Colonial Waterbirds as Indicators of Great Lakes Ecosystem Health

Rachel Warners and Sarah Hughes

Despite the size of the Great Lakes ecosystem, its array of species remains highly vulnerable to the effects of pollution. Specifically, species that feed at the top of the ecosystem's food web accumulate high concentrations of certain toxins in their bodies from eating smaller organisms exposed to the toxin. Examples of these chemicals include DDT (dichlorodiphenyltrichloroethane), a pesticide, and PCBs (Polychlorinated biphenyls) a class of chemical used in plastics and flame retardants, were disposed of in great magnitude into the Great Lakes. Two species of birds that are affected by these chemicals are herring gulls and Caspian terns which feed at the top of the food-chain. Within this population of colonial waterbirds, the chemicals cause eggshell thinning, deformities such as crossed bills and edemas, and suppressed immune systems resulting in diminished populations. Although these chemicals are now restricted, significant concentrations remain in the environment. In order to analyze and monitor the health of aquatic ecosystems around Michigan and Southern Canada these waterfowl are studied to quantify the effects of these toxic chemicals.

Field work is multifaceted and takes place over several weeks beginning in April. Sites visited include Little Charity Island, Saginaw Bay Confined Disposal Facility, Detroit Edison Monroe Power Plant, Bellow Island, and the Pipe Island Twins. In order to work with the Herring Gull and Caspian Tern chicks, several enclosures are placed around nests. Under natural conditions, a nest is successful if one chick survives till fledging. Thus, the enclosures increase survivorship as they prevent predation, contain the chicks, and keep them close to their protective parents.

The first stage of field work is EVD, which examines individual eggs before hatching. Nests observed with similar stages of development will be marked with either stakes or spray paint. A team then returns and finds the marked nests that have three eggs in order to take measurements. The measurements include the mass, length, and width. An additional test determines whether the eggs are developing. If there is no development, the egg is opened to see if the embryo is infertile or dead as well as scanned for deformities.

When the chicks reach three weeks of age, the crew returns to the islands, captures them from the enclosures, and bands one of their legs. On the first day of the third week, body measurements are taken, and the birds are then injected in one wing with PHA (phytohemagglutinin), which triggers a response from the t-cells of the immune system. The other wing is injected with PBS, (phosphate buffer saline) which serves as the control and sheep red blood cells which causes an antibody response. The second day, the wing web thickness is recorded to observe the response of the immune system to the injections. A large positive difference in the thickness corresponds to a stronger immune system than a smaller difference in thickness. A blood sample, the volume dependent on the weight of the bird, is also taken on this day. We observed the sites with known high exposure to PCBs and DDT contained birds with lower immune responses; moreover, a few crossbills were also seen at these sites. As expected, the reference site had birds with a higher immune response.

When the chicks reach four weeks of age, we recapture the banded birds and record the same body measurements from the three-week work, disregarding the wing web thickness. Another blood sample is taken from the chick in order to observe the antibody response caused by the sheep red blood cells. White blood cells are isolated from each blood sample in order to examine the immune systems of the birds. Further processing is performed on the white blood cells in the lab.

In the lab, we perform a number of tasks including packing for trips, documenting data, cleaning equipment, and analyzing eggs collected in the field. Additionally, analysis of the blood samples through a series of immune function tests takes place. This opportunity has allowed us to acquire knowledge in a hands-on manner about the effects of pollutants on Herring Gulls and Caspian Terns.