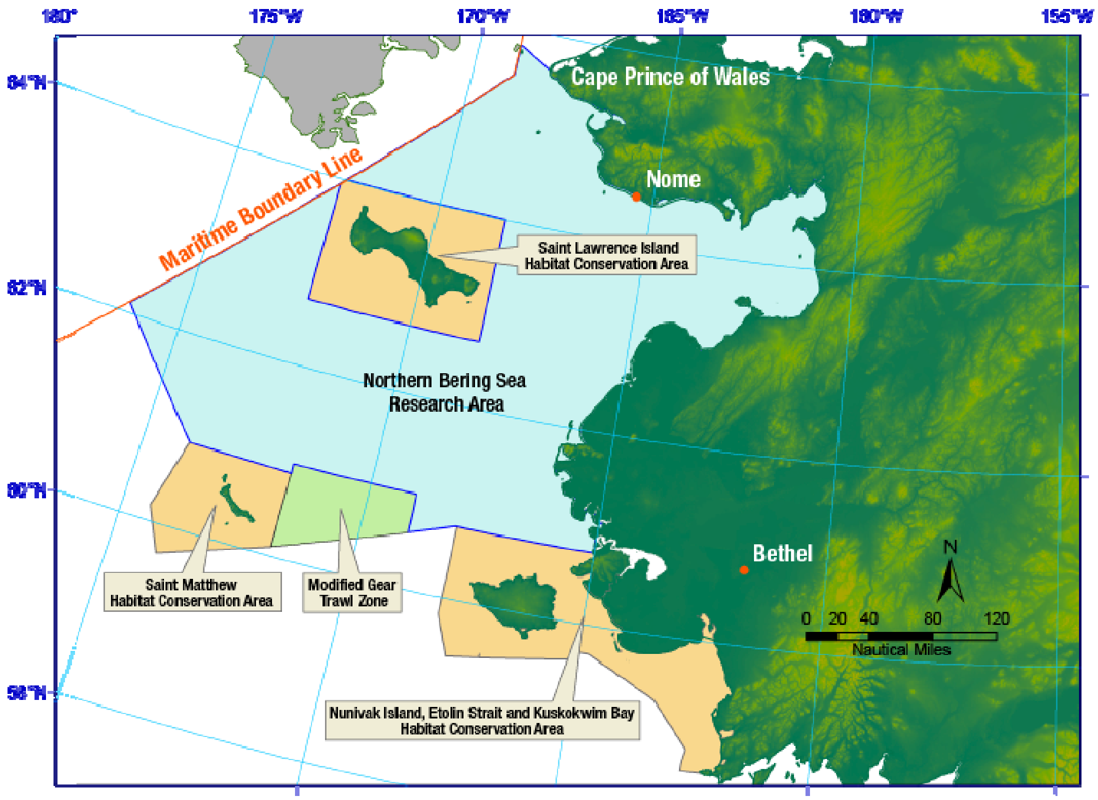
Agenda Item C-3(b)
JUNE 2011

Northern Bering Sea Research Area (NBSRA) Research Plan



Documents prepared by NOAA AFSC for the NPFMC meeting, June 2011:

1. Research Plan Outline
2. Trawl Impacts Studies
3. Summary of NBSRA Research Plan Science Workshop
4. Research Plan Development Schedule

1. Research Plan Outline

Objective: *Study the effects of non-pelagic (bottom) trawling on the NBSRA*

Bottom trawling in the Bering Sea targets groundfish species, which include flatfishes, rockfishes, Pacific cod, pollock, sculpins, and also crabs. As evident in the 2010 AFSC bottom trawl survey, at present, the only groundfish species in the northern Bering Sea (NBS) that may be of sufficient biomass and quality for commercial harvest is yellowfin sole. There has been essentially no commercial bottom trawling in the NBS to date. With ocean warming and ecosystem shift, the biomass of groundfish stocks in the NBS may increase. In anticipation of a corresponding interest in commercial bottom trawling in the NBS, the Council established the NBSRA in Amendment 89 to the Fishery Management Plan (FMP) for Groundfish of the Bering Sea and Aleutian Islands (BSAI) Management Area. The NBSRA is closed to commercial bottom trawling while the Council gathers information and enacts measures to protect valuable resources and the subsistence needs of NBS communities. The Council has tasked the AFSC with studying the potential impacts of bottom trawling in the NBSRA to inform its decisions.

Research Plan: *Trawl impacts studies – overview*

Short-term (acute) effects of bottom trawling and recovery will be studied using a BACI (before–after, control–impact) experimental design, which compares conditions in experimental corridors before and after trawling. The primary research questions are: (1) do bottom trawls have measurable and statistically significant effects and, (2) if effects are identified, does the affected area recover to its original condition in the absence of fishing? In general, this study addresses management issues related to the need for and efficacy of bottom-trawl prohibitions, as well as operational considerations related to management of closed areas.

Study sites

Effects of trawling may vary with the composition of epifauna. A prerequisite for trawl impact studies in the NBSRA is the stratification of bottom habitat types by epifauna communities. To that effect, a community analysis of the epifauna will be conducted on catches in the NBSRA from the 2010 AFSC Bering Sea bottom trawl survey. BACI trawl impact study sites will then be located randomly within each stratum. Study sites will be closed to all unrelated activities that disturb the seafloor during the study period.

Sites critical to managed species and subsistence usage of NBS communities will receive special consideration for inclusion in the study if it is ultimately helpful to resource management, and exclusion if harmful to the subjects concerned. Also considered for inclusion will be sites where yellowfin sole are relatively abundant, as observed in the 2010 AFSC bottom trawl survey, and a commercial fishery might be viable. Established benthic research stations from scientific programs will be avoided if possible. These considerations will help in prioritizing where the trawl impact study should be conducted. Input regarding critical sites is sought from four groups: (1) subsistence communities, (2) trawling industry, (3) scientific experts, (4) management agencies (ADF&G, USFWS, NOAA Fisheries). For the purpose of gathering input, a subsistence communities workshop was convened in February 2010 in Anchorage, and another is planned in September 2011; a science workshop was convened in January 2011 at the Alaska Marine Science Symposium (attached: NBSRA Science Workshop Summary). Stakeholders are invited to provide pertinent information and comments to the AFSC planning team at any time during research planning, and appropriate agencies are consulted throughout to ensure compliance with regulations. A formal process for nominating areas and species of concern could also be instituted.

Methods

Pairs of experimental and control trawl corridors (statistical blocks) are established adjacent to one another in each stratum. Potential impacts are investigated with biological and geological sampling before and after passes with a commercial bottom trawl, preferably using contracted F/Vs and directed fishing. The same sampling efforts are repeated at short (weeks) and long (1-2+ years) time points after the initial experimental trawling to measure changes in the epifauna communities.

Results

No statistically significant effects are detected -

It is concluded that bottom trawling does not create detectable changes in the epifauna community within the time-scale of the study. It is unlikely that bottom trawling will impact animals and subsistence activities that are dependent on the health of this type of benthic habitat.

Statistically significant effects are detected -

The impacts to managed and subsistence resources in relation to changes in the epifauna community will be interpreted based on knowledge of ecological linkages. This analysis will provide the information basis for the Council to consider protective measures.

2. Trawl Impact Studies

Background

Non-pelagic (bottom) trawls are a class of mobile fishing gear that is highly adaptable for use in diverse habitat types. These trawls are designed to maintain direct contact with the seabed and to efficiently remove organisms in their path. As such, they are capable of affecting large areas of the seabed and represent a widespread, recurring, spatially variable and (importantly) a manageable form of disturbance.

In general, the process of understanding mobile gear effects has three distinct phases: (1) experiments to identify changes caused by gear contact, (2) ecological studies to determine the consequences of these changes, and (3) decision-making based on a comprehensive cost-benefit analysis. Nearly all of the experiments to date have focused on benthic invertebrates and the specific changes that occur after mobile fishing gear, particularly bottom trawls, contact the seabed. This worldwide emphasis on benthic invertebrates reflects their limited mobility and high vulnerability to bottom-tending gear, and observations that structurally complex seabeds are an important element of healthy and productive ecosystems. The effects are typically measured as changes in community structure, abundance or biomass of populations, or the mean size of organisms. Although generalizations about the effects are possible, site-specific responses are likely, given variation in the composition of the benthos and differences in the intensity, severity and frequency of both natural and anthropogenic disturbances. Moreover, it must be remembered that the non-random selection of study areas makes it extremely tenuous to apply research findings from one geographic area to another. As such, the eventual management of bottom-trawling activity in the NBSRA by the NPFMC should be based on a rigorous experiment designed specifically for the area.

Investigating the effects of bottom trawls

Research to understand and quantify the effects of bottom trawls has occurred throughout the world in a variety of benthic marine habitats (NRC, 2002; Barnes and Thomas, 2005). Most of these studies have used methods based on one of two experimental approaches. Short-term (acute) effects are studied by comparing conditions in experimental corridors before and after a single pass or repeated passes of the gear. Occasionally, the recovery process is examined by resampling at a later date; these studies incorporate untrawled control corridors into the sampling program in order to account for natural variability during the study period (a before–after, control–impact, or BACI, experimental design; Green, 1979). Multiple trawled and control corridors are preferred for statistical reasons. This approach provides insights about the process of trawl disturbance and is the basis for most knowledge about trawling effects. Longer-term (chronic) effects are studied by comparing conditions in heavily fished and lightly fished or unfished areas and, as such, measure the cumulative effects of fishing. These experiments are relatively uncommon because high-quality historical fishing-effort data are frequently unavailable, and their designs are often flawed because the (unfished) "control" areas have previously been fished or they are fundamentally different than the corresponding experimental units (NRC, 2002).

Previous research in the Bering Sea

Since 1996, the TRAWLEX project[1] has been investigating potential adverse effects of bottom trawls at sites in the Bristol Bay region of the eastern Bering Sea (EBS). These sites are relatively shallow (44-57 m), have sandy substrates, show a high level of natural disturbance, and support a rich invertebrate assemblage. Both chronic and short-term effects on the benthos have been studied.

<u>Chronic effects of bottom trawls</u>

The well-documented development of commercial trawl fisheries in the EBS since 1954 presented a unique opportunity to investigate the chronic effects of bottom trawling on soft-bottom benthos (McConnaughey *et al.*, 2000; McConnaughey *et al.*, 2005). Using detailed accounts of closures and fishing activity, it was possible to reconstruct historical effort and identify untrawled (UT) areas immediately adjacent to areas that had been heavily trawled (HT) over many years. For most of the benthic invertebrate species examined, it was determined that biomass and mean body size were reduced as a result of heavy trawling, suggesting a general population decline. In a few cases, greater overall biomass accompanied the observed body-size reduction, suggesting a proliferation of relatively small individuals in the HT area. The only exception to the pattern of smaller individuals in the HT area was red king crab. In this case, mean body size was greater in the HT area, due to substantially fewer small crabs in the HT area than in the UT area. Since biomass in the HT area was lower than that in the UT area, the red king crab response to chronic bottom trawling was fewer individuals of greater mean size. Overall, these effects on body size were relatively small when compared with natural variability in a large, adjacent area closed to commercial trawling. From a community perspective, the HT benthos was less diverse, was dominated by the purple-orange sea star (*Asterias amurensis*), had less emergent epifauna and less biogenic substrate (shell) resulting in reduced structural complexity, and was more patchy overall.

[1] Point of contact for TRAWLEX research is Dr. Robert A. McConnaughey, RACE Division, Alaska Fisheries Science Center, Seattle, WA; 206-526-4150; bob.mcconnaughey@noaa.gov.

Short-term effects of bottom trawls and recovery

Another TRAWLEX study is investigating short-term effects of bottom trawling and recovery using a BACI experimental design. This project is located inside the same closure area used for the chronic effects study. The primary research questions are: (1) Do bottom trawls have measurable and statistically significant effects on soft-bottom habitat in the EBS and, (2) if impacts are identified, does the affected area recover to its original condition in the absence of fishing (if so, how quickly), or does it become fundamentally different? In general, this study addresses management issues related to the need for and efficacy of bottom-trawl prohibitions, as well as operational considerations related to management of closed areas.

Six pairs of experimental and control trawl corridors (statistical blocks) were established adjacent to one another in a previously untrawled area (Fig. 1). Each corridor was 20 km long, based on the average length of commercial bottom-trawl hauls in the area and operational considerations; each corridor was 100 m wide to contain all components of the commercial gear that was used. The number of corridors was based on a statistical power analysis that estimated the required number of samples for the projected number of sampling events. Three of the corridor pairs were oriented north-south and three were oriented east-west, to account for strong currents in the study area and possible directional effects. Overall, this study was designed to accommodate three sampling events after the experimental trawling disturbance.

Potential impacts were investigated with biological and geological sampling before and after four passes with a typical commercial bottom trawl (Nor'eastern Trawl System Inc. 91/140 two-seam Aleutian combination otter trawl with a 0.36 m footrope diameter). Invertebrates that live on the seafloor (epifauna) were sampled with 15 min tows at a speed of 3 kts, using a standard AFSC 83/112 bottom trawl that was modified to improve capture and retention of small organisms. At each of these locations, the invertebrates that live in the seabed (infauna) and the physical-chemical properties of the surficial sediments were characterized with two pairs of grab samples collected prior to trawling for epifauna. Changes in seabed morphology were assessed with side scan sonar surveys that were conducted both before and after the commercial-trawl disturbance. The sampling locations were randomly selected from uniform grids superimposed on the corridors (Fig. 2), and an ultra-short baseline (USBL) system provided precise positioning of the commercial trawl and all sampling gear. During the first year of the experiment (2001; 35 days at sea), a total of 36 epifauna samples and 144 grab samples were collected before the commercial trawling disturbance, and all 12 corridors were surveyed with side scan sonar; with the same sampling effort after the trawling disturbance. Analysis of these data indicated statistically significant effects on biomass in three of the 24 invertebrate groups examined; however, 2.4 significant results were expected due to nothing more than random variation in the data. The study area was revisited one year later (21 days at sea) and the after-disturbance-sampling protocol was repeated to assess whether longer-term (lagged) effects on the benthos had occurred. Once again, only minimal effects that could not be differentiated from random variation were observed. As such, it was concluded that the bottom trawl did not substantially affect biomass in the invertebrate populations studied (McConnaughey and Syrjala, in prep.). Analysis of the side scan sonar imagery also revealed negligible changes in the generally firm and featureless seabed, although trawl-door tracks were visible in the corridors. Trawling effects on ~160 infauna taxa are still being evaluated.

Scenario for an NBSRA BACI experiment

The environmental and biological characteristics of the NBSRA are largely unknown and, because it generally has not been trawled, it represents a very rare opportunity to study short-term trawling effects and recovery. Many of the handicaps that have constrained the design or interpretation of previous experimental work (*e.g.* uncertain disturbance history) are non-existent because of the historical ice cover. If commercial trawl fisheries ultimately develop due to a loss of sea ice, the cumulative effects of bottom-trawling disturbances could eventually be examined through a judicious use of closed-area boundaries and supporting effort information. In the meantime, one or more carefully designed BACI experiments (with directed use of the commercial trawl, as above) should be placed according to resource-management needs for the area. Although an investigation involving more realistic fishing behavior is conceivable (*e.g.* Brown *et al.*, 2005), it is unlikely that there would be sufficient pattern in the intensity and distribution of fishing effort to permit a statistical analysis with an acceptable level of Type II error (in this case, failure to reject a false null hypothesis of no effect). Ultimately, the proven design of the BACI experiment in the EBS can be adapted to conditions in the NBSRA. With fishing industry input, corridor dimensions (length, width) could be adjusted to match the best estimates of tow length and total gear width. Similarly, the intensity of disturbance (number of passes) with the commercial trawl could be set based on relevant observations from the EBS, anticipated changes in fishery practices, and other resource management considerations.

Interpretation of research findings

Statistical analysis of the experimental results will test for species-specific differences before and after disturbance with the commercial bottom trawl, while adjusting for temporal variability observed in the associated untrawled (control) areas. If no statistically significant effects are detected, it is concluded that bottom trawling did not cause detectable changes in the benthic-invertebrate community within the time-scale of the study. As such, it is unlikely that bottom trawling will impact animals and subsistence activities that are dependent on this type of benthic habitat. If, on the other hand, statistically significant effects are detected, the impacts to managed and subsistence resources related to changes in the invertebrate community will need to be interpreted based on knowledge of ecological linkages. However, worldwide success at interpreting the ecological effects of trawling is quite limited because relatively little is known about the ecology of individual benthic invertebrate species, let alone the complex linkages and dependencies that exist with managed populations. A mathematical model has been developed to evaluate the effects of fishing on benthic habitat in Alaska (Fujioka 2006), however the results are expressed in terms of equilibrium levels of specific habitat types rather than the direct effects on managed populations. More recent modeling for the prawn-trawl fishery in Australia illustrates a more direct application of experimental results for management purposes (Pitcher *et al.*, 2009). To this same end, basin-scale habitat-utilization models already developed for managed populations in the EBS (*e.g.* McConnaughey and Syrjala, 2009) could be extended to include benthic invertebrate predictors thereby providing a means to estimate population-level responses to the observed effects. Ultimately, the statistical and ecological analyses, combined with an understanding of the local recovery dynamics, will provide the information basis for the Council to consider protective measures.

Recommendations to facilitate research planning and management decision making

Precursory scientific investigations and targeted discussions with knowledgeable stakeholders should be undertaken to address specific design and execution details affecting the utility of the NBSRA experimental results. Early consensus on the interpretive scheme will also facilitate the decision-making process based on results of the study. In particular:

1. It is important to maximize the relevance of the study by carefully specifying the gear type and intensity of disturbance, based on expected practices of the fishing industry. Whereas it is possible to incorporate multiple gear types and disturbance intensities into the experimental design and thus broaden the scope of the investigation, this would significantly multiply the effort and expense required to complete the work.
2. The Type II error level should be minimized to the extent practical, so as to avoid an incorrect conclusion of no trawling effect(s). A statistical power analysis based on NBSRA trawl-survey data can be used to estimate appropriate samples sizes for specified levels of uncertainty. Because the results of this analysis will vary by species according to their unique population characteristics, it is very important to identify the species of particular interest at the beginning of the experimental design effort.
3. A systematic approach to study site selection is needed to produce representative and broadly applicable results. The usual non-random selection of study sites for trawl-impact experiments produces case-study results that are strictly limited to the location studied. However, study sites that are randomly selected from areas of similar sensitivity (*i.e.* those with distinct benthic invertebrate assemblages, or strata) would constitute

replicated experiments that legitimately represent the entire stratum of interest. Such distinct and persistent benthic invertebrate assemblages have been described in the EBS using bottom-trawl-survey data (Yeung and McConnaughey, 2006) (Fig. 3). In order to avoid the case-study limitation, a similar assemblage analysis using trawl data recently acquired in the NBSRA should be undertaken prior to random selection of BACI experimental sites. Potential study sites within a stratum that are considered to be extremely sensitive, of significant cultural/scientific value or simply are not trawlable can be purposely excluded from consideration, recognizing that experimental results may not be applicable to areas so excluded. These exclusions could be identified with a formal process resembling the one used to nominate and designate Alaska's Habitat Areas of Particular Concern (HAPC).

4. Because it is necessary to isolate the effect of experimental trawling in the BACI experimental design, it may be necessary to impose temporary restrictions on pelagic trawling and other potentially disruptive activities in order to protect the integrity of the NBSRA study sites.
5. Finally, early consideration of predictable issues would probably facilitate the Council's decision-making process. For example, it may be useful to reach consensus on acceptable levels of change (*e.g.* % increase/decrease in biomass of invertebrates or managed species) due to trawling, recognizing that such changes are inevitable. It might also be useful to identify a "common currency" for summarizing the various positive and negative changes in invertebrate/fish populations and other seabed properties that will be documented by the experiment.

NBSRA research summary and timeline

Design and execution of experiments to study the effects of bottom trawling in the NBSRA would entail the following:

1. Preliminary surveys (years 1-2+). Conduct two or more bottom trawl surveys to establish biological and environmental baselines (*i.e.* characterize pre-disturbance conditions and variability).
2. Precursory analyses (years 2-3). Use the trawl survey data: (1) in a statistical power analysis for designing the BACI experiment and (2) to examine the spatial structure of the benthic invertebrate communities, as a basis for stratifying the NBSRA for systematic trawl impact studies. Obtain input to identify priority species and the trawl-impact parameters.
3. Trawl impact experiments (years 4-5+). Initiate a replicated set of Before-After Control-Impact (BACI) investigations of bottom-trawl effects in distinct invertebrate communities (strata), preferably using contracted F/Vs and directed fishing with commercial gear.

4. Ecological studies (subsequent years). Conduct interpretive research on the ecology of the affected benthic invertebrates and their linkages to managed fish stocks.

Literature Cited

Barnes, P. W. and J. P. Thomas, editors. 2005. Benthic habitats and the effects of fishing. American Fisheries Society, Symposium 41, Bethesda, Maryland. 890 p.

Brown, E. J., B. Finney, and S. Hills. 2005. Effects of commercial otter trawling on benthic communities in the southeastern Bering Sea. Pages 439-460 *in* P. W. Barnes and J. P. Thomas, editors. Benthic habitats and the effects of fishing. American Fisheries Society, Symposium 41, Bethesda, Maryland.

Fujioka, J. T. 2006. A model for evaluating fishing impacts on habitat and comparing fishing closure strategies. Can. J. Fish. Aquat. Sci. 63:2330-2342.

Green, R. H. 1979. Sampling design and statistical methods for environmental biologists. Wiley, New York. 257 p.

McConnaughey, R. A., K. Mier and C. B. Dew. 2000. An examination of chronic trawling effects on soft-bottom benthos of the eastern Bering Sea. ICES J. Mar. Sci. 57: 1377-1388.

McConnaughey, R. A., and S. E. Syrjala. 2009. Statistical relationships between the distributions of groundfish and crabs in the eastern Bering Sea and processed returns from a single-beam echosounder. ICES J. Mar. Sci. 66:1425-1432.

McConnaughey, R. A., S. E. Syrjala and C. B. Dew. 2005. Effects of chronic bottom trawling on the size structure of soft-bottom benthic invertebrates. Pages 425-437 *in* P. W. Barnes and J. P. Thomas, editors. Benthic habitats and the effects of fishing. American Fisheries Society, Symposium 41, Bethesda, Maryland.

NRC (National Research Council, Committee on Ecosystem Effects of Fishing). 2002. Effects of trawling and dredging on seafloor habitat. National Academy Press, Washington, D.C. 126 p.

Pitcher, C.R., C.Y. Burridge, T.J. Wassenberg, B.J. Hill and I.R. Poiner. 2009. A large scale BACI experiment to test the effects of prawn trawling on seabed biota in a closed area of the Great Barrier Reef Marine Park, Australia. Fish. Res. 99: 168-183.

Yeung, C. and R. A. McConnaughey. 2006. Community structure of eastern Bering Sea epibenthic invertebrates from annual summer bottom trawl surveys, 1982-2002. Mar. Ecol. Prog. Ser. 318: 47-62.

Figure 1. Corridor layout for the Before-After Control-Impact bottom trawl impact experiment conducted in the eastern Bering Sea. Each of the six blocks represents a pair of Experimental (trawled) and Control (untrawled) corridors separated by 100 meters. Corridors are not to scale.

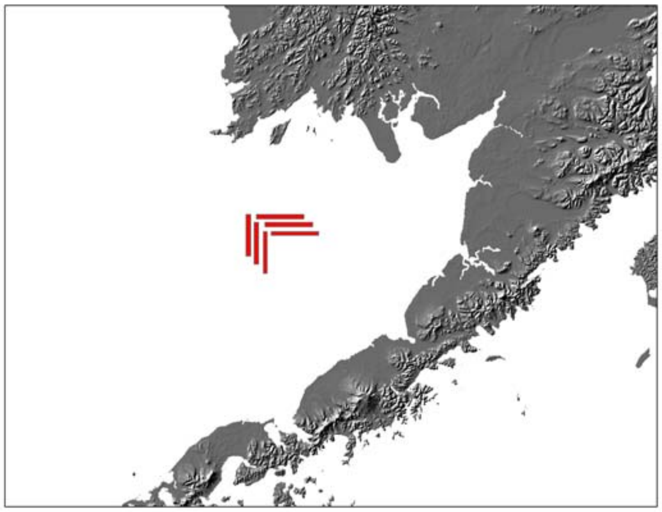


Figure 2. Schematic of the random sampling plan for the Before-After Control-Impact bottom trawl impact experiment in the eastern Bering Sea. Different colors represent different sampling events (times) during the course of the experiment. Each grid cell is sampled only once.

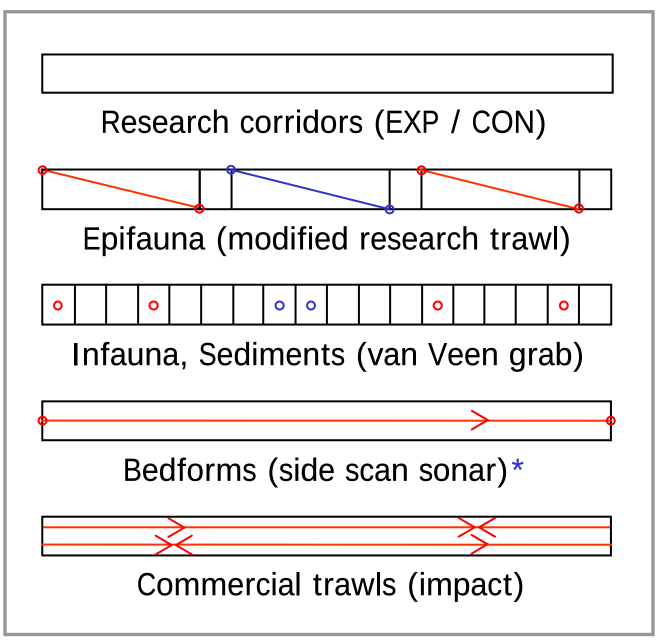
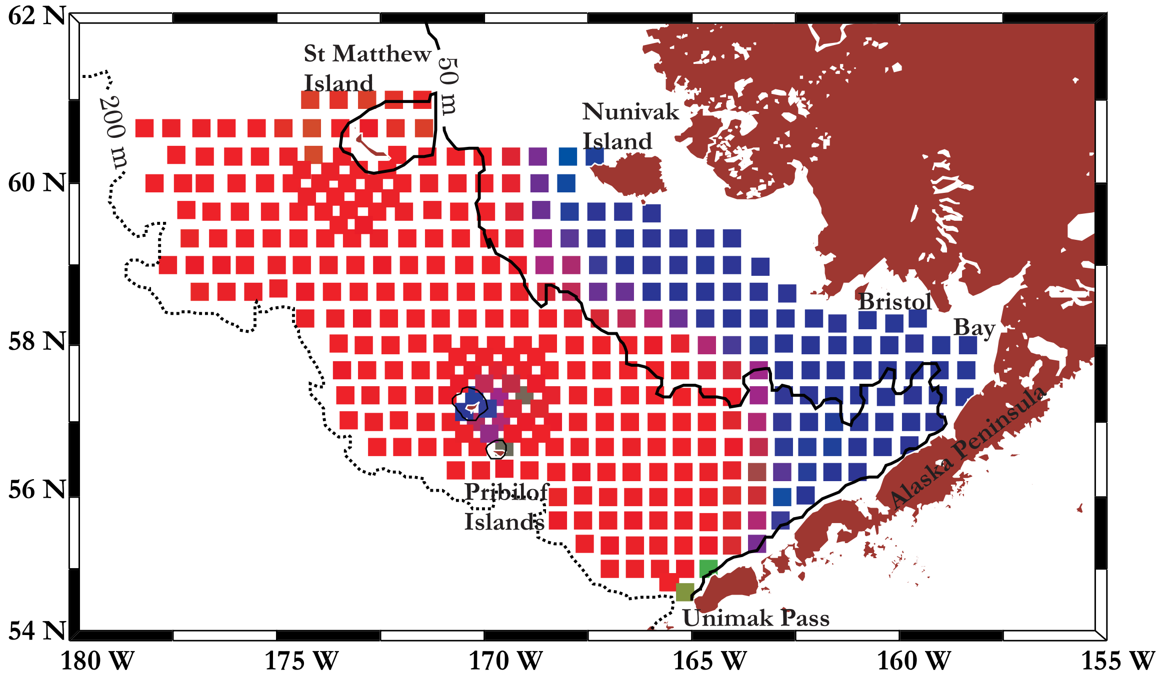


Figure 3. Probability of membership in distinct "offshore", "inshore", and "undefined" benthic invertebrate communities of the standard EBS trawl survey stations, represented in a red-green-blue (RGB) colorscale. The absolute probability of membership in the "offshore" community is represented with red, "inshore" is represented with blue, and "undefined" is represented with green. Each station is therefore represented with the combination of RGB color in proportion to the probability of its belonging to each community (from Yeung and McConnaughey, 2006, Figure 1).



3. Summary of the NBSRA Research Plan Science Workshop

The NBSRA Research Plan Science Workshop was convened at the Alaska Marine Science Symposium (AMSS) on January 17, 2011, in Anchorage, Alaska. The workshop was hosted by the NOAA Fisheries Alaska Fisheries Science Center (AFSC). The goal of the workshop was to gather information from scientists and local communities on what areas and species within the NBSRA warrant protection under this plan. More than sixty people attended, representing state and federal agencies, non-government organizations, academia, native corporations, and the fishing industry.

Russ Nelson, Director of the Resource Assessment and Conservation Engineering Division (RACE), AFSC, opened the workshop with the introduction of participants and an overview of the NBSRA. He emphasized the goal of the workshop, and that of the Research Plan: to investigate the effects of bottom trawling on bottom habitats, and provide information to assist the Council in protecting crabs, marine mammals, endangered species, and the subsistence needs of western Alaskan communities.

Bob McConnaughey (RACE) presented on how to study the effects of bottom trawls based on his research in Bristol Bay. Sue Moore (NOAA Fisheries, Office of Science and Technology) presented for Jackie Grebmeier and Lee Cooper (University of Maryland, Center for Environmental Sciences, Chesapeake Biological Laboratory), providing insights on the variability in the Northern Bering Sea (NBS) ecosystem from decades of research. Jim Lovvorn (Southern Illinois University, Carbondale) presented on the threatened spectacled eider and its critical habitats in the NBS, expounding on ecosystem linkages. Questions and discussions followed each presentation.

After the final open discussion period, Pat Livingston, Director of the Resource Ecology and Fisheries Management Division (REFM), AFSC, summarized the main concerns for study design raised during the workshop:

Type of study

An acute effects study seems most appropriate, but it is important to separate natural variability from trawl effects. There is the need to look at existing data to understand benthic community types and their variability on different temporal and spatial scales. There are questions as to what kinds of existing data are available for use in designing the study, what type of gear should be used, and the size of the area and the duration of the study.

Species considerations

Walrus and bearded seals are important subsistence species that feed mostly on the benthos. Their prey dwell deeper than can be reached by a van Veen sediment grab sampler. Sampling for their prey is problematic. There are decadal-scale changes in prey and predator feeding patterns, so it is difficult to predict what areas are or will be important to mobile predators. The occurrence of phytoplankton blooms that drive benthic productivity can vary in location and timing. Ice cover also dictates where mobile predators can gain access to prey. Given all the variability, it is difficult to predict where benthic production will be favorable and where fisheries may be likely to occur.

Spatial and temporal considerations

Given the variability of the ecosystem on a decadal scale, the duration of the study is an important consideration. The study design needs to account for seasonal and decadal signals. The frequency of trawling is a factor in the effects generated. The design also needs to address the exclusion or inclusion of the habitats for key predators - on one hand, to avoid adversely affecting the animals; on the other, to increase the understanding of them. Inshore areas are important for study for its importance to subsistence fisheries. Data mining is useful for research planning. There are existing data available from Alaska Department of Fish and Game (ADF&G) on subsistence activities. Also, Russian data on the NBS are important to consider. Regarding the scope of the study, the debate is whether it should be confined to the effects of fishing, or expanded to broader issues, such as the human dimension.

Feasibility

How feasible is it to conduct the study as will be proposed in the Research Plan? Where flatfish, primarily yellowfin sole, are concentrated now and where they might move to in the future are candidate areas for study. The present distribution and abundance of the fish are not attractive to commercial fisheries, and the future state is unpredictable. Federal resources are lacking for conducting a fishery-independent study, so an Exempted Fishing Permit (EFP) process may have to be employed. Monitoring gear will need to be added to commercial vessels under the EFP process. Finally, it is still unclear how the study that will be proposed is linked to regulatory outcomes, e.g., whether area opens if the study concludes that no adverse effects of trawling can be detected.

Nelson closed the workshop thanking the participants and urging for more information on species, habitat, and activities helpful for planning the research. He acknowledged that more basic ecological research is necessary, but it is not in the purview of the Research Plan as AFSC is tasked. He believed that the December 2011 timeline for completing the draft of the Research Plan may be optimistic. Between now and the completion of the draft Research Plan, there will ample opportunity for public input and comment, including possibly another Subsistence and Community Workshop.

Agenda and minutes of the workshop, PowerPoint presentations, and the list of participants will be posted on the Council's website.

4. NBSRA Research Plan Development Schedule

July 2009 – May 2010

- Compilation of available ecological and fisheries baseline data
- Planning for public workshops

February 8- 16, 2010, NPFMC meeting (Portland, OR) –
updates on:

- Preparations for NBSRA Community & Subsistence Workshop
- Baseline ecological and fisheries data research
- Expansion of NMFS eastern Bering Sea summer bottom trawl survey into NBSRA
- NPRB call for bottom habitat research proposals

February 24-25, 2010, NBSRA Community & Subsistence Workshop (Anchorage, AK) -
agenda includes:

- Communication of research plan objectives and current status of plan development to the public and stakeholders
- Solicitation for ecological and subsistence information from the public for research planning
- Discussion of concerns regarding scientific research and commercial bottom trawling

Participants to include Alaska Native tribal representatives, village representatives, subsistence users, commercial fishing industry

July-August 2010 – NMFS Bering Sea bottom trawl survey

January 17, 2011 *(open to public)*, NBSRA Science Meeting (Anchorage, AK) –
agenda includes:

- Communication of research plan objectives and current status of plan development to researchers
- Solicitation for data contributions and expert knowledge for research planning
- Discussion of issues regarding the experimental design to be included in the research plan

Invitees to include researchers from government and non-government institutions who have expertise in Bering Sea fisheries and ecology, industry, and those interested in research in the NBSRA (open to public)

June 6-10, 2011, NPFMC meeting (Nome, AK) –

- Report findings of 2010 NMFS bottom trawl survey in NBSRA
- Report outcomes of 2011 Science and Community/Subsistence workshops
- Presents outline of Research Plan
- Consult NPFMC on choice of study sites and subsistence concerns

September 12, 2011, NBSRA Community & Subsistence Workshop (Nome, AK) –
gather input from the communities on:

- Subsistence use and other special areas to be excluded from bottom trawling
- Other concerns to be addressed in Research Plan

December 5- 2011 (Anchorage, AK) – NPFMC review of draft Research Plan

April 2012 (Anchorage, AK) – Finalize Research Plan