Bering Sea
Ecosystem Partnership

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Bering Sea Project
Principal Investigators Meeting

Girdwood, Alaska

14-16 October 2008

Final report

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Introduction to overall project

The National Science Foundation and the North Pacific Research Board are partnering to support the "Bering Ecosystem Study" and the "Bering Sea Integrated Ecosystem Research Program" ("BEST-BSIERP"), a comprehensive study of the eastern Bering Sea ecosystem from 2007-2012. Nearly a hundred federal, state, university, and private scientists have joined together in a unified framework to study a range of issues in the Bering Sea—from atmospheric forcing and physical oceanography to humans and communities—including the attendant economic and social impacts of a changing ecosystem. BEST-BSIERP offers a system of vertically integrated hypotheses and the means to test them. The hypotheses explain how climate controls the time and place of production of upper trophic level species. Models will predict the likelihoods of population levels, trends and other attributes under several climate scenarios. BEST-BSIERP focuses on understanding trophic interactions among colony-based foragers; hot spot foragers; pelagic forage species; pelagic predators; and benthic predators. Hypotheses will be tested in a linked set of spatially explicit models that connect climate scenarios, physical and biological oceanographic models, a lower and upper trophic level ecosystem model and economic and management models. Models will forecast changes in abundance of pelagic piscivores in response to changes in predators and prey and attendant economic and management consequences. Two-way connections between the program and communities, stakeholders and the region's body of local and traditional knowledge are enabled by outreach, education and community involvement projects. The BEST-BSIERP project will enable testing and improved understanding of effects of climate change and management actions on the Bering Sea ecosystem.

PI meeting summary

The overall goal of the 2008 PI meeting was to promote information sharing and integration of the BEST and BSIERP programs. The first day focused on hypotheses, the second day on modeling and the third day on revising original hypotheses and summing up. The main approach was to employ small group discussions covering a common set of discussion points. The PIs were split into five groups that were organized to align with related groups of BEST and BSIERP hypotheses. The second day focused on comparing BEST and BSIERP model predictions and field data, with each group matched with a group of related BEST and BSIERP models. The third and final day focused on synthesizing discussion from the first two meeting days and identifying action items for future field efforts and modeling. The five hypothesis-based groups reconvened and revisited the hypothesis-based and model-based points in light of what they had learned and discussed the previous two days. In addition, the Outreach Manager (Deans) and the BEST (Moore) and BSIERP (Coyle) Data Managers made short presentations on the third day of the meeting.

Report organization

This report presents short summaries and outcomes from each of the five working groups, building from the discussion point framework that was prepared by the BEST-BSIERP Science Advisory Board and

program management staff. Working group summaries are followed by summaries prepared by each of the side meeting groups: Patch Dynamics; Retrospective; Fish; Modeling; and Cruise Planning. The raw discussion materials and notes from each of the working groups will be available as powerpoint files on the BEST-BSIERP website, and a list of attendees is presented as Appendix 1.

Working group reports

Group 1: Climate and ocean

Following the agenda for the meeting, the participants for Group 1 met three times, with a goal to improve cooperation between groups, particularly between BSIERP and BEST investigators, between observationalists and modelers, and between scientists and local communities. Group 1 discussed a series of seven topics on Day 1, and two questions that focused on the modeling efforts on Day 2. On the third day, the group met to revisit the topics of the earlier days and incorporate any modifications gained from discussions with the other groups.

Group 1 participants found that the hypotheses, which focused on how changes in physical forcing, including climate change, will impact the ecosystem, were complementary. The one change recommended by the group was to explicitly mention phytoplankton and ice algae in the hypotheses.

Several observational tidbits were presented. The Bering Sea was extremely cold in 2008, with persistence of ice over the southern shelf similar to what occurred in the very cold years in the early and mid 1970s. It was noted that although the ice was extensive, it was not as thick as the ice that occurred in the 1970s. Together with extensive sea ice, large amounts of ice algae were observed over the northern shelf in the spring. During summer, phytoplankton blooms occurred in the pycnocline over the northern shelf and in the upper mixed layer over the southern shelf.

It was commented that synthesis is best done in small groups with a free sharing of ideas and data. The relationship between modelers and observationalists was a two way street, with modelers providing information on their needs, but they also need to reach out to observationalists by sharing the results of the modeling efforts. Group 1 also commented on the need for improved communications between scientists and communities. Data and ideas need to be shared with local communities in accessible language and the communities' needs, desires, and observations transmitted back to scientists. Potential iconic results of BEST-BSIERP in the broadest sense were collection of a remarkably diverse data set. While it was noted that specific "iconic" results are not predictable, it was agreed that understanding how various portions (i.e. north versus south, coastal versus outer domain) of the Bering Sea respond to shifts in climate would be important. It was also thought that the effort to link local and traditional knowledge with scientific observations/models from the outset of the BSIERP/BEST project could help to shape future research programs.

The group identified several specific sets of data that are lacking: ice thickness, heterotrophic bacterial abundance and productivity, and summer copepod grazing rates. It was also noted that there was a lack of

observations in the nearshore and that there are few observations and no rate measurements during the October through February period, which could hinder our understanding of this system.

On the second day, the group examined some of the modeling components in more detail. It was noted that while the physical models were performing well, sea ice retreated later in the model simulations than observed in the field. It was thought that the inclusion of ice algal effects and perhaps sediments would improve the models' performance. To improve the linkage between observations and modeling, it was proposed that modelers providing predictions during cruises would expand the interaction between the modeling and the observation groups. The idea of a stripped down model version that could be run in real time at sea was suggested, but it was recognized that this would be a significant undertaking and would require a modeler to go to sea. Using the web to provide a venue on which model simulations could be examined and a method of feedback from viewers was recommended. Group 1 strongly suggested that climate predictions should be shared and discussed with local communities as a form of outreach.

Members of Group 1: Alexander; Ayojiak; Cokelet; Curchitser; Eisner; Hedstrom; Hermann; Kachel; Lomas; Morse; Sambrotto; E. Sherr; Wisniewski; Wu; Zhang. Facilitator: Stabeno

Group 2: Lower trophics

To promote the overall goal of integration of the BEST and BSIERP programs, the lower trophics group including the NPZ modeling component, met over two days to address a series of questions which were common to each working group. This small group session focused on the hypothesis and research questions developed in each program and compatibility with original BEST and BSIERP goals. The format followed the agenda used for all groups as described in the meeting agenda. A series of 7 common topics were addressed on the first day, with two questions related to the most closely allied modeling effort for this group addressed on day two (see agenda). On the third day the group reconvened to revise and discuss the questions from the two previous days and any changes that might be incorporated from the larger group discussion.

In addressing the major points of each question, group 2 participants found the BSIERP and BEST hypotheses complementary. There was some difference in approach with each (BSIERP with specific hypothesis versus BEST with broader questions), but the participants were satisfied with the matching goals as a whole and their ability to address the integrated goals of the overall program.

Observational tidbits included a number of comments from participants to suggest bottom up control as the dominant process observed in first year field studies, but more specific processes were also active. These included spatial issues as part of the discussion with several noting the importance of partitioning across multiple domains of the study area (inner, mid and outer shelf). Changes in the system from south to north were also noted. Steps towards synthesis discussed among the participants included several suggestions for data sharing and rapid dissemination of results to all PI's and especially for modeling activities to allow rapid progress. This included the need for data transfer to data management groups as well as those involved in higher trophic level studies. Dissemination of group results was discussed and

included suggestions of conceptual diagrams to distill results into visual presentations and attempts to provide quantitative forecasts of climatic effects on the system.

Educational activities listed by group 2 members were myriad and included examples of both individual and programmatic activities. Coordination by the program for PolarTREC teachers was viewed as symbolic of the enhanced activities being done and integration with community outreach. Outreach and the LTK program were regarded as the ideal leads to coordinate activities among investigators.

Research issues were discussed and several areas which were not being addressed by the program were noted. Several were well known (e.g. absence of a microbial component) and cannot be addressed under the current activities, but others were identified (e.g. mesozooplankton rates) which represent tractable problems. Based on these discussions the participants attempted to rephrase the overall group 2 BSIERP hypotheses to better represent the integrated program and recent results.

Group 2 had a very productive modeling discussion with linkages to ongoing efforts and emphasis on progress discussed. Several priorities were established, led by the need for biomass as a priority metric for model parameterization. To make rapid progress, a strong suggestion included the need for focused teleconferences between modelers and observationalists, essentially taking it one box at the time to provide intensive evaluation of designated trophic linkages (euphausiids, ice algae etc). This would be directed by the modeling group who would determine the order of topics discussed. Final recommendations are noted in the presentation.

Members of Group 2: Bacheler; Bond; Bluhm; Campbell; Cooper; Coyle; Devol; Fall; Farley; Gibson; Hillgruber; Heintz; Hollowed; Hunn; Moran; Mordy; Parker-Stetter; Stoecker; Weingartner. Facilitators: Gradinger; Harvey.

Group 3: Oscillating Control Hypothesis

To promote the overall goal of integration of the BEST and BSIERP programs, the "oscillating control hypothesis" group, including the FEAST modeling component, met over two days to address a series of questions that were common to each working group. The group spent considerable time discussing how the OCH applies to the research goals of the projects. This discussion was rewarding and fruitful in that it promoted significant discussion between representatives of different trophic level research (e.g., birds, plankton, fish) and identified commonalities and linkages between the different components of the programs and between the programs themselves.

Although many aspects of the OCH hypothesis were applicable and attractive, the discussions identified several additional characteristics of the ecosystems that were critical to understanding interannual variability and climate change. Specifically, the annual response by the piscivores to ice retreat is dependent on the size, type and timing of the primary and secondary producers and production (WHO and WHEN matters). The group advanced two scenarios for the ecosystem response to warm vs. cold years that included specific predictions regarding the roles and importance of each trophic compartment (Figure 1). This includes recognition of the relative importance, and different responses, of the large vs. small

copepods and the addition of compartments to include the whole ecosystem including microzooplankton, benthos, and top level predators. The discussion also focused on the differences between the benthically dominated Northern Bering Sea and the pelagic Southern Bering Sea.

The group agreed that the BSIERP and BEST hypotheses matched well, with the narrower BSIERP hypothesis subsumed within the broader BEST hypothesis. Both programs emphasize data collection and attempt to get to a mechanistic view. For observational tidbits from the 2008 field season, preliminary results indicated that large copepods and euphausiids did well in 2008 and that the results should achieve some understanding of the northern vs. southern plankton density and community structure. Piscivorous murres experienced food limitations in August and there appeared to be low numbers of adult pollock. Krill were consuming ice algae. The groups identified a number of linkages between the programs including the balance of controls between bottom up and top down mechanisms, energy transfer between ecosystem compartments, short term variations and long term trends, bioenergetics, pattern description, large scale physics, syntheses between observational projects, and modeling. These linkages could be exploited at the next PI meeting through targeted workshops focusing on specific topics such as birds and zooplankton, fish and bird diet comparison, and biology and physics. Understanding of the ecosystem that will be limited by the funded research includes competition and predation especially at the upper trophic levels since few direct measurements of these mechanisms are being conducted, no summer copepod grazing, no acoustic measurements of euphausiid distribution in 2009 and 2010, and that the longer-term outcomes will not be understood within the time frame of the project.

One important note was that abundance refers to different metrics depending on the scientific discipline, with plankton ecologists using concentration (# / unit volume) and fisheries ecologists using total abundance (total number or weight). It is important to recognize these differences prior to discussions so that everyone understands what is being discussed.

Although the modeling discussion, and modelers, focused primarily on the FEAST model, it is important to note that the nutrient-phytoplankton-zooplankton (NPZ) modeling efforts also will address these hypotheses. The group also recommended adding impacts to birds and whales as well as upper trophic level fish in the model. It was noted also that the model requires some rates that are not presently being measured in the field program. Steps towards synthesis and linkages between the programs and hypotheses included adding the birds and mammals, using field observations to validate the models, issues regarding the spatial grid size, and common currency.

The group identified important educational and outreach activities including dissemination of data in near real time to multiple groups at both the local and national levels. Participation of teachers and local communities also was identified as important and useful.

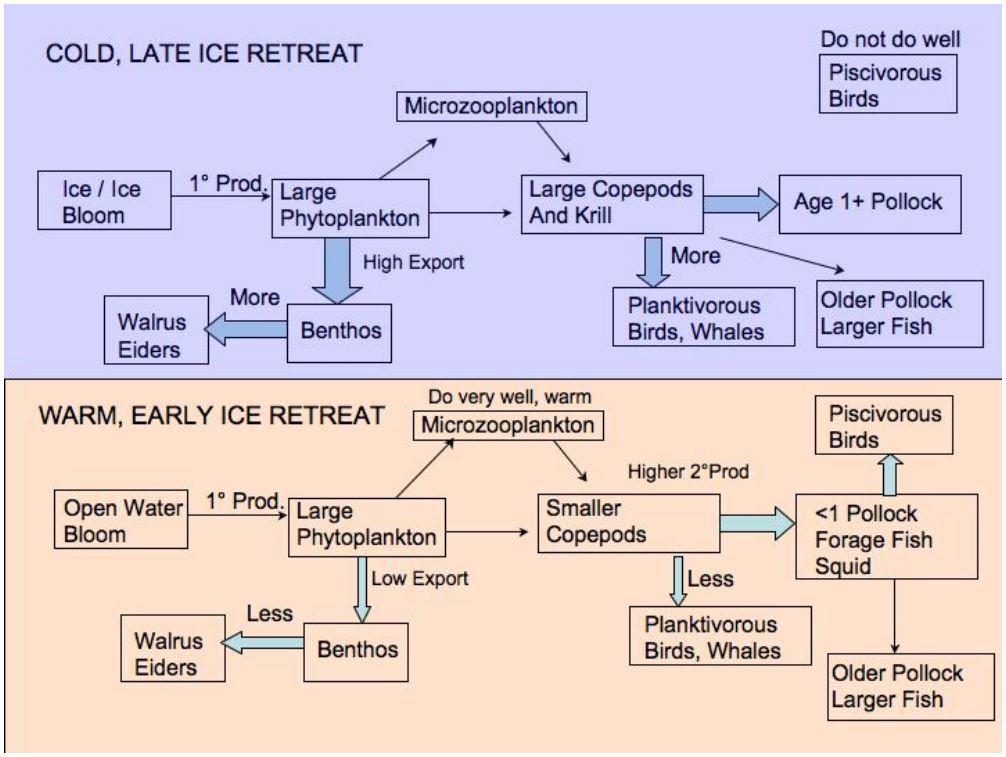

Figure 1. Diagram of ecosystem response under different conditions of climate and ice retreat.

Group 3 members: Barbeaux; Buckley; Brown; Byrd; Duffy-Anderson; Fienup-Riordan; Hamilton; Horne; Jay; Kitaysky; Lessard; Piatt; Pinchuk; Renner; Ressler; Stott. Facilitator: Ashjian. Rapporteur: Duffy-Anderson. Raconteurs: Lessard, Byrd.

Group 4: Location matters

To promote the overall goal of integration of the BEST and BSIERP programs, the "location matters" group, including the forage species (FEAST) modeling component, met over two days to address a series of questions, which were common to each working group. This group session (see adjacent box 1 for members) focused on the hypothesis and research questions developed in each program. The format followed the agenda used for all groups as described in the meeting agenda. A series of 7 common topics were addressed on the first day, with two questions related to the most closely allied modeling effort for this group addressed on day two (see agenda). Group 4 combined with group 3 when discussing the allied modeling effort (the forage species model [FEAST]). On the third day, group 4 reconvened to revise and discuss the questions from the two previous days and any changes that might be incorporated from the larger group discussion.

Group 4 participants found that the BSIERP and BEST hypothesis are complementary. Together the BSEIRP and BEST hypotheses address the gradient between the benthic-dominated north and pelagic-

dominated south ecological regions. There is different emphasis on "location matters", which is implicit in BEST and explicit in BSIERP.

Observational tidbits were the monitoring approaches to identify foraging areas of animals with electronic tags combined with assessments of prey fields and ocean conditions in those areas for walrus, kittiwakes, fur seals and murres. Steps towards synthesis were organizing small hypothesis-based working groups to synthesize results and communication, including PI town hall meetings with communities through the Community Advisory Boards and Outreach Lead, flyers summarizing research projects following a standard template and using everyday language (rather than jargon). Potential iconic results of BEST-BSIERP are the construction of ecosystem models that predict the effects of climate change across an entire ocean basin, continuing collaboration across disciplines, and an understanding of the role of ice and how loss of sea ice will affect the structure of the Bering Sea ecosystem.

Educational activities were local community involvement in land-based and at-sea science (e.g., community members on vessel), science curriculum development based on science that is done in the region and national/international media programming that illustrates the uniqueness of the science program and the productivity of the Bering Sea (e.g., BBC Frozen Planet).

Research issues were discussed and several areas which were not being addressed by the program were noted. The major limitations are well known and were that sampling misses the Bering Sea basin, western Bering Sea and nearshore areas (spatial extent), sampling misses October-January (temporal scale) and a limited number of species are studied. Based on these discussions, group 4 felt that the current wording of existing BSIERP and associated BEST hypotheses is appropriate.

Groups 3 and 4 combined for the modeling discussion. The groups found that the pollock, cod, and arrowtooth flounder focus of the model addresses hypothesis 3. However, hypothesis 3 considers impacts of/to birds and whales, but they are not explicitly included in the forage species model. The modelers agreed to add seabirds and whales to the model. The groups also found that field observations will be important for validation of model predictions, especially the current data collections (2008-2010).

Group 4 members: Goodman; Grebmeier; Heppell; Irons; John; Kuletz; Moore, S.; Mueter; Ortiz; Roby; Sullivan; Tahbone; Trites; Zacharof; Zavadil. Facilitator: Sigler

Group 5: Human-focused

As a part of BEST/BSIERP integration, Group 5, the human-focused group, met over the several days of the Girdwood PI meeting to address the common questions for the working groups.

In terms of the hypotheses, it was felt that the BEST and BSIERP hypotheses were generally complementary. It is important to note that there was less work ongoing in this hypothesis group from the BEST side, and that the BEST hypotheses had limited coverage in terms of the work currently funded to address the BEST hypotheses, and was particularly limited with respect to BEST (f) and (g) hypotheses. The wording of the BSIERP hypotheses was considered reasonable. However it was stressed that human

concerns were not merely with "abundance" of harvest, but of consistency and/or timing of harvest as well and the group suggested minor changes in the hypotheses wording to reflect this emphasis.

Several points were made on the hypotheses themselves specifically with respect to project coverage. BSIERP hypothesis 5a would be covered in general by economic modeling components, although only for a limited number of species such as pollock and cod. Many of the subsistence-focused surveys from the LTK component would focus on BSIERP hypothesis 5b. The subsistence-focused harvest surveys would link particularly well with climate downscaling and modeling to link subsistence quality with past climate conditions. It was also suggested that the "predictive models" resulting from the vertically-integrated models could be compared with the predictive models arising from LTK—i.e. the use of local experience to predict years of good or poor conditions.

Considerable discussion focused around BSIERP hypothesis 5c and precisely what was planned in terms of "management strategy evaluations" (MSEs). It was strongly felt that the strict and formal model analysis, which is currently planned for examining groundfish management control rules under the BSIERP modeling MSEs project, might be too narrow to cover a reasonable range of "strategies" by which humans might adapt to changing climate. In particular, there need to be extended analyses performed on externalities that may drive all responses (e.g. how many ESA species?). Further, is there a "social strategy evaluation" that can go along with evaluating biological reference points? It was felt that there is a need to bring social scientists together to develop the concept of the risk assessment further. For example, can we quantify increased risk associated with more dangerous weather conditions in future as fishing becomes "the even more 'most dangerous' catch"? The real questions might be tradeoffs between efficiency and flexibility (or between specialists and generalists). The scenarios also need to consider that there will be positive changes with climate; for subsistence opportunities there may be changes for the better, such as in timing and locations of fishing opportunities.

An example came from the "observational tidbits" section of the discussion. The changing climate has led to a shift to the winter bowhead whaling on the north coast of St. Lawrence Island, with more whaling in the fall when conditions are better. That is also a management strategy issue--- quota is allocated on an annual basis and whale hunters have to take their chances in spring because they don't know what conditions fall will bring… how does the managed allocation strategy mix with the "natural" strategy of the whaling captain who wants to minimize risk? Another example of seasonal timing being an issue was discussed with respect to herring migration patterns.

Several "iconic" and synthetic results were discussed. One example given was the "Calorieshed": where does production of each trophic level come from? How far away? What will you be eating and harvesting in the future? Will it be more or less than you expect? When in the season? Where will your energy be coming from? What external inputs are needed (from currents to sunlight to migration to fuel for extraction?) A second iconic result was a prediction of distribution: how will humans adapt to where the fish are? Another synthesis result will be the "competing" LTK model. The hunter's look at "what the conditions will be like this year" would be a mental model to compare with the models made by the researchers.

For outreach, several ideas were discussed. First was a suggestion of outreach through North Pacific Fisheries Management Council meetings and regular presentations during the council process, with planned visits to other communities (through council members). An example outlet of the Pribilofs radio was discussed.

A lot of the unknowns related to this dimension of the project are truly "unknown unknowns", but they may be examined through some kind of risk analysis. Many of the human decisions may be macroeconomic: for example, tied to homebuilding starts or aquaculture. It was felt that the best way to approach these in a human context was to focus on questions on the robustness and adaptability of the systems in place when they are faced with the inevitable unknowns.

For next steps, it was felt that Group 5 formed a very good synthesis group that was acting to promote important discussions. It was felt that a small working group could be formed by combining members of Group 5 with key members of other trophic level groups and with modelers. By having small workshops/meetings with specific topics (e.g. "expanding management strategy evaluations" as an example topic) when opportunities arose (e.g. at the upcoming Alaska Marine Science Symposium), these synthetic questions could be progressed substantially. The group agreed to organize the first such meeting for the January 2009 Alaska Marine Science Symposium if possible.

Group 5 members: Haynie; Kruse, G.; Kruse, S.; Noongwook; Punt; Webster. Facilitators: Aydin; Huntington.

Side meeting reports

Patch Dynamics

Preliminary findings from the 2008 field season were presented and logistical considerations were discussed. Planning for the 2009 field season was also initiated.

N. Bering / St. Lawrence Island. The March 2008 Cruise went well. Ten walruses were tracked with satellite tags and benthic samples were obtained at 40 stations. Some of the same benthic sites were re-sampled in July. Most of the research was conducted west of St. Lawrence Island. The request for 2009 is 18 days of ship time and use of a helicopter to facilitate walrus tagging.

Bogoslof Island. The July reconnaissance trip went well. Fur seal scat samples were collected and data loggers were put on thick billed murres (to be retrieved in 2009). Similar instruments were deployed on birds at the Pribilof Islands to determine whether the two populations of murres use different wintering areas. Logistical considerations for 2009 were discussed. It was noted that fur seal research permits will expire July 31 and will have to be reissued by NMFS.

Pribilof Islands. Targeted net tows were made to ground truth the acoustic signals, and found primarily age-0 pollock, Greenland halibut, and arrowtooth flounder – but no age-1 pollock. There were also some myctophids observed at night. Murres were observed heading south in the evening, and were followed and their prey were sampled at night and at morning. They were found to be eating myctophids, squid, and deep sea smelt. The murres appeared to occur primarily between St. George Island and the Pribilof Canyon, while the black-legged kittiwakes were between St. George Island and the Pribilof Canyon and an area south-west of St. Paul Island over and past the shelf edge. St. George murres made much longer foraging trips than St. Paul birds, and black-legged kittiwakes had three modes of foraging (1. birds stayed around island – likely eating sand lance; 2. Some went north and stayed on the shelf; and 3. Some headed straight to an area off shelf ca. 120 miles one-way). Stable isotope data from earlier years showed a difference between islands (St. George had shelf signals; St. Paul had slope signals), but the difference disappeared in 2008. Stomach contents of 86 birds collected at sea have not been processed yet.

Twenty-six lactating northern fur seals were successfully tagged and tracked, but did not show any hot spot feeding locations. The animals were tagged at Reef rookery and appeared to travel randomly over the middle shelf and off the shelf break. Scat samples were collected through late summer/fall to look at change in diet through season. Preliminary examination of the data suggests that northern fur seals were feeding constantly as they travelled, and were not going to specific spots to forage.

Fish surveys in 2009 will not repeat all of 2008 transects. Inclusion of Bogoslof Island in 2009 will result in some overlap of sampling areas. Adjustments will be made to overlap with the proposed shift in NOAA acoustics transects. Considerations for 2009 include squaring off areas down to Bogoslof – to cover south of the slope area where birds and fur seals fed in 2008. The 200 km scale used in 2008 was felt to be appropriate for birds and fur seals. At-sea sampling may occur 7-10 days later in 2009 to increase overlap with the timing of fur seal foraging.

Alaska Marine Science Symposium. Posters will be presented at the AMSS showing preliminary results from the 2008 field season. A one-day meeting will be held with all Patch Dynamics Study researchers to review findings and coordinate the 2009 field season.

Retrospective analyses

A side meeting on historical trends in seabird and marine mammal populations was held during the Girdwood PI meeting. The participants included principal investigators for project B68 (Retrospective Analysis of Trophic Interactions), Gordon Kruse and Franz Mueter, meeting with a group of seabird and marine mammal PIs consisting of Vernon Byrd, Kathy Kuletz, David Irons, and Andrew Trites.

Goals:

- Discuss data on seabird and marine mammal populations to be used in the retrospective analysis to help analysts understand the data.
- Discuss results from a preliminary analysis of trends in seabird productivity and abundance at St. George and St. Paul Island. Get feedback from seabird biologists to validate and interpret results.
- Discuss potential mechanisms and hypotheses that can be tested with retrospective data.

Outcomes:

The analyst (F. Mueter) gained a much better understanding of seabird productivity and abundance data and received a good crash course in seabird biology. Seabird biologists confirmed results from preliminary statistical analyses that indicate a common trend in abundance across four species of seabirds (common and thick-billed murre, red-legged and black-legged kittiwakes) at each of the islands, but showed distinct differences between islands. All seabird species at St. Paul Island have shown a continuous decline from 1975 through the present, although the decline has slowed or populations have stabilized in recent years. In contrast, all populations at St. George Island, with the possible exception of common murres, showed a steep decline from 1975 to the mid- to late 1980s, followed by a more gradual increase.

Reasons for the difference in population trends were discussed and focused on differences in access to sufficient concentrations of high-quality forage between the islands. The following hypothesis was advanced: Birds at both islands, but particularly at St. Paul, have historically relied on production along the ice edge, which typically came close to St. Paul each winter. Earlier retreat or lack of sea ice in recent years may disproportionally affect seabird populations at St. Paul Island, who do not have easy access to alternative foraging areas when prey concentration within easy foraging distance are low. In contrast, birds from St. George are much closer to the shelf edge and have relatively easy access (shorter flying distance) to enhanced production along the shelf edge and along the edges of Pribilof Canyon (where they have been observed to feed on myctophids).

Data needed to address this hypothesis were discussed. Data on SST, sea ice conditions, and primary productivity estimates from satellite observations will be examined to quantify oceanographic conditions and productivity within a fixed radius (e.g. 100 km) around the islands. The need for examining diet data to describe differences in diet between islands was highlighted (see follow-up). Myctophids may be an important diet component, but we lack data on myctophid abundance or availability. Stomach contents of major fish predators that feed on myctophids could be examined for possible trends in myctophid abundance (see follow-up).

In addition, seabird abundance trends in the Pribilofs may have been affected by subsistence harvests. It was noted that there may have been substantial harvests of seabirds, particularly at St. Paul Island (see follow-up). Movements of birds between the islands are not prevalent and do not appear to affect abundance trends.

Trends in productivity are much less consistent across species or islands and show much higher interannual variability, particularly for kittiwakes. While fledging success in murres is generally high (40-60% of eggs are fledged), kittiwakes completely fail in some years (zero or very few chicks fledged per nesting pair). Hence kittiwakes undergo extreme fluctuations (boom and bust), while murres do not. Because of these differences, productivity data should be analyzed separately for murres and kittiwakes and cannot be combined into a single, meaningful index of productivity. For kittiwakes, particularly black-legged kittiwakes at St. Paul, it may make sense to divide brood years into "successes" and "failures" for analysis (binomial).

Breeding phenology data show a single underlying trend towards earlier hatch dates in kittiwakes (both islands and species) but no trend in murres, with the exception of a possible trend towards later hatch dates in St. Paul thick-billed murres.

Several items for follow-up were identified at the meeting:

- We discussed the need to look at harvest data for seabird populations and were able to follow up during the PI meeting with Jim Fall, ADF&G. Data sources for subsistence harvest numbers were identified and we downloaded electronic copies of several relevant reports. These data will be examined for harvest data to evaluate the magnitude of harvests relative to seabird population levels (F. Mueter).
- Historical diet data for Pribilof Island seabirds and fur seals were recently summarized by Beth Sinclair (Deep Sea Research II, Pribilof Islands volume). We will request a copy of the data for use in the analysis (F. Mueter). More recent seabird diet data have been collected and processed and will be made available for the retrospective analysis (Vernon Byrd).
- We will request data on myctophid predation from REFM, AFSC to examine the use of myctophid occurrence in fish diets as an index of abundance (F. Mueter).
- Marine mammal data for the retrospective analysis have not yet been compiled but will be made available to the analyst by the end of the year (Andrew Trites).

Fish group

During the 2008 PI meeting in Girdwood, the Ichthyoplankton Surveys and Seasonal Bioenergetics groups held an informal meeting on October 14, 2008, to discuss 2008 field research and to coordinate and potentially improve sampling efforts for the upcoming field year. Participating scientists from the Ichthyoplankton Surveys and the Seasonal Bioenergetics project components were: Dr. Janet Duffy-Anderson, Dr. Lisa Eisner, Dr. Ron Heintz, Dr. Nicola Hillgruber, and Ms. Elisabeth Siddon. In order to improve relationships and connectivity between these and other BEST-BSIERP research groups, the meeting was also attended by Dr. Anne Hollowed (project number B62: Forage Fish Distribution and Ocean Conditions), Dr. John Horne and Dr. Sandra Parker-Stetter (project number B59: Surface Trawl Survey Acoustics), Dr. Alexei Pinchuk (BEST: Zooplankton/Euphausiids), Dr. Edward Farley (project number B90: Surface Trawl Survey) and Dr. Mike Sigler (BSIERP Lead PI).

During the meeting, it was concluded that sampling efforts in 2008 had been exceptionally successful. Altogether, early life history stages of walleye pollock (*Theragra chalcogramma*), Pacific cod (*Gadus macrocephalus*) and *Atheresthes* spp. had been collected on four cruises to the southeastern and eastern Bering Sea, i.e., North Pacific Climate Regimes and Ecosystem Productivity (NPCREP; February 16 – 27), NPCREP/BEST-BSIERP (May 11 – 20), BEST –BSIERP (July 3 – July 31), BASIS (September 7 – 30), and NPCREP/Eco-FOCI (September 9 – 20). Larval arrowtooth flounder and Kamchatka flounder were successfully identified at sea using new, at-sea genetic approaches, and the technique will be used again in 2009. Close scientific collaborations are already established between the groups B53 Ichthyoplankton surveys, B54 Seasonal bioenergetics, and BEST Zooplankton/Euphausiids, and are expected to grow even closer in the future. It was agreed that efforts should be made in 2009 to better overlap sampling between the NPCREP/BEST-BSIERP spring survey and the BEST/BSIERP summer cruises.

Modeling

The modelers of the BEST-BSIERP vertically-integrated modeling projects met during the 2008 PI meeting in Girdwood for a half day to touch base and have a general conversation about modeling progress. The progression of coding of the FEAST/NPZ 1-dimensional coupled model was discussed; an initial model had been built and was being calibrated with initial estimates of fish growth and foraging parameters. This 1-dimensional model would begin initial evaluation (e.g. fitting) between October 2008-January 2009, and a procedure for formalizing the statistical work was discussed. In particular, the NPZ and FEAST modelers agreed to produce a working document describing in detail the data sets and parameters that would be fit from the data sets; the document is aimed to be circulated among the modelers and to the Ecosystem Modeling Committee/NPRB prior to meeting with the Ecosystem Modeling Committee in January 2009. Several of the issues with the 3-D physical model were discussed separately, specifically with respect to fixing some boundary-value conditions that had arisen; multiple approaches were being experimented with in order to find an appropriate solution.

Cruise planning

NOAA

Anne Hollowed and Phyllis Stabeno reviewed NOAA cruise schedules during an afternoon session on Wednesday, October 15, 2008. As of the meeting date, NOAA ship schedules were still under discussion and are subject to change due to budget constraints. Prior to the meeting, Mike Sigler provided four files, two for each ship (the Oscar Dyson and the Miller Freeman). Two options reflected a full operations tempo; the other two reflected a reduced level of operations. All of the scenarios reflected a new mandatory rest policy that the Office of Marine and Aviation Operations (OMAO) recently established. It is likely that the 2009 allocation process will be chaotic due to budget situation. There are at least three proposals on the table at headquarters to address budget situation and ship allocations. These range from a fleet-wide reduction in Days at Sea (DAS) to varying combinations of reduced DAS on older ships, higher DAS on newer ships and ship lay-ups. December 1st was the deadline being discussed for decision.

While participants acknowledge that the schedules were uncertain, they did comment on the feasibility of conducting BSIERP research if a reduced schedule was approved. Three serious problems were identified:

a) The April time slot for mooring deployment was not satisfactory because sea ice is likely to prevent successful deployment of at least some of the moorings;
b) The time slot allocated for BASIS surveys started too early to be useful as a fall representation of forage fish distribution; and
c) Additional DAS will be needed to complete the entire BASIS survey grid.

With respect to issue (c), the group commented that the transects during the 2008 BASIS survey were separated (east-west) by approximately 60 nautical miles as opposed to 30 nm in previous years. This station spacing was selected to get coverage from inside Bristol Bay to the Pribilof Islands. The 60 nm east-west spacing compromises acoustic estimates of abundance for target species (i.e. age-0 pollock, and forage fish) and does not allow members of the Fish Component to compare these abundance estimates among previous years surveyed (2002 to 2007).

The group discussed possible solutions to restore the BASIS survey. The Oscar Dyson schedule currently allocates approximately 25 DAS for BASIS 2009 (September). To restore the coverage (inside to offshore waters and northern regions), and to reduce the east-west transect spacing, an additional 40 DAS is needed on the Oscar Dyson or a charter vessel, for a total of 65 DAS (mid-August through October). Sampling in both of these regions is needed to understand mechanisms influencing the spatial distribution of forage fish in the Bering Sea.

As of November 2008, issues regarding the mooring deployment cruise remain unresolved.

USCGC *Healy*

Carin Ashjian noted that the short spring cruise (Chief Scientist- Lee Cooper) is scheduled for 13-30 March 2009. The long spring cruise (Chief Scientist- Carin Ashjian) is scheduled for 4 April – 11 May 2009. The long spring cruise will not have any mid-cruise personnel transfer opportunities. *[Editor's note: following the Girdwood meeting, cruise schedules were slightly revised; the short spring cruise HLY0901 will begin at Kodiak, Alaska, on 10 March and end at Dutch Harbor, Alaska, on 31 March. The HLY0902 will begin at Dutch Harbor on 3 April and end at Dutch Harbor on 12 May. See http://www.icefloe.net/reports_healy.html for more information.]*

The National Science Foundation has decided to use an alternative vessel to Healy for the 2009 summer cruise, since Healy would exceed her Days at Sea limit (180-200) if she conducted the BEST summer cruise in addition to the remaining cruises on her schedule (all others are scheduled for areas that will likely still have ice, hence requiring an icebreaker and establishing priority for Healy). Therefore the 2009 summer cruise (Chief Scientist- Ray Sambrotto) will shift to another vessel, TBD. See discussion summarized below.

The *Healy* will begin dry dock in October 2009 and will remain unavailable until ~May-June 2010, too late for the Spring BEST 2010 cruise. An alternative icebreaker needs to be identified by the NSF.

It was suggested that the NSF provide some help for the Chief Scientists, given the large time commitment that organizing the cruises requires.

George Noongwook representing the Native Village of Savoonga gave a presentation on whaling issues, and noted that the core time for St. Lawrence Island whaling is 11-20 April; he requests continued opportunities to coordinate with *Healy* planning to minimize disruption of St. Lawrence Island whaling. The short spring cruise (Cooper, HLY0901) will work in the St. Lawrence Island Polynya. The long spring cruise (Ashjian, HLY0902) will not work in the polynya and the ship will remain 60-70 nm to the south of Saint Lawrence Island.

Replacement vessel for Summer 2009 cruise

The proposed replacement vessel is the Kilo Moana, which has limited berth space (ca. 28 berths). The group examined the proposed roster for the Summer 2009 cruise, and could not see how the science goals could be successfully carried out with only 28 berths. An alternative replacement is the Melville; however; UNOLS seems to prefer that the BEST/BSIERP group use the Kilo Moana, and Bill Wiseman noted that turning down the Kilo Moana in favor of the Melville carries some risk that our group will get neither vessel. Bill Wiseman reminded the group of the NPRB/NSF agreement which states that for NSF-funded cruises; NSF-funded scientists will be prioritized in cases where not enough berths are available. The group discussed this. Keeping in mind that the BEST/BSIERP projects are now integrated to the point where they depend on one another for success, the group decided that the Kilo Moana simply doesn't have enough berths to accommodate both BEST and BSIERP scientists, and therefore the group decided to ask Bill Wiseman to inform UNOLS that the Kilo Moana will not be an adequate replacement vessel for the 2009 Summer Cruise. Bill Wiseman asked for a preferred time window to pass along to UNOLS- the group settled on 30 d within 15 June through 15 August 2009. The NSF funded PIs

indicated that several of the groups could reduce the number of needed berths in order to include the BSIERP PIs on the summer cruise on a ship with fewer berths than Healy (e.g., Sambrotto, 3 berths; Devol, 3 berths; Stabeno/Hydro, 5 berths; total needed 31 including Moore, Multicore tech, not including Wu and Chayes and the Scripps CTD techs as they will not be necessary on the UNOLS vessel). *[Editor's note: in December 2008 the decision was made to use the WHOI ship R/V Knorr as the replacement vessel for the Healy summer cruise. http://www.whoi.edu/page.do?pid=8157]*

The group discussed gear storage. Considering that there won't be a summer *Healy* cruise, perhaps gear for the summer cruise (which should be loaded in Seattle in spring 2009) should be offloaded in Dutch Harbor as the *Healy* is en route back to Seattle. The summer cruise gear would then be ready for in-transit pickup by whichever vessel winds up as the replacement. Phyllis Stabeno said she would look into heated storage possibilities in Dutch Harbor.

An additional consideration for using a UNOLS vessel is that TWIC (Transportation Worker Identification Credential) cards may be required for free access to the ship, depending on the ship and the port used. Please see the UNOLS web site for additional information. Not all scientists need the TWIC cards but if they do not have one and the cards are required, someone will have to escort that scientist to/from the ship. Cards will be less necessary once the ship sails but some locations (e.g., the bridge) will still be off limits to people without cards unless those people are appropriately escorted. Foreign students and postdocs (J-1 and F-1 Visas) should not apply.

Logistics

Bill Wiseman noted that it may be difficult to provide substantial helicopter time for the upcoming *Healy* cruises, especially considering that most of the helicopter need is for the BSIERP project. Lee Cooper and Jackie Grebmeier stated that in fact their BEST work is closely intertwined with the BSIERP work; so that BSIERP helicopter needs should be seen as joint BEST/BSIERP needs.

Specific logistic needs for the Healy cruises were discussed. Healy will need four vans (radioisotope, stable isotope, general purpose, storage van). Two Scripps CTD techs are needed for the long spring cruise; Jackie thought that they could get by with one for the short spring cruise (although note that now Cooper has reconsidered this). Satellite imagery was identified as extremely important, especially when integrated into the Mapserver. Ocean color satellite images are critical for finding spring/ice edge blooms even though the Bering Sea frequently is cloudy. The quality of the ice imagery that will be available for the cruise remains a concern since Radarsat is no longer available cost-free. It is desirable to determine berthing early. Several lab space and equipment issues were identified that should be discussed with the CG at the logistics meeting. On-deck incubators were discussed; it is imperative to prevent freeze-up of drainage hoses and flooding of the decks with seawater. Issues such as who provided heat tape were identified as points of discussion for the CG meeting.

The cruise plan for the long spring cruise was discussed with many suggestions regarding the order of sampling. The 70 m isobath line was deemed critical. It was thought that ice edge and water column blooms would be more likely to be found in the southern region. Last year the CN line was sampled only cursorily to fill in for the Oscar Dyson (delayed for repairs in Dutch Harbor). The value of sampling the

W line was questioned. Also, the timing of sampling the 70 m line was discussed. Note that process stations cannot be sampled near the end of the cruise because of the time required to complete experiments and to then pack the gear. Phyllis suggested two scenarios, one for a heavy ice year and one for a light ice year. It was hoped that some cruise plans would be developed by the time of the logistics meeting but that is not happening. Are there any near real-time modeling results that could be used during the cruise to help guide opportunistic sampling?

Summary

Actionable items

The BEST-BSIERP Science Advisory Board (SAB) met Thursday night and Friday morning following the BEST-BSIERP Principal Investigators meeting during October 14-16, 2008. The SAB members identified the following key information, actionable items, and requests:

- **Promote building synthesis:**
  The SAB wants to encourage all PI's to build the foundation for later synthesis of program results. One building block is to assemble highlights of our 2008 results in one place. Towards this end, the SAB is requesting one "headline" from each project that we can then link to an accompanying short web page summary. This "headline" would highlight a result from your 2008 results you consider most important, novel, etc. The project headlines from each project will then be compiled on one BEST-BSIERP web page so that principal investigators can obtain a high-level view of the 2008 program results. This short web page description would consist of one or two paragraphs and one or no more than two plots of results along the lines of the material already posted for several projects this summer. If needed you could even distill this down from your project semi-annual report. More than one headline for multi-faceted projects is okay. The headlines and web page summaries will be assembled into a plenary presentation at the Alaska Marine Science Symposium (see the third item). For the BSIERP PIs, we ask that the lead PI for each project organize the headline(s) for the project they lead.

- **Alaska Marine Science Symposium, PI meeting, Tuesday afternoon January 20:**
  The Alaska Marine Science Symposium (AMSS) is scheduled for January 2008 in Anchorage Alaska. Many principal investigators plan to attend this meeting. The SAB will convene a meeting on Tuesday January 20 from 1:30-5:00 pm for any principal investigators that are attending AMSS to take advantage of a time and place when many PIs are present. Draft agendas for the overall Symposium and also for the PI meeting are posted at http://bsierp.nprb.org/meetings/index.html. The AMSS schedule also allows time for small group meetings (RAB, EMC, etc.) and a SAB meeting from 7:00-9:00 pm on Tuesday evening.

- **Alaska Marine Science Symposium, Bering Sea session, Wednesday January 21:**
  Presentations with a Bering Sea focus occur on Wednesday. BEST-BSIERP principal investigators are encouraged to request an oral presentation slot or poster. Your results will reach a large audience at AMSS. In addition, there will be a 30-minute plenary presentation covering the BEST-BSIERP program given by Mike Sigler. This presentation will focus on 2008 results and will be assembled from your "headlines" and short web page summaries

- **Alaska Marine Science Symposium, meeting of Science Advisory Board and Advisory Group:**
  The Advisory Group was introduced at the Girdwood PI meeting and is an NPRB-constituted oversight group. The NPRB Advisory Group will meet with the BEST-BSIERP Science Advisory Board Wednesday from 7:00 – 9:00 pm following the Bering Sea session at AMSS. The meeting purpose is

for the Science Advisory Board to answer questions from the Advisory Group on the BEST-BSIERP program and discuss steps for further program integration. This announcement is for your information as only the Science Advisory Board and Advisory Group will participate in this meeting. Principal Investigators will not be asked to attend.

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