

NIST Aids NOAA with Bottlenose Dolphin Health Assessments

The National Oceanographic and Atmospheric Administration (NOAA) sought the expertise of NIST to aid them in certain aspects of their management of protected marine mammals. NOAA did so because of NIST's reputation for high-accuracy measurements of environmental contaminants and expertise in the design of tissue sample collection and specimen banking protocols. One element of this partnership is NIST's contribution to NOAA's long-term bottlenose dolphin health assessments.

J.R. Kucklick, S.J. Christopher, P.R. Becker, R.S. Pugh, M. Ellisor, J.M. Keller, C.E. Bryan, J.E. Yordy, M.M. Schantz, G.C. Turk, and S.A. Wise (Div. 839)

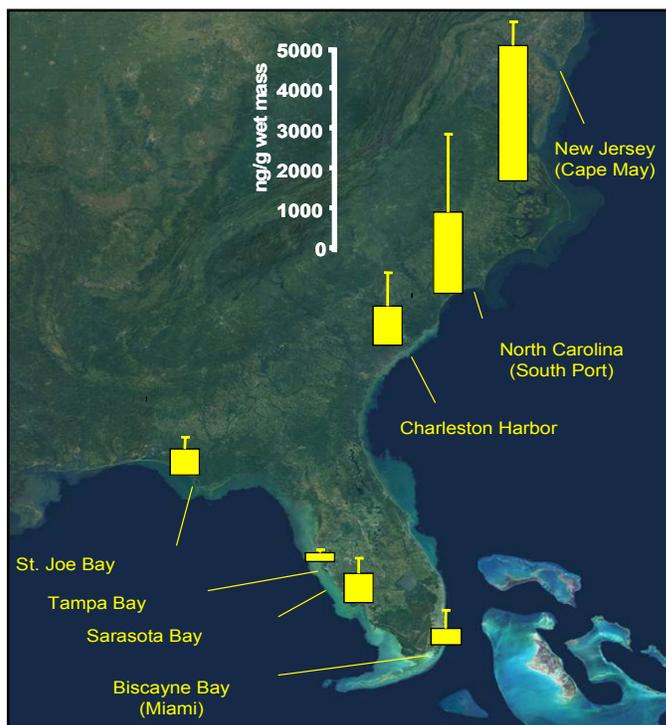
Bottlenose dolphins are considered indicators of environmental condition and were involved in several mass die-offs. Bottlenose dolphins accumulate persistent organic pollutants, such as polychlorinated biphenyls (PCBs), mercury, and brominated flame retardants (see figure) to some of the highest observed levels in wildlife, hence they are at risk from the toxic effects of these compounds. For instance, in Sarasota Bay, there is nearly complete mortality of dolphin calves born to first-time mothers. It is hypothesized that persistent organic pollutants offloaded from the mother via milk play a major role in this reproductive failure.

NIST has assisted in 16 dolphin health assessments and will be involved in 5 planned for fiscal year 2006 and 3 planned for the Mississippi Sound area as a follow-up to Hurricane Katrina. The data and expertise provided by NIST are vital to federal and academic partners who interpret toxicological and health-related information collected on the animals. Since 2000, NOAA has studied the health of bottlenose dolphins by collecting data and samples from animals captured and then released at locations along the US Atlantic and Gulf Coasts. In 2002, NOAA asked NIST to provide technical assistance for the project by (1) designing a protocol for collecting, handling, and storing blood, blubber, and skin to be used for organic contaminant and/or trace element analyses, (2) permanently archiving blood and blubber samples for future study, (3) analyzing persistent organic pollutants and trace elements in samples collected during dolphin health assessments, and (4) providing technical assistance in the field during sample collection.

NIST developed a detailed protocol for collecting samples from bottlenose dolphins during health assessments. The protocol covers the collection of skin, plasma, whole blood, and blubber samples to be analyzed for trace elements (including mercury), persistent organic pollutants,

and perfluorinated compounds such as perfluorooctane sulfonate (PFOS). Since 2002, NIST successfully applied the collection protocol during 16 health assessments from 6 locations resulting in samples from over 200 dolphins. Subsamples of plasma and blubber are being archived in the Marine Environmental Specimen Bank at the Hollings Marine Laboratory, Charleston, SC. Blubber and blood samples are being analyzed for over 100 individual persistent organic pollutants including brominated flame retardants.

NIST provides NOAA with high-accuracy contaminant measurements, the development and application of rigorous sampling protocols, and specimen banking services. Data from recent analyses of blubber samples collected from over 100 female dolphins indicate that the majority of the persistent organic pollutant load is passed to the calf.



Brominated flame retardants (polybrominated diphenyl ethers) found in bottlenose dolphin blubber.

Trace elements, including mercury, were determined in blood samples from dolphins sampled in Sarasota Bay, Florida, and coastal New Jersey. A novel sample preparation method, and a corresponding standard additions calibration scheme, was developed to allow for direct dissolution of blood samples to yield high-throughput, high-accuracy measurements via collision cell inductively coupled plasma technology. A technique is also being developed to measure mercury in skin biopsy samples. This may allow the use of skin collected from remote dart biopsies to be used for the assessment of mercury.

Impact: The services provided by NIST are a vital contribution to NOAA's program for assessing bottlenose dolphin and coastal health. The protocol established by NIST provides for a common procedure for all projects collecting samples for persistent organic pollutant or trace element analysis. Samples collected by NIST for NOAA are archived in the Marine Environmental Specimen Bank, which is a facility constructed specifically for the storage of environmental samples in a controlled, non-contaminating environment.

Analytical work completed for NOAA ties measurements to a national metrology institute with a history of providing high-quality measurement data to NOAA. Since the dolphin health assessments are long-term projects, NIST's involvement will provide continuity in the analytical data generated by the project.

Future Plans: NIST will continue to work with NOAA as they expand their dolphin health assessment project to other areas along the coastal US. Work is underway to make use of high-throughput techniques for the analysis for persistent organic pollutants in blood and blubber. The target list will be expanded to include other types of compounds of emerging concern, such as additional flame retardants and perfluorinated compounds. A control material for dolphin blood will be developed and values assigned to provide a benchmark for blood analyses.