HICEAS: Hawaiian Islands Cetacean and Ecosystem Assessment Survey

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NATIONAL MARINE FISHERIES SERVICE

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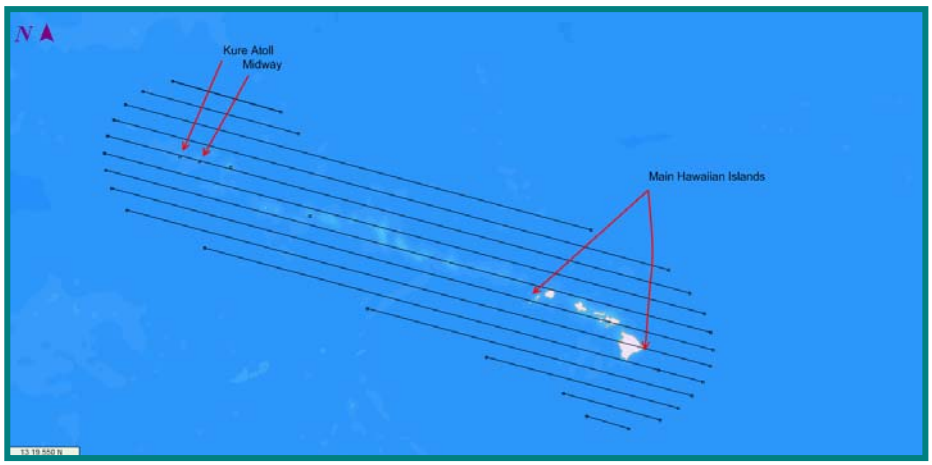
Leg 1, *McArthur II* Report: 04-21 August 2010

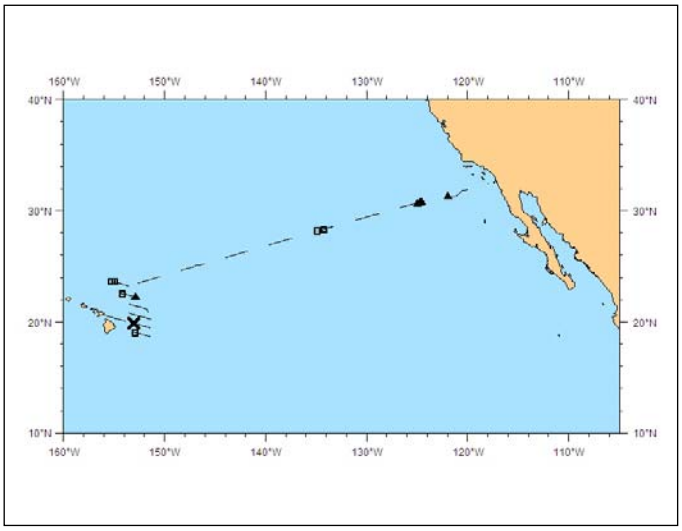
Jay Barlow, Chief Scientist

This is the first report from the 2010 Hawaiian Island Cetacean and Ecosystem Assessment Survey (HICEAS) aboard the NOAA research vessel *McArthur II*. The purpose of the survey is to study the whales and dolphins within the U.S. waters around Hawaii and to study the ecosystem in which they live. One of the primary motivations for the study is to determine the abundance of whales and dolphins so that we can assess whether bycatch in fisheries might pose a risk to these populations. The study area includes the US Exclusive Economic Zone (EEZ) around the entire Hawaiian Island Chain from the southeastern tip of the Big Island (Hawaii) to Kure Atoll, the farthest west of the Northwestern Hawaiian (see map). This study area is enormous, roughly 400 x 1800 nautical miles. The HICEAS survey is a joint effort between the Southwest Fisheries Science Center (SWFSC) and the Pacific Island Fisheries Science Center (PIFSC). Next month, the NOAA ship *Oscar Elton Sette* will join us in completing this 180-day survey effort. We have a great scientific party, a great ship, and the best crew in the fleet. We look forward to a long and productive cruise together. . .



The planned transect lines within the U. S. EEZ (a 200 nautical mile radius) around the Hawaiian Islands.

Leg 1 of our survey consisted of a 10-day transit from our home base in San Diego to the northeastern edge of our Hawaiian study area and seven additional days of survey effort (see map below). The word of the day, for the past 17 days, is "oligotrophic." Literally translated, this means "little food." No, they haven't been starving us on the *McArthur* … on the contrary, our dining has been very good. However, this term is used by oceanographers to describe areas of the world's oceans with few nutrients and very low productivity. The entire HICEAS study area is considered oligotrophic, but this term is especially true in the waters through which we passed to reach Hawaii. Little food means few marine mammals. Indeed, since we left the nutrient rich California Current, we have seen an average of less than one group of whale or dolphin per day. One major exception to this trend is sperm whales. Sperm whales were the most commonly sighted marine mammal seen on Leg 1. From previous work we know that the density of sperm whales is roughly the same in oligotrophic waters as in nutrient rich waters. Somehow this species has learned to make a living out here in the oceanic "desert."



Transect lines completed during Leg 1 of the HICEAS survey on *McArthur II*. Sighting locations are included for selected species: striped dolphins (triangles), sperm whales (squares), and pilot whales (X).

No matter how few animals are seen, every survey I participate on leaves me with at least one remarkable memory. For this cruise it was during a sperm whale encounter. The acoustic team heard a group of sperm whales and we turned the ship towards them. The visual team spotted them when they surfaced. As we were following them, Suzanne Yin saw what looked to be a large reddish squid floating on the surface. Because sperm whales are known to bring giant squid to the surface when they are feeding on them, we directed the ship to pass by the object to get a closer look and possibly a sample. The object passed directly under the bridge wing, and people were still trying to guess what it might be (see picture below).

Sperm whale placenta found floating on the sea surface near a nursery group of sperm whales.

Finally, it was suggested that it might be a sperm whale placenta. If so, this would provide us with a genetic sample and a tissue sample for other studies. We launched the small boat to recover a tissue sample as we followed the group of sperm whales. The group appeared to be a nursery group with several very small calves, including one that was a newborn. The small boat crew discovered that our object was indeed a 5-meter long placenta. They recovered a 1kg sample which we froze. How many people in the world have ever seen a sperm whale placenta? It was a memorable day.

Cetacean Biopsy Report – Juan Carlos Salinas and Suzanne Yin

Biopsy is our primary tool for obtaining genetic samples for analysis of population structure. Biopsy darts are shot using a crossbow from either the bow of the *McArthur* or from a small boat launched from that ship. Biopsy samples can be used for many other purposes as well, including studies of pregnancy rate (from hormones in blubber) and feeding ecology (from stable isotope concentrations in skin).

Table 1: Summary of biopsy effort.

Species	Common name	No. samples: Leg 1	Total samples	No. takes: Leg 1	Total takes
Physeter macrocephalus	Sperm whale	3	4	3	4
Tursiops truncatus	Bottlenose dolphin	1	1	1	1
Total		**4**	**5**	**4**	**5**

Photography Report – Jim Cotton and Desray Reeb

Photographing individual animals that are uniquely identifiable helps us understand the spatial and temporal movements of individuals between schools and islands, delineate stocks, confirm species identification, estimate species interaction with fishing gear and provide an insight to social behaviors. Unique physical characters that are targeted by photographers include the shape and size of the dorsal fin, shape of the trailing edge and ventral pigmentation of the flukes, body pigmentation, scars and deformations. Photographs are also used to help us identify species and to document geographic differences in color patterns that might indicate population isolation.

Species of special photographic interest within the Hawaiian Exclusive Economic Zone are: false killer whale, melon-headed whale, pigmy killer whale, bottlenose dolphin, sperm whale, rough-tooth dolphin, spinner dolphin and beaked whale. Many of the photos taken during this cruise will be incorporated in the various cetacean photo identification catalogues of the Hawaiian Islands. During this leg eight species were represented in 17 of the 24 sightings that were photographed. Sperm whales were the most commonly photographed species (see table on p. 4).

Rough-tooth dolphins: Note the tooth rakes on the dorsal fin of the animal in the foreground. These scars along with the differences in the profile of the trailing edge of the dorsal fin make this animal uniquely identifiable.

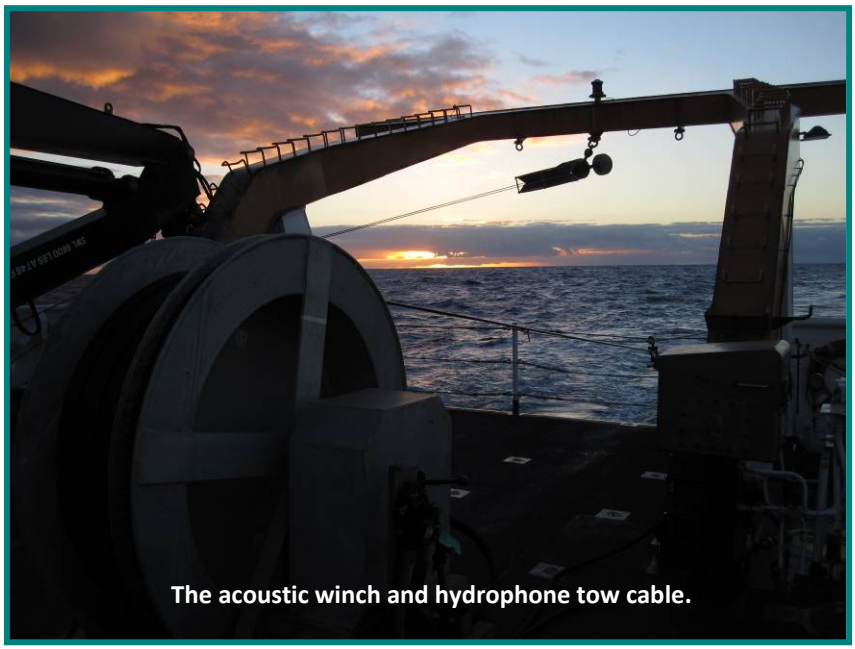
Table 2: Summary of photographic effort.

Common Name	No. sightings: Leg 1	No. photos: Leg 1	Total sightings	Total photos
Striped dolphin	2	45	2	45
Rough-toothed dolphin	1	24	1	24
Long-beaked common dolphin	2	10	2	10
Short-beaked common dolphin	3	36	3	36
Bottlenose dolphin	1	4	1	4
Short-finned pilot whale	1	83	1	83
Sperm whale	5	434	5	434
Blue whale	2	74	2	74
Total	**17**	**710**	**17**	**710**

Cetacean Acoustics Report – Cornelia Oedekoven, Yvonne Barkley, and Ann Simonis

A towed hydrophone and an acoustic survey team are a key component of the HICEAS survey. The hydrophone is capable of detecting whales and dolphins by listening for the sounds that they make. This detection methods works even when animals are submerged or when conditions are too rough or too dark to effectively see them.

Shortly after passing the last buoy marking the channels leading out of San Diego in the afternoon of 4 August, the acoustic team deployed the hydrophone array to be towed 300m behind the ship. The original array is a hybrid design including two solid hydrophones containing mid frequency elements attached to an oil-filled array containing two high frequency and two mid frequency elements. Part of our experiment will be to compare the recording quality of each type of hydrophone element in its different medium. The array was left out recording continuously around the clock until reaching the first CTD station within the Hawaiian study area on the evening of 12 August. Hereafter, we towed the array only during daylight hours.



The acoustic winch and hydrophone tow cable.

The underwater sounds captured by the array are used in many ways. Two mid- and two high-frequency channels are recorded for post-cruise processing. Real-time acoustic detection and localization of cetaceans is performed onboard by monitoring two mid-frequency channels while the visual team is surveying from the flying bridge. When detecting dolphin whistles, we try to identify these to species using the software Real-time Odontocete Call Classification Algorithm (ROCCA). In addition, a real-time automatic detector for dwarf and pygmy sperm whales (*Kogia* spp.) is run using the software Rainbow Click. To operate and monitor these different programs, two of the three acousticians are on watch simultaneously.

The main excitement for the first leg was the three successful acoustic chases. In each case, we detected clicks produced by groups of sperm whales that were missed by the visual team. Once our map indicated that they had passed the beam, we directed the ship in such a manner that eventually led to the detection of the same group by the visual team. They could then perform their 60-minute count to get school size estimates.

During the past decade or so of SWFSC cruises, the acoustic effort has evolved from an ancillary project to one of the main survey methods to estimate abundance. While we still depend on the visual team for group size estimates for nearly all detected groups of cetaceans (except maybe a lone sperm whale) and species identification for most, acoustic detection capabilities have proven their worth during this cruise. Not being as dependent on good weather conditions as the visual team, we had a total of 47 detections (Table 3) during this first leg, compared to 25 visual detections (Table 5).

This feeling of job security gets shaken up a bit, however, on a day like Sunday 15 August. We encountered abnormal electrical noise from the array and, after much troubleshooting, found that there were damaged wires leading in and out of the solid hydrophone 2 of our array. We made the decision to utilize our backup array of similar design. After a full day of splicing, soldering, molding and testing, we were once again fully operational. The new array included the first element from the original array, two more solid, mid frequency elements, and an oil array with two high frequency hydrophones. This array is now performing beautifully and is hoped to be functional until we reach San Diego in December.

Upon reaching the study area, we began performing evening sonobuoy stations. Conveniently for us, the oceanographic protocol demands that we remain in one spot for approximately one hour for the CTD cast. We use this opportunity to monitor and record the lower frequency sounds captured by a sonobuoy that are normally drowned out on our towed array by boat noise. The signal is relayed to us on the ship via radio waves while we are still in transmitting range of the buoy. Data collected in this manner may be considered a form of point transect, a method of obtaining estimates of abundance. The more common way point transects are performed is by having an observer remain at a point and record all the animals he/she detects including their distances from the point for a certain time period. The recorded distances allow estimating the number of animals the observer missed within a certain radius and hence an estimating of animal density around the point. For our experiment, the sonobuoy is the observer. However, as we do not obtain distances or group sizes from the buoy to the detected animals, a more complex calculation including sound propagation through the water and calling rates is needed to obtain density estimates. This part, however, will be done during post-cruise processing. We get to enjoy the beautiful sunsets over the tropical ocean as we toss the buoy over the side of the ship. Sonobuoys will also be deployed in the event of a blue whale or fin whale sighting to obtain high quality recordings of their low frequency vocalizations.

Table 3: Summary of acoustic detection.

Species	Common name	Number of acoustic detections	No. of visual detections through acoustics
Globicephala macrorhynchus	Short-finned pilot whale	1	1
Physeter macrocephalus	Sperm whale	16	4
Stenella coeruleoalba	Striped dolphin	3	3
Steno bredanensis	Rough-toothed dolphin	1	1
Unidentified dolphin	- -	26	0
Total		**47**	**9**

Seabirds – Michael Force and Sophie Webb

Garbage everywhere. If we were getting paid by the (metric) ton we would be rich as kings if we were able to retrieve all the trash littering the ocean during our transit to the study area. However, we're getting paid to count birds and, fortunately for us, our salary doesn't depend on the number of birds we see, otherwise we would die paupers. Leaving the California Current in our wake, we entered the waste-strewn waters along the southern edge of the North Pacific gyre. About all we could see here were plastic buckets, fishing floats, discarded fishing nets, fish totes, sorting trays, plastic bottles, glass whiskey bottles—you name it—it's out here. We even saw a baseball bat float past; obviously the slugger was so thrilled to have hit a home run, over the fence so to speak, forgot to pick it up. Our daily average of four species was remarkable and wouldn't have been possible without the help of the marine mammal observers on the 25 power binoculars.

Hawaiian Petrel. Photo by Sophie Webb

After all, our 300 metre survey strip was rarely visited by an avian form, dead or alive. The commonest bird in the strip transect prior to reaching the study area was Pacific Golden-Plover with 77 of these champion long-distance migrants. Perhaps we should petition the World Ornithological Congress to adopt the recently coined South African onomatopoetic name "Wheep-Wheep." The "Wheep-Wheep" nests in eastern Siberia and western Alaska where it raises its family before setting off on a broad southbound front, fanning out to spend the winter on Pacific Ocean islands. An interesting migration strategy but a successful one, taking advantage of a winter habitat essentially free of competitors.

During the transit, we found a total of 74 birds of 15 species, the most abundant, not surprisingly, was Cook's Petrel, followed by Leach's Storm-Petrel, Black-footed Albatross, and Hawaiian Petrel, birds characteristic of this watery "desert". Diversity increased upon reaching the study area although overall abundance was meagre indeed. For all you score-keepers out there, we found a grand total of 394 birds of 35 species. The number of species we saw per day ranged from two to fourteen for an average of seven species per day. The stratospheric total was found, not surprisingly, within 50 nautical miles of the Big Island. Saving the best for last was a "stop the presses" Jouanin's Petrel seen on the final day of Leg 1. This rare visitor from the Indian Ocean has been seen only three times previously in Hawaiian waters, including one calling from a burrow on Sand Island in 1993. This begs the obvious question: What's going on with this species?

Red-tailed Tropicbird. Photo by Sophie Webb.

Oceanographic Data Collections – Justin Garver and Corey Sheredy

Leaving sunny San Diego can be a tough thing to do, but when Hawaii is the destination, our team was more than okay to say 'bye bye' for the time being. Leaving the pier, we knew we had tropical weather and clear seas ahead. Deep thermoclines and low chlorophyll content suggested we were getting tropical, and soon we were close enough to say 'Aloha' to the Hawaiian Islands.

We sailed for the first time without the *McArthur's* late survey tech, Lacey O'Neal, whom we miss very much. Although we were sailing without Lacey's survey wisdom (and endless cribbage skills), we added quick-witted and ever-helpful Todd Walsh on our oceanographic team as the ship's survey tech. Todd enabled us to set up with ease and ready us for our oceanographic duties for HICEAS 2010.

We started the day off with a morning station of an Expendable Bathythermograph (XBT) drop in conjunction with a bucket sample (surface chlorophyll *a* and phaeophytin collection). We did four more stations like this throughout the day, and then completed the sixth and final XBT and bucket sample at sunset. And we could not possibly ask for a better place to conduct our daily activities in! Warm air and beautiful royal blue water made our stations very pleasant events indeed.

Corey launching an XBT.

On 15 August, we finally arrived in our study area, the Hawaiian EEZ. While the mammal group was kindly greeted with a group of sperm whales, we became well acquainted with something of our own. With the help of the *McArthur II* crew, the CTD soon became the primary focus of the oceanographic team. Now that we're no longer transiting, our daily schedule has changed. We start off with a CTD cast an hour before sunset, four XBT/bucket samples throughout the day, and a final CTD cast one hour after sunset.

The CTD, lovingly dubbed "Rosie" is an instrument that gives a profile of temperature, salinity and density of the water column at a very high accuracy, as well as collects water samples at specified depths. The night before we entered the EEZ, we kicked off the fun by conducting two CTD casts. The first was a test cast and the second a full cast to 1000 meters, complete with a collection of water samples.

Our CTD instrument (the SBE 911*plus* to be exact) is a primary research tool used by oceanographers. 'Rosie' has multiple sensors attached and twelve Niskin bottles intended for water collection. The five sensors include two temperature, two conductivity, and one oxygen and one pressure sensor. Sending Rosie down, we have the ability to look at precise components of the water column beneath us. Our first cast was a little hairy – the oxygen sensor displayed a very peculiar reading – a negative oxygen concentration! Fortunately, Todd was on the ball and switched the sensor's valves as soon as it was secured aboard, thus resolving the issue. In addition to information collected electronically, we have the ability to trigger the closing of Niskin bottles from the survey computer in the dry lab. We collect samples at 1000, 500, 200, 170, 140, 120, 100, 80, 60, 40, 20 meters depth and at the surface. We test the water for its chlorophyll *a* and phaeophytin content.

In addition to our XBTs, bucket samples and CTDs, the ship's thermosalinograph (TSG) collects a continuous record of the surface water temperature and conductivity. We collect data from the ship which includes meteorological data (wind speed and direction, barometric pressure, air temperature) and our longitude and latitude. Lastly, we constantly record all that we can 'see' below the ship. Attached to the bottom of the *McArthur II* is a transducer that sends an acoustic signal downwards, allowing us to 'see' and continually collect images of what is beneath the ship. This system, called acoustic backscatter, is an important component in assessing potential food available for fish and cetaceans.

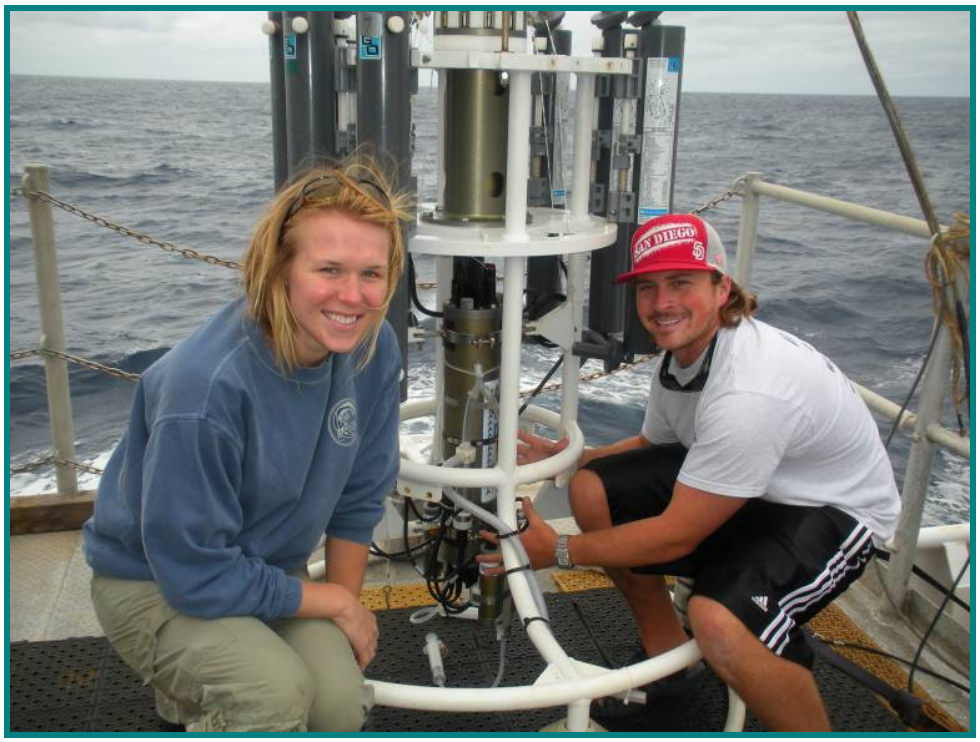
In spite of the few mammal sightings, we've enjoyed the Perseids meteor shower, bioluminescent phytoplankton at the bow, and of course, a cribbage game or two. Well, that's it for the oceanography team for Leg 1! We hope to continue a successful cruise by collecting data to help assess and support the Hawaiian Island Ecosystem. Go Oceo!

Table 4. Marine mammal visual survey effort.

Date	Start/End Time	Latitude	Longitude	Distance Surveyed	Average Beaufort
80410	1515	N32:36.26	W117:17.86	7.6 nmi	3.3
	1920	N32:25.73	W118:00.61		
80510	1808	N31:19.64	W121:54.17	90.4 nmi	4.7
	1931	N31:24.35	W122:03.03		
80610	644	N30:52.89	W124:12.71	124.9 nmi	4.6
	1945	N30:15.96	W126:39.23		
80710	711	N29:43.34	W128:47.82	124.8 nmi	4.4
	1944	N29:08.18	W131:05.25		
80810	740	N28:30.20	W133:32.98	92.6 nmi	4.2
	1911	N28:06.28	W135:05.87		
80910	648	N27:31.26	W137:21.03	130.2 nmi	4.2
	1945	N26:54.63	W139:41.57		
81010	658	N26:22.11	W141:45.47	123.8 nmi	4.3
	1955	N25:46.79	W143:59.52		
81110	621	N25:13.48	W146:05.50	114 nmi	4.6
	1911	N24:39.68	W148:20.52		
81210	658	N24:03.97	W150:26.43	120.7 nmi	4.8
	1938	N23:29.33	W152:35.41		
81310	702	N23:13.96	W153:33.60	92.2 nmi	4.2
	1949	N23:38.75	W155:14.94		
81410	702	N22:36.30	W154:21.30	81.4 nmi	4.3
	1906	N22:16.75	W152:48.86		
81510	1748	N21:09.41	W151:43.88	112.5 nmi	4.4
	1928	N20:54.80	W151:37.70		
81610	648	N20:14.97	W151:21.48	127.9 nmi	4.1
	1938	N20:48.50	W153:34.60		
81710	708	N19:55.92	W153:17.08	98.2 nmi	4.8
	1917	N19:27.65	W151:24.67		
81810	651	N18:39.16	W151:24.93	95.1 nmi	4.9
	1931	N19:04.34	W153:04.92		
81910	601	N20:05.42	W153:53.66	120.5 nmi	4.3
	1836	N20:38.50	W155:58.51		
82010	903	N19:49.76	W156:03.37	33.9 nmi	4.9
	1850	N20:12.44	W157:32.71		

Table 5. Marine mammal sightings.

Species code	Species name	No. of sightings
013	*Stenella coeruleoalba*	5
015	*Steno bredanensis*	1
016	*Delphinus capensis*	2
017	*Delphinus delphis*	3
018	*Tursiops truncatus*	1
021	*Grampus griseus*	1
036	*Globicephala macrorhynchus*	1
046	*Physeter macrocephalus*	6
075	*Balaenoptera musculus*	3
177	Unid. small delphinid	2
Total		**25**



Corey, "Rosie" the CTD, and Justin.