Marine Reserve Impacts

Why have Marine Reserves been established in Oregon?

Overview

Marine reserves are a type of marine protected area with full protections. This means that taking of marine species within an Oregon Marine Reserve is *never* allowed. Many studies from around the world show that marine reserves can provide long-term conservation benefits to marine organisms, populations, and biodiversity. In this lesson, students learn about the goals that have been set for Oregon's Marine Reserves, and how scientific data is being collected to help determine whether the goals are being met.

Learning Goals

Students will learn the following:

- *Oregon's five marine reserves were established to protect marine ecosystems.*
- *Researchers collect data over many years to determine the impacts of marine reserves and whether the goals for the* reserves are being met.
- *Understanding the impacts of marine reserves can inform and improve fishery management decisions.*

Introduction

Oregon's marine reserves were established in March of 2008 after local communities worked with state officials to choose locations that would help protect the ecosystem while also avoiding the loss of too much fishing ground, per Governor Kulongoski's Executive Order 08-07.

There are three sets of goals for Oregon's Marine Reserves:

1. ***Conservation****: To conserve marine habitats and marine biodiversity;*
2. ***Research****: To serve as scientific reference sites, to learn about marine reserves and Oregon's nearshore ocean, and to inform management; and*
3. ***Community****: To avoid significant adverse impacts to ocean users and coastal communities, such as those dependent on fishing grounds.*

In 2023, Oregon Department of Fish and Wildlife (ODFW) will report how the marine reserves are doing with respect to these goals.

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Grade Level

6-8

Anchoring Phenomenon

Marine Reserve Impacts

Driving Question

Why have Marine Reserves been established in Oregon?

Time

Entire Lesson: Two weeks
Individual Activities: 1-3 days ea

Standards

Next Generation Science Standards

LS2.A – Interdependent Relationships in Ecosystems
LS2.B - Ecosystems: Interactions, Energy, and Dynamics
LS2.C – Ecosystem Dynamics, Functioning, and Resilience

Common Core Math Standards

6.SP.B.4
7.SP.A.1
8.SP.A.1
8.SP.A.2

Photo: Oregon Sea Grant

Learning Objectives

Students will be able to:

1. *Describe the mission of Oregon's five marine reserves,*
2. *Obtain, evaluate and communicate information about marine reserves from scientific texts,*
3. *Analyze species and habitat data collected from inside and outside of marine reserve areas.*

Five marine reserves have been established in Oregon over the last decade. Management and scientific monitoring of the sites is overseen by the Oregon Department of Fish and Wildlife (ODFW). The reserves are still very new, so it is unknown if the predicted benefits of the reserves are being realized. Researchers are collecting data at the reserve sites with the hope that they will be able to detect measurable impacts from the reserves over time.

This lesson explores ways scientists collect and analyze information to help answer these questions. The lesson components are organized into themes, which together support a holistic understanding of Oregon's marine reserves and their impact. Each activity could also be used individually to supplement a unit on ecology, statistics, or ecosystems.

Essential Questions:

- *How do Oregon Marine Reserves protect ecosystems?*
- *How do we know if Oregon Marine Reserves are working?*

Photo: Oregon Sea Grant

Five Oregon Marine Reserves

- *Cape Falcon*
- *Cascade Head*
- *Otter Rock*
- *Cape Perpetua*
- *Redfish Rocks*

OMR website

Why Does this Matter?

Fishing communities are an important part of Oregon culture, and managing fisheries well is an important part of both the ecology and the economy of our coast. It is therefore important to fully understand the effects of implementing marine reserves. Communities want to know what researchers are learning about impacts of marine reserves, and whether the reserves are meeting their stated goals.

Redfish Rocks Marine Reserve

Lesson Themes

1. *Informational texts*
2. *Data analysis and quantitative thinking*
3. *Exploring the human dimension*

Lesson Procedure

Students will explore the topic of marine reserves across three instructional themes: 1) Informational Texts, 2) Data Analysis and Quantitative Thinking, and 3) Exploring the Human Dimension.

ENGAGE

Introduce the topic of marine reserves to the students by sharing the *2018 ODFW Marine Reserve Highlights* and Oregon Field Guide *Rockfish* videos. Use the *Engage and Explain* presentation to introduce the topic of marine reserves.

EXPLORE

Informational Texts

Assign students to read *The Science of Marine Reserves* to learn what a marine reserve is, what is monitored in a marine reserve, how samples are collected, and what researchers are learning. Send students to the Oregon Marine Reserves website to learn more about the formation, goals, and locations of Oregon's five marine reserves.

Activity: Ecological Monitoring Plan

Assign students to work in groups to read the Oregon Marine Reserves *Ecological Monitoring Plan* and identify main goals and objectives of the reserves. Students will take notes and prepare a mini-poster presentation summarizing the plan for one of the five marine reserves in Oregon.

Data Analysis and Quantitative Thinking

Activity: Calculating Area

In this activity, students use a scale to determine the area dimensions of a marine reserve, its associated marine protected area (MPA), and the total area of both combined. Students compare and analyze the size of marine reserve and MPA areas.

Activity: NEOLI Factors

In this activity, students explore the different qualitative and quantitative factors that contribute to MPA success. The factors are simplified into the acronym NEOLI, which means "**n**o take, well **e**nforced, **o**ld (>10 years), **l**arge (>100km2) and **i**solated by deep water or sand." Students research five Oregon marine reserves to find out how they line up with NEOLI factors.

Exploring the Human Dimension

Activity: Researcher Bios

Students learn about the career paths of researchers who study MPAs. Invite researchers to give presentations of their work and career pathway.

LESSON RESOURCES

Videos:

- *2018 ODFW Marine Reserve Highlights*
- *Oregon Field Guide: Rockfish*

Presentation:

- *Engage and Explain*

Ecological Monitoring Plan

- *Scope and Sequence*
- *EMP Note Sheet (to print)*
- *Mini-Poster Project & Template*
- *Ecosystem Comparison Table (to print)*

Calculating Area:

- *Finding Area Worksheet*
- *Maps (to print)*

NEOLI Factors:

- *NEOLI Guided Discussion*
- *NEOLI Worksheet (to print)*
- *NEOLI Answer Key*
- *NEOLI Comparison Graphs*

Researcher Bios

- *Dr. Jess Hopf*
- *Victoria Quennessen*

Vic Quennessen

EXPLAIN

Data Analysis and Quantitative Thinking

Activity: Something Fishy

This PBS Mathline activity models how scientists estimate the size of a large population by applying the concepts of ratio and proportion through a capture-recapture statistical procedure. The resource includes professional development videos for teachers.

Activity: Overfishing, the tragedy of the commons

In these activities, students explore the causes and consequences of overfishing using simulation games:

- *Fishing for the Future – Use M&Ms to model changes over consecutive seasons of a commercial fishery. Students explore how technology, population growth, and sustainable practices impact fish catch and fisheries management.*
- *FishBanks – In this multilayer web-based simulation, participants play the role of fishers and seek to maximize their net worth as they compete against other players and deal with variations in fish stocks and their catch. Participants buy, sell, and build ships; decide where to fish; and negotiate with one another. Policy options available to instructors include auctions of new boats, permits, and quotas.*

ELABORATE

Data Analysis and Quantitative Thinking

Activity: Inside and Outside the Reserves

In this activity, students use simulated data to compare hook and line samples from inside and outside an MPA. Are there differences between the two populations, and what predictions can be made for the future?

EVALUATE

Exploring the Human Dimension

Activity: Mock Town Hall

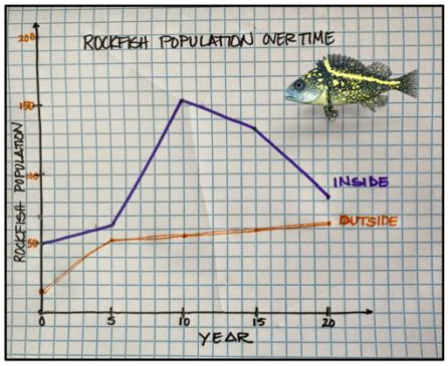
Who are the stakeholders affected by MPAs, and what are their varied beliefs and values surrounding the implementation of MPAs? Using the Human Dimensions Research section of the Oregon Marine Reserves website, students identify various stakeholders and their perspectives, and engage in roleplay of a town hall meeting about MPAs.

Mark Recapture Materials:

- *Something Fishy*

Overfishing Materials:

- *Fishing for the Future*
- *FishBanks Simulation*
- *Teacher Guide for playing FishBanks*



Inside and Outside Materials:

- *Fish Populations Worksheet*
- *Fish Graph Analysis*
- *Simulated Mean Length and Population Data [pdf] [xls]*

Human Dimensions

- *Research stakeholder perspectives*
- *Mock Town Hall guidance*

Sites for Field Experiences

- *Cascade Head Biosphere Reserve*
- *Oswald West State Park*
- *Redfish Rocks Community Team*
- *OSU's Hatfield Marine Science Center*

Next Generation Science Standards

Performance Expectation(s):

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-LS2-2 – Construct an explanation that predicts patters of interactions among organisms across multiple ecosystems.
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.

Science & Engineering Practices:

- Asking Questions and Defining Problems
- Developing and Using Models
- Constructing Explanations and Designing Solutions
- Obtaining, Evaluating, and Communicating Information

Disciplinary Core Ideas:

LS2.A: Interdependent Relationships in Ecosystems
LS2.B: Cycles of Matter and Energy Transfer in Ecosystems
LS2.C: Ecosystem Dynamics, Functioning, and Resilience

Crosscutting Concept:

Stability and Change

Math Practices:

- Make sense of problems and persevere in solving them
- Reason abstractly and quantitatively
- Construct viable arguments and critique the reasoning of others
- Model with mathematics
- Use appropriate tools strategically
- Attend to precision
- Look for and make use of structure
- Look for and express regularity in repeated reasoning

CCSS Math Content Standards:

6.SP.B.4 - Display numerical data in plots on a number line, including dot plots, histograms, and box plots.
7.SP.A.1 - Use random sampling to draw inferences about a population.
8.SP.A.1, 8.SP.A.2 - Investigate patterns of association in bivariate data.

Photos: Oregon Sea Grant

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See more lessons on the ORSEA webpage