



ESSAS

(Ecosystem Studies of Subarctic and Arctic Seas)

Science Steering Committee

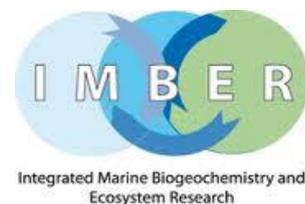
Report

of the

2015 Annual Meeting

Seattle, Washington, USA

18-19 June, 2015



Compiled by

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December 2015

Table of Contents	Page
1. Participants	3
2. Introduction and Adoption of Agenda	3
3. Adoption of last year's SSC Report	3
4. Follow-up from last year's SSC Meeting at Hakodate	3
5. 2015 ESSAS Annual Science Meeting	4
6. Working Group Status Reports	5
6.1 <i>WG on Modeling Ecosystem Response (WGMER)</i>	5
6.2 <i>WG on Arctic-Subarctic Interactions (WGASI)</i>	5
6.3 <i>WG on Bioenergetics of Subarctic Fishes (WGBSF)</i>	6
6.4 <i>WG on Human Dimensions (WGHD)</i>	6
6.5 <i>WG on Paleo-ecology of Sub-Arctic Seas (WGPESAS)</i>	7
7. ESSAS Ongoing Issues	11
7.1 <i>ESSAS Name</i>	11
7.2 <i>ESSAS Website</i>	11
7.3 <i>SSC membership</i>	12
7.4 <i>IMBER</i>	12
7.5 <i>ESSAS Budget</i>	13
7.6 <i>Open Science Meeting</i>	13
7.7 <i>North Pacific Research Board</i>	14
8. National Programs	14
8.1 <i>Canada</i>	14
8.2 <i>Iceland</i>	16
8.3 <i>Japan</i>	18
8.4 <i>Korea</i>	21
8.5 <i>Norway</i>	21
8.6 <i>Russia</i>	22
8.7 <i>USA</i>	23
8.8 <i>West Greenland</i>	25
9. Multinational Programs	27
9.1 <i>Norway/USA/Iceland/Denmark/Faroes (NUCCME)</i>	27
9.2 <i>Japan/USA/Norway (RACArctic)</i>	28
10. Next Year's Meeting	29
11. End of the Meeting	29
Appendix 1 – Participant Contact Information	30
Appendix 2 - ESSAS 2015 SSC Meeting Agenda	31

1. Participants

SSC Members in Attendance

Ólafur S. Astthorsson	Iceland
Ken Drinkwater (WGASI)	Norway
Naomi Harada (WGPESAS)	Japan
Erica Head	Canada
George Hunt	USA
Sen Tok Kim	Russia
Franz Mueter (WGASI)	USA
Sei-Ichi Saitoh	Japan
AnnDorte Burmeister	Greenland

SSC Members Unable to Attend

Yasunori Sakurai	Japan
Hyoung Chul Shin	Korea

Invited Guests

Matt Baker (NPRB)	USA
Ben Fitzhugh (WG-PESAS)	USA
Allan Haynie (WG-HD)	USA
Hyun Choel Kim (Substitute SSC member)	Korea

Contact Information for the participants is listed in Appendix 1.

2. Introduction and Adoption of Agenda

The 2015 annual meeting of the ESSAS Scientific Steering Committee (SSC) was held on 18-19 June at the University of Washington in Seattle in conjunction with and directly following the ESSAS 2015 Annual Science Meeting (15-17 April). The meeting was kindly hosted by George Hunt. Ken Drinkwater, ESSAS Co-chair, opened the meeting by welcoming the SSC members, substitute members and guests. The meeting agenda (see Appendix 2) was modified slightly to accommodate the timing of the presence or absence of certain SSC members and Working Group representatives.

3. Adoption of last year's SSC Meeting Report

A motion to adopt last year's SSC meeting report passed unanimously.

4. Follow-up from last year's SSC Meeting in Copenhagen

The status of the action items from last year's SSC meeting was reviewed. The following is the list of action items and their follow-up.

- Ken to contact Jim Overland regarding his position as co-chair of the WG-ASI.
 - Jim has stepped down as co-chair of the WG.
- Sei-Ichi will lead the effort to revise last year's proposal for Japan to fund and host the ESSAS Project Office (PO) in Japan. He will contact other SSC members for support letters if that would help.

- A separate ESSAS PO was not applied for but Sei-Ichi, who became director of the newly formed Arctic Research Centre (ARC) located at Hokkaido University in Sapporo, indicated that they will be hiring some staff in August who may be able to undertake certain administrative duties on behalf of ESSAS.

ACTION: Ken to send Sei-Ichi the responsibilities of the former coordinator of the ESSAS PO in Bergen, Margaret McBride.

ACTION: Sei-Ichi to determine what responsibilities the person at the ARC will be able to do and inform the ESSAS SSC.

- Ken will write the thank you letter to Margaret on behalf of the SSC.
 - Done.
- Ken Drinkwater will take responsibility for the Home Page and the Endorsement Section of the website including updating the featured research and ESSAS news; Franz will work on the Working Group Section: George Hunt offered to reorganize the publications including indicating which publications came from which project.
 - *The home, endorsement and working group pages were updated.*
- ESSAS co-chairs to send a letter to AnnDorte welcoming her to the SSC and indicate what we expect, including that we would like her to keep us abreast of the research of the Climate Centre as well as the fisheries group.
 - *AnnDorte Burmeister, the new SSC representative from Greenland, was contacted and informed of what is expected of her as an SSC member.*
- Ken will approach Drs. Shin and Kang about their continued interest in ESSAS. If they are still interested he will enquire what session or sessions might be of interest to them.
 - *Dr. Shin was contacted and indicated that he would replace Dr. Kang on the SSC. However, he is unable to attend the SSC meeting in Seattle but Dr. Huyen Choel Kim will attend as his substitute.*
- Ken noted that IMBER will be publishing a special edition of their Newsletter that will highlight ESSAS and its research. Several SSC members agreed to submit 1-2 page articles by 30 April.
 - *Seven articles from ESSAS were published in the May 2014 issue of the IMBER Newsletter.*

5. ESSAS Annual Science Meeting

The 2015 ESSAS Annual Science Meeting (ASM) was held in the Fishery Sciences Building at the University of Washington on 15-17 June, and was co-hosted by the School of Aquatic and Fishery Sciences and the campus-wide Future of Ice Initiative. The meeting focused its attention on the topic of the “Role of Ice in the Sea” with a 2.5 day symposium. Four themes were explored: Humans, Ice and the Sea in the Subarctic and Arctic Past (8 oral and 4 poster presentations), the Role of Sea Ice in the Arctic and Subarctic (19 oral and 6 posters), the Ecological Role of Tidewater Glaciers (8 oral and 1 poster presentations), and Social Scientific Investigations of Changing Sea Ice Conditions (8 oral presentations). In addition, there was a half day devoted to a combination of Invited and Contributed papers (8 oral and 2 poster presentations). Over 100 people from 11 countries attended the Symposium. Travel support was provided to 17 invited speakers, of whom 4 were early career scientists. In addition, 8 University of Washington students from 6 different academic units volunteered to help with staffing the meeting. This was the largest ESSAS ASM and by all indications one of the most successful.

ESSAS wants to thank those who provided financial support for the ASM including the: National Science Foundation (NSF), North Pacific Research Board (NPRB), North Pacific Fishery Management Council (NPFMC), NOAA Alaska Fisheries Science Center (AFSC), International Arctic Science Committee (IASC), and from 10 units within the University of Washington including the: College of the Environment, Applied Physics Laboratory, the Future of Ice Initiative, Department of Anthropology, Canadian Studies Program, Program on Climate Change, the Quaternary Research Center, and the Schools of Aquatic and Fishery Sciences, Marine and Environmental Affairs, and Oceanography.

6. Working Group Status Reports

6.1 WG on Modeling Ecosystem Response (WG-MER) – Enrique Curchitser

Enrique provided the following report.

A special volume in Progress in Oceanography with guest co-editors Enrique Curchitser, Shin-Ichi Ito and Kenny Rose is near completion. The theme of the volume is *Modelling and observational approaches to understanding marine ecosystem dynamics* and will be dedicated in memory of Bern Megrey. Fifteen manuscripts have been accepted and edited. The topics of these manuscripts span lower and upper trophic levels, NPZ, IBM and one management related paper. The only remaining writing before publication is the volume overview and the “In Memoriam”. Final publication is expected during this summer.

ACTION: Ken to contact Enrique once the special issue is published to discuss whether WG-MER will continue or be disbanded.

6.2 WG on Arctic-Subarctic Interactions (WG-ASI) –Franz Mueter/Ken Drinkwater

WGASI organized 2 workshops in 2014. As noted last year, an ESSAS Theme Session was proposed for the 2014 ICES ASC on the exchanges between the Arctic and the Sub-Arctic in the Atlantic Sector and the fate of the exchanged materials (physical, chemical and biological). In response to a request by ICES, we combined our proposal with one from Spain that broadened the geographical boundaries to include the subtropics. The resultant Theme Session entitled *The Role of Advection in the North Atlantic* was held in A Coruña, Spain in September 2014, and was co-sponsored by PICES, the ICES Working Group on Oceanic Hydrography and the ICES/PICES Strategic Initiative on Climate Change Effects on Marine Ecosystems (SICCME). It was co-chaired by Olafur S. Astthorson (Iceland), Seth Danielson (USA/PICES), Ken Drinkwater (Norway) and Cesar Gonzalez-Pola (Spain). The session consisted of 8 oral presentations and 4 posters, of which only 4 orals focused on the Arctic-Subarctic region. A summary of the presentations can be found at <http://www.ices.dk/news-and-events/asc/ASC-2014/Programme/Pages/Theme-Sessions.aspx> under Session Q report. The poor turnout certainly indicates that an Arctic Theme Session at the ICES ASC in a country that does not conduct much Arctic research is unlikely to be successful. In fact, It is probably better to hold such theme sessions at meetings where there is likely to be a large number of Arctic Researchers, such as Arctic Science Summit Week or other meeting focused on the Arctic.

A workshop entitled *Variability in Advection and its Biological Consequences for Subarctic and Arctic Ecosystems* that focused upon the Bering Shelf-Chukchi Sea region was held at the PICES Annual Science Meeting in Yeosu, Korea, during October 2014. It was co-sponsored by ICES with lead Franz Mueter (USA) and co-chairs, Enrique Curchitser (USA), Ken Drinkwater (Norway/ICES), Sen Tok Kim (Russia), Hiroshi Kuroda (Japan), and Sei-Ichi Saitoh (Japan). A session on *Biophysical processes at the Arctic-Subarctic interface* was accepted for the 2016 Ocean Sciences Meeting in New Orleans. The session will be chaired by Franz Mueter (UAF, Juneau, Alaska) with co-chairs Leandra de Sousa (North Slope Borough, Barrow, Alaska), Kevin Boswell (Florida International University, Miami, Florida) and Ron Heintz (Alaska Fisheries Science Center, Juneau, Alaska).

6.3 Working Group on Bioenergetics of Subarctic Fishes (WG-BSF) – Ron Heintz

Ron provided the following report.

Ron, together with Jason Link, put together a session on "Community Ecology and Trophic Interactions of Fishes" at the annual meeting of the American Fisheries Society in Quebec City, Quebec in August 2014. Over 50 papers and posters were accepted for this session. Although this was not sponsored by ESSAS and the WG-BSF, many of the presentations at this session were consistent with the terms of reference for the WG. No other WG-BSF activities occurred during the past year and none are planned for 2015, however, but they would like to continue. They made contact with others in NOAA that may be interested in participating in the WG. In addition, the Gutshop Symposia, a series of meetings loosely organized around things trophic, are being revitalized. The session at the annual meeting of the American Fisheries Society was part of this revitalization and in 2015 an even bigger session is being planned. Ron felt that it may be a good venue for enlisting participation in the working group. After Ron meets with this group during the summer, he will determine if there is enough interest to warrant continuation of the WG.

6.4 Working Group on Human Dimensions (WG-HD) – Alan Haynie

Keith Criddle, the former chair of the ESSAS WG on Human Dimensions, decided after a couple of years of trying to organize a focused activity without success that he would like to step back and let someone else chair the WG. The ESSAS co-chairs therefore invited Alan Haynie to attend our SSC meeting to provide his perspective as to how to proceed. Alan is a bio-economist who works for NOAA. He organized the Session on Human Dimension aspects during the ESSAS ASM and is also involved in several national and international efforts that are relevant to ESSAS, which focus on the responses of fishers to changes in the ecosystem as well as in the environment and on management systems that can effectively respond to climate change challenges. Alan expressed the opinion that ESSAS needs an interactive group of ecosystem and fisheries scientists working with social scientists dealing with fisheries issues. Too often the social science fisheries topics are simply add ons to ecosystem considerations or models but fisheries needs to be at a fundamental level. ESSAS needs to identify a key area that would induce interactions and it was suggested that perhaps the Belmont Forum might fund such an endeavor. Also, while mostly we think of implications of environmental variability on socio-economic decisions there are also consequences of socio-economic decisions for ecosystems. Several suggestions for consideration were provided: scenario projections for human activities in vulnerable

ecosystems; how fisheries shift if fish move and the management and policy implications; and how different nations respond to fish collapses and how have they recovered. Alan suggested a group be formed to talk about what to work on. Franz indicated that this could be done within the context of the RACArctic project that includes ecologists, fisheries scientists, fisheries managers and social scientists. He suggested that Alan be involved in a scoping session at the first Workshop that will be held in Japan in March, 2016, to develop case studies and then make plans for follow up work.

ACTION: Alan to attend the RACArctic Meeting in Japan and report back to ESSAS on the possibilities related to the formation of a group to work on interactions between ecology and fisheries and what issue they might tackle.

6.5 Working Group on Paleo-Ecology in Sub-Arctic Seas (WG-PESAS) – Ben Fitzhugh

WG-PESAS was convened for the first time at the 2014 ESSAS Annual Meeting in Copenhagen to explore and synthesize existing knowledge about the interconnected ecological dynamics of paleoclimate, oceanography, marine ecology, and anthropology (archaeology and history) -- hereafter collectively referred to as "paleoecology" -- around the subarctic North Pacific and North Atlantic at intervals within the past 20,000 years. In Copenhagen, the group proposed to consider questions that unite these topical domains through times of dramatic environmental and human change including: (1) the Deglacial (18,000 to 10,000 years before present [BP]), (2) the early to late Holocene (ca. 9000 to 3000 BP), (3) the late Holocene (3000-500 BP) and (4) the growth of subarctic commercial fisheries (500 BP-present). Each interval embraces qualitatively different modes of environmental variability in temperature, seasonality, atmospheric circulation, oceanographic circulation, biological productivity, ecological dynamics, and human settlement, economy and social organization. These variables are partially coupled, though the relationship between them has not been systematically explored in prior research at the spatial scales that concern PESAS. The primary objective of PESAS is to create a collaborative framework for that investigation and to bring available data together to frame hypotheses and develop understandings about these relationships. The North Pacific and North Atlantic share atmospheric and oceanographic characteristics and processes that make comparisons useful. These include geographically analogous modes of high and low pressure and related temporal oscillations in the strength of those modes (on seasonal, inter-annual, decadal, and potentially century to millennial scales); similar counter-clockwise subarctic oceanic gyres; oceanographically moderated climates on the eastern margins and continentally exaggerated climates on the western margins; the same or similar marine species in pelagic, benthic, near-shore, and intertidal ecosystems, histories of maritime oriented human communities.

Between the Copenhagen and Seattle meeting, additional PESAS members were recruited and individual members expanded investigations into PESAS themes. Several presentations were made on related topics and a handful of related papers were submitted or published by contributors (listed below).

With continuing support from the National Science Foundation, the second PESAS WG meeting was convened in Seattle at the 2015 ESSAS ASM. That meeting provided an opportunity to engage a broader group of scholars, including more North Atlantic specialists. This meeting included a half day panel of presentations (see below for speakers and their

titles) and a day-long working group meeting to further explore the major themes of the WG, learn more about relevant data sets, and begin to develop writing assignments for a synthesis volume with a target publication of 2017 or 2018.

Several other PESAS activities are scheduled for the summer of 2015. PESAS is sponsoring a symposium at the International Quaternary Association (INQUA) congress in Nagoya, Japan on July 28, 2015. Several core members as well as new participants will present PESAS themed work from the North Atlantic and North Pacific. At the Eleventh Conference of Hunting and Gathering Societies (CHAGS), Ben Fitzhugh, Peter Jordan and Hirofumi Kato will convene a North Pacific session “Investigating the Rise of the North Pacific Maritime Tradition (archaeology and history)” focused on several aspects of the human dimensions of PESAS.

Finally, various subsets of PESAS WG participants have leveraged the PESAS collaborations to advance scientific pursuits beyond existing knowledge. Ben Fitzhugh, Michael Etnier, Nicole Misarti, Catherine West, and Courtney Hofman submitted a proposal to the U.S. National Science Foundation for funds to initiate a new study of paleoecological and paleoclimate variability using archaeological fauna from locations around the North Pacific Rim. If funded, the research will directly address questions about century to millennial scale climate-ocean-ecology variability that could exceed historically known extremes and provide a deeper baseline and improved understanding of system dynamics needed to effectively manage fisheries in the North Pacific. Ben Fitzhugh, Mike Etnier, George Hambrecht, and Catherine West have partnered to write a paper comparing pre-commercial to commercial fisheries in the North Pacific and North Atlantic for the 2016 Society for American Archaeology Association. Anne de Vernal and Max Friesen have teamed up to link paleoecology and sea ice records with archaeological settlement history in the Western Canadian Arctic, pulling PESAS into the true Arctic, following ESSAS' lead. In related developments, a number of PESAS participants are collaborating to raise awareness of the crisis unfolding as subarctic and arctic coastal archaeological sites are thawing and eroding into the no-longer-so-frozen subarctic and arctic seas. That group has strong sponsorship within the iHOPE initiative, is gaining footing in Future Earth, and anchors a special committee on climate change and archaeological preservation for the Society for American Archaeology, the largest professional society for archaeologists in the Americas.

Next Steps: PESAS plans another half-day panel at the 2016 ESSAS ASM in Yokohama with an emphasis on NW Pacific paleoecology. PESAS WG members there will meet to advance the PESAS collaborative goals and a video conference will be planned for later that spring to engage WG members unable to join us at Yokohama . We are looking ahead to the 2017 ESSAS Open Science Meeting as a target to assemble the first synthetic presentations as drafts of the synthesis publication we plan as a capstone for the WG.

I. PESAS Presentations at the ESSAS 2015 Annual Science Meeting (PESAS members in bold).

Session 1: ***Humans, Ice and the Sea in the Subarctic and Arctic Past***. June 15, 2015

Co-Chairs: Ben Fitzhugh, Naomi Harada, and Anne De Vernal.

- **Anne de Vernal**, Claude Hillaire-Marcel, and Marie-Michèle Ouellet-Bernier. Linking marine records of sea ice cover and productivity changes with archeological archives in western Arctic and sub-Arctic regions.

- **Max Friesen.** The ultimate sea ice adaptation? Archaeological implications of Inuinnait (Copper Inuit) winter life on the sea ice.
- **Laura Gemery and Thomas M. Cronin.** Paleo-sea ice and Arctic ecosystem reconstruction using Ostracode ecology and shell chemistry.
- **Megumi O. Chikamoto, Axel Timmermann, Naomi Harada,** and Yusuke Okazaki. Understanding North Pacific deglacial CaCO₃ peaks.
- **Lester Lembke-Jene,** Gerrit Lohmann, Lars Max, Dirk Nürnberg, Xung Gong, Patrick Scholz, Maria Winterfeld, and Ralf Tiedemann. Spatial characteristics and trends of Holocene upper ocean temperatures, sea ice and productivity in the subarctic northwest Pacific.
- **Arkady Savinetsky,** Ekaterina Gorlova, Bulat Khasanov, Olga Krylovich, Dmitrii Vasyukov. Sea ice and marine productivity in the North Pacific marginal seas and coasts over the Late Holocene.
- **Guðbjörg Ásta Ólafsdóttir,** Einar Eg Nielsen, Kristen M. Westfall, Ragnar Edvardsson, Jakob Hemmer-Hansen, Sara Bonanomi, W.P. Patterson, Thomas H. McGovern, Símun V. Arge, J. Bond, and Snæbjörn Pálsson. Cod Story: multidisciplinary research on Atlantic cod, climate and historical fisheries in the North Atlantic.
- **Kota Katsuki,** Takuya Itaki, **Naomi Harada,** Boo-Keun Khim, Masao Uchida, Ryuji Tada. Response of sea-ice and primary production in the Bering Sea to solar irradiance cycles and pressure shift patterns since the last deglaciation.

II. Publications of Core PESAS WG contributors (partial list):

- **Dagomar Degroot,** (2015), “Exploring the North in a Changing Climate: The Little Ice Age and the Journals of Henry Hudson, 1607-1611.” *Journal of Northern Studies.*2015(1):69-92
- **Dagomar Degroot,** (2015) Testing the limits of climate history: The quest for a Northeast Passage during the Little Ice Age, 1594-1597.” *Journal of Interdisciplinary History* XLV:4: 459-484.
- Colin Coates and **Dagomar Degroot,** (2015) “‘Les bois engendrent les frimas et les gelées:’ Comprendre le Climat en Nouvelle-France.” *Revue d'histoire de l'Amérique française.* 68(3-4):197–219.
- Kuehn, H., **Lembke-Jene, L.,** Gersonde, R., Esper, O., Lamy, F., Arz, H., Kuhn, G., and Tiedemann, R. (2015) Deglacial history of the Subarctic North Pacific Oxygen Minimum Zone – Implications for ocean dynamics. *Nova Acta Leopoldina NF* 121 (408): 315–19.
- Kuehn, H., **Lembke-Jene L.,** Gersonde, R., Esper, O., Lamy, F., Arz, H., Kuhn, G. and Tiedemann, R. (2014): Laminated sediments in the Bering Sea reveal atmospheric teleconnections to Greenland climate on millennial to decadal timescales during the last deglaciation, *Climate of the Past*, 10 (6), pp. 2215-2236. doi:10.5194/cp-10-2215-2014
- Roberts, P., Metzuzals, K., Strey, S., Vanek, S., **Lembke Jene, L.** and Dahl, J. (2014): Transdisciplinarity and training engaged researchers. A. Chircop, S. Coffen Smout and M. McConnell (Eds.), *Ocean Yearbook*, 28(1), pp. 724 738. doi: 10.1163/22116001 02801025

- Max, L., **Lembke Jene, L.**, Riethdorf, J. R., Tiedemann, R., Nürnberg, D., Kuhn H. and Mackensen, A. (2014): Pulses of enhanced North Pacific Intermediate Water ventilation from the Okhotsk Sea and Bering Sea during the last deglaciation, *Climate of the Past*, 10 (2), pp. 591-605. doi: 10.5194/cp-10-591-2014.

III. Conference presentations by PESAS WG members outside of PESAS panels:

- **Cronin, T** “Arctic Productivity driven by Orbital Climate Cycles at the Arctic at Palaeo-Arctic Spatial and Temporal Gateways”. *3rd International Conference* Potsdam, Germany, May 18-22, 2015.
- **de Vernal, A.**, Hillaire-Marcel, C., Van Nieuwenhove, N., Fréchette, B., Gibb, O., Ouellet-Bernier, M.M.. Late attainment of full Holocene interglacial conditions in the northern North Atlantic, *European Geoscience Union*, Vienna, April 2015.
- **de Vernal, A.**, Van Nieuwenhove, N., Hillaire-Marcel, C. Millennial Scale Variability of the Arctic Ocean and Northern North Atlantic during the Holocene, *American Geophysical Union*, San Francisco, December 2014.
- **de Vernal, A.**, Hillaire-Marcel, C. Marine Records of Paleoclimate and Paleoenvironments vs Anthropological Archives in Arctic-Subarctic Regions: Missing Links. *American Geophysical Union*, San Francisco, December 2014.
- **Fitzhugh, Ben** and **William Brown**, “Do long-term marine ecosystem crashes explain human population asymmetries across the Subarctic North Pacific Rim over the past 2000 years?” Paper presented in the symposium: “Who’s Driving? People and Climate as Causes of Northern Animal ‘Crashes’”. *Alaska Anthropological Association Annual Meeting*. Anchorage, March 5, 2015.
- **Fitzhugh, Ben**, “Vulnerability and resilience on the North Pacific Rim: climate oscillation & food security, Political Economy and Pandemic.” Paper presented at the CJS-JSPS Symposium on “Long-term Sustainability through Place-based, Small-scale Economies.” UC Berkeley, CA. Sept 26, 2014.
- **Fitzhugh, Ben**, “Building a Synthetic and Comparative Perspective for Subarctic Human-Marine Ecodynamics.” U. Maryland GHEA/ CYBER/ NABO Workshop Meeting, College Park, MD. December 7, 2014
- **Fitzhugh, Ben** and **William Brown**, Poster: “Human paleodemography and ecodynamics in the Subarctic North Pacific: Teleconnections in large time and space scales?” with co-author, William Brown. American Quaternary Association Annual Meeting, (Hosted by QRC). UW, Seattle WA, August 9, 2014
- **Gemery, L.**, **T.M. Cronin**, W.M. Briggs, E.M. Brouwers, E. Schornikov, A. Stepanova, A.M. Wood, M. Yasuhara. 2015, An Arctic and Subarctic ostracode database: Biogeographic and paleoceanographic applications. *45th International Arctic Workshop*, May, Bergen, Norway.
- **Lembke-Jene, L.**, Tiedemann, R., Gong, X., Nürnberg, D., Max, L., Lohmann, G. and Gorbarenko, S. A. (2014): A Mid-Holocene shift and millennial-scale variations in North Pacific Intermediate Water oxygenation and upper ocean hydrography. American Geophysical Union Fall Meeting, San Francisco, USA, 15 – 19 December 2014.
- **Lembke-Jene, L.**, Tiedemann, R., Nürnberg, D. , Max, L. and Lohmann, G. (2014): Millennial-scale variations in North Pacific mesopelagic oxygenation and upper mixed

layer hydrography, International REKLIM Conference "Our Climate - Our Future", Umweltforum Auferstehungskirche, Berlin, Germany, 6 – 9 October 2014.

- Moros, M., Lloyd, J.M., Perner, K., Krawczyk, D., **de Vernal, A.**, Ouellet-Bernier, M.M., Blanz, T., Kuijpers, A., Jennings, E.E., Witkowski, A., Schneider, R.R., Jansen, E. Surface and subsurface multiproxy reconstruction of mid to late Holocene palaeoceanographic changes in Disko Bugt, West Greenland, *American Geophysical Union*, Montreal, May 2015
- Ouellet Bernier, M.M., **de Vernal, A.**, Hillaire-Marcel, C., and Moros, M. Paleaoceanographic changes in Disko Bugt area in relation with human settlements during the Holocene, *American Geophysical Union*, Montreal, May 2015
- Seidenkrantz, **Cronin** et al. Abstract: "Northern Hemisphere sea-ice during the Holocene - proxy data reconstruction and modelling." AGU 2014, San Francisco.

IV. Other activities:

- **Cronin**: Microfaunal and ecological analyses ongoing for ostracodes from USCGC Healy 2013 cruises to Chukchi and Beaufort Shelves.
- **Gemery & Cronin** were on the SWERUS C3-Leg 2 expedition of the Oden August 18-Oct 5 2014 coring deglacial and Holocene sediments for pale oceanographic & sea ice reconstruction.
- **Lembke-Jene**: "Sino-German Pacific – Arctic Ocean Experiment (SIGEPAX)" 2014-2017. Alfred Wegener Institute: The objective of this work is to characterise the nature of the surface and mesopelagic ocean circulation, upper ocean stratification and sea ice extent in the NW Pacific Ocean, in particular in the subarctic marginal seas from the LGM to the PI with quantitative proxies.

7. ESSAS Issues

7.1 ESSAS Name

Given the increasing emphasis within ESSAS on the Arctic, George suggested that we change our name to reflect this reality. It would also help to raise our profile within the Arctic community. It was suggested that the name be changed to the Ecosystem Studies of Subarctic and Arctic Seas, which would allow us to maintain the abbreviation ESSAS. This was unanimously agreed to by the SSC.

ACTION: Ken to inform IMBER of our name change.

Olafur noted that we will have to carefully scan the ESSAS website to ensure that all references to the Ecosystem Studies of Sub-Arctic Seas be changed and that the descriptions be consistent with the name change.

7.2 ESSAS Website

The website continues to suffer from a lack of updating. In spite of the best intentions indicated at last year's SSC meeting by individual members to take responsibility for certain sections of the website, little was done. To overcome this problem, Sei-Ichi indicated that

someone from ARC could take over responsibility for updating the ESSAS website. He suggested that we should physically move the website from IMR to the University of Hokkaido in Sapporo. This would not occur until at least the autumn when the ARC would begin hiring staff. If and when the website is moved, it was suggested that those going to the IMR site would be redirected to the new site in Japan.

ACTION: Sei-Ichi to arrange for the setting up of the ESSAS website in Japan.

ACTION: Ken to arrange for IMR to direct those contacting the IMR ESSAS website to be redirected to the new site in Japan once it is set up.

A recommendation was also made that for upcoming ESSAS meetings any material related to such meetings should be placed on the website, such as meeting venues, agenda, logistics, etc.

7.3 SSC membership

Erica Head, who has been our long time SSC representative from Canada, is planning on retiring from Fisheries and Oceans Canada later in 2015 or early 2016. Dr. Kumiko Azetsu-Scott, who like Erica, is employed by Fisheries and Oceans Canada at the Bedford Institute of Oceanography in Dartmouth, Nova Scotia, is willing to replace Erica on the SSC, and was unanimously endorsed by the ESSAS SSC members. She is an oceanographer and most recently has been involved in research on chemical tracers and ocean acidification.

ACTION: Ken to notify the IMBER Executive of our desire to appoint Dr. Azetsu-Scott to our SSC to replace Erica beginning in 2016.

7.4 IMBER

Ken updated the SSC on IMBER.

- Einar Svendsen from Norway has taken over as the Executive Officer in the IMBER International Project Officer (IPO) from Bernard Avril who has left IMBER. Lisa Maddison will remain as the Deputy Executive Officer.
- As reported last year, IMBER is wrestling whether to join the new Future Earth program. Future Earth is replacing the IGBP (International Global Biosphere Program), as well as DIVERSITAS (biodiversity) and HDIP (human dimensions). Future Earth wants more intergration of the various Global Change projects as well as more cross fertilization between natural and social sciences. IMBER has been asked to join FUTURE EARTH and is seriously considering it but has held off on its decisions, especially since they have not guaranteed money equivalent to what IGBP provided and are asking the projects to provide more, in particular on the human dimension side. Ken's opinion is that IMBER will join FUTURE EARTH as it could help direct the Oceans component so could be quite influential. There is concern that FUTURE EARTH will be dominated by terrestrial sciences, as at present its SSC includes only one natural scientist with a marine background (Corinne Le Quéré) out of a committee of 18.
- If IMBER decided not to go with FUTURE EARTH, SCOR would be willing to provide continued support for IMBER. However, the general feeling within the IMBER SSC is that it will likely join FUTURE EARTH. A final decision by IMBER is expected later this year.

7.5 ESSAS Budget

ESSAS received \$10 K for the SSC meeting which has been allotted to support Olafur Astthorsson, Erica Head, Sen Tok Kim, AnnDorte Burmeister and Hyun Choel Kim.

<u>Income</u>		<u>Expenditures (presently allotted)</u>	
IMBER	\$10,000	SSC	\$10,000

Ken noted that ESSAS is expected to receive another \$10 K for the SSC for next year. This is similar to this year but down by \$5 K from other previous years due to IMBER having less money. During the past 3 years, NASA has provided IMBER with \$30 K, of which \$10 K has been earmarked for ESSAS as they felt our program was something they wanted to support. This agreement ends this year, but Eileen Hofmann, the chair of IMBER, will be meeting with NASA representatives to renegotiate the agreement. Eileen promised to argue for continued NASA support of ESSAS but they may want to divert their funds into another component of IMBER. We should hear by the late summer or autumn on whether NASA will continue their support of ESSAS. He noted that ESSAS should consider raising funds for its SSC meetings and may have to if IMBER necessarily cuts back on the money it gives to its regional programs.

7.6 Open Science Meeting

The SSC discussed and agreed that we should hold another (our 3rd) Open Science Meeting. It was proposed to hold it in Norway during 2017. Alf Hakon Hoel and Benjamin Planque, during the ASM, argued for holding it in Tromsø. There is a lot of oceanographic and fisheries activities in Tromsø, including the Fram Centre, the Polar Institute and the University of Tromsø, whose expertise we could call on and who would likely be interested in attending. A fallback location would be Bergen. Ken felt that we should be able to obtain some money from the Research Council of Norway, who usually provides 100 K Kroner for such events. With the present exchange rate this amounts to \$12 K US. It was felt that June would be best if in Tromsø but this could be problematic for Arctic researchers as it is usually their field season. June is also a main tourist season so that accommodation could be at a premium. It was suggested that before a final decision be made on Tromsø local hotels be approached to see if we could obtain special rates and what they would cost and how they vary with month. Also we would need to estimate the difference in transportation costs of flying to Tromsø versus Bergen. We should contact Alf Hakon and Benjamin Planque to see if they are willing to head up the local organizing committee or to find someone who would be. Alf Hakon may not want to as he has just begun a 2-year secondment to the Norwegian Embassy in Washington, D.C. We should ask the IMBER IPO if they could look after the financial dealings and registration. Potential sponsors could be ICES, PICES, IMBER, Future Earth, NPRB, JAMSTEC, Hokkaido University, the Arctic Council, University on Svalbard (UNIS), University of the Arctic, and Norwegian fishing companies. ICES usually gives \$5 K and would probably be willing to publish a special volume from the symposium. A scientific steering committee (SSC) for the meeting needs to be formed. George noted the importance of obtaining distinguished speakers early so that their participation could be advertised. The steering committee could suggest such speakers. A venue for around 200 to 250 people will be needed. Initial discussion on a possible registration fee was around

\$300 dollars but this would have to be revisited depending on the costs of the venue, poster boards, coffee breaks, etc. No specific theme was identified but it was thought that we should ask Alf Hakon and Benjamin for their opinion as what might sell well in Tromsø.

ACTION: Ken to contact Alf Hakon and Benjamin Planque to see if they are willing to head up the local organizing committee or to find someone who would be. Also, we would need to ask for a preliminary budget for the venue and accommodations and request their thoughts on possible meeting themes.

7.7 North Pacific Research Board

Matt Baker, Science Coordinator for the North Pacific Research Board (NPRB), presented a talk on the organization. The goal of NPRB is to build understanding of the North Pacific, Bering Sea and the Arctic Ocean ecosystems in order to better manage marine resources. They have been helping to fund the BEST and BSIERP programs, both ESSAS endorsed, and also funded the Gulf of Alaska Project. These are now completed. Matt introduced their new Arctic program. It is asking the question: how do physical, biological and ecological processes in the Chukchi Sea influence the distribution, life history, and interactions of species or species guilds critical to subsistence and ecosystem function and how might those processes change in the next fifty years? They are especially interested in:

1. Patterns in subsistence use and potential shifts in response to ecosystem.
2. Species distribution and interaction: Physical, biological and ecological drivers and important thresholds/tipping points relevant to the distribution and life history of apex predators, species importance to subsistence, and species and species guilds essential to ecosystem function.
3. Oceanography and lower trophic level productivity: Influence of sea ice dynamics and advection on the phenology, magnitude and location of primary and secondary production, match-mismatch, benthic-pelagic coupling, and the influence of winter conditions.
4. Modeling.

The Arctic call has been announced with full proposals due 15 January 2016 and the program scheduled to begin in June and the first coordinated field season expected in June 2017.

8. National Programs

8.1 Canada (Erica Head)

Canadian scientists are involved in several national and international programmes that contribute to the goals of ESSAS.

1) Monitoring of the ecosystem in the Northwest Atlantic by scientists from Fisheries and Oceans Canada – 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 sampling along sections across 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. Survey cruises to assess macrofauna (fish and invertebrates) biomass are also made 1-2 times per year.

The AZOMP involves sampling along 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.

Other monitoring activities include 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 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.

Research Documents, containing summaries of the results of the AZMP and AZOMP for the preceding year, are peer-reviewed internally and published annually on the Fisheries and Oceans Canada (FOC) website (<http://www.isdm-qdsi.gc.ca/csas-sccs/applications/publications/index-eng.asp#RES>). Selected results also appear in annual NAFO reports and ICES Cooperative Research Reports.

2) BASIN (Basin-scale Analysis, Synthesis, and Integration)

FOC scientists contributed substantially to one of the work-packages of the EURO-BASIN programme (WP3) as authors on a synthesis paper, which was published in 2014:

Melle, W, Runge, JA, **Head, E, Plourde, S**, Castellani, C, Licandro, P, Pierson, J, Jonasdottir, S., **Johnson, C**, Broms, C, Debes, H, Falkenhaus, T, Gaard, E, Gislason, A, Heath, MR, Niehoff, B. Nielsen, T.G., **Pepin, P**, Stenevik, EK & Chust, G 2013, 'The North Atlantic Ocean as habitat for *Calanus finmarchicus*: environmental factors and life history traits' Prog. Oceanogr. 129, 244-284

3) VITALS (Ventilation, Interactions and Transports Across the Labrador Sea)

This is a Canadian ESSAS-endorsed programme that started in late 2013 and that will run for 5 years. The VITALS research network aims to 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, biologically-instrumented Argo floats) in the Labrador Sea, and new experimental measurements to evaluate the role of biological components within the system. Gliders were deployed in the Labrador slope waters in 2014 and samples were collected and biological experiments were run on AZOMP cruises in 2014 and 2015. The project leader is Paul Myers from the University of Alberta.

He provided a copy of the report from Year 2 of the study, which was assessed as providing evidence of satisfactory progress by the main funding agency (NSERC).

4) OSNAP (*Overturning in the Subpolar North Atlantic Programme*)

This international programme incorporates the results of the FOC AZOMP and VITALS, and also includes deployments of FOC moorings in the Labrador slope waters.

5) *Additional Canadian Subarctic and Arctic Research Programmes*

Time series hydrographic measurements are made by moorings deployed in Davis Strait and the Beaufort Sea (USA collaborations) and Barrow Strait. Supplementary measurements are made and sampling carried out during cruises. Process studies are carried out in the following programmes: ArcticNet, Geotraces, BaySYS, SERF and the Arctic Science Partnership. The Canadian High Arctic Research Station is being built in Cambridge Bay.

6) *Other items of interest to Canada and ESSAS*

Five regions within Canadian subarctic waters have been recognized by the Conference Of the Parties (COP) to the Convention on Biological Diversity (CBD) of the United Nations Environment Programme (UNEP) as meeting the criteria for Ecologically or Biologically Significant Areas (EBSA).

A proposal is being submitted to the European Blue Growth Horizon 2020 programme to study pelagic/benthic coupling in the Davis Strait region, where high densities of sponges occur on the bottom at depths of 1000 m, in an area that is apparently downstream of an area of high phytoplankton production.

8.2 *Iceland* (Olafur S. Astthorsson)

The main contribution of the Marine Research Institute (MRI) in Iceland to the ESSAS program has been 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 of the subarctic waters of the Iceland Sea to the north of Iceland and with particular reference to the capelin stock for which the Iceland Sea is the main summer feeding area. This has included 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.

Several other research and monitoring projects at the Marine Research Institute are also relevant to the goals of ESSAS. The primary ones are:

- Monitoring of environmental conditions and plankton biomass at about 100 standard stations all around Iceland up to four times per year.
- A survey of ground fish stocks at about 600 stations in spring and autumn all around Iceland. Data from this survey have e.g. been recently used to study the abundance and distribution of polar cod in Iceland-East Greenland waters.

- Acoustic survey of capelin in autumn and winter mainly in the Iceland and Greenland Seas will enable analysis of the 1996-1999 Iceland Sea field activity in a longer term perspective.
- MRI scientists participate in the EU supported Euro-BASIN program whose main aim is to increase knowledge on the distribution, population variations, and trophic relations of the main zooplankton and pelagic fish stocks in the Northeastern North-Atlantic in relation to global climate change.
- NAACLIM (North Atlantic Climate) is an EU supported program that aims at understanding the effects of climate on the thermo/haline circulation and assess future forecasts in surface temperature and sea ice. The role of MRI scientists is to monitor variability in the flow of Atlantic water into Nordic Seas and deepwater flow south across the Denmark Strait.

As stated above the main field activity in the Iceland Sea Ecosystem project was undertaken in 2006-2009 and since then further activity has concentrated mainly on data analysis and publications. The publications produced in 2014 were as follows:

- Astthorsson, O.S., Gislason, A., Petursdottir 2014. Zooplankton composition and trophic relations on feeding grounds of capelin in the Iceland Sea. *IMBER Update (Integrated Marine Biogeochemistry and Ecosystem Research)* 26.
- Mork K.A., Skagseth Ø., Ivshin V., Ozhigin V., Hughes S.L., Valdimarsson, H. 2014. Advective and atmospheric forced changes in heat and fresh water content in the Norwegian Sea, 1951–2010. *Geophysical Research Letters* 41, 6221–6228.
- Mork, K.A., Drinkwater K.F., Jonsson, S., Valdimarsson, H., Ostrowski, M. 2014. Water mass exchanges between the Norwegian and Iceland seas over the Jan Mayen Ridge using in-situ current measurements. *Journal of Marine Systems*, 139, 227–240
- Palsson, O.K., Gislason, A., Gunnarsson, B., Gudfinnsson, H.G., Valdimarsson, H., Petursdottir, Thorisson, K., Olafsdottir, S.R. Sveinbjornsson, S. 2014. Meginþættir í vistkerfi Íslandshafs og breytingar í lífsháttum loðnu (Main features of the ecosystem of the Iceland Sea and changes in the life history of capelin, In Icelandic). *Náttúrufræðingurinn* 84, 4-18.
- Silva, T., Gislason, A., Licandro P., Marteinsdóttir G., Ferreira, A.S.A., Guðmundsson K., Astthorsson, O.S. 2014. Longterm changes of euphausiids in shelf and oceanic habitats southwest, south and southeast of Iceland. *Journal of Plankton Research* 36, 1262-1278.
- Wilken-Jon von Appena , Koszalka I.M., Pickart R.S., Haine T. W.N., Mastropole D., Magaldi M.G., Valdimarsson, H.Girton J., Jochumsen K. og Krahnmann G. 2014. The East Greenland Spill Jet as an important component of the Atlantic Meridional Overturning Circulation. *Deep Sea Research, Part I* 92, 7585

Further Iceland Sea and ESSAS related papers presently in preparation are:

- (1) On the distribution, abundance and biology of polar cod in Iceland-East Greenland waters by Astthorsson has been submitted to the ESSAS Polar Biology special issue.
- (2) On the trophodynamics of amphipod and calanoid species by Petursdottir et al.
- (3) On krill in Icelandic waters: Abundance, distribution and population structure in relation to physical and phytoplankton spring bloom dynamics by Silva et al.

8.3 Japan (Sei-Ichi Saitoh, Naomi Harada, 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 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 such as Japanese flying squid and yellow tail, and the occurrence of several unusual warm water species, all possibly linked to warming of the waters during autumn 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. A couple of cruises to the Bering and Chukchi seas were carried out by T/S Oshoro-Maru and R/V Mirai, the results of which were presented during the ASM. In collaboration with a Japanese research project (see next section), we call for papers to contribute to a special issue entitled "Catastrophic reduction of sea ice in the Arctic Ocean – its impact on the marine organisms and ecosystems in the polar region" from Biogeosciences (<http://www.biogeosciences.net>) until September 30, 2015. The papers can be valuable for not only for understanding the current environmental changes in the Arctic Ocean but also for obtaining new predictions of marine ecosystems of both low and high trophic level organisms including fish resources in this area.
- "Catastrophic reduction of sea-ice in the Arctic Ocean – its impact on the marine ecosystems in the polar region" is an ESSAS endorsed project, funded by the Japan Society for the Promotion of Science from 2010 to 2014. Naomi Harada has been leading this project as PI. Sea-ice in the Arctic Ocean has been dramatically reduced over the past decade. This reduction causes complex and enigmatic changes in the marine ecosystem throughout the Arctic Ocean, because of the simultaneously occurrence of "disadvantageous" phenomena, such as ocean acidification and "advantageous" phenomena such as improved light conditions for marine organisms. The project focused on the western Arctic Ocean where there has been the most serious sea-ice reduction in the Arctic region. The aims of the project were to 1) understand the temporal changes in primary production and the biological pump, 2) understand the physiological response of

marine phyto- and zooplankton to ocean acidification that is occurring simultaneously with warming and freshening from the sea-ice melting, and 3) develop a model to simulate the primary production, and understand the response of marine ecosystems and the biological pump to the environmental changes caused by rapid sea-ice reduction in the Arctic Ocean. The specific results of this study is the finding of a new mechanism that lateral transports nutrient-rich water masses from the broad shelf area (e.g. Chukchi Sea) to the oceanic basin (Canada Basin) by meso-scale eddies. This mechanism has recently contributed to enhance the primary and secondary productivity in the Arctic Ocean. This finding implies that the habitat area of lower trophic level organisms is enlarging in the Arctic Ocean due to recent sea ice reduction.

- “Plankton in polar regions—toward an understanding of their characteristics” is a new project, funded by the Japan Society for the Promotion of Science from 2015 to 2019. Naomi Harada has been leading this project as PI. The decline of biodiversity (the biomass, composition, and distribution of species) on Earth reflects the fact that the ability of the Earth to sustain biodiversity in a dynamic environment has been seriously compromised by environmental stressors such as climate change and ocean acidification. Furthermore, the reduction of sea ice in the Arctic Ocean, which has progressed more rapidly than previously predicted, could exacerbate several environmental stresses, including ocean warming, acidification, and stratification. How do marine organisms in polar regions respond to ocean warming and acidification? This study focuses on phytoplankton and zooplankton, which constitute the base of the food chain in the Arctic Ocean. The goals of the research are to understand 1) the influence of ocean acidification on calcifiers; 2) the warming-associated changes of the biomasses of major and minor species; and 3) the specific functions of plankton that live in the Arctic.
- The Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT) will start a new project called “ArCS” from fiscal 2015, in which we will incorporate “integrated science”. “ArCS” stands for “Arctic Challenge for Sustainability”. This project has the following three aims.
 1. To understand climate changes in the Arctic as well as their global impact through comprehensive and integrated research.
 2. To predict future changes and assess their possible socio-economic impact.
 3. To deliver robust scientific information to stakeholders for decision making and solving problems.At the same time, MEXT will strive to reinforce international cooperation and foster young researchers through this project. This is a 5-year program from 2015 to 2019 with a yearly budget of 8M US\$. MEXT selected a network of core institutions on July 1st 2015; National Institute of Polar Research as a representative organization and Japan Agency for Marine-Earth Science and Technology (JAMSTEC) and Hokkaido University as deputy representative organizations.
- 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 Saalin rookeries/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.

- The new Hakodate Marine Science Center called “Hakodate Research Center for Fisheries and Oceans” was opened on June 2nd 2014. Hokkaido University, Hakodate Future University, Hakodate Fisheries Research Laboratory, and 6 private companies are sharing the space and starting to develop innovation in fisheries and marine science fields with governmental-industrial-academic cooperation. There is a special pier for research vessels, including Oshoro-Maru (Hokkaido University), Ushio-Maru (Hokkaido University) and Kinsei-Maru (Hakodate Fisheries Research Laboratory), in front of this center.
- A new ship, the “Oshoro-Maru V”, was built and finished in July of 2014. Construction of “Oshoro Maru V”, as the replacement ship of the “Oshoro Maru IV”, was planned and conducted with the aim of supporting the needs of the field of fisheries sciences for the future by development of human resources who can play vital roles in the field worldwide, conservation of the ocean ecosystem, and management and securing of the seafood resources. It is slightly larger than the Oshoro-Maru IV, being 78 m in length and 1598 tons, with a capacity of 99 beds including 60 for students. She is equipped with fishing methods including stern trawling, longline fishing, drift gill-net fishing, squid jigging, etc. Hokkaido University had a celebration party for the new Oshoro-Maru V on August 1st 2014 in Hakodate Research Center for Fisheries and Oceans.
- A new program “Japanese – Russian Collaborative Expedition Field Observation in the East Kamchatka current” was launched and a cruise has been conducted from June 2 to July 8, 2014 for covering southeastern Okhotsk Sea and East Kamchatka current regions along Kuril Islands (ESSAS study region) using Russian Research Vessel Prof. Multanovskiy. The PI is Jun Nishioka from the Institute of Low Temperature Science, Hokkaido University and 32 scientists from Japan, Russia, USA, and China participated in this cruise to observe bio-optics, geochemical parameters, turbulent mixing process, etc.
- To understand linkages between the Arctic and subarctic oceans, a research expedition has been conducted in the western subarctic Pacific, Oyashio region, a key study site which is strongly influenced by sub-polar marginal seas, the Okhotsk Sea and the Bering Sea. The Japanese research vessel Hakuho Maru left March 6, 2015 and conducted a 21-day expedition. The PI was Jun Nishioka from Institute of Low Temperature Science, Hokkaido University and 32 scientist from physical, chemical and biological oceanographer participated to the expedition. The expedition aims at investigating the influences of sea-ice melt water from sub-polar marginal seas on biological processes and related biogeochemical dynamics in the subarctic region.
- The ASSW (Arctic Science Summit Week) 2015 was successfully held from April 23 to 30, 2015 at the Toyama International Conference Center in Toyama, Japan with a total of 708 participants from 27 countries, under the auspices of IASC (International Arctic Science Committee) and co-organized by the Science Council of Japan. The ASSW is the largest annual Arctic Science Meeting in the world, and this was the first time it was held in Japan. The next ASSW will be held in March 2016 at Fairbanks, Alaska.

8.4 Korea (Hyun Cheol Park/Hyung-Cheol Shin)

In 2014 Korea carried out a survey of the Chukchi, East Siberian and Beaufort seas on the RV Araon between 16 July to 3 October (79 days). As part of the cruise, a sea-ice camp was occupied in the Marginal Ice Zone (MIZ) of the Beaufort Sea in cooperation with the researchers from the US Office of Naval Research (ONR). Observations included ocean to ice heat fluxes, meteorological variables, radiative fluxes, snow and ice thicknesses and sea-ice temperatures. These were taken in part to develop a sea-ice energy budget and to model sea-ice thickness evolution. A sea-ice biochemical study was performed that focused upon the effect of changing sea ice on the Arctic marine ecosystem including species composition, abundance and diversity, carbon interaction between the sea ice and the water column, particle fluxes under the sea ice, and melt ponds.

Plans are underway for the 2015 Arctic Survey. The first leg will emphasize oceanography and geophysics. A CTD line will be run through from the Bering Sea, through the Bering Strait, north to the edge of the Chukchi Sea. A hydrographic survey of the region in the deep basin north of the Chukchi Sea will also be carried out. KOPRI will deploy 2 current meter moorings along the slope of the Chukchi Sea. In addition, a sea-ice station is planned at around 81°N.

A Korean Arctic Consortium is being established and is expected to start later in 2015. It will assess research needs and priorities for the Arctic. There will be 3 target areas: research; technology and industry; and policy.

8.5 Norway (Ken Drinkwater)

MENUII (Marine Ecosystem Comparisons of Norway and the United States II), was a Norwegian funded project (2009-2012) endorsed by ESSAS that was to compare different types of ecosystem models applied to Norwegian and US ecosystems. As part of that project, an end-to-end ecosystem model called Atlantis, developed by Beth Fulton in Australia, was applied in the Barents and Norwegian seas. A follow-on Norwegian project called @eco, also endorsed by ESSAS, has continued the development of this model. The zooplankton and fish components of the model have been stabilized and a fisheries component has been added. This now allows exploration of the ecosystem responses to different climate and fishing scenarios, which will be explored in follow-up projects. Norway is involved in the organization and planning of an Atlantis Summit led by Jason Link in the USA that will bring together those groups around the world using the Atlantis model. This meeting is scheduled to take place 4-6 December, 2015 in Honolulu, Hawaii.

Norway contributed to the Euro-BASIN project with a cruise during 2013 focusing upon zooplankton dynamics in the Norwegian, Iceland, Irminger and Labrador seas. Physical oceanographic observations were also obtained. An ICES theme session on *Basin-scale dynamics at lower trophic levels in the North Atlantic* will be held at the 2015 ASC in Copenhagen co-chaired by Astthor Gislason (Iceland), Claudia Castellani (UK) and Peter Wiebe (USA). Results from the Norwegian cruise will be presented in several talks and posters.

At the 2014 PICES meeting a theme session was led by Gordon Kruse (USA) on gadoids, mostly in the Pacific but there was also one talk on Atlantic cod. A special issue on gadoids is under consideration with 5-6 papers from the PICES session and the possibility of opening it up to others who would like to contribute. One of the papers would be on the comparison of life history characteristics and the influence of climate on Pacific and Atlantic cod.

8.6 Russia (Sen Tok Kim)

In Russia there are not any scientific programs directly affiliated with ESSAS concentrating on the dynamics and structure of marine ecosystems in subarctic seas. At the same time there is a National Integrated Program of Fisheries Investigations from 2012-2016 that annually presents the results of long-term monitoring of large sea ecosystems in Western Bering Sea, Okhotsk Sea, East/Japan Sea and Western Pacific region. In these Far-Eastern seas, 5-year Integrated Governmental Programs have been going on since 1980, thereby continuing for more than 30 years. These programs have collected data on the structure and dynamics of pelagic and demersal biological communities and on the abundance of different components of the ecosystems, such as nekton, plankton and benthos in term of both their number and biomass. The program also has provided climatic and oceanographic investigations aimed at revealing the long-term trends in the environment. Results of these studies have been represented in monographs, articles and reports at conferences (Shuntov, Temnych, 2013). It should be noted that the activity of this large-scaled and complicated work has been cut back substantially during the past decade because of increasing cost of surveys.

Additional programs with other objectives have been undertaken within the governmental Program. The main results of these studies on marine ecosystem in the Sea of Okhotsk to the beginning of 2015 are as follows:

1. It has been noted that global environmental changes are concurrently taking place all over the world. Analyses of bottom sediment cores have indicated similarity and high correlations of long-term climatic and biological variability in the subarctic Sea of Okhotsk with such far apart places as Greenland, the North Atlantic, and East Asia based on paleo-information (Gorbarenko et al., 2014). The historical glaciation periods resulted in high sea-ice density in the studied region that in turn intensified the role of the Sea of Okhotsk in the formation of northwestern Pacific intermediate waters. For the past 4-6 thousand years the growth of diatom phytoplankton production in the sea probably has been controlled by the reduction of sea ice formation and weakening of surface water stratification in spring (Gorbarenko et al., 2014).
2. It was observed that the modern long-term cyclical trend of fish community dynamics in the Sea of Okhotsk had been characterized by two increases in 1980s and 2010s and a decline in 1990-2000s (Shuntov, Temnych, 2013). During the increases there was a high level of fish productivity in the ecosystem that was approximately equal in both specified periods, with the total nekton biomass reaching 20-22 million tons. In this case nekton was represented as the sum of the resources of walleye-pollock, Pacific herring, Pacific salmon, squids and a complex of mezopelagic fish. Hence the total biomass of zooplankton in last decade decreased considerably, by almost 1.5 times (Dulepova, 2013). Additional data have demonstrated that the total biomass of demersal fish in the sea was higher in the early 1990s and 2010s (Savin et al., 2011; Kim, 2014). During all time periods, the food supply for nekton and nektobenthos in the Sea of Okhotsk apparently has remained sufficient because

of the wide variability of prey items of different species and a significant predominance of the production of these food sources compared with total biomass of all consumers (Dulepova, 2013).

Top-down control on fish dynamics is probably important on early stages of fish life but this period features are still quite unclear and it has been insufficiently studied (Shuntov, Temnyh, 2013; Dulepova, 2013).

Local investigations at spawning grounds of East Sakhalin walleye pollock were carried out by Sakhalin Institute of Fishery and Oceanography and by the end of 2015 it should provide information on the horizontal and vertical distributions of walleye pollock eggs and larvae, phytoplankton, zooplankton, and such environmental factors as temperature, salinity, oxygen, currents and water mass. These data are presently being analyzed and the results are to be published in 2016.

Some important tasks in the future:

1. It is still unclear what the specific mechanisms through which the climate and ocean dynamics affect biological communities. It has been constantly expressed the importance of providing further investigations into these mechanisms, especially on different local populations group.
2. Since the intensification of mineral resources output, it is necessary to determine how mineral and biological resource production may interact, especially in high productivity regions or in areas of high species diversity in the Sea of Okhotsk.

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Shuntov V.P., O.S. Temnych. 2013. *Illusions and realities of ecosystem approach to study and management of marine and oceanic biological resources. Izvestiya TINRO, V. 173. p. 3-29.*

Dulepova E.P. 2013. *Utilization of forage resources by nekton in periods of its high abundance in the Okhotsk Sea. Izvestiya TINRO, V. 173. p. 146-163.*

Savin, A.B., E.N. Il'inskii, and N.L. Aseeva. 2011. *Long-term dynamics of bottom and near-bottom fish composition at the West Kamchatka shelf in 1982–2010, Izvestiya TINRO, V. 166, pp. 149–165.*

Kim Sen Tok. 2014. *Spatial distribution and long-term dynamics of biomass of demersal fish in the zone of the Eastern Sakhalin Current (Sea of Okhotsk). Journal of Ichthyology, 2014, Vol. 54, No. 9, pp. 660–669.*

8.7 U.S.A. (Franz Mueter)

There are currently three ESSAS affiliated research programs (1) the Bering Sea Ecosystem Study/Bering Sea Integrated Ecosystem Research Program (BEST/BSIERP, <http://bsierp.nprb.org>), (2) the Gulf of Alaska Project (<http://www.nprb.org/gulf-of-alaska-project>) and (3) the Arctic Ecosystem Integrated Survey (Arctic EIS, <https://web.sfos.uaf.edu/wordpress/arcticeis>). US scientists are also involved in a number of other national and international programmes that are relevant to ESSAS and ongoing

monitoring programs contribute data from Subarctic and Arctic waters of the US for future comparative analyses.

(1) The large, interdisciplinary BEST/BSIERP program, which aimed to better understand ecosystem processes in the Bering Sea, was funded by the North Pacific Research Board (NPRB) and ended in 2014. The publication of new papers from this effort continues with over 150 peer-reviewed publications to date, which are listed on their website (<http://www.nprb.org/bering-sea-project/detailed-results-findings/scientific-publications/>) with links to most of the papers. A series of NSF-funded projects have further integrated some of the BEST/BSIERP field data into physical and biophysical models and have synthesized observations and model results. These papers will also be available through the BEST/BSIERP website.

(2) The Gulf of Alaska Project is a 5-year study (2010-2015), also funded by NPRB, with two full field seasons (2011, 2013) that has focused on regional comparisons between the eastern and western Gulf of Alaska. 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 three themes: (i) Connectivity between offshore spawning areas and inshore nursery areas for five groundfish species, (ii) Regional comparison of the physical and biological mechanisms that determine annual survival of juvenile groundfishes and forage fishes in the eastern and western GOA regions, and (iii) Species interactions (including predation and competition) and their influence on the abundance and distribution of individual species and their habitat requirements by life stage and season.

(3) The Arctic Ecosystem Integrated Survey is a 4-year study (2012-2016) that has completed two field seasons (2012, 2013) during which comprehensive ecosystem surveys to assess the abundance, distribution, and ecology of Arctic marine species throughout the northern Bering and Chukchi Seas were conducted. A series of papers for a special issue in Deep-Sea Research are currently in review and two related papers on Arctic cod (*Boreogadus saida*) have been submitted to the Special Issue on Arctic Gadids in Polar Biology arising from last year's ESSAS ASM.

In addition to these projects, ongoing monitoring programs assess the abundance and distribution of demersal fishes in the Gulf of Alaska (biennially), the Aleutian Islands (biennially), the Bering Sea (annually), the Northern Bering Sea (opportunistically), and the Chukchi Sea (opportunistically), as well as the abundance and distribution of salmon, young-of-the-year groundfish, and forage fish in the eastern Bering Sea (annually) and in the Chukchi Sea (opportunistically). Other ongoing sampling programs include the Seward Line in the central Gulf of Alaska, a long-term observation program (LTOP) undertaken from 1998-2004 by the Northeast Pacific GLOBEC program, and continued from 2005-2009 by the North Pacific Research Board. It is now funded by a consortium of NPRB, AOOS, and EVOS. In the Bering Sea, several biophysical moorings have been deployed along the middle shelf (70 m) of the eastern Bering Sea with the first mooring (M2) sampling more or less continuously since 1997. The moorings are deployed by the Pacific Marine Environmental Laboratory with additional support from NPRB. At M2, a new OA mooring has

recently been deployed to sample the partial pressure in CO₂ (pCO₂) and pH on the southeastern Bering Sea shelf.

With increasing interest in offshore oil and gas development in Alaska's Arctic, a number of ongoing studies in the Chukchi Sea and Beaufort Sea monitor all aspects of the bio-physical environment, including a new program to develop an Arctic Marine Biodiversity Observing Network (AMBON) in the Chukchi Sea. Both national and international programs contribute to sampling a series of "hotspot" transects and stations along a latitudinal gradient from the northern Bering Sea to the northern Chukchi Sea, collectively known as the Distributed Biological Observatory (DBO, <http://www.arctic.noaa.gov/dbo/>). Transects for the DBO were selected because they exhibit high productivity, biodiversity, and overall rates of change and will serve as a change detection array for the identification and consistent monitoring of biophysical responses.

Data, metadata, and model results for all of Alaska's seas from these and many other projects are made available through the Alaska Ocean Observing System's data portal at <http://www.aos.org/>, which includes real-time data sensors, separate Ocean Data Explorers for the Arctic, Bering Sea, and Gulf of Alaska, and a Model Explorer to visualize and explore model outputs for many ocean variables.

8.8 West Greenland (AnneDorte Burmeister)

The Greenland Institute of Natural Resources (GINR) is the Greenland Self government's center for biological research whose primary objective is to provide the scientific basis for a sustainable use of the natural resources in Greenland, as well as safeguarding the environment and biological diversity. Living resources constitute a vital role for the Greenlandic society, culturally as well as financially. Resources are under pressure from development, for which reason the society is under obligation to ensure wise and sustainable exploitation for future generations and conform to international agreements.

The scientific advice worked out by GINR is independent of special interest and is prepared based on documentation from research and monitoring. Population assessments, advice etc., are produced and quality assured in international scientific committees such as: ICES, NAFO, NEAFC, IWC, NAMMCO, JCNB, PBSG, CSWG and CARMA.

The staff at GINR consist of about 60 people in six departments; Department of Administration, Section of Communication, Department of Fish and Shellfish, Department of Birds and Mammals, Environment and Mineral Resources and Greenland Climate Research Centre. GINR has office and laboratory facilities, guest accommodations and a boathouse located in Nuuk, as well as several permanent field stations in West as well as East Greenland. The Institute has also two large research ships, a stern trawler r/v Pâmiut (721 GRT) and a new research ship r/v Sanna (399 GRT) build in 2012, as well as several small boats, dinghies and snowmobiles.

The monitoring activities at the Institute focus on exploited species and constitute a significant part of the continuous scientific documentation of population dynamics. Surveys are conducted annually for fisheries species of commercial interests (i.e. shrimp, cod, Greenland halibut, snow crab, redfish, and mackerel) and at regular intervals for hunting

resources. Monitoring is carried out in collaboration with international institutions, as most populations cross international boundaries.

Greenland has no national ESSAS programme or any projects which are officially endorsed by ESSAS. Nevertheless, GINR conducts research into Arctic ecosystems and how they are affected by climate and human impacts. Research programme are mainly focused on living marine resources, fish, shellfish, marine mammals and birds as well as terrestrial mammals, vegetation and minerals and is directed towards abiotic and biotic processes in the environment in relation to climate change and its impacts upon fisheries and hunting.

The research program relevant for ESSAS in 2015 mainly focus on:

- **Pelagic and demersal fish and crustaceans** – The programme monitoring and assessing of pelagic and demersal fish and shellfish resources, which contributes studies on climate related changes in spatial distribution, abundance and reproductive potential.
 - **Sandeels** - In numerous marine ecosystems of the northern hemisphere, sandeels (*Ammodytes*) form a crucial node in the flow of energy from primary producers to top predators. The lipid content of sandeel varies markedly with season and in response to climatic variability and they serve as a bio-indicator of system productivity and change and thus enable us to monitor change and possibly predict the effect of future expected warming.
 - **Atlantic mackerel** - GINR has a range of scientific activities related to Atlantic mackerel (*Scomber scombrus*). Annual monitoring of the mackerel stock in Greenlandic waters is part of the International Ecosystem Survey in the Nordic Seas coordinated through ICES. GINR also contributes to the assessment of the mackerel stock in ICES WGWIDE. Furthermore there are a series of ongoing research projects being conducted to understand the migration and growth of the mackerel as well as the trophic interactions between mackerel and the pelagic ecosystem off East Greenland.
 - **Hydrographic parameters** - Annual monitoring of hydrographic parameters along the West Coast of Greenland.
 - **Greenland Ecosystem Programme (GEM)**. This project is an integrated monitoring and long-term research programme on ecosystems and climate change effects and feedbacks in the Arctic. GEM is one of the contributions from Denmark, including Greenland. It consists of five sub-programmes and a number of strategic cross cutting initiatives that also includes collaboration with other complimentary operational monitoring and research activities. More information of the programme can be found at: <http://g-e-m.dk/gem-programme/>.
- **CLIMATEBASIS PROGRAMME** monitors climate and hydrology in Zackenberg and Kobbefjord and is run by [Asiaq - Greenland Survey](#). The collected data build base-line information on climate variability and trends for all the other sub-programmes within GEM and serve as a trustworthy foundation for adaptation strategies for the Greenlandic society.
 - **GEOBASIS** – a monitoring programme focusing on selected abiotic characteristics in order to describe the state of Greenlandic terrestrial

- environments and their potential feedback effects in a changing climate. The programme is divided into sub-groups as: Snow properties (spatial and temporal variation in snow cover), soil properties (monitoring of key soil parameters), meteorology, flux monitoring, hydrology and geomorphology.
- **CLASIOBASIS PROGRAMME** - monitoring the glacier surface mass balance at the A.P. Olsen Ice Cap and its response to climate forcing.
 - **BIOBASIS** – monitors the dynamics of organisms and biological processes in terrestrial and limnic ecosystems at Zakenberg (High Arctic - North East Greenland) and Nuuk (Low Arctic – West Greenland). The programme includes monitoring of flora, arthropods biodiversity, birds, mammals and monitoring of freshwater biotic and abiotic dynamics.
 - **MARINE BASIS PROGRAMME** – collects physical, chemical and biological data from the Greenland coastal zone. Work is focused in two fjord systems (Godthåbsfjord and Young Sund) both influenced by glaciers connected to the Greenland Ice Sheet. Data collected enables identification of long-term trends in key parameters such as sea-ice coverage, ocean temperature, salinity and pH, nutrient dynamics, primary production and marine biodiversity. Data from the program are integrated in several work groups under the Arctic Council such as CBMP, AMAP and CAFF.
 - **Arctic Science Partnership (ASP)** – the vision of the programme is that ASP will be a leading consortium on climate, cryosphere, ecosystems, and human interactions through research, monitoring and education. It aims to facilitate and integrate active scientific cooperation between the ASP and its members and runs several field campaigns and research projects. More information is found at: <http://www.asp-net.org/>

9. Multi-national Programs

9.1 Norway/USA/Iceland/Denmark/Faroes (NUCCME)

Building upon the success of the MENU series of projects, a Research Council of Norway funded workshop was held in May 2014 in Ulvik, Norway. The workshop title was NUCCEM (Norway and United States Climate Change of Marine Ecosystems) and was an ESSAS endorsed project. The main objectives were to use future projections such as the recent IPCC model scenarios (1) to explore how they can be used in ecosystem models to determine the likely changes under anthropogenic climate change to the lower trophic levels, develop ecosystem indicators of such change, and determine related variables indicative of ecosystem productivity; (2) to examine models of living marine resources to explore how to include climate features in future projections and setting of harvest control rules; and (3) to determine the potential economic and societal consequences of climate change in the two regions. The workshop was jointly undertaken with the Nordic network: *Climate impact on fish, fishery industry and management in the Nordic Seas* (CLIFFIMA; <http://www.imr.no/cliffima/en>). This network had been examining the effects of climate change on the biological and societal systems of the Nordic Seas and hence their interests were closely aligned with those to be discussed at the NUCCEM workshop. The workshop was organized into three research tracks (i.e. break-out groups) to focus on three objectives

listed above. Each group discussed potential papers to be written and decided to publish them in a special issue. The journal *Elementa: Science of the Anthropocene* has agreed to publish the special issue. There are presently 10 papers that are in preparation and are expected to be submitted in late summer or early autumn and published in 2016. The papers cover physical oceanography, climate, lower trophic levels, fish population dynamics, fisheries and fisheries management.

9.2 Japan/USA/Norway (RACArctic)

ESSAS was recently awarded funding (497 Euros) for a synthesis activity under the Belmont Forum call on Arctic Observing and Research for Sustainability. Entitled RACArctic (Resilience and Adaptive Capacity of ARCTIC marine systems under a changing climate) the proposal was jointly submitted by Japan, the USA, and Norway, and is funded for 3 years beginning in July 2015. The project is headed by Sei-Ichi while Franz leads the US team and Ken the Norwegian team. The aim is to synthesize information from completed and ongoing regional studies on how climate variability and change in the Subarctic to Arctic transition zones may affect future marine ecosystems of the Pacific and Atlantic Arctic. In particular, it will examine how fish populations and their prey are able to adapt or respond to natural and anthropogenic changes in the Arctic and how these are expected to affect existing and future fisheries, subsistence harvests, and the socio-economic systems that depend upon them. The Project also will incorporate input from user groups who directly or indirectly depend on living marine resources and assess the strengths and weaknesses of current management institutions in Japan, the US and Norway in terms of their capacity to successfully meet the anticipated challenges associated with global warming and ocean acidification.

The syntheses will be achieved principally through a series of 3 workshops, one in each of the sponsoring nations, coupled with inter-session work. The first workshop will be held in Japan in March of 2016 at which each of the nations will provide a review of the main processes on how climate influences their particular ecosystems. A plan will be established at this meeting for the development of the comparative syntheses. The second meeting will be held in 2017 in Alaska where the emphasis will be on user input. This will include Alaskan indigenous peoples as well as local fishing companies, fishers and other fishing communities. The final workshop will be held in early 2018 in Norway and will complete the syntheses and lay out the plans for the writing of scientific papers and reports based on the results from the Project. These will include stakeholder summaries that will evaluate the potential sustainability of Arctic marine ecosystems under climate change and provide recommendations to both the fishing industry and northern communities to prepare for potential problems they might encounter. They will be written by a team consisting of both scientists and user groups. Recommendations on future internationally coordinated research and monitoring activities will also be made.

To our knowledge, this is the first international project that draws on similar and complimentary research programs across the Pacific and Atlantic Arctic to assess the resilience and adaptive capacity of Arctic marine systems to climate variability and change, with an emphasis on fish and fisheries and including socio-economic subsystems.

10. Next Meeting

The location of the next ESSAS ASM and SSC meetings will be in Yokohama, Japan and be hosted by JAMSTEC, led by Naomi Harada. The specific dates of the meeting and the topics to be covered will be determined by JAMSTEC but it will be coordinated in time with the RACArctic Project meeting to be held in Hakodate, Japan, in March of 2016.

ACTION: Naomi will discuss with her colleagues at JAMSTEC what topics they might like for the ESSAS ASM next year and report back within a month.

11. End of the Meeting

The co-chairs thanked the SSC members for their input and participation in the discussions, especially Erica Head who will be stepping down from the SSC and George Hunt for his role in organizing the ASM by obtaining rooms and arranging snacks during the SSC meeting. The meeting was then adjourned.

Appendix 1 – Participant Contact Information

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<p>Alan Haynie (Guest) NOAA/NMFS, Alaska Fisheries Science Center 7600 Sand Point Way NE, Bldg 4 Seattle, WA 98115 alan.haynie@noaa.gov</p>	

Appendix 2 - ESSAS 2015 SSC Meeting Agenda

Thursday 18 June, 2015

13:00 Introduction

- Adoption of the Agenda Ken Drinkwater/Franz Mueter
- Adoption and follow up of 2014 Meeting Report Ken Drinkwater
- IMBER and Future Earth Ken Drinkwater
- ESSAS Budget & Funding Ken Drinkwater/Franz Mueter

14:30 Working Groups (Presentations limited to 10 minutes)

- WG on Modelling Ecosystem Response Ken Drinkwater
- WG on Arctic-Subarctic Interactions Franz Mueter
- WG on Human Dimensions Alan Haynie
- WG on Bioenergetics Ken Drinkwater
- WG on Paleo-ecology Ben Fitzhugh

16:30 Future Directions-Short Term

Open Discussion

- 2015-2016
 - Workshops, Comparative Studies, Theme Sessions
- Next year's meeting
 - Theme/ Objectives, Workshops
 - Organization
 - Dates and Location (Venue)

Friday 19 June, 2015

09:00 Future Directions-Short Term Continued

Open Discussion

- SSC and WG co-chair Memberships

10:00 Future Directions-Longer-term

- Another ESSAS OSM?

- ESSAS Website

Open Discussion

- ESSAS Project Office

Sei-Ichi Saitoh/Franz Mueter

National Program Updates (Limited to 15 minutes, 10 slides)

- Greenland/Denmark

AnnDorte Burmeister

12:00 Lunch

13:00 National Program Updates (Limited to 10 minutes, 5 slides)

- Canada Erica Head
- Iceland Ólafur Astthorsson
- Japan Sei-Ichi Saitoh/Naomi Harada
- Korea Hyun-cheol Kim
- Norway Ken Drinkwater
- Russia Sen Tok Kim
- USA Franz Mueter/George Hunt

International Program Updates

- **Russia/Japan in the Sea of Okhotsk**
- **RACArctic**
- **NUCCME**

Sen Tok Kim

Sei-Ichi Saitoh/Franz Mueter

Ken Drinkwater

15:30 Wrap Up

- **Recommendations**
- **Action Items**

16:00 Adjourn