*North Pacific Research Board*

*Gulf of Alaska Integrated Ecosystem Research Program*

*2009 Special Invitation for Proposals*

*for*

# *Upper Trophic Level Component*

March 4, 2009

## Introduction

The North Pacific Research Board (NPRB) identifies in its Science Plan (NPRB 2005) the need to develop integrated ecosystem research programs (IERPs) to achieve the Board's vision of building a clear understanding of the ecosystem that enables effective management and sustainable use of resources. The IERP approach was endorsed by the National Research Council (NRC 2004) in its evaluation of the Science Plan. Toward that end, the Board developed its first IERP for the Bering Sea and Aleutian Islands large marine ecosystem (BSIERP) in 2007. The North Pacific Research Board is now launching its second Integrated Ecosystem Research Program, this one with the focus in the Gulf of Alaska (GOA). The Implementation plan for this IERP (http://www.nprb.org/science/goa_ierp.html) should be consulted carefully before responding to this Invitation for Full Proposals.

## GOA IERP Program Structure

The Gulf of Alaska Integrated Ecosystem Research Program revolves around an overarching question:

***How do environmental and anthropogenic processes, including climate change, affect various trophic levels and dynamical linkages among trophic levels, with particular emphasis on fish and fisheries, marine mammals and seabirds within the Gulf of Alaska?***

In the first instance, the goal is to ***determine and quantify the processes driving upper trophic level populations and to better understand observed and potential future variability therein as they affect key management issues in the North Pacific.*** To do so comprehensively, monitoring, modeling, retrospective analysis and process studies will need to be integrated. A comparative study, designed to investigate demographic differences at a regional geographic scale, might best elucidate critical control mechanisms for population dynamics of upper trophic level species (see GOA IERP Implementation Plan for details and other directions). The overall GOA IERP will span from climate/physics through fish, birds, and mammals and has been divided into four components which are being competed separately and will be integrated in a post proposal selection process to ensure that a fully vertical trophic understanding is obtained.

This special invitation for a full proposal concerns just the first component, which will focus on one or more upper trophic level species, at least one of which must be a fish species of commercial importance. This component should investigate the processes and mechanisms that regulate the productivity and population trends, including their variability, of the top level species of interest. You are receiving this invitation based on NPRB's review of your pre-proposal to the request circulated by NPRB in October 2008. It is imperative that the full proposal expand upon the subject matter of the pre-proposal. Any deviation from the pre-proposal must be identified clearly and explained in full.

The other three components of the integrated program will be the subject of a second request for proposals in June 2009 after final selection of **one** Upper Trophic Level Component project in May 2009. The second component will focus on the forage base which influences the productivity of the top level predator(s) chosen. The type, quality and quantity of food resources and their timing and location, are critical to understanding higher trophic level responses. Thus, the ecological breadth and scope of the second component are expected to be somewhat larger than that of other components. The third component will focus on the lower trophic level, including the biological and physical oceanographic parameters on which this portion of the ecosystem is based. Finally, the fourth component, a strong vertically-integrated modeling effort, will be essential to describe and predict the response (and variability

therein) of the portion of the GOA ecosystem to be studied, to environmental and anthropogenic processes, including climate change.

Full vertical integration across all trophic linkages will be achieved via focal meetings *after* the full proposal selection of the final three components in late 2009. It will be the aim of post-selection focal meetings during the first half of 2010 to establish vertical linkages and build cooperation between components. A scientific leadership group made up of the four lead PIs (upper, middle, lower trophic levels plus modeling components), in coordination with NPRB staff, Science Panel, Ecosystem Modeling Committee, and Advisory Board, will be established and be responsible for overall project management and integration.

**This document constitutes the formal invitation for full proposals for the upper trophic level component based on NPRB's review and selection of the pre-proposals submitted on January 28, 2009.**

## REQUIREMENTS FOR INVITED FULL PROPOSALS

A total of eight million dollars (including overall data and program management, as well as education and outreach) may be made available for this GOA IERP starting in early 2010 and ending in 2013 or 2014. The NPRB is reserving $500K for overall IERP program management as well as $200K for IERP Education and Outreach. It is anticipated that the remaining funds ($7.3M) will be distributed between the four integrated components approximately as follows: i) Upper Trophic Level Component: $2.8 million, ii) Forage base Component: $2 million, iii) Lower Trophic Level and Physical Oceanography: $1.5 million and iv) Ecosystem Modeling Component: $1 million.

**Upper-trophic level full proposals must include** a planning year (2010), not to exceed $125,000, two or three major field years (FY 2011, 2012 and potentially 2013), with a maximum of $1,025,000 in any one year and a maximum total for all three years of $2.55 million, and one or two analysis and synthesis year(s) with a minimum of $125,000 per year. This component must also include overall data management for the entire vertically-integrated GOA-IERP program. **The total budget for this component must not exceed $2.8 million**. A further description of the requirements of these proposals is found on Page 5 under the "Research Plan" section. Applicants must demonstrate that their objectives and products (e.g., data collection/analyses, final report, publications, climate and human induced change scenarios, information for resource managers) are attainable with the requested funds and within the requested award period, and that the project has a clear management application.

Staying within the financial boundaries set by NPRB will require the successful IERP proposals to demonstrate thorough understanding and maximum leveraging of existing observational and modeling programs (see GOA IERP Implementation Plan for details). Such a leveraged program will employ the major research activities (monitoring, process studies, retrospective analysis, and modeling) to the extent they are necessary to elucidate relevant patterns and trends, and their associated causal processes and mechanisms. ***The critical aspect is vertical integration.*** Given the focus on quantitative predictions, continuous communication between field work results and modeling will play a crucial role. The exact structure of the award will depend upon the decision of the NPRB on exact funding amount, review by NPRB, review by Department of Commerce officials, and the results of post-selection negotiations between the program and NPRB staff.

## Submission and Deadline

### *Submission*

Full proposals must be submitted to Carrie Eischens (carrie.eischens@nprb.org) by **4 pm (Alaska Standard Time) on Thursday, April 23rd, 2009**. Applicants will need to prepare the following information and documents (described in more detail below). Sections 1-7 will be sent out for technical reviews.

1. Summary Page(s) **(use provided template)**
2. Proposal classification **(use template provided)**
3. Contact information (**use template provided)** for the lead Primary Investigator, all other Primary Investigators, co-Investigators, Collaborators, and an Administrative Grant Managers for each institution requesting funds, as well as suggested potential Reviewers
4. Research Plan (max 20 pages, **use provided template**)
5. Budget Information and Budget Narrative (**use provided templates**)
6. Resumes (max 2 pages per person)
7. Other Requirements
8. Current and Pending Support for each PI and co-PI (**use provided template**)
9. Letters of support

**All applicants should refer to http://www.nprb.org/science/goa_ierp.html for a copy of proposal application materials, templates, and other support documents. Templates, where provided, must be used in your proposal submission. Failure to use the provided template will result in automatic dismissal of your proposal without further review.** Please contact the NPRB office by phone at (907) 644-6712, or by email to Carrie Eischens (carrie.eischens@nprb.org) if you need further information or clarification.

### *Deadline*

**Full Proposals** must follow the guidelines and criteria specified herein and **must be submitted electronically to Carrie Eischens via email to carrie.eischens@nprb.org by 4 p.m., Alaska time, April 23 2009. In the interest of fairness, no proposals received after the deadline will be considered for funding. If you have trouble submitting your proposal documents via email due to document size, please contact NPRB for assistance before the deadline. Please note that it is in your best interest to have fully submitted your proposal ahead of the deadline, and not wait until the last minute. You will receive a confirmation email once your proposal submission has been received. Please also note that no substitution documents will be accepted after the deadline has past. Documents submitted by the time of the above deadline will be the documents which go through the review process.**

## Proposal Package

The full proposal package consists of nine elements:

1. Summary Page(s) **(use template provided)**

These pages should contain the full address and contact information for each subaward recipient (i.e., agency or entity) that will be legally bound to perform the research if funded, names of all principal investigators and co-investigators that will be associated with the project and their agency/organization

affiliation and email address, proposal title, the 250 word project summary (taken from the research plan) and a place for a legally binding signature for each individual subaward recipient involved in the project. ***Note:*** these pages are not confidential and will be made available to the public. Please complete a summary page for each subaward recipient involved in the project (both those requesting funding and those providing matching funding), have it signed by the appropriate legally-binding representatives of each subaward recipient participating in this research and include with your email submission to NPRB via carrie.eischens@nprb.org. One overall Summary page is also required listing all subaward recipients, PIs and co-PIs, and the amount of funding requested or provided as match by each agency involved in the proposal. This overall Summary Page should be signed by the lead PI for the overall proposal.

2. Proposal classification **(use template provided)**

Using the template provided, provide the following information:

a. *Focal species*
b. *Over-arching hypothesis*
c. *Main management issue to be addressed*
d. *Processes to be investigated*
e. *Project deliverables*
f. *Geographic Location*: List the specific geographic location(s) within the Gulf of Alaska region in which the study will take place.
g. *Field years and months*
h. *Research Platforms and funding source*
i. *Keywords*: Describe your project with 5-10 keywords
j. *Total Budget*

3. Contact information **(use template provided)**

Using the provided template, provide the full contact information for the lead Principal Investigator, a Principal Investigator *from each organization requesting funds (one of these may be the lead PI)*, all Co-investigators, Collaborators, and an Administrative Grant Manager *from each organization requesting funds*.

4. Research Plan **(use provided template**, **20-page maximum** excluding references, but including Figures and Tables; submit your plan as a **WORD document**

The main body of the proposal will be your research plan, **limited to 20 consecutively numbered pages** formatted as follows: All pages (***including the reference section***) must have **1-inch margins** at the top, bottom and sides. Text (***including tables, figure legends, citations and references***) must be single-spaced, and the font and size must be **Times New Roman 11 point**. No page in the proposal and supporting material may be formatted to any size other than 8.5x11 inches. Color graphics are allowed, but may be reproduced in black and white and thus should be sufficiently descriptive. Note that submitted proposals will be subsequently converted to PDFs, and this conversion may impact the quality of your graphics. Please ensure an appropriate resolution is used. The research plan (and only the research plan) **must have continuous line numbers** from beginning to end to facilitate review.

**Failure to comply with any of the formatting specifications above will result in automatic dismissal of your proposal without further review.**

Following the provided template, your research plan will have the following elements:

A. Project Title.

B. Proposal Summary.

In 250 words or less, briefly explain the goal and value of the proposed work and why NPRB funds should be used, in language understandable by individuals not familiar with the specific subject area (e.g, members of Congress and the general public). This summary should include main issue to be addressed, methodology, and expected management application. This summary will also appear on the Summary page (described above) and will be made available to the public.

C. Soundness of Project Design and Conceptual Approach.

(1) State the hypothesis and objectives which will be addressed by the proposed research. Please remember that this needs to expand on the pre-proposal accepted or clearly explain any deviations.

(2) Using information provided in the GOA IERP Implementation Plan as guidance and other sources as applicable, provide a justification and demonstrate an understanding of the issues to be addressed by:

(a) Describing the elements and quantifiable process of your research. Specifically,

- justify the study species that will form the basis of your proposed work. Also identify and justify the parameters and measurements that will to be investigated. Justify why these are the essential components to address your objectives in terms of importance, commercial and/or subsistence value, and ecological significance.
- justify the essential processes to be investigated. Justify why these are the essential components to address your objectives in terms of importance, commercial and/or subsistence value, or ecological significance.
- describe the present state of knowledge (including ongoing NPRB, GLOBEC, FOCI and other research) relevant to your proposed work;
- describe the proposed work's relation to previous work and/or work in progress by all principal and co-investigators (including work conducted as part of other NPRB projects, GLOBEC, FOCI or other research);
- describe the data sources (retrospective and current) to be used and comment on their availability;
- indicate and justify the geographic location(s) and the spatial and temporal scales to be investigated; Provide a map of the study area(s) and indicate the location of survey stations, transect lines, field sites, etc.

(b) Describing how each applicable research activity (monitoring, process, retrospective, modeling) will be employed for each element and/or quantifiable process identified in (a) above and how these different activities will inform each other. If significant modeling efforts are incorporated into your Upper Trophic Level proposal, you must address the items listed in the Modeling Evaluation Criteria (Appendix 1) and present your expectation as to what would be the focus of work conducted by the Ecosystem Modeling Component of the GOA IERP program given the modeling efforts incorporated into the Upper Trophic Level Component.

(3) In developing your quantitative predictions, describe the conceptual framework/hypotheses underlying your research and describe how these hypotheses are represented in the resulting product. Describe the experimental approach (and associated power analysis) and the

analytical approach, including assumptions required, sample size, other relevant information needed to determine the utility and technical feasibility of accomplishing your research, and the expected outcome.

(4) Clearly indicate how your study would link to the forage base component, the lower trophic level and physical oceanography component and the ecosystem modeling component of the overall GOA-IERP. Describe your data needs (including space, time, and intensity) from the other GOA-IERP components (forage base component, lower tropic level and physical oceanography component and ecosystem modeling component) so NPRB will understand what is necessary in a composite vertically-integrated program based on your proposed upper trophic level study. It is expected that up to a total of $4.5 million dollars will be available to complete the middle trophic level, lower trophic level and modeling components. Thus, the description of data and models needed from the other components should be both relevant to the vertical integration as well as feasible given the planned budget.

(5) If applicable, indicate what long-term monitoring projects this proposal is requesting funding for or would require from other components of the GOA-IERP. Justify why continuing data collection from this monitoring project is critical to the success of this research program, and why it is not being funded by other organizations otherwise. In this justification you should also demonstrate the broader applicability of the proposed data collection and identify other on-going activities at the proposed site(s) that would benefit from this.

(6) Although not a requirement of the full proposal, indicate if Local and Traditional Knowledge (LTK) will be included in the proposed research and if so how. Describe how LTK activities, as defined in the NPRB Science Plan, will be incorporated into your proposed research program.

(7) The Gulf of Alaska ecosystem is closely linked to the economy and sustainability of multiple communities around the Gulf. Although not a requirement of the full proposal, if any communities are involved in the proposed research, or research results are relevant to communities, describe how community involvement activities, as defined in the NPRB Science Plan, will be incorporated into your proposed research.

D. Project Responsiveness. State what the project will accomplish and how the proposed research will significantly enhance the understanding of each of the following:

***(1) the major ecosystem processes that regulate the distribution and abundance of the specific upper trophic level species chosen as part of this proposal;***
***(2) the quantitative changes of these processes under various environmental and anthropogenic forcing scenarios;***
***(3) the direct and indirect human-induced impacts on the specified species;***
***(4) the relevance (how and why) of this research program to management of commercial and/or subsistence harvests.***

Be sure to include a description of how this proposed work differs from and builds upon past approaches (e.g., GLOBEC, FOCI) and point out the new and innovative approaches you have designed to be able to address these questions. Also, if appropriate (e.g. applicants from federal and state agencies) explicitly describe how the research activities envisioned in this proposal differ from normal agency activities that are carried out in response to their mission requirements.

Please note that proposal evaluation will be based on both scientific merit and relevance to current management issues.

E. Program Management, Timeline and Milestones.

(1) *Program Management:* Identify the research team including **one** lead Principal Investigator who will be responsible for the execution and oversight of the proposed project. Component teams are encouraged to include co-investigators from research non-profits, universities, community-based organizations, private sector and other organizations as appropriate, and management agency entities to ensure that there is a clear application to one or more resource management issues and to Gulf of Alaska communities. Demonstrate how you will coordinate and collaborate with other projects, and leverage your proposals with support from other sources. Provide a discussion of the experience and qualifications of the principal and co-investigator(s) and how you will ensure structurally that all information will be integrated. The proposed team should also include a data manager, as well as post docs and graduate students. If appropriate (e.g. if investigators are full-time federal or state employees), describe how an employee's current duties will be reassigned or backfilled if the employee takes on responsibilities for activities supported under the GOA IERP, whether that employee is supported within the overall GOA IERP program budget or by matching contributions.

(2) *Research Platforms*: Identify each research platform (e.g. ships, ROVs, AUVs) to be used and specify the funding institution. If funding is not from NPRB (i.e. not requested as part of this proposal), specify if that funding is secured or pending, whether it is a cruise dedicated to this purpose or whether it is a vessel of opportunity, and if the latter, identify how much control you would have over the mission to ensure your proposed research can be carried out.

*(3) Timeline and Milestones.*

a. Provide a table clearly detailing your timelines and associated measurable milestones that will be used to track and evaluate your project performance through the entire award period. This timeline should also include when data from each element of the proposed work will be available within and between the different components of the overall vertically-integrated GOA-IERP (e.g. field data to models, etc; see also data management plan below). Note that timelines may be adjusted following the post-selection focal meetings between selected proposals to facilitate better integrations of all projects.
b. Indicate and justify how many field years (2 or 3) are planned for the proposed study within the funding limitations described below (Section 5: Budget Information and Budget Narrative). Describe the implication of the number of field seasons chosen on the study outcome.
c. Describe the realistic products and deliverables of your project and how they will benefit management of commercial and/or subsistence species. If applicable, also include how the research will benefit management of protected species. Applicants must demonstrate that their objectives and products are attainable with the requested funds and within the requested award period, and that the project has a clear management application. Specifically identify the realistic products resulting from your project that will be of sufficient quality to appear in the scientific literature, at resource management workshops, and in documents that contain management scenario evaluations to be provided to entities such as the NPFMC, NMFS, USFWS, ADFG, and the Alaska Board of Fisheries. Note that these products and deliverables will be used to track the progress of your project and your progress and final reports will be compared to these. Also note that GOA IERP projects are subject to the NPRB Policy for Compliance with Subaward Agreements (Appendix 2).
d. Describe how you plan to disseminate the research results.

F. Data Management Plan

Data management for the entire vertically integrated module is to be included as part of the upper trophic level component. Assuming all your data needs from the other three components are met, describe the overall data management strategy for the fully-integrated vertical ecosystem program that will be in place once all components (Upper trophic level, Forage base, Lower trophic level and physical oceanography, and modeling) of the program have been selected.

The data manager identified above will have the responsibility of implementing this plan, including metadata and data dissemination within the integrated component teams during the course of the project and transfer of metadata and data to the NPRB within a maximum of 1 year after each field season.

G. Outreach and Education Plan

Education and Outreach efforts for the overall GOA IERP will be developed under the supervision of NPRB's Education and Outreach Coordinator once the overall program has been defined. No funds for E&O should be included in your budget. However, applicants should describe (1) how their project will leverage collaborating E&O resources (i.e. in your institution, or with collaborators not requiring separate funding), and (2) proposed directions or ideas for effective and useful E&O opportunities stemming from or associated with the proposal.

H. Coordination Strategy

Proposals should describe how the project will coordinate and/or collaborate with other ongoing and planned programs and projects (NPRB funded, GLOBEC, NOAA or others). Coordination and cooperation with other programs is highly encouraged and is essential to provide horizontal and vertical expansion of the issues being addressed and will thus result in a much broader scope: the total project would be greater than the sum of the individual programs. Some of the relevant past and present programs and projects have been mentioned in the GOA-IERP Implementation Plan, although those descriptions should not be viewed as a comprehensive list. If applicable, community involvement should be part of this strategy.

I. Figures and Tables

Figures and Tables are part of the **20-page limit** and should be embedded in the text of the research plan. Please ensure they are of sufficient quality to be legible when converted to PDF and/or printed in black and white.

**[You do not need numbered lines beyond this point]**

J. References

References are **NOT** part of the **20-page limit**. List all references used in the Research Plan in a format appropriate for a major journal such as *Fisheries Oceanography, Transactions of the American Fisheries Society, ICES Journal of Marine Science,* etc.

5. Budget Information and Budget Narrative (**use template provided**)

The budget for the Upper Trophic Level Component of GOA-IERP should not exceed $2.8 million over 4-5 fiscal years (starting in January 2010 (FY 2010) and ending in FY 2013 or 2014). Budgets must be allocated by federal fiscal years (Oct 1- Sep 30) and by organizations requesting funds.

The budget must include funds for:

- A planning year: January 2010 through Sep 2010 (FY 2010), not to exceed $125,000. Applicants should include the costs for all PIs to attend at least two PI focal/coordination meetings in Anchorage during the first half of 2010.
- Two or three major field years (FY 2011, 2012 and potentially 2013), with a maximum of $1,025,000 in any one year and a maximum total for all three years of $2.55 million.
- One to two analysis and synthesis years (FY 2013 and/or 2014), with a minimum of $125,000 per year.
- Ship time must be specifically detailed (year, amount, funding source – NPRB or matching).
- Budgets must include annual travel for all PIs to a special PI meeting in Alaska **and** for all lead PIs to attend the Alaska Marine Science Symposium (takes place each January in Anchorage) during each year of the study. Note that annual PI meetings might not occur in conjunction with the Alaska Marine Science Symposium. Travel to the annual symposium by lead PIs **the January following the end of the project period**, to present the results is also required.
- Data Management for the entire GOA-IERP program.
- Preparing all required reports and publication of results in appropriate scientific journals.
- Anticipated other support and cost leveraging per year and organization.

*Budget Summary Template*

Fill in the template and email the completed Excel spreadsheet with the rest of your documents. The **Budget Summary** is a series of worksheets (one for each institution/organization requesting funds) that detail by year (where years are federal fiscal years starting in October 1 and ending September 30) the following mandatory budget categories: salaries, fringe benefits, travel, capital equipment, supplies/commodities, contracts/consultants, other expenditures, indirect costs (F&A), and other support/cost sharing with other programs. The template Budget Summary includes a summary page that automatically combines all information for up to six different organizations. You may revise this template to include more institutions if necessary. Please note that each organization requesting funds must designate, at the top of their respective budget summary template, a **Principal Investigator and a Grant Administrator** to be responsible for the organizations sections of the project.

*Budget Narrative **(use template provided)***

Guided by the example in the template for the **Budget Narrative**, **each institution requesting funds must provide** a detailed description of costs listed under each budget category in the budget summary above. You may include associated spreadsheets and other supporting material if applicable.

Clearly state whether or not your project will require any **international travel**. Inclusion of international travel will not impact the review process, but approval of international travel after the approval of the proposal will require a special application that may take up to 3 month to process. Please note that the Fly America Act will apply.

Please be explicit whether your budget includes ship time, or, if it does not, how ship time and costs will be covered by other guaranteed funds.

Other support. Applications must reflect the total budget necessary to accomplish the project, including contributions from federal or non-federal grants, base organizational budgets, and/or donations. Other support is not required for this program. Please be advised that although EIRF-based (Environmental Improvement and Restoration Fund) funds are not appropriated, the U.S. Department of Commerce has made a finding that EIRF funds should be considered to be federal funding since an authorization act creates the "fund" in the U.S. Treasury. For non-federal applicants, other federal funds cannot be used for cost-sharing purposes.

Indirect Costs (sometimes referred to as overhead or F&A). The budget form may include an amount for indirect costs if the applicant has an established indirect cost rate with the Federal government. The total dollar amount of the indirect costs proposed in an application under this program must not exceed the indirect cost rate negotiated and approved by a cognizant Federal agency prior to the proposed effective date of the award, or 100 percent of the total proposed direct cost dollar amount in the application, whichever is less. If applicable, a copy of the current, approved, negotiated indirect cost agreement with the Federal government must be included. It will be retained in the office and not distributed to reviewers.

*Please ensure that your budget has been approved according to your organization's standard proposal approval process. Also, please check your final budget before submission to ensure that the addition of indirect costs as a percentage or some other revision to your budget does not cause your total budget to exceed the individual proposal funding cap for the research component addressed.*

**If your proposal exceeds the $2.8 million cap for this component it will be returned without further processing.**

6. Resumes (limited to 2 pages per individual)

Submit one Word or PDF document which includes all the resumes of the lead principal investigator, data manager and principal/co-investigators involved in the proposal (collaborators do not need to submit their resumes). Each resume is limited to two consecutively numbered pages and must include the following information:

a. A list of professional and academic credentials, mailing address, and other contact information including work phone and email address.
b. A description of current activities relevant to the proposed project.
c. A list of up to five of your most recent/relevant publications most closely related to the proposed project and up to five other significant publications as appropriate. Please highlight publications that are based on research supported by NPRB funds.
d. A list of all (or if too many, the most relevant) persons (including organizational affiliations) in alphabetical order with whom the lead principal investigator, data manager and each principal/co-investigator has collaborated on a project or publication within the last four years. If none, this should be indicated.

7. Other Requirements

Applicants should ensure that the following are included in their proposal as appropriate:

*MOUs and data sharing agreements among institutions and/or letters of collaboration* to indicate the level of organizational coordination and integration among the project team detailed in the Research Plan (sections F and H) above.

*Permits* that may be required as part of the project should be documented in the research plan and, if available, permit applications or granted permit numbers should be provided.

*Graduate Students and Post-docs* are required to be part of the project team. In your research plan list the number of graduate students and post-docs you intend to make part of your project. Include the level (M.Sc., Ph.D.), duration, and level of support they will receive.

8. Current and Pending Support Form (**use template provided**)

For each of the principal/co-investigators and other senior personnel involved in the proposal (as above), use the provided template to disclose any current and pending financial resources that are intended to support research related or similar to that included in the proposal, or that would consume the time of the proposer(s). Upload the current and pending forms to the online submission system where appropriate. The proposer must also disclose if they have submitted the proposal to other funding sources or if other funds are being used to support the research funded by the Board.

9. Letters of Support

Letters of support from relevant management agencies, communities, including Alaska Native communities and tribal governing bodies (if applicable) or others potentially impacted by project activities (e.g. seabird colony work at times of subsistence activities) or benefiting from the projects results should be provided. Letters should indicate how the results will be of use or benefit. Scan the signed letters and upload them in the appropriate place during proposal submission.

## FULL PROPOSAL REVIEW AND SELECTION PROCESS

Initial Screening of Full Invited Proposals. Upon receipt, the NPRB staff will screen the full proposals for conformance with the format and structure requirements set forth in this notice. If needed, the Executive Director will request an *ad hoc* committee of available Science Panel members to help in the initial screening. Proposals that are found by the Executive Director and the *ad hoc* committee to not comply with the requirements will be rejected without further processing.

Consultation with Interested Parties. NPRB may consult with NOAA and other Federal and State agencies, the North Pacific Fishery Management Council, and other entities, as appropriate, who may be affected by or have knowledge of a specific proposal or its subject matter.

Independent Technical Evaluations. All proposals that pass the initial screening will undergo independent, anonymous, technical peer review, conducted by regional and national experts. Reviewers will be asked to provide comments and qualitative assessments of the technical aspects for each proposal, as indicated below, and an overall summation.

a. Soundness of Project Design/Conceptual Approach *(section C in the Research Plan*): Applications will be evaluated on the applicant's comprehension of the problem(s); the overall concept proposed for resolution; justification of species, parameters, locations temporal and spatial scales to be investigated, whether the applicant provided sufficient information to evaluate the project technically; and, if so, the strengths and/or weaknesses of the technical design relative to securing productive results. Particular attention will be given to the inclusion of a clear statement of hypothesis to be tested or objectives to be addressed, the presence of a detailed experimental design with associated

power analysis as appropriate, and a list of data sources or requirements. Does the plan clearly describe how the proposed work will be linked with the other 3 components of GOA-IERP?

b. Project Responsiveness to GOA IERP (*section D in the Research Plan*):
Does the project have the potential to significantly enhance our understanding of each of the following:

***(1) the major ecosystem processes that regulate the distribution and abundance of the specific upper trophic level species chosen as part of this proposal;***
***(2) the quantitative changes of these processes under various environmental and anthropogenic forcing scenarios***
***(3) the direct and indirect human-induced impacts on the specified species;***
(4) ***the relevance (how and why) the research program will be relevant to management of commercial and/or subsistence harvests.***

c. Program Management *(sections E-H in the Research Plan*): Evaluation will include the following: Is there a clear description of proper organization and management of the project, including data management, and do the project's principal investigator(s) and other personnel have the necessary experience and qualifications for the tasks they have been assigned to? Is there a clear description of the research platforms to be used and is the proposed level of effort appropriate? Are a clear schedule and appropriate milestones and deliverables identified in tabular form in the proposal, and an appropriate plan of how the results will be disseminated? Is a reasonable data management plan proposed to achieve the proposed data management goals? Does the project plan to coordinate and collaborate with other projects and leverage their proposals with support from other sources and are the mechanics of how this will occur well described?

d. Project Costs *(Budget Summary and Budget Narrative):* The justification and allocation of the budget in terms of the work to be performed will be evaluated. Unreasonably high or low project costs will be taken into account.

Science Panel Review. All proposals to NPRB and their accompanying technical evaluations will be submitted to the NPRB Science Panel for review and scoring based on the above evaluation criteria. The NPRB science panel will meet to review proposals and develop recommendations for the Board. The panel will discuss the feasibility of success of the highly ranked proposals with respect to the requirements described in these proposals for the other 3 components of the GOA-IERP and provide advice to the NPRB concerning how to optimize such a study. If two or more projects are believed to be equally meritorious from a scientific perspective, the panel will provide a final ranking based on their view of the societal importance of the program, i.e. its importance to managers, subsistence hunters, and commercial fishermen.

Proposal Selection. The full NPRB will meet to determine which proposal to fund for the Upper Trophic Level Component of this integrated program. It is the intention of the Board to choose only one proposal at this stage. Proposals will be evaluated on the basis of meritorious science, societal importance, and how well they contribute to the integrated NPRB program.

**The NPRB reserves the right to fund no proposals and to re-compete the GOA IERP if appropriate.**

Successful applicants will be expected to agree to comply with provisions of a project management plan that will be developed by the assembled teams based on requirements identified by NPRB (see below).

Secretary of Commerce Review. By law, all recommendations of the Board are subject to final approval by the Secretary of Commerce, who must ensure that there is no duplication with other projects funded by NOAA or other Federal organizations, and that the projects selected for funding are those that best meet the objectives of this solicitation. The review will include a determination of compliance with federal regulations, including the National Environmental Policy Act, and may result in additional requirements as a condition for funding (see General Condition 2 below).

Confidentiality of Proposals. If a proposal is submitted to NPRB, but not funded, only the proposal title, names of principal investigators, funding amount requested, duration, and the proposal summary page will be released to the public upon request. If a proposal is approved for funding by NPRB and the Secretary of Commerce, then the full research proposal (excluding salary information) will be released to the public.

## Tentative Schedule

The tentative schedule is as follows (except for the proposal deadline, the schedule is subject to change):

| Scheduled Item | Tentative Timeline |
|---|---|
| Invitation for Full Proposals for upper trophic level component | March 4, 2009 |
| Full proposal Submission Deadline for Upper Trophic Level Component | April 23, 2009 |
| NPRB Funding Decisions | May 29, 2009 |
| Notification to PIs | by June 5, 2009 |
| RFP Release for full proposals for forage base, lower trophic and modeling components | by June 5, 2009 |
| Full proposal Submission Deadline for forage base, lower trophic and ecosystem modeling components | October 2, 2009 |
| NPRB Funding Decisions | December 2009 |
| Notifications to PIs | December 2009 |
| Focal meetings to complete vertical integration and coordination | First half of 2010 |
| Preliminary work/planning and organization | Summer 2010-Spring 2011 |
| Field work begins | Spring 2011 |

The exact amounts of funds awarded to an NPRB project will be determined in pre-award negotiations between the applicant and NPRB. Projects should not be initiated in expectation of Federal funding until a Notice of Award document is received. Applicants should not request a project start date before **January 15, 2010**

## FIRST YEAR PLANNING AND ORGANIZATIONAL MEETINGS

Focal Meetings. All investigators will be required to meet in Anchorage for focal group meetings during the first half of 2010 to develop agreed-upon procedures for working as one integrated team. It is expected that this will require a minimum of two face-to-face meetings with all investigators, plus teleconferences and email exchanges as necessary. The intent of these meeting (2-3 days) is to introduce PI's to one another, identify team leadership, introduce the scope of the individually proposed components, establish and ensure linkages between the four components, and consequently develop a strategy and/or refine a program and data management plan that all PIs/Co-PIs agree too. These meetings will be chaired by NPRB staff.

Project Management Plan.
By summer 2010 the selected components will need to demonstrate clearly to NPRB that a coordinated, integrated program has been developed and will be managed as such. Team members will need to develop and agree to a project management plan, based on requirements identified by NPRB program staff. At a minimum, the project management plan will include:

1. Identification of project and team leadership and individual program responsibilities.
2. Protocols and procedures on working together as a seamless team.
3. Schedule of meetings and other activities.
4. Plans for field seasons and selection of chief scientists for cruises, including equipment sharing and ship time scheduling.
5. Communications protocols between modelers and field programs, including a detailed plan that will outline when different data sets will be available to the rest of the team and how and at which point they can inform the models and in turn how and when new model outputs will inform the fieldwork.
6. Coordination with other programs.
7. Implementation and monitoring of required data sharing protocols (see below).
8. Plans for annual reviews, progress reports, data analysis, synthesis, and reporting to be responsive to program requirements. These annual reviews may be coupled with the January Alaska Marine Science Symposia and may include a more nationally prominent scientific meeting.
9. Identification of product deliverables from the research, especially as it pertains to synthesis reports, and who will be responsible for such.
10. Dispute resolution.

In the case that a project management plan is not successfully completed to the satisfaction of NPRB, funds may be withheld until all issues and concerns are resolved.

### Data Sharing Protocols

NPRB will require data sharing in solicitations and organizational meetings. When the teams are identified and organized, they will need to clearly specify milestones and expectations for the types of data and schedule of availability, and how data will be exchanged between different components of the program. The combined teams will use a data policy developed on the basis of the U.S. GLOBEC Data Policy (GLOBEC Report No. 10, February 1994), existing OPP data policies, and proposed SEARCH data policies.

### Program Adjustments

NPRB plans to annually review this comprehensive program and may request adjustments as necessary if something is going wrong.

Program leaders will schedule annual meetings of all principal investigators for planning purposes and to determine if program adjustments are necessary. NPRB expect such attendance costs to be incorporated in the overall budget for their proposals.

Program leaders will identify protocols for making adjustments in the program, if necessary. NPRB cognizant program officers may be consulted also.

**III. General Conditions**

This RFP is only a solicitation of offers and should not be construed as an expectation of award, or as any reasonable basis for detrimental reliance. NPRB is not obligated to award any specific project or any available funds. There is no guarantee sufficient funds will be available to make awards for all acceptable projects, and NPRB may choose to reject all proposals. No oral statement by any person can supersede or modify the terms of this RFP.

1. All Federal, State, private, and foreign organizations are eligible. Recipient organizations must have a DUNS number and be registered in Central Contractor Registration (www.ccr.gov) before any award can be made.

2. Responding proposals are firm offers and shall remain open for the NPRB to accept anytime before March 1, 2010 in accordance with a standard NPRB agreement for the performance of the work proposed. A proposal is accepted only when NPRB sends the applicant written approval and has a fully executed subaward agreement. A proposal accepted for funding does not obligate NPRB to provide additional future funding.

3. The applicant is responsible for obtaining all Federal, State, and local governmental permits and approvals for projects or activities to be funded under this announcement. This includes, as applicable, certification under state Coastal Zone Management Plans, section 404 or section 10 permits issued by the Army Corps of Engineers; experimental fishing or other permits under federal fishery management plans; scientific permits under the Endangered Species Act and/or the Marine Mammal Protection Act; and assistance to the Federal government in developing analysis to meet the requirements of the National Environmental Policy Act. All experiments must be conducted in compliance with law, and only pursuant to mandatory permitting duly granted by the appropriate federal and state agencies. Requirements for special permits, for example, those required for taking marine mammals, should be clearly described and whether the permit is in possession or not. The Secretary of Commerce may withhold final approval or stipulate additional conditions on projects to ensure compliance with the above.

4. Projects that require at-sea research using research vessels must comply with all research vessel safety standards in accordance with the guidelines for the operation of oceanographic research vessels owned, operated or chartered by members of the University-National Oceanographic Laboratory System (UNOLS), to ensure that research at sea is conducted to the highest practicable standards of safety and prudence. Those standards also apply to chartered non-institution vessels. (See: http://www.gso.uri.edu/unols/saf_stand/contents.htm.)

5. Funded participants are wholly responsible for the conduct of research, submission of required reports, and preparation of the results for publication. Participants will be required to submit semi-annual progress reports and a final report to be posted on the NPRB web site and in other databases. Final reports may be submitted for peer review at the discretion of the NPRB. Failure to submit timely reports or to respond to peer review comments on final reports may result in withheld

payments. Every effort should be made to submit research results for publication by an appropriate scientific journal within one year of the completion of study. The NPRB Executive Director may in his sole discretion grant written exceptions if requested timely. All manuscripts shall acknowledge that funds were provided by the NPRB through the U.S. Department of Commerce, NOAA, NMFS.

6. Funded projects will be subject to the NPRB Policy on Compliance with Subaward Agreements (Appendix 2).

7. NPRB plans on annually reviewing this comprehensive program and expects applicants to plan for these meetings and incorporate such attendance costs in the overall budget of the proposal. The NPRB may request adjustments as necessary if the program is not progressing as planned and make continued funding contingent upon such adjustments.

8. Successful applicants will be required to report their metadata and data to an agreed-upon system (e.g. NODC or USGS information infrastructure) within a maximum of one year after each field season. A project specific data management and information transfer plan will be required. Among other requirements, the plan will specify the storage media and format(s), month and location for reporting, and other relevant information that may be required by the circumstances of the project.

9. Researchers applying to do research involving human subjects are expected to demonstrate compliance with regional protocols for researcher/community interactions or the specific human subjects screening done by most academic institutions and agencies. The purpose is to ensure that privacy is protected, data are collected in a suitable manner, data are maintained in a secure environment, and results of any study are made available to participants if they indicate their interest.

10. In accordance with federal statutes and regulations, no person on grounds of race, color, age, sex, national origin, religion, marital status, pregnancy, parenthood, or disability shall be excluded from participation in, denied the benefits of, or be subjected to discrimination under this program.

**Appendix 1. Ecosystem Model Evaluation Criteria**

Introduction

The 2009 special request for proposals (RFP) for the planned Gulf of Alaska Integrated Ecosystem Research Program (GOAIERP) emphasizes the need for quantitative assessments of the impacts of environmental and anthropogenic processes affecting production, distribution, abundance, availability and variability of components of the ecosystem insofar as these are relevant to fishery management. Any successful proposal to the Ecosystem Modeling Component of the GOAIERP must pursue modeling that is integrated across all components of the relevant portion of the GOA ecosystem to be studied and must be coordinated with field work conducted as part of the overall GOAIERP. The demand for vertical integration does not require that this all be accomplished with a single seamless model: it can be accomplished with multiple hard- or soft-linked models; provided the proposal is convincing that the linkage is practical in light of the spatial and temporal resolutions of the respective models.

Proposed models must meet the highest feasible standards of predictive power, performance, and accuracy to be useful in making long-term improvements in understanding of the marine ecosystem and its processes, as well as improving fisheries management, both in terms of ecologically optimal regulation and providing predictions that are useful for economic planning. Toward that end, the NPRB established an Ecosystem Modeling Committee (EMC) to establish criteria for evaluating proposed models, and to work with the successful applicant team to ensure the highest quality in the modeling funded under IERP programs. The EMC has developed this discussion paper on models and the evaluation criteria described below. Full proposals to the ecosystem modeling component of the GOAIERP must address those criteria.

The Need for Models

There is a recognized need for fisheries science to develop methods of forecasting the production of key species in important fisheries and to forecast the dynamics of the protected species that constrain important fisheries, over time scales that encompass environmental trends that are now evident or expected. It is now understood that the forecasts should link the responses of the species of interest among themselves, to other food web components, to habitat, and to oceanography and climate in order to take full account of ecosystem interactions.

Stock assessments routinely incorporate fishing effects, but models are needed that identify the impacts of changes and trends in environmental and anthropogenic processes, including climate change. The reality of natural long term variation in climate is now scientifically accepted, with examples such as the Pacific Decadal Oscillation, the North Atlantic Oscillation or the Arctic Oscillation. Climate change also is generally regarded within the scientific community as having the potential for major impacts on present and future environmental trends. Such changes in climate, if they occur, will certainly affect the biology of the North Pacific, and thus will affect fisheries in the Gulf of Alaska. Models will be needed to assess the likely impacts of these changes in the environment on the population dynamics of biologically, commercially and socially important species in the Gulf of Alaska ecosystem.

Forecasting models are needed to provide decision support for the fishing industry and subsistence users. With the present state of our knowledge, the one certainty is that change will occur. What is needed are predictions which, in order of specificity, tell us what the change will be, when it will occur, or the probability that it will occur, or at least the range of possibilities that are likely. The example of the major ecosystem changes around the 1976/77 regime shift offers ample evidence of the need to expect change. Forecast models are needed to allow managers to be well-informed stewards of our environment.

Effective forecasting is the end point of fisheries science. It is an end point that society expects the science to deliver.

For the greatest practical utility, species population models should predict species population responses to readily measured leading indicators. Examples of variables which might serve such a function are bottom temperature at the time of spawning, or the timing of the spring bloom, or the direction and strength of winds at the time of larval first feeding. Ecosystem level models should link the leading physical indicators to biological factors which, in turn, affect the key harvested and protected species. Likely climate change might be taken into account by developing scenarios for the leading indicators based on a suite of plausible climate scenarios.

The Difficulty with Models

From the practical standpoint of a manager considering whether to use model predictions in making a decision, the crucial difficulty is in knowing the extent to which the predictions should be trusted. Good predictive power is not a foregone conclusion with ecosystem models: the systems are extremely complex, the models themselves are often dauntingly complex, our scientific theoretical knowledge about ecosystems is rudimentary, and the data available for fitting, tuning and testing the models are very sparse relative to the spatial, temporal and taxonomic detail of the models and of the system.

Because of system complexity, and the incomplete state of the underlying theoretical science, it is not credible to base the claim for a model's correctness on the simple assertion that the model incorporates the "right" mechanisms. Even if all the functional forms in the internal representation of mechanisms were correct, the parameter values and initial state description would also have to be correct to ensure correct predictions. The assessment of sensitivity of predictions to errors in parameter values and errors in the initial state description is a technical undertaking in its own right. The estimation of parameter values, and quantification of their uncertainty, is a highly technical statistical matter.

Because of the sparseness of data relative to the effective number of parameters that are being estimated, mere "goodness of fit" is not a reliable guide to the predictive accuracy of such models. For this reason, much more sophisticated statistical testing procedures are required for realistic quantification of the predictive power of such models.

Evaluation of modeling proposals under this initiative will include consideration of the proposed testing of model predictive power. The intention is to encourage projects that do quantify objective measures of model performance, so that these measures can eventually serve as indications of how good the model is, and with what confidence its predictions can be used in decision making. This is not to demand that every component of an integrated ecosystem model be subjected to quantification of predictive performance. The requirement is that the proposed projects each identify at least one component prediction as the prediction from their model which will be of significance to management, and to develop a credible plan for quantifying the anticipated performance of *that* prediction.

The following section identifies salient points that should be considered in describing the plans for testing model performance. Subsequent sections offer more detailed comments about some of the deeper statistical issues. This is not presented in the spirit of a check list that each proposal must address in a one or two sentence response to each question in the outline. Rather the NPRB is emphasizing that the credibility of the treatment of model validation will weigh significantly in the evaluation of modeling proposals and that the EMC will be charged with reviewing that aspect of each modeling proposal.

It is expected that the demand for a model validation plan will increase the effort of preparing a proposal, and will appreciably increase the effort of the project itself. It is believed that this will contribute to the quality of the products.

The material offered below should be useful to the modeling teams in drafting the model validation portion of their proposals. Any modeling group that has difficulty with this section of their proposal might benefit from expanding their team to include more statistical expertise.

Elements of a Model Testing Plan

The following items need to be addressed thoroughly in all full proposals to the Ecosystem Modeling Component of the GOA IERP. Further explanation of these evaluation criteria is given in subsequent sections.

A. What is the model intended to predict?

B. What specific aspect of the prediction is anticipated to be of direct value for fisheries management?

C. What measure of "accuracy" in the prediction is crucial to determining the usability of that prediction to fisheries management?

D. What alternative models (other mechanisms, greater degrees of spatial and temporal aggregation, simple statistical predictors) are plausible competitors whose performance will be tested against the model being developed?

E. How will the achieved predictive power of the model be compared against the performance of plausible alternatives, and how will this guide subsequent choices about model form and parameterization?

F. What data are needed and are available (provide specifics on the temporal and spatial resolution, time span covered, and data quality) to drive, calibrate, and test the model?

G. How will the existing data be used to quantify model fit and predictive power?

H. What pertinent future data are anticipated to become available within the time frame of the project?

I. How will the future data be used to quantify model fit and predictive power?

J. How has it been determined that the proposed quantity and quality of data can be expected to be sufficient for the intended use in tuning and testing the model?

K. How will the probabilistic nature of model forecasts be represented in model output, and how will this be communicated to eventual users of the model predictions?

L. What is the schedule for providing NPRB with specified data files of observations and model output fields, and how does this set of observations and outputs ensure transparency and verifiability?

Statistical Elements of Model Validation

The above list of requested items may not be wholly familiar to the entire community of modeling project proposers. Furthermore, the technical vocabulary for statistical model validation varies considerably among the various application disciplines. This complicates the task of explaining clearly in the RFP what is really wanted in connection with model testing. It may also pose a challenge when technical reviewers are asked to evaluate this aspect of the proposals received from groups from diverse disciplines. As a possible aid to this 2-way communication problem, we offer below an attempt at a unified discussion of some of the technical statistical issues, along with a consistent set of definitions drawing where possible from the technical vocabulary of modeling in the atmospheric sciences and in applied statistical decision theory. The choice of a reference lexicon from the atmospheric sciences is intended to capitalize on the relatively high level of maturity of that discipline's experience with these matters. The framework of statistical decision theory is already common currency in fisheries management, at least in some single species contexts.

Predictive Power in Context

The central concept is the quantification of what has been loosely called predictive power, performance, or accuracy in the discussion above. To make this concrete, there first must be a specification (really a choice) of what is being predicted (see item A in the above list of model evaluation criteria). The presumption is that the knowledge of the quantity being predicted would directly affect decisions by agency managers, industry planners or subsistence users (item B). Understanding how the prediction will be used for decisions should reveal how errors or inaccuracies in the prediction will lead to incorrect decisions if the prediction is acted upon, which in turn should suggest the most telling measure of accuracy appropriate for evaluating a model that is used for making this kind of prediction in this kind of decision context (item C).

Model Skill

In atmospheric modeling, the statistically assessed measure of a model's predictive accuracy, in the context of the planned use of the prediction, is called the model "skill." Several formulations are available, as appropriate for the kind of quantity being predicted and its use in a decision process. More particularly the skill can refer to different aspects of a model’s performance--notably hindcast skill, forecast skill, artificial skill, ensemble skill, conditional skill (not all of which are mutually exclusive)--which will be defined in subsequent sections.

Skill Score

Regardless of whether the skill is hindcast, forecast, artificial, ensemble, or conditional, there must be a defined metric for quantification. The "skill score" (SS) is useful for evaluating predictions of numerical variables that vary continuously or approximately continuously, such as recruitment to a specified fish population. It compares a forecaster's root-mean-squared or mean-absolute prediction errors, E_{f}, over a reference scenario, with those of a reference alternative prediction, E_{refr}, such as forecasts based entirely on the past average, a simple regression relationship, or persistence, which involve fewer variables, parameters, or mechanisms than the model being evaluated:

$$SS=1-(E_{f}/E_{refr})$$

If SS>0, the forecaster or technique is deemed to possess some skill compared to the reference technique, and it may be concluded that the addition of variables, parameters, or mechanisms beyond those of the reference technique was worthwhile.

Skill Quantified by Classification Error Rates

For binary, yes/no kinds of forecasts or detection techniques, such as the determination of a regime shift, the probability of detection (POD), false alarm rate (FAR), and critical success index (CSI) may be useful evaluators. For example, if A is the number of forecasts that rain would occur when it subsequently did occur (forecast=yes, observation=yes), B is the number of forecasts of no rain when rain occurred (no, yes), and C is the number of forecasts of rain when rain did not occur (yes, no), then

$$POD=A/(A+B)$$
$$FAR=C/(A+C)$$
$$CSI=A/(A+B+C)$$

For perfect forecasting or detection, POD=CSI=1.0 and FAR=0.0.

POD and FAR scores should be presented as a pair. A decision theoretic assessment will present the full contingency table of probabilities of true positive, true negative, false positive, false negative, conditioned on a prior and data-driven inference of the underlying probability that the system state actually is "positive" or " negative."

Hindcast Skill

A model is usually tuned to some observed data set. That is, the model parameters are adjusted to try to best replicate the observations, or are estimated from the observations by a statistical procedure. The model's ability to replicate these data is generically called the "goodness of fit" which may be measured as "hindcast skill," for instance the percent of variance of the observations that the model can capture. The observations used in this process are termed "dependent" or the "training data."

Data Assimilation

A special case of hindcast skill assessment is employed in diagnosis of the internal consistency of the model's representation of the system. A deliberately diverse and comprehensive set of data, possibly sampled at different times and intervals and different locations, may be combined by use of the model into a unified and consistent and complete state description of the system. This is called "data assimilation." Poor fit in data assimilation may reveal shortcomings of the model structure, and warrants close examination from the perspective of temporal, spatial and taxonomic aggregation in the model, known omission of mechanisms, and measurement error in the data themselves. At a minimum, it is important to be able to account for the poorness of fit, if such is seen. Good fit in a data assimilation may be less diagnostic.

Forecast Skill.

By contrast, "forecast skill" is a measure of the model's ability to reproduce observations that have in no way been involved in the model tuning process. These are "independent" data. The forecast skill can be estimated from entirely "new" data obtained after the model was tuned, i.e., real forecasts of the future. Alternatively, the forecast skill might be estimated from "holdout data" by application to a subset of data that were initially set aside, or via jackknife cross-validation.

Degrees of Freedom

In an unconstrained dynamic system, the number of independent variables required to specify completely the state of the system at a given moment is called the "degrees of freedom" of the system. If the system

has constraints--that is, definitional, kinematic or geometric relations between the variables--each such relation reduces by one the number of degrees of freedom of the system.

In fitting a model to data, as in estimating the model parameters from the data via a likelihood procedure, the number of degrees of freedom available for the statistical operation is the number of independent observations (observations that cannot be calculated exactly from the other observations), whose joint probability is affected by all of the parameters, minus the number of independent parameters in the model (parameters whose value cannot be calculated exactly from the values of the other parameters). Generally, the precision of the parameter estimates resulting from such a statistical operation will increase with the available degrees of freedom; and if the available degrees of freedom is zero or negative, the parameters cannot be resolved uniquely at all (though it may be possible to estimate some combinations of parameters, such as ratios or sums). When the joint distribution of the observations can be accounted for by a reduced set of the parameters of interest (such as a subset of the parameters, or combinations such as sums or ratios), the original model is said to be "non-identifiable," and estimation of the full set of original parameters is impossible without the provision of supplemental information (such as theoretical constraints, ancillary statistical analyses on other data, or prior distributions) not contained in the data.

Artificial Skill

Fitting a model to data can always be done, even though the model may be completely "wrong" and have little or no forecast skill. In the limit that the effective number of tunable model parameters equals or exceeds the number of degrees of freedom in the system (or when the number of available degrees of freedom for the statistical fitting goes to zero or less), the model may have nearly perfect hindcast skill, even if the real or forecast skill is nil. The "artificial skill" is the difference of hindcast skill minus forecast skill, and is a measure of the degree to which the hindcast skill would prove illusory as an indicator of forecast skill.

Parsimony and Alternative Models

Ecosystem models, like most large scale environmental models, as a class, are under pressure of degrees of freedom problems eroding their forecast skill. In practice, as the number of tuned model parameters increases, the models start to fit the noise rather than fitting the signal, and forecast skill degrades accordingly. This places a premium on effective strategies for keeping the number of model parameters to a minimum. In statistical modeling (e.g., multiple regression, GAM), there are standard procedures (e.g., stepwise significance testing, AIC) for making decisions about including model terms or adding predictor variables. Parsimony in large ecosystem models needs to be approached in a similar spirit. In part this may be addressed by a thorough exploration of the performance of simpler alternative models as the reference models for scoring forecast skill (items D and E).

Persistence models deserve special attention as candidates for simple alternatives. In meteorology and oceanography, red noise processes, such as the simple first order autoregressive, often fit the existing data about as well as much more elaborate models. Red noise models are important alternatives, because they make very few assumptions about underlying mechanisms or the state space, and they imply very low predictive power for the distant future even though the short term (and possibly medium term) predictive power is often good. Such short term predictive power can be useful in a decision process that only needs to look a short time span ahead of the ongoing monitoring, with the knowledge that adaptive corrections are feasible with each revision of the forecast with each increment of ongoing monitoring information.

Conditional Skill

Model skill (hindcast or forecast) may be measured on some conditional basis. This might be conditional on one or more of the state variables being in a specified range, or it might be conditional on more elaborate scenarios involving the system state or trajectory. For a simple example, model performance might be scored only when an ENSO index is above a certain threshold. The skill in the defined limited set of situations is termed "conditional skill."

Ensemble Forecasts

A model may be run numerous times with the same trajectory of deterministic forcing, but varying initial conditions, or independently sampling presumed real stochastic processes in the forcing, or sampling presumed real stochastic processes that are part of the model, or sampling parameter uncertainty. Each run is termed a realization and the group of all runs an ensemble. The statistics of the ensemble (mean, variance, etc) are obtained from the set of realizations. A variety of measures of the ensemble distribution can be used to estimate model sensitivity (to numerical precision, to uncertainty about initial conditions, to uncertainty about parameters, or to uncertainty about the future unfolding of real stochastic forcing) and precision. The relationship of the ensemble distribution to a known independent value can be used for a robustly conditioned estimate of forecast skill.

Skill and Forecast Confidence in Perspective

With this broad spectrum of available skill metrics for quantifying model predictive power it becomes clear why the choice of metric (item C) needs to be tailored to the proposed decision-making use (item B) of the promised useful prediction (item A). We see that high hindcast skill is not very telling, though low hindcast skill might serve some diagnostic function.

One might select a very stringent forecast skill metric like percent variance accounted for, but a less demanding forecast metric like a simple n-tile contingency approach would be appropriate when the anticipated use of the prediction is for detection or prediction of a relatively discrete state, such as a defined ecosystem configuration. Some effort should be made to explain how the skill metric is a good match to the prediction use. A conditional skill metric might be entirely appropriate if it is conditioned on a scenario that is of genuine concern, and if there is a plausible decision process that will use the prediction, in the way that it is packaged by the model, if the defining scenario arises.

Model predictions are inherently probabilistic, owing to process variation represented explicitly in the forcing and in the modeled mechanisms, and owing to parameter uncertainty. Evaluation of the probabilistic nature of the predictions can generally be accomplished through ensemble forecasts exploring the correct universe of process variation and parameter uncertainty. This should be taken into account in the estimation of skill. Ultimately, the confidence in the predictions that are delivered to the users of the prediction, should be communicated in terms of quantification both of the probabilistic nature of the prediction (item K) and the measured forecast skill appropriate to the use (possibly a conditional forecast skill).

Data Sources, Use and Sufficiency

Because quantification of forecast skill is an empirical statistical enterprise, it is crucially dependent on data, which coincidentally, in the case of biological data for ecosystem modeling, are generally in very short supply and subject to many possible questions of sampling error and measurement error. For this reason it is important to be very explicit and detailed about what data really are, or will be, available (items F and H), and exactly how they will be used for the various phases of the planned model testing

(items G and I), noting that different subsets of the data might get used for different parts of the process, such as tuning, data assimilation, or cross-validation.

The sparseness of ecological and fisheries data, relative to the scale and complexity of the system represented in an ecosystem model, raises the question whether the amount of data is sufficient to draw the conclusions that are promised (item I). Parameter estimation and forecast skill quantification both are formal statistical operations whose resolution (precision) depends on, among other things, the "sample size" of the data employed.

In planning simpler statistical exercises there are standard techniques, generally called "power analysis," for quantifying in advance the expected resolution of the estimates from a specified statistical operation on a specified quantity of data of defined quality. This allows an evaluation of whether the planned study is likely to deliver results that are sufficiently conclusive to answer the motivating question or to be useful in the decision process which will rely on them. The same logic may be pursued for much more elaborate statistical operations, such as ecosystem modeling, by simulating data sets corresponding to the size and quality that is planned, using hypothetical values of the key parameters to drive the simulation, submitting these simulated data sets to the planned analysis, and reporting the statistics of the power of the planned analysis, in context of its intended use, based on the ability of the analyses to recover the known hypothetical parameter values.

Indicators

There are striking differences in the scales and intensity of sampling, methods of measurement, and levels of resolution, as they relate to the different kinds of physical and biological data that will be combined in an ecosystem model. Often enough the biological quantities of greatest interest for decision purposes are among those with the weakest or sparsest measurements. Sometimes the quantity which is the focus of policy interest is not even well defined, such as "ecosystem health."

The use of more readily measured (and defined) surrogate variables is attractive, but raises its own set of questions that need to be addressed in the course of model validation when such "indicators" are used in the modeling. Basically, there needs to be a clear definition of what the indicator is supposed to indicate, there needs to be a set of independent measurements of that ground truth, and there needs to be a statistical analysis of how well the indicator predicts that sample of ground truth. This is essentially an assessment of "simulcast skill," in that the surrogate is being used to predict the contemporaneous ground truth. If the indicator is a leading indicator, then the claim is a forecast, and its performance should be evaluated in terms of forecast skill.

Transparency and Data Access

Science is a social activity, where quality control and consensus are the products of independent verification of claims made about a shared empirical reality. In a science such as ecosystem modeling, where the data are so sparse and hard won that replication of the data themselves would be prohibitively expensive at best, and where the prominence of historical data trajectories sometimes makes renewed measurement of the key data an impossibility, independent verification of assertions about model performance requires common access to common sets of data about which there is substantive scientific agreement concerning what was measured, where it was measured, when it was measured, and how it was measured.

NPRB will require that data sets used in the modeling projects it funds as part of the GOAIERP, and numeric output fields from data assimilation and critical model runs, be made available and thoroughly documented on the NPRB database. The proposals should commit to a schedule of delivery of specified

data files and specified files of model output, and the proposals should explain how these files would constitute an adequate set for independent attempts at verification of skill and key relationships revealed by the modeling (item L). Progress in meeting this schedule will be one of the elements of annual reviews by the EMC of funded projects. The NPRB will encourage the funded modeling projects to develop and document consensus among themselves about the quality of pertinent data.

Kinds of Models

Models developed for purposes of "explanation" may not appear to fit the paradigm of models developed for purposes of prediction, as described above. But from the standpoint of the NPRB demand for high standards of documented useful performance in the models funded under the GOAIERP, an explanatory model needs to make some verifiable significant prediction. Testing whether some hypothesized mechanisms represented in a model account for an observed pattern in data via examining the fit to those data, is essentially an evaluation of hindcast skill, which is a weak test for complex models with sparse data, as discussed above. The credibility of the hypothesized mechanism should be evaluated by identifying some corollaries, specific to the hypothesized mechanisms, and not automatically entailed in the data used for tuning the model, and then treating these as forecasts to be evaluated by the statistical machinery discussed above.

The assumptions and predictions of explanatory models require testing and assessment of predictive power that is as rigorous as that required of models intended for a direct management prediction. Thus, field research should support the testing of assumptions and predictions of an explanatory model. Such testing is necessary before the explanatory model can contribute toward the development and testing of the quantitative predictions that are the ultimate goal of the GOAIERP. One should note that some extant conceptual models, such as the Oscillating Control Hypothesis in the Bering Sea, in many cases have yet to have their assumptions or predictions rigorously tested. Such tests are important, and could be an appropriate activity within the GOAIERP.

EMC Role in Reviewing Ecosystem Modeling Proposals and Projects

Review of Full Proposals. The EMC will be involved with reviewing full proposals to the Ecosystem Modeling Component of the GOAIERP. Full proposals will be expected to address all the elements of a model testing plan (A through L), as discussed in this appendix on ecosystem model evaluation criteria. The usual NPRB standards for conflict of interest will apply for recusal of EMC members from review of particular projects where conflict might arise. EMC recommendations will be presented to the Science Panel and/or the Board for consideration.

Proposal Revisions. There is a possibility that the model validation portion of an otherwise meritorious proposal may not meet the expectations of the EMC. If that proposal is selected for funding, the successful team will be expected to meet with the EMC and make adjustments in their modeling approach as reasonable and appropriate within the funding and time limitations. If the funded team and EMC cannot agree on suitable revisions, the matter in dispute will be elevated to the Science Panel and then to the full Board for resolution.

Annual Review and Direction. The EMC will meet at least annually, but more frequently if necessary, with the successful Ecosystem Modeling team to appraise the modeling effort and recommend adjustments as necessary.

# North Pacific Research Board Policy
# Compliance with Subaward Agreements

## Purpose

The North Pacific Research Board (NPRB) supports marine research activities in the North Pacific based on highly competitive requests for proposals. Projects are funded through NPRB subawards with subrecipients who agree to comply with subaward provisions and all applicable federal law, and perform the work in the research plan. The research plan is the primary basis for selecting proposals by NPRB. It identifies hypotheses, conceptual approach, experimental design, and timelines and measurable milestones used to monitor progress based on periodic financial reports, semi-annual progress reports, and a final report. When approved and subsequently attached as an appendix 1 to the subaward, it becomes the primary basis for evaluating success or failure of the project.

In funding many research projects at institutions across the U.S. and beyond since 2002, NPRB has been fortunate to have supported many very capable principal investigators who have managed their projects successfully. The Board wishes to maintain that high success rate and intends to continue working closely with subrecipients toward successful completion of individual projects.

There are, however, the rare occasion when a project is not progressing satisfactorily. This may happen for a variety of very legitimate reasons, for example, bad weather, absence of animals, equipment failures in remote locations, acts of God, or other factors that may be outside the control of the principal investigators. NPRB fully understands there is risk inherent in conducting scientific research, especially in remote locations, and intends to work closely with subrecipients to bring about a reasonable and acceptable conclusion to those projects.

The procedures herein cover such inadvertence, but this policy is aimed more squarely at situations where principal investigators diverge from their research plan, fail to manage or report properly, or fail to meet other subaward provisions, without prior approval of NPRB. This policy describes steps that NPRB will take to address such deficiencies. Its provisions are derived mainly from a close reading of OMB Circular A-110 (referenced by § in text), NSF Award and Administration Guide (AAG), and the US Department of Commerce Financial Assistance Standard Terms and Conditions (DOC). Part 180 – OMB Guidelines on Governmentwide Debarment and Suspension also is referenced.

## Guiding Principles

In general NPRB will strive to adhere to two guiding principles in taking steps to resolve issues that may arise with research projects. The first guiding principle will be to identify performance problems as early as possible so the subrecipient, working with NPRB, has the opportunity to resolve problems before the situation worsens. NPRB will review progress reports to assess performance. It must be noted, however, that NPRB does not have the primary responsibility for detecting emerging issues. OMB A-133 §215.51(f) requires subrecipients to immediately notify NPRB, as the awarding agency in this case, of developments that have a significant impact on the subaward-supported activities, including any problems, delays, or adverse conditions which may materially impair the ability to meet the objectives of the subaward.

The second guiding principle will be to strive to resolve problems at the lowest point of potential failure, normally at the principal investigator level. Working with the principal investigators, and then the grants managers as appropriate, NPRB will strive to resolve issues at the staff level before elevating the situation to higher authority at the subrecipient or NPRB, as provided for in this policy.

**Non-compliance**

In agreeing to the subaward provisions, the subrecipient accepts full responsibility for managing and monitoring its NPRB-funded project to a successful conclusion (§215.51(a)). Subrecipients must report performance in accordance with subaward provisions, which at a minimum, require brief information on each of the following: a comparison of actual accomplishments to stated goals and objectives, research findings and quantitative data as appropriate, reasons why established goals were not met, if appropriate, and any cost overruns (§215.51(d)). It has been NPRB's experience that when problems occur, they generally involve: (1) incomplete or late finance, progress, and final reports; (2) non-achievement of objectives or milestones or pursuit of new ones without prior approval; or (3) incomplete reporting of data or metadata. These problems, as well as any other occasion when subaward provisions are not followed without prior approval of NPRB, may be viewed as instances of non-compliance.

**Problem Resolution**

Successful completion of individual research projects is of paramount importance. NPRB will proceed in good faith to work with recipients and their respective principal investigators and grants managers to resolve potential issues early and at the lowest level necessary in accordance with the two guiding principles stated above. To facilitate resolution, subrecipients are reminded that they are required to:

- Report deviations from budget and program plans and request prior NPRB approval for any change in scope or objective, even if there is no associated budget revision (§215.25(c)).
- Immediately notify NPRB of any development that may significantly impact their subaward-supported activities, particularly problems, delays, or adverse conditions which may materially impair the ability to meet their objectives and milestones. The notification must describe the action taken or contemplated and any assistance needed to resolve the situation (§215.51(f)).

Staff Resolution

Problems and issues will be resolved to the extent possible through communication between NPRB staff, normally the Science Director, and the principal investigators. If the issue cannot be resolved, the NPRB Executive Director will review the situation and notify the subrecipient, normally through the grants manager, in writing of the circumstances, the nature of the problem, citing the specific deficiency, and the status and outcomes of direct negotiation with the principal investigators to date. A copy of the written communication will be provided to the principal investigator(s). The subrecipient will be requested to respond in writing within 30 calendar days of the date of such communication, describing the steps and schedule for correcting the deficiency (AAG VII.A.2.b(i)). If the prospective actions are deemed satisfactory by the Executive Director, the grants manager will be notified of that decision in writing.

Elevation to NPRB

If deficiencies remain unresolved, or the subrecipient has not provided a satisfactory response within the 30-day period or requests to elevate the decision to the Board, the Executive Director will refer the matter in a written report to the NPRB Executive Committee. The report will present the facts as understood, describe the situation and deficiencies, provide responses from the subrecipient, and recommend remedial action as appropriate.

The subrecipient will be notified in writing of this elevation. Upon notification, the subrecipient will have up to 15 calendar days to provide additional information. The NPRB Executive Committee then will review the report and any additional information and take action as appropriate. All actions will be taken by unanimous vote of the members eligible to vote in accordance with NPRB recusal policies. Following

a decision, the NPRB Executive Committee will formally notify the subrecipient by certified mail, with copies to the principal investigator(s). The full Board will be informed of the actions taken at their next regularly scheduled meeting.

Mediation

If the above procedures fail to resolve the situation, NPRB or the subaward recipient may request formal mediation. In that event, the subaward recipient and NPRB agree to participate in at least two hours of mediation with an independent, professional mediator, with both parties agreeing to share equally in the costs of the mediation. The costs will not include costs incurred by a party for representation by counsel at the mediation. Mediation involves each side of the dispute sitting down with an impartial person, the mediator, to attempt to reach a voluntary settlement. Mediation involves no formal court procedures or rules of evidence, and the mediator does not have the power to render a binding decision or force an agreement on the parties.

Suspension without Prior Notice

NPRB may temporarily withdraw its sponsorship under a subaward, pending corrective action by the subrecipient or a decision to terminate the subaward, if the subrecipient has failed to comply with the project objectives, the terms and conditions of the subaward, or reporting requirements (§215.2(ii), §215.22(h)(1), and §215.62(a)). Action by NPRB to suspend an award normally will be taken only after the grants manager has been informed by NPRB of the proposed action and provided an opportunity for hearing, appeal, or other administrative proceeding to which the subrecipient is entitled (§215.62(b)), or the steps described above have been taken, and there has been an opportunity to correct the problem(s).

The Executive Director may immediately suspend a subaward without prior notice when it is believed that such action is reasonable to protect the interests of NPRB and the federal government (AAG VII.A.2.a(ii)). No costs incurred during a suspension period will be allowable, except those costs approved by NPRB in the suspension notice, or which, in the opinion of NPRB, are necessary and not reasonably avoidable (§215.62(c)).

The Executive Director then will send a follow-up notice of suspension by certified mail to the subrecipient (normally the grants manager), with a copy to the principal investigator(s), setting forth the reasons for suspension and its effective date. The NPRB Executive Director will inform the NPRB Executive Committee of any such action and provide a written report fully describing the situation, the need for immediate suspension, and the conditions under which the suspension may be lifted. The NPRB Executive Committee will meet as appropriate to determine the next steps for resolving the situation.

**Remedies**

After carefully reviewing the situation and responses from the subrecipient, NPRB will consider taking action as appropriate. NPRB may impose temporary special subaward conditions in accordance with §215.14. NPRB also may take actions as allowed under 215.62(a):

1. Temporarily withhold cash payments pending correction of the deficiency.
2. Disallow all or part of the cost of the activity or action not in compliance.
3. Wholly or partly suspend or terminate the current award.
4. Withhold further awards for the project or program.
5. Take other remedies that may be legally available.

NPRB also may prohibit participation by an individual as a principal investigator, co-investigator or collaborator on new projects for a specified time and under specified conditions until problems are deemed to be resolved by NPRB. Failure to provide required reports within the period specified in the subaward could delay NPRB review and processing of pending proposals for all identified principal investigators and co-PIs on a given subaward (AAG Chapter II.E.4). NPRB also may call for a full audit of expenses for the subaward in question and other subawards to the institution as appropriate.

Remedial actions will stay in effect until all issues identified in writing have been fully resolved to the satisfaction of NPRB. NPRB reserves the right to terminate a subaward if it has attempted to resolve issues under the guidance provided in this policy, but has failed to do so. In cases of termination, NPRB will adhere closely to requirements set out in §215.61 and §215.62.

**Research Misconduct**

Research misconduct means fabrication, falsification, or plagiarism in proposing or performing research funded by NPRB, reviewing research proposals submitted to NPRB, or in reporting research results funded by NPRB. In determining if misconduct has occurred and in taking action, NPRB will adhere as closely as possible to procedures described at AAG Chapter VII.C.

**Debarment and Suspension**

This policy does not refer to debarment or suspension as covered by Part 180 – OMB Guidelines to Agencies on Government-wide Debarment and Suspension (Nonprocurement), in Federal regulations at 70 FR 51865, August 31, 2005, and Executive Orders 12549 and 12689. Under those regulations, certain parties who are debarred, suspended or otherwise excluded may not be participants or principals in Federal assistance awards and subawards, and in certain contracts under those awards and subawards (§215.13). NPRB is not defined as a Federal agency pursuant to §180.950, and thus can only make recommendations to the Secretary of Commerce regarding debarment and suspension. The above procedures and remedies do not preclude a subrecipient from being subject to debarment and suspension (§215.62(d)).

**Notification**

This policy was approved by NPRB on March 2, 2009. By reference, it is made part of all NPRB subaward agreements beginning in 2009. Subrecipients will be notified of this policy during each NPRB request for proposals, and must acknowledge and agree to it when accepting subawards. Current and past subawards are covered by their subaward provisions and all applicable Federal law.