Cruise Report

Eco-FOCI Spring Mooringspop

Cruise DY22-06

NOAAS Oscar Dyson

May 10 – May 19, 2022

(Initially May 2 - May 14th 2022)

Shaun Bell

Jessica Crance

Deana Crouser

Alison Deary

LTJG Iris Ekmanis

Jeanette Gann

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Paul Hillman AFSC

Steven Kunze PMEL/GTMBA

— Traveled but did not sail

Marty Reedy USFWS

Ryan McCabe PMEL/FOCI

**Cruise Objectives:**

The primary objective of cruise DY22-06 was the recovery of the moorings at M2 and M4 followed by the deployment of surface moorings at M2 and subsurface moorings at M4.   CTD stations were to be conducted on the 70m isobath and at the boxes around each station at M2, M4, and M5. In addition to CTD measurements, bongos were to be taken at every other station along the 70m isobath and at the box stations around M2, M4, and M5. CalVET samples were to be taken at the center of each mooring box location to assess the small zooplankton population. Rapid Zooplankton Assessments were to be conducted at every other bongo station to generate data for early ecosystem assessment. CTD/Bongos were also to be occupied around the Unimak box in Unimak Pass.  A final mooring was to be deployed at mooring site UPP along with several MML mooring turnarounds and recoveries.  PUF moorings were to be deployed at various sites in the Bering Sea.

Equipment tests were scheduled to be conducted with the CPICS plankton imaging camera and the Rinko oxygen sensor which was doing comparisons of different oxygen sensors during most CTD casts. Special sample requests were made to collect zooplankton for lipid analysis (Suryan, Auke Bay Laboratory, AFSC), Harmful Algal Bloom research (Lefevbre, NWFSC), and for crab larvae (Fedewa, AFSC).

Additional personnel traveled with the science complement to record video of EcoFOCI activities and to blog the operations.

**Operations:**

The operations consisted of 5 main categories, moorings, ctd’s, bongo/CalVET tows, bird and marine mammal observations.

**1) Moorings**: Shaun Bell, Jessica Crance, Natalie Monacci and Steven Kunze.

Mooring operations for DY22-06 consisted of 3 moorings recovered and 6 moorings deployed. These included 1 ADCP (Acoustic Doppler Current Profiler) mooring recovered and 2 deployed, 2 passive acoustic moorings deployed and 2 recovered, and 2 surface moorings deployed. All mooring operations were performed without incident or damage to any instrumentation and a complete list of all instruments attached to each mooring is listed in the tables below.

Existing moorings at M4 and M5 had an acoustic release check. Both M4 moorings responded and provided locations consistent with deployment. The BSP-5A mooring also responded but the BS-5A mooring did not. These later two moorings have been out since 2019 so it is not surprising that it did not communicate. The fall cruise should prepare to drag for this mooring. Locating the mooring via the onboard sounder was not attempted.

**Moorings recovered**, ADCP = Acoustic Doppler Current Profiler; AURAL=passive acoustics; Oxygen=oxygen sensor; SBE43=oxygen\_sensor.

| Mooring | ADCP | Current Meter | Eco | MTR | Micro Cat | SBE16 | Oxygen | SBE Temp | Aural | pCO2 |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 21BSP-2A | 1 |  |  |  |  | 1 | 2 |  | 1 | 1 |
| AL21\_AU\_UN01 |  |  |  |  |  |  |  |  | 1 |  |
| AL21\_AU\_BS10 |  |  |  |  |  |  |  |  | 1 |  |

**Moorings deployed**, ADCP = Acoustic Doppler Current Profiler; Eco=flourescence; SeaCat=conductivity, temperature, depth; MicroCat=conductivity, temperature, depth; Oxygen=oxygen sensor, SBE Temp=temperature sensor; TDGP=Gas Tension, AURAL=passive acoustics, SUNA=nitrate sensor, PAR=Photosynthetic Active Radiation.

| Mooring | ADCP | Current Meter | Eco | MTR | Micro Cat | SBE16 | Oxygen | SBE Temp | Aural | TDGP | PAR | SUNA | pCO2/pH |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 22UPP-3A | 1 |  |  |  | 1 |  |  |  |  |  |  |  |  |
| 22BSP-2A | 1 |  |  |  |  | 1 | 1 |  | 1 |  |  |  | 1 |
| 22BSPR-2A |  | 1 | 1 |  |  | 1 | 2 |  |  |  |  |  |  |
| 22BSM-2A |  |  | 4 | 4 | 3 | 4 | 2 | 9 |  | 1 | 1 | 1 | 1 |
| AL22\_AU\_UM01 |  |  |  |  |  |  |  |  | 1 |  |  |  |  |
| AL22\_AU\_BS10 |  |  |  |  |  |  |  |  | 1 |  |  |  |  |

*Note: 22BSPR-2A has a prawler as the primary instrument package which includes a CTD, fluorometer and oxygen sensor.*

Additional instrumentation was deployed at M2 to support the UAF OARC (University of Alaska Ocean Acidification Research Center) to monitor marine carbon dynamics and are collectively referred to as pCO2 in the tables above:

Sensors deployed on M2 surface mooring, Peggy,:

* MAPCO2: air (1m above sea surface) CO2 and seawater (1m below sea surface) CO2  
  SeaFET: seawater (1m below sea surface) pH
* SAMI pH: seawater (1m below sea surface) pH

Sensors deployed on M2 subsurface mooring monitor marine carbon dynamics:

* SAMI pH: seawater (67m below sea surface) pH
* SAMI CO2: seawater (67m below sea surface) CO2

Three Popup-Floats (PUF) were deployed. These are moored bottom temperature recorders that will release and float as SST drifters at a pre-programmed date.

| PUF Serial ID | Deployment Location Name | Date | Latitude | Longitude | Depth |
| --- | --- | --- | --- | --- | --- |
| PUF 26 | PUF Site 9 | 2022-05-18 08:45 | 58 22.03 N | 172 33.82 W | 106.6m |
| PUF 25 | PUF Site 70m32 | 2022-05-17 16:20 | 59 14.78 N | 170 25.36 W | 68m |
| PUF 13 | PUF Site 6 | 2022-05-18 17:20 | 56 40.6 N | 171 10.72 W | 118m |

**2) CTD’s:** Shaun Bell, Natalie Monacci, Emily Lemagie, Iris Ekmanis, and Jeannette Gann.

The CTD objective for the cruise was to perform CTDs along the 72m isobath from the M2 mooring site up to the M85 mooring site which continues the long term monitoring of the Bering Sea Ecosystem. The Unimak box was a lower priority, with the southern line being given preference if possible.

The following table is a list of all the stations occupied and the water samples that were taken at each station,

**Summary of all CTD Sampling for Cruise DY22-06**

| **Station Number** | **No. of Nutrients** | **Sal. Samples** | **O2 Samples** | **Chl Samples** | **Number of DIC** | **Gann Samples** | **eDNA** | **Abs. Sample** | **FCM Sample** | **Size Frac Chlor** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| s1h1 | 7 | 1 | 6 | 6 | 10 | 1 | 3 | 1 | 2 | 6 |
| s3h1 | 7 |  | 1 | 6 |  | 1 |  |  | 1 | 1 |
| s4h1 | 7 |  | 1 | 6 |  |  | 3 |  |  |  |
| s5h1 | 7 |  | 1 | 6 |  | 1 |  |  | 1 | 1 |
| s6h1 | 7 | 1 | 1 | 6 |  | 1 |  |  | 1 | 1 |
| s7h1 |  |  |  |  |  |  |  |  |  |  |
| S7h3 | 7 |  | 6 | 6 |  |  | 3 |  |  |  |
| S8h1 | 7 |  | 1 | 6 | 2 | 2 |  |  | 1 | 6 |
| S9h1 | 7 |  | 1 | 6 |  |  |  |  | 1 | 1 |
| s10h1 | 7 | 1 | 1 | 6 |  |  |  |  |  | 1 |
| s11h1 | 7 |  | 1 | 6 |  |  |  |  | 1 | 1 |
| s12h1 | 7 |  | 1 | 6 |  |  | 3 |  |  |  |
| s13h1 | 7 |  | 1 | 6 |  |  |  |  |  |  |
| s14h1 | 1 |  | 1 |  | 1 |  |  |  |  |  |
| s15h1 |  |  |  | 1 |  | 1 |  |  | 1 | 1 |
| s16h1 | 7 |  | 1 | 6 |  |  |  |  | 1 |  |
| s17h1 | 7 | 1 | 1 | 6 |  |  |  |  |  |  |
| s18h1 | 7 |  | 1 | 6 |  |  | 3 |  |  |  |
| S19h1 | 9 |  | 1 | 6 |  |  |  |  |  |  |
| s20h1 | 9 |  | 1 | 6 |  |  |  |  |  |  |
| s22h1 | 7 |  | 1 | 6 |  | 1 |  | 1 | 1 | 6 |
| s23h1 | 7 | 1 | 1 | 6 | 7 |  | 3 | 1 | 1 | 1 |
| s24h1 | 7 |  | 1 | 6 |  |  |  |  | 1 | 1 |
| s25h1 | 7 |  | 1 | 6 |  | 1 |  | 1 | 1 | 6 |
| s26h1 | 7 | 1 | 1 | 6 |  |  |  |  | 1 |  |
| s27h1 | 7 |  | 1 | 6 |  |  |  |  | 1 |  |
| s29h1 | 7 |  | 1 | 6 |  |  |  |  | 1 |  |
| s30h1 | 7 | 1 | 1 | 6 | 7 | 1 | 3 | 1 | 6 | 6 |
| S31h1 | 7 |  | 1 | 6 | 1 | 1 |  |  | 6 | 6 |
| **Totals** | **187** | **7** | **37** | **157** | **28** | **11** | **21** | **5** | **29** | **45** |

UAF OARC Lead Natalie Monacci volunteered to lead sampling efforts and analysis for oxygen calibration samples.  A total of 34 discrete samples were analyzed by winkler titration on EcoFOCI instrumentation by Monacci during DY2206.

**3)  Bongo/CalVET tows**: Alison Deary, Deana Crouser:

Zooplankton samples and water profiler data were collected simultaneously at 24 sites.  These sites were along the 70-m isobath, at and around the M2, M4, and M5 moorings and in the Unimak Box. At each site, a bongo-profiler array was used to sample from the sea surface to 10 m off bottom. Samples were collected with a 20-cm bongo (153-µm mesh) and a 60-cm bongo (505-µm mesh) mounted on the wire just below a Sea-Bird Electronics Fastcat profiler (SBE-49). The profiler was used to indicate net depth in real time and measured temperature and salinity.  Net 1 of each bongo net (20 and 60 cm) was preserved (5% formalin-buffered seawater solution) for quantitative analysis. Both Net 2 samples were used for Rapid Zooplankton Assessment (RZA, RCountZ) at 16 stations. At mooring sites M2, M4, and M5 a California Vertical Egg Tow (CalVET) net (53-µm mesh) was used, along with the profiler, to collect triplicate samples of microzooplankton from the upper 60 m of the water column. For a total of 11 samples.

Zooplankton from Net2 were processed to fulfill several special requests. Large copepods and euphausiids were separately picked, photographed, and frozen for later lipid analysis at RZA stations where abundance was sufficient (Suryan, ABL/AFSC). Euphausiids were separately picked and frozen for later Harmful Algal Bloom toxin analysis (Lefebvre, NWFSC). Finally, contents of the 60-cm bongo, net 2 were preserved in formalin for larval crab analysis (Weems, ADF&G). Fish eggs were also picked and preserved in 100% ethanol at seven stations along the 70-m isobath for later eDNA analysis to detect if Arctic Cod eggs were present. In addition to these special requests, the zooplankton team also tested a new plankton imaging system, the CPICS. The CPICS camera collected data on 23 casts.

Table 1.  Bongo, CalVET, and special sample request totals

| Samples Collected | Tows | Number |
| --- | --- | --- |
| Quantitative tow preserved in formalin (20 and 60-cm combined) | 48 | 48 |
| Rough Count Zooplankton for Rapid Zooplankton Assessment | 32 | 32 |
| CalVET samples | 11 | 11 |
| Collect zooplankton imagery with imaging system mounted on CTD frame | 23 | 23 |
| Preservation of processed 60-bon net 2. Special request for Jared Weems. | 23 | 23 |
| Lipid samples for Rob Suryan | 15 | 15 |
| HAB samples for Kathi Lefebvre | 32 | 32 |
| Collection of gadid eggs for genetic analysis. Special request by AL Deary | 7 | 118 |
| Gears Used |  |  |
| 20BON - 20cm bongo | 24 |  |
| 60BON - 60cm bongo | 24 |  |
| CALVET - CalCOFI vertical egg net tow | 11 |  |
| CAT - Seabird SeaCAT CTD | 35 |  |

**4) Passive Acoustics Marine Mammal Ops:** Jessica Crance.

**Long-term recorders**

Three long-term marine mammal passive acoustic recorders were successfully recovered and redeployed during the survey. Of these, two were on MML marine mammal moorings and one was on a PMEL mooring. All three recorders lasted the full expected time.

**Short-term monitoring**

Passive acoustic monitoring was conducted opportunistically during the survey using sonobuoys, which were deployed approximately every 2.5 hours as ship operations, depth, and vessel traffic permitted. Sonobuoys are short-term, expendable, listening devices which transmit the acoustic signals in real-time via VHF to an antenna on the ship. A total of 27 sonobuoys were deployed for a total of over 33 hours of acoustic monitoring. Of the 27 sonobuoys, 10 were 2014 Sparton 53F DiFAR directional buoys, 7 were 2019 Sparton 53G directional buoys, 2 were 2001 Sparton 57-MOD omnidirectional buoys, and 8 were 2008 Undersea Sensor System (UND) 53F directional buoys. All 17 of the 2014 and 2019 Sparton buoys transmitted successfully, 7 of the 8 UND buoys transmitted successfully, while neither of the older omni buoys worked, for an overall success rate of 89%. The most commonly detected species was killer whales, detected on 11 buoys (46%), followed by fin and sperm whales (8 and 6 buoys respectively, 33% and 25%), and humpback whales (3 buoys, 13%).

**5. Bird Observations:** Marty Reedy.

Due to initial delays with ship staffing that prevented the ship from sailing on its initial scheduled departure date, the bird observer withdrew from the cruise on May 6th

**6. Special Projects:**

Special projects involving samples are tabulated in the CTD/Bongo section.

eDNA was also collected at selected sites from the CTD niskins for PMEL OMICS group.

The Rinko O2 sensor was brought along for more comparisons to the Aanderaa optode and the Seabird SBE43 as the fall cruise did not happen and the previous spring cruise had inadvertently been compared against a slow response aanderaa, however, no profile was seen with a sufficient enough O2 span or gradient to justify comparison.

The TDGP was also brought along to hook up to the pCO2 system.  The pCO2 system was never able to be brought online and so the TDGP was not operational.

The ABL/EMA group added an imaging flow cytobot (IFCB) to the underway SCS system to characterize phytoplankton community composition (5ml samples collected every 20 minutes, along track) aboard ship during the survey. The IFCB was left on board for continued phytoplankton community characterization throughout the summer and will be taken off after the end of the BASIS survey in September. Overall community composition (including cell sizes) of phytoplankton in addition to flagging of any harmful algal cells (HABs) will be monitored using this system.

**Summary**:

Changes in staffing included the retirement of initial scheduled chief scientist and lead mooring tech, Geoff Lebon (replaced by Shaun Bell as chief scientist and Steven Kunze as lead mooring tech), replacement of Dave Kimmel due to illness with Alison Deary. Ryan McCabe was added for the first portion of the cruise as Steven Kunze was not able to sail until May 10th. The cruise was then to be split into two portions. May 2nd – May 11th would be focused on Unimak and the 70m line, and May 11th – May 14th would focus on the M2 site.

Further issues arose when the Oscar Dyson had a non-covid medical emergency in the Steward department, initiating a No Sail scenario. Multiple attempts at getting replacement crew were performed but no one was initially identified. Additional attempts established that there was personnel available but due to travel distance and traditional Dutch Harbor weather travel complications, it was not evident that the replacement personnel would arrive in time to allow sufficient operational time in the M2 region to successfully deploy and recover the high priority moorings. Marty Reedy and Ryan McCabe were sent home during this wait period without boarding the vessel. LTJG Iris Ekmanis generously volunteered to work and had the proper training to act as a replacement in the steward department for the period that our mooring tech, Steven Kunze was available (5/10-5/14). The ship approved this plan and we were able to set a sail date on 5/10.

Upon leaving Dutch Harbor the ship headed to Site M2 to turn around all the moorings at site M2 and complete the M2 box.  All moorings were successfully deployed and recovered. We had sufficient time to start the 70m line between M2 and M4 and sampled every CTD/Bongo station between M2 and 70m14. CPICS plankton imaging camera was attached to the ctd frame and collected images for a machine learning application for in-situ plankton identification. Rapid Zooplankton Assessment was conducted at each bongo location along the 70m and zooplankton were collected for later lipid analysis and Harmful Algal Bloom toxin analysis.

We then transited to the Marine Mammal Lab site BS10 to recover/deploy an acoustic listening device prior to transiting back to Dutch Harbor.

Simultaneously to LTJG Ekmanis participating in the steward department, a replacement 2C was identified and available upon our return. The ship knew this as we departed and we were offered an extension of up to 5 days, which cut into the vessel’s two-week inport time to mitigate the impact of the delay on our science. We performed a small boat transfer to get Steven Kunze and Paul Hillman ashore and retrieve the 2C. LTJG Ekmanis then transitioned back to science.

Upon leaving Dutch Harbor the second time, the ship headed to the Unimak Pass mooring sites. A passive acoustic MML mooring was recovered and redeployed and a PMEL ADCP mooring was deployed. The southern Unimak Pass CTD/Bongo transect (4 stations) was then performed.

We then began to transit directly towards the M4 box and center station to pick up work on the 70m line. Winds picked up and weather set in and the ship slowed its transit significantly on this route. We arrived at M4, performed the box and center station operations (CTD/BONGO/Calvets) and pinged on the currently deployed M4 moorings to assure they were still present and upright. They were. We had insufficient personnel to plan on recovery/redeployment at this site (without a lead mooring tech on board) so the moorings were left in the water until the fall.

We continued up the 70m line, sampling every 4th station to make up for lost time due to the weather on the transit to M4 so that we could prioritize the center station at M5. A PUF was deployed along the way at 70M32 (an alternative site to the preferred PUF 16 location east of the 70m line at 50m depth). After completion of the M5 center station and one box corner, the vessel began its transit back to Dutch, dropping PUFs off at sites 6 and 9 along the way.

The ship docked in Dutch Harbor on May 19th.

The cruise enjoyed favorable weather throughout most of the cruise and with near zero equipment downtime, we were able to accomplish the highest priority tasks M2 deployment, M2/M4/M5 Center Stations with 75% of the box stations sampled, Unimak moorings and the Unimak southern transect. Side ops summed to 29 CTD stations, 24 Bongos and 11 Calvets.  The cruise was considered a success if evaluated against the adjusted cruise plan that was provided after the change of personnel, and it is especially noteworthy that the success of M2 was driven by LTJG Ekmanis’s selflessness to work in the Steward department. The ship’s ability to push the end date also enabled the other high priority tasks to be completed.

**Specific Recommendations and Special Acknowledgements:**

This cruise was greatly impacted by the retirement of the lead mooring tech and initial chief scientist. Field planning should be more transparent in the future in the event of a last minute change of personnel.

Due to delays and to transit logistics and operation time-windows, the science crew never managed to support a consistent shift/schedule as work was performed when needed, often at inconsistent times with long days. I would like to acknowledge the dedication this shows from the participating field staff.

Special recognition should be provided to LTJG Ekmanis for her role in supporting this mission (by augmenting the Steward department). Without this generosity, it is unlikely that the M2 site would have been fully deployed.

**Oscar Dyson daily schedule for DY22-06**

4/28 – Arrival of science party

4/29 – Load Day 1 - arrival of remainder of science party

4/30 – Load Day 2

5/1 – Initial COVID Test Day (Delayed)

5/2 – Initial Cruise Start Date (Delayed)

5/3 - (Delayed)

5/4 - (Delayed)

5/5 - (Delayed)

5/6 - (Delayed)

5/7 - (Delayed)

5/8 - (Delayed)

5/9 – Steven Kunze arrived (Delayed)

5/10 – Depart for M2 leg, transit to M2 – Ekmanis as Steward

5/11 – Arrive on site, Recover and Deploy BSP-2A and BSM-2A, sample M2 box

5/12 – Deploy BSP-2A, start 70m line

5/13 – continue 70m line, transit to BS10 (recover/deploy), transit to Dutch

5/14 – Allow Kunze and Hillman to depart, pick up 2C (steward) and have Ekmanis return to science complement, transit to Unimak. Recover and deploy UN01, UPP-3A and sample UBS line

5/15 – Transit to M4

5/16 – sample 70m line

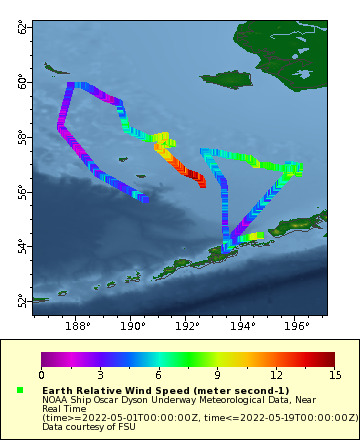
5/17 – sample 70m line, deploy 1 PUF

5/18 – Transit to Dutch, deploy 2 PUFs en-route

5/19 – Arrive in Dutch

**Plot of Cruise Track:**

Wind Speed along Track from [CoastWatch](https://coastwatch.pfeg.noaa.gov/erddap/tabledap/fsuNoaaShipWTEPnrt.html). Black Lines represent the cruise track where there was a data drop-out. For the most part, weather was supportive of operations. The transit from Unimak to M4 was against more challenging seas as can be seen in the windspeed plot below.



**Station Map**

The subsequent map provides information on discrete operations. CTD/Bongo Stations are represented by ‘.’s and are color coded by bottom temperature (legend to right). Open red circles are mooring recovery/deployment locations. Closed red circles are MML sonobuoys with whale detections (any species) whereas red plusses are sonobuoys without any detections. Black stars are PUF deployments.

