

RECOVERY

An Endangered Species Newsletter

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North America's best kept secret: Conserving Newfoundland's rare Limestone Barrens flora

BY LUISE HERMANUTZ

For those interested in rare and unusual plants, the island of Newfoundland has been called "the best kept secret in North America." Geographic location, climate and geology support a vast array of vascular plants from northern arctic/alpine plants to more southerly Appalachian species.

The island's west coast is especially diverse, with more than 200 plant species assigned as provincially rare (S1 and S2). These include Long's braya (*Braya longii*) and Fernald's braya (*B. fernaldii*), which the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designated endangered and threatened respectively in 1997. Both plants are endemic to Newfoundland, occurring only on a narrow strip of land extending approximately 150 km on the extreme western portion of the Great Northern Peninsula. They share a common limestone barrens habitat, which is



PHOTO: JOE BRAZIL

The endangered Long's braya occurs in Newfoundland — known as the "best kept secret in North America."

very tundra-like with extreme exposure to the Strait of Belle Isle and shallow, disturbed soils rich in calcium.

Habitat loss is the most immediate cause of low braya population numbers. Historically, the majority of the fishing settlements occur along this narrow strip, and development and roads have heavily impacted the limestone habitat. In addition, gravel quarrying has destroyed much of the barrens habitat.

At present, researchers know of only three populations of Long's braya, the largest of which is growing on private land. Thanks to additional populations discovered in a 1999 field survey, scientists now know of 11 populations of Fernald's braya.

The two braya species are closely

related to one another. With the exception of a few key characteristics, they look very similar. Both are arctic/alpine rosettes with a flowering stem of white flowers growing to about 1-10 cm tall. Both species have long, slender leaves flared like a spoon at the tip. The most obvious differences between the species are that Long's braya has smoother seed capsules, larger flowers (4-5 mm vs 2 mm petal length) and more greenish coloured, deciduous sepals.

The provincial government appointed a braya recovery team in 1997, with representatives from several provincial departments, Memorial University, private environmental consultants and the community. The recovery team has had two

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A challenge for Canadians

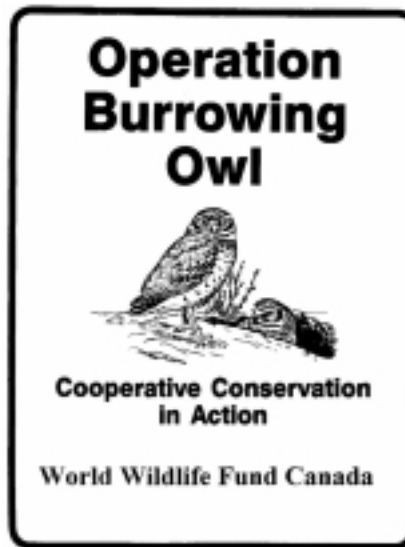
BY ELIZABETH MAY

The plight of Canada's endangered species occupies an increasing amount of space in our daily papers. With over 300 species listed by the Committee on the Status of Endangered Wildlife in Canada, and many, many more probably at risk without benefit of attention or study, the need for a legislative framework to protect and recover those species has become a high priority. Encouraging words from new Environment Minister David Anderson establish his clear understanding of the requirement that habitat be protected in order to protect species. The goalposts appear to be shifting, and greater progress in the recovery of species at risk, a forlorn hope just two years ago, now appears within our grasp.

Positive actions

But a good strong law will not be enough. Any law is only as good as its enforcement, and unlike many laws, an act to protect endangered species must encourage positive actions, more than merely constrain illegal ones. This has been the conclusion of the Sierra Club of Canada (SCC) through the last several years of meeting with and work-

ing with representatives from resource-based sectors and communities. Species at risk will need the help and sup-



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port of creative and willing participants in their recovery. Just as morality cannot be legislated, neither can volunteer effort to protect our planet's wild things.

For almost two years now, SCC has

been working with the Species at Risk Working Group, which includes the Canadian Pulp and Paper Association, the Mining Association of Canada, the National Agriculture Environment Committee, the Canadian Nature Federation and the Canadian Wildlife Federation. We have developed a shared vision for a cooperative, "made-in-Canada" approach to protecting species at risk. The key to success will be fostering a climate of cooperation, not coercion. We are advocating early engagement of all those affected, including local farmers, First Nations, residents, environmentalists, and everyone with an interest in recovery. From the start of the process, the whole panoply of interests should discard organizational hats at the door and start thinking creatively about what will work for species and the communities affected.

I am convinced that the vast majority of Canadians would be proud to participate in the recovery of a species at risk. But this participation depends on the proper cooperative approach and meaningful involvement in the recovery process. Front line efforts must focus on educating the public about species at risk, where they are found (reassuring many in resource communities that they are, almost by definition, rare!) and what must be done to bring them back from the brink of extinction. I have heard repeatedly from people on the land that an "incentive" need not be money. It could be a sign on the farm fence identifying the owner as a partner in the effort.


No one had to pay Noah to save species, although his instructions did come from the highest authority! As Minister Anderson noted in a recent speech, protecting species at risk is not "rocket science." It is a challenge we should take up as an urgent task, one in which everyone will want to play a role.

Elizabeth May is the executive director of the Sierra Club of Canada.

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The newsletter is also accessible at:
www.cws-scf.ec.gc.ca/es/recovery/archive.html


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New findings in turtle recovery

BY TOM HERMAN

During the 1999 field season, scientists and volunteers made significant progress in implementing the recovery plan for the Nova Scotia population of the Blanding's turtle (*Emydoidea blandingi*), designated as threatened in 1993 by the Committee on the Status of Endangered Wildlife in Canada.

As in previous years, participants carefully monitored turtle nesting activity in Kejimikujik National Park. In May, uncharacteristically warm weather accelerated nesting activities, yielding both the earliest nest attempt and earliest successful nesting occurrence on record for this population.

In all, participants successfully protected 18 nests with wire screens. High temperatures and low precipitation continued throughout most of the summer. As a result, hatchlings emerged early, and nesting success was relatively high. The hatchlings displayed low incidences of deformities and unusually healthy weights.

Areas beyond Kejimikujik National Park yielded some of the most exciting data. At the McGowan site, where in 1996 the largest concentration of Blanding's turtles ever identified outside the park was discovered, participants continued the search for new individuals. For the first time, several juveniles were captured at the site, bringing the total number marked in this population to 51 (41 adults, 10 juveniles). Severe drought appeared to concentrate turtles at this site. The drought provided a keen reminder of the precarious nature of available habitat, when 11 adults were confined to an isolated pothole less than 250 m².

A second discrete population outside the park was also confirmed; this population shows promise since seven of the 10 turtles that were individually marked are juveniles.

Understanding the relationship between these three populations is important to implementing a conservation strategy. Despite substantial efforts to mark individual turtles (extending back to 1969 in the park), no individual origi-

nally marked at one of these sites has been captured at either of the other two. In other words, no evidence exists of current movement between these groups.

It remains unclear whether this isolation is a result of recent human-induced landscape change or has a historical basis. Researchers are exploring this question by assessing the genetic differentiation among groups. Given the long lifespan of Blanding's turtles, and the degree of isolation required for populations to become genetically distinct, any detectable genetic structure among these populations should have arisen before European colonization. Through the use of DNA analysis, scientists have initiated a project to determine whether the populations are genetically distinct, and to conduct a larger scale examination of genetic structure in the Blanding's turtle across its range, which includes Ontario, Quebec, and several states in the Great Lakes area.



PHOTO: TOM HERMAN

Much recovery work is underway for Blanding's turtle in Nova Scotia.

Researchers are continuing to measure movements and spatial dynamics of the turtles outside Kejimikujik National Park, and to refine a predictive habitat model to locate any additional populations. Monitoring and protective screening of nests to deter predation of eggs and hatchlings will also continue within Kejimikujik National Park.

Professor Tom Herman is head of the Biology Department at Acadia University and chair of the Blanding's Turtle Recovery Team.

COSEWIC Update

Emergency listing of rare B.C. frog

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC), has designated the Oregon spotted frog (*Rana pretiosa*) an endangered species. This is the first time that COSEWIC has made an emergency designation. COSEWIC normally meets annually in late spring to consider the status of endangered wildlife. "Declaring this frog endangered now will give recovery plans a valuable head start", said Dr. David Green, a professor at McGill University and the Chair of COSEWIC.

The request for the emergency designation came from Doug Dryden, British Columbia's Director of Wildlife. "The combination of rapid decline, fragmented Canadian range, very small number of breeding adults and collapse of the species throughout its North American range puts this species at grave risk, and justifies consideration as an 'emergency listing'", said Dryden. David Fraser, endangered species specialist with British Columbia's Wildlife Branch and British Columbia's COSEWIC representative, added that the species should be considered "endangered" in an emergency designation so that "attention could be drawn to the species and recovery efforts could begin before February 2000, at the beginning of the frog's breeding season."

The evidence for declaring the Oregon spotted frog an endangered species is contained in a detailed report prepared for COSEWIC by Russell Haycock of Vancouver. The endangered status of the species will be reviewed by COSEWIC at its next regular meeting.

Best kept secret

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very successful summer field sessions, where all members participated in surveys and research on the braya species and developed stewardship initiatives with communities near the "at risk" habitats. These projects were made possible by funding from the Endangered Species Recovery Fund, administered by Environment Canada and the World Wildlife Fund (Canada).

This funding also allowed the team to involve Memorial University students in these recovery efforts. To date, one graduate and three undergraduate students have undertaken research on various aspects of braya biology. In particular, their research focuses on how various types of disturbances affect the long-term viability of the existing populations. For example, the students are studying how natural disturbances such as frost boils compare with human caused disturbances in influencing the survival and persistence of both species.

Given the limited number of sites, and the likelihood that wild braya sites will undergo future disturbance, the Memorial University Botanical Garden established *ex situ* populations of both species in 1999. These populations will provide valuable knowledge on the reproduction and growth of both species, information that will enable the recovery team to

RENEW Update

Recently released by the federal Minister of the Environment, David Anderson (see story below), Canada's plan for protecting species at risk describes recovery planning as a dynamic, two-part process. The first part, entailing the development of a Recovery Strategy for endangered or threatened species, would be led by the recovery team. In this process, experts would analyze baseline information and define the long-term goal and short-term objectives for recovering the species.

The second part of the process, the development of Action Plans by recovery action groups created by the recovery team, would describe specific measures needed to recover the species, and associated timelines. Stakeholders from the resource sector, environmental organizations, Aboriginal people, local communities, and others would be actively involved in developing and implementing the Action Plans.

As the REcovery of Nationally Endangered Wildlife (RENEW) program evolves to meet this new vision, a transition period is underway during which plans using either the traditional format or the new Recovery Strategy Action Plan format will be accepted and implemented. The first Recovery Strategy to be developed for the Peary Caribou (*Rangifer tarandus pearyi*) is currently being peer reviewed under RENEW.

establish a new population of Long's braya on protected land.

In 1999, the recovery team received funding to produce a Braya Recovery Plan. The information gained by the recovery team and students will ensure the long-term conservation of both braya species, as well as the other arctic/alpine species found on the Limestone Barrens of the province's Great Northern Peninsula. Currently the province of Newfoundland, with numerous partners, is investigating the rare plant flora of the island of Newfoundland. The first summer of fieldwork (1999) was dedicated to rare flora of the limestone barrens.

In addition to the braya species, Fernald's milk-vetch (*Astragalus robbinsii* var. *fernaldii*) has been recently designated as vulnerable and an additional nine plants are current "candidates" for COSEWIC listing. Therefore, the recovery team for Long's and Fernald's brayas views recovery work on these two plants as a test for the long-term persistence of the entire limestone barrens plant community.

Luise Hermanutz is a professor of biology at Memorial University of Newfoundland and chair of the Long's braya/Fernald's braya Recovery Team.

Environment Minister unveils plan for protecting species at risk

The Honourable David Anderson, Minister of the Environment, released *Canada's Plan for Protecting Species at Risk: An Update* on December 17 1999. This report provides Canadians with an update on the Government of Canada's strategy for protecting Canada's species at risk.

"Canadians tell us that they expect their governments to protect species and their habitats," said Minister Anderson. "Our approach balances the rights of individual landowners and

land users and the roles of other jurisdictions, with the need to ensure that species are protected, no matter where they live in Canada."

Canada's Plan for Protecting Species at Risk: An Update outlines the government's three-part strategy to protect species and habitats by:

- building on partnerships with provinces and territories through the Accord for the Protection of Species at Risk;
- promoting stewardship and incentive

programs to assist private landowners, citizens, Aboriginal peoples and organizations that are helping to protect species and habitats; and,

- introducing the proposed Species at Risk Act (SARA) early in the new year.

Copies of the Plan and related documents can be found on the Internet at: <http://www.ec.gc.ca/sara/index.html> or by contacting the Environment Canada Inquiry Centre at 1-800-668-6767.

Surveys clarify duck distribution

BY TONY E. CHUBBS, PERRY G. TRIMPER, KATHY KNOX, MICHEL ROBERT AND R. IAN GOUDIE

Since 1991, the Department of National Defence (DND) has conducted harlequin duck (*Histrionicus histrionicus*) surveys as part of its Environmental Mitigation Program supporting military low-level flying. The mitigation program has been designed to reduce potential adverse effects of disturbance on harlequin ducks during the nesting period. Adult pairs located during spring surveys are assumed to be nesting birds, and flying activity around these sites is restricted.

The past eight years of surveys by DND have clarified the known and possible breeding distribution for the eastern North American population. DND has examined all high quality breeding areas and found low numbers of birds. Since 1991, over 700 individuals were found on 37 of 46 (80%) river systems

searched. Greater numbers of harlequin ducks were observed in the northernmost portion of the study area. In 1996, DND reconfigured the training area, in part to avoid possible disturbance to harlequin ducks in areas of highest density.

In 1999, DND initiated a telemetry study in co-operation with the Canadian Wildlife Service to determine the relationship of spring pair locations and actual nesting and brood rearing areas. A total of 21 birds were caught in May and banded, and samples of blood, feathers, and faecal material were collected for DNA analysis. Eleven females were equipped with transmitters. Researchers undertook efforts to relocate the birds until August by helicopter and on foot.

Highlights of this initiative included: (1) The first nest to be located by radio telemetry in Labrador was found on June 12th, 1999. The nest was 103 metres from the river where the female was captured and contained five eggs. The nest bowl was concealed beneath the

branches of a black spruce tree in open spruce-lichen forest, a site quite dissimilar to previously discovered nest sites. The nest was revisited on June 19th, 1999 and was found to be abandoned and the clutch was missing. (2) Over 80% of pairs captured appeared to have been ready to nest, confirming breeding areas identified by DND. (3) Detailed information of habitat use and local movements of birds on their breeding areas was collected.

Tony E. Chubbs is a wildlife biologist for the Department of National Defence. Perry G. Trimper and Kathy Knox are biologists for Jacques Whitford Environment Limited. Michel Robert is a research scientist with the Canadian Wildlife Service. R. Ian Goudie is a PhD candidate at Memorial University of Newfoundland, funded in part by the Institute for Environmental Monitoring and Research. For more information on DND's Environmental Mitigation Program and ongoing monitoring programs visit the Goose Bay Office website (www.goosebay.org).

CITES Update

Parties to meet in Kenya

BY CHARLES DAUPHINÉ

Canadian officials are preparing to attend the 11th Conference of the Parties to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). The meetings will occur April 9th to 20th in Nairobi, Kenya. The parties will examine proposals to add, remove, or transfer species within the CITES appendices, which determine whether a species may be traded for commercial purposes. The proposals to be considered and the meeting's agenda may be viewed at the CITES website [<http://www.cites.org>].

Among the more noteworthy of the proposals are four from southern African countries to allow the continued sale of stockpiled ivory to Japan. CITES imposed a moratorium on trade in African ivory in 1989 to halt widespread poaching, but the populations in some countries were protected from poaching and continue to grow and produce valuable ivory. As well, Cuba has submitted a proposal to allow sale of stockpiled hawksbill turtle (*Eretmochelys imbricata*) shells to Japan. Like ivory, the commercial trade in marine turtle products is banned under CITES. Japan and Norway have proposed the transfer of several whale populations to allow trade in meat and other products, now banned by CITES and by the International Whaling Convention. Increased CITES protection is proposed for several species, including the urial (*Ovis vignei*), musk deer (*Moschus spp.*), monitor lizard (*Varanus melinus*), and timber rattlesnake (*Crotalus horridus*). Two species that occur in Canada are also involved: the Unites States has submitted proposals to transfer the North American gyrfalcon (*Falco rusticolus*) from Appendix I to II, and to include the spotted turtle (*Clemmys guttata*) in Appendix II.

Preliminary Canadian negotiating positions on the proposals and resolutions to be considered at COP 11 are being made available at the Canadian CITES authority in Ottawa. For more information, contact the CITES Authority, Canadian Wildlife Service, Environment Canada, Ottawa K1A 0H3 (FAX 819 953-6283).

Charles Dauphiné is the Scientific Authority, Wildlife Trade and International Coordination, with the Canadian Wildlife Service, Ottawa, Canada.

Canada and U.S. save shared species at risk

The American and Canadian governments have created a formal agreement to cooperate in identifying and, where feasible, recovering shared wildlife at risk. This article describes the reasons for the agreement and provides examples of how it will work.

BY MARTHA BALIS-LARSEN,
CHARLES DAUPHINÉ, AND
SUSAN JEWELL

Among the many challenges facing wildlife managers in North America is the fact that political and biogeographical boundaries rarely coincide. For example, the border separating the United States and Canada intersects nine major ecological regions, including Arctic tundra, many forest types, several mountain ranges, two coastal plains, the vast interior plains, and the Great Lakes. These regions feature a great diversity of plants and animals, many of which either migrate or range across the borders between the two countries. Some of these shared species are at risk and need urgent attention in both countries to save them from extinction.

Many North American species that are widely distributed in the continental United States extend only a short distance into Canada or migrate seasonally from Canadian breeding areas to spend the winter farther south. All of the 25 bird species considered threatened or endangered in Canada also occur in the United States. Of the 161 species of animals and plants on Canada's national threatened and endangered lists, about 70% are also found in the United States.

According to a review of Federal and State listed species in the U.S., there are more than 800 endangered, threatened, or rare species that occur in both nations. Some species considered at risk in the U.S. are found in sizable numbers in Canada, such as the woodland caribou (*Rangifer tarandus caribou*), wolf (*Canis lupus*), grizzly (*Ursus arctos*), and lynx (*Lynx canadensis*). Other species are considered at risk in Canada but are found more commonly in the U.S., such as the sage grouse (*Centrocercus urophasianus*), northern bobwhite

(*Colinus virginianus*), burrowing owl (*Speotyto cunicularia*), eastern massasauga rattlesnake (*Sistrurus catenatus catenatus*), and spiny softshell turtle (*Apalone spinifer*).

Shared species

Both nations currently consider such shared species as the right and bowhead whales (*Balaena glacialis* and *B. mysticetus*), whooping crane (*Grus americana*), Eskimo curlew (*Numenius borealis*), Kirtland's warbler (*Dendroica kirtlandii*), leatherback turtle (*Dermochelys coriacea*), and Furbish's lousewort (*Pedicularis furbishiae*) as endangered. A number of other species are considered threatened in one country and either threatened or endangered in the other, including the sea otter (*Enhydra lutris nereis*), humpback whale (*Megaptera novaeangliae*), marbled murrelet (*Brachyramphus marmoratus*), northern spotted owl (*Strix occidentalis caurina*), roseate tern

(*Sterna dougallii dougallii*), western prairie white fringed orchid (*Plantanthera praeclara*), and golden paintbrush (*Castilleja levisecta*). Several additional species are endangered in one country and extirpated in the other, like the black-footed ferret (*Mustela nigripes*), Atlantic gray whale (*Eschrichtius robustus*), and blackfin cisco (*Coregonus nigripinnis*).

Although both countries have long recognized the benefits of cooperation in the management of shared species, joint efforts have traditionally been directed at species of high economic value, such as migratory game and fisheries. The whooping crane and several other endangered species with high public profiles have been the subject of joint conservation efforts, but these initiatives were few and handled as *ad hoc* projects. Attention is now broadening to consider all species, especially those thought to be going extinct.

The American and Canadian governments have created a formal agreement to cooperate in identifying and, where

The humpback whale is considered endangered in the U.S., while in Canada the North Pacific population is considered threatened and the Western North Atlantic population is considered vulnerable.



PHOTO: GRAEME ELLIS / URSUS

SPECIAL REPORT



PHOTO: G.L. HOLROYD

sium was held in Utah to examine the owl's overall status and to seek more information on the poor survival of owls that nest in Canada and winter in the southern U.S. and northern Mexico.

To determine which other species need cooperative efforts, or in some cases additional effort, personnel from the Canadian and U.S. wildlife services have been assembling three lists of species of mutual concern. One comprises wildlife and plants listed in both Canada and the U.S., and another includes species listed only in one country but whose range historically included both countries. The third list is made up of species of special concern that are experiencing rapid population declines or require more studies to determine their status.

Cooperative efforts

By pursuing the needs revealed by these lists, the working group hopes to encourage communication and cooperative recovery efforts. These results will also be shared with the working groups that are coordinating recovery efforts for shared species.

Interagency meetings have already led to closer working relationships at the headquarters level, which is expected to benefit regional and local offices as well. Each country's endangered species management procedures, from listing to consultation to recovery to outreach efforts, will progress from the strengths of the other as we work together to identify and save species at risk that occur on both sides of the world's longest international border.

Martha Balis-Larsen, outreach specialist, and Susan Jewell, biologist, are with the Division of Endangered Species, U.S. Fish and Wildlife Service, in Arlington, Virginia. Charles Dauphiné is the Scientific Authority, Wildlife Trade and International Coordination, with the Canadian Wildlife Service, Ottawa, Canada. This article was previously published in the March/April 1999 issue (Vol. XXIV No. 2) of the U.S. Fish and Wildlife Service's Endangered Species Bulletin.

The burrowing owl is considered increasingly endangered in Canada but not at risk in the U.S.

feasible, recovering shared wildlife at risk. In April 1997, Secretary of the U.S. Department of the Interior Bruce Babbitt and former Minister of Canada's Department of the Environment Sergio Marchi signed a document entitled "Framework for Cooperation Between the U.S. Department of the Interior and Environment Canada in the Protection and Recovery of Wild Species at Risk."

Exchanging expertise

The framework supports exchanging technical expertise; identifying species that would benefit from bilateral attention; implementing joint recovery plans; recruiting partnerships between State, Provincial, and private agencies and individuals; and creating greater public awareness.

Perhaps the agreement's most important achievement, however, is to encourage more inclusive and flexible cooperative arrangements. For example, any interested party, whether govern-

ment or private, may seek the assistance of either of the two federal wildlife agencies in establishing cooperative programs with its counterpart in the other country. Moreover, action may be directed at

Perhaps the agreement's most important achievement will be to encourage more inclusive and flexible cooperative arrangements.

any shared species, regardless of jurisdiction, including species considered at risk in only one of the two countries. The burrowing owl, which has become increasingly endangered in Canada but is not considered at risk in the U.S., is a good example. In late 1998, a sympo-

Recovery plan initiated for mussels

The lower Great Lakes area in southern Ontario has historically supported the most diverse mussel community in all of Canada. Of the 53 Canadian species of pearly mussels, 40 have been known to occur in the basin. Of these, 22 are found nowhere else in Canada.

But studies conducted in the past ten years show that species losses and changes in species diversity have occurred over time in this area. Species losses have been particularly acute in the Grand, Thames, and Sydenham rivers. Within this entire area, four species appear to have been extirpated, nine are found in fewer tributaries than they occupied historically, and three others have suffered significant contraction or fragmentation of their range. In other words, 16 of 40, or 40% of the species of freshwater pearly mussels in these rivers, have either been lost or are in decline.

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has included freshwater molluscs in its mandate only since 1994. In 1999, three species were designated as endangered: the wavy-rayed lampmussel (*Lampsilis fasciola*), the northern riffleshell (*Epioblasma torulosa rangiana*) and the rayed bean (*Villosa fabalis*). Researchers are currently preparing status reports for two other species, the snuffbox (*Epioblasma triquetra*) and the salamander mussel (*Simpsonaias ambigua*).

The loss and decline in pearly mussels has been attributed to several factors, including the loss of habitat from dam construction and pollution from agricultural runoff, stormwater highway runoff, industries and utilities. Another factor is the loss of fish species that act as hosts for the development of the mussel's larvae to the juvenile stage. The larvae, called glochidia, must parasitize a fish host for up to 30 days to develop into the juvenile stage. The invasion of zebra mussels is also a factor. For example, prior to 1986 when the zebra mussel arrived, 11 species occurred in Lake St. Clair. By 1991, researchers could find no pearly mussels on the Ontario shores of the lake.



The northern riffleshell is one of three freshwater molluscs listed as nationally endangered in Canada.

Researchers are now examining the potential for recovering some of these species and ways to go about it. Scientists are first trying to determine whether species that show little resistance to zebra mussel infestation (i.e. the species that disappeared and are at risk of being replaced by zebra mussels) possess similar traits to those that are endangered, and whether those more tolerant of infestation have similar traits to species that remain more abundant.

Researchers are testing these hypotheses by transplanting three species with “endangered” traits and three species with “tolerant” traits from the Sydenham and Thames rivers into corrals in Lake St. Clair. Survival and growth of the species will be compared under current levels of zebra mussel infestations.

These studies will form an important part of an ecosystem approach now being spearheaded by the Ontario Ministry of Natural Resources to recovery planning for vulnerable, threatened and endangered aquatic species. This initiative is being financed by the World Wildlife Fund (Canada) and by the federal government's Millennium Fund.

The ecosystem approach has sev-

eral benefits. For example, it is believed to be more cost-effective than a single-species approach, and recovery actions that benefit several species at risk are selected. It also restores ecosystem health, preventing the decline of other native species.

As part of this approach, several scientists will be collecting and sharing information on the distribution, life history and habitat requirements of all aquatic species at risk. They will also be developing a matrix of ecological tolerances and requirements for each species, such as temperature and oxygen levels, the structure of stream channels, and human influences. The project is an ambitious one that will require not only the financial support of provincial and federal agencies but public participation, stewardship and partnerships with local communities.

Gerry Mackie is a professor of zoology at the University of Guelph. This article is based on research he conducted with University of Guelph graduate student David Zanatta, and on research Mackie conducted in collaboration with Janice Metcalfe-Smith of Environment Canada's National Water Research Institute in Burlington, Ontario.