San Francisco Bay Invaders
Watch it online http://www.kqed.org/quest/television/view/332
TV story length 9:16 minutes

PROGRAM NOTES
If you go exploring around the shores of the San Francisco Bay you’ll discover unwanted tourists from all over the world. Exotic species of mussels, clams, worms, seaweed and more are choking out native species and changing the bay’s ecosystem. Experts around the state are now trying to change the human behavior that brings these unwelcome visitors here.

In this segment you’ll find…

- why exotic species are a problem in the San Francisco Bay.
- how species from all over the world get into our bay.
- what is being done to prevent the further arrival and settlement of exotics.

TOPIC BACKGROUND
Invasive or exotic species are organisms that have moved into an area where they do not normally live. They may reproduce so aggressively that they can push out or eliminate native species. When invasive species move into a new area, they don’t encounter their normal predators and often they can out-compete the natives for resources. At least 250 invasive species currently live in the San Francisco Bay. Over half of the fish species and most of the bottom-dwelling invertebrates aren’t native to this area.

When invasive species enter a region and push out the natives, they slowly change the whole ecosystem. Exotics decrease the biodiversity of an area. All the previous interactions between native organisms change and the once-diverse area can end up being dominated by the newcomers or looking like somewhere else. This has a huge impact on all of the surrounding ecosystems, too.

Invasives get here through a variety of ways but are almost always brought by humans. Some species, such as the bullfrog, American oyster and striped bass, were purposely introduced as food resources. Other species are accidently introduced through home aquariums or gardens, or when they hitch a ride in the worm boxes of fishermen. But most of the Bay’s invasives come from ballast water.

Ballast water is picked up by an empty ship at its home port to provide stability when it sails. Hundreds of marine organisms board the ship along with the water. Some organisms die en route due to lack of food and light. Many survive, however, and are released with the water at the ship’s destination, which can be thousands of miles away from where it started.

In 2006, Governor Arnold Schwarzenegger signed into law a bill proposed by State Senator Joe Simitian of Palo Alto. It says that starting in 2009, all ballast water must be regulated and no organisms bigger than 50 microns can be discharged. By 2020, ballast water discharge must contain no detectable organisms of any size. The shipping industry is working on solutions to eliminate the spread of exotics, but no technology is currently available to meet these standards.
PRE-VIEWING

- Discuss the importance and fragility of marine organisms and coastal waters.
- What do you know about invasive species?
- Why is it important to protect and maintain healthy populations of native species?
- Brainstorm ideas on how invasive species might be spread either by humans or other means.
- How might invasive species affect biodiversity?

VIEWING FOCUS

NOTE: You may choose to watch the television segment twice with your students: once to elicit emotional responses and get an overview of the topic and again to focus on facts and draw out opinions.

- Record any facts you find interesting while you watch.
- List at least three exotic species found in the San Francisco Bay.
- How do exotic species impact native species?
- Why is it a big deal if exotics enter our bay and change the ecosystem?
- How do the majority of these exotics get to our bay?
- What is ballast water?
- What is the government doing to prevent the further spread of exotics in our waters?

POST-VIEWING – Links to activities mentioned can be found on the following page.

- Review students’ answers to the Viewing Focus Questions.
- Create educational material about invasive species in the San Francisco Bay. Encourage students to consider making brochures, fact sheets and posters, create a skit or make a video to educate others about invasive species.
- Write a story about how invasive species might affect your own life and why it’s important to educate others about the growing number of invasive species in the bay.
- Research and design a method to eliminate the spread of invasive species in ballast water on ships. Use the West Coast Ballast Outreach Project Web site for new technology ideas.
- Participate in the Bay Area Ant Survey. Students can collect ants in the schoolyard and contribute to an important citizen science project.
LESSON PLANS / ACTIVITIES

West Coast Ballast Outreach Project
http://ballast-outreach-ucsg.ep.ucdavis.edu/
• Here you can find educational material on ballast waters and exotic species. The Web site includes a poster, brochure, newsletters and videos on ballast water invasives and a comprehensive exotic species photo gallery.

Bay Area Ant Survey California Academy of Science
http://www.calacademy.org/education/baas/educator_resources.html
• Look here for workshops, ant collecting kits and additional Web resources related to the Bay Area Ant Survey, where students become citizen scientists and help collect data about native and invasive ants in their area.

The STRAW Project The Bay Institute
http://www.bay.org/watershed_education.htm
• STRAW provides teachers and students with the scientific, educational and technical resources to prepare them for hands-on, outdoor watershed studies, including ecological restoration of riparian corridors.

ARTICLES / READING

Biological Invasions Program San Francisco Estuary Institute
http://www.sfei.org/bioinvasions/index.html
• Here you'll find an overview of the goals and objectives of the program along with publications and recent findings.

“Guide to the Exotic Species of San Francisco Bay”
http://www.exoticsguide.org/
• This site contains a species gallery with pictures and information on common San Francisco Bay invaders.

California State Ballast Water Program
• Find information on ballast water regulations, discharge standards and recent publications.

California Marine Invasive Species Monitoring Program
http://www.dfg.ca.gov/ospr/about/science/misp.html
• This Web site contains data from baseline surveys of invasive species in California’s marine, estuary and tidal freshwater environments, legislation information, and ongoing sampling locations.

San Francisco Bay: 2K California Academy of Sciences
http://www.calacademy.org/research/izg/SFBay2K/titlepage.htm
• This ongoing study collects data about the benthic (bottom-dwelling) species of San Francisco Bay, including distribution of invasive species. The site includes information about the study, images of benthic species, distribution maps and sampling activities.

Some (exotic species) have relatively little effect (and ) don’t become that common...but a single exotic species, in some cases, has altered the way the ecosystem functions. — Andy Cohen

Look for the indicating resources from QUEST partner organizations
**FIELD NOTES**

**Go outside and...**

- Help eliminate invasive species
  - Get involved with one of the organizations below to help stop the further spread of invasive species in the bay.
  - The Bay Institute [http://www.bay.org/main.htm](http://www.bay.org/main.htm)
  - Save the Bay [http://www.savesbay.org/](http://www.savesbay.org/)
  - National Park Service [http://www.nature.nps.gov/im/units/sfan/vital_signs/Invasives/weed_watchers.cfm](http://www.nature.nps.gov/im/units/sfan/vital_signs/Invasives/weed_watchers.cfm)

- Discover the bay
  - Visit an intertidal area or a dock where invasive species may live.
  - Sketch or take pictures of the organisms you see and identify your organisms in the exotics guide. [http://www.exoticsguide.org/](http://www.exoticsguide.org/)

**FIELD TRIP**

**Visit...**

  - Pier 39, San Francisco, CA 94133
  - See native species of fish and invertebrates found in the San Francisco Bay.
  - Visit the touch pools and feel the organisms in the intertidal zone.

- Elkhorn Slough
  - 1700 Elkhorn Road, Watsonville, CA 95076
  - [http://www.elkhornslough.org/invader.htm](http://www.elkhornslough.org/invader.htm)
  - Paddle around the wetlands of the slough, look at wildlife and keep watch for unwanted invaders. Take photos and join the KQED QUEST Elkhorn Slough group on Flickr.com to link your photos to the QUEST Exploration. [http://www.kqed.org/quest/exploration/view/24](http://www.kqed.org/quest/exploration/view/24)

**FIELD RESEARCH**

**Find out more about...**

- Ballast water
  - Visit the West Coast Ballast Outreach Project Web site to learn all about ballast water and what technology is being developed to prevent the spread of exotics.

- San Francisco Bay invasive species
  - Research one or two species not native to the Bay Area and find out what impact they are having on native populations.

**FIELD TEST**

**Experiment with...**

- Collecting your own ants
  - Participate in the California Academy of Sciences’ citizen science program and learn about native ant species found in your own backyard. [http://www.calacademy.org/education/baas/index.html](http://www.calacademy.org/education/baas/index.html)

- Identifying invasive species in your own backyard
  - Explore your backyard or a local park. Take photographs or draw pictures of some of the grasses, weeds and trees.
  - Look up the species in field guides or on the Internet to identify the plants in your neighborhood.
  - How many of the species are native and how many are exotics?
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VISIT OUR PARTNERS

The Bay Institute
www.bay.org

California Academy of Sciences
www.calacademy.org

Chabot Space and Science Center
www.chabotspace.org

East Bay Regional Park District
www.ebparks.org

Exploratorium
www.exploratorium.edu

Girl Scouts of San Francisco Bay Area
www.girlscoutsbayarea.org

Golden Gate National Parks Conservancy
www.parksconservancy.org

Lawrence Berkeley National Laboratory
www.lbl.gov

Lawrence Hall of Science
www.lawrencehallofscience.org

Oakland Zoo
www.oaklandzoo.org

The Tech Museum of Innovation
www.techmuseum.org

UC Berkeley Natural History Museums
http://bnhm.berkeley.edu/

OTHER WAYS TO PARTICIPATE IN QUEST

LOG ON
kqed.org/quest

LISTEN
KQED 88.5 FM San Francisco & 89.3 FM Sacramento
Fridays at 6:30am and 8:30am

WATCH
KQED Channel 9
Tuesdays at 7:30pm

PHOTO CREDITS

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