

## Herring Gulls and Caspian Terns: Sentinels of the Great Lakes Ecosystem

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Organochlorine contamination in the Great Lakes post WWII caused severe reproductive impairments in fish-eating bird species. Polychlorinated biphenyls (PCB) used in industrial fluids, dichlorodiphenyltrichloroethane (DDT) used as an insecticide, and dioxins which are byproducts of industrial processes were the major known contributors to reproductive impairment. Reproductive impairment was characterized by growth retardation, emaciation, high levels of embryonic and chick death, edema and deformities such as clubbed feet, crossed bills, and gastroschisis. The ability of these contaminants to persist in the environment and be stored in tissues of animals allows for their accumulation in higher trophic level species (biomagnification). In 1972, the Great Lakes Water Quality Agreement was established between the United States and Canada to assess and restore the Great Lakes. The agreement listed Areas of Concern (AOCs) as regions characterized with severe degradation and(or) high contamination. The Great Lakes Restoration Initiative was recently launched for continued protection of the Great Lakes through research and restoration efforts.

Under the Great Lakes Restoration Initiative, this study comparatively assessed the effects of environmental contaminants in three colonial water birds in the Great Lakes: black crowned night herons, herring gulls and Caspian terns. Low contamination sites in Michigan's Upper Peninsula were used as references and compared to AOCs with high levels of PCBs in Saginaw Bay, western Lake Erie and a site in Grand Traverse Bay with high dioxin contamination. Grand Traverse Bay is not a designated AOC but was added to the study to compare the health effects of dioxin to PCB contamination.

All AOC and Grand Traverse Bay colonies continue to show reproductive and growth impairments that are associated with PCB contamination. Higher rates of embryonic non-viability were found in the AOCs and in Grand Traverse Bay. Embryonic viability was determined and nonviable eggs were opened to assess stage of developmental failure. In some years, chick productivity was substantially lower at AOCs than at the reference colonies. Additionally, birds at both AOCs and Bellow Island often had poor rates of growth between three and four weeks of age. Multiple cross-billed deformities have been found in chicks and embryos at both AOCs throughout the study.

All AOC and Grand Traverse Bay colonies continue to express immune suppression. Three week chicks at contaminated sites displayed significantly less swelling of the wing web twenty-four hours post phytohemagglutinin injection, indicating a smaller movement of inflammatory white blood cells and fluid to the injection site following the signals of T-cells. Suppressed antibody responses to sheep red blood cell injection at the AOCs and Grand Traverse demonstrated another form of immunosuppression.

Chicks at all AOCs and Grand Traverse Bay colonies continue to show reproductive, growth and immunological impairments. Their health indicates the broader health of the ecosystem and the people who also eat fish from the Great Lakes. The inability to delist these Areas of Concern is a problem for more than just the conservation of wildlife.