Status report for the acoustic and visual survey for cetaceans in Behm Canal and Southern Clarence Strait, Alaska

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Abstract

The Navy is interested in understanding marine mammal seasonal occurrence in and around a U.S. Navy Installation and Operation Area that is located within Behm Canal, in inland waters of Southeast Alaska. In this report, the plans to develop a marine mammal vessel survey in the spring of 2023 are described. This survey will be implemented using visual line transect and passive acoustic methods to assess the presence and distribution and to estimate density and abundance of cetaceans in Behm Canal and central Clarence Strait. The study area was divided in two strata to maximize allocation of survey effort and to sample multiple habitats where species of interest, including harbor porpoise (*Phocoena phocoena*), are known or suspected to occur. Passive acoustic methods will be used to assess seasonal occurrence of marine mammals in the region including the January 2023 deployment of a mooring in Behm Canal, and the use of sonobuoys during the visual ship survey to augment visual observations.

Background

Southeast Alaska Acoustic Measurement Facility (SEAFAC) is managed by Naval Base Kitsap and located at Back Island, in Behm Canal, Southeast Alaska. Multiple species listed under the Endangered Species Act (ESA) occur in this area, including humpback whales (*Megaptera novaeangliae*) (Mexico Distinct Population Segment [DPS]) and fin whales (*Balaenoptera physalus*), along with unlisted stocks of killer whales (*Orcinus orca*), minke whales (*Balaenoptera acutorostrata*), humpback whales (*Megaptera novaeangliae*), harbor porpoise (*Phocoena phocoena*), Dall's porpoise (*Phocoenoides dalli*), and Pacific white-sided dolphins (*Lagenorhynchus obliquidens*). The Navy maintains several in-water assets within Behm Canal. Maintenance of these assets require updated marine mammal mapping to provide temporal and spatial information on cetacean density to support the preparation of environmental planning documentation, including those needed for National Environmental Policy Act (NEPA), Marine Mammal Protection Act (MMPA), and Endangered Species Act (ESA) consultations.

The NMFS, Alaska Fisheries Science Center (AFSC), and the University of Washington Cooperative Institute for Climate, Ocean and Ecosystem Studies (CICOES) have partnered to design and implement field assessments for marine mammals in Behm Canal and Clarence Strait. Although this project will be designed to collect information on cetaceans, opportunistic sightings of other marine mammals, such as pinnipeds and sea otters, will also be recorded.

Under this agreement, the AFSC and CICOES will: 1) develop an appropriate survey design for maximal effect; 2) execute the survey using ship-based visual and limited passive acoustic methods; and 3) deliver a report on the survey design and results, including data for use in density modeling that will be undertaken by the Navy by September 2023.

Summary of tasks

The AFSC and CICOES will develop a quantitative survey design for a ship-based visual and acoustic assessment of cetaceans in Behm Canal and Clarence Strait based on previous cetacean surveys in the study area. The survey will be designed for maximum effectiveness and efficiency and include strata based on known distributions of key species and environmental features. Photographs of key species

will be collected when practicable for purposes of stock identification (humpback whales, killer whales) and abundance estimation. Incidental sighting data of pinnipeds and sea otters will also be collected.

1) Use visual and acoustic survey techniques to collect occurrence, distribution, and abundance data for cetaceans in Behm Canal and Clarence Strait (Fig. 1 - map). Information on pinnipeds and sea otters will be collected opportunistically. Data collected will inform future density estimation efforts carried out by AFSC and the Navy.
2) Prepare report on survey conducted in spring 2023.

Progress on tasks to date

Vessel survey

Vessel survey design

A vessel survey design was proposed for the Behm Canal survey consistent with the methods implemented in Zerbini et al. (2022) for a research cruise conducted in Southeast Alaska inland waters in 2019. We want to ensure the two surveys (2019 and 2023) are comparable if integration of data across the two studies is needed (e.g., to estimate the detection functions needed to compute density and abundance).

The survey area (Fig. 1) includes Behm Canal (the area where the Navy SEAFAC area is located) west of Revillagigedo Island, central Clarence Strait, and adjacent fjords and inlets, a region of 1137 km^2 (Fig. 1). For greater efficiency in the allocation of survey effort, the study area was divided into two main strata of varying geometry (Fig. 1). The stratum labeled "Main Bodies of Water" (MBW) encompasses the main waterways within Behm Canal and Clarence Strait and spans an area of 1014 km^2 (89% of the study area). The stratum labeled "Inlets" (I) includes eight small inlets associated with the MBWs (Fig. 1) whose area, together, represent the remaining 11% (123 km^2) of the total study region.

Proposed effort (622 km) was calculated assuming it will be possible to cover the entire region in seven days for a total of eight hours a day at a survey speed of 10 kts. Effort allows for transit time between survey tracklines, for time lost due to poor weather conditions (as much as 40% of the survey period), and for the time needed to launch a small skiff for satellite tag deployment or biopsy/environmental DNA (eDNA) sample collection from species of interest. Survey effort was allocated to each stratum proportional to their area (560 km for MBW and 60 km for I). Strata were divided into substrata (two for MBW and eight for I) to maximize efficiency in allocating survey tracklines (Fig. 1). Because of the relatively large number and relatively low survey effort (60 km) in stratum I, it is not practical to sample all eight substrata. Therefore, an algorithm was implemented to allocate effort in stratum I (Thomas et al. 2007; Zerbini et al. 2022) to ensure (1) the probability of selecting sub-strata was proportional to its area size (e.g., larger areas had greater probability of selection); (2) sampling would have a wide geographic spread; and (3) sub-strata would be sampled without replacement.

Survey tracklines were allocated proportional to the substratum area using the design tool in software *Distance* (version 7.2, Thomas et al. 2010). An equal spacing zig-zag design (Strindberg and Buckland 2004) was adopted for the MBW whereas a parallel transect design was chosen for the Inlets given the narrowness of most areas within the latter (Strindberg and Buckland 2004; Thomas et al. 2007).

The proposed vessel survey design is illustrated in Fig. 1. This design may be revisited once the survey vessel is selected to ensure that it is logistically possible to sample all proposed areas. If changes to the design are needed, the same rationale described above to allocate tracklines will be used to produce a new survey design. Therefore, it is not expected that the new design would differ much from the one illustrated in Fig. 1.

Delay in vessel survey implementation

The field work for this study was planned for fall 2022. Unfortunately, the final agreements and funding for this project were not signed and received, respectively, until late summer 2022. In addition, although NMFS posted a Request for Proposals on SAM.GOV for a vessel charter during the summer while the agreements were still under development, no bids were received. Based on discussions with others who have contracted vessels, this problem was most likely because vessels able to meet the requirements were already committed to other work in fall 2022. In consultation with U.S. Navy staff responsible for the interagency agreement, data on marine mammal density in the spring and fall are of most interest; thus, a procurement action for a suitable vessel was reinitiated by NMFS in early FY23 for a vessel survey to be conducted in spring of 2023.

Collection of passive acoustics data

After consultation with the Navy, it was determined that the best results would be obtained by using a combination of two approaches:

- Installing a passive acoustics recorder on the static site at SEAFAC to provide information on year-round occurrence of vocalizing marine mammals in Behm Canal in the immediate vicinity of the Navy operations area.
- Using sonobuoys for collecting passive acoustics data during the vessel survey to augment visual observations. This will occur in spring 2023. See Methods section for details.

In collaboration with the personnel at SEAFAC, a passive acoustic recording system was deployed on the power barge at the Behm Canal static site in January 2023. Two instruments were included in the mooring design (Fig. 2a). The first, a SoundTrap ST600 (Ocean Instruments, Inc., Auckland, New Zealand) passive acoustic recorder was programmed to collect data continuously at a sampling rate of 96 kHz (system sensitivity of 174.6 dB re 1 uPa). This will detect most vocalizing marine mammal species in the area, excepting porpoises and beaked whales. To capture these higher frequency species, an FPod (Chelonia Inc., Cornwall, United Kingdom) click detector and classifier was also included. The FPod will run continuously, capturing any echolocation clicks up to 160 kHz, which encompasses all cetacean species. A small cage for mounting the instruments was sent to SEAFAC the first week of January 2023. CAEP staff Berchok and Crance arrived on site the following week with the instruments, programmed them for deployment, and assembled and secured the instruments in the cage (Fig. 2b). They worked with SEAFAC personnel to rig the cage with deployment line and weight. Two rubber strips were also tied into the deployment line just below the water line to serve as a "snubber", isolating the vertical movement of the instrument cage from the movement of the barge and surface waves.

A trial deployment and recovery was carried out by SEAFAC personnel on the power barge on 10 January 2023. For deployment, the mooring was hand-lowered over the side of the barge to a depth of approximately 39 ft and secured to a cleat (Fig. 3) near the crane on the inboard side (facing the

suspension barge). Retrieval was also done by hand, although there is an option to recover via the crane in the future. Because of the classified nature of the measurements conducted during SEAFAC trials, the instruments will be retrieved by SEAFAC personnel whenever trials are occurring, and re-deployed after the trials conclude. When not in the water, the entire system, including cage, instruments, weight, and line, will be stored inside the barge with the instrument cage resting on a foam pad to prevent vibrations or other noise triggering the click detector and filling up its memory card prematurely.

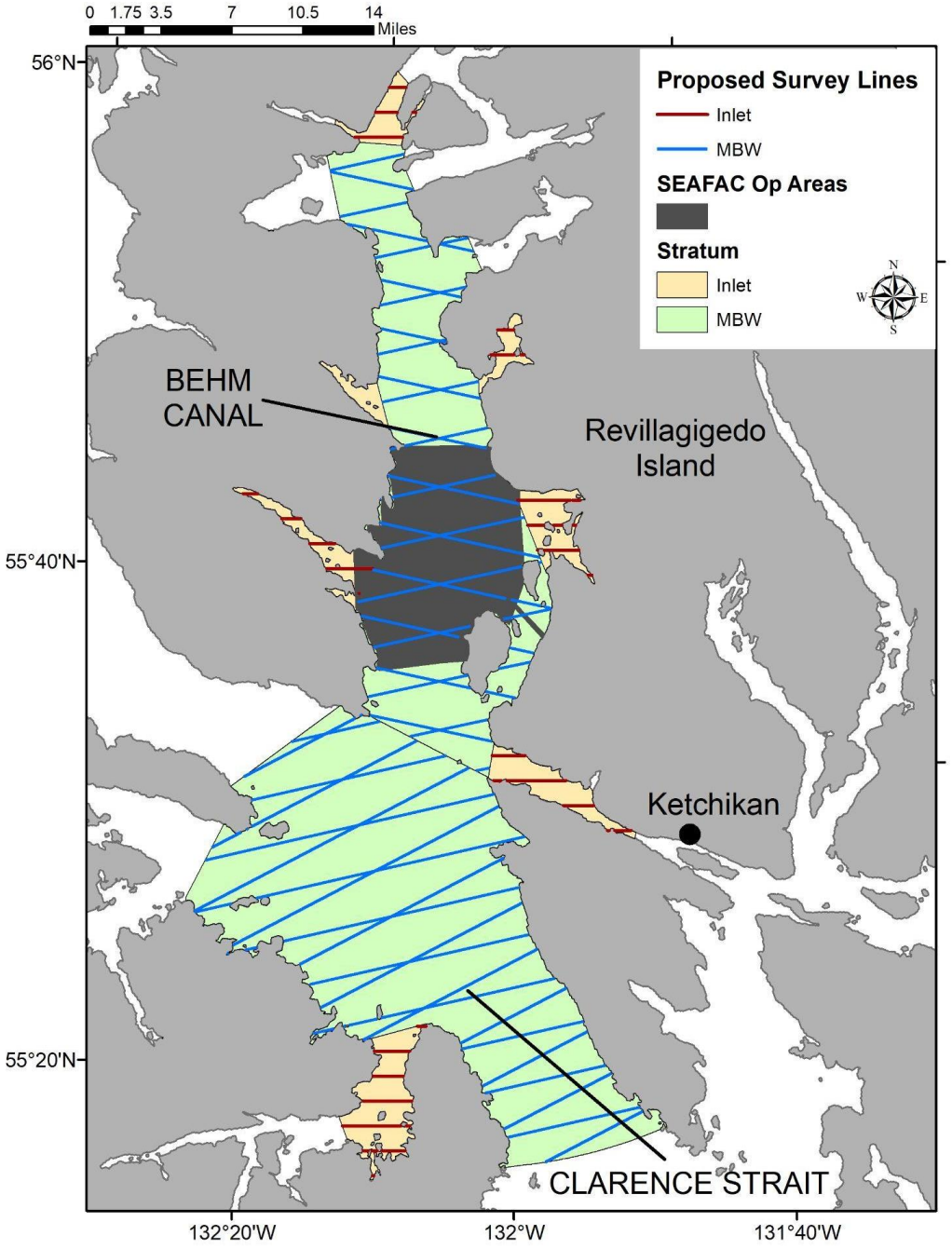

Fig. 1 – Proposed design for a cetacean line transect vessel surveys to be conducted in the spring of 2023 in western Behm Canal and adjacent areas in inland waters of Southeast Alaska.

In addition to these SEAFAC-directed recovery/redeployment events, a new SoundTrap ST600 and FPod will be sent up to SEAFAC every ~ 3 months. These instruments, already tested and programmed for deployment, will be swapped out with those currently deployed by SEAFAC personnel. NMFS staff briefed SEAFAC personnel on the procedure on removing the old instruments and attaching the new ones (a how-to manual and log for documenting deployments and retrievals has also been sent to the facility). The older instruments will be sent back to AFSC for processing and analyses of the data, as well as cleaning, testing, and programming the units for redeployment for the next three-month period.

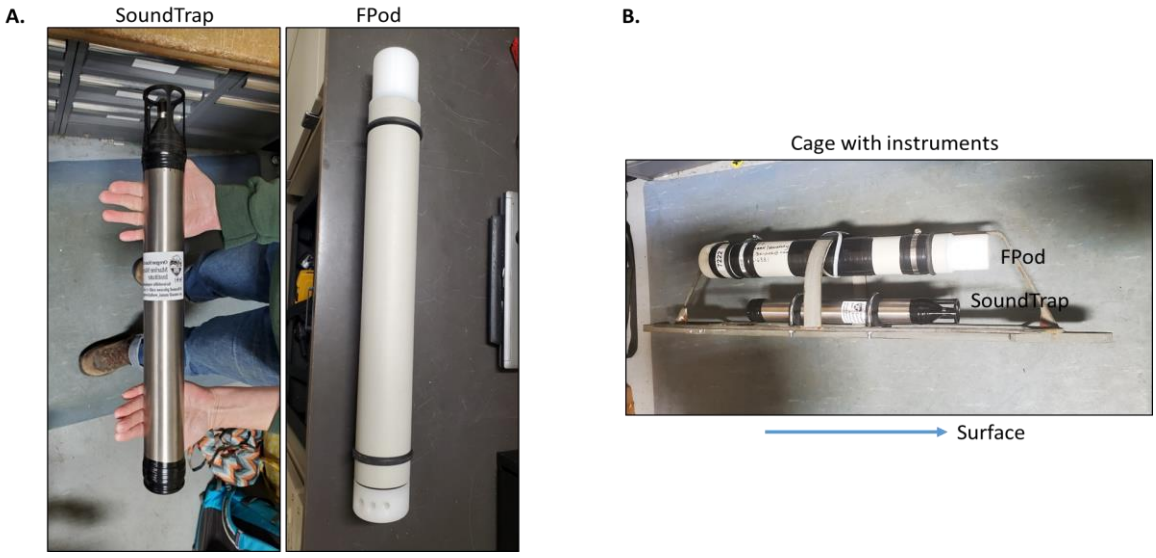

Fig. 2 - Two passive acoustic instruments included in the mooring. A) The SoundTrap ST600 (left silver instrument) will record all marine mammal vocalizations up to 48 kHz; the FPod (right white instrument) will detect echolocation clicks up to 160 kHz. B) Both instruments installed in the cage, ready for deployment.

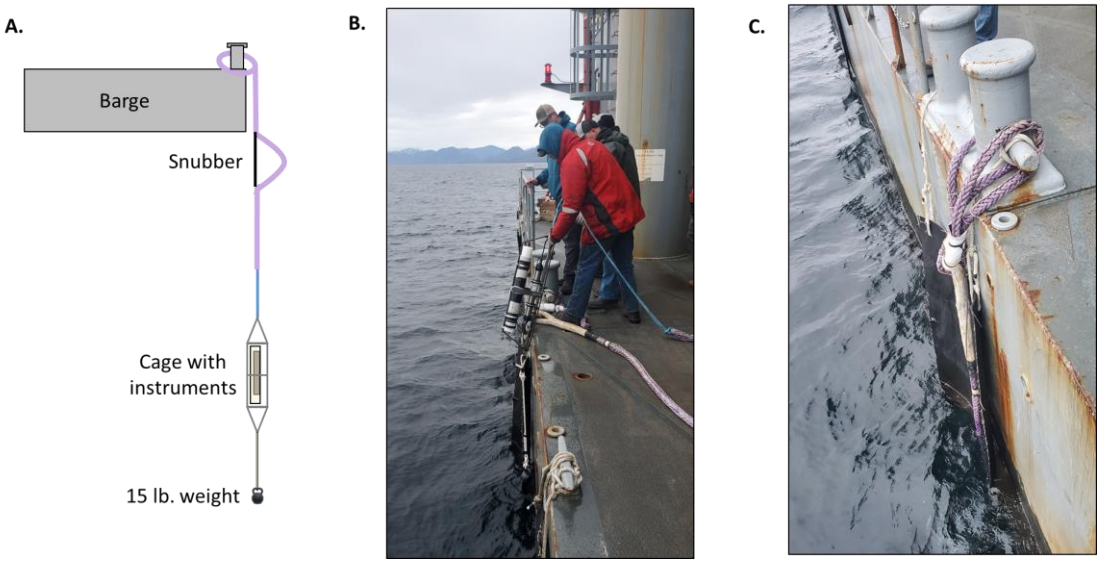

Fig. 3 - Mooring design and deployment. A) Schematic of the mooring design. B) Mooring being hand deployed. C) Deployed mooring secured to the cleat.

Methods planned for FY23

Vessel cruise, spring 2023

Visual survey methods

The survey will be carried out in passing mode (i.e., the ship will not divert from the trackline to close into detected cetacean groups; Hiby and Hammond 1989; Hammond et al. 2021) unless the survey encounters a species of interest for biopsy sampling or satellite tagging (e.g., humpback whales, killer whales).

Four observers will rotate through two observation platforms (port and starboard) located several meters above the waterline (actual height will be defined when procurement of the survey vessel is completed) every 40 minutes (each observer alternating between 80 minutes on-effort and 80 minutes resting). Observations shall start approximately 30 minutes after sunrise, end 30 minutes before sunset, and only occur in appropriate visibility conditions (i.e., 2 km or greater) and/or sea state below 4 on the Beaufort scale. Port and starboard observers will search from the beam (90°) of their respective side to approximately 10° on the opposite side of the survey line using Fujinon 7x50 reticle binoculars (~80% of the time) or naked eye (~20% of the time). A data recorder will not be involved in active searching, but will assist observers with species identification and/or group size estimates when necessary.

Data will be entered into a laptop computer connected to a portable GPS using a data logging software. Position information will be automatically logged every two minutes; navigational and environmental information will be entered at the start of the day, at every observer rotation, and when conditions change; and sighting information will be recorded whenever marine mammals are detected. Weather and visibility conditions change frequently in southeast Alaska, with the potential to influence the observer search pattern. To maximize data collection, observers will maintain search effort with slight changes in survey protocol under light rain and also under foggy conditions when the visibility is greater than ~2 km as described in Zerbini et al. (2022). Search effort will cease in moderate to severe rain or if visibility in foggy conditions is less than 2 km and will only resume when better conditions develop.

Acoustic methods

To acoustically monitor for marine mammals, sonobuoys will be deployed consistently throughout the survey area to obtain an evenly-sampled cross-survey census of marine mammal vocalizations. Sonobuoys are free-floating (can drift with the currents), expendable, short-term passive acoustic devices. They transmit audio signals to receivers on a vessel in real time using VHF radio waves; no data are stored on the sonobuoy itself. In addition, the sonobuoys are programmed to scuttle (i.e., a short is sent to a resistor in the float, which burns and deflates the float, sending the sonobuoy to the bottom). The scuttle time can be set anywhere from ½ hour to 8 hours. If high priority species are detected, multiple sonobuoys may be deployed simultaneously to localize on the calling animal and obtain location and distance estimates.

For more details regarding sonobuoy data collection protocols and the complete system used, see Crance et al. (2017). A VHF marine antenna will be installed as high up on the vessel as possible,

preferably in the crow's nest. A cable will be run from the antenna down into the bridge to the monitoring station. Having the sonobuoy monitoring station in the bridge allows the acoustic technician to interact with the captain and visual observation team and also to make simultaneous visual and acoustic observations (focal follows) when needed. Sonobuoys will be deployed by hand over the rail of the vessel while underway. A maximum of 44 sonobuoys may be deployed. A custom MATLAB-based tracking and plotting program will be used to plot the sonobuoy deployments and ship's position (updated every minute via GPS). All audio data will be recorded in ten-minute increments to an external hard drive using ISHMAEL software (Mellinger, 2001) and will be analyzed *post hoc*.

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