Final Report

Aerial Shoreline Surveys for Marine Mammals and Sea Turtles in the Hawaii Range Complex, Conducted After Navy Training Events

Koa Kai Surveys: 31 January and 5 February 2014

RIMPAC Surveys: 1 and 4–6 August 2014

Submitted to:

Naval Facilities Engineering Command Pacific
for Commander, U.S. Pacific Fleet
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Hawaiian monk seals (*Monachus schauinslandi*) on Molokai. Photo taken by Michael Richlen under NOAA Permit No. 642-1536-03.

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14. ABSTRACT
Aerial shoreline surveys for marine mammals and sea turtles were conducted subsequent to two U.S. Commander Pacific Fleet training events in the Hawaii Range Complex. The surveys involved circumnavigation of the island of Kauai in January–February and the islands of Oahu, Maui, Molokai, Lanai, and Kahoolawe in August. Both the Koa Kai and Rim of the Pacific Exercise or "RIMPAC" involved the use of mid-frequency active sonar. The Koa Kai event took place on the Pacific Missile Range Facility Barking Sands Tactical Underwater Range and Barking Sands Underwater Range Extension between Kauai and Niihau, Hawaii during 24–31 January 2014. Following the Koa Kai event, shoreline surveys were conducted on 31 January and 5 February. The RIMPAC exercise took place during an extended period from 26 June through 2 August 2014 and involved a broader expanse of ocean off the Main Hawaiian Islands. The aerial shoreline surveys described here involved circumnavigating the five islands of Oahu, Maui, Molokai, Lanai, and Kahoolawe and were performed over 4 days on 1 and 4–6 August. All surveys involved looking for stranded or near-stranded marine mammals, as well as target marine mammal/sea turtle species. A total of 134 sightings was recorded across 412 km of shoreline effort after the January 2014 Koa Kai event, and 185 sightings were made across 2,748 km of effort after the June-July 2014 RIMPAC event. After the Koa Kai event, humpback whales (Megaptera novaeangliae), unidentified sea turtle spp., Hawaiian monk seals (Monachus schauinslandi), spinner dolphins (Stenella longirostris), bottlenose dolphins (Tursiops truncatus), and unidentified dolphin spp. were recorded. After RIMPAC, unidentified sea turtle spp., monk seals, spinner dolphins, unidentified dolphins, and unidentified medium cetaceans were recorded. The most commonly observed species overall were unidentified sea turtles (67 percent of total) followed by humpback whales (20 percent of total), although the latter were only seen during the 31 January and 5 February surveys

corresponding to their winter breeding season. Monk seals were sighted in near equal numbers across both sets of surveys, which is consistent with their increasing reported preference for the main Hawaiian Islands in general (Baker and Johanos 2004). No stranded or near-stranded animals were observed during any of the total 6 days of surveys.

15. SUBJECT TERMS
Monitoring, marine mammal, aerial survey, Hawaii Range Complex

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Table of Contents

Abbreviations and acronyms ..... **ii**
1. Introduction **1**
2. Methods **2**
3. Results **2**
4. Discussion **11**
5. Acknowledgements **11**
6. Literature Cited **11**

Appendix

Appendix A: Summary of Sightings with Positions (GPS) 13

Figures

Figure 1a. Sea state conditions for 31 January and 5 February 2014 shoreline surveys. 3
Figure 1b. Sea state conditions for 1–6 August 2014 shoreline surveys. 3
Figure 2. Aerial shoreline survey sightings and effort: 31 January 2014. 5
Figure 3. Aerial shoreline survey sightings and effort: 5 February 2014. 6
Figure 4. Aerial shoreline survey sightings and effort: 1 August 2014. 7
Figure 5. Aerial shoreline survey sightings and effort: 4 August 2014 8
Figure 6. Shoreline survey sightings and effort: 5 August 2014 9
Figure 7. Shoreline survey sightings and effort: 6 August 2014 10

Tables

Table 1. Summary of sightings. 4

Abbreviations and Acronyms

RIMPAC	Rim of the Pacific

1. Introduction

Aerial shoreline surveys for marine mammals and sea turtles were conducted in 2014 subsequent to two Commander, U.S. Pacific Fleet training events in the Hawaii Range Complex. The surveys involved circumnavigation of the island of Kauai in January–February and the islands of Oahu, Maui, Molokai, Lanai, and Kahoolawe in August (**Figures 2 through 7**). These islands were chosen by the U.S. Navy based on their proximity to each training event and where mid-frequency active sonar (MFAS) was being used. The associated training events (Koa Kai and Rim of the Pacific or "RIMPAC") involved the use of mid-frequency active sonar and, in the case of RIMPAC, explosives. The Koa Kai event took place primarily on the Pacific Missile Range Facility Barking Sands Tactical Underwater Range and Barking Sands Underwater Range Extension between Kauai and Niihau, Hawaii, during 24–31 January 2014. Following the Koa Kai training event, shoreline surveys were conducted on 31 January and 5 February. The RIMPAC exercise took place during an extended period from 8 July through 2 August 2014 and involved a broader expanse of ocean off the main Hawaiian Islands. The aerial shoreline surveys described here involved circumnavigating the five islands of Oahu, Maui, Molokai, Lanai, and Kahoolawe and was performed over 4 days on 1 and 4–6 August. All surveys involved looking for stranded or near-stranded marine mammals, as well as target marine mammal/sea turtle species, in order to address the monitoring question: "Do marine mammals strand along shorelines of the main Hawaiian Islands within 1 week following naval training events?"

Aerial surveys followed previously established protocols (Mobley 2011, Mobley and Milette 2010), and have been performed in conjunction with U.S. Navy training exercises since 2008. The survey objective was to answer the U.S. Navy monitoring question of: "Do marine mammals strand along shorelines of the main Hawaiian Islands within 1 week following naval training events?"

As documented in previous aerial surveys (e.g., Mobley and Milette 2010), a variety of marine mammal and sea turtle species are commonly associated with the main Hawaiian Islands, including spinner dolphin (*Stenella longirostris*), bottlenose dolphin (*Tursiops truncatus*), green turtle (*Chelonia mydas*), and Hawaiian monk seal (*Monachus schauinslandi*). Humpback whales (*Megaptera novaeangliae*) are also present during winter months, but are not seen in the Hawaii Range Complex in summer (Mobley et al. 1999). Monk seals use the sandy beaches and lava benches of both islands to haul out (come on land), rest and nurse their pups (Baker and Johanos 2004). The broad objective of these surveys was to monitor for stranded marine mammals and sea turtles subsequent to training events. Given the low probability of encountering stranded animals, monk seal sightings were used as a "proxy" for strandings (i.e., thereby demonstrating the feasibility of sighting stranded cetaceans of comparable size). Monk seal observations are also of interest, given the endangered status of this species. Evidence suggests that the main Hawaiian Islands are increasingly becoming important habitat, with less-populated regions, such as Niihau, appearing as favored haulout locations (Baker and Johanos 2004).

2. Methods

Aerial Survey Methods

The shorelines and near-shore waters (i.e., within 1–3 kilometers [km] of shore) of selected islands were surveyed by helicopter. The Kauai surveys involved 2 days of survey effort, flying an ASTAR 350 B2-7 helicopter. For the five-island (Oahu, Maui, Lanai, Molokai, and Kahoolawe) surveys, a Bell 206L3 helicopter was used. For all surveys, the helicopters flew at 110–170 km/hour (60–90 knots), and at approximate altitude of 250 meters. All work was performed under National Oceanic and Atmospheric Administration permit #14451.

Observers documented the positions and behavior of all marine mammals and sea turtles seen within 3 km of shore using accepted distance sampling methods (Buckland et al. 2001). Data variables recorded included time, sighting angle, latitude/longitude position, altitude, sea state, species, group size (minimum, maximum, best), side of aircraft, presence/number of calves/pups and behavior, and additionally for monk seals—in-water vs. hauled out and presence of flipper tags. Numbers and locations of target species (marine mammals and sea turtles), as well as the platform's trackline, were recorded and plotted using geographical information system software. All data collection and management protocols were consistent with guidelines in the Statement of Work for this task order. Photographs/videos were obtained of monk seals and of any other species of interest, unidentified species, and/or unusual behavior (e.g., on- or near-shore occurrence of cetaceans).

3. Results

Aerial Shoreline Surveys: Sightings and Effort

- Sighting conditions were generally good across both sets of surveys, with the majority of effort occurring in Beaufort sea state 4 or better (**Figures 1a and 1b**).
- No stranded or near-stranded animals were observed during any of the total six days of surveys.
- A total of 134 sightings was recorded across 412 km of shoreline effort after the January 2014 Koa Kai event, and 185 sightings were made across 2,748 km of effort after the July 2014 RIMPAC event. Numbers of sightings and encounter rates (ER = number of individuals/km effort) by species and region are shown in **Table 1** (Parts A and B). The most commonly observed species overall were unidentified hardshell turtles (67 percent of total) followed by humpback whales (20 percent of total), although the latter were only seen during the 31 January and 5 February surveys corresponding to their winter breeding season. Monk seals were sighted in near equal numbers across both sets of surveys, which is consistent with their increasing reported preference for the main Hawaiian Islands in general (Baker and Johanos 2004).
- Maps showing sighting locations and tracklines are shown in **Figures 2 through 7**.

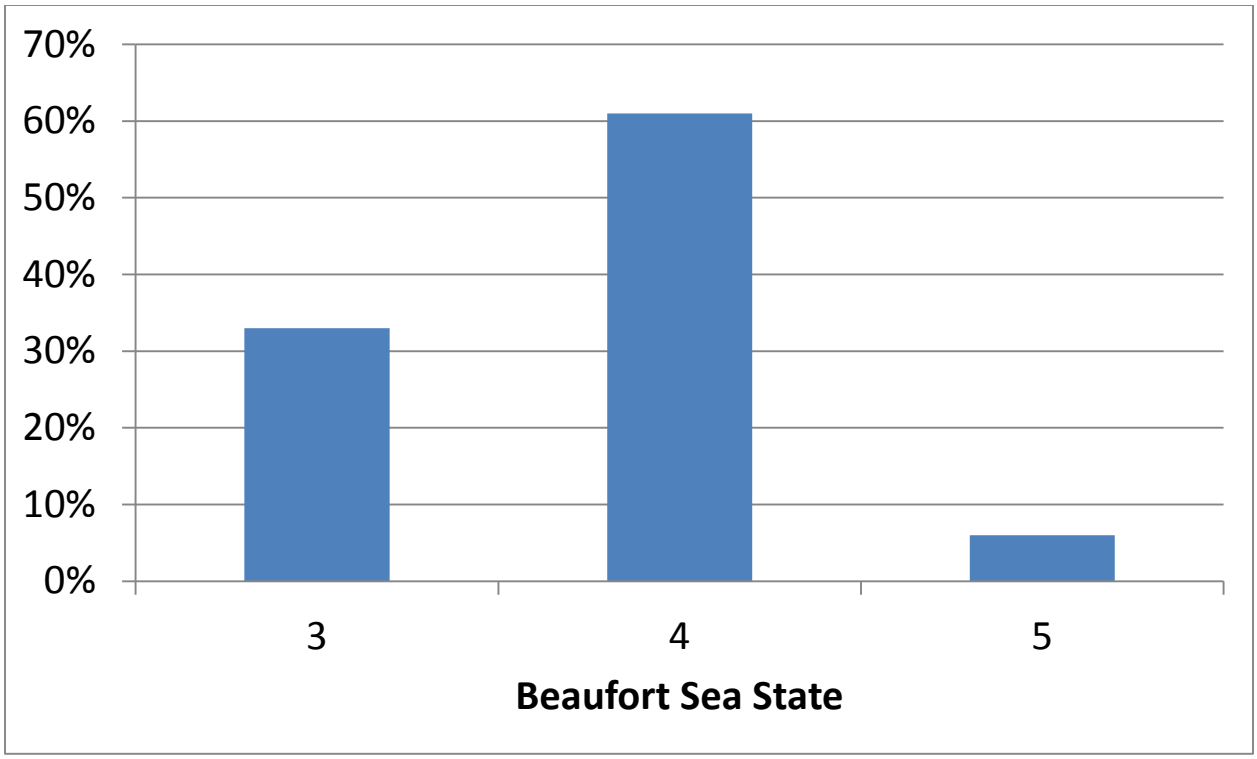

Figure 1a. Sea state conditions for 31 January and 5 February 2014 shoreline surveys.

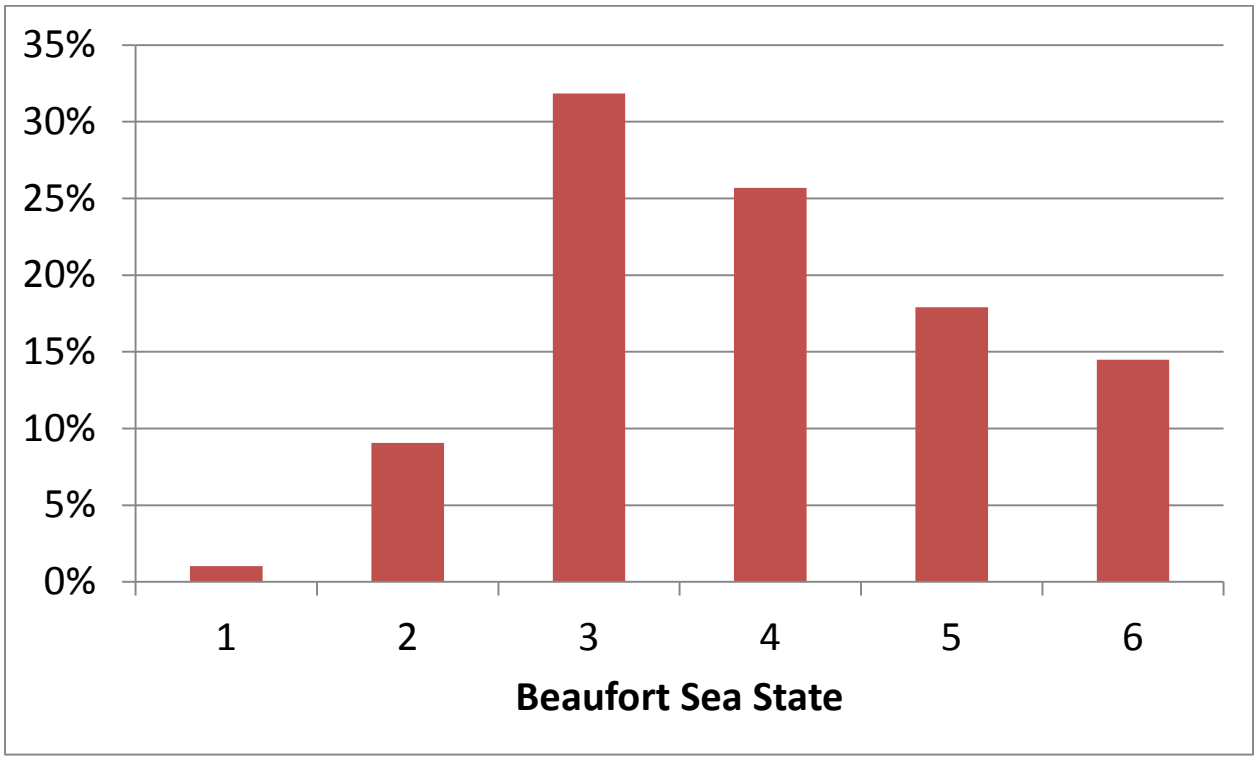

Figure 1b. Sea state conditions for 1–6 August 2014 shoreline surveys.

Table 1. Summary of sightings.

Species	Number of groups	Number of individuals	Encounter Rate (ER)*
Part A. 31 Jan and 5 Feb 2014 post-Koa Kai shoreline surveys			
Humpback whale	65	137	0.3324
Unidentified hardshell turtle	51	99	0.2402
Monk seal	14	26	0.0631
Spinner dolphin	1	12	0.0291
Bottlenose dolphin	1	1	0.0024
Unidentified delphinid spp.	2	21	0.0509
Part B. 1 & 4–6 Aug 2014 post-RIMPAC shoreline sightings			
Unidentified hardshell turtle	163	326	0.1186
Monk seal	13	17	0.0062
Spinner dolphin	7	440	0.1601
Unidentified small dolphin	1	40	0.0146
Unidentified medium cetacean	1	1	0.0004

* Part A: ER = no. individ/distance (412 km); Part B ER = no. individ/distance (2,748 km)

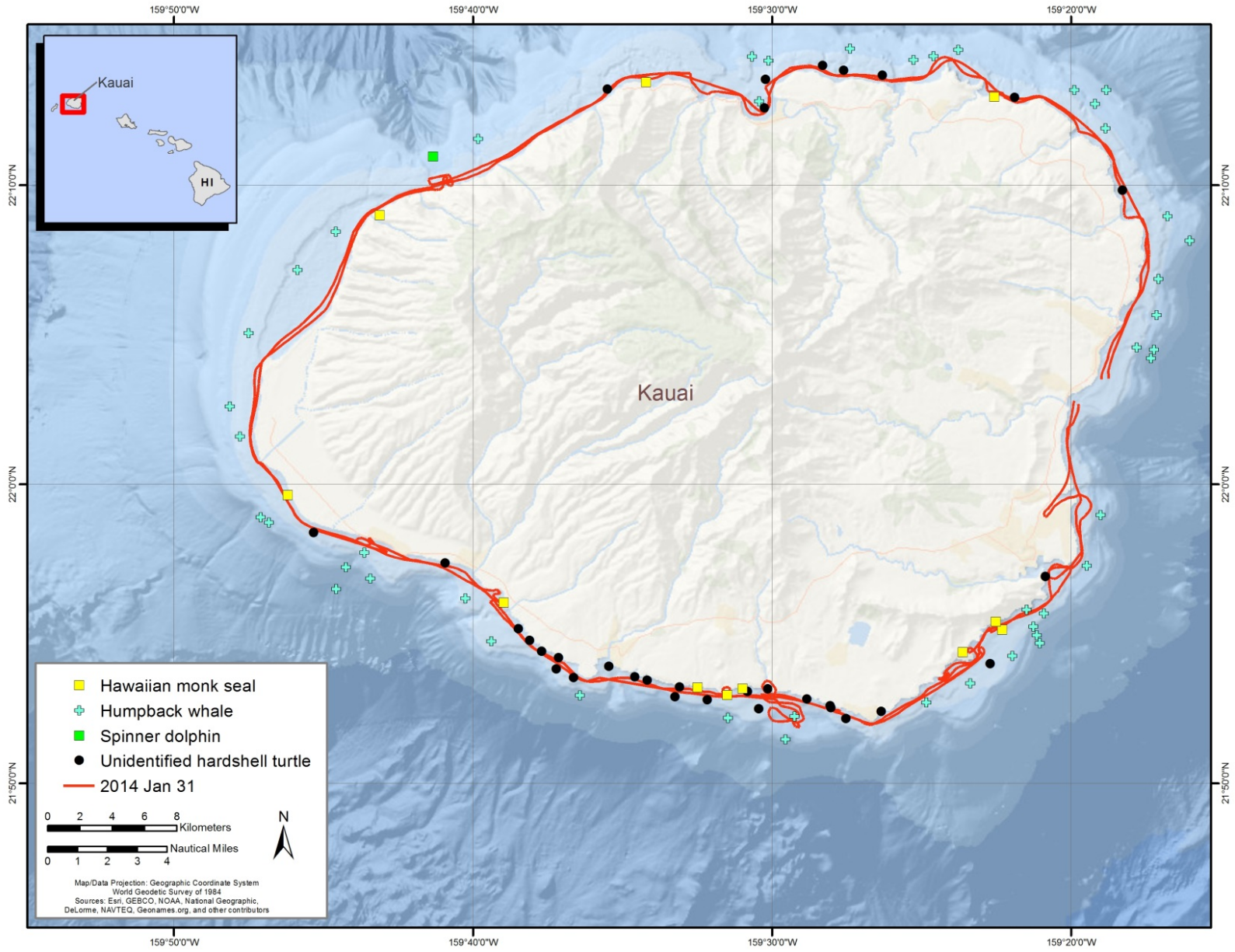

Figure 2. Aerial shoreline survey sightings and effort: 31 January 2014.

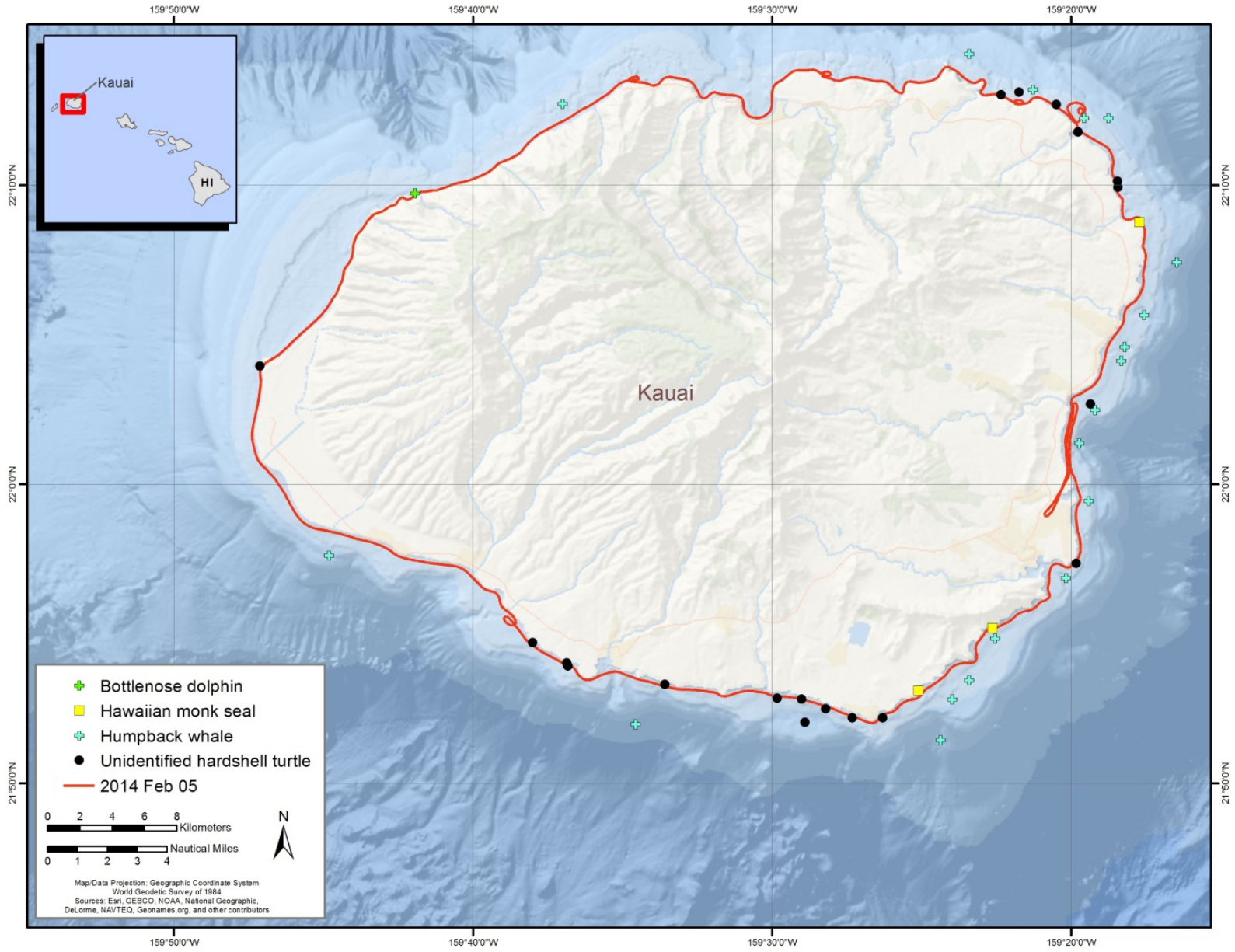

Figure 3. Aerial shoreline survey sightings and effort: 5 February 2014.

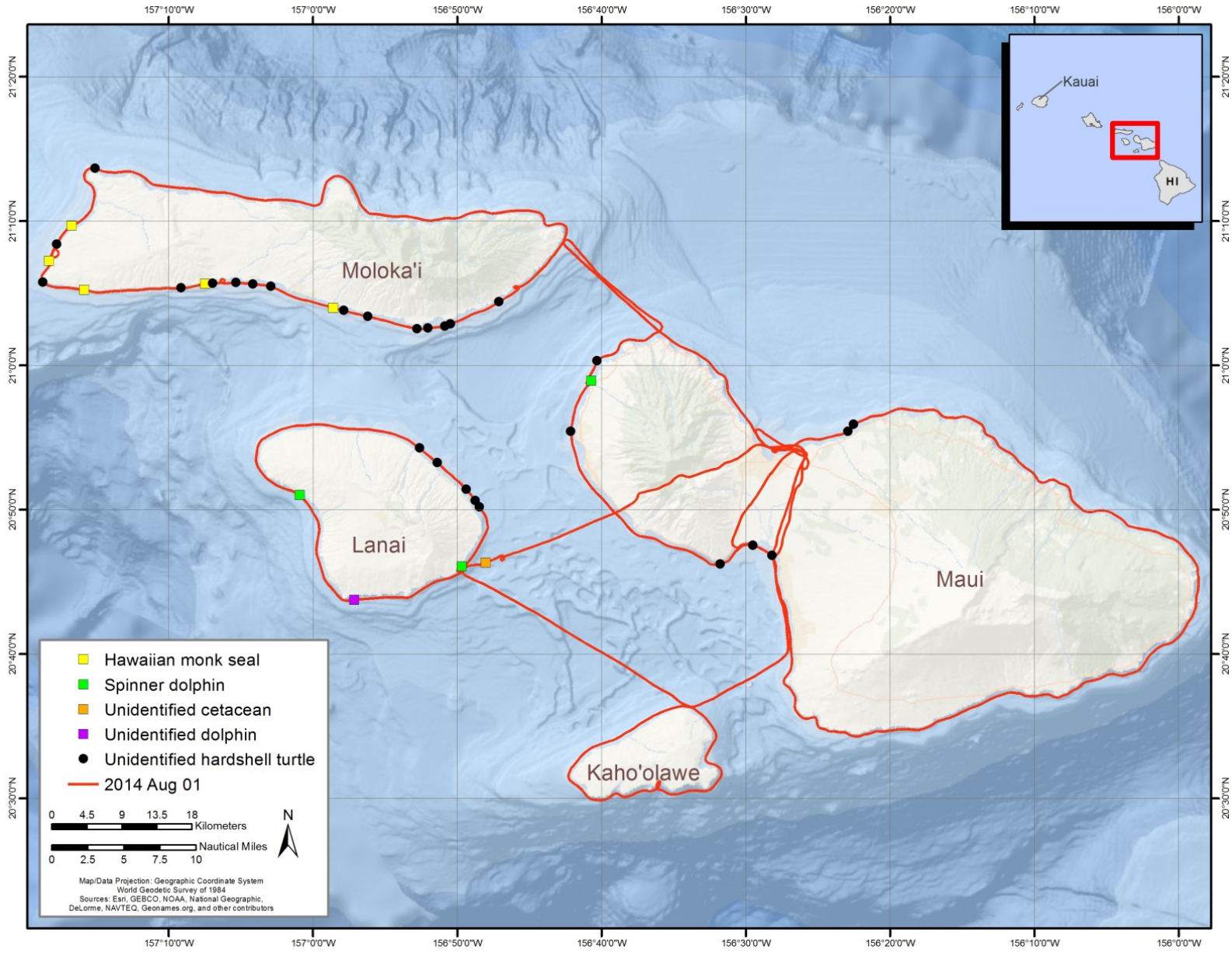

Figure 4. Aerial shoreline survey sightings and effort: 1 August 2014.

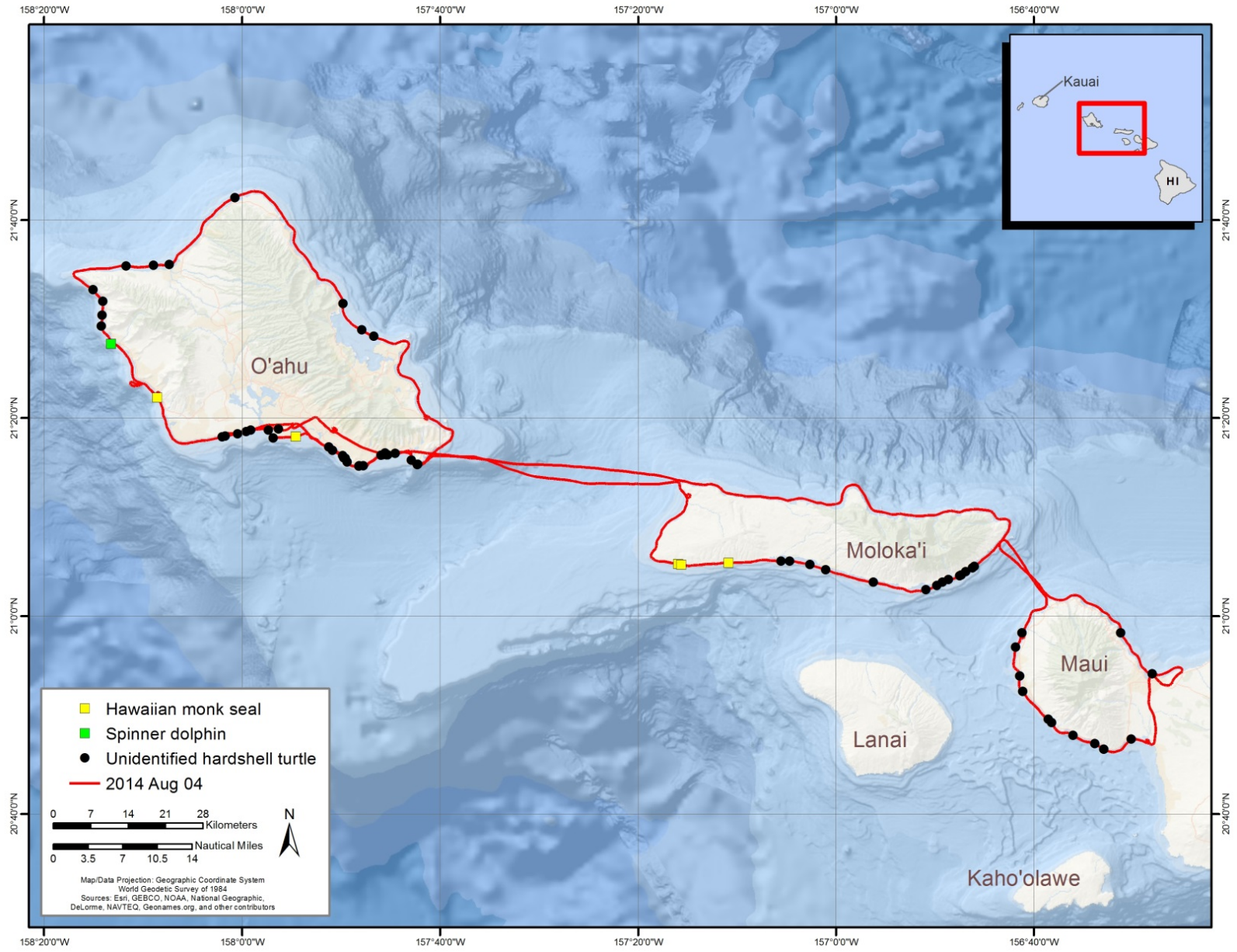

Figure 5. Aerial shoreline survey sightings and effort: 4 August 2014

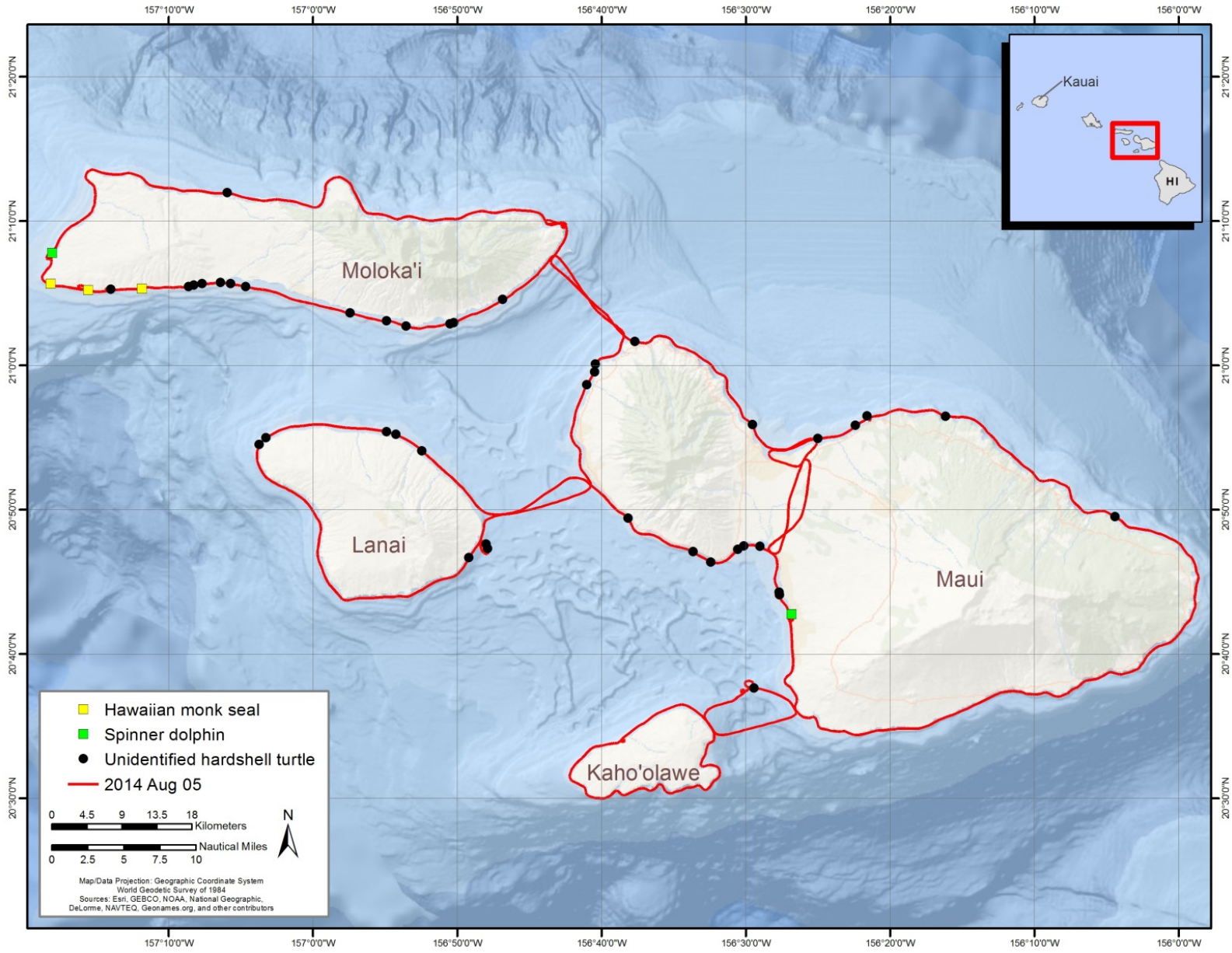

Figure 6. Shoreline survey sightings and effort: 5 August 2014

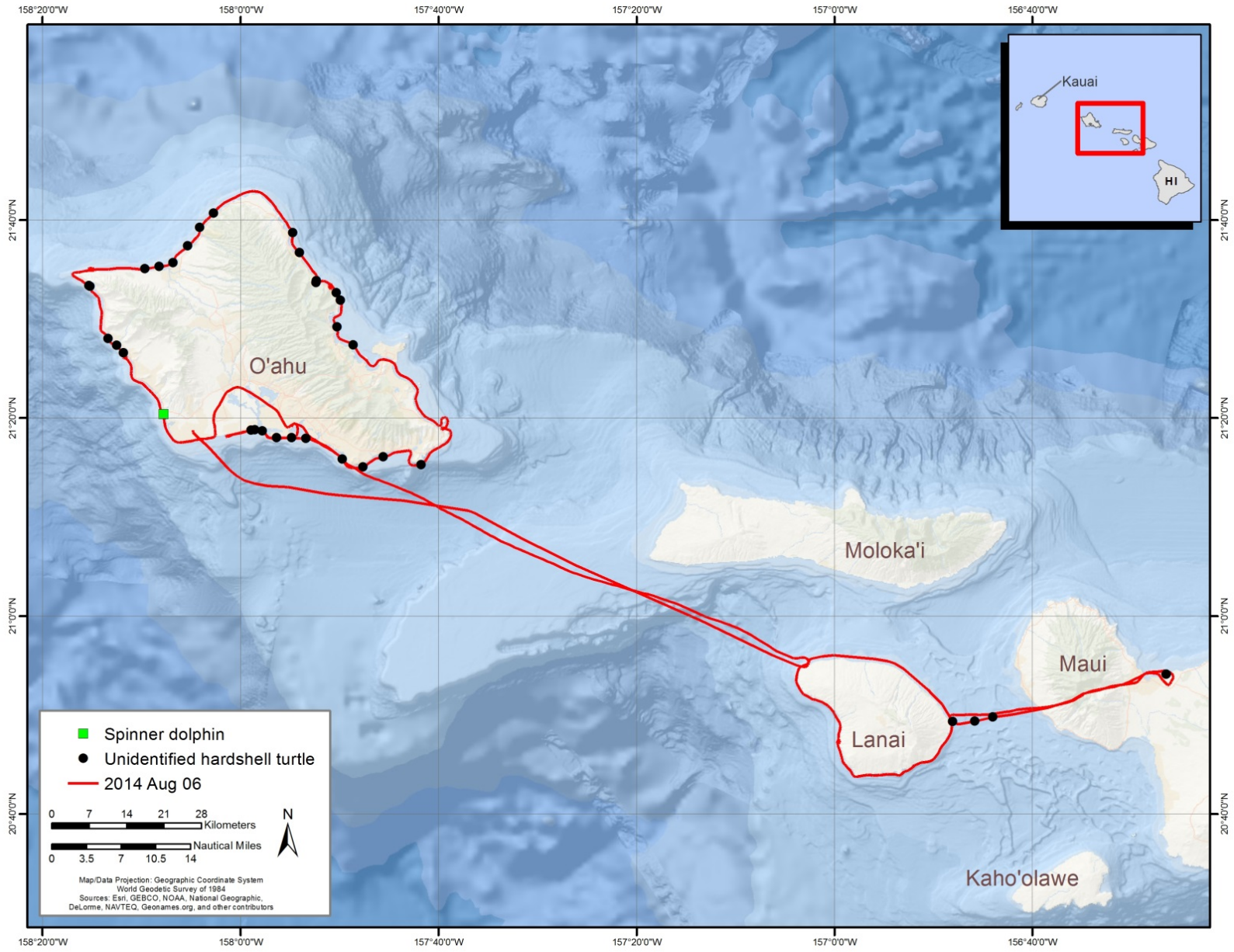

Figure 7. Shoreline survey sightings and effort: 6 August 2014

4. Discussion

The overall objective of the aerial shoreline surveys was to answer the monitoring question: “Do marine mammals strand along shorelines of the main Hawaiian Islands within 1 week following naval training events?” This report summarizes survey results involving seven of the eight main Hawaiian Islands following two U.S. Navy training events, Koa Kai (January 2014) and RIMPAC (July 2014).

Although no stranded animals were seen, the potential sightability of any stranded animals was demonstrated by the considerable number of hauled-out Hawaiian monk seals recorded throughout both sets of surveys (**Table 1, Figures 2–7, Appendix A**). A beached monk seal can arguably be used as a proxy sighting for beached cetaceans. The fact that monk seals were seen throughout most of the seven islands surveyed here is consistent with their reported increasing prevalence in the main Hawaiian Islands (Baker and Johanos 2004).

Prior to the shoreline surveys reported here, similar surveys were performed along the coastlines of various Hawaiian Islands (primarily Kauai/Niihau) across a six-year period including 2007-08 and 2010-13 in conjunction with U.S. Navy training events. Similar to the present case, no stranded animals were seen during any of those years.

5. Acknowledgements

The authors would like to thank the pilots Paul Metero, Mike Klink, and Lawrence Guillermo, as well as from Commander, U.S. Pacific Fleet Environmental and Naval Facilities Engineering Command Pacific for their support, coordination and facilitation in the implementation of these surveys. All observations were made in accordance with National Oceanic and Atmospheric Administration permit no. 14451 issued to Joseph R. Mobley, Jr.

6. Literature Cited

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Appendix A: Summary of Sightings with Positions (GPS)

Date	Time (HST)	Species	# Individuals	Latitude (°N)	Longitude (°W)
Part 1. Kauai shoreline survey results					
1-31-14	13:15:15	Humpback whale	1	21.992	159.354
1-31-14	13:16:53	Humpback whale	2	21.955	159.324
1-31-14	13:18:09	Unid hardshell turtle	1	21.949	159.347
1-31-14	13:19:15	Humpback whale	1	21.928	159.348
1-31-14	13:20:37	Humpback whale	2	21.904	159.366
1-31-14	13:21:10	Monk seal	4	21.919	159.371
1-31-14	13:30:44	Unid hardshell turtle	1	21.907	159.406
1-31-14	13:35:07	Unid hardshell turtle	1	21.877	159.467
1-31-14	13:37:11	Unid hardshell turtle	1	21.875	159.507
1-31-14	13:37:55	Humpback whale	2	21.889	159.487
1-31-14	13:40:13	Humpback whale	3	21.858	159.492
1-31-14	13:44:02	Unid hardshell turtle	1	21.885	159.514
1-31-14	13:44:37	Humpback whale	1	21.870	159.524
1-31-14	13:45:04	Monk seal	2	21.883	159.525
1-31-14	13:46:46	Monk seal	1	21.887	159.541
1-31-14	13:47:22	Unid hardshell turtle	4	21.889	159.554
1-31-14	13:48:24	Unid hardshell turtle	2	21.893	159.576
1-31-14	13:49:05	Unid hardshell turtle	1	21.898	159.591
1-31-14	13:50:32	Unid hardshell turtle	1	21.901	159.611
1-31-14	13:51:00	Unid hardshell turtle	1	21.903	159.619
1-31-14	13:51:30	Unid hardshell turtle	1	21.907	159.628
1-31-14	13:51:55	Unid hardshell turtle	1	21.913	159.635
1-31-14	13:52:17	Unid hardshell turtle	1	21.919	159.641
1-31-14	13:53:55	Monk seal	1	21.934	159.649
1-31-14	13:55:25	Humpback whale	1	21.936	159.671
1-31-14	13:56:26	Unid hardshell turtle	1	21.956	159.682
1-31-14	13:58:01	Humpback whale	1	21.947	159.724
1-31-14	14:00:49	Humpback whale	5	21.954	159.737
1-31-14	14:01:28	Humpback whale	1	21.995	159.742
1-31-14	14:02:12	Unid hardshell turtle	1	21.986	159.755
1-31-14	14:02:36	Humpback whale	2	21.979	159.780
1-31-14	14:03:42	Humpback whale	1	21.987	159.789
1-31-14	14:18:20	Monk seal	1	21.996	159.769
1-31-14	14:22:02	Unid hardshell turtle	2	21.995	159.770
1-31-14	14:22:19	Humpback whale	2	21.992	159.777
1-31-14	14:23:10	Humpback whale	1	21.990	159.782
1-31-14	14:24:28	Humpback whale	1	21.988	159.787
1-31-14	14:27:04	Humpback whale	1	21.989	159.783
1-31-14	14:27:48	Humpback whale	2	21.992	159.778
1-31-14	14:29:10	Monk seal	1	21.996	159.770

Date	Time (HST)	Species	# Individuals	Latitude (°N)	Longitude (°W)
Part 1. Kauai/Niihau shoreline survey results (continued)					
1-31-14	14:30:34	Unid hardshell turtle	1	21.996	159.770
1-31-14	14:33:02	Humpback whale	2	21.989	159.785
1-31-14	14:34:11	Humpback whale	1	21.983	159.798
1-31-14	14:35:19	Unid hardshell turtle	1	22.164	159.305
1-31-14	14:36:34	Humpback whale	1	22.139	159.295
1-31-14	14:37:02	Humpback whale	3	22.149	159.279
1-31-14	14:40:15	Humpback whale	3	22.094	159.285
1-31-14	14:41:28	Humpback whale	1	22.075	159.287
1-31-14	14:42:03	Humpback whale	1	22.070	159.289
1-31-14	14:44:19	Humpback whale	3	22.076	159.296
1-31-14	14:45:38	Humpback whale	1	22.114	159.284
1-31-14	14:48:14	Humpback whale	3	22.198	159.314
1-31-14	14:48:38	Humpback whale	3	22.212	159.320
1-31-14	14:51:45	Humpback whale	3	22.239	159.410
1-31-14	14:53:01	Unid hardshell turtle	2	22.228	159.438
1-31-14	14:53:50	Unid hardshell turtle	9	22.231	159.460
1-31-14	14:54:21	Unid hardshell turtle	5	22.233	159.472
1-31-14	14:55:27	Unid hardshell turtle	2	22.226	159.503
1-31-14	14:56:53	Humpback whale	2	22.238	159.511
1-31-14	14:58:37	Monk seal	1	22.224	159.570
1-31-14	14:59:24	Unid hardshell turtle	1	22.220	159.592
1-31-14	15:01:58	Humpback whale	1	22.193	159.664
1-31-14	15:03:03	Spinner dolphin	12	22.183	159.689
1-31-14	15:07:18	Monk seal	2	22.140	159.719
1-31-14	15:07:44	Humpback whale	2	22.141	159.743
1-31-14	15:08:45	Humpback whale	1	22.120	159.764
1-31-14	15:10:56	Humpback whale	8	22.084	159.792
1-31-14	15:12:11	Humpback whale	1	22.043	159.802
1-31-14	15:12:44	Humpback whale	2	22.027	159.797
1-31-14	15:17:16	Humpback whale	1	21.962	159.727
1-31-14	15:20:39	Humpback whale	5	21.912	159.656
1-31-14	15:21:29	Unid hardshell turtle	6	21.911	159.620
1-31-14	15:22:18	Humpback whale	5	21.882	159.607
1-31-14	15:23:27	Unid hardshell turtle	1	21.891	159.569
1-31-14	15:24:05	Unid hardshell turtle	2	21.887	159.551
1-31-14	15:24:34	Unid hardshell turtle	1	21.887	159.536
1-31-14	15:25:16	Monk seal	2	21.886	159.516
1-31-14	15:25:44	Unid hardshell turtle	1	21.886	159.502
1-31-14	15:27:18	Unid hardshell turtle	3	21.880	159.481
1-31-14	15:27:49	Unid hardshell turtle	1	21.875	159.467
1-31-14	15:29:07	Unid hardshell turtle	3	21.869	159.459
1-31-14	15:29:54	Unid hardshell turtle	1	21.873	159.439

Date	Time (HST)	Species	# Individuals	Latitude (°N)	Longitude (°W)
Part 1. Kauai/Niihau shoreline survey results (continued)					
1-31-14	15:30:39	Humpback whale	1	21.878	159.414
1-31-14	15:31:26	Humpback whale	1	21.889	159.389
1-31-14	15:31:45	Monk seal	1	21.906	159.394
1-31-14	15:32:38	Monk seal	6	21.923	159.375
1-31-14	15:34:28	Humpback whale	3	21.921	159.354
1-31-14	15:36:09	Humpback whale	2	21.916	159.352
1-31-14	15:36:55	Humpback whale	1	21.911	159.351
1-31-14	15:37:52	Humpback whale	3	21.930	159.358
2-5-14	8:39:56	Unid hardshell turtle	1	22.045	159.322
2-5-14	8:40:55	Humpback whale	2	22.023	159.329
2-5-14	8:42:30	Humpback whale	1	21.991	159.323
2-5-14	8:44:21	Unid hardshell turtle	1	21.956	159.330
2-5-14	8:45:03	Humpback whale	1	21.948	159.336
2-5-14	8:48:00	Monk seal	2	21.920	159.377
2-5-14	8:48:23	Humpback whale	2	21.914	159.376
2-5-14	8:49:33	Humpback whale	1	21.891	159.390
2-5-14	8:50:31	Humpback whale	1	21.880	159.399
2-5-14	8:51:01	Monk seal	1	21.885	159.418
2-5-14	8:51:44	Humpback whale	2	21.858	159.406
2-5-14	8:52:24	Unid hardshell turtle	1	21.870	159.438
2-5-14	8:53:23	Unid hardshell turtle	6	21.870	159.455
2-5-14	8:54:14	Unid hardshell turtle	1	21.875	159.470
2-5-14	8:54:41	Unid hardshell turtle	3	21.867	159.481
2-5-14	8:54:57	Unid hardshell turtle	4	21.880	159.483
2-5-14	8:55:37	Unid hardshell turtle	3	21.881	159.497
2-5-14	8:58:50	Unid hardshell turtle	2	21.888	159.560
2-5-14	8:59:18	Humpback whale	3	21.866	159.576
2-5-14	9:02:03	Unid hardshell turtle	1	21.899	159.614
2-5-14	9:02:08	Unid hardshell turtle	1	21.900	159.614
2-5-14	9:03:16	Unid hardshell turtle	1	21.912	159.633
2-5-14	9:10:04	Humpback whale	1	21.960	159.747
2-5-14	9:14:50	Unid hardshell turtle	1	22.066	159.785
2-5-14	9:23:03	Bottlenose dolphin	1	22.162	159.699
2-5-14	9:28:02	Humpback whale	3	22.212	159.617
2-5-14	9:42:58	Humpback whale	3	22.240	159.390
2-5-14	9:45:26	Unid hardshell turtle	1	22.217	159.372
2-5-14	9:46:03	Unid hardshell turtle	3	22.211	159.362
2-5-14	9:47:53	Humpback whale	2	22.220	159.354
2-5-14	9:48:36	Unid hardshell turtle	1	22.212	159.341
2-5-14	9:49:23	Unid dolphin	1	22.206	159.327
2-5-14	9:50:10	Unid dolphin	20	22.212	159.331
2-5-14	9:52:06	Humpback whale	5	22.204	159.326

Date	Time (HST)	Species	# Individuals	Latitude (°N)	Longitude (°W)
Part 1. Kauai/Niihau shoreline survey results (continued)					
2-5-14	9:52:50	Unid hardshell turtle	1	22.196	159.329
2-5-14	9:53:30	Humpback whale	1	22.204	159.312
2-5-14	9:55:12	Unid hardshell turtle	1	22.169	159.307
2-5-14	9:55:26	Unid hardshell turtle	1	22.166	159.307
2-5-14	9:57:51	Monk seal	1	22.146	159.295
2-5-14	10:00:01	Humpback whale	9	22.124	159.274
2-5-14	10:02:38	Humpback whale	2	22.094	159.292
2-5-14	10:04:04	Humpback whale	2	22.077	159.303
2-5-14	10:04:55	Humpback whale	2	22.069	159.305
2-5-14	10:06:54	Humpback whale	1	22.041	159.320
Part 2. Five-island (Oahu, Maui, Molokai, Lanai & Kahoolawe) shoreline survey results					
8/1/14	8:35:12	Unid hardshell turtle	1	21.228	157.252
8/1/14	8:38:22	Monk seal	1	21.161	157.278
8/1/14	8:39:50	Unid hardshell turtle	1	21.140	157.296
8/1/14	8:41:33	Monk seal	1	21.121	157.304
8/1/14	8:42:50	Unid hardshell turtle	2	21.096	157.312
8/1/14	8:44:40	Monk seal	1	21.087	157.264
8/1/14	8:49:29	Unid hardshell turtle	1	21.089	157.152
8/1/14	8:50:21	Monk seal	1	21.094	157.125
8/1/14	8:51:03	Unid hardshell turtle	3	21.095	157.116
8/1/14	8:52:45	Unid hardshell turtle	5	21.096	157.089
8/1/14	8:53:44	Unid hardshell turtle	5	21.094	157.069
8/1/14	8:54:40	Unid hardshell turtle	3	21.091	157.048
8/1/14	8:57:42	Monk seal	1	21.067	156.976
8/1/14	8:58:21	Unid hardshell turtle	3	21.063	156.964
8/1/14	8:59:46	Unid hardshell turtle	1	21.056	156.936
8/1/14	9:02:31	Unid hardshell turtle	1	21.042	156.880
8/1/14	9:03:07	Unid hardshell turtle	1	21.043	156.867
8/1/14	9:04:06	Unid hardshell turtle	2	21.045	156.848
8/1/14	9:04:30	Unid hardshell turtle	1	21.048	156.841
8/1/14	9:07:18	Unid hardshell turtle	2	21.073	156.785
8/1/14	9:22:46	Unid hardshell turtle	2	21.005	156.672
8/1/14	9:24:20	Spinner dolphin	4	20.982	156.678
8/1/14	9:29:01	Unid hardshell turtle	1	20.924	156.702
8/1/14	9:38:13	Unid hardshell turtle	1	20.770	156.529
8/1/14	9:40:17	Unid hardshell turtle	3	20.792	156.492
8/1/14	9:41:13	Unid hardshell turtle	1	20.780	156.469
8/1/14	10:46:15	Unid med cetacean	1	20.772	156.800
8/1/14	10:48:06	Spinner dolphin	100	20.769	156.830
8/1/14	10:54:17	Unid small dolphin	40	20.729	156.952
8/1/14	11:00:04	Spinner dolphin	40	20.850	157.015
8/1/14	11:13:42	Unid hardshell turtle	2	20.904	156.877

Date	Time (HST)	Species	# Individuals	Latitude (°N)	Longitude (°W)
Part 2. Five-island (Oahu, Maui, Molokai, Lanai & Kahoolawe) shoreline survey results (continued)					
8/1/14	11:14:53	Unid hardshell turtle	1	20.888	156.856
8/1/14	11:16:56	Unid hardshell turtle	5	20.857	156.823
8/1/14	11:17:20	Unid hardshell turtle	1	20.844	156.812
8/1/14	11:17:43	Unid hardshell turtle	2	20.837	156.808
8/1/14	13:46:37	Unid hardshell turtle	3	20.932	156.375
8/1/14	13:47:08	Unid hardshell turtle	6	20.924	156.382
8/4/14	7:47:27	Unid hardshell turtle		20.903	156.467
8/4/14	7:50:49	Unid hardshell turtle	1	20.971	156.521
8/4/14	8:37:25	Unid hardshell turtle	1	21.274	157.759
8/4/14	9:23:43	Unid hardshell turtle	3	21.303	158.029
8/4/14	9:24:38	Unid hardshell turtle	3	21.306	158.008
8/4/14	9:25:16	Unid hardshell turtle	2	21.310	157.993
8/4/14	9:27:28	Unid hardshell turtle	2	21.313	157.956
8/4/14	9:28:17	Unid hardshell turtle	4	21.300	157.948
8/4/14	9:29:59	Monk seal	1	21.302	157.910
8/4/14	9:33:03	Unid hardshell turtle	2	21.284	157.854
8/4/14	9:34:28	Unid hardshell turtle	1	21.270	157.830
8/4/14	9:34:51	Unid hardshell turtle	2	21.265	157.826
8/4/14	9:36:15	Unid hardshell turtle	2	21.252	157.803
8/4/14	9:38:44	Unid hardshell turtle	2	21.270	157.766
8/4/14	9:39:17	Unid hardshell turtle	2	21.271	157.755
8/4/14	9:41:30	Unid hardshell turtle	1	21.262	157.715
8/4/14	9:42:14	Unid hardshell turtle	1	21.255	157.704
8/4/14	9:58:39	Unid hardshell turtle	3	21.470	157.778
8/4/14	9:59:29	Unid hardshell turtle	2	21.481	157.798
8/4/14	10:01:32	Unid hardshell turtle	1	21.525	157.830
8/4/14	10:12:11	Unid hardshell turtle	1	21.704	158.012
8/4/14	10:18:20	Unid hardshell turtle	2	21.591	158.122
8/4/14	10:19:24	Unid hardshell turtle	3	21.590	158.149
8/4/14	10:21:06	Unid hardshell turtle	1	21.589	158.195
8/4/14	10:25:50	Unid hardshell turtle	2	21.549	158.250
8/4/14	10:26:46	Unid hardshell turtle	3	21.529	158.234
8/4/14	10:27:55	Unid hardshell turtle	1	21.506	158.236
8/4/14	10:28:41	Unid hardshell turtle	1	21.488	158.237
8/4/14	10:30:46	Spinner dolphin	90	21.458	158.220
8/4/14	10:39:56	Monk seal	2	21.368	158.143
8/4/14	10:47:44	Unid hardshell turtle	1	21.301	158.034
8/4/14	10:51:17	Unid hardshell turtle	1	21.313	157.985
8/4/14	10:54:12	Unid hardshell turtle	1	21.314	157.935
8/4/14	11:42:04	Unid hardshell turtle	1	21.279	157.848
8/4/14	11:43:05	Unid hardshell turtle	1	21.266	157.828
8/4/14	11:43:22	Unid hardshell turtle	1	21.259	157.823

Date	Time (HST)	Species	# Individuals	Latitude (°N)	Longitude (°W)
Part 2. Five-island (Oahu, Maui, Molokai, Lanai & Kahoolawe) shoreline survey results (continued)					
8/4/14	11:44:29	Unid hardshell turtle	1	21.252	157.803
8/4/14	11:44:50	Unid hardshell turtle	1	21.253	157.796
8/4/14	11:46:37	Unid hardshell turtle	2	21.271	157.764
8/4/14	11:47:00	Unid hardshell turtle	1	21.271	157.757
8/4/14	11:47:48	Unid hardshell turtle	1	21.273	157.742
8/4/14	11:50:09	Unid hardshell turtle	1	21.254	157.705
8/4/14	12:21:03	Monk seal	2	21.088	157.266
8/4/14	12:21:21	Monk seal	1	21.086	157.260
8/4/14	12:25:03	Monk seal	1	21.089	157.181
8/4/14	12:29:20	Unid hardshell turtle	2	21.092	157.092
8/4/14	12:30:17	Unid hardshell turtle	1	21.092	157.078
8/4/14	12:31:47	Unid hardshell turtle	2	21.086	157.044
8/4/14	12:33:05	Unid hardshell turtle	1	21.078	157.017
8/4/14	12:37:13	Unid hardshell turtle	1	21.057	156.937
8/4/14	12:41:54	Unid hardshell turtle	1	21.044	156.848
8/4/14	12:42:53	Unid hardshell turtle	3	21.051	156.830
8/4/14	12:43:23	Unid hardshell turtle	2	21.057	156.821
8/4/14	12:43:50	Unid hardshell turtle	2	21.061	156.810
8/4/14	12:44:52	Unid hardshell turtle	1	21.067	156.792
8/4/14	12:45:17	Unid hardshell turtle	3	21.069	156.789
8/4/14	12:45:45	Unid hardshell turtle	3	21.074	156.781
8/4/14	12:46:09	Unid hardshell turtle	1	21.081	156.770
8/4/14	12:46:27	Unid hardshell turtle	2	21.083	156.767
8/4/14	12:58:24	Unid hardshell turtle	1	20.971	156.687
8/4/14	12:59:26	Unid hardshell turtle	1	20.948	156.698
8/4/14	13:01:33	Unid hardshell turtle	1	20.899	156.690
8/4/14	13:02:44	Unid hardshell turtle	1	20.873	156.685
8/4/14	13:05:02	Unid hardshell turtle	1	20.826	156.643
8/4/14	13:05:22	Unid hardshell turtle	1	20.820	156.637
8/4/14	13:07:06	Unid hardshell turtle	1	20.799	156.601
8/4/14	13:08:24	Unid hardshell turtle	1	20.785	156.564
8/4/14	13:09:01	Unid hardshell turtle	4	20.775	156.549
8/4/14	13:11:15	Unid hardshell turtle	1	20.793	156.503
8/5/14	7:54:08	Unid hardshell turtle	1	20.932	156.492
8/5/14	8:00:51	Unid hardshell turtle	1	21.027	156.628
8/5/14	8:26:42	Unid hardshell turtle	1	21.199	157.099
8/5/14	8:37:30	Spinner dolphin	50	21.130	157.301
8/5/14	8:43:27	Monk seal	3	21.099	157.304
8/5/14	8:48:17	Monk seal	1	21.087	157.259
8/5/14	8:50:23	Unid hardshell turtle	1	21.090	157.237
8/5/14	8:53:52	Monk seal	1	21.089	157.197
8/5/14	8:56:42	Unid hardshell turtle	1	21.091	157.144

Date	Time (HST)	Species	# Individuals	Latitude (°N)	Longitude (°W)
Part 2. Five-island (Oahu, Maui, Molokai, Lanai & Kahoolawe) shoreline survey results (continued)					
8/5/14	8:56:54	Unid hardshell turtle	2	21.092	157.138
8/5/14	8:57:27	Unid hardshell turtle	1	21.094	157.128
8/5/14	8:58:18	Unid hardshell turtle	5	21.096	157.107
8/5/14	8:58:51	Unid hardshell turtle	8	21.094	157.095
8/5/14	8:59:34	Unid hardshell turtle	1	21.091	157.078
8/5/14	9:05:01	Unid hardshell turtle	8	21.061	156.957
8/5/14	9:06:52	Unid hardshell turtle	1	21.051	156.915
8/5/14	9:08:04	Unid hardshell turtle	2	21.045	156.892
8/5/14	9:11:03	Unid hardshell turtle	1	21.048	156.841
8/5/14	9:11:12	Unid hardshell turtle	1	21.049	156.837
8/5/14	9:14:41	Unid hardshell turtle	1	21.076	156.781
8/5/14	9:25:31	Unid hardshell turtle	1	21.001	156.673
8/5/14	9:25:51	Unid hardshell turtle	1	20.992	156.674
8/5/14	9:26:32	Unid hardshell turtle	4	20.977	156.683
8/5/14	9:40:09	Unid hardshell turtle	3	20.901	156.874
8/5/14	9:41:30	Unid hardshell turtle	1	20.920	156.904
8/5/14	9:41:46	Unid hardshell turtle	1	20.923	156.915
8/5/14	9:45:49	Unid hardshell turtle	1	20.916	157.054
8/5/14	9:46:06	Unid hardshell turtle	1	20.909	157.062
8/5/14	10:00:56	Unid hardshell turtle	1	20.778	156.820
8/5/14	10:02:06	Unid hardshell turtle	1	20.793	156.800
8/5/14	10:02:16	Unid hardshell turtle	2	20.788	156.798
8/5/14	10:11:31	Unid hardshell turtle	2	20.823	156.636
8/5/14	10:14:45	Unid hardshell turtle	1	20.785	156.561
8/5/14	10:15:43	Unid hardshell turtle	1	20.773	156.540
8/5/14	10:17:27	Unid hardshell turtle	2	20.788	156.509
8/5/14	10:17:53	Unid hardshell turtle	1	20.791	156.502
8/5/14	10:18:42	Unid hardshell turtle	1	20.791	156.484
8/5/14	11:21:30	Unid hardshell turtle	1	20.738	156.461
8/5/14	11:21:44	Unid hardshell turtle	1	20.735	156.461
8/5/14	11:23:34	Spinner dolphin	6	20.713	156.447
8/5/14	12:00:44	Unid hardshell turtle	1	20.627	156.491
8/5/14	12:37:40	Unid hardshell turtle	1	20.825	156.073
8/5/14	12:45:50	Unid hardshell turtle	1	20.941	156.269
8/5/14	12:49:54	Unid hardshell turtle	1	20.942	156.360
8/5/14	12:50:35	Unid hardshell turtle	2	20.930	156.373
8/5/14	12:51:57	Unid hardshell turtle	1	20.915	156.416
8/6/14	7:31:48	Unid hardshell turtle	1	20.890	156.433
8/6/14	7:32:57	Unid hardshell turtle	1	20.890	156.433
8/6/14	7:36:41	Unid hardshell turtle	1	20.890	156.433
8/6/14	9:02:16	Unid hardshell turtle	4	21.311	157.963
8/6/14	9:02:54	Unid hardshell turtle	4	21.313	157.976

Date	Time (HST)	Species	# Individuals	Latitude (°N)	Longitude (°W)
Part 2. Five-island (Oahu, Maui, Molokai, Lanai & Kahoolawe) shoreline survey results (continued)					
8/6/14	9:06:49	Unid hardshell turtle	1	21.313	157.982
8/6/14	9:09:07	Unid hardshell turtle	2	21.300	157.939
8/6/14	9:10:11	Unid hardshell turtle	6	21.300	157.914
8/6/14	9:11:12	Unid hardshell turtle	1	21.298	157.890
8/6/14	9:14:25	Unid hardshell turtle	5	21.264	157.828
8/6/14	9:16:13	Unid hardshell turtle	2	21.251	157.794
8/6/14	9:18:04	Unid hardshell turtle	3	21.268	157.760
8/6/14	9:21:47	Unid hardshell turtle	1	21.255	157.696
8/6/14	9:36:54	Unid hardshell turtle	1	21.456	157.810
8/6/14	9:38:37	Unid hardshell turtle	18	21.486	157.838
8/6/14	9:40:50	Unid hardshell turtle	1	21.532	157.831
8/6/14	9:41:32	Unid hardshell turtle	1	21.544	157.839
8/6/14	9:44:00	Unid hardshell turtle	2	21.561	157.873
8/6/14	9:44:09	Unid hardshell turtle	1	21.564	157.872
8/6/14	9:46:18	Unid hardshell turtle	11	21.611	157.901
8/6/14	9:47:43	Unid hardshell turtle	2	21.645	157.912
8/6/14	9:53:36	Unid hardshell turtle	2	21.678	158.046
8/6/14	9:54:37	Unid hardshell turtle	1	21.654	158.069
8/6/14	9:56:07	Unid hardshell turtle	2	21.623	158.089
8/6/14	9:57:18	Unid hardshell turtle	5	21.595	158.113
8/6/14	9:58:12	Unid hardshell turtle	5	21.588	158.137
8/6/14	9:59:04	Unid hardshell turtle	4	21.584	158.161
8/6/14	10:07:49	Unid hardshell turtle	1	21.555	158.253
8/6/14	10:08:04	Unid hardshell turtle	4	21.556	158.255
8/6/14	10:12:35	Unid hardshell turtle	1	21.467	158.223
8/6/14	10:13:11	Unid hardshell turtle	1	21.455	158.208
8/6/14	10:13:45	Unid hardshell turtle	1	21.443	158.197
8/6/14	10:20:40	Spinner dolphin	150	21.340	158.129