Results of 2006 RIMPAC Aerial Surveys of Marine Mammals in Kaulakahi and Alenuihaha Channels

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Results of 2006 RIMPAC Aerial Surveys of Marine Mammals in Kaulakahi and Alenuihaha Channels

Abstract

A total of six aerial surveys of marine mammals were performed on dates corresponding with scheduled dates for "choke point" maneuvers of the "Rim of the Pacific" (RIMPAC) joint military exercises in Hawaiian waters. Three surveys were performed in the vicinity of the Kaulakahi Channel (between Kauai and Niihau) (July 16, 17 and 20) and three were performed in the Alenuihaha Channel (between Hawaii and Maui) (July 24-26). The mission of the surveys was to detect, locate and identify all marine mammal species in the target areas using methods consistent with modern distance sampling theory. Marine mammals were sighted on four of the six surveys, comprising a total of 13 groups. All sightings consisted of small to medium-sized odontocetes (toothed cetaceans), including one sighting each of bottlenose dolphins, spotted dolphins, Cuvier's beaked whale, false killer whale, unidentified beaked whale and eight sightings of unidentified delphinid species. Encounter rates of odontocete sightings (sightings/km surveyed) in this series were identical to those seen during earlier survey series (1993-03) albeit at different times of the year. No unusual observations (e.g., sightings of stranded or dead animals) were noted during the total of ca. 18 hrs of survey effort.

Background

During the summer of 2006, The United States Navy Pacific Command hosted the joint "Rim of the Pacific Exercises" (RIMPAC) military exercises in the Hawaiian Islands. Due to concerns over possible responses of marine mammal species to sonar and other aspects of the naval operations (e.g., ICES, 2005), aerial surveys were scheduled for dates before, during and after scheduled "choke point" maneuvers. Specifically this involved the Kaulakahi Channel, between the islands of Kauai and Niihau, on July 16, 17 and 20; and the Alenuihaha Channel, between the islands of Hawaii and Maui, on July 24, 25 and 26. The mission of the surveys was to detect, locate and identify all marine mammals in these channel areas, as well as to report any unusual behavior, including sightings of stranded or dead cetaceans.

Since the month of July falls outside the normal seasonal residency of humpback whales (Jan-Apr) (Mobley 2004), the less abundant odontocete species (toothed cetaceans) were the target species in the present survey series. Shallenberger (1981) described 15 odontocete species as resident in Hawaii. Based on aerial surveys conducted between 1993-98, Mobley et al. (2000) estimated abundance for 11 odontocete species for the waters within 25 nautical miles (nmi) of the major Hawaiian Islands based on surveys conducted during Jan-Apr of 1993-98. An updated summary of aerial survey results for near-shore Hawaiian waters conducted from 1993-2003 identified a total of 15 odontocete species (Mobley, unpublished data, Appendix A). Barlow (2006) provided abundance estimates for 21 cetacean species, including 18 odontocetes, based on shipboard transect surveys conducted in Aug-Nov 2002 in the Hawaiian Exclusive Economic Zone (EEZ).

Method

Three surveys were performed in each of the Kaulakahi (July 16, 17 and 20) and Alenuihaha (July 24, 25, 26) channels for a total of six surveys. Survey protocol was based on distance sampling methods, which is the standard accepted approach for estimating abundance of free ranging animal populations (Buckland et al. 2001).

Surveys in both regions followed pre-determined tracklines constructed to optimize area sampled within range limits of the aircraft (Figures 1 & 2). For the Kaulakahi Channel surveys, tracklines ran mostly north-south and were spaced 7.5 km apart comprising a total length of ca 556 km.[1] For the Alenuihaha surveys, tracklines ran from northeast to southwest and were spaced 15 km apart and comprised a total length of ca. 740 km. Starting longitudes in both regions were randomly chosen per distance sampling methodology (Buckland et al. 2001) so that the exact trackline configuration varied slightly for each survey.

The survey aircraft for the first survey (July 16) was a single-engine Cessna 177RG Cardinal[1]. For the remaining five surveys a twin-engine Piper PA34 Seneca was used. Both aircraft flew at a mean ground speed of 100 knots and an average altitude of 244m (800 ft). Two experienced observers made sightings of all marine mammal species, one on each side of the aircraft. Sightings were called to a data recorder who noted the species sighted, number of individuals, presence or absence of a calf, angle to the sighting (using hand-held Suunto clinometers), and any apparent reaction to the aircraft. Additionally, GPS locations and altitude were automatically recorded onto a laptop computer at 30-sec intervals, as well as manually whenever a sighting was made. Environmental data (seastate, glare and visibility) were manually recorded at the start of each transect leg and whenever conditions changed. The two data sources (manual and computer) were later merged into a single data file. Species identifications were typically made by orbiting an initial sighting until sufficient diagnostic features were discernible to permit positive identification. When the initial sighting could not be recaptured upon orbiting, the species was recorded as "unidentified."

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[1] Due to PMRF Range Ops on July 16, 2006, flying in the Kaulakahi Channel region was not permitted. We therefore surveyed an adjacent region off the central and southwest coast of Kauai in order to avoid the warning area on that date.

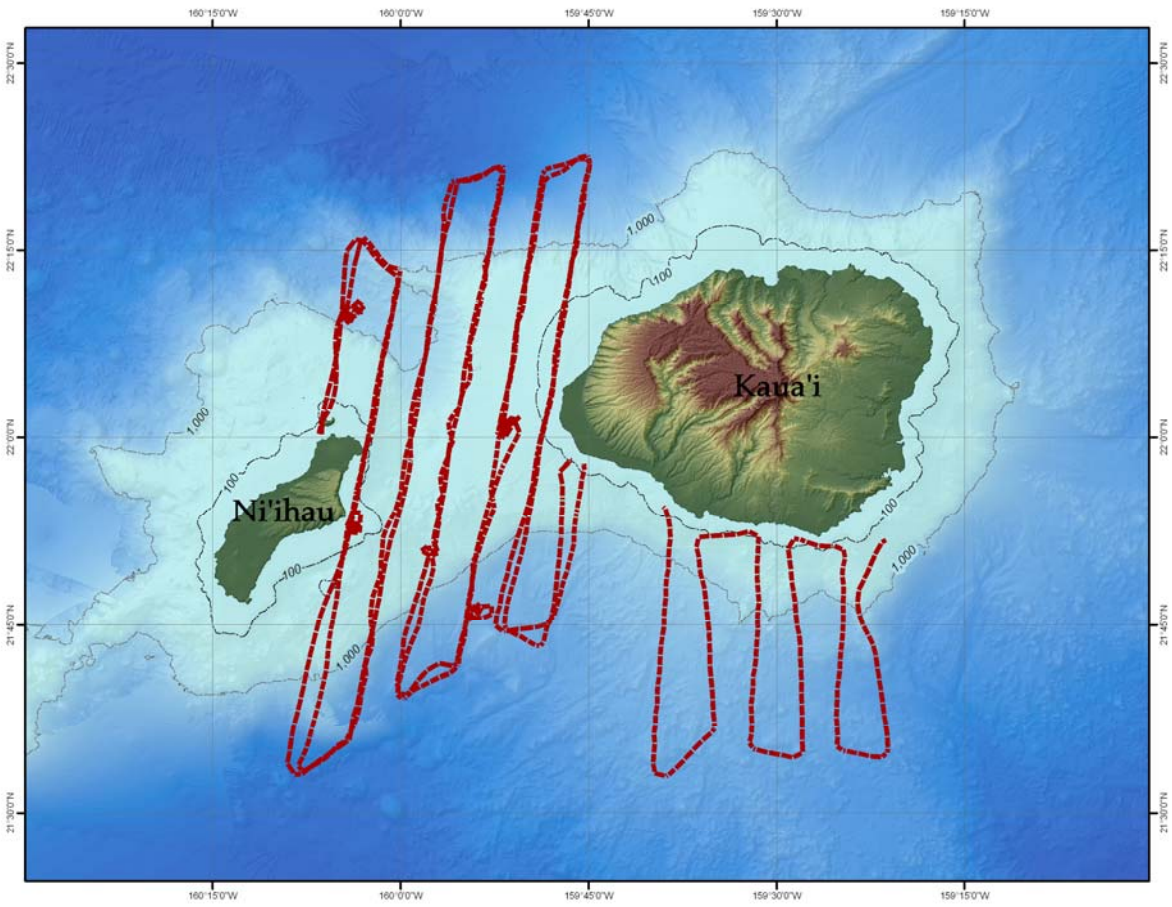

Figure 1. Survey effort for Kaulakahi Channel. GPS data (red lines) for surveys performed on July 16,17 and 20. Tracklines were 7.5 km apart and extended 13 km past the 1000 fathom contour. Total transect length was ca. 556 km. The tracklines to the south of Kauai were flown on July 16 only, when the waters of Kaulakahi Channel were closed due to scheduled operations of the Pacific Missile Range Facility (PMRF) at Barking Sands, Kauai.

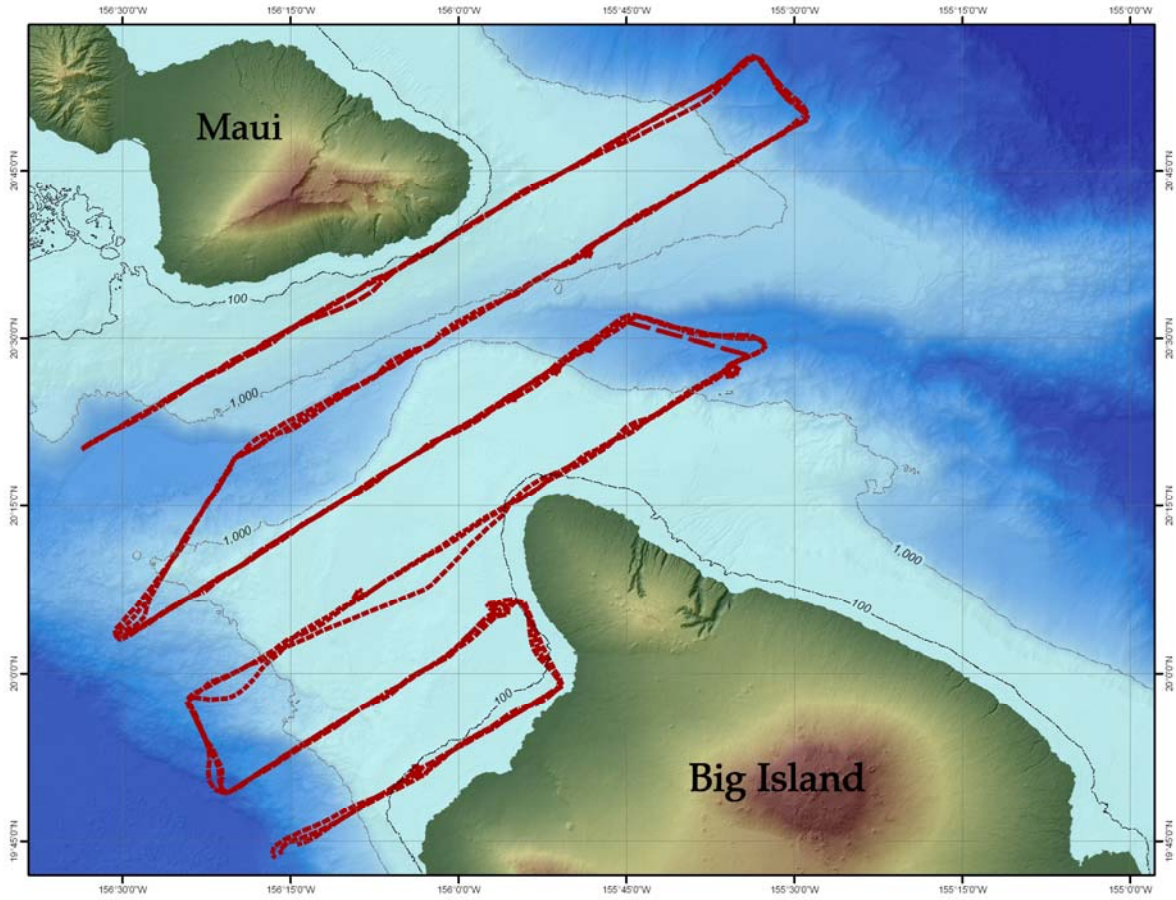

Figure 2. Survey effort for Alenuihaha Channel. GPS position data (red lines) are shown for July 24-26 surveys. Tracklines were 15 km apart and extended 13 km past the 1000 fathom limit. Total trackline distance for each survey was approximately 740 km.

Results

Overview. The six surveys comprised a total of ca. 18 hrs and ca. 3300 km of linear survey effort (Table 1). The number of sightings as well as the ability to identify species were generally hampered by poor seastate conditions that prevailed on all but one of the survey dates (July 20) (Table 1, Figure 3). Seastate is the primary factor affecting the ability to detect marine mammals (Buckland et al. 2001).

Summary of sightings. Cetacean species were detected on five of the six surveys (Table 1), including four identified species (bottlenose dolphins, spotted dolphins, false killer whales and Cuvier's beaked whale), one unidentified beaked whale species (likely *Mesoplodon densirostris*) and eight unidentified delphinid species (Table 2, Figures 4 & 5). All four of the identified species are among those typically seen in nearshore Hawaiian waters (Mobley et al. 2000; Shallenberger 1981). No unusual behavior or activity (e.g., stranded or dead animals) was observed during the six surveys.

Encounter rate comparison. One method of normalizing sightings for performing comparisons is to calculate encounter rates (groups sighted/km surveyed) (Buckland et al. 2001). In the present series a total of 13 sightings were made across ca. 3,334 km of survey effort which corresponds to an encounter rate of .0004 sightings/km. This rate is identical with the encounter rate for all odontocetes combined observed during the 1993-2003 survey series for inshore waters around the main Hawaiian Islands during the months Jan-Apr (Mobley, unpublished data, Appendix A). Therefore, the densities of marine mammal species reported here is identical with that normally seen for the Hawaiian Islands, albeit at different times of the year.

Table 1. Summary of Survey Effort and Sightings

Region	Date	No. of sightings	Survey effort (hrs)	Mean Beaufort seastate
Kaulakahi Channel	July 16	0	1.25	4.38
	July 17	2	3.96	4.06
	July 20	3	3.08	1.47
Alenuihaha Channel	July 24	1	3.28	4.36
	July 25	5	3.33	4.17
	July 26	2	3.02	4.80
	Total:	13	17.92	

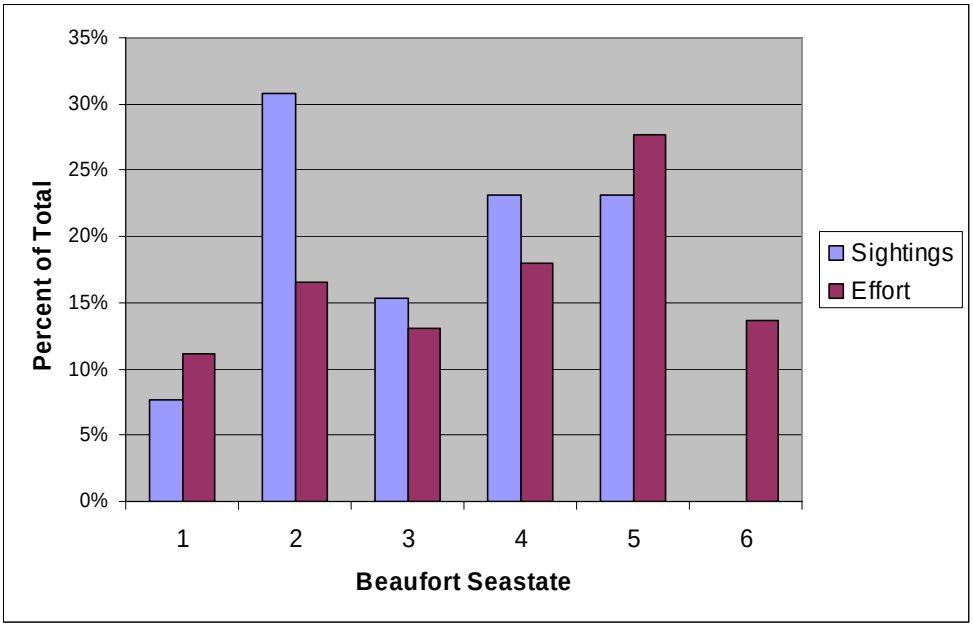

Figure 3. Summary of Beaufort Seastate Conditions. Beaufort seastate is one of the main factors affecting the ability to detect marine mammals. Normally, the ability to detect drops substantially beyond Beaufort 3. As shown, the majority of survey effort occurred in Beaufort 5, whereas the greater number of sightings occurred in Beaufort 2.

Table 2. Summary of Species Sightings by Region

Region / Species	No. groups	No. individuals
Kaulakahi Channel:		
Spotted dolphins (*Stenella attenuata*)	1	14
Unidentified delphinid species	4	21
Alenuihaha Channel:		
Bottlenose dolphin (*Tursiops truncatus*)	1	1
False killer whale (*Pseudorca crassidens*)	1	4
Cuvier's beaked whale (*Ziphius cavirostris*)	1	1
Unidentified beaked whale	1	1
Unidentified delphinid species	4	29

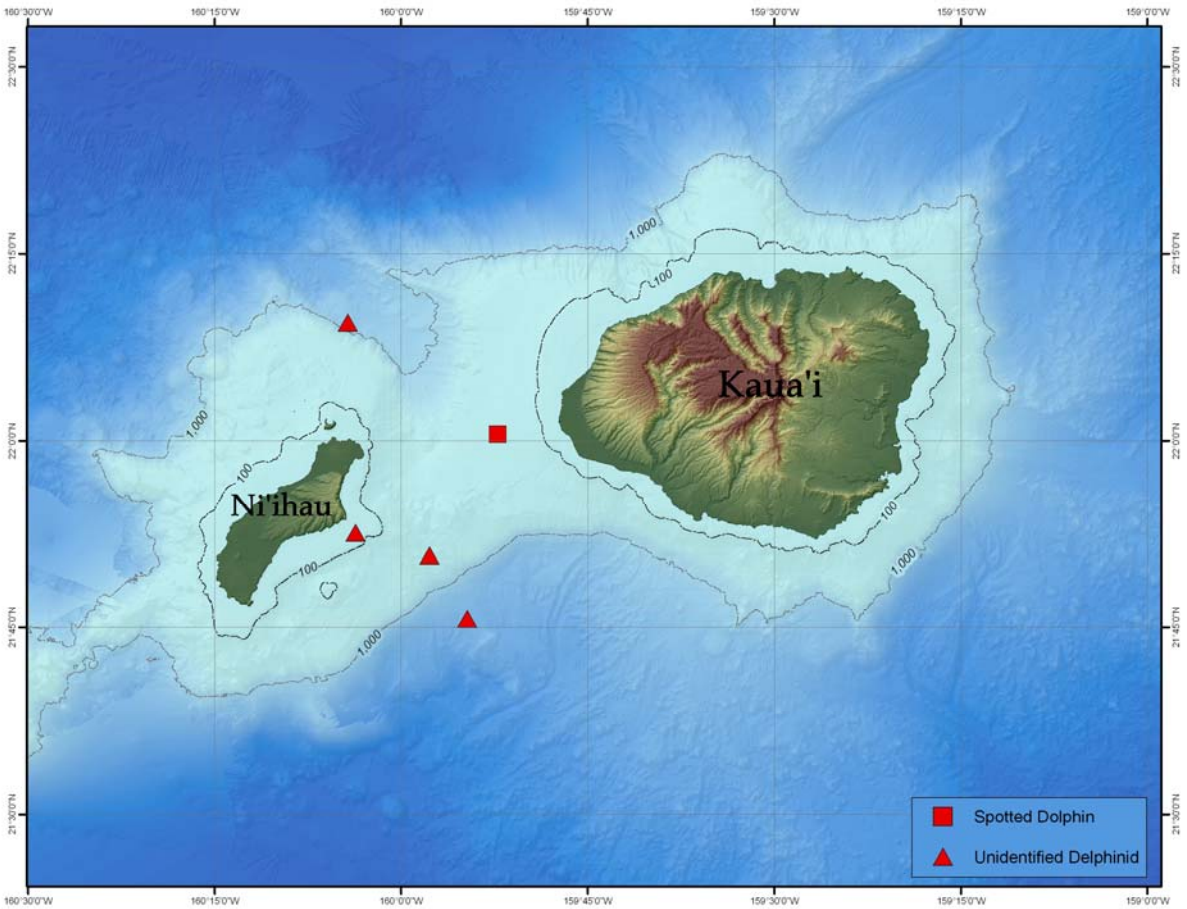

Figure 4. Kaulakahi Channel sightings. A total of five sightings occurred in the Kaulakahi Channel including one pod of spotted dolphins and four of unidentified delphinid species. Inner and outer bathymetry lines refer to 100 1000 fathom contours, respectively.

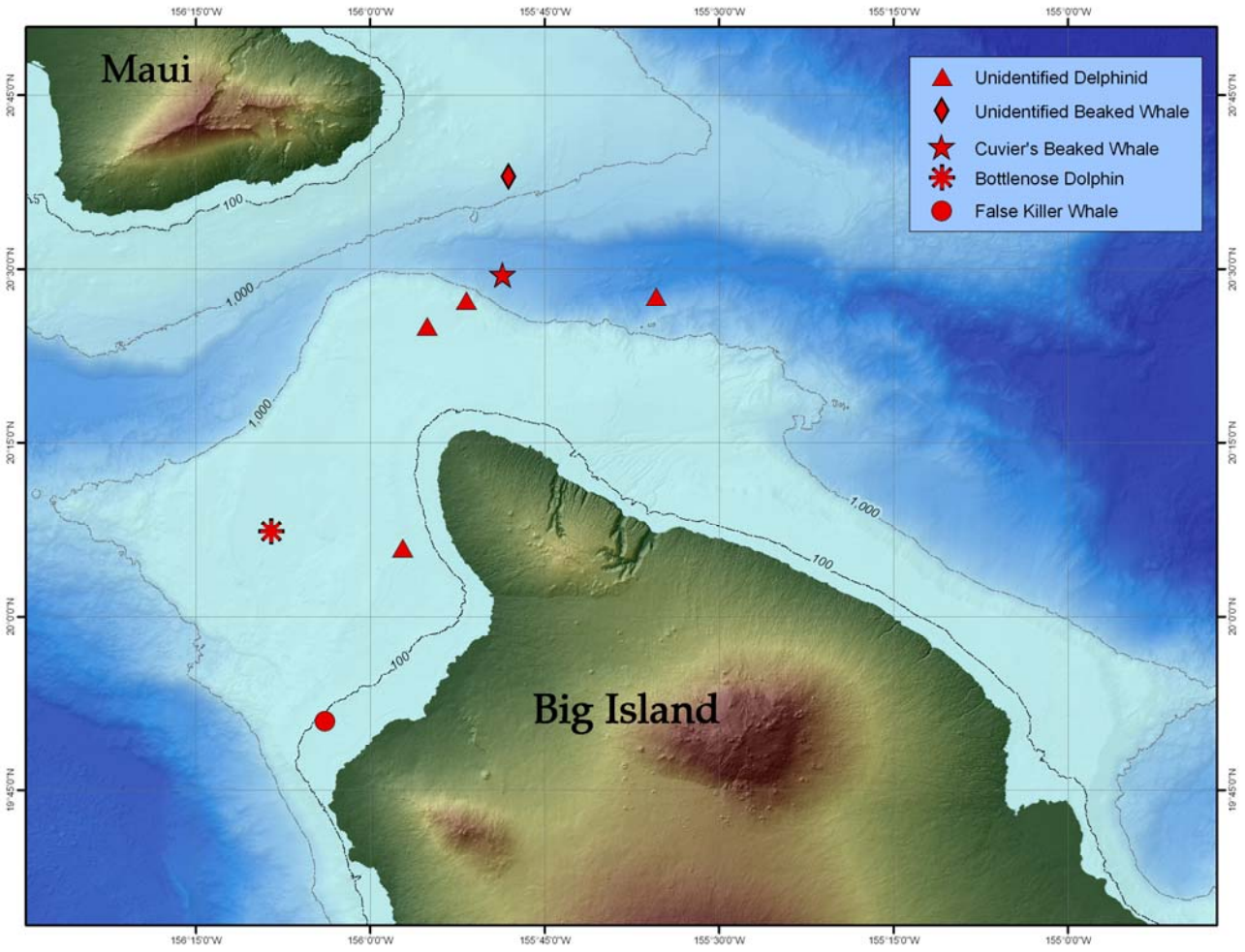

Figure 5. Alenuihaha Channel sightings. A total of 8 sightings occurred in the Alenuihaha Channel, including one pod of each of the following species: bottlenose dolphin, false killer whale, Cuvier's beaked whale and an unidentified beaked whale species (likely *Mesoplodon densirostris*). Additionally four pods of unidentified delphinids were sighted. Inner and outer bathymetry lines refer to the 100 and 1000 fathom contours, respectively.

Discussion

From the total of 13 sightings only four (31%) were positively identified to species. One sighting in the Alenuihaha Channel was identified as a beaked whale (likely Blainville's beaked whale, *M. densirostris*) but was not resighted upon orbiting, thus obviating positive species identification. The low rate of species identification was likely due to the poor seastate conditions that prevailed on all but one of the six surveys (Table 1, Figure 3) thereby making it difficult to recapture the sighting when orbiting.

The sighting of a group of four false killer whales (*Pseudorca crassidens*) was significant given recent concerns over the possible decline in their population around the Hawaiian Islands, possibly due to fisheries interactions (Baird and Gorgone 2005). In the 1993-03 aerial survey series, false killer whales were not seen after 1998 (Mobley, unpublished data), so the current sighting is the first aerial sighting since that time, though shipboard observations have been recorded (e.g., Barlow 2006).

Similarly, the sighting of a single Cuvier's beaked whale (*Ziphius cavirostris*), also in the Alenuihaha Channel, was significant given the fact that previous reports of adverse reactions to mid-range sonar primarily involved this species (ICES, 2005). It was sighted on 25 July when RIMPAC activities were scheduled to occur in the channel, and was sighted mid-channel in waters deeper than 1000 fathoms (Figure 5).

As noted, the encounter rate for sightings in the present survey series (.0004 sightings/km surveyed) was identical to that recorded for odontocete species during the 1993-03 aerial survey series for the months Jan-Apr (Mobley 2004). This suggests that densities in the Kaulakahi and Alenuihaha Channels were no more or less than those normally seen throughout Hawaiian waters, albeit at different times of the year. Barlow (2006) commented on the low densities of odontocete species noted during 2002 shipboard surveys of the Hawaiian Exclusive Economic Zone (EEZ), noting them to be lower than most warm-temperate and tropical locations worldwide. He attributed this low density to the low productivity of the subtropical gyre that affects Hawaiian waters.

In conclusion, these surveys provided no evidence of impact of RIMPAC activities on resident populations of cetaceans in the Kaulakahi and Alenuihaha Channels. No differences in cetacean densities were detected, and no unusual behavior or event (e.g., unusual aggregations or near strandings) was observed. This statement should not be interpreted as evidence of no impact, merely that no such evidence was detected during these 18 hrs of surveys.

Acknowledgements

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Appendix A

1993 - 2003 Hawaiian Islands Aerial Survey Results

Species Name	No. pods	No. indiv.
Humpback whale (*Megaptera novaeangliae*)	2352	3907
Spinner dolphin (*Stenella longirostris*)	52	1825
Spotted dolphin (*Stenella attenuata*)	31	1021
Short-finned pilot whale (*Globicephala macrorhynchus*)	73	769
Melon-headed whale (*Peponocephala electra*)	6	770
Bottlenose dolphin (*Tursiops truncatus*)	54	492
False killer whale (*Pseudorca crassidens*)	18	293
Sperm whale (*Physeter macrocephalus*)	23	106
Rough-toothed dolphin (*Steno bredanensis*)	8	90
Blainville's beaked whale (*Mesoplodon densirostris*)	9	32
Pygmy or dwarf sperm whale (*Kogia* spp.)	4	28
Striped dolphin (*Stenella coeruleoalba*)	1	20
Pygmy killer whale (*Feresa attenuata*)	2	16
Cuvier's beaked whale (*Ziphius cavirostris*)	7	13
Risso's dolphin (*Grampus griseus*)	1	8
Killer whale (*Orcinus orca*)	1	4
Fin whale (*Balaenoptera physalus*)	1	3
Unid. Dolphin	96	452
Unid. Stenella spp.	11	196
Unid. Whale	28	39
Unid. beaked whale	9	23
Unid. Cetacean	14	27
Totals:	2801	10134