

## STAR 2006: NOAA Ship *David Starr Jordan* Weekly Science Report

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### Science Summary: 2 - 8 November 2006

The first four days of this week were spent at the frenzied pace of last week, continuing our work in tandem with the fixed-wing aircraft to obtain calibration factors for dolphin school size estimates made from the ship by our marine mammal field scientists. With an 18-h exception of 15 knot winds, the seas were flat calm, the weather hot and humid, and cetaceans were everywhere. Two two-flight days and two single-flight days resulted in an additional 8 calibration schools (plus one bonus calibration for a lucky three mammal observers who happened to be on effort when the plane flew overhead and photographed a school that we were working right off our bow). The grand and fantastically successful total: 23 calibration schools for the 2006 mammal team of the *David Starr Jordan*! The small boat put in 4 more long days for intensive biopsy and marine turtle work (see Bio-DART and Marine Turtle reports below). And we held nightly meetings to discuss events of the day and plans for tomorrow.

It is intriguing that a familiar system when seen from a different perspective can teach one astoundingly new things. During each of our 10 calibration days, the ship worked a localized area no larger than 25 nautical miles across by 10 or 15 nautical miles wide. And by Day 10, we had worked several of the same areas twice. One would think that these repeated samplings of the same area over such a short period of time would show us the same kinds of animals – but no! The bound volume of ship's tracks and cetacean sightings representing back to back days put together by detail expert Gary Friedrichsen made it crystal clear that instead, "Area A" would yield 30 sightings with 75% of these being spotted and spinner dolphins, but three days later, this same area would host 15 sightings, only one of which was spotted dolphins, with the rest being beaked whales and "blackfish" (a generic term describing the darker-colored, larger cetaceans). This changing pattern hit us so often on repeating days that we began to marvel at it. In conjunction with this was an annoying flutter in our time trace of sea surface temperature and salinity, brought to my attention repeatedly by our diligent oceanographer, Candice Hall. The trace tended to fluctuate over time in a manner so wildly variable that we initially were convinced the data were garbage. After days of trouble-shooting and no discoveries of problems, however, we finally began to wonder if the fluctuations were real. And combined with the wild variations in the apex predator community, by the end of this research phase, I'll be darned if I don't think there may be some method to this madness! It is the stuff of a future process cruise we hope to conduct to be able to more precisely clarify the oceanographic mechanisms which may (or may not) be responsible for the distribution and abundance patterns we see in the cetacean communities out here.

All good things must come to an end, and on Monday, some 100 nautical miles offshore and headed directly away from land toward a distant waypoint another 350 nautical miles away, we had fully intended for the pace to finally settle down. But fate did not have this in store for us. Instead – killer whales! Mid-afternoon we quite unexpectedly came upon a large group and the 15 knots of wind that had kept our small boat in its cradle all day were suddenly quite workable. Prior to its deployment, our crack aim "Vaquita Vazquez" made a fantastic biopsy shot from the bow of the ship in front of just about the entire ship's complement ("dink" went the bolt against the back of a killer whale, and our biopsy sample was collected!). He, our other world-class biopsy expert (JC Salinas), photographer (and killer whale fanatic) Adam Ü, and distinguished visiting scientist Jeremy Rusin (today is his birthday) jumped into our Rigid Hull Inflatable and worked with the animals until sunset. The result: 381 photographs which will allow us to identify the individuals in the school (and compare them with killer whales photographed in

the eastern tropical Pacific and elsewhere during previous years), and 7 biopsy samples which will allow us to compare the genetic makeup of these individuals with killer whales elsewhere, all over the world. Through all the commotion, acoustician Laura Morse was below decks doing what she always does with a vocally intriguing whale – trying to record vocalizations. And at this time! (see acoustics report below). What an amazing, and exhausting day.

And finally, on Tuesday: Need some rest? Like slamming into a brick wall, and suspiciously close to the geographic location of our record-long bad weather last leg, we ran into it again. Seas of 6-9 feet, winds holding steady at around 24 knots, and heavy rains shut down not only the mammal survey, but the seabird work as well (you know it's bad when the hard-core birders shut down), leaving our sole scientific efforts for the oceanographer. At this writing, the weather continues to rage outside, caused by a tropical depression to the northwest of us and moving away at 6 knots, even as we move closer to it at a speed of between 7 and 8 knots. Nap anyone?

### Sightings and Effort Summary for Marine Mammals

Date	Start/ Stop Time	Position	Total nmi	Average Beaufort
110206	0644	N15:46.22 W100:05.62	55.3	1.5
	1555	N15:23.16 W099:52.61		
110306	0641	N15:32.38 W099:34.78	22.1	3.2
	1425	N15:24.51 W099:29.46		
110406	0638	N15:25.80 W099:14.16	66.2	2.4
	1552	N14:56.63 W098:26.44		
110506	0641	N15:33.42 W096:40.98	43.3	1.4
	1656	N14:42.64 W097:27.48		
110606	0631	N13:27.09 W098:28.79	57.2	3.8
	1425	N12:37.70 W099:08.52		
110706	0640	N11:32.38 W100:08.52	2.0	5.0
	0656	N11:30.73 W100:09.74		

Code	Species	Number of Sightings
001	<i>Mesoplodon peruvianus</i>	1
002	<i>Stenella attenuata</i> (offshore)	14
003	<i>Stenella longirostris</i> (unid. subsp)	6
010	<i>Stenella longirostris orientalis</i>	10
015	<i>Steno bredanensis</i>	6
017	<i>Delphinus delphis</i>	1
021	<i>Gramus griseus</i>	3
032	<i>Feresa attenuata</i>	3
037	<i>Orcinus orca</i>	2
048	<i>Kogia sima</i>	2
049	Ziphiid Whale	7
051	<i>Mesoplodon</i> sp.	1
061	<i>Ziphius cavirostris</i>	2
077	Unid. Dolphin	6
090	<i>Stenella attenuata</i> (unid. subsp.)	4

Code	Species	Number of Sightings
<b>TOTAL</b>		68

**Special Report \*\*Biopsying Dolphins to Assay for Reproductive Traits (Bio-DART)\*\* – Nick Kellar *et al.***

The word has gotten out. As opposed to last week, when business was somewhat slow (56 biopsies and 11 laser photos in 8 days), this week we had dolphins lining up, swimming in from miles around, so they could experience our unique exfoliation treatment (80 biopsies and 36 laser photos in just 2.5 days of effort). In total for the calibration section of the leg we obtained 47 useable laser photos and 136 biopsies.

However, our eco-beauticians were a little disappointed because we had a number of clients who were treated (biopsied) but their samples were lost. In many cases, the samples were sitting in the water just a few feet from the darts; some we were able to retrieve using a small dip net but many of them were lost. It appears that we need to upgrade our equipment for future endeavors. I imagine with better sample retention we could have had nearly twice the biopsies during this experiment.

Of the seven additional schools that were photographed from the air during these last 2.5 days, we sampled four of them well enough to compare calving (from aerial photos) and pregnancy (from biopsies) rates. This is a huge improvement from our 1/14 rate we had last week. Much of our success can be attributed to improvements in our approach strategy and additional time given to us to conduct focused biopsy effort (i.e., the mammal observers and aerial team were so good early on with calibration schools that we had more time to chase animals).

A hallmark of an effective feasibility study is the ability to obtain exponential improvement in success by the end of the project. It appears that we are on that track. By the end of the Jordan's calibration effort we were obtaining samples at a rate that could easily meet our goals to estimate pregnancy rates with sufficient precision to compare between relatively small geographic areas. I am terribly pleased by the results we generated thus far and can not wait to read about the efforts during the McArthur's calibration leg.

The Jordan's part of the project went as well as it did because of the amazing talent of scientists and crew aboard this ship. Everyone on board helped in one way or another, but I want to give a special thank you to Juan Carlos and Ernesto, whose expert marksmanship was surpassed only by their helpfulness and generosity. You guys are amazing.

**Special Report \*\*Acoustics\*\* – Laura Morse**

I have paced the halls of the Jordan waiting for the magic (chocolate-covered coffee) beans so touted on the *McArthur II* to fly my way but to no avail (I think they ate them all.) But no worries, I have survived on M&M's and to my great joy the sounds of silence have finally been broken this week, and no less through my most finicky instrument, the ever weighty sonobuoy. You might recall from last week's report that we encountered a lone blue whale, on which a buoy was deployed. At the time, I thought it was a silent traveler from parts unknown. However, upon reviewing the recording this week I realized this animal certainly had a lot to say, and should with careful review reveal its true identity. Fortunately, certain blue whale vocalizations are diagnostic of the population they are a part of, and knowing which

population they belong to helps to answer the much bigger question of blue whale movements throughout the Pacific Ocean.

The second and even more exciting buoy success of the week involved a group of killer whales on November 6th. Luck was with us that day, and the buoy was deployed from the small boat within 500 meters of the group. Even more exciting, vocalizations were heard immediately and continued for the next hour and a half as photographs and biopsies were taken. It is rare for killer whales here to be so vocal, so for me it was a truly momentous and exciting occasion.

Moral of the story- if you don't have magic beans, try M&M's.....

**Photography (Cornelia Oedekoven, Laura Morse, Adam Ü)**

We continued taking pictures of spotted and spinner dolphins with the laser device attached to the bottom of the camera. As described in last week's report, this device projects two parallel green laser beams onto the photographed dolphin and these will be used to measure the size of the dolphin. What we learned during the ten days of calibration where we used this device, is that it is a lot harder to obtain useful images from the small boat than initially thought. The main reason is that from the small boat the photographer has basically no warning of when and where the dolphin is going to surface. Because you are so close to the water's surface, you can only see dolphins under water that are already on the bow of the boat. Those dolphins that come in from the sides and try to catch up with the boat are actually the ones that would provide the perfect lateral angle for the picture. But the first time you see them is when they break the surface, giving you no time to get the required perfect aim at them with the laser dots showing on their body. From the bow of the ship, your angle is a lot better. On a nice sunny day you might be able to see them under water, out to about 30 m, giving you time to get a good aim before they porpoise alongside the ship.

Another highlight of the past week was two back-to-back killer whale encounters on November 5 and 6. The first sighting started out in fairly standard ETP killer whale style, meaning the whales just about vanished moments after the first approach by the small boat. Luckily, the observers on the flying bridge were able to keep track of the animals and send the small boat in the right direction, where they succeeded in getting some high quality images of eight individuals. The second sighting started out in a similar fashion and we were about to give up hope when we finally re-sighted some animals in the distance. Some of them showed genuine curiosity towards the ship but eventually moved along, leaving us to give chase. Once again, teamwork and clear communication between the ship and the small boat allowed all involved to collect almost 400 images, from which we've identified 16 different animals.

Species Code	Species	This week	Total
002	<i>Stenella attenuata</i> (offshore)	5	29
003	<i>Stenella longirostris</i> (unid.)		6
006	<i>Stenella attenuata graffmani</i>		11
010	<i>Stenella longirostris orientalis</i>	5	24
013	<i>Stenella coeruleoalba</i>		11
015	<i>Steno bredanensis</i>		12
017	<i>Delphinus delphis</i>	1	31
018	<i>Tursiops truncatus</i>		34
021	<i>Grampus griseus</i>	1	8
032	<i>Feresa attenuata</i>	2	3
036	<i>Globicephala macrorhynchus</i>		12

Species Code	Species	This week	Total
037	<i>Orcinus orca</i>	24	37*
046	<i>Physeter macrocephalus</i>		20*
049	Ziphiid whale	1	2
063	<i>Berardius bairdii</i>		3
072	<i>Balaenoptera edeni</i>		3
074	<i>Balaenoptera physalus</i>		2*
075	<i>Balaenoptera musculus</i>		22*
076	<i>Megaptera novaeangliae</i>		6*
090	<i>Stenella attenuata</i> (unid.)		1
099	<i>Balaenoptera borealis/edeni</i>		6

\* Individual whales photographed

### **Biopsy (Juan Carlos Salinas Vargas and Ernesto Isaac Vázquez Morquecho)**

Cruise 1630 Weekly Cetacean Biopsy Report for 11/02/2006 to 11/08/2006					
Species	Common Name	# Weekly samples	# Weekly Takes	Total Samples	Total Takes
<i>Balaenoptera edeni</i>	Byrde's whale	0	0	4	4
<i>Balaenoptera musculus</i>	Blue whale	0	0	9	17
<i>Delphinus delphis</i>	Short-beaked common dolphin	0	0	19	40
<i>Globicephala macrorhynchus</i>	Short-finned pilot whale	0	0	62	137
<i>Megaptera novaeangliae</i>	Humpback whale	0	0	2	5
<i>Orcinus orca</i>	Killer whale	9	21	16	38
<i>Physeter macrocephalus</i>	Sperm whale	0	0	8	8
<i>Stenella attenuata</i>	Pantropical spotted dolphin	43	68	99	167
<i>Stenella attenuata graffmani</i>	Coastal spotted dolphin	0	0	27	42
<i>Stenella coeruleoalba</i>	Striped dolphin	0	0	2	8
<i>Stenella longirostris orientalis</i>	Eastern spinner dolphin	33	77	62	158
<i>Stenella longirostris subsp.</i>	unidentified spinner dolphin	0	0	25	42
<i>Steno bredanensis</i>	Rough-toothed dolphin	0	0	11	22
<i>Tursiops truncatus</i>	Bottlenose dolphin	0	0	48	78
<i>Unid</i>	Unidentified small delphinid (e.g., Delphinus, Lag)	2*	2*	2*	2*
		87	168	396	768

\* Unidentified biopsy samples and takes were collected from a mixed school of spotted and spinner dolphins

### **Seabirds and Marine Debris (Rich Pagen and Chris Cutler)**

The mammal observer calibration, high sea turtle density and Nick Kellar's intensive biopsy effort again kept us seabird observers wearing other "unfeathered" hats much of the week, turning the flying bridge into unfamiliar territory and its inhabitants into strangers we might only see over a bowl of soup in the

mess. After the calibration ended, the usual routine failed to return in all of its glory due to Beaufort 6 conditions which kept our mammal watching friends at bay while we sang “Dreams to Remember” by Otis Redding at the top of our lungs in near-complete flying bridge solitude.

Bird density in offshore waters was low, the constantly transforming sea surface only broken by the occasional Leach’s Storm-petrel, Wedge-tailed Shearwater or the roving and ship-following mob of Red-footed and Masked Boobies who kept us in their sights. Closer to shore on the morning of the 5<sup>th</sup>, with mountains looming in the distance and an earthy greenhouse aroma on the wind, Audubon’s Shearwaters buzzed around the ship, while Least and Black Storm-petrels fluttered manically past. Large slicks formed by converging currents stretched as far as the eye could see, attended by huge flocks of Red and Red-necked Phalaropes (sometimes numbering well into the thousands). That area was remarkably free of marine debris despite its proximity to shore, while several hours later and further offshore, there was a very robust population of clear 1 liter plastic bottles (among many other things).

Bird flocks associated with tuna/dolphin schools were dominated by Brown Boobies and Black Terns, while several small groups of Rough-toothed Dolphins associating with logs were joined by Galapagos and Leach’s Storm-petrels, Wedge-tailed and Pink-footed Shearwaters, and of course more Brown Boobies. Tahiti Petrels helped us keep track of a pod of sneaky Orcas; their interest in whatever scavenging opportunities the Orcas might have provided them meant that wherever we saw the Tahiti Petrels, the Orcas were not far away.

There is rarely a lack of interesting landbird news on this ship, and this week was no different. A first year male (the demographic most likely to have serious disorientation problems according to one study) Western Tanager was found by the small boat moribund sitting on the water (yes, you read that correctly), probably only minutes away from either drowning or being noticed by a hungry avian predator. Unfortunately, there was little we could do for this bird and despite our taking it back the ship, it died a short time later. The highlight of the week by far was a Burrowing Owl that circled us several times, glancing back over its shoulder as if sizing up our worthiness as a perch. Apparently, the dearth of ground squirrels or other rodent prey on the ship was evident and the owl continued on in search of greener pastures (or any pastures, for that matter).

### **Turtle Operations (Lindsey Peavey, *et al.*)**

Four final days of calibration and coastal trackline resulted in 53 olive ridleys processed this week. Over the past two weeks, during the 10-day calibration plus a bonus day in the Northern part of the Gulf of Tehuantepec in search of coastal spotters, we (an army of many aboard) processed a total of 137 olive ridleys. That makes up for 42.5 % of the total 322 turtles processed for the entire cruise. Astonishing! It would have been impossible to do it alone and therefore I’d like to thank all my shipmates for their assistance and support, especially seabird observers Rich Pagen and Chris Cutler. During the marine mammal calibration they voluntarily spent all, and I do mean all, of their ‘free’ time processing turtles on the back deck, spinning blood and labeling vials. I am extremely grateful for their help, professionalism and senses of humor!

05 November 2006 - We certainly wrapped up this busy spell with some excitement: On our last day working with the plane and staying near shore, we sent the small boat (“J3”) out on a killer whale sighting for photographs and biopsies. J3 had a tough time closing in on the evasive whales, and during one surfacing and subsequent chase Lead Fisherman Jose Coito spotted a small piece of debris floating, thought at first to perhaps be a piece of wood. He kept his eye on it and moments later saw front flippers moving simultaneously and the tiniest wake in its trail – A BABY TURTLE! Ecstatic, the crew of

scientists on J3 diverted from their pursuit of the killer whales (unheard of!) to do a 180° and dip net a 41.8 mm-long hatchling, 35.3 miles from the closest point of land. Back on the ship and overjoyed, the rest of us raced to meet J3 upon return and marvel at the credit card-sized squirmer still equipped with its egg tooth and yolk sac – probably only days old.

With the day only half over and a hatchling encounter under our belts, it was time to deploy our third and final SDR (Satellite-Linked Time-Depth Recorder) to conclude our 11-day visit in ‘turtle town.’ A lovely, plump and feisty lady was brought on the back deck and fitted with a shiny electronic backpack complete with a transmitting antenna and one-year battery power. The vote is unanimous; her name is “Annette.” Our beloved survey coordinator Annette Henry was supposed to sail with us here on Leg 5. For reasons beyond anyone’s control she was unable to join us on the high seas, which was a disappointment for all. She was not absent though; she came to us by way of this healthy, 53.5 cm-long sub-adult, probable female. Annette Henry is a one-woman show back at the La Jolla lab and takes care of everything from research permits to our personal mail to Halloween candy. She is our lifeline while at sea and we appreciate her unwavering energy and support more than she knows – thanks Annette!

Species	Common name	Number sampled	
		Weekly	Total
<i>Caretta caretta</i>	Loggerhead	0	8
<i>Eretmochelys imbricata</i>	Hawksbill	0	1
<i>Lepidochelys olivacea</i>	Olive ridley	53	313
<b>Total</b>		53	322

### **Fish Sampled for Diet and Isotope Analysis**

Species	Samples	
	Weekly	Total
Yellowfin tuna	0	25
Skipjack*	0	13
Wahoo	0	3
Mahi mahi	0	11

\*includes black skipjack

### **Oceanographic Operations (Candy Hall)**

The STAR 2006 DSJ Oceanography Department (myself, Lindsey Peavey, and Nacho Vilchis) would like to profusely thank the Mammal Observers for creating the need for an aerial calibration operation. This project gave us the opportunity to remain within a designated area and repeatedly survey the immediate vicinity for changes to the surface and thermohaline structure of the water column. This degree of intense sampling is seldom possible during mammal cruises due to the scale of our projects, and it was fascinating to see how rapidly the water properties change within a small geographical locale.

One notable example of this trend occurred while surveying to and fro through a dolphin school on the 2<sup>nd</sup>. The TSG surface temperature and salinity oscillated over almost 2 °C’s and dropped from 33.2 psu to 32.7psu respectively before returning to their previous norm. In fact, tests were conducted to confirm the validity of the data being collected, just in case we’d lost the TSG sensors! According to Willett *et al.*

(2006), this location is well within the recorded ETP eddy belt, so perhaps we had stumbled upon the edge of an eddy generated near the Gulf's of Tehuantepec and Papagayo. This variability was quickly apparent from the shifting locale of Spinner and Spotter schools, much to Lisa's frustration. Nevertheless, the highly populated area and our esteemed Observers kept both her and the airplane extremely busy with their frequent school sightings.

Another exciting oceanographic glimpse into the secrets below us was evident in our CTD cast on the morning of the 5<sup>th</sup>. Our trackline took us close to the entrance of the Gulf of Tehuantepec, where the infamous winds have reportedly been blowing for a while. While not evident during our time there (although we previously felt their resultant swells as mentioned in an earlier report), their effects were noticed within the CTD thermohaline trace. The thermocline deepened and, more noticeably, the mixed layer depth was shown to be a much deeper, two-tiered affair. The first 'increment' in the mixed layer was recorded at 33m and the second at 61m, depicting the mixing effect of a prevailing wind, while the decreased surface temperature may indicate the presence of upwelling. Our chlorophyll levels at the 40m sampling depth ( $R_b = 113.1 \mu\text{g/l}$ ) were almost off the chart and to complete our ecosystem portrait, the Observers reported their first Blue Whale sighting since the Costa Rica Dome!

As we steam offshore towards Clipperton Island we haven't needed a chart to tell us when we've hit the ITCZ's 10 ° N thermocline ridge, as the 20 °C isotherm depth has rising to 38m. The lifting of the thermocline, caused by Ekman transport divergence across the ITCZ, is thought to have the steepest thermocline gradient during November (Kessler and Taft, 1987), i.e. now! This Ridge 'bisects the warm pool and is a significant physical feature for a great many apex predators, including members of the tuna-dolphin-seabird assemblage so characteristic of the eastern tropical Pacific in general' (Ballance *et al.*, 2006). Again it seems as if our timing is spot on!

<b>Date</b>	<b>CTD</b>	<b>XBT</b>	<b>Bongo Tow</b>	<b>Manta Tow</b>
<b>2 Nov</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>1</b>
<b>3 Nov</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>1</b>
<b>4 Nov</b>	<b>1</b>	<b>1</b>	<b>0*</b>	<b>0*</b>
<b>5 Nov</b>	<b>2</b>	<b>3</b>	<b>1</b>	<b>1</b>
<b>6 Nov</b>	<b>2</b>	<b>3</b>	<b>0**</b>	<b>1</b>
<b>7 Nov</b>	<b>1</b>	<b>4</b>	<b>0*</b>	<b>0*</b>
<b>8 Nov</b>	<b>1</b>	<b>4</b>	<b>0*</b>	<b>0*</b>
<b>Week Total</b>	<b>11</b>	<b>17</b>	<b>3</b>	<b>4</b>
<b>Grand Total</b>	<b>150</b>	<b>228</b>	<b>60</b>	<b>63</b>

\*Time restraints prohibited station as we steamed towards our Clipperton Island appointment.

\*\* Strong current cancelled Bongo station.

Ballance, L.T., Pitman, R.L. & P.C. Fiedler. 2006. Oceanographic influences on seabirds and cetaceans of the eastern tropical Pacific: a review. *Progress in Oceanography* 69: 360 – 390.

Kessler, W.S., & B.A. Taft. 1987. Dynamic heights and zonal geostrophic transports in the central tropical Pacific during 1979-84. *Journal of Physical Oceanography* 17: 97 – 122.

Willett, C.S., Leben, R.R. & M.F. Lavin. 2006. Eddies and Tropical Instability Waves in the eastern tropical Pacific: A review. *Progress in Oceanography* 69: 218 – 238.