HICEAS: Hawaiian Islands Cetacean and Ecosystem Assessment Survey

NATIONAL MARINE FISHERIES SERVICE

SOUTHWEST FISHERIES SCIENCE CENTER
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September 24, 2010

Leg 2, *McArthur II* Report: 24 August-22 September 2010

Karin Forney, Cruise Leader

As the second leg of the 2010 Hawaiian Island Cetacean and Ecosystem Assessment Survey (HICEAS) aboard the NOAA research vessel *McArthur II* comes to an end, we look back on a very successful month. As we steamed northwestward from Oahu, past the international dateline, and then back again, we encountered surprisingly cooperative weather and some rare and interesting marine mammals and seabirds. On most days, winds hovered in the 12-18 kt range rather than the usual 18-25 kts, and we were able to work for 30 days straight, without any down time. The highlight of leg 2 was, without doubt, our two encounters with Longman's beaked whales, *Indopacetus pacificus* (photos on page XX and acoustics reports on page XX), but the sperm whale we saw swimming backwards ranked among the most curious observations any of us could recall. We were also fortunate to have four encounters with one of our primary species of interest, the false killer whale, *Pseudorca crassidens*, which allowed us to evaluate and improve our joint visual and acoustic methods for detecting and counting animals as accurately as possible. We hope you enjoy our project-specific reports that follow, and please come back next month for further updates on our adventures at sea!

Ruddy Turnstone, a common wintering bird in Hawaii. Photo: Sophie Webb.

CETACEAN PHOTOGRAPHY REPORT - JIM COTTON, SOPHIE WEBB, CHRIS CUTLER

Table 1. Summary of photographs.

Common Name	# Sightings	# Photos	Total Sightings	Total Photos
Sperm whale	9	390	14	838
Striped dolphin	4	123	6	169
False killer whale	4	318	4	318
Bryde's whale	4	134	4	134
Short-finned pilot whale	2	136	4	237
Longman's beaked whale	2	943	2	943
Sei or Bryde's whale	2	20	2	20
Sei whale	1	13	1	13
Rough-toothed dolphin			1	24
Long-beaked common dolphin			2	10
Short-beaked common dolphin			3	36
Bottlenose dolphin			1	4
Pygmy killer whale			1	4
Blue whale			2	74
TOTALS	**28**	**2077**	**47**	**2824**

LONGMAN'S BEAKED WHALE, *INDOPACETUS PACIFICUS*

When your 33rd and 81st sightings on a survey cruise are of a species as poorly known as *Indopacetus pacificus* you know things are going well. Eleven days apart and within 200 nautical miles of one another, we know that these groups were different based on studies of their scars and dorsal fins (note the tooth-rake scars on males (see photo at right). While "enigmatic, infrequently seen, and little-known" best describe this warmer water denizen, we managed to get fantastic looks at the whales in both sightings. According to the state-of-the-art global marine mammal guidebook (Marine Mammals of the World: A Comprehensive Guide to Their Identification, 2008) "during at-sea sightings, the teeth have not been visible outside the closed mouth." Well, they have now (photo below).

Longman's beaked whale exhibiting teeth outside of the closed mouth. Photographer: Sophie Webb.

A group of Longman's beaked whales; top animal has cookie cutter shark scars. Photographer: Jim Cotton.

Note the cookie cutter shark scars on the uppermost animal. Although poorly represented in the photo records, we shot 943 exposures, many of which will allow us to distinguish individuals.

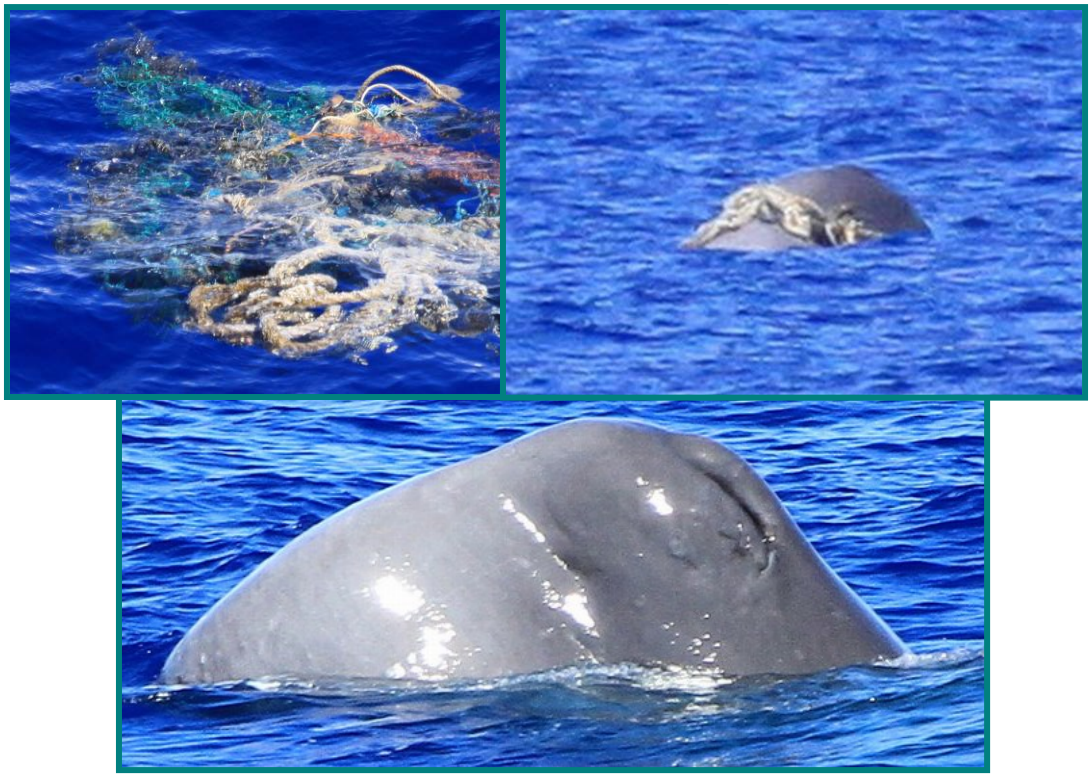
BRYDE'S WHALE, *BALAENOPTERA EDENI*

Bryde's whales showed their diagnostic rostral ridges, cookie-cutter shark scars, and unique scarring patterns on dorsal fins, including one missing much of its fin in the set of photos below.

SPERM WHALE, *PHYSETER MACROCEPHALUS*

With the many sperm whales we encountered, we photographed variably scarred dorsal fins.

A tangle of lines and netting, which a male sperm whale investigated and then remarkably swam backward and away from.



And a maternity group with a couple of animals that appeared pregnant.

STRIPED DOLPHINS, *STENELLA COERULEOALBA*

Note the difference between the normal color pattern of this striped dolphin and the aberrant pattern in the same species seen below.

CETACEAN BIOPSY REPORT –SUZANNE YIN AND DESRAY REEB

Biopsy opportunities this leg were few and far between, but our intrepid team was always ready to drop everything and zoom (carefully) to the bow, or head out in the small boat in pursuit of tissue samples. On two occasions, we launched the small boat to approach false killer whales, and returned with a total of nine tissue samples! These samples are particularly valuable because they fill a geographic gap in our genetic studies of false killer whale population structure.

The bow-based biopsy efforts this leg were hampered by windy conditions and – to make things more challenging – hazards from above. The team, assisted by visiting scientist Cotton Rockwood, found themselves undertaking frequent evasive maneuvers to avoid the digested fish projectiles sent their way from the 'booby-trapped' jackstaff (photo left). Ever vigilant, they patiently waited for sperm, sei, or Bryde's whales to get within range of the bow. Disappointingly, this did not happen very often and when it did the bolts sometimes missed their mark. In contrast, the boobies succeeded in leaving their 'mark' on at least one sun-baked scientist (photo right). Although the sampling opportunities this leg were limited, the team is looking forward to new and exciting encounters with marine mammals as the cruise continues. Please join us next month when we continue to report on the adventures of the McArthur II biopsy team.

Table 2: Summary of biopsy effort.

Species	Common name	No. samples: Leg 2	Total samples	No. takes: Leg 2	Total takes
Physeter macrocephalus	Sperm whale	0	0	3	4
Pseudorca crassidens	False killer whale	9	12	9	12
Tursiops truncatus	Bottlenose dolphin	0	0	1	1
Total		**9**	**12**	**13**	**17**

Cetacean Acoustics Report – Cornelia Oedekoven, Anne Simonis and Eiren Jacobson

Team Acoustics is happy to report an acoustically satisfying Leg 2 of the HICEAS cruise. During this leg, the acoustics team detected 100% of encounters with *Physeter macrocephalus*, *Pseudorca crassidens*, *Stenella attenuata*, and *Indopacetus pacificus* (Table 3). We did struggle with localization inaccuracies during the first week of the survey. After a few after-hours tap tests and rerouting of the hydrophone inputs, we determined that the low signal-to-noise ratio on one of the hydrophones was preventing our localization software from accurately measuring the time delay of arrival between hydrophones. We tried a few alternate hydrophone configurations and determined that using our first and fifth hydrophones produced the most precise angles for localization. This process was sometimes frustrating, but ultimately gave us a better understanding of the hydrophone array and the recording systems we are working with.

The best moment of the leg was a detection of Longman's beaked whales (*Indopacetus pacificus*) on the afternoon of August 31st. Acousticians on duty began hearing and seeing high frequency clicks that looked suspiciously like beaked whales, though not like species that the acousticians were familiar with. Shortly thereafter, the visual team reported a sighting of a large number of whales. The acoustics team quickly notified the cruise leader that we suspected beaked whales at the same bearing as the sighting. As we approached, the whales turned out to be Longman's beaked whales. There were no other cetaceans in the area, so the

acoustics team was able to capture what appears to be the first ever recording of a single species acoustic encounter with Longman's beaked whales, supported by the crucial visual team identification. Echolocation clicks and buzzes (Fig. 1) were recorded on both mid and high frequency array hydrophones.

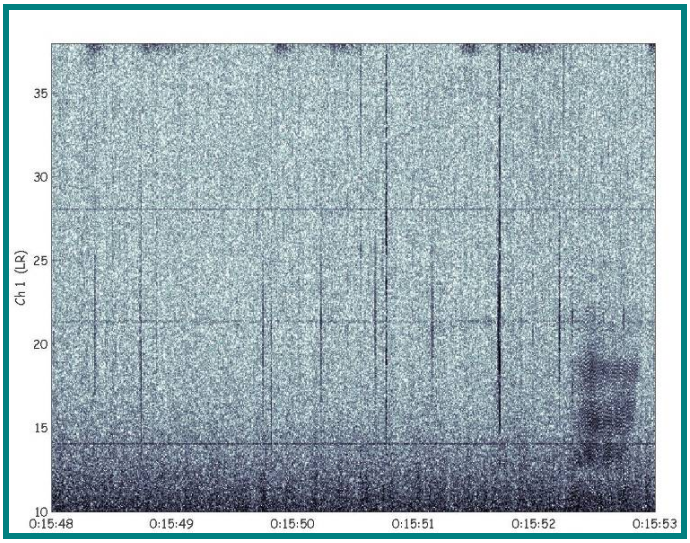


Figure 1. Longman's beaked whale click train and buzz recorded on mid-frequency hydrophone 1. Spectrogram FFT 4096, hop size 1024, page length 6 sec, frequency range 10-40 kHz.

We also attempted to capture high-quality recordings using a Biological Underwater Recording Package (BURP) deployed from the small boat and left to record at a distance from the engine noise of the small boat and ship. The BURP recordings from this encounter await post-processing to determine the presence or absence of Longman's beaked whale vocalizations. It is likely that once we closed on the group of animals, they were too occupied with charging away from the ship to consider resuming normal foraging behaviour, and thus the BURP may not have captured any vocalizations. Since the detection on August 31st, we had one other exciting encounter with Longman's beaked whales. This second sighting was a mixed group of both Longman's beaked whales and pilot whales with a group of striped dolphins also in the area. Although this recording isn't valuable for defining Longman's beaked whale click parameters, we could not believe how fortunate we were to encounter them a second time.

One of the high priority species for HICEAS 2010 is the false killer whale (*Pseudorca crassidens*). False killer whales are a focal point of this cruise because the only available abundance estimate is imprecise and there is concern over bycatch levels in Hawaii-based longline fisheries. A previous study of false killer whales in the region (PICEAS 2005) found that the scattered and fluid grouping of individuals in combination with their low-profile surfacing behavior often prevents the visual team from detecting subgroups that are detected acoustically. False killer whales are an ideal candidate for acoustic localization because of their consistent and distinctive vocalizations. In previous SWFSC surveys, 100% of false killer whales encountered were vocal.

During this cruise, we have initiated a new false killer whale-specific protocol that relies on the acoustics team to localize subgroups and relay their locations to the flying bridge. The flying bridge then attempts to match the acoustic location with a visual sighting and to estimate the size of the subgroup. We can identify the false killer whales through a combination of qualitative and quantitative whistle examinations. Acousticians can visually (Fig. 2) and aurally assess whistles and determine a false killer whale identification, while a Real-time Odontocete Call Classification Algorithm (ROCCA) performs a more sophisticated assessment of whistle attributes.

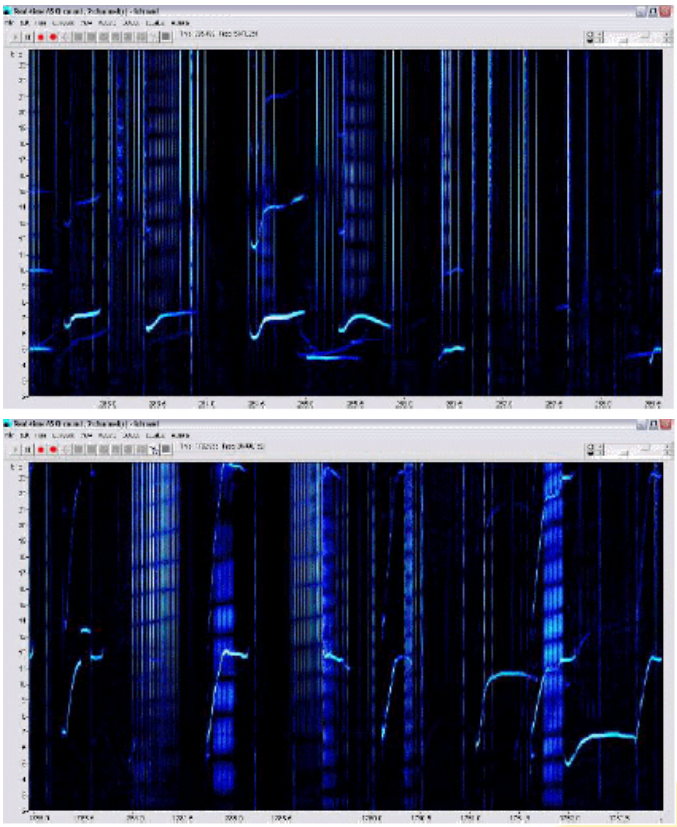


Figure 2. Clicks, whistles, and burst pulses heard during a false killer whale sighting. Spectrogram FFT 1024, hop size 512, page length 5 cm/sec, frequency range 2-24 kHz.

Our experiences using ROCCA in the field will provide valuable feedback to the program developers about the accuracy of the classifications and the general user-friendliness of the program. Implementing this new, specialized false killer whale protocol required a heightened level of cooperation between the acoustics and visual teams. We have tested and tweaked this protocol several times during Leg 2. Using the final iteration of the protocol, we directed an encounter and received visual confirmation of all subgroups. This success leaves us hoping that collaboration between visual and acoustics teams will continue to gain prominence in survey protocols and result in more accurate estimation of the status of false killer whales and other species of interest.

Table 3: Acoustic encounters during HICEAS Leg 2. General acoustic identifications are broken into visually confirmed species identifications. The proportion of all visual and acoustic encounters detected acoustically is presented as the percentage of encounters detected acoustically.

Acoustic ID	Visual ID	Total No. Acoustic Encounters	Total No. Visual Encounters	Joint Visual/Acoustic	% of All Encounters Detected Acoustically
Physeter macrocephalus	*Physeter macrocephalus*	48	17	17	100
Pseudorca crassidens	*Pseudorca crassidens*	6	4	4	100
Unidentified Dolphin	All delphinids	69	21	11	87
	Unidentified delphinid	58	6	0	91
	Stenella coeruleoalba	8	9	8	89
	Gobicephala macrohynchus	2	4	2	50
	Stenella attenuata	1	1	1	100
	Feresa attenuata	0	1	0	0
Balaenopterid	*Balaenoptera edeni*	1	4	1	25
	Balaenoptera borealis	0	1	0	0
	Balaenoptera borealis/edeni	0	6	0	0
	Balaenoptera sp.	0	2	0	0
Ziphiid	*Indopacetus pacificus*	2	2	2	100
	Ziphius cavirostris	0	1	0	0
	Ziphiid whale	2	3	0	40
	Mesoplodon sp.	0	2	0	0
Unidentified	Unidentified large whale	0	3	0	0
	Unididentified whale	0	1	0	0
	Unidentified cetaean	1	6	0	14

Seabirds – Michael Force and Sophie Webb

Seabird observations went south. We don't mean south, as in "my entire life's savings went south during the economic crisis of 2008". But rather, it was the birds heading south—the vast majority in an unstoppable rush to get down to business in the Southern Hemisphere. The early birds get first dibs on primo real estate and a head start clearing out old burrows and excavating new ones, setting up house for another year's recruitment of Cook's Petrels, Kermadec Petrels, Stejneger's Petrels, Black-winged Petrels and Short-tailed and Sooty Shearwaters. One species lacking this procreative urgency was Pacific Golden-Plover. They had already done "it," as evidenced by the appearance of freshly-plumaged juveniles (aka hatching-year birds) toward the end of the leg. This species nests on the fertile tundra of eastern Siberia and western Alaska and then flies south to spend the winter on sun-drenched soccer pitches, beaches and lawns of the Aloha State and other islands scattered throughout the south Pacific Ocean. Of course, we saw many of the common local breeders as well such as Sooty Terns, Brown Noddies, Red-footed, Brown, and Masked Boobies and Bonin, Hawaiian, and Bulwer's Petrels, and the ubiquitous Wedge-tailed Shearwater.

We covered a lot of ocean traversing from areas of high diversity and abundance at the far northwestern end of the study, through a relatively vast empty zone, reflecting either the depth of the mixed layer, our distance from the nesting colonies, or both, then again into an area of high diversity but low abundance north and northeast of the main islands. Areas of high diversity and abundance roughly coincided with a shallower mixed layer. The number of species we saw each day ranged from a low of 4 to an impressive high of 19 (a new high species count for HICEAS 2010), and a daily average of 12.5.

Black-winged Petrel. Photo: Sophie Webb

Extracting notable sightings and other highlights out of our hat, jammed full with 4012 birds of 38 species, is an act requiring the talents of a master prestidigitator. Then again, identifying some of these birds, particularly Sooty and Short-tailed Shearwater, does seem like a magical feat.

We found ten species of Pterodroma petrels; five species of Puffinus shearwaters; a possible Parkinson's Petrel (a first state record if confirmed) and a peculiar, small, unidentified shearwater possibly belonging to the bewildering Little Shearwater group.

Bonin Petrel. Photo: Sophie Webb

Stejneger's Petrel. Photo: Sophie Webb.

Red-footed Booby catching fliyingfish. Photo: Sophie Webb

Oceanographic Data Collections – Candice Hall

The oceanographic and ecosystem sampling has been an integral part of our marine mammal surveys for over two decades, because it helps us interpret the patterns of distribution and abundance of our primary species of interest. HICEAS 2010 is no exception. Although our oceanographic instruments got slightly bored measuring 26º C sea surface temperatures day-after day, and the fluorometer has hinted its apathy about running virtually empty water samples looking for the rare and elusive chlorophyll, we did see interesting patterns when we combined all our data. In particular, the water column profiles derived from our Conductivity-Temperature Depth (CTD) and Expendable Bathythermo-graph (XBT) casts have provided very valuable information on the subtle habitat changes that affect the distribution of marine mammals. The depth of the surface mixed layer (where water temperature is virtually constant) and the depths of the 20ºC and 15ºC isotherms are established methods of quantifying the physical structure of the water column and its effect on productivity. Intense stratification within the water column reduces the probability of nutrient mixing, but the more shallow the mixed layer, the greater the likelihood of interchange between nutrient-rich deep water and sunlit surface waters where phytoplankton can grow (euphotic zone). This level of productivity directly affects densities of marine mammals and seabirds within our survey area.

Our dedicated acoustics team has added depth to the mammal detection process by identifying subsurface mammals not visible to the flying bridge observers. Similarly, the oceanographic data became an unexpected tool for predicting whether our visual and acoustics teams would be bored or busy. The morning CTD provided daily information on the depth of the surface mixed layer, which – it turns out – is a decent predictor of the number of sightings expected that day (see figure on next page). It was an unusual, yet undeniably satisfying experience to be in a position to hazard an educated guess of daily trackline coverage and sightings.

In all, we've had a very productive leg, as detailed in table 4 below. Many thanks to all those who participated in our ecosystem operations, your help was much appreciated!

As Justin Garver resumes the reigns for Leg 3 and beyond, I have made it my duty to ensure the capture of all equipment gremlins, now safely contained within my under-50-lbs luggage. So long and thanks for all the fish!

Table 4. Summary of Oceanographic effort.

Ship	Leg	No. CTD casts	No. CTD chlorophyll samples	No. Surface chlorophyll samples	No. XBT drops	No. Salinity samples
MAC II	2	51	288	91	93	12
HICEAS Total		68	368	179	179	30

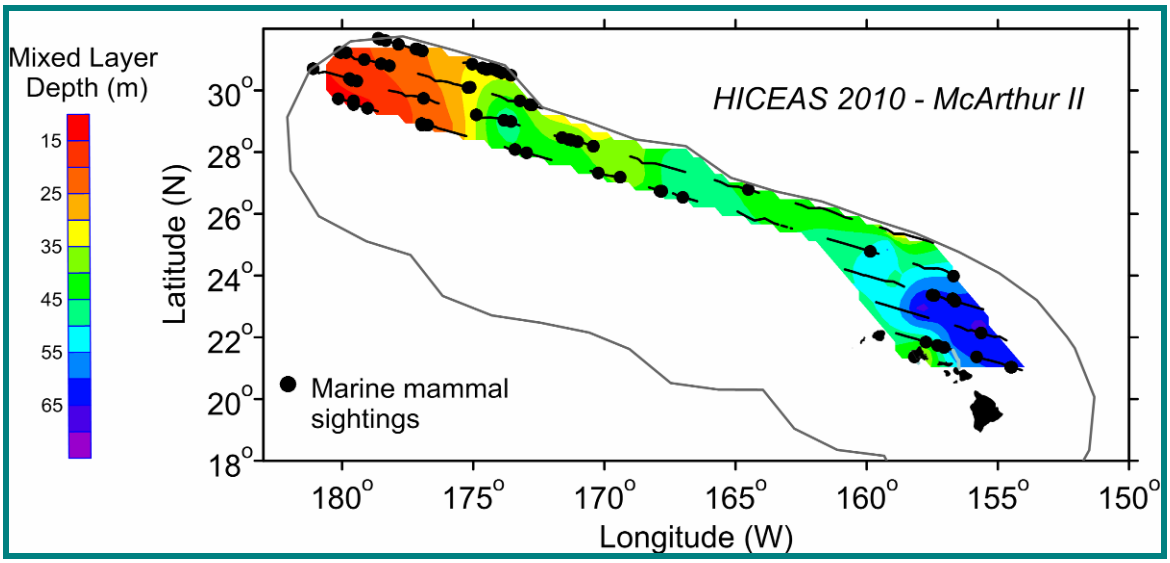
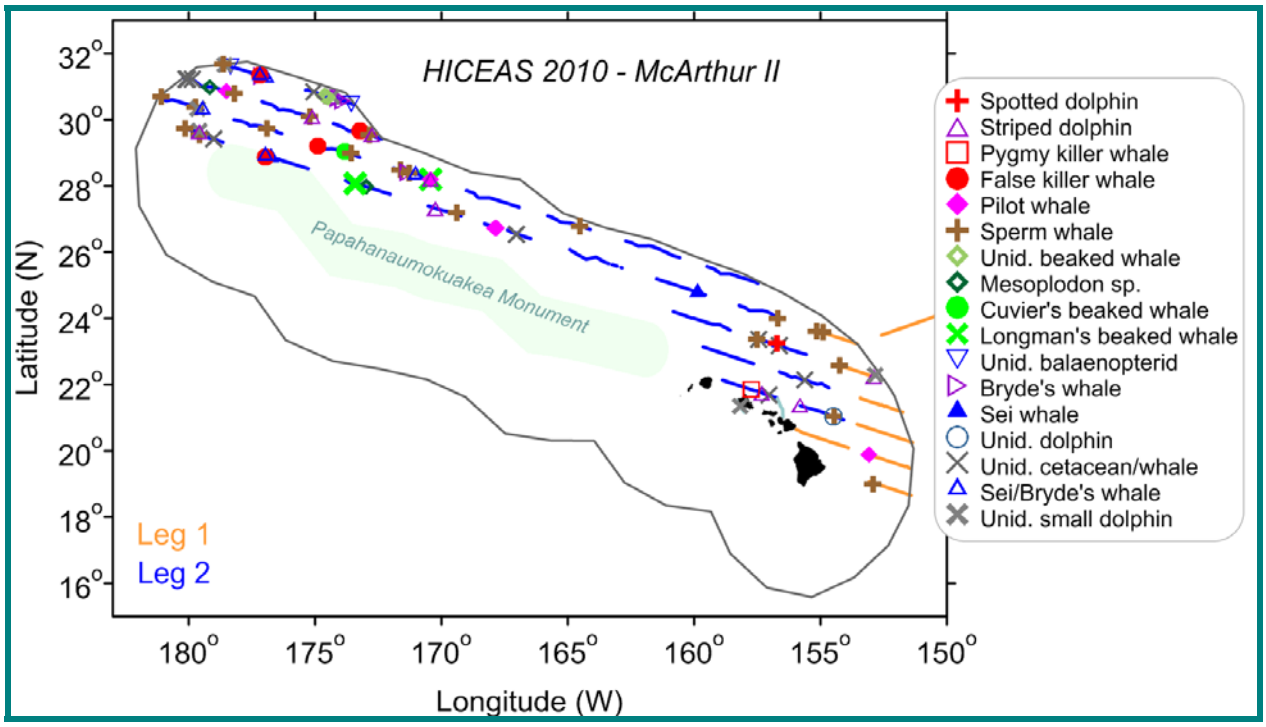


Table 5. Marine mammal sightings, Leg 2.

Species Code	Species Name	Number Sightings
002	*Stenella attenuata* (offshore)	1
013	*Stenella coeruleoalba*	9
032	*Feresa attenuata*	1
033	*Pseudorca crassidens*	4
036	*Globicephala macrorhynchus*	4
046	*Physeter macrocephalus*	17
049	Ziphiid whale	3
051	*Mesoplodon* sp.	2
061	*Ziphius cavirostris*	1
065	*Indopacetus pacificus*	2
070	*Balaenoptera* sp.	2
072	*Balaenoptera edeni*	4
073	*Balaenoptera borealis*	1
077	unid. dolphin	1
079	unid. large whale	3
096	unid. cetacean	6
098	unid. whale	1
099	*Balaenoptera borealis/edeni*	6
177	unid. small delphinid	4
277	unid. medium delphinid	1
	TOTAL	**73**

Table 6. Marine mammal visual survey effort, Leg 2.

Date	Start/End Time	Latitude	Longitude	Distance surveyed	Average Beaufort
082410	1620	N21:10.09	W158:01.64	26.0 nmi	4.6
	1853	N21:30.88	W158:18.49		
082510	0612	N22:37.85	W157:38.97	114.7 nmi	4.3
	1859	N23:08.59	W159:39.70		
082610	0617	N23:38.61	W158:34.60	125.5 nmi	4.7
	1904	N24:12.03	W160:49.84		
082710	0729	N24:42.44	W159:33.05	105.4 nmi	4.8
	1858	N25:11.78	W161:29.90		
082810	0635	N25:31.45	W162:50.87	103.6 nmi	5.1
	1858	N26:05.02	W164:56.14		
082910	0723	N26:24.54	W166:27.85	75.9 nmi	5.3
	1856	N26:51.72	W168:18.69		
083010	0735	N27:05.07	W169:13.42	74.6 nmi	4.3
	1937	N27:23.62	W170:32.42		
083110	0709	N27:44.86	W172:01.35	91.4 nmi	4.0
	1953	N28:10.24	W173:48.82		
090110	0625	N28:31.25	W175:15.90	95.1 nmi	3.8
	1903	N28:56.52	W177:09.18		
090210	0641	N29:19.40	W178:38.59	77.3 nmi	3.7
	1852	N29:46.45	E179:42.59		
090310	0648	N30:42.25	E178:53.53	81.2 nmi	4.3
	1901	N30:18.07	W179:26.21		
090410	0639	N29:59.77	W178:12.47	97.6 nmi	4.0
	1859	N29:34.60	W176:18.24		
090510	0621	N29:16.05	W174:57.24	97.0 nmi	4.0
	1836	N28:51.60	W173:13.23		
090610	0621	N30:27.74	W173:27.98	83.2 nmi	3.8
	1851	N30:53.55	W175:24.22		
090710	0631	N31:15.24	W176:49.55	88.1 nmi	4.0
	1845	N31:39.97	W178:34.94		
090810	0645	N31:15.80	E179:46.68	102.4 nmi	3.8
	1905	N30:46.17	W178:05.06		
090910	0636	N30:32.49	W177:06.01	102.6 nmi	4.0
	1702	N30:05.50	W175:11.32		
091010	0621	N29:52.94	W174:16.46	87.4 nmi	3.5
	1833	N29:25.12	W172:20.97		
091110	0613	N28:32.15	W171:53.98	75.4 nmi	3.3
	1652	N28:11.17	W170:25.40		
091210	0605	N27:51.36	W169:00.78	112.4 nmi	4.0
	1811	N27:21.06	W166:53.81		
091310	0651	N27:05.55	W165:47.45	95.5 nmi	3.5
	1856	N26:40.69	W164:05.44		
091410	0640	N26:20.54	W162:42.47	119.4 nmi	4.0
	1837	N25:50.05	W160:33.97		
091510	0631	N25:33.76	W159:29.50	113.7 nmi	4.5
	1820	N25:03.76	W157:28.18		
091610	0622	N24:23.21	W158:13.06	94.0 nmi	4.9
	1824	N23:57.78	W156:33.60		
091710	0612	N22:54.61	W155:33.59	101.2 nmi	4.5
	1810	N23:22.39	W157:30.72		
091810	0621	N22:22.85	W156:37.55	110.6 nmi	4.3
	1813	N21:53.85	W154:39.95		
091910	0606	N20:56.19	W154:05.15	92.5 nmi	4.3
	1733	N21:21.86	W155:48.50		
092010	0806	N21:00.40	W156:29.16	83.8 nmi	4.9
	1822	N21:48.47	W157:32.91		
092110	0624	N21:48.75	W157:36.59	71.2 nmi	4.1
	1444	N22:08.32	W158:54.20		



Map of combined effort and sightings completed within the study area on the *McArthur II* during legs 1 and 2 (through September 21, 2010).

Leg II scientists (left to right): Cornelia Oedekoven, Suzanne Yin, Richard Rowlett, Desray Reeb, Rachel Struch, Michael Force, Eiren Jacobson, Candy Hall, Cotton Rockwood, Karin Forney, Sophie Webb, Anne Simonis, Chris Cutler, and Jim Cotton