



Biological Oceanography:
Mary Silver Lab Summary of Activities During CIMT Ship Surveys
Submitted By: Mary Silver

Since the late 1990s, the Silver lab has been collecting data on the local abundance of toxic phytoplankton (harmful algal bloom species = HABs), species responsible for various shellfish poisoning syndromes on the US west coast. Her group has been focusing most of their attention on species of the diatom *Pseudo-nitzschia* that produce the neurotoxin domoic acid, responsible for amnesic shellfish poisoning in humans and for marine wildlife kills along the California coast. With the advent of the CIMT program in 2002, there was now an opportunity to determine, for the first time, the broader distribution of the toxin producing species in an oceanographic context, and the extent to which HAB events coincide with the presence of apex predators (marine birds and mammals). Silver's lab had already shown that many of the key vector species (e.g. krill, anchovy and sardines) acquire the HAB toxin when blooms are in the area, but no research group in the world has simultaneously measured the abundance of the toxic HAB species in the water, the oceanographic conditions at the time, the abundance of the known animal vectors of the toxins,



Mary Silver collecting water surface sample on board R/V John Martin. Photo by Rondi Robison November 2004

and the simultaneous abundance of apex predators that consume those vectors. Such a research opportunity is indeed rare, as it requires a coordinated group of experts - from physical oceanographers to chemists (who assay the growth environment that supports the HABs) to plankton biologists to experts on aquatic vertebrates: CIMT offered such a glimpse into this connectivity of environment and marine communities. The Monterey Bay system is ideal for such a study, since it has already experienced substantial avian and pinniped mortalities due to domoic acid produced by local blooms of toxic *Pseudo-nitzschia*.

For the last 5 years, the Silver lab at UCSC has accumulated records at the Santa Cruz wharf and one offshore site (M1) that provide some longer term perspective on abundance patterns of the toxic species of *Pseudo-nitzschia* in the region. The CIMT shipboard collections have presented, for the first time, a much more complete perspective on the offshore distribution of these and other HAB species in the Monterey Bay region. Key to all the studies is the recognition of the toxic species: within the genus *Pseudo-nitzschia*, the toxic species are difficult to distinguish from non-toxic congeners and hence have required identification using molecular probe technology developed for local clones of the 2 toxic species, *P. australis* and *P. multiseriis*, available from Scholin's group at the Monterey Bay Aquarium Research Institute. Overall, the Silver lab is seeking answers to questions about the physical and chemical conditions that promote HABs, including information about the phytoplankton communities in which they occur. Additionally – and key to the toxin

transfer into the food web –her group is anticipating correlations of their data on the spatial and temporal patterns of HAB events with the patterns of marine birds and mammals in the same region. To address the HAB goals, Silver’s group does semi-quantitative microscopic analyses of the entire phytoplankton community, quantitative counts of the toxic species using molecular probes, and measures domoic acid using HPLC in the Institute of Marine Sciences analytical facility at UCSC.



A) Water sampling station on board R/V John Martin; B) Atma Roberts and Itchung Cheung recover Niskin bottles from CTD cast for water samples. Pictures by Itchung Cheung and Rondi Robison 2004

At sea, Silver’s group collects water samples from the CTD hydrocasts for later



quantitative analyses in the lab of HAB cell numbers and DA in the cells. Additionally a

non-quantitative net tow is taken at each station to characterize the phytoplankton community, with subsequent analyses of the major taxa of phytoplankton, including micrographs that provide visual records of the community. (The phytoplankton community composition often tells a good deal about the nutrient status of the water and the oceanographic origin of the water mass in which the cells occur). Like most of the other oceanographic teams involved in the CIMT project, the Silver project mostly collects water samples at sea for analyses that require processing in an analytical or microscope facility onshore. The Silver group, engaged in various aspects of the project, presently includes Dr. Mary Silver, Dr. Sibel Bargu, Susan Coale, and graduate students Roz Antrobus, Veronica Vigilant, Itchung Cheung, with Dr. Peter Miller and Robin Weber being former members of the team (and now engaged in related research), and undergraduates Casey Curtiss, Chris Reeves and Heather Willoughby (the latter two being seagoing assistants on the project). The plankton data obtained during the CIMT project have provided samples and data for projects by students not directly involved in the seagoing operations or initial lab analyses – e.g. graduate student Cristy Sutherland. Because of its unique perspective and data set, the project has leveraged 3 other research awards that build on its results: 1) a joint NOAA-funded venture between the Marine Mammal Rescue Center, a sea lion focused study between Silver and Dr. Frances Gulland, a marine veterinarian, 2) a 3-campus UC study (UCSD, UCSB, UCSC, led by Silver) support by UC’s Office of the President to investigate the statewide presence of the HAB toxins, and 3) a NOAA funded project exploring the use of new HAB toxin measuring devices, led by Dr. Peter Miller (UCSC), with Drs. Silver and Kudela as co-PIs working with the state health department on toxins at key sites along the central California coast.