# Murre Populations in Flux

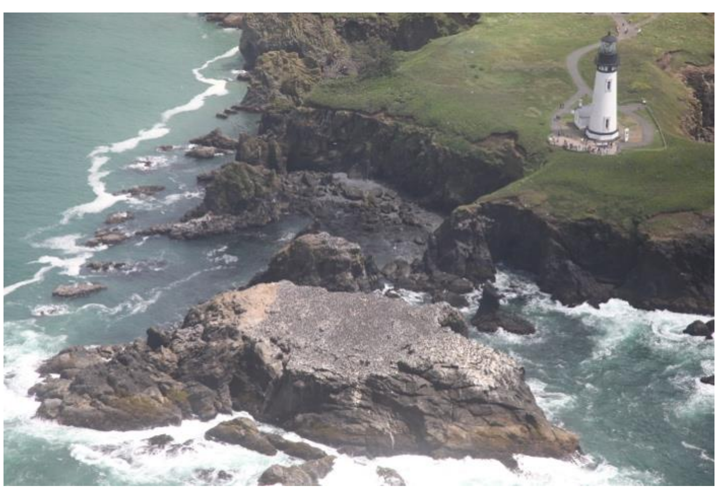
## What factors affect seabird reproductive success?

### Overview
The reproductive success of common murres at Yaquina Head Outstanding Natural Area varies from year to year. Students will learn how researchers monitor seabird populations and explore data to determine how seabird reproductive success is connected to environmental conditions and trophic relationships.

### Learning Goals
Students will learn the following:

- *Reproductive success of organisms can vary from year to year.*
- *Long term data collection provides opportunities to record patterns and detect anomalies.*
- *Reproductive success can be connected to environmental conditions.*

### Introduction
During typical breeding seasons, Yaquina Head is home to 60,000 to 80,000 common murres which nest in colonies on offshore rock formations. Researchers have been studying this colony since 2007 to learn about how the murres survive on the coast, and to determine factors that affect population size and reproductive success. In recent years at Yaquina Head, murre reproductive success (the number of young produced per female per year) has declined. Researchers have been able to detect these changes because they have been monitoring the colonies over many years.



Aerial photo of Colony Rock at Yaquina Head, Image: J. Porquez

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### Grade Level
*11-12*

### Anchoring Phenomenon
*Murre Populations in Flux*

### Driving Question
*What factors affect seabird reproductive success?*

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### *Standards*
***Next Generation Science Standards***
*LS2.A – Interdependent Relationships in Ecosystems*
*LS1.C – Organization for Matter and Energy Flow in Organisms*
*LS2.D – Social Interactions and Group Behavior*
*LS4.C – Adaptation*

## Learning Objectives

Students will be able to:

1. *Identify physical and behavioral adaptations of common murres that contribute to their reproductive success,*
2. *Use data to describe changes in murre reproductive success at a study site over different years, and*
3. *Use evidence to suggest possible contributing factors to fluctuations in murre reproductive success.*

The anchoring phenomenon of this lesson centers around variability in common murre reproductive success at a well-monitored study site. Since 2010, reproductive success of common murres (*Uria aalae*) has steadily declined at the Yaquina Head Outstanding Natural Area in Newport, Oregon. In fact, from 2014-2017, common murre colonies experienced near or total breeding failures. In the 2018 breeding season, however, scientists observed the highest hatching and reproductive success rates at the site in 8 and 10 years, respectively. In this lesson, students will find out how researchers study seabirds and use long term datasets to uncover patterns and make connections to ocean conditions.

## Essential Questions:

- *What physical and behavioral characteristic of murres improve reproductive success?*
- *What are the primary challenges for murres nesting at Yaquina Head?*
- *Can reproductive success of common murres be correlated with other ecological conditions?*
- *What benefit do long-term datasets provide?*

*Image: NOAA*

*Image: J. Porquez*


*Image: YHONA Seabird Monitoring Summary*

*Image: YHONA Seabird Monitoring Summary*

## Lesson Procedure

### ENGAGE

This unit begins with a hands-on "hook" that gets students thinking about seabird adaptations, biology, behavior, and reproductive success.

*Activity: Murre Eggs*

Hand out chicken eggs (hard boiled) to students in groups and have them make observations. Collect information from students in your preferred method. Next, hand out *model murre eggs* or show the *Murre Egg clip* and ask students to record observations. Then, ask students to compare and contrast the two types of eggs (chicken and murre).

Lead a discussion with students about why they think murre eggs look the way they do. Students will use online interactives and readings in the *Murre Egg* worksheet to learn how egg shape could be adaptive for reproductive success.

Image: Oregon Sea Grant

### EXPLORE

Now that students have started thinking about murre reproduction, the remaining sections of the lesson will shift to a focus on environmental factors affecting reproductive success.

Common murres have been studied at Yaquina Head Outstanding Natural Area since 2007. The murres gather on offshore rocks by the thousands during the summer months to nest and raise their chicks. Although this was one of the most rapidly growing colonies on the Oregon coast, the colony experienced near or total breeding failures during 2014-2017. Then in 2018, the reproductive success rate rebounded.

### LESSON RESOURCES

***Videos:***

- Murre egg clip
- Murre Life at Yaquina Head

***Murre Eggs***

- Murre Egg Student Worksheet (to print)
- *Reading: Ever Had Your Mind Blown by an Egg?*
- *Interactive: Cracking the Mystery of Egg Shape*
- *Reading: Why are Murre Eggs So Pointy*

***Model Murre Eggs***

***Distance Learning Modification:***
*Cover plastic easter eggs in modeling dough, one shaped like a chicken egg, one like a murre egg. Share the models with students and encourage them to build their own models with materials found at home.*

***Vocabulary and Concepts***

- *Reproductive success*
- *Population dynamics*
- *Long term biological monitoring practices*
- *Trophic level basics*
- *Bottom up food web processes*
- *Top down effects*
- *Environmental change over time*

***Murre Background Info***

- *Murre vs. Penguin blog post*
- *Yaquina Head Seabirds*

*Activity: YHONA Seabird Data*
Begin by asking students to brainstorm how scientists might observe populations of murres at a specific site over time. What characteristics of a study site would be helpful? Accept all answers and ideas.

Introduce the work of Oregon State University researcher Jessica Porquez, a researcher who determines hatching and reproductive success in common murre populations. Have students explore the protocol and data summary Jessica provides in the *YHONA Seabird Data* section to learn about the methods she uses to collect data and track seabird colonies at Yaquina Head. Note the type of equipment needed and how the researchers standardize data collection. Explore the *Season Summary 2017* to see some of the findings recorded by researchers in the past.

Students will then use *Distribution Data* from Yaquina Head seabird colony to plot the colony reproductive success rates over time. Ask students what they notice about their graphic representations of the data. Students should brainstorm and share with the class the factors they think may contribute to population success. List and post for the rest of the unit the top categories students believe are factors affecting reproductive success.

## EXPLAIN

*Activity: Connect with Yaquina Head Research*
Invite a seabird researcher from the *OSU Seabird Oceanography Lab* to talk to students about their research, and/or plan a field experience to Yaquina Head so that students can see the murre colony study area. If in-person travel is restricted, contact the Yaquina Head education coordinator for virtual visit options. In either case, the students should prepare in advance a list of research questions to be answered during the virtual field trip.

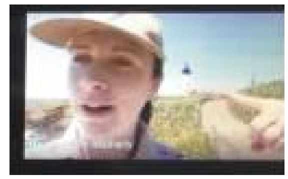
Ask students to revisit the Yaquina Head *Seasonal Summary 2017* and use a highlighter to identify some of the factors researchers have identified that might be contributing to murre reproductive success.

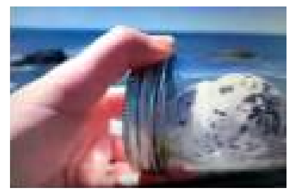
## ELABORATE

Based on previous student hypotheses, data, and background information, students will work in groups to decide what aspect of murre reproductive success they want to investigate and what data will be necessary to provide information and evidence of their claims. The students will choose data from one of the listed *Physical Science* or *Seabird Datasets* to work with. They should plot the data, interpret the meaning of the data, and then present their

*YHONA Seabird Data*
- Study Protocol - 2019
- Season Summary - 2017
- Distribution Data 2007-2018
- Aerial Photos 2008-2014

*Career Connected Learning Contacts*
- OSU Seabird Oceanography Lab
- Visit Yaquina Head





*Screenshots from YHONA Virtual Visit*

*Physical Science Datasets*
- NOAA Fisheries – Newport Hydrographic Line Research and Ocean Ecosystem Monitoring
- NOAA California Current Integrated Ecosystem Assessment
- NOAA Earth System Research Laboratory's Physical Sciences Division (Climate Indices)

*Seabird Datasets*
- North Pacific Marine Seabird Database
- Coastal Observation and Seabird Survey Team (COASST)

*Math Concepts*
- *bivariate data*
- *scatter plot*
- *correlation*
- *distribution*

*Summary Presentations*
- Research Question Recap
- Digital Choice Board

findings either by making a poster or presenting using the *Research Question Recap*. Optionally, students may use a *Digital Choice Board* to show what they have learned.

## EVALUATE

Students will present their graphs, using claim, evidence and reasoning to explain what factors they believe contribute the most to murre reproductive success. Successful student presentations will include a relevant and accurate data display, reasonable explanation of their findings, and a presentation that includes appropriate vocabulary related to populations and reproductive success.

## Next Generation Science Standards

Performance Expectations

HSLS2-1 - Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.

HSLS2-2 - Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

HSLS2-6 - 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.

HSLS2-8 - Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.

HSLS4-5 - 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.

Science & Engineering Practices:

Using mathematics and computational thinking

Engaging in argument from evidence

Disciplinary Core Ideas:

LS2.A – Interdependent Relationships in Ecosystems

LS1.C – Organization for Matter and Energy Flow in Organisms

LS2.D – Social Interactions and Group Behavior

LS4.C – Adaptation

Crosscutting Concepts:

Scale, Proportion and Quantity

Stability and Change

Cause & Effect

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*See more lessons on the [ORSEA webpage]()*