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# Movements and Spatial Use of Odontocetes in the Western Main Hawaiian Islands: Results from Satellite-Tagging and Photo-Identification off Kaua'i and

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**MOVEMENTS AND SPATIAL USE OF ODONTOCETES IN THE WESTERN MAIN HAWAIIAN ISLANDS: RESULTS FROM SATELLITE-TAGGING AND PHOTO-IDENTIFICATION OFF KAUAʻI AND NIʻIHAU IN JULY/AUGUST 2011**

by

Robin W. Baird, Daniel L. Webster, Gregory S. Schorr, Jessica M. Aschettino, Antoinette M. Gorgone, and Sabre D. Mahaffy
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**14. ABSTRACT**
This report summarizes the second year of a three-year effort in the western main Hawaiian Islands to study the residency patterns and spatial use of odontocetes in the Hawaii Range Complex. Surveys were made off Kaua‘i and Ni‘ihau over eighteen days in July/August 2011, during which time there were 65 encounters with five species of odontocetes. Twenty-four of those encounters were cued by acoustic detections from the *M*arine *M*ammal *M*onitoring on Navy *R*anges (M3R) system from the Pacific Missile Range Facility, thus providing species verifications of the acoustic system. Additionally, 22645 photographs for individual and species identification, and forty-eight biopsy samples for genetic analyses, were collected. Some highlights of the field work include: the first ever satellite tag deployments on free-ranging rough-toothed dolphins, and the first satellite tag deployment in Hawaiian waters of a bottlenose dolphin; only the second encounter with killer whales in twelve years of surveys in Hawaiian waters; and encounters with a lone pantropical spotted dolphin, always in association with a group of spinner dolphins, as has been similarly documented in 2004 and 2005. The latter two highlights suggest, respectively, that there is no resident Hawaiian killer whale population, and that this particular (at least) pantropical spotted dolphin has a long-term association with spinner dolphins. The first highlight has provided the first unbiased movement and habitat use data for both rough-toothed and bottlenose dolphins in Hawaiian waters.

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**Movements and spatial use of odontocetes in the western main Hawaiian Islands: results from satellite-tagging and photo-identification off Kaua'i and Ni'ihau in July/August 2011**

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**Summary**

Although considerable information is available on residency patterns and spatial use of odontocetes in the eastern half of the *H*awai'i *R*ange *C*omplex (HRC), much less is known about odontocetes in the western half of the HRC. In the second year of a three-year effort in the western main Hawaiian Islands, we undertook surveys off Kaua'i and Ni'ihau in July/August 2011 to examine spatial use and residency patterns using satellite tags, to provide visual verification of acoustically-detected odontocetes on the *P*acific *M*issile *R*ange *F*acility (PMRF), and to obtain individual identification photographs and biopsy samples for assessment of population identity and structure. During 18 days of field effort we covered 1972 km of trackline and had 65 encounters with five species of odontocetes. Twenty-four of the encounters, of three species, were cued by acoustic detections from the *M*arine *M*ammal *M*onitoring on Navy *R*anges (M3R) system, thus providing species verifications for future use of the M3R system on the PMRF range. During the 65 encounters we obtained 22645 photos for individual and species identification, and collected 48 biopsy samples for genetic analyses. One encounter with a group of four killer whales was only the second encounter with this species in 12 years of directed field surveys in Hawaiian waters. Photos from that encounter were compared to our photo-identification catalog, but no matches were found, further suggesting that there is no population of this species resident to the Hawaiian Islands. There were three encounters with a lone pantropical spotted dolphin, each time in association with a group of spinner dolphins. Photos of this individual matched a spotted dolphin identified off Kaua'i in 2004 and in 2005, both times with spinner dolphins, suggesting this individual may be part of a long-term association with spinner dolphins. Four satellite tags were deployed: three on rough-toothed dolphins and one on a bottlenose dolphin. These are the first tag deployments on either species in Hawaiian waters and the first deployments of satellite tags on free-ranging rough-toothed dolphins anywhere in the world. Rough-toothed dolphin tag data were obtained over periods from 7.6 to 18.5 days. Over these periods the three rough-toothed dolphins moved cumulative horizontal distances ranging from 573 to 1295 km, yet remained an average distance from the tagging locations of from 10.4 to 13.9 km. Median depths used by the three rough-toothed dolphins ranged from 816 to 1107 m, with median distance from shore ranging from 11.6 to 12.2 km. Two of the three individuals had been previously photo-identified off Kaua'i (in 2007 or 2008), and all link by association with the resident population from Kaua'i and Ni'ihau. Movement and habitat use

data were obtained over a 34-day period for the satellite-tagged bottlenose dolphin. During this time the individual remained associated with the island of Kaua'I, using waters with a median depth of 82 m. Although this individual had not been previously photo-identified, others from the group it was in had been previously documented off Kaua'i and/or Ni'ihau in 2003-2005, suggesting it is part of the island-resident population. Overall these efforts provide the first unbiased movement and habitat use data for both species in Hawaiian waters.

**Introduction**

Considerable information is available on residency patterns and spatial use of a number of species of odontocetes in the eastern half of the *H*awai'i *R*ange *C*omplex (HRC), particularly off the island of Hawai'i (e.g., McSweeney *et al.* 2007, 2009; Baird *et al.* 2008a, 2008b, 2009, 2010, 2011; Schorr *et al.* 2009; Aschettino *et al.* 2011). Favorable working conditions have resulted in a concentration of research activities off the island, where the presence of very deep water (>2000 m) close to shore has facilitated research with a number of typically deep-water species, as well as with shallow-water species. One of the main findings of this work is that there are resident populations of more than half of the species of odontocetes found off the island of Hawai'i, including short-finned pilot whales, pygmy killer whales, melon-headed whales, common bottlenose dolphins, rough-toothed dolphins, Blainville's beaked whales, Cuvier's beaked whales, and dwarf sperm whales (e.g., McSweeney *et al.* 2007, 2009; Baird *et al.* 2008a, 2009, 2010, 2011; Schorr *et al.* 2009; Aschettino *et al.* 2011; Courbis 2011; Mahaffy 2012; Cascadia Research Collective, unpublished data). In addition to these resident populations, individuals of some species are known to regularly move among the islands (e.g., false killer whales; Baird *et al.* 2008b, 2010), and at least one has two populations that use the area (melon-headed whales, which have both a resident population to the island of Hawai'i and a population that moves among all of the main Hawaiian Islands and into offshore waters; Aschettino *et al.* 2011, Woodworth *et al.* 2011).

Less is known about residency and spatial use of odontocetes in the western half of the HRC. The smaller size of the islands (Kaua'i, Ni'ihau, O'ahu) result in smaller lee areas and thus less ideal working conditions, and the shallower slopes to the islands mean that deep water is further offshore and thus in less protected areas. Most of the research that has been done has focused on photo-identification and biopsy sampling (e.g., Baird *et al.* 2003, 2006a, but see Baird *et al.* 2008c, 2011), and has identified the existence of some island-specific populations of more commonly-encountered species, like rough-toothed dolphins off Kaua'i/Ni'ihau (Baird *et al.* 2008a) and common bottlenose dolphins (hereafter bottlenose dolphins) off both Kaua'i/Ni'ihau and O'ahu (Baird *et al.* 2009; Martien *et al.* 2011). However, there is a paucity of information available for less-frequently encountered and/or deeper-water species. Navy exercises are concentrated in the western half of the HRC, thus there is a need for additional information on residency patterns and spatial use of protected species in that area to be able to assess the likelihood of exposure to exercises, interpret potential reactions, and assess overall impacts. One of the primary purposes of this project is to address this information gap. A number of tools are used to accomplish this, in particular deployment of medium-term *L*ow *I*mpact *M*inimally *P*ercutaneous *E*xternal-electronics *T*ransmitter (LIMPET) satellite tags on a number of species of odontocetes. Importantly, photo-identification results are also used to interpret spatial use patterns, building on long-term photo-identification catalogs compiled from throughout the main Hawaiian Islands, and collection of genetic samples to contribute to studies of population structure. In the first year of effort under this grant, field activities were undertaken off O'ahu (in October 2010) and Kaua'i (in February 2011), with considerable new information obtained on movements and habitat use of a number of species of odontocetes (Baird *et al.* 2011). This report summarizes results from the second year of this effort, with field activities undertaken in July and August 2011 off the islands of Kaua'i and Ni'ihau. In addition to support from N45 and the Naval Postgraduate School, these field efforts were supported in part by funding from Commander, Pacific Fleet.

**Methods**

Surveys were undertaken off the island of Kaua'i for 18 days between 21 July and 8 August 2011. Several research vessels were used: a 27' Boston Whaler outfitted with a tower and bow pulpit; a 24' rigid-hulled Zodiac; and a 32' Sea Cat. When the PMRF range was open to vessel traffic, survey efforts were coordinated with the *M*arine *M*ammal *M*onitoring on Navy *R*anges (M3R) program with the research vessel directed to areas with acoustic identifications of odontocetes. When access to the range was closed, surveys were undertaken to the south, west, or east of the range. Observers scanned 360 degrees around the research vessel, which transited typically at speeds of 15-30 km $h^{-1}$. Efforts were made to obtain photographs of all individuals in groups of odontocetes encountered and biopsy samples of most species. A laser photogrammetry system using two green dot lasers mounted 15 cm apart (Webster *et al.* 2010) was used to obtain dorsal fin measurements, when possible, to assist in assessing age class of individuals.

Satellite tagging was to be undertaken with any of a number of priority target species encountered, including beaked whales, sperm whales, melon-headed whales, false killer whales, short-finned pilot whales, or pygmy killer whales. Depending on encounter rates (and tags deployed) with those species, satellite tags were also to be deployed on lower-priority species such as rough-toothed dolphins and bottlenose dolphins. The satellite tags used were location-only SPOT5 tags (Wildlife Computers, Inc., Redmond, WA), in the LIMPET configuration (Andrews *et al.* 2008; Schorr *et al.* 2009; Baird *et al.* 2010). Attachment darts penetrated 4.2 cm into the dorsal fin. Tags were programmed to transmit for variable periods during the day corresponding to the periods with the best satellite overpasses. Tagged individuals were biopsy sampled, when possible, to allow for genetic sexing of individuals (analyses undertaken by R. Albertson, Oregon State University).

Data obtained from the Argos system was processed with the Douglas Argos-Filter v. 7.08 (available at Alaska.usgs.gov/science/biology/spatial/douglas.html) using two independent methods: distance between consecutive locations, and rate and bearings among consecutive movement vectors. Each location is assigned a "location class" by Argos, which reflects the estimated precision of the location, with the most precise locations being classes 3 and 2 (estimated error of <250 m and < 500 m, respectively). We set the Douglas Argos-Filter to automatically retain location classes 3 and 2. Maximum rate of movement was set at 20 km $h^{-1}$. Depth and distance from shore for all locations which passed the Douglas Argos-filter were determined in ArcGIS v. 9.2 (ESRI, Redlands, California) using a 50 m x 50 m multibeam synthesis bathymetry model from the Hawai'i Mapping Research Group (available at http://www.soest.hawaii.edu/HMRG/multibeam/index.php).

To determine whether individuals with overlapping tag data were acting in concert or independently, we calculated the straight-line distance (i.e., not taking into account potentially intervening land masses) between pairs of individuals when locations were obtained during a single satellite overpass. We used both the average distances between pairs of individuals and the maximum distance between pairs to assess whether individuals were acting independently.

Photographs of tagged and companion individuals were added and compared to individual photo-identification catalogs for each species maintained by Cascadia Research Collective (e.g., Baird *et al.* 2006b; Baird *et al.* 2008a; Baird *et al.* 2009). Previous sighting histories of individuals within groups were examined to assess whether individuals were: 1) part of resident populations from the areas they were tagged (or whether the group they were in included known resident individuals); 2) potentially part of offshore populations; or 3) individuals moving from other islands. For rough-toothed dolphins, a social network was generated using good or excellent quality photos of all distinctive and very distinctive individuals photo-identified off Kaua'i from 2003 through 2005 (250 identifications, from Baird *et al.* 2008a), as well as an additional 114 identifications from 2007 through January 2012. Photographs of spinner dolphins were contributed to a catalog held at the NOAA Pacific Islands Fisheries Science Center.

**Results and Discussion**

In 18 days of field efforts off Kaua'i in July/August we covered 1972 kilometers of survey trackline with 118.8 hours of survey effort (Figure 1). During this period we encountered 65 different groups of five different species of odontocetes and obtained 22645 photographs for individual and species identification (Table 1).

The most unusual sighting of the trip was a group of four killer whales, only the second sighting of killer whales in 12 years of field work in the main Hawaiian Islands (see Baird *et al.* 2006b). Identification photographs of the four killer whales were compared to Cascadia Research Collective's photo-identification catalog for this species in Hawai'i, but no matches were found. Pantropical spotted dolphins are only infrequently seen off Kaua'i (Baird *et al.* 2003, 2006a; Courbis 2011), and while there were three sightings of pantropical spotted dolphins during this field effort, all three were of the same individual, seen on three separate days and each time traveling with a group of spinner dolphins in shallow near-shore waters (Figure 1). Photographs of the spotted dolphin were compared with a catalog of this species, and this individual matched a sighting from Kaua'i from February 2004 (M. Deakos, unpublished) and to a sighting from Kaua'i in November 2005 (see Baird *et al.* 2006a). In both previous cases the spotted dolphin was also with a group of spinner dolphins and was the only spotted dolphin seen, suggesting that this individual may be a semi-permanent associate with spinner dolphins off Kaua'i.

Of the 65 total encounters, 24 were detected based on the M3R acoustic range, with the research vessel directed to the area of the acoustic detection. Of these 24, there were single sightings of spinner dolphins, bottlenose dolphins, and an unidentified odontocete, as well as 21 sightings of rough-toothed dolphins, a species known to be commonly encountered in the study area (Baird *et al.* 2008a). We collected 48 genetic samples from four of the five species for studies of population structure, including 23 samples from rough-toothed dolphins; these were sent to Oregon State University for a study of rough-toothed dolphin population structure. (See Albertson *et al.* 2011.) Sub-samples of all species were sent to the Southwest Fisheries Science Center for curation and analysis.

Four satellite tags were deployed; three on rough-toothed dolphins (Figure 2) and one on a bottlenose dolphin (Table 2). The satellite tag deployments on three rough-toothed dolphins were the first remote deployments of satellite tags on this species anywhere in the world. With attachment durations of up to 18 days, these tags provided the first unbiased movement and habitat use data available for this species in Hawaiian waters. Although the minimum cumulative horizontal distance traveled for the three individuals ranged from 573 to 1295 km, on average the three individuals remained within 10-14 km of their tagging location (Table 3), and repeatedly returned to the general area near where they were tagged (Figures 3, 4). All three individuals remained strongly associated with the islands of Kaua'i and Ni'ihau, with movements largely centered on the PMRF range (Figure 3). Two of the individuals were tagged on the same day in the same group, and they remained relatively close together during the period when tag data from the two overlapped (Figure 5). Photos of all three individuals were compared to our photo-identification catalog, and two of the individuals, HISb0860 (SbTag001, tagged 31 July 2011) and HISb0785 (SbTag003, tagged 2 August 2011) had been previously documented off Kaua'i; HISb0860 in June 2008 and HISb0785 in October and November 2007 and June 2008. Although the third individual, HISb0908 (SbTag002) had not been previously photographically documented, this individual was with others that had been previously documented off Kaua'i (including HISb0785) and was also re-sighted off Kaua'i in January 2012 (Cascadia Research Collective unpublished data). A social network showing distinctive and very distinctive rough-toothed dolphins identified off Kaua'i and Ni'ihau showed that all three tagged individuals are linked by association with the main component of the social network off those islands (Figure 6), although the first individual tagged has not been seen in association with the second or third individual. During the period of tag overlap, the first tagged individual appeared to remain separated from the other two tagged individuals (which were spatially associated), suggesting we obtained data from two, rather than three, independent groups of rough-toothed dolphins (Figure 5).

The satellite tagged bottlenose dolphin was the first of this species remotely tagged with a satellite tag in Hawaiian waters. While photos of this individual did not match any known individuals in our catalog, of the 45 photo-identified individuals from this encounter, 15 individuals had been previously documented off Kaua'i or Ni'ihau in either 2003, 2004, or 2005, suggesting the tagged individual is part of the resident population from those islands (Baird *et al.* 2009). This individual remained associated with the island of Kaua'i for the 34 days that locations were received from the tag (Figure 7), using waters with an average depth of 82 m and remaining an average of 2.24 km from shore (Table 3).

Although the samples sizes are small, this effort, combined with efforts in 2010 (Baird *et al.* 2011) and additional field effort planned for 2012, substantially increase what is known about the residency and habitat use of several species of odontocetes around the western main Hawaiian Islands. Such knowledge is important in providing a stronger basis for assessment of repeated exposure of individuals to Navy exercises, in interpreting individual and/or group reactions, and in determining high-use or ecologically-important areas of occupancy of individuals from the island-associated populations.

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**Tables and Figures**

**Table 1.** Odontocete sightings off Kaua‘i/Ni‘ihau in July/August 2011.

(*Continued on next page*)

| Species | Date | Enc. # | Group size | # photos | # genetic samples | # tag deployments |
|---|---|---|---|---|---|---|
| Bottlenose dolphin | 22-Jul-11 | 1 | 7 | 121 | 1 | 0 |
| Bottlenose dolphin | 22-Jul-11 | 3 | 7 | 414 | 1 | 0 |
| Bottlenose dolphin | 25-Jul-11 | 1 | 1 | 0 | 0 | 0 |
| Bottlenose dolphin | 25-Jul-11 | 2 | 5 | 287 | 2 | 0 |
| Bottlenose dolphin | 25-Jul-11 | 3 | 16 | 317 | 2 | 0 |
| Bottlenose dolphin | 25-Jul-11 | 4 | 15 | 123 | 0 | 0 |
| Bottlenose dolphin | 27-Jul-11 | 4 | 25 | 364 | 0 | 0 |
| Bottlenose dolphin | 28-Jul-11 | 1 | 10 | 652 | 2 | 0 |
| Bottlenose dolphin | 28-Jul-11 | 2 | 200 | 1253 | 4 | 0 |
| Bottlenose dolphin | 31-Jul-11 | 4 | 4 | 38 | 0 | 0 |
| Bottlenose dolphin | 03-Aug-11 | 1 | 45 | 2649 | 6 | 1 |
| Bottlenose dolphin | 05-Aug-11 | 2 | 2 | 167 | 1 | 0 |
| Bottlenose dolphin | 06-Aug-11 | 1 | 2 | 57 | 0 | 0 |
| Killer whale | 24-Jul-11 | 5 | 4 | 779 | 0 | 0 |
| Pantropical spotted dolphin | 04-Aug-11 | 2 | 1 | 10 | 1 | 0 |
| Pantropical spotted dolphin | 05-Aug-11 | 4 | 1 | 10 | 0 | 0 |
| Pantropical spotted dolphin | 08-Aug-11 | 4 | 1 | 10 | 0 | 0 |
| Rough-toothed dolphin | 21-Jul-11 | 1 | 4 | 53 | 0 | 0 |
| Rough-toothed dolphin | 21-Jul-11 | 2 | 2 | 146 | 1 | 0 |
| Rough-toothed dolphin | 21-Jul-11 | 3 | 5 | 219 | 1 | 0 |
| Rough-toothed dolphin | 21-Jul-11 | 4 | 1 | 0 | 0 | 0 |
| Rough-toothed dolphin | 21-Jul-11 | 5 | 65 | 1783 | 2 | 0 |
| Rough-toothed dolphin | 23-Jul-11 | 1 | 5 | 223 | 1 | 0 |
| Rough-toothed dolphin | 23-Jul-11 | 2 | 9 | 166 | 1 | 0 |
| Rough-toothed dolphin | 24-Jul-11 | 1 | 2 | 0 | 0 | 0 |
| Rough-toothed dolphin | 24-Jul-11 | 2 | 5 | 222 | 0 | 0 |
| Rough-toothed dolphin | 24-Jul-11 | 3 | 5 | 275 | 2 | 0 |
| Rough-toothed dolphin | 24-Jul-11 | 4 | 5 | 87 | 0 | 0 |
| Rough-toothed dolphin | 24-Jul-11 | 6 | 1 | 0 | 0 | 0 |
| Rough-toothed dolphin | 24-Jul-11 | 7 | 2 | 78 | 1 | 0 |
| Rough-toothed dolphin | 26-Jul-11 | 1 | 6 | 400 | 1 | 0 |
| Rough-toothed dolphin | 27-Jul-11 | 1 | 2 | 0 | 0 | 0 |
| Rough-toothed dolphin | 27-Jul-11 | 2 | 1 | 0 | 0 | 0 |
| Rough-toothed dolphin | 27-Jul-11 | 3 | 3 | 517 | 1 | 0 |
| Rough-toothed dolphin | 28-Jul-11 | 4 | 10 | 497 | 0 | 0 |
| Rough-toothed dolphin | 29-Jul-11 | 1 | 4 | 265 | 0 | 0 |
| Rough-toothed dolphin | 31-Jul-11 | 1 | 25 | 1507 | 3 | 1 |

**Table 1.** (*Continued*)

| Species | Date | Enc # | Group size | # photos | # genetic samples | # tag deployments |
|---|---|---|---|---|---|---|
| Rough-toothed dolphin | 31-Jul-11 | 2 | 12 | 540 | 0 | 0 |
| Rough-toothed dolphin | 31-Jul-11 | 3 | 7 | 262 | 0 | 0 |
| Rough-toothed dolphin | 01-Aug-11 | 2 | 9 | 186 | 1 | 0 |
| Rough-toothed dolphin | 01-Aug-11 | 3 | 18 | 963 | 0 | 0 |
| Rough-toothed dolphin | 02-Aug-11 | 1 | 12 | 184 | 1 | 0 |
| Rough-toothed dolphin | 02-Aug-11 | 2 | 3 | 66 | 0 | 0 |
| Rough-toothed dolphin | 02-Aug-11 | 3 | 1 | 0 | 0 | 0 |
| Rough-toothed dolphin | 02-Aug-11 | 4 | 11 | 87 | 1 | 0 |
| Rough-toothed dolphin | 02-Aug-11 | 5 | 2 | 147 | 1 | 0 |
| Rough-toothed dolphin | 02-Aug-11 | 6 | 10 | 1156 | 3 | 2 |
| Rough-toothed dolphin | 02-Aug-11 | 7 | 4 | 47 | 0 | 0 |
| Rough-toothed dolphin | 06-Aug-11 | 2 | 7 | 503 | 0 | 0 |
| Rough-toothed dolphin | 08-Aug-11 | 2 | 14 | 727 | 2 | 0 |
| Spinner dolphin | 21-Jul-11 | 6 | 15 | 153 | 0 | 0 |
| Spinner dolphin | 22-Jul-11 | 2 | 75 | 1135 | 0 | 0 |
| Spinner dolphin | 25-Jul-11 | 5 | 30 | 0 | 0 | 0 |
| Spinner dolphin | 01-Aug-11 | 1 | 15 | 3 | 0 | 0 |
| Spinner dolphin | 01-Aug-11 | 4 | 4 | 42 | 0 | 0 |
| Spinner dolphin | 02-Aug-11 | 8 | 14 | 214 | 3 | 0 |
| Spinner dolphin | 03-Aug-11 | 2 | 2 | 0 | 0 | 0 |
| Spinner dolphin | 03-Aug-11 | 4 | 3 | 0 | 0 | 0 |
| Spinner dolphin | 04-Aug-11 | 1 | 80 | 1004 | 2 | 0 |
| Spinner dolphin | 04-Aug-11 | 3 | 35 | 158 | 0 | 0 |
| Spinner dolphin | 05-Aug-11 | 1 | 7 | 0 | 0 | 0 |
| Spinner dolphin | 05-Aug-11 | 3 | 70 | 791 | 0 | 0 |
| Spinner dolphin | 05-Aug-11 | 5 | 8 | 0 | 0 | 0 |
| Spinner dolphin | 06-Aug-11 | 3 | 4 | 0 | 0 | 0 |
| Spinner dolphin | 08-Aug-11 | 3 | 65 | 588 | 0 | 0 |
| Unidentified dolphin | 08-Aug-11 | 1 | 1 | 0 | 0 | 0 |
| Unidentified odontocete | 26-Jul-11 | 2 | 1 | 0 | 0 | 0 |
| Unidentified odontocete | 28-Jul-11 | 3 | 1 | 0 | 0 | 0 |
| Unidentified odontocete | 03-Aug-11 | 3 | 2 | 0 | 0 | 0 |

**Table 2.** Information on satellite tag deployments during July/August 2011[1].

| Species | Tag ID | Date tagged | Individual ID | Sex[2] | Duration of signal (days) | Tagged individual previously documented |
|---|---|---|---|---|---|---|
| Rough-toothed dolphin | SbTag001 | 31-Jul-11 | HISb0860 | Unknown | 7.6 | Yes |
| Rough-toothed dolphin | SbTag002 | 2-Aug-11 | HISb0908 | Male (g) | 12.5 | No |
| Rough-toothed dolphin | SbTag003 | 2-Aug-11 | HISb0785 | Male (g) | 18.5 | Yes |
| Bottlenose dolphin | TtTag002 | 3-Aug-11 | HITt0632 | Male (m) | 34.1 | No |

[1]All tagged individuals categorized as adults based on body size. [2]Sex determined genetically (g) or by ventral morphology (m)

**Table 3.** Information on movements and habitats used by tagged individuals during July/August 2011.

| Tag ID | # locations after filtering | Minimum cumulative distance moved (km) | Distance to deployment location (km) Median (Range) | Depth (m) Median (Range) | Distance from shore (km) Median (Range) |
|---|---|---|---|---|---|
| SbTag001 | 106 | 573.6 | 13.9 (2.3-39.7) | 816 (318-2162) | 11.6 (3.7-19.5) |
| SbTag002 | 167 | 809.8 | 10.3 (0.6-30.2) | 1031 (495-2762) | 12.2 (5.4-21.5) |
| SbTag003 | 244 | 1295.8 | 10.7 (0.9-42.4) | 1107 (383-2703) | 12.2 (3.6-21.7) |
| TtTag002 | 350 | 2016.6 | 40.3 (0.2-61.4) | 82 (2-2144) | 2.24 (0.12-12.93) |

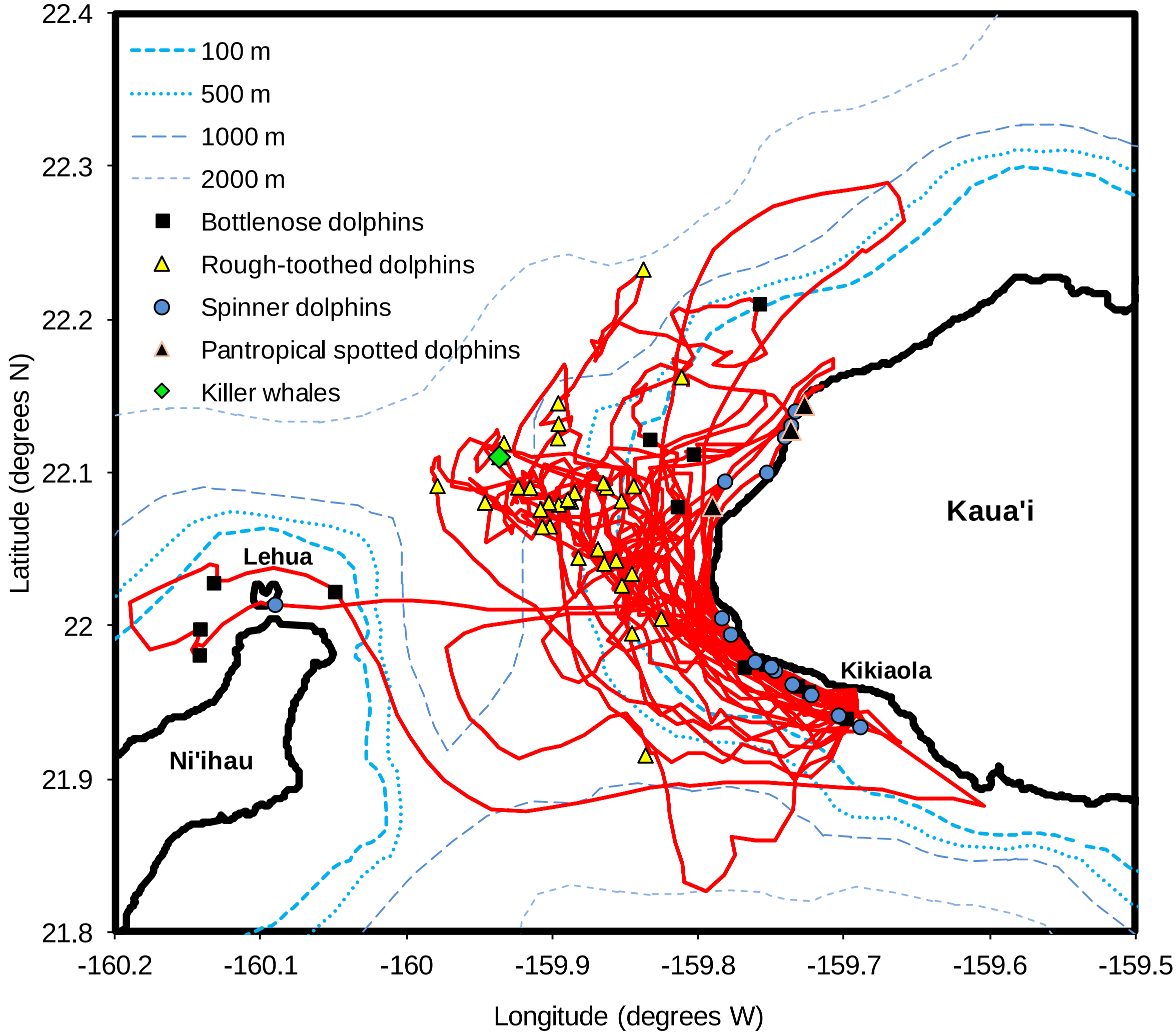


**Figure 1.** Map showing vessel tracklines and sighting locations from field efforts in July/August 2011.

**Figure 2.** Satellite-tagged rough-toothed dolphin, August 2, 2011. Photo © Robin W. Baird. This individual (HISb0785 in our catalog) has an unusual (piebald) coloration pattern, and had been previously documented off Kaua‘i in October and November 2007 and in June 2008.

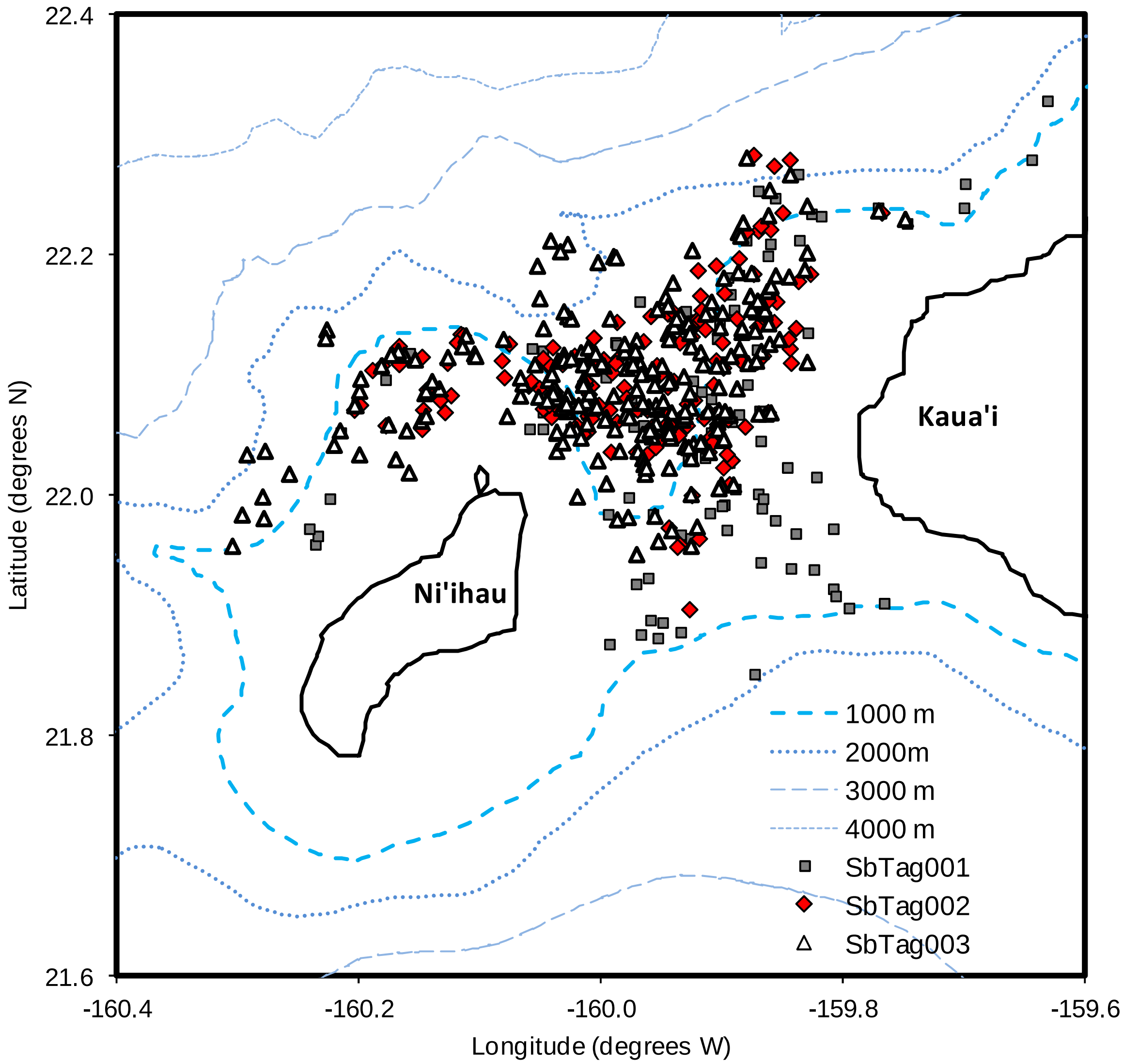


**Figure 3.** Satellite-derived locations of three tagged rough-toothed dolphins after filtering during July and August 2011. See Table 2 for details.

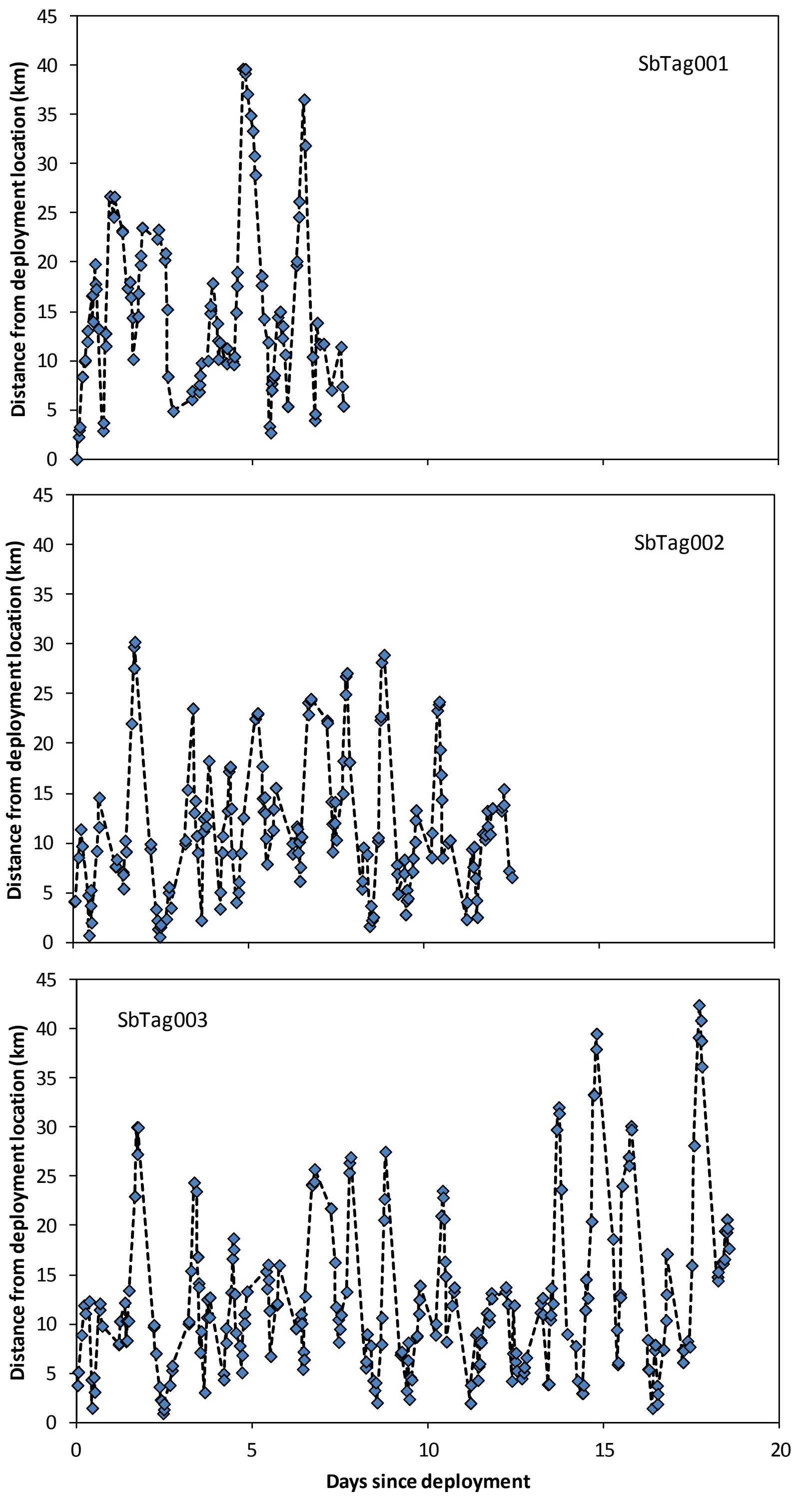


**Figure 4.** Distance from deployment location over time for three rough-toothed dolphins satellite tagged in July and August 2011. All three individuals returned to the vicinity of the tagging location during the periods when locations were received.

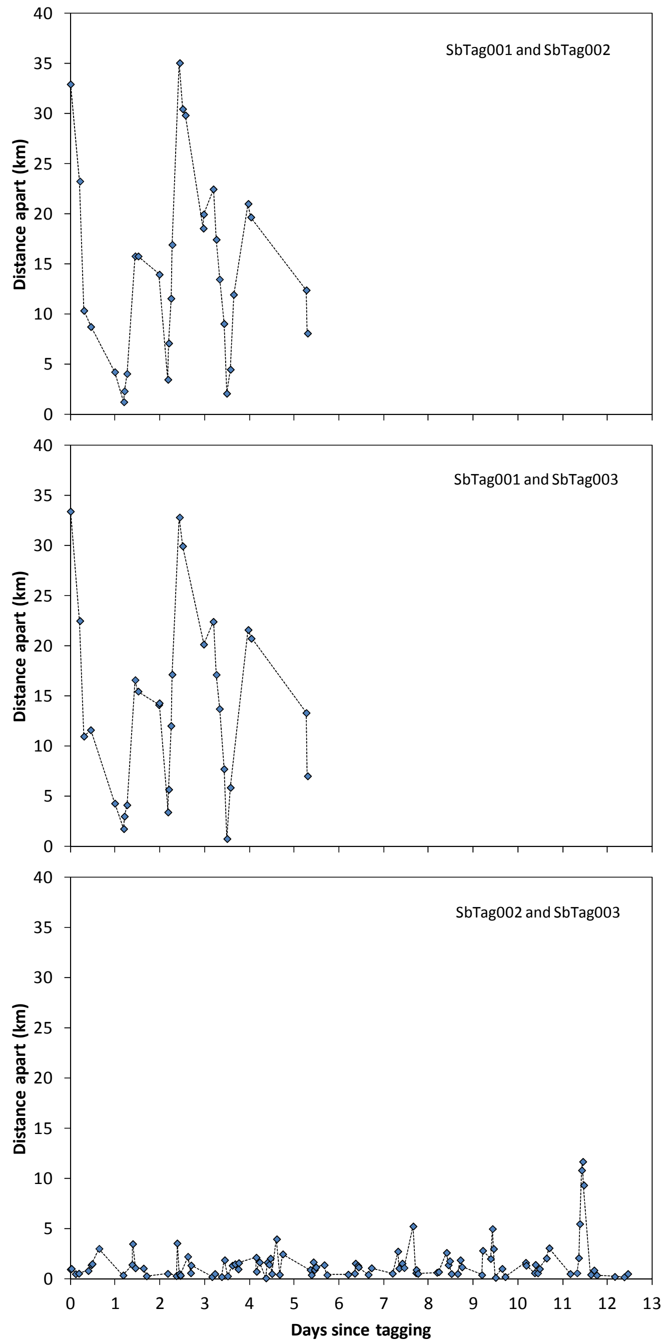


**Figure 5.** Distance between pairs of tagged individual rough-toothed dolphins during the periods of tag overlap, during satellite overpasses when high-quality locations (LC3, LC2, LC1 only) were received from both tags. The similarity in appearance between the top and middle panel reflect that SbTag002 and SbTag003 remained in association for the period of tag overlap with SbTag001. Median distance apart: SbTag001 and SbTag002 = 13.5 km (max = 35.1 km); SbTag001 and SbTag003 = 13.7 km (max = 33.4 km); SbTag002 and SbTag003 = 1.06 km (max = 11.7 km). The x- and y-axis scales are the same for comparison.

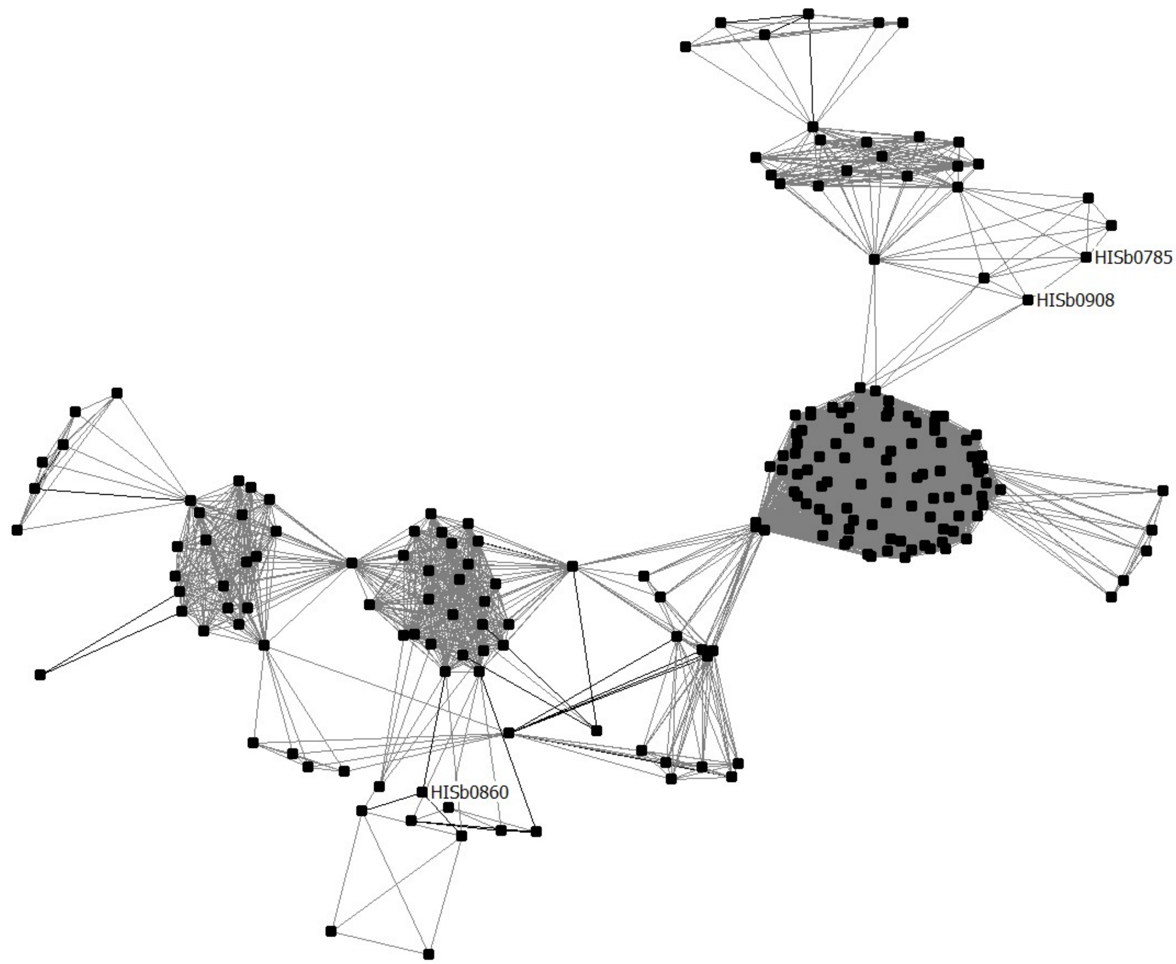


**Figure 6.** Main cluster of a social network of distinctive and very distinctive rough-toothed dolphins photo-identified off Kaua'i and Ni'ihau from 2003 through 2011, with tagged individuals identified. All identifications of rough-toothed dolphins identified in 2003 and 2005 (see Baird *et al.* 2008a) are included, with partial identifications of those photographed in 2008 and 2011. Each point represents an individual dolphin with lines connecting points for those individuals seen together in an encounter. Diagram produced with Netdraw 2.097 using a spring embedding layout. See Table 2 for tag numbers corresponding to individual identification numbers.

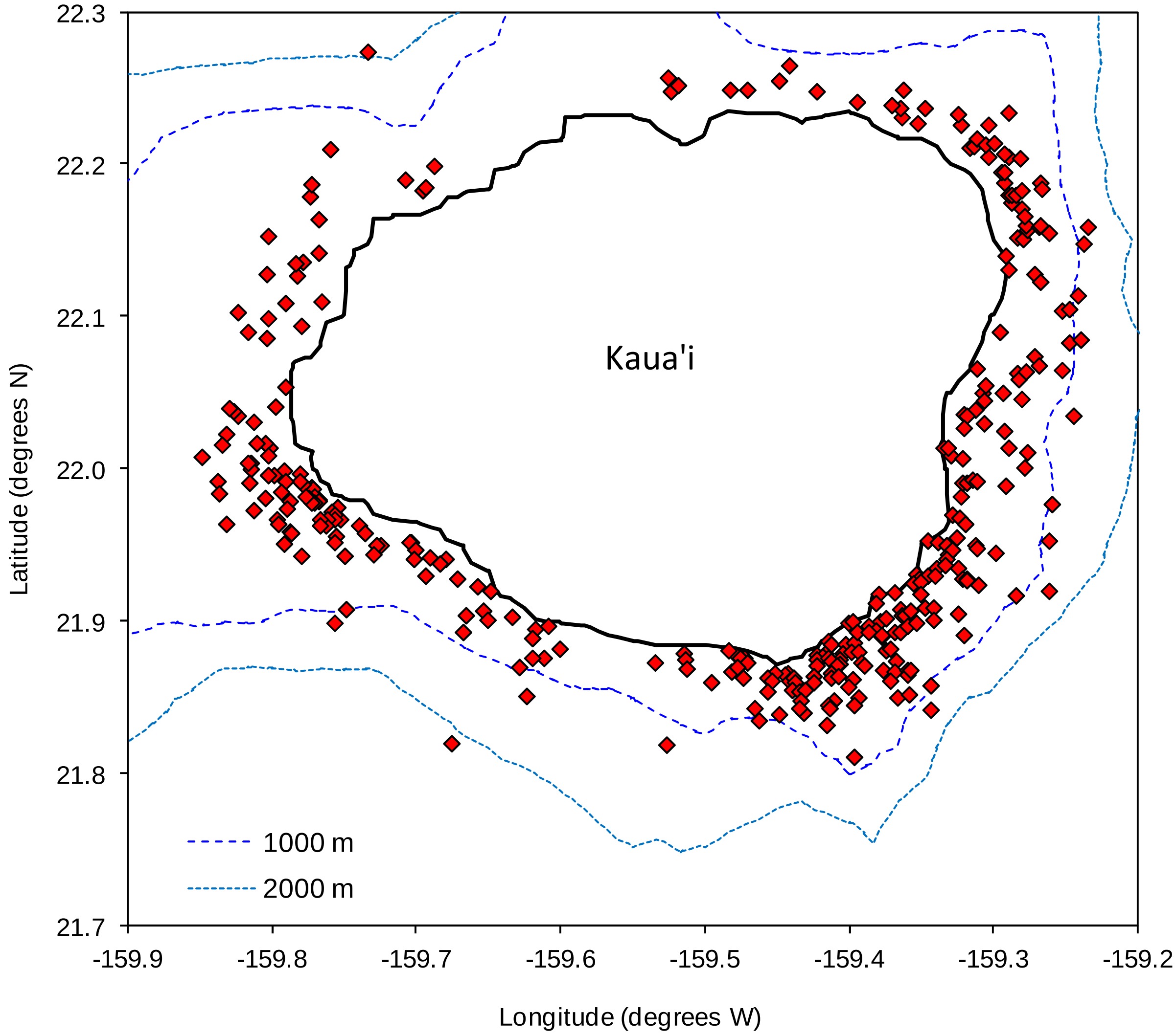


**Figure 7.** Locations of a satellite-tagged bottlenose dolphin from August 3, 2011, to September 6, 2011.

**Initial Distribution List**

| | | |
|---|---|---|
| 1. | Defense Technical Information Center<br>8725 John J. Kingman Rd., STE 0944<br>Ft. Belvoir, VA 22060-6218 | 2 |
| 2. | Dudley Knox Library, Code 013<br>Naval Postgraduate School<br>Monterey, CA 93943-5100 | 2 |
| 3. | Erin Oleson<br>National Marine Fisheries Service<br>Pacific Islands Fisheries Science Center<br>Honolulu, HI | 1 |
| 4. | John Hildebrand<br>Scripps Institution of Oceanography<br>University of California<br>La Jolla, CA | 1 |
| 5. | John Calambokidis<br>Cascadia Research Collective<br>Olympia, WA | 1 |
| 6. | Greg Schorr<br>Cascadia Research Collective<br>Olympia, WA | 1 |
| 7. | Erin Falcone<br>Cascadia Research Collective<br>Olympia, WA | 1 |
| 8. | Ching-Sang Chiu<br>Naval Postgraduate School<br>Monterey, CA | 1 |
| 9. | Curtis A. Collins<br>Naval Postgraduate School<br>Monterey, CA | 1 |
| 10. | Thomas A. Rago<br>Naval Postgraduate School<br>Monterey, CA | 1 |

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|---|---|---|
| 11. | Tetyana Margolina<br>Naval Postgraduate School<br>Monterey, CA | 1 |
| 12. | Chris Miller<br>Naval Postgraduate School<br>Monterey, CA | 1 |
| 13. | John Joseph<br>Naval Postgraduate School<br>Monterey, CA | 1 |
| 14. | Katherine Whitaker<br>Pacific Grove, CA | 1 |
| 15. | Frank Stone<br>CNO(N45)<br>Washington, D.C. | 1 |
| 16. | Jay Barlow<br>Southwest Fisheries Science Center, NOAA<br>La Jolla, CA | 1 |
| 17. | CAPT Ernie Young, USN (Ret.)<br>CNO(N45)<br>Washington, D.C. | 1 |
| 18. | Dale Liechty<br>CNO(N45)<br>Washington, D.C. | 1 |
| 19. | Dave Mellinger<br>Oregon State University<br>Newport, OR | 1 |
| 20. | Kate Stafford<br>Applied Physics Laboratory<br>University of Washington<br>Seattle, CA | 1 |
| 21. | Sue Moore<br>NOAA at Applied Physics Laboratory<br>University of Washington<br>Seattle, WA | 1 |

| | | |
|---|---|---|
| 22. | Petr Krysl<br>University of California<br>La Jolla, CA | 1 |
| 23. | Mark McDonald<br>Whale Acoustics<br>Bellvue, CO | 1 |
| 24. | Ted Cranford<br>San Diego State University<br>San Diego, CA | 1 |
| 25. | Monique Fargues<br>Naval Postgraduate School<br>Monterey, CA | 1 |
| 26. | Mary Ann Daher<br>Woods Hole Oceanographic Institution<br>Woods Hole, MA | 1 |
| 27. | Heidi Nevitt<br>NAS North Island<br>San Diego, CA | 1 |
| 28. | Rebecca Stone<br>Naval Postgraduate School<br>Monterey, CA | 1 |
| 29. | Sean M. Wiggins<br>Scripps Institution of Oceanography<br>University of California<br>La Jolla, CA | 1 |
| 30. | E. Elizabeth Henderson<br>Scripps Institution of Oceanography<br>University of California<br>La Jolla, CA | 1 |
| 31. | Gregory S. Campbell<br>Scripps Institution of Oceanography<br>University of California<br>La Jolla, CA | 1 |
| 32. | Marie A. Roch<br>San Diego State University<br>San Diego, CA | 1 |

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|---|---|---|
| 33. | Anne Douglas<br>Cascadia Research Collective<br>Olympia, WA | 1 |
| 34. | Julie Rivers<br>COMPACFLT<br>Pearl Harbor, HI | 1 |
| 35. | Jenny Marshall<br>Naval Facilities Engineering Command<br>San Diego, CA | 1 |
| 36. | Chip Johnson<br>COMPACFLT<br>Pearl Harbor, HI | 1 |
| 37. | CDR Len Remias<br>U.S. Pacific Fleet<br>Pearl Harbor, HI | 1 |
| 38. | LCDR Robert S. Thompson<br>U.S. Pacific Fleet<br>Pearl Harbor, HI | 1 |
| 39. | Jene J. Nissen<br>U. S. Fleet Forces Command<br>Norfolk, VA | 1 |
| 40. | W. David Noble<br>U. S. Fleet Forces Command<br>Norfolk, VA | 1 |
| 41. | David T. MacDuffee<br>U. S. Fleet Forces Command<br>Norfolk, VA | 1 |
| 42. | Keith A. Jenkins<br>Naval Facilities Engineering Command, Atlantic<br>Norfolk, VA | 1 |
| 43. | Joel T. Bell<br>Naval Facilities Engineering Command, Atlantic<br>Norfolk, VA | 1 |

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|---|---|---|
| 44. | Mandy L. Shoemaker<br>Naval Facilities Engineering Command, Atlantic<br>Norfolk, VA | 1 |
| 45. | Anurag Kumar<br>Naval Facilities Engineering Command, Atlantic<br>Norfolk, VA | 1 |
| 46. | Merel Dalebout<br>University of New South Wales<br>Sydney, Australia | 1 |
| 47. | Robin W. Baird<br>Cascadia Research Collective<br>Olympia, WA | 1 |
| 48. | Brenda K. Rone<br>National Marine Mammal Laboratory<br>Seattle, WA | 1 |
| 49. | Phil Clapham<br>National Marine Mammal Laboratory<br>Seattle, WA | 1 |
| 50. | Laura J. Morse<br>National Marine Mammal Laboratory<br>Seattle, WA | 1 |
| 51. | Anthony Martinez<br>NOAA Southeast Fisheries Science Center<br>Miami, FL | 1 |
| 52. | Darlene R. Ketten<br>Woods Hole Oceanographic Institution<br>Woods Hole, MA | 1 |
| 53. | David C. Mountain<br>Boston University<br>Boston, MA | 1 |
| 54. | Melissa Soldevilla<br>NOAA/NMFS<br>Southeast Fisheries Science Center<br>Miami, FL | 1 |

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|---|---|---|
| 55. | Brandon L. Southall<br>Southall Environmental Associates, Inc.<br>Santa Cruz, CA | 1 |
| 56. | David Moretti<br>NUWC<br>Newport, RI | 1 |
| 57. | Michael Weise<br>Office of Naval Research, Code 32<br>Arlington, VA | 1 |
| 58. | Dan Costa<br>University of California, Santa Cruz<br>Santa Cruz, CA | 1 |
| 59. | Lori Mazzuca<br>Marine Mammal Research Consultants, Inc.<br>Honolulu, HI | 1 |
| 60. | Jim Eckman<br>Office of Naval Research<br>Arlington, VA | 1 |
| 61. | Ari Friedlaender<br>Duke University<br>Beaufort, NC | 1 |
| 62. | CAPT Robin Fitch, USN (ret)<br>Office Assistant Secretary of the Navy Energy, Installations, and Environment<br>Washington, DC | 1 |
| 63. | Mary Grady<br>Southwest Fisheries Science Center<br>La Jolla, CA | 1 |
| 64. | Lisa Ballance<br>Southwest Fisheries Science Center<br>La Jolla, CA | 1 |
| 65. | Angela D'Amico<br>SPAWAR<br>San Diego, CA | 1 |

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|---|---|---|
| 66. | Amy Smith<br>Science Applications International Corporation<br>McLean, VA | 1 |
| 67. | Peter Tyack<br>Woods Hole Oceanographic Institution<br>Woods Hole, MA | 1 |
| 68. | Ian Boyd<br>University of St. Andrews<br>St. Andrews, Scotland, UK | 1 |
| 69. | Simone Baumann-Pickering<br>Scripps Institution of Oceanography<br>University of California<br>La Jolla, CA | 1 |
| 70. | Lisa K. Baldwin<br>Scripps Institution of Oceanography<br>University of California<br>La Jolla, CA | 1 |
| 71. | Anne E. Simonis<br>Scripps Institution of Oceanography<br>University of California<br>La Jolla, CA | 1 |
| 72. | Mariana L. Melcon<br>Scripps Institution of Oceanography<br>University of California<br>La Jolla, CA | 1 |
| 73. | Daniel L. Webster<br>Cascadia Research Collective<br>Olympia, WA | 1 |
| 74. | Daniel J. McSweeney<br>Wild Whale Research Foundation<br>Holualoa, HI | 1 |
| 75. | Sabre D. Mahaffy<br>Cascadia Research Collective<br>Olympia, WA | 1 |

| | | |
|---|---|---|
| 76. | Jessica M. Aschettino<br>Cascadia Research Collective<br>Olympia, WA | 1 |
| 77. | Tori Cullins<br>Wild Dolphin Foundation<br>Waianae, HI | 1 |
| 78. | Alison Stimpert<br>Naval Postgraduate School<br>Monterey, CA | 1 |
| 79. | Diane Claridge<br>Bahamas Marine Mammal Research Organisation<br>Abaco, Bahamas | 1 |
| 80. | Charlotte Dunn<br>Bahamas Marine Mammal Research Organisation<br>Abaco, Bahamas | 1 |
| 81. | Cathy Bacon<br>Smultea Environmental Sciences, LLC<br>Issaquah, WA | 1 |
| 82. | Ana Širović<br>Scripps Institution of Oceanography<br>University of California<br>La Jolla, CA | 1 |
| 83. | Amanda Cummins<br>Scripps Institution of Oceanography<br>University of California<br>La Jolla, CA | 1 |
| 84. | Sara Kerosky<br>Scripps Institution of Oceanography<br>University of California<br>La Jolla, CA | 1 |
| 85. | Lauren Roche<br>Scripps Institution of Oceanography<br>University of California<br>La Jolla, CA | 1 |

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|---|---|---|
| 86. | Brian Bloodworth<br>National Marine Fisheries Service<br>Silver Spring, MD | 1 |
| 87. | Antoinette M. Gorgone<br>NOAA Southeast Fisheries Science Center<br>Beaufort, NC | 1 |