

## **Chair's Summary of Program Review of Ecosystem Science**

Alaska Fisheries Science Center

Juneau, AK

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### **Review Panel Members:**

- Beth Turner, Chair (NOAA/NOS, National Centers for Coastal Ocean Science)
- Manuel Barange, Panel Member (Plymouth Marine Lab, U.K.)
- Michael Dagg, Panel Member (Retired, Louisiana Universities Marine Consortium)
- Beth Fulton, Panel Member (Commonwealth Scientific and Industrial Research Organisation, Australia)
- Sarah Gaichas, Panel Member (NOAA/NMFS, Northeast Fisheries Science Center)
- Michael Seki, Panel Member (NOAA/NMFS, Pacific Islands Fisheries Science Center)

### **Background and Overview of Meeting**

The panel was convened to review the ecosystem-related science program of the Alaska Fisheries Science Center. The panel was given terms of reference that included overarching questions to guide their review. AFSC leadership gave an overview of the responsibilities and structure of the Center. Staff scientists from AFSC and PMEL provided briefings on projects and programs in observations, process studies, modeling, synthesis products and communication. A representative from the North Pacific Fishery Management Council and one from the NMFS Regional Office provided perspective on management issues and interactions between the AFSC and these bodies. The AFSC Program Manager for Economic and Social Sciences Research offered remarks on linking social and economic information to ecosystem information. The NOAA/NMFS Senior Scientist for Ecosystem Research provided overall context from a national perspective. Public comments were accepted.

### **General Observations and Recommendations**

Panelists were greatly appreciative of the amount and quality of the science presented, and the responsiveness of AFSC staff to additional requests for information. The AFSC has a highly qualified, enthusiastic and committed staff, combined with good research facilities. The relationship between staff and management is supportive both ways. The AFSC benefits from an excellent and non-confrontational relationship with the NPFMC and its stakeholders, with few cases of management conflicts compared to other regions. This places the AFSC in a uniquely privileged position, able to develop truly innovative science outputs in the pursuit of their mandate, supported by the Council.

Panelists recognized that AFSC is dealing within a financially constraining environment, and offer their observations and suggestions with the full understanding that it will likely not be possible to implement them all within those constraints. Panelists did not feel that it was their place to recommend specific funding strategies or prioritization. Nevertheless, panelists felt obliged to provide full remarks, and allow AFSC leadership to evaluate them within their own constraints.

In relation to the terms of reference, the following observations were made:

1. Do the Centers/ST have clear goals and objectives for an ecosystem-related science program? Is ecosystem-related science integrated with the other science activities across Divisions within the Center/ST? Are the Center's/ST's ecosystem science and research activities appropriately prioritized and evaluated as part of an overall strategic plan?

The AFSC strategic planning vision has articulated ecosystem science and activities among their priorities. However, panelists had questions about whether ecosystem science is “core research” by the AFSC. For instance, the FY16 AGM identified eight funding priorities which did not include ecosystem science research aside from the climate regional action plan.

There is not a single “ecosystem program” at AFSC, but rather a series of programs including the RPA addressing recruitment processes for fish, several other programs addressing loss of sea ice, ocean acidification, and essential fish habitat, and a separate ecosystem modeling and assessment program. There does not appear to be an overarching set of goals and objectives for ecosystem research that could be used to help prioritize or even organize/streamline projects at the AFSC. A vision for ecosystem science connected with ecosystem-based advice is not yet evident.

2. Do the Center's/ST's ecosystem-related science programs focus on information to address the priority needs of the Regional Offices, other NOAA managers, Fishery Management Councils and Commissions, and other partners that require ecosystem-related information to achieve their mission?

The AFSC is appropriately driven by Council needs, and has established good dialogue with the Council to identify these. A large number of ecosystem-related projects are more funder-driven (NPRB, BOEM). The AFSC has attempted to fit their priorities into the priorities of these other funding groups, which extends the reach and extent of their own core-funded science programs. The work presented to the panel takes only a limited ecosystem view; prioritizing a relatively small set of processes and species. This constitutes an impressive (and high quality) science program, but it omits much of the ecosystem. There is no doubt that the science that is done is delivering to the council's perception of what is needed today, but it may overlook the need to consider broader (or future) stressors and risks that may not be directly requested by the Council today. There is a risk that current focus may become outdated if the management requests shift more and more to ecosystem thresholds and needs.

3. Has the Center/ST appropriately established a Regional Action Plan to identify the major climate threats to the ecosystem, identify major vulnerabilities of living marine resources with respect to climate, address the core science needs to address impacts from a changing climate, and integrate this information into management advice, congruent with the NOAA Fisheries Climate Science Strategy<sup>1</sup>?

Yes, this is in development for EBS, and still TBD for other LMEs. The AFSC clearly has the development of these RAPs as a priority. In addition, AFSC with partners has developed a ‘Habitat and Ecological Processes Research Program’ which include research plans for essential fish habitat, loss of sea ice, and Alaska ocean acidification research. There does seem to be a reticence to look into the longer term and evaluate potential future shocks or thresholds. The RAP should help in this by identifying new ecosystem questions w.r.t. climate.

4. What is the status of oceanographic, habitat, climate and ecological data required to fulfill ecosystem-related science needs? Has the Center developed strategies to obtain and manage such data?

The sheer scope of the data collection is impressive and it does deliver directly to current ecosystem-related management needs. AFSC is trying very hard to increase efficiency and use smart survey design to maintain as much temporal and spatial coverage as possible. However, as noted above, many ecosystem aspects are currently under-represented. Data management remains a challenge (this is not unique to AFSC, as the entire agency and many other scientific organizations struggle to manage increasingly large amounts of data).

5. Is the Center appropriately analyzing and modeling ecosystem-level processes? Are cumulative and integrative ecosystem-level analyses being conducted? If not, is there a plan in place to initiate or contribute to the science needed to address cumulative impacts?

Panelists were impressed with the integrated work around fur seals in central and western Aleutians. Significant breakthroughs in understanding the ecological processes that underpin walleye pollock success in the Bering Sea were made through BSIERP, although some panelists noted that even a study at that scale did not consider the whole ecosystem. Integrated work in the GoA is still in progress after their IERP concluded data collection and analysis. A number of models and forecasting efforts were presented for use in AFSC's ecosystem science program; the AFSC is to be commended for this best practice in following an ensemble approach. However, this work is extremely resource limited; both in terms of available personnel (and their long term support), as well as technically (in term of IT environment). If this work is to be maintained at its current high standard, while also moving beyond stressor specific reporting to true cumulative impacts analysis, it will need to grow in size to deal with synergistic/antagonistic effects and not just additive effects.

6. Is the Center's oceanographic, habitat, climate and ecological advice sufficiently included into living marine resource management advice? Are there suitable mechanisms to determine when such inclusion is warranted?

The AFSC's oceanographic, environmental and larval time series data is directly incorporated into management advice. The broader ecosystem perspective is also used in the decision making process, but in a more qualitative sense. While this approach is currently functional it was considered vulnerable by some panelists. The ecosystem considerations chapter is a remarkable product that is perhaps underutilized in management. Panelists could not discern formal mechanisms through the Council process to determine how ecosystem considerations should be included in a routine fashion.

7. Are the Centers'/ST's ecosystem-related science programs and products adequately peer-reviewed relative to their purpose and use? If not, has the Center/ST developed a strategy for peer-review?

AFSC staff have been productive in peer-reviewed journals, and are active in disseminating results through the Alaska Marine Science Symposium and other scientific meetings. There are several layers of review for the Ecosystem Considerations chapter. There does not seem to be an overall strategy for peer review at the Center, although perhaps none is needed.

8. Does the Center/ST appropriately communicate research results and resource needs to conduct ecosystem-related science to various managers, partners, stakeholders and the public?

Panelists noted that the fact that the AFSC has a dedicated communications team is outstanding. Similarly, the level of communication across the science community is very well executed through publications and attendance at national and international meetings (e.g. annual Alaskan Science Symposia). The delivery of ecosystem science to the NPFMC review process via the ecosystems chapter is a critical communications link that appears to be working well.

## **Panel Member's Recurrent Observations and Recommendations**

### **Theme 1 – Management Context and Strategic Planning**

#### Observations

- Panelists appreciated the overview provided by Jason Link, clarifying the long-term visions of the agency. There is a clear path laid out to evolve from single-species considerations to single-species in an ecosystem context (EAFM), with aspiration to move towards Ecosystem-Based Fisheries Management (EBFM). The AFSC is very well placed to be the first region to make this transition. A panelist expressed concern that there are no clear ecosystem objectives set, which would be the first step in the EBFM process.
- The panel heard several times that the "... customer is always the Council ...". This makes the Center appropriately responsive to Council needs. However, some panelists felt that a handful of key economically important fishery resources (e.g., pollock) will drive or constrain science activities, not only for stock assessment activities but also ecosystem science activities. There was much less emphasis provided during the review on integrative analysis at the community, habitat, and ecosystem levels of organization.
- AFSC has many policy and planning documents. While these provide sets of guidance on priorities, some panelists felt that they can also be confusing or to allow for the re-branding of business as usual, just in another context.
- Panelists noted that most advances around planning and prioritization have been made in the Bering Sea. Progress has been slower in the other LMEs. The EBS example can be used to provide conceptual models of system structure and function which could be used to help the planning process in these other regions.
- The AFSC Science Plan and the Ecosystem Goals and objectives were listed as having 4 components:
  - Recruitment Processes Alliance White paper
  - Essential fish habitat research plan
  - Loss of sea ice research plan
  - Alaska ocean acidification research plan

Panelists recognized that the success of the Recruitment Processes Alliance depended somewhat on developing hypotheses and clear objectives towards a specific goal. The other three components of this science plan might benefit from clarifying their objectives in a similar way.

- Some panelists worried that the ecosystem program at AFSC could be vulnerable under potential future budget conditions.

- Ecosystem science cannot be complete without an explicit human context, especially in a region with such high dependency on fisheries. It appears the center conducts a number of research activities on the economics of fisheries, with emerging connections with modeling efforts.

#### Recommendations to address issue

- Several panelists felt that the AFSC should develop clear goals for integrated ecosystem research in general, and not just respond to external RFPs in an *ad hoc* way. Similarly, panelists recommended that the AFSC establish a baseline level of integrated ecosystem science supported as a core activity within its science plan.
- Panelists noted that future AGMs need to include ecosystem studies and activities, if ecosystem science is truly valued by AFSC leadership.
- Taking inventory of the available skill sets and the operational vs research/development needs in each research area would highlight the relative staffing needs and whether this is in line with the intent of the various plans and strategies.
- Panelists recognized the enormous challenge as well as the importance of work in the Arctic, but the funding constraints will be limiting. A strategic plan that focuses less on potential target species and more on ecosystem change and multiple drivers was recommended by some panelists.

## **Theme 2 – Ecosystem Data**

### Observations

- Panelists recognized that extensive and well-designed data collection systems are in place and available for ecosystem analysis.
- The status of data related to essential fish habitat is somewhat less emphasized. There is a need to do more than characterize essential fish habitat as simply being where the fish are present in high concentrations. Data on the properties of a habitat that make it attractive or essential for the fish are needed, especially to predict how fish will respond to changes in habitat related to climate.
- Challenges associated with IT and data management were identified during the review: inadequate data management systems and uncoordinated efforts across programs lead to unstable links between databases, tradeoffs in biologist's time to maintain data systems rather than conduct research, and difficulties assembling portions of datasets for further analysis and sharing (these challenges are not unique to the AFSC).
- The creation of the Recruitment Process Alliance (RPA) has been great for the Center. The RPA enables expertise across Divisions in the AFSC and PMEL to join together and conduct research to understand processes affecting recruitment strength. The work conducted is of high caliber, but recruitment prediction has been shown to be extremely difficult, and is only one ecosystem process. The AFSC efforts to understand recruitment is laudable, but panelists encourage them to broaden the objectives to incorporate LME-wide issues such as energy flows, carrying capacity changes, species replacements, non-linearity of processes, and distributional shifts.
- The AFSC has been active in pursuing collaborations both within NOAA (PMEL is the prime example) and outside of the agency. This collaboration makes good use of resources and skills but is currently informal and could be lost as key personnel turn over. While the science conducted with PMEL is excellent, the focus appears to have been on

understanding system dynamics during particular stanzas in time rather than on projecting future conditions. Both are important.

- The Science Center is active in pursuing the use of advanced electromagnetic technologies such as wave gliders, sail drones, pop-up buoys, upward looking acoustics, etc. In addition to obtaining valuable data streams, the effort looks to reduce the reliance on ship time that is becoming more competitive and difficult to get.

#### Recommendations to address issue

- Many panelists noted that AFSC should strive to balance its ecosystem data collection programs to ensure that a full range of species and life stages are sampled, and maintain an appropriate balance between core assessment work, process studies, and more integrative analysis.
- Some panelists recommended a more ambitious vision to investigate the ecology of the 5 LMEs under consideration, focusing on issues such as energy flows, connectivity and exchanges, climate change impacts, etc., combining observation and modeling approaches.
- Several panelists felt that the AFSC should invest in Center-wide data management systems and investigate where data recovery efforts might bring long term benefit to multiple projects/assessments.
- To ensure that collaborative links do not dissolve with personnel turnover, panelists recommended that high level agreements should be put in place between agencies or line offices recognizing the value and intent of these connections. This was seen to be especially important with PMEL.

### **Theme 3 – Ecosystem modeling and analysis**

#### Observations

- Panelists were impressed with the synthesis and modeling that has been done, especially considering the small number of people involved. Synthesis of hundreds of contributed ecosystem indicators into the Ecosystem Considerations Chapter is an enormous task done within an extremely compressed timeframe each year by a single person, with consultation by a handful of people. A single person (<1 FTE) is insufficient to deliver the indicators across 5 LMEs.
- Considerable work is necessary to develop datasets into indicators for the Ecosystem Considerations Chapter. Many researchers do not have time or responsibilities clearly allocated in their work plans to contribute to ecosystem indicator development and reporting.
- The ecosystem modeling and analysis teams may suffer from trying to include model research and development as well as operational aspects within the same (limited) group of people. Different skill sets may be required for development versus on-going operational use.
- Panelists noted that synthesis and modeling activities appear to be understaffed and vulnerable to loss of key individual staff and/or outside funding resources.

#### Recommendations to address issue

- Some panelists recommended that the AFSC should embrace the Ecosystem Considerations Chapter as a Center-wide product, and reinforce its production accordingly through inclusion in employee performance plans.

- The synthesis groups must be reasonably resourced with some depth of support. Similarly, the maintenance of models must be supported or that capability will be lost.
- Panelists felt that provision must be made for IT hardware that meets modeling needs.
- Some panelists suggested using qualitative (conceptual) models to facilitate syntheses, to compare LMEs and alternative energy pathways (e.g. pelagic vs demersal) and how the system may have functioned through time or under perturbation.

#### **Theme 4 – Incorporation into Management**

##### Observations

- In its presentation, the NPFMC indicated that were appreciative and relied on the scientific products and advice provided by AFSC with respect to ecosystem science and research.
- The Ecosystem Considerations Chapter is presented to managers annually and is an excellent product that has developed over time to be highly responsive to SSC requests.
- The Bering Sea FEP is just beginning development, but will outline a process for using ecosystem information in Council decision making. Developing such processes in coordination with Councils is a clear and necessary step forward in formalizing the use of ecosystem science in management.
- Individual species “report cards” are proposed to include indicators relevant to each species as part of each stock assessment
- The AFSC staff developing the FEP, the IEA, and working on the ACLIM MSEs are the same staff currently involved in ecosystem modeling and the Ecosystem Considerations Chapter, so without further modeling and synthesis resources, there will be severe tradeoffs between these activities within AFSC.
- The Council does not include ecosystem metrics in their management approaches, but that does not preclude AFSC from considering them.

##### Recommendations to address issue

- Panelists felt that the AFSC should continue to support further development of the Bering Sea FEP and its Action Modules, in collaboration with NPFMC. AFSC should also fully support production and further development of the Ecosystem Considerations Chapter.
- The AFSC should accelerate IEA efforts, in particular ecosystem level risk assessment to prioritize which ecosystem processes require evaluation by more quantitative methods.
- The AFSC could undertake an exercise to uncover key links and points and failure and assess whether these are suitably resourced and supported.
- In the absence of specific metrics from the Council, the AFSC may wish to develop and propose its own objectives to assess the state of the ecosystems under consideration.

#### **Theme 5 – Communication and Peer Review**

##### Observations

- An impressive number of peer-reviewed papers resulted from the Bering Sea and Gulf of Alaska integrated ecosystem research projects, the AFSC fisheries interaction team, and the integrated fur seal-ecosystem research.
- Great examples of public outreach efforts (corals, Seattle aquarium program/fur seals, etc.) were highlighted during presentations to the panel.
- A new communication team (ca. 1-yr) has been installed at AFSC. New roles for team members, a central regional website (AFSC+AKRO), social media (Facebook, Blog,

Twitter), and outreach materials and vision are planned to be implemented. The head of the communications team has a clear vision, objectives and processes to justify these.

- The rapport that has been built through time with the management agencies and the broader community has recently been bolstered by the enthusiasm of the communications team. This is resulting in a transition from communications being almost solely science “push” (of new findings and activities) to a more balanced mix of “push” and societal/management “pull” (where they come looking for information).
- There appears to be a good relationship with the management and interagency landscape. The senior science leaders and administrative leaders of the AFSC appear to be well connected with many links to different levels of government, planning councils (etc.); providing for across agency coordination and understanding of separate and mutual needs.
- Publications from AFSC are abundant, timely and of high quality. However, there is a dearth of published over-arching syntheses and model-based publications that are only now beginning to grow in number.

#### Recommendations to address issue

- The AFSC should continue to promote dialogue with stakeholders, etc., Dialogue may develop more through the ACLIM project MSE, the Bering Sea FEP, and development of IEA conceptual models, as well as existing outreach efforts to Alaska communities.
- The AFSC should continue to support peer-reviewed publication of results, while recognizing that supporting management processes requires significant staff time and is equally important as peer-reviewed publication in promoting the use of ecosystem science in management.
- The AFSC should maintain their good support of the communication team and foster further mechanisms of stakeholder involvement to facilitate the development of responsive tools.
- The communications team can examine the possibility of using parts of the annual Ecosystem Report for broader science communications beyond the Council.

#### Other

##### Observations

- When given the opportunity to identify ecosystem aspirations, a single species, process-based focus was often the response and often for a limited sub-section of the life history of a few species. This focused form of science is a valid approach and one that has obviously delivered to council needs. However, it is not one that will forewarn of large system shifts or system-scale shocks, which may be required when thinking about a climate impacted future or a move to a more ecosystem based (i.e. across sector, not just fisheries) management.
- A focus on process and data collection rather than on synthesis is reflected in the relative numbers of FTEs supporting each area
- Relying on the system understanding provided by the IERP has some risk involved. Greater confidence in system structure and function would likely be gained from understanding the role of euphausiids, squid, habitat, biodiversity (etc).

##### Recommendations to address issue

- Panelists urged the AFSC to take a step back and consider the entire scientific philosophy behind the ecosystem science programs. A process-based single-species focus is valid

(and productive) but is not the only philosophy and may come with risks if the system changes.

- AFSC could undertake a scenario assessment considering what will be the major science drivers under alternative climate, development, management pressures and policy environments. What would these drivers mean for the volume and kinds of science required and how does that map to what is currently performed or feasible? What indicators or markers should be formally/informally tracked to assure that AFSC/NOAA is aligned with changing trends?

## Conclusions

The science that the AFSC has done to date has been of the highest quality. The IERP process has delivered a process understanding that has become the basis for targeted monitoring programs and on-going exploration of research hypotheses. However, due to flat/declining funding, logistical constraints and the particular research philosophy being employed, the work has concentrated on elaborating a sub-section of the system in some detail. This means little is known about significant sections of even the better-known ecosystems and some areas (e.g. the western Aleutians and the Arctic) are particularly poorly understood. While this approach can certainly be understood on logistical grounds it runs the risk of giving a false sense of confidence in the degree of system understanding truly possessed.

The research philosophy may be intentional; it may be that it is the only tractable means of dealing with the tension between research and operational delivery of monitoring time series. However, given the series of plans and strategic documents recently introduced, or under development, it may be opportune to step back and consider whether the philosophy remains the best means of meeting the many objectives that now need to be serviced or are likely to be required in the near future.

Whether or not the underlying research philosophy is modified, greater support must be provided to those tasked with synthesis and analyzing the data at an ecosystem-scale. The current staffing ratio of data collection:synthesis (or the order of 100:1) represents a significant imbalance. The current staff are of the highest quality, but at this level of support, synthesis can only be perfunctory (especially given the tight time scales over which it is being delivered on an annual basis). This does not mean that the current efforts are not sterling, there is evidence that the Council greatly appreciates the synthesis products developed by AFSC. However, it is a missed opportunity not to make the most of the combined data-sets and models.

Science at the AFSC is top rate and the AFSC has the potential to lead the country in Ecosystem Based Fishery Management (EBFM) due to the relatively pristine nature of its ecosystems, the cooperative nature of its relationship with a single fishery management council and a single state, and its currently impressive data and staff resources. However, this potential may go unrealized for three main reasons:

1. A science plan that does not have overall goals and objectives and does not fully consider ecosystem science to be a core activity under budget constraints that fund only core activities,
2. A currently unbalanced portfolio of ecosystem activities emphasizing data collection with inadequate synthesis and modeling resources, and

3. An emphasis on single species as the unit of ecosystem research, with few resources devoted to processes at habitat, community, and full ecosystem levels of organization.

Overall, the recommendations are to examine the overall philosophy of ecosystem science in AFSC and develop overall objectives for the ecosystem science program, increase support and integration of ecosystem science as a core activity within AFSC, to increase staff resources for modeling and synthesis, and to balance ecosystem science across the single species, habitat, community, and ecosystem levels.