A Biological Control for Purple Loosestrife?

The perennial exotic weed purple loosestrife (*Lythrum salicaria*) is degrading many wetlands throughout the temperate regions of North America. A large plant, it reaches over two meters in height. Its multiple stems are tipped with elongate spikes of purple flowers from July to September. Estimates suggest that a single mature plant can produce more than 2.5 million seeds a year.

Of European origin, purple loosestrife is now established in hundreds if not thousands of acres of Illinois wetlands. Considerable effort has been expended by the Department of Conservation to protect high-quality wetlands from invasion by this species, but control is difficult because specific herbicides or easy cultural control methods are not available. Biological control is now being considered as perhaps the only way to limit the distribution of this noxious weed.

Recent research at the Illinois Natural History Survey has explored the impact on purple loosestrife of large populations of the aphid *Myzus lythri*. These aphids overwinter as eggs on *Prunus mahaleb*, a wild cherry of European origin that grows along road-sides and forest edges. In spring the eggs hatch and three generations of aphids are produced on the cherry tree before winged aphids leave it in search of purple loosestrife on which the summer generations will live. This aphid, like its host, is of European origin and has been in North America for over 50 years.

Experiments were carried out in the greenhouse using two-year-old loosestrife plants and four-month-old seedlings. Each of the plants was inoculated with five aphids and left for eight weeks along with non-inoculated plants. By the end of that time, the inoculated plants were literally covered from top to bottom with aphids. At the end of the experiment, all plants were removed from the pots, their roots carefully washed, and the plants then dried and weighed. The inoculated plants had significantly smaller roots and shoots. In addition, none had bloomed, some showed premature leaf drop, and others were severely stunted. The control plants had large, healthy leaves and some had flowered. The four-month-old loosestrife seedlings were inoculated with two or five aphids. After eleven weeks, approximately half of the seedlings had died or were dying. No difference was noted between seedlings inoculated with two or five aphids, and a significant difference was found between experimental and non-inoculated control seedlings.

These experiments show that the aphid *Myzus lythri* has the ability to influence the growth and flowering of purple loosestrife. Since this aphid is already found in this country, why has it not been working as a natural control? The answer appears to be found in its complex life cycle. It needs *Prunus mahaleb* and plants in the genera *Lythrum* or...
Epilobium to complete its life cycle. *Prunus mahaleb*, however, is not commonly planted in North America, and the aphid population is limited by the scarcity of its wintering host. Another factor is the three-generation delay in the spring before winged aphids leave the host tree. As a consequence of this delay, their arrival on purple loosestrife does not occur until mid-June in Illinois. By this time, purple loosestrife can be quite large and will reach flowering stage before the aphid population reaches damaging levels. The need for migration is a related factor. Because aphids are feeble fliers and are carried by prevailing winds, significant losses to the population can occur during migration.

In spite of the lack of host trees, the late flight date, and the hazards of migration, *Myzus lythri* could be used as a biological control in the field. *Prunus mahaleb* could be planted near large stands of purple loosestrife so that hosts would be available and the migration distance limited. Aphids could also be mass reared during the winter months for release in April when purple loosestrife begins to grow. This schedule would give the aphid a head start of nearly two months on its natural cycle and allow the population to build before purple loosestrife begins to flower. Researchers at the Survey plan to test both of these schemes during the coming years to learn if this aphid can help to limit the spread of the noxious purple loosestrife.

David J. Voegtlin, Center for Biodiversity

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Guide for Wetland Restoration and Creation

In the past, wetlands, such as marshes, wet prairies, floodplain forests, and swamps, were regarded as waste places with little value. Often they were regarded as breeding grounds for pestilence and disease, and government programs encouraged landowners to drain these areas. Only about 10% (918,000 acres) of the approximately 9.4 million acres of wetlands that existed in Illinois before European settlement remain today. As awareness of the economic, environmental, and social values of wetlands has increased, efforts have turned toward protecting them. To that end, Illinois adopted the Interagency Wetlands Policy Act in 1989. Its short-term goal is to allow no overall net loss of existing wetland acres; a longer-term goal is to increase wetland acreage.

This Act directs state agencies to avoid impacts to wetlands when possible or to minimize them. Although the preservation of existing wetlands is certainly the most desirable option, losses do occur. The Illinois Wetlands Mitigation Policy, therefore, requires that where adverse impacts are unavoidable, the wetland loss must be compensated for through the development and implementation of a Wetland Compensation Plan approved by the Illinois Department of Conservation.

Wetland restoration and creation are two means by which compensation may be accomplished. Restoration refers to the reconstruction of a wetland where a wetland community previously existed. At potential restoration sites, one or more of the original components (wetland hydrology, hydric soils, or wetland vegetation) remains. Alternatively, wetland creation requires the construction of a wetland in a location where one never occurred. The art and science of wetland restoration and creation that emphasizes natural wetland structure and function is relatively new and the technology is incomplete. As a result, attempts to replicate natural form and function have generally been unsuccessful. In an effort to counter this trend, members of the Wetland and Preliminary Studies Group are developing a guide for the restoration and creation of wetlands. This project, supported by the Illinois Department of Conservation, is being carried out cooperatively by personnel from the Center for Biodiversity at the Illinois Natural History Survey, the Illinois State Geological Survey, and the Illinois Department of Transportation.

The Illinois Restoration and Creation Guide has several well-defined and unique objectives. The first is to improve the overall quality and success of wetland restoration and creation projects. The document will provide information for making informed decisions during each stage of the restoration or creation process. The second is to reduce costs of mitigation. The guide will outline procedures to reduce the likelihood of problems and the need to redesign the reconstruction effort after it is underway. A third objective is to help agencies comply with the Interagency Wetlands Policy Act. The guide is being written primarily for use by state agencies and will be

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Only about 10% of the original Illinois wetlands remain, but restoration becomes more feasible as our understanding of wetland form and function improves.
appropriate in both regulatory (such as to satisfy mitigation requirements) and nonregulatory contexts. A final objective is to reduce the number of staff and the amount of funding necessary to implement the Act. Because essential information will be found in a single document, orderly procedures can be followed and false starts and revised designs avoided.

The guide incorporates technical information from various sources as well as the experience of the authors and will assist practitioners with backgrounds in biology, civil engineering, and landscape architecture. However, the best restoration and creation efforts will probably be accomplished through interdisciplinary teams that include specialists in hydrology, pedology, botany, and wildlife biology.

The guide is based on the assumption that wetlands will be restored or created in order to perform particular functions, such as floodflow alteration, sediment stabilization, nutrient removal and transformation, and increased biological diversity or abundance. The working draft comprises six chapters that are correlated to stages in the wetland restoration or creation process: planning, assessment, design, construction, monitoring, and management. In each chapter, procedures are emphasized, tasks clarified, and the techniques required to perform each task outlined. Depending on particular site conditions and the circumstances of the project, tasks can be conducted according to one of two levels of effort. The design of the guide will enable individual chapters to be updated as new methods and technology become available.

A draft of the Illinois Wetland Restoration and Creation Guide will be reviewed by Department of Conservation personnel and the Interagency Wetland Committee later this year. Publication is expected in 1995.

Alicia Nugteren Admiraal, Center for Wildlife Ecology

Badgers Persevere

Much of the animal life associated with the tallgrass prairie disappeared or declined greatly as the prairie was plowed for agriculture in the 1800s. The American badger (Taxidea taxus) is one prairie "relict" species that has persisted in the Midwest, although little is known about its historic or current status. In 1989 researchers at the Illinois Natural History Survey initiated a project to map badger distribution in Illinois and to learn how this species has survived in a much altered environment. The project is supported with Pittman-Robertson funds from the Division of Wildlife Resources at the Illinois Department of Conservation (IDOC) and the U.S. Fish and Wildlife Service.

Reports of badger sightings have been collected from the public, IDOC staff, Survey biologists, and Illinois Department of Transportation personnel (the latter encounter road-killed badgers). Despite the lack of prairie-like habitat, badgers are presently distributed throughout the state. Before European settlement, badgers were probably found only in the northern two-thirds of the state; however, the clearing of forests for agriculture and strip mining altered the southern third of the state, creating open conditions more suitable for badgers.

This carnivorous species is ideally adapted to excavate and prey upon such small burrowing mammals as ground squirrels, pocket gophers, voles, and mice. As a result, badgers thrived in prairie. Currently, however, more than 65% of the land in Illinois is used for row crops, and smaller prey species such as house and deer mice are now the most common rodents in farm fields. Clearly, the prey base for badgers has decreased statewide since prairie days.

At a site in Mason County in west central Illinois, researchers are intensively studying badgers by fitting them with radio transmitters and tracking their movements. Tracking has proved more difficult than expected because individual badgers may travel more than two miles in a given night as they wander and hunt over the landscape. An adult female's home range varies from 6 to 10 square miles, and male ranges are even larger. Furthermore, there is little overlap of home ranges for badgers of the same sex, although male ranges extensively overlap those of females. In contrast, home ranges for badgers studied in Utah, Idaho, and Wyoming are typically 1 to 2 square miles. Thus, badger densities in Illinois appear sparse compared to those in western states.

Badgers have been found in all Illinois counties except four in the southern fourth of the state; their presence there is suspected but unconfirmed.
Badgers

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Unlike the unnatural cropped landscapes of Illinois, the landscapes of western states provide abundant seminatural rangelands suitable for badgers. This cover type often supports a large number of semicolonial prairie dogs and ground squirrels. In Illinois, habitats that mimic the vegetative structure of prairie grasslands provide more abundant and diverse prey for badgers than do row crops. As a result, badgers turn to cover types that are scarce—alfalfa, weedy fallow fields, and grassy cover established under the Conservation Reserve Program—and they rely on these cover types more frequently than would be predicted based on their availability. This tendency suggests that the larger home ranges observed in Illinois reflect a reduced prey base and a reduction in habitat quality.

The contemporary Illinois landscape does not allow for optimal survival and reproduction of badgers. Although 60–70% of adult females in Mason County produce young each year, the rate of survival by juveniles is low. Less than 40% of young badgers live long enough to leave their mothers. Even under the care of an adult female, juveniles are vulnerable to predation by coyotes and dogs. When immature badgers disperse from their mothers, they may travel more than 10 miles, thereby assuming the risks of crossing unfamiliar territory and many roads.

The persistence of badgers in Illinois despite dramatic changes in the landscape is testimony to the remarkable adaptability of the species. Ongoing research should reveal which, if any, prey species are of particular importance to badgers, whether or not linear habitats such as hedgerows and fences benefit badgers in intensively cropped landscapes, and whether the mortality rates of adult males and females differ.

Barbara Ver Steeg, Center for Wildlife Ecology, and Richard E. Warner, Department of Forestry, University of Illinois

Savannahs and Breeding Bird Communities

A serious problem faces managers and conservationists in Illinois: the welfare and sustainability of forests and wildlife. Oak-hickory forests throughout the Midwest are apparently not regenerating at historical (i.e., postglacial) levels, and oaks are gradually being replaced by shade-tolerant species, especially Sugar Maples (Acer saccharum). Much of the southern and central Midwest has been dominated by the oak-hickory forest-type for nearly 8,000 years, but a process of oak regeneration is underway that may fundamen­

tally change the structure of the remaining forests in Illinois and surrounding areas.

The ecological factors underlying this conversion are not fully understood, but disturbance and the lack of fire are certainly involved. As a result, the use of prescribed fire and the removal of maples are being considered to insure the perpetuation of oak-hickory forests. Juxtaposed against the problem of oak regeneration is a concern for forest wildlife and how the viability of those populations may be affected by fire and disturbance. This relationship is ambiguous for forest birds in Illinois. Many species may benefit from a more open, savannah-like conditions. Further, several species of neotropical migrants, some of which are decreasing in Illinois and throughout the Midwest, are potentially sensitive to prescribed burning and disturbance. Forest and wildlife managers obviously need baseline data if policy is to be based on a clear understanding of what fire will do to all components of the forest ecosystem.

The Center for Wildlife Ecology at the Illinois Natural History

Survey has initiated a three-year study to evaluate the effects of prescribed burning and understory removal on bird populations in oak forests. The project is supported by The Nature Conservancy, the Illinois Department of Conservation (Division of Natural Heritage), the U.S. Fish and Wildlife Service, and the Peoria Park District. Major research sites are the Peoria Wills Conservation Areas, which are owned primarily by the Peoria Park District. Birds within Singing Woods, a 953-acre forest tract, will be studied intensively. Plans are in place to remove maples and burn several areas within this tract and elsewhere within Peoria Wills during 1994–1996. The goal is to convert closed-canopy forests to more open, savannah-like forests such as those that predominated locally in presettlement times and to evaluate the positive and negative effects of this conversion on a diverse set of birds. When possible, avian abundances and breeding success will be estimated within prospective burn units be—
fore and after conversion. During each of the three years of the study, similar data will also be collected for control areas located at a distance from the converted areas. Bird populations inevitably fluctuate among years, and controls are essential so that changes in environmental conditions (for example, drought) do not confound the effects of burning.

This sampling design will allow the study of species that may be directly affected, either positively or negatively, by the conversion practices. For example, Wood Thrushes (Hylocichla mustelina), Ovenbirds (Seiurus aurocapillus), Kentucky Warblers (Oporornis formosus), and Worm-eating Warblers (Heoitheres vescivorus) are ground- or shrub-nesting species that may require saplings or forest litter and may be negatively affected by burning. All of these species are neotropical migrants found within Peoria Wilds. Alternatively, Red-headed Woodpeckers (Melanerpes erythrocephalus), Indigo Buntings (Passerina cyanea), and Northern Orioles (Icterus galbula) favor more open woodland and may benefit from the conversion techniques. A concerted effort will be made to monitor the viability of populations of these species. The effects of burning on brood parasitism by Brown-headed Cowbirds (Molothrus ater) and on rates of nest predation will be of particular interest. Some data suggest that birds associated with savannah-like forests are less likely to be parasitized. Whether this tendency stems from the behavior of the birds themselves or from some property of the habitat is unknown. Finally, the foraging behavior of selected species will be compared within and away from burn units. Data such as the number of foraging maneuvers or prey captured per unit of time will provide insight into how burning affects the availability of food resources needed during the breeding season.

More Walleye for Illinois Anglers

Walleye (Stizostedion vitreum) is a popular sport fish in Illinois and throughout the Midwest. Unfortunately, the supply for the state’s anglers does not always meet the demand. Heavy fishing pressure and limited natural reproduction combine to make it difficult for state fishery managers to maintain adequate walleye populations. In an attempt to insure a continued supply of walleye for anglers, the Illinois Department of Conservation (IDOC) has stocked large numbers of hatchery-reared walleye in Illinois reservoirs and impoundments (artificial lakes). Each year, the IDOC places millions of walleye fry (less than 1-inch long) and thousands of fingerlings (2-4 inches long) in lakes throughout the state; however, this stocking program, like those in other midwestern states, has met with mixed success.

The Illinois Natural History Survey, in cooperation with Southern Illinois University, is attempting to improve the success of walleye stocking programs by trying to find out what happens to walleye when they are stocked. A combination of field, pond, and laboratory tests are being implemented to carry out this research.

Field efforts currently evaluate walleye stocking in fifteen lakes throughout Illinois and include determination of mortality from stocking stress/shock, mortality due to predation, and survival during the first year after stocking. Mortality resulting from handling walleye at stocking time and stocking at an inappropriate lake temperature is easily determined. Experiments show that greater than 50% of the walleye can die from shock if the lake water is too warm or too cold during stocking.

If young walleye overcome the initial stress, they are then vulnerable to predators until they grow large enough not to be eaten. Predator mortality can result in the loss of an additional 10-20% of stocked walleye. Due to these and a variety of other factors, greater than 90% of stocked walleye probably do not survive past their first year of life.

(Continued on back page)
Species Spotlight

Great Blue Heron

As the early morning mist evaporated, the call of a barred owl echoing off the cypress trees gave way to the raucous squawks and screams of a Great Blue Heron rookery. Our presence was acknowledged with the swish of a small missile—a regurgitated fish landing at our feet—a rather nice “welcome gift.” It is best to observe a heron rookery from at least spitting distance.

The rookery of a Great Blue Heron resembles a treetop apartment building of nests. Other water birds, such as egrets and cormorants, often share a rookery—the more noise, the better. In Illinois, rookeries are usually located within extensive tracts of bottomland forest. The largest trees are generally chosen, and the nests are placed high in the branches. Nests are about four feet wide and a couple of feet deep—a jumble of sticks and twigs. A rookery is used through dozens of heron generations and may contain anywhere from 5 to 500 nests. The squawking of birds and the smell of excrement and decaying fish alert one to a rookery long before it can be seen. When agitated, nesting herons will whitewash intruders with excrement or regurgitate their last meal upon the unsuspecting visitor, the avian equivalent to pouring boiling oil over medieval city walls.

Great Blues occupy the rookery for almost three months. Each nest has three to seven bluish eggs, which are incubated for about a month. For six weeks, until the young birds can fly and find food on their own, the parents are responsible for their brood. Of the four to five that hatch, only two or three will survive; owls, vultures, and tree-climbing mammals take their toll, and some youngsters are pushed from the nest. Great Blues mature in 3 years and have a life span of about 20 years.

The Great Blue Heron is found exclusively in the Western Hemisphere and can be found as far west as the Galapagos and as far north as Greenland. In Illinois, it occurs primarily along major rivers but is also seen at marshes and lakes or anywhere near water. As the state’s largest heron with a wingspan of six feet, it stands four feet tall on long stiltlike legs, weighs from five to eight pounds, and is blue gray in color with white about the neck. Its beak is like a strong, pointed spear and is longer than the rest of its head.

Great Blues feed anywhere there is food, including flooded meadows, fields, and sloughs during times of runoff. They are indiscriminating carnivores and will eat almost anything that fits in their gullets—including fish, snakes, and frogs as well as field mice, small muskrats, and even lowland nesting birds. Everything is swallowed head first, which makes it easier on the gullet when regurgitating to feed the young. Great Blues have more than 30 different feeding movements, and these range from walking slowly to wing flicking to foot stirring. Like an experienced trout fisherman who knows what lures and line to use when fishing a particular area, the heron employs a variety of strategies when foraging.

Take time to enjoy this scene, for few sights are more primeval and more beautiful than the eerie silhouette of a fishing heron in the misty early morning light of an Illinois wetland.

Deformities in Aquatic Macroinvertebrates

Discharges from domestic and industrial wastewater treatment facilities contribute varying levels of pollutants to aquatic systems. These pollutants include sewage, nutrients, animal food processing wastes, paper and pulp mill byproducts, a variety of petroleum-based effluents, and other toxic chemicals. These discharges often result in macroinvertebrate assemblages below the outflow that are characteristic of specific effluents. Although numerous methodologies have been developed to characterize water quality of streams, particularly the influence of organic loading on aquatic communities located downstream from the discharge, these methodologies have contributed little to documenting the influence of toxic chemicals on aquatic macroinvertebrates.
One way in which effects of toxic contaminants on aquatic fauna can be demonstrated is through analysis of morphological deformities. Past studies have demonstrated increases in deformity frequencies in aquatic macroinvertebrates that have been collected from substrates with elevated levels of metals, polychlorinated biphenyls, pesticides, radioactive materials, and other carcinogens. Monitoring a polluted lake in Sweden during the 1970s, for example, revealed a highly significant correlation between incidence of deformities in morphological structures of aquatic worms and high mercury concentrations in sediments. Deformed macroinvertebrates have been collected from many sites in North America that contain sediments contaminated with effluent from pulp and paper mills, metals, and oil residues. Experimental work in which the conductivity levels in water were changed also resulted in morphological deformities in selected macroinvertebrates. A recent study in North Carolina focused on morphological deformities in midge larvae (Diptera: Chironomidae) and found that organic loading of streams resulted in nonsignificant increases in number and extent of deformities but that toxic conditions resulted in significant increases in both. Researchers then developed an index of toxicity that gives greater weight to more severe deformities of morphological characters observed in the midge larvae.

The application of this methodology to segmented worms (Oligochaeta), a group represented by several species commonly found in clean as well as polluted systems, is under consideration at the Survey. If this methodology shows merit, it will provide researchers with an additional way to monitor water quality, particularly in aquatic systems where high organic loading often masks the toxic effects of discharge on macroinvertebrate populations.

Mark J. Wetzel, Center for Biodiversity

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**Two-minute Naturalist**

Each Friday afternoon the University of Illinois presents *Afternoon Magazine* on its FM radio station (90.9). As a part of that program, the Natural History Survey is featured in a two-minute slot: “Illinois Naturalist.” Survey staff generate the content, which focuses on current topics of biological interest to Illinoisans. Susan Post, Charlie Helm, and Mark Schwartz serve as narrators, and Michael Jeffords and Mark coordinate the effort.

Tune in at 2:40 on Friday afternoons and you and your family (or classroom) will discover much that is fascinating about your home state. Did you know that bald eagles are on the rebound in Illinois after near extinction in the 1960s? The winter population has doubled in four years to a high of just over 2000. And what determines an early or late migration for Canada geese? They probably won’t be seen in Illinois until 10 to 20 inches of snow cover the Wisconsin landscape. The lack of open land for foraging and open water, not the cold per se, triggers the migration. And what about the central heating system of skunk cabbage? It’s the earliest flowering plant in Illinois and manages this feat by using energy stored for months in its starchy tuberous roots. It generates enough heat to melt through leftover snow and to maintain summerlike temperatures inside the plant on subfreezing mornings.

“Illinois Naturalist” also suggests how you can follow up on enticing stories like those. Where do you go and when if you want to visit a maple sugar camp—not in Vermont but right here in Illinois? Try to 90.9 on your FM dial each Friday at 2:40.
Walleye
continued from page 5

Additional field sampling is directed at estimating the types of food walleye prefer and the availability of food sources in each lake. Walleye fry eat zooplankton (free-floating microscopic organisms); fingerlings eat insects and other fish. Experiments will determine what groups/types of zooplankton, insects, and fish are eaten by walleye relative to what is available to them in each lake. Survey researchers also hope to find out what the walleye food is most abundant. With this information, stockings could be scheduled when the lakes have the most food for the fish. Improved growth and survival for walleye might result.

Results from field testing will be complemented and enhanced by pond and laboratory experiments. Tests in experimental ponds allow investigation under controlled conditions similar to those present in field tests. For example, numbers and species of larval fish, a potential food source for walleye fingerlings, can be manipulated in pond experiments to investigate the influence of larval fish density and species composition on walleye growth rates. Laboratory experiments are used to further investigate the mechanisms governing the relationships observed in pond and field experiments. Currently, laboratory tests are being used to determine how scarcity of food might influence the susceptibility of walleye stocking programs in Illinois and throughout the Midwest.

David Clapp and David Wahl with Douglas Wochieszak, Center for Aquatic Ecology

More than 90% of walleye stocked in Illinois reservoirs and impoundments probably do not survive their first year. Using a combination of field research and laboratory testing, Survey researchers look for answers.