

MEMORANDUM

TO: Council, SSC and AP Members

FROM: Clarence G. Pautzke
Executive Director

DATE: January 25, 1999

SUBJECT: Ecosystems-based Management

ESTIMATED TIME
1 HOUR

ACTION REQUIRED

- (a) Receive report from NMFS Ecosystem Principles Advisory Panel.
- (b) Receive report from the Council's Ecosystem Committee.

BACKGROUND

Ecosystem Principles Advisory Panel

The Sustainable Fisheries Act required NMFS to establish an advisory panel to develop recommendations on how to apply ecosystem principles in fishery conservation and management activities. The panel was tasked to report on the extent to which ecosystem principles are being applied, including research activities, and propose actions by the Secretary and Congress that should be undertaken to expand the application of ecosystem principles in fishery conservation and management.

Council member Dave Fluharty chaired this panel, and will report their preliminary findings. Chris Blackburn and Tory O'Connell also were members.

Ecosystem Committee

The Ecosystem Committee held a workshop on January 21-22 in Anchorage to examine opportunities for better incorporation of ecosystem information and theory into fishery management in the North Pacific. Several presentations were made on the implications of climate variability and regime shifts to fishery management, and the role of marine reserves as a management tool. The Committee also reviewed recommendations from the NMFS Ecosystem Principles Advisory Panel and the National Research Council (NRC) Report on Ecosystem Management for Sustainable Marine Fisheries to see if there are additional ecosystem-based management measures that could be considered for the North Pacific.

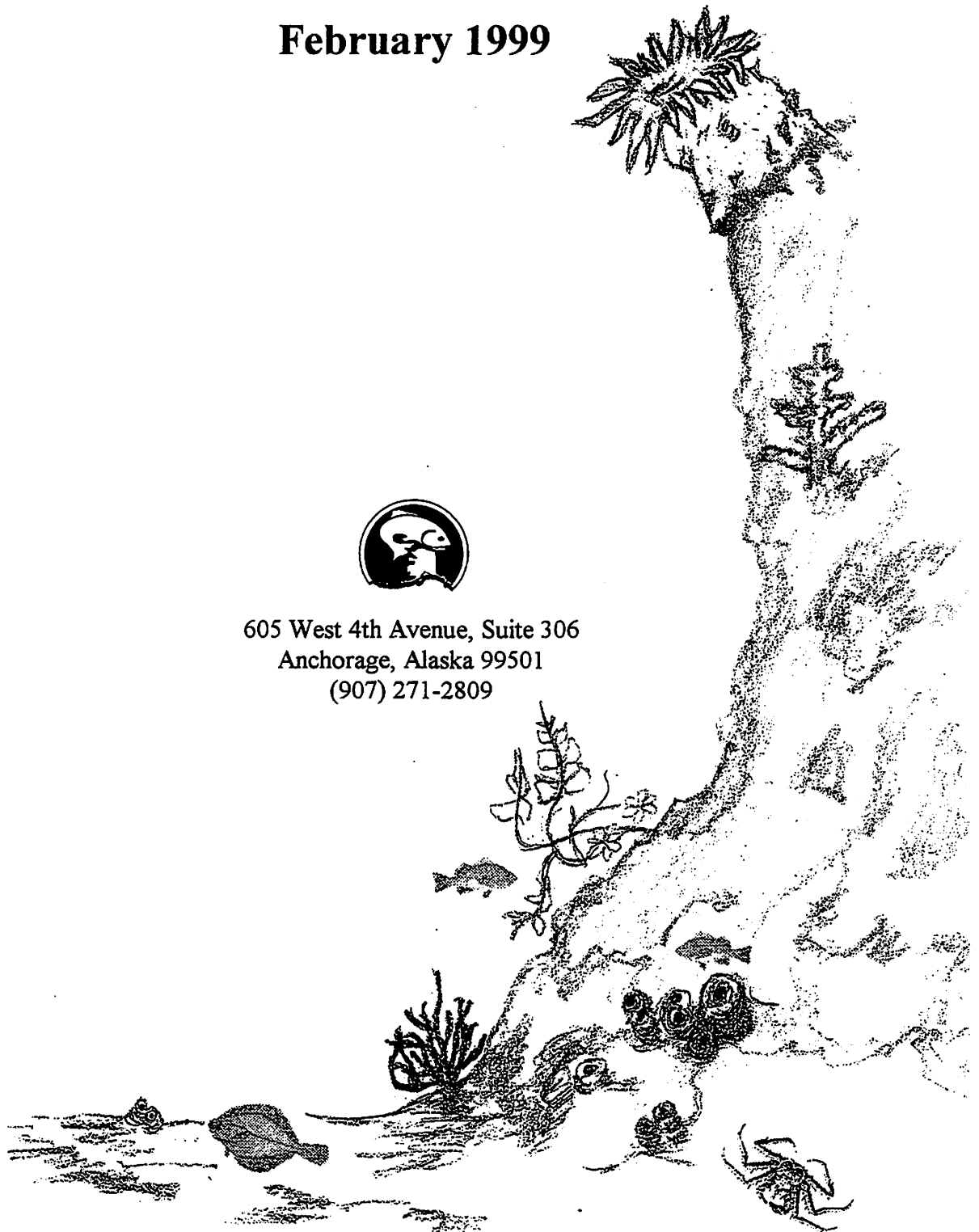
A summary of the workshop, including Committee recommendations, will be distributed at the Council meeting.

Ecosystem Committee Report to the North Pacific Fishery Management Council

February 1999



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Functions of the NPFMC Ecosystem Committee and Some Examples of Work in Progress

- ① Provide a platform for education on ecosystem topics
 - ✓ workshops and research review
 - ✓ distribution of ecosystem literature
 - ✓ interaction with other agencies, groups
- ② Obtain additional information on N. Pacific ecosystem
 - ✓ traditional knowledge and wisdom
 - ✓ local knowledge and fisheries data
- ③ Develop working definition for ecosystem management in context of NPFMC
 - ✓ review other management schemes
 - ✓ proposed definition for discussion
- ④ Develop policies for ecosystem-based management
 - ✓ draft policy similar to habitat policy
- ⑤ Provide advice
 - ✓ research priorities, adaptive management, habitat
 - ✓ Magnuson-Stevens Act mandates

Working Definition for Ecosystem-Based Management in the Context of the NPFMC

Definition: Ecosystem-based management, as defined by the NPFMC, is a strategy to regulate human activity towards maintaining long-term system sustainability (within the range of natural variability as we understand it) of the North Pacific, covering the Gulf of Alaska, the Eastern and Western Bering Sea, and the Aleutian Islands region.

Objective: Provide future generations the opportunities and resources we enjoy today.

Goals:

1. Maintain biodiversity consistent with natural evolutionary and ecological processes, including dynamic change and variability.
2. Maintain and restore habitats essential for fish and their prey.
3. Maintain system sustainability and sustainable yields of resources for human consumption and non-extractive uses.
4. Maintain the concept that humans are components of the ecosystem.

Guidelines:

1. Integrate ecosystem-based management through interactive partnerships with other agencies, stakeholders, and public.
2. Utilize sound ecological models as an aid in understanding the structure, function, and dynamics of the ecosystem.
3. Utilize research and monitoring to test ecosystem approaches.
4. Use precaution when faced with uncertainties to minimize risk; management decisions should err on the side of resource conservation.

Understanding:

1. Uncontrolled human population growth and consequent demand for resources is inconsistent with resource sustainability.
2. Ecosystem-based management requires time scales that transcend human lifetimes.
3. Ecosystems are open, interconnected, complex, and dynamic; they transcend management boundaries.

DRAFT Minutes of the Ecosystem Committee Workshop

January 21-22, 1999

The NPFMC's Ecosystem Committee met for a two day workshop in Anchorage. The purpose of the workshop was to examine opportunities for better incorporation of ecosystem information and theory into fishery management in the North Pacific. Committee members Dave Fluharty, Linda Behnken, Kevin O'Leary, Chris Blackburn, and Kristen Stahl-Johnson were present, along with approximately 20 others who attended at least one day of the workshop. The meeting was conducted based on the attached agenda. A brief summary of each report is provided below.

Insights from the Ecopath Model Andrew Trites (UBC) provided a summary of the Ecopath model and some results from a Bering Sea application. The Ecopath model is a mass balance model that was developed by Dan Pauly and others to help understand changes in the ecosystem. All energy is conserved, so biomass available for consumption must equal that lost by respiration, harvest, predation and other mortality, and unused food. Data required to run the model include biomass, diet composition, consumption rate, and production. The program can then estimate ecotrophic efficiency, which is generally a difficult (if not impossible) parameter to estimate from observations. The model is available at www.ecopath.org (for free!), and is in an excel spreadsheet format.

Trites, Livingston, Springer, and others compiled data to apply the Ecopath model to the Bering Sea. They were interested to see what effects commercial whaling had on the system. So they pulled together data from the 1950's (Russian data) and the 1980's to compare trophic flows and impacts. Graphically, the data can be illustrated in a wiring diagram of the major species groupings, and arranged by trophic level. The modeling indicated that for trophic level 3, pelagic fishes dominated in the 1950's whereas pollock dominated in the 1980's. For trophic level 4 (upper level predators), large flatfish and deepwater fish group each accounted for about 30% of the flow in the 1950's. By the 1980's, large flatfish accounted for over 60% of the flow. The model also indicated some interesting diet overlap (hence, competition) with marine mammals and fish. For example, the model indicated that the abundance of large flatfish in the 1980's impacts Steller sea lions through competition. Baleen whales and pollock were also indicated to be competitors.

The model provides insights into basic properties of the Bering Sea. The Bering Sea appears resilient and resistant to perturbations. In the model, trophic interactions alone could not explain observed changes in the system between the 1950's and 1980's. So the conclusion is that environmental factors (affecting recruitment, primary production, etc.) may be more important than predator-prey interactions in the Bering Sea.

The Committee discussed the usefulness of the model and expressed concern about the validity of the plankton data. Andrew noted that to some extent, uncertainty of data parameters is addressed because the model is balanced and adjusted as necessary. Clearly the model is a useful scientific tool to identify gaps and data needs. Additionally, the model can provide parameters for single species models, but it is not deemed ready for management applications.

Crab Recruitment and Environmental Change Gordon Kruse (ADF&G) summarize the research he and Jie Zheng have done on crab recruitment processes relative to shifts in climate and physical oceanography. For most red king crab stocks, recruitment has declined over time, and the question is why. Except for some discrete periods of overfishing, changes in crab king crab abundance are primarily due to changes in recruitment, which may be determined by environmental conditions. The strength of the winter Aleutian low is thought to drive environmental conditions (e.g., sea surface temperature) in the Bering Sea and GOA for the remainder of the year. This low was weak from 1947-76 and again in 1989-91, but was strong in 1977-88 and has been strong since

1992. It was noted that 7 of the 15 crab stocks show a pattern similar to decadal climate change; that is, years with a strong Aleutian low (and hence warmer SST) result in lower crab recruitment. Kruse and Zheng's crab recruitment hypothesis is that for red king crab, vertical mixing of the water column promotes diverse phytoplankton community of low nutritional value (red king crab prefer Thalassiosira spp.). For Tanner crabs, gonadal development is favored by warmer bottom temperatures, larval feeding is favored by warmer SST, and advection of the larvae is favored by northeasterly winds. As far as the role of spawning stock biomass, the evidence suggests density dependence for Bristol Bay red king crabs.

Crab Recruitment and Groundfish Abundance Gordon Kruse (ADF&G) presented some preliminary analysis on the relationship between crab and groundfish biomass in the eastern Bering Sea. Three possible relationships were hypothesized to exist: 1) predation - decreases in crab recruitment followed an increase in abundance of groundfish predators, 2) common forcing - crab and groundfish recruitment vary inversely and synchronously in response to environmental or lower trophic level ecological changes, and 3) species replacement - groundfish recruitment increased following a decline in crab abundance. Gordon examined crab and groundfish abundance data, as well as food habitats information to see if there was diet overlap and determine significance of predation. Data show that crabs do not appear to be a major prey item for Pacific cod, yellowfin sole, or rock sole (the three groundfish species most often implicated as crab predators). In fact, rock sole and yellowfin sole had a very low frequency of occurrence (<5%) of crab in stomach samples. Tanner and snow crab showed up in about 10-15% of the cod stomach samples. When extrapolated, cod were estimated to consume 30 billion to 70 billion snow crab (age 1-2) annually during 1990-1992. Occurrence of red king crab in cod stomachs was infrequent (<4%), and extrapolated numbers indicated a very small proportion of the red king crab biomass was consumed by cod. Although statistical analysis indicated a couple of significant correlations, they were counterintuitive or may have been spurious. In conclusion, Gordon's analysis does not indicate a simple inverse crab-groundfish relationship in the Bering Sea.

EFH Approach to Habitat Areas of Particular Concern Dave Witherell (NPFMC) provided an update on the status of the essential fish habitat (EFH) initiative. The EFH amendments, which were approved on January 20, identified types of habitat that would be considered habitat areas of particular concern (HAPC), but did not identify specific areas or assess if these areas required additional protection from fishing or non-fishing impacts. In determining whether a type or area of EFH should be designated as HAPC, four factors should be considered: ecological importance, sensitivity to degradation, exposure to human activities, and rarity of the habitat type. The EFH amendments identified three habitat types that meet these criteria and they are: living substrates in shallow waters (eelgrass, kelp, rockweed, etc.), living substrates in deep waters (sponges, coral, anemones, etc.), and freshwater areas used by anadromous fish (migration, spawning, and rearing areas).

Proposals for HAPC designation were solicited last summer. Four additional HAPC habitat types were proposed including seamounts and pinnacles, the ice edge, the shelf break, and biologically consolidated fine grained sediments. Additionally, three specific HAPC areas were proposed including a deep basin in Prince William Sound, the Chrikov Basin north of St. Lawrence Island, and the crab bycatch areas around Kodiak Island.

Dave reviewed the process for analysis of HAPC and protection measures. The first step is to examine available information to identify specific areas where HAPC habitat types occur. These maps will be useful for development consultations, fishery management, and identifying research needs. The next step will be for the EFH Core Team (or a technical sub-committee) to examine current fisheries practices (location, gear, existing regulations) to determine if any of these areas are potentially impacted by fishing. Potential for impacts to these areas, if any, would be prioritized based on ecological importance, sensitivity, exposure, and rarity. From this information, alternatives to minimize potential impacts will be proposed. The Council would then determine alternatives to be analyzed. If all goes according to schedule, analysis could be ready for initial review in

December with final action in February 2001.

Research on the Effects of Fishing Gear on Habitat Jon Heifetz (NMFS) showed a video of trawl roller gear operating on the bottom, and submersible observations of benthic habitat damage caused by trawl and longline gear. Jon also gave an overview of research being conducted in the Alaska region on the effects of fishing gear (specifically trawling) on benthic habitat. These studies include

1. Effects of a single pass of a trawl on hard bottom in the Eastern GOA
2. Effects of chronic trawling on soft bottom in the Eastern Bering Sea and around Kodiak Island
3. A retrospective analysis on the location and intensity of trawling in the GOA
4. Effects of trawling on gorgonian corals
5. Seafloor classification and technology.

Jon detailed the results from the first of these studies. The study examined the effects of bottom trawling on hard-bottom (pebble, cobble, and boulder) seafloor in the eastern Gulf of Alaska in 1996. The experiment was conducted at 200 meters depth using 20" tire gear in center of the sweep. This is gear that fishermen said was used to catch rockfish. A single pass of the trawl was made, then a research submersible videotaped the bottom within each trawl path and a nearby reference transect to obtain quantitative data. Boulders were displaced, and large epifaunal invertebrates were removed or damaged by a single pass of the trawl. Over 50% of the vase sponges and sea whips encountered by the gear were damaged. These structural components of habitat were the dominant features on the seafloor.

The submersible was also used to assess the damage of red tree coral (*Primnoa*) caused by a bottom trawl and longline gear in the Eastern GOA. *Primnoa* is thought to be very long lived, slow growing, and susceptible to disturbance. Of the 32 coral colonies observed in a trawl path, 10 were damaged. Nine broken pieces were observed, with over half of these alive after one year. Areas thought to be fished by longline gear showed smaller corals tipped over, but not the larger ones. Of the 74 corals observed, 19 were tipped over; all were alive. It was interesting that of the 51 individual rockfish observed, 39 were associated with *Primnoa*. Predatory sea stars feed on this coral.

Use of Marine Protected Areas Don Gunderson (University of Washington) provided an overview of the problems of mixed species management and the use of marine reserves as a management tool. Don noted that in some cases fishery management has failed due to inadequate funding, surprise events, collapse due to mixed stock fishing, inadequate accounting of all catch, and managing without the goal of sustainability. Marine reserves can be used as a precautionary management measure as we will never know exactly the effects of fishing on the environment and the ecosystem. Reserves can be random swaths, or designed to protect single species, communities, or specific habitat types.

Don and the Committee discussed several uses for marine reserves as a management tool. Don provided an example of using refuge areas as a management tool to address discarding. He examined the shortraker/rougheye (SR/RE) fishery in the GOA, and noted that the fishery generally goes on prohibited status during the year, resulting in mandatory discarding. By establishing refuges in areas of high fish concentration, targeting of these species could be eliminated and the fishery would not reach prohibited status during the year. Sungkwon Soh's modeling indicated that with medium sized reserves, the SR/RE exploitation rates could be maintained at the current F_{ABC} level outside the reserves and still result in sustainable harvests. It was noted that another and perhaps simpler way to approach the problem of discarding SR/RE would be to reduce the maximum retainable bycatch (MRB) allowed to keep vessels from targeting (topping off) of this species group.

The Committee agreed that the goals for any proposed reserve need to be explicit, and objective criteria need to

be established to define reserve areas.

Ice Edge as an Indicator of Environmental Change Ole Mathisen (University of Alaska) brought to the Committee's attention some data on the severity of ice off Point Barrow. The severity of the ice edge can be measured by its distance from land on a particular date, its thickness, and the number of ice free days at Prudho Bay. Ice severity is affected by climate; intensity of sun spots are thought to be directly responsible. Data indicate a cyclic pattern in the severity of ice since 1950, with 2 cycles occurring every 11 years. Data also show that the amplitude of these cycles has become lower since the late 1970's.

Ole and others noted that the ice edge is a very important component of the ecosystem and shifts in ice cover can have major impacts to the system. Because nutrients concentrate at the ice edge, and freshwater melting in the spring allows a stable surface layer to form, primary production at the ice edge can be tremendous. The ice edge should be considered as a habitat area of particular concern, although it moves and the ice is not impacted by fishing.

Report of the Ecosystem Principles Advisory Panel Dave Fluharty (University of Washington) provided a preview of a report entitled Ecosystem-based Fishery Management, that is being prepared by the Ecosystem Principles Advisory Panel. The advisory panel was formed under the MSFCMA to develop recommendations to expand the application of ecosystem principles in fishery conservation and management activities. The panel was tasked to report to Congress on the extent to which ecosystem principles are being applied in fishery conservation and management activities, including research activities, and propose actions that should be undertaken to expand the application of ecosystem principles in fishery conservation and management. Council member Dave Fluharty chaired this panel, and Chris Blackburn and Tory O'Connell were also members. The report is still in the draft stage, and Dave noted that his presentation should only be considered in that light.

The panel developed a list of basic ecosystem principles, which serve as general warnings to fishery managers seeking to attain the goal of maintaining ecosystem health and sustainability. Policies being drafted by the panel are designed to improve fishery management. The Committee discussed these policies, and were particularly concerned about the burden of proof policy. It was noted that this must be negotiable or a Bayesian approach, because there is no such thing as scientific "proof" and hence one can never meet the burden of proof. Additionally, it was noted that learning should also occur through adaptive management. To some extent we do this now, albeit in a passive fashion, with fish removals, closed areas, etc.. Monitoring and evaluation of these management actions should be undertaken.

The panel is also recommending that Fisheries Ecosystem Plans be developed. The idea is to bring together a fishery plan for a whole marine ecosystem as a first step towards a full ecosystem approach. Components of the plan include food web models, habitat needs, estimates of total removals, an assessment of uncertainty and buffers, indices of ecosystem health and use, long term monitoring plans, and an assessment of other elements out under direct NMFS/Council control.

NRC Report on Sustaining Marine Fisheries The Committee reviewed the summary of the National Research Council's report on sustaining marine fisheries. The report assesses the current state of fisheries resources; the basis for success and failure in marine fisheries management; and the implications of fishery activities to ecosystem structure and function. A prepublication of the report was released on the Internet in October, 1998. The final report will be available through the National Academy press in early 1999. A number of recommendations were made and they are summarized in the adjacent table.

The Committee discussed the NRC recommendations and strongly recommended that staff draft an evaluation of how our management measures meet these recommendations. The Committee worked its way through each recommendation and provided suggestions on how to evaluate each. In April, a report of these evaluations will be available to the Council and further actions contemplated.

Summary of the NRC Committee's recommendations.

1. Adopt conservative harvest levels for single species fisheries.
2. Incorporate ecosystem considerations into fishery management decisions.
3. Adopt a precautionary approach to deal with uncertainty.
4. Reduce excess fishing capacity and define and assign fishing rights.
5. Establish marine protected areas as a buffer for uncertainty.
6. Include bycatch mortality in TAC accounting.
7. Develop institutions to achieve goals.
8. Conduct more research on structure and function of marine ecosystems.

Conclusion

The Committee made a number of recommendations for the Council to consider. These recommendations are listed below.

Committee Recommendations

- Urge NMFS to make HAPC mapping (and research) a priority.
- Request observer program to record catch of corals and sponges (to genus or species level where possible) from all fisheries. This is particularly important given regulatory redistribution of fishing effort in the Atka mackerel and pollock fisheries. Data should be analyzed in a timely manner.
- Identify as a research need the effects of longline and pot gear on benthic fish habitat.
- Request plan team to examine shorttraker/rougheye catch and biomass data to see if TAC's need to be separate. Additionally, MRB's for the SR/RE trawl fishery should be re-evaluated.
- Recommend the Bering Sea and Gulf of Alaska be candidates for a Fishery Ecosystem Plan, and review how the principles and policies are addressed by the NPFMC
- Review the NRC recommendations and evaluate how the NPFMC meets these, and identify ways that address these recommendations, where possible. A report should be provided to the Council in April, or as soon as possible.

Attendance List for January 1999 meeting:

Dave Fluharty (committee chair)	Chuck Fowler	Kris Balliet
Chris Blackburn (member)	Ole Mathisen	Jude Hensler
Kristen Stahl-Johnson (member)	Andrew Trites	Vince Curry
Linda Behnken (member)	Don Gunderson	Mike Syzmanski
Kevin O'Leary (member)	Jon Heifetz	Eric Jordon
Dave Witherell (staff)	Tom Kline	John Gauvin
Gordon Kruse (advisor)	Karen Kolehmainar	Francine Bennis
Loh-lee Loh (advisor)	Doug Pengilly	Henry Mitchell
Clarence Pautzke	Bill Bechtol	Dorothy Childers
Jane DiCosimo	Charlie Trowbridge	

DRAFT AGENDA

NPFMC Ecosystem Committee Workshop

January 21-22, 1999. Hilton Hotel, Anchorage

The Ecosystem Committee will hold a 2-day workshop on January 21-22 (Thursday-Friday) at the Hilton Hotel in Anchorage. The workshop is primarily intended for those interested in developing ecosystem-based fishery management in the Bering Sea/Aleutian Islands and Gulf of Alaska. The purpose of the workshop will be to examine opportunities for better incorporation of ecosystem information and theory into fishery management in the North Pacific. The Committee will examine the implications of climate variability and regime shifts to fishery management. The Committee will also examine the role of marine reserves as a management tool, and discuss how to test for efficacy of time/area dispersal of fisheries. Further, the Committee will review recommendations from the NMFS Ecosystem Principles Advisory Panel and the NRC Report on Ecosystem Management for Sustainable Marine Fisheries to see if there are additional ecosystem-based management measures that could be considered for the North Pacific. A summary of the meeting presentation and discussion will be prepared for the Council. For additional information, please contact Dave Witherell or Dave Fluharty.

January 21

- 8:00 am **Effects of Regime shift/ Climate variability and fisheries in the Northeast Pacific.**
Andrew Trites "A mass balance model for the eastern Bering Sea: insights into the ecosystem effects of fisheries and regime shifts."
Gordon Kruse "Relationships of Crabs to Decadal Shifts in Climate and Groundfishes"
Discussion
- 12:00 noon Lunch (on your own)
- 1:00 pm **Effects of fishing gear on habitat, and marine reserves as a component of fishery management**
Dave Witherell "EFH Approach to Habitat Areas of Particular Concern"
Jon Heifetz "Effects of fishing gear on habitat"
Don Gunderson "Use of marine protected areas"
Discussion

January 22

- 8:00 am **Assessing efficacy of Time/Area dispersal of fisheries**
Discussion
- 10:00 am **Review of the NMFS Ecosystem Panel Report Recommendations and the NRC Report on Sustainable Marine Fisheries**
Presentation by Dave Fluharty (note that Chris Blackburn and Tory O'Connell were also panel members)
- 12:00 noon Lunch (on your own)
- 1:00 pm Committee Discussion on how the Council can incorporate this information into management of North Pacific fisheries.