ESSAS

(*Ecosystem Studies of Sub-Arctic Seas*)

Scientific Steering Committee

Report

of the

2012 Annual Meeting

Hakodate, Japan

10-11 January, 2013

Compiled by

Ken Drinkwater, Margaret M. McBride, and Franz Mueter

January 2013

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1. Participants

SSC Members in Attendance

Ólafur Astthorsson	Iceland
Ken Drinkwater	Norway
Erica Head	Canada
George Hunt	USA
Sen Tok Kim	Russia
Franz Mueter	USA
Yasunori Sakurai	Japan
Kai Wieland	Greenland/Denmark

SSC Members Unable to Attend

Jim Overland	USA
Sung-Ho Kang	Korea

Invited Guests

Ben Fitzhugh	USA
Sei-Ichi Saitoh	Japan
Skip McKinnell	Canada (PICES)

ESSAS Project Office

Margaret M. McBride	Norway

Contact Information for the participants is listed in Appendix 1.

2. Introduction and Adoption of Agenda

The 2012 annual meeting of the ESSAS Scientific Steering Committee (SSC) was held on Jan 10-11 at the Community Design Center in Hakodate, Japan in conjunction with and directly following the ESSAS 2012 Annual Science Meeting (7-9 January). The meeting was graciously hosted by Yasunori Sakurai, an SSC member and professor at the Graduate School of Fisheries Sciences, Hokkaido University, Hakodate. It was not possible to arrange a meeting time during 2012, and so it was decided to hold the meeting in early 2013. Ken Drinkwater, ESSAS Co-chair, opened the meeting by welcoming the SSC members and guests. The meeting agenda was adopted as presented and appears in Appendix 2.

3. Adoption of 2011 Meeting Report

A motion to adopt the 2011 SSC meeting report passed unanimously.

4. Follow-up from 2011 Meeting

Margaret McBride reviewed the status of the action items for the SSC members from the 2010 annual meeting. Much of the discussion related to the follow-up actions is reported in the following subsections. One important item that was not included, had to do with the Open Science Meeting (OSM) held in Seattle in May, 2010: a special issue of the ICES Journal of Marine Science was published in September of 2012; it contained 20 papers

presented at the OSM, and was dedicated to our late friend and colleague Bernard Megrey. The citation is:

Drinkwater, K.F., G.L. Hunt, Jr., O.S. Astthorsson, and E.J.H. Head. 2012. Comparative studies of climate effects on polar and sub-polar ocean Ecosystems: Progress in observation and prediction. Proceedings of the 2nd ESSAS Open Science Meeting, held in Seattle, USA, 22-26 May, 2011. ICES Journal of Marine Science 69: 1119-1328.

5. Existing Working Group (WG) Status Reports

The former WG on Regional Climate Predictions and the WG on Biophysical Coupling have now concluded their tasks. To avoid confusion in the future, it was decided to drop the numeric designation for the working groups and simply refer to them by name.

5.1 WG on Modeling Ecosystem Response (WGMER)

(Enrique Curchister)

The most significant activity of the ESSAS WG on Modeling Ecosystem Response (WGMER) since the last SSC meeting has been arranging for a special volume in memory of Dr. Bernard Megrey. Immediately following the 2011 Open Science Meeting, a verbal agreement was made with the Journal of Marine Systems, however due to their crowded schedule to publish special volumes, it was suggested that we look elsewhere for this publication. After contacting several other publishers, an agreement was reached with Progress in Oceanography. Final details have recently been worked out with the journal, and the publication will be announced to the science community within the next few weeks. This volume will be co-sponsored by PICES with guest editors: Enrique Curchitser; Shin-Ichi Ito; Kenny Rose; and Michio Kishi.

Since the 2011 SSC meeting in Seattle, no organized inter-sessional activities have taken place for this working group. As such, most group related activities have been related to individual research efforts by WGMER members. Examples include:

- Continued development and testing of coupled physical and individual based models, full life cycle models. This work has been carried out by both Curchitser and Ito, and is being implemented in both the eastern and western north Pacific.

- Work on a larval pollock model for the Bering Sea as part of the USA BEST/BSIERP program. ESSAS members Franz Mueter and Enrique Curchitser are involved in this effort.

- Establishment of the PICES WG on Regional Climate Modeling (WG-29), which has relevance to ESSAS projects in the north Pacific sub-arctic seas.

<u>Future Plans</u>

Plans for future WGMER activities are tentative. Although it is desirable that modeling efforts continue as part of ESSAS, the current lack of a critical mass suggests that these

activities might best be carried out within other ESSAS working groups. A significant ongoing activity of scientific importance is evaluating the response of sub-arctic marine ecosystems to future climate change. If a critical mass to carry out this activity emerges, it may become a central focus for WGMER.

Following this report, the SSC discussed the future of the WGMER. It was decided that the ESSAS co-chairs would ask Enrique Curchitser and Shin-ichi Ito to continue WGMER activities at least through publication of the special volume dedicated to Dr. Megrey. While ESSAS will encourage focused modeling efforts within other ESSAS working groups, maintaining WGMER will allow it to undertake self-generated activities when desired, and will facilitate recruitment of new modelers. If new members are not recruited, and the co-chairs do not wish to continue after the special issue has been published, then WGMER will be disbanded.

ACTION: ESSAS Co-chairs will write a letter to Drs. Curchitser and Saitoh requesting that they continue with WGMER at least until the publication of the special issue. At that time, they can decide whether they wish to continue the WG or not.

5.2 WG on Climate Effects at Upper Trophic Levels (WGCEUTL)

(Franz Mueter)

WGCEUTL was formed in early 2009, and concluded its activities with the publication of a special theme section in Marine Ecology Progress Series (MEPS) in November 2012. This theme section is the outcome of ESSAS 2011 OSM theme session on “Interactions between gadoids and crustaceans: The roles of climate, predation, and fisheries”. It reviews the ecological role of large marine decapods, presents selected case studies, and features comparative analyses of the dynamics of fish and crustacean populations and their interactions across several subarctic ecosystems. Collectively, these studies highlight the role of climate and predation in regulating fish and crustacean populations in these systems. A total of 8 papers were published in the MEPS theme section. Two related papers which also originated from the OSM theme session are still under review.

Future Plans

Several WGCEUTL members met at the 2013 ESSAS Annual Science Meeting (ASM) in Hakodate to discuss their individual future activities. There was some interest in establishing a broader working group on the spatial dynamics of marine organisms in Subarctic and Arctic regions that could include future work on interactions among fish and shellfish populations. No leader emerged to organize a new working group at this point, and given the emergence of several other new working groups the SSC felt that any future activities on spatial dynamics of predatory fish and crustaceans could be carried out under the WG on Arctic-Subarctic Interactions (below).

SSC members expressed deep appreciation for the efforts of former SSC member, Dr. Earl Dawe, who was instrumental in forming WGCEUTL, and who ably co-chaired the working group with much enthusiasm from its beginning. Without his efforts the working group could not have completed its mission.

5.3 WG on Arctic-Subarctic Interactions (WGASI)

(*Ken Drinkwater)*

WGASI was formed at the 2011 SSC meeting, with Ken Drinkwater and Jim Overland as co-chairs. At that point, Terms of Reference (ToRs) for WGASI were not yet available. ToRs were presented to the SSC at this meeting, however, and suggestions for rewording were provided. The resultant ToRs are:

- To review, based upon the available literature, the effects of the physical and biological fluxes between Subarctic and Arctic marine ecosystems including: physics; biogeochemistry; biology, and human societies to identify gaps in our knowledge;

- To promote — through organizing international workshops and meetings — syntheses of the results of national field investigations into Arctic-Subarctic exchanges, and their effects including understanding the process responsible for the variability within these exchanges;

- To investigate the effects of climate change on interaction between the Arctic and Subarctic in the atmosphere, marine ecosystem, and human societies;

- To undertake comparative studies on the effects and processes operating in the Atlantic and Pacific sectors of the Arctic to gain added insights into their dynamics; and

- To conduct comparative studies between the Arctic and Antarctic focusing primarily upon interaction between the Polar and Sub-polar ecosystems.

ACTION: Margaret McBride will have the ToRs for WGASI posted on the ESSAS website.

During 2012, WGASI sponsored four major events:

1. A Poster Session on *Arctic-Subarctic Interactions* at the Ocean Sciences Meeting (Salt Lake City, February, 2012) that was co-chaired by Ken Drinkwater and Tom Haines of Arctic Surface Ocean Fluxes (ASOF). An oral session was proposed originally, but with only a small number of submissions, a poster session was offered as an alternative. A total of 9 posters were displayed representing scientists from 5 countries (Canada, Japan, Norway, UK, and USA). Topics covered included: circulation patterns and freshwater fluxes; hydrography across the Arctic; zooplankton in the Bering Sea; microbial loop in the Barents Sea; and bivalves at the Polar Front. One reason for the small number of submissions was several sessions with topics that overlapped.

2. A 1-day workshop on *the* "*Effects of Climate Change on Advective Fluxes in High Latitude Regions*" prior to the PICES/ICES/IOC Symposium on Climate Change in the World's Oceans in Yeosu, Korea on 14 May, 2012 (Co-chaired by Ken Drinkwater, George Hunt, Eugene Murphy of ICED, and Jinping Zhao). This workshop was co-sponsored by ICED (Integrating Climate and Ecosystem Dynamics in the Southern Ocean). It was attended by 32 scientists from 10 different countries, with another 20 scientists contributing to workshop presentations. This workshop: reviewed the role of advection both within and between polar and sub-polar regions; examined their forcing mechanisms; considered the effects of advection on the ecology of these high latitude regions; and sought new insights through comparisons between the Arctic and Antarctic regions. Recent ecological changes and their links to climate variability were investigated,

along with development of likely scenarios of advective fluxes and their possible changes under future anthropogenic climate change. Eleven commissioned disciplinary presentations by teams consisting of experts from both the Arctic and Antarctic covering: atmospheric climate; physical oceanography; biogeochemistry; microbes; ice biota; phytoplankton; zooplankton; benthic pelagic coupling; fish; marine mammals; and seabirds. Two presentations were also given based on submitted abstracts. At the end of the presentations, three participants provided their thoughts on what they considered to be highlights of the workshop, and what future research was needed as a lead in to a general discussion. Prior to the end of the workshop a discussion was held on writing up the results of the presentations. This workshop and the general format were judged by those involved to have been very useful. It was decided to synthesize the presented material into one paper that George Hunt volunteered to lead. In addition it was decided to form a working group under IMBER to carry forward the comparative studies of the Arctic and Antarctic. More details on the workshop can be found in the PICES Press Newsletter (http://www.pices.int/publications/pices_press/volume20/v20_n2/pp_21-3_Yeosu_W4.pdf)

3. A Theme Session on *Arctic-Subarctic Interactions: Ecological Consequences* at the ICES Annual Science Conference in Bergen during September, 2012 (Co-chaired by Olafur Astthorsson, Ken Drinkwater, Ann Hollowed (PICES), and George Hunt). This 1 1/2 day session, cosponsored by ICES, PICES and the AOSB (Arctic Ocean Science Board), received an excellent response with 27 oral presentations from scientists from eight countries (Canada, France, Faroe Islands, Iceland, Japan, Norway, the Russian Federation, and the USA). It started with an overview paper showing the importance of climate-forced rates of exchange between the Arctic and Subarctic in the Western Atlantic. Subsequent talks highlighted the role of advection and fronts in structuring Arctic and Subarctic ecosystems, climate change impacts on the spatial distribution of marine species, fish dependent economies, and ecology of Subarctic and Arctic systems. Other talks focused on lower trophic level responses to climate induced changes in oceanography, and modeling studies that tracked climate change impacts through the foodweb. The session was well attended and the discussion at the end focused on the management implications of sub-Arctic and Arctic exchanges. It was recognized that there is a strong need for accurate projections of the implications of climate change on Subarctic – Arctic exchanges to allow managers to develop strategies for sustainable management.

4. A 1-day Workshop on Arctic-Subarctic Interaction at the *PICES Annual Science Meeting* in Hiroshima, Japan, during October, 2012 (Co-chaired by Ken Drinkwater, Jackie Grebmeier, Jim Overland (ESSAS/PICES) and Sei-Ichi Saitoh (ESSAS/PICES)). This workshop was co-sponsored along with PICES; the workshop consisted of 9 oral presentations and 2 posters and represented contributions from 4 different countries (China, Japan, Norway, and the USA). Most of the talks and the two posters focused upon the Pacific-Arctic sector but there were also two talks that made comparisons between regions within Pacific and Atlantic sectors. Presentations highlighted the importance of wind direction over the Bering Sea on the structure of circulation in the Bering Strait, the importance of resting phytoplankton cells during the winter and their advection in spring on the initiation of spring blooms, the advection of zooplankton from the Bering into the Chukchi Sea, and general northward shoaling of fish distributions in

response to changes in population density and to recent warming. Two comparative studies were presented, the first between the Chukchi and Barents seas. Higher fish production in the Barents Sea was concluded to be due to year-round inflow of warm Atlantic waters that provides a refuge for boreal fish species, whereas in the Chukchi Sea waters are too cold in winter to allow many fish species to overwinter and do well there. The second paper compared the role of advection between the Arctic and the subarctic in the Pacific and Atlantic sectors. Concluding discussions highlighted the need to further long-term observations, including flux measurements and the advection of fish larvae. In terms of modeling, increased effort is needed to understand sea ice and its variability. And, further comparative studies of the role of advection between the Arctic and subarctic were encouraged.

Future Plans

Based on discussions during the ASM preceding the SSC meeting, it was decided to attempt to organize workshops on (1) the exchanges between the Arctic and the Sub-Arctic, and (2) the fate of the materials (physical, chemical, and biological) that are exchanged. One workshop would focus upon the Bering Shelf-Chukchi Sea region and would potentially be held in about a year's time, prior to the next International Symposium on Arctic Research (ISAR), which is held annually in Japan in either December or January. George Hunt recommended that the influence of the flow out of the Arctic into the Bering Sea, although small relative to the flow into the Arctic, also be examined. Franz Mueter has agreed to look into the potential to hold this workshop, and to help organize it.

ACTION: Franz Mueter will contact ISAR to look into the possibility of holding a workshop in conjunction with their meeting. He will also contact and discuss the format of such a workshop with key researchers from Canada, China, Japan, Korea, Russia, and the USA.

A similar workshop with the same aims but with focus on the Atlantic Sector would also be held in 2014 to explore exchanges through Fram Strait, the Barents Sea, and the Canadian Arctic Archipelago. The fate of fluxes, both biological and physical/chemical, could potentially extend geographical boundaries well into the Subarctic (Iceland, Greenland, and Labrador) as well as into the Arctic. This workshop would be held in Europe. Ken Drinkwater has agreed to investigate possible meeting locations, preferably in association with an Arctic-focused meeting such as Arctic Frontiers held annually in January in Tromsø, Norway.

ACTION: Ken Drinkwater will contact Paul Wassmann with regard to holding such a workshop in association with Arctic Frontiers. Ken will also contact scientists working in Canada, Denmark, Germany, Greenland, Iceland, Norway, Russia, and the USA to determine their interest in such a workshop.

In 2015 or early 2016, a meeting would then be held that compares the Arctic-Subarctic exchanges in the Atlantic and Pacific sectors. It was suggested that such a meeting might follow the format at the Yeosu meeting with small groups of selected scientists tackling particular issues, and would include members from both sectors. Their task would be to compare and contrast occurrences in the two sectors.

While no ESSAS-sponsored activities are planned by the WGASI during 2013, members will take part in other Arctic-Subarctic activities, including the:

- Gordon Research Conference (GRC) on Polar Marine Science (Linking Polar Observations, Processes and Models at Regional and Global Scales) to be held in Ventura, California, March 10-15 (Ken Drinkwater; Jim Overland); and the

- Wakefield Symposium on Responses of Arctic Marine Ecosystems to Climate Change to be held 26-29 March in Anchorage (Organized by Franz Mueter; Harald Loeng is on the meeting SSC; Franz Mueter, George Hunt, Jim Overland and Ken Drinkwater will attend).

6. New Working Groups

6.1 WG on Bioenergetics (WGBIOEN)

Discussions on a new working group on the bioenergetics of subarctic fishes began at the 2011 ESSAS OSM between Dr. Ron Heintz (Alaska Fisheries Science Center, NOAA, USA) and Dr. Trond Kristiansen (Institute of Marine Research, Norway). They developed draft TORs and held their first workshop and an organizational meeting at the Hakodate meeting. The main objective of the working group is to develop a deeper understanding of climate's impact on the match between juvenile fish and their prey and the implications of that relationship for future production. Specifically, at the Hakodate meeting the group made plans to draft a manuscript that compares the overwintering process for walleye pollock in the Doto area, Bering Sea and eastern Gulf of Alaska. Based on the information provided at the meeting there appear to be important differences with respect to provisioning, size and winter food availability in these areas. These differences have implications for overwinter survival. The manuscript will be used to motivate funding for a modeling workshop aimed at sorting out the importance of these and other features for walleye pollock and Atlantic cod. Future work, possibly at the next annual science meeting, will focus on developing a similar program to explore the energetics of herring.

The SSC discussed and unanimously approved the bioenergetics working group as a WG under ESSAS. The SSC enthusiastically supports the proposed activities of the group and encourages the co-chairs to propose a follow-up workshop/session for the next ESSAS Annual Science meeting planned for April 2014 in Copenhagen, Denmark.

6.2 WG on Human Dimensions (WGHUMD)

Discussions on a possible ESSAS Human Dimensions WG have been ongoing since the session on "Anticipating socio-economic and policy consequences of changes in sub-polar and polar marine ecosystems" at the 2011 ESSAS OSM in Seattle. A group of researchers consisting of Keith Criddle (University of Alaska Fairbanks, USA), Ben Fitzhugh (University of Washington, USA), Ikutaro Shimizu (Fisheries Research Agency of Japan), Catherine Chambers (University of Alaska Fairbanks, USA & Iceland) and George Hunt (University of Washington, USA) met in Hakodate to discuss potential objectives for a Human Dimensions WG within ESSAS. This WG would conduct case studies and comparative analyses of the responses of human systems to regime shifts in biophysical systems, such as the observed transitions between gadid and crustacean dominated systems in the Northeast Pacific and

the Northwest Atlantic. This work could build on activities of the WG on gadid-crustacean interactions.

Possible questions WGHUMD will address include:

- How have human systems responded to past regime shifts?
  Examples include:
  - Decline of crab and shrimp and increase in cod and other fish in Gulf of Alaska
  - Decline in cod and increase in crab in the Western North Atlantic
  - Introduction of king crab into Barents Sea

- What are spatial and temporal scale effects of human responses to past regime shifts?

- How have alternative management responses and governance systems mitigated or exacerbated human consequences of past regime shifts?

- How have differences in the local vs. distant water character of the fisheries affected human consequences of past regime shifts?

The SSC discussed the proposal and there was general enthusiasm for a Human Dimensions working group. The SSC encourages the group to fully develop its ToRs in the next few months and to identify possible working group members. The SSC also encouraged the working group to propose a workshop on Human Dimensions for the next ESSAS Annual Science meeting planned for April 2014 in Copenhagen, Denmark.

6.3 WG on Comparative Paleo-Ecology in Sub-Arctic Seas (WGCPESAS)

Ben Fitzhugh (University of Washington, Department of Anthropology) proposed the formation of a new Working Group on Comparative Paleo-Ecology in Sub-Arctic Seas (WGCPESAS). He is presently leading a group that is comparing the Aleutian and Kuril Islands. They are investigating the timing of human settlements, variability in population numbers over time, and causes of such variability. They are interested in the ecosystem services which provide food for the people, and the role of climate on human settlements within ecosystems. The group consists of archeologists, volcanologists, ecologists, paleoecologists, paleoceanographers, anthropologists, etc. They held one workshop in 2012 that George Hunt attended and gave a presentation on oceanography and ecology of the two regions. Dr. Fitzhugh indicated that there is a similar but unrelated group working in the Atlantic. One of this group's research interests has been the Viking's march westward. He proposed to organize a working group to synthesize what is known about the subarctic marine paleoecology, with emphasis on humans, in the Pacific and the Atlantic. The goal would be to prepare an edited volume comparing data sets in the subarctic areas, looking back to the Holocene, and to examine the interactions between atmospheric, oceanic, biological, and human relationships. A formal proposal to ESSAS would follow discussions between likely contributors and potential participants.

The SSC found the proposal extremely interesting, was strongly in favor of establishing such a working group, and approved it in principal. Dr. Fitzhugh was encouraged to recruit working group members, and to draft ToRs. Assuming that members will be recruited, the approval in principal will allow WGCPESAS to be established once the SSC approves the

ToRs, which can be done by e-mail. The SSC thanked Dr. Fitzhugh for his efforts and offered to assist as needed.

6.4 Future Plans

At the end of the presentations concerning new working groups, a discussion took place on how long ESSAS should continue as a program. ESSAS officially began when it was accepted by GLOBEC as a regional program in 2005, following the publication of the ESSAS Science Plan (Hunt and Drinkwater 2005): http://www.imr.no/essas/files/essas_science_plan.pdf/en). Hence, ESSAS has been active for 8 years. During that time, 2 major ESSAS symposia have been held and many workshops. Several special issues related to subarctic seas have been published, and several more will soon be published. No end date for ESSAS was indicated in its Science Plan. Based on the number of new working groups bringing new ideas and new energy, and recent activities of WGASI, it was generally agreed that ESSAS should continue as long as it continues to be productive.

7. *Website*

Margaret McBride led a discussion of recent changes/additions, current status, and suggestions to improve the ESSAS website. Kai Wieland mentioned that he didn't think that many people were aware of our website. Margaret explained that she had inquired at the Institute of Marine Research (IMR) information department — that both hosts and provides technical support to maintain the ESSAS website — about the possibility of obtaining software that registers the number visits to the website visitors. The unfortunate response was that this feature is currently not available through IMR. Subsequent discussion resulted in the following actions:

ACTION: McBride will contact ICES & PICES to find out if they can provide links on their website to the ESSAS website

ACTION: McBride will check with authors and, when permission is granted, convert presentations from 2013 ASM to pdfs and have them posted on our website.

ACTION: McBride will check on the possibility of the addition of a search engine that goes outside of the IMR website

ACTION: McBride will look into posting the PICES link to presentations from the 2011 OSM on our ESSAS reports page.
http://www.pices.int/publications/presentations/2011-ESASS/ESSAS-2011-presentations.aspx
http://www.pices.int/meetings/international_symposia/2011/ESSAS/default.aspx

ACTION: Olafur will write a brief description to be posted together with a new publication from Iceland of ESSAS-related research

8. Ongoing Issues

8.1 ESSAS International Project Office (IPO)

Ken Drinkwater informed the SSC that funding for the ESSAS IPO will run out at the end of June, 2013. Funding has been supplied by the Research Council of Norway and the Institute of Marine Research for 5 years. He has contacted the Research Council to enquire whether they would be willing to extend the funding period, and was informed that there are two upcoming calls for proposals by the Research Council — one in February 2013 and the other in the fall — that ESSAS could perhaps apply to. Barring an extension, we would have to close the ESSAS IPO. If this occurred, the IMBER IPO has indicated that they would be willing to take on some of the responsibilities presently undertaken by the ESSAS IPO. However, owing to their heavy workload, Ken expressed the opinion that they would not be able to do all that Margaret has.

ACTION: Ken Drinkwater will keep an eye on the calls to determine if a proposal for extension of the ESSAS IPO will fit within the calls, and will follow-up with the submission of proposals if appropriate. He will also look into other possible funding options besides the Research Council.

Several SSC members offered to provide letters of support if and when any proposals were written.

8.2 Budget

The 2012-2013 ESSAS budget presented herein is only rough as the exact amount of money paid out to scientists to attend ESSAS Activities is not all in. Based on the best available information to date the following is the amount of our income and expenditures through the year.

Income		Expenditures	
IMBER*	$27,694	Yeosu (2)	$ 7,000
OSM Remainder	20,000	ICES (1)	3,000
PICES	3,000	PICES (3)	11,500
USA ICES	1,500	Hakodate (7)	23,100
		Publication costs	1,200
Total	$52,194	Total	$45,800

*The total from IMBER represents the 2012 allotment and funds left over from 2011.

PICES funded an invited speaker ( ) for the Workshop on Arctic-Subarctic Interactions held in conjunction with the PICES Annual Science Meeting in Hiroshima in October, 2012. The US ICES money was for George Hunt to attend the ICES ASC in Bergen in September, 2012.

The list of expenditures relates to various ESSAS sponsored activities. Yeosu refers to the workshop on *the Effects of Climate Change on Advective Fluxes in High Latitude Regions* held prior to the PICES/ICES/IOC Symposium on Climate Change in the World's Oceans in Yeosu, Korea on 14 May, 2012. ICES and PICES refer to the Theme Session and Workshop, respectively, at the 2012 meetings of these organizations. Hakodate refers to the ESSAS ASM and SSC meetings. The bracketed numbers in the expenditures indicate the number of participants supported by ESSAS funds.

Publication costs are associated with the ESSAS special publication from the OSM published in the ICES Journal of Marine Science.

Thus, the tentative balance is $6,394 depending on costs related to the ASM in Hakodate. Given the $15,000 that IMBER has promised, we have approximately $21,394 to spend in 2013.

Eileen Hofmann, Chair of IMBER, informed us that NOAA in the USA has earmarked $30,000 per year for the next 3 years for 3 IMBER programs, one of which is ESSAS. This does not mean that we will obtain an extra $10,000 over and above the $15,000 we receive annually from IMBER, but it does secure at least $10,000, even if IMBER runs into financial troubles. This also indicates that NOAA is supportive of the work that ESSAS is doing.

George Hunt questioned whether or not it would be a good idea to put together a proposal or two to the National Science Foundation (NSF) in the USA requesting funding to support activities of ESSAS working groups. Given that Bill Wiseman, NSF Program Director for Arctic Sciences, is familiar with ESSAS but will shortly retire, he should be approached soon regarding the possibility of getting such proposals funded. He might be more inclined to fund such a request, given that it is not clear who will take over his position, and hence how they might view ESSAS. A back-up would be to contact Neil Swanberg, the NSF Program Officer for System Sciences.

ACTION: George Hunt will contact Bill Wiseman to determine the possibility of NSF funding ESSAS WG activities.

ACTION: Margaret McBride will contact George by mid-February to remind him in case he has not already made the contact.

8.3 IMBER

As reported at the last SSC meeting, the IMBER IPO decided to leave Brest, France due to uncertainty in the French Funding. A proposal was submitted to the Research Council of Norway to fund the IMBER IPO in Bergen. This proposal was accepted with IMR providing additional funding. The IPO moved to Bergen in April 2012 with Lisa Maddison as the Deputy Executive Officer. Bernard Avril of France was hired as the Executive Officer; he began working in June 2012. Administrative assistance for the IPO has been provided by IMR. Relocation of the IMBER IPO to Bergen provides an opportunity for closer collaboration between ESSAS and IMBER, especially given that Ken Drinkwater (ESSAS Co-chair) is the Project Leader for the IMBER IPO.

An update on ESSAS activities was provided by Ken Drinkwater at the IMBER SSC meeting held in La Paz, Mexico, in May, 2012.

8.4 SSC Membership

Dr. Sei-Ichi Saitoh

At last year's meeting it was decided that we should have a third ESSAS Co-chair to represent Asia and that we should offer it to Yasunori Sakurai who has contributed much to ESSAS, and especially to Japan's ESSAS program. Dr. Sakurai was approached in October 2012 but declined due to his many other commitments. He recommended Dr. Sei-Ichi

Saitoh, who expressed his willingness to take on the position. Dr. Saitoh, whose research focus has been on satellite oceanography, has been involved in several past ESSAS activities. SSC members unanimously agreed on the appointment and thanked Dr. Saitoh for accepting the position. Dr. Saitoh was welcomed with applause. He thanked the SSC, and stated that he will work hard on behalf of ESSAS.

ACTION: Dr. Saitoh will provide a short biography to Margaret McBride to post on the ESSAS website.

Dr. Naomi Harada

Discussions between the ESSAS co-chairs and Yasunori Sakurai concerned the addition of a third Japanese SSC member to broaden representation beyond the fisheries group in Hakodate. Dr. Saitoh suggested that we invite Dr. Naomi Harada from JAMSTEC (Japan Agency for Marine-Earth Science and Technology) in Yokohama. She is a biogeochemist and paleoceanographer and is leader of the Paleoceanographic Team at JAMSTEC. She is leading a major research project on the Arctic. During the ASM, which she attended, she was asked by Sei-Ichi Saitoh and Ken Drinkwater to consider accepting the position; her response was that she would be honoured by such an appointment. The SSC unanimously agreed to appoint Dr. Harada to the ESSAS SSC.

ACTION: A letter of invitation to join the ESSAS SSC is to be sent to Dr. Harada from the 3 Co-chairs.

ACTION: Ken Drinkwater, as ESSAS representative to the IMBER SSC, will inform Eileen Hofmann (Chair of IMBER) regarding changes in ESSAS SSC membership.

Dr. James Overland

Jim Overland was unable to attend this year's meeting and some of the WGASI activities owing to other commitments. His interest to remain a member of the ESSAS SSC is uncertain. Ken Drinkwater expressed his hope that Jim will continue as he brings great insight and experience, especially with regard to atmospheric research.

ACTION: Ken Drinkwater will contact Jim Overland to determine his interest in continuing as member of the ESSAS SSC.

Dr. George Hunt

George Hunt questioned the value of his continued active participation, suggesting that ESSAS might better use its travel funds to bring in someone from one of the new WGs. He then left the room to allow an open and frank discussion. That discussion revolved around his strong connections to ESSAS and tremendous amount of work he has done and continues to do in promoting ESSAS. His large network of researchers and funders has brought in new members (e.g. Ben Fitzhugh at this meeting) and helped him raise money for ESSAS. The SSC unanimously agreed that Dr. Hunt should continue his active membership on the SSC. With regards to funding his travel, the amount ESSAS will be able to offer him will obviously depend upon the amount of funds at its disposal.

Ken Drinkwater raised the topic of appointing an SSC member from Greenland. Kai Wieland stated that when we bring in someone from Greenland, he then should resign his

membership since he personally is not engaged in any ESSAS-related research. He also expressed the opinion that it was unlikely that anyone from Greenland could be recruited based on past attempts. He suggested that we send a letter to the director of the Greenland Institute asking for a recommendation.

ACTION: ESSAS co-chairs will draft a letter to Klaus Nygaard (Director of the Greenland Institute) requesting that he recommend a person to appoint as Kai Wieland's replacement.

Ken Drinkwater raised the question of whether the SSC should also appoint a scientist from China, and suggested Dr. Jinping Zhao, an oceanographer from China who is involved in Arctic studies as well as air-sea fluxes in the Nordic Seas, as a possibility). He also raised the question of appointing a scientist from Germany, and mentioned Dr. Michael Klages who has been heavily engaged at the HAUSGARTEN observatory taking measurements of biological exchanges within the Fram Strait. Discussion followed on an optimal size for the SSC, and whether it was becoming too large.

ACTION: Ken Drinkwater will check with IMBER to determine if there is a limit to the number of members on our SSC.

ACTION: If we have not exceeded the SSC membership limit, the Co-chairs will write a letter on invitation to Dr. Klages to join the ESSAS SSC.

ACTION: If we have not exceeded the SSC membership limit, Ken Drinkwater will contact Dr. Zhao to enquire if he might be interested. If Dr. Zhao is not interested, his suggestions for eligible candidates for appointment to the SSC will be requested.

8.5 Theme Sessions, Workshops, and Meetings

There was a brief discussion on planning future ESSAS-sponsored theme sessions and workshops. It was stressed that a long-lead time is needed for many conferences or symposia, most notably ICES and PICES where ESSAS has had several activities in the past. For these two organizations, proposals need to be in at least a year in advance.

Ken Drinkwater, based on the experience in 2012, suggested that if anyone is considering an oral theme session at the Ocean Sciences Meeting, they should seek the widest possible participation otherwise it will likely become a poster session. Combining with several other active groups is a wise strategy.

George Hunt mentioned the 2014 Ocean Sciences Meeting in Honolulu (Feb. 23-28). The 2014 BEST-BESIERP Bering Sea Open Science Meeting will be held in connection with this meeting. He noted that ESSAS should be aware of these upcoming meetings as relevant venues for ESSAS workshops and theme sessions.

Ben Fitzhugh asked whether or not ICES and/or PICES provide meeting facilities for workshops scheduled in conjunction with their annual meetings. Ólafur Astthorsson indicated that ICES does not as a rule provide space for such workshops. There are usually so many ICES-associated side events that they have little available time or space for others. PICES will provide space and time (1 or 2 days) for workshops if a proposal is submitted and accepted by PICES. Such proposals have to be submitted at least a year in advance.

9. National Programs

9.1 Canada (Erica Head)

Canada has no national ESSAS programme, although Canadian scientists have been involved in the international program "NORway-CANada Comparison of Marine Ecosystems (NORCAN)", and in the Working Group on Climate Effects at Upper Trophic Levels (WGCUTL), reports of which appear elsewhere. In addition, Canadian scientists carry out a series of activities on a routine basis that contribute to ESSAS goals. These include:

Monitoring of the ecosystem in the Northwest Atlantic by scientists from the Department of Fisheries and Oceans – the Atlantic Zone Monitoring Programme (AZMP) and the Atlantic Zone Offshore Monitoring Programme (AZOMP)

Outlines of the programmes and examples of the products can be found at http://www.meds-sdmm.dfo-mpo.gc.ca/isdm-gdsi/azmp-pmza/index-eng.html and http://www.bio.gc.ca/monitoring-monitorage/azomp-pmzao/index-eng.htm, respectively.

The AZMP includes running sections on the Scotian, Newfoundland and Labrador shelves and in the Gulf of St Lawrence 1-3 times per year to measure hydrographic, chemical and biological (lower trophic levels) variables. The same measurements are made at monthly intervals at a series of fixed stations including locations off Halifax (Stn HL2, Scotian Shelf), St John's (Stn 27, Newfoundland Shelf) and in the Bay of Fundy and St Lawrence Estuary. In addition, survey cruises to assess macrofauna (fish and invertebrates) biomass are also routinely made 1-2 times per year.

The AZOMP involves running a section across the Labrador Sea once per year and sampling in the deep western boundary current beyond the Scotian Shelf. ARGO floats are also deployed in this programme. These floats drift at 2000 m, and re-surface periodically recording profiles of temperature and salinity and relaying the data to shore via satellite telemetry.

Other AZMP activities include (1) providing financial support to the Sir Alister Hardy Foundation for Ocean Science (SAHFOS) for the collection and analysis of samples by means of the continuous plankton recorder (CPR) in the Northwest Atlantic (and the analysis/interpretation of data by DFO researchers), and (2) processing remotely-sensed satellite data on ocean colour and sea-surface temperature. Images are available at http://www2.mar.dfo-mpo.gc.ca/science/ocean/ias/seawifs/seawifs_1.html.

The AZMP and AZOMP routinely report on conditions for the previous year at annual meetings held in late March. Research Documents, containing summaries of the results for the preceding year, are peer-reviewed internally and published on the DFO website (http://www.isdm-gdsi.gc.ca/csas-sccs/applications/publications/index-eng.asp#RES).
AZMP Bulletins containing articles based on the programmes are also published annually (http://www.meds-sdmm.dfo-mpo.gc.ca/isdm-gdsi/azmp-pmza/publications-eng.html) and individual scientists use AZMP data to write articles that are submitted to scientific journals.

In 2011, AZMP results have shown that on the Scotian Shelf, compared with the 1999-2011 averages, nutrient and phytoplankton levels were near normal, while zooplankton abundance was below normal.

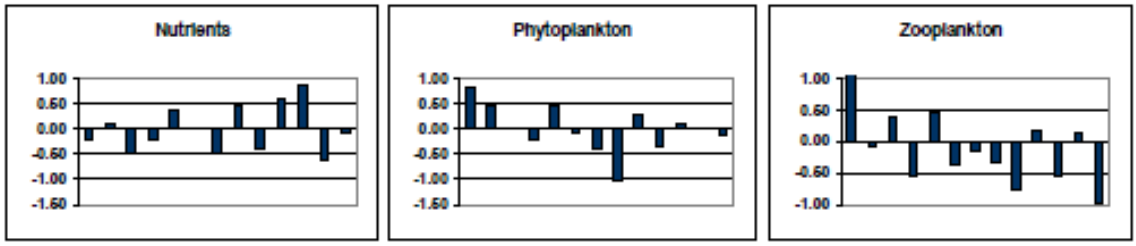

Figure 1. Annual composite indices for nutrient and phytoplankton concentrations and zooplankton abundance on the Scotian Shelf, 1999-2011.

A time series of temperature profiles constructed from ARGO float data from the central Labrador Sea since 2003 has shown that the water column has warmed substantially over time, and that the maximum depth of convective mixing in winter has varied between roughly ~200 m (2010 and 2011) and >1500 m (2008).

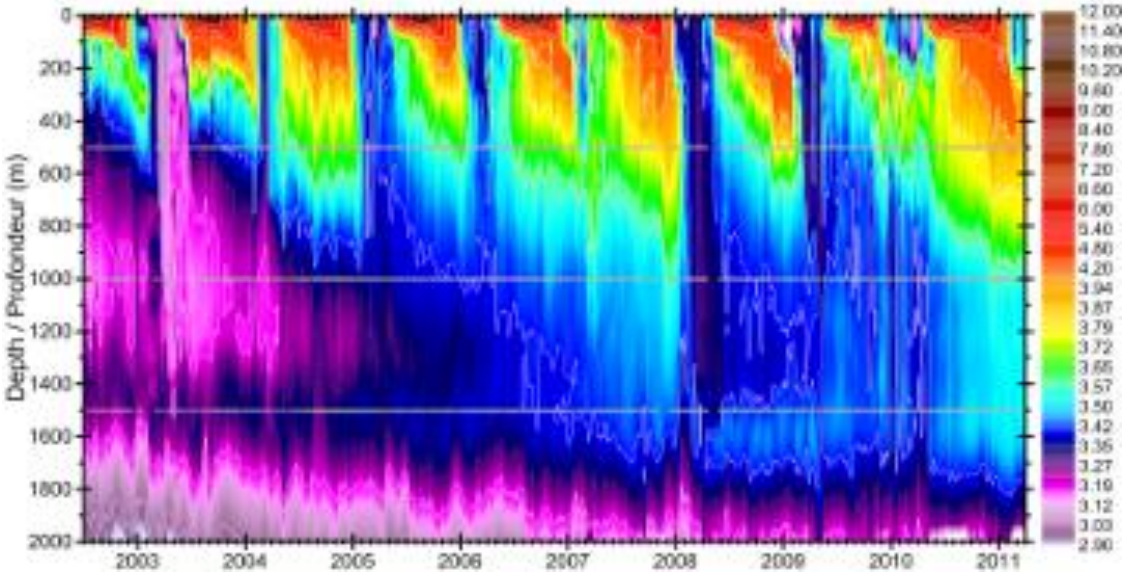

Figure 2. Time-depth plots of ocean temperature in the central Labrador Sea from Argo floats.

Other ESSAS-relevant Research Initiatives

1) *BASIN*

The "Science Plan and Implementation Strategy" for the BASIN (**B**asin-scale **A**nalysis, **S**ynthesis, and **In**tegration) programme was published in 2009 and is available on the IMBER (**I**ntegrated **M**arine **B**iogeochemistry and **E**cosystem **R**esearch) website (http://www.imber.info/products/BASIN_article.pdf). Its goal is to understand and predict the impact of climate change on key species of plankton and fish, and associated ecosystems and biogeochemical dynamics in the North Atlantic Subpolar Gyre System and surrounding

shelves, in order to improve ocean management and conservation. Thus, it shares some of the objectives of the ESSAS programme.

Canadian scientists have contributed substantially to one of the work-packages of the EURO-BASIN programme (WP3), which included the preparation of a "synthesis" paper "The North Atlantic Ocean as habitat for zooplankton: distribution of key taxa in relation to environmental factors and ecological traits, with a focus on the planktonic copepod, *Calanus finmarchicus*". This project was led by Webjørn Melle (IMR, Bergen, Norway) and the resulting MS is currently under review. Erica Head (DFO, BIO), assisted by Sigrun Jónasdóttir (DTU, Denmark), undertook the analysis and writing of the section on *C. finmarchicus* egg production, while Stephane Plourde (DFO, IML) performed the same tasks for the section on *C. finmarchicus* mortality. Catherine Johnson (DFO, BIO) was involved in preparing a section on dormancy in *C. finmarchicus*, and all three Canadian scientists plus Pierre Pepin (DFO, NWAFC, St John's) contributed data on *C. finmarchicus* demography in the NW Atlantic.

In addition, Canada will also provide a platform for two scientists from the UK EURO-BASIN group to work in the Labrador Sea during the 2013 AZOMP cruise, where they will collaborate with DFO scientists on projects focussed on phytoplankton species composition and carbon sedimentation in relation to bloom status.

2) *VITALS*

A proposal was submitted in 2012 to the NSERC Climate Change and Atmospheric Research (CCAR) Program by a network of Canadian researchers including university scientists and Government collaborators entitled "Ventilation, Interactions and Transports Across the Labrador Sea (VITALS)". Colleagues from the US will also be involved and the proposal is expected to run for 5 years. The proposal received favourable reviews, and is expected to start sometime in 2013, with its first field campaign in 2014. The VITALS research network will answer fundamental questions about how the deep ocean exchanges carbon dioxide, oxygen, and heat with the atmosphere through the Labrador Sea. New observations and modelling will determine what controls these exchanges and how they interact with varying climate, in order to resolve the role of deep convection regions in the Carbon Cycle and Earth System. The project includes the deployment of new technologies (*e.g*. Sea-cycler, gliders and biologically-instrumented Argo floats) in the Labrador Sea, and new experimental measurements to evaluate the role of biological components within the system. Even though the project is focussed in the central Labrador Sea (not a seasonally ice-covered area), it seems possible that it could be a candidate for ESSAS sponsorship, since it will investigate the hydrological cycle including the impact of runoff, sea ice and glacial melt on the ocean, stratification and on the cycling of gases, and because these investigations are to be made in order to improve predictive models at regional and global scales in the context of future climate change.

9.2 Iceland (Olafur Astthorsson)

Iceland´s main contribution to ESSAS program is through the Iceland Sea Ecosystem (ISE) project which started with a field phase in 2006-2009. The main aim of the project is to further understanding on the Iceland Sea with particular reference to the capelin stock for which the Iceland Sea is the main feeding area. This includes investigations on hydrography

(temperature, salinity, currents, watermasses), nutrients, phyto- and zooplankton and energy transfer through the ecosystem and how these factors interact with respect to the life history and distribution of the capelin.

Iceland Sea activity 2012

Activities during 2012 concentrated mainly on data analysis and publications. The publications were as follows (for detailed list and titles see ESSAS combined publication list on ESSAS web page).

1. Four papers from the Iceland Sea studies and one paper on climate related occurrence of mackerel were published in the ESSAS special volume in ICES Journal of Marine Science.

2. One paper on the predation of cod on *Pandalus* in Icelandic waters was published in the ESSAS theme section on Gadoid-Crustacean Interactions in Marine Ecology Progress Series.

3. Ten papers on the results from the Iceland Sea Ecosystem were published in the Marine Research Institute´s series Hafrannsóknir (Icelandic Marine Research).

4. A paper on the distribution, abundance and biology of polar cod was presented at the joint ICES/ESSAS/PICES/ASOB Theme session on Arctic/Subarctic interactions: ecological consequences at ICES ASM in Bergen.

Iceland contributed to the presentation on zooplankton for the ESSSAS/ICED workshop on the Effects of Climate Change on Advective Fluxes in High Latitude Regions at the Yeosu, Korea Symposium on the Effects of Climate Change on the World Oceans.

Hildur Petursdottir finished her Ph D. at the University of Tromsø based on material partly sampled during the Iceland Sea studies. The title of the thesis is Trophic relationships and the role of *Calanus* in the oceanic ecosystems south and north of Iceland and it is based on 5 publications.

Further Iceland Sea work

Further Iceland Sea work is planned on trophodynamics of amphipod and calanoid species and on capelin larvae. Also in preparation is a general overview of the Iceland Sea studies in an Icelandic Natural History magazine.

Other ESSAS related activity in Icelandic waters

Current Iceland Sea field activity is mainly related to routine hydrography and acoustic assessment of the capelin stock. This work will enable the analysis of the 1996-1999 increased activity in a longer term perspective.

Routine activity on demersal fish in Icelandic waters is also of relevance to ESSAS and contributes studies on climate related changes in spatial distribution and abundance.

MRI scientists are participating in the EU supported Euro-BASIN program which has relevance to some of the main goals of ESSAS.

NACLIM (North Atlantic Climate) is an EU supported program that has just started. This work is a follow up to a related project, THOR (Thermo-haline overturning at risk). Its aim is to study the effects of climate on the thermohaline circulation and to forcast suface temperatures and sea ice. MRI is to monitor variability in flow of Atlantic water to the Nordic Seas and deepwater flow south across Denmark Strait.

*9.3 **Japan** (Yasunori Sakurai)*

The Japanese ESSAS (J-ESSAS) program works to quantify the impact of climate variability on the structure and function of the Okhotsk Sea and Oyashio marine ecosystems, to predict the response of these ecosystems to future climate change, and to predict the associated potential economic impact. The program consists of several projects and activities:

- Shiretoko Natural World Heritage Site: the Multiple Use Integrated Marine Management Plan (2nd phase, 2013-2017). The objectives of this project are: to satisfy both conservation of the marine ecosystem and stable fisheries through the sustainable use of marine living resources; to apply ecosystem-based fisheries and tourism management; and to conduct socio-economical and socio-ecological evaluations for sustainable local communities. They have documented a number of significant changes in the ecosystem including declines in chum salmon returning to the coast of northern Japan, delays in migration, northward distributional shifts in some fish species and the occurrence of several unusual warm water species, all possibly linked to warming of the waters in the region.

- The ECOARCS/GRENE projects. In June 2010, the Japanese Cabinet decided upon a new strategy for growth: the "Strategy for becoming an environment and energy power through green innovation." In response, the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT) initiated the Green Network of Excellence (GRENE) Program in 2011. One of the projects under this program is the Arctic Climate Change Research Project with funding from 2011-2016. Under this umbrella are a number of research projects including Ecosystem Studies on the Arctic Ocean Declining Sea Ice (ECOSARCS). A number of JESSAS activities involving biogeochemistry and food web research are ongoing. Cruises to the Chukchi Sea were carried out in 2012, the results of which were presented during the ASM. Another cruise is planned for 2013.

- Development of an integrated coastal fisheries information system for sustainable fisheries in southern Hokkaido, Japan. This project will develop the information system by combining direct measurements, satellite imagery and modeling in productive coastal waters (Oyashio and Tsugaru Warm Current) and include aquaculture sites (scallop and kelp) and valuable coastal fishing grounds.

- Application of marine research to study the marine ecosystem response in the Pacific coast of northeastern Japan after the Great East Japan Earthquake disaster. This project is carrying out extensive surveys of Eastern Japan to determine the damage and recovery of ecosystem to the tsunami that occurred in March 2011.

- A general report on the projects aided by the PICES/ICES/JSFO fund for fisheries and oceanographic research on the recovery from the Great East Japan Earthquake was provided. This fund was set up to support recovery of scientific activities and especially for research on the effect of the tsunami on fishing villages and ecosystems of northeastern Japan (Tohoku region).

- Some results from the Japan-Russia joint survey for Stellar sea lions in the Okhotsk Sea were given. Northern Okhotsk rookeries have been found to be saturated since the mid-2000s. There is also an increasing trend at the Sakhalin rookeries and haul-outs as a result of overflow from Northern Okhotsk rookeries. From brandings of sea lions, there is persistence for original rookeries in the Northern Okhotsk but in the Sakhalin rookery some fractions were from Kurile, but their contribution for reproduction was very limited (<2% of total pups). There appears to be a new subpopulation being established in Sakhalin but they are not detectable by mt-DNA yet.

- A new scientific book entitled “Ecosystem and its conservation in the Sea of Okhotsk” will be published in Japanese during March 2013. Dr. Sakurai is the lead editor of this volume.

- A new ship, the Oshoro-Maru V, is being built and is scheduled to be finished in March of 2014. It is slightly larger than the Oshoro-Maru IV.

- The new Hakodate Marine Science Center is scheduled to open in the summer of 2014.

9.4 ***Korea*** *(Hyung-Cheol Shin)*

Sung-Ho Kang (Korean SSC member) expressed his regrets that he could not attend due to other commitments. The Korean report was sent in by Hyung-Cheol Shin (former Korean SSC member) in the form of a Power Point presentation. Up until 2009, Korea mainly piggybacked on foreign ships mostly in the Sub-Arctic seas. However, since the launch of their icebreaker ‘Araon’, they have been concentrating on ocean observations and geological studies in the High Arctic, and also have an interest in the Arctic-Subarctic connections. Summer oceanographic cruises were carried out in 2010, 2011, and 2012 in the Chukchi Sea. Sampling in 2012 included hydrography, currents (LADCP and 2 mooring stations), 2 ice stations and cores for paleoceanographic analysis. They are also measuring CO_2 in the atmosphere and the ocean. Biological studies include the distribution and community structure of bacteria and viruses, species composition of phytoplankton, chlorophyll-a concentrations and primary production, abundance and community structure of heterotrophic protists, the mesozooplankton community and grazing impacts on phytoplankton biomass and the algal composition in melt ponds on the sea ice. They have also undertaken sea ice studies, deploying 2 ice buoys to measure ice drift, and conducted sea ice surveys by helicopter. They will be conducting a survey in the Beaufort and Chukchi seas in August of 2013 and indicated that some berths may be available for foreign scientists.

*9.5 **Norway** (Ken Drinkwater)*

NESSAR was the Norwegian IPY project that focused on the physics and biology of the fronts between the warm, salty Atlantic waters and the colder, fresher Arctic or Polar waters. Several cruises to the Norwegian Sea and the Barents Sea were conducted during 2007, 2008 and 2009. Since the last ESSAS Meeting, results from these studies have been presented at the Ocean Sciences Meeting in Salt Lake City during February of 2012, the IPY meeting in Montreal in April of 2012, the ICES ASC in Bergen during September of 2012 and at several national Norwegian meetings. There has also been a focus on writing up the results, which will appear in a special issue of the Journal of Marine Systems. Presently there are 7 papers published on line, 3 in various stages of review, and 4-5 near submission stage. The papers cover various aspects of physics, bacteria, phytoplankton, zooplankton and fish and their interactions. It is expected that this special issue will appear in late 2013.

BarEcoRe (Barents Sea Ecosystem Resilience) is a Norwegian project that was endorsed by ESSAS in June of 2010. Its objective is to evaluate the effects of global environmental change on the future structure and resilience of the Barents Sea ecosystem through investigating the effects of past changes in climate and fisheries on the Barents Sea ecosystem, by developing indicators of ecosystem resilience, diversity and structure, and by forecasting the possible future states of the Barents Sea ecosystem under particular environmental and fisheries scenarios. The final Project meeting was held in December 2012 in Paris. The project has produced several new analysis methods and a simple model. Several papers have been produced and synthesis of the results is planned during the final 6 months of the project.

Although not ESSAS sponsored or endorsed projects, there is a great deal of activity in the Barents Sea on climate and climate-related effects by various institutions in Norway. Also, Norway will participate in the BASIN project by sending the RV G.O. Sars from Bergen to Nuuk, Greenland and back, taking physical, chemical and biological measurements with special focus on the fronts between the Atlantic and Arctic waters. They will collect data in the Norwegian Sea, the Iceland Sea, the Irminger Sea, the Labrador Sea and the West Greenland Shelf.

*9.6 **Russia** (Sen Tok Kim)*

During 2012, Russia carried out investigations in the Sea of Okhotsk — the most important commercial area in the Far-Eastern waters of Russia. During the last three decades annual surveys have been conducted on large areas of this sea, as well as small local zones within it. To understand the variability in the fish resources, intensive ecosystem investigations have been recognized to be of increasing importance. Biological resources, climatic, and oceanographic processes in the Sea of Okhotsk are presently being investigated by several institutes participating in a new integrated five-year program.

No new publications were produced in 2012 on ecosystem dynamics and aquatic organisms in the Sea of Okhotsk. Synthesis and writing of research results from the 2012 studies will likely take at least 1-2 years in their preparation. Thus, only a general review of activities during the past year is presented here.

Within the framework of the integrated research program in the Sea of Okhotsk covering 2012-2016, information on the most important commercial fishery resources (pollock and

herring) and bottom fishes on the West Kamchatka and East Sakhalin shelf areas was collected. Pelagic communities were investigated in the southern part of the Sea of Okhotsk. Early stages of walleye pollock and other fishes and invertebrates were studied. Along with biological data, information on oceanographic conditions was also gathered.
Summary results from 2012 are as follows:

1. The Sea of Okhotsk herring population abundance has declined considerably, owing to several poor year classes in recent years. This occurred subsequent to a cold period during the early 2000s when the stock size increased sharply.

2. The pollock populations reached a maximum during 2010-2011, but have started to decline in the northern and southern regions of the Sea in 2012. The previous increase in productivity of pollock resources occurred due to strong year classes originating in the relatively warm period from 2005-2009.

3. In the pelagic zone of the southern Sea of Okhotsk, the situation has not changed significantly compared to the previous period. The nekton biomass was largely comprised of northern smooth tongue (*Leuroglossus schmidti)*, Pacific gonatid squid (*Gonatopsis octopedatus)*, and Japanese anchovy (*Engraulis japonicas)*. It is believed that the increasing anchovy abundance generally coincides with the cooling temperatures favored by this species. During October-November repeated sampling indicated a high number of jellyfish in the region, comprising up to 1/3 of the estimated total biomass.

4. No noticeable changes have occurred in the demersal fish community on the shelf areas of East-Kamchatka and East Sakhalin Island. The available time-series indicates a consistent cyclical variability of the resources in the waters off Western Kamchatka. The biomass of demersal fish species remains at about the mean annual level; a small increase in biomass was observed in waters east of Sakhalin Island.

Existing information on herring, walleye pollock and demersal fish resources indicates ambiguous processes occurring during recent years. After the strongest cooling in recent decades during 2001, 2003 was the warmest year. Short-term changes in the fish stocks relative to warming or cooling have been traced against the background of a long-term warming trend. High-yield year classes of pollock in the mid-to-late 2000s most probably occurred due to the short-term warming in the Sea of Okhotsk. The poor year classes of pollock in the northern and southern parts of the Sea of Okhotsk during the past three years may, in turn, have been caused by a cold snap. Cooling or warming processes alone are unlikely to be the sole cause of the formation of strong or poor year class abundance. Rather, this likely involves a chain of events related to temperature changes in oceanic waters that are still poorly understood.

9.7 U.S.A. (Franz Mueter)

The Bering Sea Ecosystem Study / Bering Sea Integrated Ecosystem Research Program (BEST/BSIERP, http://bsierp.nprb.org) are ESSAS affiliated programs that have completed three successful field seasons (2008-2010) and are currently in their synthesis phase under the new name - The Bering Sea Project.

The program addressed five core program hypotheses through field studies, laboratory studies, and modeling:

1. Physical forcing affects food availability: Climate-induced changes in physical forcing will modify the availability and partitioning of food for all trophic levels through bottom-up processes.

2. Ocean conditions structure trophic relationships: Climate and ocean conditions influence water temperature, circulation patterns, and domain boundaries impacting fish reproduction, survival and distribution, predator-prey relationships, and the location of zoogeographic provinces.

3. Ecosystem controls are dynamic: Later spring phytoplankton blooms resulting from early ice retreat will increase zooplankton production, thereby leading to increased abundances of piscivorous fish (walleye pollock, Pacific cod, and arrowtooth flounder).

4. Location matters: Climate and ocean conditions influencing circulation patterns and domain boundaries will affect persistence of fronts and other prey-concentrating features and, thus, the foraging success of marine birds and mammals.

5. Commercial and subsistence fisheries reflect climate: Climate-ocean conditions will change and, thus, affect the abundance and distribution of commercial and subsistence fisheries.

To date, the program has resulted in 74 peer-reviewed publications, including 25 papers published in a special issue of Deep-Sea Research Part II (Volumes 65-70, 2012) on "Understanding Ecosystem Processes in the Eastern Bering Sea". 29 submissions are under review for a second special issue and a third special issue is planned for late 3013 or early 2014.

The Bering Sea Project is among the first to successfully build and run an integrated model that couples spatially-explicit component models from climate to fish to people (Fig. 3). Hindcasts for 1970 to 2004 have been made from climate to fish and these hind-casts have been partially validated with existing data. The model runs have produced results that agree with our understanding of the ecosystem. A full 30-layer ROMS-NPZ model has been run in both hind-cast and forecast modes. The fish model FEAST has only been used in hind-cast mode, but forecasts will be forthcoming.

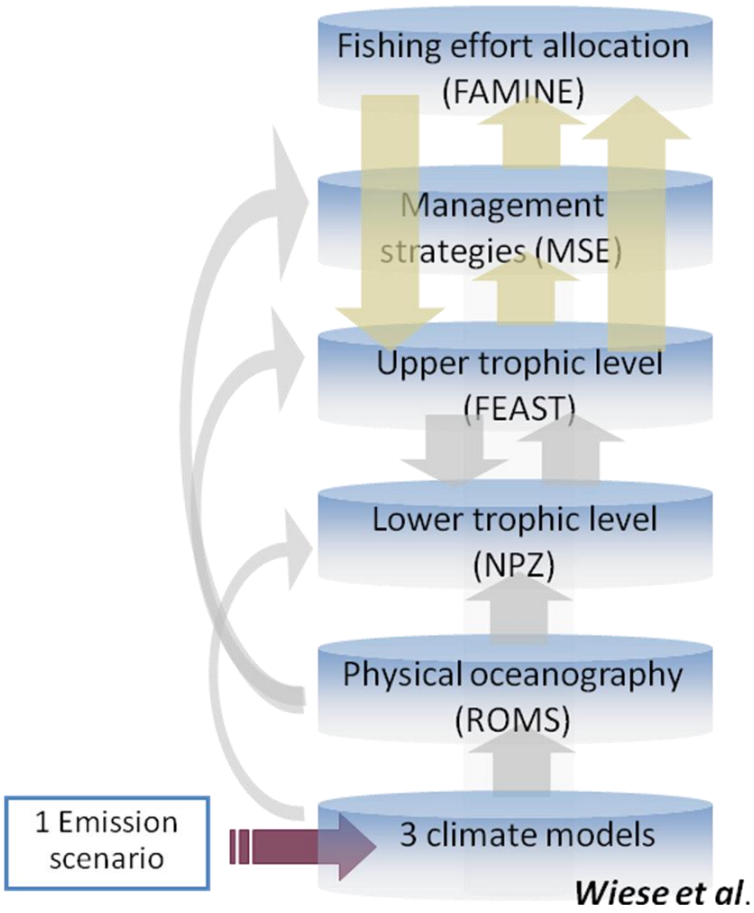

Figure 3: *The set of coupled models that have been developed and parameterized though the BEST/BSIERP program.*

Two other integrated research programs off Alaska are of relevance to ESSAS, the Gulf of Alaska Integrated Ecosystem Research Program (GOA IERP or 'Gulf of Alaska project', http://gulfofalaska.nprb.org/) and the Arctic Ecosystem Integrated Survey (Arctic Eis). The SSC agreed that project leaders from both programs should be invited to apply for ESSAS endorsement. The Gulf of Alaska project is a 5-year study (2010-2014) with two full field seasons (2011, 2013) and focuses on regional comparisons between the eastern and western Gulf of Alaska (Fig. 4). The eastern Gulf of Alaska is characterized by a narrow shelf, a relatively low biomass of fishes and high species diversity, while the western Gulf of Alaska has a broad continental shelf, a very high biomass of demersal fish and shellfish, and relatively low species diversity. The overarching hypotheses of the project focus on:

1. Connectivity between offshore spawning areas and inshore nursery areas: The primary determinant of year-class strength for marine groundfish species in the GOA is early life survival. This is regulated in space and time by climate-driven variability in a biophysical gauntlet comprising offshore and nearshore habitat quality, larval and juvenile transport, and settlement into suitable demersal habitat.

2. Regional comparison: The physical and biological mechanisms that determine annual survival of juvenile groundfish and forage fish differ in the eastern and western GOA regions.

3. Species interactions: Interactions among species (including predation and competition) are influenced by the abundance and distribution of individual species and by their habitat requirements, which vary with life stage and season.

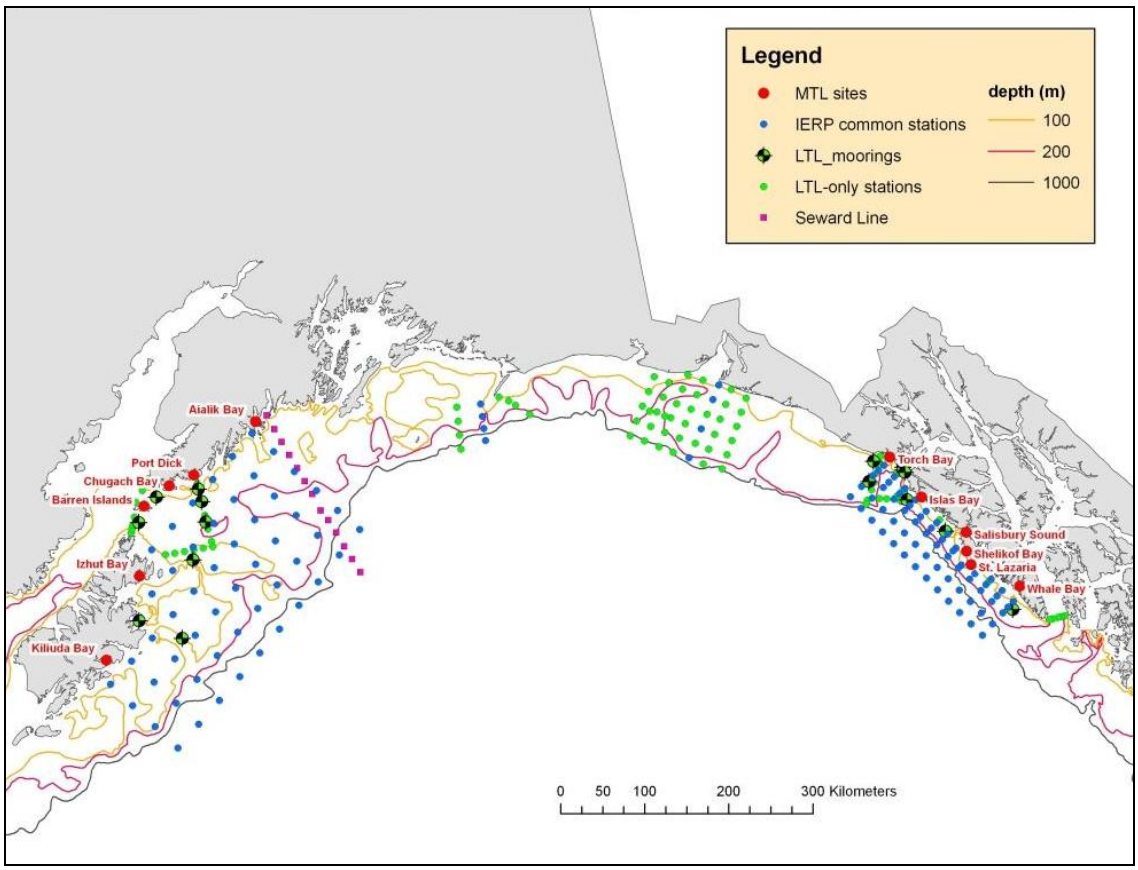

Figure 4: Geographic scope and sampling grid for the Gulf of Alaska project (GOA IERP).

Arctic Eis is a 4-year study (2012-2015) with two field seasons (2012, 2013) that will provide the first comprehensive oceanographic and fisheries assessment of the Chukchi Sea and will also sample the previously under-sampled northern Bering Sea (Fig. 5). The goal of the project is to understand the distribution of marine fishes and shellfishes, and the plankton they depend upon for food, throughout the northern Bering Sea and Chukchi Sea and to understand the connectivity and fluxes between the northern Bering Sea and Chukchi Sea.

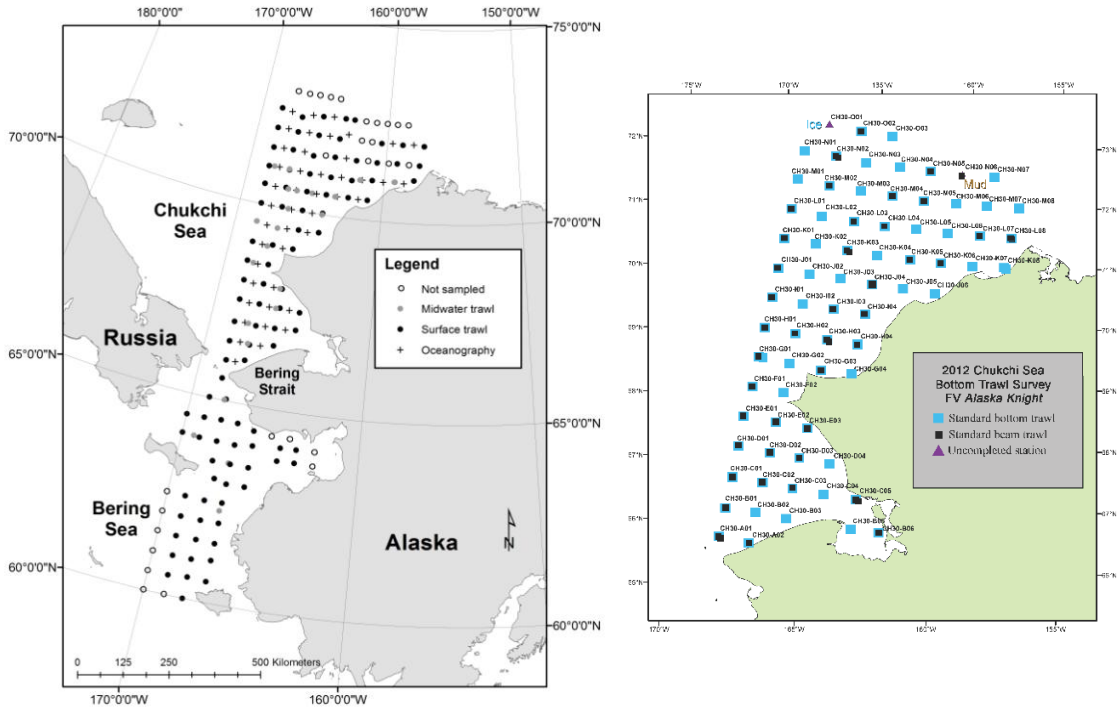

Figure 5: Geographic scope and sampling grid for the Arctic Ecosystem Integrated Survey surface and acoustic / mid-water trawl survey (left) and bottom trawl survey (right).

9.8 West Greenland (Kai Wieland)

Greenland still does not have any projects which are officially endorsed by ESSAS. Ecosystem studies are being conducted in Greenland fjord systems as well as in coastal and offshore waters by the Greenland Centre for Climate Research (GCCR), the Greenland Institute of Natural Resources (GINR) and its partners, in particular the National Institute of Aquatic Resources at the Technical University of Denmark (DTU Aqua).

10. Multi-national Programs

10.1 USA/Norway/Canada (MENUII, CAMEO, CANUSE)

Marine Ecosystem Comparisons of Norway and the United States II (MENUII) was a Norwegian funded project (2009-2012) that was to compare different types of ecosystem models applied to Norwegian and US ecosystems. The USA has been supporting their work on the joint program under CAMEO and the Canadians and USA have been involved on similar objectives under their CANUSE project. The main joint work was conducted during workshops on stock production modeling held in Wood's Hole during the springs of 2010 and 2011. From these a special section of MEPS was published in 2012 that included

10.2 Canada/Norway (NORCAN)

NORway-CANada Comparison of Marine Ecosystems (NORCAN), the comparative study between the Labrador Sea and the Norwegian/Barents seas has been delayed because of the late revision of the physical oceanographic paper led by Ken Drinkwater. This paper has recently been completed and once accepted by the guest editor, all eight NORCAN papers will soon be forwarded to Progress in Oceanography. Publication is expected in 2013. The guest editors of this special issue are Ken Drinkwater and Pierre Pepin.

10.3 Norway/US/Canada/Russia (Trophic Interactions in the Arctic-TrophArct)

The ESSAS-endorsed project Trophic Interactions in the Arctic (TROPHARCT), spearheaded by the University of Oslo, has assembled a series of 6 joint papers from Canadian, US, Russian and Norwegian scientists plus an introductory paper. These papers have been submitted to MEPS in the form of a special section, under the title "Production of harvested sub-Arctic fish stocks in a changing environment". Four of the papers have been accepted and the other 2 are in the late stages of the review process. The special section is expected to be published in 2013.

11. Next Meeting

After much discussion, there was general agreement that it would best to hold next year's annual meetings in the center of Copenhagen, Denmark if at all possible. One possible meeting place is the Nordic Council's facility located in central Copenhagen. Olafur Astthorsson, who will be going to the Nordic Council's offices in Copenhagen for a meeting, agreed to enquire as to the possibility of holding the next ESSAS meeting there and if they would be able to provide logistic support. Another possibility is the Danish Meteorological Institute, which is headed by Erik Buch.

George Hunt suggested that the ICES Secretariat might be able to suggest a few other local venues where the ASM could be held. If hotel rooms are reasonable and we have enough participants, then the hotel might provide a meeting room. He reminded the SSC that a registration fee could also be added to cover costs. The question of when to hold the meeting arose. After much discussion it was decided that the tentative dates would be 7-11 April in 2014.

ACTION: Olafur Astthorsson will contact the Nordic Council to see if they have a meeting room available during early April. If the Nordic Council does not have available facilities, ESSAS Co-chairs will explore other options in Copenhagen, e.g., the Danish Meteorological Institute, DTUaqua, or a private hotel.

Questions arose as to a fall-back plan in case nothing works out in Copenhagen. Franz Mueter stated that he might be able to host a meeting at the University of Alaska in Juneau. Ken Drinkwater said that the meeting could perhaps be held in Bergen and he could ask the Research Council of Norway for money. However, it was noted that we had been saving this for the possibility of a larger ESSAS OSM sometime later. No action will be taken towards these until the Copenhagen options have been fully explored.

A short discussion took place on the theme of the next ASM; one was related to Arctic-Subarctic interactions might attract scientists from Greenland. However, it was noted that whoever hosts that meeting should perhaps have a say on the theme. Also, new working groups might also want to suggest possible themes.

ACTION: ESSAS Co-chairs will draft and send a letter to all WG Chairs to get their suggestions for theme sessions to be held at the 2014 ASM.

12. End of the Meeting

Ken Drinkwater and Franz Mueter thanked Drs. Sakurai and Saitoh for their role in hosting both the ASM and SSC meeting. The ESSAS SSC expressed our appreciation to their students and staff for the excellent organization, facilities, and wonderful dinners. Ken and Franz also thanked all of the SSC members and others present for their input and participation in the discussions. The meeting was then adjourned.

Appendix 1 – Participant Contact Information

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Appendix 2 - ESSAS 2012 SSC Meeting Agenda

Thursday January 10, 2013

09:00 Introduction

- **Adoption of the Agenda** — **Ken Drinkwater/Franz Mueter**
- **Adoption of 2011 Meeting Report** — **Margaret McBride**
- **Follow-up from 2011 Meeting** — **Margaret McBride**
- **IMBER IPO** — **Ken Drinkwater**
- **Budget & Funding** — **Ken Drinkwater/Franz Mueter**
- **SSC Membership** — **Open Discussion**
- **Website** — **Open Discussion**
- **Project Office** — **Ken Drinkwater**

12:30 Lunch

13:30 Working Groups

- **WG on Modelling Ecosystem Response**
- **WG on Climate Effects at Upper Trophic Levels** — **Franz Mueter**
- **WG on Arctic-Subarctic Interactions** — **Ken Drinkwater**
- **WG on Human Dimensions**
- **WG on Bioenergetics**

Future Directions — **Open Discussion**

- **2013**
  - **Workshops**
  - **Comparative Studies**
  - **Theme Sessions**
- **Longer-term**
  - **How long should ESSAS go on?**

17:00 Adjourn

Friday January 11, 2013

09:00 National Program Updates

- **Canada** — **Erica Head**
- **Greenland/Denmark** — **Kai Wieland**
- **Iceland** — **Ólafur Astthorsson**
- **Japan** — **Yasunori Sakurai**
- **Korea**
- **Norway** — **Ken Drinkwater**
- **Russia** — **Sen Tok Kim**
- **USA** — **George Hunt/Franz Mueter**

International Program Updates

- **Russia/Japan in the Sea of Okhotsk** — **Yasunori Sakura/Sen Tok Kim**
- **Canada/Norway in North Atlantic (NORCAN)** — **Ken Drinkwater**
- **USA/Norway in multiple areas (MENU&MENUII)** — **Ken Drinkwater**

Next year's meeting — **Open discussion**

- **Dates and Location (Venue)**
- **Theme/ Objectives, Workshops**
- **Organization**

15:00 Adjourn