NOAA – National Marine Fisheries Service

WEEK FOUR
SEPTEMBER 15 – 22

2008 LUTH CRUISE

Studying Leatherback Use of Temperate Habitat Along the Central California Coast

CHIEF SCIENTIST:
Scott Benson

CRUISE LEADER:
Scott Benson

SURVEY COORDINATOR:
Annette Henry

SCIENTISTS (A-Z):
Steven Bograd
George 'Randy' Cutter
Peter Dutton
Karin Forney
Justin Garver
Elizabeth Zele
Juan Zwolinsky

VISITORS:
Amy Hapeman

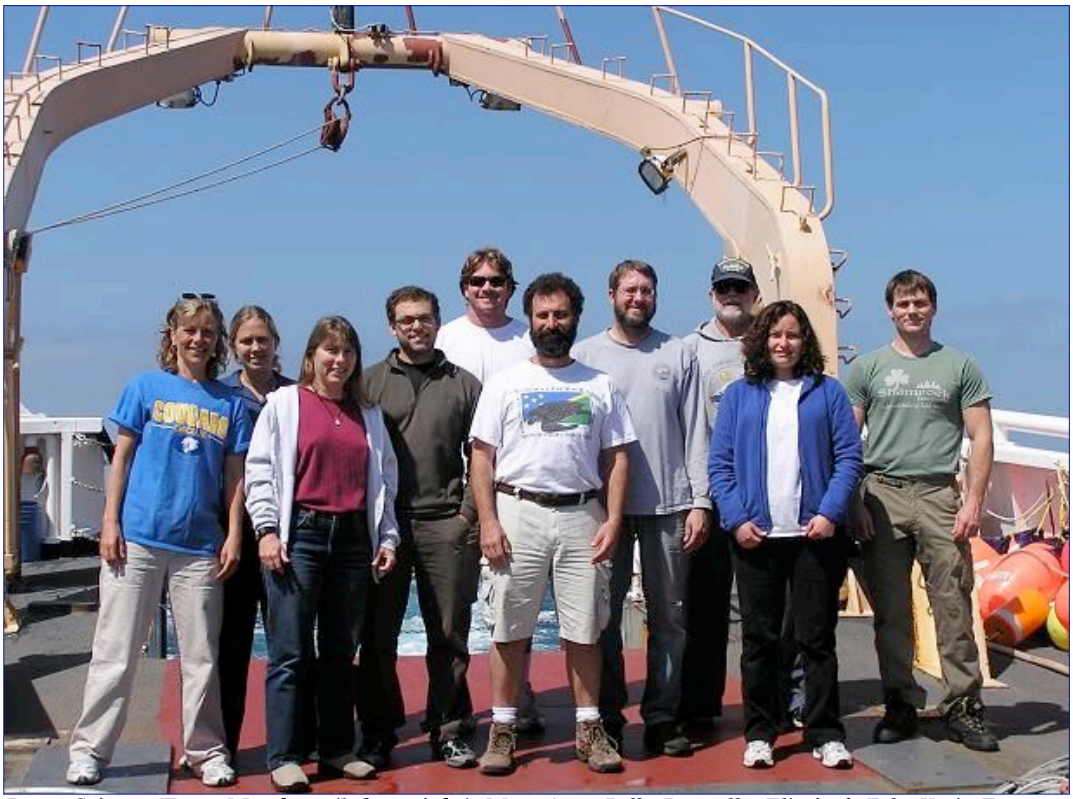
TEACHER AT SEA:
Mary Anne Pella-Donnelly

SATELLITE DATA:
David Foley

Weekly Science Summary

Scott Benson (Chief Scientist)

The beginning of the final week of our survey found us back at 'Jelly Lane' (San Mateo County coastal waters) to run the multibeam sonar (see Week 3 Report) through an area of dense jellyfish and collect additional samples of *Chrysaora fuscescens* (sea nettles) for future analysis and examination of gut contents. The jellyfish were as abundant as we encountered during the first leg and were slightly larger. We learned our lesson well near Point Reyes during the previous week and kept our net tows under five minutes duration to avoid bursting the net with the abundant heavy jellies. Following the net sampling, we spent the night at anchor to document the behavior of the internal waves with the acoustic equipment (see Week 2 Report). Overall, the extra 24 hours at the coast provided us with great acoustic data from the multibeam and downward-looking transducers, linked with net trawls that will be useful for acoustic identification of jellyfish during future surveys.



Leg 2 Science Team Members (left to right): Mary Anne Pella-Donnelly, Elizabeth Zele, Karin Forney, Juan Zwolinsky, Justin Garver, Peter Dutton, Steven Bograd, Scott Benson, Amy Hapeman, Randy Cutter.

Sea jelly; genus *Aequorea*

*"Surface trawls produced small but steady yields of moon jellies (*Aurelia labiata*) and some large specimens of the genus* Aequorea. *"*

Moon Jelly

Chico Gomez competing with the net trawl using his own net!

WEEKLY SCIENCE SUMMARY - *CONTINUED*

Following our brief visit to the coastal waters, we remained well offshore (>130 miles) for the remainder of the cruise to sample the edges of the persistent warm water eddy that has been present since our departure from San Diego during late August (See Figures 1 and 2 for summary of sampling effort). Once again we found most of the charismatic megafauna on the cold side of the front (<15.5° C), including short-beaked common dolphin (*Delphinus delphis*), northern fur seal (*Callorhinus ursinus*), northern elephant seal (*Mirounga angustirostris*), ocean sunfish (*Mola mola*), blue shark (*Prionace glauca*), Buller's Shearwater (*Puffinus bulleri*), and some unidentified alcids (either Xantus's or Craveri's Murrelet). Surface trawls produced small but steady yields of moon jellies (*Aurelia labiata*) and some large specimens of the genus *Aequorea*. In contrast, waters on the warm side (>16.5°C) were relatively empty, with the exception of swordfish (*Xiphias gladius*), and Cuvier's beaked whale (*Ziphius cavirostris*).

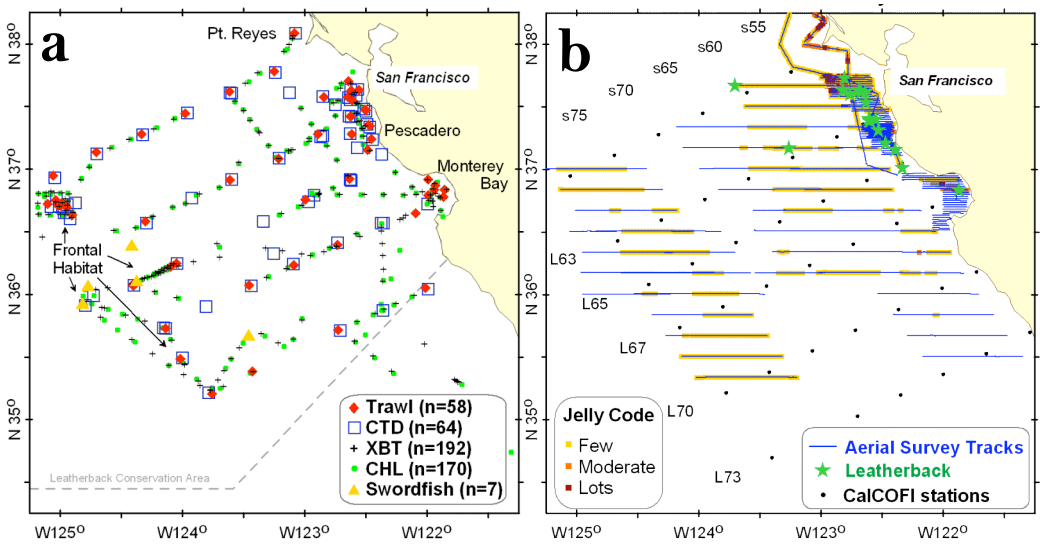


FIG 1. Cumulative plots of data collected during LUTH 2008 shipboard sampling (a) and aerial survey efforts (b).

The highlight of the week, and perhaps the entire survey, occurred while visiting the southern end of the eddy feature. Previous visits to the front indicated a strong southward flowing surface current that made trawling for jellyfish challenging. Aided by the remotely sensed products we received from Dave Foley at SWFSC-Environmental Research Division (Figure 2), we made plans to sample an area that appeared as a cul-de-sac of cooler water at the edge of the front. Upon our arrival at our intended destination we found piles of large kelp that had been transported offshore and into the 'cul-de-sac'.

"I especially thank Karin Forney *(left)* who has been aboard for both legs of the cruise and supported me and this project throughout. Her multifaceted skills, sharp mind, good humor and patience have enhanced the experience greatly."

WEEKLY SCIENCE SUMMARY - *CONTINUED*

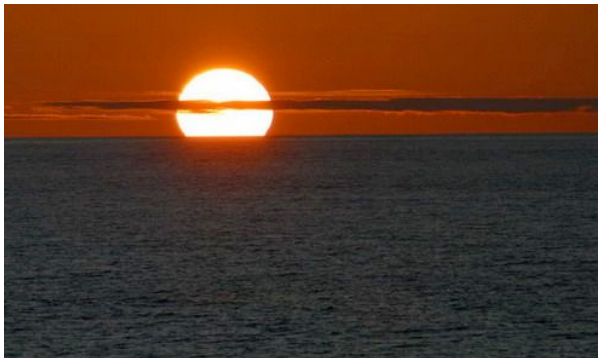
The pieces of kelp stretched northwest to the horizon, and among those pieces were hundreds of moon jellies, a few sea nettles, and the occasional purple-striped jelly (*Chrysaora colorata).* Although the density of jellyfish at this location is likely not large enough for a leatherback to obtain energy for growth and reproduction (unlike the coastal areas), it is large enough for a leatherback to temporarily interrupt a long migration. The remotely sensed characteristics of this feature match features we've seen leatherback utilize from previous telemetry data during the past six years. We hypothesize that these locations are important for leatherbacks to complete the vast migrations between nesting beaches and foraging areas in the Pacific.

The "Jelly Catchers" (left to right); Chico Gomez, Joao Alves, Peter Dutton, Vladimir Zgutnitski, and Scott Benson aboard the *Jordan* during Week 4 of LUTH 2008.

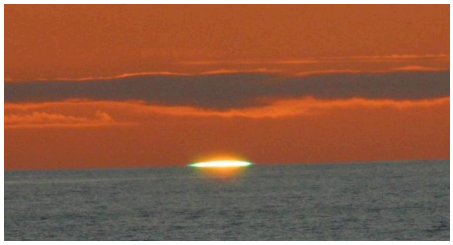
Observing on the flying bridge of the *Jordan*

As we conclude our survey, I thank the all-stars that participated and provided their expertise to document and examine leatherback use of temperate habitat at coastal and offshore waters off central California. It's been a unique and rewarding learning experience. I especially thank Karin Forney who has been aboard for both legs of the cruise and supported me and this project throughout. Her multifaceted skills, sharp mind, good humor and patience have enhanced the experience greatly. Lastly, and most importantly, I thank the crew of NOAA Ship *David Starr Jordan*, for overcoming multiple obstacles and challenges during our survey to keep us in the game. They've wrestled and repaired multiple trawl nets, replaced critical science and shipboard hardware (i.e. multibeam transducer and salt water pump), excised electronic gremlins, deployed/recovered sampling equipment in heavy seas, and adapted to our ever-changing needs. I last sailed aboard this vessel for extended periods over 15 years ago and this trip has felt like a homecoming. A ship is just a physical amalgamation of steel, diesel fuel, and related moving parts. The crew is it's soul; friends that are ready to back you up and ensure that the expedition is a success. The crew of this ship went beyond the call of duty again, just as I recall from past cruises, and it's been my pleasure and honor to learn from them and share our

With the abundance of jellies encountered during LUTH 2008, it is clear why leatherbacks cross the Pacific Ocean to visit this productive foraging hotspot.



One of the many amazing sunsets as seen from offshore waters of central California. Capping the day was the famously elusive 'green flash' (below).



Steven Bograd and Elizabeth Zele deploying the CTD during Week 4

The CTD is hoisted on and off the *Jordan* using a boom and winch

'Turtle water' consistently showed a high level of chlorophyll as seen on this filter shown above

Oceanographic Data Collection

Steven Bograd, Karin Forney, Justin Garver, and Elizabeth Zele

The Frontal Assault Continues ...

We continued to characterize the physical and biological oceanography of the offshore area of our study grid during the final week of LUTH. The warm-core eddy we encountered last week was still there (Figure 2 and Week 3 Report), and we continued to observe striking changes over short distances as we went into and out of the eddy. Not only did our instruments record changes, we could clearly detect the fronts with the naked eye. Although more than 100 miles offshore, lines of kelp fronds dotted the ocean surface (see below), at the same spots where the trawl brought up high numbers of jellies. While the warm side of the front appears to be good swordfish habitat, leatherback turtles are likely to find ample prey along the outer, cooler edges of such features. These data are giving us a better understanding of which physical features constitute critical habitat for migrating leatherbacks as they seek safe passage to their preferred grounds near the coast.

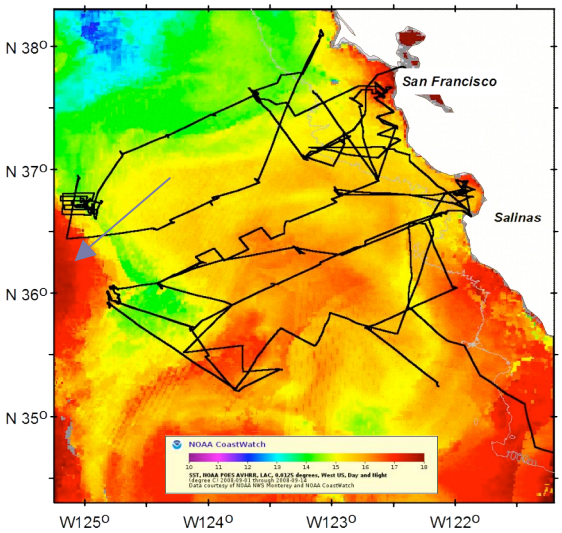
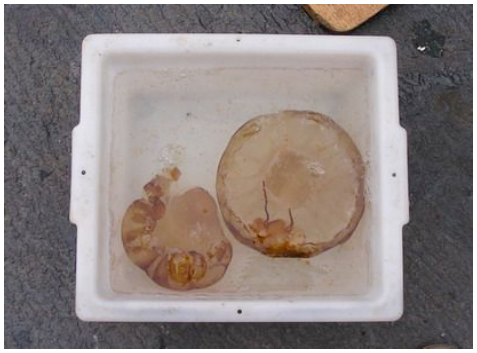


FIG 2. NOAA Ship *David Starr Jordan*'s survey track overlaid on top of a 14-day AVHRR SST composite (2-15 Sept. 2008) showing the edge of a persistent warm core region that was heavily sampled during Week 4. SST data provided daily courtesy of David Foley (JIMAR - CoastWatch).

"Although more than 100 miles offshore, lines of kelp fronds dotted the ocean surface at the same spots where the trawl brought up high numbers of jellies. "



Jellys such as these partially eaten sea nettles are often associated with frontal areas, and are a sought after food resource for larger organisms such as leatherbacks.

NOAA-NATIONAL MARINE FISHERIES SERVICE

Processing jellies from a net tow

During LUTH 2008 there were 58 net trawls and the science team processed hundreds of jellies aboard the *Jordan*.

in the *Jordan* wet lab

OCEANOGRAPHIC DATA COLLECTION - *CONTINUED*

We left the offshore eddy for a few days to go back to "Jellyfish Lane," near Pescadero, and again saw the acoustic signals of internal waves that we observed during Leg 1. These were large amplitude waves, strongest near the 50-m isobath, which appeared to bring the scattering layer (planktonic organisms, possibly jellies) towards the surface. We anchored the ship at the location of an internal wave from sunset to sunrise, giving us a full night to observe variations in the passage of these waves. As before, there were abundant jellyfish in these areas.

Large jellyfish stomach in a sample tray. The largest sea nettle collected during LUTH 2008 had a bell diameter of 55 cm.

Close-up of the science team processing jellies after a tow. Abundance was so high during some portions of Week 4, that the team worked for hours to process a net tow's jelly yield.

We continued to take near-surface chlorophyll samples hourly along our track, and at several depths at each CTD station. We have used a variety of extraction methods during LUTH Leg 1 and 2 (to address varying sub-project needs). To allow cross-calibration of these different samples, Liz Zele and Karin Forney conducted a methods comparison experiment during Leg 2. Chlorophyll was filtered in quadruplicate for 24 samples, with the chlorophylls run after 24-36 h, one week, 10 days, and after having been frozen for 10 days. The chlorophyll did degrade over time, particularly in the frozen samples, and the rate of degradation appeared nearly constant (Figure 3). This is a useful result, as it will allow us to readily compare absolute chlorophyll values that have been processed after varying durations of refrigeration or freezing during LUTH and other cruises in this study area.

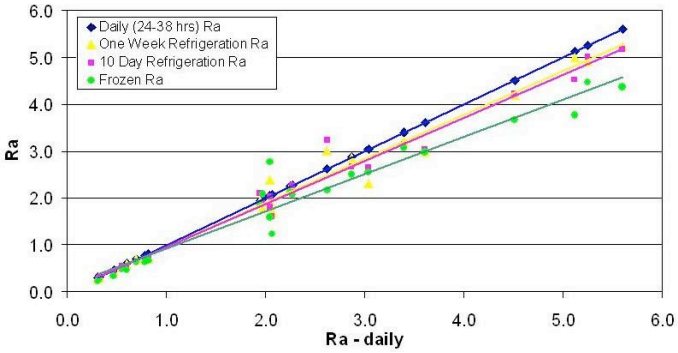


FIG 3. Comparison of chlorophyll values from 24-h, 1-week, 10-day and frozen samples. Values calculated as Ra (flourescence after acification) derived from four extraction methods.

NOAA-NATIONAL MARINE FISHERIES SERVICE

Fixes in the field: during Week 4, the multibeam 'escaped' from its bracket and required repairs while at sea

Randy Cutter during repairs to the sonar mounting system

Close-up view of the break in the pole; also showing the torn sonar cables.

ACOUSTIC STUDIES

RANDY CUTTER AND JUAN ZWOLINSKI

For most of Week 2, we have been developing an algorithm for apportioning mean volume backscattering strength (S_v) to groups of organisms, specifically to three groups: jellyfish; fish with swim-bladders; and plankton or bladderless fish (Figure 4). We use the differences of S_v from four frequencies (38, 70, 120 and 200 kHz) and the mean values to classify the $S_v(f)$ by groups (Figure 4). The algorithm for jellyfish was developed based on published literature and training data gathered from echograms acquired during trawls for jellyfish collected during Leg I of the LUTH survey. The apportioned, integrated mean volume backscatter will be used to estimate the abundance and biomass for each group, and to map their spatial distributions.

In addition to the progress with processing and analyzing the data from the EK60 echosounders, we were able to redeploy the multibeam and sidescan sonars after the engineers made repairs to the pole mounting apparatus. Their superb work provided us with solid, strong components that enabled us to continue surveying with the side-looking sonars. On the last day, the lower section of the pole broke off (see side panels on this page). Fortunately, we managed to recover the pole and secure it onboard, with only one sidescan incurring apparent damage.

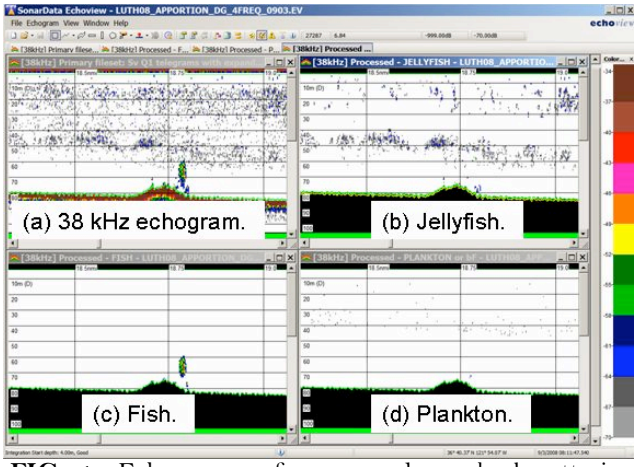


FIG 4. Echograms of mean volume backscattering strength S_v (dB) from (a) the original 38-kHz record, S_{v38} apportioned to (b) jellyfish, (c) fish, and (d) plankton.

We appreciate the attention and response of crewmembers Jun Orodio and Carlito Delapena who first noticed and notified us of the problem with the sonar pole apparatus. Also, we appreciate the outstanding effort and quality of work completed by the crew members who repaired and reinforced the sonar pole mounting apparatus and the ship's rail while underway, allowing us to continue with multibeam and sidescan operations. Exceptional individual efforts of the engineers were responsible for essentially rebuilding the retaining bracket, and securing the pivot arm bracket to the vessel with welds. Their reinforced parts held during the subsequent pole failure. Our sincere and utmost thanks go to Sam Velez, Chris Danals, John Hohmann, and Carlito Delapena for their work repairing and welding retaining components and mounting system, and to Chico Gomez, Victor Pinones, Joao Alves, and Vladmir Zgutnitski for safe recovery and redeployment (and final recovery) of the gear, and to the CO Demian Bailey and the NOAA Corps Officers for skilled ship handling during these recovery efforts.

Repaired and reinforced bracket.

NOAA-NATIONAL MARINE FISHERIES SERVICE

AERIAL TEAM COORDINATOR

ERIN LACASELLA

NOAA TWIN OTTER PILOTS:

NICOLE CABANA

JASON MANSOUR

OBSERVERS:

ERIN LACASELLA

DAN PROSPERI

TOMO EGUCHI

KATHERINE WHITAKER

KELLY NEWTON

LAURIE HALL

BRIAN HOOVER

ADDITIONAL TEAM MEMBERS:

NORMA VAZQUEZ

DANIEL PALACIOS

FIONNA MATHESON

During Week 4, the highlight for marine mammals sightings were the 65-70 short-finned pilot whales (see text).

AERIAL TEAM

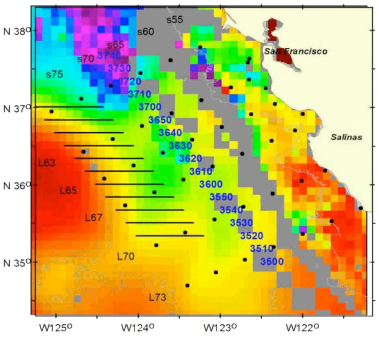
ERIN LACASELLA

This week started off a little slow. The 2000-ft fog bank didn't move much until Thursday, finally allowing us to conduct our first aerial survey in almost two weeks! NOAA Ship *David Starr Jordan* surveyed a frontal hotspot ~130 miles offshore, so we proceeded to the area, and flew transect lines starting 90-100 miles offshore, to include the eastern edge of the front (see SST image below). Each line surveyed was 40 miles long. We were able to complete eight transect lines with 6.5 hours of fuel. After re-fueling in Salinas, we headed back offshore, where excellent sea state conditions allowed us to complete the final three transect lines of the grid, surveying ~440 miles (plus 500-600 miles of transit)! Throughout the day we had sightings of fin whales (*Balaenoptera physalus*), common dolphins (*Delphinus*), ocean sunfish (*Mola mola*), scattered moon jellies (*Aurelia* sp.), and floating bits of kelp (even 150 miles offshore).

During LUTH 2008, the aerial team also conducted air-to-sea VHF tracking of biotelemetry systems on leatherbacks.

Friday turned out to be another nice day for flying. We completed four Twin Otter offshore transect lines. Each line was planned at 85 miles long, but a lingering fog bank at the outer edges of our survey area forced us to shorten the lines a few miles. We were also able to survey four shorter offshore transect lines, 45 miles in length, ending south near Piedras Blancas for a total of approximately 450 miles of survey effort for the day. Although we had no turtle sightings, we did have sightings of Pacific white-sided dolphins (*Lagenorhynchus obliquidens*), northern right whale dolphins (*Lissodelphis borealis*), Dall's porpoise (*Phocoenoides dalli*), humpback whales (*Megaptera novaeangliae*), elephant seals (*Mirounga angustirostris*), a large basking shark (*Cetorhinus maximus*), and 60-75 short-finned pilot whales (*Globicephala macrorhynchus*)!

This week we had two fantastic days of aerial surveys during the short break in the weather. We had hoped for one last chance to find a turtle offshore for a final round of suction cup tagging, but had no such luck. Unfortunately, this was our last chance for survey efforts with the *David Starr Jordan* in the study area before they headed south toward San Diego, at the conclusion of the LUTH cruise. I would like to personally thank the entire aerial team, fellow observers and our pilots, for their patience, knowledge, enthusiasm and being such wonderful people to work with. Its the team effort that makes the job so successful and rewarding, I am truly grateful for all of their help. Thank you!!!



View from above along the central California coast

Aerial observer team during LUTH 2008

The abundance of jellies often kept the entire *Jordan* science team busy from dawn to dusk

OBSERVATIONS FROM THE NOAA TWIN OTTER PILOTS

NICOLE CABANA

LT Mansour and I are happy to be participating in the LUTH project this year. The Twin Otter is an ideal aircraft for this type of survey, because it is capable of flying low and slow over the water and has a long endurance. With ideal conditions, survey flights can be 6.5 hours long. The scientists seem to enjoy the aircraft because of its large bubble windows for viewing, plus it is large enough to be comfortable on long survey flights.

Monterey Bay and the waters surrounding it are interesting to fly over due to the large oceanographic variation caused by hydrography and ocean currents. Our flights have been over extremely productive waters where the sightings occur so frequently the scientists have to work diligently to record all of them, and also over very barren areas where we can go for long periods of time without a single sighting. We also notice a marked difference in ocean color as we fly offshore and over warmer (less productive) waters. This variation creates an environment where you never know what to expect to see during surveys, and we have had some very interesting sightings, ranging from beaked whales, to pilot whales, to a basking shark!

It is also rewarding to be flying a project in conjunction with NOAA Ship *David Starr Jordan*. Participating in multi-faceted surveys is usually very rewarding because the data collected on the different platforms comes together to create a very nice final product. It has been a pleasure working with the *David Starr Jordan*, and we wish the scientists and crew the best as they head back into port.

A NOTE FROM OUR PERMITS OFFICE TEAM MEMBER

AMY HAPEMAN

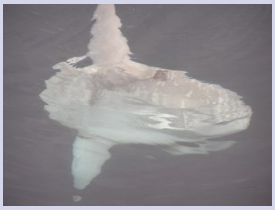
Over the past two weeks I have had a great time aboard NOAA Ship *David Starr Jordan*. LUTH 2008 has given me an invaluable opportunity to participate in the scientific research that I review and analyze as part of my job as a permit analyst in the Office of Protected Resources' Conservation, Education and Permitting Division in Silver Spring, MD. This experience will be a great asset to that work and I will leave with countless fond memories of my time here. Thank you to everyone for making this a great trip! So long and thanks for all the (jelly)fish!

A LOG FROM OUR TEACHER AT SEA

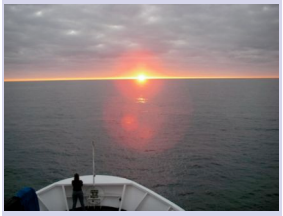
MARY ANNE PELLA-DONNELLY

It has been a remarkable trip, with more of the dynamic nature of scientific research uncovered than I had anticipated. The wealth of knowledge that has been brought together for this project is amazing. The science utilized for the LUTH 2008 survey has enabled me to begin to develop numerous lessons that will be based on this integrated project. As I have learned and interpreted some of the physics and chemistry that must be understood in order to collect the LUTH 2008 oceanographic data, the translation into junior high curriculum began. After each log was reviewed by both Scott Benson and ENS Kyle Byers, (the ship's Field Operations Officer) and sent to the NOAA Teacher-at-Sea website, the lessons became available to my classroom and others. There are two threads that run through my logs. The first is that to be an oceanographer, one must have a broad background in all sciences and the second is that field research is dynamic and requires considerable patience and diligence.

From CTDs to squid beaks, and from acoustic graphs to salps, much of the science has been sorted in my mind and in print, with some still waiting for additional background in order to make sense of it. I conducted interviews with many on the crew, both scientific and ship, and when I have asked what advice they could give to junior high and high school students, the responses have been similar. The overriding theme emphasized was to find what you love to do, pursue that love and gain some unique skills so that you will be the one chosen over your competitors to work in that field. Whenever the opportunity arose, I spoke with the ship's crew, officers and the scientists. Everyone on board has been happy to address the endless questions I have had, and emphasized how they love their professions. The trip has also given me many insights into life on board an ocean-going vessel. For many of the crew, this is their second home; they love and respect it, and consider their fellow crewmembers as extended family. This ship has been cared for with pride, and it shows. The chance to become part of this family for a few weeks has been unforgettable and enriching. Many thanks to everyone who contributed to the LUTH 2008 survey. Many more thanks to all who spend a portion of their lives contributing to the understanding of our biological resources. It is only through this understanding that educated decisions will be made that will allow our children to continue to experience the rich complexity of the ocean.



Ocean sunfish (*Mola mola*)



Sunrise from the *Jordan*

Sample from a bongo tow