

## Terms of Reference

### ESSAS Working Group 2: Bio-Physical Coupling (WGBPC)

Ecosystem Studies of Sub-Arctic Seas (ESSAS)  
28 February 2007

#### *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, investigating, 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 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. This requires quantitative estimates of the magnitude and uncertainty of future climate change for the ESSAS regions, and the frequency distribution of natural variability, such as the well-known ecosystem reorganization of the North Pacific in the mid-1970s and historical inter-decadal variability in the marginal seas of the North Atlantic. Predicting ecosystem response requires both understanding and modeling the complex linkages between climate variables and species distributions. This represents the primary focus of two ESSAS Working Groups (ESSAS Working Group 2: Biophysical Coupling Mechanisms and ESSAS Working Group 3: Modeling Ecosystem Responses).

A Goal of the **Working Group on Bio-Physical Coupling (WGBPC)** is to determine how climate-driven variability in physical conditions and processes in the ocean will affect the organisms that make up marine ecosystems and thus the transfer of energy and material through sub-arctic marine ecosystems. Physical aspects of the ocean thought to be crucial to ESSAS ecosystems include sea ice cover, ocean temperature, circulation, and stratification.

A great deal is already known about the responses of organisms to physical variability in the ocean, but the literature is scattered and there is need to summarize what is known specifically about the responses of populations and the ecosystem as a whole in the Sub-Arctic seas and how information gathered in one basin may be applied to ocean regions elsewhere in the Sub-Arctic. Thus a major task for the WGBPC will be to provide the modelers in the ESSAS WGMER with realistic values for parameterizing predictive models of ecosystem response to climate variability.

### **Tasks**

1. Summarize and evaluate the available information on the responses of marine organisms of the Sub-Arctic seas from phytoplankton to marine mammals and seabirds to variability in physical attributes of the ocean such as seasonal sea ice cover, ocean temperature, stratification, and circulation.
2. Working within the larger ESSAS framework, provide the WGMR with a realistic set of values with which to model organism responses to climate-driven variability in the physical attributes of the Sub-Arctic seas.
3. Be a community resource on retrospective and future climate change issues.

### **Implementation**

1. The Working Group on Bio-Physical Coupling shall exist for an initial period of three years, ending six months after the 2009 annual meeting of ESSAS. At this time, the ESSAS SSC will evaluate whether the WG should continue, be revised slightly or dissolved.
2. Eight to ten members will be chosen from the fields of biological and fisheries oceanography. Input from experts on future climate variability and the needs of ecosystem modelers will be sought through collaboration with ESSAS WG 1 and 3, respectively.
3. The development of the proposed products includes conducting workshops held at the annual ESSAS meetings and will require inter-sessional work. The purpose of the workshops is to review information on how changes in various physical attributes of the ocean will affect important ecosystem components. Foci of workshops will include the roles of: seasonal sea ice cover, temperature, stratification and circulation.

### **Expected Results**

Workshop products will be one or more review papers based on comparative studies, to be published in the refereed literature, that summarize the important mechanisms whereby the changes in the physical attribute under discussion affect biological constituents of Sub-Arctic ecosystems and their inter-relationships. Where possible, these papers should provide the information necessary for parameterizing the biophysical coupling parameters in ecosystem models of the sub-arctic 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 fieldwork during ESSAS.

## **Membership**

A list of the initial members of ESSAS WG-2:

George L. Hunt, Jr.	USA, Acting Chair
Earl Dawe	Canada
Elena Dulepova	Russia
Erica Head	Canada
Franz Mueter	USA
Emma Orlova	Russia
Vladimir Ozhigin	Russia
Vladimir Radchenko	Russia
Marit Reigstad	Norway
Sei-ichi Saitoh	Japan
Egil Sakshaug	Norway
Yasunori Sakurai	Japan
Paul Wassermann	Norway
Kai Wieland	Denmark