The Lionfish Invasion!

For Teachers

An adult lionfish on a coral reef. (Photo credit: Paula Whitfield)

Ideas for the Classroom

Have students or student groups prepare one or more public education programs about invasive species. Encourage students to consider various media, including publications (e.g., flyers, posters or fact sheets), visual publications, videos, drama, music, etc.

Have students write a short essay on why knowledge about invasive species is (or might be) important in their own lives.

Have students investigate possible explanations for the introduction of an invasive species of local or regional concern, and prepare a written report outlining at least one hypothesis that explains how this invasive species was introduced into its non-native habitat. The report should also explain:

- The nature of the invasive species.
- The native range of the species.
- The new, non-native range of the species, as far as it is known.

Learn More:

- Thinking Like a Scientist
- Student Guide
- Take the Quiz!
- **For Teachers**

1. Welcome
   - run-ins with an invader
2. What is an invasive species?
3. Lionfish Invade U.S. Coastal Waters!
4. Is the Aquarium Trade to Blame?
5. Some Lionfish Biology
   - biology fact sheet
6. Can We Stop the Invasion?
7. References

Ask an Expert

Report Lionfish Sightings

- The ecological impact of this species, or its potential impact. For example, has this species or might this species alter the predator/prey relationships of its new environment? Is it likely to be a better competitor than native species, and thus displace them? Might this species introduce new diseases or parasites to its new environment?

- The possible economic impacts of this species, or its potential impacts. Is this species a direct threat to human health?

A good starting point for this research is the online resources in the “Student Guide” section. The “For Teachers” section also has some useful online resources. If possible, have each student or student group choose a different species. Lastly, lead a discussion of student’s research results.

Have students answer one or more of the following questions in a report or an oral presentation:

- Besides lionfish, are there other invasive species in the Atlantic Ocean threatening the ecosystems there?

- Are lionfish, as an invasive species, a problem in other parts of the world? Is the only lionfish invasion in the Atlantic?

- How might global warming affect the invasion of lionfish in the Atlantic?

- How can we increase public awareness of the potential harm to ecosystems done by invasive species such as the lionfish?

- Are there any introduced species that were thought originally to be harmful (invasive), that turned out to be beneficial to the ecosystem?

- Are there other examples of ecosystems that have been affected by invasive species? What were the effects and what solutions were tried? How would these solutions work for the lionfish invasion in U.S. Atlantic waters?

- What is the reproductive rate of lionfish? With no natural predators and based on the current numbers in the Atlantic, how long will it take before lionfish outnumber some of the natural species that live there?

Scientists have speculated that six lionfish were released from a flooded marine aquarium in Florida because of Hurricane Andrew in 1992. At least one of these individuals was seen alive several

days later. Have students speculate about the answers to the following questions, and then generate some hypotheses about how lionfish might have colonized the Atlantic.

- How did lionfish find their way to the Atlantic Ocean?
- Were the released aquarium lionfish the source of the population that lives in the Atlantic Ocean today?
- Why do scientists think that the aquarium trade is the vector for the introduction of lionfish? What kind of evidence would they need to support their hypothesys?

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Printable Materials

Click on the links to view or print for use as handouts. Includes all the text and images of the Web site content.

Chapters (with Glossary):

• The Lionfish Invasion! (pdf, *460Kb*), includes:

- 1. Welcome to *The Lionfish Invasion!*
- 2. What is an Invasive Species?
- 3. Lionfish Invade U.S. Waters!
- 4. Is the Aquarium Trade to Blame?
- 5. Some Lionfish Biology
- 6. Can We Stop the Invasion?
- 7. References
- Glossary

Chapter Supplements:

• Run-ins With an Invader! A Chronicle of Lionfish Sightings in U.S. Waters (pdf, *168Kb*)

• Lionfish Biology Fact Sheet - Microsoft Word text version (*doc, 36Kb*),
Adobe Acrobat version (*pdf, 128Kb*)

Supporting Resources:

• Thinking Like a Scientist (pdf, *232Kb*) - Includes the supplement page: Profile of a NOAA Scientist: Paula Whitfield

• Student Guide (pdf, *140Kb*), Glossary (pdf, *112Kb*)

• Take the Quiz! - Microsoft Word text version (doc, *40Kb*)

• Quiz Answers - Microsoft Word text version (doc, *44Kb*)

• For Teachers (pdf, *100Kb*)

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Links to Lesson Plans

Alien Invasion!
http://oceanservice.noaa.gov/education/classroom/lessons/06_coastal_alien.pdf

For Grades 9-12 (easily adapted for middle school students). This introductory lesson from NOAA's National Ocean Service introduces students to the broad concept of invasive species. Students prepare a written case study on an invasive aquatic species, followed by an oral presentation. The lesson plan provides a list of possible species to choose from, and information about their introduction, impact, and control. Suggestions for extensions are also provided.

Real-Life Aliens: Introduced Species
http://www.actionbioscience.org/lessonaccess/simberloff.html

Advanced/AP High School and undergraduate level. This lesson examines issues stemming from introduced and invasive species. Students can gather statistical information about local invasive species, interview animal and plant inspectors at an international airport, investigate the pet parrot trade, and more.

Aquatic Invaders
http://www.nationalgeographic.com/xpeditions/lessons/14/g68/invaders.html

For Grades 6-8 (easily adapted for lower high school level). In this activity from the National Geographic Society, students explore the ways that native species interact in a healthy Chesapeake Bay. They then learn how exotic and invasive species can threaten the balance of the ecosystem. Students discover how various elements of the Bay's ecosystems are interconnected and investigate some of the issues associated with invasive species.

Venom!
http://www.pbs.org/oceanrealm/intheschool/school3.html

For Grades 9-12. A classroom activity from PBS that is supported by the Secrets of the Ocean Realm episode "Venom!", which

investigates the behaviors of creatures that sting and those that are able to circumvent the use of venom (available from PBS on DVD). In this activity, students learn about the nature of venom and the treatment of envenomation. They conduct an experiment to demonstrate how proteins such as venoms can be denatured. For additional information on ocean creatures that are venomous (including lionfish), see this related Web page from PBS: http://www.pbs.org/oceanrealm/seadwellers/index.html

Discovery School Lesson Plan on Invasive Plants
http://school.discovery.com/lessonplans/programs/galapagos-beyonddarwin/

For Grades 6-8 (easily adapted for grades 9-12; standards given for all grade levels). Students investigate endemic and introduced species in the Galapagos Islands, and observe how one native species has been endangered by an invasive one.

Battlefield Earth
http://www.thirteen.org/edonline/ntti/resources/lessons/battle/index.html

For Grades 9-12. Using the Internet, students research the complications and environmental impact non-native species can have on ecosystems. Students conduct a Web quest to identify other regions of the world that are damaged due to the introduction of non-native species. Students create digitized posters that highlight their particular area of research, and discuss and draw similarities and differences between regions. Finally, students select an indigenous species that has been impacted by a non-native species and devise a population control method for restoring the indigenous species to its natural status in the ecosystem.

Environmental Inquiry: Invasive Species
http://ei.cornell.edu/ecology/invspec/

For Grades 9-12. Two great student field activities: 1) Early Detection Surveys and 2) Plot Sampling: Density. Click on the link titled “Invasion Ecology” at the very bottom of either activity to go to the downloadable student worksheets, peer review forms, assessment rubrics, test questions, background material, links and more.

Growing Native in Your Community/The Power of Invasion
http://www.wildlifehc.org/managementtools/backyard-growingnative.cfm

For Grades 6-8 (easily expanded and adapted for high school students). These three lesson plans from the Wildlife Habitat Council can be used in succession or alone. They introduce students to the concepts of native plant communities and the wildlife that inhabits them. Students study native and invasive

species in the classroom and learn to identify them in the wild. Some exercises can be done in the classroom.

Invasive Species Video and Lesson Plan
http://paipm.cas.psu.edu/invasiveplan.html

For Grades 9-12. This video, hosted and narrated by BugMobile, the famous talking Volkswagen, identifies the effects that people and their activities have on watersheds, explains species diversity, introduces species classified as pests in their new environments, and analyzes the benefits of Integrated Pest Management to the environment and society. Each video includes a lesson plan with pre- and post-tests, discussion questions and suggestions for related activities. There is a cost associated with the videos, but the lesson plans are available for free download at this Web site.

Pushy Plants and Alien Animals
http://www.naturalsciences.org/conservation/invasives/index2.htm

For Grades 6-12. A great interactive exercise on invasive plants and animals geared toward the fauna of North Carolina. The exercise could be adapted for most locations in the southeastern United States.

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Online Resources for Teachers

Invasivespecies.gov
http://www.invasivespecies.gov

This Web site is one-stop shopping for everything you ever wanted to know about invasive species and the gateway to Federal efforts to control them. Learn about the impacts of invasive species and the Federal government's response, read select species profiles, and find links to agencies and organizations dealing with invasive-species issues. Invasivespecies.gov is also the official site for the National Invasive Species Council, which coordinates Federal responses to the problem.

NOAA's National Center for Research on Aquatic Invasive Species
http://www.glerl.noaa.gov/res/Programs/ncrais/ncrais.html

An introduction to the National Ocean and Atmospheric Administration's (NOAA's) National Center for Research on Aquatic Invasive Species. The Center's mission is to understand, prevent, respond to, and manage aquatic species invasions in U.S. coastal ecosystems. The Center's broad goal is to foster, coordinate, and support aquatic invasive species research throughout and across

NOAA.

The Bridge
http://www.vims.edu/bridge/

The Bridge is a growing collection of the best marine education resources available on-line. It provides educators with a convenient source of accurate and useful information on global, national, and regional marine science topics. Resources are organized as indicated on the sidebar on the left side of the screen.

Aquatic Invasive Species: An Educators Information and Materials Guide
http://www.seagrant.umn.edu/exotics/ais_guide.pdf

A compilation of selected educational material on aquatic invasive species for K-12 teachers and informal educators. Entries include curricula, print materials, posters, videos, books, CDs and Web sites.

Invasion Ecology
http://ei.cornell.edu/pubs/ie.asp

Developed by the Cornell Environmental Inquiry Program, Invasion Ecology consists of a student edition and teacher's guide designed to enable high school students to carry out authentic research. By studying non-native invasive species such as purple loosestrife and Phragmites, students will learn about the links between biology and ecology—and explore how scientists are fighting these aggressors with biological controls. Invasion Ecology was published by the National Science Teachers Association.

Case Teaching Notes for "Exotics"
http://ublib.buffalo.edu/libraries/projects/cases/exotics/exotics_notes.html

These case notes examine the biological, ecological, social, political, and economic factors surrounding exotic species, as well as the role of resource managers in shaping public policy on environmental issues. Although aimed at the college level, this is excellent background reading for 9-12 teachers.

USGS—Nonindigenous Aquatic Species Web Site (includes a searchable database**)**
http://nas.er.usgs.gov/default.asp

This Web site is a central repository for accurate and spatially-referenced biogeographic information on nonindigenous aquatic species. It provides scientific reports, online/real-time queries, spatial data sets, regional contact lists, and general information. These data are for use by biologists, interagency groups, and the public. The geographical coverage is the United States.

Global Environmental Change: Introduced Species
http://nsta.tasco1.com/showItem.asp?product=PB138X04&session=F37615A549CE420792971A5EFA692978

Introduced Species is one of four books in NSTA Press's Global Environmental Change series, a joint project of NSTA Press and the U.S. Environmental Protection Agency. Seven inquiry-based activities--using pillbugs, the school grounds, species dispersal maps, and introductory genetics--provide students with the skills they need to address the problem of nonindigenous species.

Aliens in Your Neighborhood: Invasive Species and the National Parks
http://www.nps.gov/invspcurr/alienhome.htm

Aliens In Your Neighborhood is an introduction to the National Park Service's curriculum on invasive plants. It addresses key national strategies and enables students to become working partners with the National Parks System as citizen scientists.

Invasive Species Educational Resources
http://www.invasivespecies.org/resources/

A compilation of educational resources on invasive species and integrated pest management. This Web site is sponsored by the National Science Foundation Center for Integrated Pest Management.

The Impacts of Introduced Species to the United States
http://gcrio.gcrio.org/CONSEQUENCES/vol2no2/article2.html

An easy-to-understand article by Daniel Simberloff, a leading ecologist, about the status and biology of introduced species in the United States. Published in the respected online journal, Consequences: The Nature and Implications of Environmental Change.

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National Science Education Standards

SciLinks, a major product of the National Science Teachers Association (NSTA), identifies Web-based, educationally appropriate science content that provide useful background information to students and teachers. All Web pages cited in SciLinks adhere to rigorous NSTA criteria and have been formally evaluated by NSTA professionals. NSTA members may access this directly from NSTA's SciLinks Web site (www.scilinks.org) through a list of keywords. SciLinks also support most major textbook

publishers and is directly referenced in more than 45 science textbooks, and other publications as well, enabling all teachers and students to access its database of vetted resources.

Below, you will find the SciLinks Web site keywords featured on the SciLinks Web site that are appropriate to the topic of invasive species (*The Lionfish Invasion!*) and the corresponding National Science Education Standards arranged by subject, topic and concept:

SciLinks Keyword

- Subject
  - º Topic
    - >Concept

SciLinks Keyword: Invasive Species

• **Subject:** Science in Personal and Social Perspectives

º **Topic**: Natural and human-induced hazards

> Concept: **Invasive species destroy ecosystems as surely as chemical pollution or human population growth with associated development. Whether they are called invasive, non-native, alien, exotic, or nonindigenous, introduced species are those that evolved elsewhere and have been purposely or accidentally relocated. Introduced species often find no natural enemies in their new habitat and therefore spread easily and quickly.

SciLinks Keyword: Human Impact

• **Subject:** Science in Personal and Social Perspectives

º **Topic**: Natural and human-induced hazards

> Concept: Human activities can enhance potential for hazards.

SciLinks Keyword: Ecology

• **Subject:** History and Nature of Science

º **Topic**: Science as a human endeavor

> Concept: ** Ecology is the study of relationships between living things and

their environment.

SciLinks Keyword: Aquatic Biomes

• **Subject:** Life Science

º **Topic**: Populations and ecosystems

> **Concepts:**

All populations living together and the physical factors with which they interact compose an ecosystem.

** Marine ecosystems cover almost three-quarters of the Earth's surface and contain about 97 percent of the Earth's water supply.

****Non Standard Web Page - NSES Concept Correlation:**

Some of the keywords featured in SciLinked publications don't have a perfect fit to the National Science Education Standards. These keywords may rely wholly or in part on customized Standards Concepts. NSTA educators have written these Concepts in the spirit of the Standards, but they don't appear in the official NSES publication.

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Scilinks Icon Information

The icons below are used on NSTA's SciLinks Web site (www.scilinks.org) to identify characteristics of the Web pages in its database. Resources available in *The Lionfish Invasion!* include:

 Lesson Idea
 Online Interactivity
 Graphics / Multimedia
 In the News
 Career
 Core Content
 Assessment

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