

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

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Science Summary: 25 October – 1 November 2006

And so we begin Leg 5 – one for which we've all been planning intensely and eagerly anticipating. One of the primary goals of the STAR survey is to estimate the number of spotted and spinner dolphins that are in our 20 million km² study area, that we call the eastern tropical Pacific, during the four-month period of our survey. How we go about doing this involves a relatively basic sampling design, use of a sophisticated survey method, and cutting edge analytical techniques. But out here at sea, the cornerstone of these abundance estimates is the school size estimate that each marine mammal observer makes for every school of dolphins that he/she sees during this 120 days at sea (x 2 ships). Ever tried to estimate the number of dolphins in a porpoising school? It's not an easy task. Our marine mammal observers are the best in the world and to guarantee that our numbers are rock solid, we calibrate them.

Since sailing from Acapulco last Wednesday we have been working in tandem with a fixed wing aircraft. The goal: photograph dolphin schools from the plane using sophisticated cameras and special film. Post-cruise, we will painstakingly count every single dolphin in each school. Each of these photographed schools is also observed by our scientists on the ship, at the same time as the plane is photographing them. By comparing the counts obtained from the photographs with the estimates made from the ship, we can calculate a correction factor for every one of our field scientists. These correction factors are then applied during the analytical phase of our work.

During this next few days, the goal is not to randomly survey a geographic area (as it is during the remainder of the cruise). Instead, the goal is to find as many dolphin schools as possible, so as to maximize the number of calibrations. In other words, we want to get sucked into a patch. To do this, we have chosen an area renowned amongst us long-time sailors out here for its good weather, and high density. Our historical records indicate that the magic zone is between 60 and 120 miles offshore of the central coast of Mexico. And this report is testament to the fact that our records are right on!

Weather for the past week has been absolutely spectacular and the density of animals has been astounding. A typical day for us this week begins at sunrise with only a breath of wind and the sea surface looking like an oily sheen. Within three minutes of eyes to our 25-power binoculars we have simultaneous dolphin schools to the right and the left of our bow, each one some 5.5 miles from us and some 10 miles from each other. And so it goes. At the end of a long, hot, and exhilarating day, we have racked up over 30 sightings, most of them dolphins of the genus *Stenella* (exactly what we are looking for), with a healthy serving of those elusive and difficult to detect beaked whales. The plane has made two flights of 5-6 hours each to work with us and on a record day, we have successfully collected data from four dolphin schools simultaneously from the ship and plane. At this writing we have a total of 16 calibration schools – with three more plane-and-ship days to go – a success surpassing our wildest dreams.

The fast and furious pace is intensified by the fact that our small boat is dropped in the water shortly after breakfast and brought aboard just before sundown. Teams bring turtles back to the ship throughout the day (the density of which are also astonishing – 1/3 of the entire trip's worth of turtles that we have brought on board have come from this single week!), and work more intensively with calibrated dolphin schools (see special report below). So intense is our work, and so focused are our efforts, that we have a

meeting each evening, post sunset, to update each other on results of the myriad projects going on during the day. You know there is a lot going on when you can't keep track of all the research conducted within 40 m of you! (and when you have to use the pilot's rest day to run back to Acapulco to purchase small boat fuel; we used 50% of Leg 5's supply in the first 6 days of this week!)

This effort is totally different from what we've ever done before (calibration in the past has been accomplished using a helicopter that has lived on the back of the *David Starr Jordan* and so, we have had 4 months to get our 16 calibration schools for each observer). Every single individual on this ship has been critical to our efforts and challenged. Officers record each sighting on a special navigation program on the bridge and coordinate logistics between several different projects with plans and priorities continually changing and regularly using 3 radio channels for communications. Meals are regularly skipped by the entire scientific complement, and a fair number of crew, but the galley stays open and food (and smiles) wait until we finally get a break. Long, hot hours go by in the small boat with coxswains switching out periodically to spell one another; our entire deck department has gone from tanned brown to shades nearer to black in the space of a week. The engineers keep our engines running, the ship cool, and remind us when freezer temperatures increase and threaten our samples. I am among a tired but exhilarated team – that just asks for more. It is a rare privilege to be part of such a group.

Lest we get lost in the excitement of such fast-paced action, our new visiting scientists (welcome Ph.D. candidate Nick Kellar, future head of NOAA Jeremy Rusin, and seabird biologist extraordinaire Tony Gaston) are here to remind us, with their fresh perspective, of the wonder of the animals and the system that we tend to take for granted. Late one afternoon, as the intense sun was just starting to sink low enough to promise some relief and to provide beautiful light, spotted and spinner dolphins from a large calibration school made their way over to the ship to ride the bow in dense formation just below a sheen of glassy sea. Tony's comment: "I think that watching those dolphins from the bow today is the most beautiful thing I have ever seen. If I should go blind tomorrow, I should be happy that I was here today."

Sightings and Effort Summary for Marine Mammals

Date	Start/ Stop Time	Position	Total nmi	Average Beaufort
102506	1143	N16:43.28 W099:55.05	39.2	4.3
	1856	N15:56.44 W100:01.23		
102606	0741	N15:55.19 W100:04.99	35.4	1.8
	1540	N15:54.75 W100:27.93		
102706	0637	N15:33.64 W099:50.33	49.5	1.6
	1751	N15:25.12 W099:42.49		
102806	0640	N15:06.10 W099:20.75	25.2	1.0
	1503	N15:05.77 W099:30.34		
102906	0632	N15:01.03 W098:33.62	47.2	1.5
	1523	N14:34.85 W098:29.11		
103006	0638	N15:13.05 W098:55.84	31.2	2.0
	1208	N15:09.17 W099:09.90		
103106	1450	N16:49.47 W099:56.67	22.9	3.3
	1757	N16:33.04 W100:13.73		
110106	0645	N15:56.26 W100:50.75	30.3	3.6
	1432	N15:33.84 W100:49.55		

Code	Species	Number of Sightings
001	<i>Mesoplodon peruvianus</i>	9
002	<i>Stenella attenuata</i> (offshore)	32
003	<i>Stenella longirostris</i> (unid. Subsp.)	5
010	<i>Stenella longirostris orientalis</i>	29
015	<i>Steno bredanensis</i>	7
017	<i>Delphinus delphis</i>	1
018	<i>Tursiops truncatus</i>	3
021	<i>Grampus griseus</i>	1
048	<i>Kogia sima</i>	11
049	Ziphiid whale	2
051	<i>Mesoplodon</i> sp.	4
061	<i>Ziphius cavirostris</i>	2
075	<i>Balaenoptera musculus</i>	1
077	Unid. Dolphin	2
078	Unid. Small Whale	2
090	<i>Stenella attenuata</i> (unid. Subsp.)	5
Total		116

Special Report **Aerial Photogrammetry – The Airplane Perspective (Wayne Perryman)**

The ship/aircraft operations are going very well. The Jordan has been very effective at sighting schools and the aircraft team has had very good success at locating schools detected by the ship "over the horizon." Photographic passes have been challenging as schools running low in the water present almost no sighting cues to the pilots. In spite of this, the two pilots have consistently done an excellent job putting us over the schools.

This project is a "proof of concept" effort in that it is our first attempt at calibrating school size estimates of shipboard observers with images collected from a land based aircraft, instead of the embarked helicopter used in previous years. In addition, we have added a small format digital camera to the two old film cameras we have historically used for this work. Early results from the digital camera are surprisingly good.

Coordination between aircraft based scientists, living in a 120 kt world, and ship based scientists, living in a 10 kt world, has been a challenge at times, evidence by the occasional "are you going full speed" question from the aircraft. Overall, things are going very well and we are ahead of schedule on the number of calibration schools in the can.

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

Take a couple of biopsy crossbows, a plane, and a camera with two lasers attached to it and mix thoroughly with hundreds and hundreds of spotted and spinner dolphins and you got our project, "Biopsying Dolphins to Assay for Reproductive Traits" or Bio-DART.

The aim of this project is to biopsy, from the small boat,, several hundred dolphins that have been photographed from the air calibration while at the same time capturing additional images with a hand-

held camera the has two parallel laser beams emitted from the bottom of it. From these data I hope to make comparisons between pregnancy rates (estimated from the biopsies) and calving rates (estimated from the aerial photos) while trying to identify potential demographic sampling biases (estimated from the laser beam photos).

My summary so far: This is hard!!!!

But we've collected 56 biopsies (the majority of these are from just from one school) and have nearly a dozen usable laser dot photos. These numbers are below what was envisioned. The main impediment has been that the dolphins are less than friendly. Of the 14 schools that have been photographed from the air only two have been easy to approach. I've tried different deodorants, singing less, and even hiding myself in the back of the boat. Nothing works so far. Hopefully next week we'll find many schools of dolphins interested in the extreme exfoliation treatment we provide.

Photography (Cornelia Oedekoven, Laura Morse, Adam Ü)

During our ten days of calibration we are working closely with our visiting scientist Nick Kellar on his project of intensive biopsying and photographing spinner/spotter calibration schools. Our part for his project is the intensive photographing from small boat and bow of the ship. Nick outfitted our small boat camera with a sophisticated laser device that projects two green laser beams onto the photographed dolphin. The laser beams are calibrated to travel parallel at a distance of 7.5 cm. Ideally we would get a lateral image of the dolphin with the two laser dots showing somewhere on the body. From that image we would then be able to measure the size of the animals that come close to the small boat, i.e. within range of the biopsy dart. Comparing these data with the size measurements of each dolphin in the same school coming from the aerial images, Nick will be able to detect potential biases of younger animals coming to the bow more often than older animals (or vice versa). However, as well thought out as this project is, there are – as is typical with a new field project – a few kinks to be worked out. The biggest kink so far is that the dolphins have been fairly uncooperative, running away and providing mostly tail shots. Only one school came to the bow of the small boat. But we have three more days of calibration left and hope to get more cooperative schools.

Species Code	Species	This week	Total
002	<i>Stenella attenuata</i> (offshore)	9	24
003	<i>Stenella longirostris</i> (unid.)		6
006	<i>Stenella attenuata graffmani</i>		11
010	<i>Stenella longirostris orientalis</i>	10	19
013	<i>Stenella coeruleoalba</i>		11
015	<i>Steno bredanensis</i>	1	12
017	<i>Delphinus delphis</i>		30
018	<i>Tursiops truncatus</i>		34
021	<i>Grampus griseus</i>		7
032	<i>Feresa attenuata</i>		1
036	<i>Globicephala macrorhynchus</i>		12
037	<i>Orcinus orca</i>		13*
046	<i>Physeter macrocephalus</i>		20*
049	<i>Ziphiid whale</i>		1
063	<i>Berardius bairdii</i>		3

Species Code	Species	This week	Total
072	<i>Balaenoptera edeni</i>		3
074	<i>Balaenoptera physalus</i>		2*
075	<i>Balaenoptera musculus</i>	1	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 10/25/2006 to 11/01/2006					
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	0	0	7	17
<i>Physeter macrocephalus</i>	Sperm whale	0	0	8	8
<i>Stenella attenuata</i>	Pantropical spotted dolphin	35	61	56	99
<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	21	49	29	81
<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
		56	110	309	600

Seabirds and Marine Debris (Rich Pagen and Chris Cutler)

A week of mammal observer calibration translated into very little seabird transect effort. Despite this fact, an ocean thick with turtles and a high priority for biopsy and photography of dolphin schools led to some of our busiest days of the entire cruise.

The seabird survey time we did put in often felt more like a coconut survey. Marine debris was thick this week, some slicks of debris so dense with tiny (mostly) human-made fragments that it was impossible to count them. Somewhat larger pieces of debris nearly always had their attendant triggerfish and tripletails, while large debris items (i.e., logs) often had turtles, sharks or boobies associated with them. One small turtle was observed with a 2.5 ft long piece of soft plastic trailing behind it as it swam. In an attempt to capture and free the turtle, we turned the ship and readied the dipnets. The turtle dove but when it

reappeared, the plastic had worked its way free and the turtle was back the way it should have been: unobstructed.

Because of time spent both nearshore and out to over 100 miles from shore, seabird diversity was high this week. We watched the nearshore community of Laughing Gulls, Black Terns, Black Storm-petrels and the occasional Black-vented Shearwater grade into Wedge-tailed Shearwaters and white-rumped Leach's Storm-petrels offshore. The flocks attending tuna/dolphin schools were dominated by Brown Boobies, followed by the occasional Red-footed and Nazca Boobies, Pink-footed and Christmas Shearwaters, and Brown Noddies.

We awoke on 29 October to very light winds yet with a sizeable swell coming from a storm in the Gulf of Tehuantepec. Apart from the swell, this storm didn't impact us much at all, but its effect on migrating landbirds became clear as the day progressed. Storms have a tendency to pass from the Gulf of Mexico into the Pacific Ocean across the Isthmus of Tehuantepec and, in doing so, often wreak havoc on the migrating birds that are making their way through Mexico on the way to their wintering grounds to the south. Blown off course by the northeast winds that day, an assortment of landbirds came to rest on the David Starr Jordan, and the ship began to take on the feel of Noah's Ark. Common sights that day included a Black-throated Green Warbler sitting on the barbeque, a Scissor-tailed Flycatcher preening on the railing, a Cattle Egret resting on the crane, a Barn Swallow constantly circling the ship (occasionally in the company of two Mourning Doves), and finally a Wood Thrush found floating face down in the sea.

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

We had a colossal turtle week, far surpassing even previous busy weeks. As we steamed into Acapulco last week we processed a mere 3 turtles. Steaming away from Acapulco this week and staying between 60 and 90 miles from shore for our marine mammal observer calibrations, we processed 85 turtles. That is quite a difference! This total includes a "hard down" day where we did not have small boat operations, equaling zero turtle captures. Unquestionably a hot spot, this area also arguably serves as an olive ridley nursery ground. Of the 85 turtles processed, 20 were juveniles (40 cm SCL or less) – almost 25%. Many more were seen and not captured as the small turtles are the hardest to sneak up on and successfully hand capture before they nervously 'fly' down and out of sight. This percentage blows our norm out of the water, so to speak.

Perhaps the most exciting turtle event since capturing the beautiful juvenile hawksbill back in mid-September happened on 26 October when seabird observer Rich Pagen spotted a leatherback. Yes, you are reading correctly – we (the royal "we," other unfortunate souls and I were not on the flying bridge and missed it!) saw the highly endangered Pacific leatherback. Estimated to be 4-5 feet in length, this seemed to be a sub adult, half the size of its adult counterparts: up to 165 cm SCL, over 400 kg. A rare sighting indeed. This brings our turtle species sightings up to four out of the five species found in the eastern Pacific. Bob Pitman and Chief Bosun Chico Gomez did see two of our illustrious fifth species, the green sea turtle (known in the eastern Pacific as the black turtle) around Cocos Island, and I spotted one near Malpelo, however the species has not been seen in our trackline and therefore not recorded in our ecosystem data. It would be joyous to capture and process a black turtle to round off the cruise. Stay tuned!

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	85	260
Total		85	269

Fish Sampled for Diet and Isotope Analysis

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

*includes black skipjack

Oceanographic Operations (Candy Hall)

Observer calibrations have played havoc with the XBT schedule this week, giving our turtle and net tow queen, Lindsey, a well-deserved break from oceanography. As we have generally remained within flight distance from Acapulco, the noon XBT drop has proved to be sufficient in revealing the thermohaline secrets of the deep(ish). These, in conjunction with the CTD profiles, have shown us to be in the ~ 55m thermocline depth (20 °C isotherm indicator) region, with a variable but prominent mixed layer and well defined pycnocline structure. Such features are indicative of the eastern Pacific warm pool with their warm, low salinity TSW (Tropical Surface Water) overlying a cooler, shallow but strong pycnocline water mass.

Occasional deepening of the thermocline has allowed us to believe that we may have encroached upon the outskirts of what Kessler (2006) calls the “Tehuantepec Bowl”; a depressed thermocline region possibly situated around 14 N. This Bowl is the antithesis of the Costa Rican Dome, and is thought to have low chlorophyll levels, as epitomized by our recent data collection.

Wang and Enfield (2001) believe that ‘the eastern Pacific warm pool is the result of seasonally large net heat flux and weak wind mixing’, which are certainly the conditions we have been experiencing here. Apart from one day of relatively high swells with no wind (generated by the Tehuantepec winds creating swells that wrapped around the point of Tehuantepec Bay and approached us from the east) and a day of wind with small swell, we have had millpond water conditions. The fact that the massive Pacific Ocean can produce these conditions begs this oceanographer to once again test whether it may, at some point, really be possible to walk on the seemingly tensile surface of the water...

Date	CTD	XBT	Bongo tow	Manta tow
25 Oct	1	---	1	1
26 Oct	2	1	0	0
27 Oct	2	1	1	1
28 Oct	2	1	1	1
29 Oct	2	1	1	1

Date	CTD	XBT	Bongo tow	Manta tow
30 Oct	2	1	0	0
31 Oct*	---	---	---	---
1 Nov	2	1	1	1
Total	13	6	5	5
Grand Total	139	211	57	59

* Anchored in Acapulco Bay while purchasing RHIB fuel

Kessler, W.S. 2006. The circulation of the eastern tropical Pacific: A review. *Progress in Oceanography* 69: 181–217.

Wang, C., Enfield, D.B., 2001. The tropical Western Hemisphere warm pool. *Geophysical Research Letters* 28, 1635–1638.

Visiting Scientist's Corner (Tony Gaston)

Small world - ETP Leg 5

*The deep blue beckons, silently heaving
The ghosts of great storms, even now resounding
Across the infinite arc of Ocean
Lift us gently, murmuring
"Now, you are in our power"*

*The liquid in the glass acknowledges the seas anger
Half the world away, bringing rumours
From Tahiti, Pitcairn, the Marquesas
While the breeze of afternoon
Brushes ripples on the face of the swell*

*We sit perpetually at the centre of the world
A pool of shining water 12 miles across
Pitted with gentle undulations,
Dinted occasionally by the fins of dolphins
The ragged margins trimmed with faint clouds*

*From time to time our captain, well directed,
Revolves it all slowly under the relentless sun
That slides beneath the canopy
To stab our backs, our eyes
As we roast gently on the turning spit*

*But the nights are balmy
Lullabied and rocked by the sleepless sea
The deep throb at the heart of the ship
Never ceasing: nights are kind
Dreaming of great fish, perhaps for dinner!*