Sea Grant
Woods Hole
Focal Points
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Endocrine Disruption in Wildlife Populations

Introduction

Alterations in reproduction, reduced immune function, and delayed development have been observed in wildlife populations from both terrestrial and aquatic habitats. These problems have been correlated with exposure to relatively high concentrations of organochlorine pesticides, PCBs, dioxins, and synthetic and plant-derived estrogens. Disruption in endocrine function has been speculated to be the unifying cause of these problems. To examine these phenomena, the Committee on Environment and Natural Resources (CENR) of the National Science and Technology Council (NSTC) is coordinating a multi-agency initiative on endocrine disruption.

This problem is of particular interest in southeastern Massachusetts as a result of PCB contamination from the New Bedford Harbor Superfund site. PCB input to New Bedford Harbor from electronic manufacturing operations in the 1940s to 1970s resulted in extensive sediment contamination and uptake by marine organisms. WHOI Sea Grant supported many of the investigations conducted in the 1980s to characterize the extent of contamination and identify the process controlling the fate, transport, and effects of PCBs in marine ecosystems. Investigations also dealt with identifying the risks to human consumers of New Bedford Harbor's fish and shellfish, especially to members of the Portuguese community that harvest these resources as a subsistence fishery. Current research efforts are directed at understanding the transfer of PCBs and other contaminants in marine food chains and the impacts on birds, fish, and marine mammals.

New Bedford Harbor, declared an EPA Superfund Site in 1982, was the first marine area to receive Superfund Site designation. Photo courtesy of Rinehart Coastal Research Center, WHOI

Sea Grant Research on Endocrine Disruption

Aquatic Birds

Abnormal reproductive development in the endangered Roseate Tern has been correlated with feeding in contaminated areas such as New Bedford Harbor. To examine the relationship between exposure to PCBs

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and other chlorinated compounds and abnormalities in reproductive development, Common Tern embryos from two different sites in Massachusetts are being examined. Using chemical, biochemical, and immunohistochemical methods as well as cell culture bioassays, researchers will measure exposure of the birds to a variety of environmental contaminants and assess the relationship between reproductive abnormalities and specific contaminants that mimic environmental estrogens. To date, samples of Common Tern embryos from the reference site on Cape Cod, Massachusetts, exhibited gonadal abnormalities and levels of contaminants that did not differ dramatically from those sampled at the contaminated site. Sampling from a new reference site (Kouchibougiwac, New Brunswick, Canada) has been initiated, and comparisons with the Massachusetts sites will evaluate the effect of contaminants on gonadal development.

Marine Mammals

Assessing the toxicity of chlorinated hydrocarbons in marine mammals is not an easy task, as federal laws prohibit testing using live animals and samples are difficult to obtain. Chlorinated hydrocarbons accumulate to very high concentrations in the blubber of whales and seals due their position at the top of the food chain. Such compounds have been suggested as contributing to marine mammal mortality and reproductive failure. Through DNA cloning of the aryl hydrocarbon receptor protein and other molecular biological techniques, investigators hope to better understand the sensitivity of beluga and other whales to these contaminants. This state-of-the-art technique, commonly used to study human sensitivity to toxic chemicals, offers new approaches to assessing the relative risks of chemical contaminants on protected species.

Similar approaches to those described above are being used to assess the relative risks of contaminant exposure to other species of marine mammals. Using biopsy samples from free-ranging pilot whales and archived samples from stranded animals, researchers are quantifying the expression of the CYP1A gene, a sensitive biomarker of hydrocarbon exposure and effect. The development of this non-destructive assay will prove to be a useful tool in assessing the sensitivity of protected species to environmental contaminants.

Marine Fish

Investigators are examining the molecular basis for explaining and monitoring the effects of environmental chemicals on endocrine and developmental processes in marine fish. By studying the salt marsh minnow, investigators will clone and sequence genes for cytochrome P450 that may metabolize and activate or inactivate chemical compounds. Though multiple P450 gene families occur in fish, only cytochrome P450 has been studied in any detail. By studying the diversity of other cytochrome P450 genes, researchers hope to learn more about the way fish regulate the metabolism of chemical contaminants.

The above-mentioned studies complement other projects conducted within a multi-institutional initiative on "Chemical/Biological Interactions: Receptor Mediated Effects on Reproduction and Development in Aquatic Species." Researchers from the Woods Hole Oceanographic Institution, University of Wisconsin–Madison, University of Texas, and the Medical College of South Carolina, combined efforts to study the problem of endocrine disruption, which was brought into the mainstream media in 1996 by the book, *Our Stolen Future: Are We Threatening Our Own Fertility, Intelligence, and Survival? a Scientific Detective Story*, by Theo Colborn, John Peterson Myers, and Diane Dumanoski. Sea Grant's investment into this research program was an important first step that allowed investigators to compare the responses of species from marine habitats with those in freshwater habitats such as the Great Lakes.

Future Directions

Research to be conducted during the next two years includes adapting the marine mammal receptor assays to cell culture techniques and using marine mammal cell cultures for the experiments, and the development of an archived marine mammal sample library using samples from strandings and accidental takes of different species.

For more information about the research or outreach projects profiled in *Focal Points*, contact WHOI Sea Grant at the address listed above.