Report of the Technical Committee on Monitoring

The Technical Committee on Monitoring (hereafter MONITOR) met in Qingdao, China from 18:00 to 20:00 on October 18, 2015 and from 14:00 to 19:45 on October 20, 2015. Prior to the meetings, a MONITOR briefing book, containing the draft agenda and information regarding agenda items, was circulated to MONITOR members. The briefing book was updated and recirculated prior to the meetings, as new information on agenda items was provided.

Sunday, October 18, 2015

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 Endnotes 1* and *2*).

AGENDA ITEM 2
Reports from FUTURE SSC, CPR, Advisory Panels, and Study Groups

a. Report from FUTURE SSC

Dr. Vyacheslav Lobanov presented an overview of the FUTURE program. MONITOR members discussed how MONITOR, CPR, AP-CREAMS, and AP-NPCOOS map onto FUTURE.

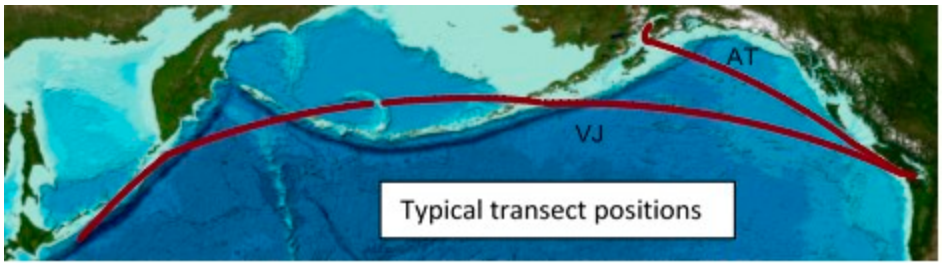
There was a question about how committees and expert groups should report to the FUTURE SSC. This year, the FUTURE SSC requested that reports from committees, expert groups, and advisory panels should be submitted separately; however, MONITOR members thought it would be better to combine them into one report (*i.e.*, CPR and MONITOR, AP-CREAMS, AP-NPCOOS, and SG-NPESR, in one report rather than in four separate ones).

b. Status of Pacific Continuous Plankton Recorder (CPR) program and activities of SAHFOS and GACS

Dr. Sonia Batten provided an update on North Pacific CPR activities. The main points of her presentation included:

1. Pacific CPR survey

Sampling
The typical annual sampling schedule is 6 transects in the eastern North Pacific, from the Washington state/British Columbia border to Cook Inlet, Alaska (AT route) between April and September, and 3 trans-Pacific transects (VJ route) between North America and Asia in spring, summer, and autumn. However, when we initiated discussions in spring on the 2015 ship schedule we discovered that the VJ ship in use since 2000 had been scrapped that month and in fact the operating company had closed up completely. Eventually we sourced an alternative company operating a similar route, and installed a tow point on the identified vessel, and the first transect took place in late June/July (*i.e.*, spring was not sampled). Owing to storm-avoidance the transect did not go through the Bering Sea but took a more southerly route to Asia. The sampling was successful however. The autumn transect commenced sampling in early October.



The AT transect started sampling in April as usual, and we expected to sample through until late September. However, we were made aware, in summer, of a dry docking scheduled for the first week of September. Consequently, our final 3 sets of tows were spaced quite close together – within about 5 weeks. On a positive note this will give us an opportunity to look at how similar the plankton counts are on shorter time scales! Six successful tows were collected in 2015.

Funding

There are no immediate concerns, although additional funding opportunities would be welcome:

- We are in year 2 of a 5-year project with the North Pacific Research Board (who expect to fund until 2035 in 5 year increments if all goes well with the project).
- Exxon Valdez Oil Spill Trustee Council funding will continue until the end of 2016 and a proposal for another 5 years will be submitted next year as part of the larger long-term monitoring group proposal.
- DFO renew annually and continue to fund through 2015. There are no indications that they will not fund in 2016, but it is too early to be sure.
- Western Pacific funding through Dr. Sanae Chiba at JAMSTEC, which will run through 2016. Renewal will be needed.

Research/Publications

A current research focus is on the anomalously warm conditions that started in late 2013 and continued through 2015. With a significant El Niño now forecast for winter 2015/2016, conditions are likely to remain unusually warm. A presentation will be given in Session S2 on Wednesday.

Recent Papers:

- Batten, S.D., Moffitt, S., Pegau, W.S., and Campbell, R. Plankton indices explain interannual variability in Prince William Sound herring first year growth. To be submitted to Fisheries Oceanography (currently undergoing internal review for Moffitt).
- Yoshiki T., Chiba, S., Sugisaki, H., Ichikawa, T., and Batten, S. (2015) Northerly shift of warm-water copepods in the western subarctic North Pacific: Continuous Plankton Recorder samples (2001-2010), Fisheries Oceanography (in press).
- Stern, R., Trainer, V.L., Moore, S.K. and Batten, S.D. (accepted pending revision) Spatial patterns of Pseudo-nitzschia genetic diversity in the North Pacific from Continuous Plankton Recorder surveys. Marine Ecology Progress Series.
- Chiba S., Batten, S., Yoshiki, T., Sasaki, Y., Sasaoka, K., Sugisaki, H., and Ichikawa, T. (2015) Temperature and zooplankton size structure: climate control and basin-scale comparison in the North Pacific. Ecology and Evolution. 5, 968-978

2. SAHFOS Activities

Dr Graham gave a presentation to MONITOR on instrumentation development at SAHFOS (see below).

3. Global Alliance of CPR Surveys (GACS)

The GACS annual meeting was held in September 2015. Discussions focused on using the sample archive for additional variables such as micro-plastics and detection of ocean acidification effects in certain taxa. Automating some of the procedures was also a topic of interest. Training courses and exchange of personnel have been effective in strengthening GACS. In terms of analysis products from the GACS database there was

discussion on emphasizing Essential Ocean Variables (EOVs) that are being developed and defined by international bodies such as GOOS.

As chair of GACS Dr Batten was invited to be a member of the recently established GOOS Biology and Ecosystems Panel (along with the MONITOR Co-Chair, Dr Chiba). This panel aims to develop EOVs, review existing observing initiatives to identify gaps, and coordinate and promote observing programs which measure EOVs.

c. Physical sensor addition to SAHFOS CPRs

Dr. George Graham, Marine Instrumentation and Data Scientist with SAHFOS, presented information on physical sensors that have been added to CPRs.

1. Rationale

The SAHFOS Continuous Plankton Recorder survey is known for its Ships of Opportunity based, regional scale epipelagic plankton sampling and reporting. Because of the spatio-temporal scope of the survey and taxonomic breadth of the time-series, CPR plankton data are integral to the assessment of marine environmental change. Emerging scientific questions and measurement capabilities are opening exciting new avenues for the future development of the CPR survey. This report summarizes the development of new plankton identification methods, which are being used in conjunction with the traditional taxonomic identification by light microscope, and potential developments of the Survey as cost effective platform for integrative monitoring of the surface ocean. A poster covering these topics is to be presented (abstract ID: OBS-P4).

2. Rapid Plankton Monitoring

Detailed speciation of CPR samples by SAHFOS expert taxonomists is a time consuming process so methods of rapid analysis (for select plankton groups or sample locations) are being investigated:

i) SAHFOS are part of a recent Horizon 2020 European Union funded project (AtlantOS; https://www.atlantos-h2020.eu/home) which has enabled the Survey to invest in dynamic imaging systems for rapid automated morphological measurement and classification of zooplankton.
ii) Submersible *in-situ* imaging systems to mount on the CPR towed body are being developed and trialled to enable rapid classification of particle types sampled by the CPR.

3. Water and Molecular Sampling

The range of plankton sampled by the CPR has been extended with the addition of an automated water sampling system – the Water and Microplankton Sampler (WaMS). Samples from WaMS have revealed new ranges of nano- and pico-sized plankton taxa, Harmful Algae and a range of organisms that are currently unknown. New molecular techniques are being utilised to explore the bacterial and microbial diversity of particulates found on the CPR silk or using the WaMS (Figure 1).

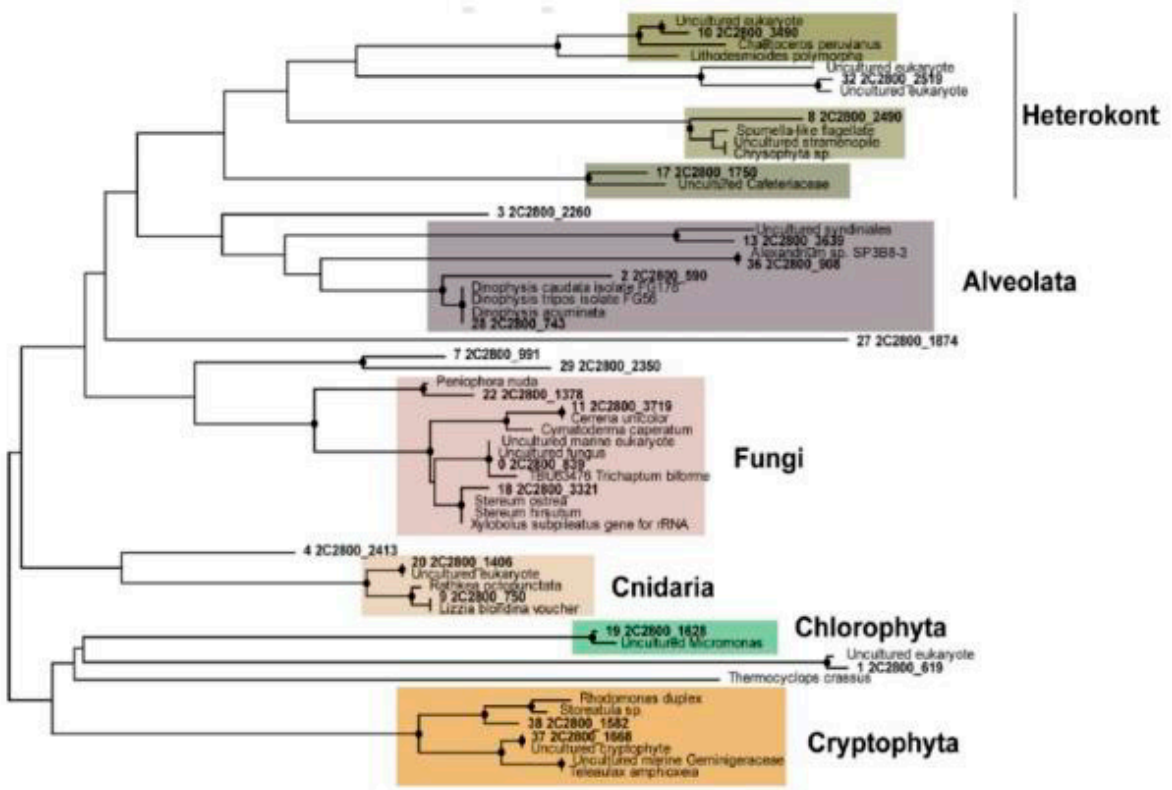


Figure 1. Subset of taxa from N. Sea sample identified using 454 sequencing technology. Adapted from McQuatters-Gallop *et al*., 2015. Estuarine Coastal and Shelf Science.

4. Physical Environment Sensing

To explore the potential of the CPR survey as a cost effective platform for measurements across the surface ocean a range of new CPR-mounted sensing technologies are being explored. A number of CPRs have historically been equipped with temperature sensors (see temperature data), and investment has recently been made in high quality *in-situ* sensors for water temperature, salinity and chlorophyll-*a* fluorescence. These measurements provide context for the plankton observations, and have potential use for validation of data products from autonomous earth observation systems (Figure 2).

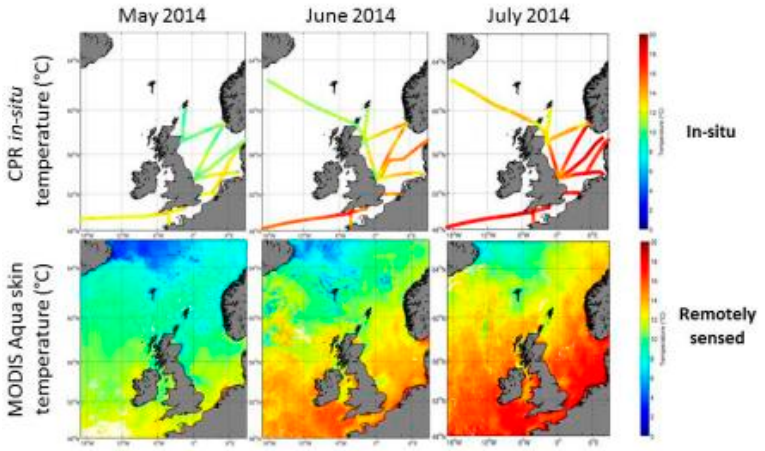


Figure 2. Comparisons of in-situ Sea Surface Temperature measurements from CPR (top) with earth observation data (MODIS Aqua 4μm night SST, bottom) from North Sea and UK Shelf.

Measured fluorescence signals are being explored in relation to Phytoplankton Colour Index (PCI) and species diversity as measured by the CPR, with research developing on the use of multi-spectral fluorescence for rapid species identification. In addition, pH and pC02 sensing systems are being developed for integration onto the CPR towed bodies.

5. Future Ambitions

For better characterization of the environmental context in which plankton are observed, or for rapid identification of the plankton themselves, as new sensing technologies are developed and miniaturized they will be integrated with the CPR. Key areas for future development will be in optical sensing (light scattering & absorption), chemical sensing (nutrient concentration) with 'lab on chip' technologies and in-situ species and toxin identification using micro-arrays.

SAHFOS would be interested in forging collaborative links with other Ocean Observing Systems/Programmes with complementary measurement capabilities, or contributing new observational data to existing Integrated Observing Systems in order to access funding opportunities to sustain and develop our monitoring and research activities.

Recommendation: More interaction with earth observation groups needed.

d. Activities of AP-CREAMS and POC

Dr. Vyacheslav Lobanov gave an overview of AP-CREAMS activities:

AP Meetings:

- 25 April 2015 Okinawa, Japan (at PAMS-2015 Symposium),
- 17 Oct. 2015 in Qingdao, China.

Joint surveys:

- EAST-I area: Joint Korea-Russia cruise in April-May 2015,
- EAST-II area: Japan-Korea-China cruise in Oct. 2015, July 2016,
- Workshop: EAST-I area: Joint Korea–Russia workshop in Donghae, Korea (SNU Marine Station), July 23–25, 2015.

Publications:

- EAST-I area: revision of the Supplementary chapter to NPESR – completed,
- EAST-II area: preparation of "*Oceanography of the Yellow and East China Sea*" in a PICES Scientific Report series – on-going.

Proposed Activities for 2016

- EAST-I – Russia–Korea joint cruise in April 2016,
- EAST-II – joint cruises in July–August 2016,
- EAST-II – completion a report on Oceanography of the Yellow and East China Sea, end of 2016,
- Training course "*Freshwater discharge and the coastal environment*", December 2016, Japan,
- Next AP Meeting on May 2016 in Vladivostok, Russia.

Action: MONITOR requests $5K to support travel to the training course "*Freshwater discharge and the coastal environment*"; 5 students and 1 lecturer, December 2016, Japan.

Recommendation: MONITOR recommends to Science Board: to extend the deadline of the EAST-II Report to the end of 2016, as this is a valuable report for which some more time is required.

e. Activities of AP-NPCOOS

Drs. Jack Barth and Sung Yong Kim gave an overview of AP-NPCOOS activities. AP-NPCOOS will form a small group to look at ferry box systems in each country. In addition, AP-NPCOOS will provide a recommendation on ecosystem EOVs for the NPESR. There are plans to hold training workshops annually that would rotate around countries; the first is planned for 2017. In addition, AP-NPCOOS plans to develop a Quality Assurance/Quality Control flow diagram for sensors and data acquisition.

Proposed scientific session for next year includes: physical/biological/chemical interactions on shelves in the context of large events and trends (broader than the "warm blob" session this year); a focused workshop on sensor issues such as biofouling and sensor drift.

Recommendation: MONITOR advises PICES to extend area of interest to include Arctic shelves. Rationale: Connection among seas, climate change, northward movement of stocks, ocean acidification.

f. Activities of SG-NPESR

Dr. Lisa Eisner gave an overview of the NPESR planned activities.

Action: Editorial Board, Review and Addition of Nominations Dec 2015 – May 2016.

The chairs of standing committees (or their delegates) sitting as the NPESR Editorial Board, chaired by the Deputy Executive Secretary of PICES, will coordinate the selection of ETSOs. As outstanding or particularly appropriate sets of observations are discovered, the Editorial Board may invite additional authors to submit.

AGENDA ITEM 3
PICES-2015 information

a. Topic Sessions and Workshops

- Dr. Lisa Eisner co-convened a 1-day BIO/MONITOR/TCODE Topic Session (S2) titled "*The 2014/15 El Niño and anomalous warming of the North Pacific: What happened?*";
- MONITOR co-sponsored a 1-day POC/BIO/MONITOR/TCODE Topic Session (S6) on "*Ocean Acidification Observation Network for the North Pacific and adjacent areas of the Arctic Ocean*" (no MONITOR co-covenor)
- Drs. Sung Yong Kim and Jack Barth co-convened (with Dr. Tony Koslow) a 1-day Workshop (W6) on "*Best practices for and scientific progress from North Pacific Coastal Ocean Observing Systems*".

See Session Summaries in the 2015 Annual Report for more details.

b. Judges for the best presentation award

MONITOR was tasked by the Science Board Chairman to judge MONITOR-sponsored Topic Session S6 and Workshop W6. Drs. Batten, Barth and Tadokoro volunteered to judge the 8 early career scientists oral presentations in S6 and Drs. Batten, Tadokoro and Eisner volunteered to judge all posters in S6 and W6 (10 and 2, respectively).

AGENDA ITEM 4
PICES-2016 MONITOR Topic Session

This item was discussed under Agenda Item 7.

Tuesday, October 20, 2015

AGENDA ITEM 5
Reports from PICES expert groups

a. Joint ISC-PICES Study Group for *Scientific Cooperation of ISC* and PICES (SG-SCISC)

Dr. Gerard DiNardo (SG-SCISC Co-Chair, ISC) presented an overview of a SG framework for ISC-PICES collaborative activities, recommendations and proposal for a Working Group on "Oceanographic Conditions and the Distribution and Productivity of Highly Migratory Fish". Further details can be found in the SG-SCISC report on an ISC-PICES framework for Scientific Cooperation in the North Pacific.

b. Joint PICES-NOWPAP Study Group on *Scientific Cooperation in the North Pacific Ocean* (SG-SCOOP)

Dr. Boldt provided an update on the final meeting of SG-SCOOP and its framework on scientific cooperation between NOWPAP and PICES.

AGENDA ITEM 6
MONITOR Terms of Reference and Action Plan

Members briefly discussed MONITOR Terms of Reference (TORs) and Action Plan. It was noted that mission #3 regarding the NPESR may need to be revised depending on SG-NPESR outcomes. Also, TORs should contain a generic line item to interact with expert groups (*e.g*., AP-NPCOOS, AP-CREAMS).

Action: MONITOR to discuss Mission (TORs) and Action Plan once PICES finalizes its Strategic Plan (for which MONITOR has already provided feedback).

Recommendation: Add some terminology regarding interactions with MONITOR expert groups (AP-NPCOOS, AP-CREAMS).

AGENDA ITEM 7
Proposals for PICES-2016

Members discussed proposals for PICES-2016 MONITOR supported topic sessions, workshops, and inter-sessional workshops. MONITOR noted that all proposed topic sessions and workshops were excellent and it was difficult to decide which sessions to support, given the limited available funds allocated to each Committee. The following were the top ranked sessions and top ranked workshops by MONITOR:

Topic Sessions:
- Proposal #20 – *Causes and consequences of 25 years of variability in ocean conditions on the ecosystems of the eastern North Pacific*;
- Proposal #21– *Understanding the changing coastal ocean: Advances and challenges in multi-parameter observations*;
- Proposal #10 – *Understanding our changing oceans through species distributions and habitat models based on remotely sensed data*.

Workshops:
- Proposal #1 – *Acidification of the North Pacific Ocean: A basin-wide assessment*;
- Proposal #7 – *Delivering quality multi-parameter data from the coastal ocean*;
- Proposal #8 – *Mesoscale and submesoscale processes in the North Pacific: History and new challenges*;
- Proposal #10 – *Distribution and risk analysis of radionuclides in the North Pacific*.

Inter-sessional workshop:
- NPESR3 – an inter-sessional workshop, early summer, location TBD.

AGENDA ITEM 8
ICES ASC theme session proposals

MONITOR members discussed and ranked ICES theme session proposals for its 2016 Annual Science Conference. There were many excellent session proposals and MONITOR considered the following sessions to be relevant to the Committee:

High Priority:
- Proposal #19 –*When is enough – enough" Methods for optimising, evaluating and prioritising of marine data collection*;
- Proposal #1 – *Fisher Collected Aquatic Data*.

Medium Priority:
- Proposal #17 – *The role of zooplankton in exploited ecosystems: top-down and bottom-up stresses on pelagic food webs*;
- Proposal #7 – *Integrated Ecosystem Assessment, how does it work, what is it good for, who is it for, and where is it going?*

AGENDA ITEM 9
Notes or action items from Science Board and ISB-2015

a. SCOR proposal ranking

Six MONITOR members provided feedback on SCOR working group proposals for PICES affiliate status. The top three ranked proposals were:
1. *Towards a global comparison of zooplankton production (ZooProd): Measurement, methodologies and applications*;
2. *Changing Ocean Biological Systems (COBS): How will biota respond to a changing ocean?*
3. *SEAmount Faunal vulnerabilty to impacts of Ocean Acidification and Mining (SEAFOAM)*.

b. Ideas for collaboration with ICES

In response to an ISB-2015 action item, Science Board was requested to identify potential areas for future collaboration with ICES, and to submit ideas to the Science Board Chair by mid-July 2015. Dr. Boldt instructed MONITOR members to provide their feedback and suggestions to her by June 30, 2015. Five members replied by the deadline. Their responses can be found in *MONITOR Endnote 3a*.

c. PICES Strategic Plan

In response to an ISB-2015 action item for each Committee to review and provide comments on the PICES Strategic Plan, especially on Themes A and B by the end of June, Dr. Boldt instructed MONITOR members to provide their feedback and suggestions to her by June 30, 2015. MONITOR provided its feedback to Science Board on June 30, 2015. Five members replied by the deadline. Their responses can be found in *MONITOR Endnote 3b*.

AGENDA ITEM 10
Report on POMA

Dr. Boldt briefly summarized the POMA award and the responsibilities of MONITOR in regard to making recommendations to Science Board on nominations provided by the Secretariat.

AGENDA ITEM 11
Relations with specific international organizations/programs

a. Ocean Observing System (AOOS)

Dr. Lisa Eisner reported on AOOS highlights for 2015, including observing activities and website improvements. Observing activities include two AOOS wave buoys deployed in 2015. One buoy was deployed at King Island near Nome (July–September) and used to assist village residents, National Weather Service forecasters, the U.S. Coast Guard, commercial and subsistence fishing, and anyone else

transiting the region which is known for extreme weather and strong currents. The other buoy was deployed in Cook Inlet (remains deployed overwinter) and feeds a live AOOS Sensor Map (with access to over 2300 stations statewide), the Coastal Data Information Program and the National Data Buoy Center. Other AOOS observing activities include deployment of bottom-mounted pressure sensors in the Beaufort Sea, seven weather stations in Cook Inlet and Prince William Sound, marine mammal tracking using gliders in the Chukchi Sea (Kotzebue Sound to Barrow), a freeze-up detection buoy to provide real time data documenting freeze up and water column conditions on arctic shelves, a Chukchi Sea ecosystem monitoring buoy, remote HF radar surface current mapping providing real time data at four locations along the Chukchi Sea coast, Seward line (Gulf of Alaska) ship surveys and ocean acidification monitoring at the Sward line, Seward hatchery and at two moorings (Gulf of Alaska and Bering Sea). Website improvements include updates to the AOOS data portal with new assets such as additional shore zone imagery, new real time weather station data from Adak in the Aleutian Islands and water level data at 3 locations (Platinum, Wales and Kotzebue, Alaska), new Arctic data layers including beluga migration corridors, aerial surveys of bowhead whales, petroleum potential, and seafloor depth, and native subsistence data (*e.g.*, harvest areas). The AOOS portal also has a "Blob Blog" to inform the public, media and other interested parties about the recent warming in the North Pacific, with an emphasis on potential effects on Alaska.

b. International Program for deployment of profiling floats (Argo)

Dr. Zenghong Liu discussed progress on global Argo and profiling float technology. The international Argo program, a global real-time ocean observing array, was initially designed to deploy 3000 profiling floats over the global none ice-covered open seas (which is called "core Argo"). Since the beginning of the Argo in 2000, an array composed of 3000 floats (300 × 300 km) had been fulfilled by the end of 2007 under the cooperation of over 20 countries. One million temperature and salinity profiles at depths of 0–2000 m had been observed by November 2012, which exceeded the total number of the profiles obtained in the past century. Data from Argo not only play an important role in operational oceanography in many countries, but also have been widely used in basic researches on ocean and atmosphere sciences. Based on a statistics from Argo project office, more than 2000 research papers from about 40 countries that use Argo data have been published in international journals since 1998. Especially after 2010, more than 200 papers were published each year. As of August 2015, over 12, 000 Argo profiling floats have been deployed by more than 20 countries, and approximately 3800 floats are still active at present. China joined the Argo program in 2002; from then on, over 300 floats have been launched in Pacific and Indian oceans, and approximately 180 floats are still active.

In 2013, the conception of "global Argo" composed of 4000 floats was proposed by international Argo program, which will extend Argo to high latitudes, marginal seas and deep waters (> 2000 m), and enhance observing in equatorial and western boundary current regions. Besides water temperature and salinity, global Argo will extend its observed parameters to biology and geochemistry, such as dissolved oxygen, pH, nitrate and chlorophyll and so on. The extension of Argo has been benefited from the development of float technology. For instance, float with ice detection algorithm is able to observe in seasonal ice-covered oceans, and new developed deep-Argo float is able to sample under 2000 m (even to 6000 m). In the past few years, Bio-Argo and Deep Argo were proposed by some countries. However, compared with traditional CTD sensors, the performance of the sensors used for new parameters is needed to be improved. The quality control for new parameters and how to effectively integrate new variables into existing dataset are the challenges that we should overcome.

From 2010, China started to develop their own profiling float (HM2000) which used Beidou satellite system for data transmission and positioning. Similar with floats using Iridium satellite, users are able to send command to the float through Beidou commander instrument. The typical transmission duration for a 0-2000 meter TS profile is about 30 minutes. China Argo has deployed some HM2000 floats in the western boundary current region of the North Pacific Ocean. In future, China will enhance the Argo observation in the western boundary current (*e.g.*, Kuroshio) and typhoon formation regions in terms of the target of "global Argo", and data from all floats will be shared with other countries through internet and GTS.

c. GOOS-Bio/Eco Panel

Dr. Sanae Chiba provided the following report.

Background

To implement the concept of Framework of Ocean Observation (FOO; IFSOO-TT, 2012, available online, GOOS organized the operational panels to develop and coordinate efforts in the implementation of a sustained and targeted global ocean observation system driven by societal needs. The tasks of the panels include identification of Essential Ocean Variables (EOVs). While OOPC and IOCCP had played roles for the physical and biogeochemical panels, biological and ecological panel was newly established in 2015 to add values to the GOOS network. See the attached flyer for its goal, mission and action plan toward 2019.

Relevance to PICES

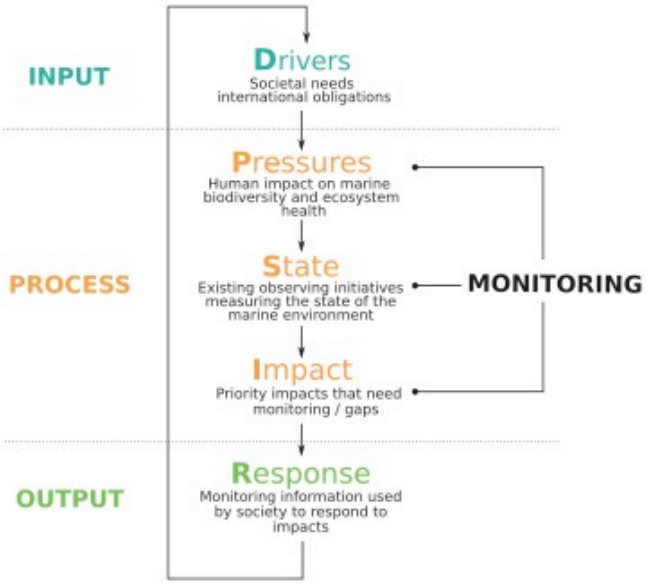
From the PICES community, Drs. David Checkley, Sonia Batten and Sanae Chiba participate in the panel. The GOOS-BE observation network will be build based on the existing observing initiatives, which includes GACS (Global Alliance of Continuous Plankton Recorders) and CALCOFI, and international organizations which are coordinating multi-regional to oceanic scale observation and data management, including PICES (see Table below) Actual implementing strategy on how GOOS-BE could collaborate with those initiatives and organizations has not been fully discussed. MONITOR, with TCODE, will play a leading role in communication with the GOOS-BE panel on how regional components of PICES observation, such as NPCOOS, should contribute to and get benefitted from GOOS-BE.

Table Existing observing initiatives, which are identified as the possible GOOS-BE collaborator.

Phytoplankton / Zooplankton
IMBER: Integrated Marine Biogeochemistry and Ecosystem Research
CLIOTOP: CLimate Impacts on Oceanic TOp Predators
IGMETS: International Group for Marine Ecological Time Series
GACS (CPR Surveys): Global Alliance of Continuous Plankton Recorders
CALCOFI: California Cooperative Oceanic Fisheries Investigations
PISCO: Partnership for Interdisciplinary Studies of Coastal Oceans
Seagrasses / mangroves
Global Atlas of Mangroves / Seagrasses (WCMC)
ZEN (more information needed): Zoostera Experimental Network
Shallow shelf (coral reefs, rocky shores…)
Reef Life Survey
The Coral Core Archives (GBR)
Fisheries / Ecosystem approach
PICES: North Pacific Marine Science Organization
ICES: International Council for the Exploration of the Sea
GOAON: Global Ocean Acidification Observation Network
PISCO: Partnership for Interdisciplinary Studies of Coastal Oceans
OTN: Ocean Tracking Network
French Tuna Observatory
Apex predators
ORNITHOECO: Birds and mammals
Others
SOOS: Southern Ocean Observing System
IMOS: Integrated Marine Observing System / Australia

Past and Future Meetings:

- November 2013, Townsville Australia: Pre-kickoff meeting with expert group,
- July 2015: the First online meeting of GOOS-BE panel,
- February 2016, New Orleans USA: First on-site meeting of GOOS-BE panel.



*In the DPSIR model, the need to monitor marine biodiversity and ecosystem health or **INPUT** is **D**riven by societal questions, sectoral trends, and national and international obligations. The **PROCESS** includes answering the questions: (1) what are the human **P**ressures affecting the environment that are or will impact marine biodiversity and ecosystems, (2) what are the existing initiatives that could be built on to measure the **S**tate of the marine environment, and (3) what are the priority **I**mpacts on the marine environment that need to be monitored and how well do existing initiatives address those needs. The answers to these questions will provide the **OUTPUT** or products that will help society, the source of the requirements, to **R**espond to identified impacts.*

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Nicholas Bax – Co-Chair – CSIRO, Hobart, Australia Nic.Bax@csiro.au
Samantha Simmons – Co-Chair – Marine Mammal Commission, Bethesda, USA ssimmons@mmc.gov
More info and list of Panel Members at http://ioc-goos.org/biology

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d. North East Asian Regional (NEAR-GOOS)

Dr. Hee-Dong Jeong discussed collaborations between NEAR-GOOS and PICES

MONITOR identified a need to increase collaboration with NEAR-GOOS and recommended that PICES support this activity. MONITOR recommended that PICES send a representative to the NEAR-GOOS meeting in Tokyo, Japan, December 8–9, 2015. Since Dr. Lobanov is involved in NEAR-GOOS, he would attend and present on PICES activities to promote collaboration. No funding would be required. In the future, however, MONITOR recommends that PICES send a MONITOR member to NEAR-GOOS meetings.

Recommendation: MONITOR recommends that PICES send a representative to the NEAR-GOOS meeting in Tokyo.

e. North Pacific Research Board (NPRB)

Dr. Matthew Baker reviewed NPRB's long-term monitoring programs and discussed ongoing/potential collaborations with PICES. NPRB's mission is to "Build a clear understanding of the North Pacific ecosystems that enables effective management and sustainable use of marine resources".

f. Partnership for Observation of the Global Oceans (POGO)

Dr. Sun Song gave a presentation on POGO and discussed ongoing/potential collaboration with PICES. The goal of POGO is to "Promote the completion of a sustained, integrated, global system of ocean observations for the benefit of society".

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

Dr. Sei-Ichi Saitoh gave a presentation on ESSAS and discussed ongoing/potential collaboration with PICES. 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 marine ecosystems".

h. Southern California Coastal Ocean Observing System (SCCOOS)

Dr. David Checkley did not make a presentation, but distributed a handout of SCCOOS activities.

AGENDA ITEM 12

Country reports

See *MONITOR Endnote 4* for country reports.

AGENDA ITEM 13

Other business

a. Update on ICES/PICES Theme Session C at the ICES 2015 ASC in Copenhagen, September 21–25, 2015.

Dr. Barth, Co-Convenor of the ICES/PICES sponsored Theme Session C on "*Ecosystem monitoring in practice*", provided a summary of the presentations and outcome of the session (see *MONITOR Endnote 4*).

b. The 3rd PICES/ICES Early Career Scientist Conference (ECSC-3)

ECSC-3 will be held over four days starting on May 29, 2017. Dr. Harold Batchelder is the PICES co-organizer of the Conference. In his email to Science Board on October 17, he announced that Korea would host the ECSC and that Dr. Tae-Wook Kim, a 2012 Pohang University PhD recipient, was nominated as the host country convenor. Dr. Batchelder requested names of two early career scientists from PICES to also serve on the Scientific Steering Committee of ECSC-3. He requested each committee and the FUTURE SSC to discuss this task with its members and provide recommendations to him by Thursday, October 22. Science

Board will review nominations at its meeting and select two to serve on the ECS SSC. Since Dr. Kim's specialty is chemistry/geochemistry, Dr. Batchelder encouraged the Committees and FUTURE SSC to look at candidates with other backgrounds so the SSC could have diverse expertise.

Action: MONITOR members to propose a candidate for ECS SSC for discussion at the Science Board meeting.

c. EAST I Report review

Dr. Vyacheslav Lobanov submitted the EAST I report to the MONITOR committee. Science Board requested that POC, MONITOR, and Dr. Phillip Mundy provide a scientific review of this report. Two or three MONITOR members volunteered to review each chapter of the report.

Action: Reviews from MONITOR members are to be submitted to Dr. Boldt on November 20, 2015. Dr. Boldt will compile reviews and submit them to the Science Board by December 4, 2015.

MONITOR Endnote 1

MONITOR participation list

Members

Jack A. Barth (USA)
Jennifer L. Boldt (Canada, MONITOR Chair)
Sanae Chiba (Japan, MONITOR Vice-Chair)
Lisa B. Eisner (USA)
In-Seong Han (Korea)
Sung Yong Kim (Korea)
Vladimir V. Kulik (Russia)
Jilong Li (China)
Vyacheslav B. Lobanov (Russia)
Sei-Ichi Saitoh (Japan)
Kazuaki Tadokoro (Japan)
Chuanxi Xing (representing Zhifeng Zhang, China)

Observers and participants

Matthew Baker (NPRB)
Gerard DiNardo (USA)
David Checkley (SCCOOS)
Richard Feeley (USA)
George Graham (SAHFOS)
Hee-Dong Jeong (NEAR-GOOS, Oct. 20)
Zenghong Liu (Argo, Oct. 20)
Andrew Ross (Canada)
Laura Richards (PICES Chair, Oct. 18)
Sun Song (POGO, Oct. 20)
Hiroya Sugisaki (Japan)

Ex-officio member

Sonia Batten (SAHFOS)

MONITOR Endnote 2

MONITOR meeting agenda

October 18, 2015

1. Welcome, Introductions and Sign-in (all)
2. Reports from PICES groups (presenters, please reserve time for questions):
   a. Report from FUTURE SSC (Lobanov)
   b. Status of Pacific Continuous Plankton Recorder (CPR) program and activities of SAHFOS and GACS (Batten)
   c. Physical sensor addition to CPRs (Graham)
   d. Activities of AP-CREAMS and POC (Lobanov)
   e. Activities of AP-NPCOOS (Barth and Kim)
   f. Activities of SG-NPESR (Sugisaki and Eisner)
3. PICES-2015 information:
   a. Information for:

   i. S2: The 2014/15 El Niño and anomalous warming of the North Pacific: What happened? (Eisner),
   ii. S6: Ocean Acidification Observation Network for the North Pacific and adjacent areas of the Arctic Ocean (no MONITOR co-covener)
   iii. W6: Best practices for and scientific progress from North Pacific Coastal Ocean Observing Systems (Kim and Barth)
b. Judges for the best presentation award (MONITOR members)
   i. S2: 1 early career scientist giving an oral presentation; no posters,
   ii. S6: 7 early career scientists giving oral presentations; 9 posters
   iii. W6: 2 posters

4. PICES-2016 – topic sessions – should we have a general MONITOR Session (proposals are due Monday)?

October 20, 2015

5. Continuation of Reports from PICES groups (presenters, please reserve some time for questions):
   a. Joint ISC-PICES Study Group for Scientific Cooperation of ISC and PICES (SG-SCISC) (King or DiNardo)
   b. Joint PICES-NOWPAP Study Group on *Scientific Cooperation in the North Pacific Ocean* (SG-SCOOP) (Boldt)
6. Review MONITOR TOR and Action Plan (MONITOR members)
7. Proposals for PICES-2016 MONITOR workshops, special sessions, inter-sessional meetings (MONITOR members)
8. ICES 2016 ASC theme session proposals
9. Notes or Action Items from SB and ISB (Boldt)
   a. SCOR proposal ranking
   b. Ideas for collaboration with ICES
   c. PICES Strategic Plan
   d. Other
10. Report on POMA (Boldt)
11. Relations with specific international organizations/programs
   a. Ocean Observing System (AOOS) – Eisner (10 minutes)
   b. International Program for deployment of profiling floats (Argo) – Xu (15 minutes)
   c. GOOS-Bio/Eco Panel –Chiba (5 minutes)
   d. North East Asian Regional (NEAR-GOOS) – Jeong (10 minutes)
   e. North Pacific Research Board (NPRB) – Baker (10 minutes)
   f. Partnership for Observation of the Global Oceans (POGO) – Song (10 minutes)
   g. (tentatively scheduled) Arctic Monitoring and Assessment Program (AMAP) – Bellerby (10 minutes)
   h. Ecosystem Study on the Sub-Arctic and Arctic Seas (ESSAS) – Saitoh (10 minutes)
   i. Southern California Coastal Ocean Observing System (SCCOOS) – Checkley (no presentation; see handout)
12. National reports – Written and Oral
   a. **Written** national reports to be provided prior to the PICES meeting. Written reports should include all relevant monitoring activities for *all* relevant years. Written reports will be posted to the PICES web page.
   b. **Oral** presentation should include highlights and updates in national reports of relevant monitor/observation activities from the last year. Powerpoint presentations will be posted to the PICES web page.

Canada	(Boldt, Hannah)
China	(Li, Zhao, Zhang)
Japan	(Chiba, Saitoh, Tadokoro)
Russia	(Kulik, Lobanov)
United States	(Barth, Napp, Eisner).

13. Other business
   a. Update on ICES/PICES Theme Session C at the ICES meeting in Copenhagen, September 21–25, 2015). “Ecosystem monitoring in practice”, Conveners: Matthias Schaber, Germany, Sven Gastauer,

Netherlands/Australia and Jack Barth, USA (PICES)
   b. The third PICES/ICES Early Career Scientist Conference (ECSC-3)
   c. EAST I report review
14. Adjorn

MONITOR Endnote 3a

Responses from MONITOR members on ideas for collaboration with ICES

Number of respondents: 5

Respondent 1:
"We could focus on areas where collaborations with other organizations (*e.g*., NOWPAP, NPAFC) already exist to add leverage and augment success. For example, PICES SG-SCOOP has identified areas of interest that are common to NOWPAP and PICES; those could be examined for potential collaboration with ICES as well (*e.g*, HABs, marine pollution, non-indigenous species, ecosystem status reporting, biodiversity). Also, the newly formed AP-NPCOOS plans to develop and advice about best practices for coastal ocean observing systems – and this may be an area for collaboration with ICES."

Respondent 2:
"…further strengthening of current research collaboration through ESSAS…"

Respondent 3:
"… it may be necessary to have joint programs related to understanding the functioning, resilience, and vulnerability of marine ecosystems and quantifying how marine ecosystems respond to human activities and natural forcing."

Respondent 4:
"…nothing specific. I am sure there are methodological and technological issues that are relevant to both organisations that could be addressed, but right now I can't think of anything from a Monitoring point of view."

Respondent 5:
"I do not have plans to collaborate with ICES yet."

MONITOR Endnote 3b

Responses from MONITOR members on the PICES Strategic Plan

Number of respondents: 5

Respondent 1 (Boldt):
1. If this is a 'visioning' document, perhaps it would be good to have a brief "Vision" statement in a similar format as that for ICES. An example from ICES – "Our VISION: To be a world leading scientific organization concerning marine ecosystems and to provide the knowledge to secure the sustainable use of the seas."
2. The five general themes of the PICES Strategic Plan are appropriate. The goals are appropriate as well, however, I like the approach used by ICES which lists supporting activities for each goal, because this would provide a clear link to and information that can be used in requests for funding (how groups can benefit from PICES). Some of the descriptions of PICES Goals include supporting activities (*e.g*., Goal 8 "PICES provides venues, organizes activities and develops procedures…"), but some do not or are vague (*e.g*., Goals 1 and 2 – do not really list any supporting activities).
3. One thing that seems to be missing from the PICES Strategic Plan is a monitor/review process. There is

a statement about reviewing Action Plans, however, how does PICES measure success of the Strategic Plan? Are there some simple performance measures that PICES uses or can use? I'm not 100% sure what the most meaningful performance measures would be, but are there some that would be relatively easy to monitor, such as, number of reports, number of workshops that were supported, *etc*.? (there are likely better and more meaningful measures…).

4. One version of a strategic plan that DFO uses (although I cannot find it online now(!), I pasted some of the information below) includes a logic model that identifies ultimate outcomes, immediate outcomes, outputs, activities, and inputs, and includes performance measures. I like the idea of having activities that are linked to outputs and outcomes; this would also help with creating performance measures and measuring success.
5. Minor edit: Goal 5, last sentence: change "out" to "our"

Strategic Plan includes (source: DFO) :

OUTCOME Statements:

a. Are NOUN based desired states. Should NOT begin with a verb,
b. Directional outcome statements (*e.g*., "improved/increased") are not allowed,
c. Avoid self-serving statements,
d. Use simple clear language.

Respondent 2:
I read through the PICES Strategic Plan and MONITOR ToR, but don't feel the specific amendments or update needed for the current versions. This might be because I am not really familiar for the nature of these documents.

Respondent 3:
All the themes and the science elements for PICES Strategic Plan are still appropriate and pertinent to PICES. I don't think there is any other emerging priorities should be captured.

Respondent 4:
I think the document is a good summary of what I understand PICES to be about. Yes, the themes are appropriate -advance and apply scientific knowledge is exactly what PICES should be doing. However, because it is a vision-type document it is very generalised and there is no real ability to capture specific emerging issues. For example, the impacts of ocean acidification (though I think that's an emerged issue rather than emerging) is captured as a general issue under resilience and vulnerability but there is no way to identify it specifically and isolate it from other impacts of a changing climate. I'm not sure this document is the place for that though.

Respondent 5:
I am fine with the current science plans.

MONITOR Endnote 4

Country Reports for 2015

Canada

Report by Jennifer Boldt, Charles Hannah, Kim Juniper, many other contributors from DFO

I. Interesting Observations in 2015

Information was provided by Perry and Chandler (2015) and Perry *et al.* 2015 (see PICES-2015, Topic Session S2 presentation on "*Anomalous warming and its impacts in the NE Pacific from a Canadian perspective*" by Perry *et al*.).

The winter of 2014 and spring of 2015 had record high sea surface water temperatures in the northeast Pacific (Figure 1). The anomalous warm conditions caused changes in the distribution and composition of fish and zooplankton species in Canadian Pacific waters. The copepod community comprised those typically seen off California and unusual fish species observed included the Pacific Pompano and the Finescale Triggerfish. The warm conditions may have implications for the migration of some species, such as salmon and Pacific Sardine, and may affect the distribution and survival of other pelagic species, such as Pacific Herring.

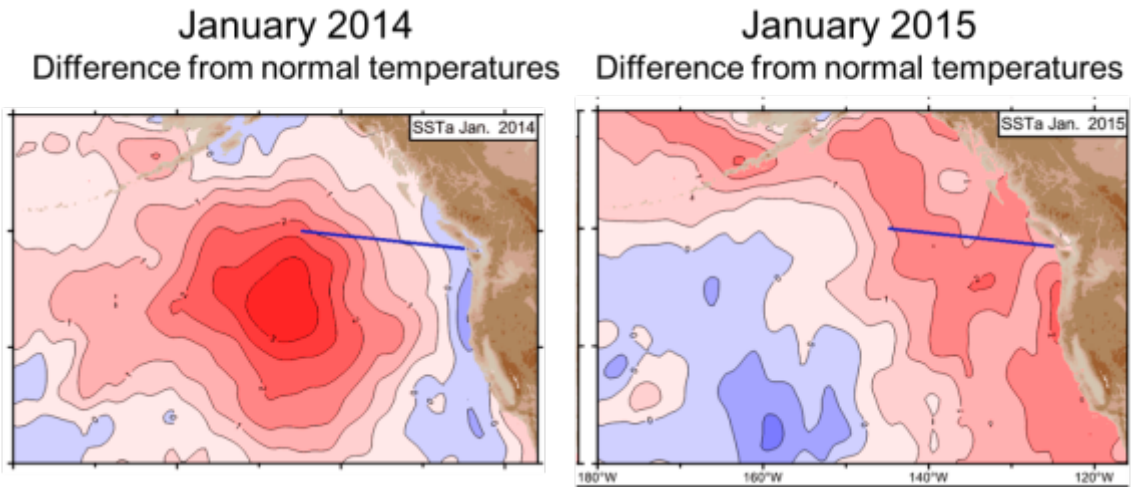


Figure 1. From Perry and Chandler (2015): "…Changes in surface water temperature from normal in the NE Pacific, in January 2014 (left) and January 2015 (right). The very warm water (dark red patch, over 3°C above normal) moved to the coast of BC by January 2015, causing record high water temperatures at some locations. The blue line represents location monitored by Fisheries and Oceans Canada since 1948. Figure courtesy of Howard Freeland, based on data available from the United States National Oceanic and Atmospheric Administration."

II. Observational programs

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

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. 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 multinet. 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 (Table 1).
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 ~200 m has been completed.
5. NEW: Strait of Georgia zooplankton survey (is funded by, and is part of, the Canada/U.S. Marine Survival of Salmon in the Salish Sea study (see Salish Sea Marine Survival Project). 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.
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 (Table 1).
3. La Perouse pelagic ecosystem survey: annual (biennial after 2015); daytime acoustic-trawl survey; west coast Vancouver Island (2012–present; presence data for 1982–2011); zooplankton, oceanographic data (Table 1).
4. Juvenile herring and nearshore pelagic survey: annual; Strait of Georgia (1992-present) and Central British Columbia (1992-2011); zooplankton and oceanographic data (Table 1).
5. Night time pelagic species and Pacific sardine survey: annual night-time trawl survey (biennial after 2014); west coast of Vancouver Island (2006-present); zooplankton, oceanographic data, and recently daytime acoustic, marine mammal, and seabird observations (Table 1).

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) (Table 1).
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 WCVI 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 (Feb.–Sep.) 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 coastwide (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) by a Fisheries Oceanography Working Group made up of DFO and university scientists. The reports summarize and synthesize results from many of the monitoring programs listed above. Annual reports, including those for 2015, are available from the DFO website.

Table 1. Some of the monitoring programs in British Columbia, Canada. SWCVI = southwest coast of Vancouver Island; WCVI = west coast of Vancouver Island; SOG = Strait of Georgia; BC = British Columbia; CC = Central Coast; GOA = Gulf of Alaska; CTD = Conductivity, Temperature, Depth (and other variables) recorder; TrawlRBR = Conductivity, Temperature, Depth (and other variables) recorder attached to the midwater trawl net.

	Line P	SOG zooplankton	La Perouse Plankton	La Perouse Pelagics	Night Time Pelagics	Hake	Salmon	Juvenile Herring
Years	1950s -2015	2015 and 1 to 5 more years	1979-2015	2012 -2015 (presence data 1968-2012)	2006-2014 (except 2007)	1995-2015 (earlier for some areas)	1998-2015 (trawl)	1992-2015 (except 1995)
General timing	Feb, June, Aug	Feb-Oct	May-June, September	Late July-Mid Aug	Mid July-Mid Aug	Mid Aug –Mid Sept	March, May, June/July, Sept, Oct	Sept
Frequency	Three times per year	Twice per month, annually	Twice per year	Annual; biennial after 2015	Annual; biennial after 2014	Biennial/ annual	Biennial/ annual, area-dependent	Annual
Area	GOA, NE Pacific	SOG	WCVI (Shelf and offshore	La Perouse, (SWCVI) offshore	WCVI, offshore (some inlets)	WC North America offshore	BC offshore, inlets, SOG	SOG, CC (some years)
Time	Day and night	Day and night	Day and night	Day	Night	Day	Day	Night
Type	CTD profiles, Niskin bottles, plankton tows	Surface water samples, net tows	Zooplankton, hydrographic, acoustic	Acoustic/ trawl	Trawl	Acoustic/ trawl	Trawl/seine (purse, beach)	Seine
Net	Zooplankton	Zooplankton	Zooplankton	Midwater trawl	Midwater trawl	Midwater trawl	Midwater trawl; seines	Small purse seine
Physics	Temp, salinity, phyto. fluorescence, chemical analyses, *e.g.*, O_2, nutrients, dissolved organic carbon, pH, trace gases	Temp, salinity, phyto. fluorescence	CTD, Water samples	CTD, Trawl RBR	CTD, Trawl RBR	Trawl RBR	CTD, Trawl RBR	CTD
Zooplankton	Bongo	Bongo, ring net	Bongo, multinet, acoustics	Bongo, acoustics	Bongo, acoustics	Acoustics	Bongo	Small bongo
Net camera	No	No	No	Half time	No	Yes	Some	No
Species sampled	All zooplankton	All zooplankton	All zooplankton; phyto.	All, focus on herring	All, focus on sardine	All, focus on hake	All, focus on salmon	All, focus on herring

Diet	No	No	No	All fish	All fish	Hake	Salmon	Some fish
Demersal	No	No	No	Occasional	No	Occasional	Occasional	No
Mammal obs.	No	No	Yes (sporadic)	No	Yes	No	No	No
Seabird obs.	No	No	No	No	Yes (2014)	No	No	No

China

Recent Progress of Marine Living Resource Monitoring in China

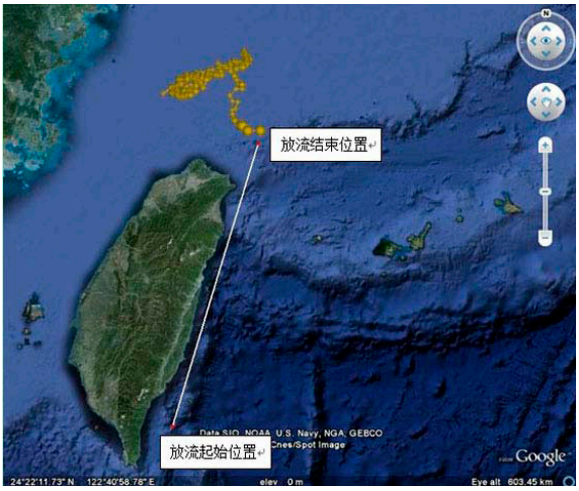
by Prof. Jilong Li
Resource and Eco-environment Research Center, Chinese Academy of Fishery Sciences

Abundant Bio-mass was found in North Continental Shelf of South China Sea by "Nanfeng".

In 2014, the Living Resource Survey Mission in North Continental Shelf of South China Sea (E114°–146°; 18°N–21°N) has been conducted by South China Sea Fishery Research Institute (SCSFRI) of Chinese Academy of Fishery Sciences (CAFS) with the newly built scientific research vessel "*Nanfeng*". This mission, lasting 21 days with 2000 nautical miles navigation, has trawled 62 times for plankton and 12 times for fish. Enormous pelagic fish Bio-mass were found during the mission. According the survey, Professor Zhou Meng from Shanghai Communication University and Dr. Chen Zuozhi from SCSFRI estimated that the pelagic fish resource in South China Sea may reach 70-150 million tons

Tuna satellite tagging experiment was successful conducted.

Up to 2014, the East China Sea Fishery Research Institute (ESFRI) of CAFS, supported by the programs of "Techniques of Open Sea Tuna Fishing Ground Prediction", "Techniques of Open Sea Environment Monitoring and Fishing Information Service" and "Offshore Fishing Techniques and New Species Exploration of South China Sea", has implemented the study of the separated satellite fish tagging techniques. The results show that the tagging rate has increased 10% with the tagging time over 90 days. With this experiment, experts has learned the migration (both of the horizontal and vertical migration) behavior of yellow fin tuna and, the maximum depth and the most suitable water temperature, current for which yellow fin tuna habituated.



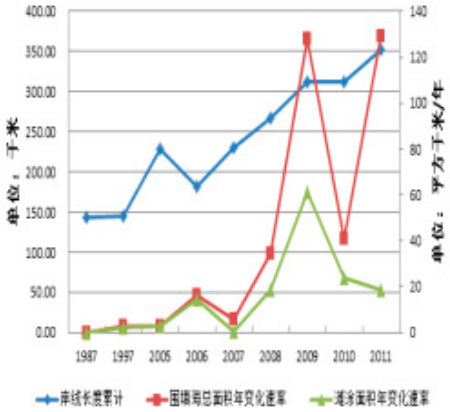
Action Plan for the Marine Living Resource Monitoring

CAFS, as the national fishery research institute, has clarified its Action Plan for the Marine Living Resource Monitoring in 2014. This action plan identified its key techniques for marine living resource monitoring and assessment, namely, the techniques including and based on trawling, acoustics, direct counting and species identification, remote sensing surveys; food web nutrition dynamics; mechanism of resource response to climate and coastal habitat changes. CAFS will focus on the living resource monitoring and assessment, fishing carrying capacity, ecosystem evolution, relation among the key stock and food web, human activities and climate changes and developing the fishing forecasting system based on new techniques in its future research activities.

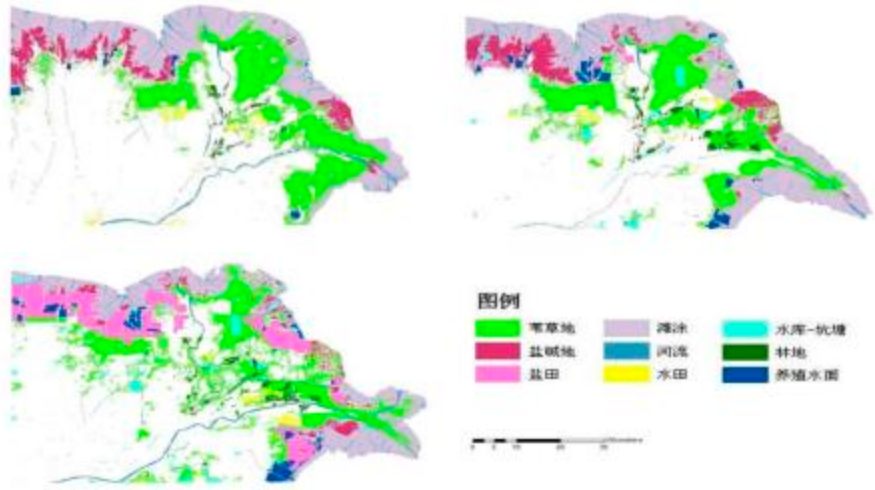
Coastal Habitat Monitoring and Near Shore Fishery Resource Investigation

Since 2000, China has conducted the coastal habitat monitoring and near shore fishery resource investigation program in the Northwest Pacific marginal seas such as East China Sea and South China Sea to support its marine living resources management.

Spatial-temporal changes of sea reclamation in Bohai Bay Tianjin region



Annual changes of the coastline in Bohai Bay Tianjin region



Wetland distribution map of the Yellow River Delta in1986, 1996, 2009.

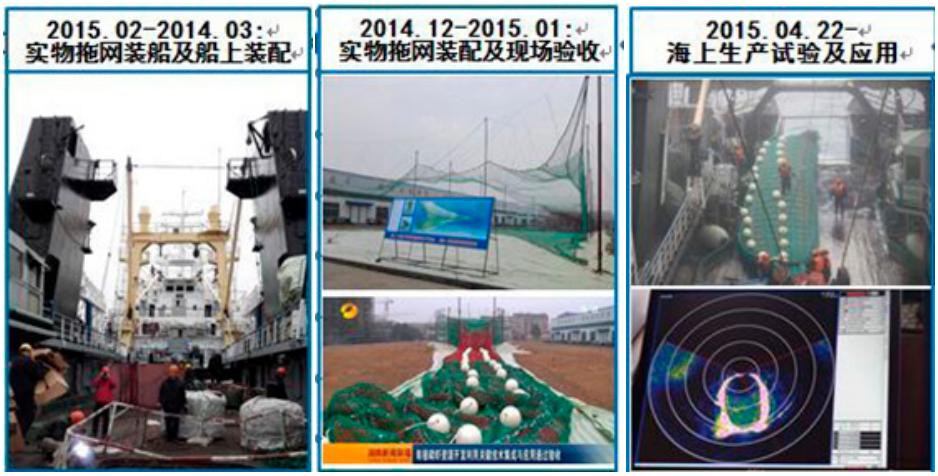
Coastal changes in Bohai Bay West Coast, 1992 *vs*. 2012

Plan for Research Vessel Building.

CAFS, as the national fishery research institute, has promulgated its Plan for Research Vessel Building in 2014. In this action plan, 4 new research vessels over 2000 Mt will be constructed for offshore and open sea living resources monitoring and investigation, 10 new research vessels over 300 Mt will be constructed for coastal and near shore living resources monitoring and investigation.

High Efficient Krill Trawler Research and Development

In 2015, ESFRI of CAFS developed BAD13B00-TN01, a high efficiency krill trawler, and experiment trawling was conducted in the Antarctica (48.1 Zone). Results show that the catches reached 45Mt/hr for day time and 21 MT/hr at night. The BAD13B00-TN01 krill trawler is 101.6m long, and has 246m jaw perimeter with mammal escape device. The normal trawling speed of BAD13B00-TN01 krill can reach 2.5–3.0 knots.



Recent Progress of Marine Living Resource Monitoring in China

by Prof. Jilong Li
Resource and Eco-environment Research Center, Chinese Academy of Fishery Sciences

Abstract

This national report gives the Recent Progress of Marine Living Resource Monitoring of China in recent years. These progresses include abundant Bio-mass was found in North Continental Shelf of South China Sea by "Nanfeng", tuna satellite tagging experiment was successful conducted, high efficient krill trawler was developed, coastal habitat monitoring and near shore fishery resource investigation program was conducted and the plans for the marine living resource monitoring techniques development and research vessel building were promulgated by CFAS.

Japan

I. JAMSTEC Report

by Sanae Chiba, RCGC JAMSTEC

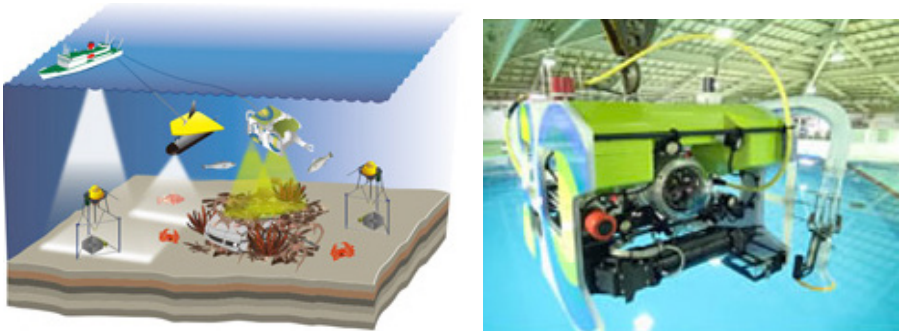
Highlights of FY 2015

1. Tohoku Ecosystem-Associated Marine Science (TEAMS)

TEAMS is collaborative projects lead by JAMSTEC, Tohoku University and AORI of the University of Tokyo, aiming to monitor restoration processes of ecosystem and fisheries of Tohoku coastal regions after the earthquake and tsunami disaster in 2011. The project consists of four research units;

Unit 1: Ecosystem Change

- To monitor sea floor condition by studying bathymetric features
- To monitor distribution and decomposition processes of debris, and assess those impacts on ecosystem using CRAMBON system etc.
- To monitor benthic ecosystem using bio-tracking systems



CRAMBOM system

Unit 2: Marine Environmental Change Monitoring:

- To monitor restoration processes of water column and seafloor environment using automated multiple physical and biogeochemical sensors and a HD camera equipped on the Lander system.
- To monitor PCB in soil and plankton/fish.

Unit 3: Habitat Mapping:

- To create habitat map and ecological envelope for several important harvested species.

Unit 4: Data Management:

- To manage and publish data on investigations and research on marine ecosystems.

TEAMS data access site (http://www.i-teams.jp/catalog/rias/metadataList)

TEAM International Symposium for Reconstruction from Disaster and Creation for Future Science, March 2–4, 2016, at The University of Tokyo
https://webpark1662.sakura.ne.jp/symposium/

2. ArCS: Arctic Challenge for Sustainability

See III-2.

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.

2. *Deep NINJA: Deep ocean observation by deep-sea float*
http://www.jamstec.go.jp/ARGO/deepninja/
JAMSTEC has deployed 14 Deep NINJA floats in collaboration with Tsurumi-Seiki Co., Ltd, primarily in the Southern Ocean in 2014. 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.

3. *TAO and TRITON Project*
http://www.jamstec.go.jp/jamstec/TRITON/real_time/
In operation is a 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*
A new type of moored buoy network, which observes sea surface heat flux components and ocean temperature and salinity in the upper layer, has been developed to understand the 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

Activities of FY 2015

1. Monitoring at the transects of A-line, O-line, and CK-line

FRA maintains 3 monitoring transects around Japan. Details of the observation are illustrated below.

A-line

Tohoku and Hokkaido National Fisheries Research Institute have carried out the oceanographic monitoring from 1987 to the present at the A-line transect in the Oyashio and Kuroshio-Oyashio transition waters. In recent years, observations were carried out in January, March, May, July, and October throughout a year. Observations are by CTD, water sampling by Niskin bottles, Norpac net, and Bongo net. We have published CTD and other data through the website (http://tnfri.fra.affrc.go.jp/seika/a-line/a-line_index2.html) after 3 and

5 years, respectively. The period of published data is from 1990 to 2012 for CTD and from 1990 to 2010 for others.

O-line
The National Fisheries Research Institute has carried out monitoring from 1999 to the present at transect 0-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. Observations by CTD, water sampling by Niskin bottles, and Norpac net.

CK-line
The Seikai Fisheries Research Institute has carried out the monitoring from 2002 to present at transect CK-line in the East China Sea. Observations were carried out in February, March, June, July, and October throughout a year. Observations are by CTD, water sampling by Niskin bottles, and Norpac net.

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

Observations have been carried out at 760 stations in the waters around Japan, except Okinawa and Hokkaido, from 1972. The frequency of observations is monthly except at 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 carries out the monitoring. Observations are by CTD and Norpac net. Data of CTD and abundance of eggs, larvae, juveniles of pelagic fish are archived in a closed database of FRESCO (Fisheries Resource Conservation) system managed by JAFIC (Japan Fisheries Information Service Center).

3. Archiving of zooplankton, fish eggs, larvae, juvenile, and fish samples

FRA is collecting the zooplankton, fish egg larvae, juvenile and fish samples. Details of the collection is below.

Zooplankton
Tohoku National Fisheries Research Institute is collecting zooplankton samples from 1950 to present. Total number of samples are more than 87,000. The samples are preserved by 5% buffered formaldehyde. Sampling area is mainly in the waters around Japan. However, 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. An inventory of the samples is archived to a closed database (see http://tnfri.fra.affrc.go.jp/seika/plankton/hyohon_home.html).

Fish
Seikai National Fisheries Institute is collecting samples. The total number of the species is about 1200, and the total number of samples is about 32,000. The samples are preserved mainly by isopropyl alcohol. DNA samples were also collected from a part of the sample. (see http://snf.fra.affrc.go.jp/gyoruihyouhon/index.html).

Fish egg, larvae, and juvenile
The National Fisheries Institute started collecting samples in 2015. The samples were mainly collected during the stock assessment monitoring project commissioned by the Fisheries Agency of Japan.

4. Data management for species composition of zooplankton by using the Darwin-Core format

OBIS (Ocean Biological Information System) and GBIF (Global Biological Information Facility) are using the data format of Darwin-Core for archiving the biological data. In Japan, BISMaL (JAMSTEC, node of OBIS = J-OBIS) and S-net (National Museum of Nature and Science, Japan node of GBIF) are also using the format. Therefore, it is easy to analyze in various temporal and special scales by using the Darwin-Core. We also use the modified Darwin-Core format to manage the zooplankton species composition data.

III. Report from Universities

by Sei-Ichi Saitoh, Hokkaido University and Takashi Ishimaru,
Tokyo University of Marine Science and Technology

Highlight of FY 2015

1. Environmental survey by university training vessels in coastal waters of Fukushima

Following the earthquake and subsequent tsunami on 11 March 2011, the Fukushima Dai-ichi Nuclear Power Plant lost power sources and cooling capability. Large amounts of radionuclides were eventually released to the environment. Much of these radionuclides found their ways into marine environment through atmospheric deposition and direct release of radioactive water. The direct release had much larger effect on local coastal environment than the atmospheric deposition; the seawater radioactivity in Fukushima seawater increased sharply from late March through early April 2011 when major release events took place. The open nature of the Fukushima coast, however, resulted in rapid flushing of radionuclides away from the coastal seawater. Radioactivity in the coastal seawater declined rapidly in April and May of 2011; the enormous elevation of seawater radioactivity in a relatively short period followed by the rapid decrease characterizes marine pollution by the Fukushima accident. Yet, some portions of radionuclides in seawater transferred to bottom sediment, and radioactivity remained rather persistently in sediment. Decease of sediment radioactivity has been much slower than that of seawater. Radionuclides were also transferred to marine biota either by seawater intake or by food ingestion. ^{137}Cs, ^{134}Cs, ^{110m}Ag, and ^{90}Sr have been detected from fish and other organisms in Fukushima waters. Commercial fishing is still practically banned in Fukushima regions and the local fishery industry is severely damaged. Regarding ^{137}Cs and ^{134}Cs, which contribute most of the radioactivity found in marine organisms of Fukushima, these isotopes are known to exchange quite rapidly between seawater and marine organisms. Hence radioactivity of marine organisms should follow the rapid decrease of radioactivity in seawater. As radioactivity in some fish species did not decrease sufficiently, there should be a continuous input of radioactive materials through their food. The mechanism and pathway of radioactivity transfer to marine organisms should be the central target of the research effort. A comprehensive survey of marine sediment and marine food web is thus called for. Starting from the first Fukushima cruise of the *Umitaka-maru* in July 2011, Tokyo University of Marne Science and Technology repeatedly sent its training vessels to Fukushima waters for the purpose of radiological research. A total of 10 cruises of the *Umitaka-maru* and the *Shinyo-maru* will be completed by October 2015. Hokkaido University sent training ship *Oshoro-maru* to Fukushima waters for joining and following those radiological researches from July 26 to August 7, 2015.

2. ArCS: Arctic Challenge for Sustainability

Launched in 2015, ArCS is a collaborative project of JAMSTEC, NIPR, and Hokkaido University. ARC (Arctic Research Center)-HU is established in Hokkaido University on April 1, 2015, to conduct trans-disciplinary Arctic research. Hokkaido University has a plan to send the T/S *Oshoro-maru* to Arctic Ocean for oceanographic research in 2017 and 2018 through this ArCS project.
http://www.arc.hokudai.ac.jp/en/
http://www.arcs-pro.jp/en/index.html

Korea

1. Report from NFRDI (National Fisheries Research & Development Institute)

New Ocean Survey

NFRDI was carried out the coastal upwelling observation program to understand the ecological and spatio-temporal variation by the development of coastal upwelling in the eastern coast of Korea during summer season. This survey is carried out 5 times during 3 month at each year on 24 stations with 4 lines. The measured factors in this survey are temperature, salinity, transparency, zoo- and phyto plankton, DO, nutrients and meteorological factors.

Additional Moored Buoy

NFRDI constructed the real-time red-tide observation buoy system on early August in 2015 around the southeastern coast of Korea. This moored buoy measures temperature, salinity, current speed, dissolved oxygen, chl.-*a* and meteorological factors with each 30 minute interval on real-time. This buoy system is operated to understand the oceanic conditions around the frequent appearance area of HAB and to detect the outbreak of HAB in the first stage around the southeastern coast of Korea.

Service the Real-time Oceanographic Data to fishermen

NFRDI operate 29 Real-time Information System for Agriculture environment (RISA) around the coastal area of Korea. This system measures temperature, salinity and dissolved oxygen every 30 minute with several depths. The data from this system were serviced by internet web-page, mobile web-page, SMS (Short Message Service) and mobile phone application.

Satellite Tracking Buoys and Tagging Experiment

NFRDI deployed 15 satellite tracking buoys to understand the behavior of giant jellyfish around the Yellow Sea and northern East China Sea in spring and summer 2015. NFRDI also carried out the tag experiments with 3 satellite tags in giant jellyfish body around the southern part of Korea and Jeju Island in summer and autumn 2015.

2. Report from KHOA (Korea Hydrographic & Oceanographic Administration)

Additional HF-Radar and Large-scale Ocean Buoy Stations

KHOA operated 50 tidal stations, 6 ocean stations, 27 moored ocean buoys, 26 HF-radar systems and 1 ocean research station until 2014. In 2015, KHOA constructs additional 7 HF-radar systems around Incheon-Bay, *etc*., which will be operated from December 2015. KHOA also constructs additional 1 large-scale ocean buoy around East Sea, which will be operated from December 2015.

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

Operation and Construction the Ocean Research Station

KIOST constructed 3 ocean research stations, which are Ieodo Ocean Research Station, Gageo Ocean Research Station and Yellow Sea Ocean Buoy), until 2013. KIOST also operates 2 ocean research stations, which are Gageo Ocean Research Station and Yellow Sea Ocean Buoy (Ieodo Ocean Research Station was operated by KHOA since 2007). KIOST have a plan to construct new ocean research station around the northwestern area of Korea until late 2015.

4. Report from KMA (Korea Meteorological Administration)

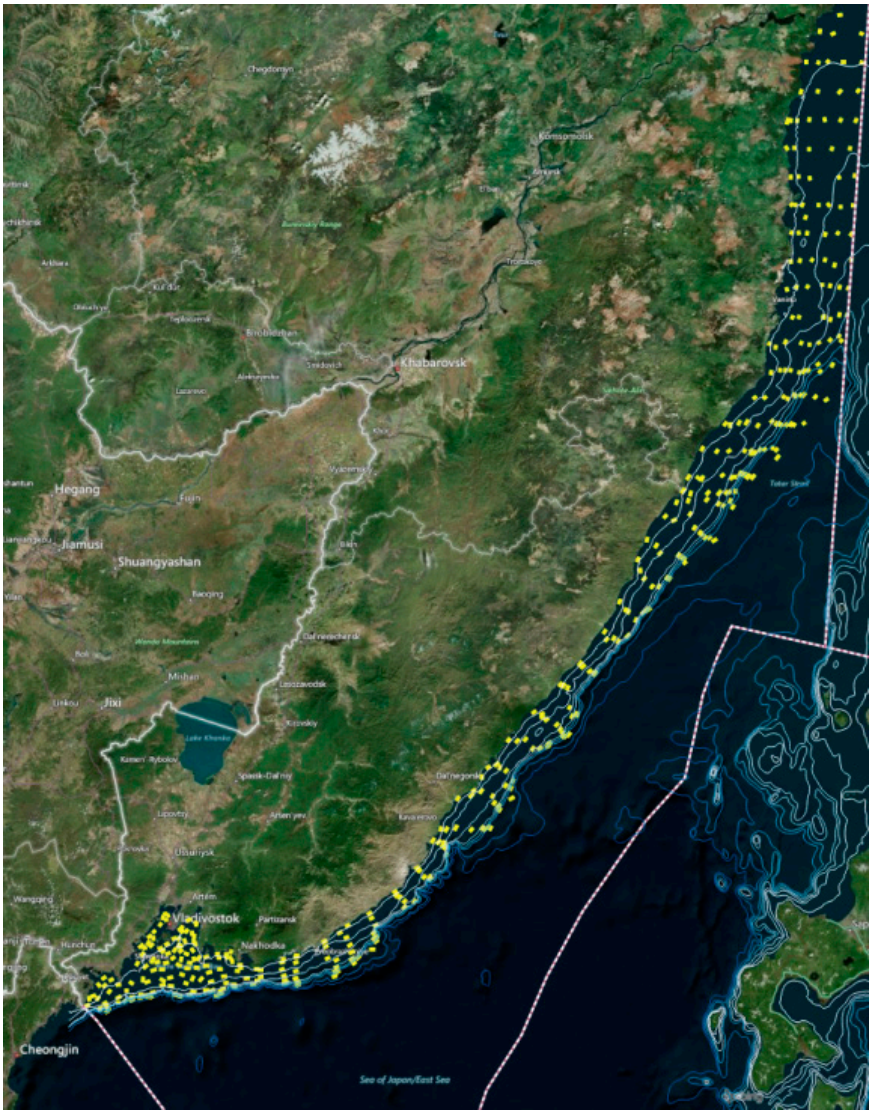
Additional Oceanic Meteorological Observation System

KMA has operated 11 ocean buoys, 9 light tower observation systems, 6 wave gauges, 44 wave buoys, 18 coastal disaster observation systems, 2 port observation systems, 10 vessel observation equipment, 1 research vessel and 1 oceanic weather station until 2015.

Russia

Monitoring Activities (fisheries independent surveys) at TINRO-Center
Update on 2014

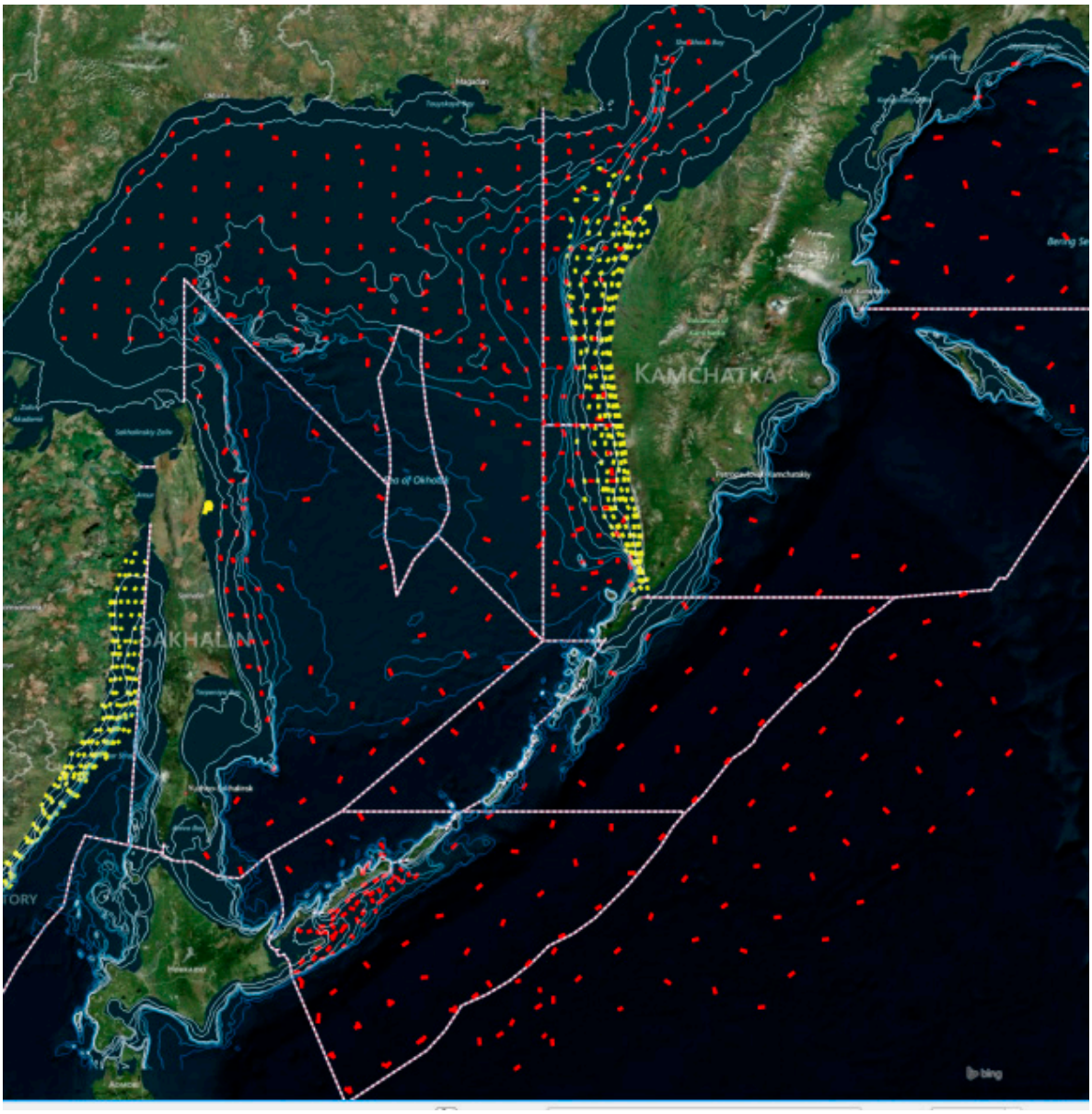
There were 3 bottom trawl surveys in each subzone of Primorye fisheries zone (172 + 123 + 139 = 434 trawl stations). Trawling tracks are shown below.



TINRO-Center conducted several fisheries independent trawl surveys in the Sea of Okhotsk:

1. To estimate walleye pollock spawning biomass in spring (275 midwater trawls)
2. To estimate salmon juveniles above the deep water zone during October, 2014 (62 trawls in the upper layer of pelagial).
3. To estimate abundance of demersal fish and nekton and benthos 239 bottom trawls were used at the shelf of Western Kamchatka in Summer.
4. To estimate abundance of animals before possible construction of the oil-well 10 trawls at the bottom and 9 trawls in the pelagial were made in the same positions at the shelf of North-Eastern Sakhalin.

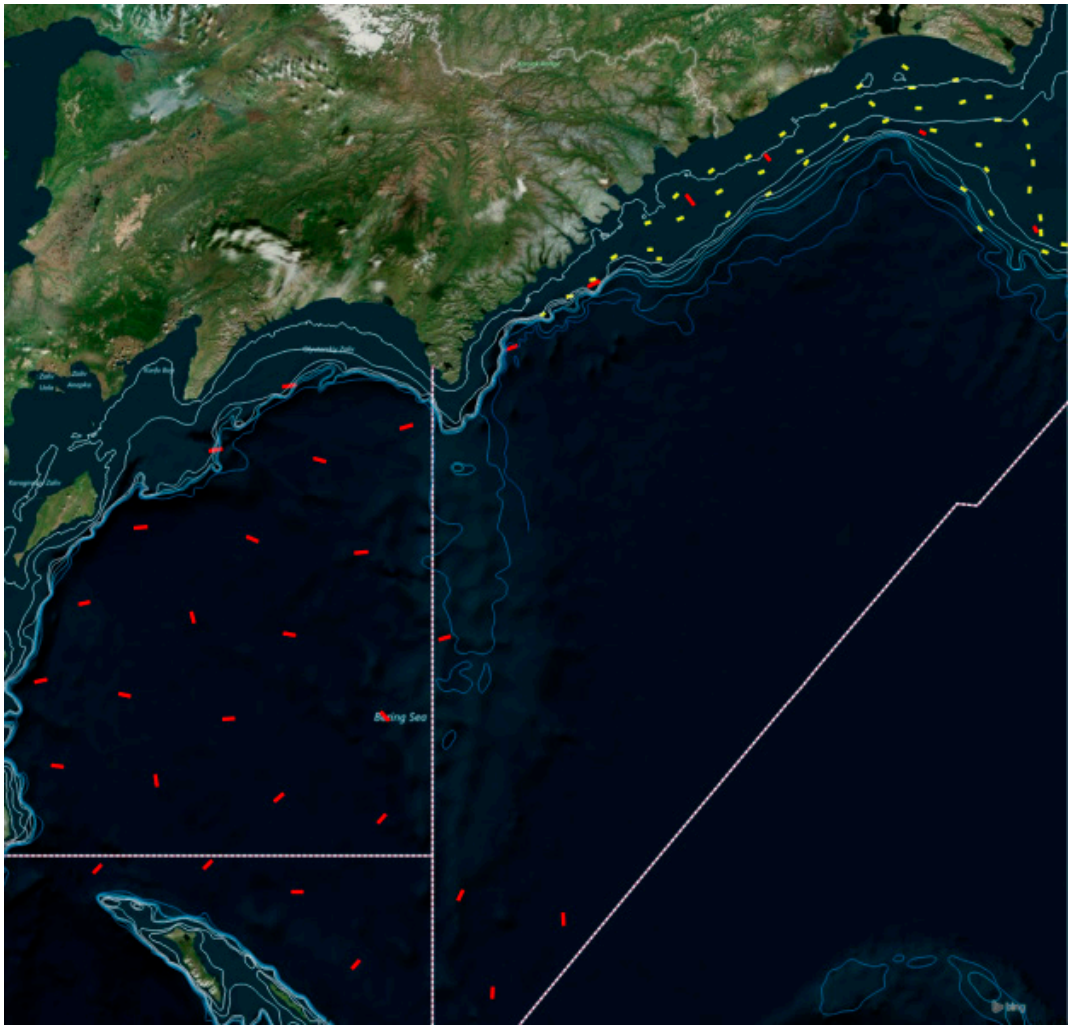
Here and further trawling tracks in pelagial are shown in red and at the bottom in yellow lines.



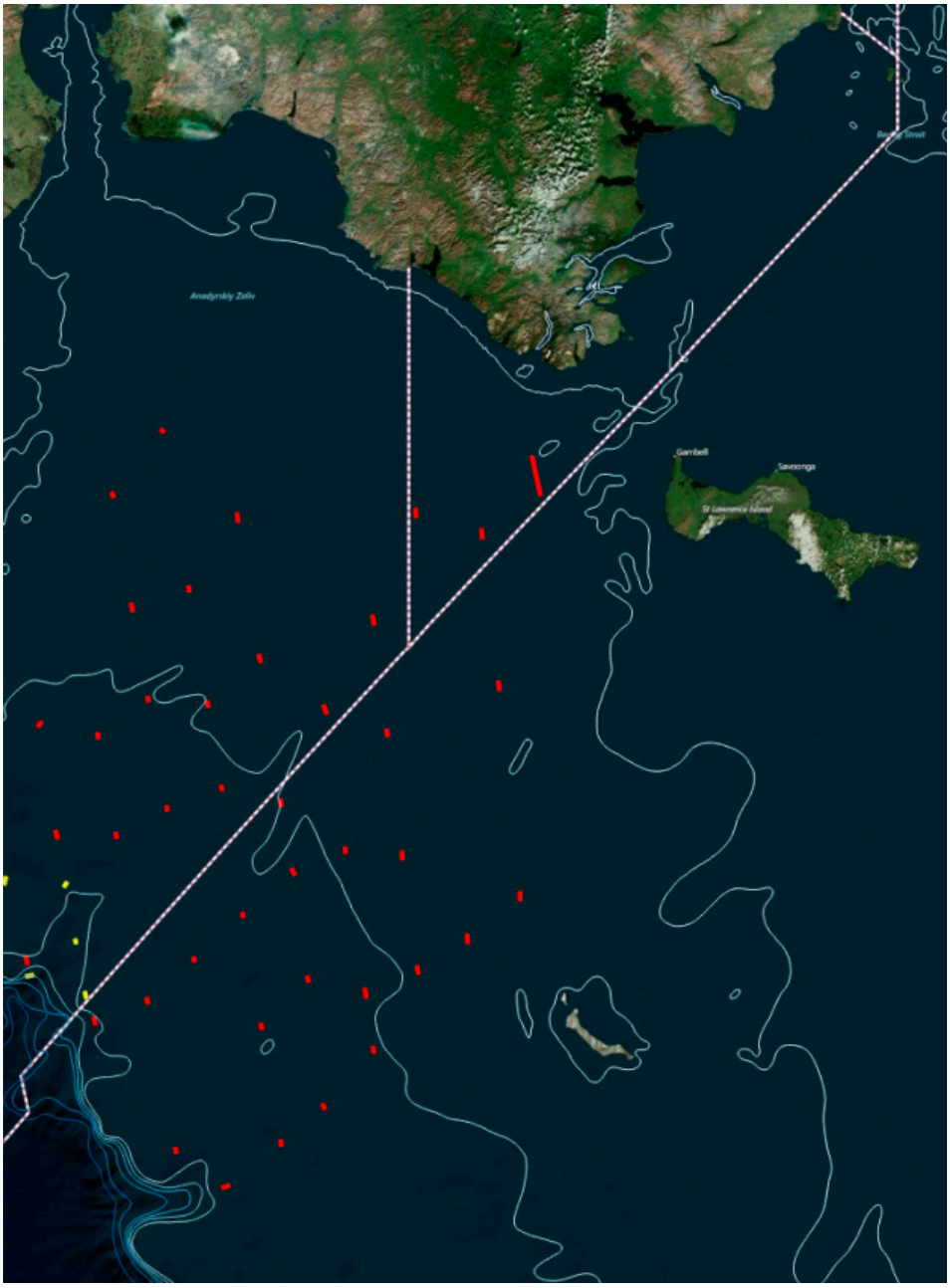
There were 53 midwater trawls for walleye Pollack above the shelf of the southern Kuril Islands.

TINRO-Center also conducted 105 trawls in the upper layer of pelagial in the offshore waters of the Pacific ocean during Summer crossing the salmon routes of migration and 18 trawls on September.

In the western part of the Bering Sea 27 trawls in the upper layer of pelagial were made to estimate abundance of salmon on the October and 45 at the bottom + 6 midwater trawls were conducted to study communities above the shelf of Koryak mountains and Navarin cape.



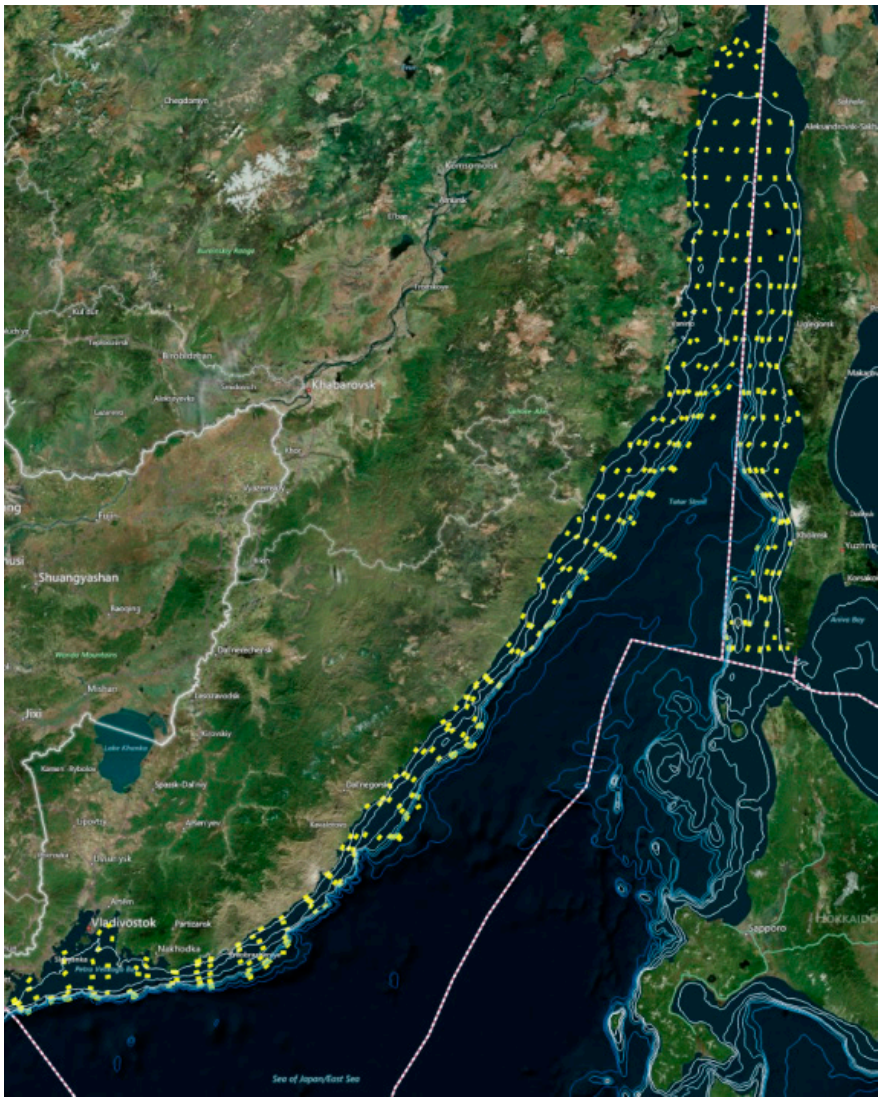
In the eastern part of the Bering Sea survey added 41 midwater trawls on the end of September and 5 trawls at the bottom on the end of October.



Each trawl station in almost every survey is a complex of CTD down to the bottom, plankton station (0–200 m depth) and full measurements of every animal species plus bioanalysis of the most important species.

Monitoring Activities (fisheries independent surveys) at TINRO-Center
The information which has already passed the 1st level of quality control at the Regional Data Center in 2015.

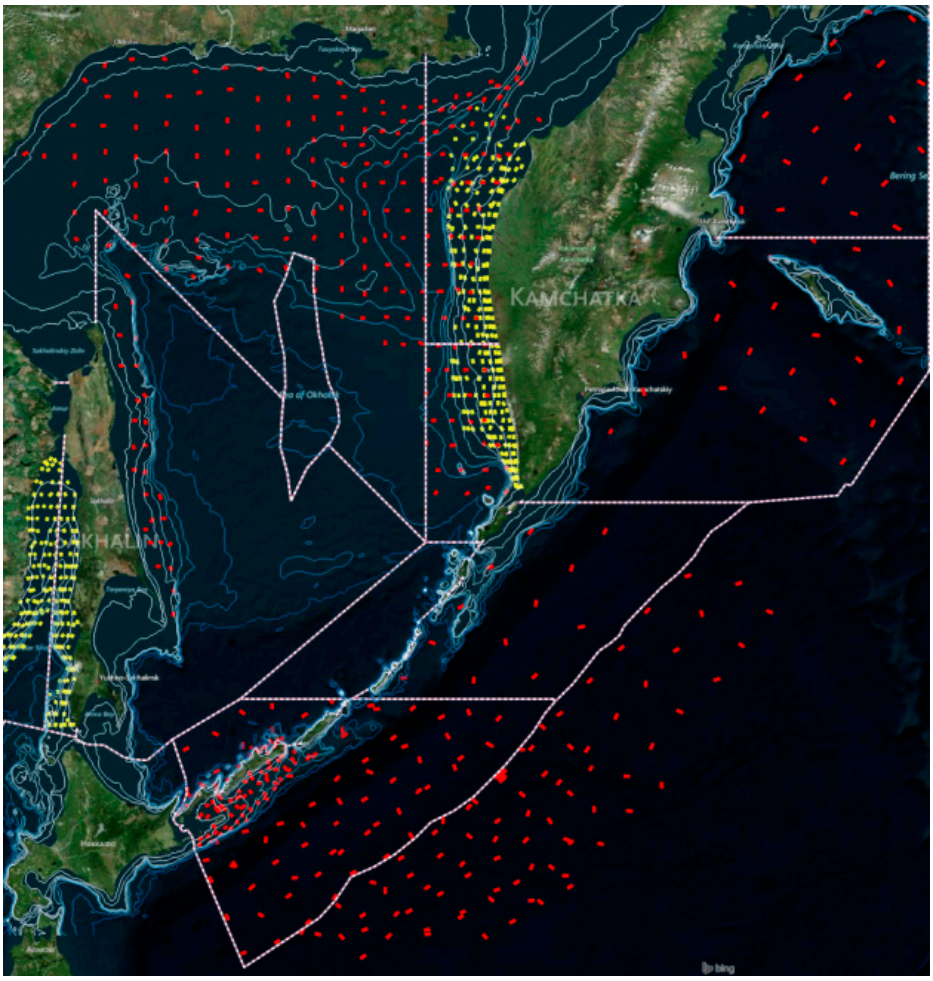
A complex survey consisted of 431 stations at the bottom of Japan/East Sea down to 800 m in Spring and early Summer. Trawling tracks are shown below.



TINRO-Center conducted several fisheries independent trawl surveys in the Sea of Okhotsk as usual:

1. to estimate walleye pollock spawning biomass in spring (235 midwater trawls). During this year the north-western part had fewer stations due to our budget problems.
2. to estimate abundance of demersal fish and nekton and benthos 251 bottom trawls down to 550 m depth were used at the shelf of Western Kamchatka in Summer.

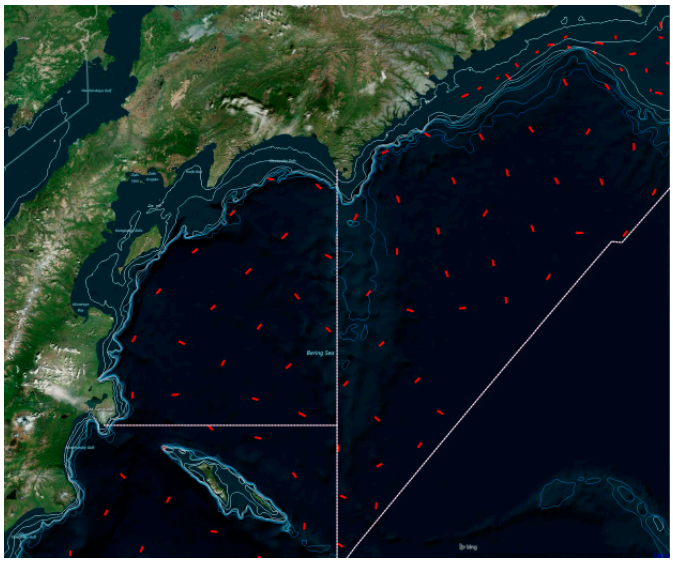
Here and further trawling tracks in pelagial are shown in red and at the bottom in yellow lines.



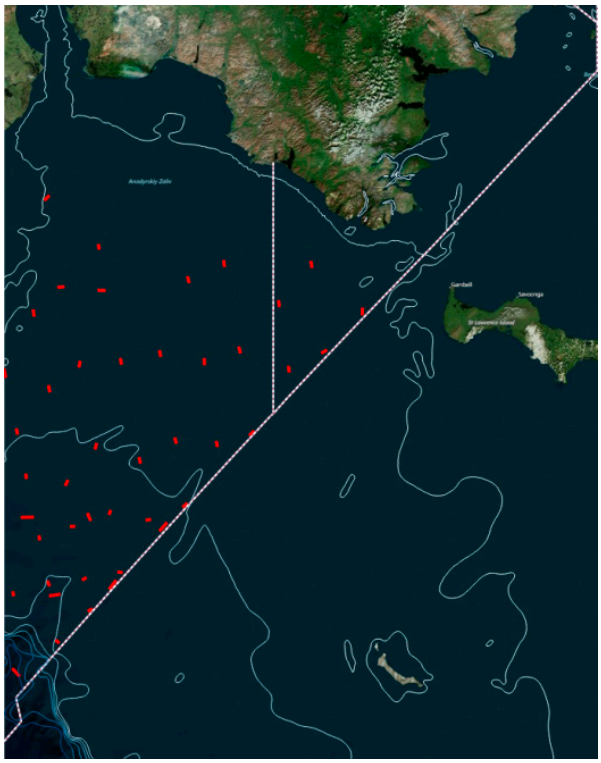
There were 74 midwater trawls for walleye Pollack above the shelf of the southern Kuril Islands.

TINRO-Center conducted also 75 trawlings in the upper layer of pelagial in the offshore waters of the Pacific Ocean during Summer crossing the salmon routes of migration and 93 trawls in the end of Summer to estimate the part of mackerel (*Scomber* spp.) and other Southern (relatively to Russian EEZ) fish. Mackerel put a record of 4-6 megatonnes in biomass migrated to the area of research. Sardinops also continued to grow in abundance.

In the western part of the Bering Sea 84 trawls plus 17 trawls in the adjacent Pacific waters in the upper layer of pelagial were made to estimate abundance of salmon in Summer.



In the eastern part of the Bering Sea survey added 44 midwater trawls on July.



Each trawl station in almost every survey is a complex of CTD down to the bottom, plankton station (0–200 m depth) and full measurements of every animal species plus bioanalysis of the most important species.

TINRO-Center's data can be downloaded in aggregated form (by period, regions, *etc*.):
https://www.researchgate.net/profile/Vladimir_Kulik/publications?pubType=dataset
or
https://www.researchgate.net/profile/I_Volvenko/publications?pubType=dataset

USA

Alaska

by Lisa Eisner, Alaska Fisheries Science Center, NMFS, NOAA

NOAA – Fisheries, the Alaska Fisheries Science Center (AFSC) continued monitoring of Alaska's Large Marine Ecosystems in 2015. Monitoring efforts consisted of fisheries independent surveys are well as process oriented research that continued long time series of environmental and biological data. Below are short descriptions of some of the major monitoring activities completed during the year.

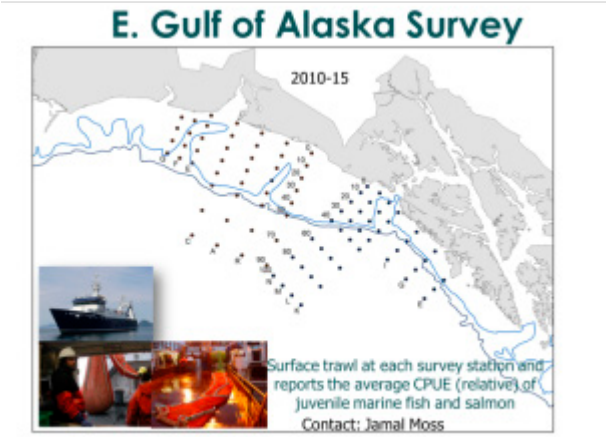
Spring Gulf of Alaska Larval Fish Survey – The Ecosystems and Fisheries-Oceanography Coordinated Investigations Program (Eco-FOCI) conducted a spring larval fish survey in the western Gulf of Alaska, from mid May to early June aboard the NOAA Fisheries Survey Vessel Oscar Dyson. The survey occupied gridded stations between Shumagin Islands and Prince William Sound, Alaska and uses a Bongo plankton net as the primary sampling tool. Stations are 10 nm apart. The primary targets for this survey are pollock larvae, but all larval fish are enumerated. In addition to data on distribution and abundance of pelagic fish larvae, the survey yields data on water temperature and salinity and the distribution and abundance of zooplankton. Results from this survey are used to better understand recruitment variability in Alaska fish species.

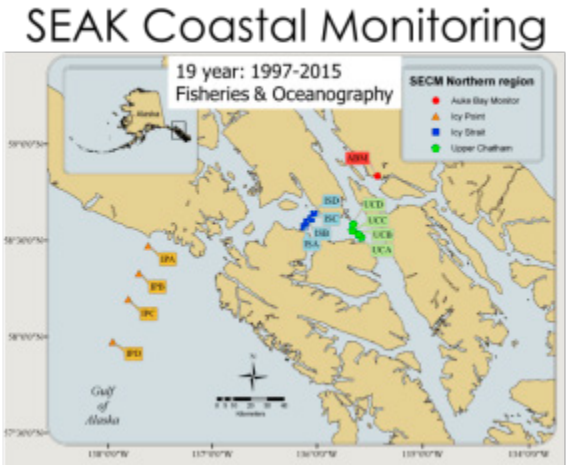
Gulf of Alaska Bottom Trawl Survey – The AFSC has been conducting bottom trawl surveys in the Gulf of Alaska for groundfish since 1980. This is a biennial survey; in odd years they sample the Gulf of Alaska and in even year the Aleutian Islands. Three chartered fishing vessels were used in the 2015 survey and almost 800 stations were occupied. A stratified random sampling design is used to pick stations that represent different survey strata depending on depth and area. This year's survey was conducted between late May and mid August. In addition to data on the distribution, biomass, and abundance of crab and groundfish species, the survey yields data on water temperature, distribution, biomass, and abundance of invertebrate species, and sex and size of selected fish species. Detailed reports for the surveys can be found at on the AFSC web site (http://www.afsc.noaa.gov/Publications/techmemos.htm).

Winter Gulf of Alaska Acoustic Trawl Survey – The AFSC conducts annual winter acoustic-trawl surveys in the Gulf of Alaska. This year the initial cruise in February sampled the area around Sanak and the Shumgin Islands, and the March cruise sampled in Shelikof Strait and off Alaska's Kenai Peninsula. Distance between acoustic trawl transects varies with area, and trawls are taken opportunistically along the transects, depending on acoustic sign. The primary targets for this survey are pollock, but other fishes are also assessed. The survey was conducted on the NOAA Fisheries Survey Vessel Oscar Dyson. In addition to data on distribution, biomass, and abundance of pelagic fish species, the survey yields data on water temperature and salinity, and the sex and size of selected fish species. Detailed reports for the surveys can be found at (http://www.afsc.noaa.gov/Publications/ProcRpts_intro.htm)

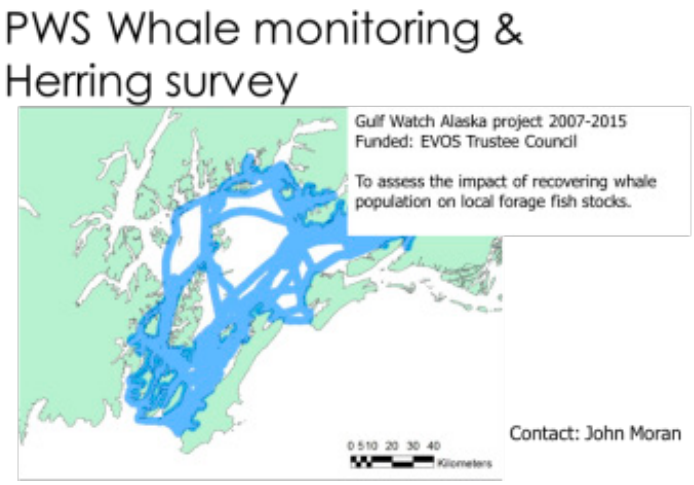
Summer Gulf of Alaska Acoustic Trawl Survey – The AFSC has been conducting summer acoustic trawl surveys in the Gulf of Alaska since the early 2000s, but 2015 was one of the first years that the entire survey grid was occupied. This is a biennial survey; in odd years they sample the Gulf of Alaska and in even years the eastern Bering Sea. Acoustic transects are run and trawls are taken opportunistically along the transects, depending on acoustic sign. The primary targets for this survey are pollock and rockfish, but forage fish are also assessed. The survey was conducted mid June through mid August on the NOAA Fisheries Survey Vessel Oscar Dyson. In addition to data on distribution, biomass, and abundance of pelagic fish species, the survey yields data on water temperature and salinity, distribution and biomass of euphausiids and the sex and size of selected fish species. Detailed reports for the surveys can be found at http://www.afsc.noaa.gov/Publications/ProcRpts_intro.htm. Results from this cruise will be used in a North Pacific wide study of the effects of the warm water and El Niño conditions experienced off the west coast of North America this year.

Summer Gulf of Alaska Juvenile Pollock, Salmon and Forage Fish Surveys – The AFSC Recruitment Processes Alliance conducted a series of summer cruises in the Gulf of Alaska (GOA) and Southeast Alaska (SEAK) Coastal Waters that lasted from late June to early September. The Recruitment Processes Alliance is a consortium of Programs at the AFSC that collaborate on recruitment processes research. It includes the Recruitment Processes, Ecosystem Monitoring and Analysis, Recruitment Energetics and Coastal Assessment, and Resource Ecology and Ecosystem Modeling Programs. All cruises were conducted on a chartered fishing vessel and focused on the juvenile stages of important groundfish and salmon species. Regular gridded stations were occupied in the eastern and western Gulf, and physical, chemical, and biological data were collected. Water column measurements for temperature, salinity, nutrients, chlorophyll-*a*, and phyto- and zooplankton species abundance were taken. Pelagic trawls with small mesh cod ends were used to assess the distribution, abundance, and biomass of small pelagic fishes. These data are intended to increase our knowledge of what limits recruitment of pelagic species in the Gulf of Alaska, and will also be useful in a North Pacific-wide study on the effects of the warm water and El Niño conditions experienced off the west coast of North America this year.

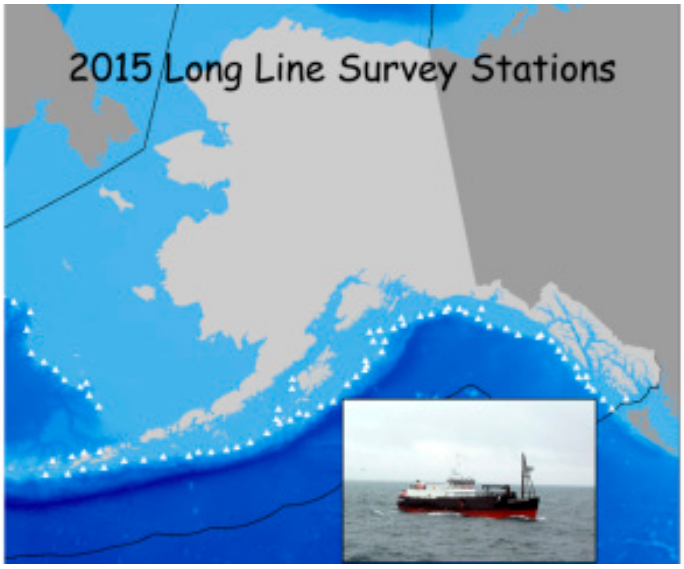




Prince William Sound (PWS) whale monitoring and herring survey – This survey has been conducted by Gulf Watch for 5 years so far (out of a 20 year project) to monitor humpback whale predation on recovering PWS herring. Humpback whales numbers in the North Pacific have been increasing at 5–7% annually since the end of commercial whaling. Up from a low of 1500 in the late 60s, there are now over 20,000 humpbacks in North Pacific waters.

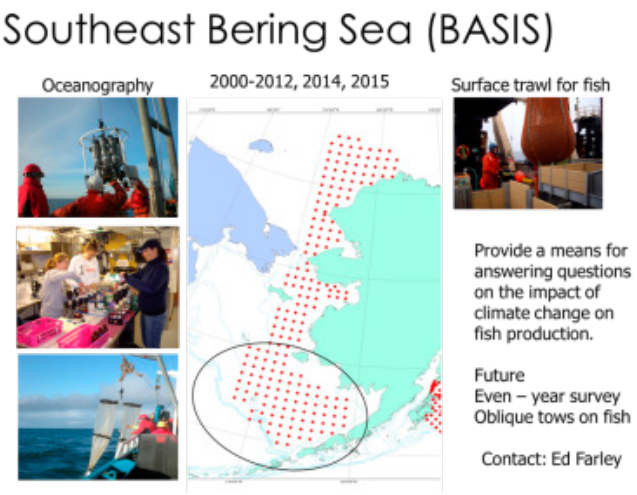


AFSC Summer Long Line Surveys – The annual Alaska Fisheries Science Center longline survey, conducted since 1979, monitors abundance of sablefish and other major groundfish species which inhabit the upper continental slope of the Gulf of Alaska, Aleutian Islands, and Bering Sea. This survey samples depths up to 1000 meters including rough bottom habitat providing information for areas rarely sampled by other research surveys in Alaska. Survey catches are used to compute relative population numbers and relative length frequencies for major species including sablefish, Greenland turbot, Pacific cod, giant grenadier, spiny dogfish, and rougheye, blackspotted, shortraker, and shortspine thornyhead rockfish. In 2015, one hundred fifty-two hauls were completed May–September in the Bering Sea and Gulf of Alaska. Summarized data and annual cruise reports from this survey can be accessed publicly through the Alaska Fisheries Science Center's website: http://www.afsc.noaa.gov/ABL/MESA/mesa_sfs_ls.php.



Eastern Bering Sea Bottom Trawl Survey – The AFSC has been conducting bottom trawl surveys in the eastern Bering Sea for groundfish and crab since 1975. The survey has been annual since 1979. Two chartered fishing vessels are used to conduct a survey of over 300 stations 20 nm apart on the inner, middle, and outer shelf (http://www.afsc.noaa.gov/RACE/groundfish/ebs.htm and http://www.afsc.noaa.gov/Kodiak/shellfish/crabEBS/crabsurvey.htm). This year's survey was conducted between late May and early August. In addition to data on the distribution, biomass, and abundance of crab and groundfish species, the survey yields data on water temperature and salinity, underwater light levels, spectral variation in light, distribution, biomass, and abundance of invertebrate species, and sex and size of selected fish and crab species. Detailed reports for the surveys can be found at on the AFSC web site (http://www.afsc.noaa.gov/Publications/techmemos.htm).

Summer Eastern Bering Sea Juvenile Pollock and Forage Fish Survey – The AFSC Recruitment Processes Alliance conducted a special research cruise this summer to examine physical, chemical, and biological conditions in the EBS during a second consecutive year of warm conditions. The cruises were from mid August through early October aboard the NOAA Fisheries Survey Vessel Oscar Dyson. Regular gridded stations were occupied over the middle and outer shelf. Water column measurements for temperature, salinity, nutrients, chlorophyll-*a*, and phyto- and zooplankton species abundance were taken. Pelagic trawls with small mesh cod ends and fisheries acoustics were used to assess the distribution, abundance, and biomass of small pelagic fishes.



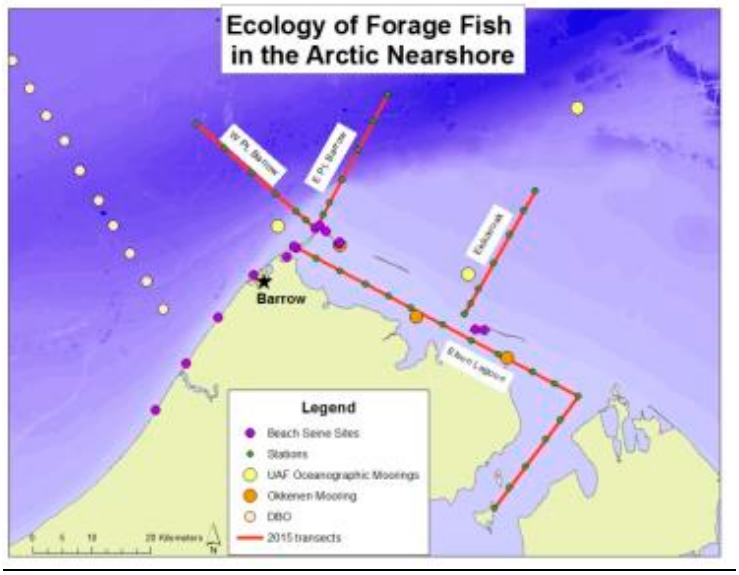
Northern Bering Sea Juvenile Salmon and Forage Fish Survey – The AFSC Ecosystem Monitoring and Analysis Program conducted a pelagic fish survey of the northeastern Bering Sea during the first three weeks of September on a chartered fishing vessel. Regular gridded stations were occupied over the middle and outer shelf. Water column measurements for temperature, salinity, nutrients, chlorophyll-*a*, and phyto- and zooplankton species abundance were taken. Pelagic trawls with small mesh cod ends were used to assess the distribution, abundance, and biomass of juvenile salmon and other small pelagic fishes.

Physical Oceanography of the eastern Bering Sea -- NOAA's Pacific Marine Environmental Laboratory (PMEL) conducted 2 cruises to the eastern Bering Sea to deploy/recover moorings and continue a time series of physical, chemical, and biological measurements made along a transect on the 70 m isobath of the EBS. This is part of the Ecosystems and Fisheries-Oceanography Coordinated Investigations Program. The first cruise was in late April and the last cruise was in late September/early October. Both cruises were aboard the NOAA Fisheries Survey Vessel Oscar Dyson. PMEL maintains 4 sentinel moorings over the middle shelf of the eastern Bering Sea and services these moorings twice per year. Water column measurements for temperature, salinity, nutrients, oxygen, chlorophyll-*a*, and zooplankton are made along the transect that connects the moorings. Primary production experiments and phytoplankton taxonomic data were also collected in 2015 (as was done in 2014) to better evaluate warm year effects on phytoplankton ecology. Information on PMEL moorings can be found at http://www.ecofoci.noaa.gov/moorings/efoci_currentMoorInfo.shtml and information regarding the Ecosystems and Fisheries-Oceanography Coordinated Investigations Program can be found at http://www.ecofoci.noaa.gov/.

Chukchi Sea Arctic Ecosystem Surveys – The AFSC EcoFOCI program has been conducting Arctic Ecosystem surveys since 2010. In 2015, two cruises were executed, one on the NOAA Ship Ronald Brown which occupied a series of hydrographic and plankton transects in the Chukchi and Beaufort Seas from early August to early September. The second was a shorter cruise for 3 weeks in September aboard a chartered fishing vessel to deploy moorings, collect groundtruth measurements and do surveys for baleen whales and other marine mammals. Water column measurements for temperature, salinity, nutrients, oxygen, chlorophyll a, and zooplankton species abundance were taken on the NOAA Ship Ronald Brown using CTDs and a Tucker Sled. Water column sampling on the second cruise was also with a CTD and marine mammal observations were collected with sonobuoys and through visual observation (Big Eye binoculars). Data from both cruises are being used to better understand the impact that climate change and anthropogenic activities such as oil and gas exploration are having on arctic ecosystems and protected species.

Ecology of Forage Fishes in the Arctic Nearshore – The AFSC Recruitment Energetics and Coastal Assessment Program conducted a nearshore summer survey in 2015. This research is focused on characterizing seasonal changes in the distribution, demographics, trophic position and nutritional condition of forage fish during the summer season near Pt. Barrow, Alaska. These data are necessary for developing policies relating to oil and

gas development, increased marine transportation, marine mammal conservation, and climate change impacts in the Arctic. Objectives include: 1) Compare and identify the biological and physical parameters that are associated with patterns in species composition, distribution and abundance of forage fish and zooplankton in the nearshore Chukchi and Beaufort Seas and Elson Lagoon; 2) Identify seasonal changes in forage fish size, age, otolith elemental signature, feeding habits, energetic content, and habitat in these areas; and 3) Identify the physical parameters that influence water exchange between Elson Lagoon and nearshore Chukchi and Beaufort Seas and the dynamics of the water column structure in the lagoon passes. There were 2 sampling components in 2015: 1) Beach seining component where they visited 13 sites that are legacy sites, and have been sampled once per year from 2004–2012. Since 2013, they sampled the sites on a weekly basis for a 7-week period during the summer ice-free season; and 2) Vessel component which had 2 surveys to look at seasonal changes. This is the second year visiting these transects.



MONITOR Endnote 5

Report on ICES/PICES Theme Session C on "*Ecosystem monitoring in practice*" at the ICES 2015 ASC in Copenhagen, September 21–25, 2015

Convenors: Matthias Schaber, Germany, Sven Gastauer, Netherlands/Australia and Jack Barth, USA/PICES

In recent years there has been a shift in focus of marine monitoring programs that have traditionally addressed particular ecosystem components like biogeochemical parameters or commercial fish species stocks towards assessing the entire ecosystem. Accordingly, a range of methods and equipment is employed to measure diverse ecosystem components and to be able to detect changes, monitor key processes and observe the whole ecosystem in general. Despite recent advances in monitoring techniques, the need for continued development of tools and techniques remains. Working towards a more holistic approach and improved coverage of components at higher spatio-temporal resolutions, there is a need for creative and alternative use of available resources – including personnel, ship time and data, as well as research platforms, vessels, and remote sensing, amongst other things.

The session was attended by approximately 50–70 participants. Contributions included 14 (15) talks and 5 posters and addressed three core areas of innovative ecosystem monitoring techniques: (1) novel methods and datasets to be applied/examined when following an ecosystem approach in monitoring; (2) studies recently or currently conducted applying measures to follow a more holistic approach to ecosystem monitoring; (3) new joint survey programs focusing on combining or expanding existing surveys to broaden measurements of ecosystem parameters and e.g. marine strategy framework descriptors in an ecosystem survey.

The two opening papers (C:02, C:05) highlighted the necessity to expand the use of existing databases, to make time series more openly available and to increase interactive sharing of data. The catch phrase for jointly used databases as eponymous for one presentation was "collect once, use often" and related to the assessment of hitherto un-analyzed trends in indicators like phytoplankton, zooplankton, salinity, nutrients, non-indigenous species etc. Paper C:07 showed that when following an ecosystem approach in surveying areas with novel methods, historic data to compare new findings with are of crucial importance. Additionally, it was shown that monitoring vast spatial areas requires large monitoring programs at a sufficiently high spatial resolution. Paper C:08 demonstrated how existing physical and oceanographic data can be used for seasonal ecosystem forecasts and to predict distribution patterns of marine organisms to optimize survey design. However, it was pointed out that interdisciplinary communication and discussions in terms of data collection, use of data for modeling and corresponding policy decisions remain a challenge. The last paper (C:03) of the first session section provided a summary of the 2015 ICES WGFAST (Working Group on Fisheries Acoustics, Science and Technology) meeting and pointed out how modern acoustic technologies are employed to work towards an ecosystem approach in scientific surveys and to observe the ocean resources on multiple scales.

The second section on the use of alternative survey platforms (*i.e.*, commercial fishing vessels) was opened by Paper C:12. It was presented how traditional surveys can be combined with auxiliary survey segments and data to optimise the survey design and increase the spatio-temporal coverage of surveys. Papers C:09 and C:01 showed examples of interdisciplinary monitoring and the additional sampling of further measurements to introduce the ecosystem component into existing monitoring programs, while simultaneously highlighting resulting challenges such as seasonality of sampling. Paper C:14 showed how through the use of auxiliary survey platforms (chartered fishing vessel) and through the concurrent monitoring of both environmental and biological/multispecies parameters the spatio-temporal coverage of a survey can largely be increased to derive estimates about medium- to long-term changes in physical properties of large areas and their influences on habitat quality and species distribution. The final paper in this section (C:13) showed how novel, non-invasive methods and alternative research platforms (*e.g.*, unmanned aerial drones in combination with submerged optical systems) can be used to assess nursery habitats of marine species in areas that would be inaccessible to traditional sampling operations or where the use of traditional sampling methods would be detrimental to ecosystem health.

Within the final section on possible joint monitoring programs as an approach to integrated ecosystem monitoring, Paper C:10 highlighted the challenges of ecosystem surveys in developing countries. Examples of various levels of data collection were shown (*e.g*., hydrography, plankton, fish, predators, plastics *etc*.). Key challenging factors identified were time management, sampling frequency and international cooperation. The three papers C:06, C:11 and C:04 focused on pre-requisites and potentials to integrate existing survey programs into monitoring programs that allow for the collection of additional relevant ecosystem parameters, *e.g*., marine strategy framework directive (MSFD) indicators. This was presented as added value to existing surveys, as an effective alternative to new surveys. Results from a workshop with participants from different marine sectors were presented, demonstrating how forces can be joined to address different MSFD descriptors in existing surveys. Challenges highlighted were limited availability of resources during existing survey programs, limited communication across entities involved as well as a clear, concise and precise definition of actual survey objectives.

During the discussion, the main topics of the session were discussed and the need for continuous, further development of currently available survey techniques was highlighted. The use of alternative platforms (e.g., chartered fishing vessels, ferries, *etc*.) providing data on a more continuous basis, when compared to the snapshot like picture resulting from traditional surveys, was received as an important tool to improve the timing and design of current surveys. A further highlighted challenge was the adequate use of already available data. A vast amount of information is currently being recorded and stored routinely, but largely remains underused, once more “collect once, use often” was stated as a leitmotiv. Further, it was generally agreed that there is an urgent need for more interdisciplinary cooperation and communication. Besides these challenges the session managed to highlight some innovative approaches addressing current needs in state of the art monitoring of marine resources. It was shown that through out of the box thinking and actions, innovation can be made possible and lead towards an improved understanding of the marine ecosystem.

Paper C:13 (Kilfoil *et al*.) was given an Honourable Mention in the category for Best Oral Presentation by an Early Career Scientist.