**Oregon Department of Fish and Wildlife**
**Marine Resources Program**
**Semi-annual update on Oregon Dungeness Crab Commission Fishery Improvement (FIP) work plan**
**Assessment Period: August 2022 – January 2023**
**Report Date: February 2023**

| Goal/Performance Indicator | Actions | Due Date | Responsibilities | Progress |
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| 2. Identify the main non-target species and provide information on the status of these species.<br><br>PI 2.1.3, 2.2.3 | A. Assess the amount (weight) of bait used by species in the fishery each year and identify which species are actively managed (i.e. for management targets such as an LRP). | ~~Aug 2023~~ Proposed Feb 2024 | Troy Buell (ODFW) | A and B - ODFW continues to actively process and enter crab logbook data which provides information on bait use in the fishery. Due to the extended season opening management needs and the delayed season opener ODFW is requesting a 6-month extension to complete this bait assessment. This time will allow ODFW to contact bait dealers and focus on this analysis in a slower time of the crab season.<br><br>C – ODFW is on track to complete assessment of in-house crab fishery bycatch data collected during pre-season and in-season ride-along trips, by August 2024. During this reporting period ODFW collected bycatch data on 12 preseason test trips. |
| | B. Provide available stock status information on bait species that account for 5% or more of the total catch (by weight) in the fishery. | ~~Aug 2023~~ Proposed Feb 2024 | Troy Buell (ODFW) | |
| | C. Provide encounter rates and/or catch data (numbers) for out of scope species (non-ETP amphibians, reptiles, birds, mammals, e.g. orange sea pen, pelagic cormorant). | Aug 2024 | Troy Buell (ODFW) | |
| 3. Demonstrate that the main non-target species are above biological based limits<br><br>PI 2.1.1, 2.2.1 | A. For species that account for 5% or more of the total catch (if any) and have management targets (such as an LRP), provide annual stock status information over the past 10-15 years relative to the target. | Aug 2023 | Troy Buell (ODFW) | A and B - ODFW continues to actively process and enter crab fish ticket data which documents all species commercially landed during operation of the fishery. ODFW is on track to complete assessment by August 2023 (A) and 2024 (B). |
| | B. For species that account for 5% or more of the total catch (if any) and do not have management targets and | Aug 2024 | Troy Buell (ODFW) | |

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| | all out of scope species, provide available abundance trend information (catch or CPUE data, observer data, abundance surveys, etc). | | | |
| 4. Demonstrate that there is a strategy in place that is designed to maintain the main non-target species at sustainable levels.<br><br>PI 2.1.2 and 2.2.2 | A. For species that account for 5% or more of the total catch (if any) describe the strategy used to maintain these species at or above biological based limits or if none, develop and implement such a strategy.<br>B. For species that account for 5% or more of the total catch (if any) provide an objective rationale and evidence for why the above strategy will work based on some direct information the UoA and/or species involved. | Aug 2025<br><br>Aug 2025 | Troy Buell (ODFW)<br><br>Troy Buell (ODFW) | A and B - ODFW continues to actively process and enter crab fish ticket data which documents all species commercially landed during operation of the fishery. ODFW is on track to complete assessment by August 2025. |
| 5. Provide evidence that the fishery does not hinder recovery of ETP species.<br><br>PI 2.3.1 | A. Continue to participate in and support the Oregon Whale Entanglement Working Group and/or the Crab Advisory Group (OWEWG) to develop short- and long-term options for reducing whale entanglements in Dungeness crab fishing gear.<br><br>B. Continue research to monitor whale distribution off the Oregon coast to identify whale hotspots. | Ongoing (through Aug 2025)<br><br>Ongoing (through at least Aug 2021) | Hugh Link (ODCC)<br><br>Leigh Torres (OSU) | A - ODFW re-initiated a stakeholder advisory group to ODFW, renamed the Oregon Entanglement Advisory Committee (OEAC) to provide ODFW with information and broad perspectives from a range of stakeholders on strategies to support the co-occurrence of economically viable fixed gear fisheries and thriving marine life populations off Oregon. All information about this re-formed advisory group and information on our kick-off meeting hosted in October 2022 is on our website here.<br><br>B – ODFW and OSU's progress report to NMFS summarizing work done for completing the two Section 6 funded projects to investigate co-occurrence of large whales and the crab fishery are included as Attachment A. Within this reporting period, ODFW and OSU submitted a manuscript on factors influencing overlap |

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| | C. Continue to develop the Conservation Plan for endangered and threatened whales. | Aug 2025 | Tim Novotny (ODCC) and Troy Buell (ODFW) | between the fishery and rorqual whales to the peer reviewed journal Biological Conservation. ODFW and OSU began work on the second Section 6 proposal to continue the aerial surveys beyond June 2022 and further expand on the initial modeling efforts.<br><br>C – A summary of ODFW's efforts to continue development of a Conservation Plan in 2022 is included in the ODFW crab fishery newsletter posted here. |
| 6. Demonstrate that there is a strategy in place that is designed to ensure the fishery does not pose a risk of serious or irreversible harm to the habitats.<br><br>PI 2.4.2 | A. Develop and implement new technologies to monitor crab vessel locations and compliance with closed areas. | Aug 2025 | Hugh Link (ODCC) | A - ODFW has continued to work with a software developer to build and start field testing an integrated vessel tracking electronic logbook system for the ocean commercial crab fishery in this reporting period. The pilot system is currently being tested on 9 crab commercial vessels. ODFW remains committed to working with industry to test electronic monitoring (EM) systems for vessel tracking and developing procedures for how systems can be used to provide near real-time fishery data by the 2026-27 crab season (see Section 5.3.3.3 starting on page 94 of the draft CP titled "Electronic Monitoring"). |
| 7. Demonstrate that Information is adequate to determine the risk posed to the habitat by the fishery.<br><br>PI 2.4.3 | A. Continue research and monitoring of coastal habitats identified in the Oregon Nearshore Strategy, including:<br>• Survey of seafloor structures and habitat composition<br>• Examination of species, communities, and habitat relationships to habitat monitoring priorities. | Ongoing (through Aug 2025) | Scott Marion (ODFW) | A - ODFW conducted a fishery-independent survey of habitat condition and fish and invertebrate communities in an important commercial fishing region. Transects were conducted using a stereo video sled and a Didson imaging sonar in the recently re-opened bottom trawl RCA (Rockfish Conservation Area) in the vicinity of Heceta Bank. Video surveys were also implemented in shallow kelp-bearing habitats in the vicinity of Depoe Bay using a small ROV. |
| 10. Demonstrate that monitoring, control | A. Develop and implement new technologies to streamline | Aug 2025 | Hugh Link/Troy Buell | A - ODFW has continued to work with a software developer to build and start field |

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| and surveillance mechanisms ensure the management measures in the fishery are enforced and complied with.<br><br>PI 3.2.3 | logbook submittals and to monitor compliance with closed or restricted fishing areas (marine reserves).<br><br>B. Work with fishermen to educate them on the importance of reporting whale entanglements. | | (ODCC) (ODFW) | testing an integrated vessel tracking electronic logbook system for the ocean commercial crab fishery in this reporting period. The pilot system is currently being tested on 9 crab commercial vessels. ODFW remains committed to working with industry to test electronic monitoring (EM) systems for vessel tracking and developing procedures for how systems can be used to provide near real-time fishery data by the 2026-27 crab season (see Section 5.3.3.3 starting on page 94 of the draft CP titled "Electronic Monitoring").<br><br>B. The newly formed stakeholder group Oregon Entanglement Advisory Committee (OEAC) met in October. The group received brief introductions and was asked to provide feedback on outreach materials, including a revised Oregon Best Practices Directive for minimizing entanglement risk. ODFW incorporated feedback from the group and final revised directive was distributed to vessel operators during the 2022-23 crab season hold inspections by ODFW and OSP.<br><br>Information on reporting marine life entanglement was included in the ODFW crab fishery newsletter finalized in Jan 2023 and posted here. ODFW mailed the newsletter to all crab buyers, permitholders and interested parties, as well as posted on our website. |

# ATTACHMENT A

# NOAA Species Recovery Grant Semi-Annual Progress Report

Grant number: NA19NMF4720109

Project title: Identifying Co-occurrence Between Whales and Fishing Effort in Oregon to Reduce Entanglement Risk

Grantee name: Oregon Department of Fish and Wildlife

Contact information for project managers:

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Dates of the award period: 7/1/2019-12/31/2022

Dates covered by the progress report: 07/01/2022-12/31/2022

Description of the tasks scheduled for the reporting period and tasks accomplished during the reporting period:

As described in the project proposal, the Oregon Department of Fish and Wildlife (ODFW) planned for most of the work under this award to be conducted by Oregon State University (OSU) under an Intergovernmental Agreement (IGA) establishing a contractual relationship between the two parties, which was executed on October 4, 2019. This report addresses tasks accomplished under a No Cost Extension to complete the work. Elements of the project timeline were significantly impacted by the response to the novel coronavirus pandemic, as described previous progress reports.

**Overlap analysis between whale and fishing effort maps**

Methods and results established during the previous reporting period to analyze co-occurrence patterns of rorqual whales and Dungeness crab fishing effort remain unchanged. A manuscript was written to present the results of this study and was subject to internal review by three ODFW reviewers. Manuscript was revised to incorporate internal feedback from ODFW and submitted for publication in the journal Biological

Conservation where it is currently in review. The manuscript in review is provided as an attachment to this report.

**Conference Attendance and other disseminations of the Project**

During this reporting period, Dr. Derville presented the results of this project in a virtual talk at the 24th Biennial conference on the Biology of Marine Mammals (Miami, Aug 2022). The talk was entitled “Anticipating large whale entanglement risk off Oregon, USA: a predictive approach to spatial conflict” (abstract #SMM2022197).

The GEMM Lab also maintains an up-to-date research page describing this project

https://mmi.oregonstate.edu/gemm-lab/opal-overlap-predictions-about-large-whales-identifying-co-occurrence-between-whales

Explanation of any problems or delays in accomplishing planned activities:

Restrictions related to COVID-19 at the national, state, county, and agency levels have impacted the project in numerous ways, including but not limited to delays in conducting aerial surveys, boat-based surveys, outreach, and hiring processes. These delays have had downstream impacts to the project timeline. For example, hiring delays have pushed back timelines for conducting analysis of both whale survey data and fishing effort data

Due to these factors, ODFW was unable to complete fishing effort raster layers for fixed gear fisheries other than Dungeness crab within the project timeline and staff time budgeted as match for this grant. Other fixed gear fisheries off Oregon utilize orders of magnitude fewer vertical lines than the Dungeness crab fishery, therefore ODFW prioritized production of Dungeness crab fishing effort raster layers for overlap analysis. ODFW continues to have a strong interest in evaluating overlap with other fixed gear fisheries and intends to continue work to produce those fishing effort raster layers for overlap analysis using state funds that have not been budgeted as match for any grant.

# NOAA Species Recovery Grant Semi-Annual Progress Report

Grant number: NA22NMF4720105

Project title: Enhancing Co-occurrence Assessment of Whales and Fishing Gear in Oregon Waters through Incorporation of Prey Data and Residency Analysis

Grantee name: Oregon Department of Fish and Wildlife

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Dates of the award period: 7/1/2022-6/30/2025

Dates covered by the progress report: 07/01/2022-12/31/2022

Description of the tasks scheduled for the reporting period and tasks accomplished during the reporting period:

As described in the project proposal, the Oregon Department of Fish and Wildlife (ODFW) planned for most of the work under this award to be conducted by Oregon State University (OSU) under an Intergovernmental Agreement (IGA) establishing a contractual relationship between the two parties, which was executed on August 5, 2022. This report addresses tasks scheduled during the reporting period as outlined in *Figure 3. Milestone timeline of proposed project* of the project proposal. Additional details on OSU's work can be found in Attachment 1.

**Vessel-based endangered species survey and prey data collection (Step 1)**

Two marine mammal observers collected vessel-based marine mammal survey data during one five-day cruise aboard the NOAA research vessel *Bell M. Shimada* in September 2022. Prey (krill) data was concurrently collected via active acoustics and bongo net tows. Subsamples of individual krill were frozen for caloric analysis.

**Endangered species helicopter transects (Step 2)**

OSU coordinated monthly surveys aboard United States Coast Guard (USCG) helicopters throughout the reporting period. The design calls for each of four tracklines to be flown monthly for a total of 24 planned tracklines during the reporting period, and OSU completed 16 of these. All planned tracklines for North Bend-South and North Bend-North were completed, with one additional trackline completed in August for North Bend-North. Only two out of six planned tracklines for Newport and one out of six planned tracklines for Warrenton were completed due to a combination of weather, mechanical issues, base shutdowns, and diversions for search and rescue missions.

OSU reported derelict gear locations observed during helicopter surveys to ODFW, and ODFW posted locations on the ODFW derelict gear program web page for vessels participating in derelict gear recovery programs.

**Small boat surveys (Step 4)**

Four days of small boat survey work were planned during the reporting period, but weather, a lack of suitable aggregations, and small boat maintenance issues limited survey days. One day of small boat survey work was conducted during the reporting period, in September 2022. Biopsy samples were obtained from three humpback and one fin whale, and photo-id samples were obtained for six humpback whales. An additional sixteen humpback whale biopsy samples were collected by collaborators on other projects. These samples will be analyzed by OSU and contribute data to this project.

**Compilation of environmental predictor variables (Step 5)**

Environmental data was collected during ship-based surveys in Step 1.

**Promote reporting of whale sightings (Step 6)**

ODFW included Whale Alert promotion in the 14$^{th}$ annual Dungeness Crab Fishery Newsletter which was developed during this reported period but published in the next reporting period.

**Develop and manage “fleet alert” system (Step 7)**

ODFW and OSU completed development of an email template for alerts to be distributed via ODFW’s crab fishery list serv based on whale aggregations observed during USCG helicopter trackline surveys. No alerts were sent during the reporting period because no notable aggregations were observed in crab fishing grounds.

**Raise awareness of issue and project (Step 9)**

OSU presented a poster and video on the project at the Society of Marine Mammalogy conference in August 2022. For more general audiences, OSU presented a poster and video at a university open house event, published three blog posts, and gave a presentation on the project to about 20 undergraduate interns from underrepresented groups.

**Analysis of krill data (Step 11)**

OSU developed a processing template for krill acoustic data, processed data collected from 2018-2022, and conducted a hierarchical cluster analysis to classify krill swarms. OSU used bomb calorimetry to analyze caloric content of 184 previously collected individual krill, and nearly completed processing of caloric samples collected during September 2022 vessel-based surveys in step 1. OSU also nearly completed processing bongo net samples collected from 2018-2022 for zooplankton community composition.

**Genetic DPS assignment (Step 17)**

Four humpback whale biopsy samples were processed by the OSU Cetacean Conservation and Genetics lab for sex determination, but not yet for DPS assignment.

**Site fidelity analysis by individual and DPS (Step 17 & 18)**

No work was conducted on the site fidelity analysis during the reporting period.

Explanation of any problems or delays in accomplishing planned activities:

Fewer than planned helicopter tracklines were completed for Newport and Warrenton due to a combination of weather, mechanical issues, base shutdowns, and diversions for search and rescue missions.

Fewer than planned small boat survey days were completed due to weather, a lack of suitable aggregations to sample, and small boat maintenance issues.

Work on the site fidelity analysis did not begin during the reporting period because the lead analyst, Dr. Derville, was not available until January 2023.

**Enhancing co-occurrence assessment of whales and fishing gear in Oregon waters through incorporation of prey data and residency analysis**

Prepared by Kim Bernard[1], Rachel Kaplan[1,2], and Craig Hayslip[2]
[1]College of Earth, Ocean, and Atmospheric Sciences, OSU
[2]GEMM Lab, Marine Mammal Institute, OSU

**15 January 2023**

Our study has a total of thirteen objectives with eighteen action steps to achieve these objectives. Here, we report on action steps 1, 2, 4-7, 9, 11, and 17. These fall under research objectives 1-3, 6, and 10-12. Our progress to-date on each of these seven objectives is provided below.

**Objective 1: Continue our standardized aerial surveys for whales and turtles aboard US Coast Guard (USCG) helicopters for another two years (current dataset spans 2019-2021). [STEP 2]**


**Figure 1.** United States Coast Guard MH-60 Jayhawk helicopter after completing a whale survey flight out of Warrenton, Oregon. Photograph by Craig Hayslip.

Monthly helicopter surveys of Oregon coastal waters were conducted through a partnership with the United States Coast Guards (USCG) starting in February 2019. This report covers the months from July to December 2022 (Table1). Four 150 nm transects were flown each month out of USCG stations in North Bend (NB), Newport and Astoria/Warrenton, weather permitting. Three of the transects were covered with Aerospatiale HH/MH-65 Dolphin helicopters (North-NB, South-NB, Newport), while the Warrenton transect was surveyed with the larger Sikorsky HH/MH-60 Jayhawk (Figure 1). One observer surveyed waters on one side of the trackline, with the helicopter flying at 500 ft altitude and at 90 knots speed. Any major change in altitude or deviation from the designed route resulted in an interruption of the survey effort. Observations were preferentially made in passing mode (Schwarz et al., 2010), with the helicopter breaking track to investigate detected cetacean groups only in a minority of cases. Upon detection of cetacean groups, perpendicular distance was estimated either visually or using a handheld geometer (Pi Technology).

A total of 16 cetacean surveys have been conducted aboard USCG helicopters since July 1, 2022. As of 30 December 2022, we have conducted the following number of complete surveys: NB-South = 6 (11.11 hours of effort); NB-North = 7 (12.03 hours of effort); Newport = 2 (4.22 hours of effort); Warrenton = 1 (1.55 hours of effort). Limited numbers of surveys were done from Newport and Warrenton due to a combination of weather, mechanical problems with helicopters, base shutdowns, or diversions for search and rescue operations.

Table 1. Dates of cetacean surveys conducted aboard USCG helicopters off the Oregon coast, by month and trackline, since July, 2022. Grey boxes indicate that the trackline was not surveyed during that month, due to weather, helicopter mechanical issues, or base shutdowns.

| | | NB-South | NB-North | Newport | Warrenton |
|---|---|---|---|---|---|
| 2022 | July | 7-Jul | 22-Jul | | |
| | August | 10-Aug | 22-Aug, 30-Aug | 27-Aug | |
| | September | 29-Sep | 16-Sep | | |
| | October | 30-Oct | 29-Oct | 21-Oct | 19-Oct |
| | November | 20-Nov | 10-Nov | | |
| | December | 22-Dec | 4-Dec | | |

During these surveys, a total of 6 different species of cetaceans were recorded: blue whales, fin whales, humpback whales, killer whales, northern right whale dolphins, and Risso's dolphins. A total of 65 sightings of these species were recorded, which amounts to observation of 261 individuals once group size at each sighting is accounted for. After filtering out the off-effort or unsuitable sightings of identified whales, humpback whales were observed in greatest numbers (40 individuals, 19 groups), followed by killer whales (8 individuals, 1 group), fin whales (6 individuals, 2 groups), and blue whales (1 individuals, 1 group). Twenty-seven sightings (including 40 individuals) were qualified as "unidentified baleen whales."

**Objective 2: Continue our collaboration with NOAA colleagues to place marine mammal observers on research cruises aboard the NOAA Ship Bell M. Shimada during Northern California Current research cruises (NCC; current dataset spans 2018-2021). [STEP 1]**

From September 23–29, two marine mammal observers collected data on marine mammal distributions from aboard the NOAA vessel *Bell M. Shimada* between Heceta Head, Oregon, and Seattle, Washington (Figure 2). Despite mechanical challenges that shortened the cruise, the team conducted five successful days of survey effort. During the cruise, the team also collected concurrent data on krill via continuous underway active acoustics (Simarad EK80 echousounder) and bongo net tows for zooplankton community analysis (Objective 3). In addition, individual krill (n = 161) were collected and frozen at -80° C for caloric analysis (Objective 3).

**Figure 2.** PhD student, Rachel Kaplan, scans the waters for whales during an NCC research cruise aboard the R/V *Bell M. Shimada*. Photograph by Maria Kavanaugh.

**Objective 3: Analyze active acoustic data collected using echosounders on the Shimada during NCC cruises to model the environmental drivers of species-specific krill swarms and describe how the structure and caloric content of krill patches relates to whale occurrence in real-time (plankton net tow, echosounder and marine mammal observations conducted simultaneously since 2018). [STEPS 1, 5, 11]**

Acoustic Analysis

During this reporting period, we analyzed acoustic echosounder data collected from aboard the *Bell M Shimada* from 2018-2022. First, we developed a processing template in the program Echoview (version 13.1) specific to our data needs and used it to identify krill aggregations. Then, we exported descriptive metrics about each aggregation (e.g., depth in the water column, height of aggregation).

We used hierarchical cluster analysis on preliminary descriptive krill acoustic data to classify krill swarms into four distinct swarm types (Figure 3):

1) Short, shallow, moderately dense swarms: ~45 m depth, ~5 m tall, moderately dense (n=2158)
2) Dense, tall, mid-water column swarms: ~200 m depth, ~80 m tall, highest density (n=254)
3) Short, deeper swarms: ~230 m depth, ~5 m tall, medium density (n=692)
4) Small, low density, mid-water column swarms: (~100 m), lowest density (n = 2362)

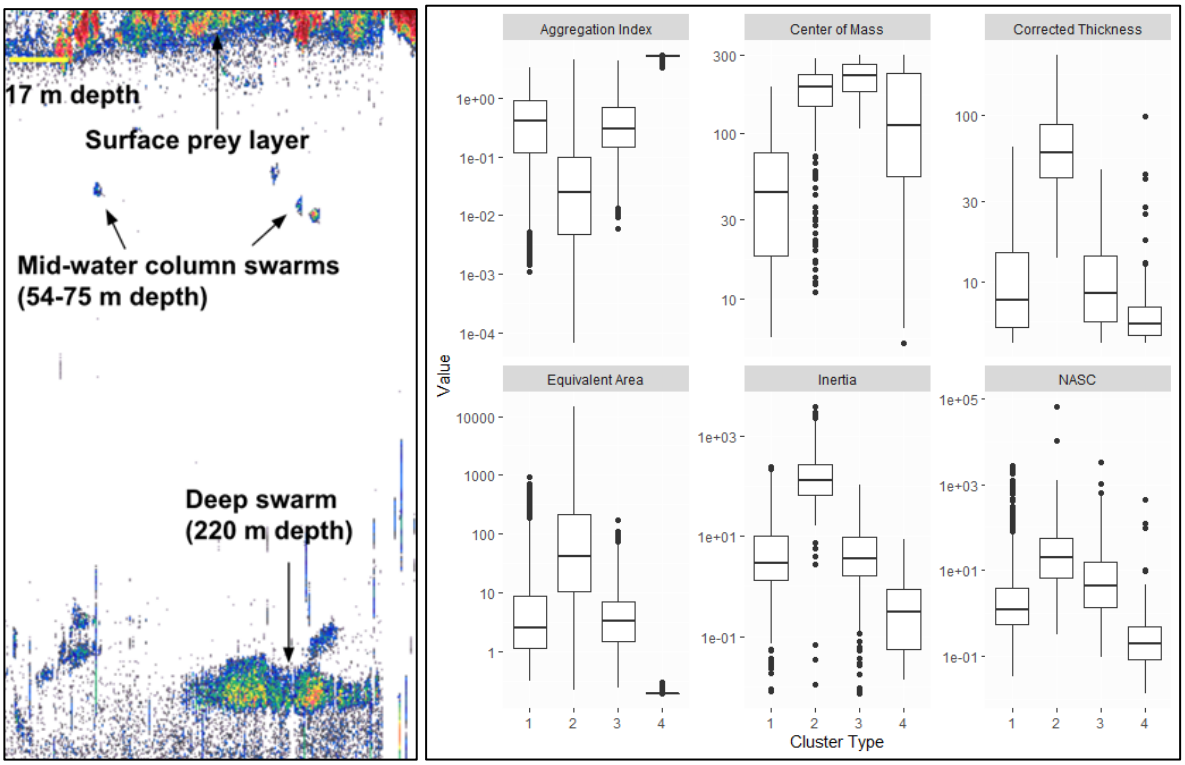


**Figure 3. Left Panel.** Annotated echogram from the March 2020 NCC cruise aboard the R/V *Bell M. Shimada* showing prey aggregations at several depths in the water column. **Right Panel.** Krill swarm metrics used to identify four distinctly different krill swarms (Cluster Type). Variable descriptions are as follows: Aggregation Index ($m^{-1}$) is a measure of the distribution density. Center of Mass (m) is a measure of the mean swarm depth. Corrected Thickness (m) is a measure of the swarm height. Equivalent Area (m) is a measure of the distributed evenness within a krill swarm. Inertia ($m^{-2}$) is a measure of a swarm's dispersion or spread. And NASC (Nautical Area Scattering Coefficient, $m^2nmi^{-2}$) is a measure of the acoustic backscattering area per swarm and is used as a proxy for scatterer density. These data were obtained from NCC cruise acoustic data.

Caloric Analysis

Bomb calorimetry is the gold standard for caloric analysis of prey species, including krill. In May 2022, individual krill were collected for caloric analysis aboard the R/V *Bell M. Shimada* (n=184). These were processed for their caloric content during summer and fall 2022 using bomb calorimetry (Figure 4).

Preliminary analyses indicate possible higher caloric content in *Thysanoesssa spinifera* than *Euphausia pacifica* krill, and that reproductive activity, as described by spermatophore presence for both males and females, may also drive differences in caloric content (Figure 5). The second round of caloric samples, collected in September 2022, are currently being processed, and will add to the sample size and statistical power of this analysis.

**Figure 4.** Abby Tomita (left) and Hadley Robinson (right) process krill samples for caloric analysis. Photograph by Rachel Kaplan.

In addition, processing of the nighttime bongo nets from 2018-2022 is underway and nearly complete. This data will be used to contextualize the krill communities from which the caloric samples were collected, as well as the concurrent acoustic data.

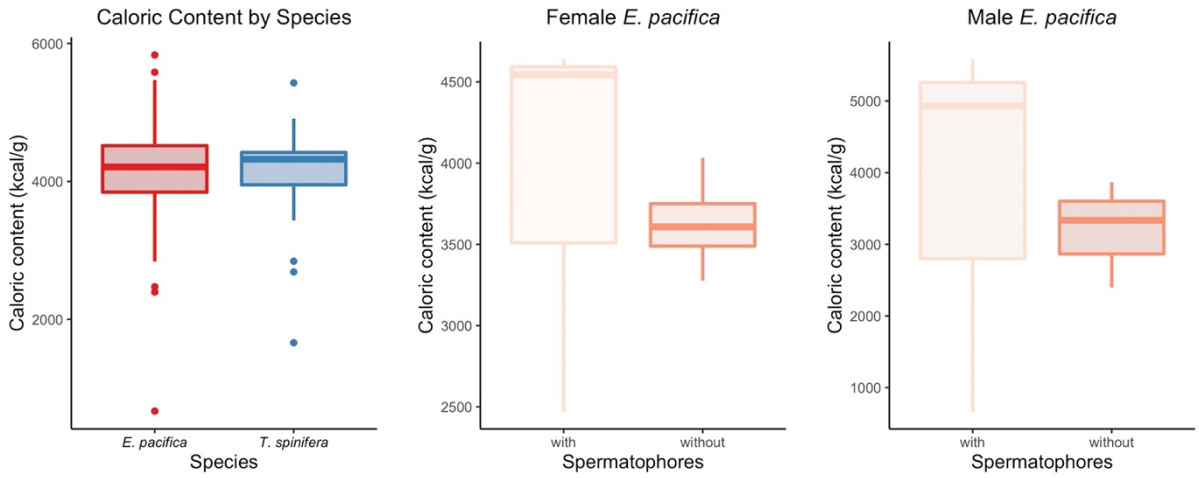


**Figure 5. Left Panel.** Box and whisker plots showing caloric content (kcal/g) of *Euphausia pacifica* and *Thysanoessa spinifera*. **Middle Panel.** Box and whisker plots showing caloric content (kcal/g) of *E. pacifica* females with and without spermatophores. **Right Panel.** Box and whisker plots showing caloric content (kcal/g) of *E. pacifica* males with and without spermatophores.

**Objective 6: Continue boat-based photo-id and biopsy tissue sampling of baleen whales in coastal Oregon waters, and perform genetic analysis of 120 humpback whale tissue samples collected by ourselves and collaborators across the whole US West Coast region for assignment to DPS. [STEPS 4, 17]**

On 09/15/2022 on a survey from Newport, we sighted humpback whales (8), fin whales (3), a minke whale (1), and Dall's porpoise (10). Biopsy samples were obtained from three humpbacks and one fin whale (Figure 6). Photographs for photo-ID were taken of 6 humpbacks. The four biopsy samples were processed at the Cetacean Conservation and Genomics Lab (CCGL) at OSU for sex determination, but not yet for genetic information needed for DPS assignment. In addition, eight humpback whale biopsy samples were collected by Cascadia Research Collective (CRC) as part of other projects. Those data will be shared with our project after they are processed by CCGL. Eight more humpback whale biopsy samples collected as part of an OSU/NOAA project will also be used.


**Figure 6.** Alejandro Fernández Ajó processes a biopsy sample from a humpback whale during field work to collect photo-IDs and biopsies off Newport, Oregon. Photograph by Dawn Barlow.

**Objective 10: Develop and implement a "fleet alert system" to inform fixed gear fishers of near-real time whale distribution while aerial whale surveys are on-going. [STEP 7] AND Objective 11: Continue promoting the use of the Whale Alert app by citizen scientists and compilation of historical and contemporaneous datasets of rorqual whale sightings off the Oregon coast. [STEP 6]**

Objectives 10 and 11 are contingent upon finalizing our study of rorqual whale distribution with respect to crab fishing effort. This work was part of the first phase of project OPAL funded by our previous NOAA Section 6 grant. Good progress has been made on this with a publication currently under review in Biological Conversation. We foresee progress being made on Objectives 10 and 11 within the next reporting period.

**Objective 12: Continue broad outreach and engagement about our research objectives, methods, and progress through various formal and informal avenues to increase awareness and participation in efforts to reduce entanglement risk to whales. [STEP 9]**

The process, context, and importance of this work has been communicated through diverse outreach efforts during this reporting period (Objective 11). During the Society of Marine Mammalogy conference (August 1-5, 2022 in West Palm Beach, Florida), a virtual poster (*Linking Spatial Distributions of Whales and their Euphausiid Prey Within the Northern California Current Ecosystem*) and accompanying video summary shared preliminary results of the krill acoustic analysis and prey-informed species distribution models with a specialist audience.

Other efforts have shared this work for a non-specialist audience. On September 24, an open house at Hatfield Marine Science Center welcomed over 200 guests. A poster at this event shared about this project's aims, motivation, and approach, while a short video recorded live in the field the previous day told guests about the fieldwork currently in progress on the *Bell M. Shimada* and its connection to project goals. In addition, two blog posts have also shared about this research for a general audience: one focused on data collection during the September 2022 *Bell M. Shimada* cruise (link: https://blogs.oregonstate.edu/gemmlab/2022/10/10/surprises-at-sea/), and one written by an

undergraduate intern involved in the project (https://blogs.oregonstate.edu/gemmlab/2022/10/03/bombs-away-a-summer-of-bomb-calorimetry/) (Figure 7).

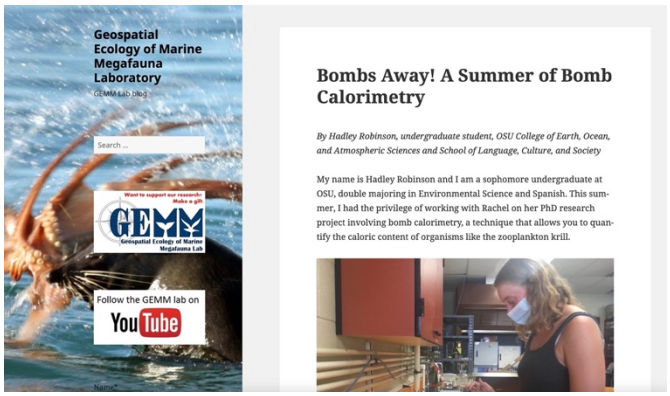


**Figure 7.** Screenshot showing one of the blogs written by undergraduate intern, Hadley Robinson.

Over the summer of 2022, three paid undergraduate interns were trained in krill identification, microscopy, and bomb calorimetry, and they assisted with krill caloric sample processing. One intern has continued through the fall as a DEI intern, and she plans to continue assisting with lab work (Objective 3). In addition, a presentation to about 20 undergraduate interns from underrepresented groups through Oregon State University's ARC-Learn program described this project in order to share the process of data collection, analysis, and ecosystem modeling.