PROJECT REPORT

VESSEL: NOAA Ship *Oscar Elton Sette*, SE-24-04

PROJECT PERIOD: April 23, 2024 to May 22, 2024

AREA OF OPERATION: High seas, with the study area between ~8-15°N and ~140-150°W

TYPE OF OPERATION: Visual, acoustic, and biological survey of false killer whales

ITINERARY:

April 23	Embarked scientists Applegate, Barkley, Bendlin, Bradford, Gorgone, Hill, Ligon, Lloyd-Lim, Madrigal, McCue, McCullough, McLean, Norris, Ronco, Sinclair, and Yin. Departed Ford Island at 0900 for fuel pier. Departed Pearl Harbor at 1600. Commenced transit to study area.
April 24	Conducted acoustic survey effort 2 hours prior to sunrise and visual and acoustic survey effort during daylight hours along transit trackline. Diverted to Kona at 1000 for urgent medical issue. Departed Kona at 1800. Commenced transit to study area.
April 25 - April 26	Conducted acoustic survey effort 2 hours prior to sunrise and visual and acoustic survey effort during daylight hours along transit trackline. Collected water for eDNA analysis during false killer whale encounters. Maintained readiness for small boat launches on false killer whales pending suitable weather conditions. Deployed 2 CTD casts with water collection after sunset.
April 27 - May 11	Conducted acoustic survey effort 2 hours prior to sunrise and visual and acoustic survey effort during daylight hours along study area tracklines. Collected water for eDNA analysis during false killer whale encounters. Maintained readiness for small boat launches on false killer whales pending suitable weather conditions. Deployed 4-6 CTD casts (the first two with water collection) after sunset.
May 12 - May 20	Conducted acoustic survey effort 2 hours prior to sunrise and visual and acoustic survey effort during daylight hours along transit trackline (early departure from study area due to inclement weather). Collected water for eDNA analysis during false killer whale encounters. Maintained readiness for small boat launches on false killer whales pending suitable weather conditions, with

	launches occurring on May 16. Deployed 2 CTD casts with water collection after sunset.
May 21	Conducted visual and acoustic survey effort along the transit trackline until 1300 when demobilization was initiated.
May 22	Returned to Ford Island at 1000. Disembarked all scientific personnel.

MISSIONS AND RESULTS:

The goal of the Survey for Continued Observation of Pseudorca Extent (SCOPE) was to maximize biological data collection of pelagic false killer whales to inform future development of the Hawai‘i pelagic false killer whale management area. The study area (Figure 1) was chosen because genetic analyses to date have indicated a difference between pelagic false killer whales in the central North Pacific and eastern tropical Pacific, and this area offered the potential to detect possible boundaries or overlap in these two groups. Additionally, predicted densities of false killer whales are higher closer to the tropics. Finally, while there are sightings in the study area from previous NOAA Fisheries surveys, there are no biopsies or other more specific biological data. SCOPE offered an opportunity to collect biological data in an area that has not been surveyed in recent decades and is unlikely to be readily surveyed as part of other regional efforts. Data collection consisted of visual and acoustic survey effort, ecosystem sampling, and small boat launches.

A. Visual and acoustic survey effort

1. Methods

While SCOPE was not a design-based line-transect survey (i.e., with tracklines designed to meet specific line-transect requirements for abundance estimation), line-transect data collection methods were used to visually and acoustically survey for false killer whales and other cetacean species. A set of transit and study area tracklines was established prior to the survey, although the Chief Scientist monitored trackline progress and weather conditions and regularly adjusted the tracklines to meet scientific and scheduling objectives. The target ship speed was 10 knots (speed over ground) while on a trackline.

A daily watch for cetaceans was maintained by visual observers on the flying bridge during daylight hours unless precluded by weather (i.e., Beaufort sea state of 7 or higher or rain that limited visibility to 1 nmi or less). The 8-member observer team rotated through 4 positions every 30 minutes and scanned for cetaceans using 25x and 7x binoculars and unaided eyes. Cetacean sighting information, watch effort, viewing conditions, and other required information were entered into a computer attached to the ship’s GPS (for course, speed, and position information) using the program WinCruz. Upon sighting a cetacean group, the ship was maneuvered to approach the group, and the on-effort observers confirmed the species of the sighted group and made independent estimates of its size. When the observers completed scientific operations for a sighting, the ship returned to the trackline either at or ahead of the previous sighting location.

A towed hydrophone array was deployed approximately 340 m behind the ship each morning 2 hours before sunrise and retrieved each evening after search effort ended. The 5-member acoustician team monitored incoming data in pairs during 2-hour shifts. Acoustic detections of vocalizing cetacean groups or subgroups were localized in real-time using the open source software PAMGuard. During on-effort search periods, the acoustics team did not provide information about detections to the visual team to avoid cueing the observers to the presence of cetaceans. However, once false killer whales were detected and localized by the acousticians, the observers were notified and the ship was directed to the group.

2. Results

Twenty-eight days of visual and acoustic survey effort were attempted during SCOPE, although both operations were halted for most of one day (April 24) to attend to an urgent medical issue, and visual survey effort was limited for part or all of 18 additional days due to inclement weather (i.e., high sea state and swell, frequent squalls). As a result, the number of cetacean sightings (n=22 of at least 8 species; Table 1) was extremely low relative to that of acoustic detections (n=168 of at least 14 species; Table 2). Half of the sightings (n=11) were made while off-effort. Sixty-four percent (n=7) of the off-effort sightings were made in pursuit of an acoustic detection, including all five false killer whale sightings (Table 1). Overall, there were 12 acoustic detections of false killer whales (Table 2), including 5 in the SCOPE study area (Figure 1).

B. Ecosystem sampling

1. Methods

During false killer whale encounters, water was collected for eDNA analysis using the flow-through system on the ship. Once the ship was in the proximity of a detected group, the flow-through was turned on for at least 5 minutes to flush out the system. Water was then collected into 20 L carboy containers as the ship passed through locations where false killer whale subgroups had been sighted or acoustically-detected. Collected water was filtered real-time using a compressed air diaphragm pump onto Millipore Sigma filters (0.4 μm pore size, 142 mm diameter), and the filters were stored in a -20℃ freezer for future processing. Water collection continued until subgroup approaches ceased or until the 3-person sampling team deemed that additional collection was impractical or unnecessary.

Each evening, sequential CTD casts to 500 m depth were conducted 9 km apart, with a total of 2 nightly casts made outside the SCOPE study area and 4–6 casts (as time allowed) within. The first cast collected water in the upper 200 m of the water column for eDNA surveillance (of epipelagic food webs), with 3 rosette-mounted Niskin bottles triggered at 160 m depth, 3 bottles at 115 m, 3 bottles at 70 m, and 3 bottles at 25 m. A 2-person sampling team filtered water directly from the Niskin bottles using the compressed air diaphragm pump onto Millipore Sigma filters (0.4 μm pore size, 142 mm diameter). Three replicate samples were collected by filtering one bottle from each depth (in random order), and the filters were placed in separate cryovials that were stored in the

-20℃ freezer. For a negative control, 4 L of deionized water were filtered every other night, and the filter was stored in the -20℃ freezer. The second cast collected water within 200 m depth to measure chlorophyll concentration (using fluorometry), with bottles triggered at depths of 200, 150, 125, 100, 80, 65, 50, 35, 20, and 0 m (surface). Fluorometry processing was conducted by a single scientist using a vacuum pump, and the filters stored in a liquid nitrogen dry shipper for further analysis. The remaining casts within the study area were profile casts only (i.e., no water collected) to characterize the oceanographic environment.

2. Results

Water was collected for eDNA analysis during 75% (n=9) of the 12 false killer whale detections, with 1,960 L of water filtered into 39 filters that are still waiting to be processed. Of the remaining three false killer whale groups, two were distant evening detections that could not be pursued, and the last was approached from the small boat for biopsy sampling and other biological data collection (see below). A total of 80 CTDs were cast during SCOPE, including 22 casts with water collection for eDNA surveillance and 16 casts with water collection for fluorometry.

C. Small boat launches

1. Methods

Weather conditions permitting, up to two small boats (a 19-ft SAFE Boat and a 17-ft Northwind) were launched on false killer whale groups (or other cetacean groups of interest) to collect photo-identification images and biopsy samples and to deploy satellite tags. Data on approached groups (e.g., group size, behavior, number of calves) and sampling activities (e.g., number of photos and biopsies) were recorded electronically on an iPad. A handheld GPS automatically recorded the vessel's track at 1-second intervals. Digital SLR cameras with telephoto zoom lenses were used for taking photographs, focusing on the dorsal fin (for individual identification) and the full body (for scarring and health assessment). Biopsy sampling was conducted using a Barnett RX-150 crossbow and Ceta-Dart bolts with sterilized, stainless steel biopsy tips (25 mm long x 8 mm diameter). A Dan Inject air rifle and arrows (designed by Wildlife Computers) were used to deploy Wildlife Computers location-only (SPOT) or location-depth (SPLASH) satellite tags. The tags were attached to the dorsal fin with 2 sterilized, 6.5-cm titanium darts with backward facing petals.

2. Results

Inclement weather prevailed during SCOPE, limiting opportunities for small-boat launches on false killer whales or other cetacean groups. Only one false killer whale detection was made during launchable weather conditions (Sighting 17 on May 16; Table 1). Both small boats were launched and 705 photographs were taken, 3 biopsy samples were collected, and 3 satellite tags were deployed.

Despite the rough weather, SCOPE provided an invaluable opportunity to inform a pressing management issue, survey an understudied area, develop a species-specific

survey approach, and incorporate eDNA surveillance as a new ship-based monitoring tool for cetaceans in the Pacific Islands. Project performance metrics (n=9) were established in the SE-24-04 Project Instructions. Results of these metrics indicate a high project performance with minimal ship-related impacts (Table 3).

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Appendix: Tables and Figures

Tables

Table 1. Summary of cetacean sightings made during SCOPE, including the sighting number and date, the code and common name of the sighted species, whether the sighting was made while on or off effort, and if the sighting was also acoustically detected (yes or no, with sightings that were made in pursuit of an acoustic detection denoted as yes-A).

Sighting No.	Date	Species code	Common name	Effort type	Acoustically detected
1	04/24/24	002	Pantropical spotted dolphin	On	Yes
2	04/27/24	077	Unidentified dolphin	On	No
3	04/27/24	051	Unidentified *Mesoplodon*	Off	No
4	04/27/24	033	False killer whale	Off	Yes-A
5	04/27/24	277	Unidentified medium dolphin	On	Yes
6	05/04/24	177	Unidentified small dolphin	Off	No
7	05/07/24	036	Short-finned pilot whale	Off	Yes-A
8	05/09/24	033	False killer whale	Off	Yes-A
9	05/10/24	002	Pantropical spotted dolphin	On	Yes
10	05/11/24	079	Unidentified large whale	On	No
11	05/11/24	033	False killer whale	Off	Yes-A
12	05/13/24	036	Short-finned pilot whale	On	Yes
13	05/13/24	177	Unidentified small dolphin	Off	No
14	05/14/24	077	Unidentified dolphin	On	Yes
15	05/15/24	033	False killer whale	Off	Yes-A
16	05/16/24	002	Pantropical spotted dolphin	On	No
17	05/16/24	033	False killer whale	Off	Yes-A
18	05/16/24	021	Risso’s dolphin	Off	Yes
19	05/18/24	037	Killer whale	Off	Yes-A
20	05/19/24	015	Rough-toothed dolphin	On	Yes
21	05/21/24	046	Sperm whale	On	Yes
22	05/21/24	046	Sperm whale	On	Yes

Table 2. Summary of acoustic detections by cetacean species[1] made during SCOPE, including the species code, common name, and number of detections. The number of species detections (n=171) is higher than the number of detections (n=168) due to mixed-species encounters. Minke whales were not tracked as discrete detections.

Species code	Common name	No. of detections
002	Pantropical spotted dolphin	2
015	Rough-toothed dolphin	13
021	Risso's dolphin	4
031	Melon-headed whale	2
032	Pygmy killer whale	2
033	False killer whale	12
036	Short-finned pilot whale	4
037	Killer whale	2
046	Sperm whale	48
059	Blainville's beaked whale	3
061	Goose-beaked whale	11
065	Longman's beaked whale	1
071	Minke whale	Presence
077	Unidentified dolphin	28
080	Unidentified *Kogia*	2
177	Unidentified small dolphin	19
277	Unidentified medium dolphin	9
377	Unidentified large dolphin	9

[1]Aside from the detections associated with sightings (Table 1), these species identifications are considered preliminary pending further review of the acoustic data.

Table 3. Planned and realized values of project performance metrics specified in the SE-24-04 Project Instructions.

Metric	Planned value	Realized value
Days at sea	30 days	30 days
On-effort visual survey days	26 days	9 days[1]
On-effort towed array survey days	26 days	27 days
Successful and efficient small boat launches on false killer whale groups during workable conditions	100%	100%
Nighttime acoustically-detected false killer whale groups successfully tracked until morning	80%	n/a[2]
False killer whale biopsy samples collected (per group on which the small boat is launched)	≥2	3
False killer whale satellite tags deployed (per group on which the small boat is launched)	≥1	3
Water samples collected from false killer whale groups for eDNA analysis	80%	75%[3]
Successful completion of CTD casts at 4-6 sequential stations	20 nights	14 nights[4]

[1]The 18 full or partial days lost to weather include 5 days when the *Sette* could not maintain a sufficient survey speed during Beaufort sea state 6 (i.e., workable) conditions.
[2]There were no false killer whale detections during the pre-sunrise period of acoustic monitoring.
[3]If the group sampled by small boat is excluded, this percentage increases to 82%.
[4]It was determined after the onset of the survey that the 4-6 sequential stations would only occur in the SCOPE study area (i.e., a maximum of 20 nights). Weather conditions prevented CTDs on 3 nights and required an early departure from the study area. CTD casts (range=1-6) occurred on 22 nights in total.

Figures

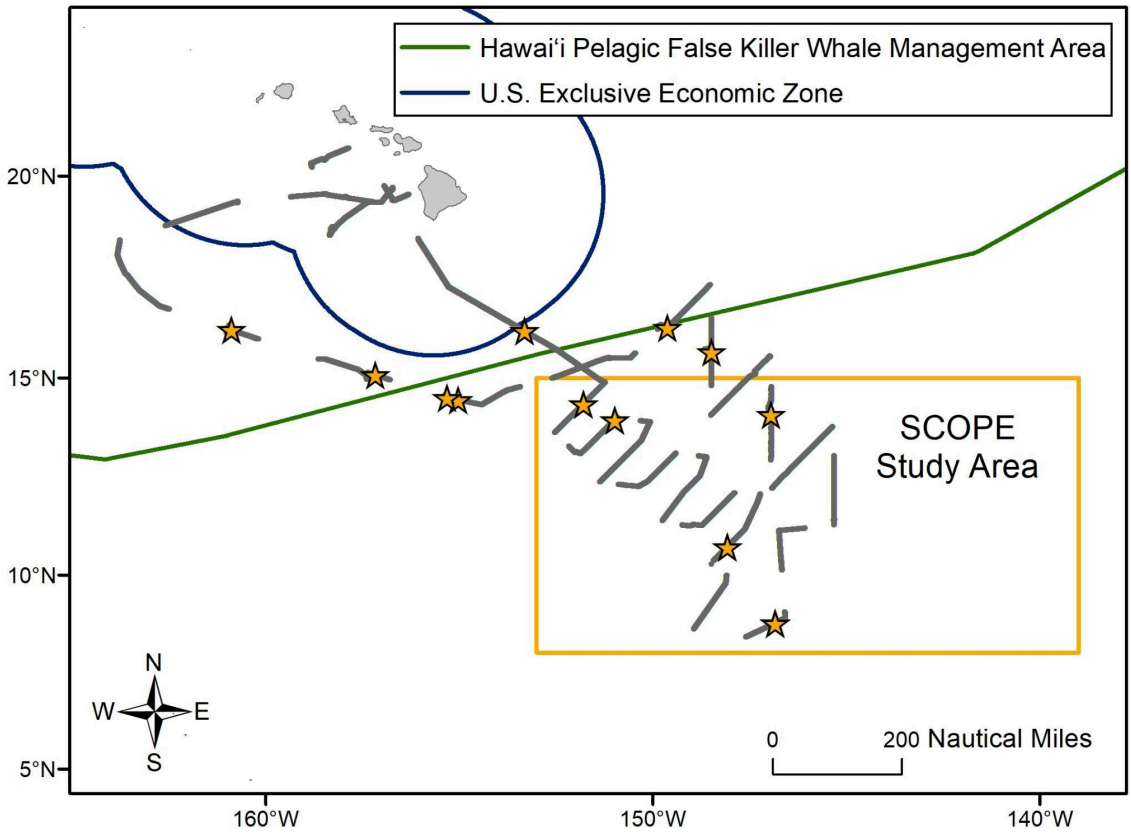

Figure 1. Map of acoustic effort (gray lines) and false killer whale detections (orange stars, n=12) during SCOPE, relative to the study area (gold box), the Hawai'i pelagic false killer whale management area (green line), and the U.S. Exclusive Economic Zone around the Hawaiian Islands (blue line).