

Rust Never Sleeps

Trip at a Glance

Through a role-playing simulation, students focus on negative impacts on aquatic ecosystems created by the invasion of rusty crayfish. Students assume the role of rusty crayfish, native crayfish, juvenile fish, or largemouth bass.

Destination

Students will be able to

- ✿ Describe the effects that rusty crayfish have on aquatic ecosystems.
- ✿ Identify reasons why rusty crayfish populations have spread.
- ✿ Compare food chains that include native species and those that include introduced species.
- ✿ Describe the role crayfish play in aquatic food webs.

Adventure Levels

Grades 4–6

Areas of Interest

Science, Social Studies, and Mathematics

Locale

Open area such as a gym or schoolyard

Length of Stay

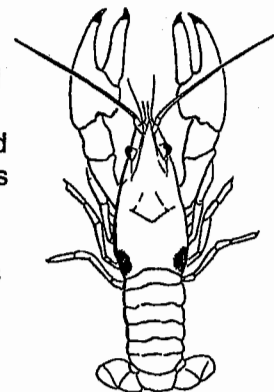
30–45 minutes

Invader Background Check

Crayfish ("crawdads") are found in almost all aquatic habitats of the Great Lakes region including lakes, creeks, rivers, and swamps. By feeding on plant materials, insects, and snails and by being a favorite prey item of sport fish, such as bass and sunfish, crayfish function as important members of aquatic food webs. The use of crayfish as fishing bait and for school projects has led to the introduction of nonnative or exotic crayfish species; one such species is the rusty crayfish. Commercial harvesters and ship ballast water have also been implicated as a means of transport.

Field work conducted by the Illinois Natural History Survey has documented that the rusty crayfish, a nonnative species first collected in Illinois in 1973, has rapidly expanded its range in the state. Since 1973 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.

Rusty crayfish cause a variety of negative impacts to aquatic ecosystems. They are a large, very aggressive species that can displace native crayfish. Being forced out of habitats that provide refuge from predators, native crayfish are either consumed by fish or mammal species, or forced to swim to other areas to feed. Rusty crayfish have also been shown to reduce aquatic plant abundance and diversity. In some lakes, plants have been nearly eliminated. These aquatic plants are important because they provide habitat for invertebrates, shelter for young fish, and nesting substrate for fish.



Foreign Language

Ecosystems
Exotic species
Food web
Rusty crayfish

Amenities Provided

Identification Tags 25.1–25.6
Rusty Crayfish Fact Sheet 25.7

Things to Pack

150–200 poker chips or cardboard squares to represent food (aquatic plants and insects)
Six rope circles to represent safe areas in aquatic plant beds
Dry erase board or paper
Mittens (optional)



Passport for Success

Students should have already been introduced to food chains, ecosystems, and exotic species.

Itinerary

1. Before the activity begins, prepare the Identification Tags. Make copies, laminate them (optional), and cut out individual tags. See step 4 for the number of each species needed to start the game. More rusty crayfish and adult bass are used as the game progresses, and additional tags are needed if variations are used as described in step 5 of "Directions."
2. Go over background information with students. Read the Rusty Crayfish Fact Sheet to the class for introductory information on why rusty crayfish possess many advantages. Present an overview of the simulation and read the rules for each species. (These are written on the Identification Tags found on activity sheets 25.1–25.6 and also provided below.)

Rusty Crayfish

You are safe as long as you are in the rope circle. If you are tagged, go to the sideline. In a real situation, crayfish would seek shelter under a rock or in vegetation.

You must collect 10 food chips in order to survive.

You can use two hands to collect and store your food.

You will be given an additional 20 seconds to feed (due to higher metabolic rate).

Native Crayfish

You are safe as long as you are in the confines of the rope circle. If tagged you must go to the sideline. In a real situation, crayfish would seek shelter under a rock or in vegetation.

You must collect 7 food chips in order to survive.

You can use only one hand to collect and store your food.

You may be asked to leave a plant bed if the rusty crayfish have outcompeted you.

You must leave the plant bed once all the food chips have been used up.

Juvenile Fish

You are safe as long as you are in the confines of the rope circle. If tagged you must go to the sideline.

You must collect 5 food chips in order to survive.

You can use only one hand to collect and store your food.

You may be asked to leave a plant bed if the rusty crayfish have outcompeted you.

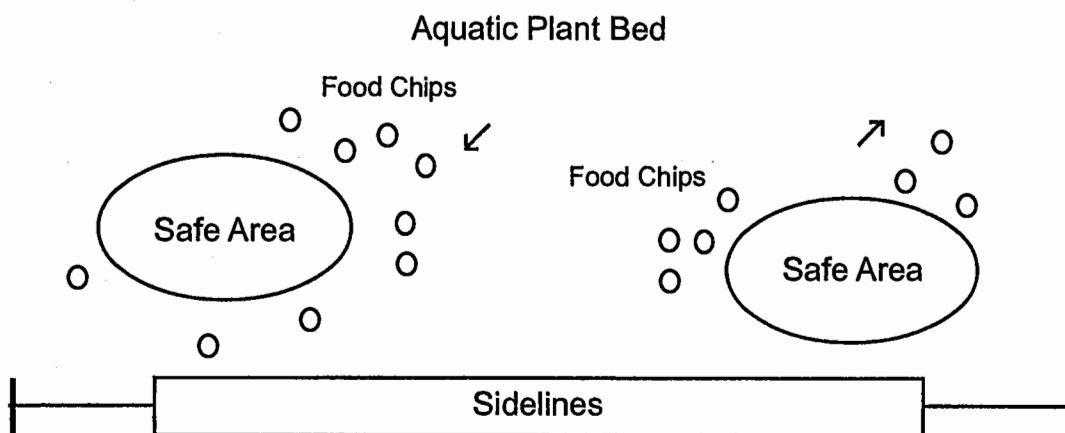
You must leave a plant bed once all the food chips have been used up. There can be only 2 juvenile fish at each plant bed. This number may change depending on class size.

Adult Bass

You may tag any crayfish or juvenile fish while they are feeding to indicate that you consumed them. You may not tag them if they are in the rope circle.

If you tag any crayfish or juvenile fish, you must walk them over to the sidelines before feeding again.

3. Set up the simulation area as shown below. Place the six rope circles in the playing area and scatter poker chips around each of the rope circles. The poker chips represent food items found in aquatic plant beds; the rope circles are safe areas in the aquatic plant beds. Poker chips can be divided evenly among each plant bed, or you can have some plant beds that are more productive (more chips) or less productive (fewer chips).



4. Distribute the identification tags to assign students roles as either adult bass, juvenile fish, rusty crayfish, or native crayfish. For a class of 25 students, you may wish to have five adult bass, five juvenile fish, ten native crayfish, and five rusty crayfish. This would reflect a situation just after rusty crayfish have been introduced into the area. Discuss the food chain that the simulation portrays, and have students visualize the habitat in the simulation as it might occur in its natural setting.
5. Conduct the simulation following the steps in "Directions," and have a follow-up discussion when students resume their seats in the classroom. Possible questions (with possible answers) include the following:

What happened to the native crayfish population as the game went on? *Native crayfish populations went down while rusty crayfish populations increased.*

Why did this happen? *They displace native crayfish such as the virile crayfish (*Orconectes virilis*) and the northern clearwater crayfish (*Orconectes propinquus*) in northern Illinois lakes, creeks, and rivers. Being forced out of habitats that provide refuge from predators, native crayfish are either consumed by fish or mammal species or forced to move to other areas.*

What happened to the rusty crayfish population and why? *They grow larger, are more aggressive, feed longer, and attain very high population densities. It has also been shown that because of this higher metabolic rate, rusty crayfish might consume twice as many invertebrates than do virile crayfish.*

How are juvenile fish affected by rusty crayfish? What might happen to the aquatic ecosystem if there are fewer juvenile fish? *Juvenile fish may need to compete with rusty crayfish for food sources. This bottleneck effect can reduce fish populations.*

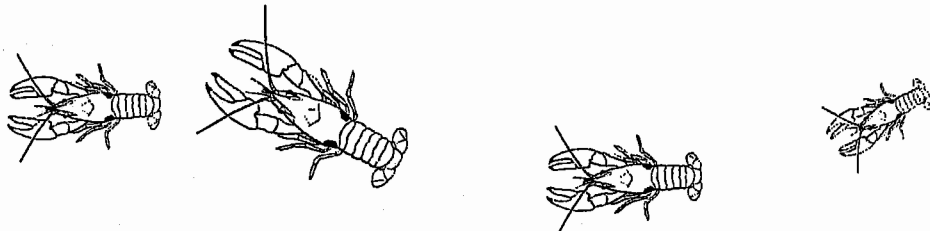
What other organisms might be affected by the introduction of rusty crayfish?

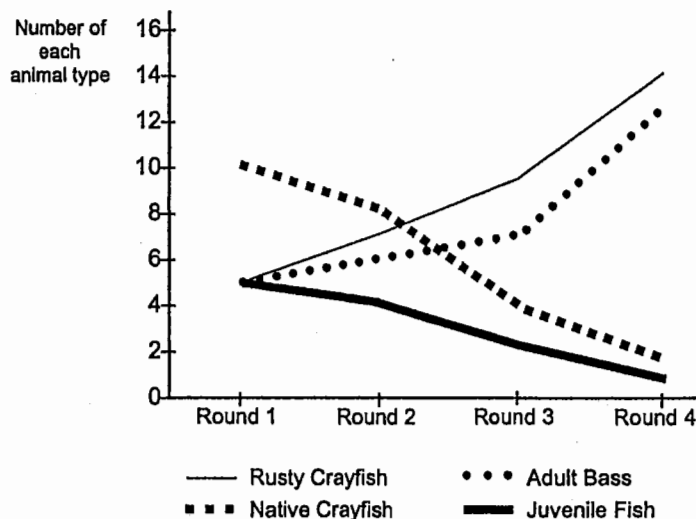
The available plankton for other species would decrease. There may be less vegetation available to fish that are dependent on vegetation for laying eggs. (Crayfish females carry fertilized and unfertilized eggs on the ventral side of their abdomen on the swimmerets; eggs are not laid on vegetation. Once hatched young crayfish may stay with the female for several weeks.)

6. Additional work to assign for assessment purposes includes the following:
- Draw or write a description of food chains that include native species and food chains that include introduced species.
 - List reasons why rusty crayfish have been able to outcompete native crayfish.
 - List other exotic species and impacts they have had on ecosystems.
 - List ways to get the public to help stop the spread of rusty crayfish (in the form of a public service announcement, poster, or sign). Raise awareness that crayfish used as bait or released from aquaria into the wild can cause biological pollution and can be illegal in some states.

Directions

1. Start the game by having the juvenile fish, native crayfish, and rusty crayfish feed by collecting food chips. (Adult bass are actively feeding throughout the game.) Stop the game after crayfish have had a chance to feed for a few minutes (depending on class size). Native crayfish and juvenile fish must now stop feeding, but rusty crayfish can continue for an additional 30 seconds.
2. If all the food chips have been used up at this time, inform the crayfish and juvenile fish that they must move to another plant bed. If there are food chips remaining, only the larger more aggressive rusty crayfish may stay and feed; the native crayfish and juvenile fish must leave.
3. Begin the feeding activity again and continue until all the food chips have been gathered or only rusty crayfish are left. Only the juvenile fish, rusty crayfish, and native crayfish that have collected enough food chips to survive will remain as they are for the start of the second round.
4. Begin the second round by having all tagged students on the sidelines reenter the game as adult bass or rusty crayfish. Native crayfish and juvenile fish that did not collect enough food reenter the game as rusty crayfish. Species that survived by collecting enough food chips will assume the same role as before. Count the numbers of each species for the beginning of the second round. This is the count used for your graph.
5. Continue game for another two or three rounds or as time permits. After each round compute the number of fish and crayfish that are ready to start the next round, and graph this data. For "Round 1" data, plot the numbers for each species that were used to start the game (at step 4 of the "Itinerary"). Plot the number of species starting the second round for "Round 2" of your graph, and so on. You may wish to try a round without any rusty crayfish or with only rusty crayfish and bass. The sample graph on the next page will differ from the results of a classroom simulation, but it is closer to the kind of results that are found in nature.





Travel Tips

- ✦ Instead of identification tags, different colored arm bands can be used to identify adult bass, juvenile fish, rusty crayfish, and native crayfish.
- ✦ Refer to the diagram at the beginning of this activity for setting up the playing area.
- ✦ Bring a dry erase board or note pad to graph results of population changes.
- ✦ Impress on students that aquatic ecosystems are very complex and that this activity is a very simplified version of what may happen.
- ✦ Be sure to adjust length of feeding time and number of each species for larger and smaller classes.
- ✦ The following benchmarks are from the Illinois State Learning Standards, and are likely similar to standards in other states. Contact your own state's board of education for your learning standard. Describe relationships among various organisms in their environments (science 12.B.2a). Explain how human activity affects the environment (social science 17.C.2c). Organize and display data using pictures, tallies, tables, charts, bar graphs, and line graphs (mathematics 10.A.2a).

Debriefing

Evaluation is based on the written responses to questions assigned at step 6.

Extending the Visit

- ✦ This activity can be used as an introduction to exotic species. Students may wish to research other exotic species and the impacts they have had on other ecosystems.
- ✦ On a state map have students locate areas where rusty crayfish are found today.

Places to Go

Web Sites:

Illinois Natural History Survey, Introduced Crayfish in Illinois Web site:
<http://www.inhs.uiuc.edu/chf/pub/surveyreports/jan-feb96/crayfish.html>



Sea Grant Nonindigenous Species (SGNIS) Web site: <http://www.sgnis.org>

Fact Sheets and Publications

Minnesota Sea Grant

Rusty Crayfish: A Nasty Invader, Biology, Identification, and Impacts. 1995. X34.

View at Minnesota Sea Grant Web Site: <http://seagrant.umn.edu/exotics/rusty.html>

Travel Agents

Tim Prange

Max McGraw Wildlife Foundation

Dundee, IL

Dave Guritz

Max McGraw Wildlife Foundation

Dundee, IL

Mary Mickus

Jurica Nature Museum

Lisle, IL

Identification Tags

Make five or more copies of this page.

Rusty Crayfish

You are safe as long as you are in the rope circle. If you are tagged, go to the sideline.

In a real situation, crayfish would seek shelter under a rock or in vegetation.

You must collect 10 food chips in order to survive.

You can use two hands to collect and store your food.

You will be given an additional 20 seconds to feed (due to higher metabolic rate).

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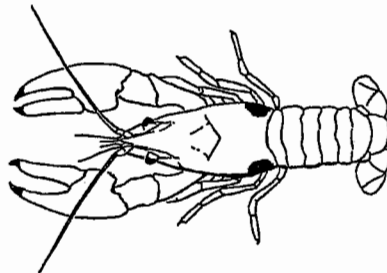
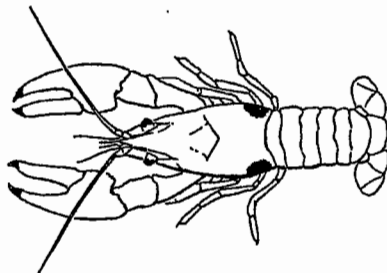
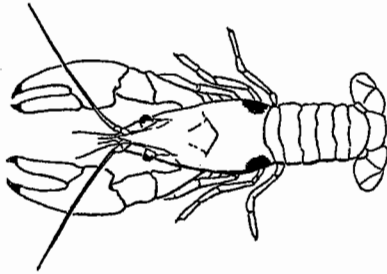
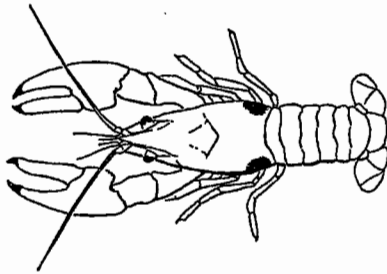
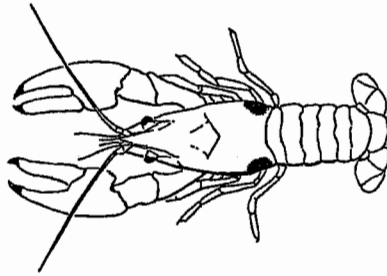
You must collect 10 food chips in order to survive.

You can use two hands to collect and store your food.

You will be given an additional 20 seconds to feed (due to higher metabolic rate).

Identification Tags

These drawings go on the backs of the Rusty Crayfish identification tags.



Identification Tags

Make five or more copies of this page.

Adult Bass

You may tag any crayfish or juvenile fish while they are feeding to indicate that you consumed them. You may not tag them if they are in the rope circle.

If you tag any crayfish or juvenile fish, you must walk them over to the sidelines before feeding again.

Adult Bass

You may tag any crayfish or juvenile fish while they are feeding to indicate that you consumed them. You may not tag them if they are in the rope circle.

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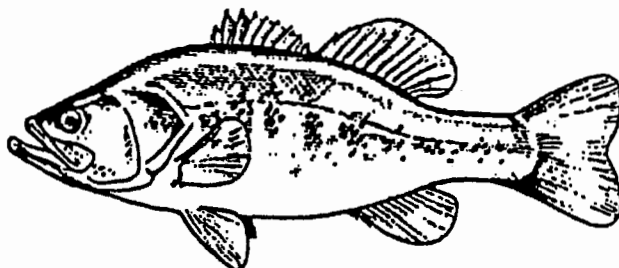
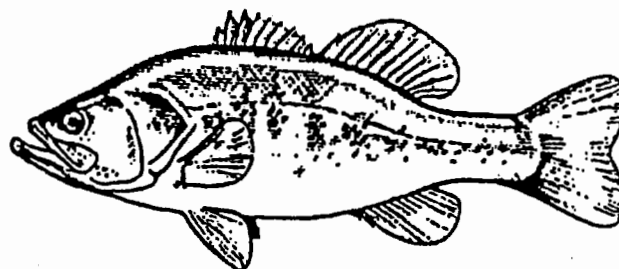
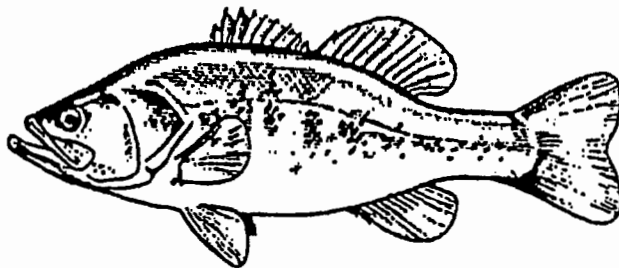
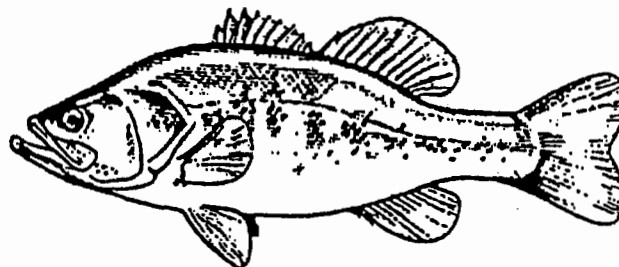
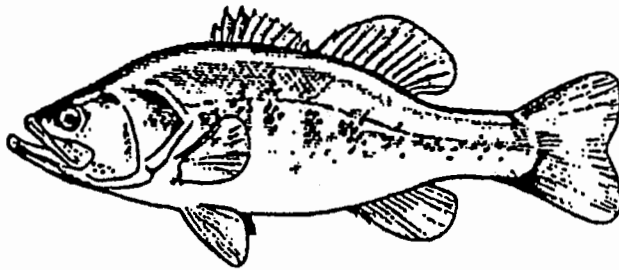
Adult Bass

You may tag any crayfish or juvenile fish while they are feeding to indicate that you consumed them. You may not tag them if they are in the rope circle.

If you tag any crayfish or juvenile fish, you must walk them over to the sidelines before feeding again.

Identification Tags

These drawings go on the backs of the Adult Bass identification tags.



Identification Tags

Make five or more copies of this page.

Juvenile Fish

You are safe as long as you are in the confines of the rope circle. If tagged you must go to the sideline.

You must collect 5 food chips in order to survive.

You can use only one hand to collect and store your food.

You may be asked to leave a plant bed if the rusty crayfish have outcompeted you.

You must leave a plant bed once all the food chips have been used up.

There can be only 2 juvenile fish at each plant bed. This number may change depending on class size.

Native Crayfish

You are safe as long as you are in the confines of the rope circle. If tagged you must go to the sideline. In a real situation, crayfish would seek shelter under a rock or in vegetation.

You must collect 7 food chips in order to survive.

You can use only one hand to collect and store your food.

You may be asked to leave a plant bed if the rusty crayfish have outcompeted you.

You must leave a plant bed once all the food chips have been used up.

Native Crayfish

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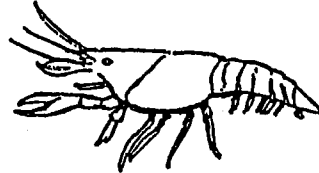
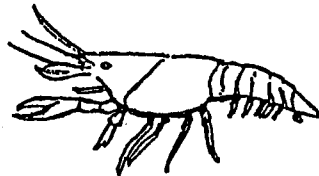
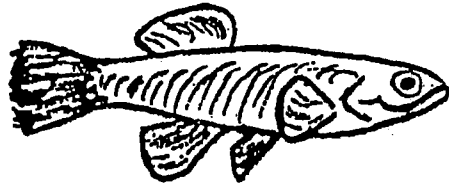
You can use only one hand to collect and store your food.

You may be asked to leave a plant bed if the rusty crayfish have outcompeted you.

You must leave a plant bed once all the food chips have been used up.

Identification Tags _____

These drawings go on the backs of the Juvenile Fish and Native Crayfish identification tags.



Rusty Crayfish Fact Sheet

Crayfish or ("crawdads") are found in almost all aquatic habitats of the Great Lakes region, including lakes, creeks, rivers, and swamps. By feeding on plant materials, insects, and snails and by being a favorite prey item of sport fish, such as bass and sunfish, crayfish function as important members of aquatic food webs. The appetite of sportfish for crayfish has led to the introduction of nonnative or exotic species. When fishermen use crayfish as bait, they often dump unused crayfish 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*). Rusty crayfish are also sold to schools by biological supply houses; these crayfish may have been released into the wild. Commercial harvesters and ship ballast water have also been implicated as a means of transport.

Rusty crayfish are thought to be native to the Ohio River basin, including such states as Ohio, Kentucky, and Indiana. Today they can be found in these states as well as in New Mexico, Minnesota, Michigan, Wisconsin, and all the New England states except Rhode Island. Fieldwork conducted by Illinois Natural History Survey biologists has documented that the rusty crayfish, a nonnative species first collected in Illinois in 1973, has rapidly expanded its range in the state. Since this time 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.

Rusty crayfish cause a variety of negative impacts to aquatic ecosystems. They are a large, very aggressive species that may displace native crayfish such as the virile crayfish (*Orconectes virilis*) and the northern clearwater crayfish (*Orconectes propinquus*) in northern Illinois lakes, creeks, and rivers. Being forced out of habitats that provide refuge from predators, native crayfish are either consumed by fish or mammal species or forced to move to other areas. In areas where rusty crayfish are now found, virile and northern clearwater crayfish are either present in small numbers or totally absent.

Rusty crayfish have also been shown to reduce aquatic plant abundance and diversity. In some lakes, plants have been nearly eliminated. These aquatic plants are important for aquatic ecosystems in that they provide habitat for invertebrates, shelter for young fish, and nesting substrate for fish. Although other crayfish eat aquatic plants, rusty crayfish eat even more because of their higher metabolic rate and appetite. They also grow larger, feed longer, and attain very high population densities. It has also been shown that because of this higher metabolic rate, rusty crayfish might consume twice as many invertebrates than do virile crayfish.

The activity "Rust Never Sleeps" focuses on some of the negative impacts rusty crayfish have had on aquatic ecosystems. Students take the role of rusty crayfish, native crayfish, juvenile fish, or largemouth bass during this activity.

This information was taken from the Minnesota Sea Grant publication, *Rusty Crayfish: A Nasty Invader* and Illinois Natural History Survey Document #2122 *Introduced Crayfishes in Illinois*.