

MEMORANDUM

TO: Council, SSC and AP Members

FROM: Chris Oliver *CO*
Executive Director

DATE: May 22, 2002

SUBJECT: Research Priorities

ESTIMATED TIME 1 HOUR

ACTION REQUIRED

Discuss and identify research priorities.

BACKGROUND

The BSAI and GOA Groundfish Plan Teams revised the current list of research priorities during its November 2001 joint meeting (Item C-8(a)). No revisions were provided by the Crab Plan Team. In April, the SSC also agreed to organize a working group to draft thematic priorities to be reviewed and finalized by the SSC at this meeting. After receiving comments from NMFS and the SSC at this meeting, the Council will forward a revised set of research priorities to NOAA for use in preparing its annual budget. These will also be forwarded to the North Pacific Research Board.

**BSAI and GOA Plan Team Recommendations for Changes (*in italics*) for the
2002 Research Priorities**

A. Critical Assessment Problems

1. Some of our stocks are disproportionately harvested across large areas of the GOA and BSAI due to area closures, other management actions, or fishery behavior. Additional analysis should be undertaken to examine potential effects of disproportional harvesting.
2. More information is needed on "other species." Observer data should be collected and analyzed for individual species. Better estimates of abundance are needed. Lastly, life history data is limited for many species in this complex. *Stock assessments at the assemblage level (sharks, skates, squid, sculpins, and octopus) are planned in the near future.*
3. Rockfish: There is a general need for better assessment data, particularly investigation of stock structure and biological variables.
 - a) Supplement triennial trawl survey biomass estimates with estimates of biomass or indices of biomass obtained from alternative survey designs.
 - b) Obtain age and length samples from the commercial fishery, especially for Pacific ocean perch, northern rockfish, and dusky rockfish.
 - c) Increase capacity for production ageing of rockfish so that age information from surveys and the fishery can be included in stock assessments in a timely manner.
4. Pacific cod: Recent research into aging Pacific cod is being completed and looks promising. The next step would be to evaluate its application to production-aging for Pacific cod.
5. Walleye pollock: There is a continuing need for research on stock structure as it relates to assessments. There is a critical need for a ~~tagging study to focus on~~ stock interactions *studies and pollock recruitment patterns*. We continue to emphasize the need for age-structured assessments of recognized stock units. ~~As the Bering Sea pollock population has declined, the forecasts of future pollock recruitment have undergone greater scrutiny. Research on alternative forecasting methods is needed~~

The SSC believes that the magnitude of the catch, size and age structure of the EBS stock harvested in the Russian zone in the vicinity of the transboundary area is needed. It may be necessary to consider fishing removals from the Russian zone and their impact on EBS pollock mortality in the estimates of ABC and TAC.

Assessment of the status of the Gulf of Alaska resource is critically dependent upon results of resource surveys. ~~Beginning next year,~~ these surveys will be conducted every two years. While this is a positive development, various ways of supplementing the biennial survey data should be evaluated.

More research should also be conducted on the movement of pollock between the GOA and BSAI and across regions within GOA and BSAI, (e.g., Bogoslof, Donut Hole, PWS, Shelikof, and SE inside).

More research using acoustic data should be conducted.

6. Crab research: Research should be expanded on handling mortality, stock structure and life history parameters.
7. Age- and length-structured assessments: These assessments integrate several data sources using some weighting scheme. Little research has gone into evaluation of different weighting schemes, although the weight can have a large effect on the assessment results. Research is needed on which weighting schemes are robust to uncertainties among the different data sources. Age structured assessments depend upon age determination techniques and ongoing age validation is needed.

Correct model specification is critical to stock assessment. Further research is needed on model performance in terms of bias and variability. In particular, computer simulations, sensitivity studies, and retrospective analyses are needed. As models become more complex in terms of parameters, error structure, and data sources, there is a greater need to understand how well they perform.

8. Life history information, e.g., growth and maturity data, is incomplete for a number of stocks. This information is essential for determination of ABC, OFL and preferred fishing mortality rates. Maturity data are lacking for: Pacific cod, Dover sole, other flatfish, sablefish, and many species of rockfish. *An opportunity exists for collecting Pacific cod ovaries and determining maturity during winter surveys scheduled for 2001.* Life history and distributional patterns of Greenland turbot are lacking. To better understand sablefish recruitment variability, additional information on the geographical distribution and movement of juvenile sablefish is needed. *More research should be done on sources of age-specific fish mortality.*
9. Identification of the origin of chum and chinook salmon stocks captured incidentally in the groundfish fisheries is needed. The chum salmon stocks in particular are recognized as a mixture of Asian and North American origin. Resolution of stock origin is important in the consideration of bycatch management.
10. There is need for information about stock structure and movement of walleye pollock, Atka mackerel, Pacific cod, POP, and other rockfish. *Specifically, we need information on temporal and spatial distributions of spawning aggregations of fish (especially Pacific cod).*
11. Further research is needed about management strategies that provide for conservation of aquatic resources. Topics that need attention include: which measure of biomass should be used in biomass-based adjustment of ABC and OFL; what measure of average recruitment to use in $B_{40\%}$; the effect of seasonality in spawning, recruitment, and harvest on optimal harvest rate; adaptive management schemes which are designed to provide understanding of multispecies interactions and spatial population dynamics. One objective is to develop multispecies analysis of stocks.
12. Presentation of uncertainty in stock assessments is often lacking or incomplete. Further research is needed into which methods are most appropriate for capturing uncertainty in the status of populations. The use of Markov Chain-Monte Carlo (MCMC) methods appears to be a promising line of research and its use with AD Model Builder should be further explored.
13. Management measures such as time-area closures and other restrictions are frequently imposed, but rarely rescinded. Studies are needed to evaluate the effectiveness of management measures on conserving populations, achieving management goals and assessing other ecosystem effects.

14. The Groundfish Teams expressed concern regarding the lack of coverage by trawl survey in both the eastern GOA and in all deepwater strata during 2001 and strongly recommended continued coverage of deeper stations in future surveys.

B. Stock survey concerns

- (a) Conservation of aquatic resources in the North Pacific is critically dependent on a consistent time series of trawl, hydroacoustic, and longline surveys. The continuity of these series must remain one of the highest priorities of NMFS and the Council. Data analysis should be expanded to include non-target, non-FMP species.
- (b) Explore ways for inaugurating or improving surveys to assess rockfish (including nearshore pelagics), pollock, squid and Atka mackerel.
- (c) Expand bottom trawl surveys in the Gulf of Alaska and Bering Sea to include slope areas that encompass the population range of Greenland turbot, rockfish, thornyheads, and sablefish.
- (d) Conduct surveys of the Aleutian Islands management area to assist in the assessment of groundfish stocks found in this region.
- (e) Improve surveys for Bering Sea crab complementary to the existing Bering Sea crab/groundfish survey (e.g. Norton Sound, Pribilof Islands, St. Matthew Island, and Bristol Bay).
- (f) Direct observation (e.g. submersible and dive surveys) offers unique opportunities to directly examine gear performance, fish behavior in the proximity of gear, gear related habitat impacts, and differences of fish density between trawlable and nontrawlable habitat.
- (g) There is a continuing need to perform gear calibration and fish observation studies to validate indices of abundance (e.g. fishing longline and trawl gear side-by-side, and fishing different baits on longline gear over the same stations).
- (h) Little scientific sampling has occurred of seamounts within the EEZ for groundfish, halibut, and crab abundance. Surveys that sample these seamounts may improve estimates of total abundance in the EEZ, particularly for sablefish and rockfish stocks.
- (i) Data from annual ADF&G crab surveys should be examined and their usefulness for assessing groundfish abundance in near-shore areas should be evaluated. Dialogue between ADF&G and NMFS assessment scientists regarding ways of gaining more useful groundfish data from this survey should be encouraged.

C. Expanded Ecosystem Studies

- (a) Considerable research is being conducted on the effects of climate on the biology and dynamics of marine populations. Research effort is required to develop methods to incorporate climate variability and its influence on processes such as recruitment and growth into our models of population dynamics.
- (b) There have been considerable recent advances in using naturally occurring stable isotopes in diverse types of studies. Examples include identifying residence times and areas at various life

stages; computing trophic levels and food web dynamics; examining ontogenetic changes and patterns of migration. Studies using these natural markers should be encouraged.

- (c) ~~Because of the importance of marine mammal and seabird considerations in fisheries management, further studies are needed on interactions among fisheries, marine mammals, and seabird populations. In particular relationships among oceanographic conditions and animal condition and health should be explored. Research should be done on sources of age-specific fish mortality.~~
3. *Explore the utility of placing trained marine mammal/seabird observers onboard vessels conducting fishery surveys. Such observations may contribute to abundance estimates, or to provide indices of abundance and associations with oceanography and prey distributions. In particular, relationships among oceanographic conditions and animal condition and health should be explored.*
 - a) *More research should be collected by placing trained marine mammal/seabird biologists on line transect surveys to begin an index of abundance for birds.*
 - b) *Encourage data exchanges between USFWS and NMFS RACE and NMML.*
 4. Effort is needed on status of stocks and distribution of forage fishes, such as capelin, eulachon, and sand lance. Forage fish are an important part of the ecosystem, yet little is known about these stocks. The Lowell-Wakefield Symposium (October 1996) presented current research on forage fishes.
 5. Studies of the effects of harvesting and processing activities on the ecosystem and habitat should be instituted. One example would be a study contrasting species diversity and abundance in the red king crab savings area with that in adjacent regions.
 6. Trophic dynamics research should be undertaken on the relationships among critical species, e.g., Pacific cod and its prey (including shrimp and crabs). The feasibility of constructing multispecies models using ongoing collection of gut contents data should be investigated.
 7. Groups of species in the rockfish and flatfish families are now managed as "species complexes." Research should be expanded on the question of biological linkages among the components of "species complexes" that justify this management approach. Further, are there other, unidentified groups of species that are ecologically related and could be managed as a unit?
 8. Studies are needed to identify essential habitat for groundfish and forage fish species in the Gulf of Alaska and Bering Sea. This identification is required by the MSFCMA and would benefit from field studies conducted across a matrix of spatial, temporal, and life history stages. Mapping of nearshore and shelf habitat should be continued for FMP species.
 9. Expand studies of distribution, abundance, and productivity of seabird populations and ensure that data are collected in ways that provide for rigorous analyses of seabird/marine mammal/oceanographic/fisheries interactions. ~~The majority of~~ Historic data on seabirds in Alaska was collected during the 1970s (through OCSEAP); but the quantity of data collected afterwards has been insufficient to adequately examine trends in these interactions.
 10. *Historic (i.e., OCSEAP) data existing in the USFWS Pelagic Database needs be reformatted to update and make the data accessible, to enable analysis on seabird/fishery interactions.*
 11. *More recent (1990's - present) data needs be consolidated and added to the pelagic database.*

12. *Seabird diet needs to be described for more areas and species, including winter diet needs of seabirds. Existing and historic diet data needs to be consolidated and put into a format accessible and appropriate for examination of long-term trends. Very little is known about winter diets of birds.*
13. *Multivariate statistical analysis of the time series of annual survey data may identify which species regularly occur in assemblages. Mapping these assemblages through space and time may reveal changes in the distribution and abundance of the species of the Eastern Bering Sea. These mappings and trajectories may be applicable to adaptive management approaches suggested for exploring ecosystem concerns. Although related analyses were started by NMFS in the late 1970's, they have not been conducted in recent years. Recent advances in spatial statistics may prove fruitful tools for re-examining these existing data.*
14. *Uncertainty about the relationship between the Steller sea lion population and groundfish fisheries has taken an elevated significance. With this uncertainty as to the extent of factors affecting Steller sea lions, it is critically important to investigate the effects of mitigation measures on the sea lions, the fisheries, and the ecosystem. The monitoring must be based on an experimental design that provides information about the interaction of fisheries and Steller sea lions. Five questions are central to future work:*
15. *What is the distribution of fish in relation to areas used for fishing, and what are the seasonal changes?*
 - a) *What is the distribution of fish in fishing areas before and after fishing?*
 - b) *How do Steller sea lions use pollock in relations to pollock distributions?*
 - c) *How does the Steller sea lion's pollock feeding habits influence sea lion population dynamics?*
 - d) *Does the fishery effect Steller sea lions in other ways (e.g., behavioral disturbance)?*
 - e) *How much is needed per SSL compared to what is there seasonally and geographically – demand vs. availability, to address localized depletion?*
16. *More research should be conducted to estimate jellyfish abundance trends because it may be an ecosystem indicator ~~and acts~~ (it is a habitat for pollock).*
17. *There is an apparent increase of a parasite occurrence in some flatfish stocks (flathead sole and Greenland turbot) in the Bering Sea. This may signal changes in the ecosystem and has important consequences for the fishery. Research on this should be pursued.*
18. *Killer whale depredation of sablefish catches has been a problem in the Bering Sea since the beginning of the survey. Additional information on the impacts of killer whale depredation on sablefish in the ecosystem and in the sablefish survey should be assessed.*

D. Social and economic research

There is a critical need for the development and continued maintenance of basic social and economic information databases on the fisheries and fisheries dependent communities of GOA and BS/AI. This information is required for establishing a baseline to be used in the evaluation of the impacts of alternative management measures.

1. There is a need to develop a cross section-time series of data on:
 - a) Ex-vessel and wholesale prices (information is needed on actual transactions and sources of variability).
 - b) Inventories and exports (greater detail on product form, volume, and transactions prices).
 - c) Cost of variable inputs to fishing
 - d) Patterns of ownership in fishing and processing operations (concentration, vertical integration, foreign participation).
 - e) Employment and earnings for crew and skippers
 - f) Patterns of employment/unemployment, earnings, transfer payments in fishery dependent communities, and
 - g) The location where goods and services are purchased.

2. There is a need for economic analyses of:
 - a) The demand for fisheries products (exvessel, wholesale, international, and retail markets)
 - b) Production functions for catch and processing
 - c) Regional models of economic activity in fishery dependent communities,
 - d) An assessment of the cumulative efficiency and equity consequences of management actions that apply time/area closures
 - e) An assessment of the consequences of the halibut/sablefish IFQ program (changes in product markets, characteristics of quota share markets, changes in distribution of ownership, changes in crew compensation, etc.)
 - f) Estimates of the net economic benefits of recreation and subsistence harvests, and,
 - g) Improved representation of fleet behavioral response to alternative fishing opportunities to provide better prediction of how fishing effort will shift in response to time/area closures.

3. Research pertinent to assessment of the social impacts of actions contemplated by the Council include:
 - a) Fishery/Community Linkages: Field research aimed at capturing the full array of linkages between fisheries and social and economic life in fishery dependent communities.
 - b) Social Assessments: Selected community and industry assessments should be conducted to establish baseline conditions underlying social problems identified by the Council and the Advisory Panel. As appropriate, these projects can be extended to generate time series information.
 - c) Social Impacts: Social impact and policy research should be conducted regarding the identification and potential effects of alternative management actions.
 - d) Develop better methods for determining the social costs and benefits of management actions (e.g. through the use of non-market valuation techniques).

E. Bycatch problems

1. Research on gear modification and other methods for reducing bycatch should be expanded.
2. A better quantification of discard mortality rates is needed, especially for ~~halibut~~ and crab.
3. Data on size/age and sex of crabs taken as bycatch are needed to assess impacts.
4. Comprehensive evaluations are needed of single and multiple time/area closures and other bycatch management measures.

5. Develop better methods for assessing the social costs of bycatch.
6. Identify sources of variability in actual and estimated bycatch rates.
7. Collect bycatch information in the directed halibut fisheries using observer coverage. Current logbook information is inadequate to quantify this bycatch. *Research efforts should also include development of video monitoring options.*

F. Fishery Monitoring

1. Inseason management and stock assessment are critically dependent on catch estimates. There is a need to conduct ongoing analyses of the accuracy and precision of catch estimates in all fisheries. An analysis of the utility of fishery logbook information should be conducted. In particular, determine if it is possible to gain insight into fleet performance from such information. Examine feasibility for developing a representative CPUE index and determine if it is proportional to stock size
2. Evaluate sampling procedures used by observers and various catch estimation procedures. Recent analyses have been conducted on efficient methods of collecting representative biological data from target species. Similar studies should be conducted on the collection of prohibited species biological data.
3. Development of catch and bycatch sampling procedures for individual vessel accountability programs.

SUMMARY:
INTERAGENCY CRAB RESEARCH MEETING
December 12-14, 2001

Hilton Hotel, Anchorage, AK

This is a very brief summary of the research presentations, and a bit less brief summary of the Marine Protected Area presentations.

RESEARCH REVIEW: Dec 12 -13

Attendance at the research overview was high: 57 agency and university staff signed the roster on Tuesday (list attached). The presence of new blood was evident, and the variety and high quality of the work described was testimony to healthy growth in the Alaskan crab research arena. There was a noticeable wealth of new projects on the life history and fishery biology of snow crab.

Wednesday afternoon, the following research topics were offered up as areas needing attention (order does not indicate priority):

1. Culturing snow crabs; problem is feed production
2. Optimum conditions for snow crab larvae
3. Deeper water surveys for snow crabs
4. Snow crab movements
5. Tanner & snow crab tag development
6. Juvenile growth rates to identify recruitment year classes
7. Juvenile snow crab habitat
8. Recruitment as dependent on settlement strength
9. Where do larvae go?
10. Coordinated sea temperature data program
11. Survey catchability – all crab species; also interspecific interactions and their effect on catchability
12. Golden king crab – life history, stock assessment, habitat requirements
13. Validation of lipofuscin age method, including temperature validation
14. Settlement and habitat requirements for all commercial crabs
15. Physiological stress thresholds for all commercial crabs
16. Faunal relationships of crab parasites
17. CTD type data, especially during deep water crab surveys

Here are the suggestions from participants for possible topics for next year:

1. Tools and technology, e.g., archival tags
2. Larval distribution, including tools for tracking

There was also a suggestion to include a broader range of scientists (e.g., oceanographers) and to hold the meeting in January. After the meeting adjourned, there was a clear indication from a number of participants that December is the preferred month. Your further suggestions for next year's topic are strongly encouraged.

MARINE PROTECTED AREA SESSION: Dec 13-14

There were a series of informative presentations:

1. John Olson described the status of the federal MPA program, including the scope of the executive order, the inventory of sites with existing protection, and the designation criteria.
2. Sylvie Gu nette provided a quick tour of the theoretical and empirical evidence for the benefits of marine reserves, on a backdrop of the global issue of failed fisheries. Reserves are known to result in larger and more fish, largely in cases of sedentary reef fish; however, benefits to fisheries (outside reserves) depend on a number of factors, including life history of the species how effort is redistributed, and what other management tools are used. Reserve design features to consider include location (sources vs. sinks), size, and replication via a network of closed areas. Reserves may be necessary (esp. to protect spawning and nursery areas, critical habitat) but not sufficient, certainly not a panacea. The printout of Sylvie's slides was handed out at the meeting and is available upon request. Also, copies of the various publications she cited are available from Doug Woodby upon request.
3. Paul Rago gave an in depth recounting of effects on fisheries of 3 large area closures on Georges Bank from 1994-2001. He emphasized the establishment of goals and a monitoring program, and reviewed the response of 3 groundfish species (cod, haddock, and yellowtail flounder) as well as the fine-scaled response of both the scallop fleet and the scallop resource. Spawning stock biomass of these species increased by 50%, 400%, 880% and 1600% respectively since 1994 when the closures went into effect. Size distributions broadened (examples given for haddock), especially for scallops in the reserves, and Paul showed pictures of some remarkably large scallops. He provided details of the scallop vessel monitoring system (VMS, satellite based GPS tracking system) and the information it provided on redistribution of effort: many dredge hours were redirected to hard bottom areas with lower catch rates. Future prospects for the scallop fishery are likely to include rotational fishing in closed areas. In conclusion, he noted several benefits from the closures, including species recovery and the scientific value of the closures as experimental control areas. But he also noted that reserves alone can't solve the problems: there needs to be a reduction in excess fishing capacity.

Paul's Power Point slides (19 mb) are temporarily available at the ftp site:

<ftp://ftp.wh.who.edu/pub/dropoff/rago/>

If you want a copy and can't obtain it there, please contact Doug Woodby. An ftp site can be established for long-term use on a state server.

4. Sylvie Gu nette's second talk described her modeling efforts to examine the efficacy of marine reserves for highly migratory species. Her study asked the question if the recent cod collapse off Newfoundland could have been prevented by imposition of marine reserves. In summary, no, unless the reserves were a large majority of the grounds, or if there also were strong controls on effort (3 gear types), and acceptance of reduction in yield. Her model, spatially explicit for migration and redistribution of effort, may be a useful tool for investigating the potential for reserves in Alaskan waters (Jim Taggart is initiating an application to crabs in Glacier Bay).
5. Jim Taggart described his experimental design to monitor movements of tagged crab and halibut across various reserve boundaries in Glacier Bay. This study, using sonic tags and arrays of receivers (under development), is intended to determine to what extent there is exchange between closed and open waters, and hence to evaluate the efficacy of the current closures and future phase-out of all commercial fishing in Glacier Bay proper.
6. Doug Woodby explained the purpose and expectations of the ADF&G task force on MPAs, which is primarily to make recommendations to the Board of Fisheries on 1) goals and uses of MPAs in Alaska, 2) reserve site selection criteria, 3) monitoring and evaluation of closed areas, and 4) public process. The report will also include 1) an inventory of currently closed areas, 2) a review of the scientific basis for reserves, 3) a review of programs in nearby jurisdictions, and 4) a review of the current process for MPA designation in Alaska.

At the conclusion of the MPA session on Friday, the following MPA (Reserve) issues were offered as needing attention:

1. A series of closed areas could act as controls, representing major ecological areas.
2. Catalogue what we have in relation to what presence of ecological types.
3. Are growth rate trends heritable, and selected for by fishing?
4. Female aggregation areas (Tanner and Dungeness crab) may be candidate areas for protection.
5. There is a lack of evaluation and monitoring of currently closed areas.
6. Reserves can serve as a hedge against uncertainty.
7. Important to define objectives
8. Interagency group may wish to propose to test reserves with large-scale experiments.