



MARINE BIOTECHNOLOGY & BIOINFORMATICS FOR TEACHERS
MOSS LANDING MARINE LABS NSF ITEST GRANT
TEACHER LESSON PLAN FOR CLASSROOM USE
WHY ARE THE SHORE BIRDS DYING?

Title of Lesson: Why are the shore birds dying?

Designed by

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Background

Students will collect data and make observation in the field while investigating the possible cause of death of shorebirds. This activity is designed to help students develop field sampling and observation techniques, experience the natural habitat, and the effects of invasive species on population dynamics and biodiversity. Through bioinformatics research, students will make connections between the invasion of non-native species and their impact on the native species.

Description of Audience: This biotechnology/bioinformatics activity is designed for use by 9th – 12th grade students of diverse cultural background and various skill levels.

State Standards: This biotechnology/bioinformatics activity fulfills the following State of California Science Standards:

- Biology 6b: *Students know* how to analyze changes in an ecosystem resulting from changes in climate, activity, introduction of nonnative species, or changes in population size.
- Science Investigation and Experimentation m: Investigate a science-based societal issue by researching the literature, analyzing data, and communicating, the findings.

National Standards: This biotechnology/bioinformatics activity fulfills the following National Science Standards:

- Standard A: Develop abilities and understanding in field of scientific inquiry
- Standard C: Expand understanding of life sciences
- Standard F: Explore an important issue of science in a social perspective

STEM Connection: The following careers can be tied to this activity:
Biological technician, biostatistician, wildlife biologist, environmental health scientist, and environmental science and protection technician.

Goals(s):

The goal of this lesson is to answer questions such as:

- What makes a species survive better in a specific area?
- Why is an invasive species effective?
- What environmental implications do endangered species have?

Learning Objective(s)

Upon completion of this lesson, students will be able to:

- perform field surveys and observations, and make detailed and valid records
- analyze population data
- compare niches between native and non-native species

- determine the effects of invasive species on the ecosystem

Purpose/Rationale

This lesson is designed to allow students to experience a biologically diverse environment that has been invaded by invasive species. As they use scientific survey techniques and analyze population size, the concepts of invasive species population explosion and niche replacement become concrete. Through these activities, students visualize the interconnectedness of organisms and thus develop an understanding for the importance of biodiversity and the harmful effects of invasive species on the entire ecosystem. These concepts align with National Science Education Standards A: Develop abilities and understanding in field of scientific inquiry; C: Expand understanding of life sciences; and F: Explore an important issue of science in a social perspective.

Materials/Resources

In order to complete this lesson, the following materials are needed:

Student field guides
Survey worksheets
Clipboard and pencils
Transect lines and quadrates
Digital cameras
Laptop computer

Prior Teacher Preparation

To get ready for this lesson, teachers should research on the native and non-native flora and fauna of the area of interest. It is helpful to prepare field guides that are customized to the location and the students' skill level and survey worksheets for student use in the field. Transportation and other logistics of the field trip must be coordinated prior to the trip. Sampling equipment such as transect lines and quadrates can be bought from laboratory supply companies or may be loaned from local research facilities or wildlife centers.

3-Step Procedure

#1 Introduction

- Expand students' prior knowledge of analyzing the morphology and species identification of invasive and native species of mussels to a broader view of the ecosystem.
- Find out what students' ideas are on the concerns for invasive species - uncover misconceptions!
- Review vocabulary: invasive species, native species, and non-native species.
- Use PowerPoint presentation to introduce the concepts of ecosystem, community, niche, population, population size, and biological survey.
- Form four field groups of five students. Communicate tasks and expectations with students.

#2 Exploration

- While in the field, students will work in groups to perform observations and surveys on native and non-native organisms. They will practice these techniques following protocol and record data accurately on prepared worksheets.
- Path of inquiry: What are the physical characteristics of this habitat? What organisms reside in this habitat? Which ones are native species and which ones are non-native? How do scientists determine their population size? Students will answer these questions on the prepared worksheets.
- Students compare the niches occupied by various organisms. They will discuss the effects of competition between native and non-native species. They will examine the theory of niche overlapping and competitive exclusion and its implications on biodiversity and the overall stability of the ecosystem.

#3 Application

- Students will share results of their population survey and their observations on the niches occupied by different species.

- Provide students with population data of the invasive European Green Crab (*Carcinus maenas*). They are to map the distribution and invasion history of the European Green Crabs world wide. Then they will use Excel to analyze population data and chart the population growth.
- Students will use the internet to research on the correlation between the rise of the European Green Crab population and the increased death toll of shore birds.
- Student interest can be extended by further research on distribution and population dynamics of other native and non-native species.
- A good follow-up activity to reinforce concepts learned today is to select one of the invasive species of interest and track the population growth in a certain environment over time. Students can predict its effects on the habitat and which native species will be impacted most due to overlapped niches and competitive exclusion.
- This activity allows students to practice biological survey techniques and data analysis. Therefore, it may be related to careers in any biological and environmental research fields that involve field sampling or data analysis, for example, biological technician, biostatistician, wildlife biologist, environmental health scientist, and environmental science and protection technician.

Assessment

- Student understanding may be assessed by their entries in field survey and their responses on the mapping worksheets.
- Each group will develop a PowerPoint presentation to explain the connection between the European Green Crab and the shorebird populations. This assessment tool provides evidences for understanding the complex implications of non-native species have on an ecosystem.
- Goals and learning objectives are met when students can explain the death of shorebirds due to a parasite carried by the invasion of the European Green Crabs, rather than the direct competition in the niche. This demonstrates students' understanding on the complexity of the ecosystem and the multitude of impacts by non-native species.
- An alternative activity for a student with a special need will be reading publications on non-native species or visiting websites that explain the effects of non-native species in great details.
- Students who choose to go beyond the scope of this activity are encouraged to explore their local environment, identify an invasive species of interest, and discuss the possibility of a monitoring or eradication project with local environmental organizations, research facility, or government agencies.

Teachers' Self Evaluation

Reflect on strengths and weaknesses of the lesson as taught.

- Describe individual student responses to techniques used. How did they react?
- Discuss student "thinking" and ideas.
- Include samples of students answers on lab sheet or journal entry (photocopy is fine).
- Ask students for a brief evaluation of lesson. Include their responses.
- Discuss fulfilled and unfulfilled expectations. Any surprises?
- In retrospect, how would you modify this lesson?