


**Table 2: Summary of some contaminant-related effects observed in Herring Gulls and other fish-eating waterbirds inhabiting the Great Lakes.**

Contaminant Effect	Evidence in the Great Lakes	Current Status
<p><b>Eggshell Thinning</b> -caused by high DDE levels in the 1950s, 1960s and 1970s.</p>  <p>Thinshelled Herring Gull egg</p>	<p>-first confirmed reproductive problem related to contaminants found in birds on the Great Lakes. -resulted in widespread eggshell breakage, causing population declines of fish-eating waterbird species including Double-crested Cormorants, Ospreys, Bald Eagles, Black-crowned Night-Herons and Herring Gulls.</p>	<p>-due to regulatory controls and ban of DDT, eggshell thinning is no longer a problem resulting in improved reproductive success of affected species.</p>
<p><b>Reproductive Failure</b> -causes include early embryonic death, embryo toxicity and abnormal parental behaviour during incubation.</p>	<p>Herring Gulls, Double-crested Cormorants and Bald Eagles were not reproducing during the late 1960s and 1970s when highest levels of organochlorines were present.</p>	<p>-due to significant declines in organochlorine levels, reproductive success has improved in most fish-eating waterbird species. -Bald Eagles have returned to nest in many areas of the Great Lakes, except for the shorelines of Lake Ontario. -the reproductive success of Bald Eagles is improving, but is not sufficient to maintain a stable population.</p>
<p><b>Congenital Deformities</b></p>  <p>Double Crested Cormorant with deformity</p>	<p>-most deformities reported in the early to mid-1970s from contaminated sites on Lake Ontario and in the 1980s on Lake Michigan. -crossed bills, jaw defects, extra limbs, and malformed feet, joints and eyes were found in Herring Gulls and at least eight other species of fish-eating waterbirds.</p>	<p>-waterbirds continue to display higher rates of deformities (e.g. bill defects in Bald Eagles) compared to clean sites outside of the Basin. -greatest incidence in areas of high contamination such as Green Bay (Lake Michigan) and Saginaw Bay ( Lake Huron). -studies continue on the links between contaminants and developmental problems in certain waterbird species.</p>
<p><b>Biochemical Changes</b></p>	<p>-abnormal liver function in Herring Gulls including: increased activity of enzymes that attack toxic chemicals entering the body; elevated levels of porphyrins; and, unusually low levels of vitamin A. -low levels of Vitamin A may increase susceptibility to infectious diseases, possibly affecting the survival and development of young chicks.</p>	<p>-biochemical measures indicate that Herring Gulls are still chemically stressed. -full effect of biochemical changes on the reproduction or life span of waterbirds is not known at this time.</p>
<p><b>Enlarged Thyroid</b> -linked to exposure to certain contaminants (e.g. PCBs, DDE, dieldrin).</p>	<p>-most prevalent in Herring Gulls from contaminated sites including Saginaw Bay (Lake Huron), Green Bay (Lake Michigan), western Lake Erie and Lake Ontario.</p>	<p>-in response to decreased contaminant levels in the Great Lakes aquatic food chain, the severity of enlarged thyroid has decreased in Herring Gull populations.</p>

Table 2 continued

Contaminant Effect	Evidence in the Great Lakes	Current Status	
<p><b>Endocrine Disruption (feminization)</b>                      -DDE is the most potent, abundant, persistent and bioaccumulative chemical that disrupts sex hormone function. - sufficient exposure during early embryonic stages can result in abnormal development of male reproductive tissues and could reduce the number of normal males that return to the breeding colony. -can result in supernormal clutches (nest with five or more eggs) as a result of two or more females occupying the same nest.</p>	<p>-this effect was observed as early as the 1970s in Lake Ontario Herring Gulls when concentrations of DDE were high.</p>	<p>-the incidence and extent of endocrine disruption in Great Lakes Herring Gulls is currently unknown. -research is underway to examine the relationship between chemicals that mimic hormones and effects observed in several waterbird species in the Great Lakes basin. -a skewed sex ratio and supernormal clutches could also result from increased mortality of males. -supernormal clutches are still being found on some Great Lakes Herring Gull colonies. -very few of the eggs in a supernormal clutch are fertile and hatch.</p>	
<p><b>Suppressed Immune Function</b>                      -several contaminants (e.g. PCBs and TCDDs) suppress important immune functions and can increase susceptibility to infectious diseases.</p>	<p>-at highly contaminated sites Herring Gulls and Caspian Terns have suppressed T-lymphocyte function, atrophy of the thymus gland, and altered white blood cell counts.</p>	<p>-recent studies indicate T-cell-mediated immunity in Herring Gull chicks suppressed by 35-45% in highly contaminated colonies in Hamilton Harbour (Lake Ontario), Saginaw Bay (Lake Huron) and western Lake Erie. - research is underway to determine the extent and significance of this suppressed immune function in fish-eating waterbirds, as well as examine the relationships between immunological and other physiological effects.</p>	
 <p>Super normal clutch size</p>	<p><b>Genotoxicity</b>                      -polycyclic aromatic hydrocarbons (PAHs) and some metals are capable of inducing genetic mutations.</p>	<p>-DNA fingerprinting revealed higher mutation frequencies in young Herring Gulls inhabiting Hamilton Harbour compared to three rural sites (Kent Island in the Bay of Fundy, Chantry Island in Lake Huron and Presqu'ile Provincial Park in Lake Ontario).</p>	<p>-these mutations in DNA are thought to occur very early in development. -such mutations may result in increased genetic disease or altered gene function leading to unfavourable changes in the gene pool.</p>