Terms of Reference

ESSAS Working Group 4: Climate Effects at Upper Trophic Levels (WG-CUTL)

Ecosystem Studies of Sub-Arctic Seas (ESSAS)
25 March 2008

Introduction

A major goal of ESSAS is to predict the potential impacts of climate variability on the sustainable use of the Sub-Arctic seas. ESSAS has elected to employ a comparative approach to investigate, in each of the sub-arctic seas, which energy pathways appear particularly vulnerable to decadal and longer-term climate change. The ecosystem response to climate change can be non-linear with thresholds, have complex interactions between species, and feature different species responses to similar climate fluctuations in different ecosystems. Reducing uncertainty about the future states of ESSAS ecosystems depends on developing the ability to project future climate states as well as predicting the response of the ecosystem to changes in climate. Predicting future climate states is the primary focus of ESSAS Working Group I on Regional Climate Prediction. Understanding and modeling the complex linkages between observed and projected climate variability and species distributions is the primary focus of two ESSAS Working Groups (ESSAS Working Group 2: Biophysical Coupling Mechanisms and ESSAS Working Group 3: Modeling Ecosystem Responses).

Goals

The main goal of Working Group 4 on Gadoid-Crustacean Interactions (WGGCI) is to assess the effects of ocean climate variation and fishing on the interactions between gadoid fishes and crustaceans by conducting a comparative study across multiple sub-arctic marine ecosystems.

Approach

Gadoid fish and crustaceans are important components of the benthic food web in most subarctic ecosystems and are often among the most important commercial fisheries in these systems. Much is already known about the responses of gadoid fish and crustaceans to physical variability in the ocean. However, there is a need to summarize what is known specifically about the responses of these populations in subarctic seas to climate variability in the context of fishery takes and to contrast and compare these responses among different ecosystems. This working group deliberately focuses on a small set of interacting species to identify consistent associations between the major, commercially important, gadoid fish and crustacean species in each system and to evaluate their responses to observed climate variability. Identifying associations will improve our understanding of ocean climate effects or 'bottom-up' processes that are important in regulating these populations. Our working hypothesis is that gadoid fish and crustaceans respond in opposite ways to ocean climate variation and that such variation results in differences in productivity and abundance between gadoids and crustaceans.

The physical aspects of the ocean that may be crucial in regulating these responses in the ESSAS ecosystems include sea ice cover, ocean temperature, circulation, and stratification. Our approach is consistent with the ESSAS approach of making comparisons across multiple ecosystems. It is recognized that population responses may not be consistent across all sub-arctic ecosystems, but similarities and differences will help identify ecosystem features that are related to the functional mechanisms governing gadoid – crustacean interactions and dynamics. These mechanisms may operate at the adult stages (e.g. through predation or variations in reproductive success), during early life history stages (e.g. through effects on survival of larval or early benthic/demersal stages) and/or at lower trophic levels (variations in

food availability). This study is intended to complement other studies of effects of ocean climate on productivity at low trophic levels (e.g. BSIERP/BEST in the Bering Sea, ESSAS Working Group on Biophysical Coupling) to elucidate how bottom-up processes function in regulating ecosystem structure.

To achieve its goals the working group will engage experts from as many subarctic ecosystems as possible to obtain the best available datasets on variability in abundance of gadoids and crustaceans, as well as relevant ocean climate indices and fisheries takes from each system. Data analyses will be conducted within and across ecosystems to identify important associations and to examine similarities and differences among ecosystems. Results from these analyses should lead to a better understanding of the functional relationships between gadoid and crustacean populations and between climate variability and these populations.

Tasks

1. Summarize and evaluate the available information on the responses of gadoid fish and crustaceans in the Sub-Arctic seas to variability in physical attributes of the ocean (such as seasonal sea ice cover, ocean temperature, stratification, and circulation).
    a. Compilation of relevant literature
    b. Compilation of relevant datasets. For each ecosystem, these datasets should include:
        i. annual estimates of abundance or biomass of important gadoid and crustacean populations
        ii. annual estimates of recruitment to these populations, where available
        iii. total annual harvests from these populations
        iv. ocean climate indices thought to be relevant to the populations by local experts

2. Conduct statistical analyses of relevant data sets from each ecosystem, including:
    a. correlation analyses
    b. multivariate analyses of within and between-system patterns of variability
    c. models of species interactions

3. Be a resource to other working groups within ESSAS, to the larger ESSAS community, and to other researchers on retrospective and future climate change issues in regards to gadoid and crustacean resources.

Implementation

1. The Working Group on Gadoid-Crustacean Interactions shall exist for an initial period of three years, ending six months after the 2011 annual meeting of ESSAS. At that time, the ESSAS Scientific Steering Committee will evaluate whether the WG should continue as is, continue under revised terms of reference, or be dissolved.

2. Twelve to fourteen members will be chosen from the fields of gadoid and crustacean biology, as well as physical, biological and fisheries oceanography. Input from experts on future climate variability, bio-physical coupling, and the needs of ecosystem modelers will be sought through collaboration with ESSAS WG 1, 2, and 3, respectively.

3. The development of the proposed products includes:
    a. Conducting a workshop to be held at one of the annual ESSAS meetings. The purpose of the workshop will be to review information on how changes in climate will affect gadoid and crustacean populations
    b. Literature searches and data compilation with help from local experts in each of the regions; a student will be recruited to assist with these tasks (funds for a M.S. student for 2 years have been secured)
    c. Conducting data analyses (student, with help from working group members)

d. Preparing presentations for workshops, preparing manuscripts
e. Conducting e-meetings as necessary to review progress and coordinate tasks

Expected Results

We anticipate one or more comparative papers based on a review of the literature and new data analyses to summarize important associations between climate variability and the relative productivity of gadoid and crustacean populations in subarctic ecosystems. Where possible, the paper(s) should provide the information necessary for parameterizing relevant relationships between gadoid and crustacean populations in ecosystem models of the subarctic seas. Where sufficient data are lacking to accomplish this task, there should be a clear statement concerning the lack of specific data that could guide future fieldwork.

Membership

A list of the initial members of ESSAS WGGCI:

Boris Berenboim	Russia
AnnDorte Burmeister	West Greenland
Earl Dawe	Canada (Co-chair)
Franz Mueter	USA (Co-chair)
Vladimir Ozhigin	Russia
Yasunori Sakurai	Japan
Shareef Siddeek	USA
Don Stansbury	Canada
Jan Sundet	Norway
Dan Urban	USA
Jie Zheng	USA

Regions of study (tentative):

Barents Sea
East Greenland / Iceland
West Greenland
Labrador/Newfoundland
Eastern Bering Sea
Gulf of Alaska
Oyashio Current region