

**FINAL REPORT**

**Vessel Based Marine Mammal  
Survey Off Kaua'i, January 2012**



**30 July 2012**

**HDR**

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Cover Photo: Blainville's beaked whale (*Mesoplodon densirostris*) off Kaua'i (photo Mark Deakos, NMFS Permit # 14451).

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## Abbreviations and Acronyms

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BARSTUR	Barking Sands Tactical Underwater Range
BSS	Beaufort Sea State
BSURE	Barking Sands Underwater Range Expansion
CRC	Cascadia Research Collective
DIFAR	Directional Frequency Analysis and Recording
hr(s)	hour(s)
HRC	Hawaii Range Complex
HST	Hawaii Standard Time
ICMP	Integrated Comprehensive Monitoring Plan
km	kilometer(s)
m	meter(s)
M3R	Marine Mammal Monitoring on Navy Ranges
MFAS	Mid-Frequency Active Sonar
MSO	Marine Species Observer
NAVFAC	Naval Facilities Engineering Command
NMFS	National Marine Fisheries Service
NUWC NWPT	Naval Underwater Warfare Center Division Newport
PMRF	Pacific Missile Range Facility
RHIB	Rigid-hulled Inflatable Boat
SPAWAR	Space and Naval Warfare Systems Command
SPUE	Sightings Per Unit Effort
U.S.	United States
USNS	U.S. Navy Ship

WILD Wildlife Identification Logging and Display  
XBT Expendable Bathythermograph

## Section 1 Introduction

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As part of the compliance requirements of the Marine Mammal Protection Act of 1972 and the Endangered Species Act of 1973, the United States (U.S.) Navy developed the Integrated Comprehensive Monitoring Program (ICMP) and range specific monitoring plans including the Hawaii Range Complex (HRC) (Department of the Navy [DoN] 2008, 2009). The ICMP applies by regulation to those activities on U.S. Navy training ranges and operating areas for which the U.S. Navy sought and received incidental take authorizations. In order to support the U.S. Navy in meeting regulatory requirements for monitoring established under the Final Rules and to provide a mechanism to assist with coordination of program objectives under the ICMP, this survey was conducted to confirm the Marine Mammal Monitoring on Navy Ranges (M3R) acoustic detections and marine mammal satellite tagging was prior to a training event, the Submarine Commander's Course exercise, which would be conducted in the same area during February 2012. This report presents the methods and preliminary results of a vessel-based visual and acoustic survey effort that was conducted in conjunction with a tagging and species-validation project. The survey occurred from 11 to 19 January 2012 in the waters west of Kaua'i in the Pacific Missile Range Facility (PMRF) instrumented range within the HRC. This cruise was designed as a non-random, non-systematic survey designed to optimize encounter rates for the purpose of visual validation of acoustic detections and satellite tagging of species for which population size, habitat use, and movement pattern data are lacking and which may be exposed to U.S. Navy training. The U.S. Navy's high-priority species for this survey included beaked whales, sperm whale (*Physeter macrocephalus*), false killer whale (*Pseudorca crassidens*), killer whale (*Orcinus orca*), melon-headed whale (*Peponocephala electra*), and pygmy killer whale (*Feresa attenuata*). Medium-priority species would be short-finned pilot whale (*Globicephala macrorhynchus*), Risso's dolphin (*Grampus griseus*), blue whale (*Balaenoptera musculus*), sei whale (*Balaenoptera borealis*), Bryde's whale (*Balaenoptera edeni*), minke whale (*Balaenoptera acutorostrata*), and rough-toothed dolphin (*Steno bredanensis*) and other small dolphin species. Low-priority species would include spinner dolphin (*Stenella longirostris*) and humpback whale (*Megaptera novaeangliae*).

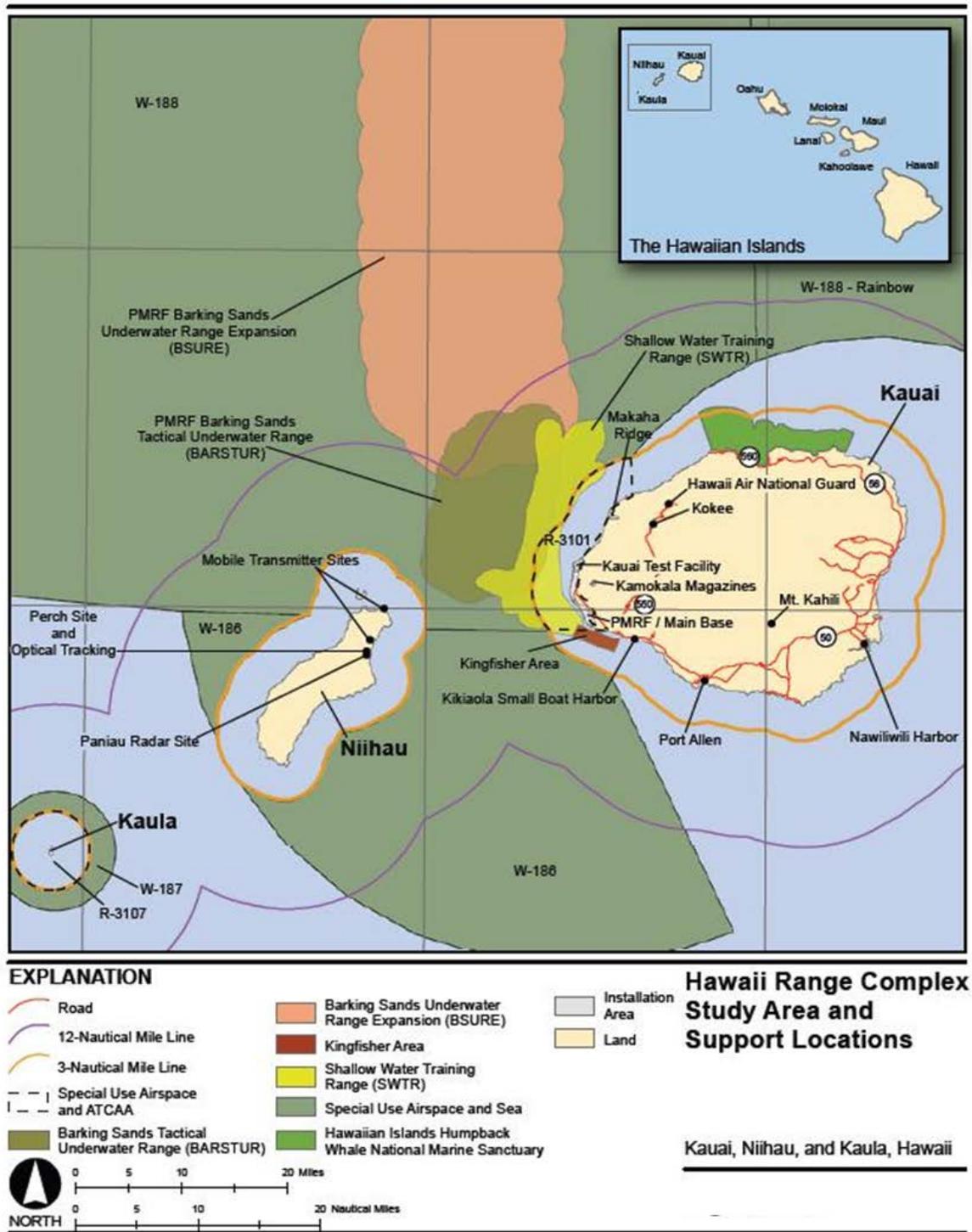
The results of the marine mammal monitoring reported here are part of a long-term monitoring effort under the U.S. Navy's Marine Species Monitoring Program issued to HDR Environmental, Operations and Construction, Inc..

## Section 2 Methods

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The survey was conducted from 11 to 19 January 2012 in the area of the U.S. Navy's PMRF, which contains BARSTUR (hydrophone range) and BSURE (instrumented range) off of the west side of Kaua'i (**Figure 1**). Primary objectives of the cruise were to: (1) obtain visual sightings of marine mammals detected acoustically by scientists on the PMRF BSURE and BARSTUR and deploy satellite tags on marine mammals; and (2) collect photographs of marine mammals for species identification and mark-recapture abundance estimates. Secondary objectives of the cruise were to: (1) collect close-range acoustic data from marine mammals using sonobuoys launched from the USNS *Sioux*. Data will be used

for comparison with data collected using range hydrophones and for future analyses.



**Figure 1.** Area off Kaua'i showing the instrumented ranges, BARSTUR hydrophone range, and Shallow Water Training Range, where the survey took place (Figure from DoN 2008b).

Primarily the survey would occur within: (1) areas of lowest Beaufort sea state (BSS) to facilitate sightings (2) areas of deep water to sight primary species; and (3) instrumented range to visually confirm

marine mammal acoustic detections. Key personnel, including marine species observers (MSOs), acousticians, and the data logging manager are listed in **Table 1**. All personnel were involved in marine species observations but several had additional duties, such as tagging, preparing and deploying sonobuoys, and managing the Wildlife Identification Logging and Display (WILD) software data entry.

**Table 1. Observers and Roles.**

Observer	Affiliation	Role(s)
Jessica Aschettino	CRC	MSO and tagging/biopsy crew on the RHIB
Mark Deakos	HDR Inc.	MSO
Sean Hanser	NAVFAC PACIFIC	MSO and Lead Navy Scientist
Christopher Kyburg	SPAWAR	MSO and managed WILD data collection
David Moretti	NUWC NWPT	M3R Acoustician
Steven Martin	SPAWAR	M3R Acoustician
Thomas Norris	Bio-Waves Inc.	MSO and Acoustician
Morgan Richie	NAVFAC Pacific	MSO
Julie Rivers	U.S. Pacific Fleet	MSO
Philip Thorson	HDR Inc.	MSO and Cruise Leader
Deron Verbeck	CRC	Boat driver and tagging/biopsy crew on the RHIB
Daniel Webster	CRC	Lead Scientist and tagging/biopsy crew on the RHIB
Paula von Weller	HDR Inc.	MSO
Suzanne Yin	HDR Inc	MSO



**Figure 2: The USNS *Sioux* (T-ATF 171).**

The survey was conducted from the USNS *Sioux*, a 68.6 meter (m) long ship used for towing, salvage, and diving operations. This vessel has the ability to travel at speeds of 7 to 18 kilometers/hour (km/hr) with an observer height of 10.4 m and can stay at sea for several weeks, which allowed observers to work throughout daylight hours within the instrumented range off PMRF. Observations were primarily conducted from the outside bridge area, but during periods of bad weather the observers moved inside the bridge control room (same height as the observer outside bridge area). Observations were made using the protocol developed by the National Marine Fisheries Service (NMFS) Southwest Fisheries Science Center (SWFSC) (Kinzey et al. 2000). The bridge observation area had port and starboard side Big Eye (25 X 150) binoculars, however, they were not equipped with reticles to determine distance from the vessel. The survey was conducted using an observation team of three individuals—two dedicated observers in either the port or starboard station searching with the Big Eye or 7 x 50 hand-held Fujinon reticled binoculars, and a third observer using 7 x 50 hand-held reticled binoculars in the centerline position. The third observer also served as the data collector.

Sighting data were collected during daylight hours, approximately 07:20 to 18:00 local time (Hawaii Standard Time [HST]) when weather conditions permitted (such as BSS of 0–6 and visibility greater than 1.9 km). At periods when conditions were above BSS 6 with rain or sea spray, the observation crew was reduced to one observer and observations were conducted from within the navigation bridge due to safety concerns. Survey data sightings, observers on station, environmental conditions, BSS, and sightings were recorded using WILD marine species data collection software. WILD continuously recorded the track of the ship using a Global Positioning System (Garmin, Olathe, Kansas) unit attached to the railing of the observer's bridge of the USNS *Sioux*.

Because the primary goal of this survey was to validate species identification for marine mammals detected acoustically by the PMRF hydrophones and M3R team, humpback whale sightings were treated differently. Basic humpback whale sighting data including location and group size were recorded,

however, no additional time were spent with humpbacks so that the MSOs would remain focused on detections of the primary or lesser-studied species.

The primary approach was to use acoustic detections from the PMRF M3R hydrophone system to locate marine mammals. M3R would provide the Cruise Leader or Lead Scientist with a hydrophone designation where a marine mammal had been detected and the ship was then re-directed to the area of the hydrophone's location to visually confirm the species. In addition, sightings were photographed for photo-identification studies and satellite tags deployed when possible. Opportunistic sightings were made *en route* to acoustic detection areas in order to maximize survey effort. Acoustic detections from PMRF are contained in a separate report.

### **Oceanography**

Oceanographic data was planned originally to be collected with an expendable bathythermograph (XBT) data acquisition system and an XBT hand-held launcher at regular intervals during the survey or following selected marine mammal sightings. This was not possible due to malfunctioning data acquisition software.

### **Tagging**

The initial plan was to launch and retrieve the tagging rigid-hulled inflatable boat (RHIB) each day from the USNS *Sioux*. This would have allowed the RHIB team to save time traveling from Port Allen, Kaua'i to the survey area each day and to work from aboard the USNS *Sioux* during high BSS. However, due to complications with retrieval of the RHIB on the first day at sea, this part of the operation was discontinued, and the RHIB and tagging team launched and returned to Port Allen each day.

### **Sonobuoys**

Standard and Directional Frequency Analysis and Recording (DIFAR) sonobuoys were deployed from the aft deck of the USNS *Sioux* when sightings were made of priority species, such as beaked whales or pilot whales, or as requested by the M3R crew. In addition to the receiver on the ship, a portable receiver was set up at PMRF to also receive sonobuoy data. Analysis of sonobuoy recordings is planned for the future.

## **Section 3 Results**

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A total of 96 hrs of observation effort occurred during the nine survey days and 1,330 km of track line observations. A total of 161 cetaceans were sighted representing eight confirmed species and four categories of unidentified species groups (**Tables 2-3; Figures 3-12**). Some sightings were classified only as unidentified delphinid, or *Mesoplodon* spp., with several categorized as unidentified cetaceans or mysticete. Confirmed species included Blainville's beaked whale (*Mesoplodon densirostris*), bottlenose dolphin (*Tursiops truncatus*), humpback whale, minke whale, rough-toothed dolphin, short-finned pilot whale, sperm whale, and spinner dolphin.

The humpback whale was the most frequently sighted species ( $n = 122$ ; 75.8 % of all sightings), followed by the rough-toothed dolphin ( $n = 6$ ; 3.7 % of all sightings) (**Table 2**). The remaining species or unidentified groupings had 1 to 5 sightings each (0.6 % to 3.1 % of all sightings) (**Table 2**). The large numbers of humpback whales were expected for this time of year as the survey occurred during this species' winter breeding season. Due to this survey's priority to focus on visual confirmation of acoustically-detected species, the ship tracks would often circle around an area, therefore, it possible that some individual humpback whales were sighted multiple times giving an overestimate of the number of their sightings.

**Table 2. Summary of sightings of marine mammals by species.**

Species	Number of sightings	Percentage of total sightings
Blainville's beaked whale	4	2.5
Bottlenose dolphin	1	0.6
Humpback whale	122	75.8
Minke whale	1	0.6
Rough-toothed dolphin	6	3.7
Short-finned pilot whale	5	3.1
Sperm whale	4	2.5
Spinner dolphin	4	2.5
Unidentified <i>Mesoplodon</i> spp.	1	0.6
Unidentified delphinid	5	3.1
Unidentified mysticete	5	3.1
Unidentified cetacean	3	1.9
<b>Total</b>	<b>161</b>	<b>100.0</b>

**Table 3. Summary of Sightings.**

Sighting No.	Time (HST)	Species	BSS	Group Size			Latitude (° N)	Longitude (° W)	Ship Bearing	Animal Bearing	Initial Distance (m)	Species Confirmation Confidence
				Low	High	Best						
<b>11 January 2012</b>												
1	07:23	Humpback whale	2	-	3	2	21.955	159.920	162	250	1,648	Medium
2	07:39	Unidentified cetacean	2	-	-	1	21.936	159.906	162	347	2,023	High
3	07:44	Unidentified delphinid	2	-	-	1	21.930	159.902	162	69	500	Low
4	07:47	Humpback whale	2	-	3	2	21.926	159.900	162	277	15,000	-
5	07:49	Humpback whale	1	-	-	2	21.925	159.899	163	298	3,234	High
6	07:50	Humpback whale	1	-	-	2	21.923	159.898	163	45	450	High
7	08:10	Humpback whale	1	1	1	1	21.899	159.882	163	20	2,010	-
8	08:13	Humpback whale	1	-	-	1	21.895	159.880	163	271	6,770	-
9	08:29	Humpback whale	4	2	2	2	21.904	159.874	148	8	1,000	High
10	08:41	Humpback whale	4	-	-	1	21.923	159.874	141	20	655	-
11	08:41	Bottlenose dolphin	4	-	-	3	21.926	159.874	144	67	2,373	Medium
12	08:50	Humpback whale	4	-	-	2	21.937	159.871	135	24	4,302	-
13	09:22	Humpback whale	3	-	-	3	21.951	159.860	188	94	1,175	-
14	09:52	Humpback whale	3	1	1	1	21.975	159.830	137	-25	2,886	High
15	10:00	Spinner dolphin	3	-	-	90	21.985	159.820	135	4	3,234	-
16	11:13	Unidentified delphinid	4	-	-	4	22.012	159.810	145	25	2,300	-
17	11:14	Spinner dolphin	4	5	-	8	22.013	159.811	164	90	2,300	-
18	14:57	Unidentified delphinid	3	-	-	3	22.120	159.978	157	280	300	-
19	16:34	Spinner dolphin	3	-	-	50	22.030	159.839	168	18	3,686	High
<b>12 January 2012</b>												
1	08:19	Humpback whale	2	1	1	1	21.866	159.617	273	125	2,885	High
2	10:13	Humpback whale	2	-	-	1	22.116	159.942	154	110	4,694	High
3	10:53	Humpback whale	2	-	-	1	22.217	159.897	68	190	6,770	High
4	13:10	Unidentified cetacean	3	-	-	1	22.346	159.874	241	90	20	-
5	13:23	Blainville's beaked whale	3	-	-	1	22.350	159.873	193	25	380	-
6	16:12	Short-finned pilot whale	3	-	-	50	22.247	159.844	160	335	1,283	High
7	16:35	Rough-toothed dolphin	3	2	2	2	22.231	159.851	261	70	50	High
<b>13 January 2012</b>												
1	07:25	Humpback whale	3	1	1	1	21.937	159.715	336	357	1,175	-
2	07:43	Humpback whale	3	-	-	3	21.943	159.740	276	38	5,210	High
3	08:12	Humpback whale	3	3	4	3	21.942	159.780	264	2	5,210	High
4	08:19	Humpback whale	3	-	-	2	21.943	159.788	298	45	5,210	High

Sighting No.	Time (HST)	Species	BSS	Group Size			Latitude (° N)	Longitude (° W)	Ship Bearing	Animal Bearing	Initial Distance (m)	Species Confirmation Confidence
				Low	High	Best						
5	08:24	Humpback whale	3	-	-	1	21.946	159.793	307	250	3,234	High
6	08:56	Short-finned pilot whale	3	-	-	30	21.908	159.766	141	110	522	-
7	09:53	Humpback whale	3	-	-	1	21.878	159.714	121	100	1,175	-
8	10:21	Short-finned pilot whale	5	-	-	1	21.902	159.729	324	260	400	High
9	10:33	Short-finned pilot whale	5	-	-	8	21.900	159.737	214	120	522	-
10	10:39	Short-finned pilot whale	5	8	15	10	21.902	159.741	340	90	522	High
11	11:10	Humpback whale	5	-	-	1	21.923	159.752	320	45	1,283	-
12	12:04	Humpback whale	3	-	-	4	22.028	159.838	314	58	3,675	-
13	12:21	Humpback whale	3	-	-	2	22.068	159.844	5	45	1,500	-
14	12:28	Humpback whale	3	-	-	2	22.088	159.845	5	50	5,210	-
15	12:53	Humpback whale	3	1	1	1	22.128	159.831	173	310	2,029	High
16	12:57	Humpback whale	3	1	1	1	22.116	159.831	182	335	2,029	High
17	13:29	Humpback whale	4	-	-	1	22.059	159.872	222	282	2,885	High
18	13:33	Humpback whale	4	-	-	1	22.060	159.872	222	312	1,175	High
19	13:37	Humpback whale	4	-	-	3	22.047	159.882	185	310	1,282	Medium
20	13:41	Humpback whale	4	-	-	1	22.037	159.882	176	270	50	Medium
21	14:03	Humpback whale	4	1	1	1	21.995	159.872	110	251	1,487	High
22	14:09	Humpback whale	4	-	-	1	21.994	159.860	87	2	2	High
23	14:20	Humpback whale	4	-	-	2	21.993	159.833	79	355	4,000	High
24	14:20	Humpback whale	4	-	-	2	21.993	159.833	79	5	5,210	High
25	14:20	Humpback whale	4	-	-	1	21.993	159.833	79	0	6,770	High
26	14:42	Humpback whale	4	-	-	1	22.030	159.823	10	235	638	High
27	14:44	Humpback whale	4	-	-	2	22.035	159.823	6	40	5,210	High
28	14:46	Humpback whale	4	-	-	1	22.038	159.823	2	5	6,770	Medium
29	14:55	Humpback whale	4	-	-	1	22.056	159.822	4	35	2,608	High
30	15:01	Humpback whale	4	-	-	1	22.068	159.822	7	45	6,770	High
31	15:05	Humpback whale	4	-	-	2	22.074	159.822	359	30	2,381	-
32	15:10	Humpback whale	4	2	-	3	22.085	159.823	353	28	5,169	-
33	15:14	Humpback whale	4	-	-	1	22.092	159.823	3	50	3,686	-
34	15:17	Humpback whale	4	-	-	2	22.098	159.825	357	50	972	-
35	15:30	Humpback whale	3	-	-	1	22.122	159.825	358	67	4,302	-
36	15:32	Spinner dolphin	3	-	-	50	22.125	159.831	2	54	1,340	High
37	15:52	Humpback whale	3	-	-	1	22.118	159.831	182	330	2,381	High
38	15:54	Humpback whale	3	-	-	3	22.111	159.831	183	355	2,010	High
39	16:01	Humpback whale	3	-	-	1	22.092	159.830	169	325	522	High

Sighting No.	Time (HST)	Species	BSS	Group Size			Latitude (° N)	Longitude (° W)	Ship Bearing	Animal Bearing	Initial Distance (m)	Species Confirmation Confidence
				Low	High	Best						
40	16:04	Humpback whale	3	-	-	2	22.080	159.829	180	90	441	-
41	16:13	Humpback whale	3	-	-	3	22.057	159.829	179	2	5,169	High
42	16:27	Humpback whale	3	-	-	1	22.013	159.827	183	230	969	High
43	16:32	Humpback whale	3	-	-	1	22.000	159.827	176	260	3,225	High
44	16:33	Humpback whale	3	-	-	2	21.996	159.827	177	5	5,210	High
45	16:41	Humpback whale	3	-	-	1	21.974	159.826	176	70	4,302	High
46	16:48	Humpback whale	4	-	-	2	21.954	159.826	177	90	300	Medium
47	16:49	Humpback whale	4	-	-	1	21.949	159.825	186	280	1,171	High
48	16:53	Humpback whale	4	-	-	2	21.940	159.824	122	320	1,710	Medium
49	16:54	Humpback whale	4	-	-	1	21.939	159.822	124	25	4,267	High
50	17:32	Humpback whale	4	-	-	1	21.885	159.722	118	50	3,234	Medium
<b>14 January 2012</b>												
1	07:36	Humpback whale	3	-	-	2	22.146	159.829	20	55	2,000	High
2	07:55	Humpback whale	3	-	-	1	22.173	159.839	306	352	1,482	High
3	09:51	Humpback whale	3	-	-	1	22.223	159.891	164	292	4302	High
4	09:59	Humpback whale	3	-	-	1	22.224	159.897	322	150	2,489	High
5	11:03	Humpback whale	4	-	-	1	22.224	159.905	169	20	3,206	High
6	11:54	Humpback whale	4	-	-	1	22.264	159.843	339	50	3,234	High
7	12:38	Humpback whale	4	-	-	2	22.243	159.886	200	85	3,234	High
8	14:06	Unidentified delphinid	5	-	-	3	22.232	159.803	113	20	100	-
9	15:14	Rough-toothed dolphin	6+	-	-	9	22.240	159.793	297	0	10	-
<b>15 January 2012</b>												
1	08:36	Humpback whale	5	-	-	2	22.248	159.891	220	295	3,234	Low
2	08:50	Humpback whale	5	-	-	3	22.255	159.890	28	160	2,029	High
3	09:08	Humpback whale	5	-	-	2	22.274	159.888	335	225	3,686	High
4	09:17	Unidentified mysticete	5	-	-	1	22.268	159.903	229	45	1,472	High
5	09:19	Unidentified mysticete	5	-	-	1	22.265	159.906	230	320	1,282	High
6	10:11	Blainville's beaked whale	6+	1	1	1	22.252	159.980	236	110	500	-
7	11:06	Sperm whale	6+	-	-	1	22.	159.952	154	350	3,234	Medium
8	12:41	Sperm whale	5	-	-	1	22.173	159.889	64	5	unk	-
9	17:00	Unidentified mysticete	5	-	-	1	22.044	159.914	302	200	5,210	High
10	17:26	Unidentified mysticete	5	-	-	1	22.055	159.940	124	335	5,196	-
11	17:51	Sperm whale	5	-	-	1	22.027	159.895	124	30	3,686	High
<b>16 January 2012</b>												
1	17:06	Humpback whale	4	-	-	2	22.030	159.848	354	10	3,234	High

Sighting No.	Time (HST)	Species	BSS	Group Size			Latitude (° N)	Longitude (° W)	Ship Bearing	Animal Bearing	Initial Distance (m)	Species Confirmation Confidence
				Low	High	Best						
2	17:40	Humpback whale	4	-	-	1	22.124	159.850	5	35	2,381	High
3	17:58	Rough-toothed dolphin	4	-	-	2	22.177	159.8846	8	Unk	10	-
4	17:59	Rough-toothed dolphin	4	-	-	2	22.179	159.845	10	0	10	-
<b>17 January 2012</b>												
1	07:29	Humpback whale	3	-	-	1	22.006	159.839	345	110	1,200	-
2	07:51	Humpback whale	3	-	-	1	22.050	159.854	342	320	820	Low
3	08:14	Humpback whale	5	-	-	1	22.042	159.881	216	45	380	High
4	12:15	Humpback whale	4	-	-	1	22.131	159.858	64	28	3,686	Medium
5	12:27	Unidentified mysticete	5	-	-	1	22.143	159.839	53	2	3,234	-
6	12:35	Humpback whale	5	-	-	1	22.154	159.828	33	44	3,234	Medium
7	12:46	Humpback whale	5	-	-	2	22.169	159.812	50	35	5,210	High
8	12:52	Humpback whale	5	-	-	2	22.181	159.813	332	21	1,282	High
9	16:20	Rough-toothed dolphin	5	-	-	4	22.225	159.891	206	2	300	High
10	17:37	Humpback whale	5	-	-	1	22.093	159.938	194	298	3,676	High
<b>18 January 2012</b>												
1	07:33	Humpback whale	3	-	-	1	22.004	159.846	341	10	2,381	High
2	07:45	Humpback whale	3	-	-	1	22.022	159.852	355	25	1,175	Medium
3	08:03	Humpback whale	3	-	-	1	22.051	159.863	347	15	2,381	High
4	08:08	Humpback whale	3	-	-	1	22.059	159.866	333	3	4,302	Medium
5	08:20	Humpback whale	4	-	-	1	22.077	159.872	352	310	2,381	High
6	08:26	Rough-toothed dolphin	4	-	-	6	22.086	159.873	1	5	100	High
7	08:30	Humpback whale	4	-	-	1	22.093	159.873	6	90	6,770	High
8	10:31	Blainville's beaked whale	5	-	-	1	22.140	159.918	181	100	441	-
9	12:39	Humpback whale	5	-	-	1	22.167	159.927	4	115	3,225	-
10	13:23	Unidentified cetacean	5	-	-	1	22.144	159.894	161	75	2,608	Medium
11	14:05	Humpback whale	5	-	-	2	22.101	159.943	160	18	3,234	High
12	14:15	Humpback whale	5	-	-	1	22.085	159.930	139	1	24	-
13	14:15	Humpback whale	5	-	-	1	22.084	159.928	142	99	3,234	-
14	14:16	Humpback whale	5	-	-	1	22.083	159.927	140	110	3,234	-
15	14:42	Humpback whale	5	-	-	1	22.071	159.924	303	48	3,686	-
16	14:48	Sperm whale	5	-	-	1	22.078	159.933	329	285	5,210	High
17	14:51	Humpback whale	5	-	-	1	22.082	159.936	326	335	723	Low
18	14:57	Humpback whale	5	-	-	1	22.092	159.943	339	170	1,487	High
19	15:05	Humpback whale	5	-	-	1	22.113	159.938	25	260	2,381	Medium
20	15:42	Humpback whale	5	-	-	3	22.139	159.933	137	234	3,206	High

Sighting No.	Time (HST)	Species	BSS	Group Size			Latitude (° N)	Longitude (° W)	Ship Bearing	Animal Bearing	Initial Distance (m)	Species Confirmation Confidence
				Low	High	Best						
21	16:06	Unidentified delphinid	5	2	-	2	22.109	159.907	341	270	522	High
<b>19 January 2012</b>												
1	07:20	Humpback whale	2	-	-	1	21.990	159.837	10	350	2,381	High
2	07:30	Humpback whale	2	-	-	1	22.006	159.841	356	82	4,302	High
3	07:32	Humpback whale	2	-	-	1	22.009	159.841	327	70	3,686	High
4	07:33	Humpback whale	2	-	-	1	22.010	159.841	340	280	2,860	High
5	07:36	Humpback whale	2	-	-	2	22.011	159.839	127	90	3,234	High
6	07:38	Humpback whale	2	-	-	4	22.009	159.836	122	320	4,302	High
7	07:41	Humpback whale	2	-	-	1	22.006	159.831	121	30	3,234	High
8	07:50	Humpback whale	2	-	-	2	21.996	159.815	123	4	2,886	High
9	08:03	Humpback whale	2	-	3	2	22.002	159.821	328	10	5,169	High
10	08:22	Humpback whale	2	-	3	2	22.033	159.844	328	30	4,302	High
11	08:28	Humpback whale	2	-	-	2	22.043	159.851	342	40	6,770	-
12	08:49	Humpback whale	2	-	-	1	22.081	159.870	338	45	3,234	-
13	08:52	Humpback whale	2	-	-	3	22.086	159.872	336	80	2,860	High
14	09:23	Humpback whale	2	2	3	3	22.130	159.905	128	348	6,770	High
15	09:33	Blainville's beaked whale	2	-	-	3	22.125	159.897	141	45	522	High
16	09:49	Humpback whale	2	-	-	2	22.107	159.892	170	8	2,608	-
17	10:10	Humpback whale	2	-	-	1	22.085	159.907	219	17	5,210	-
18	10:13	Humpback whale	2	-	-	1	22.082	159.909	241	40	1,084	Medium
19	10:14	Humpback whale	2	-	-	1	22.082	159.910	280	265	3,234	High
20	10:27	Humpback whale	3	-	-	2	22.099	159.918	345	330	1,282	Medium
21	11:16	Humpback whale	3	-	-	2	22.081	159.929	157	45	5,169	High
22	11:17	Humpback whale	3	-	-	1	22.080	159.929	172	93	6,770	High
23	11:46	Mesoplodon spp.	3	-	-	1	22.083	159.938	349	10	150	
24	11:54	Humpback whale	3	-	-	1	22.088	159.931	67	330	723	High
25	14:10	Humpback whale	3	-	-	1	22.141	159.947	168	85	3,686	High
26	14:13	Humpback whale	3	-	-	1	22.136	159.947	160	348	13,251	High
27	15:00	Humpback whale	3	-	-	3	22.094	159.951	302	8	1,770	High
28	15:09	Humpback whale	3	-	-	1	22.101	159.963	297	130	441	High
29	15:45	Humpback whale	2	-	-	1	22.099	159.941	250	280	441	High
30	16:21	Minke whale	2	-	-	1	22.114	159.947	52	10	522	Medium

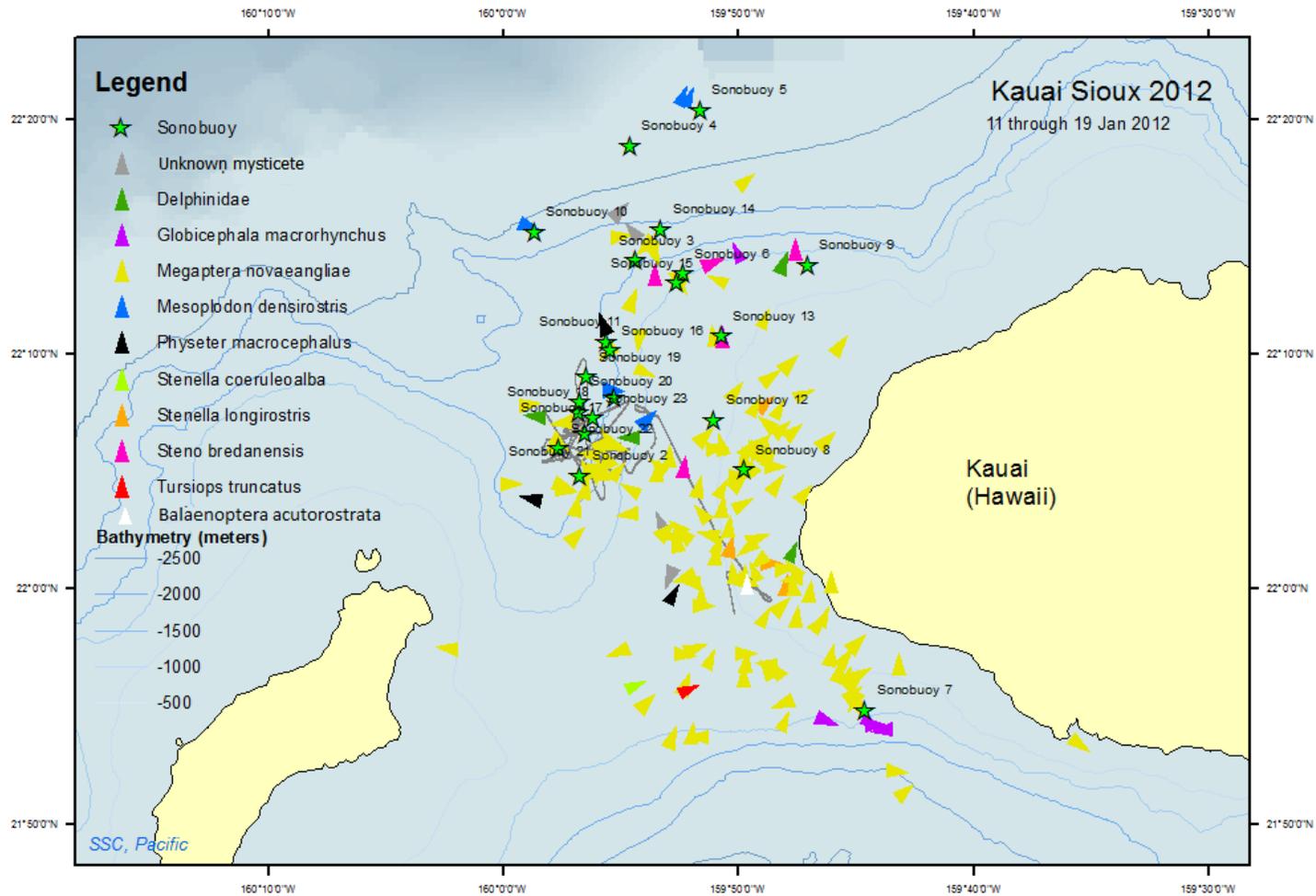


Figure 3. Combined ship tracks, marine mammal sightings, and sonobuoy deployments for the period of 11 to 19 January 2012.

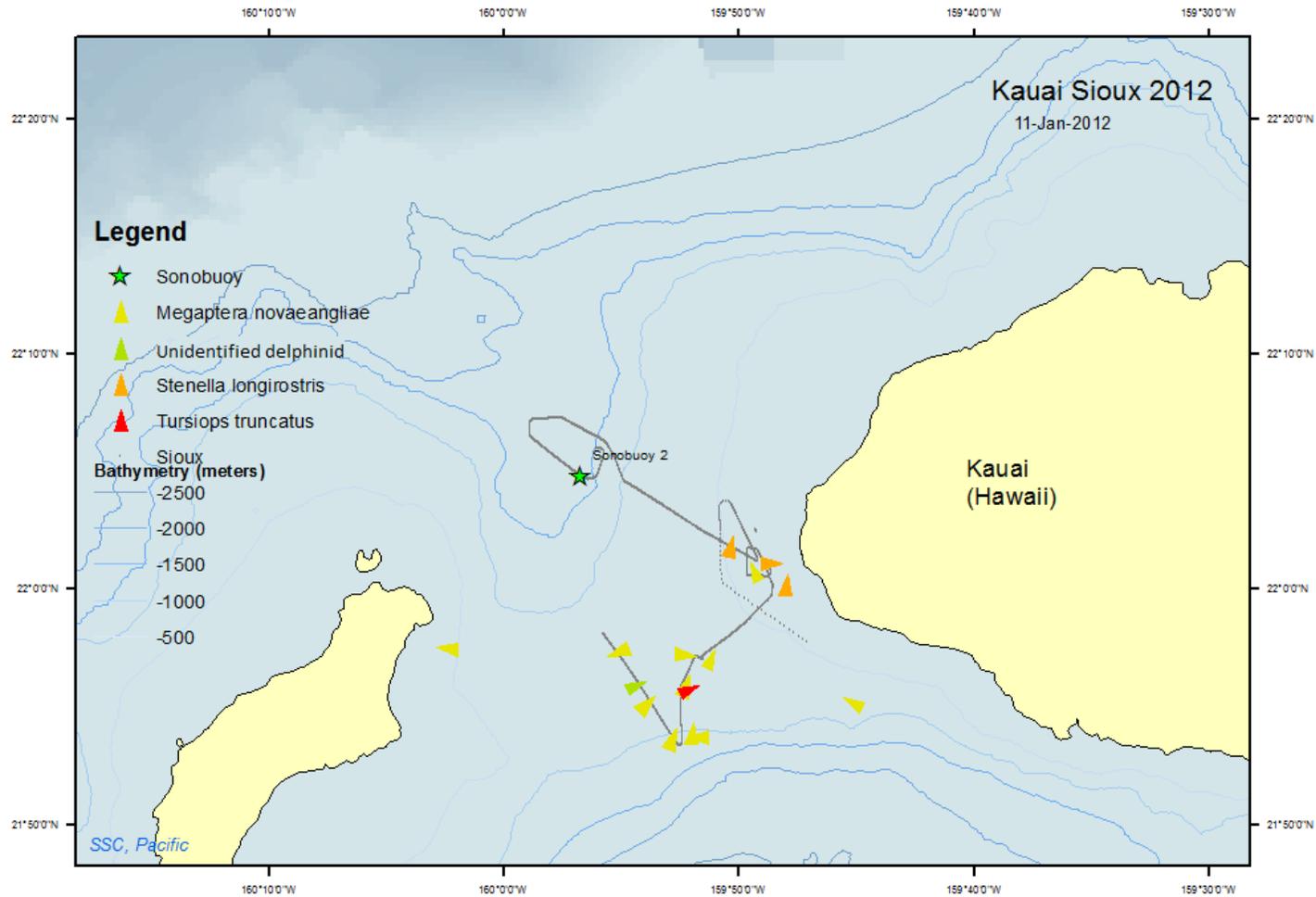


Figure 4. Ship tracks, marine mammal sightings, and sonobuoy deployments for 11 January 2012.

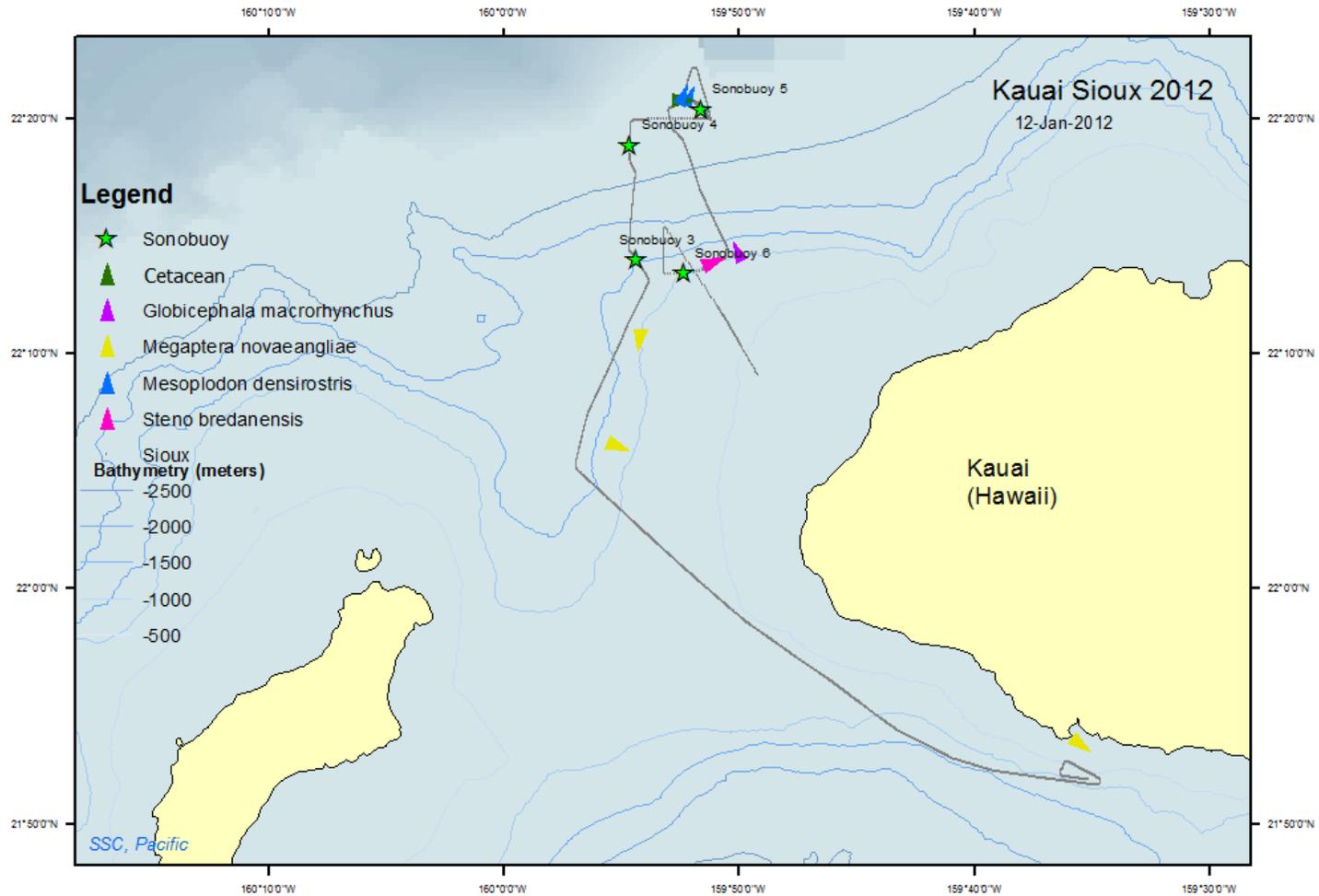


Figure 5. Locations of Cetacean Sightings Seen and Sonobuoy Deployments for 12 January 2012.

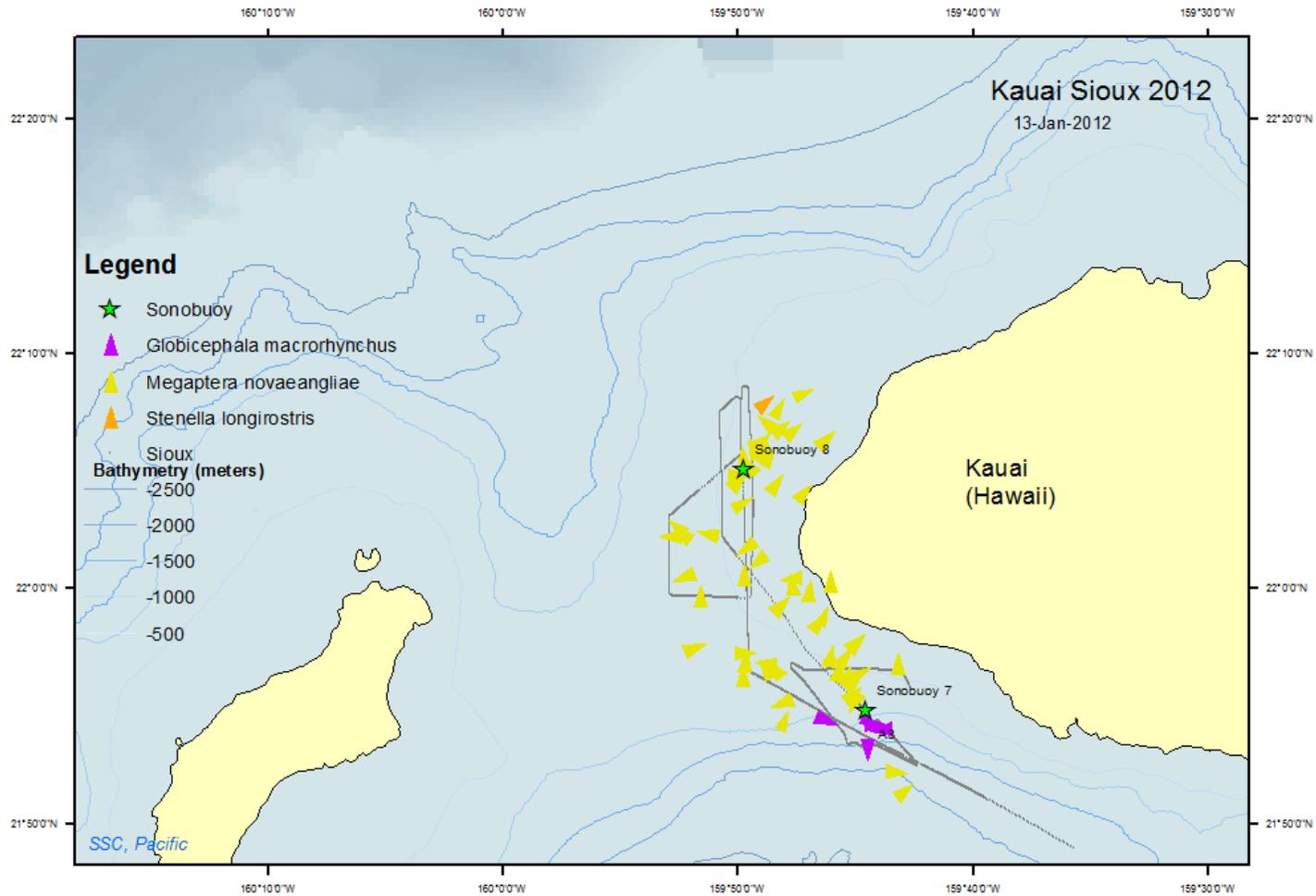


Figure 6. Ship tracks, marine mammal sightings, and sonobuoy deployments for 13 January 2012.

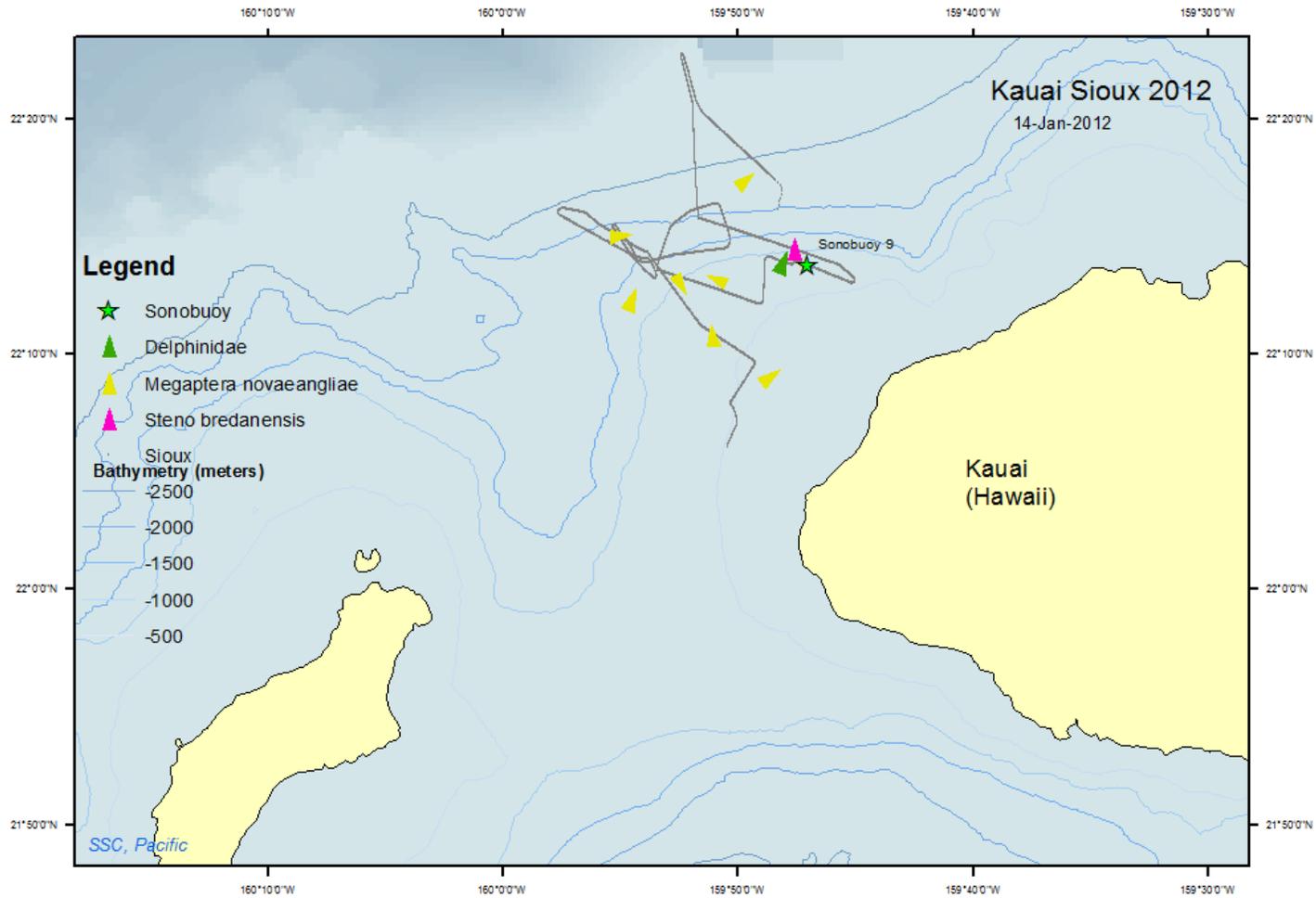


Figure 7. Ship tracks, marine mammal sightings, and sonobuoy deployments for 14 January 2012.

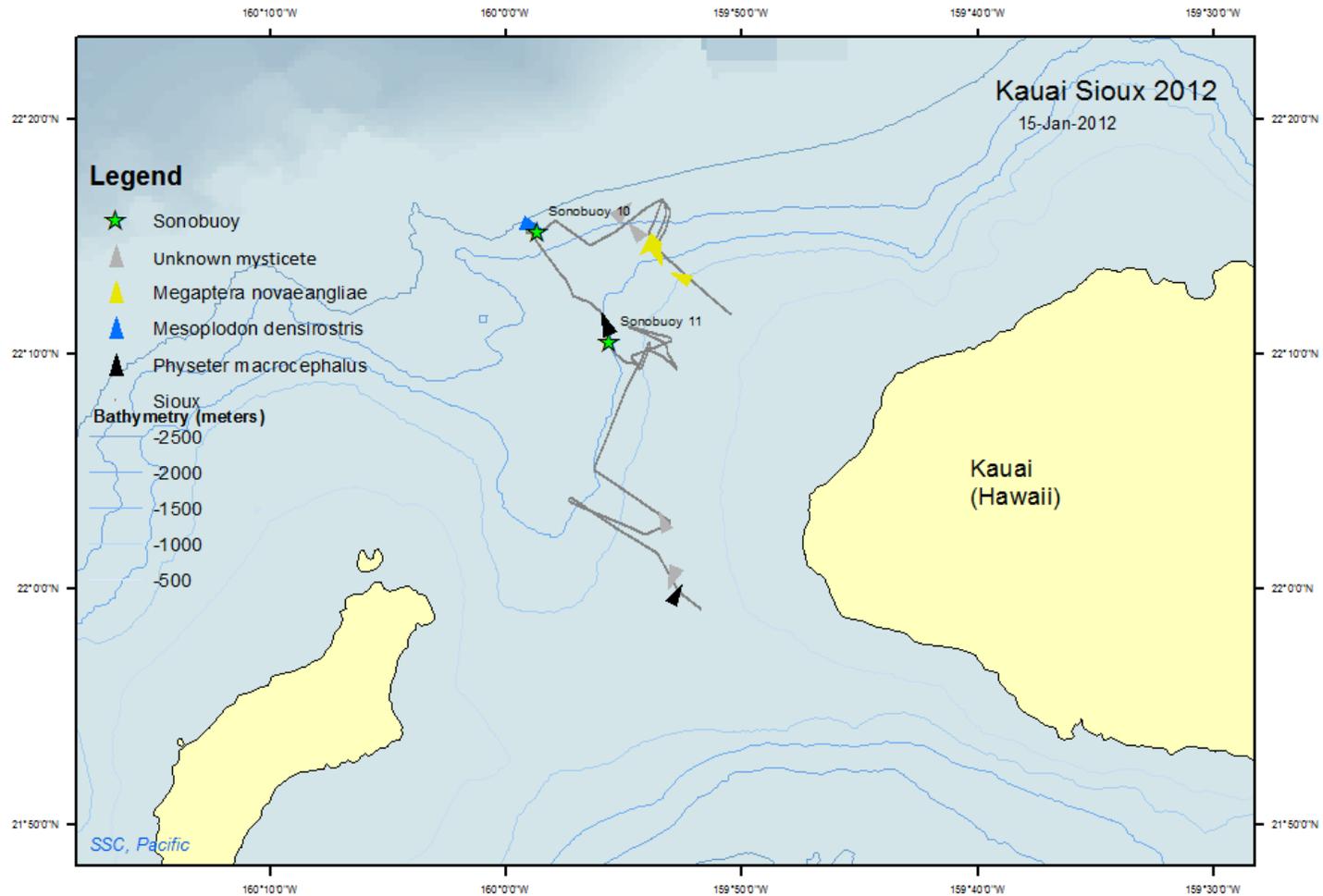


Figure 8. Ship tracks, marine mammal sightings, and sonobuoy deployments for 15 January 2012.

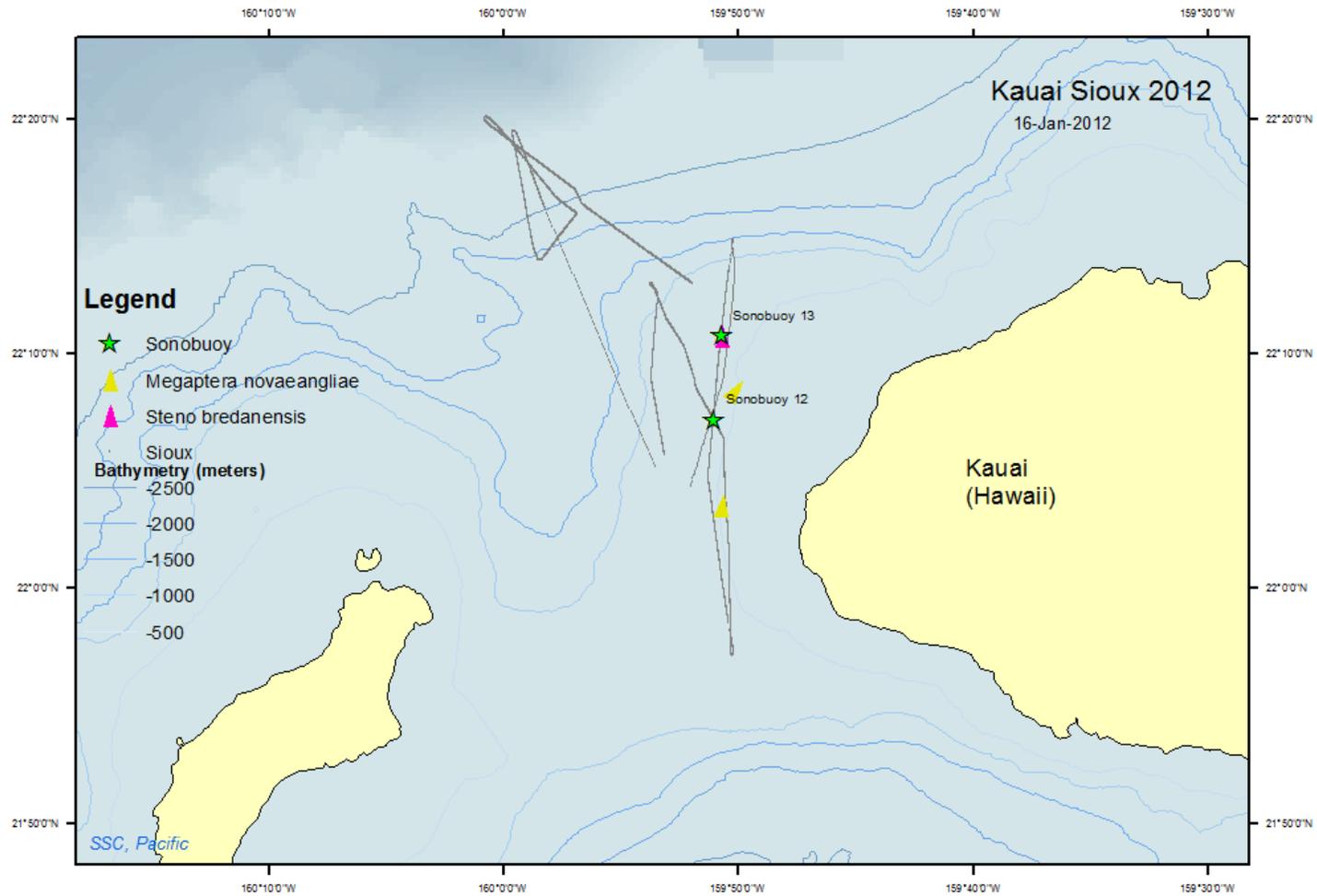


Figure 9. Ship tracks, marine mammal sightings, and sonobuoy deployments for 16 January 2012.

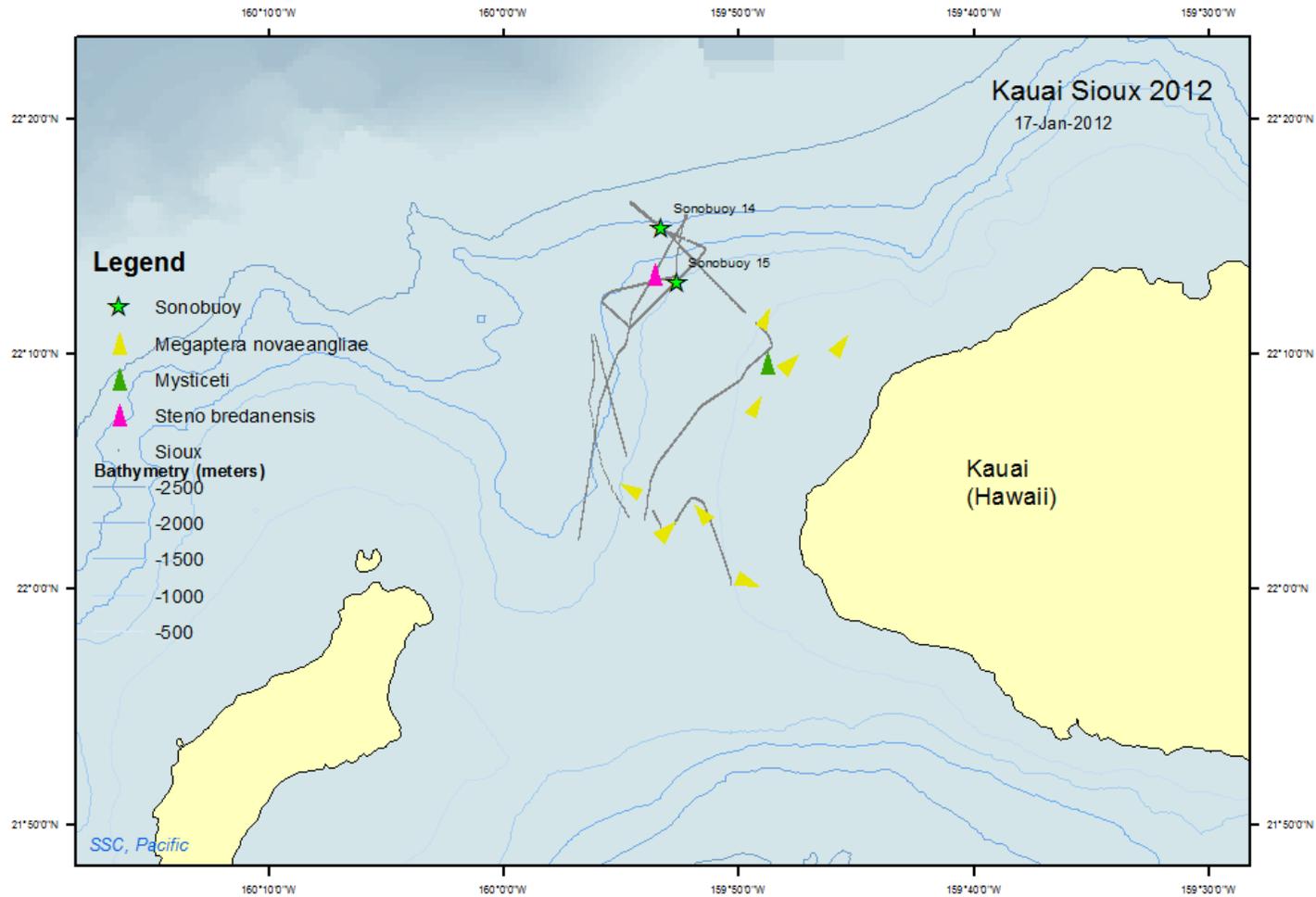


Figure 10. Ship tracks, marine mammal sightings, and sonobuoy deployments for 17 January 2012.

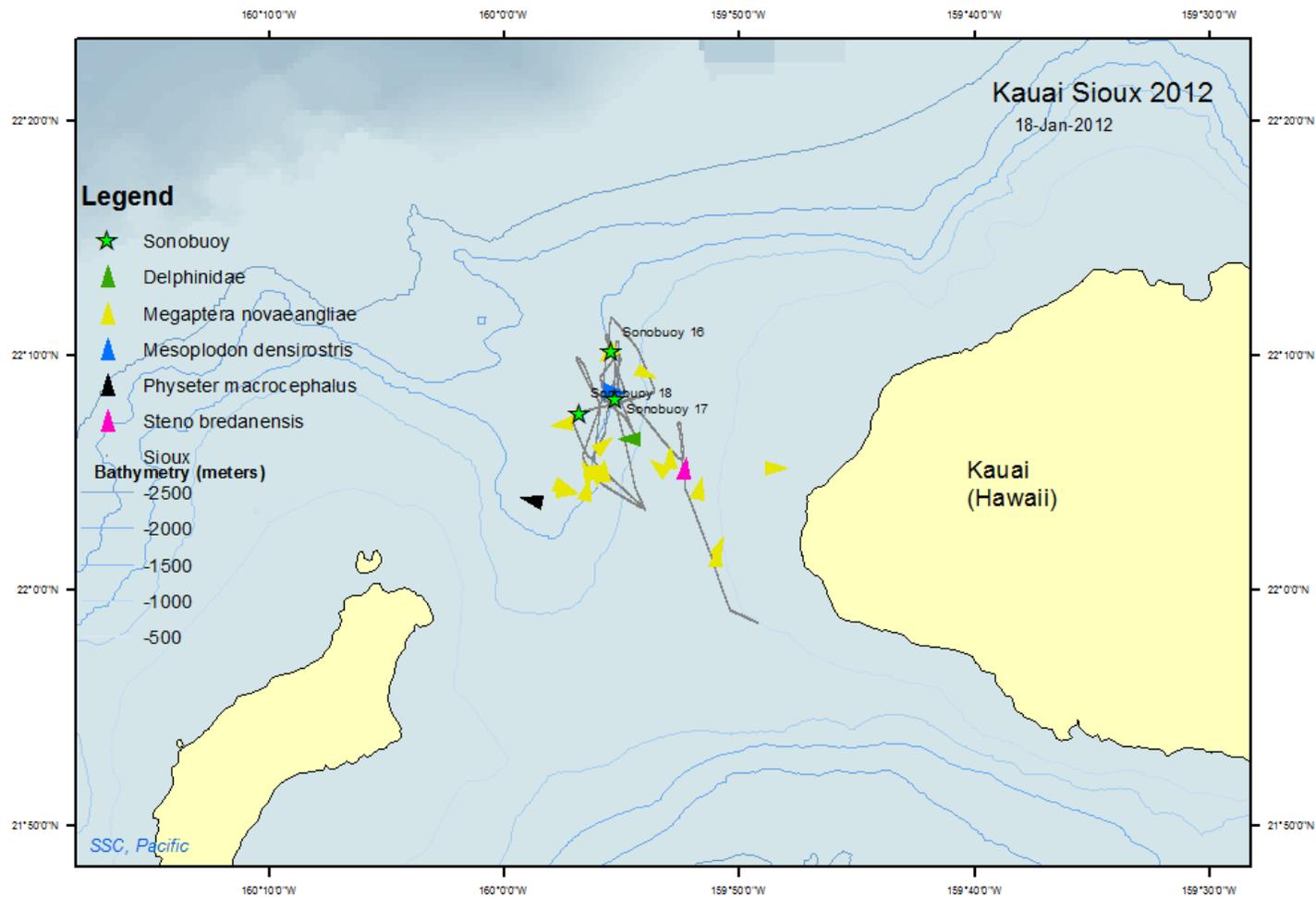


Figure 11. Ship tracks, marine mammal sightings, and sonobuoy deployments for 18 January 2012.

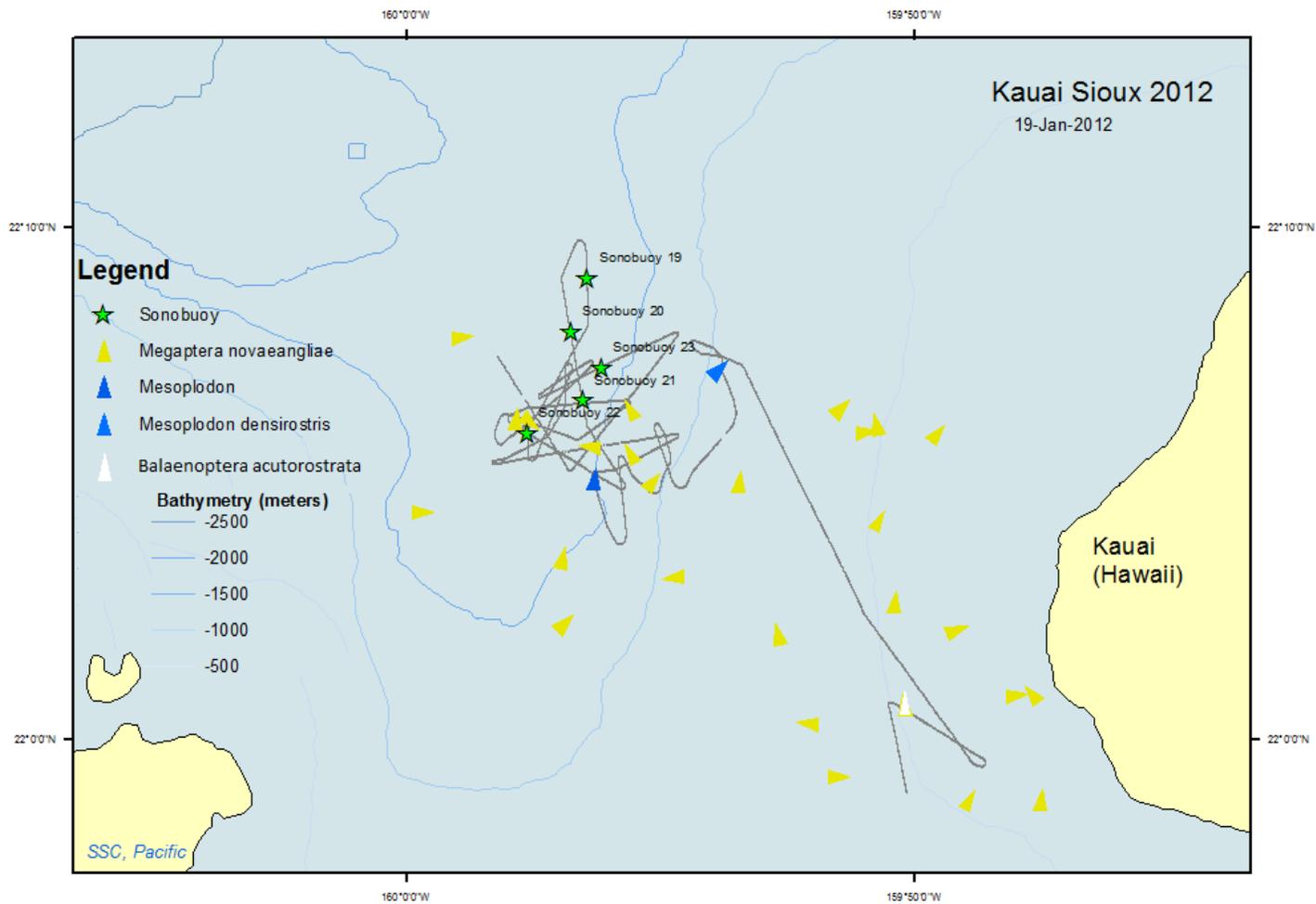


Figure 12. Close up map of ship tracks, marine mammal sightings, and sonobuoy deployments for 19 January 2012.

### **Sightings Per Unit Effort (SPUE)**

The SPUE was calculated as the total survey effort (hr/km) divided by the total number of marine mammal sightings ( $n=166$ ). BSS ranged from 0 to 7, and sightings were made during all BSS. The SPUE for marine mammals was equal to 1.68 sightings per hr, or 0.12 sightings per km. Humpback whales were not the primary concern of this survey; therefore, the SPUE without humpback whales is 0.41 sightings per hr and 0.03 sightings per km. The SPUE with humpback whales is likely an overestimate, as the M3R group would sometimes direct the ship towards acoustic detections that were then visually confirmed and may not have been visually detected otherwise.

### **RHIB Tagging and Survey**

The RHIB covered 656 km of trackline in 42.2 hrs of survey effort (Baird et al. 2012). Survey conditions were generally poor, with 69.4% of the trackline conducted in BSS 3 or greater. Sighting rates were limited by the poor sea conditions, with a total of 13 sightings of five species of odontocetes (Blainville's beaked whale, bottlenose dolphin, rough-toothed dolphin, short-finned pilot whale, and spinner dolphin) during the survey (Baird et al. 2012).

Three cetaceans were tagged with location-only SPOT5 tags (Wildlife Computers, Inc., Redmond, Washington) during this survey (Baird et al. 2012). The tagged species were two short-finned pilot whales and one rough-toothed dolphin. The satellite tags transmitted for periods of 11.7 to 73.2 days (Baird et al. 2012).

### **Sonobuoys**

Eighteen sonobuoys (including two DIFAR) were deployed from the USNS *Sioux* during the survey (**Table 4**). Thirteen sonobuoys were deployed in conjunction with a marine mammal sighting, and the remaining five sonobuoys were deployed at the beginning of the cruise to test the recording system or as requested by the M3R team. The data from the sonobuoys has not been analyzed, but is expected to occur in the future.

**Table 4. Summary of sonobuoy deployments.**

Date	Time (HST)	Latitude (° N)	Longitude (° W)	Depth (m)	Notes
11 January 2012	11:43	22.037	159.819	30	Bad sonobuoy, stopped after short time
11 January 2012	14:13	22.080	159.946	30	Good sonobuoy but did not record until the end
12 January 2012	11:08	22.233	159.906	30	Sonobuoy audio ended at 11:33
12 January 2012	11:53	22.315	159.910	30	Good audio – picked up distant humpback whale
12 January 2012	13:41	22.339	159.860	30	Deployed on a Blainville's beaked whale sighting
12 January 2012	16:57	22.225	159.873	30	Deployed on pilot whale, recorded good whistles
13 January 2012	10:53	22.914	159.743	30	Deployed near pilot whale but did not hear them. Picked up humpback whales
13 January 2012	16:03	22.083	159.829	30	Deployed near spinner dolphins, mostly heard humpback whales
14 January 2012	14:25	22.230	159.786	30	Deployed near rough-tooth dolphins, mostly heard humpback whales and faint boings
15 January 2012	10:09	22.253	159.978	120	Deployed within 500 m of surface active Mesoplodon
15 January 2012	11:52	22.175	159.927	120	Deployed just before sperm whale sighting
16 January 2012	15:05	22.120	159.851	305	Deployed near a sperm whale, re-acquired later and recorded twice more
16 January 2012	17:59	22.181	159.845	30	DiFar Sonobuoy deployed west of Barking Sands, Queens Pond. Picked up boings and humpback whales inshore
17 January 2012	14:06	22.255	159.921	305	Deployed near Mesoplodon detection by M3R near hydrophone 2-1
17 January 2012	14:38	22.217	159.879	305	Second sonobuoy deployed near 2-1, stopped recording after 30 min
18 January 2012	09:57	22.169	159.924	305	Deployed near Mesoplodon detection near hydrophone 4-4 and 4-5, recorded for 7 hours
18 January 2012	10:35	22.135	159.923	305	Deployed near Mesoplodon detection, also boings, sperm whale clicks and humpback songs
18 January 2012	13:53	22.125	159.945	30	DiFar Sonobuoy -Humpback whale songs and boings, test of DiFar

## Section 4 Discussion

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### Survey

Important events were the sightings of several Blainville's beaked whales, especially the breaching behavior (See photos in **Appendix A**), and the first visually-validated detection at PMRF. The observation team aboard the USNS *Sioux* was able to visually confirm several detections from the M3R team as well as supplement acoustic data with sonobuoys deployed from the ship.

The use of the USNS *Sioux* was beneficial in that the ship could stay at sea for several weeks and the observing crew was able to be in the survey area at first light and stay until sunset adding valuable observation time to each day. The observation deck area was well above the water and at a similar height to National Oceanic and Atmospheric Administration survey ships, providing an excellent view. With the size of the USNS *Sioux*, MSOs were able to continue safely observing in BSS 6 and 7 conditions which led to several of the sightings made during this cruise.

The MSO team provided feedback to SPAWAR for WILD to improve the data logging program on surveys (e.g., consecutive numbering of sightings throughout the survey cruise rather than starting new each day and suggested extra data fields).

The USNS *Sioux* had two pairs of Big Eye binoculars, but both were in poor shape and had no reticles. Future surveys should attempt to temporarily replace the ship's Big Eye binoculars with the reticled Big Eyes purchased for marine species surveys in 2007.

### Tagging

Unfortunately, the plan to stage the tagging RHIB on the USNS *Sioux* did not work out during this cruise. It is possible that the launch and retrieval of the RHIB could be conducted safely and successfully on future cruises if the ship's crew conducts pre-cruise launch and retrieval practice. Despite having to return to Port Allen each day and with high wind and swell conditions during several days of the cruise, the tagging team was able to tag three individuals (Baird et al. 2012).

## Section 5 Acknowledgements

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We would like to thank Captain Esqueda and the crew of the USNS *Sioux* for their assistance throughout the survey cruise. NMFS' Pacific Islands Fisheries Science Center provided XBTs for the cruise. Aude Pacini (HDR Inc) provided logistical support throughout the cruise. We thank CDR Edan Antoine (C3F) and Noel Maghirang (MSCPAC) for arranging the use of the *USNS Sioux* and PMRF Range Control for their support and coordination of the M3R, tagging, and survey effort. Observations and tagging were conducted under NMFS permits 14451 to Joseph Mobley (University of Hawai'i) and 15330 to Robin Baird (CRC), respectively.

## Section 6 Literature Cited

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## Appendix A: Marine Mammal Photos

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12 January 2012



Figure A-1: Pilot whale - 12 January 2012 Sighting # 6 (photo by Christopher Kyburg).



Figure A-2: Rough-tooth dolphin - 12 January 2012 Sighting # 7 (photo by Sean Hanser).

**13 January 2012**



**Figure A-3: Pilot whales - 13 January 2012 Sighting # 10 (photo by Mark Deakos).**

**14 January 2012**



**Figure A-4: Rough-tooth dolphin - 14 January 2012 Sighting # 9 (photo by Mark Deakos).**

**15 January 2012**



**Figure A-5: Blainville's beaked whale - 15 January 2012 Sighting # 6 (photo by NAVFAC).**

**18 January 2012**



**Figure A-6: Blainville's beaked whale - 18 January 2012 Sighting # 8 (photo by Mark Deakos).**

**19 January 2012**



**Figure A-7: Minke whale - 19 January 2012 Sighting # 30 (photo by Suzanne Yin).**