Great Blue Heron

A Sentinel Species for the River

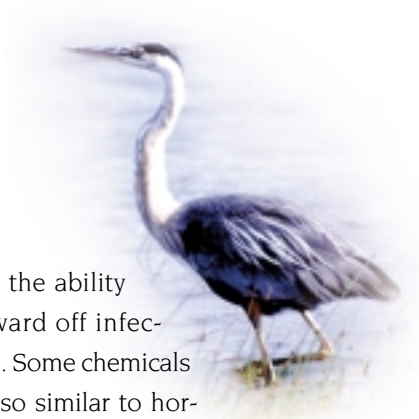


Photo: Canadian Wildlife Service

Background

A number of different factors can disturb bird populations. Despite conservation and protection efforts, toxic substances transported in our water and air can accumulate in ecosystems, with repercussions for wildlife. Many chemicals, including organochlorine pesticides like DDT and polychlorinated biphenyls (PCBs), break down very slowly, tending to build up at increasingly elevated concentrations in the food chain. For this reason, fish-eating birds are often selected as bioindicators of environmental contamination.

The Great Blue Heron was selected as a sentinel species, or bioindicator, of the state of the St. Lawrence River because of its distribution in both freshwater and saltwater environments, its position at the top of the food chain, and its relatively limited feeding grounds. Concentrations of contaminants in the tissue of herons, in other words, reflect local contamination of an ecosystem. At high concentrations, many contaminants are very toxic and can lead to animal mortality. At the low concentrations observed in the environment, these contaminants are less toxic but may still have negative effects on essential biological functions like reproduction, growth and the ability to ward off infection. Some chemicals are so similar to hormones, they can interfere with the transmission of chemical signals responsible for the sound functioning of an organism.

Photo: Patrick Labonté, Canadian Wildlife Service

A Great Blue Heron stays close to its nest

Overview of the Situation

This migratory bird is sensitive to disturbance, generally nesting on islands that are not easily accessed by humans or land predators. Some 160 active colonies (or "heronries") have been counted in Quebec, including about 30 along the St. Lawrence River, from Lake Saint-François, upstream, down to Sept-Îles and the Magdalen Islands in the gulf (Figure 1). They vary in size from year to year, but are usually comprised of several dozen pairs. The largest colony in Quebec, and probably the entire world, is found on Lake Saint-Pierre, with more than 1000 nests. After a period of seven years to several decades, depending on the size of the colony, heronries deteriorate and are abandoned in favour of new sites nearby. Disturbance by humans and predation can also hinder reproductive success and cause herons to leave a colony. All these factors make it difficult to estimate heron population trends. At present, the total population of Great Blue Herons in Quebec has reached roughly 25 000 birds, one-third of which nest along the St. Lawrence. The population appears to have stabilized after experiencing an increase from the mid-1960s to the early 1980s.

Figure 1. Location of Great Blue Heron colonies

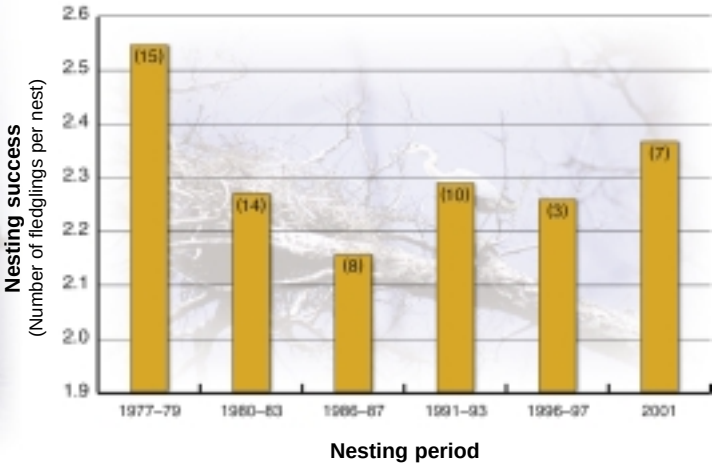
In a 2001 survey of St. Lawrence heronries, there were an average 2.4 young birds per clutch, with an average reproductive success (percentage of fledglings relative to number of eggs laid) of 58%. Some colonies seem to grow while others shrink, but, overall, the heron population is being maintained, since this species generally lays five eggs and sees an average of 2.5 young to the fledgling stage. Figure 2 shows the consistency of nesting success over time in the colonies studied.

The Great Blue Heron does not therefore appear to have been overly affected by organochlorine substances like DDT, which was found at high concentrations

Photo: Patrick Labonté, Canadian Wildlife Service

The heronry on Dickerson Island

Figure 2. Nesting success of Great Blue Heron (number of young per clutch) in St. Lawrence colonies between 1977 and 2001



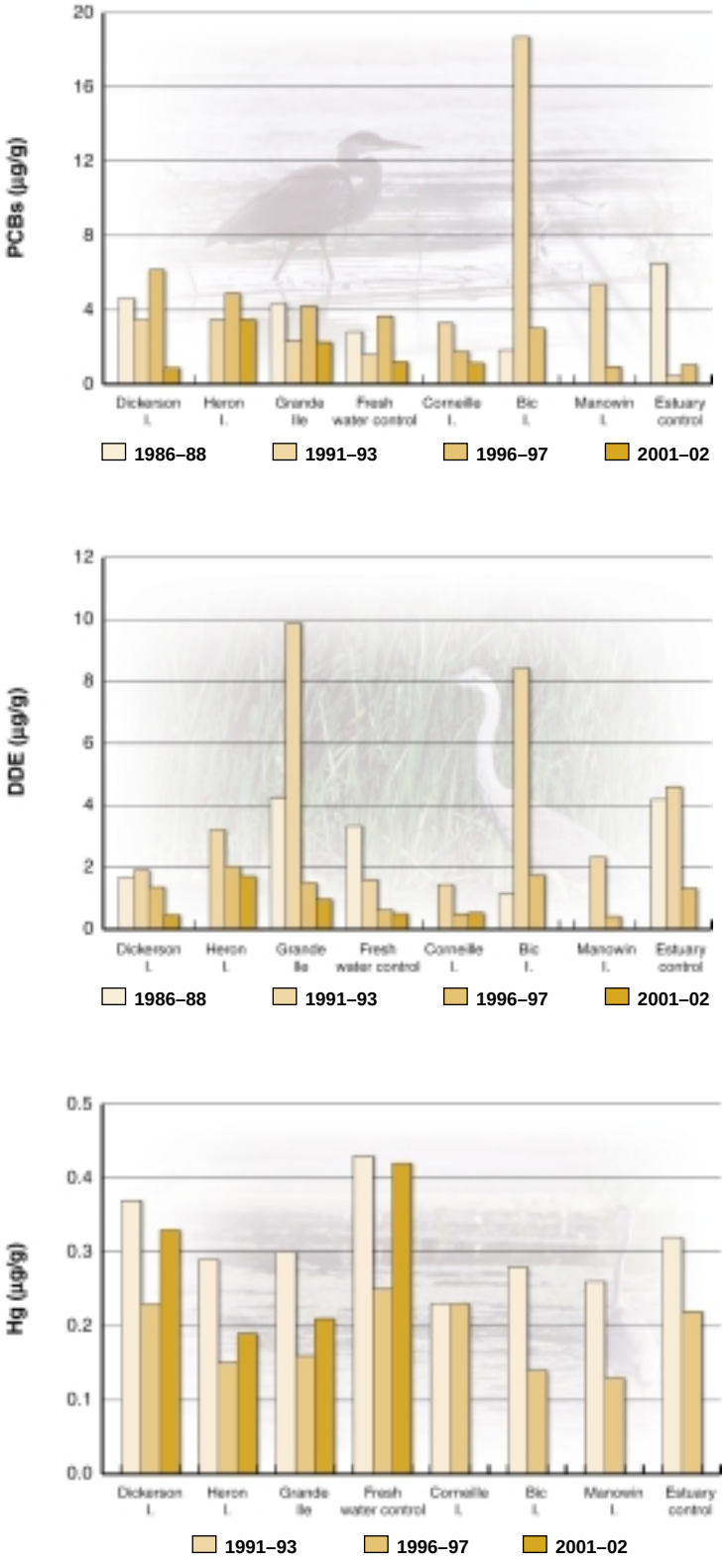
Note: Figures in parentheses indicate the number of colonies used in the calculations.

in the environment during the period 1960–1980. Yet, analyses performed since the late 1970s indicate that, among piscivorous (fish-eating) birds, the Great Blue Heron is one of the most highly contaminated with DDT and PCBs. The monitoring of contaminants in this species has been refined since the 1970s and 1980s, when only eggs were analysed. Today, scientists analyse the blood and feathers of young-of-the-year, young birds being more representative of local pollution than adults, who spend their winters down south.

Few differences were found between the colonies of the St. Lawrence and reference colonies located further inland with respect to contaminants in heron eggs (Figure 3). PCBs, DDE (the main breakdown product of DDT) and mercury levels are below the levels at which reproduction or survival are affected. A slight reduction in contaminant levels over time has been observed, although additional data is necessary to confirm this trend. Concentrations of dioxins and furans, two groups of particularly toxic substances, do not appear to present a risk. Eggs better reflect the accumulated contamination in females at wintering grounds than local contamination.

The substances detected in the blood of young herons differ among colonies, with those located in fresh water generally having higher levels of PCBs and DDE (Figure 4). Mercury concentrations are similar among all the St. Lawrence colonies, but concentrations are higher inland. Mercury levels in the blood of young St. Lawrence herons nonetheless appear high compared to levels reported in studies done elsewhere in North

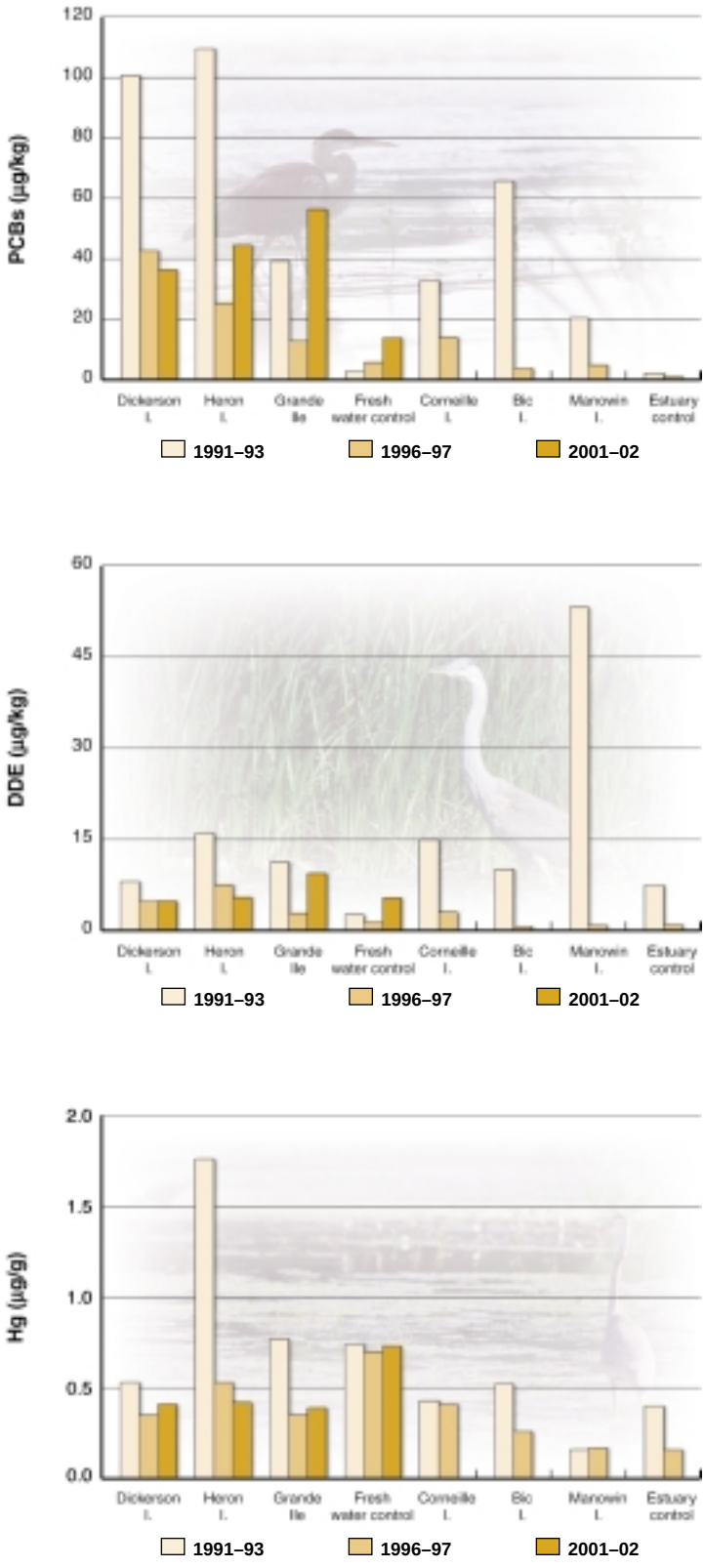
Figure 3. Changing concentrations of total PCB, DDE and mercury (Hg) in heron eggs



America, being close to the concentrations at which survival is affected in other species. There was no difference in concentrations of PCBs and mercury over time; DDE concentrations, however, appear to have dropped slightly. Again, additional data will be required to confirm this trend.

In addition to analysing for contaminants, heron eggs and blood are also examined biochemically. The biochemical substances (or biomarkers) measured constitute the reponse of an organism to toxic substances and reflect the extent of exposure to and impact of these substances. These analyses also help us to determine the more subtle effects of contaminants on the health of birds and may lead to a better understanding of trends observed in populations. The results of the biomarker analyses are quite interesting. Differences in levels of vitamin A in eggs and in blood of young herons were observed among colonies. These disparities are related to contaminant concentrations: the level of vitamin A in plasma drops as PCB concentrations rise (Figure 5). Vitamin A is essential to development and growth, and a deficiency may disrupt endocrine system function and affect certain essential biological functions. While we do not yet have adequate information to determine the impact of such a deficiency on the survival of young herons, it is probable that it impairs development and interferes with the capacity for survival.

Figure 4. Changing concentrations of total PCB, DDE and mercury (Hg) in heron blood



Outlook

Young herons living in colonies located in fresh water and brackish water are more contaminated than those in the estuary and gulf. Generally speaking, contamination in the St. Lawrence River is lower than the toxic effects level for Great Blue Heron. Despite this, our results reveal differences among colonies and among river sections, reflecting local and regional variations in contamination. Combined with the stress associated with food availability,

Figure 5. Relationship between concentrations of total PCBs and retinol in heron plasma

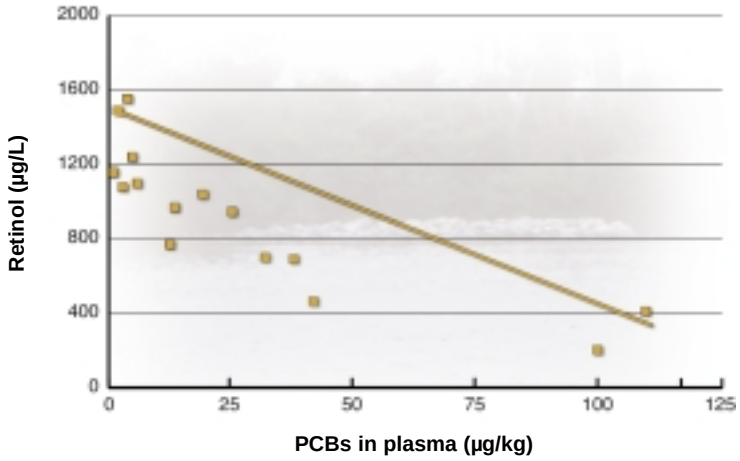


Photo: Michel Leblond, © Le Québec en images, CCDMD

Photo: Michel Leblond, © Le Québec en images, CCDMD

KEY VARIABLES

By analysing the main contaminants in the blood of young herons, scientists can better understand their actual exposure to bioaccumulable toxic substances, while obtaining some indication of the potential effects of these substances. Information on the average number of young per clutch and average reproductive success (percentage of fledglings relative to number of eggs laid) is vital to assessing whether or not the Great Blue Heron population is thriving.

human disturbance and loss of habitat, low concentrations of contaminants acting on sites responsible for organism function may constitute a risk to wildlife. Long-term monitoring of contaminants, biomarkers and reproductive success is essential to assessing the state of health of young herons and the condition of the entire population of Great Blue Herons.

Photo: Michel Leblond, © Le Québec en images, CCDMD

To Know More

CHAMPOUX, L., J. RODRIGUE, J.-L. DESGRANGES, S. TRUDEAU, A. HONTELA, M. BOILY, and P. A. SPEAR. 2002. Assessment of contamination and biomarker responses in two species of herons on the St. Lawrence River. *Environmental Monitoring and Assessment* 79(2): 193–215.

CHAMPOUX, L., J.-L. DESGRANGES, J. RODRIGUE, A. HONTELA, S. TRUDEAU, and P. A. SPEAR. 2000. *Évaluation d'indicateurs biochimiques chez le* Grand Héron, Ardea herodias, *et le* Bihoreau gris, Nycticorax nycticorax, *en relation avec la contamination du Saint-Laurent*. Série de rapports techniques n° 354. Environment Canada – Quebec Region, Canadian Wildlife Service.

DESGRANGES, J.-L. 1995. "The Great Blue Heron", pp. 242–245, in J. Gauthier and Y. Aubry (eds.), *The Breeding Birds of Québec: Atlas of the Breeding Birds of Southern Québec*. Association québécoise des groupes d'ornithologues, Quebec Society for the Protection of Birds and Canadian Wildlife Service, Environment Canada – Quebec Region. Montreal.

Prepared by: Louise Champoux
Environmental Conservation Branch
Environment Canada

State of the St. Lawrence Monitoring Program

Four government partners — Environment Canada, the ministère de l'Environnement du Québec, the Société de la faune et des parcs du Québec, and Fisheries and Oceans Canada — are pooling their expertise and efforts to provide Canadians with information on the state of the St. Lawrence and long-term trends affecting it. To this end, environmental indicators have been developed on the basis of data collected as part of each organization's ongoing environmental monitoring activities. These activities cover the main components of the environment, namely water (quality and quantity), sediments, biological resources (species diversity and condition), uses and, eventually, shorelines.

For additional copies or the complete collection of fact sheets, contact the St. Lawrence Vision 2000 Coordination Office:

1141 Route de l'Église
P.O. Box 10 100
Sainte-Foy, Quebec G1V 4H5
Tel.: (418) 648-3444

The fact sheets and additional information about the program are also available on the Web site: **www.slv2000.qc.ca** .

Published by Authority of the Minister of the Environment

Published by Authority of the Ministre d'État aux Affaires municipales et à la Métropole, à l'Environnement et à l'Eau du Québec

Catalogue No. En4-11/2002E
ISBN 0-662-33222-9
Envirodoq: ENV/2002/0350A
Legal deposit – National Library of Canada, 2002
Aussi disponible en français sous le titre: *Le grand héron – Une espèce sentinelle du fleuve*