NIST Assists NOAA with Bottlenose Dolphin Health Assessments

NIST continues to provide its expertise to the National Oceanic and Atmospheric Administration (NOAA) in certain aspects of NOAA's management of protected marine mammals. One element of this partnership is NIST's contribution to NOAA's long-term bottlenose dolphin health assessments. NIST has assisted in 20 dolphin health assessments and will be involved in two planned for 2007. The data and expertise provided by NIST are vital to federal and academic partners who interpret toxicological and health-related information collected on these important coastal animals.

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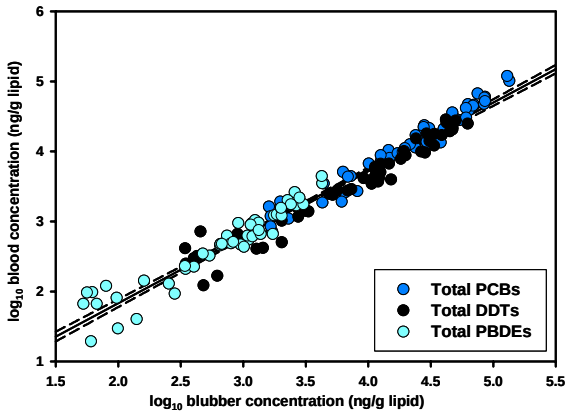
Bottlenose dolphins are considered indicators of environmental condition. They accumulate persistent organic pollutants, such as polychlorinated biphenyls (PCBs), DDTs, and brominated flame retardants, as well as mercury from their local environment to some of the highest levels observed in wildlife. The toxic effects of persistent pollutants have been implicated in very high (> 50%) mortality of dolphin calves born to first-time mothers and the occurrence of dolphin mass mortality events. Since 2000, NOAA has studied the health of bottlenose dolphins by collecting data and samples from animals captured and then released at several locations along the U.S. Atlantic and Gulf Coasts. In 2002, NOAA asked NIST to provide technical assistance for the project by (1) designing a protocol for use at all east coast sampling locations for collecting, handling, and storing blood, blubber, and skin to be used for organic contaminant and/or trace element analyses; (2) permanently banking blood and blubber samples for future studies; (3) analyzing samples collected during dolphin health assessments for persistent organic pollutants and trace elements; and (4) providing technical assistance in the field during sample collection. To date, samples have been collected from over 300 dolphins. Subsamples of plasma and blubber from most of these collections are banked in the NIST Marine Environmental Specimen Bank at the Hollings Marine Laboratory, Charleston, SC. Samples have been analyzed for a suite of legacy pollutants, such as PCBs, mercury and other trace elements, and a number of compounds of emerging interest such as brominated flame retardants. Two studies have been performed by NIST in which means of assessing persistent organic pollutants and trace elements in dolphins using minimally invasive methods were examined. Remote biopsy techniques that do not require capturing the animal, which is stressful to wild dolphins, are available for collection of skin and blubber. To validate the remote biopsy technique for trace elements, paired skin and blood samples were collected from captured dolphins. In addition, a body location study was performed on a deceased dolphin to examine the variability of mercury and trace elements in skin taken from different locations. The data show variation in mercury content in skin on the order of 15%, whereas other elements such as lead and cadmium exhibit greater than 50% variability across an individual animal. Mercury in skin was also highly correlated to blood mercury concentrations in blood. These data imply that skin obtained from a remote dart biopsy may be used to assess mercury contamination in blood.

A similar study was performed using paired blood and blubber samples from captured dolphins. Samples were analyzed for persistent organic pollutants. Data from this study show that concentrations in blubber and blood are highly correlated (see figure). Although dolphins and many other marine mammals carry large burdens in their blubber (nearly 1 g in some animals), the pollutants are not compartmentalized in blubber as previously believed, but are in equilibrium with blood. Thus for mercury and organic contaminants, remote dart biopsies can be used to assess contamination in blood, blood being the main vehicle of organ exposure to these toxicants.



Impact: NOAA has an extensive remote biopsy collection program for many different marine mammal species. Results from NIST's investigations indicate, at least for bottlenose dolphins, that samples collected in this manner can provide useful data on the exposure of dolphins to mercury and persistent organic pollutants such as PCBs, DDTs, and brominated flame retardants.