2024 Report of MONITOR Committee

Virtual and Honolulu, USA

October 16/17 and October 27, 2024

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MEETING INFORMATION

Business meetings for the MONITOR Technical Committee will be held for two days, both online and in a hybrid setting.

1st-day session October 16, 2024, Wednesday Monday 1700-1830 (US/Canada PDT) and October 17, 2024, Thursday 0800-0930 (Beijing, China), 0900-1030 (Korea/Japan), 1000-1130 (Vladivostok, Russia) Topic: 2024 PICES MONITOR Business Meeting (Day 1) Time: Oct 16, 2024 09:00 AM Seoul Join Zoom Meeting https://kaist.zoom.us/j/84021634029 Meeting ID: 840 2163 4029 Find your local number: https://kaist.zoom.us/u/keAgVbUvCQ
2nd-day session October 27, 2024, Sunday 1800-2000 at Honolulu, USA (Hawaii Convention Center 302B) and October 28, 2024, Sunday 1200-1400 (Beijing, China), 1300-1500 (Korea/Japan), 1400-1600 (Vladivostok, Russia) Topic: 2024 PICES MONITOR Business Meeting (Day 2) Time: Oct 27, 2024 06:00 PM Hawaii Join Zoom Meeting https://kaist.zoom.us/j/82341534044 Meeting ID: 823 4153 4044 Find your local number: https://kaist.zoom.us/u/kBg1BAThx

AGENDA

Day 1: October 17, 2024, 0900-1030 (KST; *Note: times may shift*)

1. 09:00-09:10 Welcome, Introductions, and Sign-in [10 mins]
2. 09:10-09:25 Updates and discussion topics [15 mins]
    a. Updates from ISB: Kim
    b. Activities of the CPR: Ostle
    c. ECOP Presentation Award Judge volunteer
    d. PICES-2025 session/workshop proposals review procedure (if time allowed)
3. 09:25-09:30 Break [5 mins]
4. 09:30-10:30 National reports – Written and Oral [60 mins]
   Written: Please provide national reports before the PICES meeting. Include relevant monitoring activities for relevant years. Written reports will be posted to the PICES web page.
   Oral: Please include highlights and updates in national reports of relevant monitor/observation activities from the last year. PowerPoint presentations will be posted on the PICES web page.
   The presentation will be given in a random order this year:
    - Canada Boldt, Ross
    - Japan Kitamura, Tadokoro, Abe
    - Korea Kim, Jung, H You
    - Russia Kulik, Lobanov
    - United States Barth, Jacobson, Brooks
    - China Zhao, Zhang, Cui, Zhou
5. 10:30-10:35 Other business [5 mins]

Day 2: October 27, 2024, 1800-2030 (HST; *Note: times may shift*)

6. 18:00-18:10 Welcome, Introductions, and Sign-in [10 mins]
7. 18:10-18:20 Updates/Recap from the previous meeting [10 mins]
8. 18:20-18:50 Updates from PICES Groups [30 mins]
    a. 18:20-18:30 Activities of FUTURE: Boldt [10 mins]
    b. 18:30-18:40 Activities of AP-CREAMS: TBD [10 mins]
    c. 18:40-18:50 Activities of AP-NPCOOS: Jackson [10 mins]

   18:50-19:00 Break [10 mins]
9. 19:00-19:40 Relations with international organizations [40 mins]
    a. 19:00-19:10 Activities of the UNDecade: Bograd [10 mins]
    b. 19:10-19:20 Activities of the ESSAS: Saitoh [10 mins]
    c. 19:20-19:30 Activities of the ARGO: Takeshita [10 mins]
    d. 19:30-19:40 Activities of the NPRB: Baker [10 mins]
10. 19:40-20:00 Other business: PICES-2025 session/workshop proposals discussion [20 mins]

LIST OF ACRONYMS

AP	Advisory Panel
AP-CREAMS	Advisory Panel for a CREAMS/PICES Program in East Asian Marginal Seas
AP-NPCOOS	Advisory Panel on North Pacific Coastal Ocean Observing Systems
CMT	Committee
ECOP	Early Career Ocean Professional
EG	Expert Group
ETSO	Environmental Time Series Observations
FUTURE	Forecasting and Understanding Trends, Uncertainty, and Responses of North Pacific Marine Ecosystems
ISB	Inter-sessional Science Board
POMA	PICES Ocean Monitoring Service Award
SEES	Social-Ecological-Environmental System
SG-NPSER	Study Group on North Pacific Ecosystem Status Report
TCODE	Technical Committee on Data Exchange
TOR	Terms of Reference
WG	Working Group
WG-35	Working Group on Third North Pacific Ecosystem Status Report (WG-NPESR3)
WG-38	Working Group on Mesoscale and Submesoscale Processes

AMAP	Arctic Monitoring and Assessment Programme
AOOS	Alaska Ocean Observing System
CeNCOOS	Central and Northern California Ocean Observing System
CPR	Continuous Plankton Recorder
GOOS	Global Ocean Observing System
IOOS	Integrated Ocean Observing System
IOCCP	International Ocean Carbon Coordination Project
NANOOS	Northwest Association of Networked Ocean Observing Systems.
NEAR-GOOS	North Eastern Asian-Global Ocean Observing System
NPRB	North Pacific Research Board
OOI	Ocean Observatories Initiative
POGO	Partnership for Observation of the Global Oceans
WOA	World Ocean Assessment

DAY 1

AGENDA ITEM 1: WELCOME AND INTRODUCTION

MONITOR Chair Prof. Sung Yong Kim called the online meeting to order, participants introduced themselves, and the agenda were reviewed and adopted.

Attendees:

At the beginning of the 1st-day meeting**: [members]** Vyacheslav B. Lobanov (Russia), Sung Yong Kim (MONITOR Chair, Korea), Hak Ryul You (Korea), Hiroto Abe (Japan), Kazuaki Tadokoro (Japan), Minoru Kitamura (Japan), Jack Barth (USA), Mariela Brooks (USA), Kym Jacobson (MONITOR Vice-Chair, USA), Jennifer Boldt (Canada), Clare Ostle (CPR)

Note that the group photo was taken at the end of the 1st day meeting

AGENDA ITEM 2: UPDATES FROM THE ISB AND UPDATES FROM EGS

1. Updates from ISB
    a. New member(s): Dr. Hak Ryul You (Korea)
    b. POMA/Zhu-Peterson Awards decision
    c. POMA and PODA
        i. Data management words to manage marine observations or data based on ocean monitoring (template preparation in progress)
        ii. Cautionary remark on the POMA webpage to differentiate with PODA
        iii. GC approved the PODA.
    d. PICES Annual Meeting 2024 @ Honolulu, USA (Oct. 26-Nov. 3)
        i. MONITOR business in-person meeting @ 302B, 1800-2000 on Oct. 27
        ii. MONITOR dinner (TUE or WED; no sports day; TBD)
    e. PICES Annual Meeting 2025 @ Yokohama, Japan (Nov. 7-Nov. 16)

2. Activities of North Pacific CPR: Clare Ostle

This year marks the 25th consecutive year of data collection, the figure below (figure 1) shows the sample coverage:

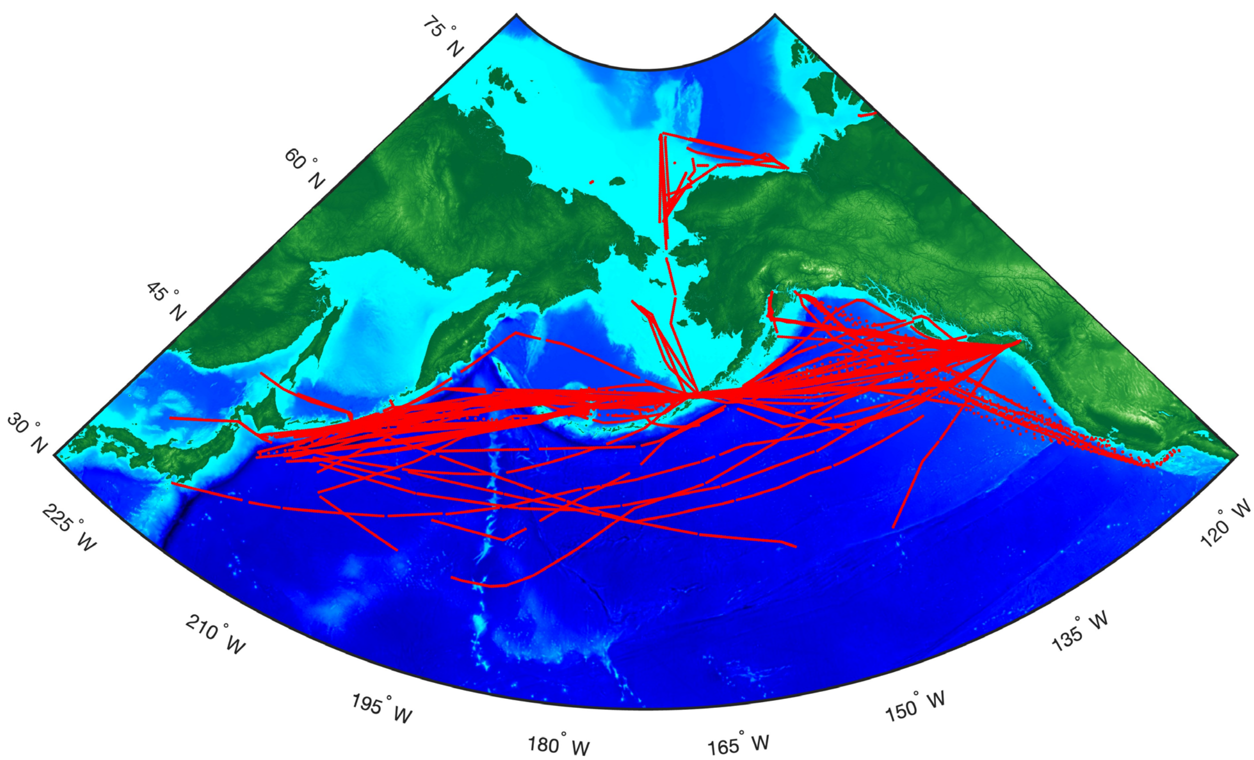

Figure 1. CPR sample locations in red (2000-2024). Please note samples often overlap, and there are additional transects to be added to the figure for 2024 once sampling has been completed.

Funding remains consistent with support from the USA (NPRB, EVOS TC), Canada (DFO) and in-kind support from Japan (University of Hokkaido). Two new NPRB research projects started in January 2024 (funded from 2024-2027). One of these projects, entitled "Extending the North Pacific Continuous Plankton Recorder survey into the Western Arctic Ocean, PI C. Ostle", will help to support the new route through the Bering Strait into the Arctic Ocean, alongside molecular investigations on CPR samples. We have carried out molecular analyses on samples from 2023 and had high counts of the potentially-toxic algae *Alexandrium* spp. on our July 2023 samples from the Bering Sea. The other project is entitled "Through the Looking Glass: Zooplankton and seabird community structure in a changing North Pacific, PI B. Hoover", in which we are collaborating with colleagues at the Farallon Institute (CA, USA) to investigate microplastics and seabirds in the Gulf of Alaska. This revisits the earlier project which ran from 2002-2006 and that collected seabird observations from CPR transects. We have had some difficulty getting seabird observers onboard the merchant vessels that tow CPRs but have found alternative vessels that are cruising within a similar space and time that we are hoping to use.

The CPR survey sampled the east-west transect in April to October (unfortunately we had a failed tow during July and August due to a broken propeller), and the north-south transect, monthly, from April to October in 2024. Identification and counting of plankton samples is ongoing. We continue to deploy next generation PlankTag sensors that measure temperature, salinity, and fluorescence on the CPRs on both the east-west and north-south routes.

Monthly abundances from the North Pacific CPR Survey for selected plankton can be generated for user-specified regions using this extraction tool: https://www.dassh.ac.uk/lifeforms/ https://doi.mba.ac.uk/data/3086

Recent publications, reports and articles:

Boldt, J.L., Joyce, E., Tucker, S., and Gauthier, S. (Eds.). 2023. State of the physical, biological and selected fishery resources of Pacific Canadian marine ecosystems in 2022. Can. Tech. Rep. Fish. Aquat. Sci. 3542: viii + 312 p. https://www.dfo-mpo.gc.ca/oceans/publications/soto-rceo/2022/technical-report-rapport-technique-eng.html

Kleparski L. Ostle C., Batten S.D., Djeghri N., Hauri C., Pagès R., and Strom S. How marine heatwaves are reshaping phytoplankton in the Northeast Pacific (*in prep*).

Li, K., J. C. Naviaux, S. S. Lingampelly, L. Wang, J. M. Monk, C. M. Taylor, C. Ostle, S. Batten, and R. K. Naviaux. 2023. Historical biomonitoring of pollution trends in the North Pacific using archived samples from the Continuous Plankton Recorder Survey. Science of the Total Environment 865:161222. Elsevier B.V. https://doi.org/10.1016/j.scitotenv.2022.161222

Ostle C, P. Hélaouët. 2023. The Continuous Plankton Recorder as a platform for sensor development PICES Press 31 (2), 64-65.

Ostle, C., and Batten, S. (*submitted*) NOAA Ecosystem Status Report 2024: Continuous Plankton Recorder Data from the Aleutian Islands and Southern Bering Sea: Lower Trophic Levels in 2023. https://www.fisheries.noaa.gov/resource/data/ecosystem-status-report-2023-aleutian-islands

Ostle, C., and Batten, S. (*submitted*) NOAA Highlight Report 2024: Continuous Plankton Recorder Data from the Eastern Bering Sea: Lower Trophic Levels in 2023. https://www.fisheries.noaa.gov/resource/data/ecosystem-status-report-2023-eastern-bering-sea

Ostle, C., and Batten, S. (*submitted*) NOAA Ecosystem Status Report 2023: Continuous Plankton Recorder Data from the Gulf of Alaska: Lower Trophic Levels in 2023. https://www.fisheries.noaa.gov/resource/data/ecosystem-status-report-2023-gulf-alaska

Powell, K., and C. Ostle. 2023. Where I work. Nature 613:406. https://doi.org/10.1038/d41586-023-00024-1

Ratnarajah, L., R. Abu-Alhaija, A. Atkinson, S. Batten, N. J. Bax, K. S. Bernard, G. Canonico, A. Cornils, J. D. Everett, M. Grigoratou, N. H. A. Ishak, D. Johns, F. Lombard, E. Muxagata, C. Ostle, S. Pitois, A. J. Richardson, K. Schmidt, L. Stemmann, K. M. Swadling, G. Yang, and L. Yebra. 2023. Monitoring and modelling marine zooplankton in a changing climate. Nature Communications 14. Springer US. https://doi.org/10.1038/s41467-023-36241-5

Sydeman, W. J., S. Ann, M. García-Reyes, C. Kroeger, B. Hoover, S.D. Batten, and N. A. Rojek. 2023. Progress in Oceanography. Effects of currents and temperature on ecosystem productivity in Unimak Pass, Alaska, a premier seabird and biodiversity hotspot. Progress in Oceanography. https://doi.org/10.1016/j.pocean.2023.103082

3. ECOP Presentation Award Judge volunteers
    a. S04: Observational frontier and new studies for understanding of ocean and ecosystem (16 talks with 3 invited talks and 21 posters)
        i. Oral – Oct. 31 Thursday 0900-1740 (Jack Barth, Kym Jacobson)
        ii. Poster – Oct. 31 Thursday 1800-2100 (Jennifer Bodlt, Kazuaki Tadokoro)
    b. Each Committee will select ONE oral and ONE poster award from all Sessions/Workshop they judge. If you see no presentations are qualified, you don't need to select an

4. New Protocol for PICES-2025 Session/Workshop Selection
    a. Sept. 2024: Session/Workshop Proposal application open
    b. Mid-Nov.: Session/Workshop Proposal application close (after two weeks from the end of PICES-2024)
    c. Mid-Late Nov.: Committees to review/rank the proposals through virtual meeting/review sheet
    d. Early Dec.: SB to hold a virtual meeting to make recommendations for the proposals
    e. Year-end: GC to approve the SB recommendation

AGENDA ITEM 4: NATIONAL REPORTS

1. Canada

Overview and Summary of 2023

Fisheries and Oceans Canada (DFO), Pacific Region, conducts annual reviews of physical, chemical and biological conditions in the ocean (Fig. 1), to develop a picture of how the ocean is changing and to help provide advance identification of important changes which may potentially impact human uses, activities, and benefits from the ocean. The annual reviews consist of a 2-day meeting and a State of the Pacific Ocean report (Boldt et al. 2024).

DFO's Fieldnotes provides an overview of science field research and monitoring to be conducted each year by DFO and collaborators in the Northeast Pacific and Arctic oceans, and in the coastal and interior waters of British Columbia and Yukon. An interactive map, on the Fieldnotes website, shows the location and information about these field research and monitoring programs.

We thank the Indigenous communities whose territories we visit during our work. Their continued commitment, and their values, knowledge, insights and wisdom are invaluable to our collective efforts to build healthy oceans and aquatic ecosystems, sustainable fisheries and safe navigation. Mussi, huy ch q'u, quanaqutit, hu sukiłq̓ukni, g̱ilakas'la, sechanalyagh, haawa, t'ooyak̲siy̓ n̓iin, thank you!

Figure 1. Map of areas reported on in the State of the Ocean report, including Line P, and Ocean Station Papa. Source: Boldt et al. (2024).

Below is the overview and summary from DFO's recent State of the Pacific Ocean report, with the same Figure and Section numbers as in the report (Boldt et al. 2024):

"Climate change continues to be a dominant pressure acting on NE Pacific marine ecosystems. In 2023, global land and ocean temperatures were the warmest on record (Ross and Robert, Section 8). Record warm average annual temperatures were observed across B.C. relative to the 1950 to 2023 time series (Curry et al., Section 7). Precipitation was well below average in B.C., while snowpack was generally below-normal through the winter, rapidly decreasing to well below-normal by June 1, due to early snowmelt across the province as record warm temperatures occurred in summer and fall (Curry et al., Section 7). In late summer and fall, severe drought conditions were experienced nearly everywhere in B.C., coinciding with record warm temperatures and below-normal precipitation, leading to a record wildfire year. Despite warmer air temperatures, sea surface temperatures (SSTs) were near average in the northeast Pacific (Ross and Robert, Section 8). The Pacific Decadal Oscillation (PDO) was strongly negative, which led to record warm SSTs in the northwest Pacific, but did not result in a cool year for the northeast Pacific because it occurred on a background of steadily rising temperatures due to climate change. The year finished with above average SSTs reflecting the onset of El Niño (Figures 3-1 and 3-2; Ross and Robert, Section 8). The 2023 average annual SST, at shore stations along the B.C. coast, was generally warmer than in 2022, with a coast-wide average increase of 0.4ºC (Hourston et al., Section 11). 2023 was a continuation of a warm period that started in 2013. This 11-year span of above-normal annual SST is the longest warm period in the shore station records (1935-2023) (Hourston et al., Section 11). Overlying multi-year oscillations in the annual SST, there is a long-term trend with ocean temperatures rising at a rate of 0.85ºC per 100 years, up from 0.63ºC per 100 years estimated a decade ago (Figure 3-3; Hourston et al., Section 11). Surface waters in the NE Pacific continued to be anomalously fresh in 2023 but strong anomalies were only seen at Ocean Station Papa (not throughout Line P); this continues a freshening trend observed for the last seven years (Ross and Robert, Section 8). Increasing CO_2 in the atmosphere has increased the acidification of the ocean, which will continue to intensify with the rise of anthropogenic carbon levels in the atmosphere (Evans, Section 18). In spring 2023, marine CO_2 conditions on the central B.C. coast and in the northern Salish Sea improved slightly compared to 2019-2020, but these returned to more corrosive and low pH conditions for the remainder of the year (Evans, Section 18).

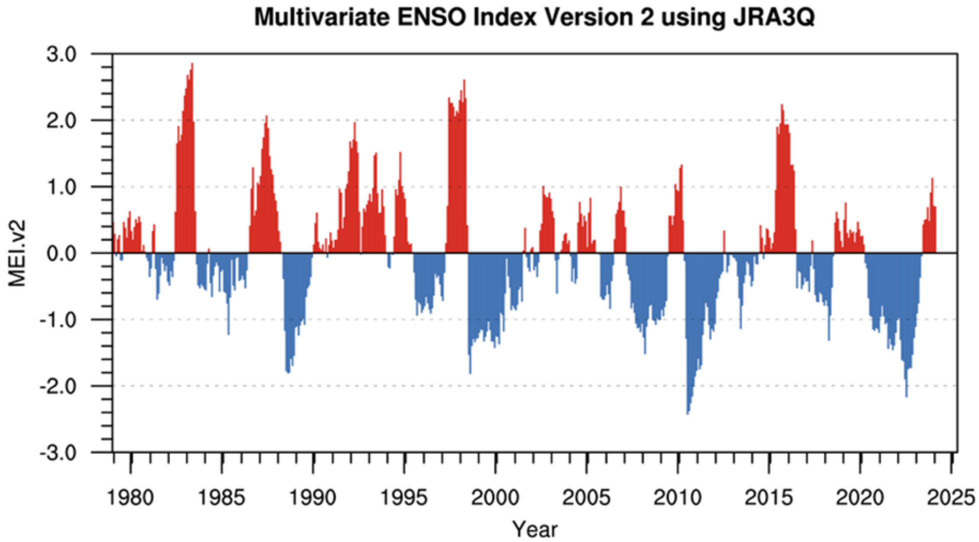

Figure 3-1. The multivariate ENSO Index. Data source: NOAA/ESRL/Physical Sciences Division – University of Colorado at Boulder/CIRES; https://psl.noaa.gov/enso/mei/

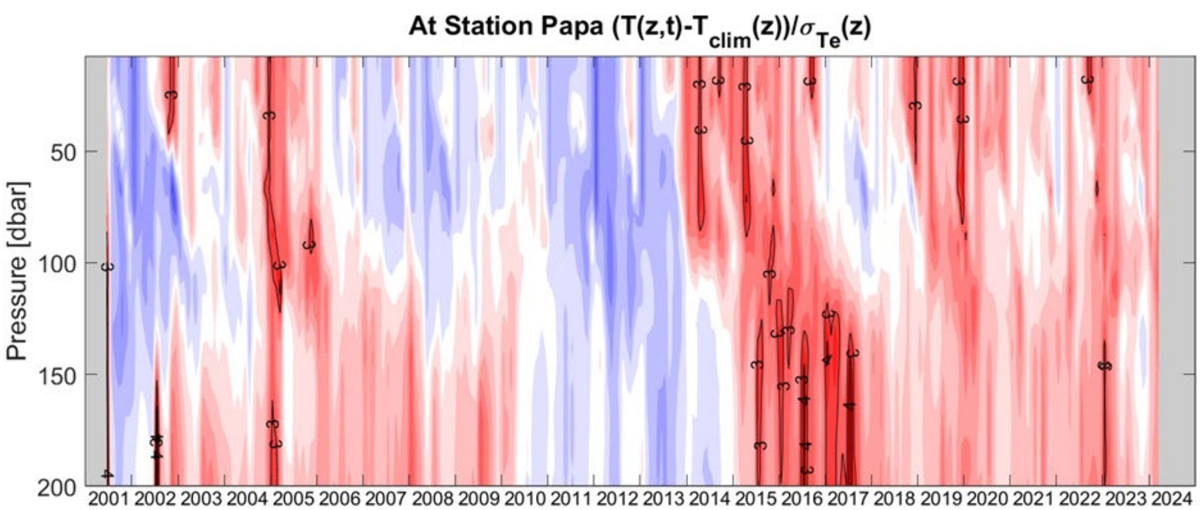

Figure 3-2. Temperature anomalies, as observed by Argo floats near Ocean Station Papa. Anomalies are calculated relative to the 1991-2020 seasonally-corrected mean and standard deviation (from the Line P time series). Cool colours indicate cooler than average temperatures and warm colours indicate warmer that average temperatures. Dark colours indicate anomalies that are large compared with standard deviations from the climatology. The black lines highlight regions with anomalies that are 3 and 4 standard deviations above the mean. Source: Ross and Robert, Section 8.

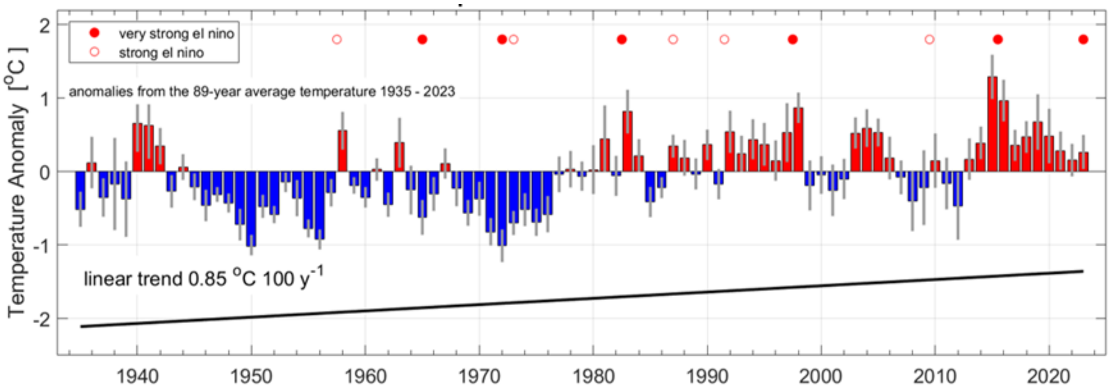

Figure 3-3. Annual-average temperature trend based on the observations from all shore stations for 1935-2023 (black line). The bars represent the anomalies over all the stations (a coast-wide indicator), (red – above average, blue – below average), the vertical grey lines show the variability in the shore station data for each year. Strong and very strong El Niño years using the NOAA ONI index are indicated by the red open and solid dots along the top of the plot. Source: Hourston et al., Section 11.

Marine Heatwaves (MHW) were widespread in surface waters offshore and in Canada's Exclusive Economic Zone (EEZ) after April 2023, with the largest extent in late July and early August (Hilborn et al., Section 19). The proportion of the B.C. EEZ in MHW status increased through the spring to >90% at its maximum at the beginning of August. However, while MHW conditions were present throughout the year, a number of cool events occurred, particularly in the Southern Shelf Bioregion and surrounding Vancouver Island. By the end of 2023, MHW conditions were present along the continental shelf and in coastal waters, with approximately one third of the B.C. EEZ in MHW status. The size, intensity, and frequency of MHWs in the NE Pacific is increasing (Hilborn et al., Section 19).

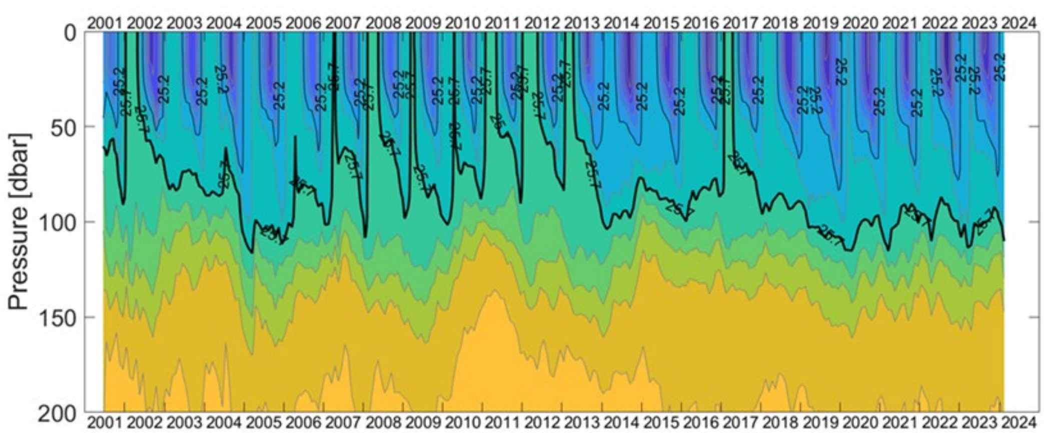

Figure 3-4. Coloured contour plot of density as observed by Argo floats near Station Papa (P26: 50° N, 145° W). The colours indicate potential density (yellow is denser and blue lighter). The black lines highlight the σ=25.2 kg/m^3 (thin) and 25.7 kg/ m^3 (thick) isopycnals. Source: Ross and Robert, Section 8.

MHWs are associated with reduced vertical mixing, which causes increased winter stratification. This results in decreased nutrient supply from deep to surface offshore waters. Winter stratification was stronger in 2022/23 relative to 2021/22 and 2020/21, therefore mixing of nutrients to the surface was likely weaker in 2022/23, but still fairly normal (Figure 3-4; Ross and Robert, Section 8). Multiple hypoxia events were observed in B.C.'s waters in 2023. There were sustained hypoxia events in southern Queen Charlotte Sound in summer 2023, with similar events observed in summer 2022. Intense wintertime upwelling in Queen Charlotte Sound drove a hypoxia event in February 2023 (Hannah et al., Section 12). In September 2023, waters below ~100 m were hypoxic in Juan Perez Sound for the first time since annual sampling began in summer 2017 (Jackson et al., Section 16). In fall, hypoxic waters came within 50 m of the surface in the La Perouse area (off southwest Vancouver Island), but the spatial extent of the hypoxia was smaller than in 2021 and 2022 (Dosser et al., Section 13).

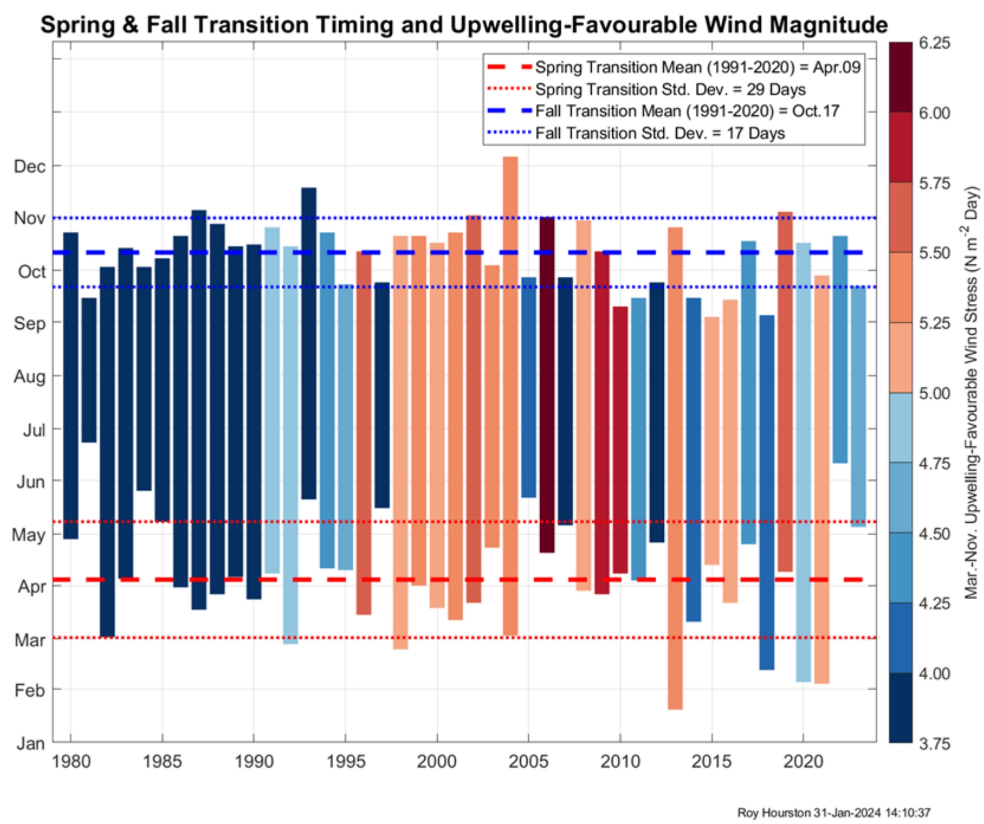

Figure 3-5. Annual spring and fall transition timing and March-November upwelling-favourable wind stress magnitude, 1980-2023. Bold dashed lines indicate the average spring (red) and fall (blue) transition dates. Light-dashed lines indicate standard deviations of the spring (red) and fall (blue) transition dates. Source: Hourston and Thomson, Section 9.

The timing and magnitude of upwelling of deep, nutrient-rich water off the west coast of Vancouver Island (WCVI) is an indicator of marine coastal productivity across trophic levels from plankton to fish to sea birds. Variability in the upwelling index corresponds with variations in the strength and/or longitudinal position of the Aleutian low-pressure system in the Gulf of Alaska. The 2023 transition timing of spring upwelling was late (early May) relative to the 1991-2020 mean, and the magnitude of warm season upwelling-favourable winds was below the long-term average, resulting in an expectation of below-average upwelling-based coastal productivity (Figure 3-5; Hourston and Thomson, Section 9). In contrast, February upwelling-favourable winds were much higher than average for the sixth consecutive year (Hourston and Thomson, Section 9). Persistent upwelling, particularly along the southern Vancouver Island continental slope, brings California undercurrent source waters onto the shelf, supplying nutrients and saline water to surface waters and extending deep, oxygen-poor waters over the shelf eastward toward the coast (Dosser et al., Section 13).

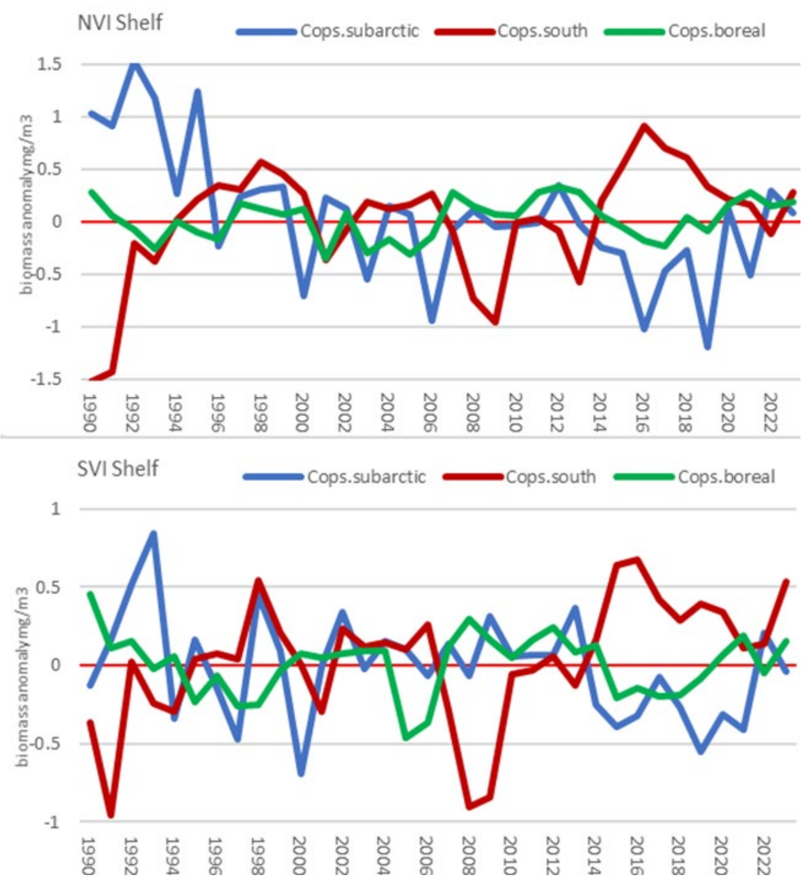

Figure 3.6. Zooplankton species-group anomaly time series, 1990-2023. Line graphs are annual log scale anomalies. Northern Vancouver Island (NVI; top panel) shelf; Southern Vancouver Island (SVI; bottom panel) shelf; subarctic copepods blue; southern copepods red; boreal copepods green. Blank years mean no samples were collected. Source: Galbraith and Young, Section 22.

Phytoplankton biomass in 2023 was similar to that of previous years along Line P (although there was an increase in one area during spring; Peña, Section 17) and along the Continuous Plankton Recorder transect (shelf and offshore; Ostle et al., Section 50). Sub-arctic and boreal copepods (favourable for fish growth) dominated the zooplankton communities from late spring into early summer but were replaced by southern copepods (less favourable for fish growth) in the late summer/fall (Galbraith et al., Section 22; Ostle et al., Section 51). There had been a steady decline in abundance of southern copepods in all areas since 2015, but that trend switched in 2023, especially in the southern shelf region (Figure 3-6; Galbraith et al., Section 22). Boreal shelf and subarctic copepods decreased or were near average biomass across all areas. An increase in gelatinous zooplankton biomass across shelf areas was observed in 2023, mainly due to an increase in salps and doliolids through late summer and into fall. Euphausiid biomass in 2023 was average to above average (Galbraith et al., Section 22).

Changes to the physical environment, phytoplankton, and zooplankton communities can have impacts on higher trophic levels. There was a continued increase in the biomass of shelf rockfish, several slope rockfish, and many flatfish species in the most recent 5-10 years (Anderson et al., Section 29). In contrast, Arrowtooth Flounder and Pacific Spiny Dogfish biomass declined in recent years. Dogfish stocks experienced the steepest declines with a particularly precipitous decrease in outside Vancouver Island waters (Anderson et al., Section 29). The 2023 total survey biomass estimate of Pacific Hake off the west coasts of Canada and the U.S. was the third lowest in the time series, only slightly higher than the lows of 2001 and 2011 (Gauthier and Stanley, Section 32). Less than 3% of this estimated survey biomass was encountered in Canadian waters, the lowest of the survey time series, and was confined to the west coast of Vancouver Island. Extreme heat events, such as the atmospheric heat dome of 2021, may have a long-term effect on Olympia Oyster survival and reproduction; however, no evidence of decrease in density was observed at index sites in 2023 (Herder and Bureau, Section 22).

The growth rate of Cassin's Auklets is linked to the abundance of their primary prey, *Neocalanus cristatus* copepods, which are more abundant during relatively cold years (Hipfner, Section 23). As in 2021 and 2022, the representation of *N. cristatus* in Cassin's Auklet nestling diets on Triangle Island in 2023 was well below what would be expected based on PDO conditions (Hipfner, Section 23). The fish-based diets fed to nestling Rhinoceros Auklets are also affected by prey availability, with nestling auklets growing more quickly in years in which their diets include more Pacific Sand Lance. Diets fed to nestling Rhinoceros Auklets on Protection Island in the Salish Sea and Lucy Island in Chatham Sound included normal amounts of Pacific Sand Lance and Pacific Herring, but diets were very low in Sand Lance at Pine Island in southern Queen Charlotte Sound (Hipfner, Section 23). Systematic cetacean surveys conducted from 2020 - 2023 have provided the first season-specific abundance estimates for Humpback Whales, Harbour Porpoises, and Dall's Porpoises for Canadian portions of the southern Salish Sea and Swiftsure Bank. All three species are present in the area year-round, though distribution and abundance vary seasonally. Quantifying the return of Humpback Whales and Harbour Porpoises to the southern Salish Sea provides evidence of this ecosystem's capability to support recovering populations of marine mammals (McMillan et al., Section 33).

In the Salish Sea, trends of increasing temperature and decreasing oxygen were observed at all depths, except at depths > 75 m in the northern Strait of Georgia (SOG), and waters were generally trending fresher at the surface and saltier at depth (Dosser et al., Section 33). During summer 2023, conditions were cooler, more saline, and more oxygenated than average in the subsurface waters of the SOG, with warm, more saline, less-oxygenated waters in Juan de Fuca Strait. During fall, warm, saline, and less oxygenated water occurred throughout much of the system, with a layer of less oxygenated water in Juan de Fuca Strait at depths of around 100 m. The annual Fraser River discharge was the 2nd lowest in the 101-year record, with historically low discharge in June and July (Figure 3-7; Dosser et al., Section 33; Wang et al., Section 38).

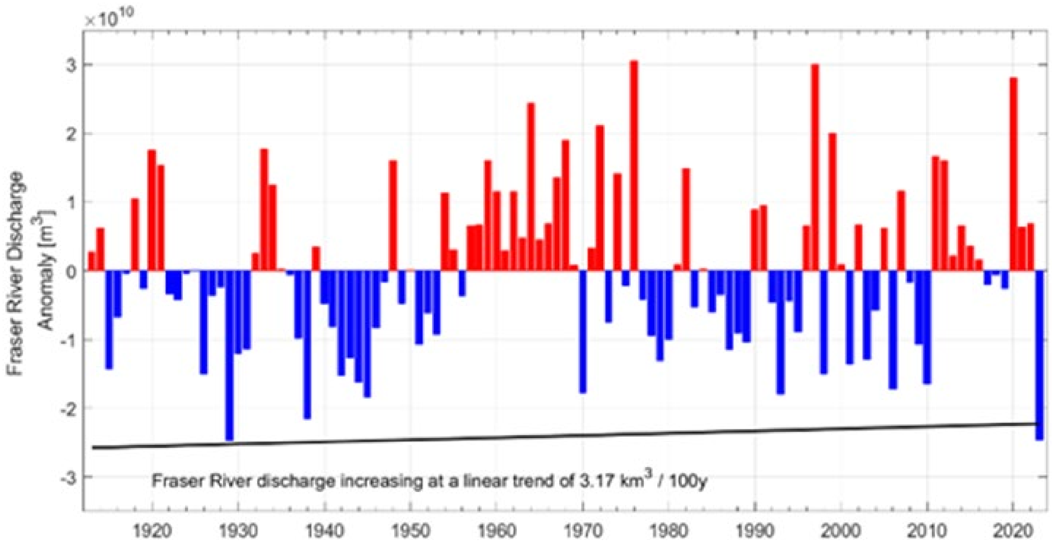

Figure 3-7. Time series of the annual Fraser River discharge anomaly and linear trend. Data extracted from the Environment and Climate Change Canada Real-time Hydrometric Data web site (https://wateroffice.ec.gc.ca/mainmenu/real_time_data_index_e.html) on 28 Feb 2023. Source: Dosser et al, Section 33.

In the SOG, 2023 and 2022 were the only two years in the 2015-2023 time series when all five Harmful Algal Blooms taxa formed dense (>100 cells per mL) blooms (Esenkulova et al., Section 42). In summer, there were widespread, very dense blooms of *Noctiluca scintillans* and dense but localized blooms of *Heterosigma akashiwo* and *Dictyocha*; a few local blooms of *Rhizosolenia setigera*, and *Pseudo-nitzschia* were seen in late summer and spring respectively; *Alexandrium* (Paralytic Shellfish Poison causing taxa) occurrence was noticeably lower than usual while *Dinophysis* (Diarrhetic Shellfish Poison causing taxa) was close to average (Esenkulova et al., Section 42). Harmful algal blooms can cause finfish and shellfish mortalities, impacts to human health, and economic losses.

Marine Aquatic Invasive Species (AIS) are increasing in both range and abundance in B.C. For example, there has been an expansion of European Green Crab including new detections near Prince Rupert and the Skeena River estuary (Howard et al., Section 35). This high-impact invader that negatively affects eelgrass, an important fish habitat, was detected for the first time on Haida Gwaii in July 2020 (Howard et al., Section 35). Preventing the spread of AIS requires management and monitoring of anthropogenic pathways and vectors as early detection of AIS can inform management and policy. Other anthropogenic pressures include oil spills, vessel traffic, and underwater noise. For example, in 2023, there were 1137 oil spills reported to the Canadian Coast Guard and DFO Spill Response was activated for 53 spills; the most significant spills were the MV Maipo River spill in Nanaimo, the Fraser River Fuel Barge spill, and the overboard Fuel Truck incident in Chancellor Channel (Herborg et al., Section 36).

Annual variation in spring bloom timing and community composition may affect the food web through a temporal match or mismatch between prey and predators. In 2023, the SOG spring bloom timing was typical compared to the long-term average (Allen and Latornell, Section 40; Esenkulova et al., Section 42). Model estimates indicate that the 2023 summer diatom biomass was low compared to the long term average and the diets of zooplankton were more nanoflagellate-based than the long term mean (Suchy and Allen, Section

41). In 2023, the SOG total zooplankton biomass (averaged over the year) increased from 2022 and was higher than the time series average since 1996 (Young et al., Section 43). Medium and large-sized copepods, euphausiids, and amphipods (important juvenile salmon prey) dominated the biomass; however, the euphausiid biomass was low in the summer of 2023 (Young et al., Section 43).

Coastwide Pacific Herring biomass increased during 2010-2020 and leveled off in 2021-2023, dominated by the SOG stock; however, in some assessed areas, such as Haida Gwaii, there have been prolonged periods of low biomass (Figure 3-8; Cleary et al., Section 24).

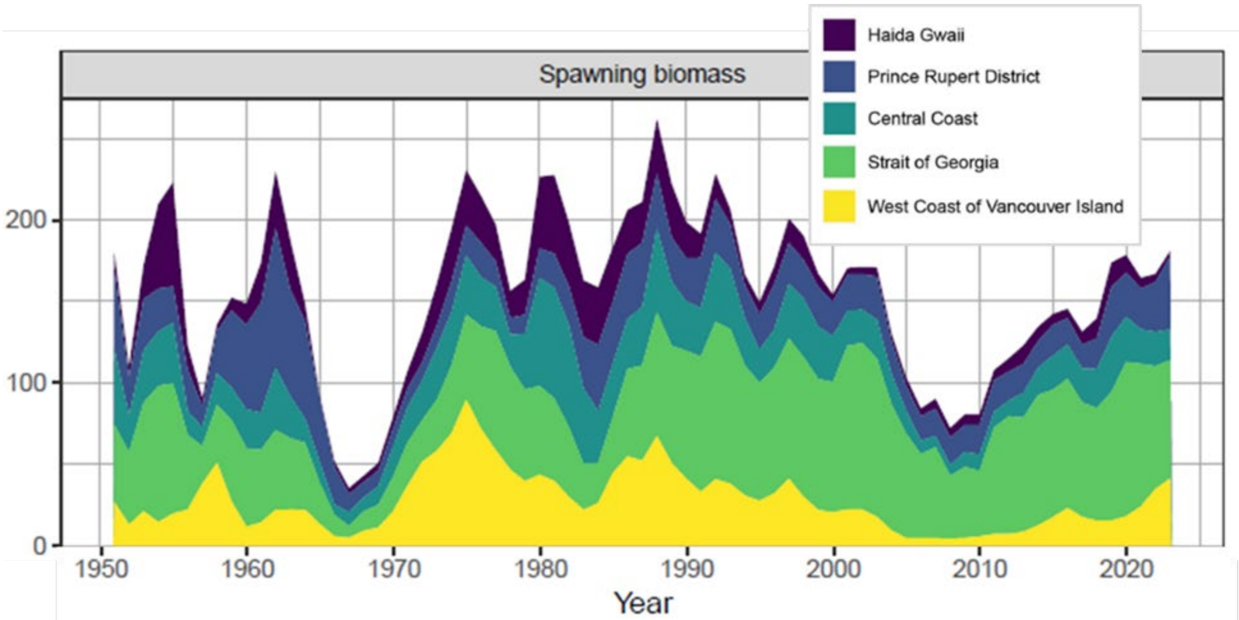

Figure 3-8. Pacific Herring spawning biomass of five assessed areas, 1951- 2023. Source: Cleary et al., Section 27.

In summer 2023, Pacific Herring biomass in continental shelf waters off the WCVI (mixed stocks) was the 2nd highest in the 2006-2023 time series with CPUE particularly high off the southwest coast of Vancouver Island (Boldt et al., Section 25). In the SOG in 2023, the relative biomass of age-0 Pacific Herring was the highest it has been since 2010 and above the time series mean, since 1992 (Boldt et al., Section 44). Age-0 herring were smaller than average, but their condition was above average. In 2023, Northern Anchovy were present in 24% of the SOG age-0 Pacific Herring survey sets; half the value observed in 2022 (Boldt et al., Section 44). In 2023, the index of Fraser River Eulachon spawning stock biomass was estimated to be one of the lowest in the time series, 1995-2023 (~10 tonnes; Flostrand et al., Section 46) at a level comparable to 2022. However, mean Eulachon catch per unit effort from a WCVI multispecies bottom trawl survey was moderately high with a slight reduction in average catch weight from 2022, but an increase in the total number of eulachon caught (Flostrand et al., Section 46).

In the fall of 2023 in the SOG, the juvenile Coho Salmon survey abundance index was the highest on record for over 25 years and continued an upward trend that started in 2010. Chinook, Sockeye, and Chum Salmon were below average, while Pink Salmon was low, which is typical for an odd-numbered year (Neville, Section 47). On the continental shelf of the northern and western coast of Vancouver Island, Chum Salmon was the dominant juvenile salmon species encountered in summer and fall, where index values were the highest in both time series (King et al, Section 29). Fall caught juvenile Coho Salmon were also above average. All other species were close to the time series average although the juvenile Sockeye Salmon index, while only average, increased substantially from the historic low summer index values estimated for 2021 and 2022. All juvenile salmon species except Chum Salmon had above average condition (King et al., Section 29). Marine survival estimates of B.C. Sockeye Salmon indicator stocks were generally below or near the long-term average for 2023, except for Chilko and Tahltan Lakes, which showed longer-term negative trends (Bailey and Freshwater, Section 30). Freshwater productivity was variable with several stocks showing above average productivity (Chilko, Osoyoos, Quesnel, Tahltan, Tatsamenie) while Sproat and Wenatchee Lakes showed below average productivity in recent years (Bailey and Freshwater, Section 30). Fraser River Sockeye Salmon lengths in 2023 were ranked 17th and 6th smallest, for ocean age-2 and ocean age-3 fish, respectively, out of 30 odd-numbered years since 1964. This is consistent with documented recent decreases in body size, particularly for older fish. Fraser River Pink Salmon body size in 2023 was the 2nd smallest since estimates began in 1927 (Latham et al., Section 48)."

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2. United States of America

Jack Barth (Oregon State University), Kym Jacobson (Northwest Fisheries Science Center, NMFS, NOAA) and Mariela Brooks (Alaska Fisheries Science Center, NMFS, NOAA)

This report includes highlights during 2023-2024 for select monitoring efforts off the US west coast. There is a wide range of coastal ocean observing off the US Pacific coasts. These include:

- NOAA fishery and ecosystem surveys (groundfish, Pacific hake, coastal pelagics)
- Long-term hydrographic and zooplankton lines: CalCOFI (California), Newport Hydrographic (Oregon), Trinidad Head (California)
- U.S. Integrated Ocean Observing System, IOOS (NOAA)
- U.S. National Science Foundation's Ocean Observatories Initiative (OOI)
- Moorings, hydrographic and biogeochemical sampling off Monterey Bay, California
- Observations from National Marine Sanctuaries (NOAA)
- Underwater gliders
- Wave buoys and wave models
- Carbon chemistry (pCO2, pH) (NOAA, university)
- Bird and marine mammal observations
- Harmful Algal Bloom monitoring

Alaska oceanography and fisheries surveys and observations include:

- North Pacific Ocean
    - Sea Level Pressure (SLP) by season
    - Sea Surface Temperature (SST) by season
- Bering Sea and Arctic
    - Ice Extent
    - SST (northern and southeastern)
    - Phytoplankton
        - Spring bloom
        - Coccolithophores
    - 2024 surveys
        - Oceanographic biophysical mooring and hydrographic
        - Arctic Distributed Biological Observatory (ecosystem)
        - Ground Fish Bottom Trawl
        - North Bering Sea surface trawl and ecosystem
        - Harbor Seal Aerial Surveys
- Gulf of Alaska (GOA)
    - SST (GOA and Aleutian Islands)
    - 2024 surveys
        - Ground Fish Bottom Trawl (biennial)
        - Winter and Summer Acoustic-Trawl
        - Sablefish Longline
        - Spring Ichthyoplankton (biennial)

- Juvenile Groundfish and Forage Fish
- Southeast Coastal Monitoring (SECM) surface trawl and eocsystem
- Western GOA Summer Beach Seine for Pacific cod
- Marine mammal surveys

CALIFORNIA CURRENT CLIMATE AND FISHERIES OCEANOGRAPHY SURVEYS AND OBSERVATIONS FOR 2023-2024

Environmental Conditions in the California Current during 2023-2024

During 2024, the summer upwelling season in the northern California current started early in late March and lasted through at least September (**Figure 1**, right). To date, the 2024 cumulative upwelling continues

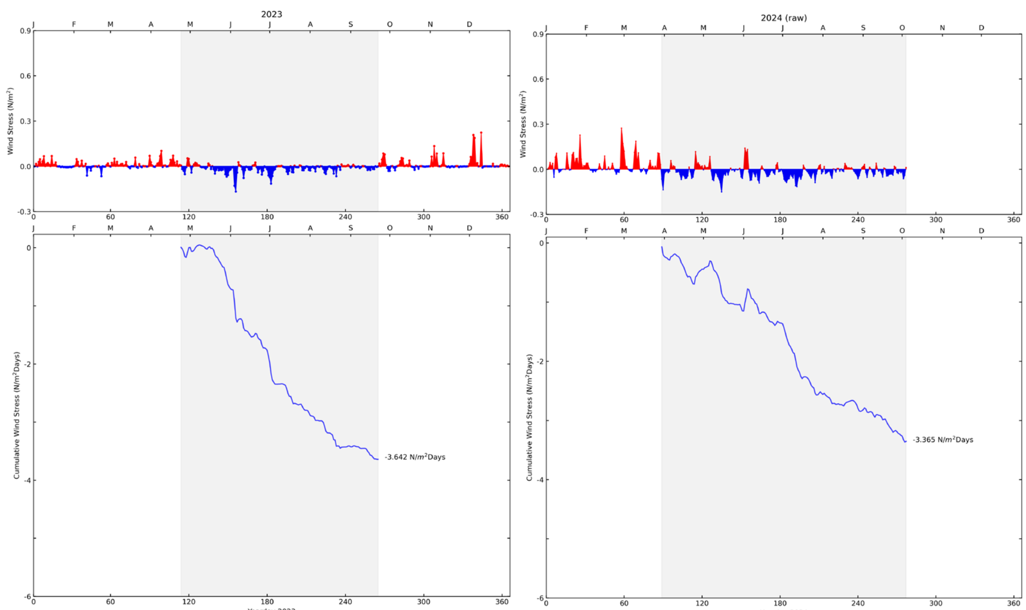


Figure 1. Cumulative north-south wind stress measured off Newport, Oregon, from (left) 2023 and (right) 2024. (Courtesy of J. Barth and J. Marquardt, Oregon State University, https://www.nanoos.org/products/cui_oregon/cui.php)

the trend to values larger than the long-term average. The total 2024 wind forcing was similar to that during 2023, but with the 2023 season starting later. (**Figure 1**, left).

Sea surface temperature (SST) was above normal offshore in the California Current during 2023, with colder than average water near the coast due to wind-driven upwelling (**Figure 2**, right). These warm waters have been designated as Marine Heat Waves and the one in 2023 is similar, but not identical to "the blob" Marine Heat Wave of 2014 (**Figure 2**, left).

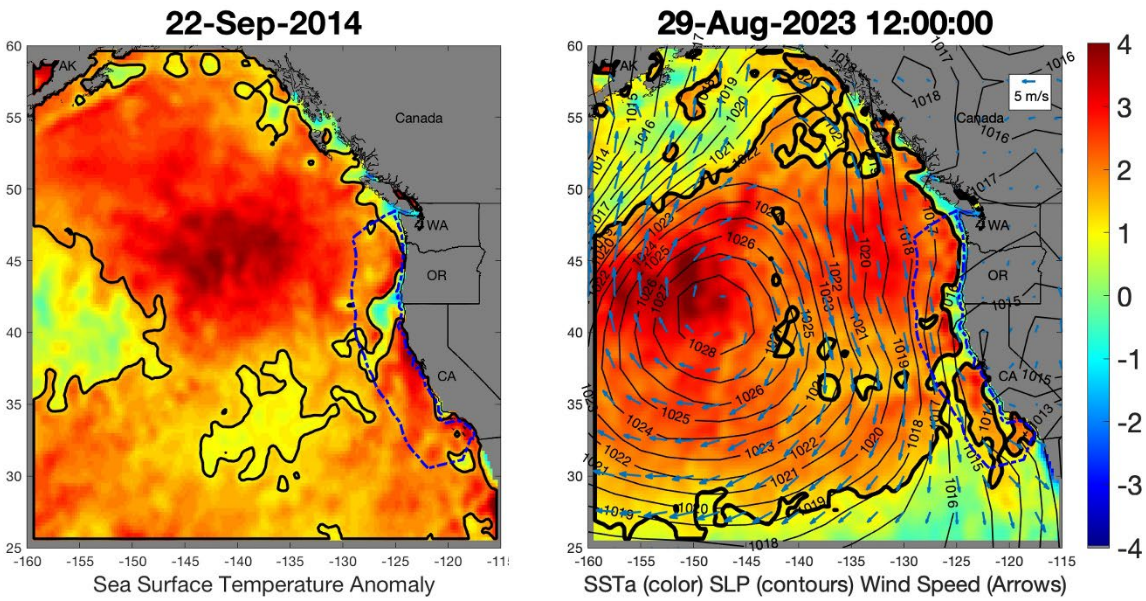


Figure 2: (left): The Marine Heat Wave (MHW) known as "the blob" at its near maximum areal extent in September 2014; (right) The 2023 MHW at its near maximum areal extent in August 2023. Dark outline shows the current extent of Marine Heat Wave conditions, as delineated by values of the normalized SST + 1.29 SD from normal. Blue dashed line represents the US West Coast EEZ. Data from NOAA's Optimum interpolation Sea Surface Temperature analysis (OISST), with the SST anomaly calculated using climatology from NOAA's AVHRR-only OISST dataset. From https://www.integratedecosystemassessment.noaa.gov/regions/california-current/california-current-marine-heatwave-tracker-blobtracker .

The most recent sea-surface temperature anomaly maps in September 2024 show waning of the offshore marine heat wave waters and persistence of cold, upwelled waters near the coast (**Figure 3**).

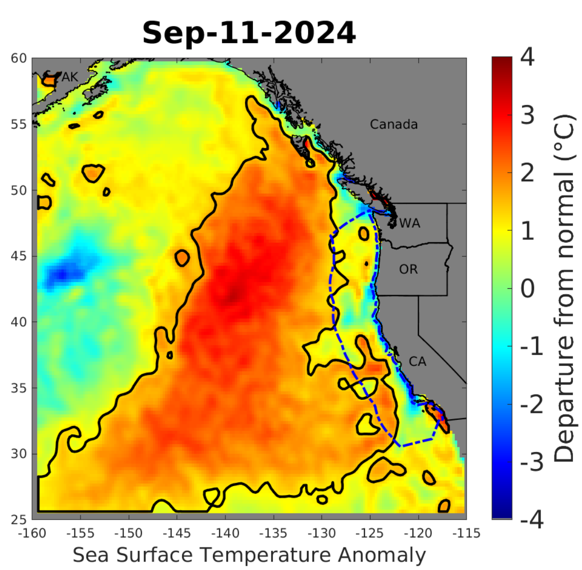


Figure 3: Science-quality (delayed 3-weeks), daily interpolated standardized sea surface temperature anomalies (SSTa) in the California Current ecosystem. Figure details as in Figure 2.

NOAA continues to monitor marine heat waves off the US west coast, documenting the increase in occurrence and size of the marine heat waves over the last four decades (**Figure 4**) (https://www.integratedecosystemassessment.noaa.gov/regions/california-current/california-current-marine-heatwave-tracker-blobtracker).

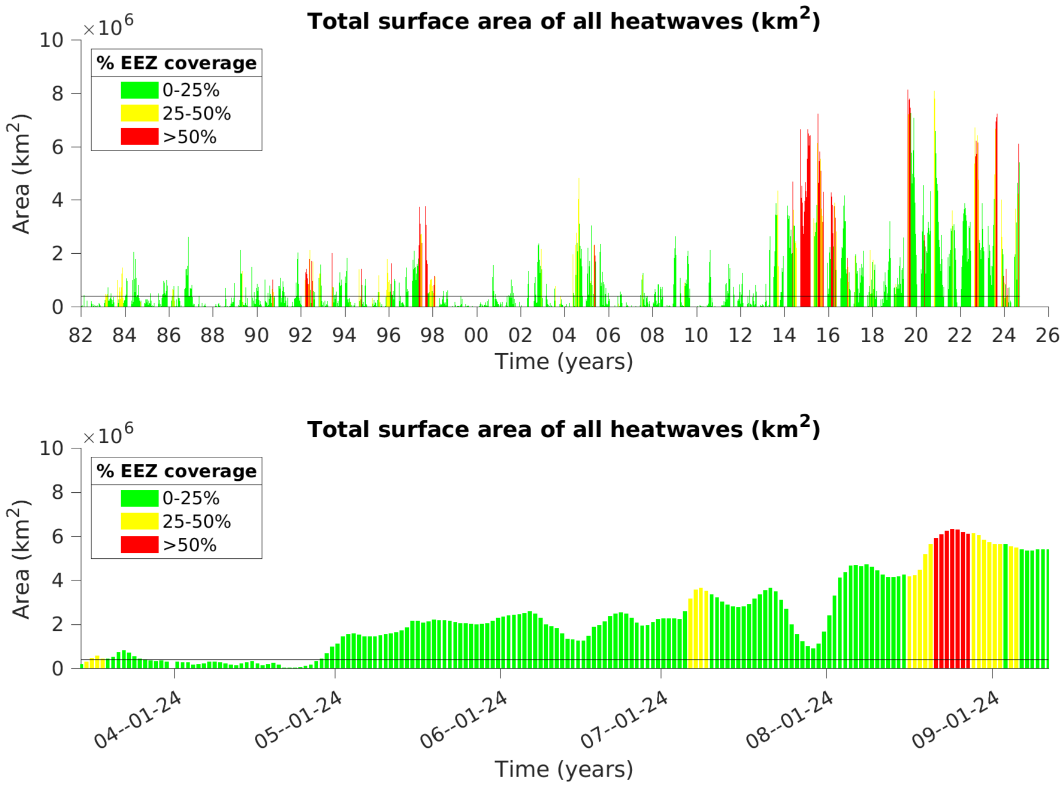
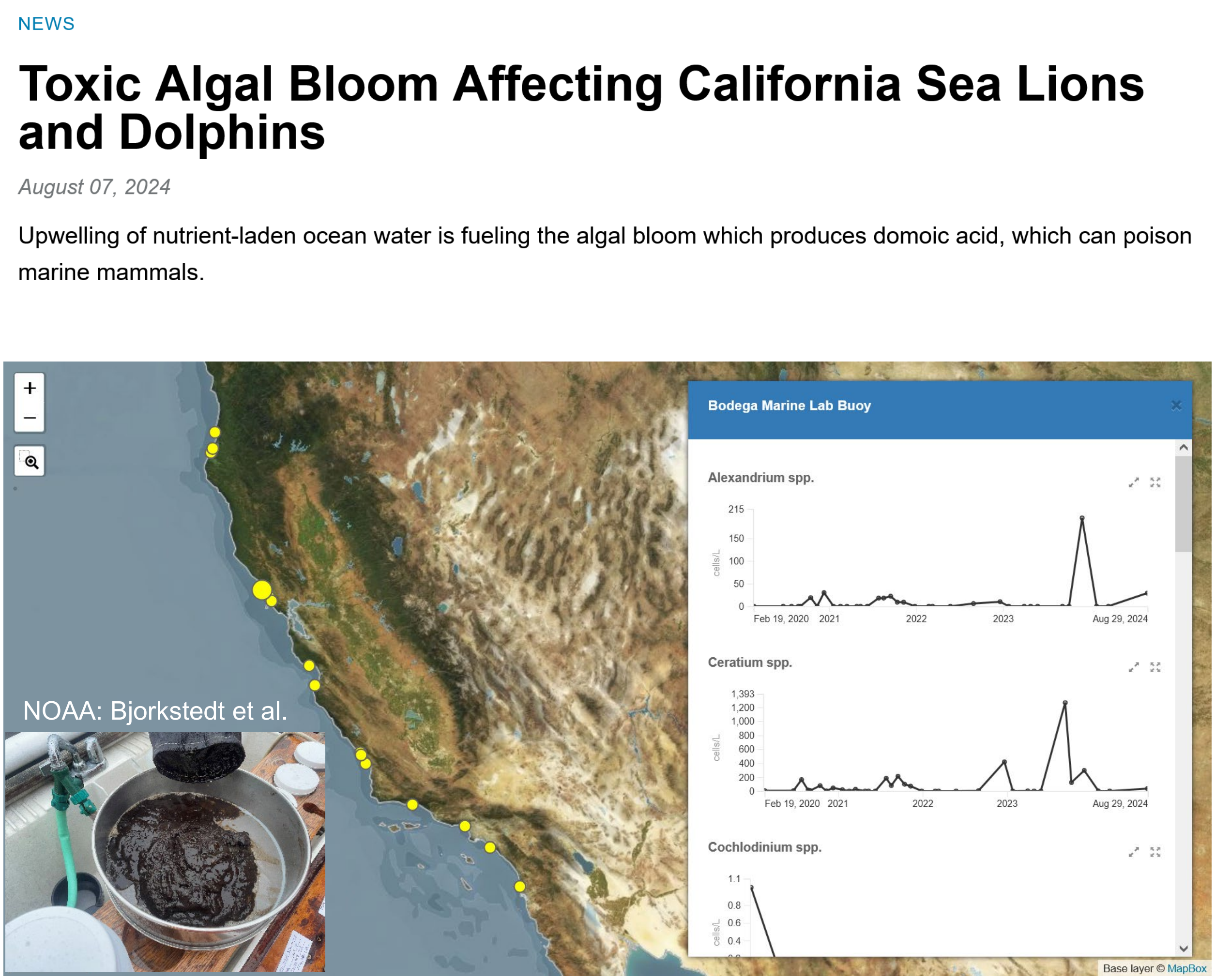


Figure 4: (top) Retrospective analysis of sea surface temperature anomalies in the California Current region, 1982-present. Figure shows daily total surface area from the entire study region (Figure 2) in heatwave status over time. Thin horizontal line indicates the area threshold cutoff (approx. 400,000 km2) used for tracking and analysis of Marine Heat Waves. Color indicates the % of the US west coast EEZ (area within blue dashed line, Figure 2) in heatwave status; (bottom) Daily estimated area of SST anomalies in the California Current region over the previous 12 months, color coded by relative EEZ coverage. From https://www.integratedecosystemassessment.noaa.gov/regions/california-current/california-current-marine-heatwave-tracker-blobtracker.

Harmful Algal Bloom

In late summer 2024, strong upwelling fueled the growth of a harmful algal bloom (**Figure 5**). There are Harmful Algal Bloom monitoring networks in both California (https://sccoos.org/california-hab-bulletin/) and Oregon/Washington (https://www.nanoos.org/products/habs/real-time/home.php). Harmful algal blooms can harm marine fisheries and marine mammals.


NEWS

Toxic Algal Bloom Affecting California Sea Lions and Dolphins

August 07, 2024

Upwelling of nutrient-laden ocean water is fueling the algal bloom which produces domoic acid, which can poison marine mammals.

Figure 5: (top) Headline about late summer 2024 Harmful Algal Bloom; (bottom) Example of California Harmful Algal Bloom monitoring network.

Hypoxia Mapping

By combining the various governmental (NOAA, Oregon Department of Fish and Wildlife, OOI) and academic monitoring efforts, new high-resolution maps of the spatial distribution of low-oxygen (hypoxic) zones off Oregon and Washington. **Figure 6** shows a map from 2021 and maps using all available data for 2022-2024 are in progress. A map of near-bottom hypoxia from a NOAA fishery survey conducted relatively early in the upwelling season from June 21-28 shows areas of hypoxia (dissolved oxygen < 1.4 ml/L) over the southern Washington continental shelf, reaching south to the outer continental shelf off Northern Oregon (**Figure 7**).

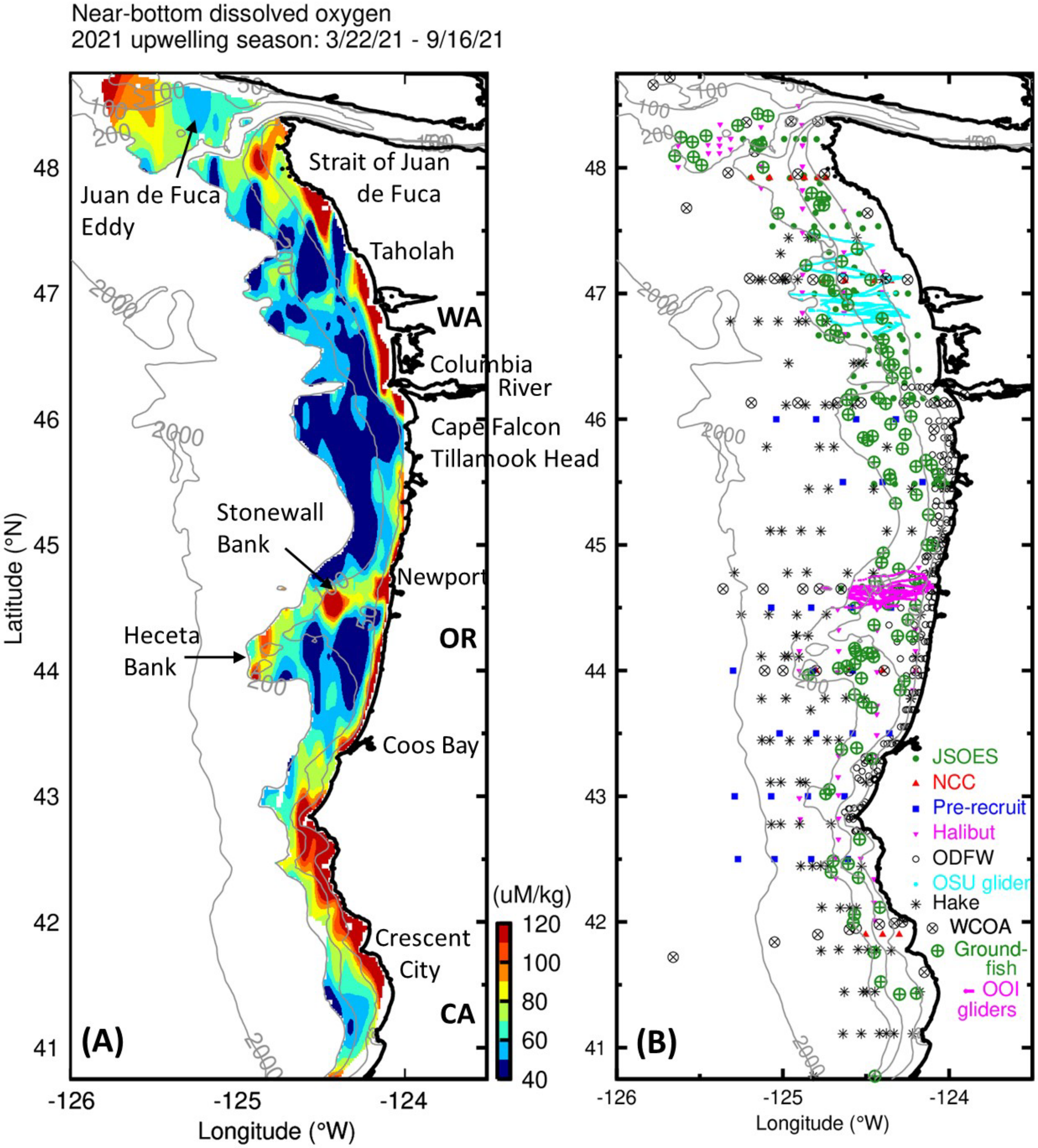


Figure 6: Maps of dissolved oxygen and sample locations during summer 2021. (A) Near-bottom dissolved oxygen in μmol kg^{-1}; the blue-cyan transition at 61 μmol kg^{-1} denotes the hypoxia threshold. (B) Sample locations color-coded by program. Bottom depth in m; the 200-m isobath marks the edge of the continental shelf. (From Barth et al., 2024)

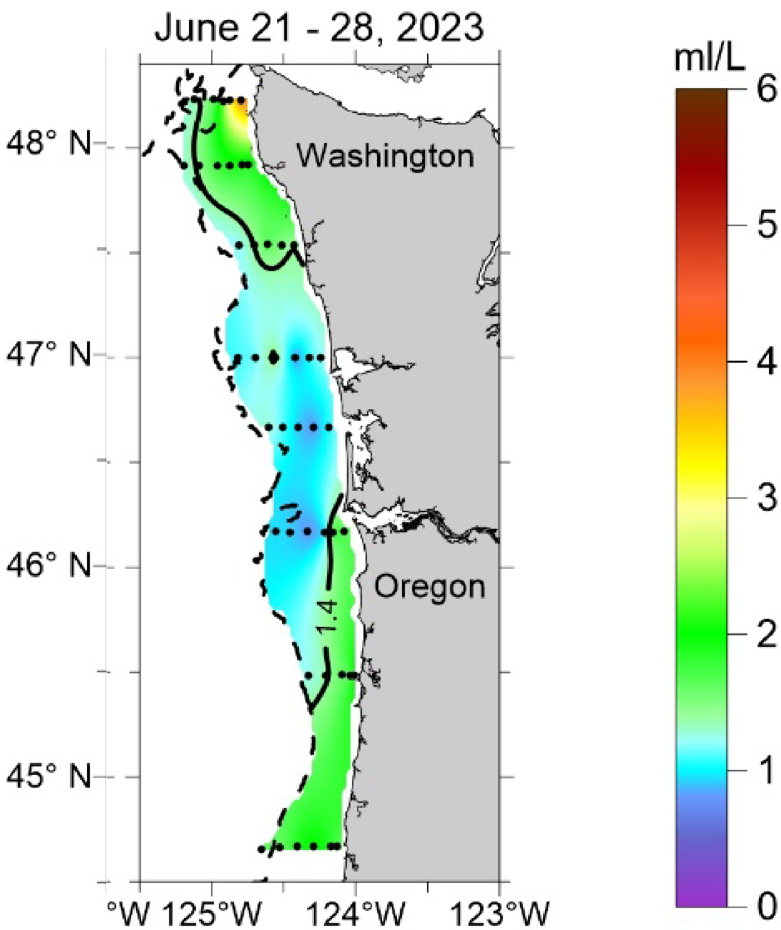


Figure 7: Map of near-bottom dissolved oxygen (ml/L) from a NOAA fisheries survey. (From Leising et al, 2024)

U.S. Integrated Ocean Observing System, IOOS (NOAA), 2023-2024

The west-coast regional associations of the U.S. Integrated Ocean Observing System (IOOS) funded by the U.S. National Oceanic and Atmospheric Administration continue to operate year-round during 2023-2024. From north-to-south, this includes the Alaska Ocean Observing System (AOOS, https://aoos.org), the Northwest Association of Networked Ocean Observing Systems that includes the states of Oregon and Washington (NANOOS, https://www.nanoos.org), then Central and Northern California Ocean Observing System (CeNCOOS, http://www.cencoos.org), and the Southern California Coastal Ocean Observing System (SCCOOS, https://sccoos.org) (**Figure 8**). Another new activity in recent years is that CeNCOOS and SCCOOS have combined their data delivery on the California Ocean Observing Systems Data Portal (https://data.caloos.org/). Lastly, NANOOS, CeNCOOS and SCCOOS each celebrated their 20th anniversary during 2023-2024. The CeNCOOS and SCCOOS 20th anniversary was celebrated together with the 75th anniversary of the start of CalCOFI (California Cooperative Fisheries Investigations).

Figure 8: Overview of the U.S. Integrated Ocean Observing System (IOOS) funded by the National Oceanic and Atmospheric Administration.

During the last few years, these regional IOOS associations have made substantial investments in infrastructure through the U.S. Bipartisan Infrastructure Law and in new observational capabilities through the U.S. Inflation Reduction Act (IRA, aka climate change bill). Each of the west coast regional associations has invested in underwater gliders, buoys/moorings and high-frequency radar. Additional examples of infrastructure investment include three Imaging FlowCytoBots (IFCB) for NANOOS (southern Oregon, La Push, and Puget Sound moorings) to extend the twelve-sensor California IFCB network (https://sccoos.org/ifcb/) to the north. AOOS is also investing and installing IFCBs. SCCOOS in investing in shore-stations and additional CDIP (Coastal Data Information Program) wave buoys, lidar and cameras to expand their Coastal Flood Monitoring Network.

With IRA funds, the west coast IOOS regional associations are making investments in expanded biogeochemical observations using pH and nitrate sensors on gliders. There is also a coordinated effort in expanding the use of passive acoustic monitoring and listening for coded acoustic tags from moorings and gliders. IRA funds will also support data system expansion, model improvements for U.S. west coast ROMS and WCOFS (NOAA's West Coast Operational Forecast System, https://tidesandcurrents.noaa.gov/ofs/dev/wcofs/wcofs.html) applications, and operational wave forecasts for the Columbia River mouth and plume area.

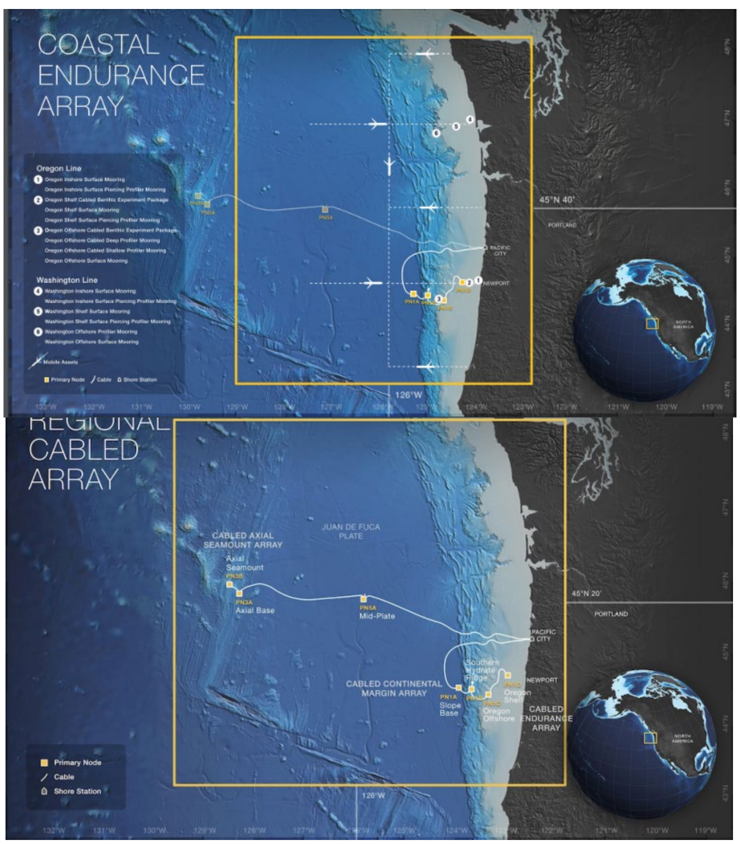
During 2023-2024, the Backyard Buoys project (https://backyardbuoys.org/) was launched to enable Indigenous and coastal communities to gather and use wave data, enhancing their blue economy and hazard protection. By leveraging low-cost and scalable marine technology, Backyard Buoys offers a system for community-managed ocean buoys and web apps that simplify data access to complement Indigenous

Knowledge. This is a partnership of AOOS, NANOOS and the Pacific Islands Ocean Observing System (http://www.pacioos.hawaii.edu/).

NANOOS continues to improve and add features to its data visualization and data products web page, the NANOOS Visualization System (https://www.nvs.nanoos.org). Both observational data, from buoys, gliders, land stations, high-frequency radars, and satellites, and output from circulation, wave, weather, and biogeochemical numerical models are hosted on NVS. The "Real-Time HABs" website (https://www.nanoos.org/products/habs/real-time/home.php) incorporates contextual data and other data products to enhance interpretation and understanding of the Environmental Sample Processor data (e.g., maps of water paths).

U. S. National Science Foundation's Ocean Observatories Initiative (OOI)

The Ocean Observatories Initiative (OOI) is a science-driven ocean observing network that delivers real-time data from more than 800 instruments to address critical science questions regarding the world's ocean. OOI data are freely available online to anyone with an Internet connection (https://oceanobservatories.org). Data can be explored and downloaded from: https://dataexplorer.oceanobservatories.org/. There are five arrays of platforms collecting continuous data including three in the Northeast Pacific: Endurance coastal array off the coasts of Oregon and Washington; Regional cabled array including Axial Seamount and Hydrate Ridge; Ocean Station Papa (**Figure 9**). The OOI is approaching 10 years of continuous data.



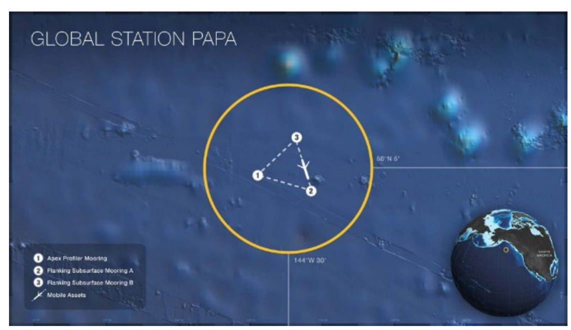


Figure 9: Location maps for the Ocean Observatories Initiative arrays in the eastern North Pacific. For more details see https://oceanobservatories.org/research-arrays/ .

There are 800 instruments deployed, 36 different types measuring more than 200 parameters. The instruments are deployed on 80+ platforms consisting of cabled and uncabled moorings, cabled instruments, and autonomous vehicles. As of late 2023, there were 287 million requests for data, 90 terabytes of data provided including 119 billion rows of data stored. The Ocean Observatories Initiative (OOI) is designated as a United Nations (UN) Endorsed Action as part of the UN Decade of Ocean Science for Sustainable Development 2021-2030.

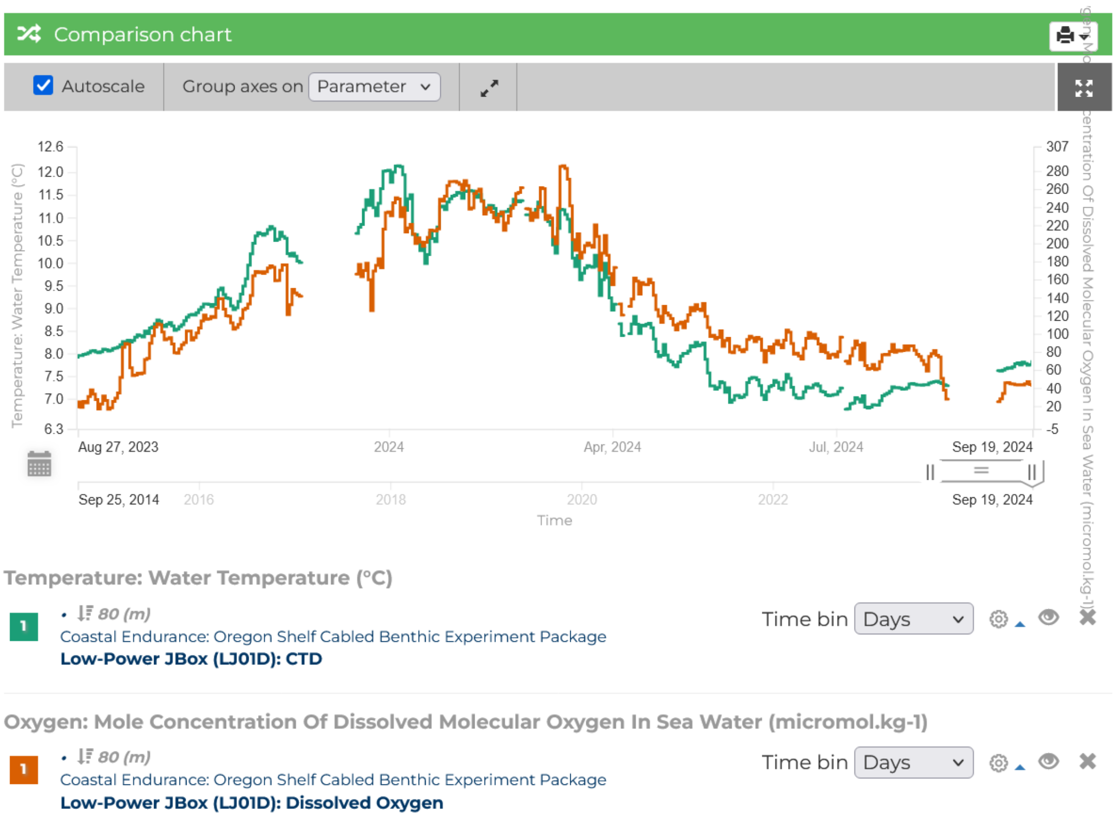


Figure 10: Example of data from the OOI mooring array off Oregon showing temperature and dissolved oxygen during late 2023 to September 2024 showing the seasonal evolution of with lower water temperatures and low dissolved oxygen (created from https://dataexplorer.oceanobservatories.org/).

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Leising, A., M. Hunsicker, N. Tolimieri, G. Williams and A. Harley, 2024. 2023-2024 California Current Ecosystem Status Report. NOAA, PFMC, 159 pp. https://www.pcouncil.org/documents/2024/02/agenda-

item-h-1-a-cciea-team-report-1-2023-2024-california-current-ecosystem-status-report-electronic-only.pdf/
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Ecosystem and Fisheries Survey Monitoring Efforts on the US West Coast, 2023-2024:

Annual results of most of these monitoring efforts are summarized in the California Current Integrated Ecosystem Assessment Report to the Pacific Fisheries Management Council (PFMC) each March: https://www.pcouncil.org/documents/2024/02/agenda-item-h-1-a-cciea team-report-1-2023-2024-california-current-ecosystem-status-report-electronic-only.pdf/

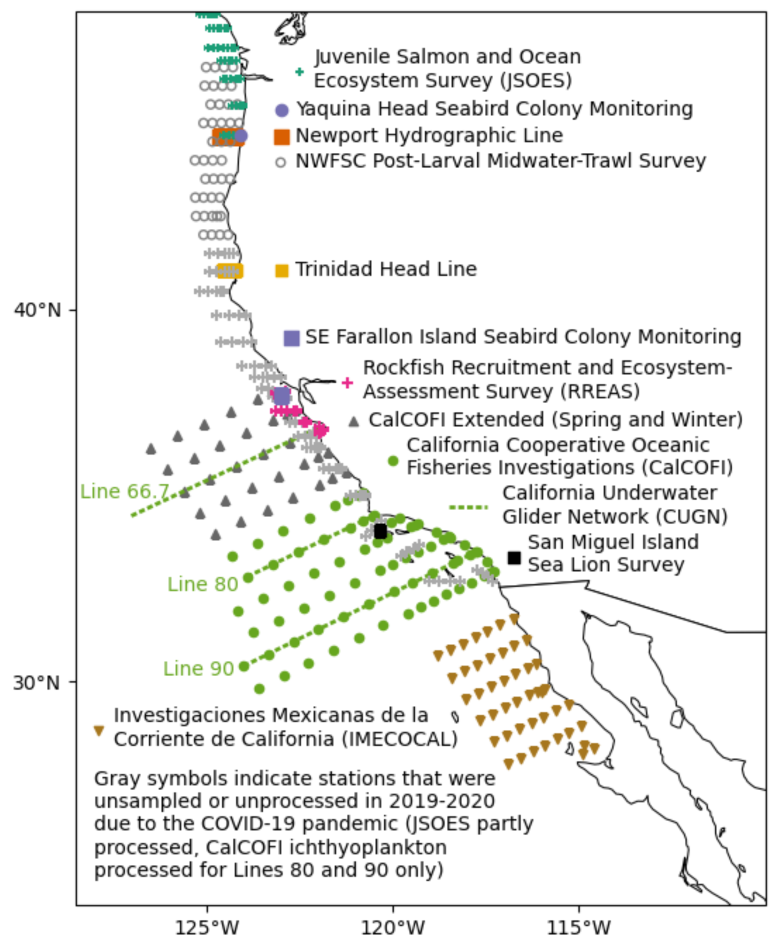

Figure 11. Overview of Hydrological and biological surveys conducted by the National Marine Fisheries Service in the California Current ecosystem. From the 2021 State of the California Current Report by E. Weber, NOAA Fisheries, SWFSC.

There are three NOAA surveys that collect physical data through lower trophics seasonally to bi-weekly (depending upon the program) off Washington, Oregon and California. These include research and monitoring programs on the Newport Hydrographic Line in Oregon, the Trinidad Head Line in Northern California, and the California Cooperative Fisheries Investigations (CalCOFI) in Southern California. An additional three ecosystem projects sample annually for oceanographic conditions, lower trophics, and fish of different target species. The location of these efforts and the seabird colonies and stationary sea lion monitoring site at San Miguel Island, California are shown in **Figure 11**.

- The Newport Hydrographic Line is sampled bi-weekly to monthly, year round (since 1996). Sampling occurs at 7 stations evenly spaced from 1-25 nm from shore. At each station, water column properties are measured (T, S, Oxy, aragonite); surface water is collected for nutrients, chlorophyll, and phytoplankton; and plankton nets collect zooplankton, fish and invertebrate larvae. provides the index of northern and southern copepod biomass. In 2024, northern copepods continued an overall positive trend since the extreme lows during the 2014-2016 heatwave. They were >1 s.d. above the mean in spring and early summer 2022 before dropping early in biomass before their regular seasonal transition in the fall (**Figure 12**).

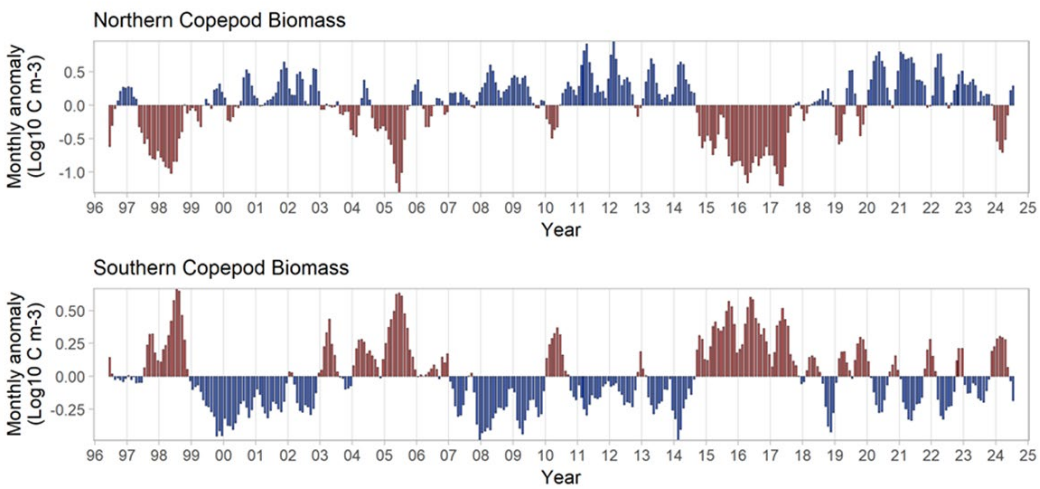

Figure 12. Three-month running mean of anomalies of biomass of northern and southern copepod taxa recorded off Newport, OR at NH05: Peterson Plankton Lab, NOAA, NMFS, Newport, OR.

Associated with the NH Line are the Northern California Current broadscale ecosystem surveys. Twice to three times annually, biophysical sampling is expanded to the edge of the EEZ along the NH Line and transects from the CA/OR border to northern WA. These surveys, conducted for 20+ years, provide the spatial data needed to evaluate lower trophic level responses to environmental variability throughout the NCC; a key step for building species distribution models. To take the next step toward EBFM, future spring surveys now incorporate sampling of larval and juvenile fishes. Together, with the SWFSC RREAS sampling off CA, fish recruitment can be examined throughout the CC. These NCC surveys also provide a unique platform for collaboration; addressing questions that include unmanned systems, machine learning and Omics. Examples include sampling phyto- and ichthyoplankton with high resolution cameras (iFCB and ISIIS), data processed with machine learning; eDNA of phyto-, zoo- and ichthyoplankton; development of predator/prey distribution models to reduce whale entanglements.

Following a strong El Nino that had persisted from May 2023 to April 2024, during the 2024 NCC surveys, scientists were eager to see if there were any observable biological effects. During May, water temperatures were not abnormally high, but lots of doliolids were collected in the plankton nets and few krill were collected during the survey. These are generally signs associated with warm ocean conditions. In September, offshore surface water temperatures were 17°C, and pyrosomes were present in the nets at most of the offshore stations, and they were abundant on the surface at night off the Heceta Head transect in Oregon. These are also strong indications of warm ocean conditions. *Contact J. Fisher (NOAA, NWFSC)*

- The Trinidad Head Line also samples for lower trophics and hydrography and provides an index *of Euphausia pacifica*, a key krill species within the CCE, which is sampled year-round along the Trinidad Head Line off northern California.
  Mean length of adult *E. pacifica* is an indicator of productivity at the base of the food web, krill condition, and energy content for predators. *E. pacifica* length was near average for much 2023 (**Figure 13a**). During fall 2023, length decreased substantially and remained below average until spring 2024. Following the onset of upwelling, length increased and remained near or above average for most of summer 2024. Throughout 2023 the total biomass of *E. pacifica* fluctuated around the timeseries mean (**Figure 13b**). A substantial decrease in biomass during winter 2023/24 reflects smaller body size of adult *E. pacifica*. Text and figure provided by Roxanne Robertson, Cooperative Institute for Marine, Earth, and Atmospheric Systems at Cal Poly Humboldt and Eric Bjorkstedt, Southwest Fisheries Science Center, NOAA. *Contact: E. Bjorkstedt (NOAA, NWFSC)*

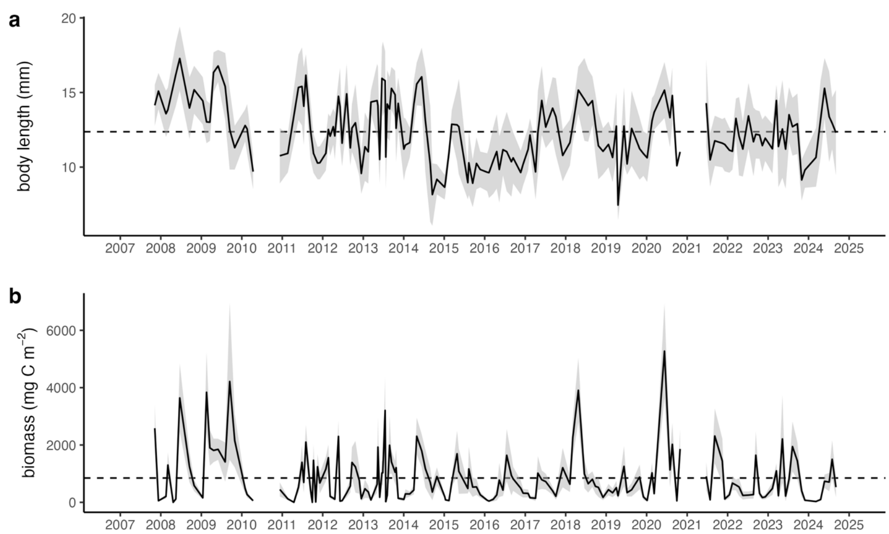

Figure 13. Krill observations along the Trinidad Head Line, 2007 – May 2023. a) Monthly mean length of *E. pacifica* and b) total biomass of *E. pacifica* . Gray envelopes indicate ± 1.0 s.d.

- Three of the quarterly 2024 CalCOFI cruises are reported herein. All four cruises sample a fixed grid (**Figure 14**) for lower trophics in the Southern California Bight (SCB), with the winter and spring cruises extending north to sample transects up to San Francisco. The winter (January 2024) cruise was cut short by continuous ship mechanical failures causing the NOAA FSV Lasker to return to port several times during the cruise, resulting in less than half of the scheduled sampling. The spring cruise (April 2024) yielded much more success with every scheduled station sampled, which was the first time we were able to complete the entire extended pattern with the newly added (in 2022) Channel Islands and Monterey Bay Sanctuaries-CalCOFI stations. During the spring cruise, on NOAA FSV Shimada, north of Point Conception, near shore, there were thick continuous "carpets" of Velella vella, in high densities never previously observed by our veteran (30+ years) sea-going team. Spring Continuous Underway Fish Egg Sampler (CUFES) samples revealed patterns of Pacific Sardine eggs (low densities) near shore in the SCB and between Monterey and San Francisco, Northern Anchovy eggs near shore primarily in the SCB, and Jack Mackerel eggs primarily offshore on the southern-most transect and offshore from Monterey (Figure below). During the summer CalCOFI cruise (July 2024) salps were in high densities throughout nearly all of the shelf stations, tapering off as the sampling moved off the continental shelf. CalCOFI ichthyoplankton samples from the 2024 cruises are not yet completed processed with preliminary observations of very thick phytoplankton-predominant samples, which is sticky and slow to sort through. The other cruise samples from 2024 have not yet been processed. The final CalCOFI cruise of 2024 is scheduled to depart on November 15 with a plan to occupy ~2/3 of the station grid in the SCB. *Contact: Noelle Bowlin (NOAA, SWFSC)*

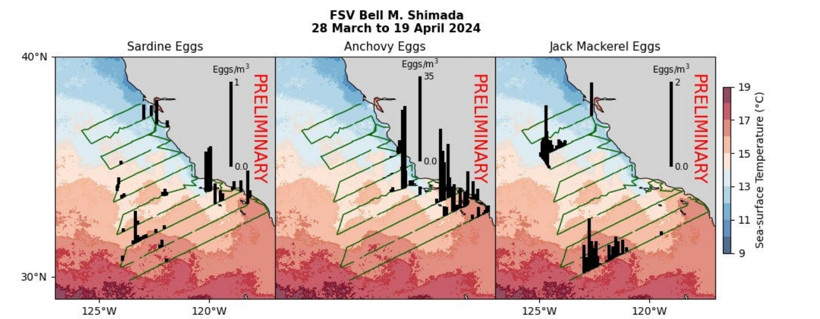

Figure 14. Preliminary results from 2024 CalCOFI spring survey.

In addition to these surveys there are several coastwide fisheries surveys designed to provide data for stock assessments.

The NOAA Fisheries Northwest Fisheries Science Center (NWFSC) in collaboration with Canada's Department of Fisheries and Oceans conduct Integrated acoustic trawl (IAT) surveys on a biennial basis to assess the abundance, distribution, and biology of Pacific hake (*Merluccius productus*; hereafter, "hake") along the west coast of the U.S. and Canada. Age- and sex-specific estimates of total population abundance derived from IAT surveys are a key fishery-independent data source for the joint U.S.–Canada Pacific hake stock assessment. A time series of survey estimates of hake abundance and age composition is used in an age-structured assessment model, which ultimately acts as a foundation for advice on U.S., tribal, and international harvest levels. The surveys also collect key environmental data (temperature, salinity, dissolved oxygen) as well as samples for environmental DNA (eDNA) and RNA (eRNA) and the presence, distribution, and identification of harmful algal bloom (HAB) species and the toxins they produce. The most recent full survey was conducted in between 27 June and 5 September, 2023 (**Figure 15**). In 2023 adult hake were observed on 69 transects, ranging from off Pismo Beach, California to the midpoint of Vancouver Island, by Nootka Sound. Areas of strongest adult hake sign were observed along Northern California and Southern Oregon. The initial NWFSC hake survey was conducted in 2003. Transect spacing was expected to be 10 nmi from Point Conception (34.5°N) to the north end of Vancouver Island (50.5°N) and 20 nmi spacing north of Vancouver Island to Dixon Entrance (54.5°N). To cover the entire survey area with the above constraints, the survey returned to the 1500 m offshore limit protocol used in the pre-SaKe survey period (1995-2011), and also skipping every eighth transect from the starting point to the north end of Vancouver Island. In 2024 efforts were conducted together to test a new net that is proposed to be used to sample both Pacific hake and coastal pelagic species starting in 2025. *Contact: Julia Clemons (NOAA, NWFSC)*

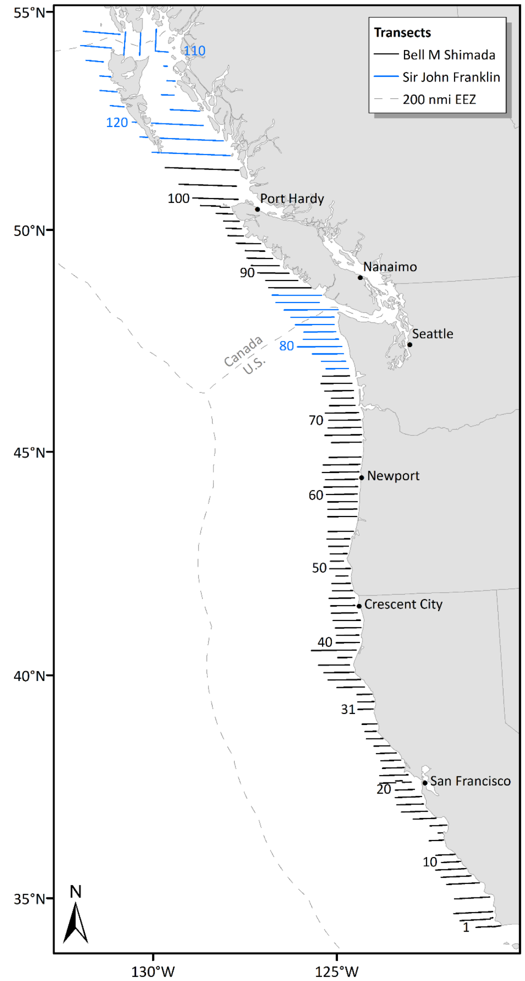

Figure 15. Acoustic-trawl survey transects in 2023 for the NOAA Ship Bell M. Shimada (black, NWFSC) and the Sir John Franklin (blue, DFO).

Groundfish surveys have also been conducted over the shelf and slope (55 – 1280 m) annually by the NWFSC since 2003 (except in 2020) from the border with Mexico to Canada. The survey collects data on the majority of the 91 groundfish included in the West Coast Groundfish Fishery Management Plan. The survey also collects key environmental data (temperature, depth, dissolved oxygen, turbidity, in vivo fluorescence, irradiance, wind speed, location) in association with each tow for use in ecosystem based fisheries management (EBFM).

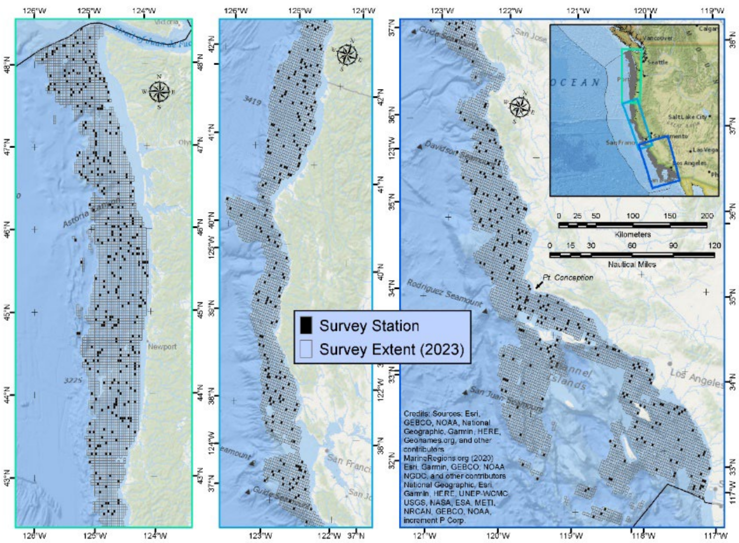

Figure 16. Summary of stations for 2023 NOAA groundfish survey off U.S. west coast. Left panel = northern Washington State through northern California. Right panel = northern California through southern California. *Aimee Keller NOAA Fisheries*

The NWFSC chartered four commercial fishing vessels to conduct the survey in 2023 using standardized trawl gear. Fishing vessels were contracted to survey the area from Cape Flattery, WA to the Mexican border in Southern California (**Figure 16**), beginning in the later part of May and continuing through October.

An Aberdeen-style net with a small mesh (1 1/2" stretch) liner in the codend was used for sampling. The survey followed a stratified random sampling scheme with 15-minute tows within 2 geographic strata (80% N of Pt. Conception, CA and 20% S) and 3 depth strata. In 2023, the groundfish survey successfully sampled 662 of 752 targeted stations, collected 217 fish species and 203 invertebrate species. *Contact: Aimee Keller (NOAA, NWFSC)*

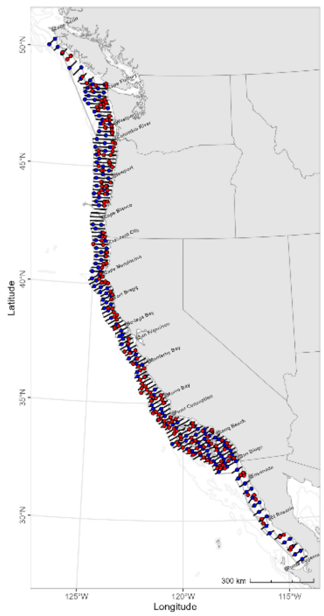

Figure 17. Sampling stations of the 2024 NOAA SWFSC survey for coastal pelagic species. Red dots are trawls and blue are underway CTD casts.

The NOAA Fisheries Southwest Fisheries Science Center conducts an annual California Current Ecosystem Survey (CCES) focused on Coastal Pelagic Species. The 2024 survey sampled the entire US west coast using 10-nmi transect spacing, including sampling down to Sebastián Vizcaíno Bay in Baja California (the furthest south this survey has gone before), as well as Vancouver Island for the first time since 2019 (**Figure 17**). Overall, NOAA ship *Reuben Lasker* sampled for 80 out of the 85 allotted sea days, completing 131 transects, 174 trawls, and 200 underway CTD casts. As usual, this year's survey was again complemented with nearshore sampling by the fishing vessels *Long Beach Carnage* and *Lisa Marie*, as well as collaborating with the Mexican research institute IMIPAS to facilitate nearshore sampling in Baja California. The end result was complete, continuous coverage of nearshore waters from the southern tip of Baja California to the U.S.-Canada border. Owing to minimal, if not zero, delays from each of the vessels, this survey had some of the most synchronous coverage in sampling between the nearshore vessels and *Lasker* to date.

Preliminary observations indicate that the central stock of Northern Anchovy were prevalent between San Francisco and the U.S.-Mexico border; Jack Mackerel were observed throughout the entire west coast, but predominantly in the Southern California Bight and north of San Francisco; and Pacific herring were found mostly of Washington and Vancouver Island. *Contact: Josiah Renfree (NOAA, SWFSC)*

The Juvenile Salmon Ocean Ecosystem Survey off Washington and Oregon targets juvenile salmon in surface waters, and also samples surface-oriented fishes, squid and jellies. Yearling Chinook salmon (*Oncorhynchus tshawytscha*) abundance during June surveys correlate positively with returning spring Chinook jack and adult salmon counts at the Bonneville Dam in the Columbia River (with 1 and 2 year lags, respectively), as do the abundance of yearling coho salmon (*O. kisutch*) to subsequent coho salmon smolt to adult survival (Morgan et al. 2019). Catch-per-unit effort of yearling Chinook salmon during the June 2024 survey was near average while coho salmon catches were above average. Based solely on the correlations observed in previous years, this suggests that adult returns of spring Chinook salmon in 2026 will be close to average and and coho salmon returns in 2025 will be higher than average, though other ecological factors will influence this relationship. California market squid (*Doryteuthis opalescens*) and Pacific pompano (*Peprilus simillimus*) were observed at higher than average densities since the beginning of the marine heat wave. In 2024, the density of market squid was lower than it has been since 2013, prior to the heat wave, while Pacific pompano densities continued to be higher than average. *Contact:Brian Burke (NOAA, NWFSC)*

Rockfish Recruitment and Ecosystem Assessment Survey (RREAS): Catches of YOY groundfish have been enumerated from central California in late Spring since 1983 from the, with catches of most other forage taxa reliably estimated from 1990 onward. The survey was expanded to sample most California marine waters starting in 2004 (Sakuma et al. 2016, Santora et al. 2021), and a comprehensive list of additional forage taxa that are also encountered is available in either of those manuscripts. The NWFSC Pre-recruit/NCC survey has included a nighttime trawling component using identical gear and methods since 2011. The taxa reported here are both among the most frequently encountered forage species in this survey, and among the most important forage taxa for higher trophic level predators. Catches were standardized by using a Bayesian delta-GLM to estimate year effects while accounting for spatial and temporal covariates, and to estimate approximate 95% confidence limits (see Ralston et al. 2013, Santora et al. 2021b).

The 2023 survey effort in the "Core Area" was comparable to previous years apart from 2020. Standardized anomalies of log-transformed catch indices of key forage taxa in 2023 (**Figure 18**) suggest continued high abundance of adult northern anchovies, while YOY anchovy continued to decline below the time series average (Fig. H.2. Catches of Pacific sardine showed a modest increase in the central region to slightly above average level. The anchovy and sardine results in this region are consistent with findings from a coastwide acoustic-trawl CPS survey in 2023. The survey observed high abundances of YOY rockfish and YOY Pacific hake in 2023. YOY rockfish catches were at the highest level since the 2015-16 marine heatwave, and there was a notable increase in juvenile groundfish diversity as well. Krill abundance declined after several years of increasing; coastwide RREAS data indicate that krill abundance has been generally higher in northern areas relative to southern areas in recent years. Myctophids (lanternfishes) also declined to the below long-term average levels observed in recent years. Catches of market squid were slightly less abundant in 2023 and near the long-term average, while octopus abundance remained at below-average levels. Similar to 2022, the cumulative results of these trends indicate a fairly productive ecosystem, with anchovy continuing to dominate the forage community but with a greater abundance of alternative forage, and with very few taxa being at low abundance levels. *Taken from the 2024 Ecosystem Status Report presented to the council in March 2024 with permission by John Field (NOAA, SWFSC)*

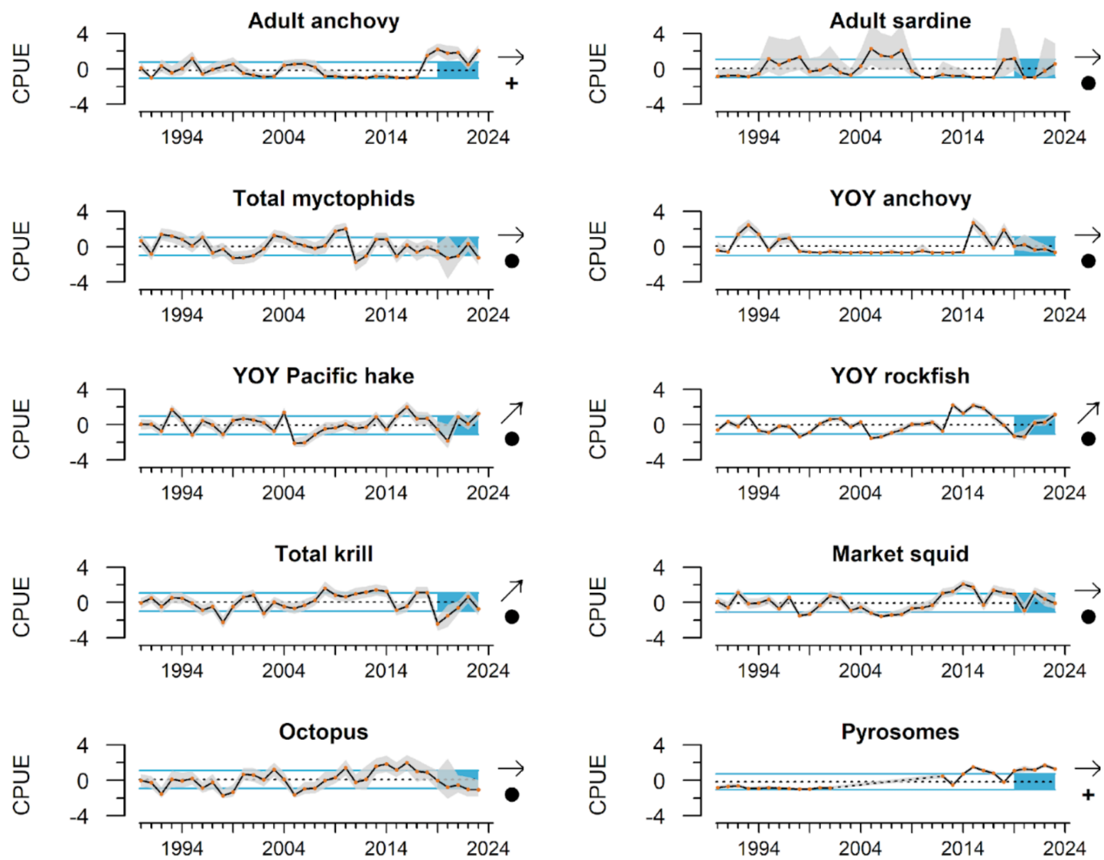

Figure 18. Standardized anomalies (based on ln transformed delta-glm model results) of key forage taxa sampled by the Rockfish Recruitment and Ecosystem Assessment Survey in the core survey region (Central California) 2023.

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NORTH PACIFIC CLIMATE AND ALASKA FISHERIES OCEANOGRAPHY SURVEYS AND OBSERVATIONS FOR 2023-2024

Compiled by Mariela Brooks, NOAA Alaska Fisheries Science Center (AFSC), USA

Acknowledgements: Shaun Bell, Matthew Callahan, Emily Fergusson, David Kimmel, Emily Lemagie, Jens Nielsen, Lauren Rogers, Wess Strasburger, Rob Suryan, Rick Thoman, and Ellen Yasumiishi

Time series of fisheries and oceanographic data and ecosystem evaluations from ecosystem status reports (ESR) can be found at https://www.fisheries.noaa.gov/alaska/ecosystems/ecosystem-status-reports-gulf-alaska-bering-sea-and-aleutian-islands. Excerpts from the 2024 ESR are included as indicated.

North Pacific Climate (Excerpt, Lemagie and Bell 2024 ESR)

Sea surface temperatures (SST) and sea ice data from the NOAA High-resolution Blended Analysis of Daily SST and Ice (OI SST V2), along with 10-m wind data from the NCEP/NCAR Reanalysis II[1] from September 2023 – August 2024 are described here. SST were anomalously warm throughout most of the Alaskan marine waters in November 2023, but the prevailing wind anomalies and storminess in the winter through spring associated with the Aleutian low pressure system contributed to cooling the surface waters until by the summer SST was similar to or cooler than climatological mean temperatures (**Figure 19**). While the decreasing tendency of the SST anomaly was consistent across most of the Alaskan marine waters, the mechanisms and details of this evolution varied by region.

Southward winds associated with the near normal location of Aleutian low advected seasonal sea-ice southward in winter. Through spring, southward winds from the U.S. Arctic, contributed to a maximum sea-ice extent over the Bering Sea shelf that reached near historical norms despite the warm fall conditions. Eastward wind anomalies around 45-50°N in winter through early spring, associated with southward Ekman transport, may have reduced northward heat transport through the Aleutian passes and along the eastern coastal Gulf of Alaska, leading to a cooling tendency across the Bering Sea and Gulf of Alaska shelves and coastal regions. The eastern Gulf of Alaska remained anomalously warm much of this time period, which is consistent with the El Niño conditions in autumn through early spring. The cooling tendency over the Gulf of Alaska basin in spring may have been associated with counterclockwise wind anomalies driving

Ekman pumping of subsurface waters towards the surface. Storminess and strong winds also contributed to vertical mixing across the regions, which is associated with cooler surface temperatures. In particular, over the eastern Bering Sea shelf, there were large negative SST anomalies in summer 2024, but observations from the ecosystem observatory M2 on the Eastern Bering Sea shelf reported a substantially deeper than historical mean mixed-layer depth through the summer while the vertically-integrated heat content was similar to the climatological mean (not shown).

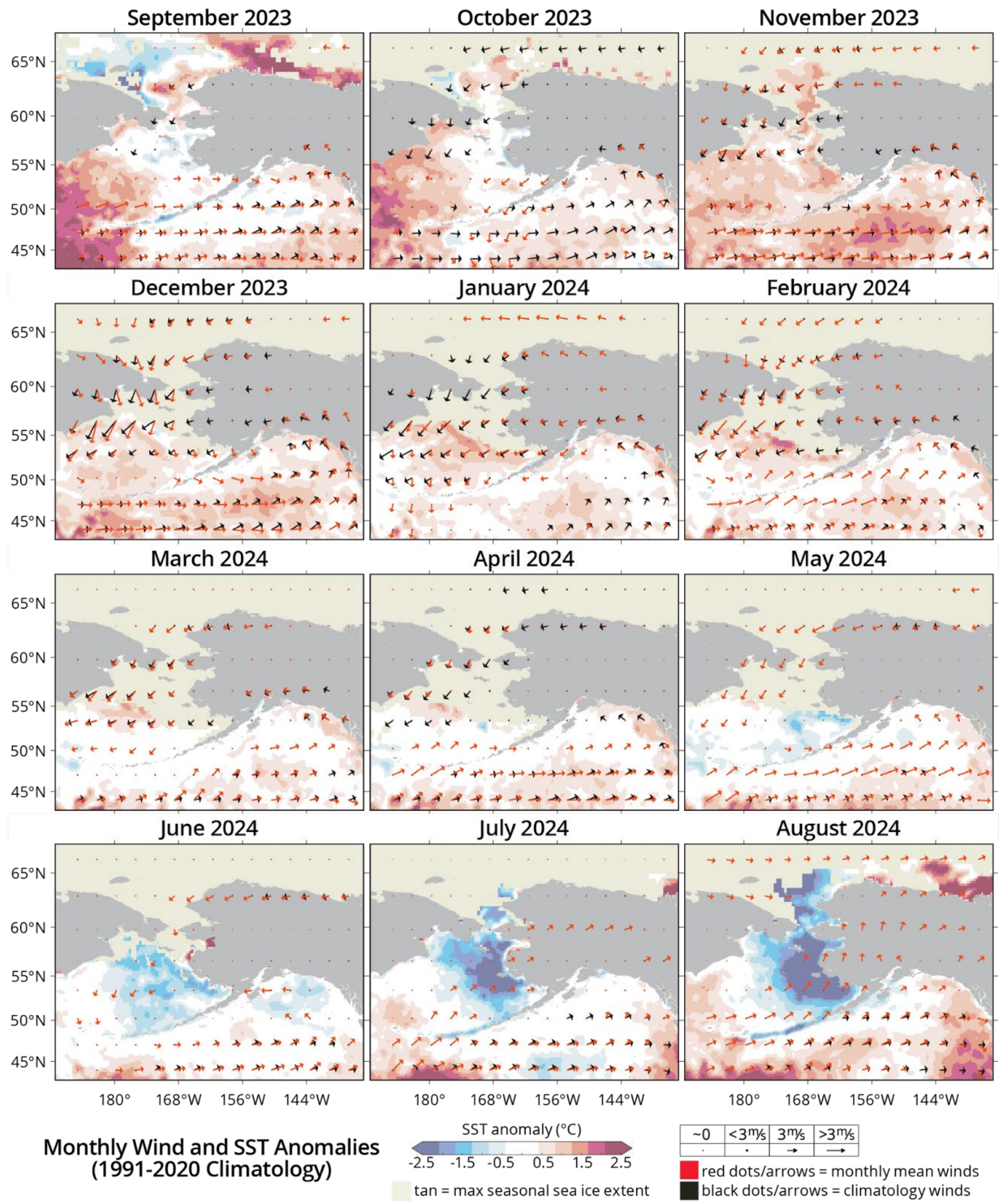


Figure 19. Monthly mean maps of sea surface temperature (SST) anomalies and surface winds. Monthly climatological winds (black) are compared to monthly mean winds (red). The climatological period is from 1991–2020. SST data are from the NOAA High-resolution Blended Analysis of Daily SST and Ice (OISST), and 10-m wind data are from the NCEP/NCAR Reanalysis II; both are available from NOAA's Physical Sciences Laboratory. *Figure courtesy of Emily Lemagie (NOAA PMEL)*

Bering Sea

Sea Surface Temperature (SST)

Satellite derived estimates of SST for the Bering Sea were compiled by Matthew Callahan (NOAA AFSC). In winter and spring (December 2023 – May 2024), SSTs were similar to the long-term mean (1985-2014, **Figure 20**). The northern Bering Sea and southeastern Bering Sea experienced below average (cooler) SST values in late summer and early fall (July – September 2024), with a brief period of near average values in late July. Time series SST data and plot are updated daily and available at https://shinyfin.psmfc.org/ak-sst-mhw/.

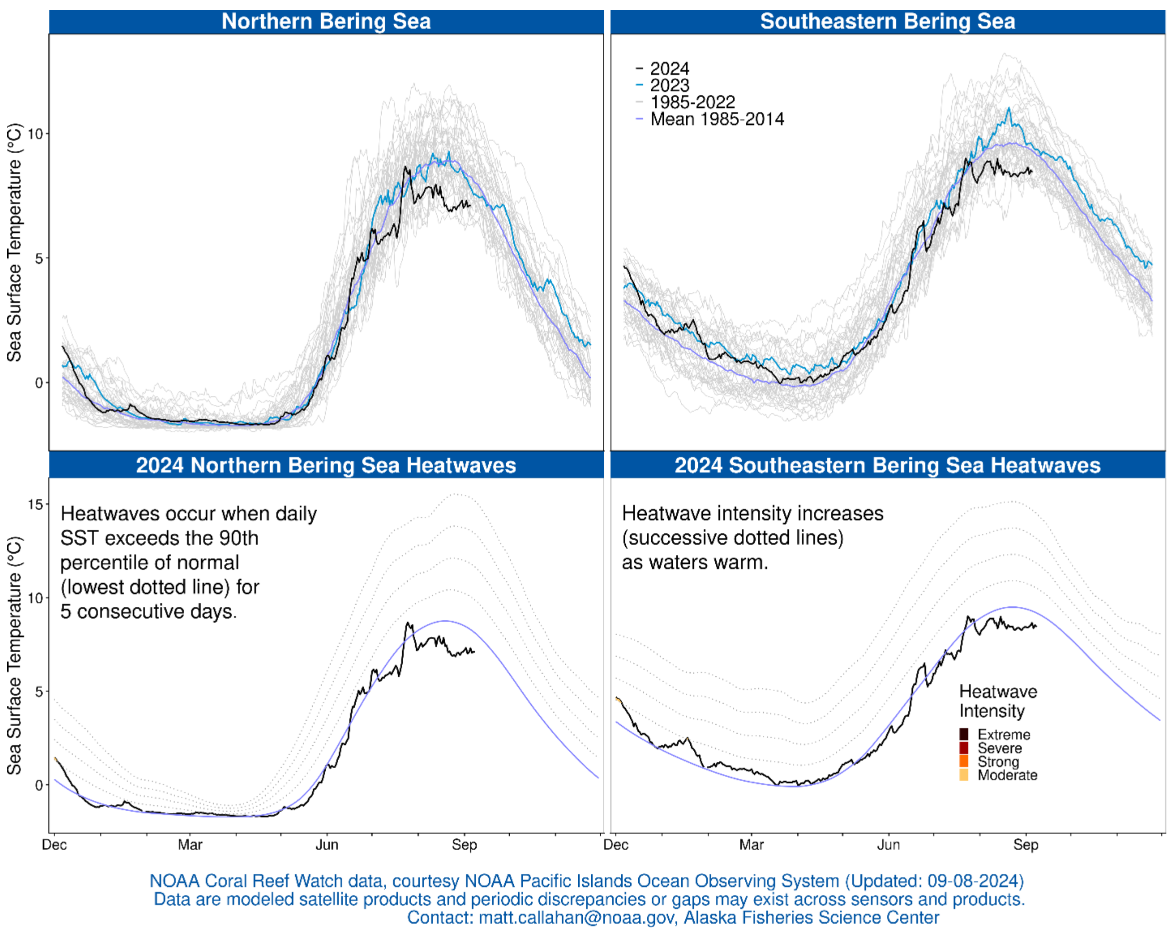


Figure 20. Daily mean SST for 2023 and 2024 compared to long-term mean (1985-2015) for the northern Bering Sea (north of 60°N) and southeastern Bering Sea (south of 60ºN) from satellite derived SST estimates. *Figure courtesy of Matt Callahan (NOAA AFSC)*.

Sea Ice Extent

Bering Sea ice extent in 2023/2024 was compiled by Rick Thoman (ACCAP, UAF)

Early Season Ice

Early season (October 15 to December 15, 2023) ice extent was similar to most years since 2013 except for 2022's very high values and lower than any year prior to 2007. Over the 46-year period of record, early season mean sea ice extent has decreased by 63%.

Seasonal Sea Ice Extent

Maximum sea ice extent occurred in late March 2024 (**Figure 21**). The 2023-24 average ice extent was slightly higher than 2022-23. While a significant recovery from the extreme 2017-18 and 2018-19 seasons, the 12-month average extent was similar to what were considered "low stanza" years prior to 2010. Note: the current season is based on preliminary data and slight changes usually occur in extent values after final processing.

Sea Ice Thickness

This year's report uses version 2.06 of the combined CryoSat-2/SMOS sea ice thickness from the Alfred Wegener Institute. There are only very minor differences from version 2.05 that was used last year. For the week of March 15-21, sea Ice thickness in most regions was slightly lower than the same week in 2023.

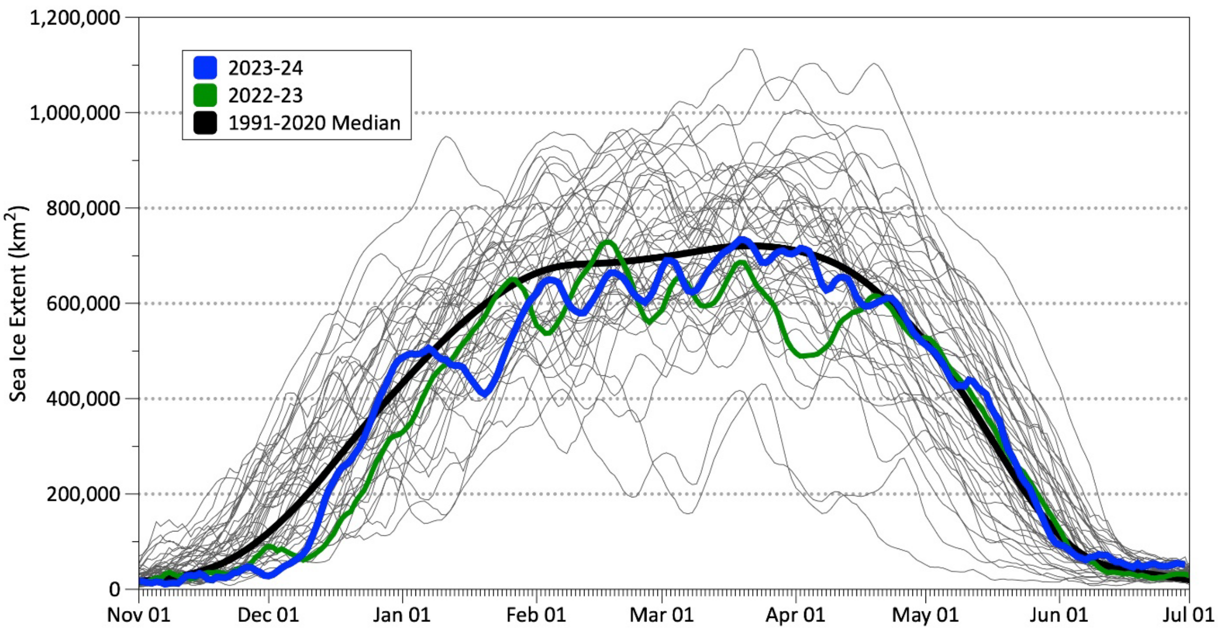


Figure 21. Bering Sea seasonal sea ice extent for 2023-24 (blue) and 2022-2023 (green) plotted against the 1991-2020 median (black). Maximum ice extent occurred in late March 2024. *Figure courtesy of Thoman, ACCAP (UAF).*

Spring phytoplankton blooms

In subarctic systems, such as the eastern Bering Sea, the timing and magnitude of the spring bloom have large and long-lasting effects on biological production with subsequent impacts on higher trophic levels including commercial fish stocks. The fate of the spring bloom (pelagic grazing or sinking to benthos), and its timing, also impact benthic feeders in the Bering Sea. Recent climatic changes in the Bering Sea have included reduced sea ice and warming ocean temperatures, with consequent changes to the food web. Understanding annual changes in spring phytoplankton biomass and peak timing dynamics are thus important metrics for depicting ecosystem changes.

Satellite chlorophyll-a (chl-a) data, a proxy for phytoplankton biomass, allows analysis of large spatial scale patterns in phytoplankton dynamics. Weekly averaged satellite ice data and Chl-a estimates from near real time VIIRS (https://shinyfin.psmfc.org/ak-chlorophyll/) show noticeable ice edge blooms in April 2024 for large parts of the NBS, compared to open water blooms in the southeastern Bering Sea (**Figure 22**). The timing of the spring bloom this year appeared to be consistent with the long-term average.

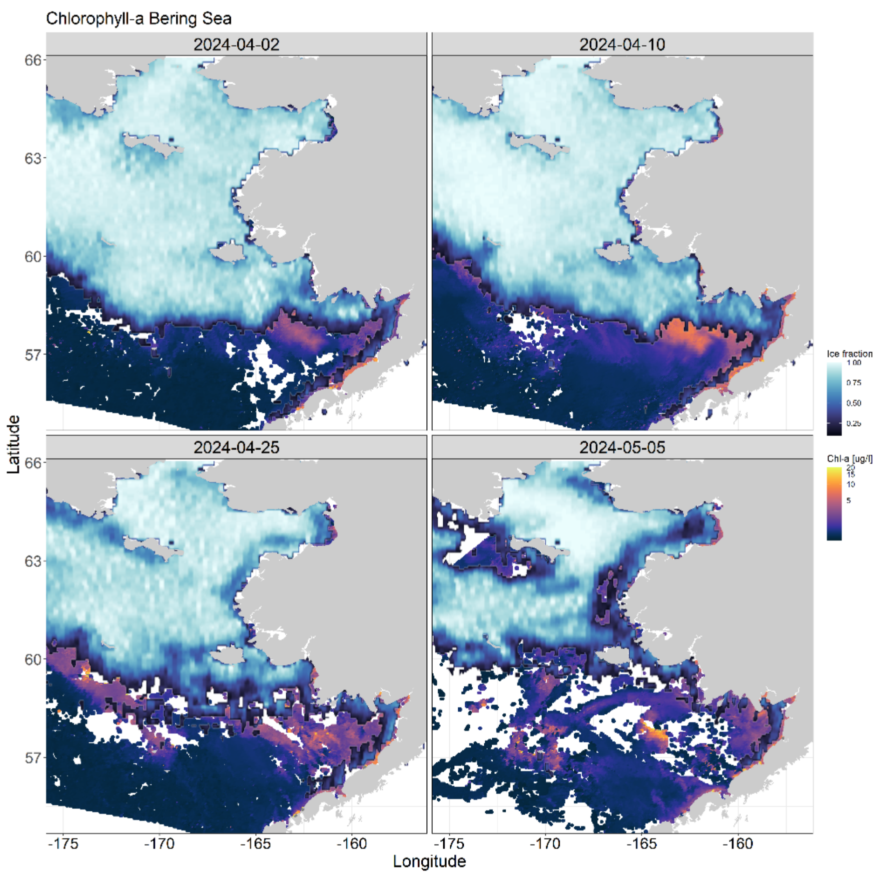


Figure 22. Weekly averaged satellite Chl-a estimates from the Bering Sea using near real time VIIRS (https://shinyf in.psmfc.org/ak-chlorophyll/). *Figure courtesy of Jens Nielsen and Matt Callahan (NOAA AFSC).*

Rapid Zooplankton Assessment (RZA) in the Southeast Bering Sea

Spring 2024 RZA

Preliminary data from the spring season RZA indicated that large copepods (> 2 mm) were relatively low in abundance and mostly concentrated on the southeast Bering Sea outer shelf (**Figure 23**). There were many outer shelf Neocalanus, however they appeared to be too big for the larval pollock to eat. The densities of small copepods (< 2 mm) were roughly average at levels that were higher than cold years but lower than recent warm years (**Figure 24**), with overall abundance levels that suggest adequate forage for larval fish.
Contact: Dave Kimmel

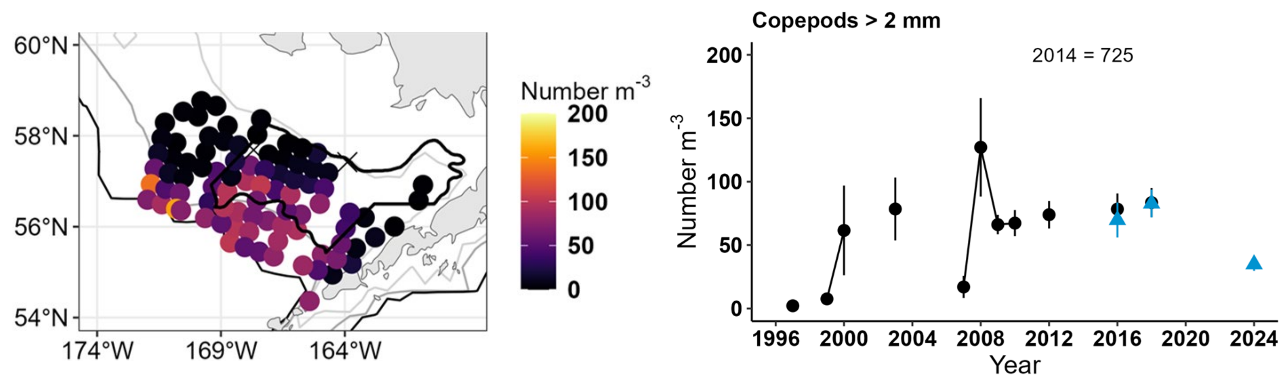


Figure 23. Spring 2024 southeast Bering Sea Rapid Zooplankton Assessment of large copepod (> 2 mm) abundance as a mapped density distribution (left panel) and time-series (right panel). Time-series data shows lab processed data (black circles) as well as RZA samples that are processed at sea (blue triangles).

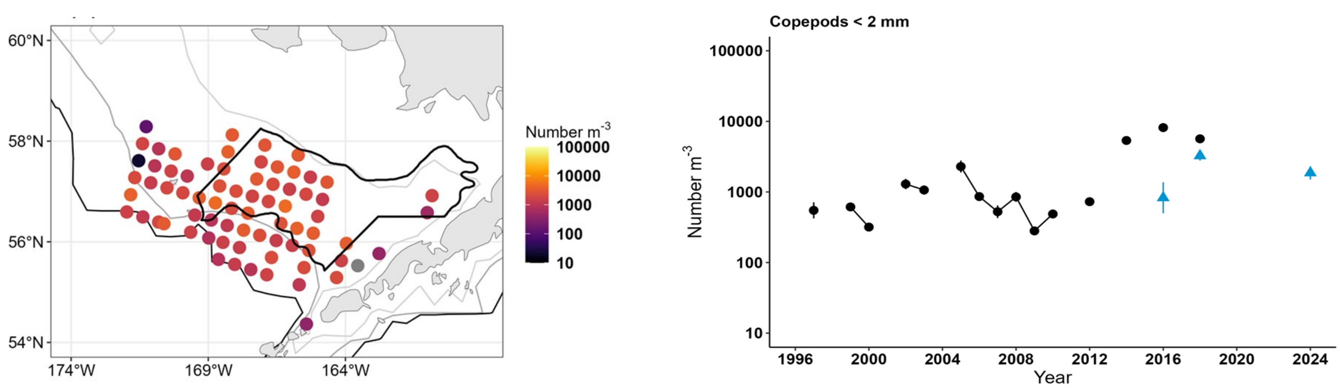


Figure 24. Spring 2024 southeast Bering Sea Rapid Zooplankton Assessment of small copepod (< 2 mm) abundance as a mapped density distribution (left panel) and time-series (right panel). Time-series data shows lab processed data (black circles) as well as RZA samples that are processed at sea (blue triangles).

Fall 2024 RZA

Preliminary data from the fall season RZA indicated that large copepod (> 2 mm) densities were very low in the southeast Bering Sea shelf, with moderate density increases to the north (**Figure 25**). Many euphausiids were observed. The observed abundance of small copepods (< 2 mm) was moderate and similar to colder years but reduced in comparison to more recent warm years (**Figure 26**). Fewer lipid-rich large copepods (*Calanus)* means less high-quality food for age-0 pollock on the southeast Bering Sea shelf, and reduced small copepods suggests lower productivity on the shelf.

Contact: Dave Kimmel

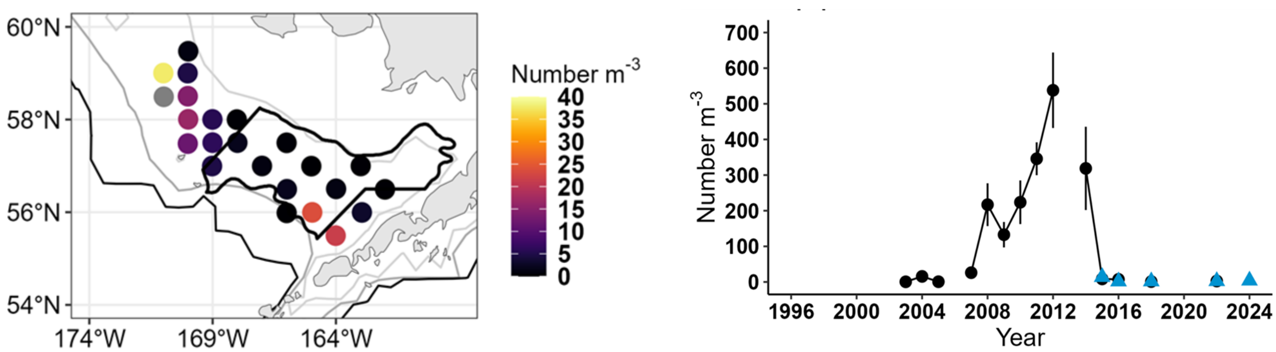


Figure 25. Fall 2024 southeast Bering Sea Rapid Zooplankton Assessment of large copepod (> 2 mm) abundance as a mapped density distribution (left panel) and time-series (right panel). Time-series data shows lab processed data (black circles) as well as RZA samples that are processed at sea (blue triangles).

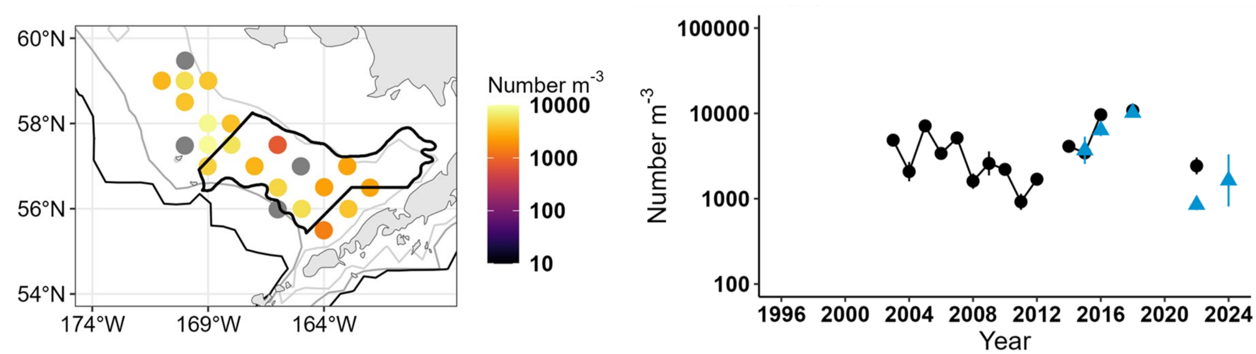


Figure 26. Fall 2024 southeast Bering Sea Rapid Zooplankton Assessment of small copepod (< 2 mm) abundance as a mapped density distribution (left panel) and time-series (right panel). Time-series data shows lab processed data (black circles) as well as RZA samples that are processed at sea (blue triangles).

2024 Highlighted Surveys in the Bering Sea

Many of the 2024 AFSC and Pacific Marine Environmental Lab (PMEL) surveys in the Bering Sea are described in detail in the link: https://www.fisheries.noaa.gov/alaska/science-data/2024-alaska-fisheries-science-center-field-season. Select excerpts are included below. Credit: NOAA Fisheries.

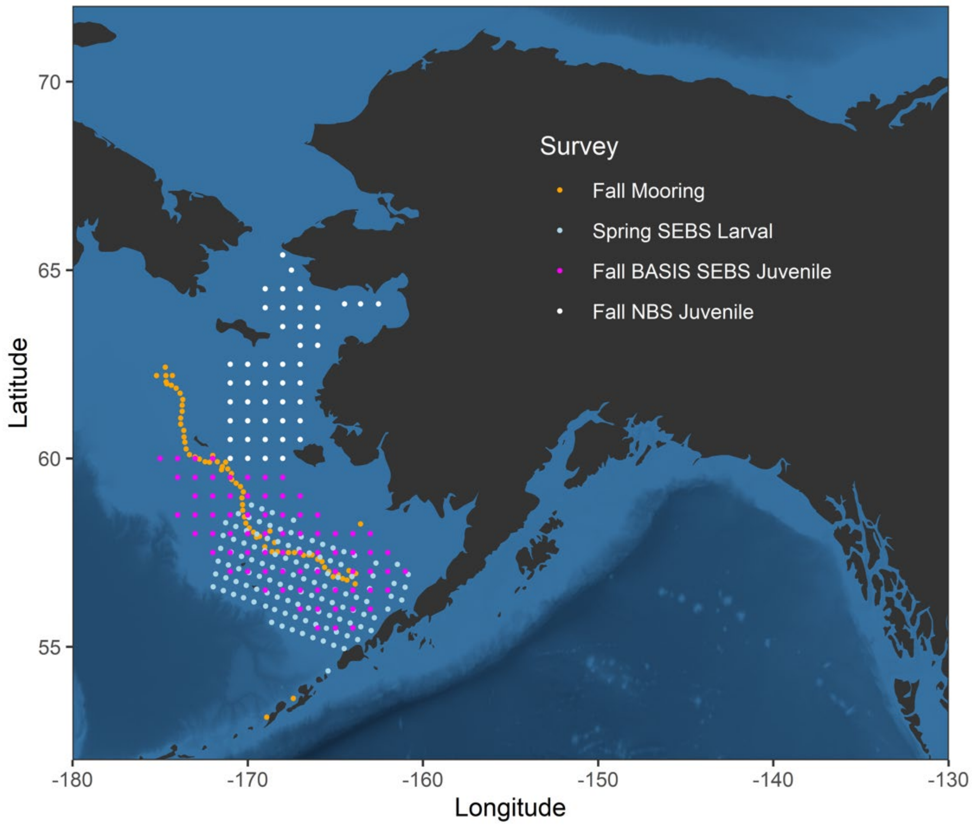


Figure 27. Surveys including physical oceanography (all stations), lower trophic level and juvenile fish sampling. Oceanographic, lower tropic level, and mooring survey stations in spring (light blue) and fall (orange), Northern Bering Sea juvenile fish survey stations in fall (white), and similar BASIS southeastern Bering Sea survey in fall (pink). Figure courtesy of the Recruitment Processes Alliance (RPA, NOAA AFSC).

Spring and Fall Mooring Cruise in the Bering Sea (**Figure 27**). The Spring survey occurred from April 26 to May 10, 2024, and the fall survey occurred from September 3-26, 2024. This annual survey provides baseline fisheries and oceanographic data to support sustainable management of living resources in the Bering Sea and the rapidly changing US Arctic ecosystem. The goals of the survey include the recovery and deployment of NOAA biophysical and passive acoustic moorings located in the Bering Sea, perform CTD measurements, as well as Bongo and net tow surveys for zooplankton and fish larvae at long-term sampling sites. *Survey contact: Heather Tabisola (NOAA AFSC)*

EcoFOCI Spring Icthyoplankton Survey from May 17 – 31, 2024 in the eastern Bering Sea. The primary objective of the EcoFOCI Spring Ichthyoplankton Survey is to assess eggs and larvae of commercially-important fishes, including walleye pollock and Pacific cod, over the eastern Bering Sea shelf. Observations

support research on fisheries recruitment processes and contribute to our understanding of how young fish and their zooplankton prey respond to changes in climate.
Survey contact: Kelia (Keely) Axler (NOAA AFSC)

Annual Bottom Trawl Survey of the Eastern Bering Sea from May 27 – August 20 in the eastern Bering Sea. The 2024 Eastern Bering Sea Bottom Trawl Survey was led by scientists from the Alaska Fisheries Science Center with participation from the Alaska Department of Fish & Game (ADF&G), International Pacific Halibut Commission (IPHC), and regional universities.

The objectives of this survey are to monitor the marine ecosystem of the eastern Bering Sea, produce fishery independent biomass and abundance estimates for commercially important fish and crab species, and collect other biological and environmental data for use in ecosystem-based fishery management.

The data will be used by scientists to track abundance and distribution trends of fish, crab, and other bottom-dwelling marine species over time. Biological and oceanographic data will also be used in ecosystem modeling efforts conducted by AFSC and other scientists. All data will be made available to the public.
Survey contact: Duane Stevenson (NOAA AFSC)

Summer Acoustic-Trawl Survey of Walleye Pollock in the Bering Sea from June 5 – July 20, 2024. The objective is to estimate the abundance and distribution of age-1+ walleye pollock (Gadus chalcogrammus) across the eastern Bering Sea shelf to inform stock assessment modeling and resource management. Scientists used acoustic backscatter and targeted trawling to achieve this objective. In addition, data on forage species (e.g., krill) was collected, and related research on small camera systems and the feasibility of nighttime acoustic survey sampling was done.
Survey contacts: Denise McKelvey, Abigail McCarthy, and Sandy Parker-Stetter (NOAA AFSC)

Northern Bering Sea Ecosystem and Surface Trawl Survey from September 2 – 26 (Figure 9). The 2024 Northern Bering Sea Ecosystem and Surface Trawl survey is a multi-disciplinary research survey by the Alaska Fisheries Science Center (AFSC), the Alaska Sustainable Salmon Fund (AKSSF), Alaska Department of Fish and Game (ADF&G), the University of Alaska, U.S. Fish and Wildlife Service (USFWS), and the Pacific Marine Environmental Laboratory.

Objectives of the survey were to collect information on: 1) physical and biological oceanographic conditions, 2) phytoplankton community composition and the presence of harmful algal bloom (HAB) species and toxins, 3) distribution, abundance, and size of salmon and other pelagic fish species with surface trawl operations, 4) diet, condition, and trophic ecology of fish, 5) environmental DNA and genetic origin of salmon, 6) ecology of juvenile snow crab and yellowfin sole with benthic grab and beam trawl operations, 7) distribution and abundance of seabirds, and 8) salmon shark migration.
Survey contacts: Jim Murphy, Dan Cooper, and Ed Farley (NOAA AFSC), and Sabrina Garcia and Katie Howard (ADF&G)

Gulf of Alaska

Sea Surface Temperature (SST)

Satellite derived estimates of SST for the western and eastern Gulf of Alaska were compiled by Matthew Callahan (NOAA AFSC). The western Gulf of Alaska SSTs in 2024 were similar to the long-term mean (1985-2014, **Figure 28**). The eastern Gulf of Alaska experienced above average (warmer) SST values in winter and spring (December 2023 – May 2024) as well as parts of July and August 2024. This included periods of moderate heatwave intensity in December 2023, January 2024, and May 2024. The eastern Gulf of Alaska SST values were near average values in late May, June, and late August/early September. The Time series SST data and plot are updated daily and available at https://shinyfin.psmfc.org/ak-sst-mhw/.

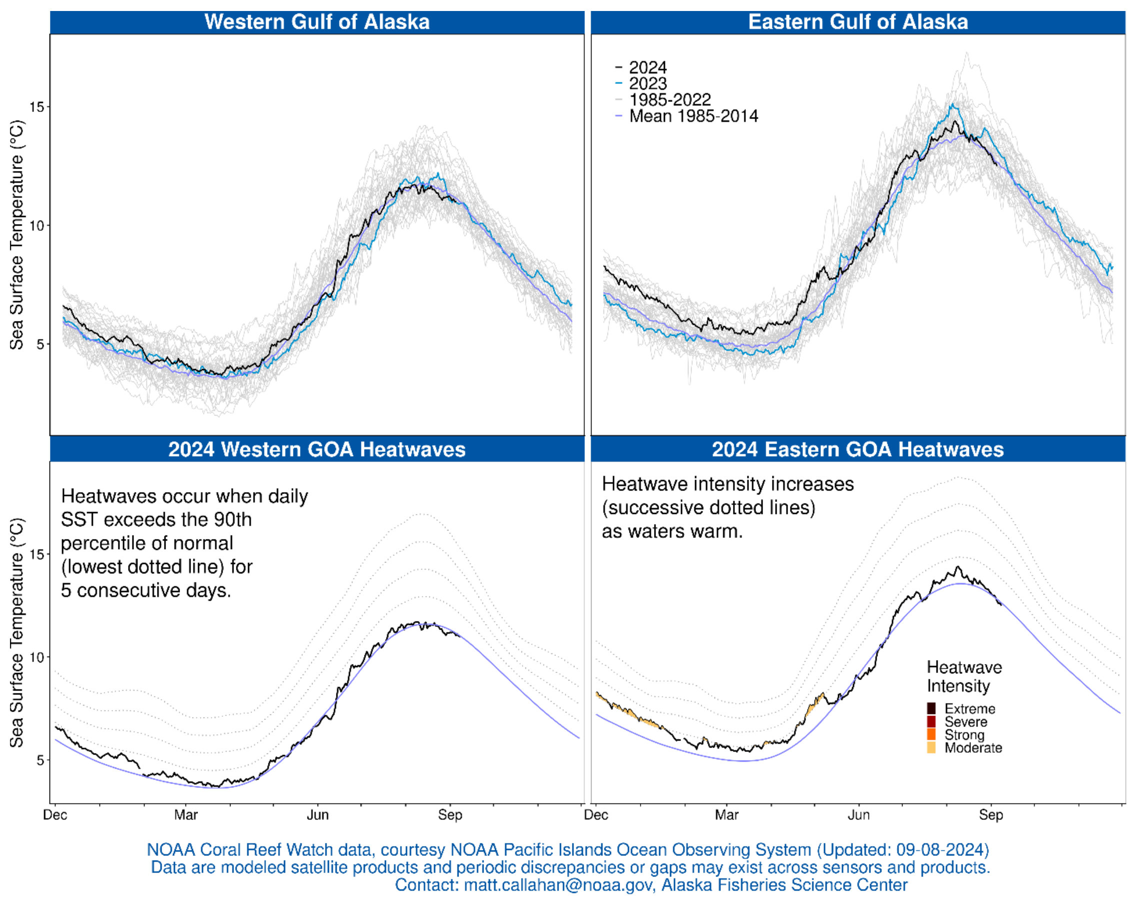


Figure 28. Daily mean SST for 2023 and 2024 compared to long-term mean (1985-2015) for the western and eastern Gulf of Alaska (GOA) from satellite derived SST estimates.
Figure courtesy of Matt Callahan, NOAA AFSC.

Spring phytoplankton blooms

Satellite chlorophyll-a (chl-a) data, a proxy for phytoplankton biomass, allows analysis of large-scale patterns in phytoplankton dynamics. Weekly averaged satellite Chl-a estimates from the Gulf of Alaska using near real time VIIRS (https://shinyfin.psmfc.org/ak-chlorophyll/) show noticeable nearshore coastal blooms in late April 2024, and with evidence for several larger eddies resulting in enhanced chl-a and offshore blooms by early May (**Figure 29**).

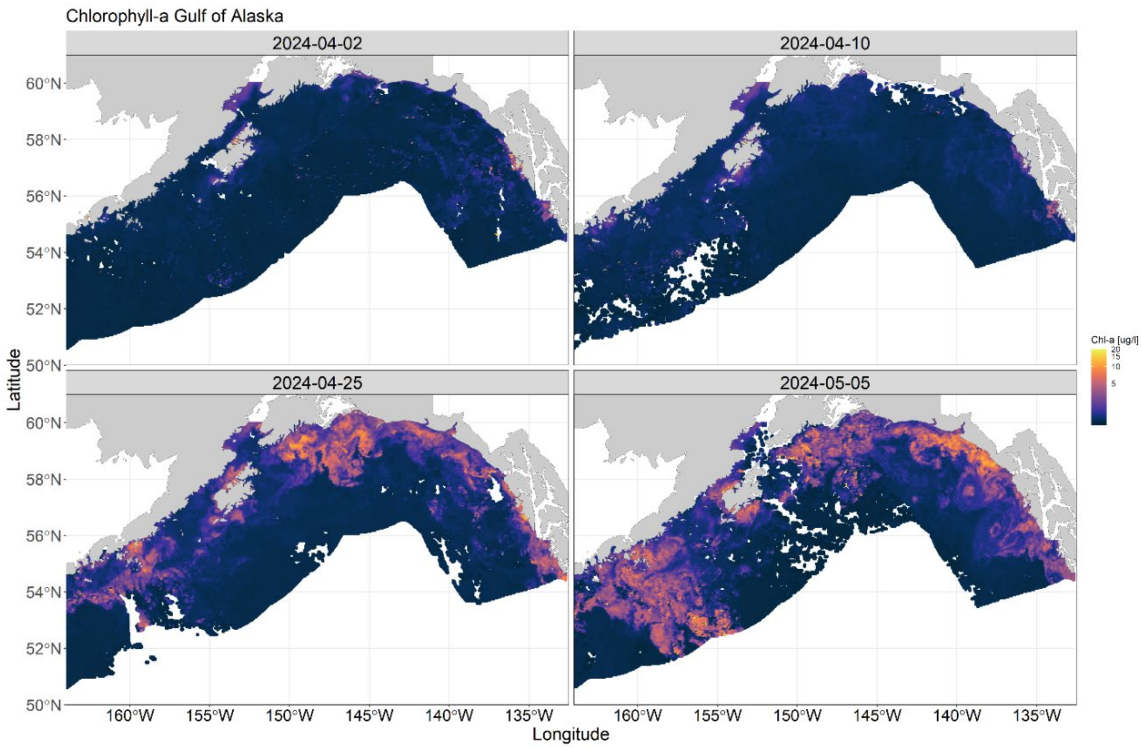


Figure 29. Weekly averaged satellite Chl-a estimates from the Gulf of Alaska using near real time VIIRS (https://shinyf in.psmfc.org/ak-chlorophyll/).

2024 Highlighted Surveys in the Gulf of Alaska

Many of the 2024 AFSC and PMEL surveys in the Gulf of Alaska are described in detail in the link: https://www.fisheries.noaa.gov/alaska/science-data/2024-alaska-fisheries-science-center-field-season. Select excerpts are included below. Credit: NOAA Fisheries.

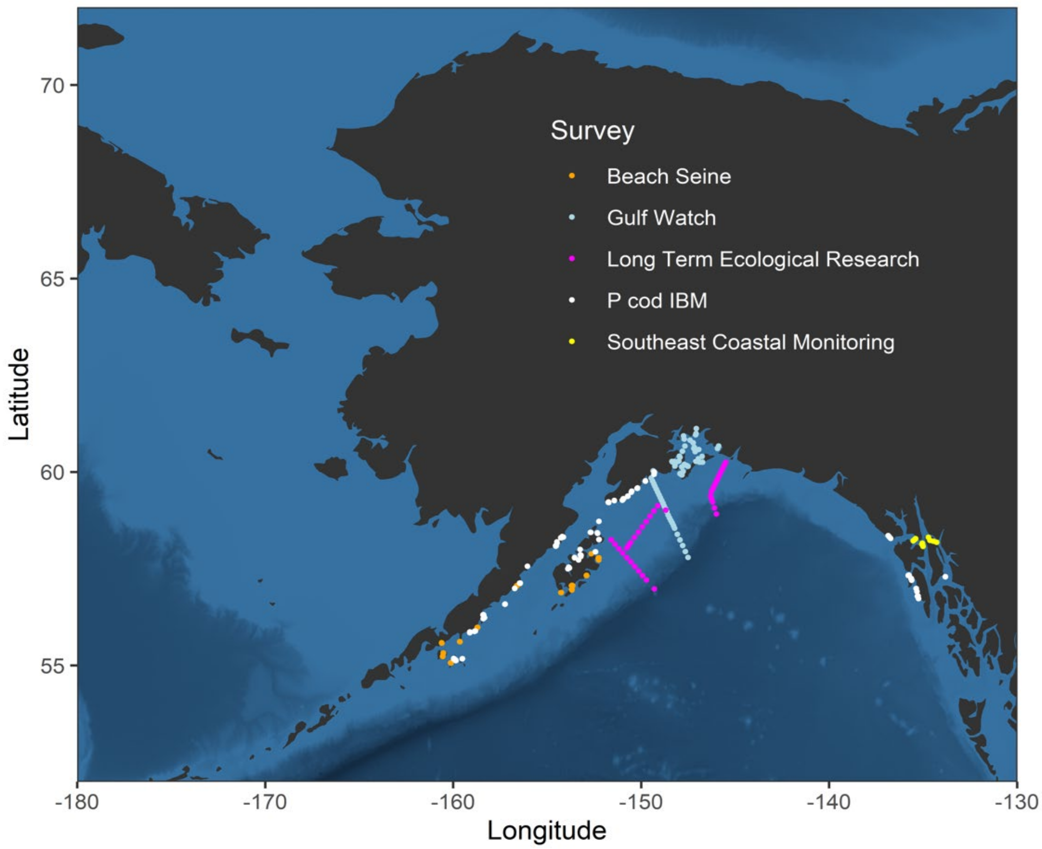


Figure 30: Surveys including physical oceanography, lower trophic level and juvenile fish sampling. Survey stations from the Gulf of Alaska including beach seine (orange), Gulf Watch Alaska (light blue), Northern Gulf of Alaska Long-term Ecological Research Site (pink), juvenile Pacific cod individual-based model study (white), and Southeast Coastal Monitoring (yellow). Figure courtesy of the Recruitment Processes Alliance (RPA, NOAA AFSC).

<u>Southeast Coastal Monitoring (SECM)</u> *(Excerpt, Fergusson and Strasburger 2024 ESR)*

The Southeast Coastal Monitoring project (SECM, Auke Bay Laboratories, AFSC) has been investigating how climate change may affect Southeast Alaska (SEAK) nearshore ecosystems in relation to juvenile salmon and associated biophysical factors since 1997 (Murphy et al. 2020, Fergusson et al., 2020a). Spring/summer zooplankton lipid content data have been collected annually in Icy Strait since 2013 (Figure 12). Juvenile pink (*O. gorbuscha*), chum (*O. keta*), sockeye (*O. nerka*), and coho (*O. kisutch*) salmon size data have been collected annually in Icy Strait during monthly (June and July) fisheries oceanographic surveys. We report July 2024 size (fork length) data in relation to the past 28-year trend from Icy Strait (**Figure 31**) and 2024 zooplankton mean lipid content (% wet weight) anomalies for specific taxa in relation to the 12-year trend in Icy Strait (**Figure 32**). These zooplankton are an important prey resource to fish that reside in Icy Strait. Total percent lipid content was determined using a modified colorimetric method (Van Handel, 1985). *Survey contacts: Wesley Strasburger and Emily Fergusson (NOAA AFSC)*

The length anomalies observed in 2024 for juvenile salmon continue to reflect the colder water temperatures experienced in their early marine residency in Icy Strait. Larger fish generally have increased foraging success and a decreased predation risk resulting in higher survival. Based on the 2024 length frequency results relative to the long-term averages by species, juvenile salmon are entering the Gulf of Alaska (GOA) in 2024 with below-average size. Further growth and survival will be dependent on favorable over-winter conditions in the GOA.

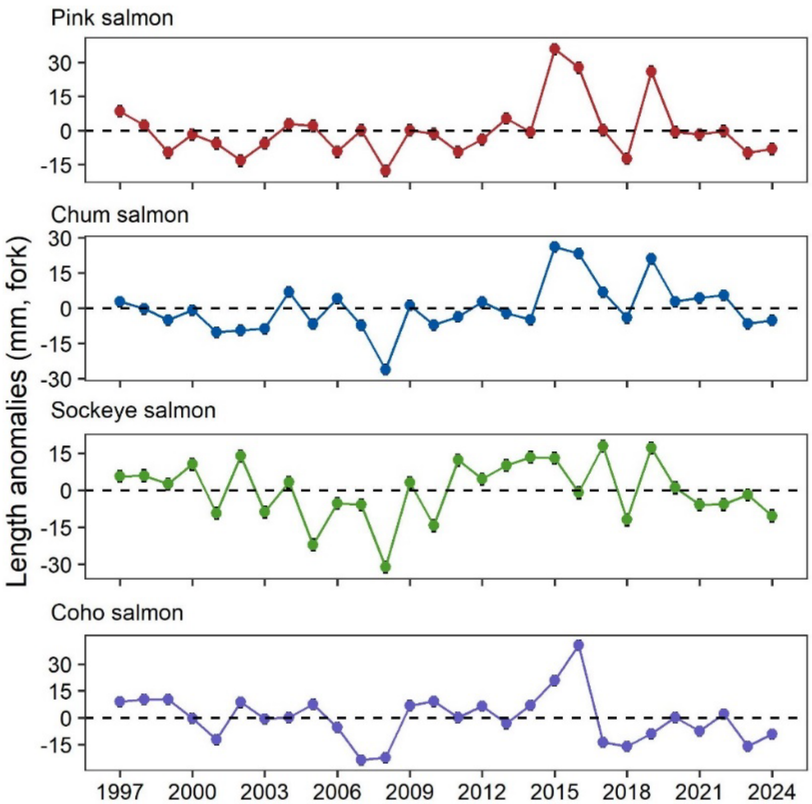


Figure 31. Average fork length (mm; ±1 standard error) anomalies of juvenile salmon captured in Icy Strait, AK by the Southeast Coastal Monitoring project, 1997-2024. Time series average is indicated by the dashed line. Figure courtesy of Emily Fergusson, NOAA AFSC.

The zooplankton nutritional quality in 2024 suggest positive feeding conditions for larval and juvenile stages of many commercially and ecologically important species of fish (ex. pollock, salmon, and herring) that reside in Icy Strait, which may directly or indirectly affect fish growth and recruitment. Additionally, a qualitative assessment of zooplankton abundance found that abundance was above average for most zooplankton taxa, which, in conjunction with the nutritional quality, suggests positive feeding conditions available in Icy Strait.

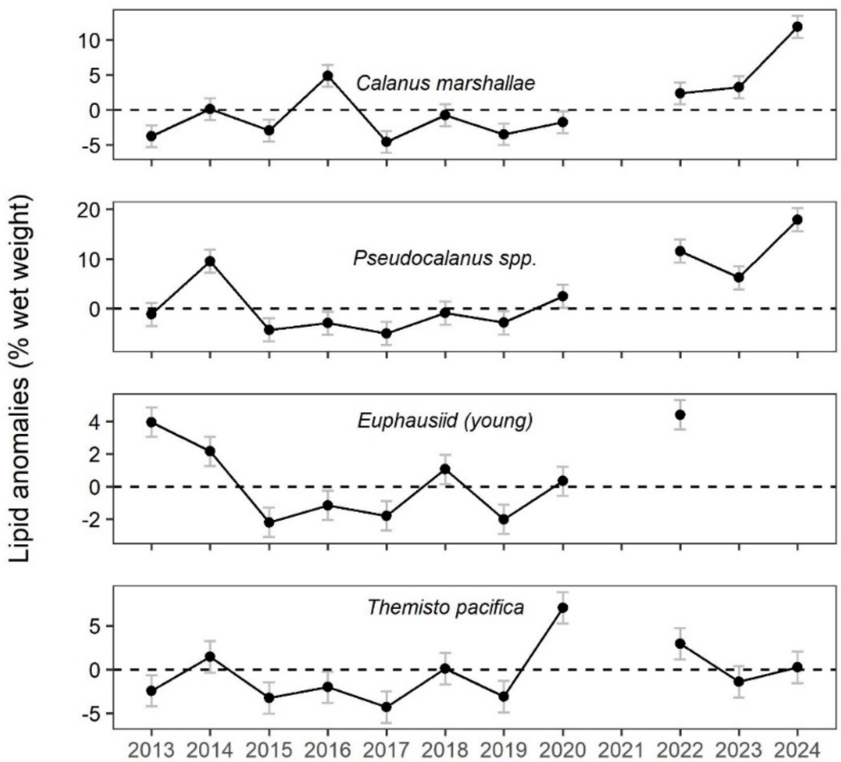


Figure 32. Lipid content (% wet weight) anomalies with error bars (standard error) from key zooplankton taxa collections in Icy Strait, AK by the Southeast Coastal Monitoring project, 2013-2024. The dashed line represents the time series mean lipid content. There is no data for 2021 and no data for euphausiids in 2023 or 2024. Higher nutritional quality prey items indicated by positive anomalies. Figure courtesy of Emily Fergusson, NOAA AFSC.

Pacific Cod IBM Survey in June and July 2024. This is the 3rd of a 4-year study validating the Juvenile Pacific Cod Individual Based Model (IBM) developed under the GOA-Integrated Research Program. The IBM predicts strength of juvenile Pacific cod settlement in the nearshore throughout the Gulf of Alaska based on annual oceanographic conditions and cod ecology (**Figure 33**). Abundances of age-0 and age -1 Pacific cod from field sampling are being compared IBM-predicted settlement fractions for each nearshore nursery area in the GOA to validate the model predictions. Habitat-abundance relationships, daily ages from otoliths, and genetics will also be used to refine the model predictions. This is a multi-faceted project led by RECA staff in collaboration with REFM, CICOES, UAF, ABL Genetics.

This summer the abundance of juvenile Pacific cod was quantified from 38 sampling locations in nearshore areas between Southeast Alaska and the Shumagin Islands (**Figure 34**) using baited underwater cameras (**Figure 35**) and beach seines. Juvenile cod were collected from each location for aging, and energetic and genetic analyses. A total of 151 beach seines and 257 camera deployments were conducted. Juvenile Pacific cod occurred in 71% of the beach seine samples. HOBO temperature loggers were deployed at 25 stations to collect year around temperature data. Each buoy marking a HOBO deployment had a tag with a QR code (see attached) to direct interested individuals to a website describing the project. The website will continue to be updated with information and data throughout the remainder of the project.
Contacts: Johanna Page and Katharine Miller (NOAA AFSC)

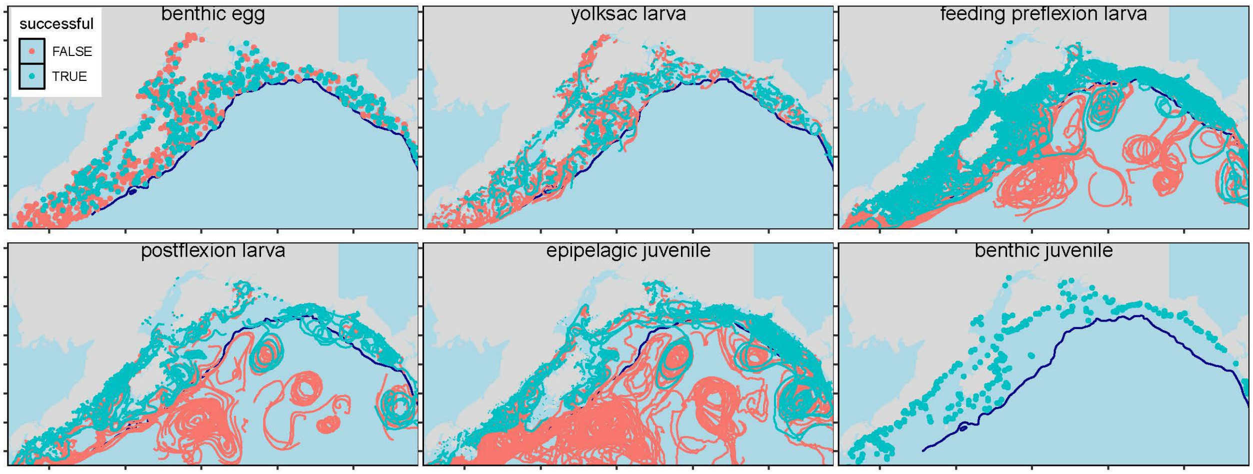


Figure 33. Juvenile Pacific Cod Individual Based Model (IBM) developed under the GOA-Integrated Research Program. This map shows where the model predicts Pacific cod to be at the different developmental stages from offshore spawning to nearshore settlement areas. The model incorporates the Regional Ocean Modeling System (ROMS) model (includes annual freshwater run-off, oceanographic currents), and ecological aspects of Pacific cod throughout their early developmental stages.

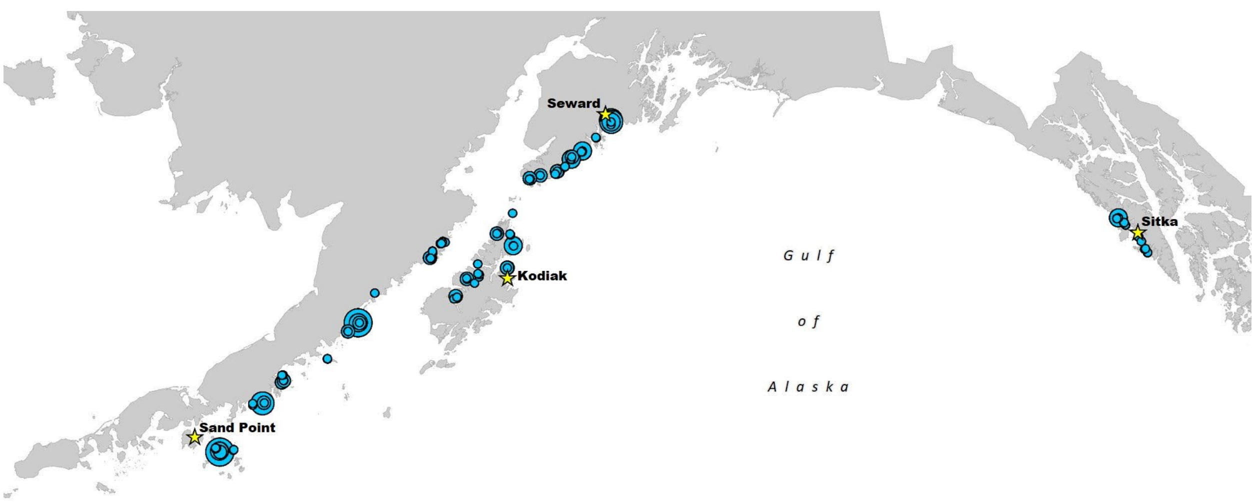


Figure 34. Pacific cod IBM project sampling in June and July 2024 included 38 sampling locations in nearshore areas between Southeast Alaska and the Shumagin Islands.


Figure 35. Image captured small Pacific cod with one of the baited cameras.

Gulf of Alaska Coral Settlement Plate Recovery and Deployment from August 3 – 6, 2024. This survey included scientists from the Alaska Fisheries Science Center and Tjärnö Marine Laboratory University of Gothenburg, Sweden with support from the Deep Sea Coral Research and Technology Program and North Pacific Research Board.

This is the third field excursion for this project and includes two objectives; 1) to continue investigating recruitment processes of a dominant deep water coral species in the Alaska region, Primnoa pacifica (red tree coral), utilizing Artificial Reef Monitoring Structures (ARMS); 2) to investigate fertilization and larval ecology in Primnoa pacifica specimens collected in the field. Once back in the laboratory, the specimens will be divided into three groups: a) one group will be kept for general observation, b) a second group will be strip-spawned and examined for motile sperm, count concentrations, and fertilization, c) a third group will be preserved for histology to confirm reproductive phases.
Survey Contacts: Rhian Waller, Lara Maleen Beckmann (University of Gothenburg, Sweden), and Jerry Hoff (NOAA AFSC)

Aleutian Islands Biennial Summer Bottom Trawl Survey from June 4 – August 13, 2024. The Alaska Fisheries Science Center of NOAA Fisheries conducts the biennial bottom trawl surveys aboard chartered commercial fishing vessels (**Figure 36**). Survey teams consist of commercial fishers and survey scientists including NOAA staff, contractors, and fishery observers.

The research objective is to characterize the ecologically and economically important fish, crab, and other species that live on or near the seafloor. The standardized survey fishing methods of the provide observations of species, their densities, and biological characteristics such as length, gender, age, and feeding habits. These observations become abundance time series used in stock assessments and ecological models.

Survey contact: Ned Laman (NOAA AFSC)

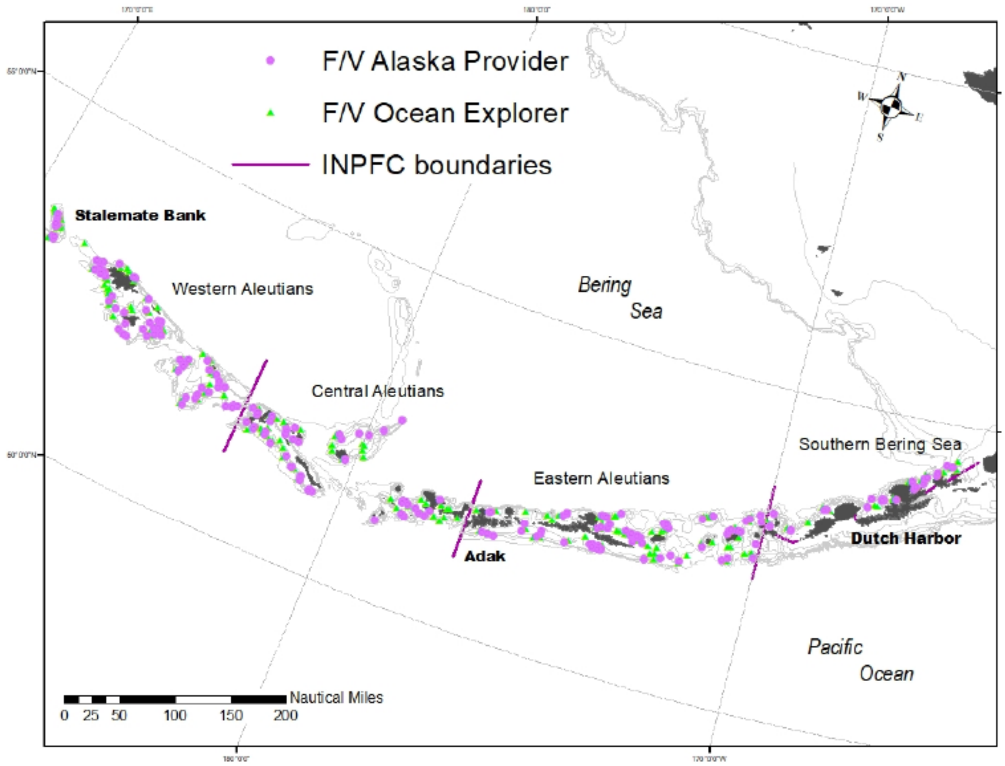


Figure 36. Survey area and station map for 2024 Aleutian Islands bottom trawl survey. There are 400 stations allocated to 2 chartered fishing vessels across the ~1,700 km from Unimak Pass to Stalemate Bank.

3. China

Buoy Observations of Hypoxia off the Yangtze River Estuary, 2023-2024

The Observation and Research Station of Yangtze River Delta Marine Ecosystems (MORSE marine station, Figure 1) was established to monitor the status of marine ecosystems right outside of the mouth of the Yangtze River in 2009. One of the notable ecological problems is hypoxia here. Hypoxia off the Yangtze River Estuary (YRE) is one of the largest hypoxic areas in the world. Years of cruise observations since 1999 and dig data before that showed that the dissolved oxygen (DO) concentration off the estuary has a decreasing trend and a remarkable fluctuation in different time ranging from tidal scale to decadal scale. A buoy-based observational plan named the Second Institute of Oceanography Hypoxia Observation Time Series (SHOTS) was set up to monitor summer hypoxia since 2009 except for the interruption in 2012.

The SHOTS buoy system consists of a surface buoy and a sub-mooring (Figure 2). The surface buoy supports the monitoring instruments of 3 to 4 layers in the vertical, consisting of the top cell at the surface and 2-3 cells within the pycnocline. The sub-mooring uses a TRBM to acquire data at the bottom. Coupled inductive and acoustic communication technologies are comprehensively used to transmit the underwater data measured to the surface buoy; then the surface buoy data logger sends all the data to the shore station via satellite and cellphone. The parameters observed by the buoy are sea temperature, salinity, dissolved oxygen, turbidity, Chl a, nitrate, pH and current.

During the summer of 2023, the buoy system conducted continuous observations in the YRE, with four layers of observations from the surface to the seafloor, including meteorological, current, temperature, salinity, dissolved oxygen, chlorophyll, nitrate, and pH from August 11 to December 31 (Figure 3 and 4). During the summer of 2024, the buoy system was deployed in July 21, with five layers of observations from the surface to the seafloor, including the same parameters as in 2023.

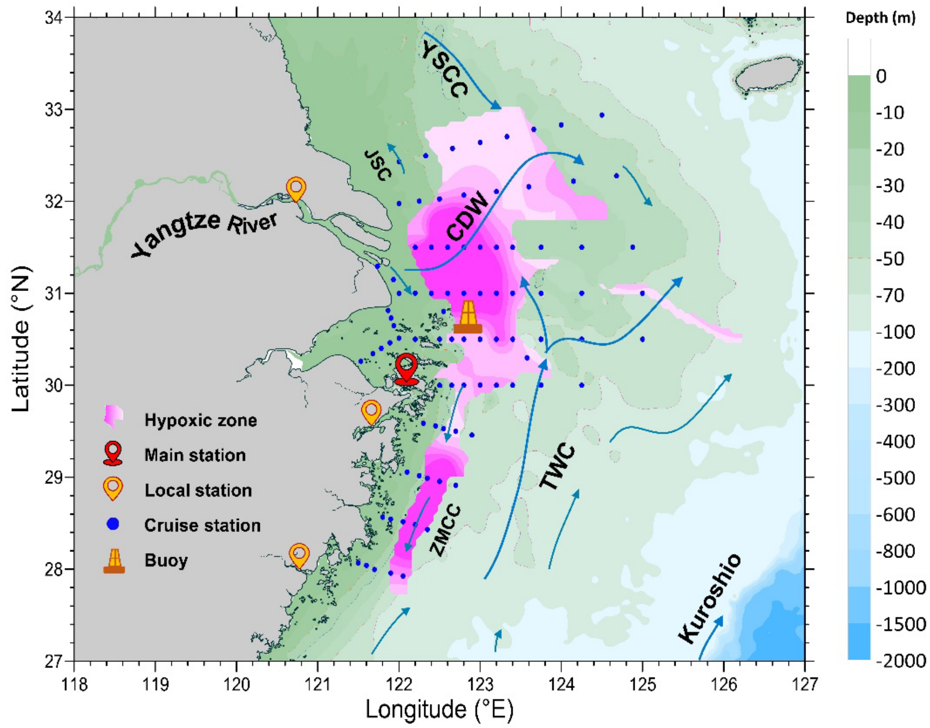


Figure 1. Map of MORSE with reported historic hypoxia zones (pink shading) and schematic of the summer circulation off the YRE. CDW: Changjiang (Yangtze River) Diluted Water; YSCC: Yellow Sea Coastal Current; TWC: Taiwan Warm Current; JSC: Jiangsu Shoal Current; ZMCC: Zhe-Min Coastal Current.

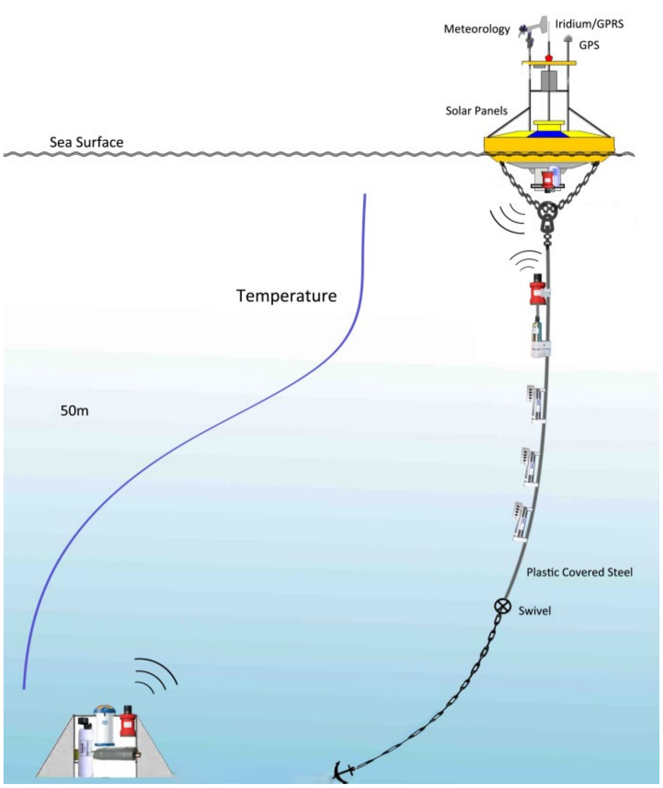


Figure 2. (Top) The sketch of real-time buoy system. (Bottom) Buoy deployment at sea.

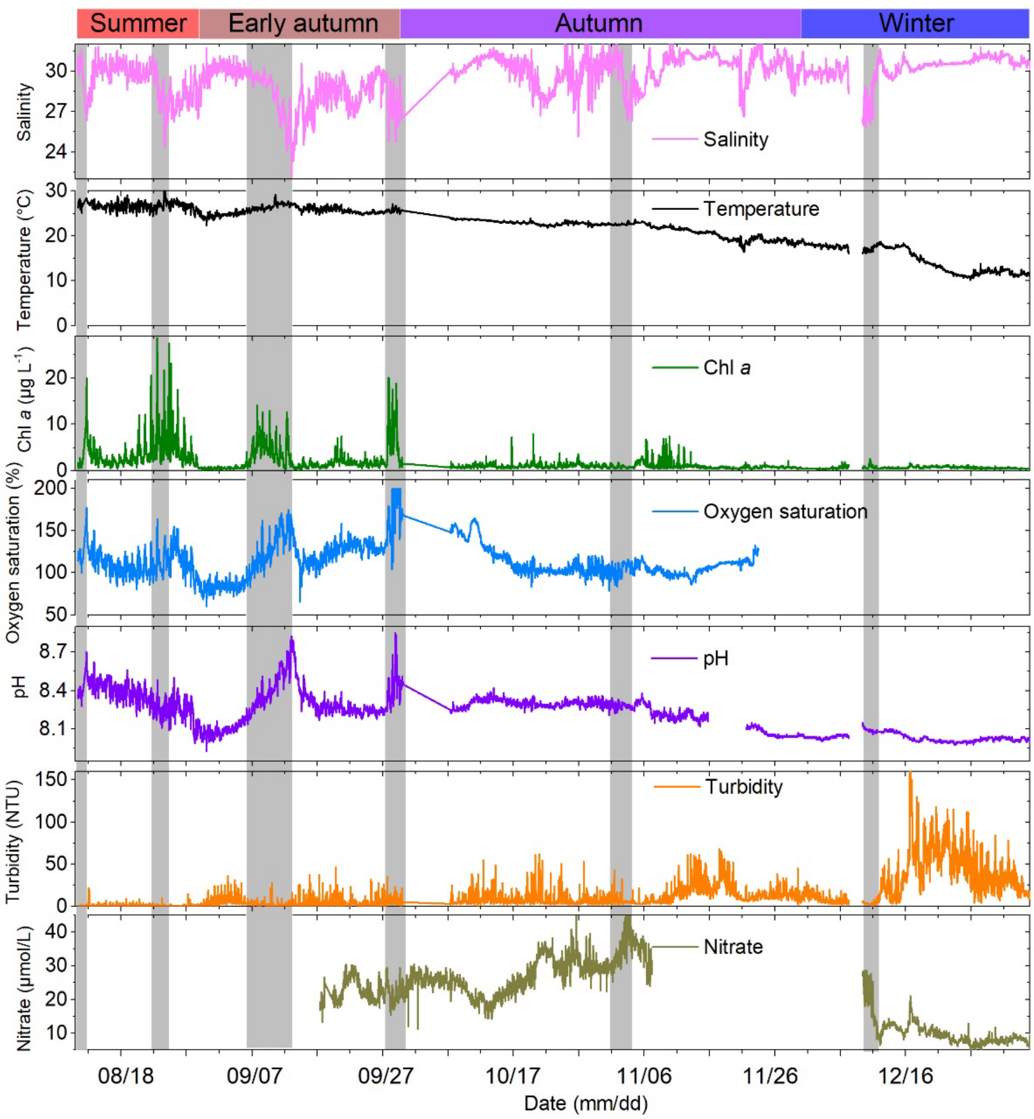


Figure 3.The time-series data of surface salinity, temperature, chlorophyll-a, DO saturation, pH, Turbidity, and Nitrate from summer to winter in 2023

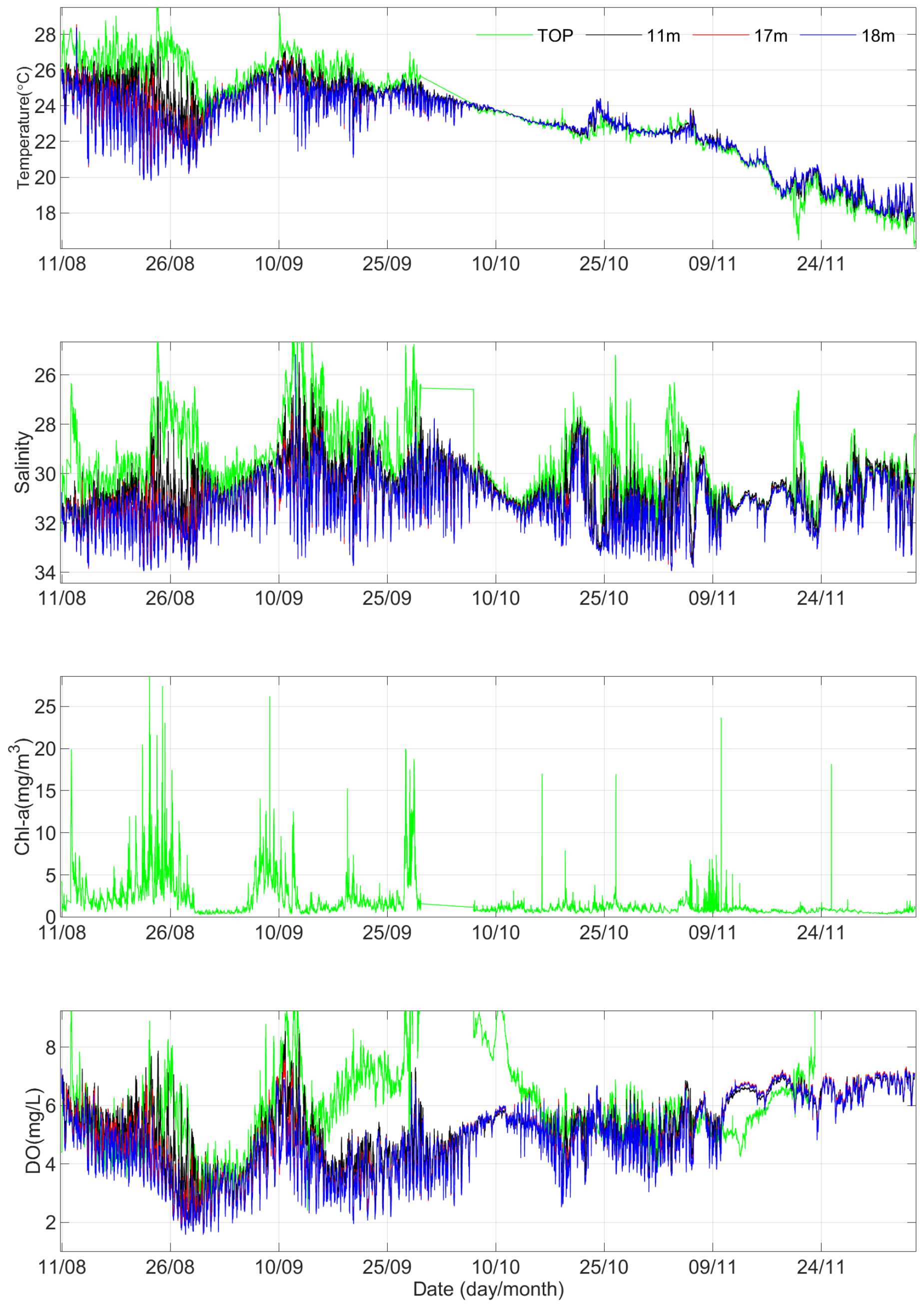


Figure 4.The time-series data of temperature, salinity, chlorophyll-a, and DO at four depths in summer 2023

4. Republic of Korea

1. National Institute of Fisheries Science (NIFS)

Marine Heatwaves (MHWs) monitoring in the Korea Waters

In summer of 2024, the marine heatwaves were started from mid-July and were continued to mid-August because of maintaining for a long time of strong heatwaves around the Korea Peninsula. In this period, SSTA (Sea Surface Temperature Anomaly) around the Korea Peninsula was about 1~3°C. To serve real-time water temperature along the coast of Korea, NIFS operates 140 real-time water temperature monitoring system with 30-minute interval. In addition, NIFS issues abnormal water temperature warning to minimize the fisheries damage in aqua-farm when the abnormal water temperature appears in the coastal area.

2. Korea Meteorological Administration (KMA)

Ocean weather observation system around the Korea Peninsula

KMA operates 34 ocean data buoys to observe the wind, air pressure, humidity, water temperature, wave heights and wave direction in the Korea Waters. They will install large-scale marine data buoys in this year, consisting of one 10-meter buoy in the coastal area of the Yellow Sea, and replaced old 3-meter buoys with the New buoy.

3. Korea Hydrographic and Oceanographic Agency (KHOA)

Real-time Korea Ocean Observing Network

KHOA operates the Korea Ocean Observing Network (KOON) which consists of tidal stations, ocean stations, ocean research stations, ocean buoys, and surface current stations (HF-Radar). KOON, composed of 139 stations, provides real-time ocean information with improved data quality for the needs of the maritime policy, the maritime industry, and the public activities. KHOA currently operates 54 tidal stations, 2 ocean stations, 3 ocean research stations, 36 moored ocean buoys, and 44 HF radar stations.

The Korean coast experienced an average sea level rise of 3.03 mm/yr over the past 34 years (1989-2022). Notably, the recent 10-year period from 2013 to 2022 witnessed a significant increase of 4.51 mm/yr, approximately 1.3 times higher compared to the 30-year average.

5. Japan

National Report of Japan Fisheries Research and Education Agency (FRA) (by Kazuaki Tadokoro, Fisheries Resources Institute, Shiogama field station)

Zooplankton sample collection of Japan Fisheries Research and Education Agency

FRA has been collecting zooplankton samples from the 1950s to the present. The sampling gear includes NORPAC nets, Bongo nets, larval nets, Neuston nets, MTD nets, VMPS, IKMT, MOHT, and more. As of August 30, 2024, 281,607 samples have been collected. These samples are preserved in 5% buffered formaldehyde and stored in a dedicated facility at the FRA Fishery Resources Institute, Shiogama Field Station (Fig. 1). The primary sampling area is the waters around Japan, but samples have also been collected from the western North Pacific, central North Pacific, and Peruvian waters. Samples were collected by FRA, prefectural fisheries institutes, the Japan Meteorological Agency, and universities. These samples have been used to study the relationship between marine ecosystems and climate change, as well as the biodiversity of marine ecosystems.

(a)

(b)

Fig. 1 Sample storage building at Shiogama field station of FRA Fishery Resources Institute. Exterior (a) and inside (b) of the Building.

Geographical and seasonal variation of mesozooplankton community around Japan in 2012

The community structure of zooplankton in this region has not been thoroughly understood. To gain insights into the community structure and its geographical and seasonal variations, we analyzed zooplankton samples collected at stations established by the Japan Fisheries Research and Education Agency and a prefectural institute in 2012. The zooplankton communities were classified into four groups through cluster analysis. Group 1 is considered a cold-water community, as it mainly comprises cold-water species (Table 1). Group 2 represents a transitional community, consisting of both cold- and warm-water species. Both Group 3 and Group 4 are considered warm-water communities, with Group 3 exhibiting a higher abundance of neritic species. Clear seasonal shifts in the zooplankton communities were observed in the waters around Japan. In the Oyashio waters, Group 1 predominated from winter to summer, followed by Group 2 in autumn (Fig. 2). In the Kuroshio waters, Group 3 was dominant from winter to spring, while Group 4 prevailed from summer to autumn. In the Sea of Japan, Group 3 mainly appeared from winter to summer in the southern part, while the northern part exhibited a prevalence of

Group 2. Summarizing the results (Fig. 3), from winter to spring, the warm Group 1 appeared in the southern part of the waters, the transitional group appeared in the mid-region, and the cold group appeared in the Oyashio region. In summer, the warm Group 1 disappeared, shifting to the warm Group 2. In autumn, the cold group disappeared, transitioning to the transitional group, while the distribution of warm Group 2 expanded northward. These changes are likely related to the seasonal temperature increase around Japan. These results suggest that temperature changes affect the seasonal and geographical variations of the zooplankton community.

Table 1 The dominant species for each group

	a Cold group	N haul^{-1}	**b** Transition group	N haul^{-1}	**c** Warm group 1	N haul^{-1}	**d** Warm group 2	N haul^{-1}
1	Pseudocalanus newmani	538	Pseudocalanus newmani	1281	Penilia avirostris	534	Flaccisagitta enflata*	232
2	Metridia pacifica	334	Oithona atlantica*	1133	Paracalanus parvus parvus	231	Paracalanus aculeatus aculeatus*	229
3	Eucalanus bungii	248	Clausocalanus pergens*	442	Ditrichocorycaeus affinis	227	Clausocalanus furcatus*	185
4	Neocalanus plumchrus	174	Ditrichocorycaeus affinis	214	Pseudevadne tergestina	225	Oncaea venusta	149
5	Pseudocalanus minutus*	172	Metridia pacifica	183	Oithona longispina	221	Oithona plumifera	145
6	Oithona similis	157	Paracalanus parvus parvus	158	Oithona plumifera	170	Clausocalanus minor*	101
7	Triconia borealis	74	Ctenocalanus vanus	132	Ctenocalanus vanus	161	Mesosagitta minima	79
8	Neocalanus flemingeri*	68	Oithona longispina	114	Calanus sinicus	130	Penilia avirostris	75
9	Oithona atlantica	59	Neocalanus plumchrus	88	Evadne nordmanni	102	Oncaea mediterranea	69
10	Neocalanus cristatus*	46	Penilia avirostris	74	Oncaea venusta	77	Canthocalanus pauper*	59
	Others	226	Others	816	Others	1087	Others	1489
	Total	2096	Total	4635	Total	3165	Total	2812

*Inidicator species（p < 0.0001、indicator value > 0.7）

Blue: cold species
Red: warm species
Green: cosmopolitan

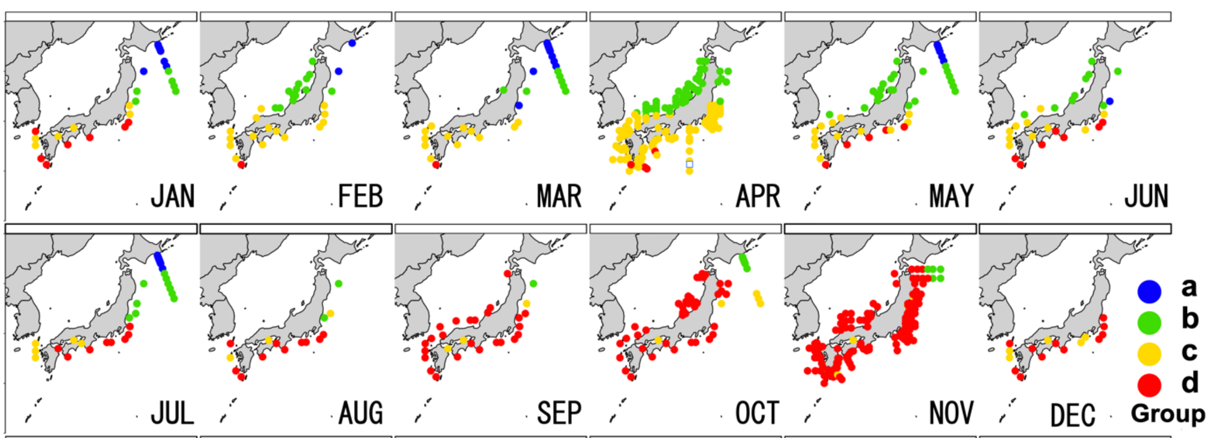


Fig.2 Distribution of each group in 2012

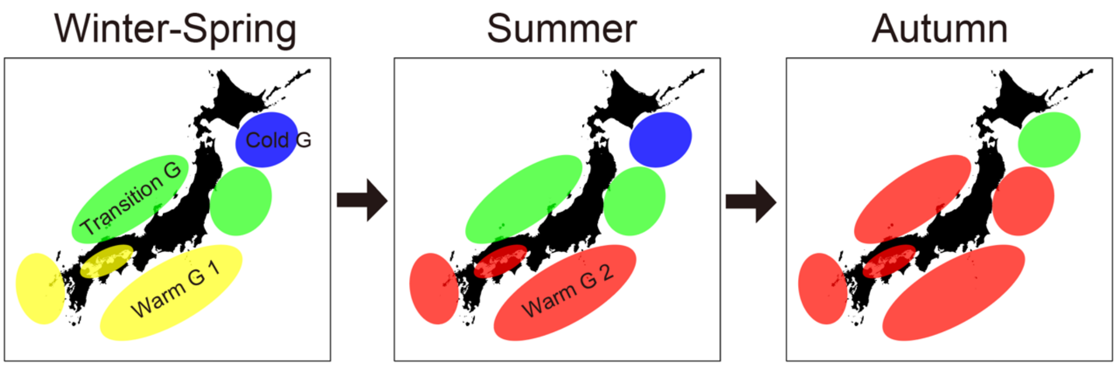


Fig.3 Schematic of seasonal change of geographical distribution of zooplankton community

National report from Hokkaido University, Japan (by Hiroto Abe at Faculty of Fisheries Sciences)

Hokkaido university has two training ships, one is *Oshoro-Maru* and the other is *Ushio-Maru*. The former has contributed to monitoring open ocean/marginal seas in the North Pacific including Bering Sea over the decades, while the latter has monitored coastal areas around Hokkaido island, Japan. In this year's report, I would like to introduce our monitoring effort conducted by *Ushio-Maru* in Funka bay, Hokkaido, Japan (Fig. 4). Funka bay is a cone-shaped bay with having maximum bottom depth of approximately 100 m, which is closed except for southeast entrance where Oyashio and Kuroshio-originated water flows in. This bay is rich in fishery resources such as cod, octopus, salmon, flat fish, and famous for aqua farming for scallop as well. In summer, when tight stratification forms in the upper layer, the bottom layer is isolated without oxygen supply from the surrounding and suffers severe oxygen depletion. Using mooring, we have monitored ocean environment in terms of water temperature, salinity, oxygen, and ocean current since 2012. The result of water temperature is shown in Fig. 5. Water temperature at 10 m depth ranges 2 °C to 24 °C. Last year showed record-breaking highest water temperature in summer. Summer water temperature usually ranges from 18 to 22 °C, but 2023 reached 24 °C for the first time since our monitoring initiation in 2012. Near-bottom dissolved oxygen was also remarkably low as shown in Fig. 6, sufficiently below 2ml/L of oxygen, the standard of hypoxia occurrence.

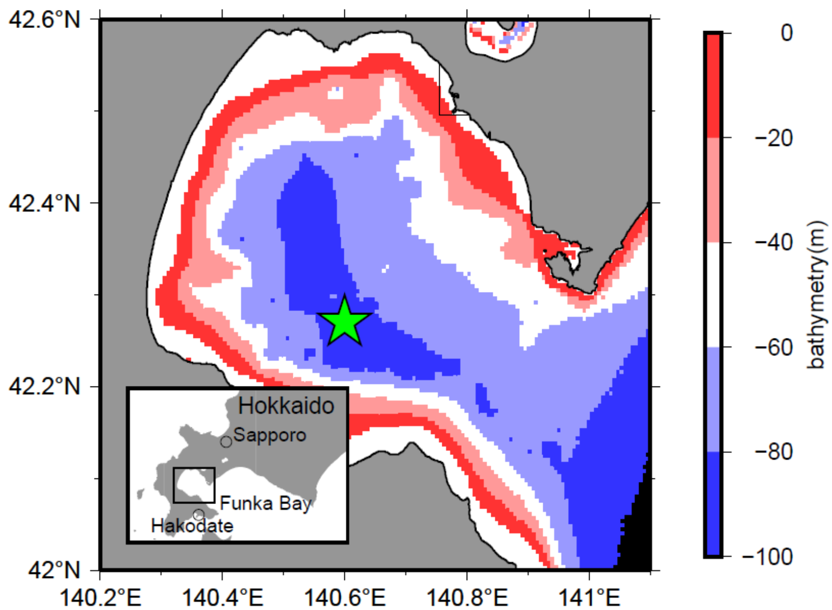


Fig. 4. Location of mooring observation, Funka bay, Hokkaido Japan with bathymetry.

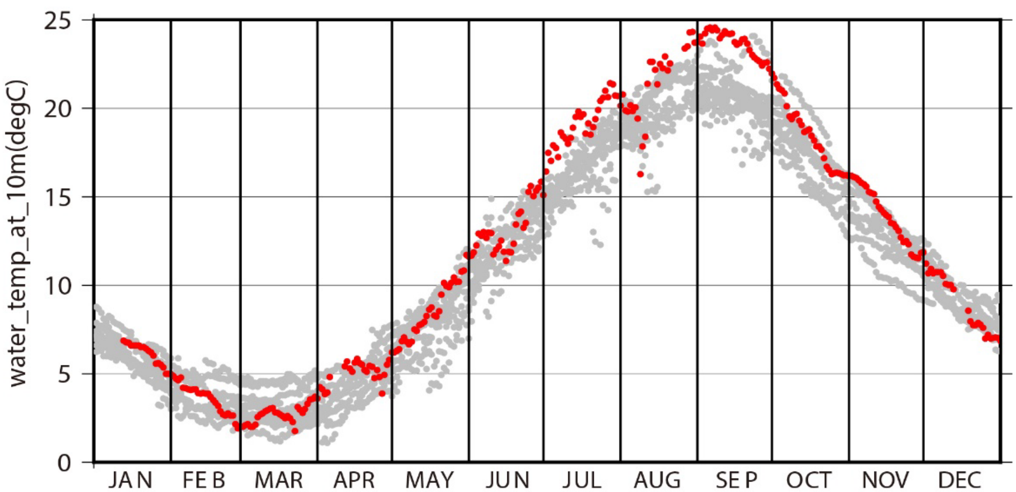


Fig. 5. Seasonal cycle of water temperature at 10 m depth measured by moored temperature logger for the period of 2012 – 2023 with highlighting year of 2023 in red. See Fig. 1 for the location.

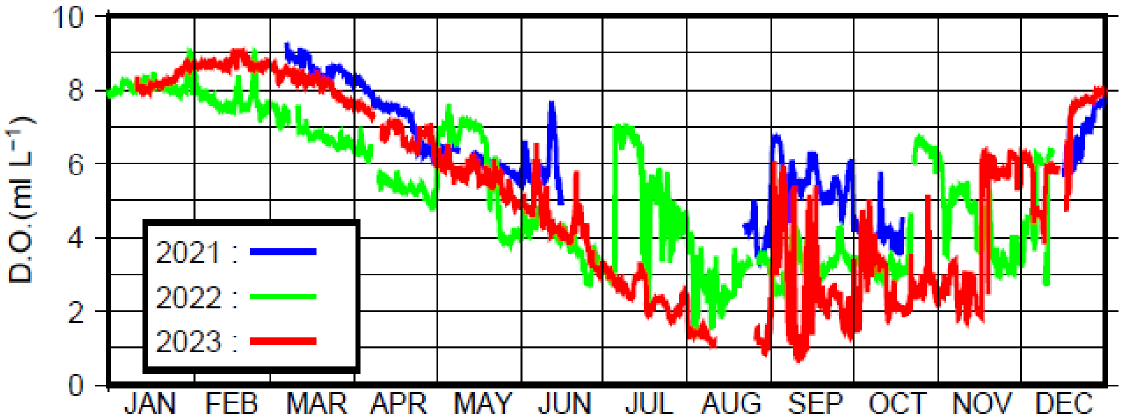


Fig. 6. Dissolved oxygen (DO) at 1 m above the sea floor measured by moored DO meter for the period of 2021 – 2023. See Fig. 1 for the location.

Report from Japan Agency for Marine-Earth Science and Technology (JAMSTEC)

Minoru Kitamura, RIGC JAMSTEC

JAMSTEC is in charge of variety of ocean monitoring programs. These programs are under operation. Although there were some COVID19 patients onboard during some research cruises in 2024, ships operation turned back to normal mode in JAMSTEC.

<u>1. K2 Biogeochemical Time-series, the western subarctic Pacific</u>

The K2 (47°N, 160°E, 5200 m) is a time-series station to observe biogeochemical processes and long-term trend of ocean environment in the western subarctic gyre of the North Pacific. Observations and sample collections by using mooring systems, shipboard hydrographical observations, and satellite remote sensing are key components in the time-series study at K2. Since 2001, sediment trap moorings have been deployed. Currently, many kinds of sensors/samplers such as CTDs, pH and DO sensors, water samplers, and an ADCP are also attached into the mooring system. Further hydrographic observations are made from shipboard during annual maintenance visits by a surface vessel. During the visits at K2, CTD casts up to 10-m above the sea floor, analysis of seawater (salinity, dissolved oxygen, phosphate, silicate, nitrate, nitrite, dissolved inorganic carbon, dissolved organic carbon, total alkalinity, and phytoplankton pigments), incubation experiments for primary productivity, and etc. are carried out. In 2024, recovery and redeployment of the mooring system and hydrographic observations will be planned during the October cruise.

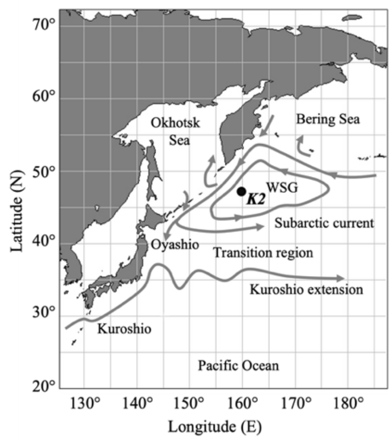


Fig. 7. Location of the time-series station K2 and the surface current systems (modified from Qiu, 2023). WSG means the Western Subarctic Gyre.

From the long-term observations at K2, several environmental trends are distinguished.

(a) Warming of SST: there is a long-term trend toward rising SST at K2 (Fig. 8). Satellite data revealed that annual mean SSTs slightly increased from 1982 to 2021 (0.8 ˚C/100years) while quite high values were observed in 2022 and 2023. The increase rates of SST varied seasonally; the highest value (4.6 ˚C/100years) was shown in September while there was almost no change in SSTs in March (Fig. 9).

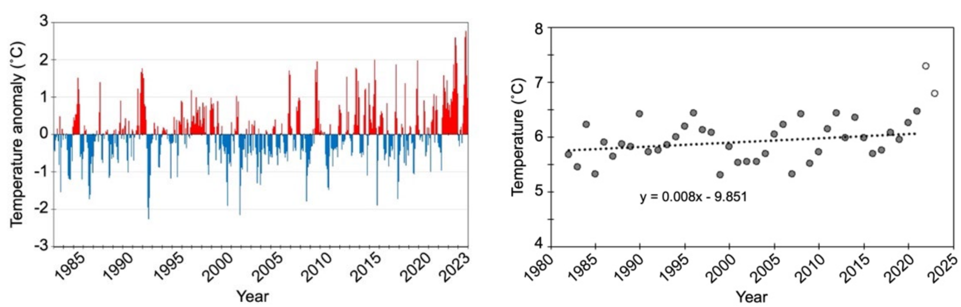


Fig. 8. Time-series of satellite derived monthly mean SST anomalies (left) and annual mean SSTs (right). A regression line in the right panel is derived from data collected from 1982 to 2021.

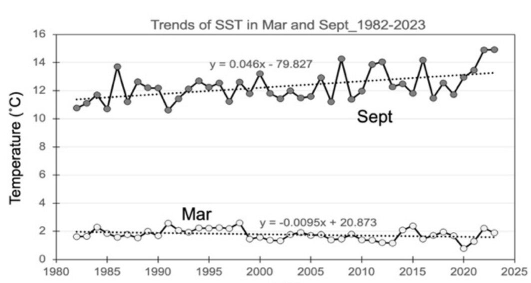


Fig. 9. Seasonal difference of SST trends.

(b) <u>Surface Chl.*a*</u>: satellite derived surface Chl.*a* concentrations were also compiled to understand long-term trend of phytoplankton biomasses. Seasonal peak and minimum in Chl.*a* concentrations are observed in June and April, respectively, and high concentrations are observed in the warm season (from June to October) (Fig. 10). As regards two decadal change, both the increase and decrease trends are hardly detected from time-series of Chl.*a* concentrations and Chl.*a* anomalies (Fig. 11). However, mean concentrations of Chl.*a* during the warm season seems to be decreased in this research period if three data showing extremely high Chl.*a* concentrations (in 2020, 2022 and 2023) are omitted (Fig. 12). Maybe there was a decreasing trend in surface Chl.*a* concentration as the basic trend at K2 until end of 2010s, but high Chl.*a* concentrations which deviated from the trend were frequently observed after 2020.

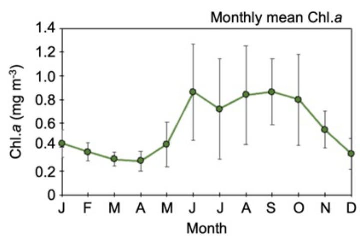


Fig. 10. Seasonal variability of monthly mean Chl.*a* concentrations (mg m^{-3}) around K2.

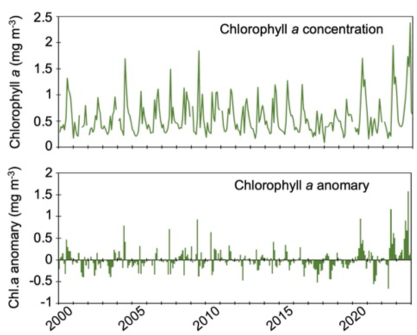


Fig.11. Two decadal variabilities of monthly mean Chl.*a* concentrations (top) and monthly mean Chl.*a* anomaly (bottom) around K2.

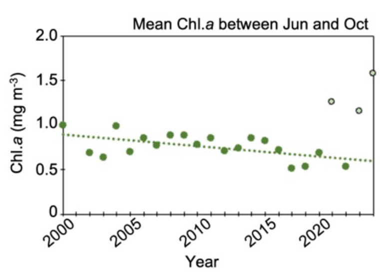


Fig. 12. Time-series of mean Chl.*a* concentration (mg m^{-3}) in the warm seasons (June-October). The dotted line is a regression line excluding three data of 2020, 2022 and 2023.

(c) Acidification: the rate of increase of oceanic pCO_2 at K2 was similar to that of atmospheric pCO_2. In the surface layer of the ocean, the annual mean pH significantly decreased at a rate of 0.002±0.0006 $year^{-1}$ mostly in response to oceanic uptake of anthropogenic CO_2. Annual mean $\Omega_{aragonite}$ at K2 also decreased significantly. Marine organisms, especially calcifying species, and ecosystem might be very susceptible to acidification in this region.

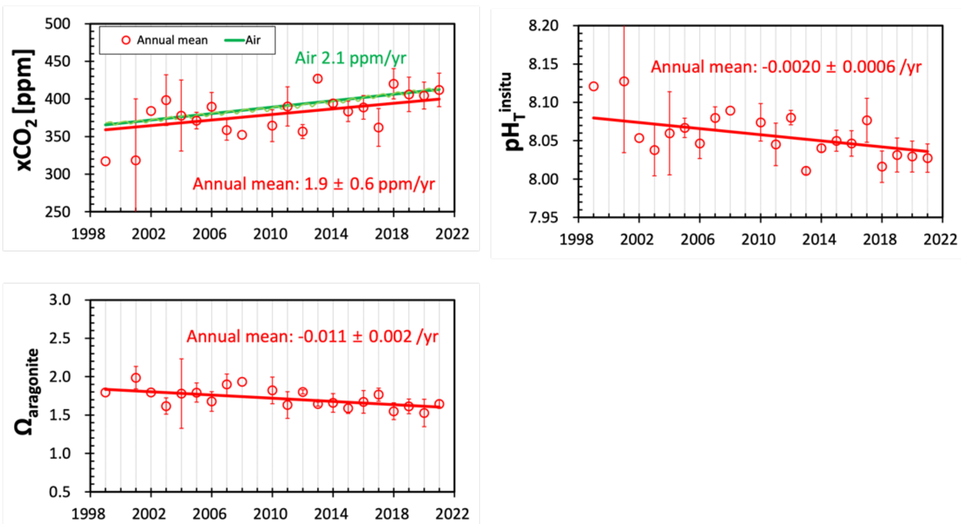


Fig. 13. Time-series of xCO_2, pH and $\Omega_{aragonite}$ in surface water at K2.

(d) Biological pump: from the sediment trap experiment at K2, several characteristics of the biological pump in this area are distinguished; (1) high rain ratio (the ratio of particulate organic carbon flux to inorganic carbon flux), (2) major component of the sinking particles is organic opal, (3) small vertical attenuation of POC, and (4) decadal decrease of $CaCO_3$.

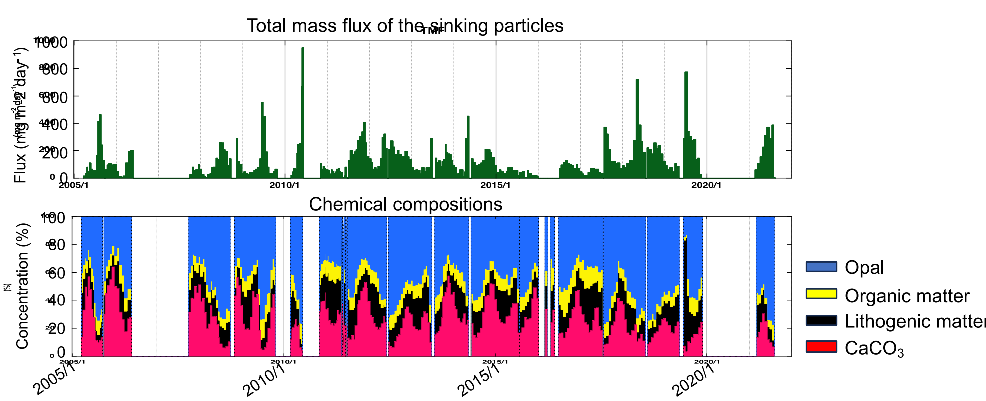


Fig. 14. Time-series of total mass flux of the sinking particles (top) and chemical composition (bottom) obtained by the sediment trap experiment at about 4800 m in K2.

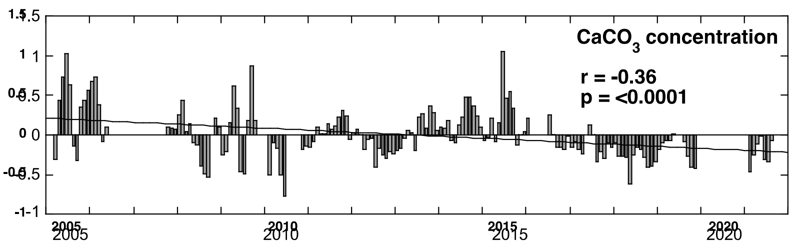


Fig. 15. Decreasing trend of $CaCO_3$ obtained by the sediment trap experiment at K2.

The ocean condition in 2023 can be characterized by comparison with previous data. Except three months (January, February and May), monthly mean anomalies of SSTs around K2 were positive (Fig. 8). And monthly mean SSTs in September and October were quite high, the former (14.91˚C) was the highest record through the 40 years long observations. As regards Chl.*a*, monthly mean anomalies were maintained to be positive throughout the year except January (Fig. 11). Very high Chl.*a* concentrations were observed from August to October. Especially, that in October was the highest through the study period from 2000 to 2023. High Chl.*a* concentrations during from late summer to autumn was a characteristic feature of 2023.

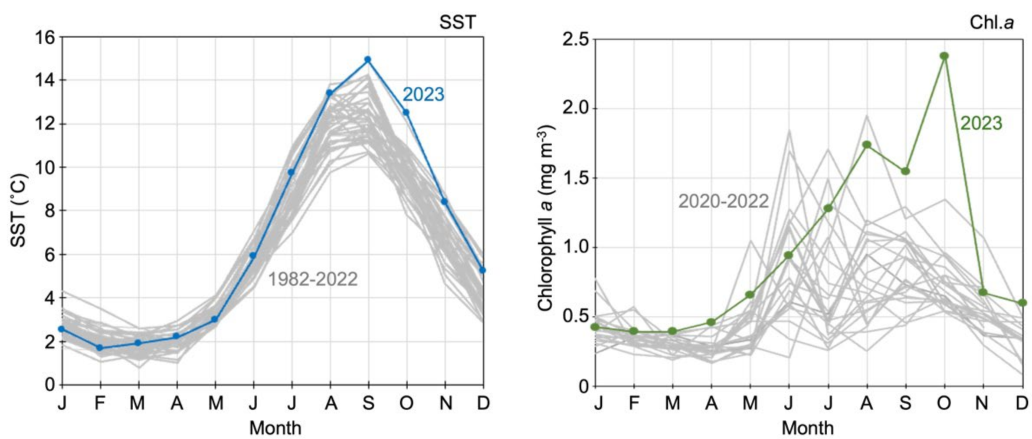


Fig. 16. Seasonal variabilities of monthly mean SSTs in 2023 compared with those from 1982 to 2022 (left) and Chl.*a* in 2023 compared with those from 2020 to 2022 (right).

2. Sediment trap experiment at KEO, the western subtropical Pacific

The Kuroshio Extension Observatory (KEO; 32°18′N, 144°36′E) is a mooring station maintained under NOAA's Ocean Climate Stations Project. The KEO mooring has meteorological instruments as well as sensors to measure upper ocean environments. JAMSTEC deployed other mooring system with sediment traps near the KEO since 2014. From 2014 to 2019, only a sediment trap was moored. After 2019, two sediment traps were installed at 1800 and 4900 m in depths in the mooring system. In November 2024, the mooring system will be recovered. After the sample recovery, the sediment trap mooring will be redeployed in November 2024.

3. Ocean-atmosphere observations in the Philippine Sea by moored buoy

A time-series observation station was established at the Philippine Sea (13ºN, 137ºE) in 2016. To obtain real-time air-sea data, a surface buoy system (Ph buoy) has been deployed in the site. Payloads in this buoy for atmospheric observations are temperature, humidity, wind, atmospheric pressure, rainfall amount, long and short-wave radiations sensors. In addition, to collect environmental parameters in the surface ocean, water temperature, salinity, and dissolved oxygen sensors and an ADCP are installed to bottom of the buoy or the mooring wire rope above 300 m in depth. In 2023 summer, the buoy system was successfully recovered and redeployed. Next recovery and redeployment will be planned in 2025 autumn.

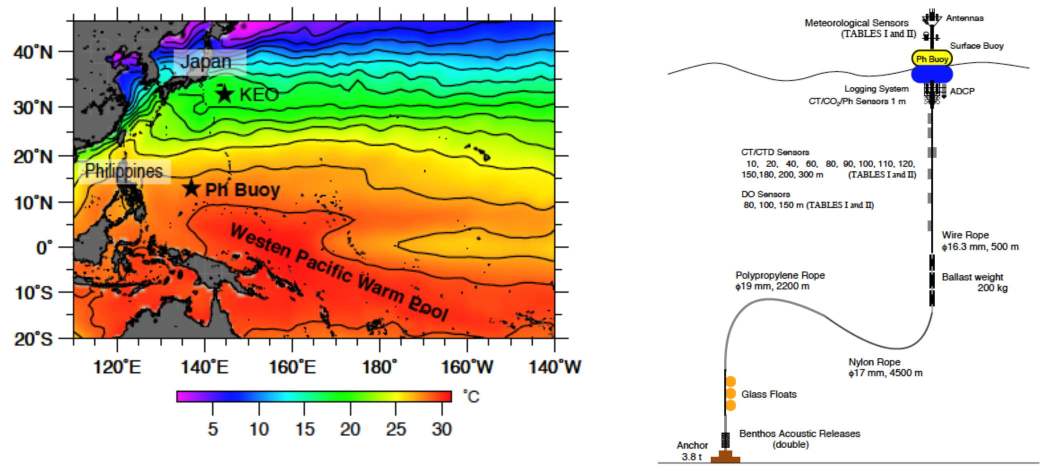


Fig. 17. Deployment site of the Ph buoy (left) and schematic diagram of the buoy (right).

6. Russia

Monitoring Activities in Russian Federation *(V. Lobanov, V. Kulik)*

1 Monitoring of marine ecosystem safety of Kamchatka Peninsula

After abrupt mortality event at the southeastern coast of Kamchatka Peninsula caused by HAB in September 2020, a special program to study marine ecosystem of Kamchatka was launched in Russia. Three cruises were implemented by POI FEB RAS in collaboration with other institutes in 2022-2023 (Fig. 1, 2) to study structure and dynamics of East Kamchatka Current including its mesoscale eddies, their impact on shelf area, influence of river discharge on coastal waters. In 2023-2024 (Fig. 3), monitoring of chemical parameters of Kamchatka River was organized to look at seasonal variability of nutrients in river water associated with volcanic ashes and snow melting. It was supposed that variation of nitrate vs phosphorus content might control domination of different planktonic species including toxic ones. Cruise and on-land observations will be continued in 2025-2026.

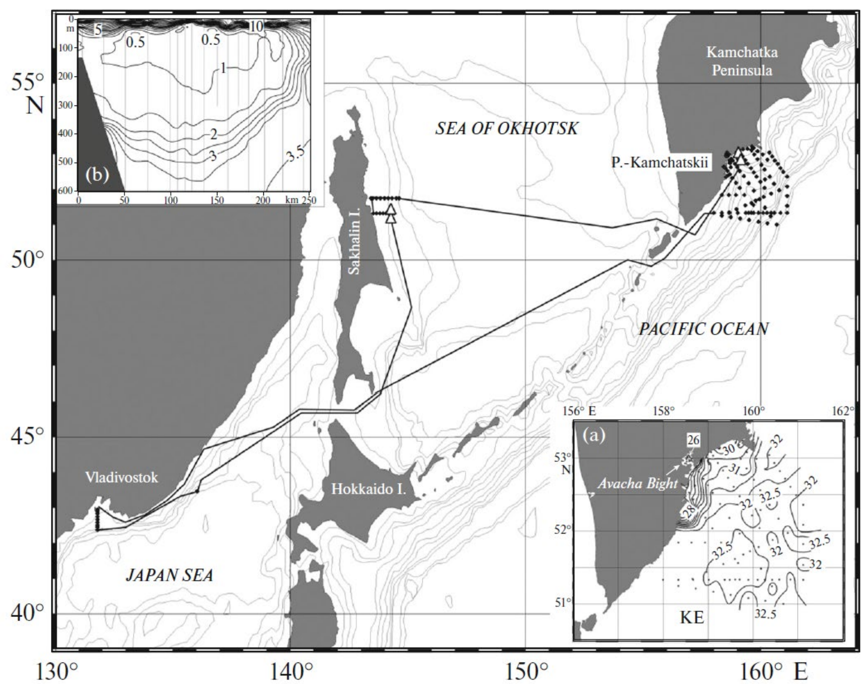


Figure 1. Scheme of cruise 80 of R/V *Professor Gagarinskiy* in June–July 2022. Dots show positions of oceanographic stations; triangles show mooring positions; isobaths are in m. Insets: (a) salinity distribution (psu) in surface layer near southeastern Kamchatka; (b) water temperature distribution (°C) along transect across the Kamchatka eddy (KE); thin vertical lines – positions of CTD profiles (Lobanov et al., 2023)

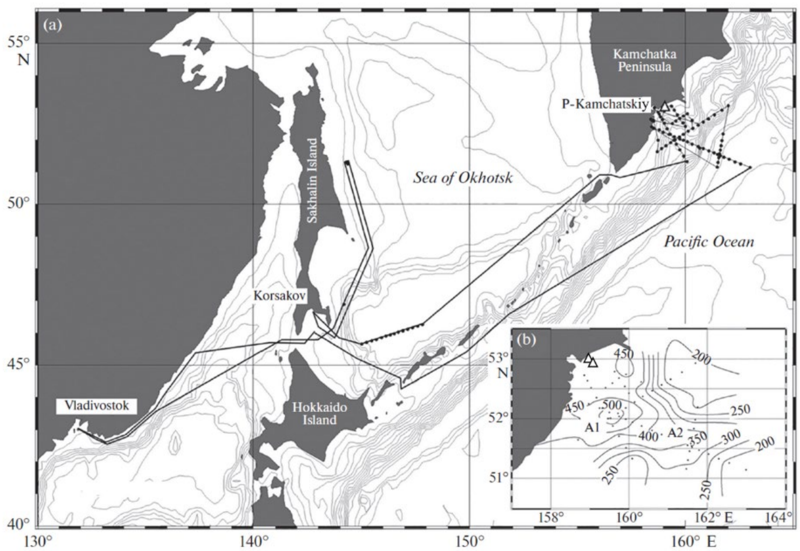


Figure 2. Scheme of the cruise 65 of R/V *Akademik Oparin* in November 26–December 12, 2022 (a) and depth distribution of isopycnal surface 26.8 in Avachinskiy Bay area of Kamchatka. A1 and A2, positions of cores of deleting anticyclonic eddy. Dots show position of oceanographic stations; triangle, position of shelf moorings in Avachinskiy Bay (Lobanov et al., 2024)

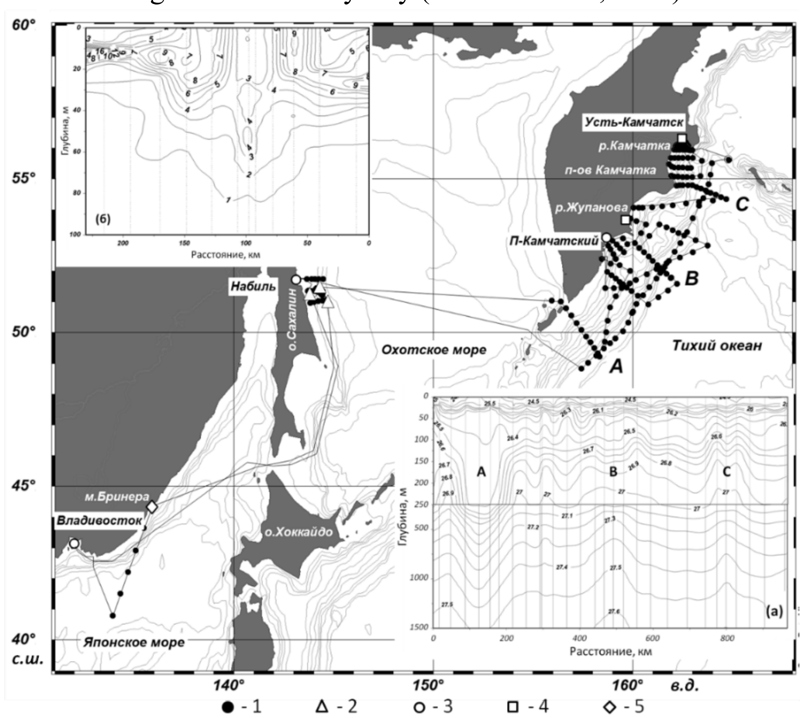


Figure 3. Scheme of the cruise 68 of R/V *Akademik Oparin* in Agust 8–September 18, 2023. Insets: (a) vertical distribution of potential density anomaly at the section along Kamchatka trench crossing anticyclonic eddy A and two cyclonic eddies B and C, (b) vertical section of Chl-a fluorescence; 1- CTD stations; 2 – moorings; 3 – ports; 4- boat works; acoustic experiment location (Lobanov et al., 2025, in press)

2 Fukushima-1 NPP impact on the Pacific and the Okhotsk Sea

Research program of radionuclide monitoring in the ocean associated with Fukushima-1 NPP accumulated water discharge started by Japan in August 2023 (Fig. 4). This monitoring is mainly focused on Russian EEZ and areas of fisheries activity located just to the east of Japan along the Kuril Islands.

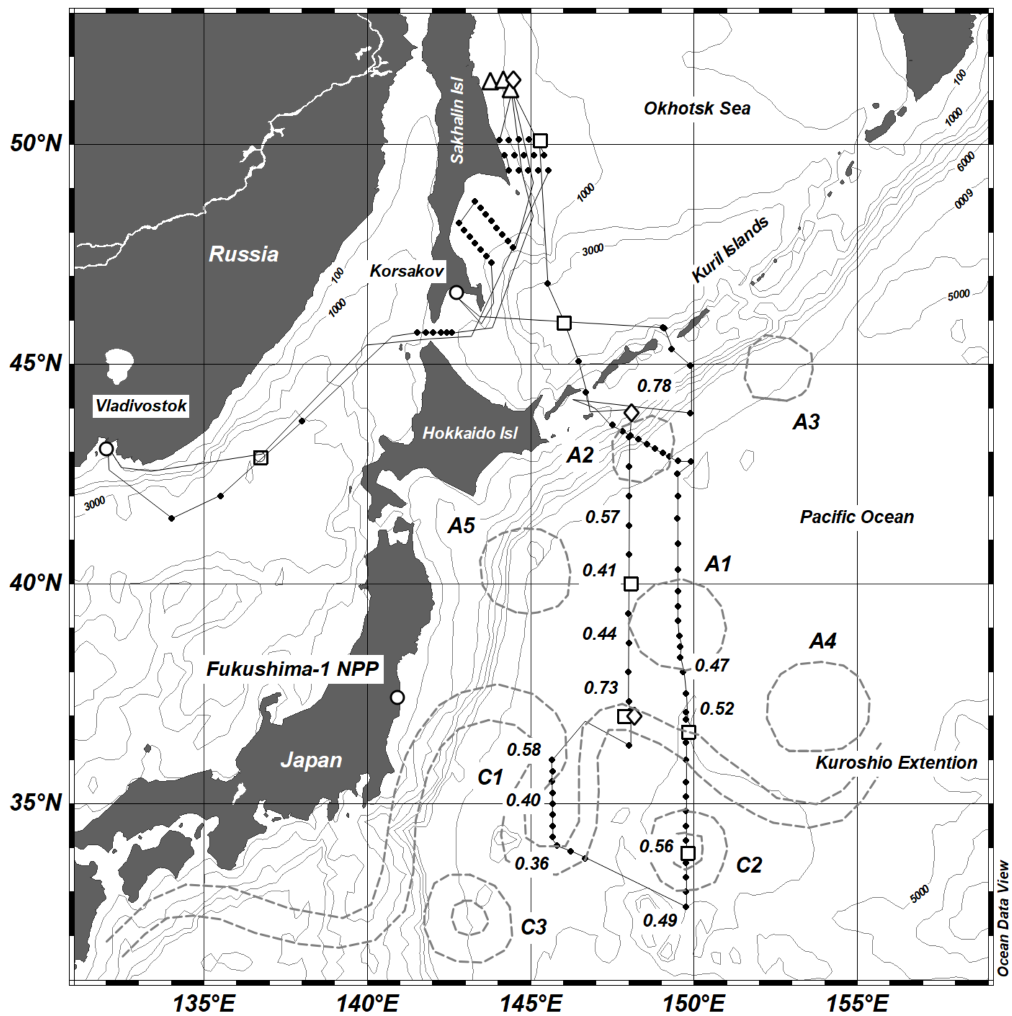


Figure 4. Scheme of the cruise 71 of R/V *Akademik Oparin* in June 4 – July 15, 2024. Numbers indicate concentration of tritium in surface waters in tritium unit (1 TE=0.119 Bk/l). Dashed lines shows Kuroshio Extension and anticyclonic (A1-A5) and cyclonic (C1-C3) eddies. Dots show position of oceanographic stations; triangle, position of shelf moorings off Sakhalin Insland; square – vertical sampling for radionuclides; diamonds – direct spectrometric underwater measurements (Lobanov et al., 2025, in press)

More than 120 tons of seawater samples have been collected and prepared for subsequent analysis, not only from the ocean surface, but also from various depths. In addition to tritium, an assessment will be made of the content of other radioisotopes – cesium, strontium, beryllium, radium, and lead. Samples of plankton and marine biota were taken. Direct measurements of radionuclide in ocean water, performed by Kurchatov

Institute using high-precision gamma spectrometers, showed that the content of the isotope ^{137}Cs in the ocean at concentrations of more than 10 Bq/l was not detected, which does not exceed the safe norm for drinking water (11 Bq/l). Laboratory analysis of the first samples confirmed that the content of ^{137}Cs in the ocean was about 0.1 miles Bq/l, i.e. significantly less than the permissible norm and 1000-10000 times less than what we observed in 2012, a year after the accident at the Fukushima-1 NPP. Analyses of the first 12 samples for tritium content in the ocean surface layer showed that to the east of Japan, in the area from the Southern Kuril Islands in the north (44°N) to subtropical waters in the south (33°N), its content varies from 0.40 to 0.78 TE. At the same time, the highest values were found in the main branch of Kuroshio (36°N) and near the Southern Kurils. These are slightly elevated concentrations, but almost close to the natural background and should not cause any concern.

3 Fishery-independent surveys by TINRO

These surveys are conducted regularly by the Pacific branch (TINRO) of the State Research Center Federal State Budget Scientific Institution "Russian Federal Research Institute of Fisheries and Oceanography" (VNIRO)

Each midwater trawl station accompanied by hydrological and hydrobiological stations just before or after the trawling. TINRO's vessels conducted 599 midwater trawls during fishery-independent surveys in the Northwestern part of the Pacific Ocean in 2023 (Fig. 5). 52 of those trawls were conducted in the High Seas. There are 151 bottom trawls conducted by R/V in 2023, which saved in the database of TINRO (Fig. 6). Other surveys are in progress or have not been processed yet.

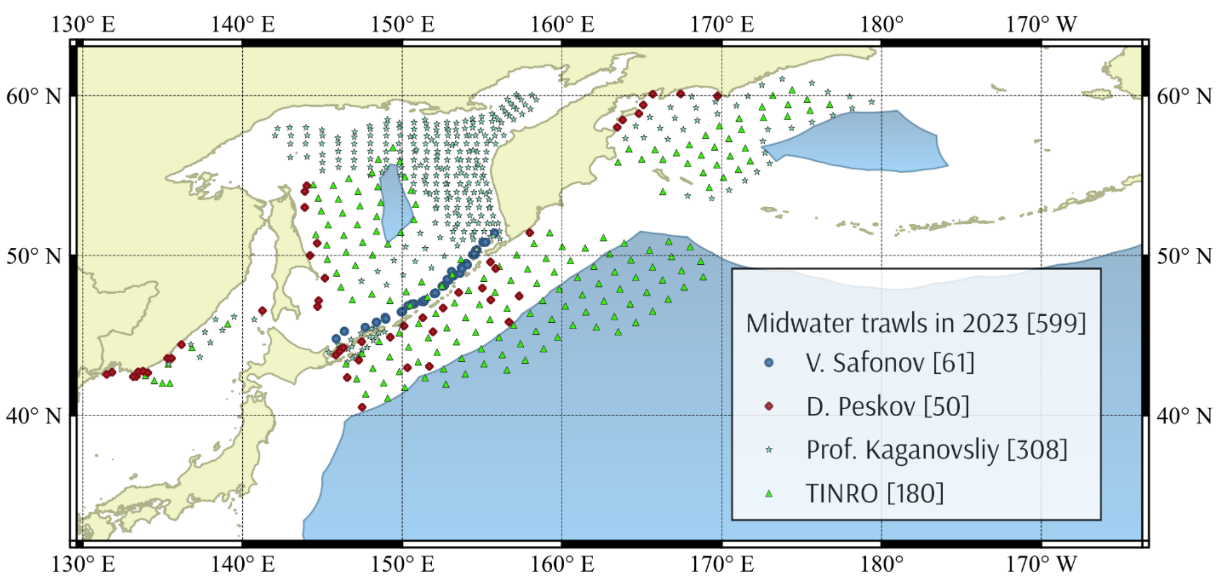


Fig. 5. Midwater trawls, conducted by TINRO's R/V in 2023

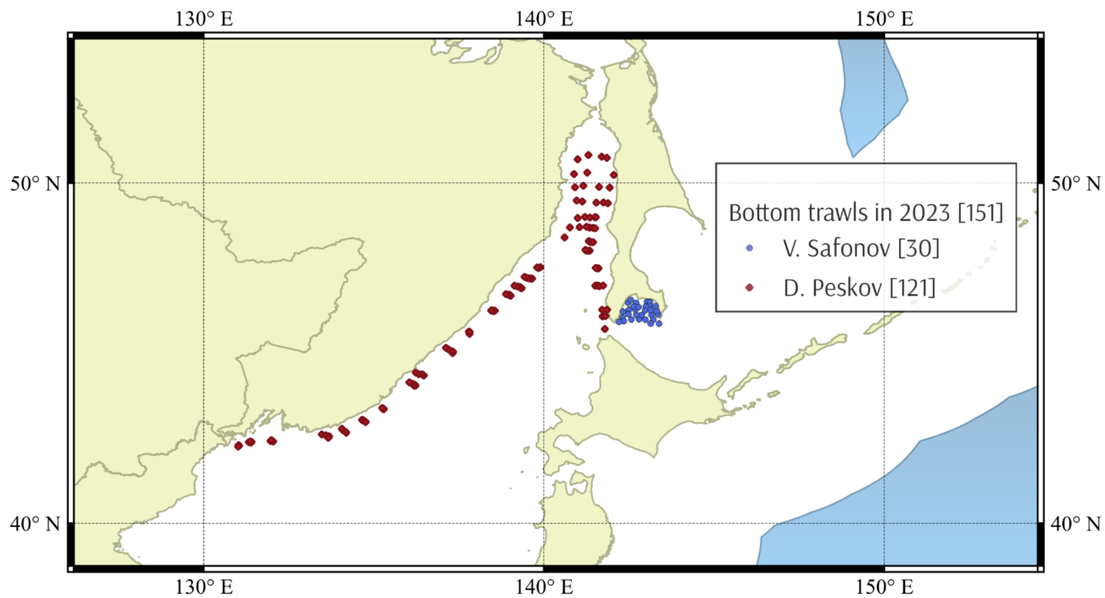


Fig. 6. Bottom trawls conducted by TINRO's R/V in 2023

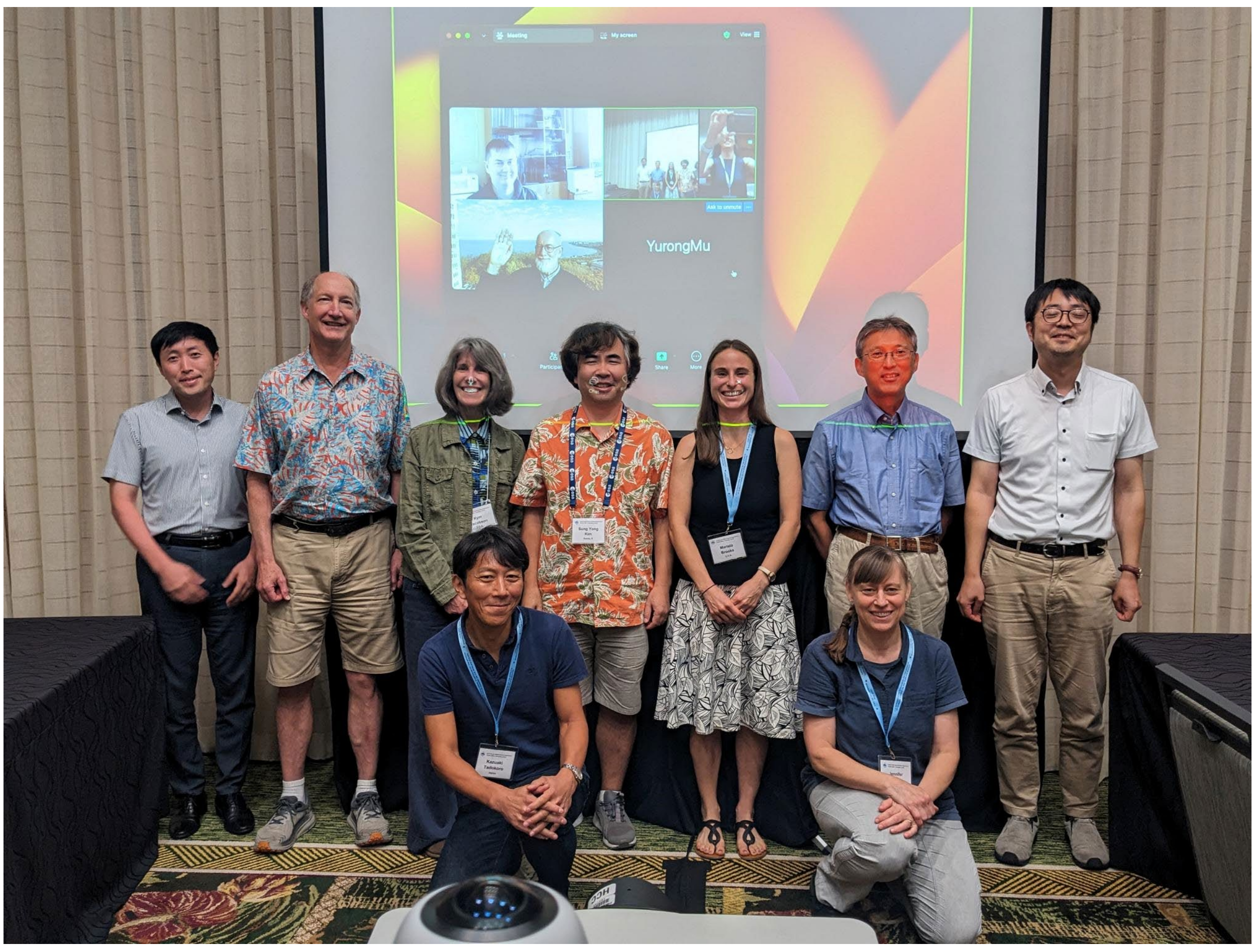
The DAY 1 meeting was adjourned.

DAY 2

AGENDA ITEM 7: WELCOME AND INTRODUCTION

MONITOR Chair Prof. Sung Yong Kim called the meeting to order, participants introduced themselves (name, affiliation, roles in PICES/MONITOR, and research area), and the agenda was reviewed and adopted.

Attendee of the 2nd day meeting: **[on-site members]** Sung Yong Kim (MONITOR Chair, Korea), Jennifer L. Boldt (Canada), Hiroto Abe (Japan), Kazuaki Tadokoro (Japan), Minoru Kitamura (Japan), Jack Barth (USA), Kym Jacobson (MONITOR Vice-Chair, USA), Mariela Brooks (USA), **[on site observers]** Sung San Park (Korea), Sonia Battten (PICES, CPR), **[virtual members]** Vyacheslav B. Lobanov (Russia), Vladimir V. Kulik (Russia) **[virtual observers]** Yurong Mu (China)



AGENDA ITEM 8: UPDATES/RECAP FROM THE PREVIOUS MEETING

The Chair reviewed the previous meeting.

AGENDA ITEM 9: UPDATES FROM EXPERTS GROUPS

1. Activities of FUTURE: Jennifer Boldt

Four new ECOP members joined the FUTURE SSC: Mackenzie Mazur (Canada), Hitomi Oyaizu (Japan), Seongbong Seo (Korea), Erin Vera Satterthwaite (USA).

The FUTURE SSC has submitted a manuscript titled "On the Development of a Transdisciplinary International Science Programs to Advance Ocean Sustainability: the PICES FUTURE Program". The objective of this manuscript is to evaluate the success of the FUTURE program in addressing its Science Plan, including assessing if the program evolved to meet changes and needs, identifying gaps in scientific advancement, determining the cause of gaps, and providing lessons learned for large-scale science programs. The lead authors are Shion Takemura and Mitsutaku Makino; other authors include the FUTURE SSC members. The manuscript was submitted to the ICES Journal of Marine Science in September 2024.

There will be a FUTURE Symposium at PICES-2024 on Monday, October 28. Please plan to attend.

2. Activities of AP-CREAMS: Vyacheslav B. Lobanov

Meetings:

a. AP Meeting on 26 July 2024 in Seoul, Korea
b. AP Meeting on 24 Sep. 2024 online
c. AP Meeting on 26 Oct. 2024 in Honolulu (during PICES Annual Meeting, planned)

Workshops:

a. A workshop on "Changing social-ecological-environmental system of the North East Asian Marginal Seas: New challenges for integrative marine science" was organized during PICES-2023 in Seattle, USA;
b. CREAMS 30th Anniversary & CSK-II Joint-Workshop « International collaboration for science of East Asian Marginal Seas in a changing climate: circulation, biogeochemistry, and socio-economic research», July 25-26, 2024, Seoul, Korea

Scientific sessions:

a. "Past, Present and Future of CREAMS program: 30 years of international research in North East Asian Marginal Seas" at PICES-2024 in Honolulu, USA

Publications:

a. Region 19 chapter of PICES NPESR3 has been completed and published in Feb 2024 https://meetings.pices.int/publications/special-publications/NPESR/2021/PICES_NPESR3_Region19_Report.pdf

Cooperation with other organizations:

a. Northwest Pacific Action Plan (UNEP/NOWPAP) and CEARAC representative Dr. Takafumi Yoshida attended AP-CREAMS meeting and discussed future plans of joined activity;
b. IMBeR representative Ms. Suhui Qian participated in AP Meeting on 26 July 2024 (online) and presented current activity of IMBeR and possible directions for collaboration;
c. Co-chairs of IOC/WESTPAC Asian Marginal Seas project Profs. SungHyun Nam and Jing Zhang updated on the project current activity at each AP meeting.

The term of AP-CREAMS ends in 2024, and the group would like to continue its activity for another term. This was discussed at the AP-CREAMS meetings on July 26, 2024 and September 24, 2024 and is included into the report submitted to parent committees of PICES.

Membership changes: Profs. Joji Ishizaka (co-chair, Japan) and Guebuem Kim (Korea), Drs. Jae Hak Lee (co-chair, Korea) and Heedong Jeong (Korea) stepped down and are replaced by Prof. Shinichiro Kida (Japan), Prof. Minkyoung Kim (Korea) and Dr. Gwang Ho Seo (Korea). Profs. Sung Huyn Nam (current member, Korea) and Jing Zhang (current member, Japan) were appointed as new co-chairs.

Geographic scope changes: it is agreed to expand geographic area covering by the AP from Asian Marginal Sea (EAST-1 and EAST-2) to Northwestern Pacific and its marginal seas in the PICES area.

ToR of the AP should be changes accordingly to indicate new geographic coverage and more attention to ECOP activity as below (changes are in italic):
1. To coordinate programs to study marine ecosystem and its variability in the *Northwestern Pacific* and marginal seas in the PICES area, under global changes, both natural and anthropogenic; effect of long-term and extreme changes in the abiotic and biotic environments of this region.
2. To facilitate the establishment of permanent observation and data exchange networks in this region.
3. To convene workshops/sessions/mentorships to evaluate and compare results from the program.
4. To enhance capacity building, knowledge dissemination, cooperation with other international marine organizations/programs in the region.
5. To provide more opportunities for ECOPs to join particularly from Asian countries

3. Activities of AP-NPCOOS: Jennifer Jackson

There was no report.

AGENDA ITEM 10: UPDATES FROM INTERNATIONAL ORGANIZATIONS

1. Activities of the SMARNET: Steve Bograd

Objective 1: Convene global partners through knowledge networks to facilitate research, knowledge generation and capacity sharing in support of sustainable marine ecosystems in a changing climate.

Objective 2: Leverage and build upon joint ICES-PICES collaborations to expand our networks and increase resilience of marine & coastal resources and the communities that depend on them

2. Activities of the WGICA: Sei-Ichi Saitoh

Activities of the ICES-PICES-PAME working group on Integrated Ecosystem Assessment for the Central Arctic Ocean (WGICA)

WGICA Annual Meeting was held on October 22-23, 2024, Copenhagen, Denmark (Hybrid). WGICA prepare IEA Report No.2 titled "Ecosystem Assessment of the Central Arctic Ocean: Description of Human activities, its Pressures and Vulnerability of the Ecosystem". At present time, this report is under reviewing and will be published as ICES CRR Report next year. WGICA will revise Ecosystem Overview next year based on the IEA Report No,2. WGICA plan to publish next report on Climate assessment recent 3 years.

ESSAS Open Science Meeting 2025 in Japan

ESSAS (Ecosystem Studies of Sub-Arctic and Arctic Seas) plan to hold Open Science Meeting in June 24-26, 2025 in Japan. Venue is NIPR, Tachikawa, Tokyo, Japan. Main theme is Past, Present, and Future of Marine Biodiversity and Ecosystems. Session proposal was gathered 13 and PICES members submitted a couple of session proposals. Abstract deadline will be on February 28, 2025. Registration site will be opened from December 1, 2024. Please see the following web site.

https://essas.arc.hokudai.ac.jp/

3. Activities of the ARGO: Yui Takeshita

The One Argo design is an ambitious, next phase for the global Argo program. It consists of Core-Argo, Deep-Argo, and Biogeochemical (BGC) Argo, and has a target array size of 4700 floats; 2500 floats from Core, 1200 from Deep, and 1,000 from BGC. The implementation of One Argo has stalled in recent years, and the number of Argo floats have settled at around 70% of the target array size over the past 4 years. Number of core float deployments have declined, but are compensated by increasing number of US BGC-Argo deployments.

This increase in US BGC-Argo float deployments is largely due to the Global Ocean Biogeochemistry Array (GO-BGC) project. Supported through the NSF mid-scale research infrastructure program, GO-BGC is funded to deploy 500 BGC floats globally equipped with sensors for O_2, nitrate, pH, chlorophyll fluorescence, optical backscatter (proxy for phytoplankton biomass), and downwelling irradiance. We have deployed 212 BGC floats so far, and plan to deploy ~300 more through November 2026. The quality of the data is extensively validated through thousands of discrete samples taken at the time of deployment, largely in collaboration with GO-SHIP. These samples are used to validate the independently adjusted float BGC data. On average, float and bottle agree to (mean ± 1 std) -1.3 ± 8.1 µmol/kg (O_2), 0.4 ± 1.3 µmol/kg (NO_3), and -0.008 ± 0.024 (pH), demonstrating the high-quality data generated from BGC-Argo floats. Due to GO-BGC and contributions from other US and international partners, there are now 584, 4+ sensor BGC-Argo floats operating worldwide. This enables, for the first time, basin to global analysis of these BGC parameters. The BGC-Argo array is about 50% of the target density in the North Pacific.

We continuously strive to improve data access for the community. For example, scientists at the NOAA PMEL group developed the One Argo toolbox (available in Matlab and R), which allows for streamlined data search and parsing of One Argo data. Furthermore, BGC-Argo is now available and pre-loaded on WebODV, the online version of the highly successful Ocean Data View program. Finally, there are multiple groups working on developing gridded BGC data from shipboard and BGC-Argo data using machine learning approaches. One such example is the GO-BAIO2 product, a 1x1 gridded, monthly O_2 product at 58 depth levels from 2004-2023. GO-BAIO2 shows a clear, global deoxygenation trend that is consistent with Earth system models. Such gridded products, combined with satellite data, are now actively being used to model Albacore Tuna distribution in the Pacific (presentation by Mary Margaret Stoll in Session 4). We believe that BGC-Argo can contribute to fisheries science and management in a variety of ways. To maximize our impact to this community, we strongly desire feedback and suggestions on how to improve data access, quality, or any other topics that could help advance PICES objectives.

4. Activities of the NPRB: Robert Baker

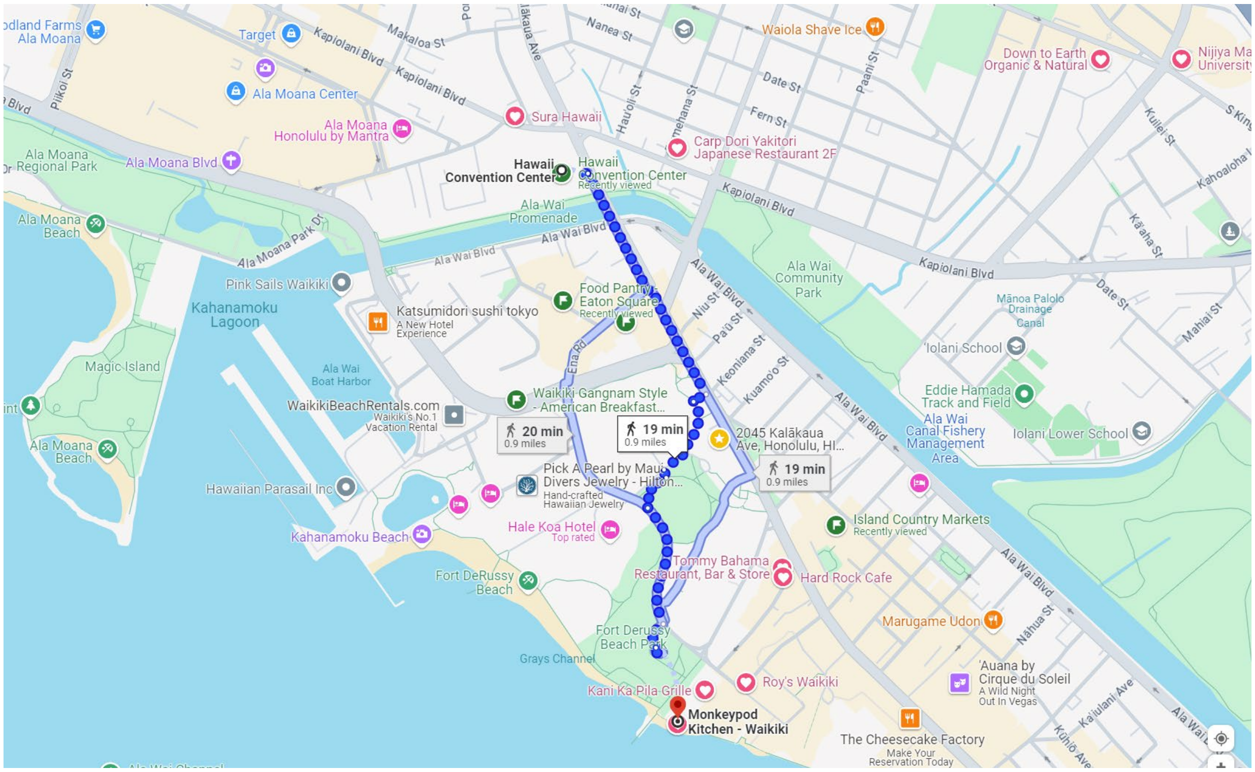
AGENDA ITEM 11: OTHER BUSINESS

1. Discussion

- POMA template and find POMA candiates
- Comment on PICES external review
- A fact sheet requested from Communication WG
- Need to consider candidates for the next MONITOR chair because the current chair ends his 2nd term in 2025

The Chair recapitulated the DAY2 discussion National reports; updates of EGs; review proposal based on votes. Further discussion on timing of briefing book. Request to have it later.

AGENDA ITEM 12: DINNER



http://www.monkeypodkitchen.com/
2169 Kālia Rd unit 111, Honolulu, HI 96815, United States; +1-808-900-4226

The DAY 2 meeting was adjourned

APPENDIX

A. MONITOR ACTION PLAN (2020-2025)

Mission (Terms of Reference)

1. Identify the principal monitoring needs of the PICES region, and develop recommendations to meet these needs, including training and capacity building;
2. Serve as a forum for coordination and development of inter-regional and international components of the North Pacific Ocean Observing Systems, including the Global Ocean Observing System (GOOS). Facilitate method development and inter-comparison workshops to promote calibration, standardization, and harmonization of data sets;
3. Contribute to the development of the North Pacific Ecosystem Status Report (NPESR), advising editors and lead authors on monitoring issues, identifying the need for particular time series and their continuities, the period on which they need to be updated for PICES Science Programs, and recommend to Science Board that they endorse the need to establish or maintain particular time series;
4. Recommend interim meetings to address monitoring needs and PICES–GOOS activities;
5. Review and advise Science Board on outcomes and annual operations of the North Pacific Continuous Plankton Recorder (CPR), including providing technical advice on parameters to be measured and possible linkages to other marine monitoring initiatives and programs in the North Pacific and elsewhere;
6. Provide annual reports to the Science Board and the Secretariat on monitoring activities in relation to PICES;
7. Interact with TCODE on management issues of monitoring data.

To implement its mission, the MONITOR Committee will address each of the six main goals of the PICES Strategic Plan (https://meetings.pices.int/About/PICES-Strategic-Plan-Oct-2016.pdf):

PICES Strategic Plan Goals:

1. Foster collaboration among scientists within PICES and with other multinational organizations
2. Understand the status and trends, vulnerability and resilience, of marine ecosystems
3. Understand and quantify how marine ecosystems respond to natural forcing and human activities
4. Advance methods and tools
5. Provide relevant scientific information pertinent to North Pacific ecosystems that is timely and broadly accessible
6. Engage with early-career scientists to sustain a vibrant and cutting edge PICES scientific community

Goal 1: Foster collaboration among scientists within PICES and with other multinational organizations

Action 1.1 Promote collaboration and communication among Ocean Observing Systems internal and external to the PICES region.

Task 1.1.1 Define PICES' role, assist, and participate in the implementation of international programs (e.g., GOOS).

Action 1.2 Promote the process of creating regular NPESRs as a way to gain collaboration among organizations, scientific programs, and stakeholders.

Task 1.2.1 Establish and maintain a dialogue with organizations, programs, and stakeholders on potential ways to increase the value of NPESR to scientists, industry, government, and communities.

Task 1.2.2 Seek input from intergovernmental regulatory organizations on the content, format, and value of the NPESR.

Goal 2: Understand the status and trends, vulnerability and resilience, of marine ecosystems

Action 2.1 Promote the use of Global (GOOS), GOOS Regional Alliances (e.g., IOOS, CIOOS, NEAR-GOOS), and other ocean observing systems as tools to understand the functioning of marine ecosystems.

Task 2.1.1 Identify and describe the major observing systems and programs (present and proposed) in the PICES region.

Task 2.1.2 Provide a forum at annual PICES meetings for the exchange of information on ocean observing systems and programs among PICES member countries.

Action 2.2 Promote the use of the PICES NPESR to understand the functioning of marine ecosystems.

Task 2.2.1 Conduct sessions and workshops at the PICES annual meetings.

Task 2.2.2 Contribute to the production of the NPESR.

Task 2.2.3 Evaluate the report and contribute to improving the process used to create it.

Goal 3: Understand and quantify how marine ecosystems respond to natural forcing and human activities

Action 3.1 Linked to the PICES Science Program activities, understand and quantify the impacts of climate on marine ecosystems.

Task 3.1.1 Solicit advice from member countries, scientists, and stakeholders for what type of information is needed for NPESR to be useful to understand and quantify impacts

Task 3.2.1 Develop a strategy for promoting and funding PICES observing activities, and actively communicating their relevance and utility. For example, i) North Pacific Continuous Plankton Recorder transects. ii) ocean observing systems, iii) international surveys (e.g., EAST-I area Joint Korea-Russia cruise, ferry-box monitoring between Donghae and Vladivostok , EAST-II area Joint Japan-China-Korea cruise), iv) North Pacific seabird and marine mammal transects.

Goal 4: Advance methods and tools

Action 4.1 Use MONITOR's resources and involvement in global and regional Ocean Observation Systems to provide advice on methods and guide scientific activities.

Task 4.1.1 Propose sessions or workshops for the PICES annual meeting to address emerging issues in ocean observing science.

Action 4.2 Use NPESR as a forum for providing information on the current status of ocean observing to guide scientific activities.

Task 4.2.1 Provide a recommendation on emerging information needs and critical issues in methodology to multiple stakeholders, including scientists, industry, government, and communities.

Goal 5: Provide relevant scientific information pertinent to North Pacific ecosystems that is timely and broadly accessible

Action 5.1 Create and oversee expert groups to support PICES Science Programs and activities.

Task 5.1.1 Make recommendations to the Science Board on the establishment of new expert groups to support the PICES Science Program and activities.

Task 5.1.2 Delegate representatives as members of the PICES Science Program Advisory Panels to enable communication among groups.

Task 5.1.3 Review the PICES Data Inventory, and identify data and/or data products developed under the direction of the MONITOR not currently recorded in the Data Inventory and inform the TCODE Chair and the Secretariat.

Action 5.2 Publish reports and workshop proceedings on a timely basis.

Action 5.3 Review the current MONITOR web page and identify new web-based products to support committee's communication with members and stakeholders.

Goal 6: Engage with early-career scientists to sustain a vibrant and cutting edge PICES scientific community

Action 6.1 Use PICES involvement in Ocean Observing Systems as a means for promoting collaboration among scientists.

Task 6.1.1 Conduct collaborative workshops and summer schools.

Task 6.1.2 Recruit scientists from under-represented groups to participate

Action 6.2 Use the North Pacific Ecosystem Status Report as a tool or means to promote collaboration and communication among PICES scientists.

Task 6.2.1 Conduct collaborative workshops for authors, whenever possible, as part of the process that creates the report.

Task 6.2.2 Recruit scientists from under-represented groups to participate.

B. PICES OCEAN MONITORING SERVICE AWARD (POMA)

1. Background

Progress in many aspects of marine science is based on ocean observations, monitoring, and the management and dissemination of the data provided by these activities. Long-term monitoring observations are particularly critical to detecting and understanding ecosystem changes. In addition to long-term monitoring, there are new innovative observation methods that are being developed alongside technological advancements, such as autonomous vehicles, remote data collection, ocean observing systems, new sensors and techniques, and algorithms, which contribute to the implementation of sustainable observation. Monitoring activities are often taken for granted or even targeted for budget cuts when organizations experience financial constraints. With this in mind, it was proposed at the 2006 Annual Meeting in Yokohama, Japan, that a new PICES award be established to acknowledge monitoring and data management activities that contribute to the progress of marine science in the North Pacific. The principles of the award were approved at the 2007 inter-sessional Science Board/Governing Council meeting, also in Yokohama, and the name and description of the award were finalized at the 2007 Annual Meeting in Victoria, Canada. At PICES-2019, a review of the Award was conducted and a decision was reached to broaden the eligibility criteria to include "innovative advances in ocean monitoring and service".

2. Aims

The PICES Ocean Monitoring Service Award (POMA) aims to recognize organizations, groups, and outstanding individuals that have contributed significantly to the advancement of marine science in the North Pacific through long-term ocean monitoring, data management, and innovative advances in ocean monitoring. The award also strives to enlighten the public on the importance of those activities as fundamental to marine science. It draws attention to an important aspect of the PICES Convention that is not so much in the limelight: "to promote the collection and exchange of information and data related to marine scientific research in the area concerned."

3. Eligibility

The award is given for significant contributions to the progress of marine science in the North Pacific through long-term monitoring operations, management of data associated with ocean conditions and marine bio-resources in the region, and development of advanced and innovative technologies for ocean monitoring or all categories. Recipients may include, for example, research vessels, research or administrative institutes or portions thereof, or technical groups involved in monitoring, data management, and dissemination, or the development of tools or technologies that have been shown to enhance ocean monitoring or a combination of these activities. Outstanding individual efforts may also be recognized.

4. Nomination and Selection

Nominations from individuals or groups from PICES member countries should be sent with supporting documentation to the Executive Secretary (Sonia.Batten@pices.int) by the deadline specified in the Call for Nominations. The Technical Committee on Monitoring (MONITOR) and the Technical Committee on Data Exchange (TCODE) will evaluate independently the documents submitted with each nomination, and recommend some or all of the nominations for consideration by Science Board. Evaluations will include the relevance, duration and balance of activities (ocean observation, resource monitoring, data management, etc.). If more than one nomination is considered worthy of recognition by MONITOR or TCODE, rank preferences will be provided to Science Board by each Technical Committee. A maximum of one award will be given each year. To keep a large pool of potential candidates, Science Board will reserve any surplus of recommendations for review in two consecutive years and will be reactivated if nominator gives approval.

5. Award and Presentation

The award consists of a certificate signed by the PICES Chair and the PICES Science Board Chair, which will be presented to the recipients (or their representatives) at the Opening Session of the PICES Annual Meeting. No financial support from PICES will be provided to the recipient to attend the Annual Meeting where the award is given. Should any representative be unable to attend the Annual Meeting, a Delegate of the recipient's country will be asked to accept the award on behalf of the recipient.

6. Call for Nominations

The award consists of a certificate signed by the Nominations for the POMA Award are accepted annually **from NOVEMBER 1st** of the preceding year, **to MARCH 31st** of the award year. Nominations, along with supporting documentation, should be sent to the PICES Executive Secretary (Sonia.Batten@pices.int) by MARCH 31. Late nominations will not be accepted.

C. COMMITTEE/PROGRAM AWARDS

1. Best Presentation Awards

These awards are intended to enhance the visibility and recognition of early-career scientists at PICES Annual Meetings and to encourage the development of outstanding presentations.

A maximum of one Best Oral Presentation award may be given by each Committee, regardless of the number of Topic or Contributed Paper Sessions sponsored. Recipients for Best Oral Presentation must qualify as an early career scientist.

Judging Guidelines for Oral Presentations

a. Each Committee Chair **may** select one award recipient from among the early career scientists giving oral presentations at Topic Sessions sponsored by that Committee, regardless of the number of sessions sponsored. **If none of the presentations is of sufficient quality, it is not necessary to make an award.**
b. The award will be presented to the recipient by the Chair of the sponsoring Committee at the Closing Session.
c. When two or more Committees jointly-sponsor a Topic Session, the Science Board Chair will determine which Committee is responsible for evaluating presentations in these sessions;
d. Where a Committee has parallel sessions, the Committee Chair may ask a Convenor(s) or Committee Member(s) to judge the session(s) presentations. The Committee Chair will then consult with the designated judge before deciding on an award recipient.
e. Each Committee Chair/FUTURE Co-Chairs is responsible for determining how to select a speaker to receive the award;
f. Criteria for selecting candidates:
    i. **Presenter** must be an early career scientist and first author of presentation.2
    ii. Scientific content of the presentation
    iii. Clarity of presentation (speak to the audience not to the screen so that people can hear; present the subject so the audience can understand; present clear conclusions; leave sufficient time for questions).
    iv. Good quality illustrations that are simple and to the point.
    v. Abstract clearly summarizes the presentation.
    vi. Presenter responds clearly and thoughtfully to questions.
g. The names of all best presentation recipients must be provided to the Secretariat by the end of the last Topic Session in order to allow time for preparation of the certificates before the Closing Session.
h. Awards will consist of a certificate with the name of the recipient and title of presentation, and be signed by the Chair/Co-Chairs of the awarding Committee/FUTURE.

Eligibility

a. Applicants should not be more than 5 years beyond receipt of the PhD.
b. The Committee/FUTURE Co-Chairs will be provided a score sheet identifying the early-career scientists in their session(s).

2. Best Poster Awards

Only one Best Poster Presentation award may be given by each Committee, regardless of the number of Topic or Contributed Paper Sessions sponsored. Best Poster Presentation recipients are Early Career Scientists only (subject to the eligibility requirements below).

Judging Guidelines for Posters

a. Each Committee judge delegated by the Committee Chair will review posters from the Topic Sessions assigned to their Committee.
b. **In the event that there is only one poster in a session, the Committee Chair may make an award if all eligibility criteria have been met, and the poster is considered worthy. If none of the posters is of sufficient quality, it is not necessary to make an award.**
c. Each Committee Chair will provide his/her choice to the Secretariat by the end of the Poster Session
d. At the Closing Session, the award will be presented by the Chair/Co-Chairs of the Committee/FUTURE responsible for evaluating that Topic Session

Eligibility

a. Only ECS posters accepted by Convenors of Topic Sessions/workshops are eligible for the Best Poster Award.
b. The recipient of the award must be the **senior author** of the poster **AND be mostly responsible for its scientific content**.
c. The recipient must have attended the Annual Meeting, and been present at the poster to field questions during the scheduled poster session.

D. PICES DATA POLICY

2018/A/6: Data Management Policy (https://meetings.pices.int/about/PICES-Policy)

1. Principles and Definitions

As stated in Article III of the Convention for the North Pacific Marine Science Organization (PICES), the Organization is to promote the collection and exchange of information and data related to marine scientific research in the North Pacific Ocean and its adjacent seas.

The PICES strategy on capacity development identifies TCODE as the committee responsible for the development of communication networks for the exchange of data and information.

Data gathered as a result of PICES activities will be responsibly managed to guard against loss and to ensure continued accessibility. The management of data using external data management systems is preferred to using internal PICES resources.

For any data provided to PICES, PICES will respect the ownership rights and any restrictions placed on these data by the provider.

- Data include data products and model outputs related to PICES activities. Metadata are data about data.
- End-users include a person, organization, group (including PICES expert groups) using data.
- Data providers include a person, organization, group (including PICES expert groups) providing data.
- The data inventory refers to data for which PICES has the primary responsibility to manage.

2. Roles and Responsibilities

The Technical Committee on Data Exchange (TCODE) is responsible to:

- Manage the PICES data inventory.
- Assist Expert Groups to identify data that are to be included in the data inventory.
- Assist Expert Groups in the development of data management options and strategies.
- Make recommendations to the Science Board on PICES data management and priorities, with particular emphasis on correcting or mitigating any known or anticipated deficiencies.

The PICES Secretariat is responsible to:

- Support TCODE in the maintenance of the data inventory.
- Support TCODE to correct or mitigate any known or anticipated deficiencies.

Science Board is responsible to:

- Include data management requirements in the Terms of Reference of each PICES expert group.
- Review the recommendations proposed by TCODE and provide recommendations to the Governing Council as necessary.

Expert Groups are responsible to:

- Identify any data developed during the activities of the expert group and inform TCODE and PICES secretariat.
- Develop, with assistance from TCODE, strategies, or options for managing data used by the expert group.

3. Data Produced by PICES

All data produced by PICES are considered to be publicly available unless explicitly specified otherwise.

Results, conclusions, or recommendations derived from the data associated with PICES do not imply an endorsement from PICES.

Contributions of data from PICES expert groups will adhere to the expert groups' Terms of Reference and be submitted to TCODE for inventory while the group is active.

All data, including metadata, should be archived using standard codes, formats, and protocols.

4. Data Provided to PICES

The quality assurance of data is the responsibility of the data provider.

In the event that PICES becomes aware that there may be quality issues in the data, PICES will inform the data providers as soon as possible.

Data providers should inform the PICES secretariat of any policies that may place special conditions on their redistribution.

End users are responsible for the proper use of the data and metadata provided.

PICES may reformat data or metadata but will never change the data provider's original record.

Data must be acknowledged, preferably using a formal citation.

5. Citation

Data citations should facilitate giving scholarly credit and normative and legal attribution to all contributors to the data, recognizing that a single style or mechanism of attribution may not be applicable to all data.

Where DOIs exist (Digital Object Identifier), they should be included in the citation.

E. MONITOR COMMITTEE MEMBERS

(As of December 10, 2024)

Dr. Clare Ostle (MONITOR)
ex officio CPR Member to MONITOR
The Marine Biological Association
The Laboratory, Citadel Hill,
Plymouth, PL1 2PB
+44 01752 426307
claost@mba.ac.uk

Dr. Jennifer L. Boldt (FUTURE-SSC, MONITOR, WG-43)
Fisheries and Oceans Canada
Pacific Biological Station
3190 Hammond Bay Rd.
Nanaimo, BC
Canada V9T 6N7
+1-250-756-7110
Jennifer.Boldt@dfo-mpo.gc.ca

Dr. Tetjana Ross (MONITOR, WG-50)
Institute of Ocean Sciences
Fisheries and Oceans Canada
P.O. Box 6000
Sidney, BC
Canada V8L 4B2
+1-250-363-6438
tetjana.ross@dfo-mpo.gc.ca

Dr. Hiroto Abe (MONITOR)
Faculty of Fisheries Sciences
Hokkaido University
3-1-1 Minato-cho
Hakodate, Japan 041-8611
+81-138-40-8843
abe@fish.hokudai.ac.jp

Dr. Minoru Kitamura (MONITOR)
Research Center for Global Change
Japan Agency for Marine-Earth Science and Technology
2-15 Natsushima
Yokosuka, Kanagawa
Japan 236-0061
+81-46-867-9440
kitamura@jamstec.go.jp

Dr. Kazuaki Tadokoro (MONITOR)
Stock Productivity Section
Tohoku National Fisheries Research Institute, FRA
3-27-5 Shinhama-cho
Shiogama, Miyagi
Japan 985-0001
+81-22-365-1191
+81-22-367-1250
den@affrc.go.jp

Dr. Zhengguo Cui (MONITOR)
Yellow Sea Fisheries Research Institute
Chinese Academy of Fishery Sciences
106 Nanjing Rd., Shinan District
Qingdao, Shandong
People's Republic of China 266071
(86-532) 137 9199 4798
(86-532) 8581 1514
cuizg@ysfri.ac.cn

Dr. Zhifeng Zhang (MONITOR)
Marine Environmental Chemistry Division
National Marine Environmental Monitoring Center (NMEMC), MEE
42 Linghe St., Shahekou District
Dalian, Liaoning
People's Republic of China 116023
+86-411-8478-2732
+86-411- 8478-2732
zfzhang@nmemc.org.cn

Dr. Xianyong Zhao (MONITOR)
Yellow Sea Fisheries Research Institute, CAFS
106 Nanjing Rd.
Qingdao, Shandong
People's Republic of China 266071
+86-532-8583-5363
+86-532-8581-1514
zhaoxy@ysfri.ac.cn

Dr. Feng Zhou (MONITOR)
Laboratory of Satellite Ocean Environment Dynamics
Second Institute of Oceanography, MNR
36 Baochu North Rd.
Hangzhou, Zhejiang
People's Republic of China 310012
(86-571) 81963106
(86-571) 88839374
zhoufeng@sio.org.cn

Prof. Sung Yong Kim (AP-NPCOOS, MONITOR, SB, WG-38, WG-47, WG-49, WG-50) MONITOR Chair
Environmental Fluid Mechanics Laboratory (EFML)
Department of Mechanical Engineering, KAIST
291 Daehak-ro, Yuseong-gu
Daejeon, Republic of Korea 34141
+82-42-350-1523
+82-42-350-1510
syongkim@kaist.ac.kr

Dr. Hea-Kun Jung (MONITOR)
East Sea Fisheries Research Institute
National Institute of Fisheries Science(NIFS)
1194, Haean-ro, Yeongok-myeon
Gangneung-si, Gangwon-do
Republic of Korea 25435
+82 33 660 8533
Hkjung85@korea.kr

Dr. Vladimir V. Kulik (MONITOR)
Laboratory for biological resources of the Far-Eastern and Arctic Seas
Pacific branch (TINRO)
of the Russian Federal Research Institute Of Fisheries and Oceanography (VNIRO)
4 Shevchenko Alley, Vladivostok, Primorsky Kray, Russia 690091
vladimir.kulik@tinro-center.ru

Dr. Vyacheslav B. Lobanov (AP-NPCOOS, CREAMS-AP, FUTURE-SSC, MONITOR, POC)
CREAMS-AP Co-Chair
V.I. Il'ichev Pacific Oceanological Institute (POI), FEB RAS
43 Baltiyskaya St.
Vladivostok, Primorsky Kray
Russia 690041
+7-4232-312-377
+7-4232-312-573
lobanov@poi.dvo.ru

Dr. Jack A. Barth (AP-NPCOOS, GC, MONITOR, SG-ER)
College of Earth, Ocean, and Atmospheric Sciences (CEOAS)
Oregon State University
104 CEOAS Admin. Bldg.
Corvallis, OR
U.S.A. 97331-5503
+1-541-737-1607
+1-541-737-2064
jack.barth@oregonstate.edu

Dr. Mariela K Brooks (MONITOR)
Auke Bay Laboratories
NOAA Alaska Fisheries Science Center
17109 Point Lena Loop Road
Juneau, U.S.A. 99801
907-789-6653
mariela.brooks@noaa.gov

Dr. Kym Corporon Jacobson (MONITOR)
MONITOR Vice-Chair
Fish Ecology
Northwest Fisheries Science Center, NMFS, NOAA, Hatfield Marine Science Center
2030 SE Marine Science Dr.
Newport, OR
U.S.A. 97365
+1-541-867-0375
+1-541-867-0389
kym.jacobson@noaa.gov

Mr. Hak-Yoel You (MONITOR)
Oceanographic Observation Division
Korea Hydrographic and Oceanographic Agency (KHOA)
351 Haeyang-ro, Yeongdo-gu
Busan, Republic of Korea 49111
+82-51-400-4230
peterhak@korea.kr