Summary

SEBSCC Synthesis Working Group
Meeting of 1-2 August 2001

		e-mail
Present:	Nick Bond	bond@pmel.noaa.gov
	Ric Brodeur	rick.brodeur@noaa.gov
	Liz Conners	liz.conners@noaa.gov
	Chuck Fowler	charles.fowler@noaa.gov
	Sue Henrichs	henrichs@ims.uaf.edu
	Anne Hollowed	Anne.Hollowed@noaa.gov
	George Hunt	glhunt@uci.edu
	Jim Ianelli	Jim.Ianelli@noaa.gov
	Nancy Kachel	nkachel@pmel.noaa.gov
	Allen Macklin	macklin@pmel.noaa.gov
	Jeff Napp	Jeff.Napp@noaa.gov
	Jim Overland	overland@pmel.noaa.gov
	Sigrid Salo	salo@pmel.noaa.gov
	Robert Schabetsberger	Robert.Schabetsberger@noaa.gov
	Jim Schumacher	twocrow@gilanet.com
	Beth Sinclair	Beth.Sinclair@noaa.gov
	Alan Springer	springer@ims.uaf.edu
	Al Tyler	ffavt@aurora.alaska.edu
	Lucy Vlietstra	lvlietst@uci.edu
Absent:	Phyllis Stabeno	stabeno@pmel.noaa.gov

A. Objectives:

SEBSCC wants us to produce a report on how the southeastern Bering Sea works. This will be delivered to a science writer next July. After discussion, we agreed that we would use the Hunt et al. Synthesis paper that has been submitted to the special issue of Deep Sea Research Part II as a starting point for examining what we have learned about the Bering Sea in the SEBSCC program. (See http://www.pmel.noaa.gov/sebscc/special_issue/manuscripts/hunt_eco.pdf for an early draft of this paper.) There was a consensus that the Oscillating Control Hypothesis was a start on the process of relating changes in the Bering Sea to climate and that the group should use it as a basis for seeking assumptions and predictions to quantify and test.

B. Approach:

It was agreed that we would focus our efforts on the 1990s and see what they give us for testing the OCH. Reference to earlier decades will be primarily to provide a context for observations in the 1990s. Effort should be made to identify advances stemming from the SEBSCC program, but that our efforts to synthesize should not be limited to SEBSCC-derived data.

We agreed on 9 questions that we would try to examine or resolve:

1) What has been the role of Human Impacts?
   a. We agreed to bring to the October meeting a list of hypotheses as to how human activities may have altered processes in the Bering Sea. We will use these hypotheses to help Ann Hollowed focus on where to look in her data. We expect to raise this question more than answer it. It remains important in trying to separate the effects of climate change from anthropogenic change.
   b. Issues to consider include:
      The role of the spatial distribution of fishing on the distribution of pollock
      What is the role of bycatch in the Bering Sea?
      Has fishing activity affected the rates of change in the Bering Sea?

2) What is or has been the likely role of large baleen whales in the structuring of the Bering Sea ecosystem?
   a) We agreed to try to develop a set of hypotheses about their potential impact, to facilitate the testing of predictions. There already is a body of work on this subject (e.g., the Trophic Cascade Hypothesis- Merrick et al), and Andrew Trites, Pauly and Pat Livingston have been working on this as well. This area seems appropriate for a brief review.

3) We identified a need to dig a bit deeper than the OCH paper did to evaluate whether there has been a sufficient change in the amount of primary production to account for the changes that have been observed in the Bering. This is not a trivial issue, as Schell has argued that there has been a 30% or greater decrease, whereas Stockwell et al 2001 suggest a 30% increase, at least in 1997, and Rho et al (Deep Sea Research Part II submitted) suggest that there may have been a similar 30% increase in 1998 as well.
   a) Our first task will be to assess whether there has been a change and if so in what direction, and, if possible, by how much. **Sue Henrichs** "volunteered" to work on this via the stable isotope side and to talk with **Terry Whitledge, Rho** and others (?**Steve Zeeman**) so see how far we can go in resolving this.
   b) We also decided that we needed to look at nutrients, especially to see if there is any evidence that the amount over the shelf may have changed. **Jeff Napp** was "volunteered" to work with **Terry Whitledge** and **Phyllis Stabeno** to explore this issue. In particular, is there evidence for more on-shelf or cross-shelf advection that could have affected the abundance of nutrients on the middle shelf or their renewal during the spring and summer. It was hoped that Jeff might have some data from 1995/96 to add to the SEBSCC data gathered after that.
      Specific questions included:

Has there been a change in the amount of nitrate at depth at the start of the production season in mid-March?

Is there renewal, or more renewal during the spring and summer in the 1990s than in earlier decades?

Is there more or less nitrate left in October/November than was previously the case?

Is there evidence that more of what is present is taken up now than previously?

c) We discussed the possibility that, with sufficient knowledge of wind mixing and the amounts of nutrients at depth in the water column, we might be able to use the wind field as a proxy for primary production, or at least for post-bloom production. **Nick Bond** is going to look into this aspect.

d) It was also felt of value to continue to work on the relationship between the role of sea ice, wind, solar energy and stratification in spring (**Phyllis Stabeno** was volunteered).

e) There was an acknowledged need for more information on post-bloom production.

4) An area of major interest was the issue of whether there have been significant changes in the pathways of energy or the end-points to which energy flows in the eastern shelf ecosystem. To address this issue, we will examine a number of time series to test whether energy is now going more to pelagic than benthic groups of fish, invertebrates, birds and mammals. We will also look for synchrony in unusually strong or weak year-classes.

a) Time series of fish that will be explored by **Al Tyler** and **Ann Hollowed** include:

Walleye Pollock
Pacific Cod
Atka Mackerel
Alaska Plaice
Rock Sole
Arrowtooth Flounder
Yellowfin Sole
Herring
Pacific Ocean Perch
Greenland Turbot

b) Zooplankton time series for:

euphausiids and copepods- **Jeff Napp**

Jellyfish-**Ric Brodeur**

c) Salmon, including smolt output and adult return- **Ric Brodeur**, with help from Grodon Kruse, Jack Helle and Kate Myers

d) Marine Mammals- **Beth Sinclair**
including:
Northern Fur Seals
Steller Sea Lions
Harbor Seals
Pacific Walrus
Small Cetaceans
Belugas
Killer Whales
Dall's Porpoise
Large Baleen Whales

e) Seabirds- **George Hunt/Lucy Vlietstra**
Including population trends and reproductive success of:
Black-legged Kittiwake
Red-legged Kittiwake
Common Murre
Thick-billed Murre

f) Benthic invertebrates- **Liz Conners** and Sarah Gaiches

5) The question was raised as to how life history characteristics of fish (e.g., long life spans vs short life spans) affect the way different species react to annual vs decadal-scale changes in climate. Depending on the characteristics of the species' responses, some species might have greater lags in the response of their population structure or biomass than others. No individual was assigned responsibility for this area, and it was expected that it would be covered as various time series were investigated.

6) Another area of concern was that of the transfer functions that might show how closely coupled various trophic levels might be. **Ric Brodeur** volunteered to examine rations of age-0 and age-1 pollock and to see what their impact on crustacean zooplankton might be. He will contact Pat Livingston and Kerim Aydin to take advantage of their ongoing modeling efforts. **George Hunt** will look into updating consumption by seabirds, and if available, we will rely on modeling by Andrew Trites to estimate consumption of zooplankton and small fish by large baleen whales. It was hoped that Chris Baier and **Alan Springer** could provide estimates of crustacean zooplankton consumption by chaetognaths and jellyfish, respectively. **Jeff Napp** will be requested to coordinate the work with Chris. This overview of the consumption of crustacean zooplankton should give us a means of testing a central assumption of the OCH, that is whether crustacean zooplankton have the potential to be a limiting resource for fishes.

7) A question of general interest is whether global warming is resulting in a more variable physical environment. To examine this question within the framework of SEBSCC, we agreed to compare the variability in parameters of ocean climate in the 1990s with variability in the preceding two or three decades. **Nick Bond** and **Jim Overland** agreed to examine appropriate time series to answer this question. **Jim Overland** will also revisit the question of the relative importance of the PDO and the AO and whether there has been a secular change in their influence on the eastern Bering Sea.

8) The PROBES program developed a spatially explicit hypothesis about the fate of production, with the benthos benefiting in the middle domain and the pelagic benefiting in the outer domain. It was felt that it would be beneficial to revisit this hypothesis using time series of data on invertebrates from the bottom trawl surveys. **Liz Conners** will be heading up this effort.

9) We will also look at how spatial variability in water temperature, including the spatial extent of the cold pool may affect the ontogeny or distribution of fish. **Nancy Kachel** volunteered to help with assembling the necessary data on bottom temperatures. An individual to focus on the biological side has yet to be identified.

C. Timetable:

- October 12 PICES Victoria:

We will meet for two hours or so as a separate group to assess our progress. We will try to sharpen the focus on SEBSCC and the 1990s, and determine which of the questions we have a reasonable chance of answering. Three areas need to be addressed by all:

1) Hypotheses about the how human activities may have influenced the responses of the eastern Bering Sea to climate change.
2) What are the likely effects of large baleen whales on the system and its responses to climate change?
3) For the time series listed in question 4, identify years of higher or lower values than usual. Use 1 standard deviation from the mean as a measure of deviation. For the mean, develop four indices, 1970 to the present (or as close to that span as possible), a second set from 1970 to76, a third from 1977 to 1988 and a fourth from 1989 to 1999.

- February 02- at a time that does not conflict with NPFMC or Ocean Sciences meeting.

- April/early May 2002: Final assessment of structure and content of report

- 1 July 2002: Complete Draft available to Contracted Science Writer

Thanks to all for attending and contributing so much!

Appendix:

Agenda
SEBSCC Synthesis Working Group
First Workshop 1-2 August 2001

Wed. 1 Aug.

13:00: Welcome, modify and approve agenda, select Rapporteurs

Decide when to have any prepared presentations (early in meeting or near the end)

13:15: A. Objectives:

Develop a synthesis of what we know about how the Bering Sea ecosystem "works" and the role of climate in modifying ecosystem properties.

Relate modes of ecosystem function to variation in pollock biomass and year-class strength.

? Do we want to address other commercially harvested species?
? Do we want to address changes in the populations or ecology of seabirds, pinnipeds, and cetaceans?
? Are there other Objectives that we need to consider?

15:00: B. Approach:

How should we try to Integrate the available knowledge?

1) Conceptual Models: PROBES, TCH, OCH
2) Quantitative Models/Simulations
3) Correlation Analyses

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16:00: C. Talks and Presentations

Liz Conners: Time series of benthos from the Trawl Surveys
Sue Henrichs: Stable isotopes and primary production
Jeff Napp: Time series of zooplankton biomass from the Oshoro Maru
Ric Brodeur: time series of jellyfish from the Trawl Surveys

Thurs 08:30: C. Data Resources/Time Series

What are the important pieces we need to include? How good are the data?

1) Climate (e.g., wind speed, wind direction, ice)
2) Physics (e.g., SST, bottom temperatures, mixed layer depth; on-shelf transport; cross-shelf transport)
3) Nutrients (nitrate, ammonia, silicate)
4) Primary Production
5) Zooplankton
   - Copepods
   - Euphausiids
   - Medusae
6) Fishes
   - Species (e.g., pollock, capelin, herring, P. cod, arrowtooth flounder)?
   - Relationships (e.g., spawner biomass vs eggs/age-0; age-0 vs age–1; age 1 vs. age-2+)
7) What are critical densities of "prey" for efficient fluxes?
8) What determines risk of predation? Are there thresholds?
9) What do birds and mammals tell us about the ecosystem? Are they reliable?
10) What is the role of climate in each step? What is its effect on distribution, timing of life history events, rates of flux or change?

13:00: D. How to Proceed?

1) Time Table
   - Meet again at PICES X
   - Other Meetings
2) Goals for PICES X
3) Assignments for PICES X
4) End Product for the Working Group

16:00: F. Adjourn