Final Report

Aerial Shoreline Surveys for Marine Mammals and Sea Turtles in the Hawaii Range Complex, Conducted After Navy Training Events. Five-Year Summary Report 2010–2014

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Spinner dolphins (*Stenella longirostris*), photographed by Mark Deakos, taken under National Oceanic and Atmospheric Administration Permit No. 642-1536-03.

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14. ABSTRACT

Aerial shoreline surveys following U.S. Navy (Navy) training events were conducted in the Hawaii Range Complex to monitor for strandings and to document sightings of marine mammals and sea turtles in an effort to answer the monitoring question: “Do marine mammals strand along shorelines of the Main Hawaiian Islands (MHI) within 1 week following Navy training events?” This report summarizes marine mammal and sea turtle sighting data obtained during 67.5 hours of aerial survey effort over 16 days in the MHI between 2010 and 2014. These surveys were conducted during the week following seven Navy training events (NTE) that involved mid-frequency active sonar and explosives. Researchers identified a total of 386 marine mammal sightings and 383 sea turtle sightings. Humpback whales (Megaptera novaeangliae) and Hawaiian monk seals (Neomonachus schauinslandi) were the most common species observed, representing nearly 87 percent of all sightings. No marine mammal strandings were observed during any of the aerial surveys. Archival records from the local stranding network were examined to better interpret this result of no stranding observed on the post-exercise aerial surveys, with two goals. First, to investigate if the probability of zero strandings over the course of the aerial survey series is reasonable to expect when compared to the rate of reported strandings. And second, reported stranding data was reviewed for all dates corresponding to NTEs for which the aerial surveys were performed in order to compare the rate of reported strandings immediately before the NTE with the period during and immediately after the NTE combined. Reported strandings occurring between 2010 and 2014 were examined according to species, location, date of the stranding report, and the estimated date of the stranding determined from necropsy findings. A total of 88 strandings were examined according to island and species over the 5-year period. Sixteen cetacean species were reported as stranded with spinner dolphins (Stenella longirostris) and humpback whales

being the most common, representing over 30 percent of all the strandings. The absence of observed strandings from the aerial shoreline surveys did not significantly depart from the baseline rate of reported strandings for the MHI during the same period. This means that it is plausible to see zero strandings across 16 survey days given the overall baseline rate. No significant difference was found between the probability of a stranding occurring before an NTE for which an aerial survey was performed and the probability of stranding occurring during or within 7 days after these NTEs.

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Abbreviations and Acronyms

BARSTUR	Barking Sands Tactical Underwater Range
BSURE	Barking Sands Underwater Range Expansion
HRC	Hawaii Range Complex
km	kilometer(s)
MHI	Main Hawaiian Islands
m	meter(s)
Navy	U.S. Navy
NTE(s)	Navy training event
PMRF	Pacific Missile Range Facility
RIMPAC	Rim of the Pacific
SCC	Submarine Commanders Course
U.S.	United States
USWEX	Undersea Warfare Exercise

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Abstract

Aerial shoreline surveys following U.S. Navy (Navy) training events were conducted in the Hawaii Range Complex to monitor for strandings and to document sightings of marine mammals and sea turtles in an effort to answer the monitoring question: “Do marine mammals strand along shorelines of the Main Hawaiian Islands (MHI) within 1 week following Navy training events?” This report summarizes marine mammal and sea turtle sighting data obtained during 67.5 hours of aerial survey effort over 16 days in the MHI between 2010 and 2014. These surveys were conducted during the week following seven Navy training events (NTE) that involved mid-frequency active sonar and explosives. Researchers identified a total of 386 marine mammal sightings and 383 sea turtle sightings. Humpback whales (*Megaptera novaeangliae*) and Hawaiian monk seals (*Neomonachus schauinslandi*) were the most common species observed, representing nearly 87 percent of all sightings. No marine mammal strandings were observed during any of the aerial surveys. Archival records from the local stranding network were examined to better interpret this result of no stranding observed on the post-exercise aerial surveys, with two goals. First, to investigate if the probability of zero strandings over the course of the aerial survey series is reasonable to expect when compared to the rate of reported strandings. And second, reported stranding data was reviewed for all dates corresponding to NTEs for which the aerial surveys were performed in order to compare the rate of reported strandings immediately before the NTE with the period during and immediately after the NTE combined. Reported strandings occurring between 2010 and 2014 were examined according to species, location, date of the stranding report, and the estimated date of the stranding determined from necropsy findings. A total of 88 strandings were examined according to island and species over the 5-year period. Sixteen cetacean species were reported as stranded with spinner dolphins (*Stenella longirostris*) and humpback whales being the most common, representing over 30 percent of all the strandings. The absence of observed strandings from the aerial shoreline surveys did not significantly depart from the baseline rate of reported strandings for the MHI during the same period. This means that it is plausible to see zero strandings across 16 survey days given the overall baseline rate. No significant difference was found between the probability of a stranding occurring before an NTE for which an aerial survey was performed and the probability of stranding occurring during or within 7 days after these NTEs.

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1. Introduction

As part of the regulatory compliance process associated with the Marine Mammal Protection Act and the Endangered Species Act, the United States Navy (Navy) is responsible for meeting specific monitoring and reporting requirements for military training and testing. In support of these monitoring requirements associated with the Hawaii Range Complex (HRC), aerial shoreline surveys for marine mammals and sea turtles in the HRC were conducted from 2008-2014, subsequent to Navy training events (NTEs) (Mobley 2008, 2011; Mobley and Milette 2010; Mobley and Pacini 2012). These monitoring efforts were conducted in order to address the following monitoring question:

> *Do marine mammals strand along shorelines of the Main Hawaiian Islands within one week following Navy training events?*

The definition under the Marine Mammal Protection Act for a marine mammal "stranding" is that "(A) a marine mammal is dead and is (i) on a beach or shore of the U.S.; or (ii) in waters under the jurisdiction of the United States (including any navigable waters); or (B) a marine mammal is alive and is (i) on a beach or shore of the United States and is unable to return to the water; (ii) on a beach or shore of the U.S. and, although able to return to the water, is in need of apparent medical attention; or (iii) in the waters under the jurisdiction of the U.S. (including any navigable waters), but is unable to return to its natural habitat under its own power or without assistance" (16 United States Code § 1421h).

The marine mammal monitoring reported here is part of a long-term monitoring effort under the U.S. Navy's Marine Species Monitoring Program (contract # N62470-10-D-3011 or N62470-15-D-8006) supported by HDR. Under this contract, the aerial shoreline surveys conducted in the years 2010–2014 involved circumnavigating one or more of eight Main Hawaiian Islands (MHI; Niihau, Kauai, Oahu, Molokai, Lanai, Kahoolawe, Maui, and Hawaii, also known as the Big Island) to search for strandings of marine mammals along the coasts during the week following an NTE that incorporated the use of mid-frequency active sonar and/or explosives. As a secondary goal, sightings of sea turtles were also recorded. For these surveys, the islands chosen for circumnavigation had been identified by the Navy based on their proximity to the recent NTE. These NTEs included the "Koa Kai," the Submarine Commanders Course (SCC), the Undersea Warfare Exercise (USWEX), and the Rim of the Pacific or "RIMPAC." Prior to 2014, the Koa Kai events mostly took place around the islands of Oahu, Molokai, Lanai, Maui and Kahoolawe but primarily on the Pacific Missile Range Facility (PMRF) Barking Sands Tactical Underwater Range (BARSTUR) and Barking Sands Underwater Range Expansion (BSURE) between Kauai and Niihau thereafter. The SCC generally occurs two times per year in the HRC and is designed to test prospective commanding and executive officers in all of the skills required for successful submarine command. These exercises involve anti-surface and anti-submarine training. USWEX events can occur several times per year and are designed to evaluate the Navy's anti-submarine warfare capability. RIMPAC generally takes place during the months of June and July during even-numbered years and involves a broader expanse of ocean off the MHI.

Also under this contract in 2013, a shore-based survey on the ground was carried out in tandem with the aerial shoreline survey around the island of Niihau to ground-truth the efficacy of aerial surveys in detecting stranded marine mammals by using hauled-out Hawaiian monk seals (*Neomonachus schauinslandi*) as a proxy for stranded animals (Ampela et al. 2015). A total of 29 Hawaiian monk seals were sighted by the on-shore crew compared with 11 by the aerial team observing the same beaches on the same day. Despite the clear advantage of shore-based observation in terms of accuracy, the authors noted that the rugged terrain and difficulty in accessing many of the beaches in question underscored the tactical and practical advantages of aerial observation.

On a subsequent task order under this contract, and the subject of the present report, HDR was tasked with summarizing all results from aerial shoreline surveys for years 2010 to 2014 that had been conducted after an NTE in the HRC. This work comprises the first part of this report. As described below in **Chapter 3**, no strandings were sighted during the entire set of aerial surveys. This result suggested two further research questions that were addressed by analyses of stranding records from the local stranding response network, and are reported here in the second part of this report: 1) was the result of zero aerial sightings of strandings consistent with respect to the background stranding rate as logged by the regional stranding network; and 2) was an analysis of the stranding network's data able to detect a difference (i.e., comparing pre- and post-exposure to NTEs) in stranding rates *with regard to the same set of NTEs* where the aerial survey method had not.

2. Methods

2.1 Aerial Survey Methods

Sixteen days of aerial shoreline survey effort were conducted between 2010 and 2014 following seven NTEs (**Table 1**). Locations of survey effort reflected the differences in NTE types (Koa Kai, SCC, RIMPAC, and USWEX) and the spatial nature of the exercises. SCC monitoring included shoreline surveys of only Kauai and Niihau while Koa Kai monitoring encompassed all the MHI until 2014 when it focused only off Kauai. RIMPAC and USWEX cover larger expanses of ocean, and post-exercise monitoring, therefore, included the four-island chain of Maui, Molokai, Kahoolawe, and Lanai (and associated islets) and often the west (Kona) side of the Big Island of Hawaii or Oahu.

Prior to the NTE, the Principal Investigator (Joseph Mobley) and lead pilot for the survey attended pre-planning sessions with the Navy Technical Representative and other U.S. Navy staff at Pearl Harbor. Pilots were briefed on proper communication protocols for entering and departing the HRC.

The aircraft was either a small, fixed-wing aircraft (5 days) or, most often, a helicopter (11 days). Surveys were conducted from an altitude of approximately 820 to 1,000 feet (250 to 305 meters [m]) flying at a ground speed of 60 to 100 knots (110 to 185 kilometers [km]/hour), covering near-shore waters (i.e., within 1 to 3 km of shore) and the adjacent beach/coastline. The flight crew included the pilot, a data recorder, and two primary observers highly experienced with marine mammal and sea turtle species of Hawaii, scanning each side of the aircraft. Primary observers scanned continuously through the surveys.

Table 1. Summary of aerial shoreline survey effort, 2010–2014.

Date of Survey	Training Event	Training Event Dates	Aircraft	Average Altitude (m)	Islands Circumnavigated[6]
11/18/2010[1]	Koa Kai	11/12/10 - 11/17/10	Robinson R44 helicopter	305	Oahu (15%), Maui, Molokai, Kahoolawe, Lanai, west Hawaii (27%)
11/22/2010[1]	Koa Kai	11/12/10 - 11/17/10	Robinson R44 helicopter	305	Oahu (18%), Maui, Molokai, Kahoolawe, Lanai, west Hawaii (30%)
2/24/2011[2]	USWEX/ SCC	2/16/11 - 2/23/11	Aero Commander	305	Kauai, Niihau
2/26/2011[2]	USWEX/ SCC	2/16/11 - 2/23/11	Aero Commander	305	Kauai, Niihau
2/28/2011[2]	USWEX/ SCC	2/16/11 - 2/23/11	Aero Commander	305	Oahu (53%), Maui (55%), Molokai (57%), Lanai, Kahoolawe, west Hawaii (61%)
3/5/2011[2]	USWEX/ SCC	2/16/11 - 2/23/11	Aero Commander	305	Oahu (22%), Maui (59%), Molokai (49%), Lanai, Kahoolawe, west Hawaii (42%)
2/23/2012[3]	SCC	2/14/12 - 2/18/12	Partenavia P.68 Observer	305	Kauai and Niihau
2/25/2012[3]	SCC	2/14/12 - 2/18/12	Agusta 109A helicopter	305	Kauai and Niihau
8/20/2013[4]	SCC	8/12/13 - 8/14/13	AStar AS350 helicopter	244	Kauai and Niihau (93%)
8/22/2013[4]	SCC	8/12/13 - 8/14/13	Agusta 109A helicopter	244	Kauai
1/31/2014[5]	Koa Kai	1/23/14 - 1/31/14	AStar 350 B2-7 helicopter	250	Kauai
2/5/2014[5]	Koa Kai	1/23/14 - 1/31/14	AStar 350 B2-7 helicopter	250	Maui, Molokai, Kahoolawe, Lanai
8/1/2014[5]	RIMPAC	7/7/14 - 8/1/14	Bell 206L-3 helicopter	250	Oahu, Molokai, Maui (34%)
8/4/2014[5]	RIMPAC	7/7/14 - 8/1/14	Bell 206L-3 helicopter	250	Maui, Molokai, Kahoolawe, Lanai
8/5/2014[5]	RIMPAC	7/7/14 - 8/1/14	Bell 206L-3 helicopter	250	Oahu, Lanai
8/6/2014[5]	RIMPAC	7/7/14 - 8/1/14	Bell 206L-3 helicopter	250	Oahu (15%), Maui, Molokai, Kahoolawe, Lanai, west Hawaii (27%)

[1]Mobley (2010); [2]Mobley (2011); [3]Mobley & Pacini (2012); [4]Ampela et al. (2015); [5]Mobley & Deakos (2015); [6]Percentages reflect the portion of the island's coastline surveyed

Observers called out positions and behavior of all marine mammals and sea turtles seen within 3 km of shore and along the immediate beach/coastline using accepted distance sampling methods (Buckland et al. 2001). The data recording software used varied across years. The data recording device began as a laptop computer and was later replaced with an iPad.

Observers provided environmental information including Beaufort sea state, glare (as a percentage of the field of view that was impaired), and visibility (the farthest distance that 25 dolphins would likely be sighted) at the start of each survey and each time sighting conditions changed. When a sighting occurred, observers first notified the recorder which side of the plane the sighting was on, then obtained a clinometer angle reading once the sighting was aligned with the beam of the aircraft. Additional sighting information included species determination, if possible, and an estimate of group size and general behavior (including if a Hawaiian monk seal was in the water or hauled-out). Occasionally the aircraft circled the sighting, and photographs were taken to assist with species confirmation and accurate determination of group size. Special attention was paid to ascertain whether a marine mammal was distressed, injured, stranded, or dead.

2.2 Stranding Analysis Methods

The goal of the stranding analysis was to provide further insight into the compiled results of the aerial survey series above in **Table 1**. The two questions to be answered were: 1) was the result of zero aerial sightings of strandings consistent with respect to the background stranding rate as logged by the regional stranding network; and 2) was an analysis of the local stranding network's data able to detect a difference (i.e., comparing pre- and post-exposure to NTEs) in stranding rates *with regard to the same set of NTEs* where the aerial survey method had not.

For the purpose of this report, marine mammal strandings reported around the MHI for calendar years 2010 through 2014 were examined. This included all reported strandings of dead cetaceans on a beach or shoreline or found floating within 1 km of a shoreline, and any live-stranded cetaceans that were found on a beach or shoreline and unable to return to their natural habitat under their own power. All live-stranded cetaceans between the start of calendar year 2010 and the end of calendar year 2014 died within 2 weeks of the initial stranding event. In most cases, live-stranded cetaceans either died between the time of the initial report and stranding response personnel arriving on scene or the animals were euthanized on site. In 2010, two animals were transferred to rehabilitation at the University of Hawaii at Hilo where the striped dolphin (*Stenella coeruleoalba*) lived for 17 hours and the Blainville's beaked whale (*Mesoplodon densirostris*) for 13 days. No rehabilitation facility has been available to house live-stranded cetaceans in the Hawaiian Islands since 2010.

The subset of stranding data examined in this report involved evaluating Level A stranding data provided by the Pacific Islands Regional Office (National Marine Fisheries Service/National Oceanic and Atmospheric Administration) and data obtained by Hawaii Pacific University during cetacean stranding responses carried out between the start of calendar year 2010 and the end of calendar year 2014. Level A data included stranding event details such as species, date, location, condition, an assessment of human interaction, sampling, and animal disposition. In addition to examining Level A data obtained by Hawaii Pacific University during stranding responses, Level B and C data, such as necropsy reports generated by Hawaii Pacific University and analytical results obtained during the course of cause-of-death investigations were evaluated. For live-stranded cetaceans, the initial stranding date was assumed to be the same day that a live-stranded animal was reported on a beach or shore. Necropsy findings were used to estimate the initial stranding date for dead-stranded cetaceans. Date of first observation was used as the initial stranding date for dead-stranded cetaceans that were initially reported

alive. Date of death was estimated at the time of necropsy for fresh dead cetaceans on a scale of days post-mortem. Date of death was estimated for carcasses with moderate to advanced decomposition at the time of necropsy and/or carcass recovery on a scale of weeks post-mortem. Estimated date of initial stranding was back-calculated according to the estimated number of days post-mortem from the day of the stranding report. In the cases of animals that were not fresh dead, a range of dates was provided to encompass varying rates of decomposition. In a few cases only skeletal material was recovered where it was not possible to estimate the initial stranding date. In these cases the latest possible stranding date that would have resulted in skeletal material at the time of the stranding report is provided. The dates of stranding reports, estimated initial stranding dates or date ranges, locations, and cetacean species stranded throughout the MHI were presented for each of the calendar years 2010, 2011, 2012, 2013, and 2014 (see **Appendix D**). Maps of the stranding reports for each of the calendar years 2010, 2011, 2012, 2013, and 2014 can be viewed in **Appendix E**.

Stranding data includes number of strandings (dead- or live-stranded cetaceans along a shoreline) that occurred between calendar years 2010 and 2014. Data were examined according to species stranded and island. For example, over the 5-year period, the number of days where a stranding occurred on the island of Kauai (9) and the days where a stranding did not occur on Kauai (1,815) were compared to the days of aerial surveys around Kauai where a stranding was detected (0) and the total number of days of aerial surveys around Kauai where no strandings were detected (10). This approach was repeated for each of the main island regions surveyed. A chi-square analysis was done for each island region to examine if the proportion of days with strandings was significantly different on days when aerial surveys were flown compared to days when aerial surveys were not flown using the 5 years of stranding data.

A chi-square analysis was also done for *the same set of NTEs* for which an aerial survey from **Table** 1 was performed, to compare the frequency of a stranding occurring during or within 7 days following those NTEs, with the frequency of a stranding occurring with the same number of days preceding the NTE. For example, if an NTE lasted 5 days, the “during or within NTE” period would total 5 + 7 = 12 days; then the number of days examined preceding the NTE would also be 12 days to balance out the comparison. This analysis makes the assumption that all strandings used in this analysis are equally likely to be detected regardless of species or shoreline area.

This comparison was performed a) per island, and b) using the unit of one aerial circumnavigation of the island in question as a proxy for one day of reporting (for that island) by the stranding response network. This method accounts for the case where only part of an island’s coastline was circumnavigated.

3. Results

3.1 Aerial Shoreline Surveys: Effort

Between 2010 and 2014, 16 days were dedicated to flying shoreline surveys following an NTE in search of stranded marine mammals (**Appendix A**, **Figures 1-12**). This resulted in a total of 67.5 hours of surveying. All eight islands (Niihau, Kauai, Oahu, Molokai, Lanai, Maui,

Kahoolawe, and Hawaii) were encircled at least once except for Hawaii (Big Island), which was only partially surveyed since the NTEs had occurred to the west of the island.

3.2 Aerial Shoreline Surveys: Marine Mammal Sightings

A total of 386 marine mammal sightings was made across the 5 years of surveys, consisting of six confirmed species (common bottlenose dolphin, *Tursiops truncatus*; false killer whale*, Pseudorca crassidens*; spinner dolphin*, Stenella longirostris*; humpback whale*, Megaptera novaeangliae*; short-finned pilot whale*, Globicephala macrorhyncus*; and Hawaiian monk seal) and three unconfirmed species (unidentified medium cetacean, unidentified dolphin, and unidentified small dolphin) (**Table 2**). The recorded sightings represent a mixture of near-shore (e.g., humpback whale, spinner dolphin) and off-shore (e.g., short-finned pilot whale, false killer whale) species resident or seasonally resident to Hawaiian waters (**Table 2**). This derives from the fact that, when circumnavigating the islands, one observer surveyed the waters near shore including the immediate beach/coastline, while the other observer surveyed offshore. Additionally, during transits to and from regions, the aircraft typically crossed over deeper water. Sightings were dominated by humpback whales with 251 (65.0 percent), followed by Hawaiian monk seals with 84 (21.8 percent) and spinner dolphins with 31 (8.0 percent). The number of individuals sighted was dominated by spinner dolphins with 1,508 (66.5 percent), followed by humpback whales with 431 (19.0 percent), unidentified dolphins with 131 (5.8 percent), and Hawaiian monk seals with 123 (5.4 percent). Only one sighting each was made of false killer whales. Only one sighting each was made of false killer whales (5 individuals) and short-finned pilot whales (2 individuals). No stranded or near-stranded animals were observed during any of the total 16 days of surveys. Maps showing sighting locations and tracklines by survey are shown in **Appendix C**.

Table 2. Summary of marine mammal sightings and total individuals observed.

Species	Total Sightings	Percent of Sightings	Total Individuals	Percent of Individuals
Bottlenose dolphin	5	1.3%	25	1.1%
False killer whale	1	0.3%	5	0.2%
Hawaiian monk seal	84	21.8%	123	5.4%
Humpback whale	251	65.0%	431	19.0%
Short-finned pilot whale	1	0.3%	2	0.1%
Spinner dolphin	31	8.0%	1,508	66.5%
Unidentified medium cetacean	1	0.3%	1	0.0%
Unidentified dolphin	11	2.8%	131	5.8%
Unidentified small dolphin	1	0.3%	40	1.8%
Grand Total	**386**		**2,266**	

3.3 Aerial Shoreline Surveys: Turtle Sightings

A total of 383 unidentified hardshell turtle sightings were made during the 16 days of surveys, consisting of 707 individual turtles. No distressed or injured turtles were observed. Given the

makeup of turtle species in Hawaii, the majority were likely green sea turtles (*Chelonia mydas*) with a very small proportion being hawksbill sea turtles (*Eretmochelys imbricata*). A list of all turtle sightings can be found in **Appendix B** and maps of the sighting locations, and effort tracklines are shown in **Appendix C**.

3.4 HRC Stranding Data

Maps showing stranding locations by year are shown in **Appendix E**.

3.4.1 Archive of Strandings Reported between 2010 and 2014

From the archive of the stranding database of NMFS Pacific Islands Regional Office and Hawaii Pacific University, a total of 88 stranding events was reported between calendar years 2010 and 2014 (see **Appendix D**), where a live or dead cetacean stranded on a beach or shoreline or within 1 km of a shoreline in the MHI. In addition, 66 other cetacean strandings were reported during this period that represented free-swimming dolphins or whales that were either entangled, injured, or outside of their normal habitat. The majority of these additional stranding reports of distressed cetaceans (N=38; 58 percent) were of entangled humpback whales.

The numbers of shoreline strandings ranged between 12 and 22 each year for the MHI as a whole, averaging 17.6 strandings each year over the 5-year period. The majority of strandings occurred on Oahu (33.0 percent) and Hawaii Island (22.7 percent), followed by Maui (12.5 percent), Kauai (10.2 percent), Lanai (8.0 percent), Molokai (6.8 percent), Kahoolawe (5.7 percent), and Niihau (1.1 percent) (**Table 3**)**.** Oahu also had the highest stranding rate per km of coastline (0.076 per km over 5 years), followed by Lanai (0.075) and uninhabited Kahoolawe (0.072), which is more than 1.5 times that of the other islands. Most aerial survey effort was focused on the island of Kauai, where 10.2 percent of the reported strandings occurred between 2010 and 2014 (**Table 3**).

Table 3. Summary of strandings broken down by island.

Island	Coastline Length (km)	Total Marine Mammal Strandings	Percentage	Strandings per km of Coastline over 5 Years
Hawaii Island	640	20	22.7%	0.031
Kahoolawe	69	5	5.7%	0.072
Kauai	201	9	10.2%	0.045
Lanai	93	7	8.0%	0.075
Maui	309	11	12.5%	0.036
Molokai	192	6	6.8%	0.031
Niihau	90	1	1.1%	0.011
Oahu	382	29	33.0%	0.076
Total	**1,976**	**88**		0.045

Sixteen different species were identified as stranded over the 5-year period, with the majority represented by spinner dolphin (17.0 percent) and humpback whale (13.6 percent) (**Table 4**). The next most frequently reported stranded species included short-finned pilot whale, sperm whale (*Physeter macrocephalus*), and striped dolphin, all at 10.2 percent, followed by melon-headed whales (*Peponocephala electra*, 6.8 percent), dwarf sperm whale (*Kogia sima*; 4.5 percent), and unidentified marine mammals (4.5 percent), followed by three reports of pygmy sperm whale (*Kogia breviceps*; 3.4 percent), and two reports each of stranded Blainville's beaked whale, bottlenose dolphin, false killer whale, unidentified *Stenella* spp., and unidentified whales. Other species reported only once in 5 years included an unknown blackfish, killer whale (*Orcinus orca*); Longman's beaked whale (*Indopacetus pacificus*); and Risso's dolphin (*Grampus griseus*), rough-toothed dolphin (*Steno bredanensis*), and pan-tropical spotted dolphin (*Stenella attenuata*).

Table 4. Summary of stranded marine mammals by species as reported in the Hawaii Pacific University stranding database.

Species	Total Reported Shoreline Strandings	Percentage
Spinner Dolphin	15	17.0%
Humpback Whale	12	13.6%
Short-finned Pilot Whale	9	10.2%
Sperm Whale	9	10.2%
Striped Dolphin	9	10.2%
Melon-headed Whale	6	6.8%
Dwarf Sperm Whale	4	4.5%
Unknown	4	4.5%
Pygmy Sperm Whale	3	3.4%
Blainville's Beaked Whale	2	2.3%
Bottlenose Dolphin	2	2.3%
False Killer Whale	2	2.3%
Stenella spp.	2	2.3%
Unknown whale	2	2.3%
Blackfish	1	1.1%
Killer whale	1	1.1%
Kogia spp.	1	1.1%
Longman's Beaked Whale	1	1.1%
Risso's Dolphin	1	1.1%
Rough-toothed Dolphin	1	1.1%
Pan-tropical Spotted Dolphin	1	1.1%
Grand Total	**88**	

3.4.2 Comparison to Aerial Survey

Analyses were performed to answer two questions with respect to reconciling zero stranding sightings from the aerial surveys with baseline rates derived from the stranding database:

1) *Was the result of no strandings across all aerial survey days consistent with the rate of strandings recorded in the stranding database?*

A chi-square analysis for each island surveyed indicated no significant difference ($p > .05$) when the proportion of strandings detected on the days surveyed were compared to the proportion of reported strandings on any day of a given year (**Table 5**). This comparison was performed for each island. For the purposes of this comparison, the unit for the stranding database was a reporting day, and the unit for aerial surveys was a single circumnavigation of an island. In cases where a partial circumnavigation was performed, a non-integer value is found in the cell.

2) *Can the stranding database be used to detect a "before vs. after"* difference in stranding rate for the same NTEs *after which the aerial shoreline surveys were performed?*

Table 5. Chi-square analysis comparing the ratio of days with and without reported strandings with the ratio of days strandings were observed during aerial surveys.

Island	No. Days with Stranding		No. Days without Stranding		Chi-Square[2]
	Stranding database[3]	Aerial Shoreline surveys	Stranding database[3]	Aerial Shoreline surveys[1]	
Hawaii	20	0	1805	1.61	0.018
Kahoolawe	5	0	1820	6.00	0.016
Kauai	9	0	1816	6.00	0.030
Lanai	7	0	1818	7.00	0.027
Maui	11	0	1814	5.48	0.033
Molokai	6	0	1819	6.06	0.020
Niihau	1	0	1824	3.87	0.002
Oahu	29	0	1796	3.07	0.050

[1]A whole number represents a complete circumnavigation of the island, and serves as a proxy for a unit day in comparison to a days in which a reported stranding could occur

[2]Chi-square value > 3.84 is significant at $p < 0.5$

[3]Stranding database covers the same 5-year period as the aerial surveys

With regard to NTEs for which an aerial survey was performed, the number of strandings recorded in the database in the period during the NTE through 7 days afterward was compared to the same span of days immediately prior to that exercise.

Table 6 lists seven reports of stranded animals that occurred or were estimated to have occurred during or within 1 week following a given NTE. The chi-square analysis comparing total strandings before an NTE (**Table 1**) to the total strandings during and 7 days following an NTE found 6 strandings before the NTE and 6 strandings in the period during or 7 days following the NTE. This resulted in a chi-square of zero, not statistically significant. Given the small sample size of 12 strandings, the statistical power of this analysis was quite low (0.18). This suggests that with a sample size of 12 strandings, there was only an 18 percent probability of detecting an effect. According to G*power analysis, the total number of strandings necessary to achieve a recommended power of .80 would be 88 for a large effect size and 32 for a medium effect size. In comparison, 88 was the total number of all strandings recorded in the database between 2010 and 2014.

Table 6. Strandings that occurred during or within 1 week following NTEs.

Date reported	Location	Species	NTE	Training Event Location	Training Event Dates	Estimated Stranding Date
2/28/11	Lanai[1]	Humpback whale	SCC	Oahu, Molokai, Lanai, Maui and Kahoolawe	2/15/11 – 2/23/11	2/25/11-2/28/11
8/15/13	Maui[1]	Spinner dolphin	SCC	Oahu, Molokai, Lanai, Maui and Kahoolawe	8/12/13 – 8/14/13	8/15/13
2/05/14	Oahu[2]	Pygmy sperm whale	Koa Kai	Kauai / Niihau	1/23/14 – 1/31/14	1/22/14-1/29/14
7/25/14	Oahu[1]	Short-finned pilot whale	RIMPAC	MHI	7/7/14 – 8/01/14	7/24/14
7/31/14	Kauai[1]	Short-finned pilot whale	RIMPAC	MHI	7/7/14 – 8/01/14	7/31/14
7/31/14	Kauai & Oahu[1]	Short-finned pilot whale	RIMPAC	MHI	7/7/14 – 8/01/14	7/31/14
8/04/14	Hawaii Island[1]	Spinner dolphin	RIMPAC	MHI	7/7/14 – 8/01/14	7/21/14-7/25/14

[1]Distance between stranding location and NTE location is unknown
[2]Distance between stranding location and NTE location is greater than 160 km

One stranding had an estimated initial stranding date that spanned before and during the NTE and was, therefore, not included in the chi-square analysis. One stranding (28 February 2011), involving a humpback whale calf found on Lanai, was reported on the same day as an aerial survey in that same region. **Figure 1** shows the stranded animal on a rocky shoreline adjoining steep cliffs on the southern shore of Lanai. The region was remote and could not be reached by researchers by vessel or on foot, so a necropsy was not performed. The carcass was first reported at 1300 hours at high tide on 28 February 2011, and, according to GPS data, the aerial survey team passed over this area at approximately 1430 hours that same day.

Figure 1. A stranded humpback whale calf found dead on Lanai on 28 February 2011 on the same day as an aerial survey of that region. The top photo shows the calf from a distance at the base of the cliffs on a remote rocky beach while the bottom photo is zoomed in on the calf. Photos taken under NOAA permit #932-1905.

4. Discussion

This report summarizes survey results involving all eight of the MHI following seven Navy NTEs: Koa Kai (November 2010 and January 2014), USWEX (February 2011), SCC (February 2011, February 2012, and August 2013), and RIMPAC (July 2014).

The overall objective of the aerial shoreline surveys was to answer the monitoring question:

> "Do marine mammals strand along shorelines of the MHI within 1 week following Navy training events?"

Two sources of data were available to address this question: a) aerial surveys of the shorelines of nearby islands conducted after an NTE; and b) a database of stranding reports for all the MHI that occurred during the same 5-year period. With respect to the aerial survey data, no strandings were observed on any of the 16 days surveyed. This implies that either no strandings were present at these times, or that they were present but not detected. Pertinent to the latter possibility, the second most frequent sighting (following humpback whales) were of hauled-out monk seals (N=84), which are similar in size to the smallest cetaceans (e.g., spinner dolphins). This strongly suggests that a stranded animal as small as a dolphin would be detectable (Ampela et al., 2015).

The stranding database was used to retrospectively inform two questions:

1) Was the result of no stranding sightings across all aerial survey days consistent with the rate of strandings recorded in the database?

2) Can the stranding database be used to detect a "before vs. after" difference in stranding rate for the same NTEs after which the aerial shoreline surveys were performed?

With regard to the first question, the complete absence of strandings reported by the surveys did not depart significantly from the baseline rate of strandings for the MHI during the same period (Table 5). This means that it is plausible to see zero strandings across 16 survey days given the overall baseline stranding rate.

With regard to the second question, an examination of stranding data between 2010 and 2014 indicates that stranding events did occur in the MHI either during or within 1 week following the aerially surveyed NTEs. However statistically, strandings were equally likely to occur during the equivalent number of days before the start of the NTE: 6 strandings occurred during NTEs, compared with 6 strandings before NTEs with a chi-square result of zero, with the caveat of low statistical power due to low sample size (N=12 strandings). This suggests that the presence of NTEs did not increase the probability of strandings, at least for the NTEs used in this study (i.e., the ones after which aerial shoreline surveys were performed [**Table 1**]).

As concerns the humpback whale calf carcass reported on 28 February 2011, and missed by the aerial survey crew that same day, the photos (**Figure 1**) offer some insight into how that omission may have occurred. The inset rocky beach against the steep cliffs and the shadowing, as well as the similarity in color of the whale and the rocks, may have obscured the aerial

team's ability to see the animal from the air. This particular survey was also one of the few conducted in a fixed-wing aircraft where the position of the engine can partially obstruct the observers visual field compared with that from a helicopter.

Stranding frequency over the 5-year period on a species-specific basis likely reflects some combination of near-shore versus off-shore habitat preference and population size. The 16 species of cetacean that were reported as stranded over the 5-year period live in diverse habitats based on mean depth of sightings. For example, Risso's dolphin, which comprised 1.1 percent of the reported strandings, is most often sighted in 4,000 to 5,000-m depths (Baird et al. 2013). This species strands very infrequently in Hawaii, with only two strandings reported in the past 25 years. The Longman's beaked whale stranding that occurred in 2010 represented 1.1 percent of the strandings reported, but this is likely an overestimate of the stranding frequency for this species. At the time of the Longman's beaked whale stranding in 2010 there had been only 10 confirmed stranding reports world-wide of Longman's beaked whales in 100 years, and the 2010 event represents the only known stranding of the species from Hawaiian waters (West et al. 2013). On the other hand, spotted dolphins and rough-toothed dolphins were also reported as stranding only once in the 5-year period, which is surprising considering that these species represent the second and third most commonly sighted odontocete species during small-vessel surveys in Hawaiian waters (Baird et al. 2013). Cuvier's beaked whale and pygmy killer whale are both well documented as inhabiting Hawaiian waters (Baird et al. 2011, Faerber and Baird 2010, McSweeney et al. 2009, Baird et al. 2008) but were not reported as stranded over the 5 years. Fraser's dolphins have also been reported in Hawaiian waters but did not strand during the 5 years (Baird et al. 2013). In contrast, spinner dolphins are a well-known species and were the most frequently stranded cetacean of the 16 species reported over the 5-year period, accounting for 17 percent of the strandings. This near-shore cetacean species was also the most frequently sighted species during the aerial surveys, with over 1,500 dolphins observed from the air during 16 days of survey effort. An examination of stranding frequency, population size, sighting rates, and mean water depth of sightings across all species of cetaceans would help to clarify expected species-specific stranding rates for the Hawaii region.

With regards to which island had the highest frequency of strandings, Oahu represented one-third of all reported strandings. Even when correcting for the amount of coastline available for stranding for each island, the stranding rate per km of shoreline was highest for Oahu among all the MHI (**Table 3**). Given that Oahu hosts close to 1 million people (over 70 percent of the state's population), it may be logical to deduce that more people walking its coastlines would translate to more stranded animals being detected. However, the next two islands with the highest stranding rates per km of coastline are Lanai, which hosts the majority of its tiny population in the center of the island away from the coastline and Kahoolawe, which is uninhabited. Given these results, the proportion of stranding differences by island could reflect different densities of marine mammals around the different islands. However, it is worth noting that Lanai has daily tour boats traveling its coastline for dive and snorkel trips and Kahoolawe has regular coastline surveys that would increase the likelihood of detecting strandings. Coastlines that are hospitable to urban development (with easy access to the water) may also be coastlines that are easily accessible for carcasses or animals in distress to come ashore. This may be why many of the strandings appear to be adjacent to urban areas (see

Appendix E maps). Similar coastlines in non-urban areas that are not regularly surveyed should perhaps be regions of focus where additional strandings may be unaccounted for.

There are a number of factors to consider when interpreting Hawaiian stranding data obtained over the 5-year period. Overall, we would expect that the number of strandings reported along Hawaiian shorelines or observed during aerial surveys represent only a small number of cetaceans that die at sea. An analysis to estimate the proportion of Big Island spinner dolphins that die and are found stranded suggests that less than 5 percent of Hawaiian cetaceans that die are reported as stranded (West et al. unpublished data). This is considerably lower than a 25 percent carcass recovery rate for coastal California bottlenose dolphins (Carretta et al. 2010) and a 13 percent carcass recovery rate from Brazil, where incidentally caught dolphin carcasses were tagged and then released to estimate the proportion of dead dolphins represented by strandings (Prado et al. 2013). A variety of factors is likely responsible for the very low stranding rate in Hawaii, including the extensive presence of fringing reefs, high proportion of inaccessible coastlines, and large number of scavenging sharks (Faerber and Baird 2010), as well as dominant currents that run parallel and westward towards the open ocean. Estimating the proportion of both near-shore and offshore dolphins that die and are found stranded would help clarify the percentage of stranded marine mammals across cetacean species that are likely to be detected during any type of shoreline survey in Hawaii versus those that are swept out to sea or consumed by scavengers.

In cases where strandings are reported from cetaceans with moderate to advanced decomposition, limited data and poor tissue quality make it unlikely that cause of death can be determined. At the other extreme, in only the freshest of dead cetaceans, new ear-fixation techniques employed within hours of death have the potential to be used to detect acoustic trauma using scanning electron microscopy (Morell et al. 2014). Gas bubble analysis represents another technique that requires the freshest of animals and highly specialized equipment, sample-collection training, and instrumentation for analysis. This analysis provides a means to evaluate the composition of gas bubbles observed in the vasculature of cetaceans during necropsy (Bernaldo de Quiros et al. 2011), providing an opportunity to contribute data to better understanding the complexities involved in gas bubble formation in cetaceans.

Many threats to Hawaiian cetacean populations have been identified as a result of stranding investigations in this region of the Pacific. Anthropogenic impacts to cetaceans include two cases in 2013 that received national media attention when five fish hooks, associated fishing gear, and a plastic bottle were recovered from the stomach of an endangered false killer whale, and a plastic bag was recovered from the esophagus of a Risso's dolphin. Two short-finned pilot whales that stranded in 2013 and 2014 each had approximately 25 pounds of debris in their stomachs, including fishing gear such as line, rope, and an eel trap, as well as trash bags. In 2014, a dead spinner dolphin struggled and drowned after becoming entangled in fishing net (West et al. unpublished data) and ship strikes have been observed in Hawaiian waters. Shootings have caused the death of Hawaiian monk seals and there are anecdotal reports of dolphins also being targeted on Hawaii Island. Cause-of-death investigations have resulted in the discovery of many infectious diseases in Hawaiian cetaceans. Perhaps most notably, morbillivirus was detected in a Longman's beaked whale that stranded in Maui in 2010, which is the first report of this virus in any marine mammal from the central Pacific (West et al. 2013).

Monitors have reported mortality in a Hawaiian spinner dolphin from *Cryptococcus gatti*, representing the first published report of this fungal disease in Hawaiian wildlife (Rotstein et al. 2010). *Brucella* has been identified from several Hawaiian cetaceans, including a rough-toothed dolphin and striped dolphin, and is believed to be the cause of mortality in a neonate sperm whale where morbillivirus was also identified (West et al. 2015). The first cetacean circovirus has been identified as well as four novel cetacean herpes viruses from this region (West and Waltzek, unpublished data) and most recently, toxoplasmosis was the cause of death in a stranded spinner dolphin. Other parasitic diseases have also been observed in stranded cetaceans in Hawaii. The ability to continue to obtain high quality data including necropsy results from stranding events is critical to monitoring the impacts of identified threats on Hawaiian cetacean populations as well as to gaining a better understanding of what role, if any, NTEs play when cetaceans strand in this region of the Pacific.

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A

List of Marine Mammal Sightings with Positions (GPS)

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Appendix A. List of Marine Mammal Sightings with Positions (GPS)

Date	Time (HST)	Species	# Individuals	Latitude (°N)	Longitude (°W)
11/18/10	7:51	Spinner Dolphin	23	21.27220	157.71500
11/18/10	8:10	Unidentified Dolphin	50	21.21820	157.28780
11/18/10	8:58	Spinner Dolphin	110	20.74710	156.85230
11/18/10	9:59	Spinner Dolphin	24	20.59260	156.60990
11/18/10	10:01	Spinner Dolphin	35	20.59020	156.60960
11/18/10	11:24	Spinner Dolphin	100	20.72110	156.45380
11/18/10	11:40	Unidentified Dolphin	12	20.60500	156.24070
11/18/10	12:45	Spinner Dolphin	36	19.47800	155.93060
11/18/10	14:20	Spinner Dolphin	15	20.64470	156.07660
11/18/10	15:27	Bottlenose Dolphin	1	21.22240	157.23870
11/22/10	7:44	Spinner Dolphin	40	21.26630	157.83170
11/22/10	8:22	Spinner Dolphin	28	21.08070	157.26020
11/22/10	8:49	Unidentified Dolphin	6	20.73990	156.97270
11/22/10	8:51	Spinner Dolphin	42	20.73060	156.94480
11/22/10	9:38	Spinner Dolphin	12	20.93490	156.69750
11/22/10	9:45	Unidentified Dolphin	1	20.81240	156.63150
11/22/10	10:44	Spinner Dolphin	50	20.59350	156.54900
11/22/10	10:48	Humpback Whale	1	20.60700	156.57810
11/22/10	10:51	Spinner Dolphin	52	20.59030	156.61230
11/22/10	12:09	Unidentified Dolphin	3	19.73480	156.05830
11/22/10	12:17	Spinner Dolphin	40	19.63700	155.99770
11/22/10	12:43	Unidentified Dolphin	5	19.47980	155.92820
11/22/10	13:40	False Killer Whale	5	19.91800	156.01320
11/22/10	14:57	Humpback Whale	1	21.15970	156.70790
02/28/11	8:07	Humpback Whale	3	21.27342	158.07467
02/28/11	8:15	Humpback Whale	2	21.30083	158.00723
02/28/11	8:28	Humpback Whale	2	21.31975	157.60860
02/28/11	8:35	Humpback Whale	2	21.24857	157.38885
02/28/11	8:36	Humpback Whale	1	21.23462	157.34712
02/28/11	8:39	Humpback Whale	2	21.19810	157.25587
02/28/11	8:48	Humpback Whale	2	21.08103	157.20635
02/28/11	8:49	Humpback Whale	2	21.08205	157.15760
02/28/11	8:51	Humpback Whale	2	21.08775	157.09815
02/28/11	8:53	Humpback Whale	1	21.07232	157.02712
02/28/11	8:55	Humpback Whale	1	21.05955	156.97905
02/28/11	8:58	Humpback Whale	2	21.03523	156.86908
02/28/11	8:59	Humpback Whale	6	21.04003	156.84302
02/28/11	9:02	Humpback Whale	1	21.08863	156.75222
02/28/11	9:04	Humpback Whale	1	21.12530	156.71873
02/28/11	9:08	Humpback Whale	2	21.10903	156.64160
02/28/11	9:10	Humpback Whale	1	21.05692	156.60188

Date	Time (HST)	Species	# Individuals	Latitude (°N)	Longitude (°W)
02/28/11	9:10	Humpback Whale	2	21.04958	156.59577
02/28/11	9:18	Humpback Whale	1	20.84233	156.67212
02/28/11	9:19	Humpback Whale	1	20.82093	156.64883
02/28/11	9:22	Humpback Whale	3	20.77735	156.56905
02/28/11	9:24	Humpback Whale	2	20.78643	156.50682
02/28/11	9:28	Humpback Whale	1	20.69530	156.45723
02/28/11	9:28	Humpback Whale	2	20.68892	156.45733
02/28/11	9:30	Humpback Whale	2	20.62647	156.46070
02/28/11	9:31	Humpback Whale	2	20.62252	156.48300
02/28/11	9:32	Humpback Whale	1	20.62647	156.50327
02/28/11	9:32	Humpback Whale	2	20.63787	156.50817
02/28/11	9:32	Humpback Whale	3	20.64128	156.49912
02/28/11	9:36	Humpback Whale	2	20.58673	156.42337
02/28/11	9:47	Unidentified Dolphin	3	20.64115	156.06673
02/28/11	9:54	Humpback Whale	2	20.65217	156.00078
02/28/11	10:10	Humpback Whale	2	20.12600	155.90388
02/28/11	10:14	Humpback Whale	2	20.02815	155.83977
02/28/11	10:14	Humpback Whale	2	20.02657	155.83920
02/28/11	10:15	Humpback Whale	1	19.97555	155.85272
02/28/11	10:19	Humpback Whale	2	19.88878	155.91802
02/28/11	10:19	Humpback Whale	2	19.88757	155.91912
02/28/11	10:21	Humpback Whale	2	19.85075	155.97805
02/28/11	10:25	Spinner Dolphin	7	19.75060	156.06162
02/28/11	12:20	Spinner Dolphin	35	19.74167	156.05427
02/28/11	13:36	Humpback Whale	3	19.74715	156.06127
02/28/11	13:39	Humpback Whale	1	19.83610	155.99240
02/28/11	13:39	Humpback Whale	1	19.83717	155.99117
02/28/11	13:44	Humpback Whale	3	19.93600	155.89092
02/28/11	13:46	Humpback Whale	2	19.98725	155.83792
02/28/11	13:51	Humpback Whale	2	20.11438	155.89260
02/28/11	13:53	Humpback Whale	1	20.16705	155.90910
02/28/11	13:53	Humpback Whale	1	20.16843	155.90957
02/28/11	13:56	Humpback Whale	2	20.25182	155.89282
02/28/11	13:57	Humpback Whale	1	20.28515	155.88763
02/28/11	14:00	Humpback Whale	2	20.32400	155.95062
02/28/11	14:19	Humpback Whale	1	20.58208	156.52687
02/28/11	14:19	Humpback Whale	1	20.59367	156.54562
02/28/11	14:20	Humpback Whale	2	20.60650	156.56268
02/28/11	14:21	Humpback Whale	1	20.60862	156.58035
02/28/11	14:21	Spinner Dolphin	50	20.60375	156.59965
02/28/11	14:30	Humpback Whale	1	20.49953	156.64560
02/28/11	14:31	Humpback Whale	1	20.50147	156.62930
02/28/11	14:33	Humpback Whale	1	20.50720	156.55395
02/28/11	14:36	Humpback Whale	1	20.59113	156.54220
02/28/11	14:57	Humpback Whale	2	20.92627	157.04012

Date	Time (HST)	Species	# Individuals	Latitude (°N)	Longitude (°W)
02/28/11	14:58	Humpback Whale	2	20.93302	157.02302
02/28/11	14:58	Humpback Whale	2	20.93462	157.01458
02/28/11	15:03	Humpback Whale	1	20.88630	156.84548
02/28/11	15:04	Humpback Whale	2	20.86322	156.82252
02/28/11	15:05	Humpback Whale	1	20.83543	156.79943
02/28/11	15:09	Humpback Whale	2	20.73625	156.87367
02/28/11	15:10	Humpback Whale	2	20.73260	156.88697
02/28/11	15:11	Humpback Whale	1	20.72303	156.92525
03/05/11	7:56	Humpback Whale	1	21.13562	157.34898
03/05/11	8:02	Humpback Whale	1	21.08195	157.15027
03/05/11	8:02	Humpback Whale	1	21.08207	157.13435
03/05/11	8:07	Humpback Whale	1	21.05728	156.97110
03/05/11	8:09	Humpback Whale	2	21.05215	156.92088
03/05/11	8:12	Humpback Whale	2	21.03665	156.89653
03/05/11	8:18	Humpback Whale	2	21.12357	156.72195
03/05/11	8:20	Humpback Whale	1	21.17315	156.73298
03/05/11	8:21	Humpback Whale	3	21.19013	156.71910
03/05/11	8:25	Humpback Whale	1	21.06102	156.65338
03/05/11	8:29	Humpback Whale	1	20.95105	156.69793
03/05/11	8:32	Humpback Whale	1	20.85197	156.67308
03/05/11	8:34	Humpback Whale	1	20.82497	156.64618
03/05/11	8:34	Humpback Whale	1	20.81945	156.64028
03/05/11	8:34	Humpback Whale	1	20.80788	156.62917
03/05/11	8:35	Pilot Whale	2	20.80112	156.61615
03/05/11	8:38	Humpback Whale	1	20.77368	156.51835
03/05/11	8:39	Humpback Whale	1	20.78772	156.50003
03/05/11	8:41	Humpback Whale	1	20.72618	156.46092
03/05/11	8:43	Humpback Whale	1	20.66737	156.45257
03/05/11	8:51	Humpback Whale	1	20.59607	156.24987
03/05/11	9:02	Humpback Whale	1	20.74402	155.97438
03/05/11	9:18	Humpback Whale	1	20.30287	155.87227
03/05/11	9:27	Bottlenose Dolphin	5	20.10842	155.89207
03/05/11	9:28	Humpback Whale	1	20.09108	155.88172
03/05/11	9:33	Humpback Whale	1	19.95102	155.87407
03/05/11	9:35	Humpback Whale	1	19.89377	155.91355
03/05/11	9:40	Humpback Whale	1	19.80397	156.02305
03/05/11	12:01	Humpback Whale	3	19.72125	156.05918
03/05/11	12:32	Humpback Whale	2	20.57717	156.53110
03/05/11	12:32	Humpback Whale	3	20.58348	156.53408
03/05/11	12:32	Humpback Whale	1	20.59692	156.54693
03/05/11	12:45	Humpback Whale	1	20.61350	156.68778
03/05/11	12:52	Humpback Whale	1	20.80742	156.79722
03/05/11	12:52	Humpback Whale	3	20.81468	156.79710
03/05/11	12:53	Humpback Whale	2	20.84085	156.80820

Date	Time (HST)	Species	# Individuals	Latitude (°N)	Longitude (°W)
03/05/11	12:54	Humpback Whale	1	20.87795	156.83577
03/05/11	12:55	Humpback Whale	2	20.88760	156.84683
03/05/11	12:55	Humpback Whale	1	20.89970	156.86323
03/05/11	13:14	Spinner Dolphin	50	20.74112	156.87853
03/05/11	13:18	Humpback Whale	1	20.81748	156.79993
03/05/11	13:18	Humpback Whale	2	20.81928	156.80012
03/05/11	13:18	Humpback Whale	1	20.82108	156.80038
03/05/11	13:20	Humpback Whale	1	20.88085	156.84157
03/05/11	13:20	Humpback Whale	1	20.88760	156.84880
03/05/11	13:21	Humpback Whale	1	20.90825	156.87235
03/05/11	13:21	Humpback Whale	2	20.90940	156.87393
03/05/11	13:22	Humpback Whale	1	20.91927	156.88858
03/05/11	13:22	Humpback Whale	1	20.92925	156.91855
03/05/11	13:23	Humpback Whale	1	20.93392	156.94020
03/05/11	13:24	Humpback Whale	1	20.94082	157.00003
03/05/11	13:29	Humpback Whale	1	20.96472	157.16172
03/05/11	13:34	Humpback Whale	1	21.05118	157.38450
03/05/11	13:35	Humpback Whale	1	21.05620	157.40237
03/05/11	13:35	Humpback Whale	1	21.06008	157.41815
03/05/11	13:36	Humpback Whale	1	21.06633	157.44675
03/05/11	13:38	Humpback Whale	3	21.08398	157.52388
02/23/12	8:52	Humpback Whale	1	22.18502	159.29625
02/23/12	8:54	Humpback Whale	1	22.23633	159.37362
02/23/12	8:56	Humpback Whale	1	22.24322	159.44107
02/23/12	8:57	Humpback Whale	2	22.24283	159.45180
02/23/12	8:58	Humpback Whale	1	22.23727	159.51405
02/23/12	8:59	Humpback Whale	3	22.23785	159.53730
02/23/12	9:00	Humpback Whale	1	22.23798	159.55535
02/23/12	9:02	Humpback Whale	2	22.21487	159.62790
02/23/12	9:02	Humpback Whale	4	22.21090	159.63903
02/23/12	9:04	Humpback Whale	1	22.22620	159.70307
02/23/12	9:06	Humpback Whale	1	22.23057	159.69290
02/23/12	9:09	Humpback Whale	1	22.14633	159.74397
02/23/12	9:10	Humpback Whale	2	22.16122	159.74210
02/23/12	9:10	Humpback Whale	1	22.16122	159.74210
02/23/12	9:11	Humpback Whale	2	22.16503	159.75760
02/23/12	9:12	Humpback Whale	2	22.13657	159.76258
02/23/12	9:13	Humpback Whale	1	22.10842	159.77038
02/23/12	9:15	Spinner Dolphin	70	22.07660	159.79065
02/23/12	9:24	Humpback Whale	2	22.04478	159.80383
02/23/12	9:25	Humpback Whale	2	22.04278	159.81235
02/23/12	9:25	Humpback Whale	2	22.05287	159.81863
02/23/12	9:28	Humpback Whale	1	22.04545	159.89360
02/23/12	9:28	Humpback Whale	1	22.04407	159.90353

Date	Time (HST)	Species	# Individuals	Latitude (°N)	Longitude (°W)
02/23/12	9:30	Humpback Whale	1	22.03795	159.97653
02/23/12	9:30	Humpback Whale	1	22.03973	159.97950
02/23/12	9:32	Humpback Whale	1	22.04455	160.04522
02/23/12	9:33	Humpback Whale	1	22.03590	160.07032
02/23/12	9:39	Humpback Whale	2	21.98063	160.04360
02/23/12	9:39	Humpback Whale	2	21.99355	160.04732
02/23/12	9:43	Humpback Whale	2	22.01357	160.06773
02/23/12	9:45	Hawaiian Monk Seal	2	22.00255	160.08272
02/23/12	9:49	Humpback Whale	2	21.97347	160.12678
02/23/12	9:50	Humpback Whale	1	21.97670	160.15457
02/23/12	9:51	Humpback Whale	2	21.96993	160.16243
02/23/12	9:52	Humpback Whale	2	21.94150	160.16585
02/23/12	9:54	Humpback Whale	2	21.91163	160.20617
02/23/12	9:55	Humpback Whale	1	21.88488	160.23698
02/23/12	9:56	Humpback Whale	1	21.85380	160.24788
02/23/12	9:57	Humpback Whale	1	21.82425	160.25480
02/23/12	9:59	Humpback Whale	1	21.79180	160.23828
02/23/12	10:01	Humpback Whale	2	21.79093	160.19228
02/23/12	10:03	Humpback Whale	1	21.84332	160.15878
02/23/12	10:04	Humpback Whale	1	21.85643	160.14090
02/23/12	10:12	Humpback Whale	1	21.97358	159.97283
02/23/12	10:12	Humpback Whale	1	21.97422	159.97123
02/23/12	10:14	Humpback Whale	1	21.99277	159.92493
02/23/12	10:17	Humpback Whale	3	22.01498	159.82067
02/23/12	10:21	Humpback Whale	2	21.95850	159.72410
02/23/12	10:26	Humpback Whale	1	21.89950	159.62623
02/23/12	10:28	Humpback Whale	1	21.88227	159.56255
02/25/12	9:04	Humpback Whale	2	21.86272	159.44857
02/25/12	9:07	Hawaiian Monk Seal	1	21.89338	159.39692
02/25/12	9:14	Hawaiian Monk Seal	1	22.01985	159.33257
02/25/12	9:18	Humpback Whale	4	22.11895	159.28882
02/25/12	9:20	Hawaiian Monk Seal	1	22.16813	159.30307
02/25/12	9:32	Humpback Whale	1	22.23017	159.56998
02/25/12	9:32	Hawaiian Monk Seal	1	22.23012	159.57853
02/25/12	9:35	Humpback Whale	2	22.18625	159.64967
02/25/12	9:37	Spinner Dolphin	50	22.17540	159.66295
02/25/12	9:41	Humpback Whale	1	22.12620	159.73902
02/25/12	9:41	Hawaiian Monk Seal	2	22.11813	159.74267
02/25/12	9:45	Humpback Whale	2	22.02977	159.79342
02/25/12	9:46	Hawaiian Monk Seal	1	22.00238	159.78012
02/25/12	9:49	Humpback Whale	2	21.95940	159.80835
02/25/12	10:07	Hawaiian Monk Seal	1	22.00168	160.10557
02/25/12	10:08	Humpback Whale	2	21.98175	160.11867
02/25/12	10:11	Humpback Whale	2	21.94195	160.16675

Date	Time (HST)	Species	# Individuals	Latitude (°N)	Longitude (°W)
02/25/12	10:11	Hawaiian Monk Seal	1	21.93752	160.16923
02/25/12	10:12	Hawaiian Monk Seal	1	21.93222	160.17375
02/25/12	10:12	Hawaiian Monk Seal	1	21.93110	160.18297
02/25/12	10:13	Humpback Whale	2	21.91633	160.20177
02/25/12	10:14	Hawaiian Monk Seal	1	21.90377	160.21360
02/25/12	10:15	Hawaiian Monk Seal	2	21.89815	160.21988
02/25/12	10:15	Hawaiian Monk Seal	1	21.89360	160.22690
02/25/12	10:16	Hawaiian Monk Seal	4	21.86505	160.23687
02/25/12	10:16	Hawaiian Monk Seal	1	21.86375	160.23615
02/25/12	10:21	Humpback Whale	4	21.77888	160.21108
02/25/12	10:24	Humpback Whale	2	21.82720	160.17653
02/25/12	10:29	Humpback Whale	1	21.87807	160.10393
02/25/12	10:30	Humpback Whale	3	21.90873	160.07095
02/25/12	10:35	Humpback Whale	1	21.98135	160.00288
02/25/12	10:43	Humpback Whale	1	21.97488	159.77038
02/25/12	10:44	Hawaiian Monk Seal	1	21.96802	159.74262
02/25/12	10:45	Hawaiian Monk Seal	1	21.95455	159.70587
02/25/12	10:46	Hawaiian Monk Seal	1	21.94520	159.67312
02/25/12	10:47	Hawaiian Monk Seal	1	21.93212	159.65632
08/20/13	9:16	Bottlenose Dolphin	16	22.23807	159.54695
08/20/13	9:33	Spinner Dolphin	12	22.07042	159.78213
08/20/13	9:38	Bottlenose Dolphin	2	22.03193	159.79853
08/20/13	10:33	Hawaiian Monk Seal	1	21.97295	160.05568
08/20/13	10:38	Hawaiian Monk Seal	3	21.87563	160.12651
08/20/13	10:40	Hawaiian Monk Seal	2	21.87125	160.14204
08/20/13	10:45	Hawaiian Monk Seal	1	21.78656	160.20269
08/20/13	10:52	Hawaiian Monk Seal	1	21.85458	160.24062
08/20/13	10:52	Hawaiian Monk Seal	1	21.86128	160.23715
08/20/13	10:53	Hawaiian Monk Seal	2	21.86742	160.23571
08/20/13	10:54	Spinner Dolphin	130	21.88200	160.22959
08/20/13	10:57	Hawaiian Monk Seal	1	21.90705	160.20763
08/20/13	11:01	Hawaiian Monk Seal	1	21.94635	160.14680
08/20/13	11:04	Hawaiian Monk Seal	2	21.96448	160.12189
08/20/13	11:09	Hawaiian Monk Seal	2	22.00034	160.07561
08/20/13	11:11	Hawaiian Monk Seal	1	21.99456	160.05646
08/20/13	11:41	Hawaiian Monk Seal	1	21.88288	159.52383
08/20/13	11:41	Hawaiian Monk Seal	1	21.88352	159.52197
08/22/13	9:38	Hawaiian Monk Seal	1	21.95883	160.06807
08/22/13	9:39	Hawaiian Monk Seal	1	21.97527	160.05620
08/22/13	9:43	Hawaiian Monk Seal	2	22.00067	160.07430
08/22/13	9:43	Hawaiian Monk Seal	2	22.00050	160.07458
08/22/13	9:44	Hawaiian Monk Seal	1	22.00503	160.08788
08/22/13	9:45	Hawaiian Monk Seal	1	22.00519	160.08921
08/22/13	9:46	Hawaiian Monk Seal	1	22.00338	160.08957

Date	Time (HST)	Species	# Individuals	Latitude (°N)	Longitude (°W)
08/22/13	9:46	Hawaiian Monk Seal	1	22.00272	160.09204
08/22/13	9:46	Hawaiian Monk Seal	2	22.00195	160.09350
08/22/13	9:47	Hawaiian Monk Seal	1	22.00123	160.09604
08/22/13	9:48	Hawaiian Monk Seal	1	21.99805	160.10676
08/22/13	9:48	Hawaiian Monk Seal	2	21.99584	160.10882
08/22/13	9:50	Hawaiian Monk Seal	1	21.98238	160.11507
08/22/13	9:50	Hawaiian Monk Seal	2	21.98157	160.11543
08/22/13	9:53	Hawaiian Monk Seal	3	21.94148	160.16032
08/22/13	9:54	Hawaiian Monk Seal	1	21.92808	160.17998
08/22/13	9:55	Hawaiian Monk Seal	1	21.92330	160.18916
08/22/13	9:55	Hawaiian Monk Seal	1	21.91721	160.19568
08/22/13	9:57	Hawaiian Monk Seal	1	21.89960	160.21105
08/22/13	9:59	Hawaiian Monk Seal	2	21.85000	160.24313
08/22/13	10:02	Hawaiian Monk Seal	1	21.79225	160.23472
08/22/13	10:05	Hawaiian Monk Seal	2	21.78102	160.19978
08/22/13	10:09	Hawaiian Monk Seal	3	21.87072	160.13848
08/22/13	11:24	Spinner Dolphin	45	22.09872	159.75587
08/22/13	11:30	Unidentified Dolphin	22	22.18988	159.64652
08/22/13	12:36	Unidentified Dolphin	8	21.95665	159.32715
01/31/14	13:15	Humpback Whale	1	21.99200	159.35400
01/31/14	13:16	Humpback Whale	2	21.95500	159.32400
01/31/14	13:19	Humpback Whale	1	21.92800	159.34800
01/31/14	13:20	Humpback Whale	2	21.90400	159.36600
01/31/14	13:21	Hawaiian Monk Seal	4	21.91900	159.37100
01/31/14	13:37	Humpback Whale	2	21.88900	159.48700
01/31/14	13:40	Humpback Whale	3	21.85800	159.49200
01/31/14	13:44	Humpback Whale	1	21.87000	159.52400
01/31/14	13:45	Hawaiian Monk Seal	2	21.88300	159.52500
01/31/14	13:46	Hawaiian Monk Seal	1	21.88700	159.54100
01/31/14	13:53	Hawaiian Monk Seal	1	21.93400	159.64900
01/31/14	13:55	Humpback Whale	1	21.93600	159.67100
01/31/14	13:58	Humpback Whale	1	21.94700	159.72400
01/31/14	14:00	Humpback Whale	5	21.95400	159.73700
01/31/14	14:01	Humpback Whale	1	21.99500	159.74200
01/31/14	14:02	Humpback Whale	2	21.97900	159.78000
01/31/14	14:03	Humpback Whale	1	21.98700	159.78900
01/31/14	14:18	Hawaiian Monk Seal	1	21.99600	159.76900
01/31/14	14:22	Humpback Whale	2	21.99200	159.77700
01/31/14	14:23	Humpback Whale	1	21.99000	159.78200
01/31/14	14:24	Humpback Whale	1	21.98800	159.78700
01/31/14	14:27	Humpback Whale	1	21.98900	159.78300
01/31/14	14:27	Humpback Whale	2	21.99200	159.77800
01/31/14	14:29	Hawaiian Monk Seal	1	21.99600	159.77000
01/31/14	14:33	Humpback Whale	2	21.98900	159.78500

Date	Time (HST)	Species	# Individuals	Latitude (°N)	Longitude (°W)
01/31/14	14:34	Humpback Whale	1	21.98300	159.79800
01/31/14	14:36	Humpback Whale	1	22.13900	159.29500
01/31/14	14:37	Humpback Whale	3	22.14900	159.27900
01/31/14	14:40	Humpback Whale	3	22.09400	159.28500
01/31/14	14:41	Humpback Whale	1	22.07500	159.28700
01/31/14	14:42	Humpback Whale	1	22.07000	159.28900
01/31/14	14:44	Humpback Whale	3	22.07600	159.29600
01/31/14	14:45	Humpback Whale	1	22.11400	159.28400
01/31/14	14:48	Humpback Whale	3	22.19800	159.31400
01/31/14	14:48	Humpback Whale	3	22.21200	159.32000
01/31/14	14:51	Humpback Whale	3	22.23900	159.41000
01/31/14	14:56	Humpback Whale	2	22.23800	159.51100
01/31/14	14:58	Hawaiian Monk Seal	1	22.22400	159.57000
01/31/14	15:01	Humpback Whale	1	22.19300	159.66400
01/31/14	15:03	Spinner dolphin	12	22.18300	159.68900
01/31/14	15:07	Hawaiian Monk Seal	2	22.14000	159.71900
01/31/14	15:07	Humpback Whale	2	22.14100	159.74300
01/31/14	15:08	Humpback Whale	1	22.12000	159.76400
01/31/14	15:10	Humpback Whale	8	22.08400	159.79200
01/31/14	15:12	Humpback Whale	1	22.04300	159.80200
01/31/14	15:12	Humpback Whale	2	22.02700	159.79700
01/31/14	15:17	Humpback Whale	1	21.96200	159.72700
01/31/14	15:20	Humpback Whale	5	21.91200	159.65600
01/31/14	15:22	Humpback Whale	5	21.88200	159.60700
01/31/14	15:25	Hawaiian Monk Seal	2	21.88600	159.51600
01/31/14	15:30	Humpback Whale	1	21.87800	159.41400
01/31/14	15:31	Humpback Whale	1	21.88900	159.38900
01/31/14	15:31	Hawaiian Monk Seal	1	21.90600	159.39400
01/31/14	15:32	Hawaiian Monk Seal	6	21.92300	159.37500
01/31/14	15:34	Humpback Whale	3	21.92100	159.35400
01/31/14	15:36	Humpback Whale	2	21.91600	159.35200
01/31/14	15:36	Humpback Whale	1	21.91100	159.35100
01/31/14	15:37	Humpback Whale	3	21.93000	159.35800
02/05/14	8:40	Humpback Whale	2	22.02300	159.32900
02/05/14	8:42	Humpback Whale	1	21.99100	159.32300
02/05/14	8:45	Humpback Whale	1	21.94800	159.33600
02/05/14	8:48	Hawaiian Monk Seal	2	21.92000	159.37700
02/05/14	8:48	Humpback Whale	2	21.91400	159.37600
02/05/14	8:49	Humpback Whale	1	21.89100	159.39000
02/05/14	8:50	Humpback Whale	1	21.88000	159.39900
02/05/14	8:51	Hawaiian Monk Seal	1	21.88500	159.41800
02/05/14	8:51	Humpback Whale	2	21.85800	159.40600
02/05/14	8:59	Humpback Whale	3	21.86600	159.57600
02/05/14	9:10	Humpback Whale	1	21.96000	159.74700

Date	Time (HST)	Species	# Individuals	Latitude (°N)	Longitude (°W)
02/05/14	9:23	Bottlenose dolphin	1	22.16200	159.69900
02/05/14	9:28	Humpback Whale	3	22.21200	159.61700
02/05/14	9:42	Humpback Whale	3	22.24000	159.39000
02/05/14	9:47	Humpback Whale	2	22.22000	159.35400
02/05/14	9:49	Unidentified Dolphin	1	22.20600	159.32700
02/05/14	9:50	Unidentified Dolphin	20	22.21200	159.33100
02/05/14	9:52	Humpback Whale	5	22.20400	159.32600
02/05/14	9:53	Humpback Whale	1	22.20400	159.31200
02/05/14	9:57	Hawaiian Monk Seal	1	22.14600	159.29500
02/05/14	10:00	Humpback Whale	9	22.12400	159.27400
02/05/14	10:02	Humpback Whale	2	22.09400	159.29200
02/05/14	10:04	Humpback Whale	2	22.07700	159.30300
02/05/14	10:04	Humpback Whale	2	22.06900	159.30500
02/05/14	10:06	Humpback Whale	1	22.04100	159.32000
08/01/14	8:38	Hawaiian Monk Seal	1	21.16100	157.27800
08/01/14	8:41	Hawaiian Monk Seal	1	21.12100	157.30400
08/01/14	8:44	Hawaiian Monk Seal	1	21.08700	157.26400
08/01/14	8:50	Hawaiian Monk Seal	1	21.09400	157.12500
08/01/14	8:57	Hawaiian Monk Seal	1	21.06700	156.97600
08/01/14	9:24	Spinner dolphin	4	20.98200	156.67800
08/01/14	10:46	Unidentified med cetacean	1	20.77200	156.80000
08/01/14	10:48	Spinner dolphin	100	20.76900	156.83000
08/01/14	10:54	Unidentified Small Dolphin	40	20.72900	156.95200
08/01/14	11:00	Spinner dolphin	40	20.85000	157.01500
08/04/14	9:29	Hawaiian Monk Seal	1	21.30200	157.91000
08/04/14	10:30	Spinner dolphin	90	21.45800	158.22000
08/04/14	10:39	Hawaiian Monk Seal	2	21.36800	158.14300
08/04/14	12:21	Hawaiian Monk Seal	2	21.08800	157.26600
08/04/14	12:21	Hawaiian Monk Seal	1	21.08600	157.26000
08/04/14	12:25	Hawaiian Monk Seal	1	21.08900	157.18100
08/05/14	8:37	Spinner dolphin	50	21.13000	157.30100
08/05/14	8:43	Hawaiian Monk Seal	3	21.09900	157.30400
08/05/14	8:48	Hawaiian Monk Seal	1	21.08700	157.25900
08/05/14	8:53	Hawaiian Monk Seal	1	21.08900	157.19700
08/05/14	11:23	Spinner dolphin	6	20.71300	156.44700
08/06/14	10:20	Spinner dolphin	150	21.34000	158.12900

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B

List of Turtle Sightings with Positions (GPS)

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Appendix B. List of Turtle Sightings with Positions (GPS)

Date	Time (HST)	Species	# Individuals	Latitude (°N)	Longitude (°W)
11/18/2010	07:47:34	Unidentified Hardshell Turtle	1	21.26730	157.83230
11/18/2010	07:50:28	Unidentified Hardshell Turtle	1	21.26810	157.76600
11/18/2010	07:54:43	Unidentified Hardshell Turtle	2	21.25650	157.70350
11/18/2010	08:15:23	Unidentified Hardshell Turtle	8	21.17560	157.26340
11/18/2010	08:19:28	Unidentified Hardshell Turtle	1	21.08970	157.29890
11/18/2010	08:21:28	Unidentified Hardshell Turtle	1	21.07930	157.25470
11/18/2010	08:35:38	Unidentified Hardshell Turtle	2	20.96080	157.00950
11/18/2010	09:01:38	Unidentified Hardshell Turtle	1	20.76940	156.82400
11/18/2010	09:02:08	Unidentified Hardshell Turtle	3	20.78020	156.81700
11/18/2010	09:02:33	Unidentified Hardshell Turtle	1	20.78920	156.81060
11/18/2010	09:02:48	Unidentified Hardshell Turtle	5	20.79480	156.80710
11/18/2010	09:07:48	Unidentified Hardshell Turtle	1	20.90060	156.87210
11/18/2010	09:10:08	Unidentified Hardshell Turtle	1	20.92670	156.93220
11/18/2010	09:12:43	Unidentified Hardshell Turtle	1	20.94630	157.00730
11/18/2010	09:18:03	Unidentified Hardshell Turtle	1	21.07130	157.00010
11/18/2010	09:28:28	Unidentified Hardshell Turtle	1	21.10450	156.74130
11/18/2010	09:29:33	Unidentified Hardshell Turtle	1	21.12460	156.72070
11/18/2010	09:35:08	Unidentified Hardshell Turtle	1	21.01300	156.65070
11/18/2010	09:36:43	Unidentified Hardshell Turtle	6	20.98150	156.67970
11/18/2010	09:37:53	Unidentified Hardshell Turtle	2	20.95100	156.69400
11/18/2010	09:38:48	Unidentified Hardshell Turtle	3	20.93380	156.70140
11/18/2010	09:40:08	Unidentified Hardshell Turtle	1	20.92200	156.69890
11/18/2010	09:42:43	Unidentified Hardshell Turtle	1	20.86400	156.67820
11/18/2010	09:44:48	Unidentified Hardshell Turtle	1	20.82010	156.63740
11/18/2010	09:48:58	Unidentified Hardshell Turtle	2	20.78970	156.58150
11/18/2010	09:51:28	Unidentified Hardshell Turtle	1	20.78160	156.51350
11/18/2010	11:23:47	Unidentified Hardshell Turtle	5	20.72990	156.45700
11/18/2010	11:27:48	Unidentified Hardshell Turtle	2	20.69250	156.44790
11/18/2010	11:29:36	Unidentified Hardshell Turtle	1	20.65010	156.44740
11/18/2010	12:02:24	Unidentified Hardshell Turtle	1	20.26400	155.90350
11/18/2010	12:10:26	Unidentified Hardshell Turtle	1	20.12030	155.88980
11/18/2010	14:27:30	Unidentified Hardshell Turtle	1	20.74070	155.98000
11/18/2010	14:48:02	Unidentified Hardshell Turtle	6	20.92020	156.39070
11/18/2010	14:51:38	Unidentified Hardshell Turtle	1	20.90810	156.47650
11/22/2010	07:46:19	Unidentified Hardshell Turtle	1	21.26970	157.83800
11/22/2010	07:56:28	Unidentified Hardshell Turtle	1	21.28100	157.67080
11/22/2010	07:56:38	Unidentified Hardshell Turtle	1	21.28390	157.66700
11/22/2010	07:56:58	Unidentified Hardshell Turtle	1	21.28900	157.65920
11/22/2010	07:57:08	Unidentified Hardshell Turtle	1	21.29160	157.65550
11/22/2010	08:31:18	Unidentified Hardshell Turtle	2	21.07670	157.02800
11/22/2010	09:07:48	Unidentified Hardshell Turtle	1	20.90060	156.87210
11/22/2010	09:08:53	Unidentified Hardshell Turtle	2	20.91790	156.89690

Date	Time (HST)	Species	# Individuals	Latitude (°N)	Longitude (°W)
11/22/2010	09:08:58	Unidentified Hardshell Turtle	1	20.91900	156.89920
11/22/2010	09:09:53	Unidentified Hardshell Turtle	1	20.92590	156.92510
11/22/2010	09:10:18	Unidentified Hardshell Turtle	2	20.92730	156.93720
11/22/2010	09:11:13	Unidentified Hardshell Turtle	1	20.93010	156.96650
11/22/2010	09:11:18	Unidentified Hardshell Turtle	1	20.93060	156.96920
11/22/2010	09:17:18	Unidentified Hardshell Turtle	1	21.07240	157.02160
11/22/2010	09:18:58	Unidentified Hardshell Turtle	1	21.06450	156.97550
11/22/2010	09:19:23	Unidentified Hardshell Turtle	5	21.06180	156.96480
11/22/2010	09:25:48	Unidentified Hardshell Turtle	1	21.06440	156.79900
11/22/2010	09:25:53	Unidentified Hardshell Turtle	1	21.06530	156.79710
11/22/2010	09:26:53	Unidentified Hardshell Turtle	2	21.07870	156.77490
11/22/2010	09:27:23	Unidentified Hardshell Turtle	1	21.08680	156.76420
11/22/2010	09:27:53	Unidentified Hardshell Turtle	3	21.09470	156.75350
11/22/2010	09:28:13	Unidentified Hardshell Turtle	1	21.10000	156.74630
11/22/2010	09:28:48	Unidentified Hardshell Turtle	1	21.11070	156.73510
11/22/2010	09:29:03	Unidentified Hardshell Turtle	2	21.11570	156.73090
11/22/2010	09:37:53	Unidentified Hardshell Turtle	1	20.95100	156.69400
11/22/2010	09:39:53	Unidentified Hardshell Turtle	2	20.92730	156.69740
11/22/2010	09:40:43	Unidentified Hardshell Turtle	1	20.90960	156.69480
11/22/2010	09:40:58	Unidentified Hardshell Turtle	1	20.90470	156.69150
11/22/2010	09:41:03	Unidentified Hardshell Turtle	1	20.90270	156.69090
11/22/2010	09:41:08	Unidentified Hardshell Turtle	1	20.90080	156.69020
11/22/2010	09:41:48	Unidentified Hardshell Turtle	3	20.88430	156.69060
11/22/2010	09:43:13	Unidentified Hardshell Turtle	1	20.85350	156.66810
11/22/2010	09:44:28	Unidentified Hardshell Turtle	2	20.82690	156.64460
11/22/2010	09:44:38	Unidentified Hardshell Turtle	1	20.82360	156.64090
11/22/2010	09:46:58	Unidentified Hardshell Turtle	1	20.81340	156.63240
11/22/2010	09:47:53	Unidentified Hardshell Turtle	1	20.80370	156.61000
11/22/2010	09:48:03	Unidentified Hardshell Turtle	5	20.80180	156.60540
11/22/2010	09:50:18	Unidentified Hardshell Turtle	1	20.77460	156.54400
11/22/2010	09:50:33	Unidentified Hardshell Turtle	1	20.77180	156.53700
11/22/2010	09:51:33	Unidentified Hardshell Turtle	1	20.78320	156.51190
11/22/2010	09:51:48	Unidentified Hardshell Turtle	2	20.78830	156.50720
11/22/2010	10:33:13	Unidentified Hardshell Turtle	1	20.78650	156.47620
11/22/2010	10:33:48	Unidentified Hardshell Turtle	1	20.77560	156.46340
11/22/2010	10:34:18	Unidentified Hardshell Turtle	1	20.76150	156.46270
11/22/2010	10:34:58	Unidentified Hardshell Turtle	3	20.74340	156.46070
11/22/2010	10:35:23	Unidentified Hardshell Turtle	4	20.73210	156.45710
11/22/2010	10:35:43	Unidentified Hardshell Turtle	1	20.72370	156.45180
11/22/2010	10:36:18	Unidentified Hardshell Turtle	1	20.70800	156.44950
11/22/2010	10:36:28	Unidentified Hardshell Turtle	1	20.70340	156.44940
11/22/2010	10:36:38	Unidentified Hardshell Turtle	1	20.69910	156.44940
11/22/2010	10:36:58	Unidentified Hardshell Turtle	1	20.69030	156.44810
11/22/2010	10:37:08	Unidentified Hardshell Turtle	1	20.68580	156.44770
11/22/2010	10:37:13	Unidentified Hardshell Turtle	1	20.68350	156.44780

Date	Time (HST)	Species	# Individuals	Latitude (°N)	Longitude (°W)
11/22/2010	10:37:18	Unidentified Hardshell Turtle	1	20.68130	156.44780
11/22/2010	10:37:33	Unidentified Hardshell Turtle	1	20.67460	156.44790
11/22/2010	10:37:38	Unidentified Hardshell Turtle	1	20.67230	156.44790
11/22/2010	10:38:18	Unidentified Hardshell Turtle	1	20.65450	156.44710
11/22/2010	10:38:23	Unidentified Hardshell Turtle	1	20.65240	156.44740
11/22/2010	10:39:03	Unidentified Hardshell Turtle	1	20.63660	156.45490
11/22/2010	10:40:03	Unidentified Hardshell Turtle	1	20.61480	156.44330
11/22/2010	11:04:48	Unidentified Hardshell Turtle	1	20.51210	156.54220
11/22/2010	11:05:43	Unidentified Hardshell Turtle	1	20.52950	156.53010
11/22/2010	11:11:38	Unidentified Hardshell Turtle	2	20.59270	156.43400
11/22/2010	11:11:43	Unidentified Hardshell Turtle	1	20.59290	156.43160
11/22/2010	11:11:58	Unidentified Hardshell Turtle	1	20.59260	156.42450
11/22/2010	14:40:11	Unidentified Hardshell Turtle	1	20.94040	156.34880
11/22/2010	14:41:06	Unidentified Hardshell Turtle	2	20.93160	156.37300
02/28/2011	08:05:06	Unidentified Hardshell Turtle	2	21.33168	158.13332
02/28/2011	08:09:27	Unidentified Hardshell Turtle	2	21.30028	158.12182
02/28/2011	08:16:00	Unidentified Hardshell Turtle	1	21.30318	157.97492
02/28/2011	08:16:21	Unidentified Hardshell Turtle	1	21.30107	157.96305
02/28/2011	08:16:57	Unidentified Hardshell Turtle	3	21.29668	157.94278
02/28/2011	08:17:24	Unidentified Hardshell Turtle	3	21.29547	157.92755
02/28/2011	08:18:12	Unidentified Hardshell Turtle	3	21.29448	157.90008
02/28/2011	08:22:09	Unidentified Hardshell Turtle	1	21.25543	157.78263
02/28/2011	08:23:12	Unidentified Hardshell Turtle	1	21.26795	157.74943
02/28/2011	08:52:15	Unidentified Hardshell Turtle	6	21.08432	157.07633
02/28/2011	08:52:36	Unidentified Hardshell Turtle	1	21.08373	157.06470
02/28/2011	08:53:00	Unidentified Hardshell Turtle	4	21.08042	157.05177
02/28/2011	08:53:21	Unidentified Hardshell Turtle	1	21.07693	157.04078
02/28/2011	08:55:39	Unidentified Hardshell Turtle	2	21.05702	156.96975
02/28/2011	08:56:03	Unidentified Hardshell Turtle	7	21.05377	156.95737
02/28/2011	08:57:27	Unidentified Hardshell Turtle	3	21.04270	156.91305
02/28/2011	09:01:42	Unidentified Hardshell Turtle	1	21.06483	156.78205
02/28/2011	09:02:18	Unidentified Hardshell Turtle	1	21.07765	156.76658
02/28/2011	09:03:27	Unidentified Hardshell Turtle	1	21.10172	156.73750
02/28/2011	09:12:09	Unidentified Hardshell Turtle	1	21.03025	156.64438
02/28/2011	09:13:39	Unidentified Hardshell Turtle	1	20.99503	156.67993
03/05/2011	07:42:24	Unidentified Hardshell Turtle	2	21.25593	157.76860
03/05/2011	07:43:03	Unidentified Hardshell Turtle	1	21.26422	157.74503
03/05/2011	08:01:27	Unidentified Hardshell Turtle	1	21.08177	157.18245
03/05/2011	08:04:15	Unidentified Hardshell Turtle	1	21.08257	157.08370
03/05/2011	08:13:54	Unidentified Hardshell Turtle	5	21.04313	156.84622
03/05/2011	08:14:24	Unidentified Hardshell Turtle	3	21.04812	156.82890
02/25/2012	09:22:28	Unidentified Hardshell Turtle	2	22.21787	159.34260
02/25/2012	09:22:59	Unidentified Hardshell Turtle	1	22.22082	159.35913
02/25/2012	09:24:41	Unidentified Hardshell Turtle	1	22.23677	159.40110

Date	Time (HST)	Species	# Individuals	Latitude (°N)	Longitude (°W)
02/25/2012	09:26:25	Unidentified Hardshell Turtle	1	22.23190	159.44513
02/25/2012	09:26:59	Unidentified Hardshell Turtle	1	22.23337	159.46113
02/25/2012	09:27:12	Unidentified Hardshell Turtle	1	22.23233	159.46472
02/25/2012	09:27:54	Unidentified Hardshell Turtle	2	22.23375	159.48115
02/25/2012	09:28:27	Unidentified Hardshell Turtle	2	22.23008	159.49680
02/25/2012	09:30:04	Unidentified Hardshell Turtle	1	22.21982	159.51747
02/25/2012	09:31:12	Unidentified Hardshell Turtle	1	22.22800	159.54250
02/25/2012	10:48:58	Unidentified Hardshell Turtle	2	21.90975	159.63648
02/25/2012	10:49:21	Unidentified Hardshell Turtle	3	21.90500	159.62923
02/25/2012	10:49:31	Unidentified Hardshell Turtle	1	21.90315	159.62527
02/25/2012	10:50:09	Unidentified Hardshell Turtle	1	21.89720	159.61115
08/20/2013	09:12:18	Unidentified Hardshell Turtle	1	22.23665	159.46650
08/20/2013	09:12:42	Unidentified Hardshell Turtle	1	22.23763	159.47974
08/20/2013	09:15:34	Unidentified Hardshell Turtle	1	22.23394	159.55053
08/20/2013	09:26:31	Unidentified Hardshell Turtle	1	22.16789	159.70378
08/20/2013	09:26:57	Unidentified Hardshell Turtle	1	22.16397	159.71523
08/20/2013	09:51:10	Unidentified Hardshell Turtle	1	21.90420	159.62777
08/20/2013	09:52:10	Unidentified Hardshell Turtle	1	21.89798	159.61074
08/22/2013	11:07:35	Unidentified Hardshell Turtle	6	21.87087	159.46262
08/22/2013	11:08:23	Unidentified Hardshell Turtle	4	21.87945	159.48903
08/22/2013	11:09:14	Unidentified Hardshell Turtle	1	21.88030	159.49874
08/22/2013	11:09:39	Unidentified Hardshell Turtle	1	21.88097	159.51755
08/22/2013	11:10:03	Unidentified Hardshell Turtle	1	21.88332	159.53608
08/22/2013	11:10:14	Unidentified Hardshell Turtle	4	21.88324	159.53723
08/22/2013	11:10:26	Unidentified Hardshell Turtle	3	21.88340	159.54221
08/22/2013	11:10:58	Unidentified Hardshell Turtle	2	21.88344	159.54859
08/22/2013	11:11:31	Unidentified Hardshell Turtle	1	21.88897	159.57710
08/22/2013	11:12:17	Unidentified Hardshell Turtle	1	21.88898	159.60540
08/22/2013	11:13:50	Unidentified Hardshell Turtle	1	21.90400	159.62863
08/22/2013	11:14:42	Unidentified Hardshell Turtle	1	21.92410	159.64851
08/22/2013	11:14:47	Unidentified Hardshell Turtle	1	21.92561	159.65053
08/22/2013	11:25:34	Unidentified Hardshell Turtle	3	22.11793	159.74293
08/22/2013	11:25:59	Unidentified Hardshell Turtle	1	22.12294	159.74147
08/22/2013	11:27:47	Unidentified Hardshell Turtle	1	22.15887	159.71698
08/22/2013	11:37:30	Unidentified Hardshell Turtle	1	22.22769	159.49471
08/22/2013	11:37:52	Unidentified Hardshell Turtle	2	22.22682	159.49715
08/22/2013	11:47:35	Unidentified Hardshell Turtle	1	22.18707	159.31187
08/22/2013	11:48:09	Unidentified Hardshell Turtle	1	22.17024	159.30476
01/31/2014	13:18:09	Unidentified Hardshell Turtle	1	21.94900	159.34700
01/31/2014	13:30:44	Unidentified Hardshell Turtle	1	21.90700	159.40600
01/31/2014	13:35:07	Unidentified Hardshell Turtle	1	21.87700	159.46700
01/31/2014	13:37:11	Unidentified Hardshell Turtle	1	21.87500	159.50700
01/31/2014	13:44:02	Unidentified Hardshell Turtle	1	21.88500	159.51400
01/31/2014	13:47:22	Unidentified Hardshell Turtle	4	21.88900	159.55400

Date	Time (HST)	Species	# Individuals	Latitude (°N)	Longitude (°W)
01/31/2014	13:48:24	Unidentified Hardshell Turtle	2	21.89300	159.57600
01/31/2014	13:49:05	Unidentified Hardshell Turtle	1	21.89800	159.59100
01/31/2014	13:50:32	Unidentified Hardshell Turtle	1	21.90100	159.61100
01/31/2014	13:51:00	Unidentified Hardshell Turtle	1	21.90300	159.61900
01/31/2014	13:51:30	Unidentified Hardshell Turtle	1	21.90700	159.62800
01/31/2014	13:51:55	Unidentified Hardshell Turtle	1	21.91300	159.63500
01/31/2014	13:52:17	Unidentified Hardshell Turtle	1	21.91900	159.64100
01/31/2014	13:56:26	Unidentified Hardshell Turtle	1	21.95600	159.68200
01/31/2014	14:02:12	Unidentified Hardshell Turtle	1	21.98600	159.75500
01/31/2014	14:22:02	Unidentified Hardshell Turtle	2	21.99500	159.77000
01/31/2014	14:30:34	Unidentified Hardshell Turtle	1	21.99600	159.77000
01/31/2014	14:35:19	Unidentified Hardshell Turtle	1	22.16400	159.30500
01/31/2014	14:53:01	Unidentified Hardshell Turtle	2	22.22800	159.43800
01/31/2014	14:53:50	Unidentified Hardshell Turtle	9	22.23100	159.46000
01/31/2014	14:54:21	Unidentified Hardshell Turtle	5	22.23300	159.47200
01/31/2014	14:55:27	Unidentified Hardshell Turtle	2	22.22600	159.50300
01/31/2014	14:59:24	Unidentified Hardshell Turtle	1	22.22000	159.59200
01/31/2014	15:21:29	Unidentified Hardshell Turtle	6	21.91100	159.62000
01/31/2014	15:23:27	Unidentified Hardshell Turtle	1	21.89100	159.56900
01/31/2014	15:24:05	Unidentified Hardshell Turtle	2	21.88700	159.55100
01/31/2014	15:24:34	Unidentified Hardshell Turtle	1	21.88700	159.53600
01/31/2014	15:25:44	Unidentified Hardshell Turtle	1	21.88600	159.50200
01/31/2014	15:27:18	Unidentified Hardshell Turtle	3	21.88000	159.48100
01/31/2014	15:27:49	Unidentified Hardshell Turtle	1	21.87500	159.46700
01/31/2014	15:29:07	Unidentified Hardshell Turtle	3	21.86900	159.45900
01/31/2014	15:29:54	Unidentified Hardshell Turtle	1	21.87300	159.43900
02/05/2014	08:39:56	Unidentified Hardshell Turtle	1	22.04500	159.32200
02/05/2014	08:44:21	Unidentified Hardshell Turtle	1	21.95600	159.33000
02/05/2014	08:52:24	Unidentified Hardshell Turtle	1	21.87000	159.43800
02/05/2014	08:53:23	Unidentified Hardshell Turtle	6	21.87000	159.45500
02/05/2014	08:54:14	Unidentified Hardshell Turtle	1	21.87500	159.47000
02/05/2014	08:54:41	Unidentified Hardshell Turtle	3	21.86700	159.48100
02/05/2014	08:54:57	Unidentified Hardshell Turtle	4	21.88000	159.48300
02/05/2014	08:55:37	Unidentified Hardshell Turtle	3	21.88100	159.49700
02/05/2014	08:58:50	Unidentified Hardshell Turtle	2	21.88800	159.56000
02/05/2014	09:02:03	Unidentified Hardshell Turtle	1	21.89900	159.61400
02/05/2014	09:02:08	Unidentified Hardshell Turtle	1	21.90000	159.61400
02/05/2014	09:03:16	Unidentified Hardshell Turtle	1	21.91200	159.63300
02/05/2014	09:14:50	Unidentified Hardshell Turtle	1	22.06600	159.78500
02/05/2014	09:45:26	Unidentified Hardshell Turtle	1	22.21700	159.37200
02/05/2014	09:46:03	Unidentified Hardshell Turtle	3	22.21100	159.36200
02/05/2014	09:48:36	Unidentified Hardshell Turtle	1	22.21200	159.34100
02/05/2014	09:52:50	Unidentified Hardshell Turtle	1	22.19600	159.32900
02/05/2014	09:55:12	Unidentified Hardshell Turtle	1	22.16900	159.30700

Date	Time (HST)	Species	# Individuals	Latitude (°N)	Longitude (°W)
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08/01/2014	08:39:50	Unidentified Hardshell Turtle	1	21.14000	157.29600
08/01/2014	08:42:50	Unidentified Hardshell Turtle	2	21.09600	157.31200
08/01/2014	08:49:29	Unidentified Hardshell Turtle	1	21.08900	157.15200
08/01/2014	08:51:03	Unidentified Hardshell Turtle	3	21.09500	157.11600
08/01/2014	08:52:45	Unidentified Hardshell Turtle	5	21.09600	157.08900
08/01/2014	08:53:44	Unidentified Hardshell Turtle	5	21.09400	157.06900
08/01/2014	08:54:40	Unidentified Hardshell Turtle	3	21.09100	157.04800
08/01/2014	08:58:21	Unidentified Hardshell Turtle	3	21.06300	156.96400
08/01/2014	08:59:46	Unidentified Hardshell Turtle	1	21.05600	156.93600
08/01/2014	09:02:31	Unidentified Hardshell Turtle	1	21.04200	156.88000
08/01/2014	09:03:07	Unidentified Hardshell Turtle	1	21.04300	156.86700
08/01/2014	09:04:06	Unidentified Hardshell Turtle	2	21.04500	156.84800
08/01/2014	09:04:30	Unidentified Hardshell Turtle	1	21.04800	156.84100
08/01/2014	09:07:18	Unidentified Hardshell Turtle	2	21.07300	156.78500
08/01/2014	09:22:46	Unidentified Hardshell Turtle	2	21.00500	156.67200
08/01/2014	09:29:01	Unidentified Hardshell Turtle	1	20.92400	156.70200
08/01/2014	09:38:13	Unidentified Hardshell Turtle	1	20.77000	156.52900
08/01/2014	09:40:17	Unidentified Hardshell Turtle	3	20.79200	156.49200
08/01/2014	09:41:13	Unidentified Hardshell Turtle	1	20.78000	156.46900
08/01/2014	11:13:42	Unidentified Hardshell Turtle	2	20.90400	156.87700
08/01/2014	11:14:53	Unidentified Hardshell Turtle	1	20.88800	156.85600
08/01/2014	11:16:56	Unidentified Hardshell Turtle	5	20.85700	156.82300
08/01/2014	11:17:20	Unidentified Hardshell Turtle	1	20.84400	156.81200
08/01/2014	11:17:43	Unidentified Hardshell Turtle	2	20.83700	156.80800
08/01/2014	13:46:37	Unidentified Hardshell Turtle	3	20.93200	156.37500
08/01/2014	13:47:08	Unidentified Hardshell Turtle	6	20.92400	156.38200
08/04/2014	07:47:27	Unidentified Hardshell Turtle	1	20.90300	156.46700
08/04/2014	07:50:49	Unidentified Hardshell Turtle	1	20.97100	156.52100
08/04/2014	08:37:25	Unidentified Hardshell Turtle	1	21.27400	157.75900
08/04/2014	09:23:43	Unidentified Hardshell Turtle	3	21.30300	158.02900
08/04/2014	09:24:38	Unidentified Hardshell Turtle	3	21.30600	158.00800
08/04/2014	09:25:16	Unidentified Hardshell Turtle	2	21.31000	157.99300
08/04/2014	09:27:28	Unidentified Hardshell Turtle	2	21.31300	157.95600
08/04/2014	09:28:17	Unidentified Hardshell Turtle	4	21.30000	157.94800
08/04/2014	09:33:03	Unidentified Hardshell Turtle	2	21.28400	157.85400
08/04/2014	09:34:28	Unidentified Hardshell Turtle	1	21.27000	157.83000
08/04/2014	09:34:51	Unidentified Hardshell Turtle	2	21.26500	157.82600
08/04/2014	09:36:15	Unidentified Hardshell Turtle	2	21.25200	157.80300
08/04/2014	09:38:44	Unidentified Hardshell Turtle	2	21.27000	157.76600
08/04/2014	09:39:17	Unidentified Hardshell Turtle	2	21.27100	157.75500
08/04/2014	09:41:30	Unidentified Hardshell Turtle	1	21.26200	157.71500
08/04/2014	09:42:14	Unidentified Hardshell Turtle	1	21.25500	157.70400

Date	Time (HST)	Species	# Individuals	Latitude (°N)	Longitude (°W)
08/04/2014	09:58:39	Unidentified Hardshell Turtle	3	21.47000	157.77800
08/04/2014	09:59:29	Unidentified Hardshell Turtle	2	21.48100	157.79800
08/04/2014	10:01:32	Unidentified Hardshell Turtle	1	21.52500	157.83000
08/04/2014	10:12:11	Unidentified Hardshell Turtle	1	21.70400	158.01200
08/04/2014	10:18:20	Unidentified Hardshell Turtle	2	21.59100	158.12200
08/04/2014	10:19:24	Unidentified Hardshell Turtle	3	21.59000	158.14900
08/04/2014	10:21:06	Unidentified Hardshell Turtle	1	21.58900	158.19500
08/04/2014	10:25:50	Unidentified Hardshell Turtle	2	21.54900	158.25000
08/04/2014	10:26:46	Unidentified Hardshell Turtle	3	21.52900	158.23400
08/04/2014	10:27:55	Unidentified Hardshell Turtle	1	21.50600	158.23600
08/04/2014	10:28:41	Unidentified Hardshell Turtle	1	21.48800	158.23700
08/04/2014	10:47:44	Unidentified Hardshell Turtle	1	21.30100	158.03400
08/04/2014	10:51:17	Unidentified Hardshell Turtle	1	21.31300	157.98500
08/04/2014	10:54:12	Unidentified Hardshell Turtle	1	21.31400	157.93500
08/04/2014	11:42:04	Unidentified Hardshell Turtle	1	21.27900	157.84800
08/04/2014	11:43:05	Unidentified Hardshell Turtle	1	21.26600	157.82800
08/04/2014	11:43:22	Unidentified Hardshell Turtle	1	21.25900	157.82300
08/04/2014	11:44:29	Unidentified Hardshell Turtle	1	21.25200	157.80300
08/04/2014	11:44:50	Unidentified Hardshell Turtle	1	21.25300	157.79600
08/04/2014	11:46:37	Unidentified Hardshell Turtle	2	21.27100	157.76400
08/04/2014	11:47:00	Unidentified Hardshell Turtle	1	21.27100	157.75700
08/04/2014	11:47:48	Unidentified Hardshell Turtle	1	21.27300	157.74200
08/04/2014	11:50:09	Unidentified Hardshell Turtle	1	21.25400	157.70500
08/04/2014	12:29:20	Unidentified Hardshell Turtle	2	21.09200	157.09200
08/04/2014	12:30:17	Unidentified Hardshell Turtle	1	21.09200	157.07800
08/04/2014	12:31:47	Unidentified Hardshell Turtle	2	21.08600	157.04400
08/04/2014	12:33:05	Unidentified Hardshell Turtle	1	21.07800	157.01700
08/04/2014	12:37:13	Unidentified Hardshell Turtle	1	21.05700	156.93700
08/04/2014	12:41:54	Unidentified Hardshell Turtle	1	21.04400	156.84800
08/04/2014	12:42:53	Unidentified Hardshell Turtle	3	21.05100	156.83000
08/04/2014	12:43:23	Unidentified Hardshell Turtle	2	21.05700	156.82100
08/04/2014	12:43:50	Unidentified Hardshell Turtle	2	21.06100	156.81000
08/04/2014	12:44:52	Unidentified Hardshell Turtle	1	21.06700	156.79200
08/04/2014	12:45:17	Unidentified Hardshell Turtle	3	21.06900	156.78900
08/04/2014	12:45:45	Unidentified Hardshell Turtle	3	21.07400	156.78100
08/04/2014	12:46:09	Unidentified Hardshell Turtle	1	21.08100	156.77000
08/04/2014	12:46:27	Unidentified Hardshell Turtle	2	21.08300	156.76700
08/04/2014	12:58:24	Unidentified Hardshell Turtle	1	20.97100	156.68700
08/04/2014	12:59:26	Unidentified Hardshell Turtle	1	20.94800	156.69800
08/04/2014	13:01:33	Unidentified Hardshell Turtle	1	20.89900	156.69000
08/04/2014	13:02:44	Unidentified Hardshell Turtle	1	20.87300	156.68500
08/04/2014	13:05:02	Unidentified Hardshell Turtle	1	20.82600	156.64300
08/04/2014	13:05:22	Unidentified Hardshell Turtle	1	20.82000	156.63700
08/04/2014	13:07:06	Unidentified Hardshell Turtle	1	20.79900	156.60100
08/04/2014	13:08:24	Unidentified Hardshell Turtle	1	20.78500	156.56400

Date	Time (HST)	Species	# Individuals	Latitude (°N)	Longitude (°W)
08/04/2014	13:09:01	Unidentified Hardshell Turtle	4	20.77500	156.54900
08/04/2014	13:11:15	Unidentified Hardshell Turtle	1	20.79300	156.50300
08/05/2014	07:54:08	Unidentified Hardshell Turtle	1	20.93200	156.49200
08/05/2014	08:00:51	Unidentified Hardshell Turtle	1	21.02700	156.62800
08/05/2014	08:26:42	Unidentified Hardshell Turtle	1	21.19900	157.09900
08/05/2014	08:50:23	Unidentified Hardshell Turtle	1	21.09000	157.23700
08/05/2014	08:56:42	Unidentified Hardshell Turtle	1	21.09100	157.14400
08/05/2014	08:56:54	Unidentified Hardshell Turtle	2	21.09200	157.13800
08/05/2014	08:57:27	Unidentified Hardshell Turtle	1	21.09400	157.12800
08/05/2014	08:58:18	Unidentified Hardshell Turtle	5	21.09600	157.10700
08/05/2014	08:58:51	Unidentified Hardshell Turtle	8	21.09400	157.09500
08/05/2014	08:59:34	Unidentified Hardshell Turtle	1	21.09100	157.07800
08/05/2014	09:05:01	Unidentified Hardshell Turtle	8	21.06100	156.95700
08/05/2014	09:06:52	Unidentified Hardshell Turtle	1	21.05100	156.91500
08/05/2014	09:08:04	Unidentified Hardshell Turtle	2	21.04500	156.89200
08/05/2014	09:11:03	Unidentified Hardshell Turtle	1	21.04800	156.84100
08/05/2014	09:11:12	Unidentified Hardshell Turtle	1	21.04900	156.83700
08/05/2014	09:14:41	Unidentified Hardshell Turtle	1	21.07600	156.78100
08/05/2014	09:25:31	Unidentified Hardshell Turtle	1	21.00100	156.67300
08/05/2014	09:25:51	Unidentified Hardshell Turtle	1	20.99200	156.67400
08/05/2014	09:26:32	Unidentified Hardshell Turtle	4	20.97700	156.68300
08/05/2014	09:40:09	Unidentified Hardshell Turtle	3	20.90100	156.87400
08/05/2014	09:41:30	Unidentified Hardshell Turtle	1	20.92000	156.90400
08/05/2014	09:41:46	Unidentified Hardshell Turtle	1	20.92300	156.91500
08/05/2014	09:45:49	Unidentified Hardshell Turtle	1	20.91600	157.05400
08/05/2014	09:46:06	Unidentified Hardshell Turtle	1	20.90900	157.06200
08/05/2014	10:00:56	Unidentified Hardshell Turtle	1	20.77800	156.82000
08/05/2014	10:02:06	Unidentified Hardshell Turtle	1	20.79300	156.80000
08/05/2014	10:02:16	Unidentified Hardshell Turtle	2	20.78800	156.79800
08/05/2014	10:11:31	Unidentified Hardshell Turtle	2	20.82300	156.63600
08/05/2014	10:14:45	Unidentified Hardshell Turtle	1	20.78500	156.56100
08/05/2014	10:15:43	Unidentified Hardshell Turtle	1	20.77300	156.54000
08/05/2014	10:17:27	Unidentified Hardshell Turtle	2	20.78800	156.50900
08/05/2014	10:17:53	Unidentified Hardshell Turtle	1	20.79100	156.50200
08/05/2014	10:18:42	Unidentified Hardshell Turtle	1	20.79100	156.48400
08/05/2014	11:21:30	Unidentified Hardshell Turtle	1	20.73800	156.46100
08/05/2014	11:21:44	Unidentified Hardshell Turtle	1	20.73500	156.46100
08/05/2014	12:00:44	Unidentified Hardshell Turtle	1	20.62700	156.49100
08/05/2014	12:37:40	Unidentified Hardshell Turtle	1	20.82500	156.07300
08/05/2014	12:45:50	Unidentified Hardshell Turtle	1	20.94100	156.26900
08/05/2014	12:49:54	Unidentified Hardshell Turtle	1	20.94200	156.36000
08/05/2014	12:50:35	Unidentified Hardshell Turtle	2	20.93000	156.37300
08/05/2014	12:51:57	Unidentified Hardshell Turtle	1	20.91500	156.41600
08/06/2014	07:31:48	Unidentified Hardshell Turtle	1	20.89000	156.43300

Date	Time (HST)	Species	# Individuals	Latitude (°N)	Longitude (°W)
08/06/2014	07:32:57	Unidentified Hardshell Turtle	1	20.89000	156.43300
08/06/2014	07:36:41	Unidentified Hardshell Turtle	1	20.89000	156.43300
08/06/2014	09:02:16	Unidentified Hardshell Turtle	4	21.31100	157.96300
08/06/2014	09:02:54	Unidentified Hardshell Turtle	4	21.31300	157.97600
08/06/2014	09:06:49	Unidentified Hardshell Turtle	1	21.31300	157.98200
08/06/2014	09:09:07	Unidentified Hardshell Turtle	2	21.30000	157.93900
08/06/2014	09:10:11	Unidentified Hardshell Turtle	6	21.30000	157.91400
08/06/2014	09:11:12	Unidentified Hardshell Turtle	1	21.29800	157.89000
08/06/2014	09:14:25	Unidentified Hardshell Turtle	5	21.26400	157.82800
08/06/2014	09:16:13	Unidentified Hardshell Turtle	2	21.25100	157.79400
08/06/2014	09:18:04	Unidentified Hardshell Turtle	3	21.26800	157.76000
08/06/2014	09:21:47	Unidentified Hardshell Turtle	1	21.25500	157.69600
08/06/2014	09:36:54	Unidentified Hardshell Turtle	1	21.45600	157.81000
08/06/2014	09:38:37	Unidentified Hardshell Turtle	18	21.48600	157.83800
08/06/2014	09:40:50	Unidentified Hardshell Turtle	1	21.53200	157.83100
08/06/2014	09:41:32	Unidentified Hardshell Turtle	1	21.54400	157.83900
08/06/2014	09:44:00	Unidentified Hardshell Turtle	2	21.56100	157.87300
08/06/2014	09:44:09	Unidentified Hardshell Turtle	1	21.56400	157.87200
08/06/2014	09:46:18	Unidentified Hardshell Turtle	11	21.61100	157.90100
08/06/2014	09:47:43	Unidentified Hardshell Turtle	2	21.64500	157.91200
08/06/2014	09:53:36	Unidentified Hardshell Turtle	2	21.67800	158.04600
08/06/2014	09:54:37	Unidentified Hardshell Turtle	1	21.65400	158.06900
08/06/2014	09:56:07	Unidentified Hardshell Turtle	2	21.62300	158.08900
08/06/2014	09:57:18	Unidentified Hardshell Turtle	5	21.59500	158.11300
08/06/2014	09:58:12	Unidentified Hardshell Turtle	5	21.58800	158.13700
08/06/2014	09:59:04	Unidentified Hardshell Turtle	4	21.58400	158.16100
08/06/2014	10:07:49	Unidentified Hardshell Turtle	1	21.55500	158.25300
08/06/2014	10:08:04	Unidentified Hardshell Turtle	4	21.55600	158.25500
08/06/2014	10:12:35	Unidentified Hardshell Turtle	1	21.46700	158.22300
08/06/2014	10:13:11	Unidentified Hardshell Turtle	1	21.45500	158.20800
08/06/2014	10:13:45	Unidentified Hardshell Turtle	1	21.44300	158.19700

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C

Maps of Aerial Survey Tracks and Marine Mammal and Sea Turtle Sightings by Survey

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Appendix C. Maps of Aerial Survey Tracks and Marine Mammal and Sea Turtle Sightings by Survey

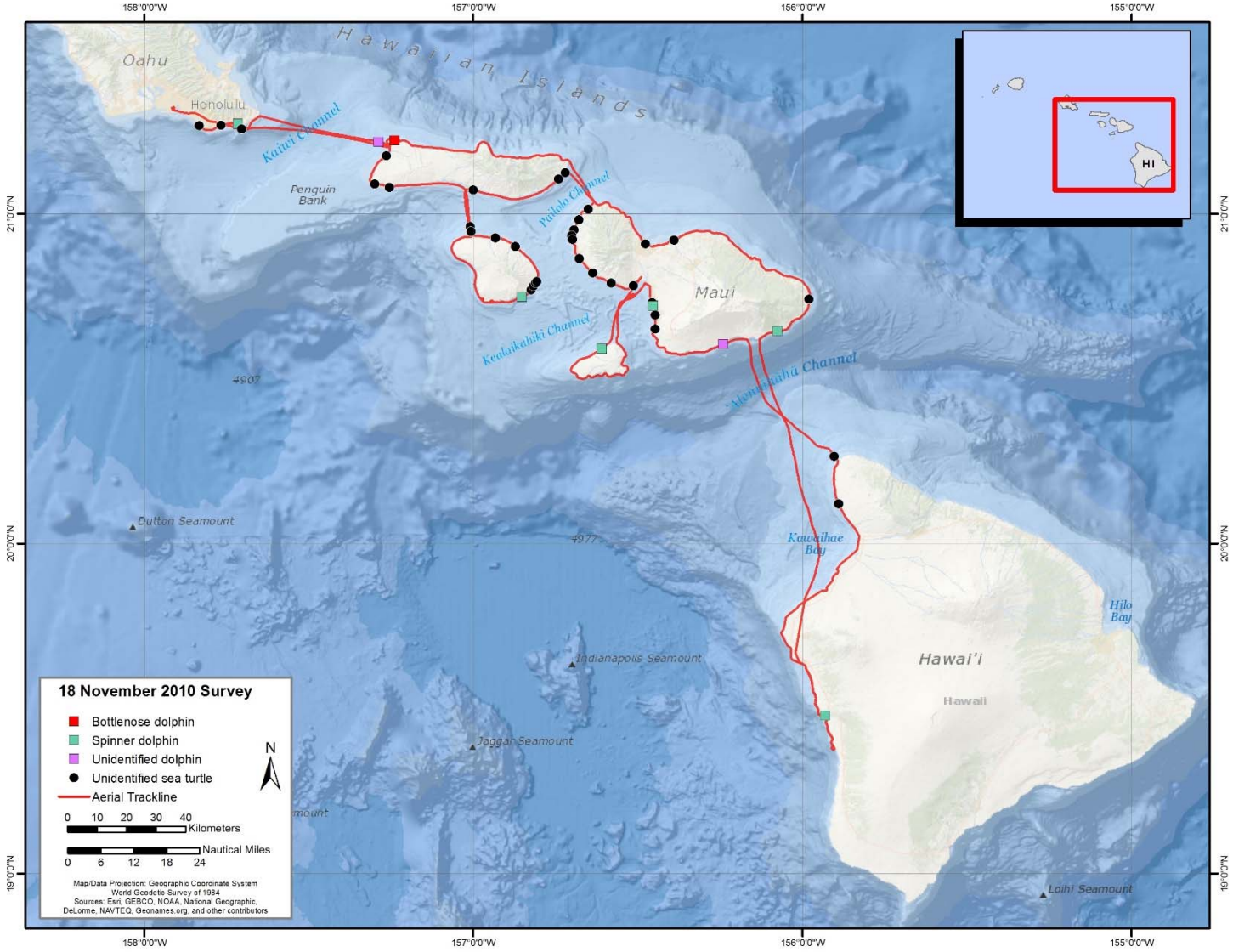

Figure 2. Aerial shoreline survey effort tracklines and marine mammal and sea turtle sightings on 18 November 2010.

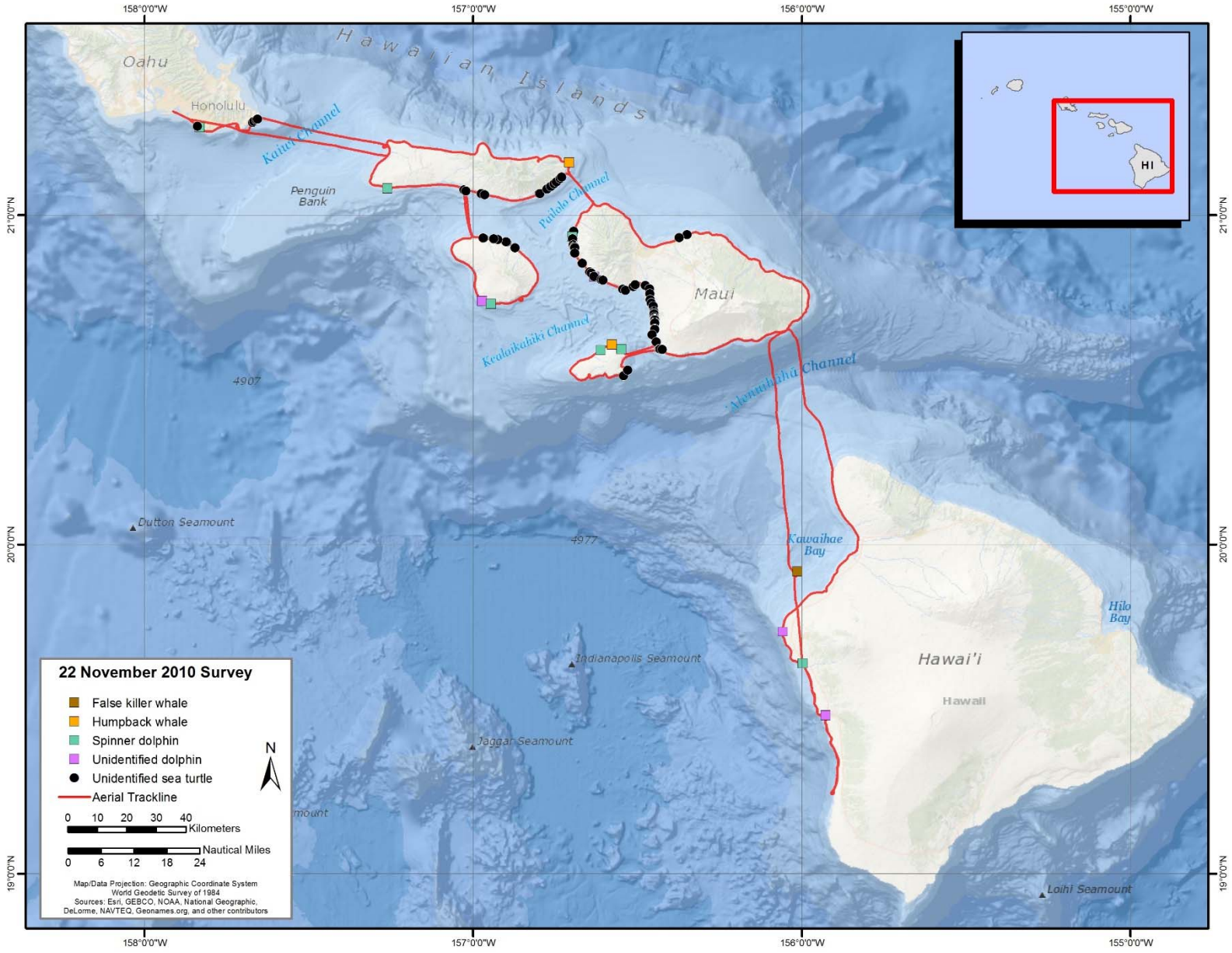

Figure 3. Aerial shoreline survey effort tracklines with marine mammal and sea turtle sightings on 22 November 2010.

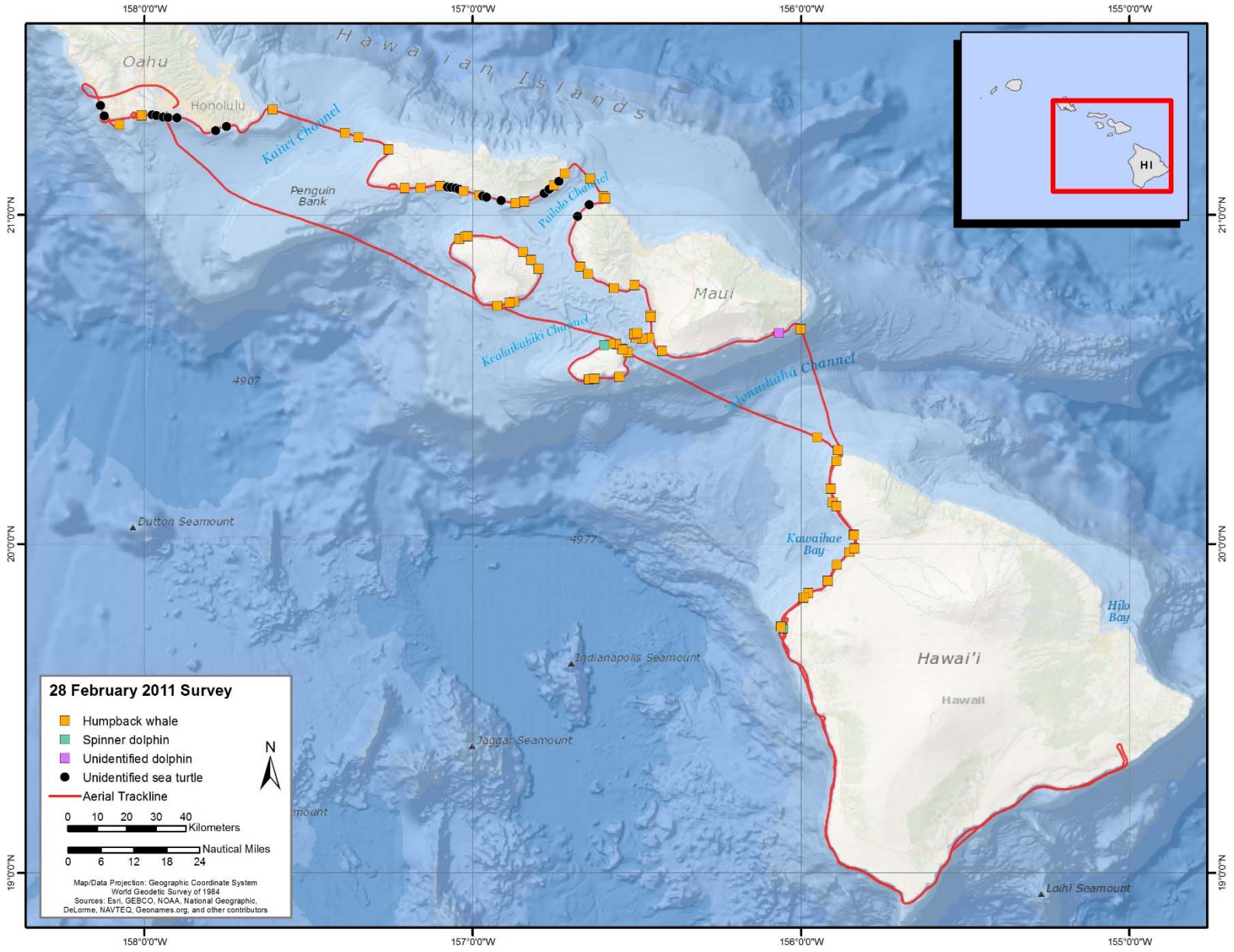

Figure 4. Aerial shoreline survey effort tracklines with marine mammal and sea turtle sightings on 28 February 2011.

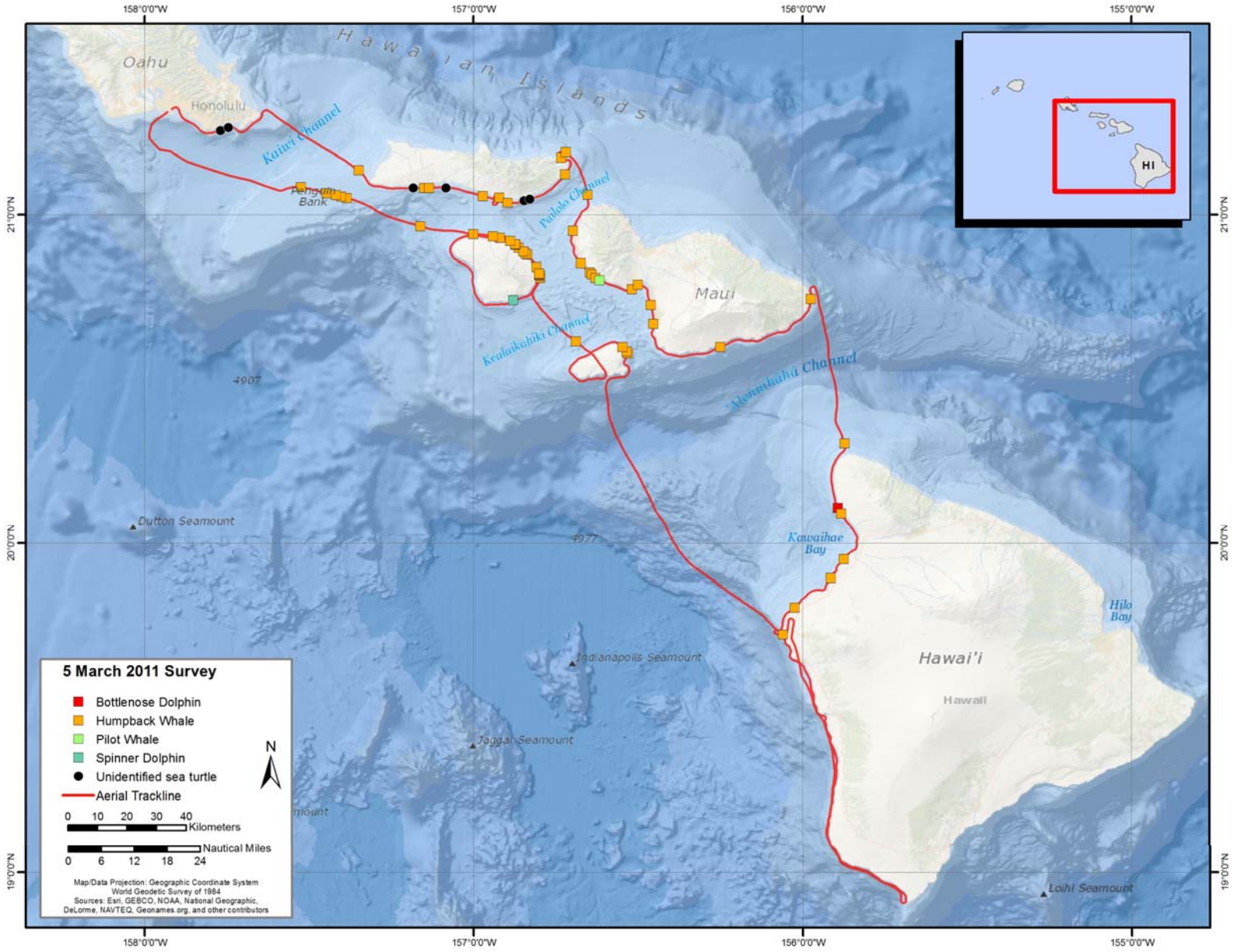

Figure 5. Aerial shoreline survey effort tracklines with marine mammal and sea turtle sightings on 5 March 2011.

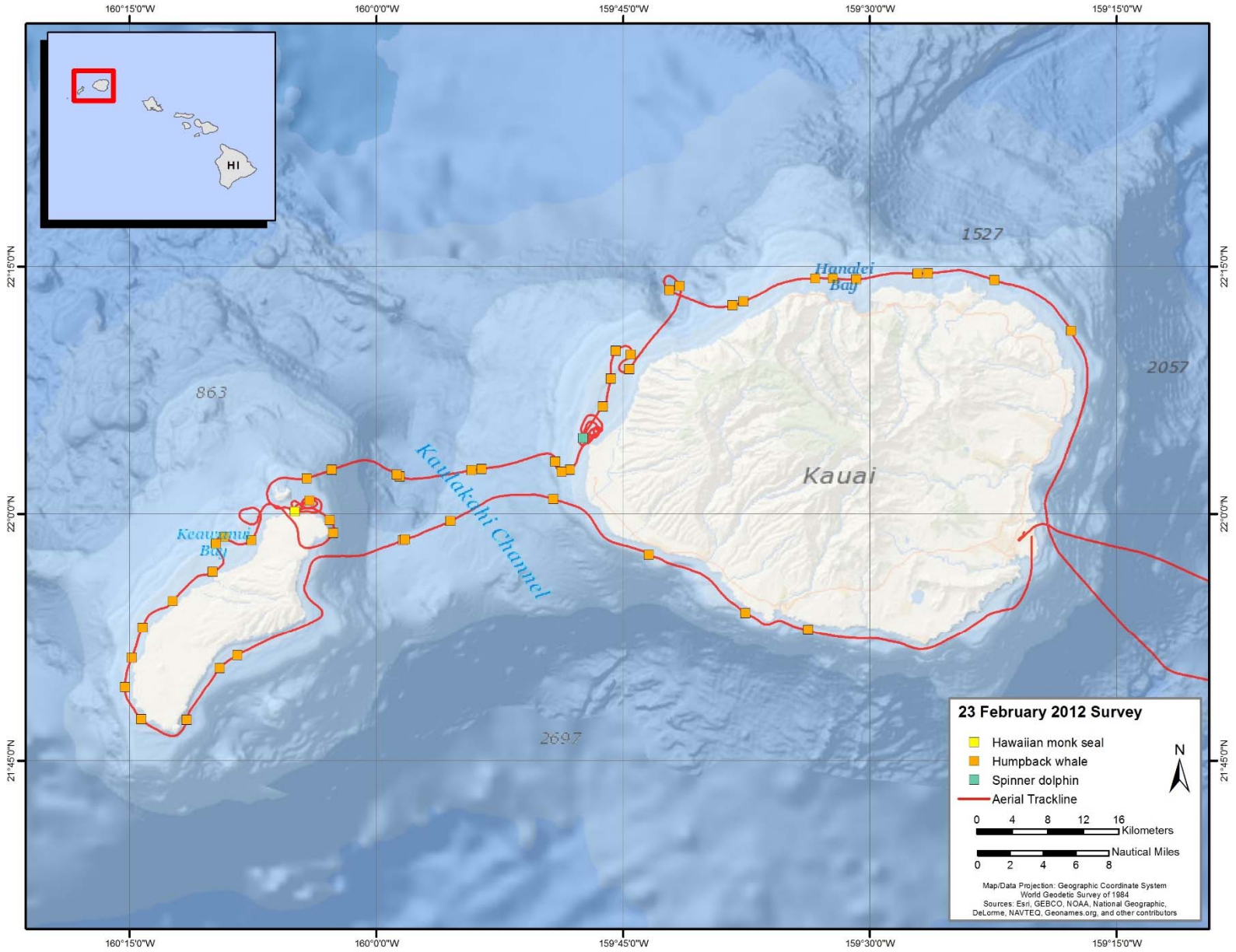

Figure 6. Aerial shoreline survey effort tracklines with marine mammal sightings on 23 February 2012.

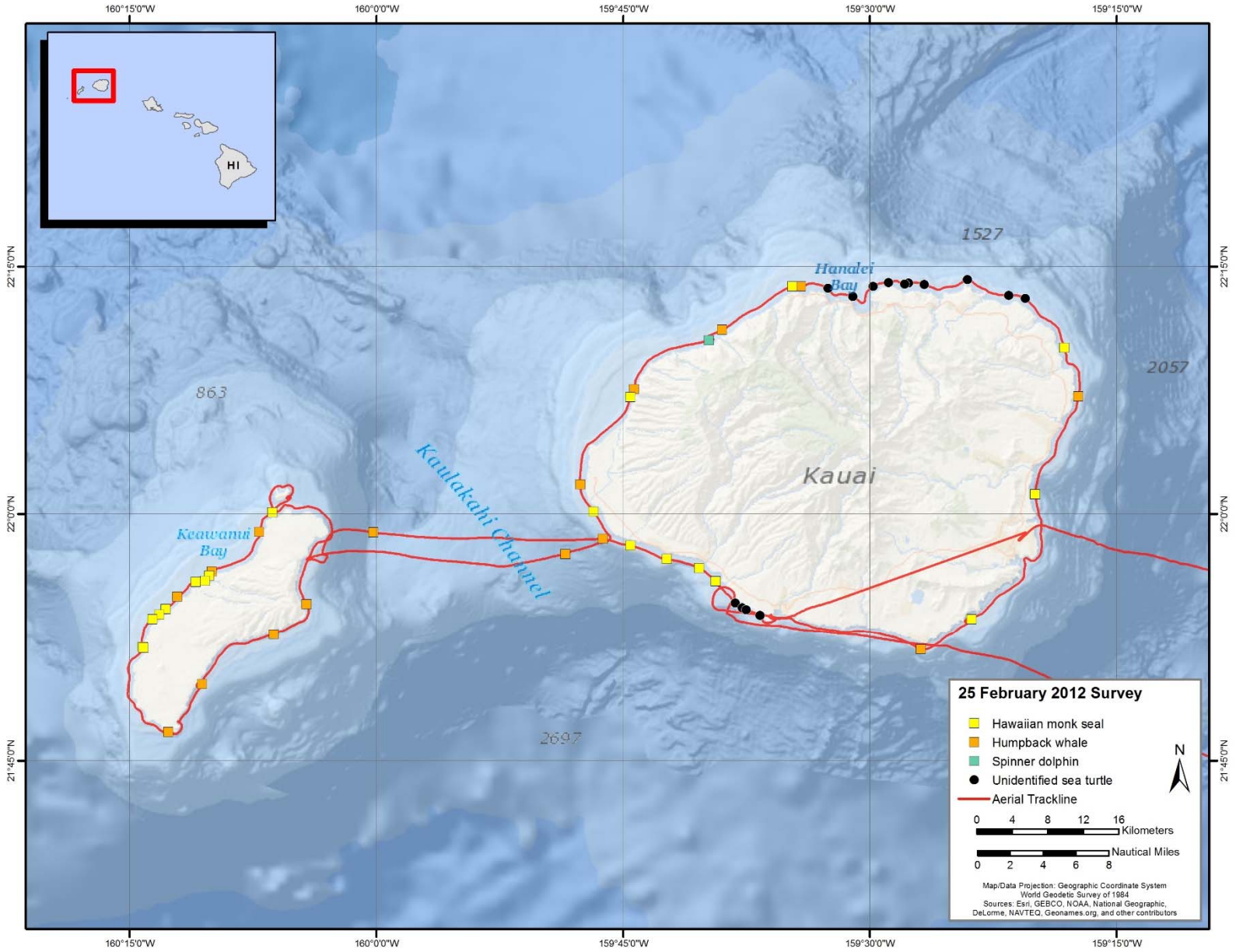

Figure 7. Aerial shoreline survey effort tracklines with marine mammal and sea turtle sightings on 25 February 2012.

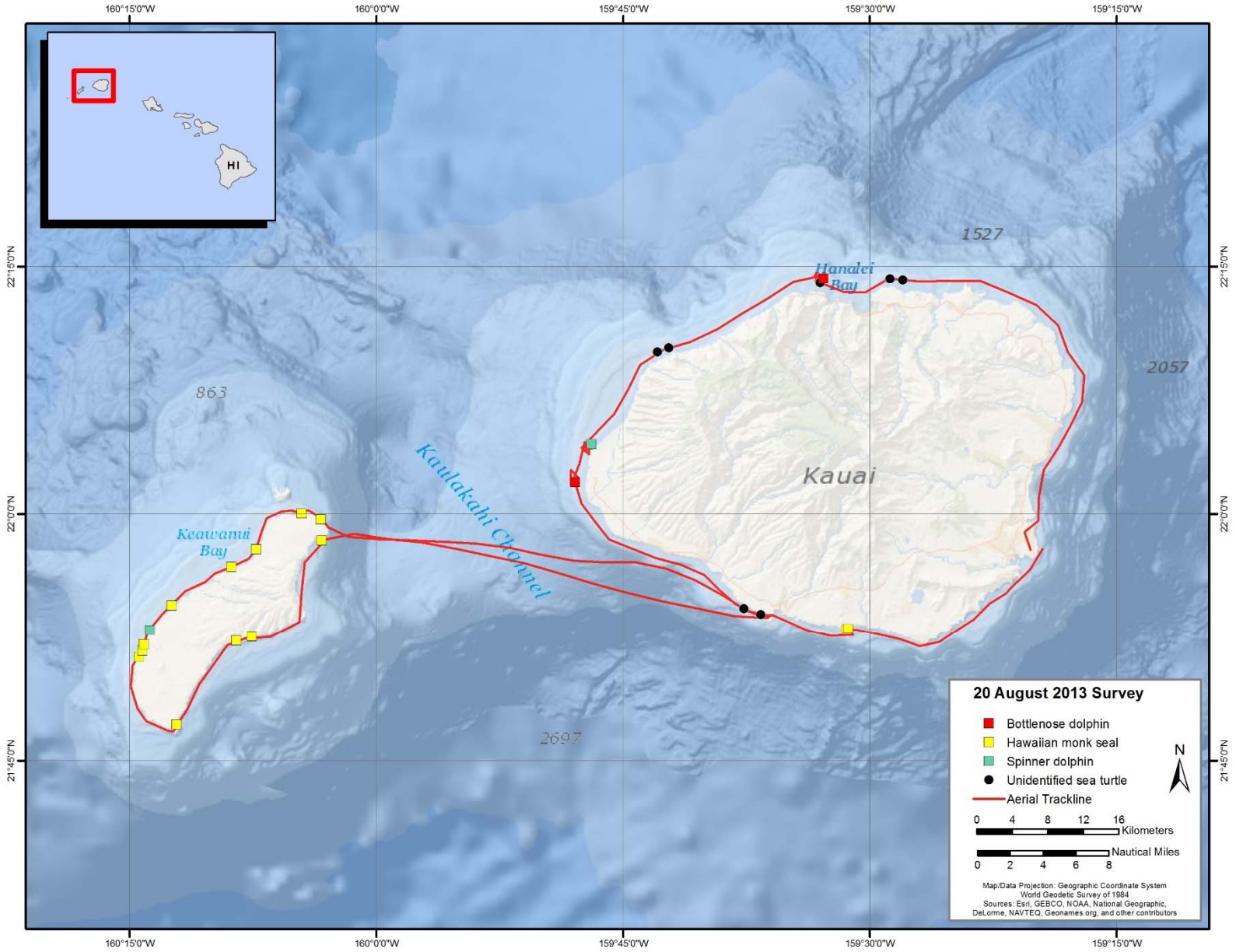

Figure 8. Aerial shoreline survey effort tracklines with marine mammal and sea turtle sightings on 20 August 2013.

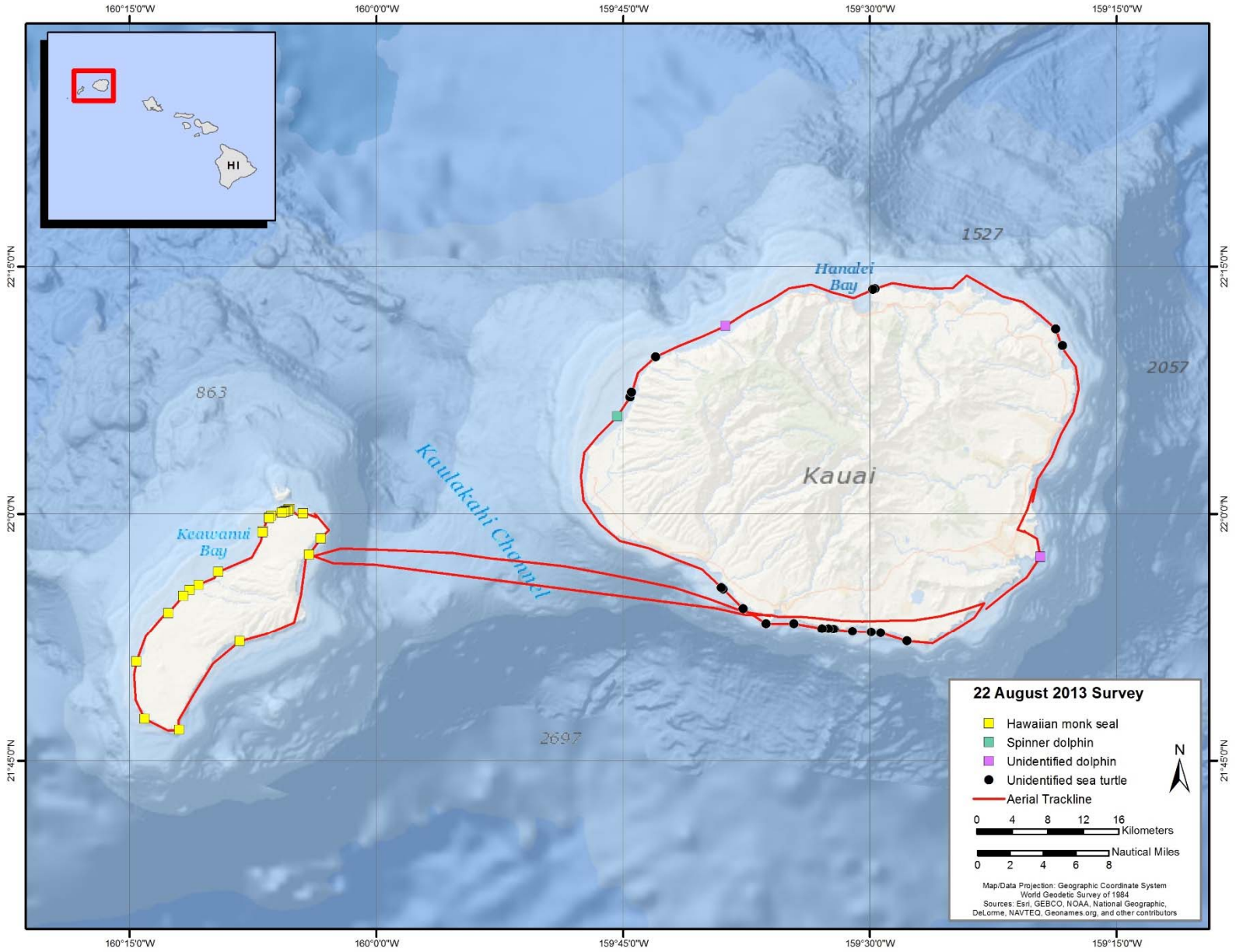

Figure 9. Aerial shoreline survey effort tracklines with marine mammal and sea turtle sightings on 22 August 2013.

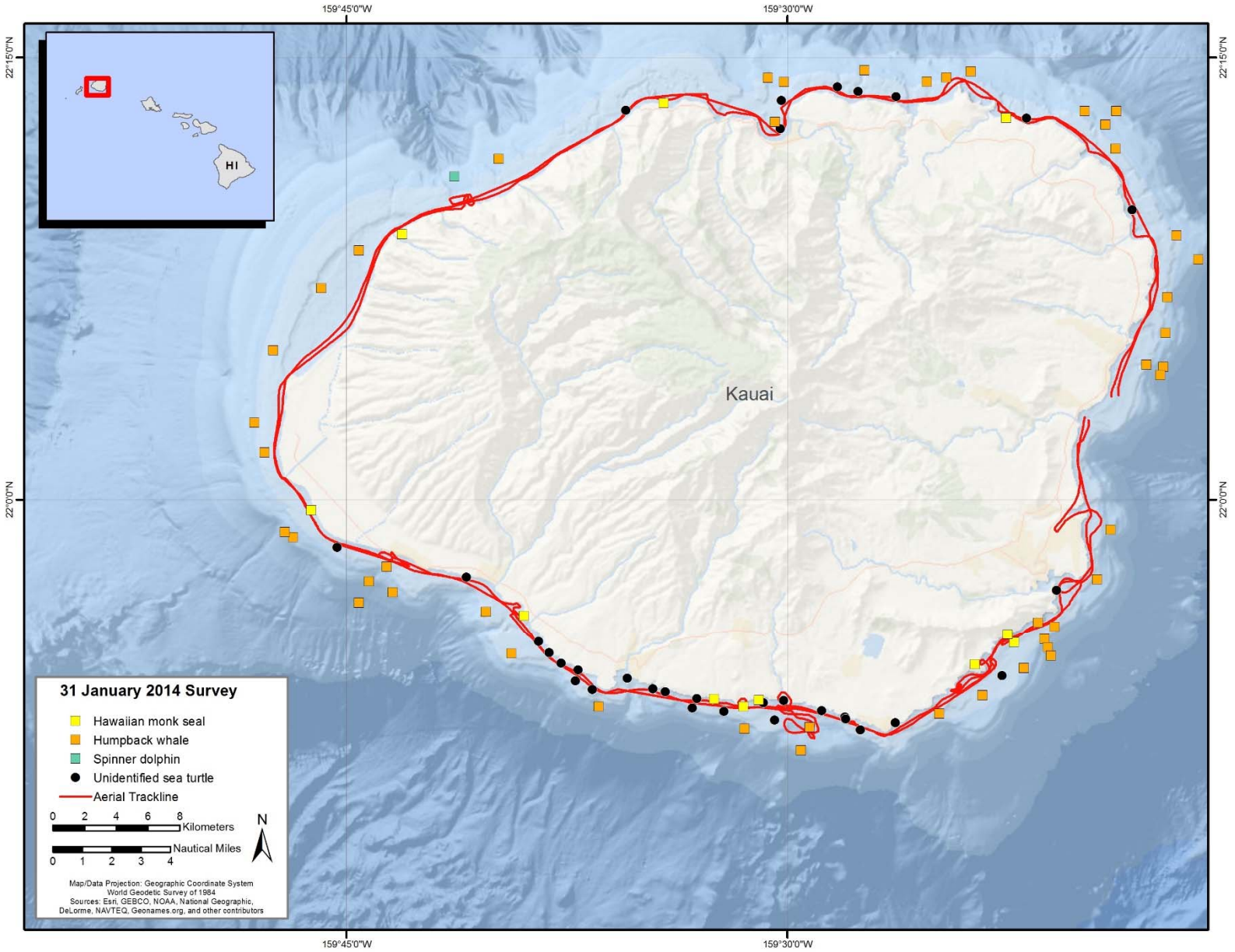

Figure 10. Aerial shoreline survey effort tracklines with marine mammal and sea turtle sightings on 31 January 2014.

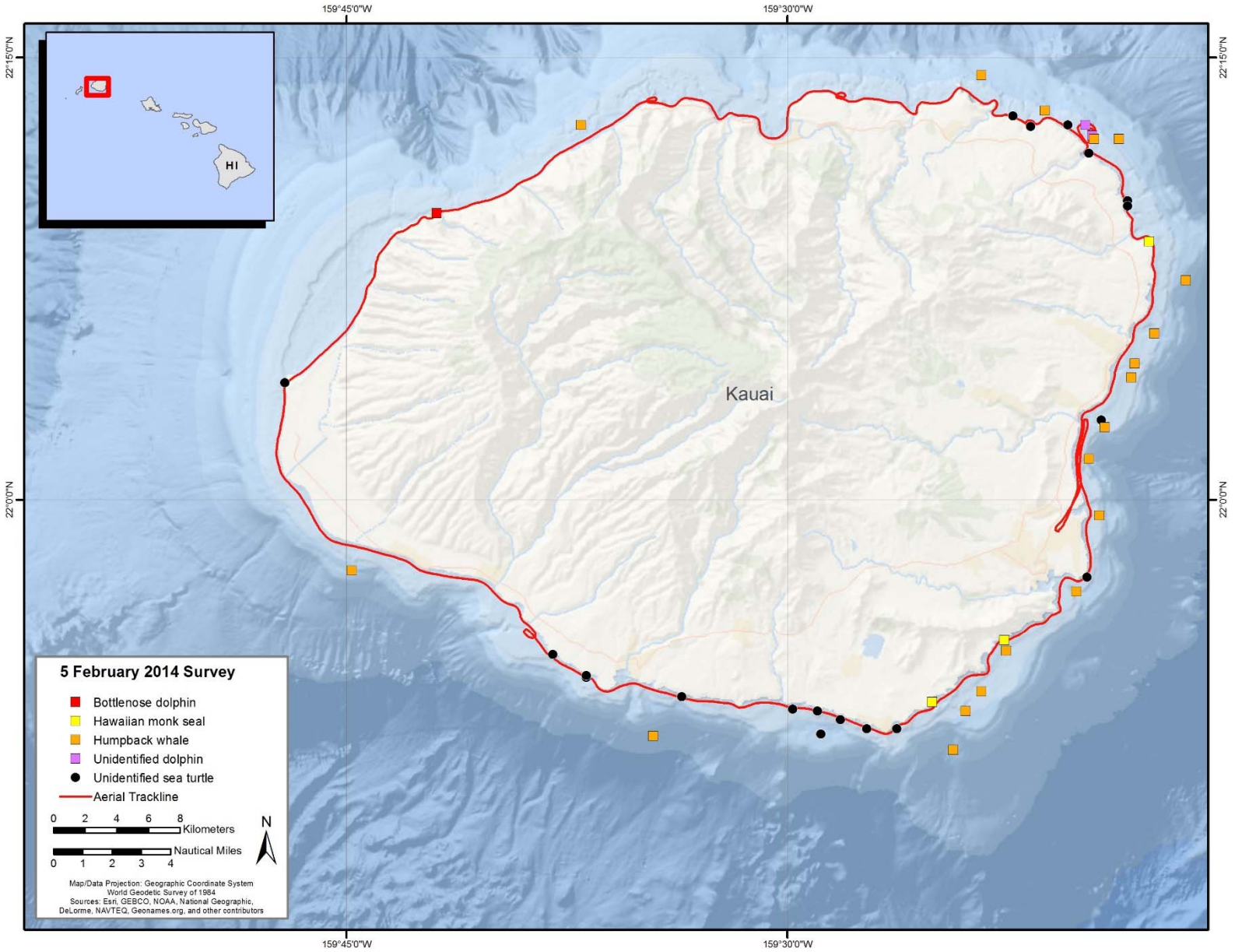

Figure 11. Aerial shoreline survey effort tracklines with marine mammal and sea turtle sightings on 5 February 2014.

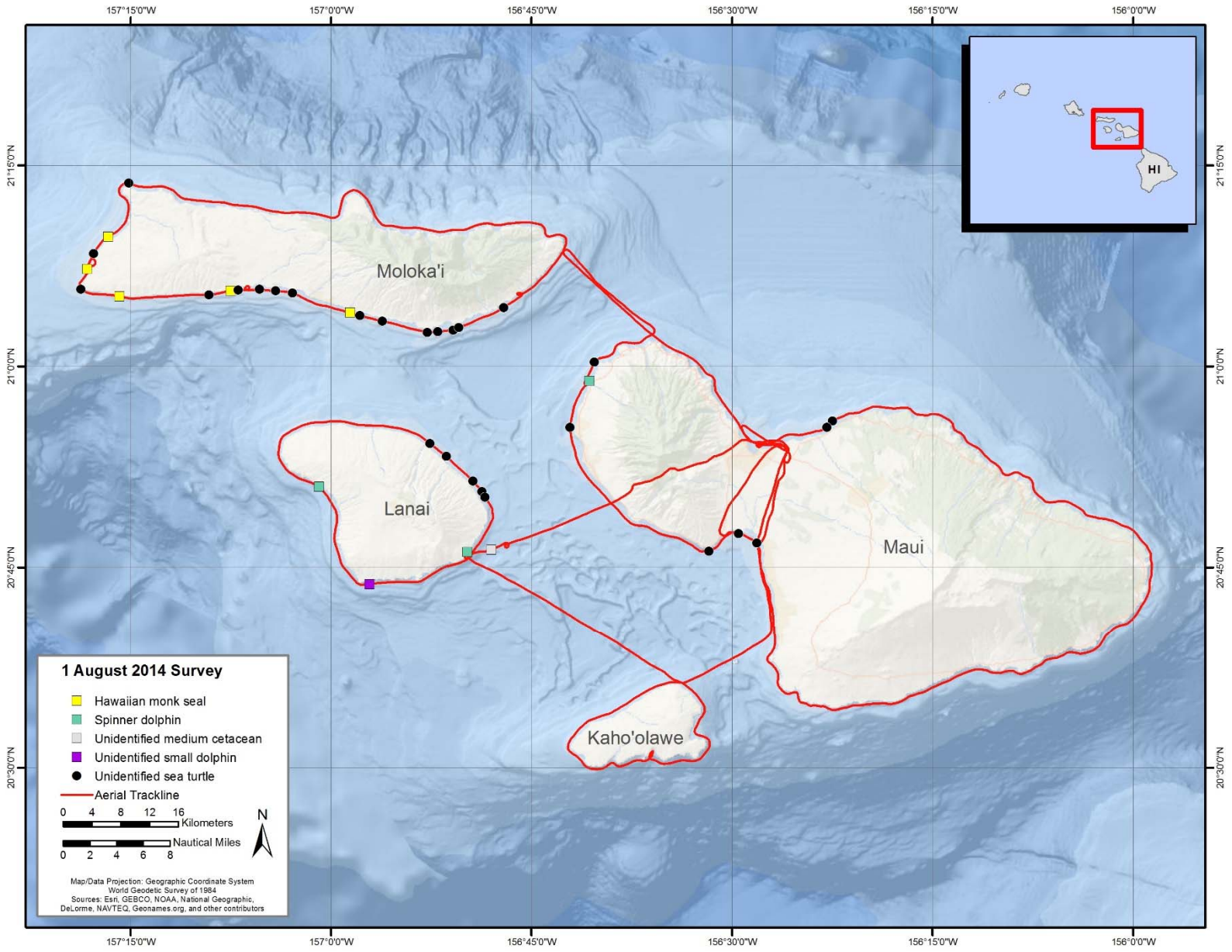

Figure 12. Aerial shoreline survey effort tracklines with marine mammal and sea turtle sightings on 1 August 2014.

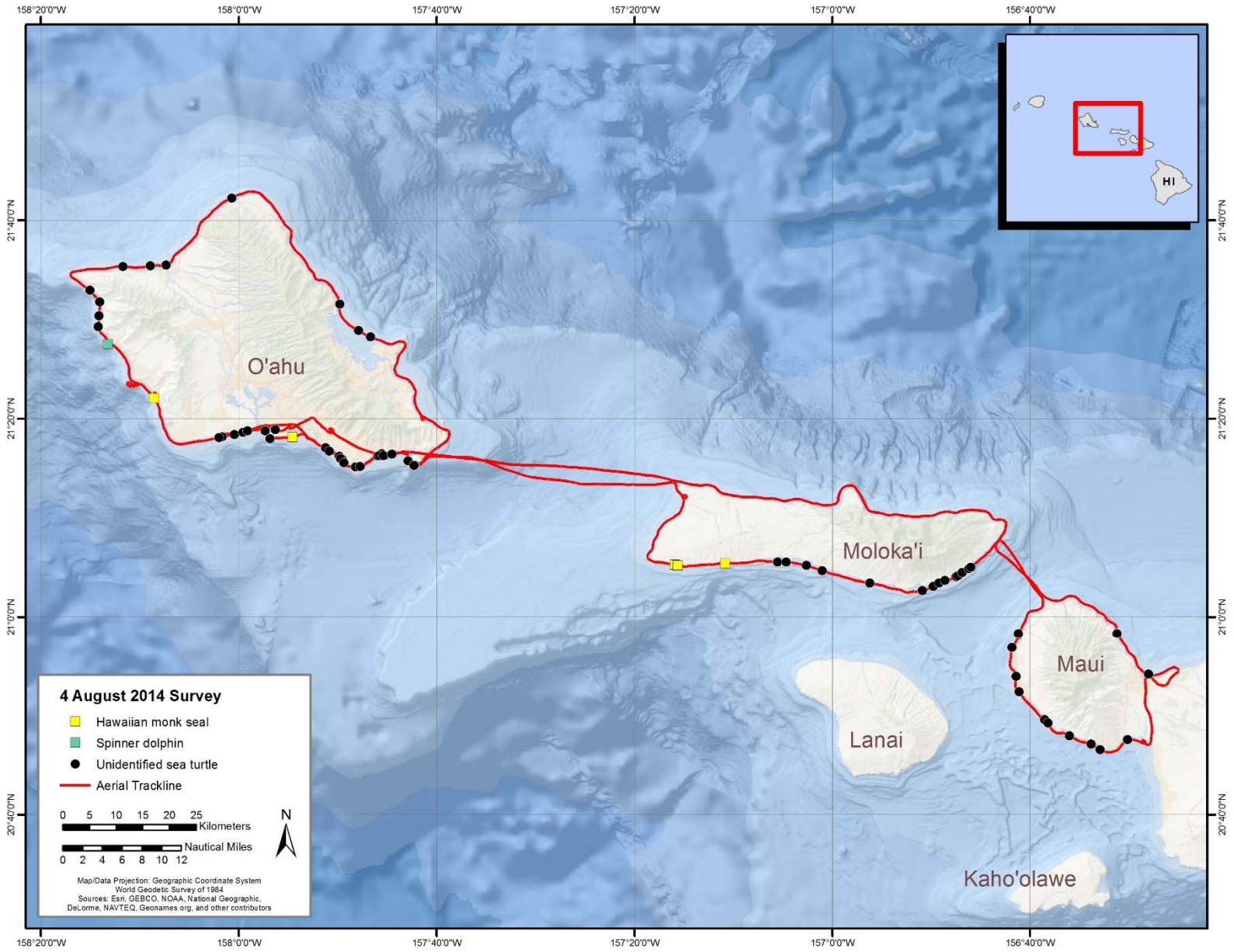

Figure 13. Aerial shoreline survey effort tracklines with marine mammal and sea turtle sightings on 4 August 2014.

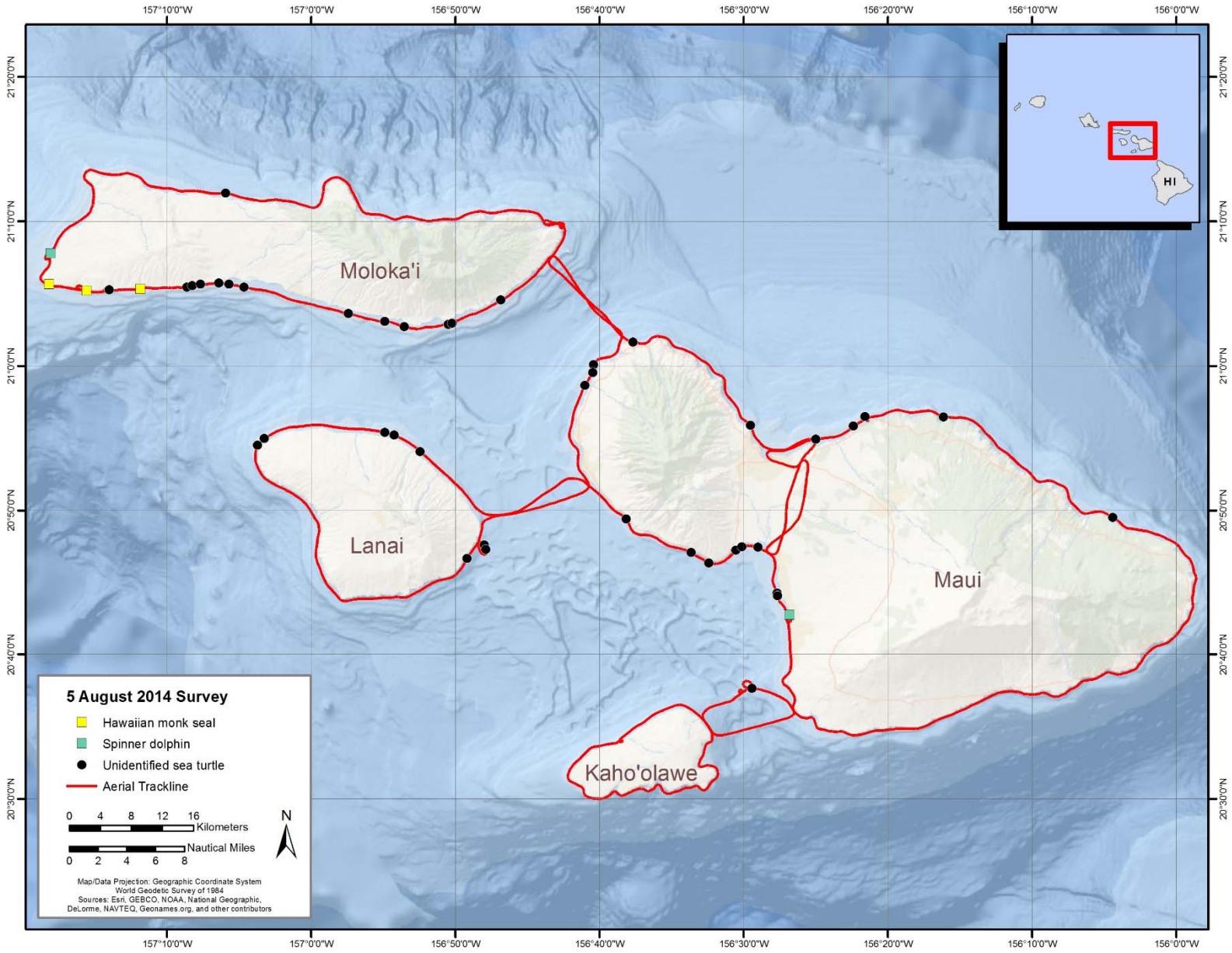

Figure 14. Aerial shoreline survey effort tracklines with marine mammal and sea turtle sightings on 5 August 2014.

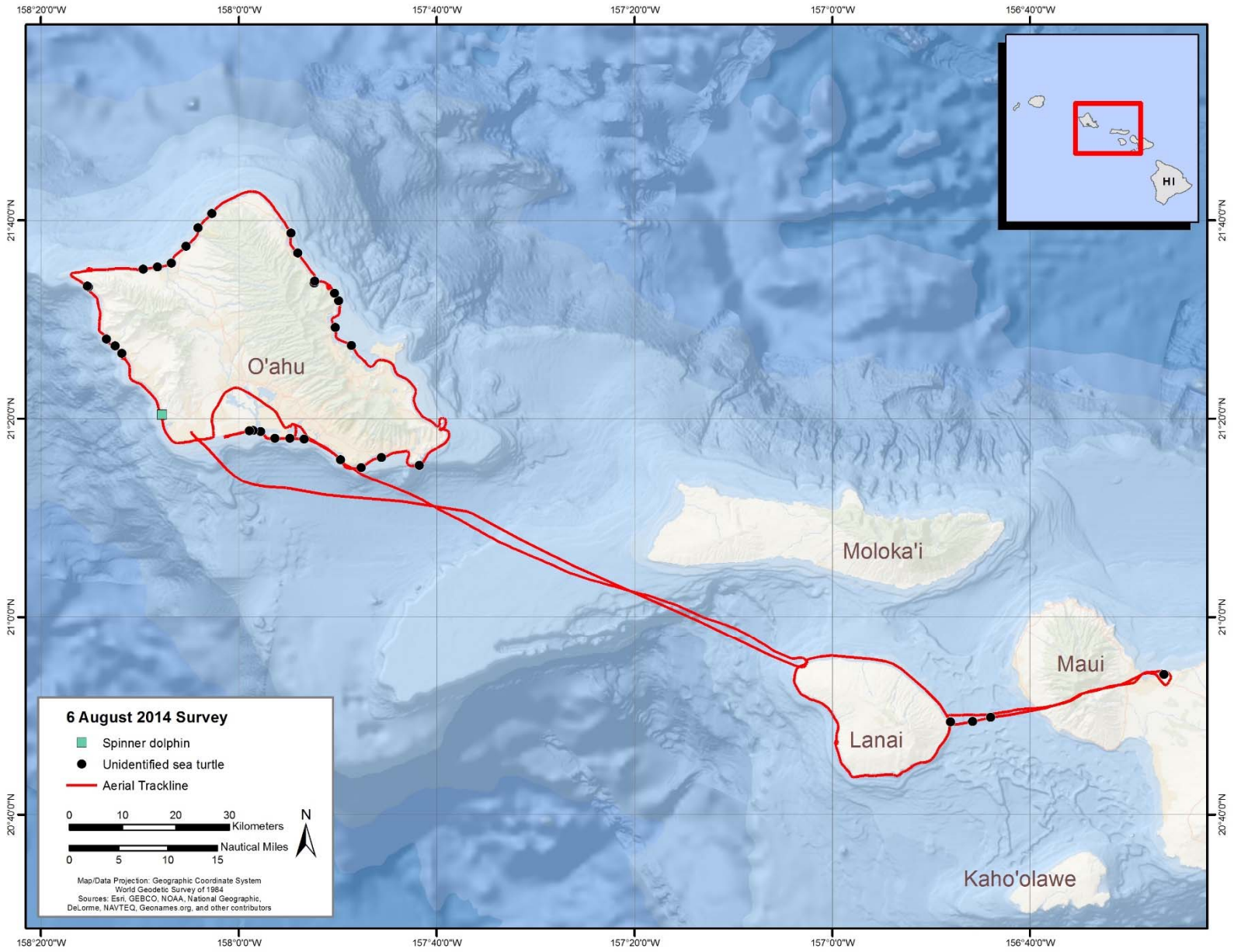

Figure 15. Aerial shoreline survey effort tracklines with marine mammal and sea turtle sightings on 6 August 2014.

D

List of Marine Mammal Strandings with Positions (GPS)

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Appendix D: List of Marine Mammal Strandings with Positions (GPS)

Stranding Report Date	Estimated Stranding Date	Species	Latitude (°N)	Longitude (°W)	Island	Region
1/14/2010	12/14/2010-12/21/2010	Humpback Whale	21.58119	157.88619	Oahu	Punaluu
2/22/2010	2/3/2010-2/12/2010	Humpback Whale	21.10980	157.30405	Molokai	Halena
3/4/2010	2/4/2010	Unknown	20.86297	156.14383	Maui	Keanae
3/4/2010	2/4/2010	Sperm Whale	20.20380	155.73093	Hawaii	Kapaau
3/5/2010	2/5/2010 (at the latest)	Unknown	20.99795	156.55075	Maui	Kahakuloa
3/22/2010	3/22/2010	Longman's Beaked Whale	20.71958	155.98708	Maui	Hana
4/15/2010	4/12/2010-4/14/2010	Spinner Dolphin	21.31910	157.67009	Oahu	Waimanalo
6/14/2010	6/14/2010	Striped Dolphin	19.18392	155.90720	Hawaii	Milolii
6/22/2010	6/12/2010-6/15/2010	Pilot Whale	20.59783	156.55928	Kahoolawe	
6/22/2010	5/22/2010-6/08/2010	Pilot Whale	20.59591	156.55705	Kahoolawe	
7/13/2010	7/01/2010 (at the latest)	Sperm Whale	23.43000	159.84000	Kauai	North
7/27/2010	7/01/2010-7/07/2010	Sperm Whale	20.71920	155.98736	Maui	Hana
8/16/2010	8/16/2010	Blainville's Beaked Whale	20.75515	156.45961	Maui	Maalaea
9/27/2010	9/17/2010-9/24/2010	Dwarf Sperm Whale	20.20395	155.73114	Hawaii	Paholo
10/7/2010	09/28/2010-10/4/2010	Pilot Whale	21.15945	156.73761	Molokai	Halawa
10/13/2010	9/13/2010	Unknown	20.59783	156.55928	Kahoolawe	
10/29/2010	10/19/2010-10/25/2010	Melon-headed Whale	21.45582	157.73769	Oahu	Kaneohe
5/5/2010	4/5/2010 (at the latest)	Unknown	21.87431	159.43822	Kauai	Poipu
11/27/2010	11/27/2010	False Killer Whale	21.07903	157.00300	Molokai	Kawela
12/28/2010	12/20/2010-12/25/2010	Pygmy Sperm Whale	21.18075	156.99239	Molokai	Kalaupapa
12/16/2010	12/02/2010 (at the latest)	Unknown	18.17667	156.13833	Hawaii	South
2/13/2011	2/12/2011-2/13/2011	Bottlenose Dolphin	22.04167	159.33455	Kauai	Lydgate Park
2/28/2011	2/25/2011-2/28/2011	Humpback Whale	20.74151	156.87929	Lanai	
3/6/2011	2/6/2011-2/13/2011	Humpback Whale	19.74312	155.06333	Hawaii	Hilo
3/20/2011	3/19/2011-3/20/2011	Melon-headed Whale	21.42009	157.74408	Oahu	Kailua
4/11/2011	4/1-2011-4/8/2011	Humpback Whale	20.88397	156.86010	Lanai	Lanai
5/21/2011	5/20/2011-5/21/2011	Bottlenose Dolphin	22.03450	159.33590	Kauai	Lydgate Park

Stranding Report Date	Estimated Stranding Date	Species	Latitude (°N)	Longitude (°W)	Island	Region
5/30/2011	5/30/2011	Sperm Whale	21.63958	157.91708	Oahu	Laie
6/25/2011	6/15/2011-6/19/2011	Blainville's Beaked Whale	18.91626	155.66826	Hawaii	South Point
7/8/2011	7/8/2011	Melon-headed Whale	20.91801	156.49150	Maui	Waiehu
7/22/2011	7/14/2011-7/19/2011	Striped Dolphin	20.86878	156.84215	Lanai	
8/12/2011	8/11/2011-8/12/2011	Spinner Dolphin	19.62713	156.00953	Hawaii	Kona
8/23/2011	7/23/2011 (at the latest)	Sperm Whale	19.63757	154.98024	Hawaii	Paradise Park
8/30/2011	8/27/2011-8/30/2011	Spinner Dolphin	21.39116	158.15692	Oahu	Nanakuli
12/16/2011	12/13/2011-2/15/2011	*Kogia* sp.	21.18075	156.99239	Molokai	Kalaupapa
9/23/2011	9/23/2011	Rough-toothed Dolphin	22.15778	159.30499	Kauai	Anahola
1/23/2012	Unknown	Humpback Whale	22.17866	159.65250	Kauai	Na Pali Coast
5/28/2012	5/25/2012-5/28/2012	Pygmy Sperm Whale	20.59278	156.55250	Kahoolawe	Hakieawa
7/1/2012	6/21/2012-6/28/2012	Dwarf Sperm Whale	20.91512	156.49175	Maui	Waihee-Waiehu
7/6/2012	7/5/2012-7/6/2012	Striped Dolphin	21.36365	157.70938	Oahu	Waimanalo
7/9/2012	7/9/2012	Melon-headed Whale	21.42371	-157.74343	Oahu	Kailua
7/23/2012	7/20/2012-7/22/2012	Spinner Dolphin	21.44891	158.19651	Oahu	Waianae
8/22/2012	6/30/2012-8/22/2012	Sperm Whale	19.56075	154.88801	Hawaii	Puna
8/6/2012	7/06/2012 (at the latest)	Unknown Whale	19.13567	155.50467	Hawaii	Punaluu
8/27/2012	8/28/2012	Sperm Whale	20.25683	155.81062	Hawaii	Hawi
9/20/2012	9/10/2012-9/17/2012	Spinner Dolphin	20.59052	156.55037	Kahoolawe	
11/6/2012	10/26/2012-11/03/2012	*Stenella* sp.	19.48769	154.81819	Hawaii	Kapoho
12/26/2012	12/26/2012	Short-finned Pilot Whale	21.50774	157.84371	Oahu	Kaneohe
1/9/2013	1/9/2013	Humpback Whale	20.91338	156.89168	Lanai	Kaiolohia
1/14/2013	1/14/2013	Humpback Whale	21.27878	157.74458	Oahu	Hawaii Kai
2/26/2013	12/26/2012-1/26/2013	Sperm Whale	19.00207	155.57849	Hawaii	Na'alehu
2/27/2013	2/17/2013-2/24/2013	Short-finned Pilot Whale	20.85893	156.83192	Lanai	Keomuku
3/2/2013	3/1/2013-3/2/2013	Striped Dolphin	21.42276	157.74358	Oahu	Kailua
2/3/2013	2/2/2013-2/3/2013	Humpback Whale	21.45332	158.20085	Oahu	Waianae
3/27/2013		Unknown Whale		0.00000	Kauai	Offshore
2/4/2013	01/04/2013-01/20/2013	Melon-headed Whale	21.12828	157.29695	Molokai	

Stranding Report Date	Estimated Stranding Date	Species	Latitude (°N)	Longitude (°W)	Island	Region
8/3/2013	8/3/2013	Spinner Dolphin	19.74341	156.05378	Hawaii	Kailua-Kona
3/16/2013	3/16/2013	Humpback Whale	20.92295	156.94492	Lanai	
4/16/2013	4/13/2013-4/16/2013	Humpback Whale	21.71112	157.98440	Oahu	Kahuku
8/9/2013	8/9/2013	*Stenella* sp.	21.46550	157.75881	Oahu	MCBH
9/7/2013	9/4/2013-9/6/2013	Spinner Dolphin	21.89288	159.60486	Kauai	
8/15/2013	8/15/2013	Spinner Dolphin	20.64670	156.44300	Maui	
9/19/2013	9/19/2013	Spinner Dolphin	21.33508	157.69534	Oahu	Waimanalo
9/23/2013	9/13/2013-9/20/2013	Dwarf Sperm Whale	21.34606	157.70263	Oahu	Waimanalo
10/5/2013	10/5/2013	False Killer Whale	18.91244	155.67697	Hawaii	South Point
10/7/2013	10/7/2013	Striped Dolphin	21.36609	157.70976	Oahu	Waimanalo
10/3/2013	9/3/2013 (at the latest)	Killer Whale	20.80252	156.80913	Lanai	
10/26/2013	9/26/2013-10/12/2013	Sperm Whale	21.44301	157.81082	Oahu	Kaneohe
11/16/2013	11/16/2013	Risso's Dolphin	20.92267	156.37597	Maui	Kuau
11/18/2013	11/4/2013-11/8/2013	Spinner Dolphin	22.06629	159.78233	Kauai	PMRF
12/25/2013	12/25/2013	Dwarf Sperm Whale	20.71751	156.44703	Maui	Kihei
1/7/2014	1/7/2014	Spinner Dolphin	21.27788	157.70951	Oahu	Port Lock
2/5/2014	1/22/2014- 1/29/2014	Pygmy Sperm Whale	21.35170	157.96678	Oahu	Pearl Harbor
3/10/2014	3/10/2014	Spinner Dolphin	19.71769	156.04892	Hawaii	Kona
4/1/2014	4/1/2014	Striped Dolphin	21.25528	157.79336	Oahu	Kahala
4/18/2014	3/29/2014-4/4/2014	Humpback Whale	21.97729	160.05398	Niihau	
4/22/2014	4/21/2014	Striped Dolphin	21.50870	157.83849	Oahu	Kahaluu
5/13/2014	4/1/2014-4/13/2014	Unknown Whale	18.94033	155.63414	Hawaii	Na'alehu
6/10/2014	6/10/2014	Melon-headed Whale	20.03213	155.82594	Hawaii	Kawaihae
6/11/2014	5/27/2014- 6/1/2014	Spinner Dolphin	21.51197	157.83675	Oahu	Kahaluu
7/6/2014	6/23/14- 6/30/2014	Short-finned Pilot Whale	21.44408	157.80596	Oahu	Kaneohe
7/25/2014	7/24/2014	Short-finned Pilot Whale	22.20397	159.50289	Kauai	Hanalei
7/31/2014	7/31/2014	Short-finned Pilot Whale	22.20457	159.50339	Kauai	Hanalei
7/31/2014	7/31/2014	Short-finned Pilot Whale	21.39887	157.72183	Oahu	Kailua

Stranding Report Date	Estimated Stranding Date	Species	Latitude (°N)	Longitude (°W)	Island	Region
8/4/2014	7/21/2014-7/25/2014	Spinner Dolphin	19.89280	155.90510	Hawaii	Waikoloa
8/11/2014	8/11/2014	Spinner Dolphin	21.32569	158.11996	Oahu	Koolina
8/21/2014	8/21/2014	Striped Dolphin	20.76919	156.45901	Maui	Kihei
9/21/2014	9/21/2014	Spotted Dolphin	21.31835	157.66943	Oahu	Waimanalo
9/30/2014	9/30/2014	Striped Dolphin	21.40634	157.73990	Oahu	Kailua
12/1/2014	12/1/2014	Blackfish	19.73817	155.03960	Hawaii	Hilo
12/5/2014	12/5/2014	Sperm Whale	20.78601	156.46864	Hawaii	Maalaea

E

Maps of Reported Marine Mammal Shoreline Strandings by Year

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Appendix E: Maps of Reported Marine Mammal Shoreline Strandings by Year

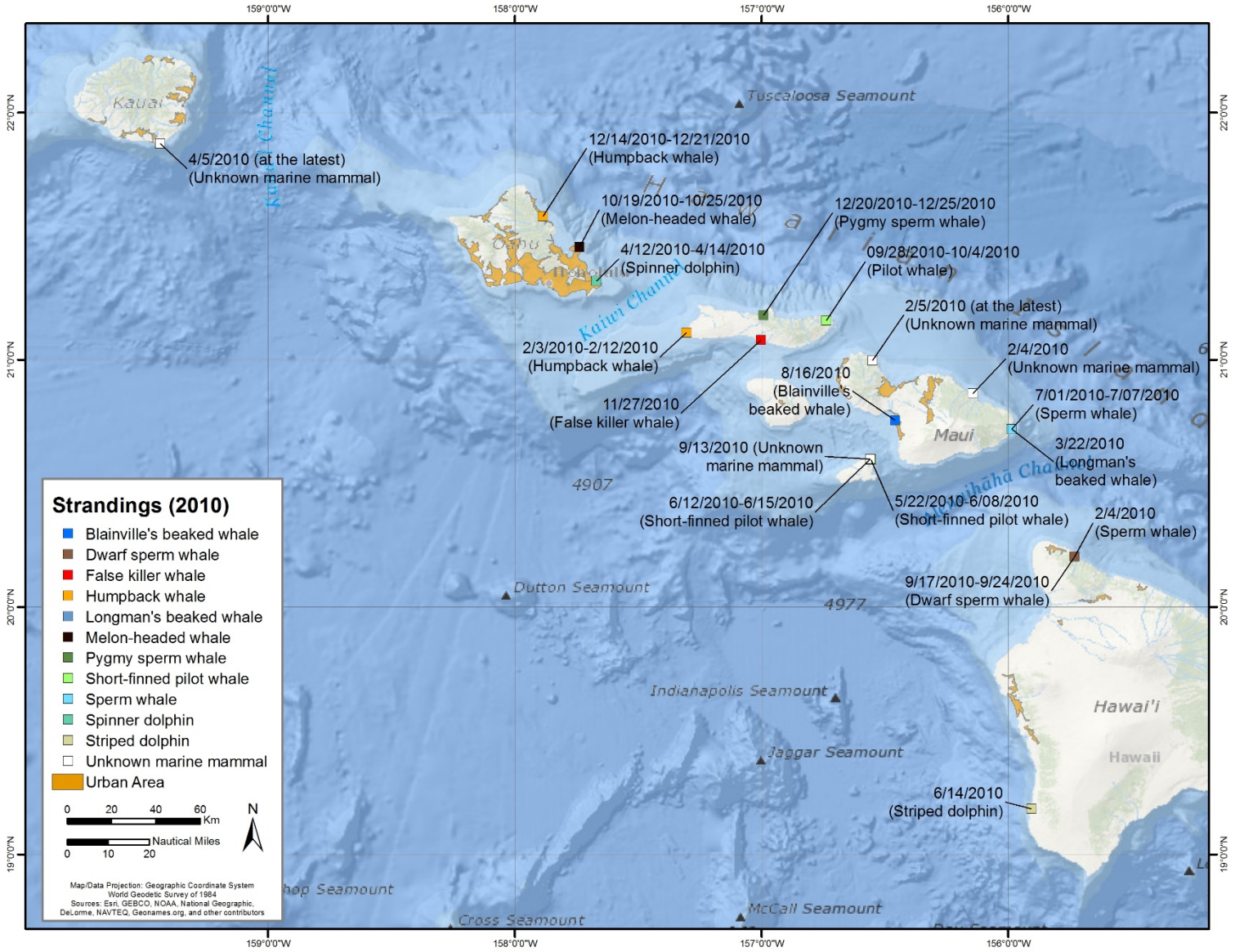

Figure 16. Reported marine mammal shoreline strandings for calendar year 2010.

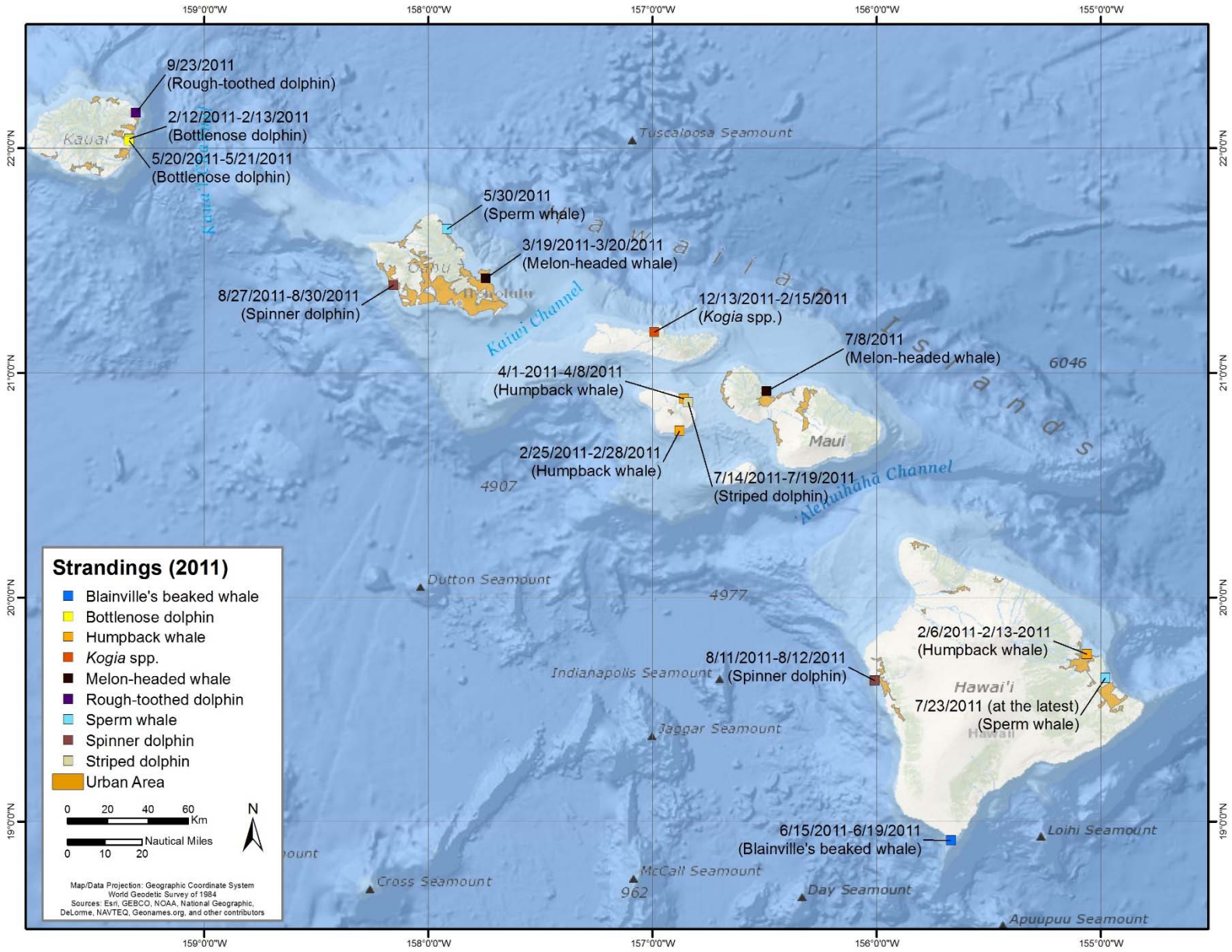

Figure 17. Reported marine mammal shoreline strandings for calendar year 2011.

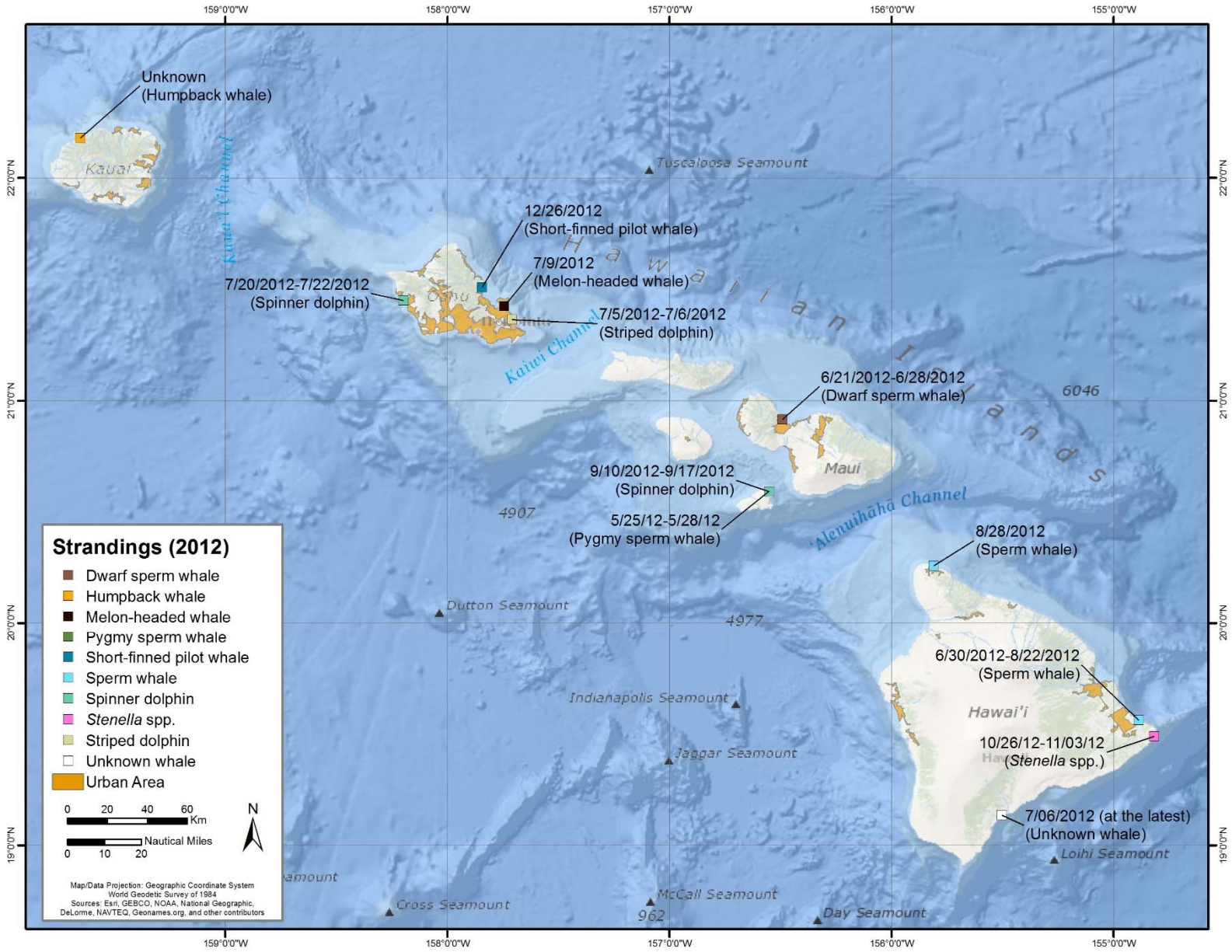

Figure 18. Reported marine mammal shoreline strandings for calendar year 2012.

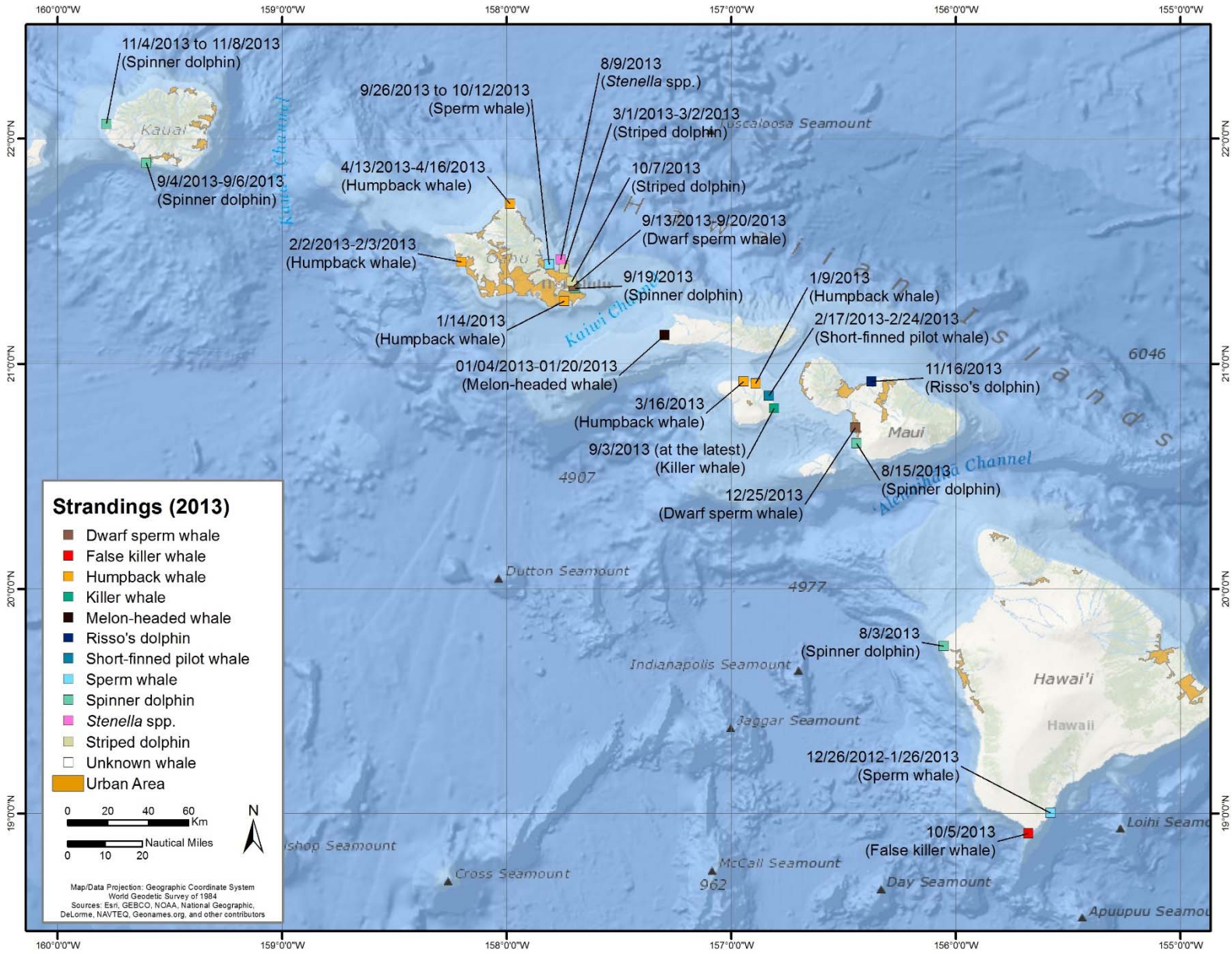

Figure 19. Reported marine mammal shoreline strandings for calendar year 2013.

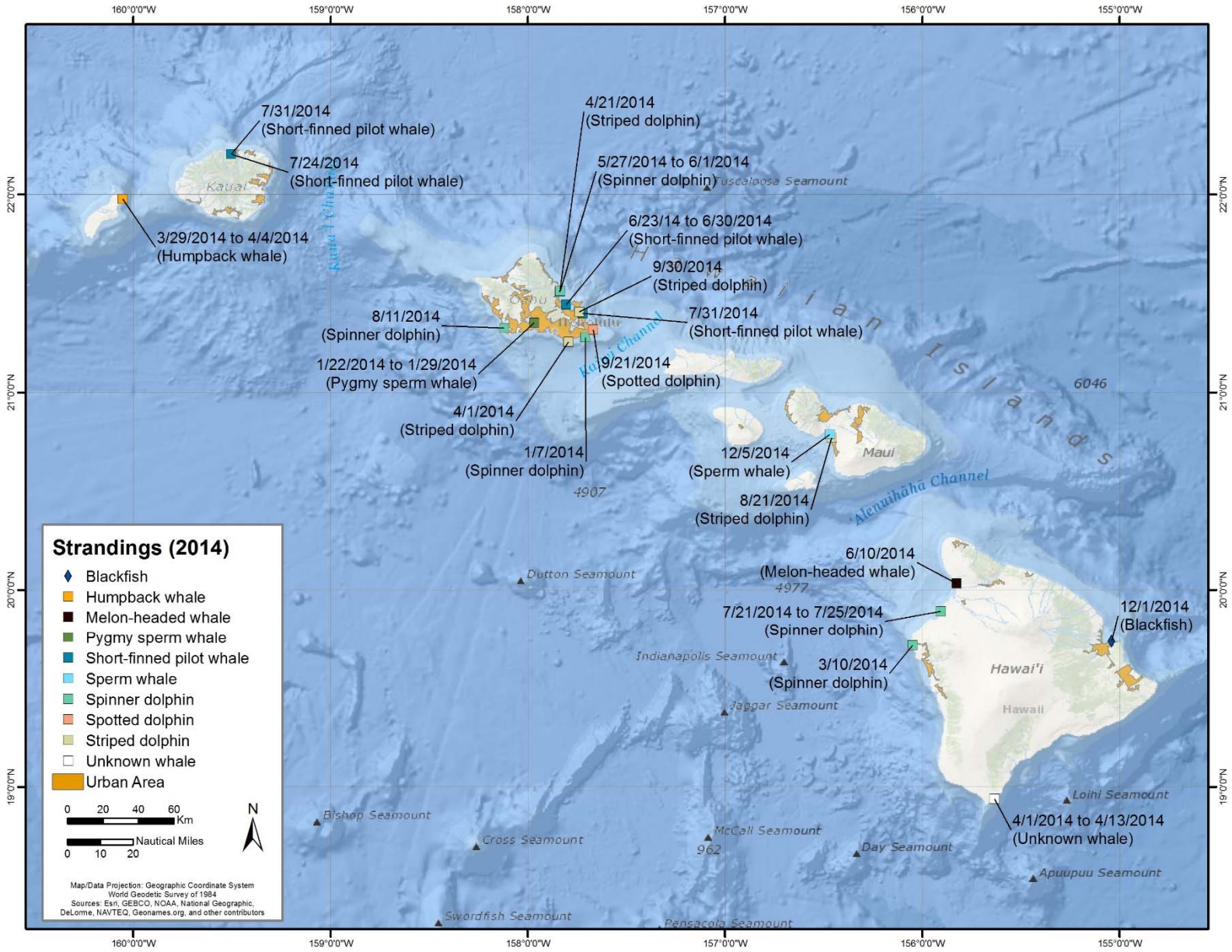

Figure 20. Reported marine mammal shoreline strandings for calendar year 2014.

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