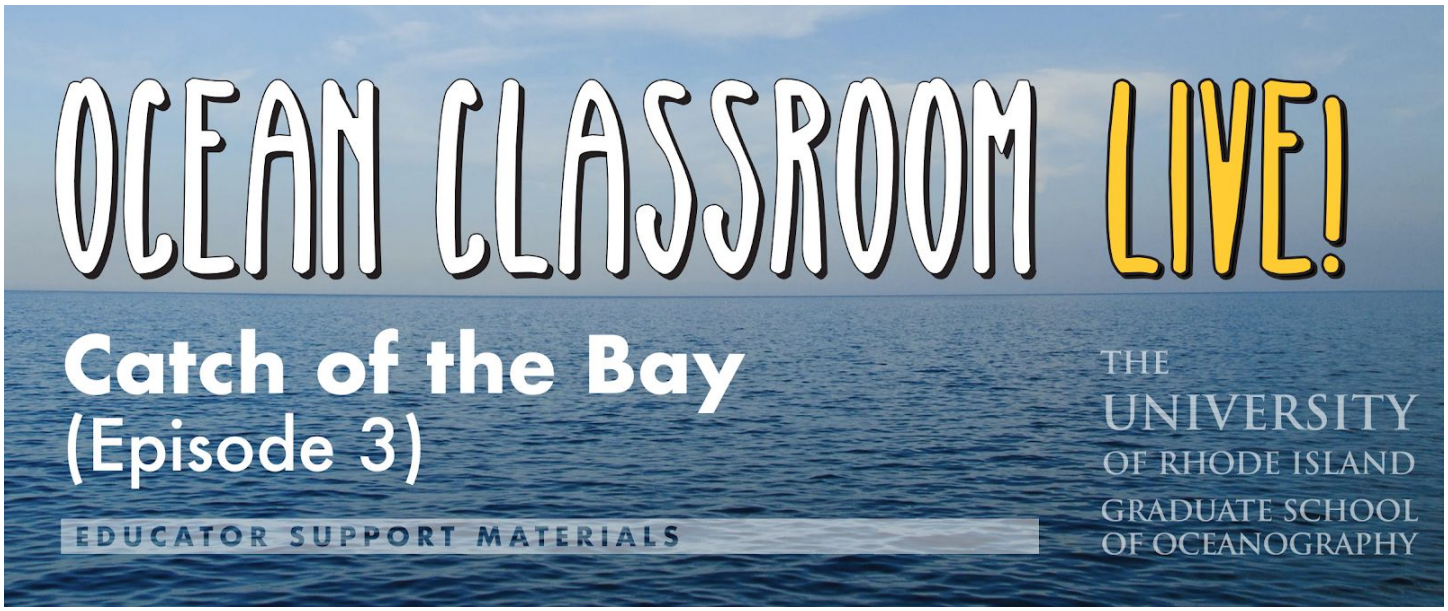

The URI GSO Fish Trawl Survey has sampled the bottom fish and invertebrate community in Narragansett Bay for over 60 years—one of the longest such surveys in the world. In this episode of Ocean Classroom (Live!), join fish trawl assistant and GSO student Nina Santos, GSO student Joe Langan and the Inner Space Center's Holly Morin as they discuss what the survey is revealing about conditions in Narragansett Bay, including the effects of climate change on the bay's fish populations and its food web.

Discussion Questions

- Why is collecting long-term data important?
- What changes have occurred in Narragansett Bay over the 60 years of this survey?
- What are the most common species in Narragansett Bay?

Resources

Graduate School of Oceanography
As one of the nation's premier academic oceanographic institutions, the University of Rhode Island's Graduate School of Oceanography (GSO) educates marine scientists, students, policymakers, business leaders and citizens and helps develop the knowledge and skills necessary to address present and future marine challenges.

- GSO: https://web.uri.edu/gso/
- Inner Space Center: http://innerspacecenter.org/
- Rhode Island Teachers At Sea: https://web.uri.edu/gso/research/outreach/rhode-island-teachers-at-sea-program/
- Narragansett Bay Classroom: https://web.uri.edu/gso/research/outreach/narragansett-bay-classroom/
- GSO Facebook: https://www.facebook.com/URIGSO/

University of Rhode Island Graduate School of Oceanography Fish Trawl
The University of Rhode Island Graduate School of Oceanography Fish Trawl Survey is a state-funded survey of the bottom fish and invertebrate community in Narragansett Bay, Rhode Island. The survey was initiated in 1959 by Charles J. Fish, founder and director of the *Narragansett Marine Laboratory, the precursor to the Graduate School of Oceanography. The Fish Trawl Survey was developed to quantify the seasonal occurrences of migratory fish populations, whereas scientists had previously relied on anecdotal information.*

- Fish Trawl landing page: https://web.uri.edu/gso/research/fish-trawl/
- History: https://web.uri.edu/gso/research/fish-trawl/history/
- Species: https://web.uri.edu/gso/research/fish-trawl/species/
- Fish Trawl Data: https://web.uri.edu/gso/research/fish-trawl/data/

Suggested Standards

Next Generation Science Standards K-12 Performance Expectations relating to collecting data, biology, ecosystems/animals.

Elementary School

Grade K. Forces and Interactions: Pushes and Pulls
- **K-PS2-1. Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.**
- **K-PS2-2. Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.**

Grade K. Interdependent Relationships in Ecosystems: Animals, Plants, and Their Environment
- K-ESS3-1. Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live.
- K-ESS3-3. Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.

Grade K: Weather and Climate
- K-ESS2-1. Use and share observations of local weather conditions to describe patterns over time.
- K-ESS3-2. Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.

Grade 1: Structure, Function, and Information Processing
- 1-LS1-1. Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.
- 1-LS1-2. Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive.

Grade 1: Space Systems: Patterns and Cycles
- 1-ESS1-1. Use observations of the sun, moon, and stars to describe patterns that can be predicted.
- 1-ESS1-2. Make observations at different times of year to relate the amount of daylight to the time of year.

Grade 2: Interdependent Relationships in Ecosystems
- 2-LS4-1. Make observations of plants and animals to compare the diversity of life in different habitats.

K-2.Engineering Design

- K-2-ETS1-1 Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

Grade 3: Interdependent Relationships in Ecosystems

- 3-LS2-1. Construct an argument that some animals form groups that help members survive.
- 3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.
- 3-LS4-4. Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.

Grade 3.Inheritance and Variation of Traits: Life Cycles and Traits

- 3-LS1-1. Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.
- 3-LS3-1. Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.
- 3-LS3-2. Use evidence to support the explanation that traits can be influenced by the environment.
- 3-LS4-2.Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.

Grade 3: Weather and Climate

- 3-ESS2-1. Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.

Grade 4: Structure, Function, and Information Processing

- 4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.
- 4-LS1-2. Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.

Grade 5: Matter and Energy in Organisms and Ecosystems

- 5-PS3-1. Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.
- 5-LS1-1. Support an argument that plants get the materials they need for growth chiefly from air and water.
- 5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

Grade 5: Earth's Systems

- 5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

Grades 3-5: Engineering Design

- 3-5-ETS1-1.Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- 3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
- 3-5-ETS1-3.Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Middle School

MS.Matter and Energy in Organisms and Ecosystems

- MS-LS1-6. Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.
- MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
- MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.
- MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

MS.Interdependent Relationships in Ecosystems

- MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services

MS.Growth, Development, and Reproduction of Organisms

- MS-LS1-4. Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.
- MS-LS1-5. Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.

MS. Natural Selection and Adaptations

- MS-LS4-4. Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.

MS. Human Impacts

- MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment
- MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

MS. Engineering Design

- MS-ETS1-1.Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
- MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- MS-ETS1-3.Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
- MS-ETS1-4.Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

High School

HS.Matter and Energy in Organisms and Ecosystems

- HS-LS2-4. Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.

HS.Interdependent Relationships in Ecosystems

- HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

- HS-LS2-6. Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
- HS-LS2-7 Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
- HS-LS2-8 Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce
- HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.

HS. Natural Selection and Evolution

- HS-LS4-2. Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.
- HS-LS4-3. Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
- HS-LS4-4. Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
- HS-LS4-5.Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.

HS. Weather and Climate

- HS-ESS3-5. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.

HS.Engineering Design

- HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
- HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Ocean Literacy Principles

OLP1: The Earth has one big ocean with many features.
OLP2: The ocean and life in the ocean shape the features of Earth.
OLP3: The ocean is a major influence on weather and climate.
OLP4: The ocean makes Earth habitable.
OLP5: The ocean supports a great diversity of life and ecosystems.
OLP6: The ocean and humans are inextricably interconnected.
OLP7: The ocean is largely unexplored.