Introduced Crayfishes in Illinois

The practice of introducing non-native plants and animals into new areas for food production and sport and as pets has occurred commonly throughout human history. While many of these introductions go unnoticed or cause little harm to our natural resources, some cause severe problems for the native organisms that live in areas where introductions occur.

In Illinois, the introductions of aquatic species, such as the common carp, grass carp, and zebra mussel, have drastically affected our streams, rivers, and lakes. One of the newest threats to our native aquatic plants and animals are crayfishes. Field work conducted by Illinois Natural History Survey (INHS) biologists has documented that the rusty crayfish, a non-native species first collected from Illinois in 1973, has rapidly expanded its range in the state and that a second non-native species has recently become established in the state.

Crayfishes, also known as crawfish or crawdads, are found in almost all aquatic habitats in Illinois including lakes, creeks, rivers, and swamps. By feeding on plant material, insects, and snails, and by being a favorite food item for sportfishes, such as basses and sunfish, crayfish function as important members of aquatic food webs. The appetites of sportfishes for crayfishes have led to the introduction of non-native species. When fishermen use crayfishes as bait, they often dump unused crayfishes into lakes and rivers at the end of the day. This practice has most likely led to the establishment and rapid spread of the rusty crayfish (Orconectes rusticus) in Illinois. The rusty crayfish was first collected in Illinois in 1973 from the Illinois River at Peoria, and until 1985 was known from only nine locations. Since then the species has spread throughout the northern half of Illinois and can be found in almost all the major rivers in that part of the state. A field study conducted from June 1994 to October 1995 found the rusty crayfish at 39 sites in Illinois, 24 of which were in or near areas that receive intense recreational fishing pressure.

Researchers at INHS and other institutions have documented the effects rusty crayfish have on aquatic ecosystems. The most dramatic effect is the displacement of native crayfish species. Prior to the appearance of rusty crayfish, the virile crayfish (Orc-
Wetland Restoration at the Middle Fork River Forest Preserve

Over the past several decades, dramatic losses in wetland acreage have occurred across the United States. More than half of the country’s original wetland area has been lost, and over 200,000 more acres disappear each year. Illinois, in particular, has been devastated, losing more than 90% of its original wetland acres. This loss is of special concern because of the important functions that wetlands perform.

Many people now realize the value of wetlands in helping contain and disperse floodwaters, to the rapid development of the science of wetland creation and restoration.

In east-central Illinois, Survey researchers, in cooperation with the Champaign County Forest Preserve District, the Grand Prairie Friends, and The Nature Conservancy, have worked to restore a kettle marsh along the Middle Fork of the Vermilion River. Historically a wetland, this area had been drained by underground field tiles and had been previously used as pasture. In 1990, the drainage tile system was dismantled, restoring the natural hydrology. Almost immediately, wetland vegetation began to return, emerging from the existing seedbank, as well as establishing from nearby seed sources and from seeds brought in by wildlife. Forty-six species were recorded in the first year alone, dominated by native plants, such as spikerush, water plantain, beggar-ticks, and marsh yellow cress. Little vegetation was planted. Natural revegetation and community development were allowed to proceed at their own pace.

As documented by yearly vegetation sampling since 1991, wetland plants, such as duckweed, smartweed, sedge, and millet, established and flourished almost immediately, while others, like arrowhead and rice cutgrass, did not reach prevalence for a couple of years. Although rare at first, problematic, aggressive species, such as cattail and reed canary grass, became more dominant in the passing years. This growing and diverse wetland plant community encouraged the immigration of wildlife. Songbirds, shorebirds, rails, waterfowl, muskrats, coyotes, rabbits, deer, turtles, frogs, and snakes have all found this new wetland. Two birds listed as endangered in Illinois have been observed in the wetland, specifically the pied-billed grebe and the northern harrier (or marsh hawk). In 1994, a pied-billed grebe nested successfully in the marsh, producing several offspring.

Research, monitoring, and management of the wetland are continuing with the help of Illinois State Geological Survey researchers. In addition to continued vegetation sampling, water levels both above and beneath the ground are being monitored with staff gauges and groundwater wells. Researchers are investigating the development of the plant community over time and hope.

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Human Monocytic Ehrlichiosis

Human monocytic ehrlichiosis, first recognized in 1987, is a disease characterized by fever, headache, malaise, myalgia, and nausea or vomiting. Most cases of this sometimes fatal disease have occurred in the Southeast and the Midwest usually in spring and early summer. The vector of the causative agent of the disease is thought to be the lone star tick, *Amblyomma americanum*.

The disease was first thought to be caused by infection with *Ehrlichia canis*, a pathogenic organism found in dogs, but in 1991 the causative agent was found to be an unrecognized species of *Ehrlichia*. This organism was named *Ehrlichia chaffeensis* late in 1991. Five cases of human monocytic ehrlichiosis have been reported in Illinois. In 1994 a case was reported in Jackson County. To date in 1995, four cases have been reported, all in southern Illinois: one case in Alexander County, one case in Johnson County, and two cases in Perry County. The Johnson County case was fatal. The suspected vector, the lone star tick, is abundant in the southern third of Illinois, and it is of widespread but sporadic occurrence in the northern two-thirds of the state. Lone star tick populations are dependent upon white-tailed deer populations.

In spring 1992, microbiologist Jacqueline Dawson of the Centers for Disease Control and Prevention, Atlanta, Georgia; physician Jeffrey Nelson, an INHS affiliate from Rush Presbyterian St. Luke’s Medical Center, Chicago; INHS mammalogist Edward Heske; and INHS entomologist John Bouseman initiated collaborative field studies of human ehrlichiosis in Illinois. Investigations were conducted in Monroe, Clark, Lee, and Winnebago counties. As a result of these studies the first seropositive (positive for Ehrlichiosis antibodies in blood serum) wildlife (raccoons) in Illinois were discovered in Lee County in 1992, and the first seropositive deer were discovered in Monroe County in 1992. Seropositive deer also were found in Winnebago County in 1993. The deer findings were reported in the Journal of Wildlife Diseases, vol. 30, no. 2 (April 1994), pp. 162-168.

It appears that white-tailed deer serve as a reservoir for ticks infected with human ehrlichiosis and that they play an important role in the natural history of the disease in this country. Deer carrying *Ehrlichia* antibodies seem to be more prevalent in southerly latitudes and at low elevations that have milder climates. Deer may serve as sensitive markers of *Ehrlichia*’s distribution. Further research will be needed to clarify this relationship.

John K. Bouseman, Center for Economic Entomology, and Jeffrey A. Nelson, M.D., Rush Presbyterian St. Luke’s Medical Center, Chicago, and an affiliate of the INHS Center for Economic Entomology.
Identification of Genetic Stocks in Midwest Game Fish

Since the turn of the century, transfer of fish from one lake to another has been a common practice among fisheries managers. An underlying assumption has been that all individuals within a species are similar and able to survive and reproduce in diverse habitats. Recent evidence indicates, however, that populations within a species can be genetically quite different from one another. It has also been assumed that artificial propagation and subsequent introduction of fish into a lake is effective in increasing the number of harvestable fish in that lake, but despite years of stocking efforts, many natural populations remain static or are declining.

Population geneticists have shown that species often are composed of genetically distinct stocks. Each stock represents a group that has survived and evolved in isolation from other stocks. Unfortunately, many management programs have failed to acknowledge potential stock differences. As a result, individuals from one stock have often been transported and introduced into waters containing a different stock. Such stock mixing poses a significant genetic risk to native populations; when transplanted individuals survive and interbreed with the resident stock, the resulting offspring may be poorly adapted.

For management programs to incorporate conservation genetics principles, information on existing stock boundaries is critical. Unfortunately, little work has been done to define stock boundaries in the upper Midwest. One reason for this has been an inability to detect significant levels of genetic variation within a regional context. Newly developed molecular genetic techniques, however, now allow us to detect those levels of genetic variation.

Illinois Natural History Survey scientists and graduate students are working with biologists from the Wisconsin and Minnesota Departments of Natural Resources to study the population genetic structure of a number of fish species in the upper Midwest. Fifteen species with diverse life history traits and management priorities are being targeted. These include heavily managed game species, such as muskellunge and walleye, as well as nongame species, such as the Johnny darter. The data generated will be used to determine if watershed boundaries correlate with the boundaries of genetic stocks. If patterns of stock structure are consistent among the diverse species studied, managers may be able to implement effective stock management for all species of concern and predict the most likely stock boundaries for species for which genetic data are unavailable.

The study area is of interest because of the proximity of three large drainage basins: the Mississippi River, Hudson Bay, and the Great Lakes. Where possible, three populations of each species were sampled from each of the major tributaries within each of these drainage basins. This sampling hierarchy allows scientists to determine the relatedness of populations within and among tributaries and, therefore, the limit of detectable genetic differences using the newest available techniques.

Genetic data obtained thus far (with proteins, mitochondrial DNA, and nuclear DNA) confirm the presence of distinct genetic stocks within the upper Midwest. In addition, results obtained for each of the diverse species studied are in general agreement. Stock boundaries generally

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Genetic Stocks
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conform to existing watersheds, although in some areas genetic stocks appear to correlate with older, postglacial watersheds. For example, populations in the upper Fox and upper Rock Rivers (Mississippi River basin) are genetically distinct from downstream populations located closer to the mainstem Mississippi River. Instead, they are genetically similar to populations from tributaries of Lake Michigan (Great Lakes basin). For management purposes, such results indicate that existing watersheds may form a starting point for the reduction of genetic risks associated with stock transfer, but additional information provided by this study will allow more precise identification of stock boundaries.

When the study is complete, recommendations for alterations to existing management practices (e.g., establishment of stock-based management units and geographical limits to transportation and introduction of fish) will be discussed with management biologists from all states involved. We hope that the information will be used to improve the efficacy of stocking where it is deemed necessary, and to protect the genetic integrity of our fisheries resources for long-term productivity.

Robert D. Fields and David P. Philipp, Center for Aquatic Ecology

Wetlands
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to relate these changes to the hydrology of the wetland. Initial results indicate that certain plant species, such as beggar-ticks, spikerush, and ragweed, fluctuate dramatically between wet and dry years. Monitoring of potentially problematic, aggressive plant species is continuing and, when necessary, control measures are taken. In November 1994, a controlled burn was conducted in an effort to help control cattail and reed canary grass. In response to this action, plant species diversity increased sharply, to over 60 species. Unfortunately, both target species increased slightly, while two highly desirable species (arrowhead and water plantain) decreased greatly. Based on these conflicting results, the use of fire as a management tool to control problem vegetation in the wetland is still being studied.

Finally, taking the restoration process one step further, surrounding areas are being restored to native prairie and oak savanna habitats. This continuing process involves many aspects of vegetation establishment and management, including the seeding and planting of prairie species and the regular use of fire to control problem vegetation and encourage the growth of fire-adapted prairie and savanna species. Continued monitoring of the entire restoration will ultimately allow the effectiveness of various habitat management techniques to be evaluated. Although restoration and management are ongoing, the overall goal of this project is to develop a natural, functioning, wetland-centered ecosystem that contributes to the natural resources of Illinois. Researchers also hope to gain valuable knowledge about the science of restoration and apply it successfully to similar types of restoration and management projects in the future.

Brian Wilm, Scott Simon, and Marilyn Morris, Center for Wildlife Ecology

A restored wetland at the Middle Fork River Forest Preserve.
As you walk in the woods during the fall and winter, you may discover a small tree with fragrant yellow blossoms. Your first thought might be that this plant has its seasons mixed up and “thinks” its spring. If you dust off your botany, though, you may recognize witch hazel, a small tree belonging to the plant family Hamamelidaceae and related to the sweet gum.

Illinois has one native species of witch hazel, *Hamamelis virginiana*, which grows in colonies in the understory of dry or moist woods. The plant seldom reaches more than 10 feet tall and can be identified by its scallop-margined leaves that turn brilliant yellow in the fall and are arranged alternatively on zigzagging branches. This allows each leaf maximum exposure to the sun filtering through its shady domain. The plant’s blossoms appear after the leaves have fallen, forming yellow clusters along the branchings and increases the likelihood that this year’s crop will have room to grow.

The tree has also been called water-witch. The word witch comes from an Anglo-Saxon word meaning “to bend.” The forked springy branches of witch hazel were used by early settlers, and later dowsers, as divining rods to search and detect underground water and minerals.

Native Americans showed pioneers how to make extracts for use as eye washes, liniment, and to stop bleeding. Modern uses include an astringent made from the tannin-rich bark, twigs, and leaves to be used on insect bites, stings, sunburn, and as a soothing after-shave lotion. In the past, even the army has used branches of witch hazel for camouflage purposes.

As you take a walk in the woods seek out the witch hazel’s yellow blossoms and popping seedpods as they bring a bit of a reprieve during those gray days of fall and winter.

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**Teacher’s Guide to “The Naturalist’s Apprentice” (facing page)**

**Flower Forms**

**Objective:** to learn some of the different arrangements of flower petals

**Materials:** multiple copies of *Flower Forms*

**Vocabulary:** corolla, petal, cross-pollination, pollen

**Comments:** Flowers are endlessly diverse and can be very simple or quite complex. These characteristics have long fascinated people and insects, but for different reasons. The arrangement and shape of the petals (corolla) of a flower help botanists identify the plant. The different petals also attract insects for the transfer of pollen from one flower to another. This process is called cross-pollination. In this edition of *The Naturalist’s Apprentice*, we will investigate some of the different flower petal (corolla) arrangements by trying to match descriptions with flower drawings.

**Procedure:**
1. Introduce the subject of flowers with the material presented above and in *Species Spotlight.*

2. Distribute copies of *Flower Forms* and have students match the description in column 1 with the correct flower picture in column 2. **Answers:** E, I, C, A, G, D, J, H, B, F

3. Have students try to name an insect that would be likely to pollinate each flower type.
**Flower Forms**

The arrangement of petals on a flower helps botanists identify a plant and also attracts insects to the flower to help the plant move pollen to other plants of the same species. This process is called cross-pollination. Read the flower descriptions in column 1 and find the flower type in column 2 that is closest to the description.

<table>
<thead>
<tr>
<th>Column 1</th>
<th>Column 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>petals surrounded by a small crown around the throat of the flower</td>
<td></td>
</tr>
<tr>
<td>cross-shaped flowers</td>
<td></td>
</tr>
<tr>
<td>funnel-shaped flowers</td>
<td></td>
</tr>
<tr>
<td>hoodlike or helmet-shaped</td>
<td></td>
</tr>
<tr>
<td>rays surrounding central disc</td>
<td></td>
</tr>
<tr>
<td>flat and wheel-like</td>
<td></td>
</tr>
<tr>
<td>flower with a pouch</td>
<td></td>
</tr>
<tr>
<td>a lone spur or tube at end of flower</td>
<td></td>
</tr>
<tr>
<td>tubelike flower</td>
<td></td>
</tr>
<tr>
<td>bell- or cup-shaped</td>
<td></td>
</tr>
</tbody>
</table>

**Diagram**

- A: petals surrounded by a small crown around the throat of the flower
- B: cross-shaped flowers
- C: funnel-shaped flowers
- D: hoodlike or helmet-shaped
- E: rays surrounding central disc
- F: flat and wheel-like
- G: flower with a pouch
- H: a lone spur or tube at end of flower
- I: tubelike flower
- J: bell- or cup-shaped
Introduced Crayfishes
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*conectes virilis* and the northern clearwater crayfish (*Orconectes propinquus*) occurred commonly in northern Illinois' lakes, creeks, and rivers. In areas where rusty crayfish are now found, both the virile and northern clearwater crayfish are either present in very small numbers or totally absent. The rusty crayfish is a large, aggressive species compared to other Illinois crayfishes and as such is able to force these other species out of habitats that provide refuge from predation. Deprived of these habitats, species such as the virile and northern clearwater crayfishes are either consumed by fish or mammal predators or are forced to move to other areas. Researchers outside of the Survey have shown that rusty crayfish can affect other members of the aquatic food chain by rapidly expanding their population sizes after moving into new habitats. These large populations can, over time, consume most of the aquatic vegetation used for refuge from predation by juvenile fishes.

In recent field work, INHS biologists discovered a population of a second non-native crayfish species in Illinois. The golden crayfish (*Orconectes rusticus*), a species that occurs natively in central and southern Missouri, was first collected in Illinois in 1992. Subsequent work has shown that a reproducing population of the golden crayfish occurs in a restricted portion of Apple Creek in Greene County and that displacement of native species is not apparent. In an effort to determine if rusty crayfish are unique in their ability to outcompete native crayfishes, future work will focus on determining if the golden crayfish is able to displace other species.

Current Illinois law prohibits the possession and sale of live rusty crayfish. Its strict enforcement represents the only means currently known to slow the spread of the rusty crayfish. Native Illinois crayfishes, especially our rare and endangered species, can ill afford to be forced from native habitat by foreign invaders.

Christopher A. Taylor, Center for Biodiversity