STAR 2006: NOAA Ship *McArthur II*
Weekly Science Report

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Science Summary: 12-18 October 2006

This has been a week of transitions. As you may recall, last week your intrepid explorers were complaining about the cold influence of the Humboldt Current and the general lack of tropical dolphin species. This week we left all that behind and traveled consistently North through what is certainly one of the most interesting and dynamic oceanographic regions in the world. We traversed three major current systems, the westward South Equatorial Current, the eastward Equatorial Counter Current, and the eastward (subsurface) Cromwell Current. Our course took us about 250 miles offshore of the Galapagos Islands. Our sea surface temperature climbed from 21.5°C to 27.0°C. Unfortunately we did not see the typical surface features that mark the boundaries between currents (probably because we passed them at night). [If you are wondering what a current really looks like, watch Finding Nemo again.]

The marine mammal life has followed these oceanographic transitions perfectly. In the far South, we found sparse numbers of blue whales, sperm whales and pilot whales. As we approached the productive Equatorial water, we saw an increase in the numbers of blue whales and black fish (pilot whales, false killer whales, and bottlenose dolphins). On the day we crossed the equator, we began, for the first time on this leg, to see large schools of common dolphins … a clear marker of rich, upwelling-modified waters. Yesterday, we knew we had finally crossed into the Eastern Tropical Pacific when we began to see large schools of spotted and spinner dolphins.

As you can seen from our weekly totals below, we had our best week of the cruise for collecting biopsy samples and taking photographs. We were able to launch the small boat twice and were even able to add to our Lab's small collection of pelagic false killer whale biopsies. We also got four more biopsy samples from blue whales. This cruise may go down in the memory of most people on board as the year-of-the-blue-whale. We saw more of them south of the Equator and distributed over a greater area than anyone can remember. Is this a sign that blue whales are really recovering? If so, which population are we talking about? We presume these are Antarctic blue whales spending their winter in productive tropical waters, but as they say, only your geneticist can tell for sure. We look forward to hearing about future analyses of our hard-earned samples. Congratulations to all our photographers and biopsiers for their dedication and long hours this week.

Squid continue to be a highlight of the evening activities (competing with the cribbage tournament for that honor). On Monday night, the day before we crossed the Equator, we found a real bonanza of squid (What is a group of squid called? An armful?). Danna and Mindy worked until 2am measuring, sampling and determining maturity states.

Sightings and Effort Summary for Marine Mammals

DATE	Start Stop Time	Position	Total Distance	Average Beaufort
101206	0646	S12:00.13 W091:56.01	102.8 nmi	4.6
	1905	S10:50.80 W093:29.68		
101306	0656	S10:03.23 W094:39.17	77.1 nmi	5.1
	1916	S09:10.72 W095:55.22		
101406	0710	S08:20.11 W097:02.41	75.0 nmi	4.1
	1914	S07:25.41 W098:18.16		
101506	0713	S06:11.49 W098:09.34	71.7 nmi	4.5
	1909	S04:51.36 W097:37.70		
101606	0708	S03:34.15 W097:06.88	72.9 nmi	4.3
	1744	S02:22.50 W096:21.87		
101706	0707	S00:57.83 W095:51.89	49.3 nmi	4.0
	1907	N00:20.24 W095:22.18		
101806	0706	N01:40.03 W094:56.28	79.0 nmi	4.1
	1849	N02:38.46 W093:45.82		

CODE	SPECIES	TOT#
002	*Stenella attenuata (offshore)*	*1*
013	*Stenella coeruleoalba*	*1*
015	*Steno bredanensis*	*1*
017	*Delphinus delphis*	*6*
018	*Tursiops truncatus*	*4*
021	*Grampus griseus*	*2*
033	*Pseudorca crassidens*	*2*
034	*Globicephala sp.*	*2*
036	*Globicephala macrorhynchus*	*3*
046	*Physeter macrocephalus*	*3*
049	*ziphiid whale*	*2*
070	*Balaenoptera sp.*	*6*
072	*Balaenoptera edeni*	*4*
075	*Balaenoptera musculus*	*7*
077	*unid. dolphin*	*2*
079	*unid. large whale*	*7*
099	*Balaenoptera borealis/edeni*	*1*
101	*Stenella longirostris (southwestern)*	*2*
177	*unid. small delphinid*	*7*
	TOTAL	*63*

Biopsies (Suzanne Yin and Erin LaBrecque)

Species	Common Name	Weekly		Total	
		Samples	Takes	Samples	Takes
Balaenoptera edeni	Bryde's whale			1	1
Balaenoptera musculus	Blue whale	4	4	9	10
Delphinus delphis	Short-beaked common dolphin			2	3
G. macrorhyncus	Short-finned pilot whale	3	5	18	21
Pseudorca crassidens	False killer whale	3	5	3	5
Stenella attenuata	Pantropical spotted dolphin			1	1
Tursiops truncatus	Bottlenose dolphin	6	9	20	41
Total		16	23	54	82

Photo-id Report (Isabel Beasley and Jim Cotton)

A record week for photography with 11 different species photographed. Blue whales featured prominently again (with linked biopsy photos)… as well as some interesting looking southern hemisphere striped dolphins, showing subtle variations to their 'classic' color pattern.

Species Code	Species	This week	Total
002	*Stenella attenuata* (offshore)	1	2
011	*Stenella longirostris* (whitebelly)		6
101	*Stenella longirostris* (southwestern)	2	3
013	*Stenella coeruleoalba*	1	7
015	*Steno bredanensis*		1
017	*Delphinus delphis*	2	9
018	*Tursiops truncatus*	2	13
021	*Grampus griseus*	1	1
026	*Lagenodelphis hosei*		2
031	*Peponocephala electra*		1
033	*Pseudorca crassidens*	1	5*
036	*Globicephala macrorhynchus*	3	25*
037	*Orcinus orca*		4*
046	*Physeter macrocephalus*	2	3
072	*Balaenoptera edeni*	2	8*
075	*Balaenoptera musculus*	5	15*
076	*Megaptera novaeangliae*		1
TOTAL		**22**	**106**

* Individual whales photographed

Seabird and Marine Debris (Michael Force and Sophie Webb)

And we thought last week was unbelievable in terms of diversity! We didn't think it could get much higher, but this week it certainly did just that, eclipsing the previous record species total by five species. We saw a remarkable 36 species of seabirds, more than any other week of STAR 2006. Furthermore, our daily average of 14 is the highest it's been since early in Leg 2 during those halcyon days traipsing through the Equatorial Countercurrent. It wasn't immediately obvious to us, but based on this avian variety pack, we undoubtedly surveyed several different marine habitats. There were numerous highlights, too many to list individually. Petrels in the genus *Procellaria* figured prominently. They are well known scavengers of the southern oceans, and one of them, Parkinson's Petrel, has a strong propensity to associate with blackfish. A flock of 60, the most anyone on board has ever seen at one time, was staying close to a mixed group of false killer whales and bottlenose and rough-toothed dolphins, eagerly picking up any scraps that the dolphins left behind. Among the nine species of petrels was our first Henderson Petrel, and a couple of Murphy's Petrels. Storm-petrels stole the show this week with seven species including a real show stopper: White-throated (Polynesian) Storm-Petrel. It was the first one for STAR 2006, and likely the only one. Everyone on the flying bridge had amazing views of this gorgeous storm-petrel as it performed its peculiar splash-down and push-off flight only metres off the bow. It even remained long enough for Sophie to get some photos. Other notable storm-petrels included White-faced and White-bellied Storm-Petrels, likely the last we'll see of these engaging stormies. However, I'll gladly be proven wrong. Birds slightly out of place were a Black Noddy out in the middle of nowhere, about 650 NM southwest of the Galapagos, and a Ruddy Turnstone.

We didn't see very much marine debris this week other than the requisite plastic bottle and occasional fishing float. However, an empty plastic laundry basket drifted past, our first basket case of the cruise. Perhaps not the last as the weeks wear on.

Oceanographic Operations (Melinda Kelley)

	Day	CTD	XBT	Bongo	Manta
Leg 3	Thursday	2	3	1	1
	Friday	2	3	1	1
	Saturday	2	3	1	1
10/12	Sunday	2	3	1	1
to	Monday	2	3	1	1
10/18	Tuesday	2	4*	1	1
	Wednesday	2	3	1	1

*equatorial XBT cast

With many oceanographic features along the track line, the week was full of excitement for the oceanography team. The week began with sea surface temperatures of 21° C (69.8^{o} F) and mixed layers reaching 50-60 meters. Net tows brought in cod ends full of

interesting animals while CTD casts continued allowing us to collect and monitor chlorophyll levels in the water column.

Moving into the middle of the week, the team prepared to observe and record the expected changes that would come with crossing the South Equatorial Current. Monday evening's CTD cast displayed an unusual mixed layer between 200 and 275 meters. This deep mixing layer continued to appear in Tuesday morning's CTD cast, as well as in the 9am and 12pm XBT profiles. Jay pointed out the change occurring with the surface mixed layer of the XBT profiles; the surface mixing layer moved up to 30-40 meters. The final Tuesday equatorial XBT cast was successfully launched thirty minutes after the normal 3pm cast. It showed a profile free of the deep mixed layer and a shallow surface mixed layer of 20-30 meters.

As we continued to cross the Equator and move north we observed the effects of the countercurrent during the Wednesday morning CTD cast. Due to this fast subsurface current, it was difficult for the bridge to maintain a decent wire angle throughout the CTD cast.

The week ended with sea surface temperatures at 23° C. Stay tuned, the water is heating up!

Squid Report (Danna Shulman)

On the subject of squid, it is my pleasure to report the discovery of a squid bachelor party just south of the equator. On Sunday and Monday the intrepid fishermen pulled up 36 (33 *Dosidicus* and 3 *Stenoteuthis*) and 72 (all *Dosidicus*) squid, respectively. While most squid on both nights were immature, almost all of the sexually mature animals were males. The ever-amazing Mindy stayed up late with me to help document Monday's catch. Since then, we've returned to modest catches of less than half a dozen.

My gratitude to the dedicated squid jigging team (Stan, Art, Lucas, and Jim) cannot be overemphasized. Thanks in equal measure must be meted out to all those hands who have helped to scrub the pernicious ink stains from the decks. Many thanks also to the dip netters, who have caught a number of juvenile squid that I've tried to keep in the fish box--with limited success. Squid are notoriously difficult to maintain in captivity and they are particularly unhappy with warmer waters, so, lacking a chiller, I'll be ending these husbandry attempts.

I did get a few successful hatchlings from the artificially fertilized eggs, which were preserved for later study. More eggs were fertilized on Monday night (from the single mature female).

Squeakly Report (Shannon Rankin and Liz Zele)

The week for acoustics mirrored that of the observers, magnified by several orders of magnitude .... periods of calm and moderation, interrupted by insane chaos.

To obtain a location of a vocalizing dolphin, the acoustician must first obtain an angle to a vocalization (easy enough), and then obtain successive angles as the ship progresses (no problem, almost fun). By plotting these successive angles, we are able to see a convergence on our map, indicating the location of the dolphin or dolphin school. Now, imagine multiple schools of dolphins, from next to the ship to the horizon. Each whistle give us a new angle-- but, to whom does this whistle belong? The angles of dolphins far from the ship change at a slower rate than angles from dolphins near the ship-- unless they are running away from the ship, in which case the angles hardly change. As we are frantically trying to obtain as many angles as possible to clear up this "mess" of multiple subgroups, we must match some of these groups to the appropriate "sighting", and track the others until they pass the beam of the ship and are out of range of the observers. Now, imagine during this mess we turn and all of a sudden, the flow of angles we had just begun to get comfortable with changes by 40 degrees to the right. If the dolphin school A was on the right side, you will want to subtract 40 degrees from whatever angle you previously had. If dolphin school A was on the left side, then you will add 40 degrees. Except, you do not actually KNOW which side they are on, so get the angles and try to figure it out. Fast, because they are always changing. And then there is dolphin school B. And C. Do your math quick! Whew, and if you survived that (and any additional twists and turns), and if you might find a second or two in between conversations with the flying bridge, localizing multiple dolphin groups, matching visual and acoustic detections, and taking notes--- well, then quick! Prepare the next tape for recording! Toss over that sonobuoy on that whale! Re-locate the dolphins for the flying bridge (WHICH group was theirs in the first place???)! Run ROCCA to get acoustics species ID! Wait, is that a new group ahead!?!?!

And then, when you think you finally can't take anymore... crazy ship noise!

This week has left us with headaches and twitches, and longing to drown our frayed nerves in some good old-fashioned ale. We've deployed 11 sonobuoys (Brydes and blue whales), had 30 acoustic detections not sighted by the observers (4 were sperm whales), and we made recordings of striped, spotted and spinner dolphins, bottlenosed, rough-toothed, and common dolphins, pilot whales, and false killer whales. Two schools of pilot whales and one group of Risso's dolphins were the only groups that managed to keep their peace.

Dippers' Doldrums (Jim Cotton)

The distribution of flyingfish continued to be patchy and few in numbers as we surveyed in a northwestward direction, beginning about 700 miles west of the southern border of Peru and ending about 200 miles NNW of the Galapagos.

Most of the flyingfish were netted during three night stations. On our best night, we collected four species. It is interesting to note that nearly all of the Two-winged flyingfish collected were juveniles. Lantern fish were the most abundant of all species during the first half of the week and the diminutive tropical form of the Pacific Saury (*Elassichthys adoceus*) dominated the collection during the last half of the week.

Squid were present at all the stations and aquatic insects (*Halobates*) were only seen at four of the twelve stations.

Net results for this past week are as follows:
100 Lantern fish
81 Saury
23 Two winged flyingfish
11 Short winged flyingfish
8 Four winged flyingfish

Fish Sampled for Diet and Isotope Analysis

	Samples	
Species	**Weekly**	**Total**
Mahi mahi	1	1
Wahoo	-	1