9 Abyssal pelagic (oceanic / pelagic)
10 Abyssal bethic

Disciplinary Areas of Study

Biology
- Population Dynamics
- Physiology
- Trophic Dynamics
- Ecological energetics
- Biological Oceanography
- Fisheries Oceanography

Geophysical Sciences
- Physical Oceanography
- Chemical Oceanography
- Atmospheric Sciences

Trophic dynamics

1. diet composition/ spp + geographic origin
2. trophic level
3. food quality + energetics

DRAFT AGENDA

GULF ECOSYSTEM MONITORING PLAN

Prince William Sound Focus Group

Wednesday, July 19, 2000
9 a.m. – 5 p.m.

Introductions
Opening Remarks
Description of focus group process

GEM Update
- Historical background
- Mission and goals
- Long-term Monitoring as key element
- Conceptual Foundation

Examination of criteria and definitions
- Human needs and products
  - Management needs
  - Agency mandates
- Ecological importance of species and relation to GEM
- Threats or stressors to individual resources or ecosystem
- Indicators/origins of change
- Feasibility/tractability
- Identification of monitoring plan elements
- Description of existing projects

Use of major themes to construct integrated monitoring plan

- Harbor seal theme
- Kittiwake/murre theme
- Sandlance/herring/salmon theme

Ted Cooney Bob Spies 7/20/00

Science-Management Interface

Start small - Support patrick model development.

Monitor = states of components → productivity.

Graphic - themes - criteria

process mechanism.

dominant meteorology.

ocean state ✓

freshwater forcing
wind patterns (forcing)
input ocean circulation
output ocean circulation.
- ADP at Hinchinbrook.
-

APPRISE

Food
Habitat
Removals

modeling

variables

Document. Changing Ocean State

variables

Monitoring Themes | Research Themes.

Themes	Harbor Seal (numbers)	Sea otter (numbers)	Forage Fish (numbers)	Birds (numbers. State) (Sea Lion physiol)	of Mgmt. Science Interface	Dominant Meteorology	Modeling understanding Ocean State.
third							
second							
first trophic	Euph. Calanoids						
physics							
contaminants							

TOM who?

8/10/2000

Phil, Bob, and Molly,

Here a few thoughts on GEM monitoring I'm sorry that it is so lengthy but when I think of the different things that GEM can do and where it can lead my comments are pretty brief I've left out a lot but I hope what I've included are of some value to you In preparing this, I've asked a few of my colleagues to add their thoughts

Dan Hull (sp?, the fisherman from Cordova) was concerned that GEM might not address fisheries issues I was surprised at this comment because I felt from the GEM document that GEM has this as its central goal In fact if I had to summarize the goal of GEM it would be something like

To enhance the management of marine resources through an understanding of marine ecosystem processes and to achieve a mechanistic or deterministic understanding (as opposed to a statistical or correlative) of the Gulf of Alaska (GoA) shelf A mechanistic understanding should permit the development of a better predictive capability of biological productivity that benefits a multitude of users

In simpler terms, GEM seeks not to simply measure and count things, but explain WHY in some years we observe a biologically productive system with high fisheries yields, while in other years landing collapse The bottom line is that the physical environment, and its variability, strongly influence the magnitude, distribution and structure of the biological environment, and hence the web of life leading to fish, seabirds, and marine mammals GEM should seek to understand the details of the HOW

I tend to be wary (perhaps too much so) of all the discussion concerning physical environmental regime shifts and concurrent ecosystem changes I'm wary of these because I don't understand the mechanistic connection between say an SST anomaly (or a PDO) and a change in fish or bird populations How strong are those relationships really? Is there a cause and effect between the two? Most of our observed time series are VERY SHORT both in duration and the number of observations and I think there is some danger in assuming that correlations based on a few year's worth of data are statistically stationary (Indeed some of the paleoclimatic reconstructions of salmon runs that Bruce Finney has put together suggest that correlations between salmon recruitment and an environmental index [such as SST, SOI] are not stationary) A mechanistic understanding of the ecosystem is far more useful than a correlative one because the former approach informs us of the processes that lead to a population response to a changing environment Such information is crucial to model development of recruitment and the ecosystem I cite the interesting relationship between (heavily smoothed) PDO and salmon catch These imply co-variation on ~20 year time scale We have about 100 years of data for each Impressive as those time series look when overplotted, do 5 points really constitute a statistically firm result? This is akin to thinking that one can estimate escapement up a river with 5 samples In contrast if we can determine the mechanistic links between whatever it is that the PDO represents in terms of a perturbation to salmon recruitment success, then we would have much more confidence in an apparent correlation based on few samples The work necessary to achieve this understanding has not been done GEM offers the first realistic possibility of doing so I would hope that this is the direction and focus that GEM maintains

Somebody at the workshop asked how you get scientists communicating with one another Ted Cooney stated at the Jan EVOS workshop that getting different disciplines on board the same vessel helps He is right and my experience with GLOBEC supports this The different disciplines develop a deep appreciation for the spatial and temporal scales of physical and biological variability as the data is being obtained You can (and will need to) get people together in meetings, but being in the field together really enhances interaction As far as meetings go, push for smaller, more informal and intimate get-togethers where sub-groups of PIs can let their hair down and hash out ideas without having to make formal presentations I would encourage GEM management to partake in an occasional cruise or informal meeting – it will help you keep a hand on the pulse of the program There's a place for the bigger, more formal meetings and the annual EVOS workshops suffice in this regard Of course the various means for public outreach as discussed in the GEM plan is important One outreach approach would be to have the public participate in some of the fieldwork and these informal meetings

Some other partners and linkages to GEM
The Alfred P Sloan Foundation's interest the Census on Marine Life This is a relatively new interest by this foundation, but I know they have joined in some NOPP programs
The North Pacific Marine Research Program – whatever that might evolve into Clearly there will be common interests between GEM and this program
PICES – your best route to accomplish this connection is through Vera Alexander here at SFOS or through Tom Royer at Old Dominion University They can help encourage a Japanese involvement in the central gulf, which complements GEM objectives I think the Japanese would be a willing collaborator through complementary work in the deep gulf

Specific scientific recommendations

ISSUE 1
I strongly urge that adequate consideration be given to the shelf outside of Prince William Sound, Cook Inlet and upstream (e g , east and northeast) of Kodiak Island While these regions are biologically important, many fish and their prey utilize the shelf during portions of their life history where they must find conditions supporting their long-term survival Moreover, renewal of nutrients and planktonic species in the inshore regions largely depends on exchange processes occurring over the shelf and slope Two important aspects of the shelf are that it possesses an energetic circulation field and it affects communication between the shelfbreak/slope and the inshore waters of PWS, CI, and Shelikof Strait Flows on the shelf (particularly the Alaska Coastal Current) and over the slope are vigorous, persistent, and extensive These flows are the oceanographic mechanism by which environmental signals from distant regions are carried into the northern Gulf of Alaska These signals are modified in transit by winds, runoff and other

local processes occurring in the northern gulf Those signals (temperature, salinity, nutrient content, species composition) are ultimately transmitted into the inshore regions It is therefore important to understand what is happening (transport, water properties, biological constituents and processes) on the shelf and over the slope in order to understand CI, PWS, and Kodiak These processes regulate the magnitude and pattern of biological productivity on the shelf, offshore and inshore, ultimately including the fisheries yield for this region

Summary points

1 The Gulf of Alaska shelf and slope influence biological productivity in PWS, CI, Kodiak through
 - exchange of nutrients, phytoplankton, and zooplankton between offshore and inshore, and
 - distinct biological production processes occurring on the shelf and slope

2 What is the seasonal and interannual variability in these biologically important parameters (e g , oceanographic structure, nutrients, phytoplankton production, zooplankton assemblages, condition, and production)?

3 How is this variability related to variations in biological production in PWS, CI, Kodiak?

4 How do variations in shelf properties and cross-shelf exchange affect inshore biological productivity?

5 How are 3 - 4 linked to broader scale (North Pacific) physical forcing?

What is the best way to do this? At this time I suggest that GEM look to maintain the long term monitoring begun by the GLOBEC on the shelf We sample on and across the shelf offshore of Seward, within PWS, and on the shelf offshore of Hinchinbrook Entrance The sampling therefore covers the entrance and exit to PWS as well as offshore waters upstream of Kodiak and Cook Inlet It captures the ACC *before* it bifurcates around Kodiak Island I hope that GLOBEC will continue this sampling for the next four years, at which point it will end I recommend that GEM maintain this valuable "finger on the pulse" of this ecosystem

The current GLOBEC sampling consists of physics (temperature-salinity, current mapping), nutrients, phytoplankton (total biomass and production), zooplankton (distribution, abundance, community composition), and some fish work (juvenile salmon being the main target of GLOBEC, with emphasis on distribution, diet, and condition) EVOS is presently supporting seabird & marine mammal observations (distribution, species, and abundance) on these cruises We are planning on 7 cruises/year, each of 9-days duration The cruises are in March, April, May, July, August, October, and December These times are chosen because they capture crucial biological and physical seasonal transitions on the shelf and slope (as outlined in the table below) The zooplankton, fish, and seabird work must be done simultaneously with the physics as the biological distributions appear closely linked to the physics (See also my comment on how to get scientists talking with one another.) Moreover, the biological data cause the physicists to ask the biologically relevant questions, e.g., Why do the species assemblage differ between sites in some years and not others? What makes region A more productive than region B? The zooplankton work uses both point collections with nets and continuous acoustical sampling that delineates the important spatial scales of species and biomass distributions. These are tied to fronts and eddies which the physics resolves. Transect sampling as opposed to isolated station sampling is crucial in this regard. A danger of having a few isolated stations is that serious undersampling occurs and the results are aliased. New instruments entering the research community will further improve our ability to determine composition and distribution of a wider variety of organisms while transecting. As GEM progresses and we understand better these distributions and shelf features, it is possible that the sampling effort can be reduced without any loss of information. Indeed at the conclusion of the GLOBEC program, GEM will be in a much better position to recommend modifications to this sampling, and what emerging technologies should be utilized. GEM also gains from the GLOBEC work by building upon a time series that will consist of ~7 years of uninterrupted sampling at the conclusion of GLOBEC. As it stands now, GLOBEC builds upon a spottier time series that began in the 1970s at these locations.

Sampling schedule and rationale for GLOBEC monitoring on the Gulf of Alaska shelf. (KEY for Winds, Discharge, and Stratification: S = strong, M = moderate, W = weak; D = downwelling winds, U = upwelling winds; V= variable; L = Low, H = High, Gray = Deep, nutrient-rich water moves onshore)

Month	**Sampling**				**Physical Rationale**			**Biological Rationale**
	CTD	Nut	Zoo	Fish	Winds	Disch	Strat	
March	X	x	x		D S	L	W	Zooplankton migrate from depth (at shelfbreak) & are transported inshore
April	X	x	x		D M	L-M	W V	Phytoplankton bloom
May	X	x	x		D M-W	M	M V	Maximum Oceanic copepod biomass.
July	X	x	x	x	D/U W	M-H	S	Max zooplankton abundance; yoy salmon enter shelf
August	X	x	x	x	D/U W	M-H	S	Max yoy salmon abundance on shelf
October	X	x	x	x	D S	H	H	Late season yoy salmon on shelf, fall primary production pulse
Decem-ber	X	x	x		D S	M	M	Fall-winter pre-conditioning for spring nutrients, small zooplankton conditioning.

COST:
$1.5 - $2 million/yr includes logistics

ISSUE 2

It is imperative that GEM initially conduct a short (~5 year) monitoring of the flow through Hinchinbrook Entrance and Montague Strait This provides crucial information on what is going in and out of the sound and it is essential in providing the modelers with an important boundary condition and data to evaluate model performance It is very likely that a 5-year intensive measurement program will capture significant interannual variability and indicate cheaper means to systematically monitor transport (The latter might be achievable through winds and/or relatively inexpensive pressure gauges deployed on either side of these straits) A similar effort should be established at the mouth of Cook Inlet to quantify what goes in and out of the inlet and the factors influencing this exchange Exchange will vary seasonally and interannually so year-round measurements are crucial The work of Niebauer et al in PWS was based on single moorings in Hinchinbrook and Montague Without doubt these measurements were spatially aliased Nonetheless, the data underscore the fact that the throughflow through the sound is vigorous and probably causes substantial changes in both the water mass properties and the plankton in the sound within a few months Those results also underscore the intimate connection between PWS and the shelf Quantifying this linkage is crucial The SEA measurements in Hinchinbrook were similarly aliased and moreover did not capture the crucial upper 40 m of the ocean (where most of the flow occurs) Those results also underscore the intimate connection between PWS and the shelf

Summary points

1 What are the seasonal and interannual variations in transport and constituent fluxes into and out of PWS and CI?

2 How do changes in these fluxes affect the timing and magnitude of biological production within PWS and downstream in the Alaska Coastal Current?

3 Develop a simple means of monitoring these fluxes in the future for predictive purposes

COST

YEARS 1 – 2 $400K/yr (equipment will be needed), Years 3 – 5 $250K/yr for both PWS and CI

(Possible sharing of logistics with shelf monitoring)

ISSUE 3

The GAK 1 sampling should be maintained It has long been known that temperature anomalies obtained here reflect broad scale thermal anomalies in the northern gulf and Bering Sea The spatial coherence scale of the GAK 1 salinity measurements are not as well known However, as we work with these data (in conjunction with the GLOBEC sampling) we are developing an appreciation for this It appears that GAK 1 salinity measurements do reflect changes in the freshwater content of the Alaska Coastal Current (for at least the northern gulf) and there are suggestions emerging that these data can be used as an index for at least part of the ACC transport Salinity is correlated with nutrients and is relatively easy to measure (compared to nutrients) Salinity also provides us with a measure of mixed layer variations (springtime onset, strength of stratification) in the ACC and the onshore influx of nutrient-rich bottom water onto the shelf in summer Our tentative thinking is that this annual deep-water renewal re-supplies the shelf with nutrients that are subsequently consumed the following spring and therefore affect biological productivity

We discussed the possibilities of a similar type mooring offshore of Yakutat This could be done cheaply and provide a measure of the upstream variability in the ACC (at least for temperature and salinity) The Yakutat measurements will tell us what the ACC properties look like as it emerges from Southeast Alaska Of course there is no prior time series to build upon for this region However, some of our work from GAK 1 suggests that Seward sea level (measured by NOAA) and freshwater variability are weakly (although significantly) correlated on monthly time scales If freshwater variability and Yakutat sea level (again measured by NOAA) are correlated then it is possible that the extensive sea level time series at Yakutat could serve as a proxy for low-frequency freshwater variations in this region of the gulf (I don't want to oversell this idea though because there are some big differences in the shelf between Seward and Yakutat that might prevent such a correlation from being established at Yakutat) I am going to meet with Canadian colleagues in late September and make the pitch to them that similar measurements be made on the BC shelf While there are no guarantees that this will be done, I think there is some interest on their part in this regard A geographical distribution of these data would help detect temperature and salinity signal propagation and provide some idea of how the freshwater influx into the gulf is geographically partitioned

Summary points

1 What are the spatial coherence scales of temperature and particularly salinity variations in the Alaska Coastal Current? (Southeast Alaska is a major source of freshwater for the GoA shelf)

2 To what extent are northern Gulf of Alaska environmental conditions (the GEM area) coupled to upstream (e g , eastern gulf) influences?

3 How is freshwater forcing partitioned around the gulf?

4 How rapidly are inner shelf signals propagated from upstream of GEM into the GEM area?

COSTS
GAK 1 $75K/yr
YAKUTAT $100K/yr for first 2 years, $80K/yr thereafter

ISSUE 4
I think that GEM should consider some sediment coring at a few locales on the shelf and in Prince William Sound to assess past biological productivity Although, I am not an expert on this subject, the sediment record might delineate decadal and longer period variations in productivity There are a variety of biogeochemical techniques that are

employed in these analyses that yield spectacular information on taxa, production, etc The value of these data is that they serve as a proxy record that pre-dates the instrumental record They can provide a historic time series that help understand the present and predict the future One approach to such a program is to have a small pilot study based on a few cores, which provide preliminary data and recommendations A subsequent study might be somewhat larger to fill gaps identified by the pilot study Such a project would be a short-term and phased study that would neatly serve the goals of GEM The cores are archived and as more information becomes available through GEM the cores can be further interpreted Thus a sustained coring effort is not envisioned as a permanent part of GEM

Summary points

1 What does the historical record tell us about long term variations in northern GOA productivity?

2 What is the relation between these historical productivity changes and larger scale environmental variations?

3 To what extent can the past productivity records help us understand the present and predict the future?

COSTS I don't really know - $150K/yr of program is probably reasonable assuming logistics can be piggybacked

ISSUE 5

GEM should also consider supporting/maintaining a few interdisciplinary moorings that include nutrient samplers, bio-optical packages (fluorometers), physics, and sediment traps (The latter catch the products of biological production that rain down from the surface Analysis of these products provides a wealth of information on production processes) In the near future, acoustic and optical sensors will be available to measure zooplankton composition and abundance in situ, prototypes of such devices are already in the field At the moment the North Pacific Marine Research Program is supporting one of these moorings on the Gulf of Alaska shelf (on the Seward Line) I urge that this be maintained As the GEM program evolves I would argue for another at the shelfbreak and another within PWS (at a minimum) Naturally, this does not have to come together immediately but these time series are invaluable in determining the timing, magnitude, nature of seasonal, interannual, and synoptic scale production The biophysical moorings should be deployed where there is frequent shipboard coverage of the region surrounding the moorings so as to provide the spatial context for the time series

Summary points

1 What is the link between short-period (daily – weekly) events to seasonal and interannual variations in production?

2 How rapidly are physical events transmitted to biological production?

3 Critical for evaluating bio-physical model performance and data assimilation

COSTS
$175 - $250K/mooring (for equipment, depends upon location)
$150K/yr analysis and maintenance
Logistics not included – likely can piggyback some of this

ISSUE 6
Modeling
I urge GEM to use models in several ways First and foremost is to establish hypotheses and explore ecosystem sensitivity – how does the shelf respond if we change one or two drivers (wind, freshwater)? What happens to Cook Inlet productivity if we decrease flow into the inlet from the gulf for some part of the year? How sensitive is the ecosystem if we change this rate constant or a particular prey or predator's biomass or abundance? One could go on – but the point of these exercises is to focus our observational efforts and get people to think about interconnections The second approach is toward a truly predictive model Can models re-create the observed variability? It is just as important to know where a model is in error as it is to know where it is working well Too often we hear about how well a model performs but little about where it fails But if the model isn't working correctly on a critical point then we have to ask why? Knowing that will yield BIG RESULTS As GEM progresses, our models will become more sophisticated and improve their predictive capability I would envision a time when we are using data-assimilative models in near real-time fashion Here the monitoring observations are blended into the model as it is running The observations update the model - essentially correcting it This approach is exactly what is used in weather-forecasting models It is also the approach that is used in climate forecast models as applied to ENSO for example

Summary points

1 Models help us explore ecosystem sensitivity and therefore focus GEM program

2 Model success tells us what we know reasonably well, model failure tells us what we need to know

3 Predictive capability (data assimilation)

COSTS $100K+/yr (??)

ISSUE 7 LOGISTICS
The work outlined above requires efficient and sophisticated sampling from an adequate vessel I urge GEM to consider using the University's R/V Alpha Helix where applicable (The Helix is owned by the National Science Foundation but operated by UA) It comes with all of the oceanographic equipment needed to perform the sampling described and is staffed by a crew with long experience in oceanographic research The equipment is also maintained and operated by a highly experienced marine technical staff The vessel operates 24 hours a day so sampling continues around the clock In most cases, the cruises are turnkey operations for the scientists as they spend little preparation time in configuring and maintaining the equipment The vessel, crew, and marine technicians are

available to all vessel users – not solely to UA scientists All users receive the same level of service Since the ship's oceanographic equipment (CTDs, ADCPs, MOCNESS, autoanalyzers, etc) stays with the ship this equipment is available to any user NSF pays for maintenance on routinely used equipment and so the user does not bear these costs except for any expendable items Each year we submit a proposal to NSF to upgrade the vessel's instrumentation This proposal is formulated based on anticipated needs of NSF-funded scientists However, if those requests are funded the new equipment is available to all Helix users regardless of their funding source On the other hand if GEM was to use the Helix and purchase a piece of equipment, that equipment stays with GEM There are considerable cost efficiencies realized in this way that should benefit GEM

Moreover, there is considerable emphasis placed on safe operations, as these are mandated by NSF and the national consortium of academic research vessel operators (UNOLS) of which the Alpha Helix is a member I've spent ~25 years going to sea on both UNOLS vessels and charters and increasingly appreciate the safety aspects of the UNOLS vessels This is an especially important point when one realizes that the majority of ship users are landlubbers and ignorant of the hazards of working on a vessel Oftentimes the efficiency and safety factors are overlooked when basing platform decisions solely on a day rate We are hoping to replace the Helix before the end of this decade with a more modern research vessel Our plan is to have a larger vessel capable of undertaking traditional oceanographic research (what we do now) with a fisheries research capability The latter includes trawling operations and state-of-the-art acoustics specifically designed for fisheries research Such an improved vessel would be invaluable to GEM I'm happy to report that NSF has funded the preliminary design phase for the new vessel

Summary points

1 Operational efficiencies realized through experienced crew
2 High Safety standards maintained and enforced
3 Ship equipment supplied and maintained for the users
4 Experienced marine technical staff for reliable deployment, operation, and maintenance of equipment

COST ~$12 5/day (varies depending upon demand – more demand lower day rate)

Leveraging with other agencies

I strongly urge that GEM give this a high priority The recommendations I've outlined provide a framework for many research endeavors that could (and should) be supported by other agencies That research would enhance GEM without requiring additional GEM expenditures enabling GEM to get a bigger bang for its bucks For example, there are a variety of remote sensing programs of interest to NASA, particularly in ocean color, that would benefit from the GEM infrastructure There are endless ideas residing in the heads of scientists who could leverage money from NSF, NOAA, NOPP, NASA, NPMR, etc I think GEM can and should profitably avail itself to these possibilities

A final thought

We begin GEM highly ignorant of the gulf ecosystem It is clear though that the interannual variability in the physical environment is very large and oftentimes much larger than the longer-period fluctuations in the environment I believe that there are complex and non-linear interactions between the physical environment and the marine ecosystem These interactions drive changes in biological components at a variety of time and space scales, which can only be discriminated by careful and systematic observations coupled with models

At this stage of GEM, I think ISSUE 1 is of highest priority on this list provided We are bound to make mistakes and the GEM in years 1-5 will undoubtedly be different from years 10-15 There's also a lot of hard-slogging required and there are no quick and easy answers to be expected The work outlined above is unglamorous, expensive and time-consuming But if we do it right, GEM will establish a legacy that 1) locally provides future generations with a deep understanding of the GoA ecosystem and 2) catalyzes similar type efforts globally GEM can serve as the new paradigm for the way we address ecosystem management both in the ocean and on land

I appreciate the hard work you are putting into GEM and I thank you for considering these thoughts

Good luck,
Tom

Vick

Gulf of Alaska Coastal Communities Coalition (GOAC3)
P.O. Box 201236, Anchorage Alaska 99520
Phone: (907)561-7633 Fax: 561-7634
goaccc@alaska.net

COMMENTS REGARDING
THE EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL proposed GULF ECOSYSTEM MONITORING
by Gale K. Vick
Director, Gulf of Alaska Coastal Communities Coalition

August 1, 2000

Our many thanks to Molly McCammon and the Exxon Valdez Oil Spill Trustees Council (EVOS/TC) for inviting the Gulf of Alaska Coastal Communities Coalition (GOAC3) to the Kodiak Focus Work Group for the proposed Gulf Ecosystem Monitoring program (G.E.M.) today. It is a major undertaking and we feel privileged to be part of it.

I have the following comments regarding today's work session and the upcoming October work session.

While we represent the outlying communities of Kodiak Island, the GOAC3 also represents communities from Prince of Wales Island to the North Gulf and down the eastern Aleutians. This area is considered to be – by the federal government and the State of Alaska - the "Gulf of Alaska."

As we discussed at the meeting, "Gulf Ecosystem Monitoring" connotes the entire Gulf of Alaska, even though it is subtitled to specify only the North Gulf. The program includes Kodiak Island area and the Eastern Alaska Peninsula, but excludes Yakutat area and Southeast Alaska. I know this is necessary because both the funding and the mission are specific to those communities which suffered during the 1989 Exxon Valdez oil spill. My suggestion, however, is to make the "North Gulf" more specific. There is a lot of sensitivity from Southeast communities on this issue.

One of the greatest potential benefits of the proposed G.E.M. project is the identification and cataloging of past and current research and data, projects and papers, players and issues. It is an idea that is long since overdue. The lack of an "over all big picture understanding" is something that everyone laments, from scientists to fisherman to impacted communities to regulatory agencies. It would take an independent non-governmental organization, such as the Trustee Council, to act as the agent for developing such a world view. Or at least developing the template and working with another, similar group, on complementary baseline studies for Southeast Alaska.

The research potential for the G.E.M. project that has been discussed may or may not include information that can be extrapolated to Southeast communities but it is not likely to reflect the distinctive sub-regional differences and concerns. Sub-elementary research would be helpful.

What are some of the ecosystems issues that Southeast shares in common with the North Gulf? (1) Near-shore depletion of halibut, (2) water temperature changes (3) regime shifts, (4) Steller sea lion studies (Eastern herd Stellers are not considered endangered but National Marine Fisheries Service and Alaska Department of Fish & Game includes them in research studies to provide baseline data), and, (5) a wide range of social and economic impacts from regulatory changes.

Certainly Southeast would benefit from data that is collected for the North Gulf. This data could help provide the basis for other sources of funding that would integrate Southeast research with the North Gulf. It would certainly be in the purview of the GOAC3 to seek funding for complementary studies. A combined, and perhaps, simultaneous, research project could help us all avoid the "piece-meal" kind of approach that agencies (and ourselves) have currently been forced to take in reviewing and proposing regulatory changes.

We look forward to participating in the upcoming EVOS/TC G.E.M. workshop (October 12-13th in Anchorage) and we look forward to a continued partnership in developing baseline data for the Gulf of Alaska.

Once again, our many thanks.

Sincerely,

Gale K. Vick

Gale K. Vick
Executive Director
Gulf of Alaska Coastal Communities Coalition.

cc: GOAC3 Board of Directors
GOAC3 Technical Team

Gulf of Alaska Coupled Circulation/Hydrological/Ecosystem Model Theme

Jia Wang

Title: Coupled Ocean-Hydrological-Ecosystem Model in the Gulf of Alaska

Objectives:

1. Establish a high resolution GOA ocean circulation model (Fig. 1), a hydrological model for freshwater discharge into GOA (Figs. 2a and 2 b) from coasts, and an ecosystem model,
2. Couple the hydrological model to ocean model, and further to the ecosystem model,
3. Build a foundation for physical forcing to other GEM projects and a solid foundation toward a nowcast/forecast system for GOA after accomplishing objectives (1) and (2).

Geographic areas:

Entire GOA, including PWS, Cook Inlet, Kodiak Island, etc. (see Fig. 1)

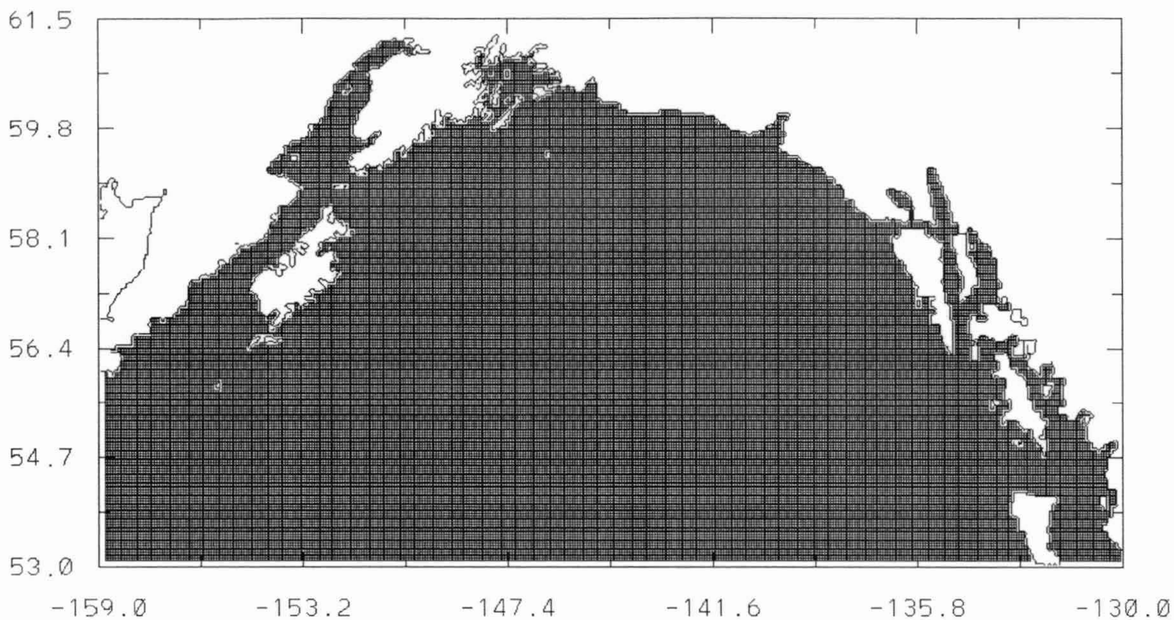

Figure 1. The GOA ocean circulation model grid.

Scientific Hypotheses:

1) Wind-driven circulation is controlled by the Aleutian Low. What is the seasonal pattern of the GOA ocean circulation?
2) Freshwater runoff in GOA is characterized by both point source (53% of the total runoff by seven largest rivers) and line source (47%). How does runoff contribute to the Alaskan Coast Current (ACC) and the general ocean circulation on seasonal and interannual time scales?
3) What is the tidal current pattern and residual current pattern along coasts of GOA?
4) How does the GOA circulation influence the PWS circulation in terms of physical advection, biological transport, and ecosystem dynamics?

Research Teams

- Dr Jia Wang (IARC and IMS, UAF, Project Leader)
- Dr Meibing Jin (IMS, UAF, co-PI)
- Mr Linong Yan, (Ph D Candidate, IMS, UAF)
- Ms Yongmei Qin (MSc Candidate, IMS, UAF)

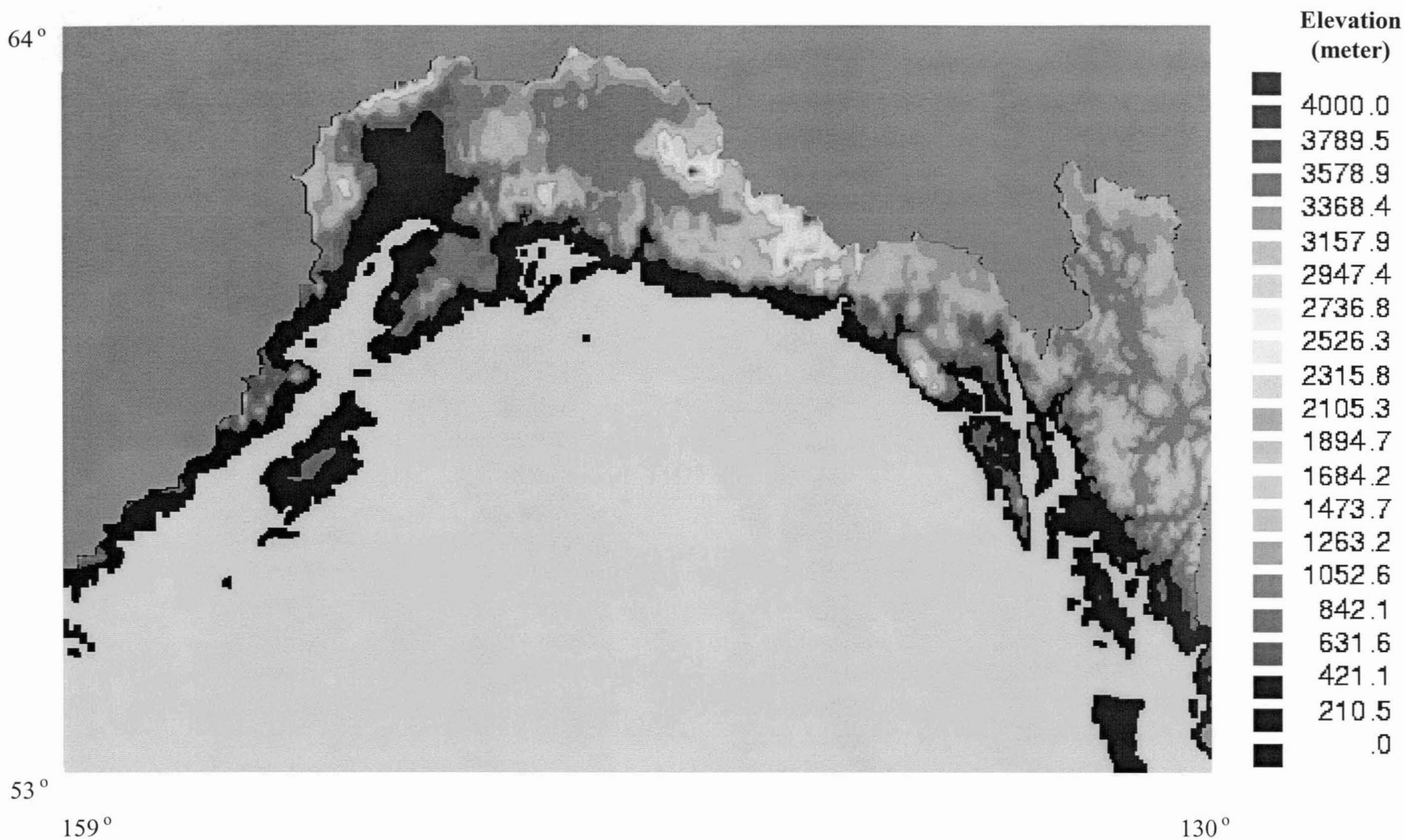

Figure 2a. A Digital Elevation Model (DEM) with total watershed area dischargin into GOA.

Figure 2b. Steady-state total watershed number at every grid point.

PROJECT SUMMARY

Title THE SEABIRD TISSUE ARCHIVAL AND MONITORING PROJECT (STAMP)

Contact Information Geoff Weston York
USGS, Alaska Biological Science Center
1011 East Tudor Road, Anchorage, AK 99503
(907) 786-3928
(907) 786-3636
geoff_york@usgs gov

Project description/objectives

The banking of seabird specimens has been a major part of ecosystem environmental monitoring in Europe and Canada The most successful application of these procedures is the long-term banking (since 1968) by the Canadian Wildlife Service (CWS) of Herring Gull (*Larus argentatus*) eggs from the Great Lakes Both this effort and the collection and banking of eggs and tissues from seabirds of the Atlantic and Pacific coasts are conducted by the CWS as part of its Wildlife Toxicology Program (Mineau et al 1984, Elliott 1985, Wakeford and Kasserra 1997) The value of seabird eggs and tissues for monitoring persistent organic contaminants in the Canadian Arctic has been recently discussed by Muir et al (1999) In addition, the eggs of alcids (a family of colonial seabirds) were identified as key media for circumpolar monitoring by all Arctic nations of persistent organic pollutants (e g , PCBs, chlorinated pesticides, dioxins) For AMAP Phase II Years 1998-2003 (AMAP Scientific Experts Workshop, Girdwood, Alaska, April 1998

In the summer of 1998, a pilot project to begin the banking of seabird eggs and to develop a program for monitoring contaminants in seabirds was initiated through collaboration between U S Geological Survey/Alaska Biological Science Center (ABSC), the Alaska Maritime National Wildlife Refuge (AMNWR), and the National Institute of Standards and Technology (NIST) as an off shoot of the Alaska Marine Mammal Tissue Archival Project (AMMTAP) This pilot project dubbed the Seabird Tissue Archival and Monitoring Project (STAMP) involved collecting murre eggs from four breeding colonies in the AMNWR system The four colonies, which range geographically from the Arctic Ocean (Chukchi Sea) to the North Pacific (Gulf of Alaska), were Cape Lisburne (eastern Chukchi Sea), St George Island (southeastern Bering Sea), East Amatuli Island (northwestern Gulf of Alaska, entrance to Cook Inlet), and St Lazaria Island (eastern Gulf of Alaska) Common murre (*Uria aalge*) eggs were obtained at three of these sites (St George, East Amatuli, and St Lazaria islands), which will allow comparisons of a diving, fish-eating species to be made between the Gulf of Alaska and Bering Sea regions Thick-billed murre (*U lomvia*) eggs were collected at the fourth site (Cape Lisburne), because this is the dominant species north of Bering Strait If funding increases, the program will be expanded to include sampling thick-billed murre eggs at St George Island, which will allow comparisons of a diving, fish-eating species to be made between the Bering and Chukchi environments Additional support will also allow for collecting and archiving black-legged kittiwake (*Rissa tridactyla*) eggs at East Amatuli and St George islands and Cape Lisburne (kittiwakes are not present at St Lazaria)

Adding black-legged kittiwakes to the program will allow comparisons of a surface-feeding fish-eating species to be made among all three regions (i e , Gulf of Alaska, Bering and Chukchi seas) Also, two more colonies may be added to the program, if conditions permit (Bluff in Norton Sound, which supports common murres and black-legged kittiwakes, and Little Diomede Island in Bering Strait, which supports black-legged kittiwakes and both murre species) The proposed study will help improve sampling and analytical efforts that will be used to establish a scientifically sound baseline on the occurrence of persistent bioaccumulative toxins (PBT's) in seabirds inhabiting Alaska's coastal marine environments

Seabirds occupy high positions in the marine food web and are considered sensitive indicator species for the marine environment Chemical analysis of their tissues can be particularly useful in determining whether bioaccumulation of contaminants (and potential biological effects) associated with human activities, including offshore drilling and commercial shipping, is occurring in marine food chains The collection of seabird tissues over a period of several years will provide an archive of samples that can be used to determine baseline contaminant levels against which future contaminant measures can be compared Currently, very little is known regarding the presence and effects of contaminants in Alaskan seabird populations, particularly in SE Alaska However, AMNWR maintains a considerable database on seabird populations at the colonies targeted for egg collection These data indicate that common murre numbers have declined about 30% and reproductive success has averaged about 0 5 fledglings per egg (range 0 4-0 7) at St Lazaria Island since 1994 Common murres also declined about 15% at St George Island since 1996, while productivity averaged about 0 3 fledglings per egg (range 0 2-0 5) In contrast, the reproductive success of this species has averaged about 0 7 fledglings per egg (range 0 5-0 8) at East Amatuli Island since 1993, and population numbers now appear to be increasing at about 7-9% per year (numbers remained relatively stable for the first seven years following the T/V *Exxon Valdez* oil spill) Murres have also increased at a rate of about 7% per year at Cape Lisburne since the mid-1980's, where thick-bills comprise about 75% of the total murre population (productivity of thick-billed murres has averaged about 0 7 fledglings per egg, range 0 5-0 9, at this colony since 1995, the first year these data were collected) The combination of contaminant burden and population data will foster informed hypotheses-based research into the ecological pathways, fate, and effects of contaminants in Alaskan seabird populations These data will also provide the baseline for the long term monitoring of these populations in Alaskan coastal marine environments

The goals of the Seabird Tissue Archival and Monitoring Program are to archive a representative collection of tissues from Alaskan seabirds for current and future contaminant analysis and monitoring of long-term trends in environmental quality The Project has three objectives

1 Collect tissues from representative seabirds that are suitable for determining levels of organic and inorganic contaminants from locations throughout the coastal Alaskan environment (Table 1)

Table 1- STAMP - Responsibilities and locations for collecting, banking, and analyzing Common and Thick-billed Murre (*Uria aalge* and *U lomvia*) eggs in 2000-02

Activity	Location	Responsibility
Field Collections	Cape Lisburne, Chukchi Sea	USFWS
	Little Diomede I , Northern Bering Sea	USFWS
	Bluff, Northern Bering Sea	USFWS
	St George I , Southern Bering Sea	UAF/USFWS
	East Amatuli I , Entrance to Cook Inlet	USFWS
	St Lazaria, Southeast Alaska	USFWS
Egg Processing	ABSC, Anchorage, AK	USGS
Sample Banking	NBSB[1], Charleston, SC	NIST
Analysis	Columbia, MO	USGS
	Charleston, SC (Special Compounds &QA/QC)	NIST
	Gaithersburg, MD (Special Compounds &QA/QC)	NIST

1-National Biomonitoring Specimen Bank

Collections of tissues for archival purposes are limited to freshly laid eggs and other fresh tissues obtained by researchers or subsistence harvesters When samples archived by this project are analyzed, researchers must have confidence that the samples were collected under prescribed, acceptable protocols Neither dead and stranded animals nor old specimens archived from past programs will <u>normally</u> be accepted by this project (rare or endangered species would be an exception)

2 Process, transport, catalog, and curate the tissues in a condition suitable for long-term storage and contaminant analysis

STAMP samples will be maintained by NIST in the National Biomonitoring Specimen Bank (NBSB), Charleston, SC After collection, samples will be processed in Anchorage, and packaged and frozen at – 80 °C, and transported to the NBSB When NIST receives the frozen samples they will be homogenized, cataloged, and archived according to protocols consistent with those employed by the National Biomonitoring Specimen Bank Storage will be under liquid nitrogen vapor at -150 C, which is the best condition available for minimizing sample degradation Requests by other researchers and agencies for archived samples will be considered on a case-by-case basis Eggshells will be archived by Dr Kevin Winker at the University of Alaska Museum in Fairbanks

3 Analyze tissues for selected PBT's

Sample analysis will occur at the USGS, MESC laboratory and at NIST facilities during each year following collection Elements of interest include, but are not limited to PCB's, DDT, DDE, chlordane, dieldrin, mirex, chlorobenzenes, HCH, TBT, and mercury (both inorganic and methylmercury) All partners will collaboratively synthesize analytical data resulting in a final report to the AMNWR and at least one peer reviewed publication The report will provide an estimate of (1) baseline levels of the contaminants of interest in the eggs and tissues of the seabirds, (2) geographical variation in the levels of these compounds among the colonies, and (3) differences in chemical patterns among the colonies This report and publication will serve to increase current knowledge for scientists, managers and the public on the occurrence of PBT's in Alaskan seabird populations The resulting data and reports on PBT's in seabird eggs will also be delivered to the Alaska Native Health Board (ANHB) and the Alaska Department of Health and Social Services, Department of Epidemiology for inclusion into their respective databases and programs regarding toxins in subsistence foods The ANHB is an advocacy organization for Native health issues and is well suited to disseminating complex scientific data to rural areas that will be meaningful and culturally relevant

Additional partners include the people of Little Diomede Island and the U S Air Force 611th CES/CEVP (USAF) The egg gatherers of Diomede have voluntarily donated subsistence gathered eggs for this project out of their interest in food safety The USAF provides significant cost sharing through free storage for field gear at Cape Lisburne and much reduced room/meal rates at their nearby radar site, thereby saving AMNWR in the order of $8,000-$10,000 per field season They in return have access to resulting data for inclusion into their own environmental work

If funded, egg collection will begin during the summer of 2000 and continue in 2001 Processing, homogenization, and archival would occur each year upon receipt of the eggs from the field locations Analytical work will be performed during the winters of 2000/01 and 2001/02, and an interim report documenting these results will be prepared by Spring of 2002 The final project report will be completed by December of 2002, and manuscript(s) will be prepared for submission to peer-reviewed journal(s) after the final report has been reviewed and accepted

Budget

Cost Sharing (Funds indicate sum amounts for the proposed two year project)

	USGS	AMNWR	NIST	USAF
SALARY	$25K	$11K	$10K	---
MATERIALS	$1K	$16K	$5K	---
LOGISTICS	$1K	$16K	$1K	$10K
ANALYSIS	$20K	$0	$30K	---

Total Cost Share **$ 146K**

Requested Funds

	USGS	AMNWR	NIST	USAF
MATERIALS	$0	$0	$5K	$0
TRAVEL	$5K	$20K	$0	$0
ANALYSIS	$50K	$0	$10	$0
ARCHIVAL	$0	$0	$10K	$0
OVERHEAD	$0	$0	$0	$0

Total Requested **$ 100K**

Kenai River W

Jun
Cook I

This is interesting - and good to know re: CI focus group.
Phil North - EPA - is on the invite list, as is Brett Huber - KRSA.

In attendance: **Community members**
Ann Garibaldi, Mary Price, Alan Bor
Carmichael, Michele Brown, Brett Hu
Fandrei, Robert Bondurant, and Dale
Mohorcich, Dean Hughes (for Gary L
Athons.

Overall purpose of workshop

1) To work collaboratively in dec
activities in the Kenai River Wate
2) Cultivate possibilities and posi

Desired meeting outcomes:

1) Prioritized list of project propo
2) Recommendations to the Steeri
3) Recommendations for improvir
4) Prioritized list of future researc

Introduction:

Steering Committee John Mohorci
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consensus decision-making and pr
workshop. He introduced the proposed agenda and desired outcomes for the meeting, as well as a matrix for use in evaluating proposed projects.

A participant asked for clarification regarding the Steering Committee's deadline for accepting pre-proposals. The Steering Committee answered that pre-proposals are due as of this meeting, but in the event that the proposals don't meet the criteria the committee might consider a "Plan B."

There was discussion about how much time to allot to each presenter. The consensus of the group was that presenters could take up to fifteen minutes followed by time for questions from the audience with a maximum of 20 minutes for each project proposal. Participants also indicated a desire to keep time limits flexible, so as not to curtail useful discussion.

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TRUSTEE COUNCIL

MEETING NOTES

Kenai River Watershed Research Priorities Workshop

June 22, 2000 (9:30 a.m. - 2:30 p.m.)
Cook Inlet Aquaculture Association, Kenai

In attendance: **Community members and presenters**: Michael Lilly, Sam McDowell, Robert Ruffner, Ann Garibaldi, Mary Price, Alan Boraas, Doug Reger, Dick Reger, Mike Bergholtz, Mary King, Andrew Carmichael, Michele Brown, Brett Huber, Morgan Evans, Rick Wood, Judy Warren, Dennis Randa, Gary Fandrei, Robert Bondurant, and Dale Bondurant; **Steering Committee members**: Suzanne Fisler, John Mohorcich, Dean Hughes (for Gary Liepitz) and Phil North; **Facilitators**: Dan and Heidi Chay and Dave Athons.

Overall purpose of workshop (May 31 and June 22):

1) To work collaboratively in deciding how to distribute $340,000 earmarked for research and related activities in the Kenai River Watershed.
2) Cultivate possibilities and positive relationships for future collaborations.

Desired meeting outcomes:

1) Prioritized list of project proposals.
2) Recommendations to the Steering Committee re: spending the $340,000.
3) Recommendations for improving project proposals.
4) Prioritized list of future research areas.

Introduction:

Steering Committee John Mohorcich welcomed participants and reviewed the context and purpose of the workshop. Facilitator Dan Chay invited participants to introduce themselves. He reviewed consensus decision-making and project evaluation criteria generated by participants at the May 31 workshop. He introduced the proposed agenda and desired outcomes for the meeting, as well as a matrix for use in evaluating proposed projects.

A participant asked for clarification regarding the Steering Committee's deadline for accepting pre-proposals. The Steering Committee answered that pre-proposals are due as of this meeting, but in the event that the proposals don't meet the criteria the committee might consider a "Plan B."

There was discussion about how much time to allot to each presenter. The consensus of the group was that presenters could take up to fifteen minutes followed by time for questions from the audience with a maximum of 20 minutes for each project proposal. Participants also indicated a desire to keep time limits flexible, so as not to curtail useful discussion.

Presentation of Proposals

Presentations began at 10 00 a m and concluded around 1 45 with a half-hour break for lunch A brief summary of each proposal follows in the order they were presented

1 **Kenai River Prehistory Archaeological and Geological**, three related proposals presented by Alan Boraas, Kenai Peninsula College, Anthropology Department, with Doug Reger, and Dick Reger

1A "Archeaological Excavation and Interpretation of KEN-147 and KEN-063"
The purpose of the project is to conduct archaeological excavation at KEN-147 (Slikok Creek area) and to collate previous archaeological (KEN-063), geological, fisheries and ethnohistoric information to test the Weir Fishing hypothesis Primary investigator Dr Alan Boraas , KPC Project duration 2 years, beginning May, 2000 Amount requested $9,829

1B "Kenai River Prehistory"
The purpose of the project is to compile 25 years of research in the Kenai River drainage to produce a monograph on historic and prehistoric use The resulting report will be usable for land managers to meet government information needs and provide source information for researchers and teachers of area history Primary investigator Dr Doug Reger, Affiliate Research Archaeologist, KPC Project duration 1 year, beginning Oct , 2000 Amount requested $15,530

1C "Drainage History of the Lower Kenai River"
The purpose of the project is to provide information on long-term changes of the lower Kenai River to help predict how prehistoric peoples used this resource area Distributions of modern and former river positions will be mapped and related to dated archaeological sites Primary investigator Dr Dick Reger Affiliate Research Geologist, KPC Project duration 2 years, beginning Sept , 2000 Amount requested $16,530

2 **Educational Video of Activities on the Kenai River**, presented by Judy Warren, Sterling Area Senior Citizens, Inc
The project is to produce a 20 minute educational video emphasizing how various user groups affect the habitat and environment of the Kenai River watershed ecosystem The video will cover what is being protected, what has been impacted, and measures taken to correct that impact, as well as safe boating procedures The video will be shown to visitors and residents at the Sterling Senior Center Lead agency Sterling-Area Senior Citizens Project duration 1 year, beginning Aug , 2000 Amount requested $4000

3 **Ground-Water and Surface-Water Interactions in Kenai River Salmon Redds, Alaska,** presented by Michael Lilly GW Scientific, Fairbanks, AK
The project will provide information for monitoring the long-term impacts of development in the Kenai Watershed and associated impacts of ground water on salmon redds (spawning beds) Project objectives are to establish ground-water and surface water interaction index sites in upper, middle, and lower river sections, collect baseline hydrologic and geochemistry data, use the Internet to distribute data, reference information and dynamic visualizations of hydrologic processes, and design a basin-scale monitoring network to help characterize ground-water and surface-water interactions in developed and undeveloped areas Primary investigators Michael Lilly, GW Scientific, and David Nyman, Restoration Science and Engineering Project duration Summer 2000 to Dec , 2001

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The proposal includes five options with amounts requested as follows

3A	Lower Basin	$129,400
3B	Visualization	$ 13,475
3C	Middle Basin	$ 88,800
3D	Geochemistry	$ 95,000
3E	Upper Basin	$ 88,800

4 **Distribution of Northern Pike and other Introduced Fish Species**, presented by Mike Bergholtz, Cook Inlet Aquaculture Association
The goals of the project are to assess the distribution of northern pike, and other introduced species, in the Kenai River watershed, and to educate the public on the distribution and potential negative impacts, both biological and economical Project objectives include conducting a priority survey to assess northern pike distribution associated water quality testing, developing informational posters and pamphlets, and creating age appropriate lesson plans Lead agency CIAA Project duration 1 year+, beginning Aug , 2000 Amount requested $ 60,755

5 **Storm Drain Sedimentation Basin Treatment System Efficiency Analysis**, presented by Andrew Carmichael, City of Soldotna
The project is to evaluate four storm run-off water sedimentation basin treatment facilities adjacent to the Kenai River and Soldotna and identify which type of system removes contaminants most efficiently and effectively Information gathered through this study will provide an accurate analysis of the above-ground vegetative and underground sedimentation basin designs' relative water treatment efficiencies as well as provide present day storm water effluent and contaminant level data as compared to baseline levels established through a 1998 study Lead agency City of Soldotna Project duration 1 year, beginning Dec , 2000 Amount requested $27,228

6 **Lower Kenai River Salmon Impediment Study** presented by Michele Brown, The Nature Conservancy
The project is to identify and map stream crossings (roads) and other impediments to salmon movement on lower Kenai River tributaries, including "No Name" Creek, Beaver Creek, Slikok Creek, Soldotna Creek, and Funny River, and to recommend strategies for correcting them The project will use techniques developed by ADF&G for use elsewhere on the peninsula Lead agency TNC Project duration 1 year? Amount requested $43,000

7 **Feasibility Study for Using Aerial Photogrammetry to Assess Kenai River Riparian Habitat,** presented by Mary King, ADF&G
The proposed study will use selected photos from historic aerial photo sets of the Kenai River (1975, 1985, 1998) to assess changes in bank position and vegetative cover over time The study will focus on changes occurring along the mainstem of the Kenai River during two periods (1975-1985 and 1985-1998), plus overall change (1975-1998) Assessment of changes during these periods may provide insight as to the relationship of habitat changes with growth in recreational use and urban development along the Kenai River Lead agency ADF&G Project duration Sept , 2000 to May, 2001 Amount requested $ 24,600

8 **"The Glacier Kings" Television Documentary on Kenai River Watershed and King Salmon,** presented by Morgan Evans, Alaska Digi Video Productions
The project is to produce a one-hour research documentary program for television and video tentatively entitled "The Kenai River's Ancient Glacier Kings" The program is an in depth study of the Kenai River King Salmon from the evolution of the Kenai River Watershed as a habitat to the present day, using extensive on-camera interviews with State and local experts in fisheries biology, paleontology, anthropology and archaeology Lead agency Alaska Digi Video Productions Project duration July, 1999 to June, 2001 Amount requested $78,450

9 Development of a Wetlands Classification System for the Kenai Peninsula Lowlands, presented by Ann Garibaldi for Keith Boggs, Alaska Natural Heritage Program
The role of wetlands in terms of their contribution to the Kenai River and the watershed's ecological integrity is unclear yet is considered critical to conservation of the river and its salmon fishery The project is to develop a wetland classification system (i e , vegetation communities and landscape classifications) for the Kenai Peninsula Lowlands This system could serve as a tool for measuring nutrient discharge, and carbon and invertebrate drift between wetland and freshwater aquatic systems, mapping wetlands, linking wetland types to fish habitat, and ranking wetland types in terms of rarity and importance Lead agency Alaska Natural Heritage Program Project duration 1 year Amount requested $93,508

10 Evaluation of Light-Penetrating Walkways on Vegetation (tentative title), presented by Mary Price, US Fish & Wildlife Service
The project is in the conceptualization phase The goal is to assess the effectiveness of current practices regarding placement of light-penetrating walkways, which are being used to prevent bank trampling and erosion along the Kenai River Tentatively, a controlled study would be undertaken to measure light penetration and plant growth under different types of walkways placed at various elevations Lead agency ? Duration ? Amount requested ?

Group Ranking of Proposals

After hearing the proposals, the group discussed how to prioritize them The consensus of the group was to use the "dots" (N/3) method The title and amount requested for each proposal were posted on flip chart paper Each participant was then given 6 adhesive dots to distribute on the list however they wished The results follow The total number of dots each proposal or sub-part received is indicated in the far right hand column

7	Aerial Photogrammetry Assessment of Riparian Habitat	$ 24,600	9
10	Evaluation of Light Penetrating Walkways on Vegetation	?	9
3A	Ground-Water/Surface-Water -- Lower Basin	$129,400	7
6	Lower Kenai R Salmon Impediment Study	$ 43,000	7
3C	Ground-Water/Surface-Water -- Middle Basin	$ 88,800	6
3B	Ground-Water/Surface-Water -- Visualization	$ 13,475	5
8	The Glacier Kings A Historical Study	$ 78,450	5
9	Development of Wetland Classification for Pen Lowlands	$ 93,508	5
1	Kenai River Prehistory (all 3 parts)	$ 41,900	5
1C	Drainage History of Lower Kenai River	$ 16,530	5
4	Distribution of Northern Pike & Other Introduced Species	$ 60,755	4
5	Storm Drain Sedimentation Basin Treatment Analysis	$ 27,228	2
1A	Archaeological Excavation & Interpretation	$ 9,829	1
1B	Kenai River Prehistory Monograph	$ 15,530	1
3	Ground-Water & Surface Water Interactions (all 5 parts)	$315,475	1
2	Educational Video of Activities on Kenai River	$ 4,000	0
3D	Ground-Water/Surface-Water -- Geochemistry	$ 95,000	0
3E	Ground-Water/Surface-Water -- Upper Basin	$ 88,800	0

The group briefly discussed next steps Participants recommended that grant applicants be given the opportunity to develop their proposals, refine their budgets, etc prior to final decision-making by the Steering Committee Participants also recommended that the Steering Committee consider inter-relations among proposals, as well as ways to foster connections between related projects when making funding decisions Applicants were encouraged to let the Steering Committee know if partial funding from the Kenai River Center would help leverage future funding The Steering Committee planned to meet following the workshop to identify proposals for which it needs more information

Full proposals will be due on July 6 Interested parties can request copies of proposals at the Kenai River Center, 514 Funny River Road

Prioritized List of Future Research Areas

As a final exercise, participants prioritized a list, generated at the May 31 meeting, of issues needing to be addressed by future research and related activities in the Kenai River watershed The "dots" (N/3) method was used The total number of dots each item received is indicated in parentheses

- Development impacts in watershed (tributaries and mainstream) impervious cover, wastewater, fertilizer nutrient loading, cumulative impacts, habitat fragmentation, habitat alteration (evaluate restoration and use patterns) (15)
- Landscape hydrology ground water, surface water, wetlands, and interaction between ground and surface water (9)
- Habitat riparian aquatic (water quality, pollution including ground and surface water interaction), uplands, wetlands fisheries resources (including carcass nutrient loading and impact of woody debris) (8)
- Catalog of existing Watershed information and other existing information that is pertinent to Watershed (CIIMS project is partial answer?) (6)
- Evaluation of existing regulations, coordination of these regulations, and impacts to fisheries/habitat (6)
- Public knowledge including assessment through opinion research (5)
- Watershed wide aquatic nutrient dynamics including upland contribution and nutrient loading (4)
- Restoration on tributary streams (4)
- Wetland functions (4)
- Public engagement/stewardship (4)
- Fisheries resources anadromous, resident, and introduced (2)
- Geomorphology including meander history (2)
- Salmon history through use of nitrogen isotopes (2)
- Culture history including prehistoric and post-contact (2)
- Social interactions including recreational, industrial, etc (2)
- Watershed analysis mapping of known data (2)
- Research funding sources available (1)
- Wildlife including habitat and population dynamics (1)
- Offshore impacts pollution, fisheries (1)
- Economics (0)
- Synthesis of cataloged information (0)
- Vegetation mapping of watershed (0)
- Relationship between pollution in fresh and marine environments and impacts to fish (0)

Wrap-up

The group was asked to comment on what went well with the day's process and what could have gone better

"Went Well

Better structure, more clear

Went well

"Could have gone better"

Schedule at different time of year

Central Region Groundfish and Shellfish Research Schedule, ADF&G - Comm Fish

Area	Target Species	Frequenc	Gear	Next	Time Series	Funding
Cook Inlet						
Kachemak	Shrimp	Triennial	Small-mesh Trawl	May-00	1974-present	Gen Fund
Kachemak	Clams	Annual	Rakes	May-00	1992-present	Gen Fund
Kachemak	Crab/Groundfish	Annual	Bottom Trawl	Jul-00	1989-present	Gen Fund
Kamishak	Herring	Annual	Aerial & Seine	Apr-00	1973-present	Prog Rec
Kamishak	Crab/Groundfish	Annual	Bottom Trawl	Jun-00	1990-present	Gen Fund
Kamishak	Scallops	Biennial	Dredge	May-01	1984-present	Gen Fund
Outer Kenai	Sablefish	Annual	Longline	Aug-00	1999-present	Prog Rec
Cook Inlet	Salmon	Annual	Aerial & Ground	Jun-00	1962-present	Gen Fund
Cook Inlet	Salmon	Annual	Video	Jun-00	1998-present	Prog Rec
Prince William Sound						
Internal PWS	Pollock	Biennial	Acoustic	Feb-00	1995-present	Prog Rec
Internal PWS	Sablefish	Annual	Longline	Sep-00	1996-present	Prog Rec
Internal PWS	Shrimp	Annual	Pots	Oct-00	1989-present	Gen Fund
Internal PWS	Crab/Groundfish	Biennial	Bottom Trawl	Jun-01	1990-present	Gen Fund
Kayak Island	Scallops	Biennial	Dredge	May-00	1995-present	Gen Fund
Copper River	Dungeness	Annual	Pots	Aug-00	1985-present	Gen Fund
Other						
Internal PWS	Sablefish -Tagging	Biennial	Bottom Trawl	Jun-01	1999-present	Prog Rec
PWS/Cook Inlet	Sharks - Tagging	Annual	Opportunistic	Ongoing	1997-present	Prog Rec
HOM,CDV,WHT	Groundfish	Annual	Port Sampling	Ongoing	1989-present	AKFIN

File ResPltfrm xls

GULF ECOSYSTEM MONITORING PLAN
FOCUS GROUP DRAFT AGENDA
Prince William Sound
Wednesday, July 19, 2000
10 a.m. – 5:30 p.m.
***Exxon Valdez* Restoration Office**
645 G Street Suite 400, Anchorage, AK 99501-3451
907-800-478-7745 or 907-278-8012

Design a regionally implemented, globally coordinated and integrated monitoring program

10:00: Introductions of participants - Mundy

10:05: Opening remarks - McCammon

10:20: Relationship between GEM program and the draft monitoring plan - Spies

10:50: Orientation to the focus group process - Mundy

11:20: Coffee break

11:30: Criteria for project selection and definitions of terms – Mundy
- **11:40: Human needs and impacts, products, agency mandates – Focus Group**
- **12:05: Ecological importance – ecological indicators – Focus Group**

12:30: Lunch break (on your own)

- **1:30: GEM program mission and goals – Focus Group**
- **1:55: Gap analysis - metadatabase – Focus Group**
- **2:20: Relation to other programs, leveraging – Focus Group**

2:40: Major themes of the draft monitoring plan - Mundy
- **2:50: Harbor seal theme – Focus Group**

3:20: Coffee break

- **3:30: Kittiwake/murre theme– Focus Group**
- **4:10: Sandlance/herring/salmon theme – Focus Group**

4:50: Concluding remarks – McCammon

5:00: Post Mortem – Focus Group

5:30: Adjourn

http://www.frontier.iarc.uaf.edu:8080/~jwang/research.html/