Chemical analysis of threatened and endangered species in San Diego Bay:

San Diego Bay Trophic Transfer Project

Progress Report, June 2008

Primary Investigator: Dr. Rebecca Lewison, San Diego State University

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EXECUTIVE SUMMARY

- The focus of this grant is to **use isotope and element analysis to understand the impact of trophic structure and contaminants on threatened and endangered species in San Diego Bay**, specifically focusing on East Pacific green turtle and California Least Terns. The research team currently includes two SDSU faculty (Lai & Lewison), a senior NOAA scientist (Seminoff), two graduate students (Komoroske & Fournier) and 5 project interns who are current students or recent undergraduates from UCSD and SDSU.
- The project has **established collaborative relationships** with **Dr. Dimitri Deheyn from Scripps Institution of Oceanography** and **Dr. Andrew Mason who runs the Molecular Toxicology Laboratory at California State University, Long Beach**. Thanks to these collaborations, we have made **excellent progress designing and initiating key chemical analyses** needed to characterize the trophic linkages and levels and pathways of toxic substances to our two signal species - East Pacific green turtle and California Least Terns.
- Since the project began in January, we have made very good progress. We have **acquired necessary field equipment**, **established our sampling sites**, **initiated sample collection**, and **begun laboratory analyses** (stable isotope and trace metal).
- **The SDBTTP team has been working effectively to meet the objectives of the project. We have held full team meetings every 2 months to ensure we are working efficiently and productively. In the next 6 months, we will be focusing on continued sample collection, ongoing stable isotope and trace metal analyses, and the initiation of organic compound analyses.**

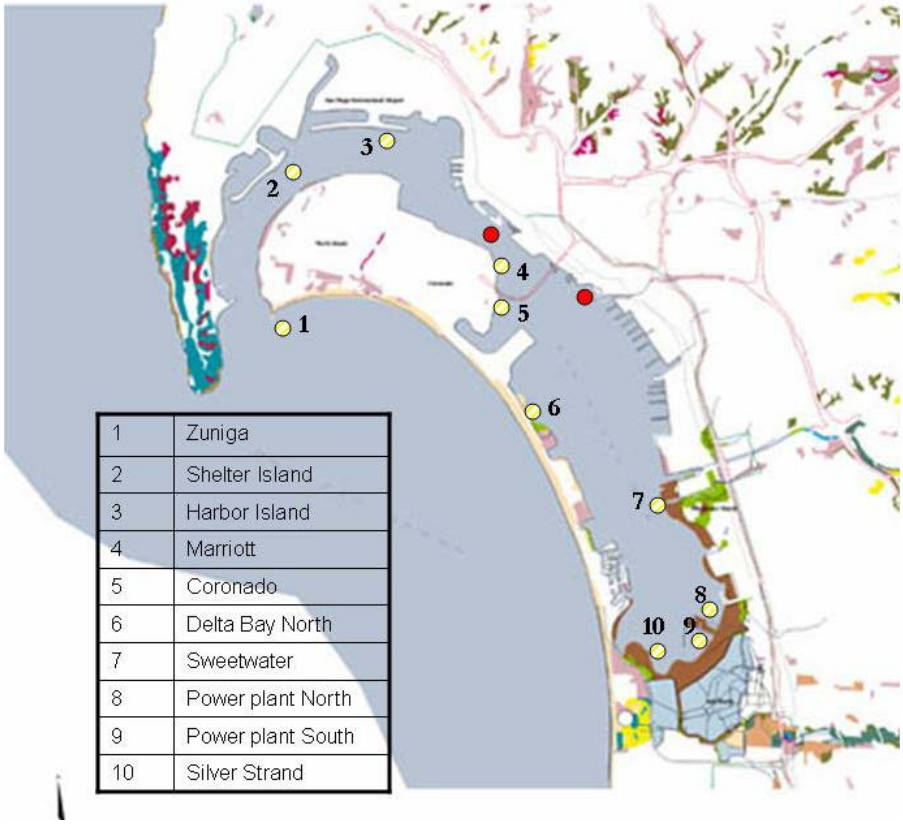
PROGRESS TO DATE

Environmental sampling

Sampling sites

We have identified 10 sites throughout the Bay as permanent sampling locations (**Figure 1**). The two sites denoted by **red** circles are Switzer and Chollas Creek (North to South respectively). We are considering additional surface (plankton, fish, eelgrass) sampling at these sites to complement ongoing monitoring underway by the Levin Lab at Scripps.

As outlined in our proposal, these samples sites reflect the stratified ecoregions from the State of the Bay report (2007) and will adequately represent the environmental heterogeneity of the Bay.



1	Zuniga
2	Shelter Island
3	Harbor Island
4	Marriott
5	Coronado
6	Delta Bay North
7	Sweetwater
8	Power plant North
9	Power plant South
10	Silver Strand

Figure 1. Permanent sampling sites

Sampling equipment

There were two key pieces of sampling equipment that we had custom designed for this project – the purse seine net and the plankton net. Despite some logistical challenges and delivery delays, both have proved to be critical to data collection efforts. The purse seine net is

designed to capture surface feeding fish that serve as the core prey items for California Least Terns and are representative of the mid-level trophic species. The plankton net is designed to target icthyoplankton and other larger planktonic species that will help clarify transfer rates of toxic substances to higher trophic levels

Based on existing characterizations, ongoing data collections and heterogeneity within the Bay, we have established a sample collection regime across the 10 sites (**Table 1**).

Site number/name	Collection regime
1 - Zuniga	Total mercury, Methylmercury, sea grass, algae, water, sediment, fish, plankton
2 – Shelter Island	Total mercury, Methylmercury, sea grass, algae, water, sediment, fish, plankton
3 – Harbor Island	sea grass, algae, water, sediment, fish, plankton
4 - Marriott	sea grass, algae, sediment, fish, plankton
5 - Coronado	Total mercury, sea grass, algae, water sediment,
6 – Delta Bay North	Total mercury, sea grass, algae, water, sediment, fish, plankton
7 - Sweetwater	Total mercury, sea grass, algae, water, sediment, fish, plankton
8 – Power plant North	sea grass, algae, water, sediment,
9 – Power plant South	Total mercury, Methylmercury sea grass, sediment, fish, plankton
10 – Silver strand	sea grass, algae, water, sediment,

Table 1 . Types of samples that are collected at each site each month.

Chemical analyses

Stable isotopes

We have stable isotope analyses underway for the following sample types: eelgrass and sea turtle blood and tissue. Complimentary stable isotope analyses on California Least Tern eggs and their prey are being run by J. Fournier. Analysis of mega-invertebrates will proceed as collections allow - these organisms are sampled opportunistically. Blood collected from live-captured turtles between November 2007 and May 2008 has been centrifuged to separate out the plasma from red blood cells. Only the plasma, a fast turnover tissue, will be analyzed for isotopes.

To ensure analytical quality control, we have initiated a quality control study to compare analysis results from the mass spectrometer at San Diego State University to those from the same equipment at Scripps. This comparison is critical because this study will compare data from 2007 with those from previous research seasons to determine temporal variability in isotopic signatures. Thus, high confidence in the comparability of sample results emerging from these two labs is essential for this project. A total of 5 skin and 5 blood plasma samples were compared. The results, produced in June 2008, suggest that the isotopic analysis of the same tissue at the two labs was comparable, although not identical (**Table 2**). Nevertheless, this comparison supports the use of the SDSU laboratory for analyzing the turtle tissue and habitat samples that have been collected so far.

			$\delta^{13}C$		%C		$\delta^{15}N$		%N	
Capture Date	CCL (cm)	Tissue	SIO	SDSU	SIO	SDSU	SIO	SDSU	SIO	SDSU
3-Apr-03	106.9	SKN	-14.3	-14.7	41.8	42.4	18.5	18.6	13.5	13.8
3-Apr-03	94.5	SKN	-14.6	-15.2	41.1	40.1	17.5	17.2	12.8	12.7
3-Apr-03	85.5	SKN	-11.6	-12.4	38.0	40.1	16.7	16.6	11.7	13.0
4-Dec-03	95.5	SKN	-15.3	-15.5	43.0	42.0	17.7	17.9	13.8	14.0
4-Dec-03	86.1	SKN	-15.1	-15.6	42.3	42.9	17.0	17.1	13.9	14.0
18-Nov-04	63.2	PLA	-17.4	-17.6	44.5	48.3	17.4	16.8	11.1	11.7
8-Apr-04	74.9	PLA	-15.6	-16.0	45.8	42.9	17.2	16.8	11.5	11.0
29-Jan-04	98.3	PLA	-15.4	-16.0	45.9	43.8	17.3	17.0	11.2	10.8
4-Dec-03	95.5	PLA	-16.7	-17.1	47.0	44.4	17.2	17.6	11.0	10.6
29-Jan-04	95.5	PLA	-16.5	-17.0	46.7	44.3	17.8	17.5	11.0	10.5

Table 2. Summary of stable nitrogen ($\delta^{15}N$), stable carbon ($\delta^{13}C$) and elemental composition (%C, %N) results for turtle tissue analyzed at San Diego State University (SDSU) and Scripps Institute of Oceanography (SIO).

Elemental analyses (trace metals)

Trace metal analyses have been initiated at Scripps to identify the level of concentration of metals in prey fish, plankton, California Least Tern eggs and feathers. Complimentary trace metal analyses of turtle blood, scutes, eelgrass and mega-invertebrates are currently being conducted by L. Komoroske. These analyses will establish concentration levels across all the sampled species.

NEXT STEPS

- Sampling will continue at all sites each month
- Stable isotope and trace metal analysis will continue to cover all sampled collections
- As part of a recent collaboration with Dr. Andrew Mason at CSU Long Beach, we are also working to extend our initial analytical plan to explore the mechanisms by which elevated metals may be impacting our species of interest – this analysis is called micro-localization and metal speciation. Samples identified as having particularly elevated concentrations of lead, mercury, cadmium, copper and other toxic metals will be transported to CSULB on dry ice for analysis by directly coupled High Performance Liquid Chromatography- Inductively Coupled Plasma- MS (HPLC-ICP-MS). This analysis will provide a clearer picture of the biochemical association of the metals with blood proteins. Results from this analysis move beyond simple level detection and description and will point to the mechanisms by which negative impacts of these compounds may be mediated.

  This exciting and innovative analysis leverages the Port support for this project. We are currently working to secure funds to cover remaining laboratory expenses that are not in the existing budget.
- Analysis of persistent organic compounds will begin in August following a week long training session for our team members at The National Institute for Standards and Technology (NIST) analytical laboratory. These analyses will identify organic compounds in all collected samples: turtle blood, scutes, California Least Tern eggs and feathers, mega-invertebrates, eel grass, soil and water.