Report on the Technical Committee on Monitoring

The Technical Committee on Monitoring (hereafter MONITOR) met twice in Vladivostok, Russia: 1.) 18:00 to 20:00 on Sunday, September 24, 2017 and 2.) 14:00 to 18:00 on Wednesday, September 27, 2017. Prior to the meetings, a MONITOR briefing book, containing the draft agenda and information regarding agenda items, will be circulated to MONITOR members. The briefing book was updated and recirculated as new information was provided.

MONITOR Meeting participants. From left to right: Song Yong Kim, Vyacheslav Lobanov, Sonia Batten, Jennifer Boldt, Tetjana Ross, Vladimir Kulik, HeeYoon Park, Jilong Li, Sei-Ichi Saitoh, Kazuaki Tadokoro.

Sunday, September 24, 2017

AGENDA ITEM 1
Welcome and introductions

MONITOR Chair, Dr. Jennifer Boldt, called the meeting to order, participants introduced themselves, and the agenda was reviewed and adopted (***MONITOR Endnote 1***and ***MONITOR Endnote 2***).

AGENDA ITEM 2
PICES-2017 information and judges

a. Topic Sessions and Workshops at PICES-2017
MONITOR was a sponsor of the following Topic Sessions and Workshops at PICES-2017:

- S4: MONITOR Topic Session (S4) on "*Adverse impacts on coastal ocean ecosystems: How do we best measure, monitor, understand and predict?*" Co-convenors: Akash Sastri (Canada), Naoki Yoshie (Japan), Jack Barth (USA)

- MONITOR/TCODE Workshop (W1) on "The role of the northern Bering Sea in modulating the arctic II: International interdisciplinary collaboration". Co-sponsored by NPRB. Co-convenors: Matthew Baker (USA), Lisa Eisner (USA), Kirill Kivva (Russia)

b. Judges for the Best Presentation award

MONITOR was tasked by the Science Board Chair to judge a MONITOR-sponsored Topic Session S4. Best Oral Presentation was awarded to early career scientist, Jiyoung Lee, for her talk on "*Seasonal microbial community composition in the Jinhae Bay hypoxic zone, South Korea*". Best Poster was awarded to early career scientist, Rikuya Kurita, for his presentation on "*High-resolution monitoring of phytoplankton communities using spectral fluorescence signatures*".

AGENDA ITEM 3

Reports from PICES groups

a. FUTURE SSC

Dr. Vyacheslav Lobanov, FUTURE SSC liaison to MONITOR, provided a review of FUTURE's goals, liaisons to committees, how expert groups and committees map onto the FUTURE program, expert groups (WG 35, WG 36, WG 40), plans to expand the FUTURE footprint on the PICES website, advancements made during the FUTURE inter-sessional meeting, and the PICES-2017 FUTURE Plenary Session (S10).

b. Advisory Panel on North Pacific Coastal Observing Systems (AP-NPCOOS)

Dr. Sung Yong Kim gave an overview of AP-NPCOOS's activities and its meeting at PICES-2017. AP members from Canada, Korea Japan, and Russia attended the meeting. AP-NPCOOS TORs were reviewed and it was noted that the AP maps onto all 4 regions of FUTURE conceptual schematic.

AP-NPCOOS products in 2018:

- A set of publications (overview paper and six papers from individual countries in a special issue in *Journal of Ocean Technology* in spring 2018);
- PICES Summer School on "*Coastal ocean observing systems and ecosystem monitoring*" (July 9–13, 2018, Victoria, Canada);
- A Topic Session will be proposed for PICES-2019 to accommodate the outcomes of Summer School;
- Dr. Jack Barth will
  - co-convene a Workshop (W8) on "*Connecting climate, ocean and ecosystem observation – Ocean observation futures*" at the 4th International Symposium on "*The effects of climate change on the world's oceans*", June 4–8, 2018, in Washington, DC, USA;
  - be a Plenary Speaker in Session 3 on "*Challenges in observing and modeling Pacific transitional areas*" at the International Symposium on "*Understanding changes in transitional areas of the Pacific*", April 24-26, 2018, La Paz, Mexico. (The talk is relevant to MONITOR and AP-NPCOOS activities. Dr. Barth will invite input from MONITOR and AP members as the meeting gets closer.)

c. Advisory Panel for a CREAMS/PICES Program in East Asian Marginal Seas (AP-CREAMS)

Dr. Lobanov reported that Drs. David Checkley and K.I. Chang stepped down as members; new members to replace them have been requested; a Canadian member would be welcome too.

- AP-CREAMS held an inter-sessional meeting May 11–12, 2017, in Toyama, Japan. The AP reviewed activities and joint meeting with NOWPAP on May 10, 2017.
- At PICES-2017, AP-CREAMS discussed the status of international cooperation, including a Korea-Japan-

China cooperative cruise, other prospective cruises, and a cruise to mark 20 years after start of CREAMS 1999.

AP-CREAMS products:

- EAST I report (Supplement Chapter to the second version of NPESR): This report was edited for publication in 2016. AP-CREAMS is still waiting for a decision from GC.
- EAST II publication: A draft will be completed by the end of 2017, submitted to the CREAMS editorial board, and submitted to PICES in March 2018. Given that many authors are involved in writing this report, authors requested 6 months extension to finish the report.

Plans for 2018 and beyond:

- Inter-sessional meeting in April–May 2018, Hangzhou, China;
- Annual meeting at PICES-2018, October 25–November 4, 2018, Yokohama, Japan;
- EAST-I area: Joint Korea-Russia cruise in November 2018 (R/V *Akademik M.A.Lavrentyev*);
- EAST-II area: Japan-China-Korea cruise in July 2018 (T/V *Nagasaki-maru*);
- EAST-II Korea-Japan-China April 2018 (*Onnuri*);
- Development of basin-scale EAST-I + EAST-II survey 2018–2019;
- Proposal for a PICES Summer School on "*Satellite oceanography*", jointly with NOWPAP, late August 2018, Seoul, Korea.

d. Working Group on Third North Pacific Ecosystem Status Report (WG-NPESR3/WG 35)

WG 35 Co-Chair, Mr. Peter Chandler, provided an update on the NPESR. WG members have developed an online submission system for contributing ETSOs to help make writing NPESR a more straightforward process. Lead authors have been identified for each region plus the subjects of human dimensions and climate variability separately. A schedule of the NPESR process was outlined. Following PICES-2017, NPESR regional assessments will be submitted to MONITOR and FUTURE, and in the summer of 2018, there will be a synthesis and writing workshop. Some challenges include: ETSOs have not been submitted online in the numbers expected. Of the hundreds proposed, 65 have been submitted, and there is an imbalance in nationality and subjects. ETSO coordinators will continue to try to get ETSOs, but they will use a hybrid approach: lead authors will write assessments with support of contributing authors and they will continue to emphasize the ETSOs database.

AGENDA ITEM 4

POMA, other business, ISB-2017, PICES-2017 notes

a. POMA

MONITOR committee members were encouraged to solicit additional nominees for next year's POMA (PICES Ocean Monitoring Service Award). This award aims to recognize organizations, groups and outstanding individuals that have contributed significantly to the advancement of marine science in the North Pacific through long-term ocean monitoring and data management.

b. Other

- Committee members were encouraged to provide the following information to the MONITOR Chair by September 27, 2017:
  - Any proposals and requests for funding, including travel, publications, *etc*. (*e.g*., summer school);
  - Proposals for new expert groups, with suggested members and recommended co-chairs (if known);
  - Changes in expert group membership.

- NPAFC Annual Meeting will be held May 21–25, 2018, in Khabarovsk, Russia. A workshop will be held just after the Annual Meeting on May 26–28, 2018 for the International Year of the Salmon – "*Pacific salmon production in a changing climate*".

Wednesday, September 27, 2017

AGENDA ITEM 5
Proposals for 2018

MONITOR reviewed topic sessions, workshops, and inter-sessional workshops for 2018 and identified some for which it would be interested in sponsoring:

Topic Sessions at PICES-2018:
- *Internal tides and nonlinear internal waves in North Pacific shallow seas: observations, modeling, and implications for coastal marine ecosystems*;
- *Influence of climate and environmental variability on pelagic and forage species*.

Workshops at PICES-2018:
- *PICES contribution to Central Arctic Ocean (CAO) ecosystem assessment (Second)*;
- *Identifying common reference points and leading indicators of ecosystem change*.

Inter-sessional workshops:
- NPESR3 Synthesis Workshop
- PICES contribution to Central Arctic Ocean (CAO) ecosystem assessment (First).

AGENDA ITEM 6
ICES ASC theme session proposals

MONITOR members will discuss and rank ICES theme session proposals for its 2018 Annual Science Conference via email when the proposals become available.

AGENDA ITEM 7
Relations with other PICES groups/programs, and international and national organizations and programs

a. Status of Pacific Continuous Plankton Recorder (CPR) program and activities of Sir Alister Hardy Foundation for Ocean Science (SAHFOS) and GACS

Dr. Sonia Batten provided an update on CPR, SAHFOS, and GACS research, training, publications and funding status ***MONITOR Endnote 3***). As of the end of 2016, over 25,000 samples have been collected, of which about 6,800 have been analysed for plankton abundance data. Funding is reasonably secure through 2018 for sampling operations and analysis of the eastern Pacific samples, however, funding to analyse the western Pacific samples has come to an end, and a replacement source must be found. See ***MONITOR Endnote 3*** for publications in 2017.

b. Ecosystem Study on the Sub-Arctic and Arctic Seas (ESSAS)

Dr. Sai-Ichi Saitoh-san provided an update on ESSAS activities. The goal of ESSAS is to compare, quantify and predict the impact of climate variability and global change on the productivity and sustainability of Sub-Arctic and Arctic marine ecosystems. ESSAS is an IMBeR Regional Programme. Focused research in Sub-Arctic and Arctic regions is carried out by working groups: Arctic-Subarctic Interactions, Paleo-Ecology of Sub-Arctic Seas, Human Dimensions, Bioenergetics of Subarctic and Arctic Fishes. In 2015, Japan, the U.S., and Norway submitted a proposal entitled "Resilience and adaptive capacity of Arctic marine systems under a changing climate" to the Belmont Forum CRA "Arctic Observing and Research for Sustainability" (RACArctic). This was one of ten programs accepted. Principal investigators are Sei-Ichi Saitoh, Ken Drinkwater, and Franz Mueter. The goal of this 3-year project is to review and synthesize results from national programs in the three member countries (Japan, USA, Norway) to assess the resilience and adaptive capacity of these arctic marine systems in a changing climate, from both a natural and social science perspective. Anticipated products from this project include three synthesis papers on climate change impacts and challenges in the Pacific Arctic and Atlantic Arctic gateways as well as an overall synthesis paper.

An ESSAS Open Science Meeting was held in Tromsø, Norway, June 11–15, 2017. The ESSAS Annual Meeting is planned for June 11–15, 2018, Fairbanks, AK. The ESSAS website is in the process of being moved to Hokkaido University: http://essas.arc.hokudai.ac.jp/.

c. North East Asian Regional GOOS (NEAR-GOOS)

Dr. Vyacheslav Lobanov provided an update of NEAR-GOOS activities. NEAR-GOOS is an intergovernmental network under IOC/WESTPAC and part of 13 regional alliances and covers area of Asian marginal seas. Established in 1996, it consists of 2 members from each of 4 countries (Japan, Korea, China, Russia). The mission is "to develop a comprehensive and sustained ocean observing network in the North-East Asian regional seas and coastal regions, especially focussed on observations, monitoring and other activities that cannot be easily implemented by countries acting independently. This network will embrace a wide range of data types and will be accompanied by pilot observing experiments, trials and demonstrations, training and useful products for use by the participating members and as a contribution to the GOOS and other global observing initiatives." Three working groups were established: data management, products, ocean forecasting systems. Pilot projects include:

1) New generation satellite – SST at 4 km grid;
2) Cross-basin climate monitoring section; conduct simultaneous data collection in Russian and Japan waters and share data (POI and JMA); done end of October/Nov;
3) Regional operational ocean forecasting;
4) Ferry-based monitoring (in test mode);
5) Satellite tags on seals.

NEAR-GOOS has established a sustained international data exchange system that provides useful information for oceanographic community. Over its more than 20 years history NEAR-GOOS developed technology of oceanographic data management, exchange and services, communication with data providers and users. Further development of NEAR-GOOS would require more involvement of partners/data providers by strengthening collaboration with other regional and organizations and programs (*e.g.*, GOOS, PICES, PAMS, others).

Dr. Lobanov invited MONITOR to participate in NEAR-GOOS Annual Meeting, November 20–22, 2017, Fuzhou, China.

d. Alaska Ocean Observing System (AOOS)

Dr. Lisa Eisner and Molly McCammon provided a report on AOOS activities (***MONITOR Endnote 4***). AOOS continues to support ongoing observing activities throughout Alaska waters.

e. GOOS Biology and Ecosystems Panel (BioEco)

Drs. Batten and Sanae Chiba provided an update on the GOOS BioEco Panel activities.

The recent focus of the panel has been on developing specification sheets for each of the Essential Ocean Variables (EOVs) see (www.gosocean.org/eov). The next phase is to develop workplans to implement them, within the various communities that monitor each variable.

For each EOV, a workplan is being developed. The Live Coral Cover EOV is one of the first, but the EOV Zooplankton Diversity scores highly on the feasibility scale, and will be addressed soon. The workplan includes:

- Description of the 2- and 5-year vision,
- Identifying the need (science questions, societal drivers),
- Identifying the capability (networks, infrastructure, monitoring sites, portfolio of methods, partners),
- Identifying the impacts (engagement of stakeholders, inform global assessments, engage developing countries, capacity building, delivery of data),
- Actions (how to achieve the vision, coordination and integration and secure funding).

A workshop on the "*Implementation of multidisciplinary sustained ocean observations*" (IMSOO) was held February 8–10, 2017, in Miami, USA), with the attendance of ~50 researchers across disciplines to identify applications and innovation priorities to benefit from multidisciplinary observations within three demonstration themes (plankton, boundary currents and oxygen minimum zones); see the IMSOO workshop report). One output from the Plankton demonstration theme was a proposed SCOR Working Group on Integration of Plankton-Observing Sensor Systems to Existing global Sampling Programs under the leadership of Emmanuel Boss (University of Maine) and Anya Waite (Alfred Wegener Institute), and with the participation of Sonia Batten and Frank Muller-Karger from the GOOS BioEco Panel.

Action: Dr. Batten to communicate with MONITOR members for contact names of zooplankton experts in PICES countries.

f. World Ocean Assessment II (WOA II)

Dr. Chiba provided an update on the World Ocean Assessment II. The United Nations Regular Process for Global Reporting and Assessment of the State of the Marine Environment, including Socioeconomic Aspects, commonly called the 2nd Process of the World Ocean Assessment (WOA II), was launched in 2016 and the UN plans to publish the assessment document in 2020. The first products of the 2nd Process were three Technical Abstracts, produced based on the WOA I (2015), and distributed at the UN Ocean Conference in June 2017. The abstracts target policy makers and address the major UN ocean related issues, particularly Biological Diversity in the Areas Beyond National Jurisdiction (BBNJ), Sustainable Development Goals (SDGs) and Impact of Climate Change and related Changes in the Atmosphere on the Oceans, respectively.

The Group of Experts, the leaders of the writing team, are currently preparing the draft structure of the WOA II. The structure was examined through the five regional workshops held in 2017, in countries in the North Atlantic, North Pacific, South Atlantic, South Pacific and Indian Ocean. The North Pacific Regional Workshop was hosted by WESTPAC and held in November 28–30, 2017 in Bangkok, Thailand. PICES was encouraged to send representatives to the North Pacific regional workshop. Dr. Chul Park, (PICES Chair), Dr. Hiroaki Saito (Science Board Chair) attended as well as the two co-chairs of Working Group on the *Third North Pacific Ecosystem Status Report* (WG 35; Dr. Sinjae Yoo and Mr. Peter Chandler). Dr. Yoo provided a brief overview of the structure and timetable for the third North Pacific Ecosystem Status Report. It is anticipated that PICES will be asked to provide nominations for the Pool of Experts. The Group of Experts will develop the final draft of the structure of WOA II by February 2018 and submit it to the Ad Hoc Working Group of the Whole on the Regular Process for Global Reporting and Assessment of the State of the Marine Environment (AHWGW) in April 2018. (Dr. Chiba is a Group of Experts member.)

g. Collaboration with HD Committee

Dr. Mitsutaku Makino, Human Dimensions Committee Vice-Chair, provided a summary of a proposed new PICES-MAFF Project "Building Capacity for Coastal Monitoring by Local Small-scale Fishers". The overall project goal is to build capacity to monitor coastal ecosystems and coastal fisheries by local small-scale fishers. It will lead to better fisheries management and more adaptive/resilient community. The proposed project, funded by Japan under a PICES framework, is about monitoring activities by local small-scale fishers in Indonesia. The Ministry of Agriculture, Forestry and Fisheries (MAFF) will provide funding for the project through the Fisheries Agency of Japan (JFA). The project period is for 3 years (from April 2017 to March 2020. The MAFF financial contribution is from the Official Development Assistance (ODA) Fund and therefore, involvement of developing Pacific Rim countries in project activities is required. The case study site is Indonesia and will introduce mobile phone-based technology for ecosystem monitoring and fisheries monitoring by the small-scale coastal fishers in Indonesia. The objective is to achieve better enforcement of local fisheries rules (*i.e*., decrease of domestic illegal, unreported and unregulated fishing), and to increase understandings about ecosystem changes by local people (*e.g*., HAB, new invasive species, *etc*.). MONITOR members were encouraged to participate in the Project Science Team (PST). The PST will meet prior to the PICES-2018.

AGENDA ITEM 9
Country reports

MONITOR members provided summaries of monitoring activities in their countries. See ***MONITOR Endnote 5*** for country reports.

MONITOR Endnote 1

MONITOR participation list

Members

Sonia Batten (SAHFOS *ex officio*)
Jennifer Boldt (Canada, Chair)
Sung Yong Kim (Korea)
Vladimir Kulik (Russia)
Jilong Li (China)
Vyacheslav Lobanov (Russia)
In-Seong Han (Korea)
HeeYoon Park (Korea)
Tetjana Ross (Canada)
Sei-Ichi Saitoh (Japan)
Kazuaki Tadokoro (Japan)

Members unable to attend

China: Zhifeng Zhang, Xianyong Zhao
Japan: Sanae Chiba
USA: Jack Barth, Lisa Eisner, Jeffrey Napp

Observers

Peter Chandler (Canada)
Zhongyong Gao (China)
Mitsutaku Makino (Japan)
Hiroya Sugisaki (Japan)
Yong Lin (China)

MONITOR Endnote 2

MONITOR meeting agenda

September 24, 2017, 18:00-20:00

1. Welcome, Introductions and Sign-in
2. PICES-2017 information and judges
3. Reports from PICES groups (presenters, please reserve time for questions):
   a. Report from FUTURE SSC (Lobanov)
   c. Activities of AP-NPCOOS (Barth and Kim)
   d. Activities of AP-CREAMS (Lobanov)
   e. Activities of SG-NPESR (Yoo/Chandler)
4. POMA, other business, notes from ISB-2017, PICES-2017

September 27, 2017, 14:00-18:00

Welcome, Introductions, and Sign-in

5. Proposals for 2018
6. ICES ASC theme session proposals
7. Relations with PICES groups/programs and international and national organizations and programs
   a. Status of Pacific Continuous Plankton Recorder (CPR) program and activities of Sir Alister Hardy Foundation for Ocean Science (SAHFOS) and GACS (Batten)
   b. Ecosystem Study on the Sub-Arctic and Arctic Seas (ESSAS) –Saitoh
   c. North East Asian Regional (NEAR-GOOS) –Lobanov
   d. Ocean Observing System (AOOS) –Eisner
   e. Collaboration with PICES HD committee –Makino
   f. GOOS BIO-ECO –Batten/Chiba
   g. World Ocean Assessment II (WOA II) – Chiba
8. Country reports
   a. **Written** national reports to be provided prior to the PICES meeting. Written reports should include all relevant monitoring activities for *all* relevant years.
   b. **Oral** presentation should include highlights and updates in national reports of relevant monitor/observation activities from the last year.
9. Other business

MONITOR Endnote 3

Status of Pacific Continuous Plankton Recorder (CPR) program and activities of SAHFOS and Global Alliance of CPR Surveys (GACS)

Sonia Batten

North Pacific CPR program

Now in its 18th year of operation, CPR sampling continued on the standard transects during 2017 (Fig 1). A typical year sees 6 transects sampled from Juan de Fuca Strait to Anchorage, Alaska (spaced monthly from about April to September) and 3 trans-Pacific transects from Juan de Fuca Strait to Asia (in spring, summer and autumn). At this time, the autumn trans-Pacific transect is uncertain owing to the shipping company transferring its ships to other regions, a replacement ship is being sought but may not be fitted with towing gear before 2018.

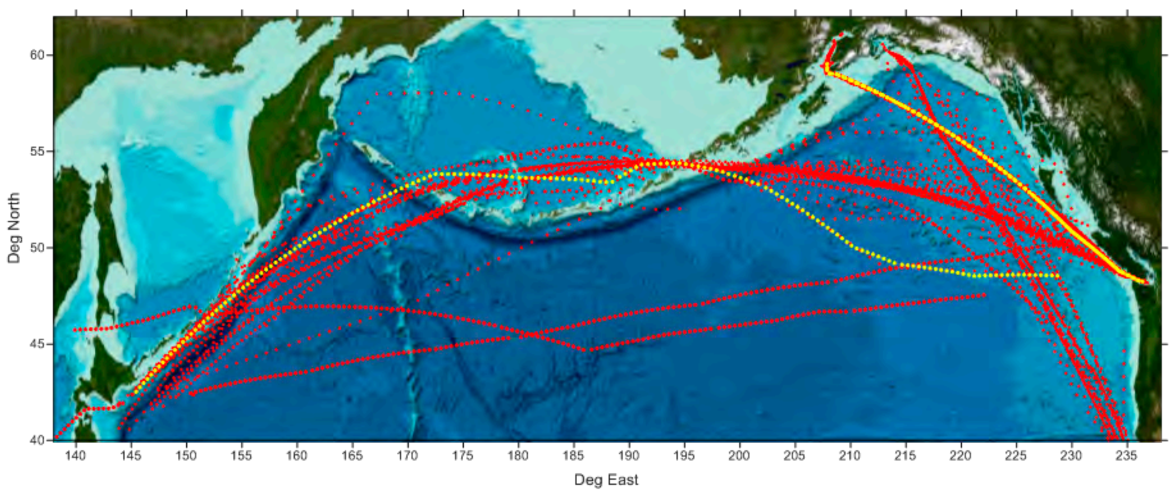


Fig 1. All historic Pacific CPR samples (red, 2000–20016) together with the April to June 2017 samples (yellow). Summer 2017 samples are still being processed.

Both Pacific CPRs are now fitted with a CTD-F to record underway data on T, S and Chl-*a* fluorescence. These data are available through the PICES website, or from S. Batten.

Recent publications:

- Fu, C., Olsen, N., Taylor, N., Grüss, A., Batten, S., Liu, H., Verley, P., and Shin, Y.-J. (2017) Spatial and temporal dynamics of predator-prey species interactions off western Canada. *ICES Journal of Marine Science*, doi:10.1093/icesjms/fsx056.
- Batten, S.D., Raitsos, D.E., Danielson, S.,Hopcroft, R.R., Coyle, K. and McQuatters-Gollop, A. (2017). Interannual variability in lower trophic levels on the Alaskan Shelf. *Deep-Sea Research II*. https://doi.org/10.1016/j.dsr2.2017.04.023.

Funding is reasonably secure through 2018 for sampling operations and analysis of the eastern Pacific samples, however, funding to analyse the western Pacific samples has come to an end, and a replacement source must be found.

SAHFOS Activities

The Sir Alister Hardy Foundation for Ocean Science (SAHFOS) is the CPR parent organisation and a representative has presented information on SAHFOS activities that may be of interest at recent PICES meetings. One such activity is the undertaking of molecular studies of CPR samples, which can reveal information about the organisms in the water that cannot be acquired with light microscopes used in conventional CPR sample analysis. A good example of this is the diatom genus *Pseudonitschia*; more than 30 species have been recorded from Pacific CPR samples using molecular methods, while only 2 groups can be determined with the microscope.

Adding instrumentation to the towed body (treating the CPR as a platform itself) can expand the information that can be acquired during the tow. Pacific CPRs have a CTD-F fitted, but other instrumentation is available (and continually being developed) that could be used, such as multispectral fluorometers, small-volume water samplers for microplankton.

SAHFOS runs training courses in specific aspects of plankton identification such as larval fish identification (Nov 2016) and phytoplankton taxonomy (July 2017). Basic CPR operation training for new surveys is provided as required. Also published in 2017, written by SAHFOS staff and collaborators, is the book "*Marine Plankton: A practical Guide to Ecology, Methodology and Taxonomy*", Oxford University Press, ISBN: 9780199233267.

Global Alliance of CPR Surveys (GACS) activities

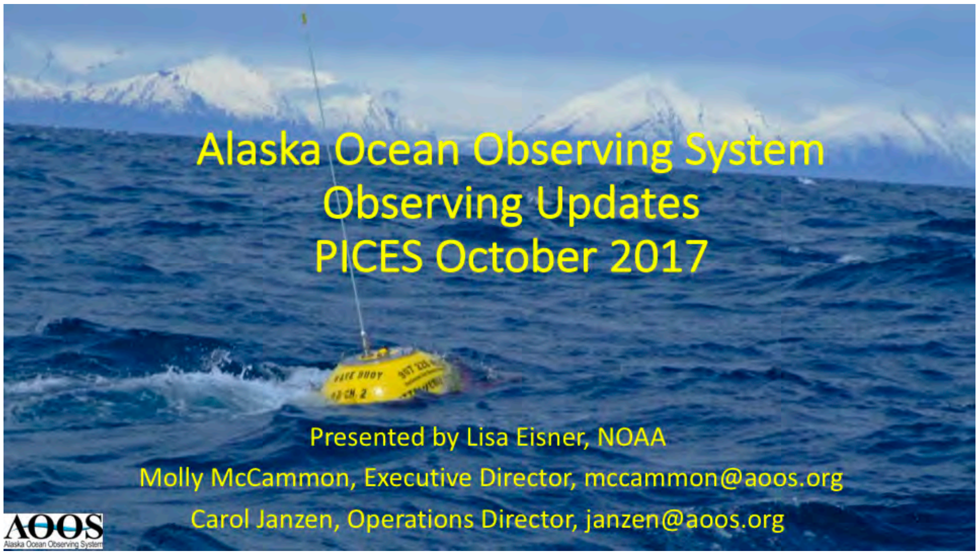
GACS brings together the various regional CPR surveys that operate around the world. It provides materials and support for new surveys and is working towards data products that can support the goals of global programs such as GOOS. A proposal to the Biodiversity Indicators Partnership (BIP) for a New Partnership (as an Indicator Producer) by Batten and Chiba, is under consideration. We proposed that GACS could provide a suite of Zooplankton Diversity Indices such as:

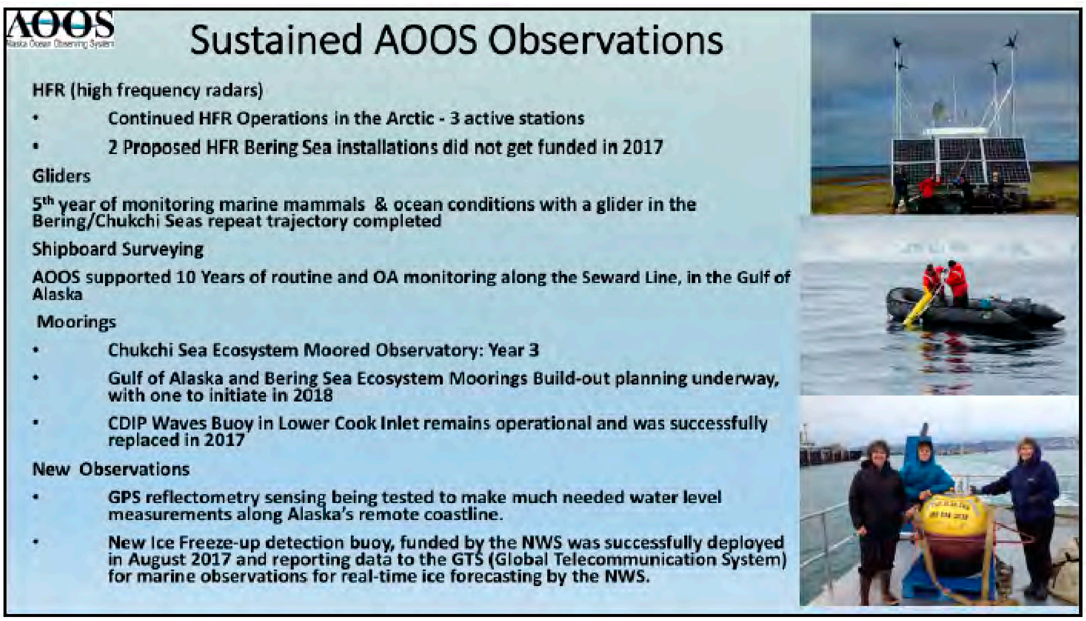
1. Zooplankton Abundance, which indicates the quantity of the prey species of fish, birds and mammals,
2. Zooplankton Size Index, which indicates the quality of the prey species of fish, birds and mammals,
3. Zooplankton Species Richness, which indicates the species diversity of the marine ecosystem,
4. Community Structure, which indicates the ecological functions of zooplankton, and
5. Abundance of Key Species, *e.g*., jelly fish, which indicates the extent of marine ecosystem health.

Most of the more recent CPR expansion activities are outside the PICES area of interest. However, this September marks the second annual sampling of the Northwest Passage with a CPR deployed from the UK ship *RRS Shackleton*, by colleagues from eastern Canada. Expanding Pacific CPR activities further north in the Bering Sea and on into the Arctic would make an exciting link with this new survey.

Northwest Pacific samples are being used to test a new technique recently developed by JAMSTEC, using micro X-ray computed tomography (CT) to quantitatively measure acidification impact on planktonic organisms. The Japanese CPR team started a feasibility study to apply this technique to measure variation in shell density of foraminifera collected by the CPR. Once the feasibility is established within the GACS framework, it could be a global standard method to monitor ocean acidification impacts on marine ecosystems.

MONITOR Endnote 4





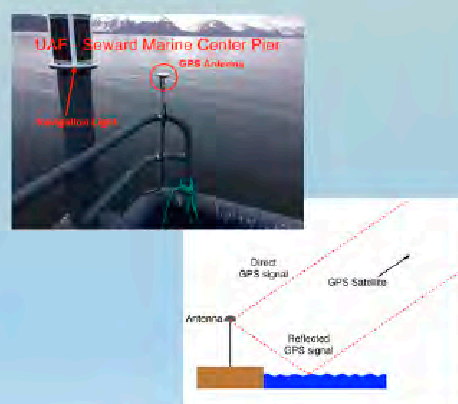
AOOS continues to support ongoing observing activities throughout Alaska.

AOOS is working closely with the NOAA National Weather Service to expand water level measurements to fill gaps in in-situ observations. The goal is to increase water level observations, in particular, along the remote coastlines of western Alaska and the Arctic.

In order to accomplish this, new technologies are being tested that will be cost effective alternatives to in-water NWLON water level installations, which are expensive and difficult to maintain in the ice impacted regions of Alaska. Alaska currently only has three NWLON installations in the Aleutians and Bering Sea/Arctic regions, leaving these remote coastlines severely undersampled with respect to water level observations.

New Technologies: Real-Time Water Level Observing Using GPS Reflectometry

- AOOS and the NWS are testing land-based, GPS or Global Navigation Satellite System (GNSS) reflectometry water level measurement approach
- Uses reflected satellite GPS signals to determine height of reflecting water surface relative to stable GPS antenna of fixed local height
- Two separate projects are underway:
  - private industry partner ASTRA, LLC installation in Seward
  - private research associate UNAVCO, who works with the the NSF-funded Plate Boundary Observatory Program - installation in St. Michael (western AK)



Images: Courtesy of ASTRA, LLC.

AOOS

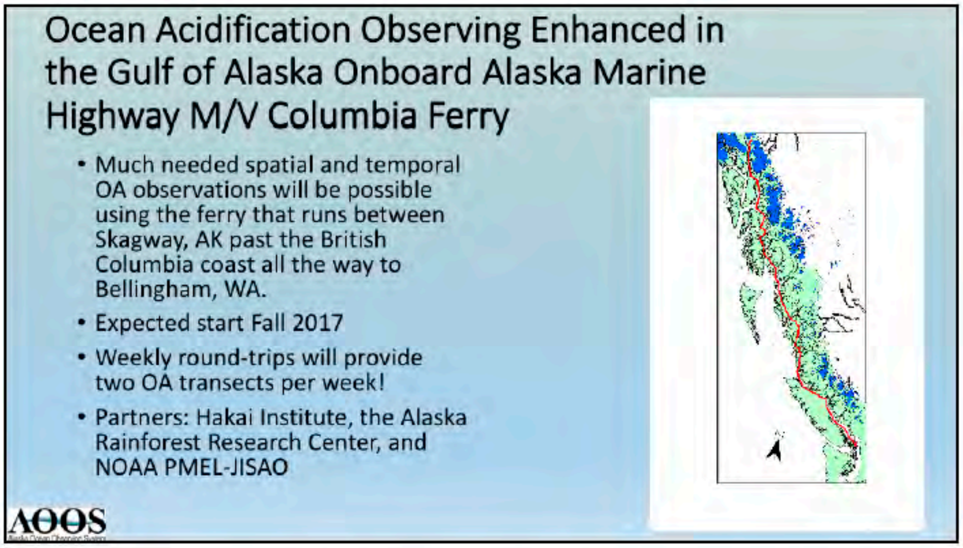
The premise behind reflectometry are simple.
An antenna is installed on land, which enables this technology to work year round.

Variations in water level are recorded as changes in the position of the antenna relative to the reflecting water surface.

The GPS signal traverses two paths from a satellite to the antenna, where the first is a direct path, and the second path is a reflected path from the antenna off the water surface.

Though GPS receivers cannot decipher the two paths, the interference between the signals is used to determine the reflecting surface height relative to the antenna height.

Field trials are underway and results will be presented at the AGU Ocean Sciences meeting in Portland, Oregon 2018.



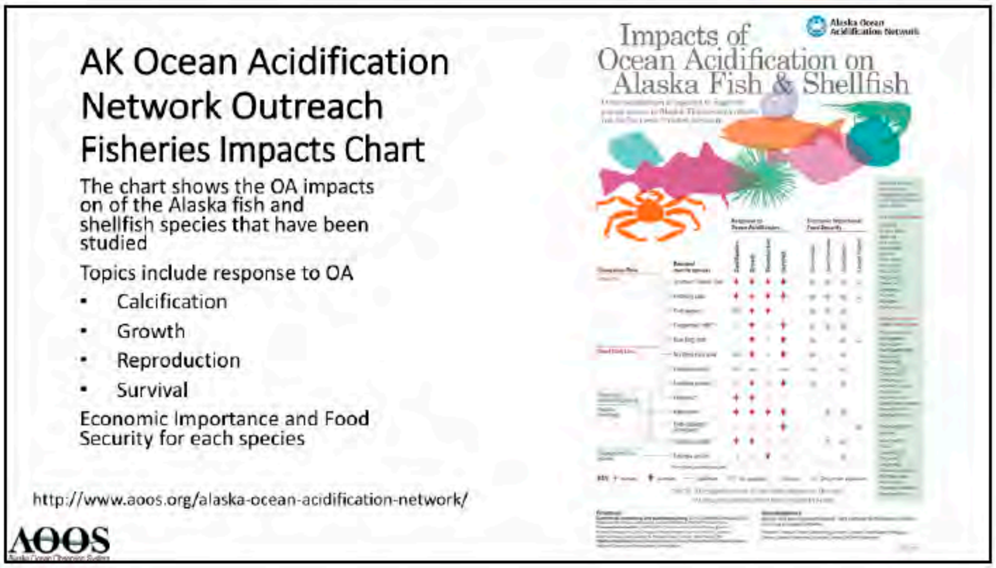
One initiative AOOS is involved with is increasing observing and public awareness of ocean acidification across the region.

The Hakai Institute, AOOS and the Rainforest Research Center with support from NOAA PMEL-JISAO worked together to enable the collection of core oceanographic measurements using a continuous sampling General Oceanics 8050 pCO_2 Measuring System installation onboard the Alaska Marine Highway passenger ferry M/V Columbia. The ferry modifications and the instrument installation was completed in the spring of 2017, in time for the 2017 sailing. The ferry is still undergoing maintenance and repairs, but is due to set sail in October 2017.

Observed variables will include temperature, salinity, pCO_2 (partial pressure of carbon dioxide) and dissolved oxygen. Measurements with this system are made every 2.5 minutes on seawater drawn from 3 meters below the surface through an intake line in the bow thruster cavity, and atmospheric pCO_2 is measured from an air intake on the foredeck.

This installation will work to gather information from the more variable conditions experienced nearshore where glacial melt, runoff and stronger biological signals require repetitive spatial and temporal observations in order to quantify the signal to noise and other sources of OA variability.

See the Alaska Ocean Acidification Network for more information on OA activities across the region.
http://www.aoos.org/alaska-ocean-acidification-network/

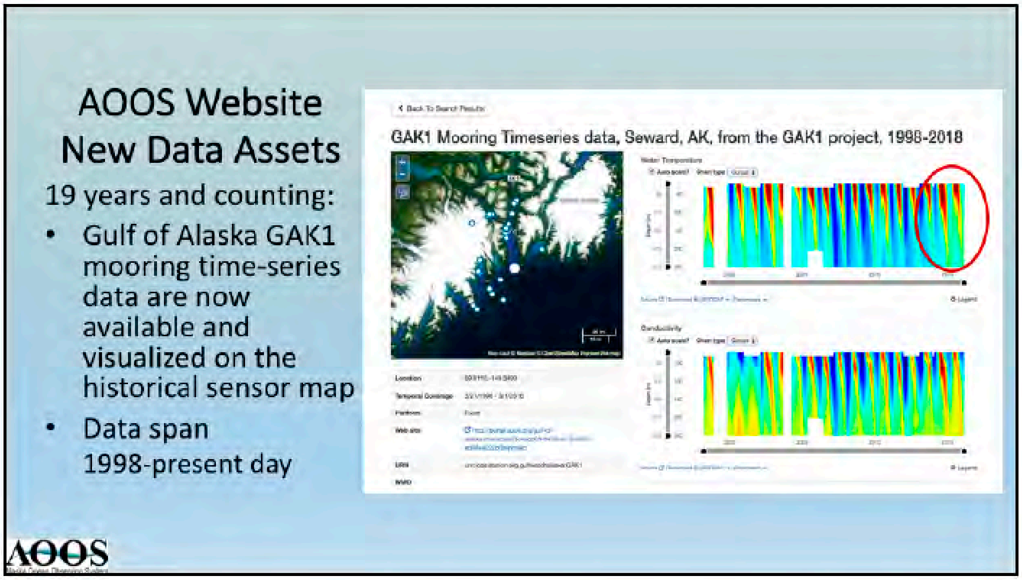


The Alaska Ocean Acidification Network recently produced a poster showing the known impacts of ocean acidification on Alaska fish and shellfish.

The poster lists 13 Alaska species for which ocean acidification research has been conducted.

The findings reflect peer reviewed literature and in almost all cases, the effect of ocean acidification is negative.

The poster highlights the significant change we are likely to see in our marine ecosystem due to ocean acidification,
It points to further research on species response. The vast majority of Alaska marine species, including top commercial, sport, and subsistence species, have not been studied.



The GAK1 mooring in the Gulf of Alaska is one of the longest time series in the region. These data are now available for download and visualiztion on the AOOS Ocean Data Explorer, the AOOS flagship data portal.

The data indicate in the the most recent years the evolution of warmer waters resulting from “the Blob,” which was the name given to an evolving patch of SST anomalous waters that eventually affected the entire west coast.

For more information on the Blob and the impacts of the Pacific Sea Surface Anomalies, visit the following links:
https://alaskapacificblob.wordpress.com/
http://www.nanoos.org/resources/anomalies_workshop/workshop1.php
http://www.nanoos.org/resources/anomalies_workshop/workshop2.php

MONITOR Endnote 5

Country Reports for 2017

Canada

Jennifer Boldt, Tetjana Ross, and contributors to the State of the Pacific Ocean Report

I. Highlights from 2016–2017

- The large mass of water observed in the Northeast Pacific Ocean in 2014 and 2015 (the "Blob"), characterised by surface and subsurface temperatures well above normal (defined as the 30 year average between 1981 and 2010), dissipated in 2016 (except for a brief interval in mid-summer).
- BC coast SST above normal, but not record setting, for the first half of the year and normal for the remainder of the year.
- In early 2016 the strong El Niño conditions first observed in late 2015 gradually weakened and transitioned to La Niña conditions by the end of the year.
- The offshore phytoplankton community composition, influenced by the warm waters of the past few years, showed a return to a more normal distribution in 2016. The higher trophic zooplankton community continued to exhibit characteristics consistent with warmer ocean temperatures.
- A large bloom of coccolithophorids occurred in June 2016 along the shelf break of Vancouver Island and in August in the southern Strait of Georgia.
- The spawning biomass of herring was near historic high levels in the Strait of Georgia. Although the abundance of juvenile herring was low in 2016, they were observed to be in good condition. Herring biomass levels in other regions of BC varied.
- The 2016 aggregate return of Fraser River Sockeye Salmon was the lowest on record. However, not all B.C. stocks exhibited a decline; returns of Sockeye Salmon stocks on the west coast of Vancouver Island (WCVI), the Central Coast and the Columbia-Okanagan system exceeded the pre-season forecast and were above the average return levels based on all years of data.
- The number of humpback whales observed in B.C. waters continues to increase.
- Harbour seal numbers in the Strait of Georgia have been stable since the 1990s.
- Steller Sea lion (Eastern population) numbers appear to be increasing.
- Unusual events reported in 2016 included abundances of plankton washing along beaches of the west coast of Vancouver Island (often gelatinous plankton), coccolithophorid blooms in the Strait of Georgia, and off of the WCVI, high abundances of juvenile rockfish along the west coast of Vancouver Island and Northern Anchovy in the Strait of Georgia, and sighting of unusual shark species.
- 2017 – pyrosomes present off the West Coast of B.C.

II. Observational programs

A. Monitoring by research vessel surveys (physical/chemical/biological/fisheries oceanography)

Ongoing:

1. Line P: continuing at 3 surveys/year (February, May/June, August/September), starting in the 1950s. The main goal is to determine ocean conditions and water property changes in the open NE Pacific. Areas of emphasis: hydrography, biogeochemistry, plankton dynamics (http://www.pac.dfo-mpo.gc.ca/science/oceans/data-donnees/line-p/index-eng.html). It is run by DFO/IOS, but there is extensive participation by university and international scientists for specialised water chemistry sampling related to dissolved organic carbon, pH, trace gases, etc. Sampling is conducted during both day and night. Types of sampling include CTD profiles, Niskin bottles, and plankton tows using a

Bongo and a mutinet. Physical measurements include temperature, salinity, phytoplankton fluorescence and many chemical analyses (*e.g*., oxygen, nutrients).

2. NE Pacific continental margin: continuing at ~4 surveys per year, covering outer coast of Vancouver Island and parts of Queen Charlotte Sound/Hecate Strait. Areas of emphasis: time series of zooplankton and hydrography (nutrients, O_2, T, S, pH), and their links to climate variability and trends. The La Perouse plankton survey is carried out twice per year in May-June and September, 1979-present. Sampling occurs off the WCVI (shelf and offshore) during the day and night. Sampling includes hydrographic, acoustic, zooplankton (Bongo and multinet and acoustics), CTD, and water samples.
3. Strait of Georgia: continuing at 4 surveys per year, with intensified sampling in 2010 and 2011. Areas of emphasis: hydrography and circulation, nutrients, phytoplankton, vertical flux of organic matter and contaminants.
4. Bowie Seamount: Offshore MPA (established 2008). A baseline video/ROV survey of the habitat and fauna of the upper ~200m has been completed (http://www.pac.dfo-mpo.gc.ca/oceans/protection/mpa-zpm/bowie/index-eng.html).
5. Strait of Georgia zooplankton survey (is funded by, and is part of, the Canada/US Marine Survival of Salmon in the Salish Sea study: see https://www.psf.ca/what-we-do/salish-sea-marine-survival-initiative). The main survey goal of this survey is to determine the species composition, spatial and temporal trends in zooplankton in the Canadian waters of the Salish Sea, for understanding interannual variability in salmon survival. It began in 2015 and is expected to continue for 1–5 additional years. This survey occurs twice per month during February to October in the Strait of Georgia mostly during daytime, but with some nighttime operations. Sampling includes surface water samples, net tows (Bongo, ring net), CTD for temperature, salinity, and phytoplankton fluorescence.

B. Ecosystem process surveys (including some surveys used for species stock assessments)

1. Small mesh multi-species survey: The main goal is to estimate abundance and trends of shrimp and other species (*e.g*., eulachon). Areas and years of the survey are WCVI 1973-present, Queen Charlotte Sound (QCS; 1998-2014). The survey is conducted annually in May 5 for WCVI, and the future of the QCS survey is unknown. This is a trawl survey conducted during daytime with a small mesh bottom trawl. All species captured are recorded and quantified, and a sub-set of species sampled for biological traits (e.g., length, weight, age). Also, temperature at depth is recorded. Results for the WCVI survey are reported annually in the DFO State of the Pacific Ocean reports (http://www.pac.dfo-mpo.gc.ca/science/oceans/reports-rapports/state-ocean-etat/index-eng.html)
2. Juvenile and adult Pacific salmon marine surveys: multiple surveys annually; Strait of Georgia (1997–present); west coast Vancouver Island (1998–present), Queen Charlotte Sound (1998–present); Central and Northern British Columbia (1998–2012); zooplankton and oceanographic data.
3. La Perouse pelagic ecosystem survey: annual (biennial after 2015); daytime acoustic-trawl survey; west coast Vancouver Island (2012–2015; presence data for 1982–2011); zooplankton, oceanographic data .
4. Juvenile herring and nearshore pelagic survey: annual; Strait of Georgia (1992–present) and Central British Columbia (1992–2011); zooplankton and oceanographic data.
5. Night time pelagic species and Pacific sardine survey: annual night-time trawl survey (biennial after 2014); west coast of Vancouver Island (2006–2014); zooplankton, oceanographic data, daytime acoustic data, and marine mammal and seabird observations.
6. Integrated pelagic ecosystem survey: (2017) day/night trawl survey; west coast of Vancouver Island; zooplankton, oceanographic data.

C. Fishery-independent stock assessment and species at risk surveys

Fishery-independent surveys carried out either annually or at regular intervals for a number of harvested species (hake, multispecies groundfish, invertebrates) or species-at-risk. Increasing use of acoustics and underwater video, and increasing effort to collect and incorporate environmental information. Main surveys include:

1. Groundfish bottom trawl surveys: biennial; in even numbered years west coast of Vancouver Island (2004–present), and west coast Haida Gwaii (2006–present), in odd numbered years Hecate Strait (1984-present) and Queen Charlotte Sound (2003–present); oceanographic and oxygen data.
2. Pacific hake acoustic survey: biennial (was triennial); west coast North America, southern California to Dixon Entrance (1977–present).
3. Other fish surveys: Pacific halibut (longline), sablefish (longline), lingcod (dive), rockfish (video), *etc*.
4. Salmon abundance (freshwater): estimates of adult salmon leaving and juvenile salmon arriving at the ocean are obtained annually in many rivers.
5. Dungeness crab trap survey: The goal is to index crab population. Survey times: 1988–present; May and October; semi-annual. Area: Strait of Georgia. Samples collected in daytime. This is a trap survey that uses crab traps. All species captured are recorded and quantified, and all crabs are sampled.
6. Green sea urchin dive survey: The goal is to estimate population abundance; Survey times are 2008–present for southeast Vancouver Island and 1995 to present for northeast Vancouver Island; during September; surveys are biennial and conducted during the daytime. This is a dive survey. All species observed on transect recorded, and green urchins are sampled.
7. Marine mammal surveys: throughout British Columbia.
8. Seal Island Intertidal clam survey: The goal is to estimate population abundance. Survey times are 1940–present, spring/summer, conducted on a triennial basis in the Strait of Georgia during the daytime at low tide. This is a beach survey, where transects are sampled using quadrates and clam rakes for butter clams.
9. Inshore shrimp assessment surveys: The goal is to estimate shrimp abundance and trends. Survey times are: 1998–present during spring/summer/fall, conducted annually until 2012, and are now biennial surveys in the Strait of Georgia, Knight Inlet, and Chatham Sound during daytime. This is a trawl survey that uses a small mesh bottom trawl (with excluder). All species captured are recorded and quantified, and shrimp sampled for length and weight.
10. Prawn survey: The goal of this survey is to index spawning population. Survey times are 1985–present, November and February, on a semi-annual basis in Howe Sound during the daytime. Prawn traps are used and all species captured are recorded and quantified; spot prawns are sampled for length and weight.
11. Species At Risk monitoring surveys for Northern Abalone: The main goal is to monitor abalone populations relative to recovery targets. Surveys have various start dates, some as early as 1978–present; conducted during May on a five year rotation in the Central Coast and south coast during daytime. This is a dive survey and all species observed on transects are recorded, and abalone are measured in-situ.
12. Species At Risk monitoring surveys for Olympia Oyster: The goal is to estimate and monitor abundance and trends. Survey times are 2009–present, during spring/summer on a five year rotation in the Strait of Georgia and West Coast of Vancouver Island during daytime at low tide. This is a beach survey using quadrats. All species are counted in quadrats.
13. Sea cucumber surveys: The goal is to provide biomass estimates. Survey times are 1997–present. Month of sampling is area dependent (February–September) on 4 year+ intervals, coast-wide. This is a dive survey in which the following species are sampled: *Parastichopus californicus* (sometimes *Cucumaria miniata* and *C. pallida*).

D. Aquatic Invasive Species Surveys

1. Aquatic Invasive Species intertidal monitoring surveys: annual surveys with shifting geographic focus to eventually provide baseline information coast-wide (2006–present).

2. Aquatic Invasive Species European Green Crab trap surveys: annual surveys with shifting geographic focus, annual monitoring of Pipestem Inlet, Barkley Sound, tagging and depletion studies (2006–present).

E. ARGO profiling drifters

Canada has been very active in this successful international program. Since the start of the program, Canada has deployed many floats (see http://www.argo.ucsd.edu/).

F. North Pacific Continuous Plankton Recorder

Canada has contributed financial support since 2008 for the North Pacific CPR program plus hosts a local sorting center (at IOS), and collaborates with project lead Sonia Batten on some of the analyses and publications (see http://pices.int/projects/tcprsotnp/).

G. Ocean observatory networks (Ocean Networks Canada)

The 'inland seas' component has operational undersea cabled observatory nodes and coastal radar (VENUS network) in the Strait of Georgia (since 2008) and in Saanich Inlet (since 2006). The installation of sensor platforms on ferries on three routes between Vancouver and Vancouver Island was completed in 2015. An ocean glider program, initiated in 2014, provides additional mobile observing capacity for coastal waters. Two community-based cabled observatories are currently operating (since 2012) in coastal locations, one on Vancouver Island and another in the Canadian Arctic at Cambridge Bay Nunavut. Additional community-based cabled observatories are being installed at up to five coastal British Columbia sites, with completion expected in late 2016.

The 'offshore' cabled network (NEPTUNE) is a part of a broader US/Canada northeast Pacific observing system. The Canadian component (installed 2009) consists of a fully operational, 812 km elliptical undersea cabled observatory loop extending from southern Vancouver Island across the continental shelf and slope to the Endeavour Segment of the Juan de Fuca Ridge. The observing system at the Endeavour node is currently undergoing expansion, to be completed in 2017. Autonomous oceanographic moorings (since 2012) in the Salish Sea provide continuity between the VENUS and NEPTUNE observing systems. For more information see http://www.oceannetworks.ca/.

H. British Columbia Shore Station Oceanographic Program

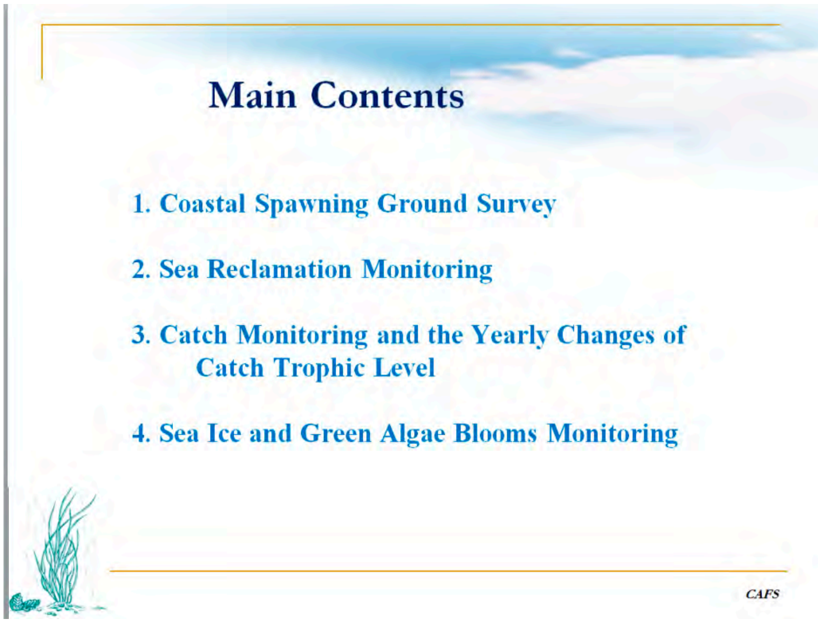
The British Columbia Shore Station Oceanographic Program (often referred to as the BC lighthouse data) began in 1914. Sea surface temperatures and salinities have been monitored daily at lighthouses on the west coast of Canada. Observations are logged and forwarded monthly to the Institute of Ocean Sciences where they are quality controlled and archived (http://www.pac.dfo-mpo.gc.ca/science/oceans/data-donnees/lighthouses-phares/index-eng.html).

III. Information Synthesis and Communication

A DFO "State of the Ocean" report is prepared annually (1999–present). The reports summarize and synthesize results from many of the monitoring programs listed above. Annual reports, including those for 2016, are available from the DFO website: http://waves-vagues.dfo-mpo.gc.ca/Library/40617944.pdf and http://www.pac.dfo-mpo.gc.ca/science/oceans/reports-rapports/state-ocean-etat/index-eng.html.

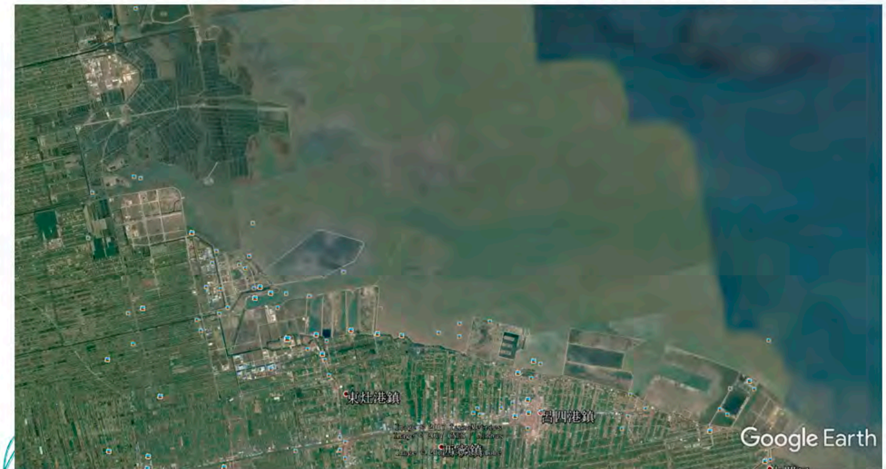
China

Jilong Li, Chinese Academy of Fishery Science



2. Sea Reclamation Monitoring

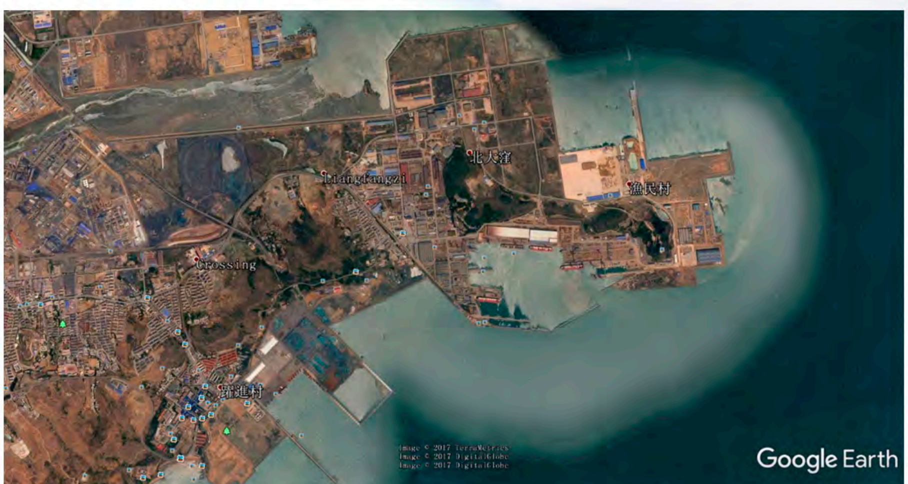
Vast sea reclamation are still under going and causes fish habitats to lose, however, A restrictive measure are adopted for sea reclamation approval take place in 2017.



Sea reclamation along the coast of Jiangsu Province

CAFS

2. Sea Reclamation Monitoring



Sea reclamation at the coast of Huludo city of Liaoning Province

CAFS

2. Sea Reclamation Monitoring

Xiamen New airport construction site

CAFS

3. Catch Monitoring and the Yearly Changes of Catch Trophic Level

Since 1980s. A catches statistics mechanism was set up in China

Cluster of main fish in the catches of Bohai Sea, Yellow Sea, East China Sea and South China Sea

	中英文名 Chinese/English Name	学名 Scientific Name	综合营养级 average trophic level	营养级偏差 Stdev
低营养级肉食性鱼类 Carnivorous fishes in low class	鲻鱼(Flathead grey mullet)*	Mugil cephalus	2.00	0.17
	梭鱼(grey mullet)*	Mugil soiuy	2.00	0.19
	鲱(herring)	Clupea pallasi	2.20	0.20
	沙丁鱼（sardine）	Sardina melanostictus	2.28	0.50
	玉筋鱼(sandlance)	Ammodytes personatus	2.30	0.10
	鲳(pomfret)	Pampus argenteus	2.53	0.10
	马面鲀(filefishes)	Navodon septentrionalis	2.70	0.40
	鳓(long-finned herring)	Ilisha elongata	2.73	0.64
	鳀(anchovy)	Engraulis japonicus	2.75	0.50
中营养级肉食性鱼类 Carnivorous fishes in middle class	鲷(sea bream)	Chrysophrys major	2.90	0.49
	梅童鱼(Spinyhead croaker)	Collichthys lucidus	2.93	0.60
	白姑鱼(Silver croaker)	Argyrosomus argentatus	3.00	0.43
	竹荚鱼(Japanese jack mackerel)	Trachurus japonicus	3.00	0.00
	金线鱼(Golden threadfin bream)*	Nemipterus virgatus	3.00	0.57
	黄姑鱼(yellow drum)	Paranibea semiluctuosa	3.15	0.20
	蓝圆鲹(Japanese scad)	Decapterus maruadsi	3.18	0.45
	小黄鱼(small yellow croaker)	Pseudosciaena polyactis	3.26	0.63
	方头鱼(tilefish)	Branchiostegus japonicus	3.35	0.50
	大黄鱼(large yellow croaker)	Pseudosciaena crocea	3.47	0.56
高营养级肉食性鱼类 Carnivorous fishes in high class	石斑鱼(banded grouper)	Epinephelus drummondhayi	3.50	0.60
	鲐(Chub mackerel)*	Pneumatophorus japonicus	3.50	0.80
	鮸鱼(Mi-iuy croaker)	Miichthys miiuy	3.70	0.37
	鲅鱼/马鲛(spanish mackerel)	Scomberomorus niphonius	3.73	0.80
	带鱼(hairtail)	Trichiurus haumela	3.80	0.40
	海鳗(morey eel)	Muraenesox cinereus	3.83	0.67

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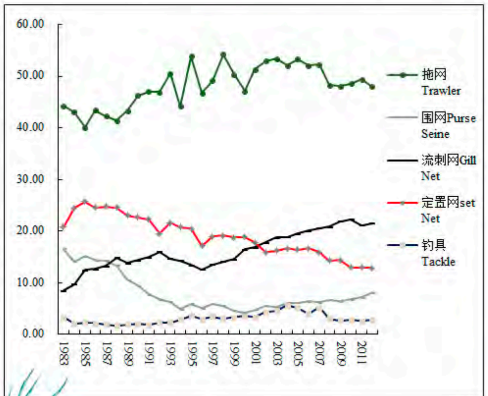
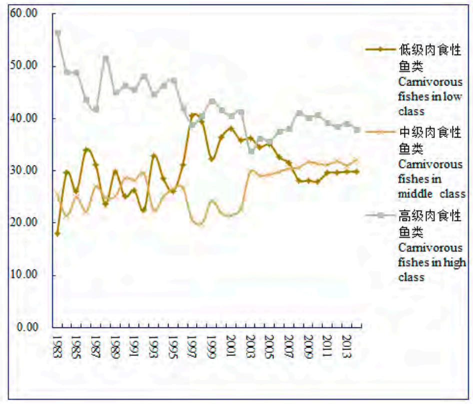
3. Catch Monitoring and the Yearly Changes of Catch Trophic Level

The analysis result with these catch data from 1984-2015 shows that the marine ecosystem are changing:





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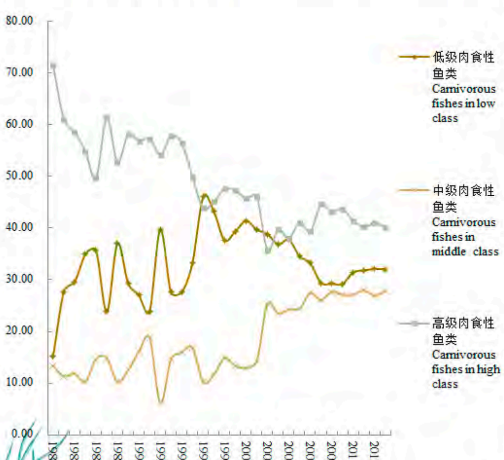
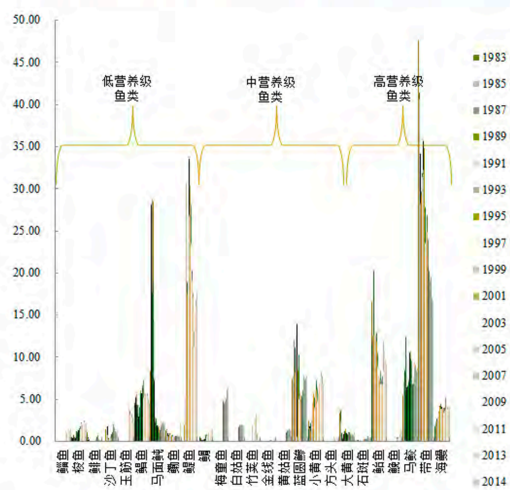
3. Catch Monitoring and the Yearly Changes of Catch Trophic Level

Eastern Seas of China

Composition changes of different fish trophic level cluster of the **Eastern Seas of China**



Composition changes of fish catch of The Eastern Seas of China



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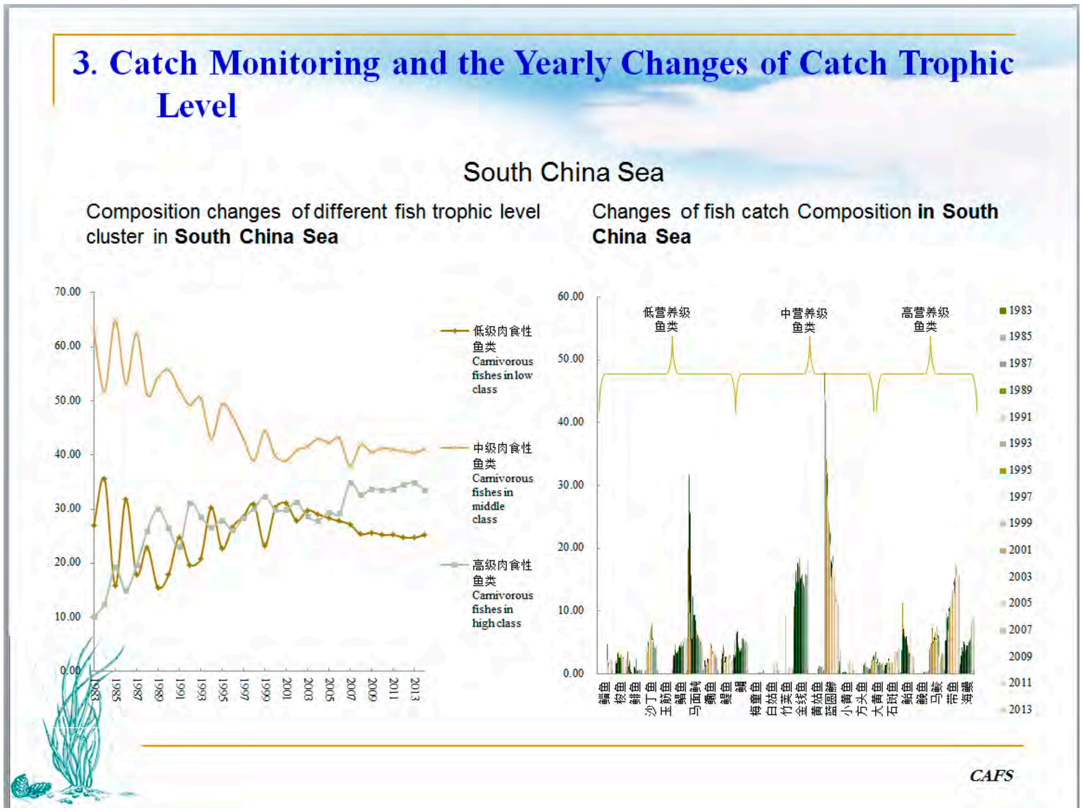
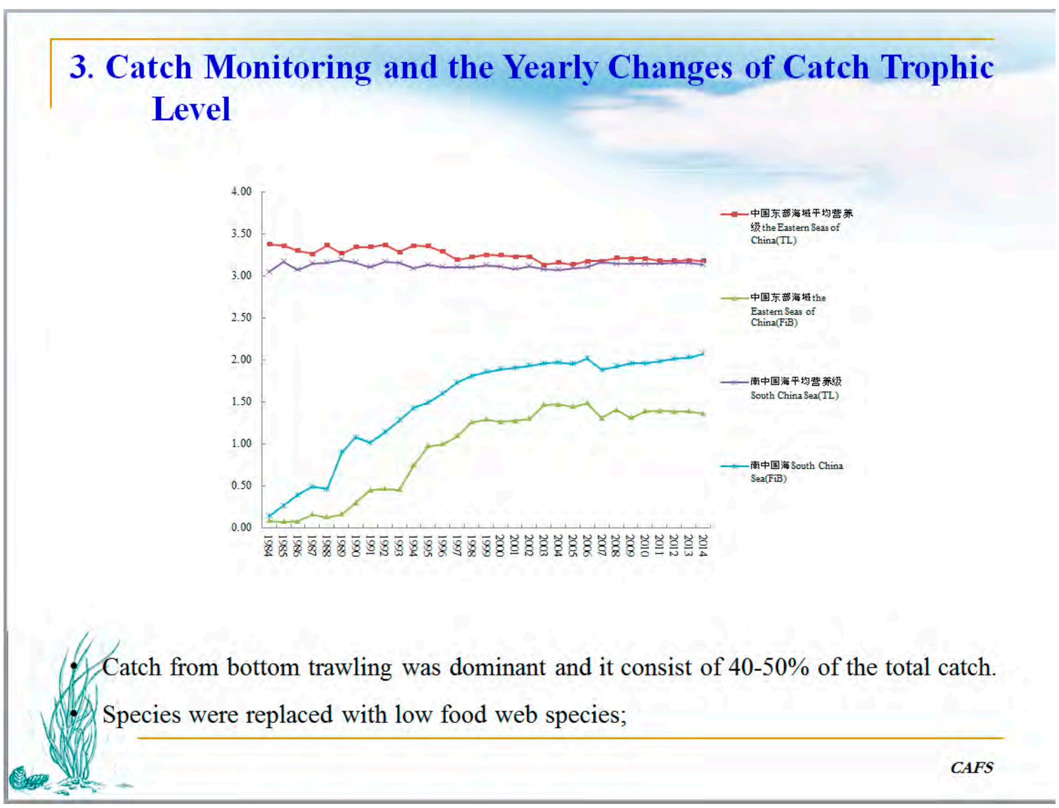

3. Catch Monitoring and the Yearly Changes of Catch Trophic Level
South China Sea
Composition changes of different fish trophic level cluster in South China Sea
Changes of fish catch Composition in South China Sea
低级肉食性鱼类 Carnivorous fishes in low class
中级肉食性鱼类 Carnivorous fishes in middle class
高级肉食性鱼类 Carnivorous fishes in high class
低营养级鱼类
中营养级鱼类
高营养级鱼类
CAFS


3. Catch Monitoring and the Yearly Changes of Catch Trophic Level
中国东部海域平均营养级 the Eastern Seas of China(TL)
中国东部海域 the Eastern Seas of China(FiB)
南中国海平均营养级 South China Sea(TL)
南中国海 South China Sea(FiB)
Catch from bottom trawling was dominant and it consist of 40-50% of the total catch.
Species were replaced with low food web species;
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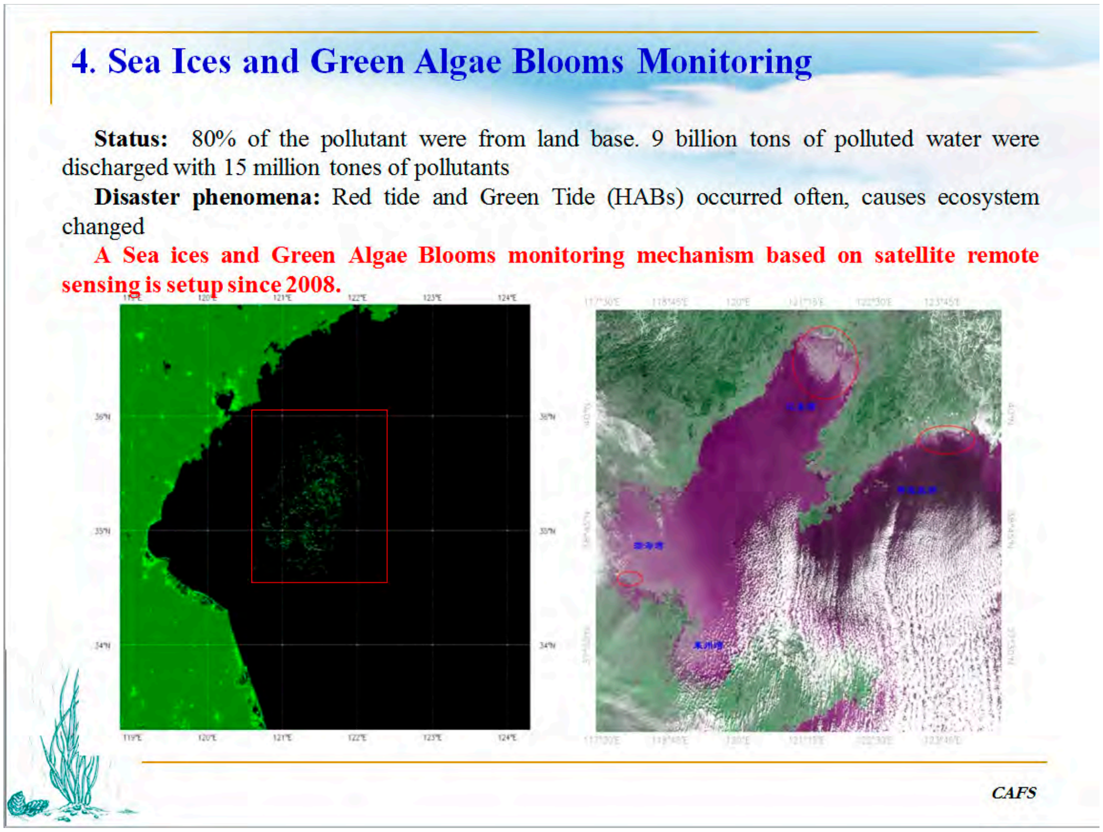

4. Sea Ices and Green Algae Blooms Monitoring
Status: 80% of the pollutant were from land base. 9 billion tons of polluted water were discharged with 15 million tones of pollutants
Disaster phenomena: Red tide and Green Tide (HABs) occurred often, causes ecosystem changed
A Sea ices and Green Algae Blooms monitoring mechanism based on satellite remote sensing is setup since 2008.
CAFS

Japan

I. Report from JAMSTEC by Sanae Chiba, RCGC JAMSTEC

Update of Conventional Observation Programs of Research Center for Global Change

RCGC (Research and developmental Center for Global Change) is in charge of variety of ocean observation programs. Conventional monitoring projects as shown below are succeeded and under operation by RCGC. These projects yet are mainly limited to physical, chemical and atmospheric observation. JAMSTEC has had no rigid background/history for long-lasting biological/ecosystem monitoring programs in context of global change study although it has extensively promoted studies on deep-sea biology.

1. Argo JAMSTEC (http://www.jamstec.go.jp/ARGO/argo_web/argo/index_e.html)

The Pacific Argo Regional Center (PARC) has been established as a joint collaboration between the Japan Agency for Marine-Earth Science and Technology (JAMSTEC), the International Pacific Research Center (IPRC) at the University of Hawaii, and the Commonwealth Scientific and Industrial Research Organization (CSIRO). The PARC takes on the responsibility to validate all float data in the Pacific through rigorous scrutiny and to derive regional products based on these floats.

The global data point map of temperature and salinity was updated (data up to July 2017) http://argoweb1.yes.jamstec.go.jp/ARGO/argo_web/argo/?page_id=56&lang=en. The map of gridded mixed layer depth with its related parameters (MILA GPV: MIxed Layer data set of Argo, Grid Point Value) (data up to July 2017) was updated (Fig. 1). http://www.jamstec.go.jp/ARGO/argo_web/argo/?page_id=71&lang=en. Download and visualization services of Argo gridded dataset "MOAA GPV" and "MILA GPV"have started from JAMSTEC GODAC data site. http://www.godac.jamstec.go.jp/argogpv/e/.

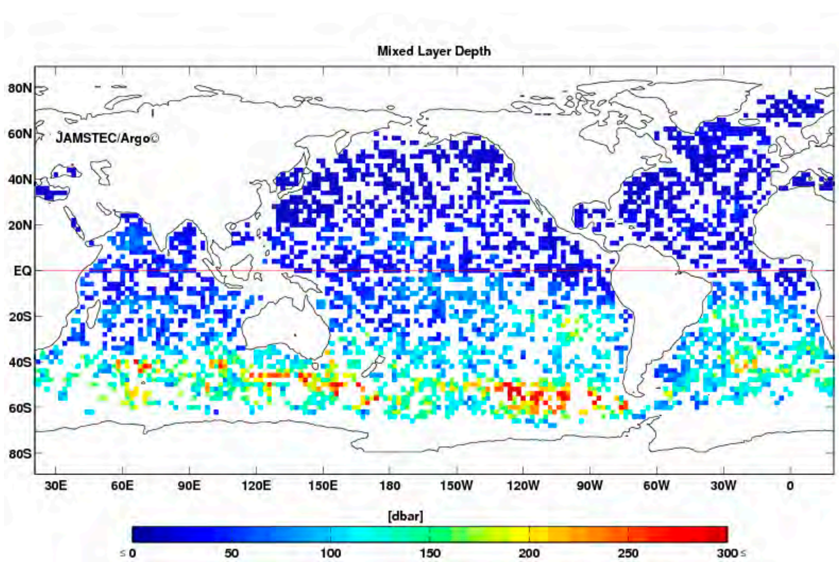
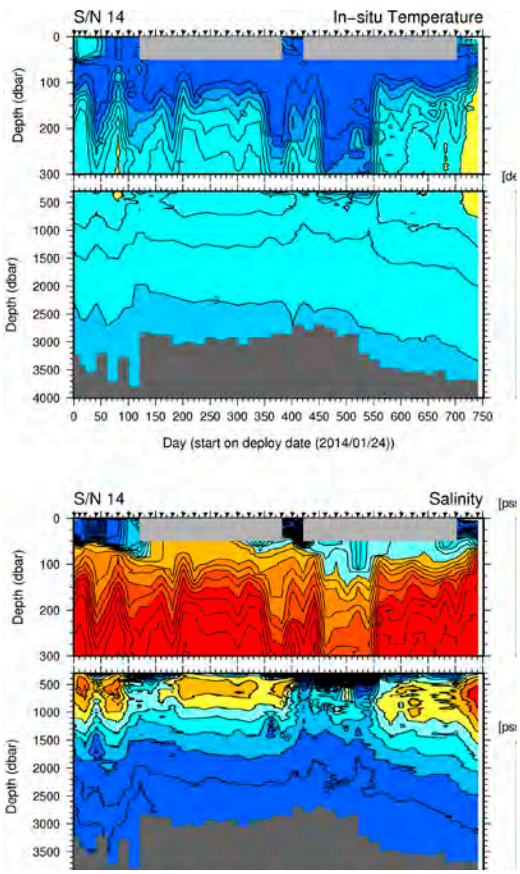


Figure 1 Mixed Layer date set of Argo, Grid Point Value.

2. Deep NINJA: Deep ocean observation by deep-sea float (http://www.jamstec.go.jp/ARGO/deepninja/)

JAMSTEC has deployed 23 Deep NINJA floats in collaboration with Tsurumi-Seiki Co., Ltd, primarily in the Southern Ocean up to July 2017. As of July 25, 2014. A Deep NINJA float (S/N 6) deployed off the Adelie Coast of Antarctica measured deep profiles under sea ice throughout an Antarctic winter and continued to observe seasonal changes of the deep/bottom waters for more than one year. In 2016, three Deep NINJAs were deployed in the Western Indian Ocean and subtropical North Pacific. In 2017, one and two floats were deployed in the South Pacific/Southern Ocean and North Pacific, respectively. The example trajectory and profiles of a float are shown in Figure 2.



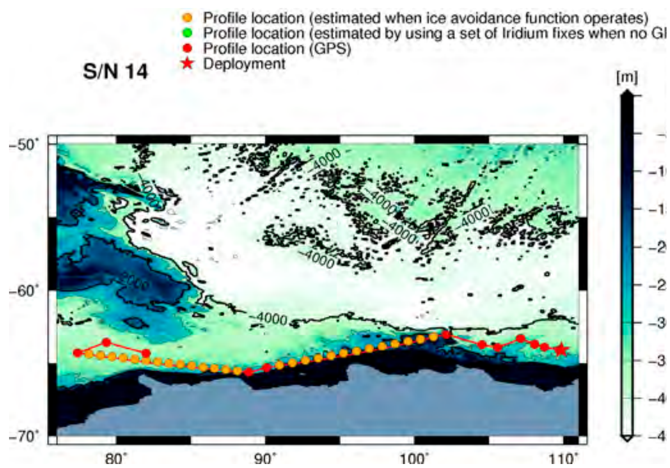


Figure 2 Left: *In-situ* temperature and salinity profiles obtained by the Deep NINJA float S/N 14. Upper: the trajectory of the Deep NINJA float S/N 14.

3. TAO and TRITON Project (http://www.jamstec.go.jp/jamstec/TRITON/real_time/)

Operating moored ocean buoy (TRITON) network to obtain real-time air-sea data in the equatorial western Pacific and eastern Indian Ocean for improved detection, understanding and prediction of El Niño and La Niña.

4. IOMICS Project: Indian Ocean Moored buoy network Initiative for Climate Studies (http://www.jamstec.go.jp/iorgc/iomics/)

Developed new-type of moored buoy network, which observe sea surface heat flux components and ocean temperature and salinity in the upper layer, to understand mechanism of the Indian Ocean's variation and its importance for global climate system under a cooperative framework among surrounding countries.

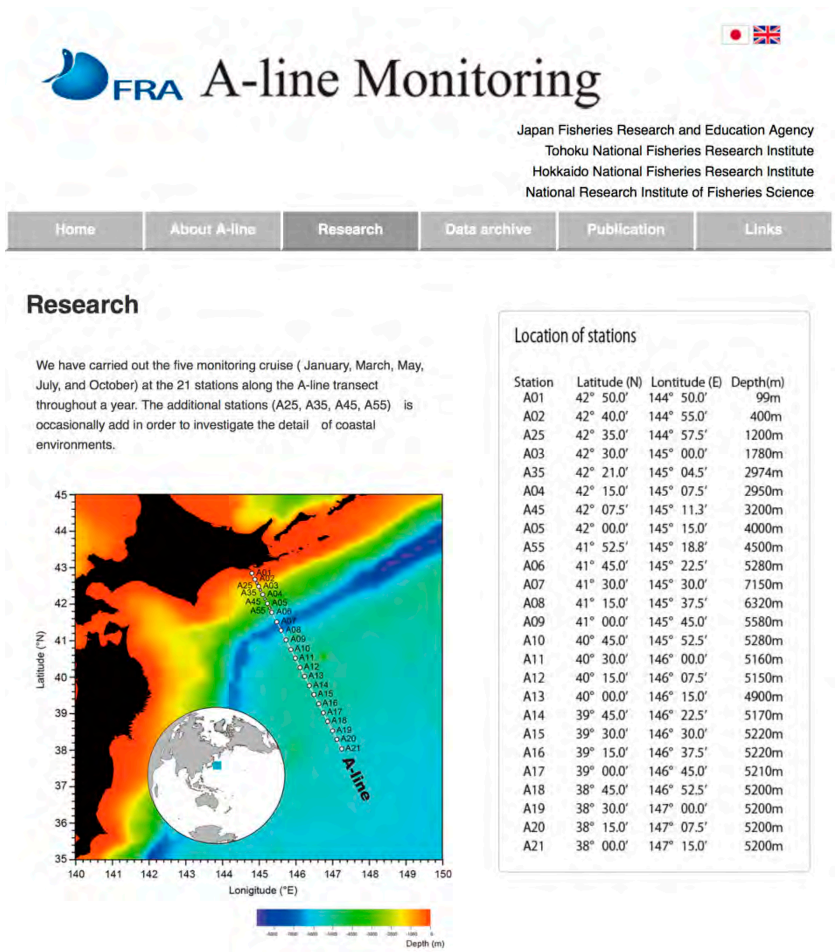
5. Repeat Hydrography (http://www.jamstec.go.jp/iorgc/ocorp/data/post-woce.html)

Repeat hydrography along the WOCE observation lines, *etc*. Observation of chemical tracers, total alkalinity, pH, Ω, and nutrients to accurately quantify influences of global warming and ocean acidification on marine ecosystems, as well as to depict changes of the ocean heat content and the distribution of substances in seawater.

II. Report from Fisheries Research Agency (FRA) by Kazuaki Tadokoro, Tohoku National Fisheries Research Institute

1. A-Line Monitoring (http://tnfri.fra.affrc.go.jp/seika/a-line/a-line_index.html)

Tohoku and Hokkaido National Fisheries Research Institute have carried out the oceanographic monitoring from 1987 to present at a transect A-line in the Oyashio and Kuroshio-Oyashio transition waters. In recent year, 5 times observations were carried out in January, March, May, July, and October throughout a year. Observation items are CTD, water sampling by Niskin bottles, Norpac net, and Bongo net. In this year, 5 time of cruses were carried out. The oceanographic data are opened and available from the website. Period of published data are from 1990 to 2014 for CTD and from 1990 to 2012 for others.



2. O-Line Monitoring

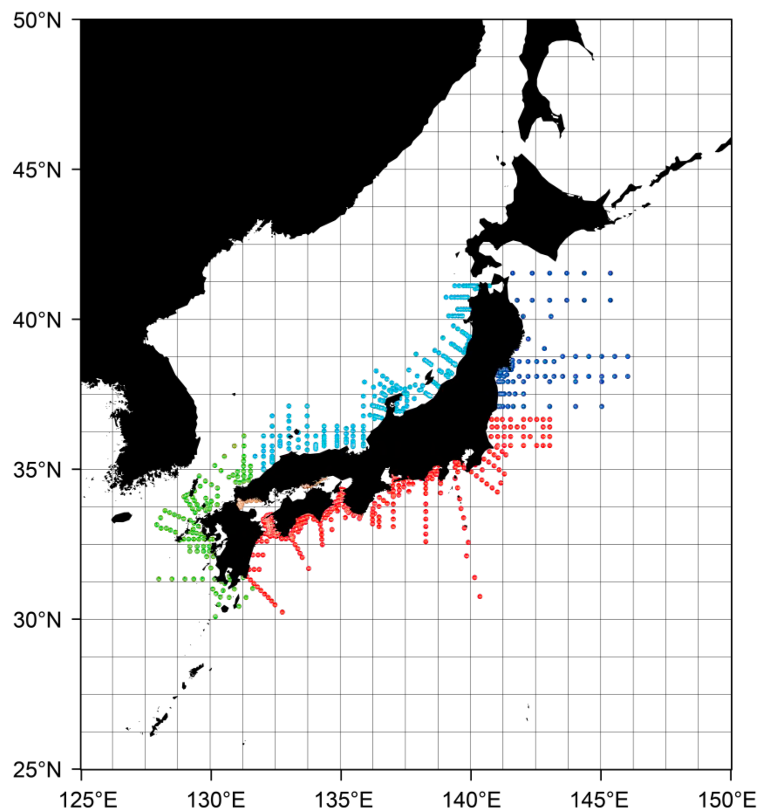
National Fisheries Research Institute have carried out the monitoring from 1999 to present at a transect O-line (138°W, 27°N to 34.30°N) in the Kuroshio waters. The observations were carried out in January, March, May, August, and October throughout a year. Observation items are CTD, water sampling by Niskin bottles, and Norpac net. In this year, 5 time of cruses were carried out.

3. CK-line

Seikai Fisheries Research Institute have carried out the monitoring from 2002 to present at a transect CK-line in the East China Sea. The observations were carried out in February, March, June, July, and October throughout a year. Observation items are CTD, water sampling by Niskin bottles, and Norpac net. In this year, 5 time of cruses were carried out.

4. Monitoring of stock assessment project commissioned by Fisheries Agency of Japan

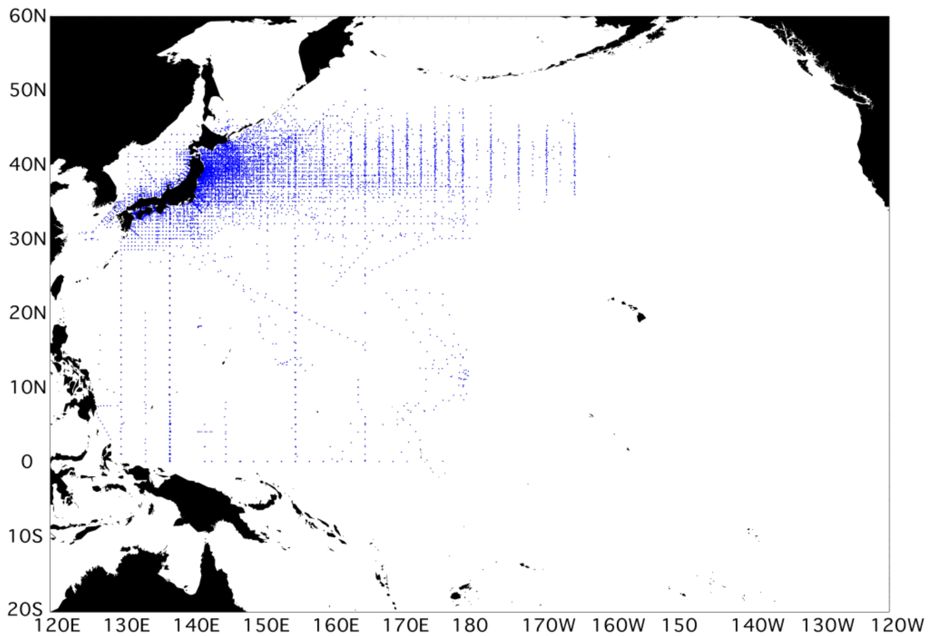
The observations have been carried out at 760 stations in the waters around Japan except with Okinawa and Hokkaido from 1972. The frequency of the observation is monthly except with the station in the Sea of Japan. In the Sea of Japan, the observations are carried out during spring and autumn. Annual sampling number is about 7000. The prefectural fisheries institute mainly carry out the monitoring. Observation items are CTD, and Norpac net. Data of CTD and abundance of egg, larvae, juvenile of pelagic fish are archived in the closed database of FRESCO (Fisheries Resource Conservation) system managed by JAFIC (Japan Fisheries Information Service Center).



Observation stations for monitoring of the stock assessment project.

5. Zooplankton sample collection (http://tnfri.fra.affrc.go.jp/seika/plankton/hyohon_home.html)

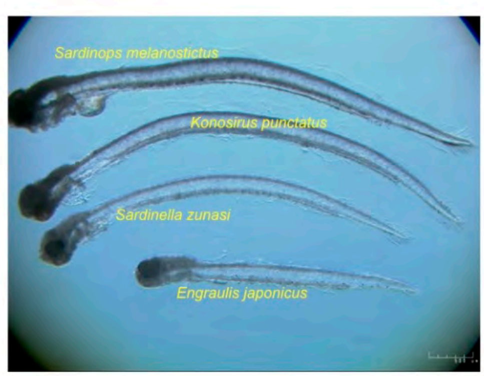
Tohoku National Fisheries Research Institute is collecting zooplankton samples from 1951 to present. Total number of sample is more than 125000 at present (September 1, 2017). The samples are preserved by 5% buffered formaldehyde. Sampling area is mainly in the waters around Japan. However the samples were also collected in the western North Pacific, central North Pacific, and Peruvian waters. Samples were collected by FRA, prefectural fisheries institutes, Japan Meteorological Agency, and university. The inventory of the sample is archived to the closed database.



Sampling location of zooplankton samples

6. Fish eggs, larvae, juvenile sample collection

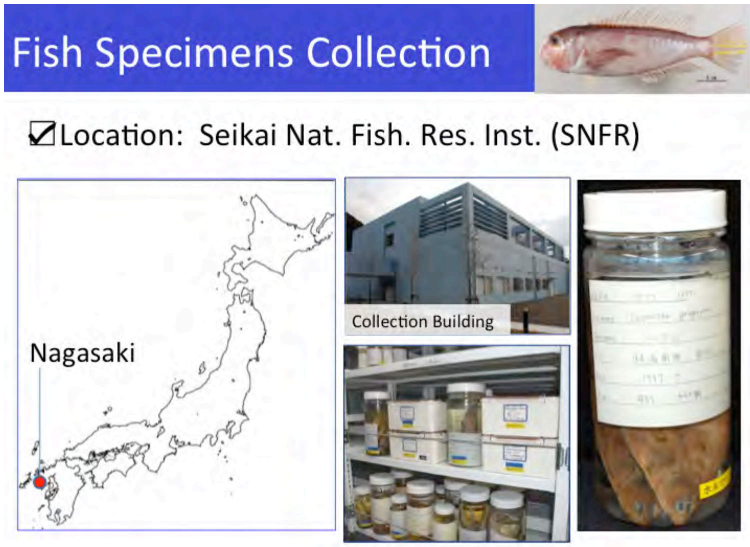
National Fisheries Institute started to collect the samples from 2015. The samples were mainly collected by monitoring of stock assessment project commissioned by Fisheries Agency of Japan. Now the recent samples are collecting, however the historical samples will collect in immediate future.



Fish larvae specimen samples

7. Fish specimens sample collection (http://snf.fra.affrc.go.jp/gyoruihyouhon/index.html)

Samples number about 1200, with a total number of about 32,000. The samples are mainly preserved by isopropyl alcohol. DNA samples were also collected from a part of the sample.



Location, collection building and specimens of fish samples

III. Report from Hokkaido University by Sei-Ichi Saitoh (Arctic Research Center) and Atsushi Ooki, Makoto Sanpei, Atsushi Yamaguchi, Toru Hirawake (Faculty of Fisheries Sciences, Hokkaido University)

Hokkaido University has conducted two oceanographic field campaigns for a new Japanese Arctic Research program, Arctic Challenge for Sustainability (ArCS), in sub-Arctic and Arctic waters in 2017. The first one was a research cruise by T/S *Oshoro-maru* in northern Bering Sea and southern Chukchi Sea, and second was a research cruise by R/V *Mirai* in Chukchi Sea, in this summer–autumn season.

Hokkaido University has a plan to conduct a cruise by *T/S Oshoro-maru* in the Bering Sea and southern Chukchi Sea in summer 2018.

1. T/S *Oshoro-Maru* cruise

A research cruise in the Arctic Ocean by *T/S Oshoro Maru* in 2017 was partly supported by the governmental project on the Arctic environment, Arctic Challenge for Sustainability (ArCS), and carried out various surveys on oceanography and ecosystem with a theme ‘Response and biodiversity status of the Arctic ecosystems under environmental change’.

The observation items were CTD, water collection in the water column, biological and chemical analyses of the water, sediment sampling, fish larvae collection, plankton collection. We successfully operated a GPS radiosonde balloon for upper-air weather observation, Acoustic Doppler Current Profiler (ADCP) and Argo float for water current observation, and bio-optical measurements for satellite oceanography. Sea bird and mammal sighting surveys were also conducted from the upper bridge. Data will be published in Data Record of Oceanographic Observations and Exploratory Fishing, Database of the ArCS or relevant database.

Research area A covers Emperor Seamount Chain surrounding sea area and Aleutian Islands surrounding sea area. Research area B covers the Bering Strait – Saint Lawrence surrounding sea area, Bering Sea continental shelf and basin area. The *Oshoro-Maru* entered Dutch Harbor on July 3 after observations in Research area A, then left for Research area B on July 6 (Figure 1). The ship entered Nome on July 14 after observations in a part of Research area B, then left for Research area B again on July 16 (Figure 2).

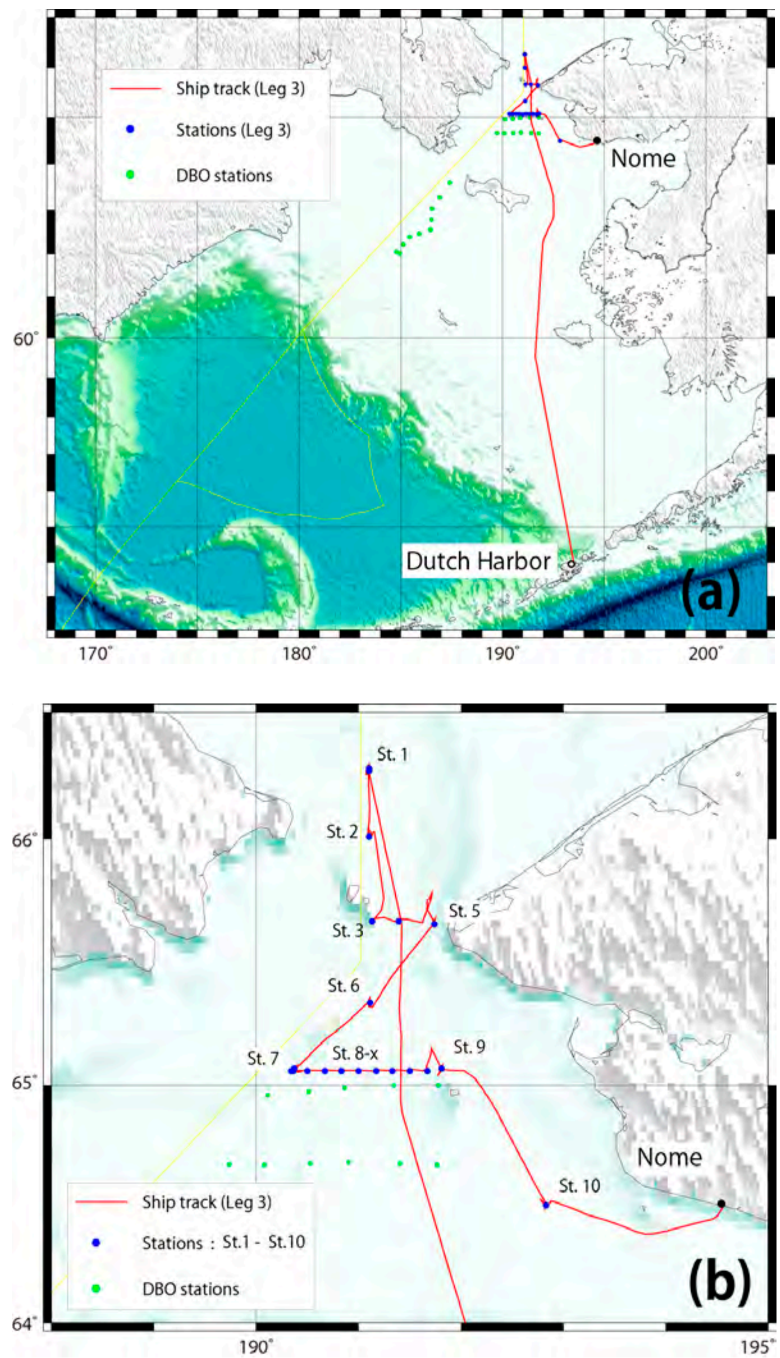


Figure 1. Map of cruise track (a) and sampling stations of Leg-3 (b).

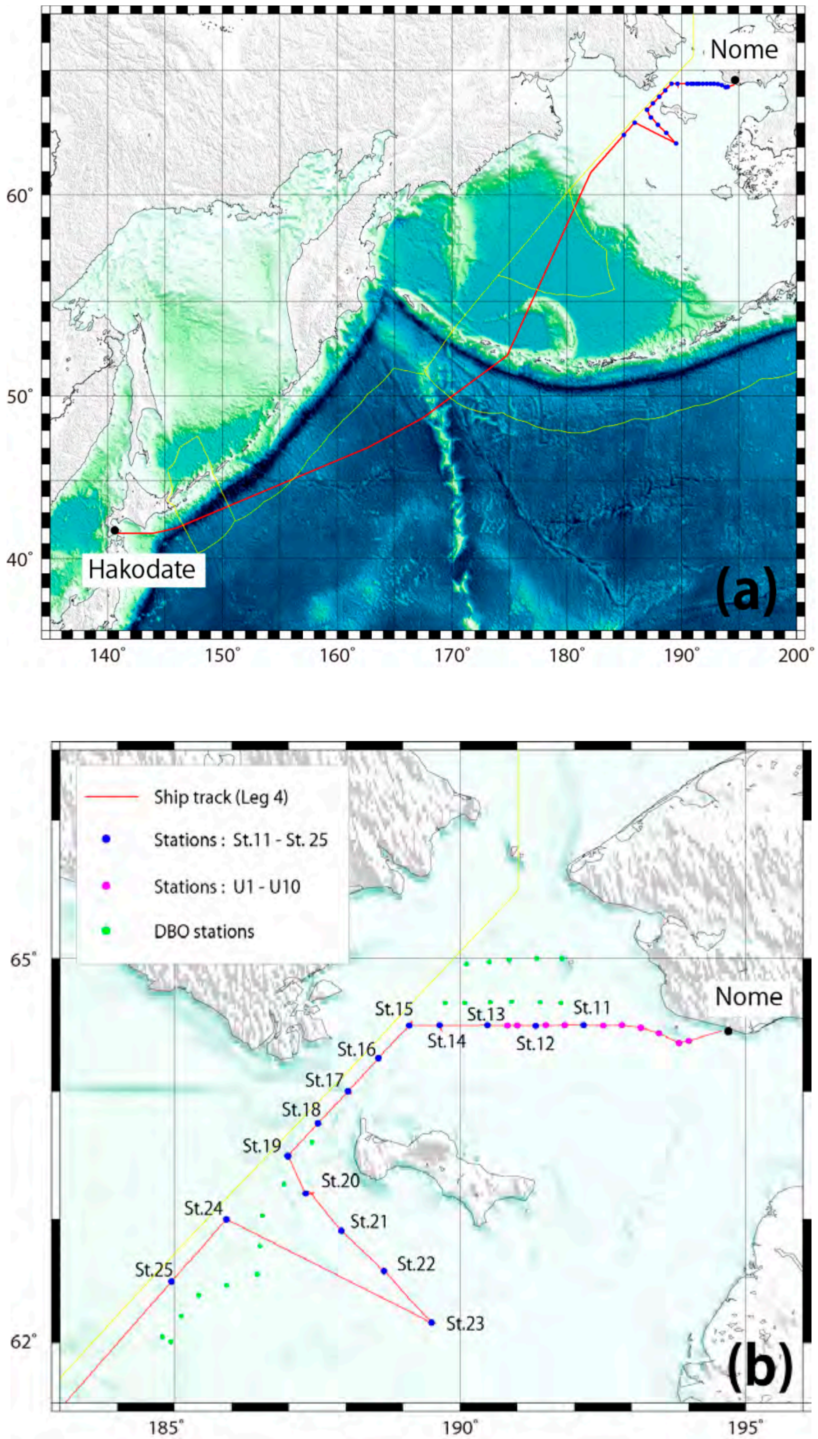


Figure 2. Map of cruise track (a) and sampling stations of Leg-4 (b).

2. R/V *Mirai* cruise

Through ArCS project, JAMSTEC and Hokkaido University has a plan to conduct a research cruise by *R/V Mirai* in Chukchi Sea in summer-autumn season. This is on-going now.

3. T/S *Oshoro-maru* cruise plan in 2018

Through ArCS and OMIX (Ocean Mixing Processes) projects, Hokkaido University has a plan to conduct a research cruise by *T/S Oshoro-maru* in the Bering Sea and southern Chukchi Sea in summer from June 14 (Tokyo) to August 2 (Hakodate) 2017. Dr. Toru HIrawake will be chief scientist of this cruise.

Research area A covers Aleutian Islands surrounding sea area. Research area B covers southern Chukchi Sea, Bering Strait - Saint Lawrence surrounding sea area, and northeastern Bering Sea continental shelf area. She will enter Dutch Harbor on June 26 after observation in Research area A, then leave for Research area B on June 29. She will enter Dutch Harbor again on July 15 after observation in a part of Research area B, then leave for Hakodate on July 17 (Figures 3 and 4).

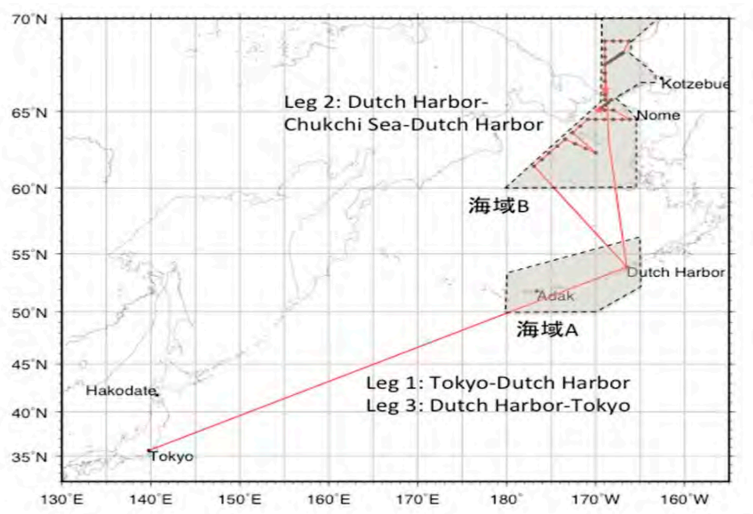


Figure 3. Map of T/S *Oshoro-maru* cruise plan in summer 2018

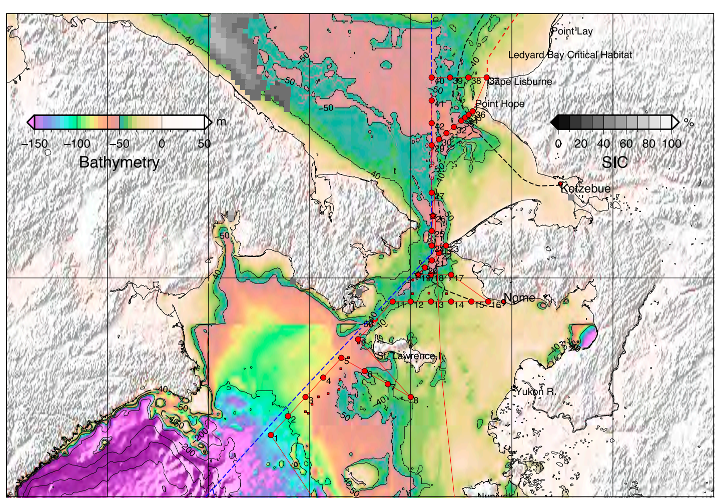


Figure 4. Map of planned observation stations by the T/S *Oshoro-maru* in summer 2018.

Korea

I. Report from NIFS (National Institute of Fisheries Science)

1. Ocean acidification surveys in the Korea waters

Serial ocean acidification surveys are carried out 3 times a year on 79 stations in the Korea Waters since 2015. In these surveys, NIFS measured TIC (Total Inorganic Carbon), TA (Total Alkalinity), $p\mathrm{CO_2}$ and pH at each station, with standard depths. From the results of aragonite saturation, which was calculated from pH, NIFS estimated the ocean acidification states spatially and temporally.

2. Wave-glider survey around the coastal upwelling area

NIFS operated a wave-glider to understand the ocean conditions by appearance of coastal upwelling along the eastern coast of Korea during July and August in 2017. The wave-glider had temperature, salinity, Chl-*a*, wind speed/direction sensors and ADCP (Acoustic Doppler Current Profiler) attached to it. From these data, NIFS analyzed in detail the physical, biogeochemical and atmosphere features related with coastal upwelling.

3. Real-time Information System for Aquaculture around the Korean coastal area

NIFS operates 54 Real-time Information System for Aquaculture environment (RISA) around the coastal area of Korea. This system measures temperature, salinity and dissolved oxygen every 30 minutes at several depths. The data from this system were serviced by internet web-page, mobile web-page, SMS (Short Message Service) and mobile phone application. In 2017, abnormally high water temperature, which was higher 2~7℃ compared to mean values, occurred in the Korean coastal area during July and August. Based on observed data by this system, NIFS was able to provide high temperature alerts to fishermen.

II. Report from KHOA (Korea Hydrographic and Oceanographic Agency)

1. Additional HF-Radar systems and buoy

KHOA currently operates 50 tidal stations, three ocean stations, 31 moored ocean buoys, 40 HF-radar systems and three ocean research stations, which make 127 Korea ocean observing networks in total. By the end of 2017, four additional HF-radar systems will be installed around the southwestern coast of Korea to enhance the capacity of real-time surface currents monitoring progress.

2. Ulleung-Do ocean characteristic monitoring

In addition to the existing vessel survey of ocean characteristics near Ulleung-do on the east coast, a wave glider was deployed in February and November 2017. The glider was mounted with CTD, ADCP sensors and Multi-bean echo sounder to measure wave height, ocean current and bathymetry to enhance the capacity of existing ocean models during demanding seasons.

III. Report from KIOST (Korea Institute of Ocean Science & Technology)

1. Low salinity water observation using wave-glider in the Northern East China Sea

KIOST operated a wave-glider to understand the behavior of low salinity water masses, which should be diluted by the Changjian River, from mid-August to early-September in 2017. From the results from the wave-glider, which measured temperature, salinity, Chl-*a*, turbidity and ocean current, KIOST will be analyzed to understand the ocean conditions due to the behavior of the low salinity water mass, and make an algorithm to estimate the surface salinity using satellite measurments.

2. Operation and construction of ocean research stations

KIOST constructed 3 ocean research stations: Ieodo Ocean Research Station, Gageo Ocean Research Station and Socheongcho Ocean Research Station. These 3 stations, which have been operated by KHOA, have measured various ocean and weather conditions. The main applications of these stations are to improve comprehensive ocean and weather observations and provide core scientific information and data for global environmental change studies.

IV. Report from KAIST (Korea Advanced Institute of Science and Technology)

1. Coastal Ocean Observing System in Korea

KAIST has constructed a Coastal Ocean Observing System (COOS). COOS generally consists of the observing system by satellites, buoys, gliders Argo floats, tide gauges, HF radars, marine platforms and other *in-situ* coastal observations. This system will be used for rescue, coastal environmental accidents, fisheries, coastal disasters and other various coastal problems.

Russia

Monitoring Activities (fisheries independent surveys) at TINRO-Center by Vladimir V. Kulik

1. Information imported to the Regional Data Center in 2017

TINRO-Center conducted an expedition on the R/V *Professor Kaganovskiy* (2017-04-11– 2017-05-30) in the Sea of Okhotsk (Figure 1) to estimate walleye pollock spawning biomass in spring (269 midwater trawls) and abundance of all other species caught by trawls.

The northern Sea of Okhotsk (without the East Sakhalin subzone) is the only one part of the Far-Eastern Seas that is monitored annually by the same vessel: R/V *Professor Kaganovskiy* (Figure 2) and method of trawling, having at least 181 stations per year (Table 1). Thus we present here the results of estimation of indices of abundance in that part of the Sea of Okhotsk only.

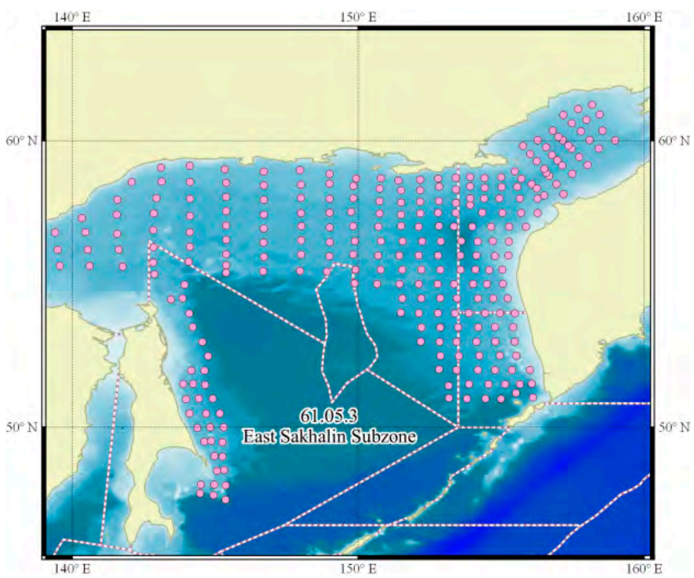


Figure 1 Locations of trawlings by the R/V *Professor Kaganovskiy* (2017-04-11–2017-05-30).

There were 94 taxon units – mostly fish species including 4 squid species discovered in midwater trawls during the expedition in the northern part of the Sea of Okhotsk in 2017. Our specialists have found 140 fish species and 23 Cephalopoda species since 2004, but only 18 fish species and 3 squid species occurred in more than 5% cases.

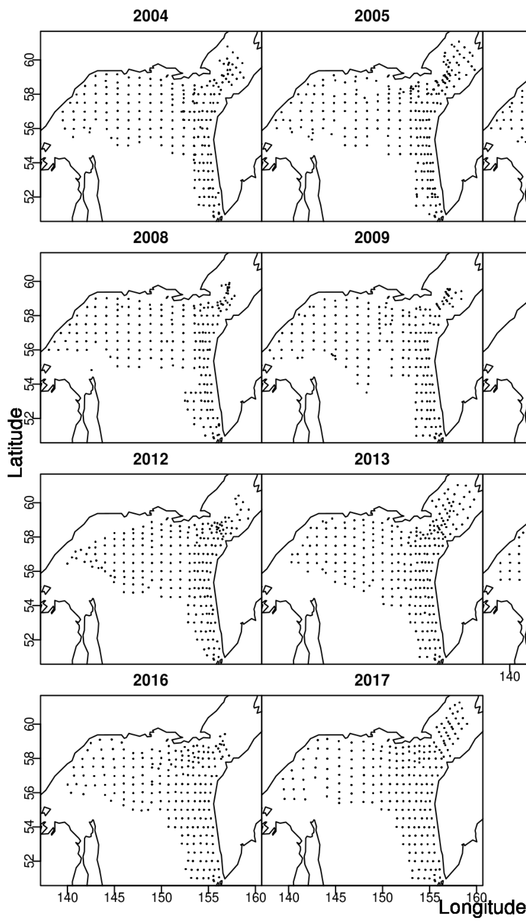


Figure 2 Locations of midwater trawl stations in the Kamchatka–Kuril (FAO 61.05.4), West Kamchatka (FAO 61.05.2) and northern Sea of Okhotsk (FAO 61.05.1) subzones in spring.

Table 1 The quantity of stations by years in the Kamchatka-Kuril, West Kamchatka and northern Sea of Okhotsk subzones

Year	Begin	End	Number of stations
2004	2004-04-02	2004-05-29	220
2005	2005-04-02	2005-06-04	240
2006	2006-04-07	2006-06-02	205
2007	2007-03-31	2007-06-01	181
2008	2008-04-03	2008-05-31	209
2009	2009-04-02	2009-05-21	218
2010	2010-03-31	2010-05-23	198
2011	2011-04-05	2011-05-25	249
2012	2012-04-11	2012-05-25	228
2013	2013-04-04	2013-05-25	258
2014	2014-04-11	2014-05-23	242
2015	2015-04-09	2015-05-24	207
2016	2016-04-11	2016-05-25	218
2017	2017-04-11	2017-05-24	232

We selected 6 fish species (Table 2) and 3 squid species (Table 3) that frequently occurred annually and had relatively high biomass.

Table 2 Selected fish species.

Species	CEP*	Occurrences	Share (%) from the total number of station since 2004
Gadus (Theragra) chalcogramma	Therchal	2926	94.2
Aptocyclus ventricosus	Aptovent	1370	44.1
Mallotus villosus	Mallvill	1243	40.0
Eumicrotremus soldatovi	Eumisold	1055	34.0
Clupea pallasii	Cluppall	997	32.1
Limanda sakhalinensis	Limasakh	938	30.2

*CEP – Cornell Ecology Programs abbreviation

Table 3 Selected squid species

Species	CEP	Occurrences	Share (%) from the total number of station since 2004
Gonatus madokai	Gonamado	521	16.8
Berryteuthis magister	Berrmagi	497	16.0
Boreoteuthis (Gonatopsis) borealis	Gonabore	348	11.2

There are many methods to estimate biomass of species using such kind of data that we have (kg km^{-2}). For comparative purpose we estimated indices of biomass using Joint Dynamic Species Distribution Models (JDSDM) following an example of James Thorson (Thorson *et al.*, 2016) in his R package for Vector autoregressive spatio-temporal modeling (VAST). We chose 3 spatial and 3 spatio-temporal factors in his gamma observation model for positive densities. Encounter probability in the chosen model fitted better than positive-catch-rate component (Figure 3).

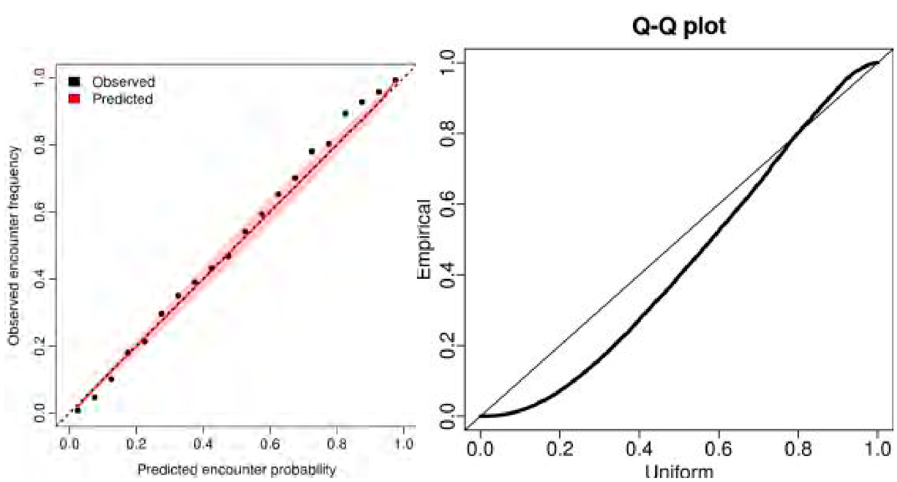


Figure 3 Predicted encounter probability against observed encounter frequency (on the left) and positive-catch-rate component (on the right).

Thus we fitted simpler geostatistical delta-generalized linear mixed models (delta-GLMM) for each of the species individually following a single species spatio-temporal example (Thorson et al. 2015). The results from JDSDM are shown below (Figure 4). They were closely related to the results from single species delta-GLMMs ($r > 0.8$, $p < 0.0001$), but the latter had higher amplitude of abundance's dynamics and had better positive-catch-rate Q-Q plots.

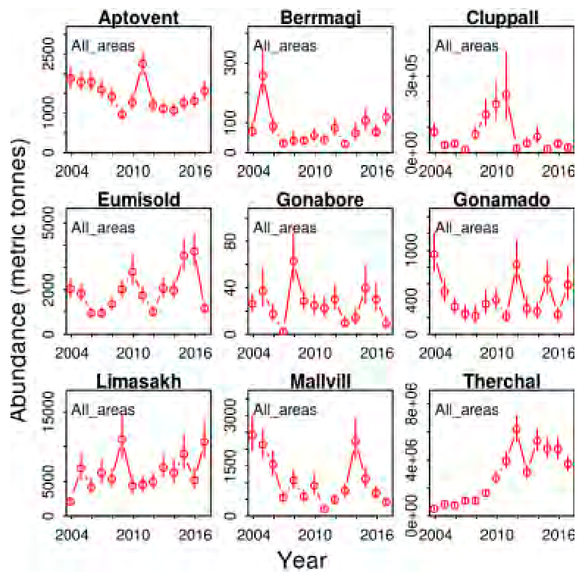


Figure 4 Indices of abundance of frequently met species of fish and squids in the northern part of the Sea of Okhotsk (without the East Sakhalin subzone) during spring calculated in JDSDM.

Walleye pollock (Therchal) was distributed almost everywhere in the region of monitoring. This fish was strongly connected with Factor 1 that took 56.6% of explained variance of encounters, but its loadings of spatio-temporal variation in positive-catch-rate were close to zero in the first two factors, that took almost 84% of explained variance (Figure 5).

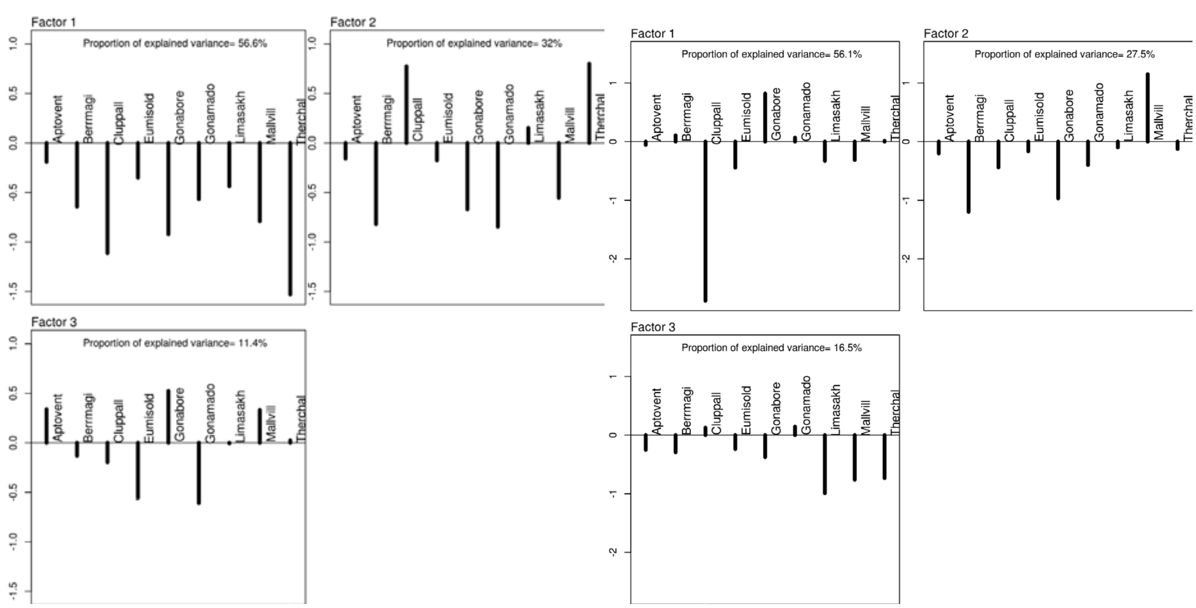


Figure 5 Factor loadings of spatio-temporal variation of encounters (left) and positive-catch-rate (right).

Pacific herring (Cluppal) and Pacific capelin (Mallvill) were distributed closer to the shore than the vessel could get to, thus the estimates of their abundance relate to the region of observation only. The same we can say about estimates of abundance of squids especially Boreopacific gonate squid (Gonabore) and Schoolmaster Gonate Squid (Berrmagi) that prefer mesopelgial and deeper slope than the most of the trawlings occurred. At the same time all these species had stronger loadings on the first 2 factors representing spatio-temporal variation in positive-catch-rate than the dominant fish – walleye pollock – had.

Talking about tendencies in the biomasses starting with the dominant fish (walleye pollock) we cannot be sure even in the direction of tendency, because there was obvious underestimation in 2013 that made negative tendency since 2012 insignificant using either delta-GLMM or JDSDM estimates (Figure 6).

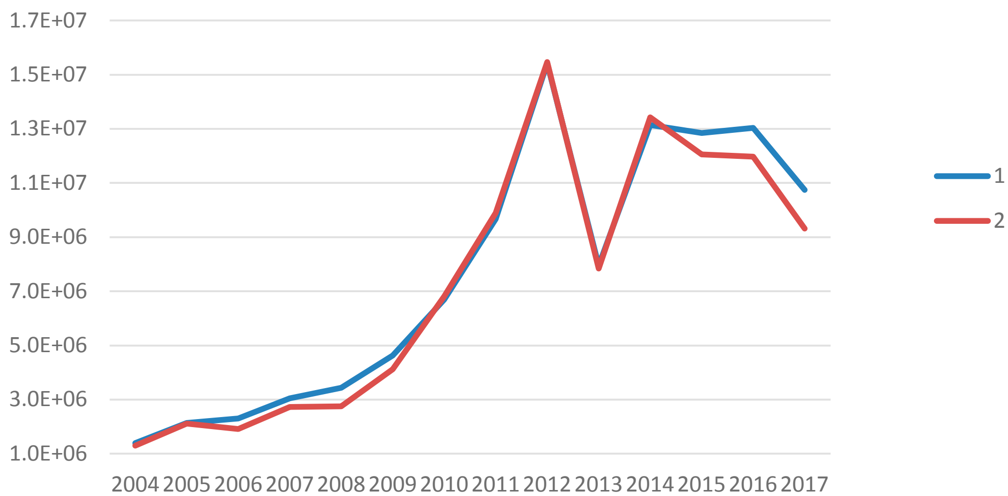


Figure 6 Biomass of adult (fork length > 20 cm) walleye pollock (metric tonnes) in the Northern part of the Sea of Okhotsk (without the East Sakhalin subzone) during spring calculated in delta-GLMM (1) and JDSDM (2) and divided by 0.4 (that is traditionally used as catchability coefficient in TINRO-Center).

At the same time if we ignore the estimate of biomass in 2013 then we get negative and significant ($p < 0.02$) linear tendency since 2012, and Durbin–Watson test shows nonsignificant p-values (>0.5).

Walleye pollock spawning stock biomass (SSB) and total stock biomass (TSB) are estimated annually using many indices of stock abundance calculated not only from trawl surveys but also from acoustic and egg surveys (the same vessel at the same time), standardized CPUEs and data gathered by scientific observers during fishing operations in spring (mainly January through March and first 10 days of April). After tuning statistical age-structured model “Synthesis”(Ilyin *et al.*, 2016) by colleagues from KamchatNIRO (Varkentin A.I. and Ilyin O.I.) we can see that decreasing of neither SSB nor TSB was not expected in 2017 (Figure 7).

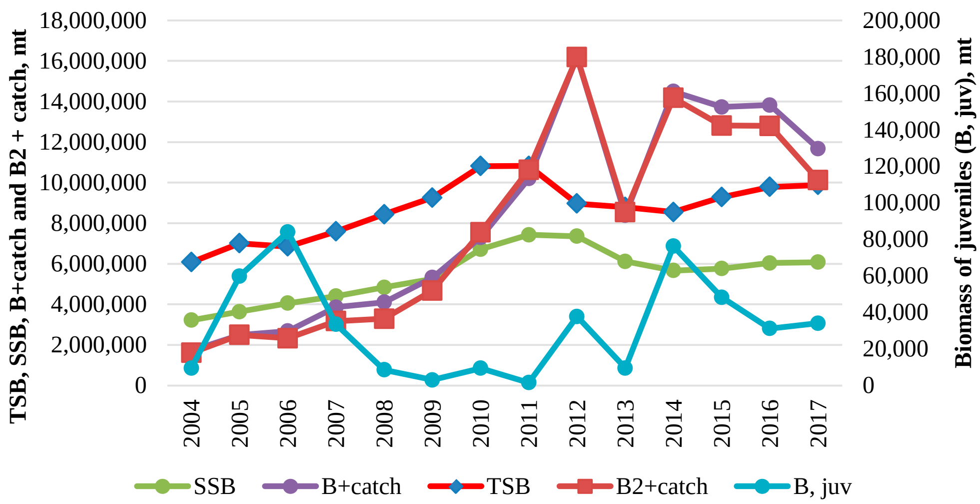


Figure 7 TSB and SSB of walleye pollock estimated in the model "Synthesis" for the region combining Kamchatka-Kuril, West Kamchatka and Northern Sea of Okhotsk subzones, Biomass of adults + catch before the survey (B+catch) and juveniles (B, juv) calculated from the annual trawl survey in delta-GLMM and Biomass of adults + catch before the survey (B2 + catch) calculated in JDSDM for the same region.

So far we do not see good accordance between tendencies in the dynamics of biomass of the main fishery object in the Sea of Okhotsk that were estimated by different methods. Thus we do not speculate on tendencies further.

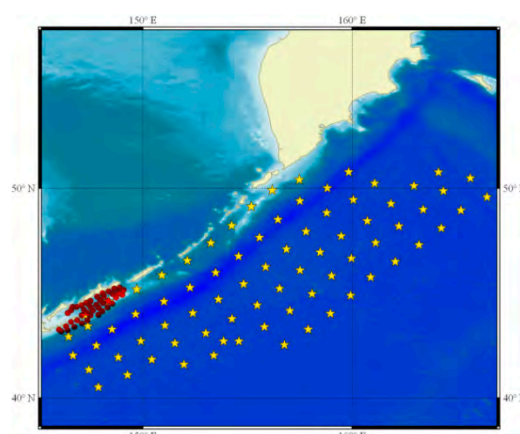
Ilyin, O.I., Varkentin, A.I., and Smirnov, A.V. 2016. On one model approach to assessment of state for the stock of walleye pollock Theragra chalcogramma in the northern Okhotsk Sea. Izv. TINRO **186**: 107–117. Available from http://izvestiya.tinro-center.ru/jour/article/view/127.

Thorson, J.T., Ianelli, J.N., Larsen, E.A., Ries, L., Scheuerell, M.D., Szuwalski, C., and Zipkin, E.F. 2016. Joint dynamic species distribution models: a tool for community ordination and spatio-temporal monitoring. Glob. Ecol. Biogeogr. **25**(9): 1144–1158. doi:10.1111/geb.12464.

Thorson, J.T., Shelton, A.O., Ward, E.J., and Skaug, H.J. 2015. Geostatistical delta-generalized linear mixed models improve precision for estimated abundance indices for West Coast groundfishes. ICES J. Mar. Sci. **72**(5): 1297–1310. doi:10.1093/icesjms/fsu243.

2. Other stations observed in 2017 and imported at the moment to the database of Regional Data Center of TINRO-Center

There were 43 midwater trawls conducted by the R/V *Professor Kaganovskiy* (2017-03-27–2017-04-04) to estimate walleye pollock stock above the shelf of the southern Kuril Islands as usual (right).

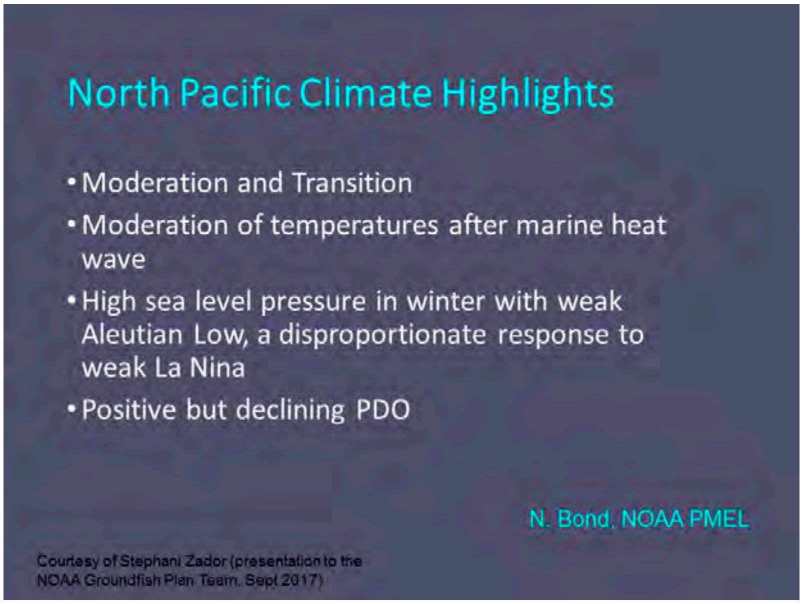


TINRO-Center conducted 77 trawlings in the pelagic upper layer by the R/V *Professor Kaganovskiy* (2017-06-01– 2017-07-04) in the offshore waters of the Pacific Ocean crossing routes of migration of salmon. There are some other expeditions in process of conducting or importing to Regional Data Center of TINRO-Center. A full list of expeditions and types of observations, conducted in 2017, will be available in 2018.

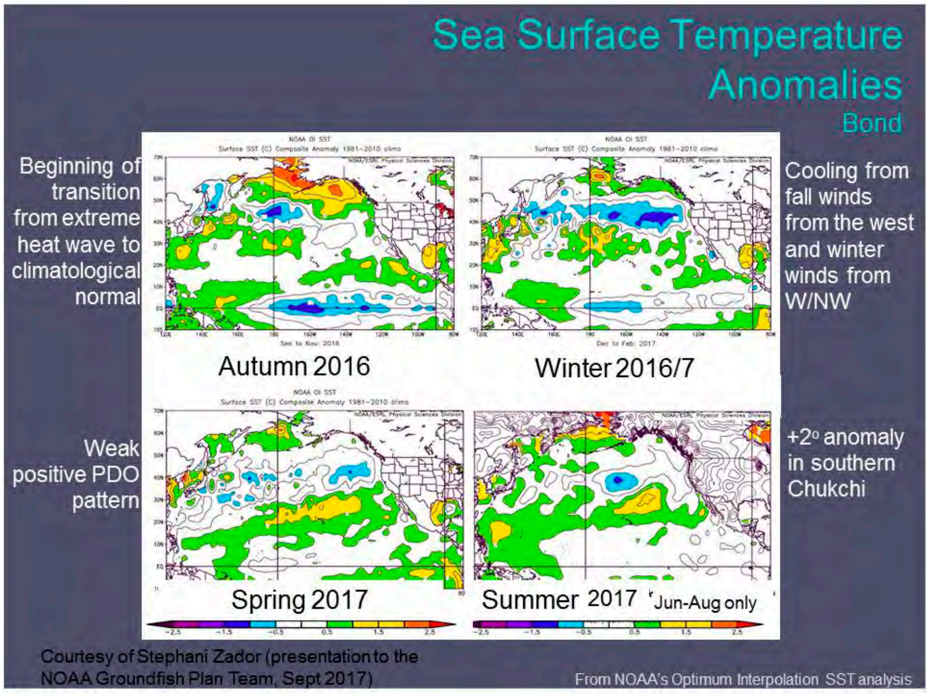
USA

Lisa Eisner, Alaska Fisheries Science Center

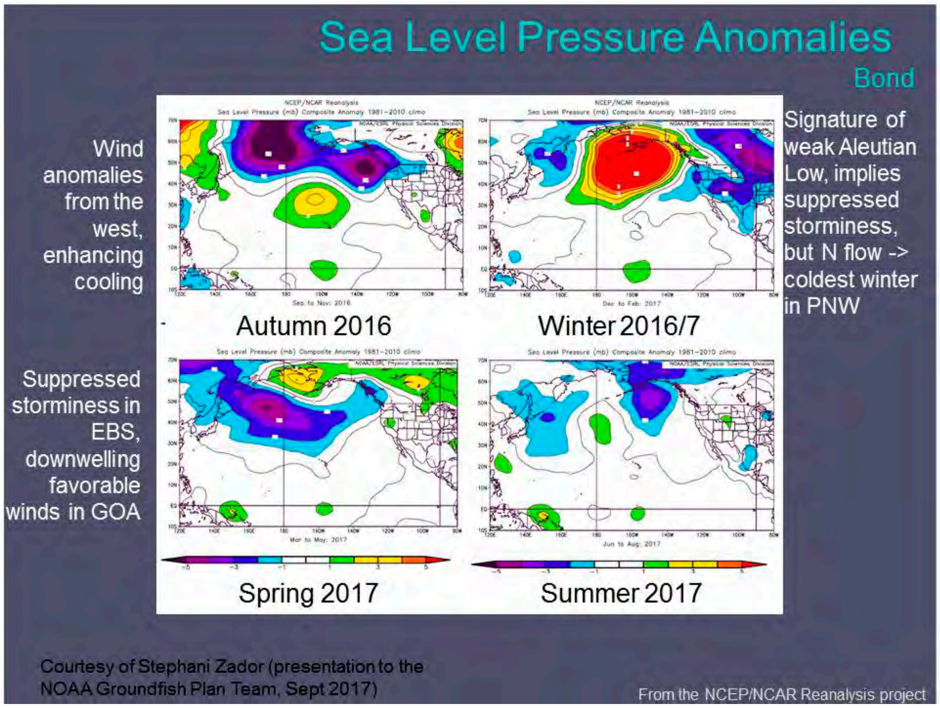
The report for 2017 shows information for Alaskan marine waters. North Pacific climate information kindly provided by Dr. Nick Bond at Pacific Marine Environmental Lab (PMEL), Seattle, WA.



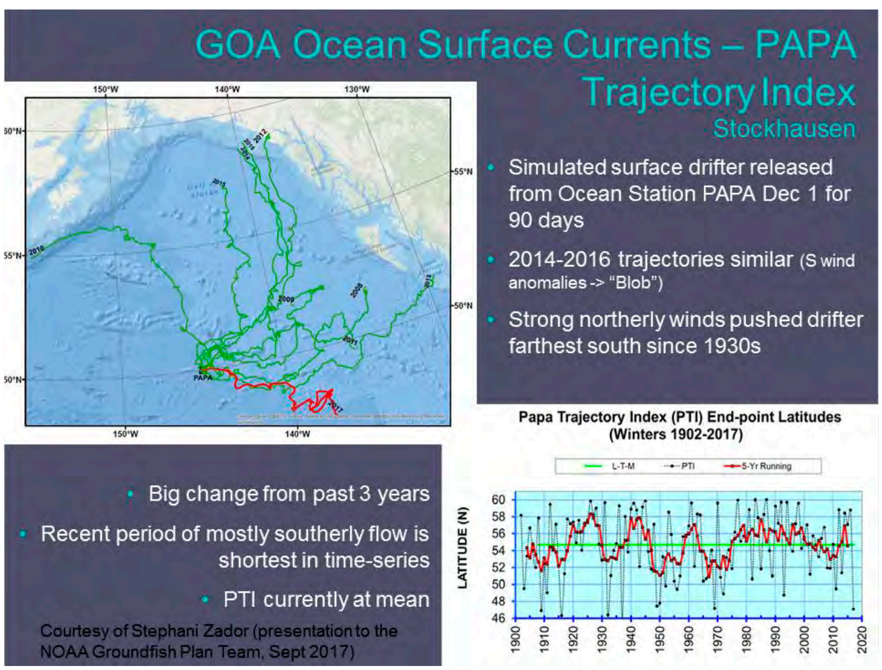
Sea surface temperature anomalies (compared to 1981-2010 climatology) show changes over past year.



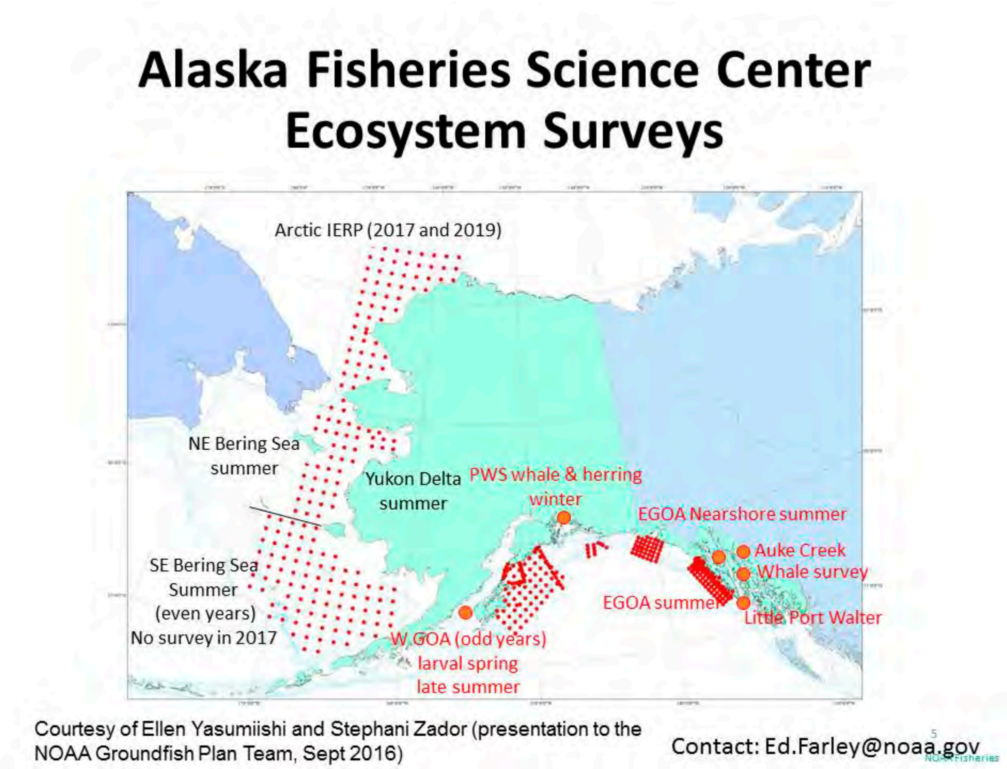
Sea level pressure anomalies are also in relation to 1981-2010 climatology.

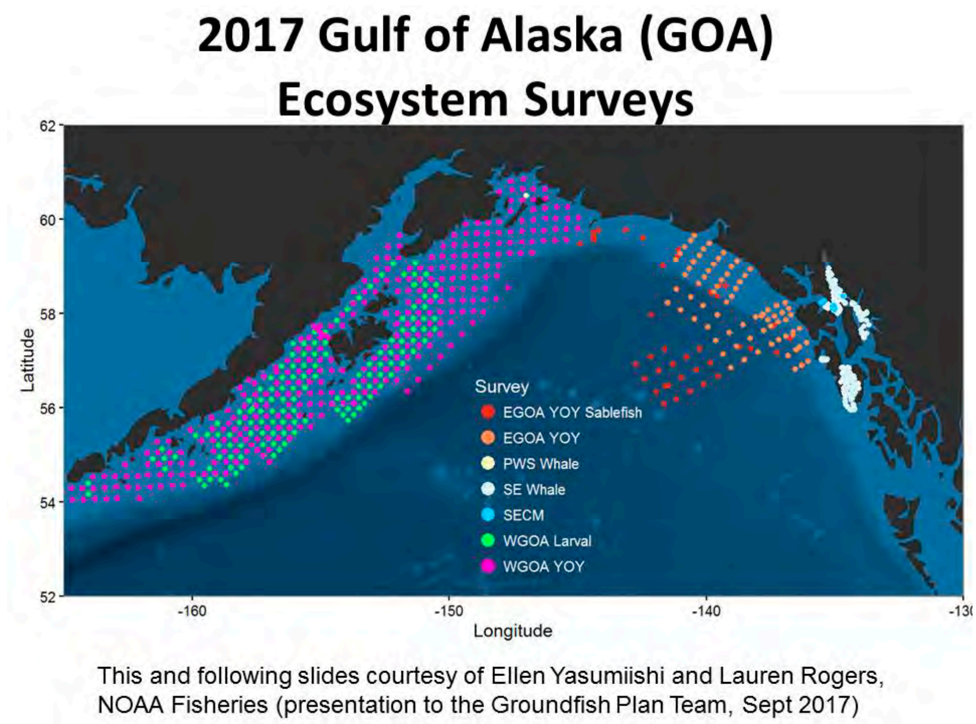


Gulf of Alaska (GOA) surface currents were southerly in 2017, unlike previous years.

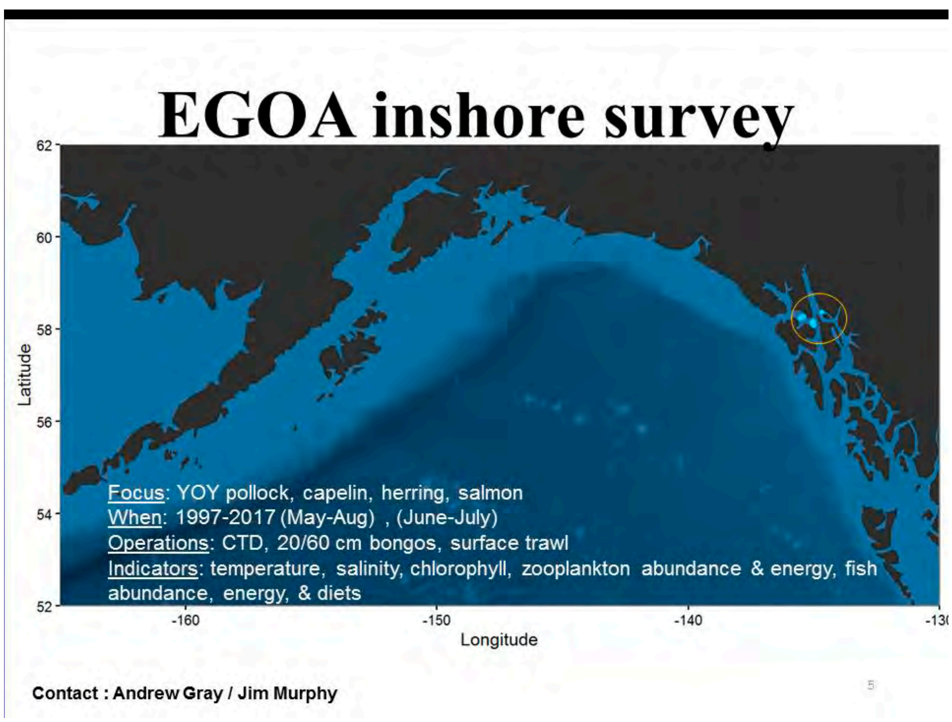


The map below shows ecosystem surveys in the Bering and Chukchi seas and the Gulf of Alaska (GOA). In odd numbered years (such as 2017), more surveys focus on the GOA; whereas, in even numbered years more surveys focus on the Bering Sea.

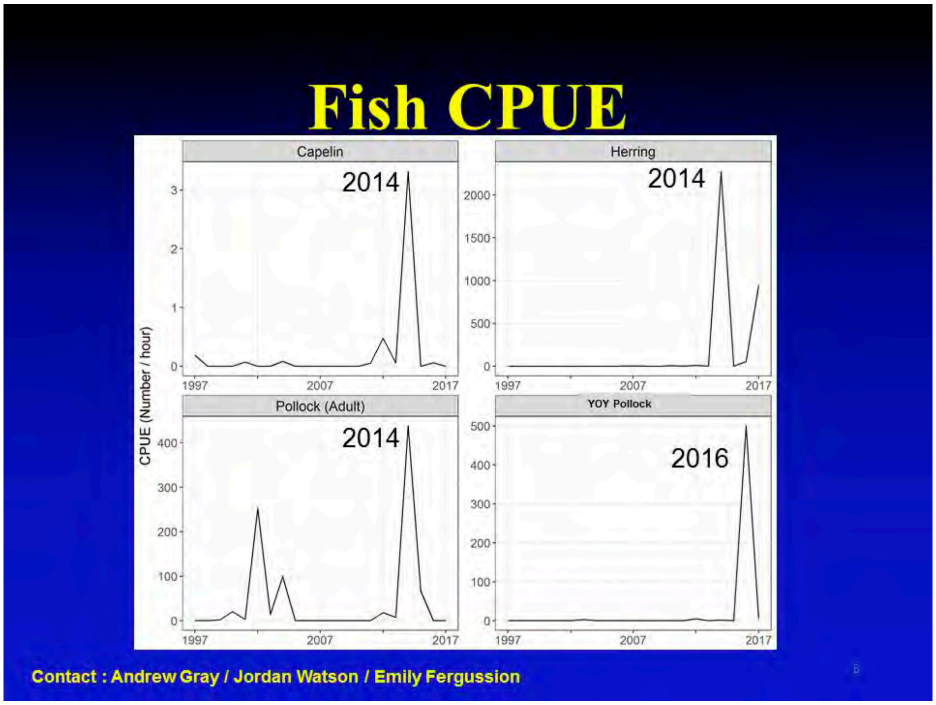




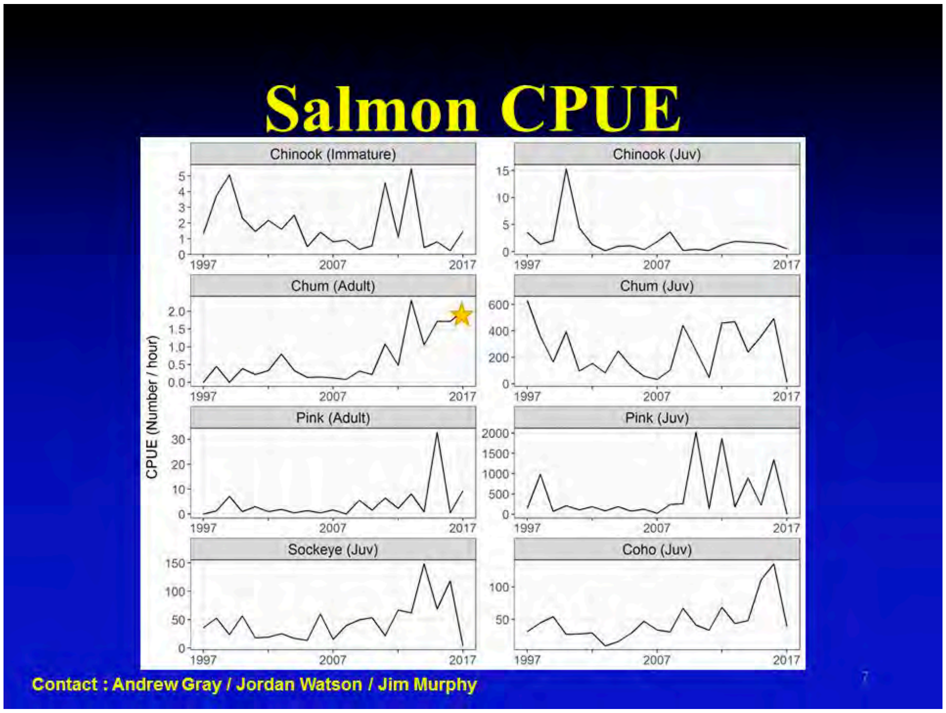
The blue dots show survey locations in the eastern GOA sampled 2–4 times per year.



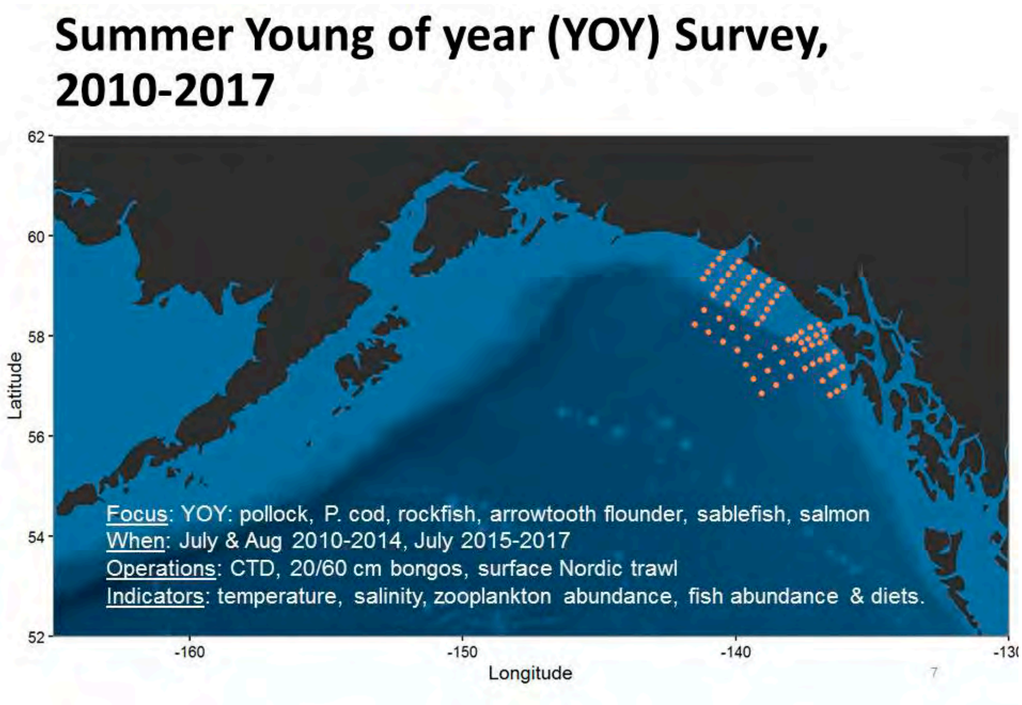
Fish abundance in catch per unit effort (CPUE) for the eastern GOA is shown below for forage fish. Peak numbers were observed in 2014 for capelin, herring and adult pollock, while high numbers of age-0 pollock were seen in 2016. Only herring had fairly high numbers in 2017.



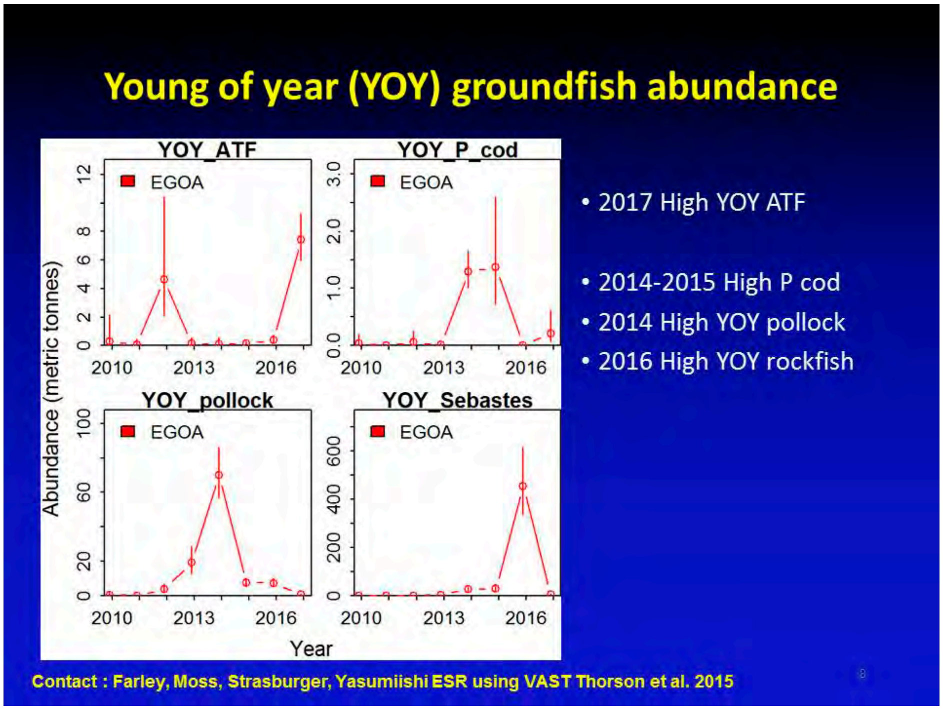
Salmon abundances were low in 2017 with the exception of adult Chum salmon.



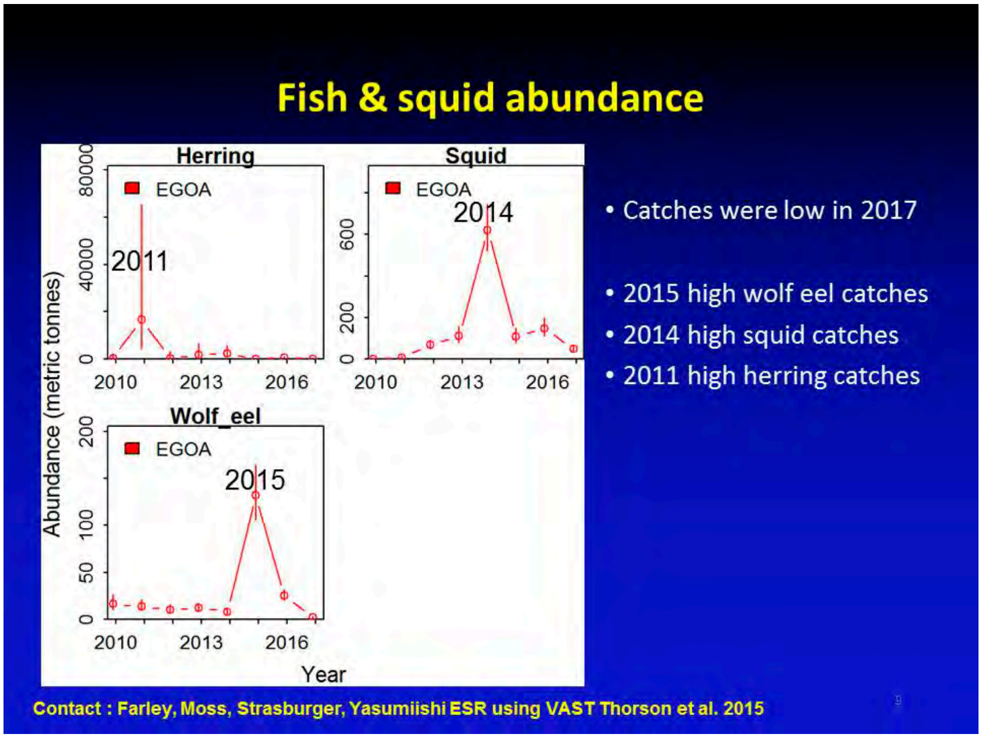
The eastern GOA young of year survey occurred during July at the stations shown below.



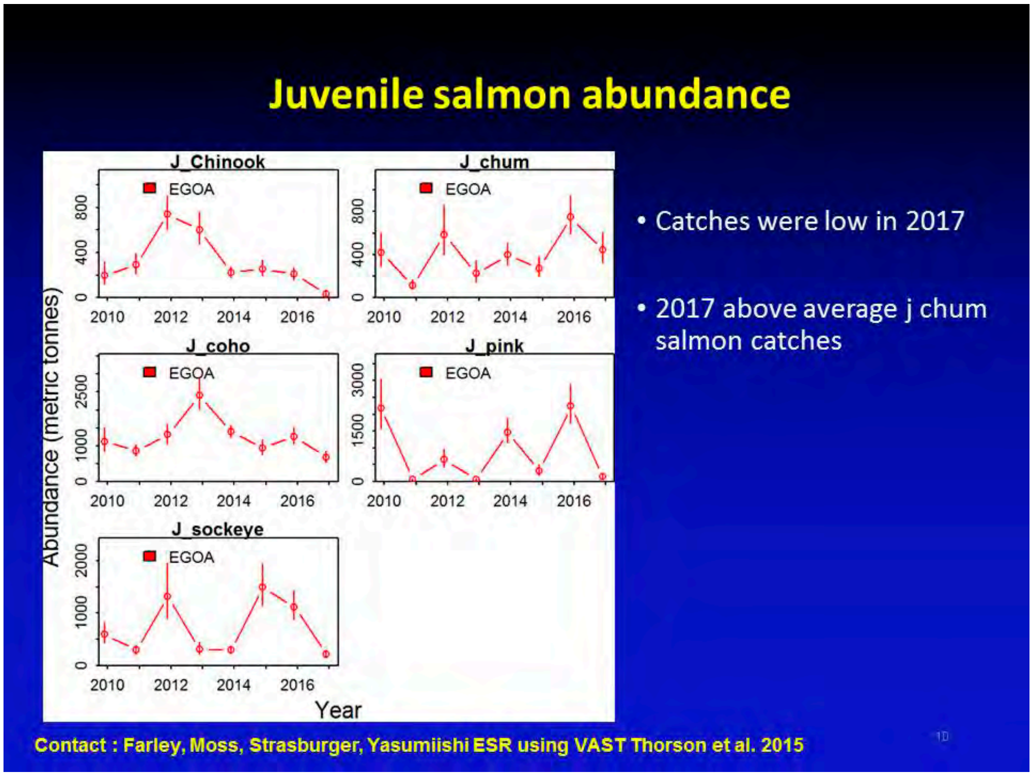
In 2017, Young of year (*i.e*., age-0) arrow tooth flounder (ATF), Pacific cod (Pcod), pollock and rockfish (Sebastes) in the eastern GOA are shown below. Only ATF had high abundance in 2017.



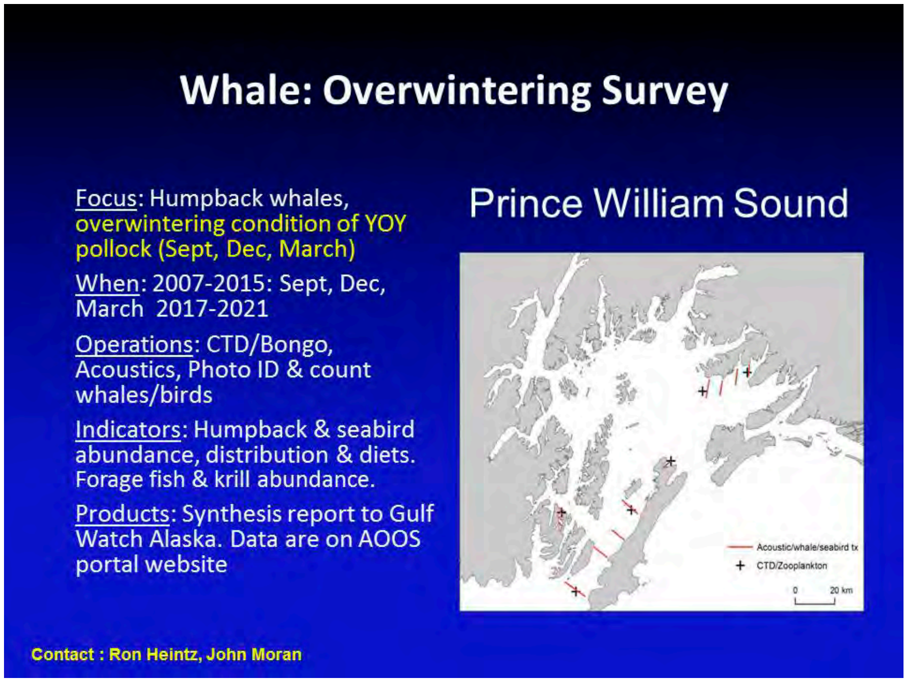
Fish and squid abundances in the eastern GOA were low in 2017.

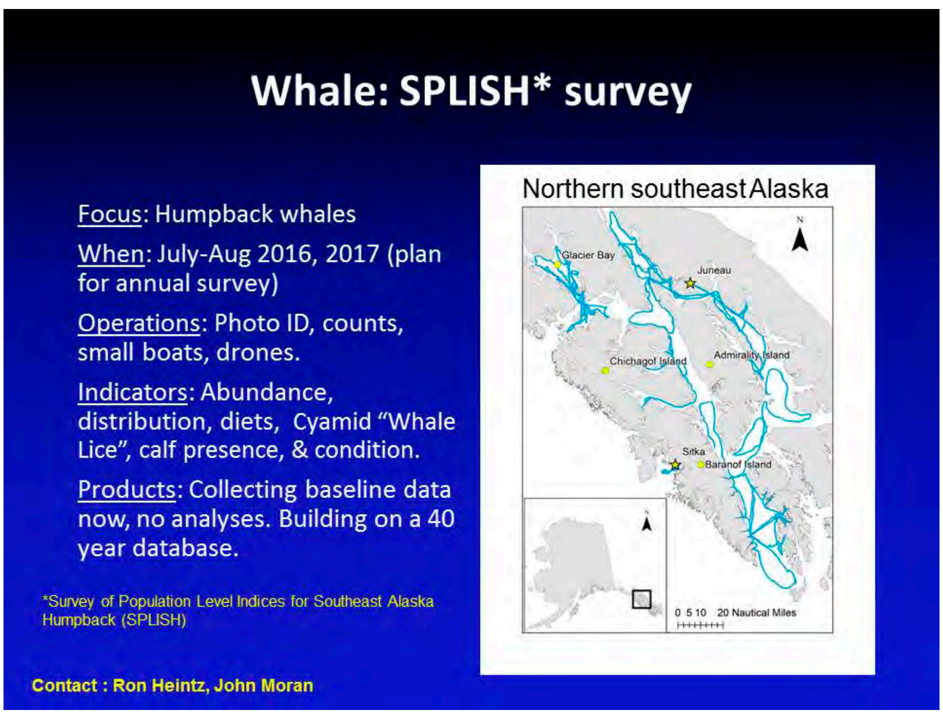


The only juvenile salmon with above average catch was chum salmon; the other species were low.

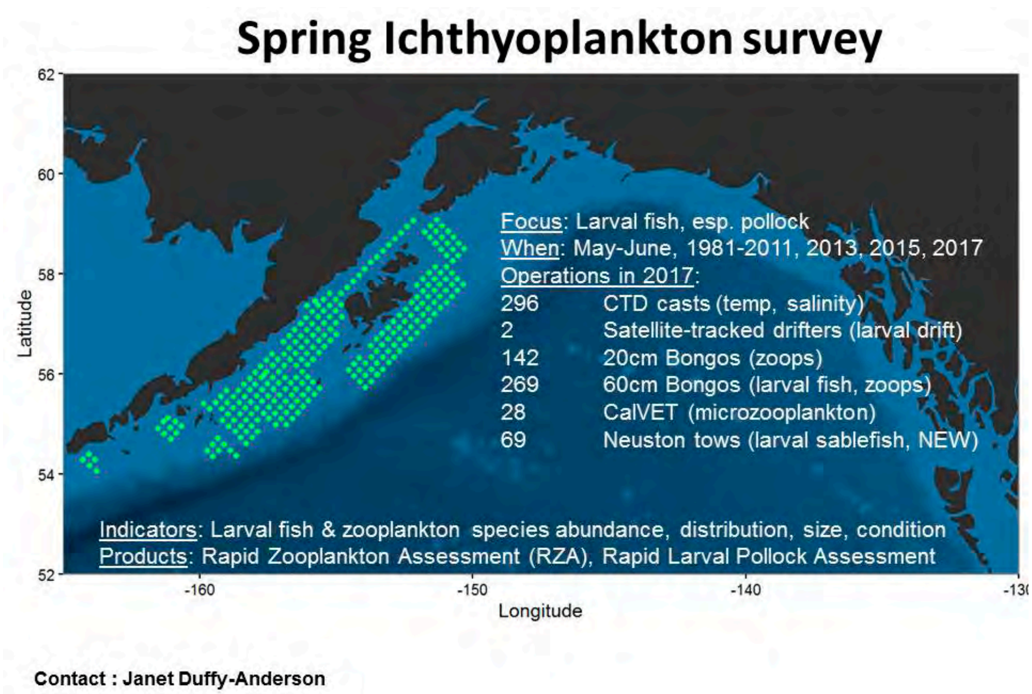


Humpback Whale surveys were conducted in Prince William Sound (over-wintering survey) and in southeast Alaska (SPISH survey) in 2017.

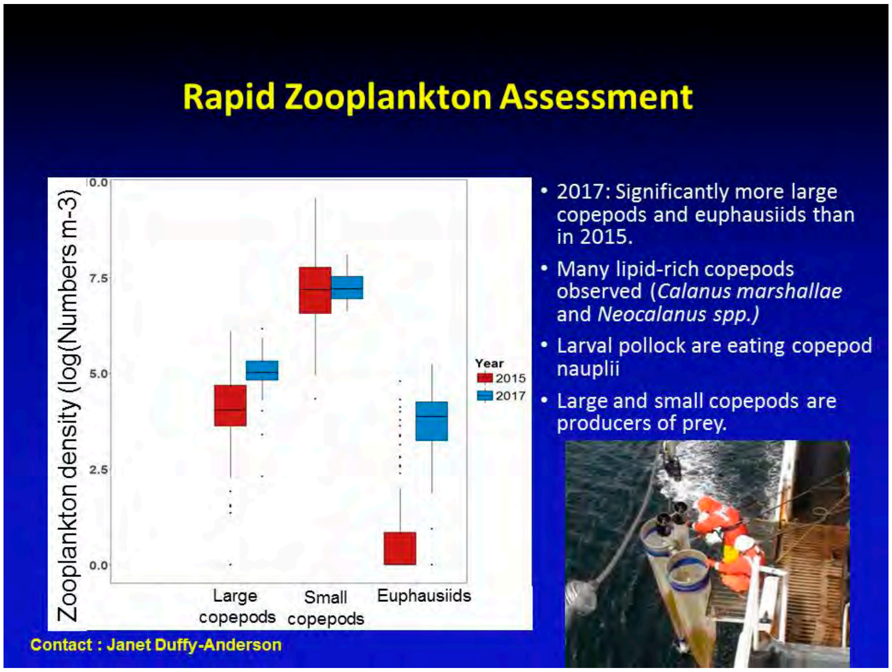




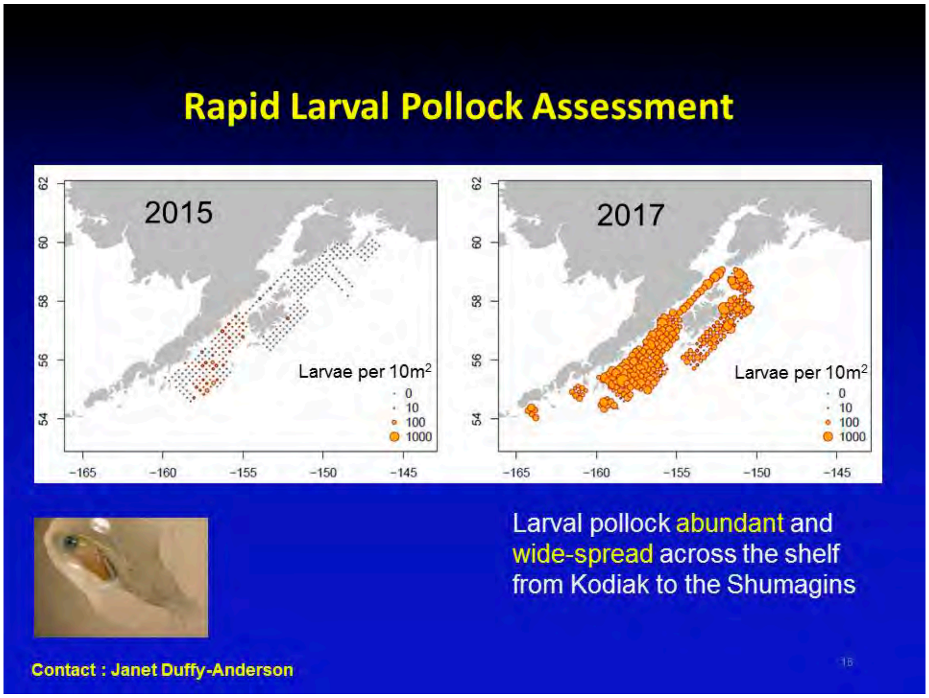
Zooplankton and larval fish were collected during May-June at stations shown below.



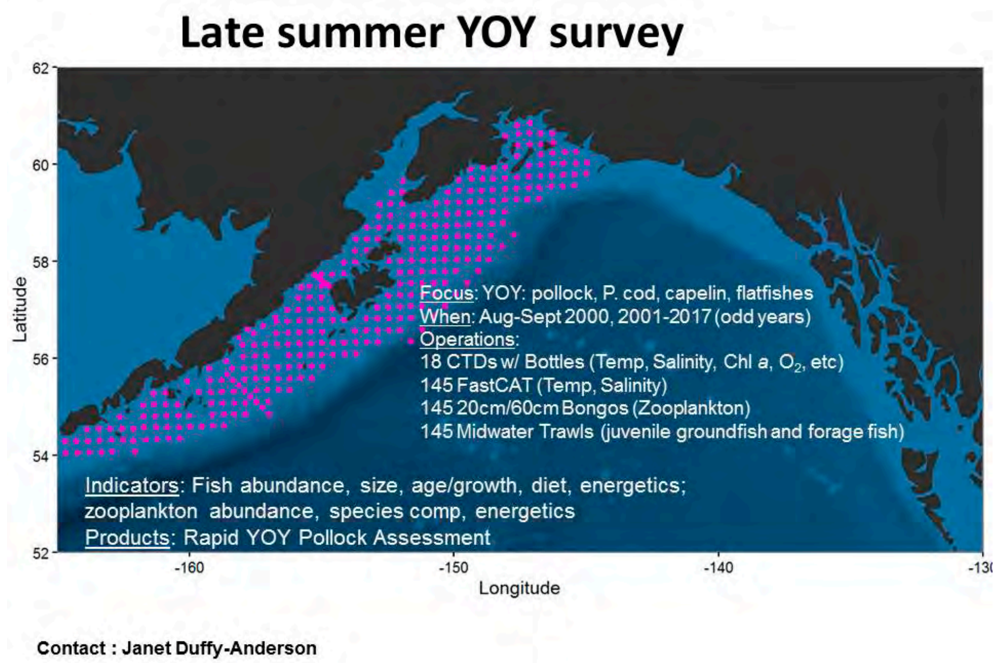
An at-sea rough count of zooplankton shows differences between years with more large zooplankton collected in 2017 than in 2015.



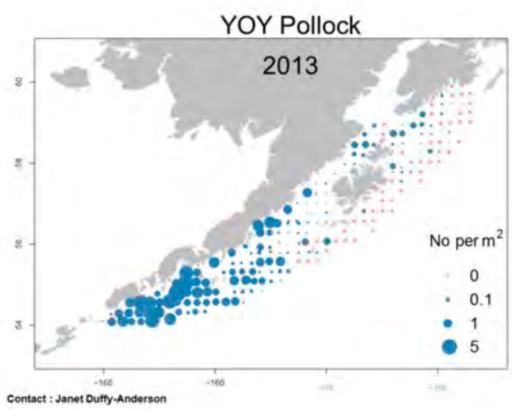
Larval pollock also more abundant in 2017 than in 2015.

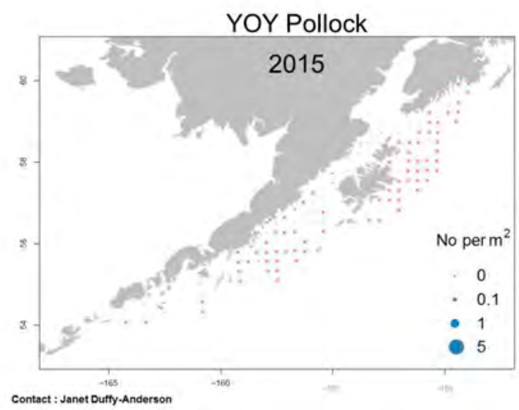


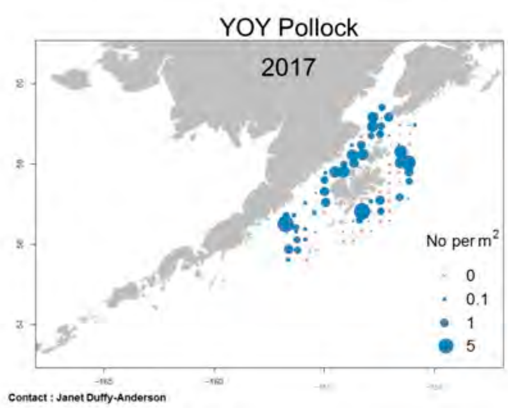
Age-0 (YOY = young of year) fish were surveyed during August–September at stations shown below.



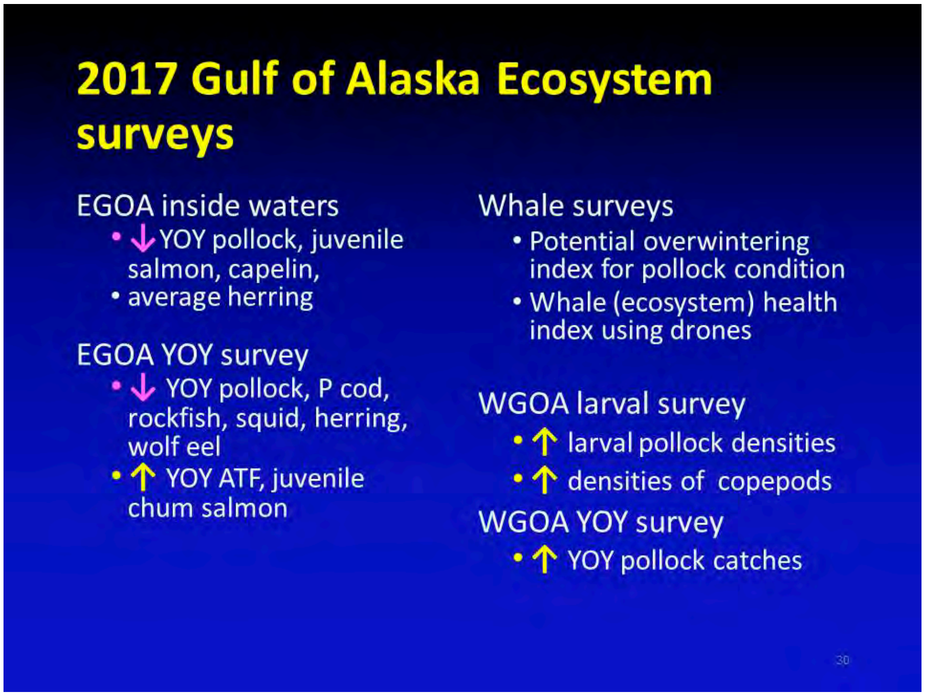
Young of year (YOY) pollock were in higher numbers in 2013 and 2017 than in 2015. These fish were concentrated the east in 2013 and around Kodiak Island in 2017.

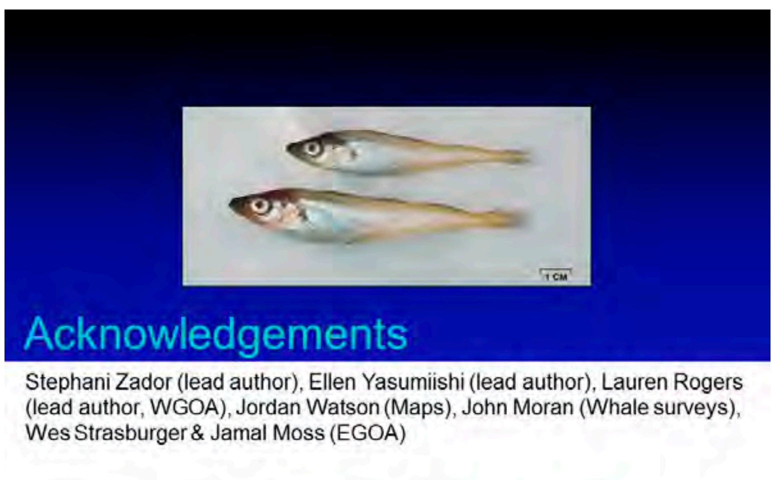






The results for 2017 Gulf of Alaska Ecosystem surveys are summarized below.





Other NOAA surveys in Alaska, 2017

Alaska fisheries Science Center (AFSC):

- Eastern Bering Sea summer bottom trawl survey (extended to north Bering): **ground fish**
- North eastern Bering Sea summer survey: **pelagic fish/salmon**
- Gulf of Alaska Winter Acoustic Trawl survey: **ground fish**
- Gulf of Alaska Summer Acoustic Trawl survey: **ground fish**
- Gulf of Alaska Bottom Trawl survey: **ground fish**
- Eastern Gulf of Alaska (new tagging & lab work): **sable fish**
- Auke Creek Research Station in Juneau, Southeast Alaska: **salmon**

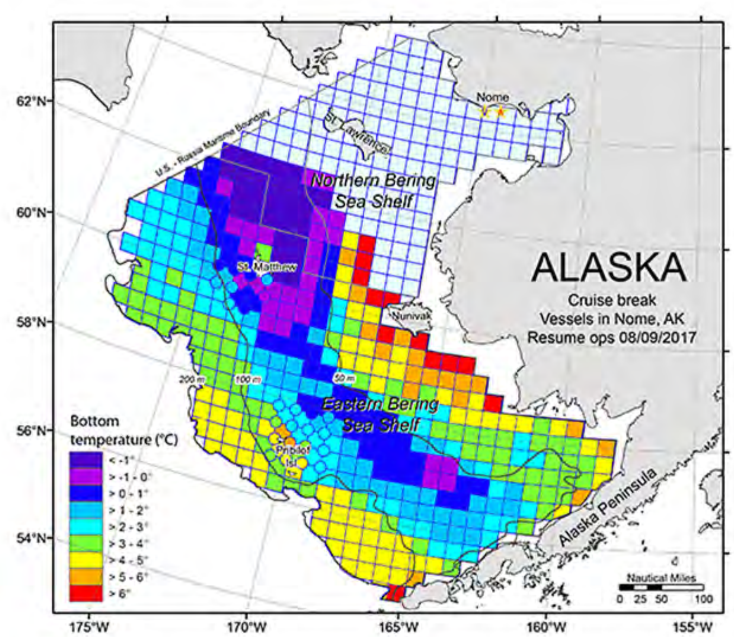
Pacific Marine Environmental Lab (PMEL) and AFSC:

- Eastern Bering Sea Physical Oceanography, 4 moorings, **spring/fall hydrography** along 70m isobath, **phytoplankton/coccolithophore sampling, zooplankton** taxa
- Eastern Bering and Chukchi seas: Sail Drones (https://www.pmel.noaa.gov/itae/follow-saildrone-2017): **T, S, Chl-*a*, carbon parameters (including CO_2)**

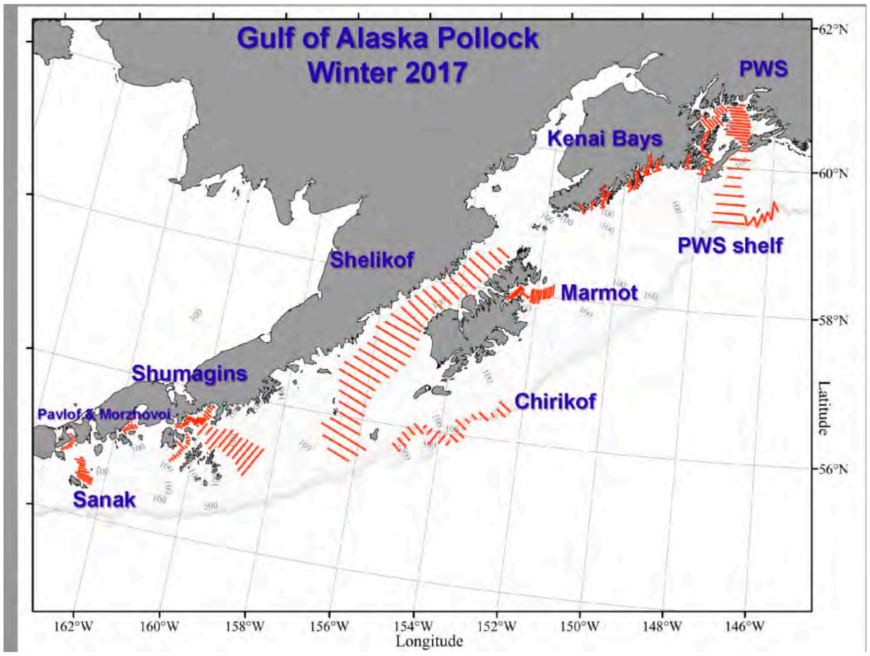
For more information see the Ecosystem Considerations for Alaska:
http://access.afsc.noaa.gov/reem/ecoweb/Index.php

Locations for most of the other AFSC fisheries surveys conducted in 2017 are shown in maps below.

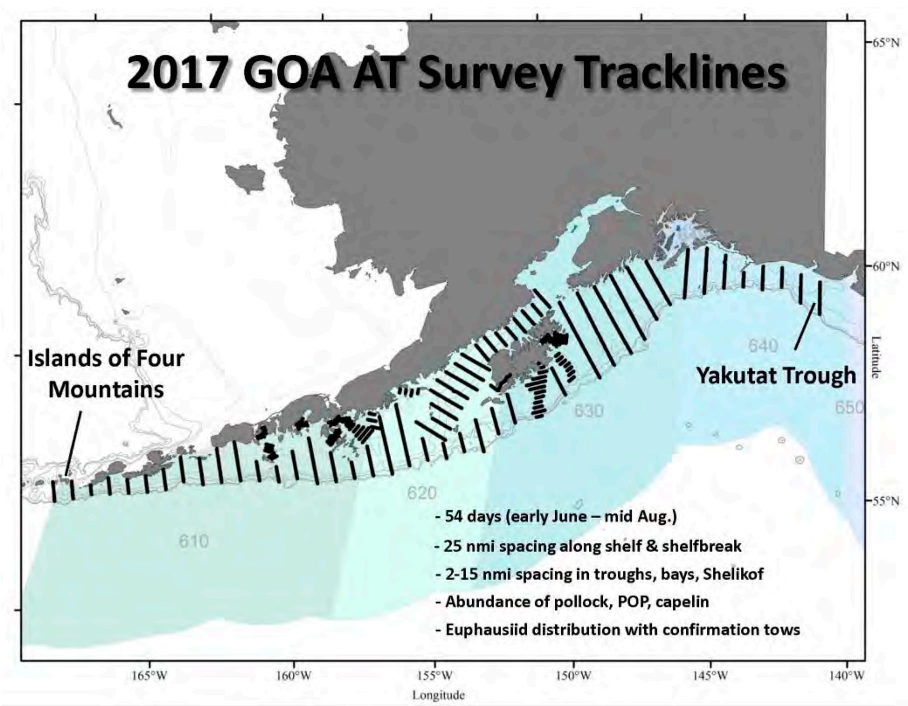
Eastern Bering Sea bottom trawl survey grid for 2017 with bottom temperature. The cold pol (T < 2 °C) was further south than in 2014-2016. See https://www.afsc.noaa.gov/Science_blog/EBS_11.htm



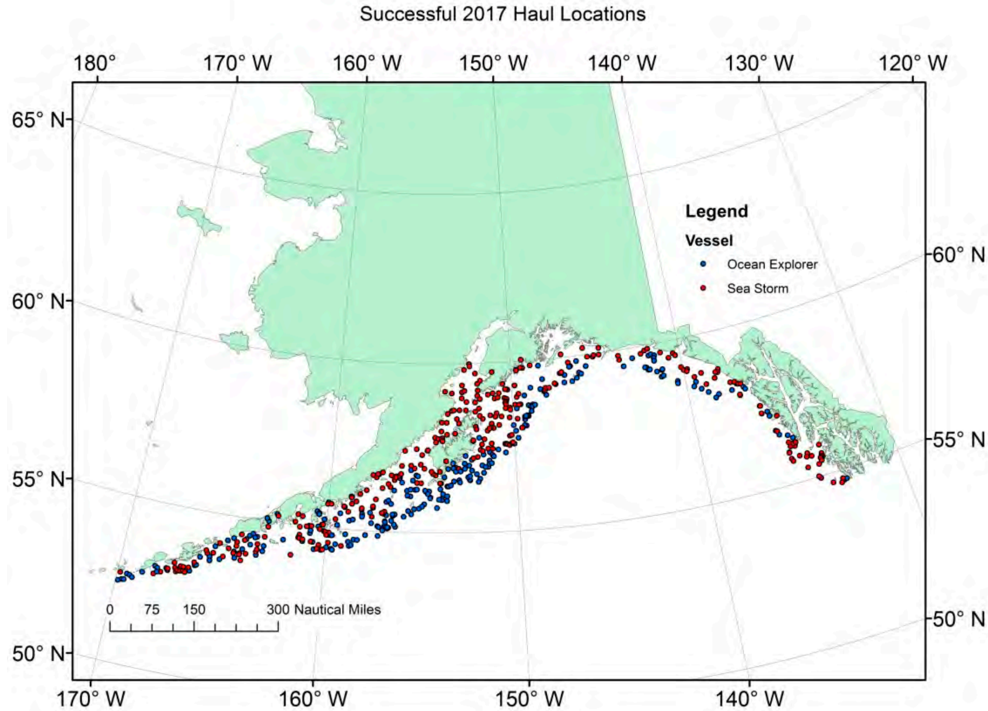
The Gulf of Alaska winter (February- March) acoustic transects for pollock (red lines) are shown below.



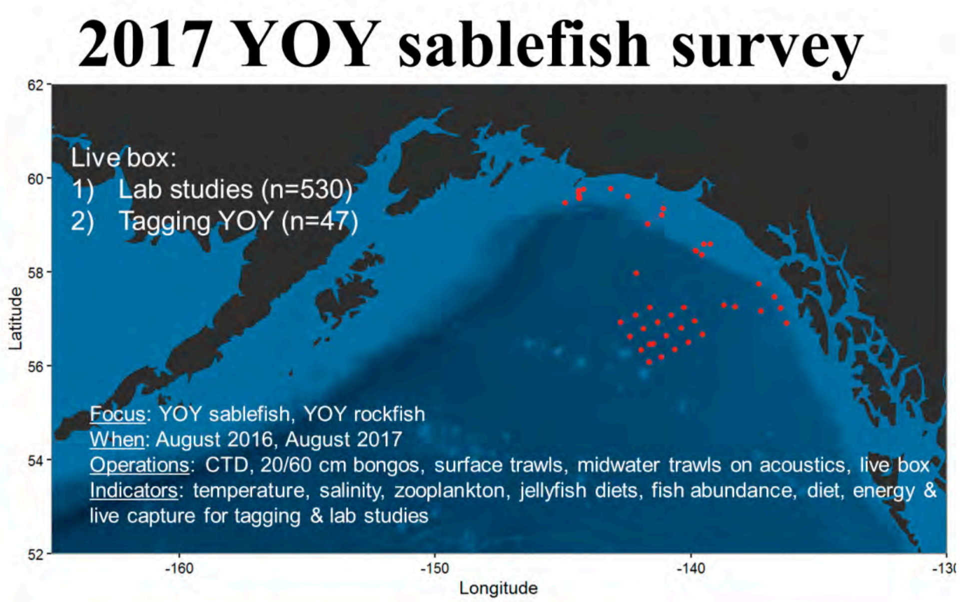
The Gulf of Alaska summer (June to mid-August) acoustic transects for pollock (black lines) are shown below.



The Gulf of Alaska summer bottom trawl stations sampled for ground fish are shown below.



Sablefish were collected at stations below. Fish were captured alive for laboratory experiments and tagging studies, using a live box attached to the cod end of the net.



Recent highlights from US West Coast ocean observing by Jack Barth, Oregon State University, USA

- The U.S. National Oceanic and Atmospheric Administration’s Integrated Ocean Observing System has received support to complete the US West Coast land-based coastal radar array by installing systems along the Washington coast. These will be installed and run by the Northwest Association of Networked Ocean Observing Systems (NANOOS).

- The Ocean Observatories Initiative (OOI) continues to run three arrays in the North Pacific:
  1. A set of mooring at Ocean Station Papa in collaboration with DFO Canada and the U.S. NOAA,
  2. A cabled array off the Pacific Northwest run by the University of Washington,
  3. A set of moorings, sea-floor platforms and gliders as part of the OOI Endurance Array off Oregon and Washington. This is run by Oregon State University.

  OOI has received word that it will be funded for five more years starting in spring 2018.

- The U.S. continues to expand measurements of ocean chemistry, in particular pH and dissolved oxygen (DO) in support of ocean acidification and hypoxia monitoring and studies. These measurements range from pH, pCO_2 and DO sensors on the OOI buoys to simple DuraFET-based pH sensors deployed in the rocky intertidal. Here’s an example of what we’re learning from a recent paper by Chan et al. (2017).

  Chan, F., Barth, J. A., Blanchette, C. A., Byrne, R. H., Chavez, F., Cheriton, O., Feely, R. A., Friederich, G., Gaylord, B., Gouhier, T., Hacker, S., Hill, T., Hofmann, G., McManus, M. A., Menge, B. A., Nielsen, K. J., Russell, A., Sanford, E., Sevadjian, J., and Washburn, L., 2017. Persistent spatial structuring of coastal ocean acidification in the California Current System. *Nature Scientific Reports*, **7**, 2526, doi:10.1038/s41598-017-02777-y.

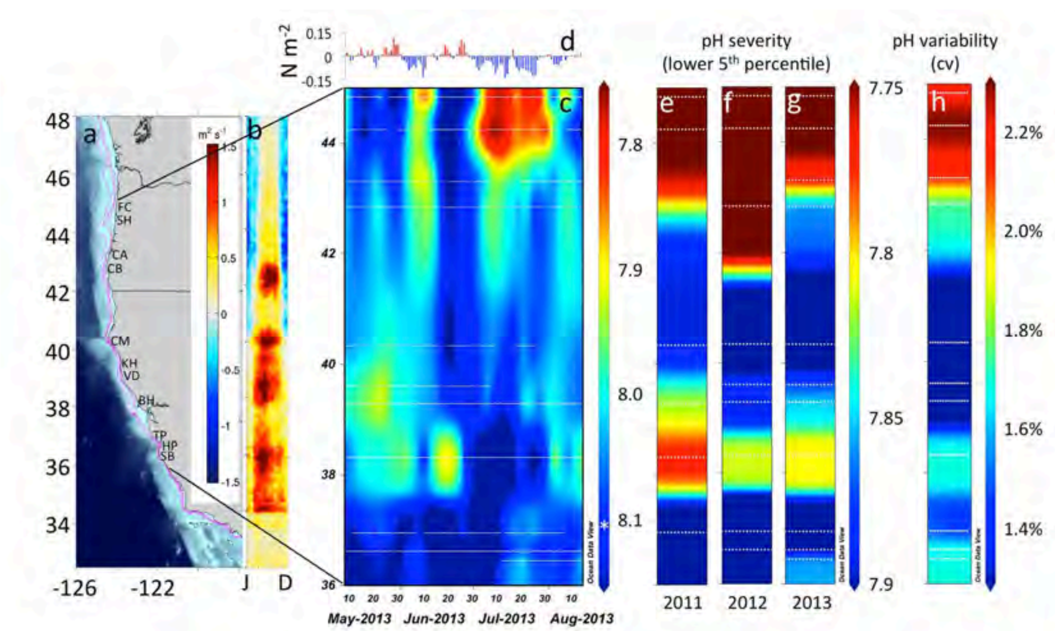


Figure 1. (**a**) Intertidal pH_{total} variation across the CCLME study domain of contrasting shelf topography as delineated by the 75 m, 100 m, 200 m isobaths (magenta), and (**b**) wind-driven cross-shelf surface transport ($m^2 s^{-1}$)(see scale inset in a). Map was generated from the ETOPO1 dataset[42] in Matlab v8.2 (http://www.mathworks.com/products/matlab). (**c**) Variation in pH at the event-scale during part of the 2013 upwelling season with asterisk denoting global mean surface pH[12] and (**d**) accompanying daily wind stress ($N m^{-2}$) at 44.65°N, (**e**–**g**) severity of low pH exposure (lower 5th percentile) across three years of deployment and (**h**) pH variability. White dotted lines in pH panels denote station locations.