Seabirds

Seabird Youth Network

2017

Seabird Youth Network

AUK ECOLOGICAL CONSULTING

Pribilof School District

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THALASSA

NATIONAL PARK SERVICE

U.S. FISH & WILDLIFE SERVICE

oikonos

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Seabird Youth Network	Auk Ecological Consulting	Pribilof School District	Ram Papish	Oregon State University
National Park Service	Thalassa	US Fish and Wildlife Service	Oikonos	NORTAC

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Seabirds

SEABIRDS

A seabird is a bird that spends most of its life at sea. Despite a diversity of species, seabirds share similar characteristics. They are all adapted for a life at sea and they all must come to land to lay their eggs and raise their chicks. Most seabirds gather in large colonies along marine shorelines to breed and raise their young.

TARGET GRADE LEVELS

Lessons were created for grades 4-8 with activities that can be modified for lower or higher grades.

CURRICULUM FRAMEWORK

The curriculum consists of seven lessons. The lessons are designed to reinforce and expand the lesson themes, and provide hands-on opportunities for students to investigate and integrate the information they have learned.

THIS CURRICULUM ACCOMPLISHES THE FOLLOWING OBJECTIVES:

- Identify and summarize characteristics of seabirds
- Develop an understanding of the breeding and feeding ecology of seabirds
- Increase the awareness of environmental and human threats to seabirds
- Explore the human use of seabirds
- Introduce students to how and why researchers study seabirds

WHAT ARE ASSESSMENT METHODS?

Assessment methods vary with each lesson; any of these methods can be given a point value. Methods include:

- Research summaries
- Worksheets
- Oral presentations

HOW MUCH TIME DO I NEED?

Each lesson can be completed in one class period of 55 minutes.

HYPERLINKS

Over time some hyperlinks may become obsolete. We apologize in advance for non-working links.

ACKNOWLEDGMENTS

Funding for the curriculum was provided by the National Park Services Shared Beringian Heritage Program.

Lessons and activities were developed by Ann Harding (Auk Ecological Consulting) and Tonia Kushin (Pribilof School District), and designed for use by middle-school students on St. Paul Island (the Pribilofs, Alaska). Preparation of these original lesson plans was funded by the North Pacific Research Board (NPRB). Thank you to everyone who contributed towards this effort, especially Marc Romano (Alaska Maritime National Wildlife Refuge, AMNWR) for the presentation on Seabird Monitoring in Chapter 6; and Robb Kaler (U.S. Fish and Wildlife Service) for the Seabirds.net exercise in Lesson 1.

The need to bring these lessons together into one curriculum that would be both easier to teach and share within the education community was motivated by a link between students on the Pribilof Islands and the Commander Islands in Russia, and funded by the National Parks Service Shared Beringian Heritage Program.

Thanks to Jessie Beck (Oikonos) for the addition of the northern fulmar bycatch exercises in Chapter 4, and Ram Papish for his artwork. Rachael Orben (Oregon State University), Ram Papish, Ann Harding, Tonia Kushin, and Marc Romano designed the accompanying PowerPoint presentations. Many thanks to the dedicated staff at the St. Paul Seabird Camp (Kendra Bush St. Loius at AMNWR, Ram Papish, Tonia Kushin, and Veronica Padula at the University of Alaska, Anchorage), for helping try-out and refine many of the activities and PowerPoint presentations. Many thanks to Tim Bowman and Heather Wilson (both with USFWS) for sharing the on-line counting exercises used in Chapter 6.

Many thanks to our reviewers: Marc Romano, Jessie Beck, Shannon Fitzgerald (NOAA), Veronica Padula, Ram Papish, and Rachael Orben.

Layout, design, and educational standard information was provided by Pam Goddard at Thalassa Education.

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CURRICULUM OVERVIEW

Seabirds

Subject Area(s): Life Science	**Grade Levels:** Elementary/Middle School	**Teaching Time** 55 minutes per lesson

Lesson Topics:	seabirds, feeding, breeding, conservation, traditional culture, research methods, marine indicators	**Key words:**	seabirds, ecosystem, invasive species, conservation, traditional use, indicator species, monitoring, and research
Learning Objectives:	Students will learn the main groups of seabird species, what is a seabird, several feeding strategies, reasons for conservation, traditional uses, seabirds as indicators and other reasons/ways to study seabirds.	**Focus Question**	What is a seabird and why are they important?

LESSONS		STATE STANDARDS	NEXT GENERATION SCIENCE STANDARDS		
		AK	MS-LS2 Ecosystems	Minutes	Grades
LESSON ONE	Seabird Basics	SC2;SC3.2;SE1	LS2.A: Interdependent Relationships in Ecosystems LS2.B: Cycle of Matter and Energy Transfer in Ecosystems	55	4-8
LESSON TWO	Seabird Feeding	SC2;SC3.2;SE1	LS2.A: LS2.B:	55	4-8
LESSON THREE	Seabird Breeding	SC2;SC3.2;SE1	LS2.A: LS2.B:	55	4-8
LESSON FOUR	Seabird Conservation	SC2;SC3.2;SE1	LS2.B ; LS2.D: Biodiversity and Humans ETS1.B: Developing Possible Solutions	55	4-8
LESSON FIVE	Cultural Importance of Seabirds	SC2;SC3.2;SE1	LS2.D: Biodiversity and Humans	55	4-8
LESSON SIX	Seabird Research Tools and Methods	SC2;SC3.2;SE1	LS2.D	55	4-8
LESSON SEVEN	Seabirds as Marine Indicators	SC2;SC3.2;SE1	LS2.A	55	4-8

The Seabird Youth Network website (http://seabirdyouth.org/seabird-activities/) has large group games and activities that reinforce the concepts presented in Lessons 1-4.

See Appendix II for detailed information on educational standards.

CURRICULUM OVERVIEW FOCUS QUESTIONS

LESSON 1: SEABIRD BASICS

How are seabirds adapted to life at sea?

Why are the bones of some seabirds lighter than others?

Are seabird bones hollow?

How long can seabirds live?

LESSON 2: FEEDING AND DIET

What do seabirds eat?

How do seabirds catch their food?

How do seabird parents feed their chicks?

LESSON 3: BREEDING

Where do seabirds nest?

What are the advantages and disadvantages of the different nesting areas?

How many chicks do seabirds raise each year and how does this compare to land birds?

LESSON 4: CONSERVATION

What threats are causing seabird populations to decline?

What methods are used to reduce the number of seabirds killed by fisheries?

What species of seabirds have gone extinct?

How do invasive species present a risk to seabirds?

LESSON 5: CULTURAL IMPORTANCE OF SEABIRDS

What are the myths or legends associated with seabirds?

How do humans use seabirds?

LESSON 6: SEABIRD RESEARCH TOOLS AND METHODS

Who monitors seabird populations?

How are seabird populations monitored?

Why are seabird populations monitored?

LESSON 7: SEABIRDS AS INDICATORS

How do seabirds tell us about the ocean?

Why are seabirds considered ecological indicators?

LESSON ONE

SEABIRD BASICS

Seabird Youth Network

OBJECTIVES:

- Students will be able to list characteristics of a seabird and discuss the specialized behaviors seabirds possess.
- Students will know the main groups of seabirds and characteristics of each group.
- Students will use internet resources to find photos and information about the main species of seabirds that breed on the Pribilof Islands, Alaska.

FOCUS QUESTIONS

- How are seabirds adapted to life at sea?
- Why are the bones of some seabirds lighter than others?
- Are seabird bones hollow?
- How long can seabirds live?

WHAT MAKES A SEABIRD A SEABIRD?

A seabird is a bird that spends most of its life at sea. Although all seabirds breed on land, they find their food out at sea, and some even sleep on the water.

Despite huge variation among different species, they all share similar characteristics.

They are all **adapted to life at sea**.

Seabird Physiology

- **Salt Glands.** Imagine drinking only sea-water! Seabirds need a way to get rid of all this salt, and most species have salt glands on their head that concentrate all the salt that the birds take in through their water and food. When lots of salt has built up, it either flows out of the gland (out the nostril), or the bird "sneezes" it out!

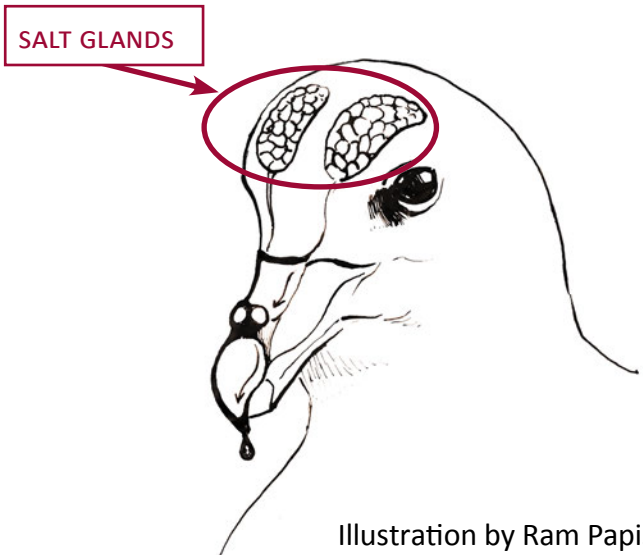


Illustration by Ram Papish

LESSON ONE SEABIRD BASICS

- **Dense Bones.** Many diving seabirds (like penguins) have dense bones to reduce buoyancy when they dive deep for food.
- **Feet and Legs.** The shape and size of feet and legs can tell us a lot about how seabirds feed and spend their time. Species that spend a lot of time on the ocean (like puffins) usually have short, strong legs and webbed feet that act as paddles.
- **Wings.** Wing shape can also tell us a lot about a seabird's feeding behavior. Diving species have short wings. Some species, like penguins, can't fly at all! Instead, their short, strong wings act as flippers and the birds "fly" underwater to catch their prey.
  - Tufted puffins are an example of a diving bird with short wings. They can still fly, but they have to flap their wings most of the time (they have been described as flying like a bumblebee) and this takes a lot of energy.
  - Species that cover great distances over the open ocean and catch their prey near the surface of the water have long slender wings that help them glide on the wind. The wandering albatross has the largest wingspan (wing-tip to wing-tip) of any living bird. Over 11 feet! Compare this wingspan to your height!

Wandering albatross. © Mario QU, via Creative Commons

Tufted puffin. © Myer S. Bornstein, via Creative Commons

Wandering albatross

- Spend most of their life flying
- One banded bird was recorded travelling 6000 km in 12 days
- Live for over 50 years
- Breeds in Southern hemisphere
- Breed every 2 years

Tufted puffin

- Breeds throughout the North Pacific Ocean
- Nest in a burrow dug with their bill and feet
- Lay one egg
- Feed on fish, squid, and invertebrates
- Bring multiple fish back to their chick at the colony in their bill

LESSON ONE | SEABIRD BASICS

- **Waterproof Coat.** Many seabirds spend most of their life in very cold water. They have thick layers of down and feathers to keep them warm and dry, and a special gland that releases oil to keep feathers waterproof.
- **Head Structure.** Some species, like the boobies and gannets, have specialized adaptations to their head (strong bills, thicker bones, and air sacks) so that they can survive their high impact diving.

Gannets diving for food. © Keith Marshall, via Creative Commons.

- Gannets breed in the North Atlantic.
- They plunge-dive for fish, diving into the ocean from heights up to 130 feet!
- Gannets reach speeds of 60-90 mph when they hit the water!
- They gulp in air as they descend, and fill up air sacks around the neck and shoulder to protect them when they hit the water.
- Watch this video and more by searching on "Gannets plunge in the sea.": https://www.youtube.com/watch?v=D8vaFl6J87s

LESSON ONE SEABIRD BASICS

SEABIRD BEHAVIOR

Seabirds also have specialized behavior to help them live and feed in the marine environment.

- **Diet.** Seabirds eat primarily fish, squid, and zooplankton.
- **Long-lived.** Most seabirds live a long time (between 20-60 years!)
- **Few chicks.** In general, seabirds also have fewer chicks (1-3) than other species of land birds, and often don't start breeding until later on in life (2-10 years old).
- **Hard-working parents.** Parent seabirds spend a lot of time and effort rearing their chick. Parents of some of the larger albatross species feed their chick at the colony until they are 10 months old.

Living for a long time and having fewer chicks per year has likely evolved because of their unpredictable marine conditions, challenges of finding food at sea, and the relative lack of predation compared to land-birds.

WHERE DO SEABIRDS LIVE?

Seabirds can be found worldwide, from the tropics to both polar-regions. We all know that penguins live in the snowy Antarctic, but did you also know they live in Australia and South Africa?

African penguin. © Robert Cave, via Creative Commons

African penguin

- African penguins live on the SW coast of Africa.
- They dive on average 30 meters deep (but can dive as deep as 130 meters!).
- They live for about 10 years, but don't start breeding until they are 4 years old.
- They lay 2 eggs in a nest burrowed in guano or sand.

LESSON ONE SEABIRD BASICS

MAIN ORDERS OF SEABIRDS

(seaducks, loons, grebes, and phalaropes are sometimes also included as seabirds)

- **The penguins.** *Sphenisciformes.* All are highly adapted to underwater travel, but cannot fly. Except for the Galapagos penguin, they all live in the Southern Hemisphere.

Rock hopper penguin. © Mark "Clancy", via Creative Commons

- **The auks and the gull-like birds.** *Charadriiformes.* Auk species both fly and swim with their wings. They live only in the Northern Hemisphere. Species include the puffins, murres, and auklets. The gull-like birds include the gulls, terns, jaegers (skuas), and skimmers.

Least auklet. © Ram Papish

- **The tubenoses.** *Procellariformes.* All tubenose species have their nostrils enclosed in tubes. They include the albatrosses, fulmars, petrels, shearwaters and prions.

Layson albatross. © Chrysoptera, via Creative Commons

- **Other seabirds.** *Pelecaniformes.* This order includes the gannets, pelicans, boobies, tropic birds, cormorants, and frigate birds.

Frigate bird. © D200-Paul, via Creative Commons

LESSON ONE SEABIRD BASICS

SEABIRDS BREEDING ON THE PRIBILOF ISLANDS

An estimated 2.8 million seabirds nest on the Pribilof Islands, Alaska. Due to the importance of these colonies, the islands were included in the Alaska Maritime National Wildlife Refuge in 1984.

Auks

- Thick-billed murre
- Common murre
- Tufted puffin
- Horned puffin
- Least auklet
- Crested auklet
- Parakeet auklet

Gulls

- Black-legged kittiwake
- Red-legged kittiwake

Tube-noses

- Northern fulmar

Other seabirds

- Red-faced cormorant

U.S. Fish and Wildlife Seabird Species List
This website has links to detailed accounts on all the seabird species breeding in Alaska.
http://alaska.fws.gov/mbsp/mbm/seabirds/species_list.htm

LESSON ONE | ACTIVITY 1.1: SEABIRD CHARACTERISTICS

OBJECTIVE:

- Students will be able to list characteristics that differentiate a seabird from a land bird, and discuss the specialized behaviors seabirds possess.

PROCEDURES:

- Use prior knowledge, the links provided on pages 14 and 15, and a basic Google search to find characteristics of birds in general, and land birds vs. seabirds.
- Give students 1-3 minutes to fill in the Venn diagram on **Worksheet 1.1.1 Seabirds vs. Landbirds** by themselves or in small groups.
- After this time period, project a Venn diagram and allow each group to share some ideas as the teacher guides the discussion, using the answer key on page 17, to include the appropriate material in each section.
- **Worksheet 1.1.2 Specialized Behaviours** complete as a class.

EXTEND AND EXPLORE

DEMONSTRATE 'DENSE BONES'

Materials:

beaker of water, a cork, and a paperclip

Procedure:

- Place the cork in the beaker of water.
  - The cork (which floats in water) represents land bird bones and shows why a land bird has hollow bones to help it be lighter and more able to fly.
- Place the paperclip in the beaker of water.
  - The paperclip (which will sink in the water) to show why diving seabirds would benefit from dense bones when going into/under the water to capture prey.

DEMONSTRATE 'WING SHAPE'

Materials:

Flashlight and photos of flying seabirds from the websites provided below.

LESSON ONE | ACTIVITY 1.1: SEABIRD CHARACTERISTICS

Procedure:

- Project the photos on a Smart board, Promethium board, or wall. Look at the different shapes of flying seabirds, and discuss what wing-shape tells us about the feeding behavior of different species.

DEMONSTRATE 'HEAD STRUCTURE'

Materials:

Paper and paperclips

Procedure:

- Ask students to make paper airplanes without direct instruction.
  - Paperclips are allowed if requested.
- Line students up on one side of the classroom.
- Give each student a chance to fly their plane across the room.
- Group the planes by how they flew.
  - Examples: short distance, long distance, nose dive, circular.
- Discuss the characteristics of each group.
- Bring their attention to the shape of the nose, and the "wing" area of the plane.
- Link all of these similar characteristics to those of a bird: the similarity between the sharp plane nose and a seabird bill that aerodynamically cuts through water not air.

RESOURCES:

- Black-backed albatross (example of long-distance flier that soars to cover great distances) https://www.flickr.com/photos/liamq/5544284476/in/photolist-9rVUBE-9s2i7k-KEtmu-9ukhsw-con4Lo-9s247T-KED9c-9rVUwG-6Ntcnw-oCMdYY-9s5iFw-9rVUsY-cpqnMW-9s5pNq-9s287r-DMadeC-DYf1oR-6szKRW-6NtcBU-5bVTbY-6Np3qg-DYeV5V-DMPwNA-4uCDNo-cpsGo7-D1Sj9c-rWQVi9-5dNbyG-cpsFiY-9s573C-Dw8JLm-9s2eax-5bVFtq-onAoPq-8qrnME-bF9xtV-7APw8S-cqMeuA-7APw5U-coNAbL-8pyPgS-cp6Xnm-crs7sY-5wMVMh-oC42pm-cpqn5Y-cpsGTQ-42GvFp-8LRPwU-duRcRF
- Northern fulmar (example of a seabird that is an incredible soarer) https://www.flickr.com/photos/tjmartin/14934584785/in/photolist-oKHDK8-rbBVzh-95AqoZ-9jqVVw-oHFujb-oKFELN-eLKSk-oKFvFJ-oHFv6b-oteanv-99MccN-RLeGa2-9Biehk-e5e3yu-7WXYkX-4L8tv1-9WUuCL-e58ptv-4rp3oZ-eJ7WM3-8WgG8J-8pGMZV-og4DLw-4u79Nd-e5e33u-NQxnsS-oaRXMu-nNj6E8-dRfQ2j-qYu99b-874soj-4YHvxG-dTbWN6-8rVcXq-bEYEqQ-8rVd1j-9eoEUY-5W6fJs-9Nb9qY-nWMv8A-fgiGwi-fsVVYK-rh8S8v-GfESw1-jzxbK-ieReW1-oNg46B-aht4KS-eRzamn-atB8P1

LESSON ONE | ACTIVITY 1.1: SEABIRD CHARACTERISTICS

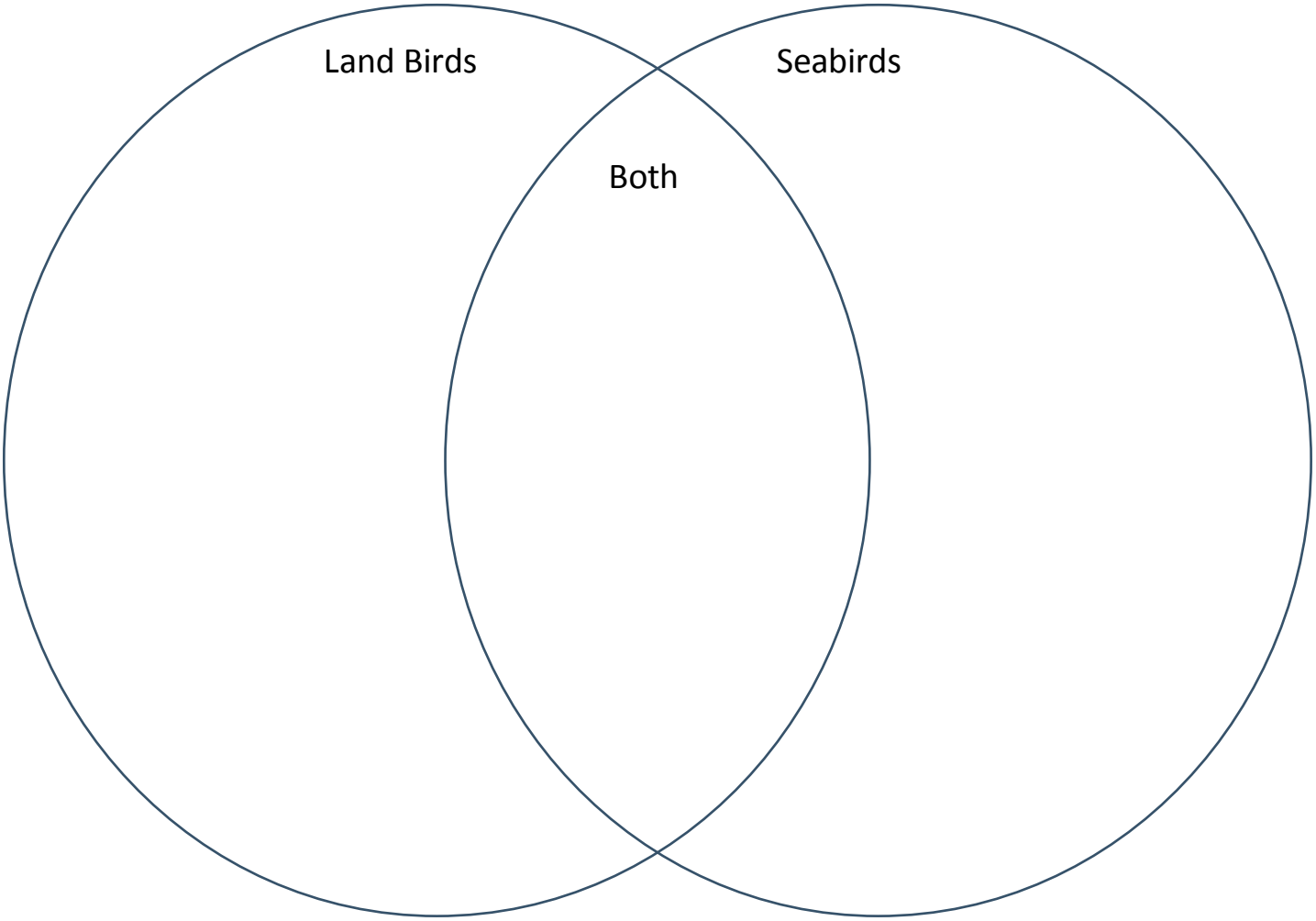
- Flying northern gannet (example of a great soarer or glider)
https://www.flickr.com/photos/dah_professor/5602296202/in/photolist-9x4etQ-6Ntd4q-8apdYb-nTuHVY-fa9e3w-9cgtM3-fc3Ngf-58uNZb-8tWi7F-jXrxt1-i6FXXv-8pFtD6-fLHHE9-oFHKYa-5CTEoL-7ZW9Bq-nEGnHn-oTvdKq-8Aweuh-6C93JM-fF5bsQ-gwC3W-9rQy6L-ct8MTb-9ctWcH-gc4VM1-bAN626-7FdGEa-CVZB3j-f4pJ1R-ejbTDp-bdWQt4-8ACeA7-Y4Aad-ATNq6v-ap1bnX-7DPhLu-obXMEG-97f95z-8zCPiy-8A3dWk-pbykYq-2VA1U6-9b1TdD-5N82Dm-6TUwHJ-aPwsHt-qPB64c-nYbT9B-qREiZs
- Greater black-backed gull (example of species of seabird that can soar while looking for food such as fish, eggs, birds, and even some mammals)
https://www.flickr.com/photos/suckamc/2049206887/in/photolist-485HPe-6npxRm-e4zi1D-x4M5r7-8KRKfR-8AU5s2-8AXcHq-6ZFmUW-9aiEdd-einUDo-dVBSSz-dLXYiR-myNz9q-4SDYAp-6TA9Ws-8AXcBj-dHzNwP-6PMb3Z-jGRutV-nykadn-einVSL-hCA5K-6Qwdjx-FyLX1f-e6z4Vx-dHFf9N-47HhU1-2dCEGk-27fq9-m6Hmw4-c5oArS-dom1jS-ab4BS6-5bQCTF-7Xm5Se-KquSGm-p7XWKP-e6kKAC-6CbPr3-e9t7rd-5E93B9-kMEB-949L1M-9E2boN-2snr3W-P8Lf7-578Wcs-8aUSoT-2QxLjV-61wk5T
- Frigate bird in flight
https://www.flickr.com/photos/sfleming/6966976972/in/photolist-bBDzwC-5qmtGw-7An1EA-fFFU9f-BWrpC-egU6fU-cvG2h9-8221xx-9yJVwW-PDxd6-ehNbxV-ehU5pE-eB2xny-ojj3GX-pGnVn7-4jG8af-9YfKrL-fbui6W-g8BE1v-6jYkLm-oJkQg1-n1PSab-7T3W9q-qiQXvA-dp773B-pP6qqq-59Y2cq-4u4HP6-6bLiou-8nrWkD-7rwKj7-7o3SNi-cJxEcE-bEbjiX-xkiBd-2SQMCb-b5H3Yp-bhHJet-8G62CM-btLxNt-c8mJob-4eSjPX-b8MLUg-dJGSmW-QZBou-7zbt7N-9wVrpa-4Q7osh-q6QSSV-BPnTYB
- Frigate birds soaring
https://www.flickr.com/photos/22047287@N06/2126003685/in/photolist-4eSjPX-b8MLUg-dJGSmW-QZBou-7zbt7N-9wVrpa-4Q7osh-q6QSSV-BPnTYB-7jKVZT-dmge5J-7iSGPa-7433dZ-5EjW1Y-aP3T9a-r97wc3-6VD8ZG-9uQtQ-ctZFD5-96PhtS-4HE6b7-49SNJU-bgeTPD-3ih35K-cYmcaC-9U5UMg-a9mPfM-cr3n99-79bBpB-7434Dt-rGwEQB-qjktW4-7bCk16-7BcFZu-25qSrt-6JpuBv-qsE8L-83kXhU-746ZCY-GxGBFC-ns3yCL-nzJm9U-83kXeA-7BcFS7-7LpZWt-GZsa4S-ctZEX5-cCGqij-9NbFLH-7432g2
- Flying Atlantic puffin (has small wings for body size, and needs to flap hard to fly)
https://www.flickr.com/photos/77268987@N02/9239329585/in/photolist-FB92Tf-f5rYMX-8gxQnD-czkW7u-qRbiti-eRtHRr-GZmdZA-6FHS9P-eXD2Wm-8e1Hcd-nQ6Gh4-NJZf7-omLWwc-eGWRHY-68xUYX-d1PFvb-dWFANs-mYyrgB-eNC1bj-PugYw-psxiPn-f9R74y-nkD3ct-bTb69B-eSisSm-aCf8Kz-6GfF2L-9H1RoN-kJX362-6zncVk-4VpAzX-8RNAdC-9ZAeGG-4Z33dS-8qdZC3-enrotG-4VpjS6-59ejgG-f7zrjN-JkHxZL-fewEQf-ckEdRS-odMvJ-6ETSFU-GUgpVf-ctPWi9-cH18AN-9URJEV-nvuq7j-pJ9hqK
- Common murre flying. The wings of murres are adapted for "flying" under water to catch prey. Wings are small relative to body size, and birds have to flap hard to fly.
https://www.flickr.com/photos/dlbezaire/3728574670/in/photolist-ppaEKB-GYTPgr-GEML4U-GWCPwj-H5XzPB-H2YTu3-H2YRRJ-H5Xxt4-GarSno-6FtVmb-GWCHbJ-zWbUsT-uiMxgL-GarXjC-GarWub-GaxsGV-Gaxsi8-GWCRHo-GEMH21-H2YNtS-zWbVH8-GarWoj-H2YRzm/

LESSON ONE | WORKSHEET 1.1.1: SEABIRD VS. LAND BIRDS

Venn Diagram of Bird Characteristics

Name:_____ Date:_____

Instructions: Using the Venn Diagram below, list characteristics of LAND BIRDS and SEABIRDS. Put characteristics they have in common in the overlapping center area.

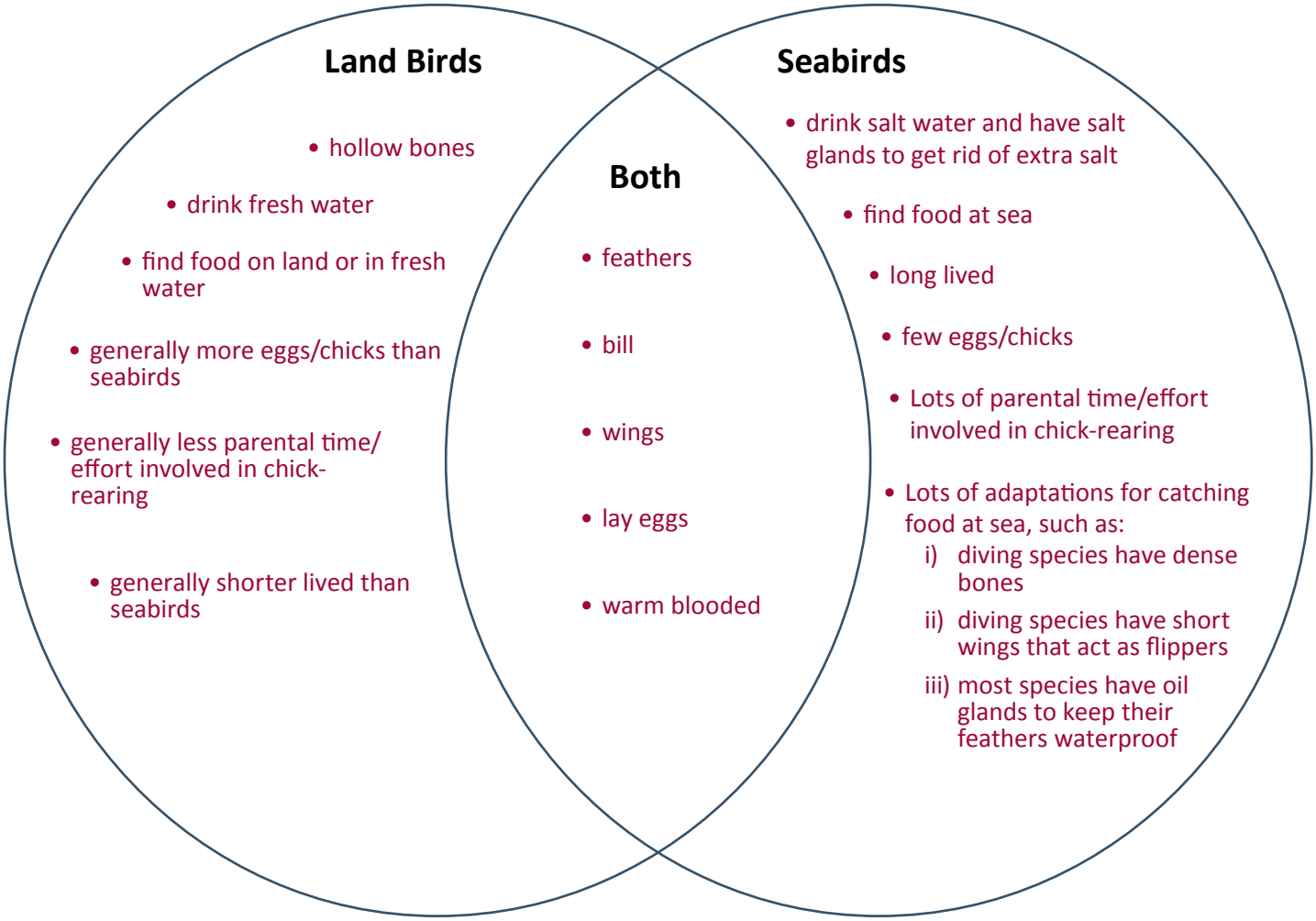


LESSON ONE | **WORKSHEET 1.1.1: TEACHER KEY**

Venn Diagram of Bird Characteristics

Name:_____ Date:_____

Instructions: Using the Venn Diagram below, list characteristics of LAND BIRDS and SEABIRDS. Put characteristics they have in common in the overlapping center area.

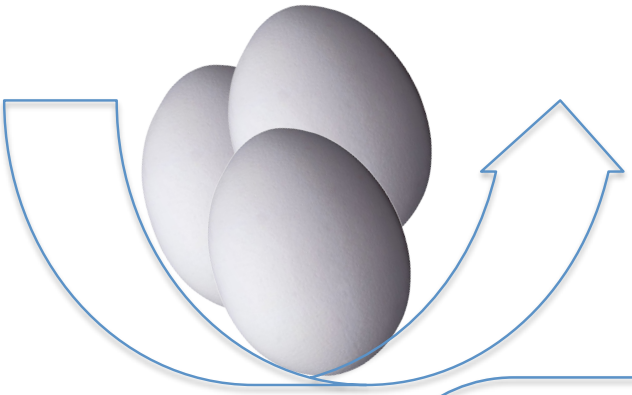


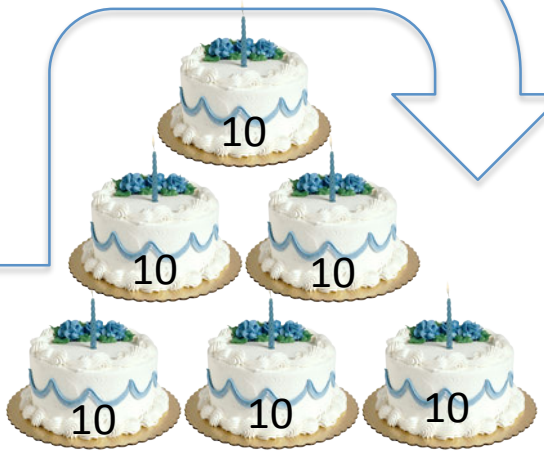
LESSON ONE	WORKSHEET 1.1.2: SPECIALIZED BEHAVIORS

Seabird Specialized Behaviors

Name:_____ Date:_____

Instructions: Complete as a class. Fill in the blanks with specialized behaviors that help seabirds live and feed in the marine environment.



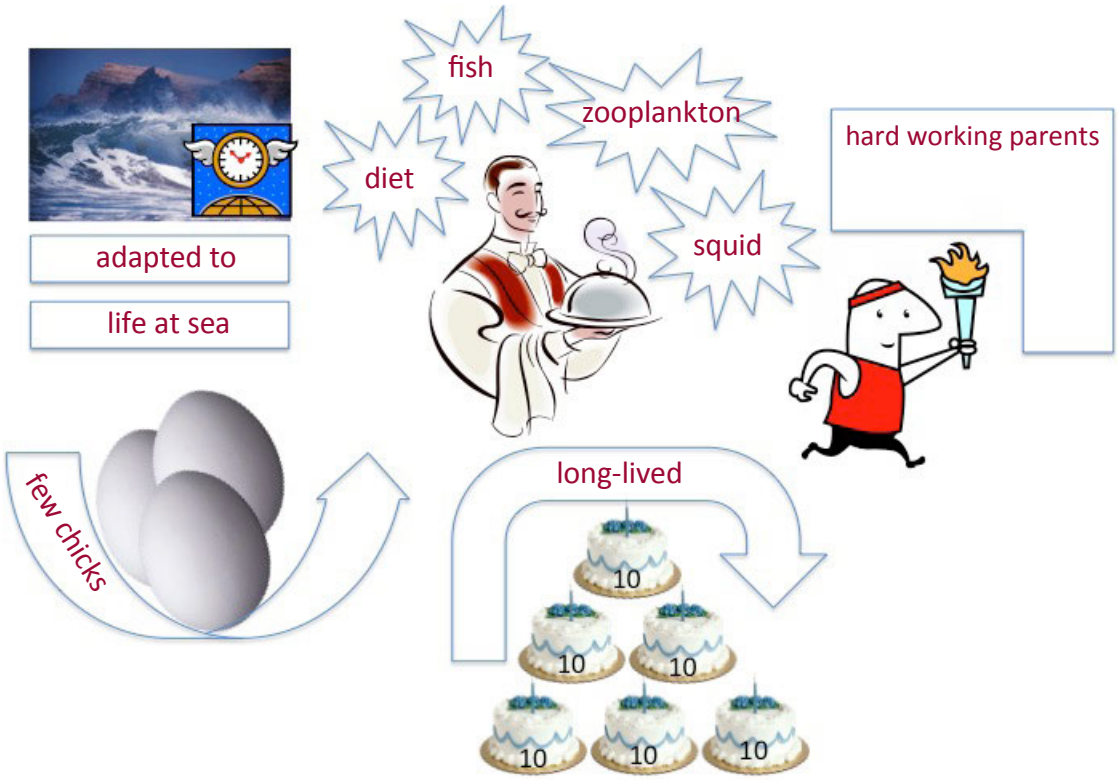


LESSON ONE	WORKSHEET 1.1.2: TEACHER KEY

Seabird Specialized Behaviors

Name:_____ Date:_____

Instructions: Complete as a class. Fill in the blanks with specialized behaviors that help seabirds live and feed in the marine environment.



- Adapted to Life at Sea. Live/feed at sea when not nesting.

– represented by the = sign.

- Diet – represented by the chef. Items to go in callouts: Diet, zooplankton, fish, squid
- Hard-working parents – represented by the runner/athlete.
- Few Chicks – represented by the few eggs.
- Long Lived – represented by the birthday cakes.
  Words "Long Lived" go in the arrow

LESSON ONE | ACTIVITY 1.2: SEABIRD GROUPS

OBJECTIVE:

- Students will be able to describe the characteristics of four seabird groups.

MATERIALS:

- PowerPoint Lesson 1: Seabird Basics
- **Worksheet 1.2.1 Seabird Groups T-Chart**
- Science notebook or blank paper
- **Worksheet 1.2.2 Seabird Groups**
- Internet access for the Extend and Explore

PROCEDURES:

- Show the class the PowerPoint Lesson 1: Seabird Basics.
- Complete **Worksheet 1.2.1 Seabird Groups T-Chart** as a class with guidance from the teacher.
- Ask students to complete **Worksheet 1.2.2 Seabird Groups** in small groups.

EXTEND AND EXPLORE:

- Research the seabirds species where you live. Assign each species to one of the four groups you learned about in this exercise.

LESSON ONE WORKSHEET 1.2.1: SEABIRD GROUPS T-CHART

Name:_____ Date:_____

Directions: Ask students to draw the T-chart below on a piece of paper or in their science notebook. The teacher will then choose 1 seabird group at a time from the Answer Key on page 22, and use that as a guide to lead students in a note taking activity. Have students write key words in bullet format rather than the whole sentences in the characteristics descriptions on page 22.

Seabird Groups	Characteristics

LESSON ONE	WORKSHEET 1.2.2: SEABIRD GROUPS

Match Seabird Group to Description

Name:_____ Date:_____

Instructions: On the short line, write the letter of the definition (on the right) that matches the term (on the left).

_____ **Tubenoses**

_____ **Penguins**

_____ **Other seabirds**

_____ **Auks and gull-like birds**

A. All are highly adapted to underwater travel, but cannot fly. Except for the Galapagos penguin, they all live in the Southern Hemisphere.

B. Auk species both fly and swim with their wings. They live only in the Northern Hemisphere. Species include the puffins, murres, and auklets. The gull-like birds include the gulls, terns, jaegers (skuas), and skimmers.

C. All of these birds have their nostrils enclosed in tubes. They include the albatrosses, fulmars, petrels, shearwaters, and prions.

D. This group of birds includes the gannets, pelicans, boobies, tropic birds, cormorants, and frigate birds.

LESSON ONE | WORKSHEET 1.2.2: TEACHER KEY

Match Seabird Group to Description

Name:_____ Date:_____

Instructions: On the short line, write the letter of the definition (on the right) that matches the term (on the left).

____C___ **Tubenoses**

____A___ **Penguins**

____D___ **Other seabirds**

____B___ **Auks and gull-like birds**

A. All are highly adapted to underwater travel, but cannot fly. Except for the Galapagos penguin, they all live in the Southern Hemisphere.

B. Auk species both fly and swim with their wings. They live only in the Northern Hemisphere. Species include the puffins, murres, and auklets. The gull-like birds include the gulls, terns, jaegers (skuas), and skimmers.

C. All of these birds have their nostrils enclosed in tubes. They include the albatrosses, fulmars, petrels, shearwaters, and prions...

D. This group of birds includes the gannets, pelicans, boobies, tropic birds, cormorants, and frigate birds.

LESSON ONE | ACTIVITY 1.3: SEABIRDS OF THE PRIBILOFS

OBJECTIVE:

- Students will be able to state what species of seabirds breed on the Pribilof Islands and why birds might select one island over the other for a breeding colony.

MATERIALS:

- PowerPoint **Lesson 1a: Seabirds of the Pribilof Islands**
- Internet access

PROCEDURES:

Show the students PowerPoint **Lesson 1a: Seabirds of the Pribilof Islands**.

Go to www.seabirds.net and follow the steps listed below to see what seabird species breed on the Pribilof Islands.

1) Located at the bottom of the page, click on *"Seabird Information Network"*. That will bring you to a list of shared seabird databases.

2) Click on *"North Pacific Data Portal"* (see citation information below), then click *"Explore the map"*.

3) You should see a map of the North Pacific showing North America and Asia with transparent hexagons. You can use the computer mouse to zoom in and out on the map. Find North America… then Alaska… then the Aleutian Islands…

4) You can then click on the zoom (+) button… and find the Pribilof Islands (North of the Aleutian Islands, in the Bering Sea).

5) From the *"Species Filter"* in the upper right screen, uncheck *"Seabird population index"* and *"Seabird productivity index"*; keep *"Seabird colony register"* checked.

6) From the species list along the right side of the screen, check the box next to common murre, crested auklet, least auklet, and thick-billed murre.

7) You can zoom right in on the Pribilofs, and will see that there are four colored circles, one for each island (St. Paul, St. George, Otter and Walrus Island)

8) Place your curser over St. Paul Island, and make a note of how many common murres, crested auklets, least auklets, and thick-billed murres there are.

9) Do the same for St. George Island.

10) Which island has the most common murres? crested auklets? least auklets? and thick-billed murres?

11) Why might one Pribilof Island have more seabirds than the other Pribilof Island?

12) What reasons might one island have more seabirds than the other island? Suitable cliff ledges for nesting habitat? Fewer nest predators like eagles or foxes? Other ideas?

Website Citation for the North Pacific Seabird Data Portal

At the time this curriculum was produced, the portal was last updated in January 2017.

The data and indices reported on the North Pacific Seabird Data Portal are contributed by numerous researchers. Where appropriate, please cite relevant data sources. The North Pacific Seabird Data Portal may be cited as:

Seabird Information Network. 2017. North Pacific Seabird Data Portal. Available on http://axiom.seabirds.net/maps/north-pacific-seabirds/.

LESSON ONE | ACTIVITY 1.4: SEABIRD FACT SHEET

OBJECTIVES:

- Students will conduct a review of birds that breed on the Pribilof Islands.
- Students will be able to identify species of seabirds from photographs and sort them into the 4 main groups of seabirds.
- Students will learn the Unangan names of seabirds.
- Students will use the knowledge they have gained in this lesson to create a seabird fact sheet.

PROCEDURES:

Guide the students through steps 1 - 3 below to gather the information needed to complete Worksheet 1.4.1 Seabird Fact Sheet.

Allow each student to pick a seabird to research and complete the fact sheet.

A Horned puffin fact sheet is provided to use as a template.

1) Conduct a general review of which seabirds breed on the Pribilof Islands, Alaska. View the species accounts videos created by students during seabird camp on the Pribilof Islands. http://seabirdyouth.org/project-videos/

2) Show a series of color photos (for a small class size) or images on a smart board (for a large class size) and ask students to identify each species. If color photos are available, student will do a sorting exercise to group the species into the 4 main groupings they learned about in Activity 1.2. http://alaska.fws.gov/mbsp/mbm/seabirds/species_list.htm

3) Students will practice the Unangan (Aleut) names for each species. For practice pronouncing Unangan words go to: http://tanamawaa.com, http://www.apiai.org/services/community-services/traditional-foods-program/glossary-vocabulary/, and http://www.apiai.org/culture-history/word-of-the-week/.

LESSON ONE | ACTIVITY 1.4: SEABIRD FACT SHEET

Common Name	Scientific Name	Unangan Name
crested auklet	*Aethia cristalla*	Kunugyux̂
least auklet	*Aethia pusilla*	Chuuchiiĝix̂
parakeet auklet	*Cyclorrhynchus psitacula*	Agaluuyax̂
red-faced cormorant	*Phalacrocorax urile*	Aagyuuĝiigamax̂ or ingatux̂ or Aagyuux̂
common murre	*Uria aalge*	Sakitax̂ or ulux̂txax̂
thick-billed murre	*Uria lomvia*	Sakitax̂ or ulux̂txax̂
tufted puffin	*Lunda cirrhata*	Uxchux̂
horned puffin	*Fratercula corniculata*	Qagidaĝ or Uxchux̂
black-legged kittiwake	*Rissa tridactyla*	Gidaax̂ / gidaaĝix̂ or Qaĝayaax̂
red-legged kittiwake	*Rissa breevirostris*	Qaĝayaax̂

This website has links to detailed accounts on all the seabirds species breeding in Alaska.

http://alaska.fws.gov/mbsp/mbm/seabirds/species_list.htm

LESSON ONE	WORKSHEET 1.4.1: SEABIRD FACT SHEET

Species Scientific Name: Common Name:

Conservation Status Unangan Name:

ALASKA: GLOBAL:

Breed	Eggs	Incubation	Fledge	Nest	Feeding Behavior	Diet

LESSON ONE	WORKSHEET 1.4.1: SEABIRD FACT SHEET

Species Scientific Name: Common Name:

Conservation Status Unangan Name:

ALASKA: GLOBAL:

LESSON ONE	WORKSHEET 1.4.1: FACT SHEET EXAMPLE

HORNED PUFFIN *Fratercula corniculata*

Conservation Status

ALASKA: Moderate GLOBAL: Least Concern

Unangan Name: Qagidaĝ or Uxchux̂

Breed	Eggs	Incubation	Fledge	Nest	Feeding Behavior	Diet
June-July	1	40 days	34-43d	burrow	surface dives	fish, squid, other invertebrates

DESCRIPTION

The horned puffin is one of the most sought after seabirds in Alaska by tourists and photographers.

In summer they have a black back, and a white belly and face. They have small black leathery skin protrusions above the eyes (up to 12 mm) that create the horned appearance from which they are named after. The large bill is bright yellow with a red tip, and their legs and feet are a bright orange to reddish.

In winter their bill is smaller and duller (some of the outer sheath covers fall off), "horns" are lost, the face turns grey and feet become a pale fleshy color.

DISTRIBUTION

The species is widespread in the North Pacific Ocean. During the breeding season it nests in the Gulf of Alaska, Aleutian Islands, and islands in the Bering and Chukchi Seas, and the Sea of Okhotsk. Rare breeder in British Columbia. 87% of world population breeds in Alaska, and 13% breed in Russia.

Horned puffins spend their winter at-sea, never visiting land. They can be found offshore throughout the North Pacific during winter months.

CONSERVATION CONCERNS

- Hunting and harvest. Adults and eggs harvested for subsistence in some areas of Alaska, particularly in Bering Strait region, but this harvest is minimal and localized (largely because of their inaccessible nesting sites).
- Vulnerable to oil pollution because of marine habitats and flightless period during the winter months (during molt), but major oil mortality events have not been reported.
- Plastic particles are frequently found in gizzards.
- Fishing nets. Unintentional capture by gill nets is widespread in the North Pacific.
- Introduced mammals. Mammalian predators were once absent from most islands in the Northeast Pacific, but arctic fox (*Alopex lagopus*), red fox (*Vulpes vulpes*), Norway rats (*Rattus norvegicus*), and ground squirrels (*Spermophilus undulatus*) have been introduced onto many seabird colonies in Alaska. These predators have had large impacts on many seabird populations, although horned puffins were less affected than some species because they usually nest in less accessible crevices.
- Puffins may desert their nests if humans disturb them during the breeding season.

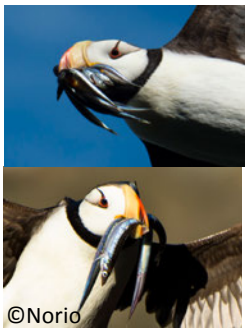

Horned Puffin. © Ann Harding

CULTURAL USE

Unangan (indigenous people of the Aleutian Islands of Alaska (USA) and Kamchatka Krai (Russia)) used the skin of horned puffins for clothing. It could take over 40 puffin skins to make one parka. Feathers were worn outside during rainy weather and inside during colder dry weather. The colorful puffin bills were used as ornaments on clothing, in children's rattles, and on mittens worn in ceremonial dances.

COOL FACT

Spines on a puffin's tongue and the roof of the mouth act as hooks holding on to fish while the beak is open catching more fish. The average catch is 10 fish but the record is 62 by an Atlantic puffin in Britain!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LESSON ONE	WORKSHEET 1.4.1: FACT SHEET EXAMPLE
HORNED PUFFIN	*Fratercula corniculata*
Conservation Status	Unangan Name: Qagidaĝ or Uxchux̂
ALASKA: Moderate	GLOBAL: Least Concern

References

Piatt, J. F., and A. S. Kitaysky. 2002. Horned Puffin (*Fratercula corniculata*). In The Birds of North America, No. 603 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Cornell Lab of ornithology species account page:

http://www.allaboutbirds.org/guide/horned_puffin/lifehistory

VIDEO coverage

http://www.youtube.com/watch?v=MVOndUJqx0Q

http://www.youtube.com/watch?v=Xd_XuX05m0k

http://www.youtube.com/watch?v=Y7A3LEUu37o

WEBSITES

http://video.nationalgeographic.com/video/puffin_atlantic_iceland

https://www.natgeokids.com/nz/discover/animals/birds/puffin-facts/

http://easyscienceforkids.com/all-about-puffins/

http://projectpuffin.audubon.org/

http://www.bbc.co.uk/nature/life/Atlantic_Puffin#intro

LESSON TWO

SEABIRD FEEDING

Seabird Youth Network

OBJECTIVE:

- Students will be able to describe what seabirds eat and how their morphology influences what they eat.

FOCUS QUESTIONS

- What do seabirds eat?
- How do seabirds catch their food?
- How do seabirds feed their chicks?

DIETARY RANGE

- Some species of seabird have a fairly specialist diet (eating one or very few types of prey); the least auklet eats mostly zooplankton.
- Other species are generalists (eating a variety of prey, depending on what is available); the thick-billed murre will eat fish, crustaceans, zooplankton, and squid.
- There is a broad range in the degree of specialism, with a continuum from highly-specialized to broadly-generalist species.

WHAT DO THEY EAT?

Seabirds eat primarily **fish, squid, and zooplankton**. A few species eat carrion, or take other seabird eggs or chicks.

Eulachon. © Tom Kline, via Creative Commons.

Eulachon

- Also called hooligan and candlefish.
- Popular prey species for seabirds because of their high fat content.
- Up to 15% of their total body weight is fat!
- If they are caught and dried, they can be used as candles! Hence, their name — candlefish.

LESSON TWO SEABIRD FEEDING

Squid

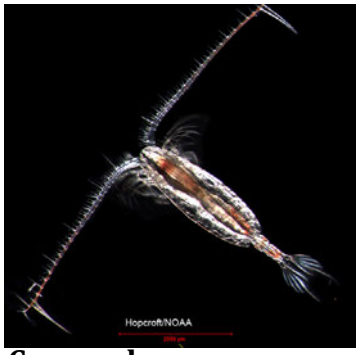
- Squid are cephalopods (like the octopus)
- Use jet propulsion to move through the water
- Some species of squid move nearer the surface of the water at night (vertical migration), making them easier for seabirds to catch

Squid (*Berryteuthis magister*).
© NOAA

Zooplankton. © Matt Wilson/Jay Clark, NOAA NMFS AFSC, Public Domain

Zooplankton

- Microscopic animals that eat other plankton
- Major food source for many marine predators, including fish, whales, and seabirds
- Common zooplankton eaten by seabirds include copepods (meaning "oar-foot"), amphipods, and euphausiids



Copepod. (*Calanus marshallae*).
© Hopcroft/NOAA

LESSON TWO SEABIRD FEEDING

HOW DO THEY CATCH FOOD?

Seabirds have six basic feeding strategies: surface feeding, pursuit diving, plunge diving, kleptoparasitism, scavenging, and land predation.

1) SURFACE FEEDING

Many seabirds feed on the surface of the ocean.

Ocean currents, or the vertical migration of some prey species (such as some species of squid) causes prey to concentrate near the surface of the water making them available to seabirds.

Surface feeders either feed:

(a) **While flying** (black skimmers, storm petrels.)

These species either: (i) **grab food** from the water in mid flight (like the frigate bird), (ii) **patter and hover** on the water's surface (like some species of storm petrel), or (iii) **skim the surface** of the water (like the skimmer).

Black Skimmer. © MurrayH77, via Creative Commons.

Black skimmer

- Breeds in North and South America
- Lower bill is dragged in water. Bill shuts when it touches something in the water
- Eats fish, insects, crustaceans, and molluscs

White vented storm petrel. © NKS Swampie, via Creative Commons.

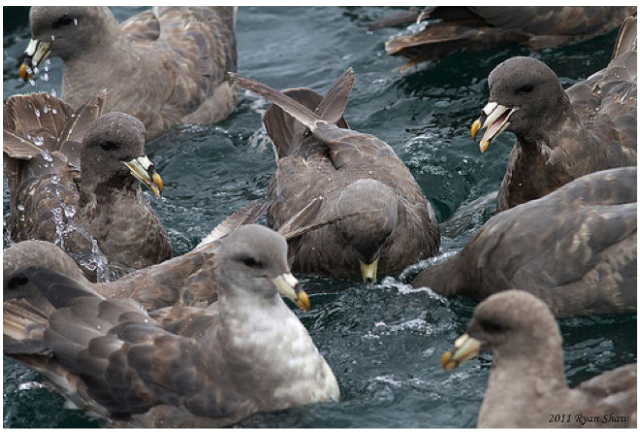
White vented storm petrel

- Also known as Elliot's storm petrel
- Lays one egg
- Little is known about the species, and only one nest-site has ever been found

LESSON TWO SEABIRD FEEDING

(b) **While swimming** (fulmars, shearwaters)

The bills of these species are adapted for catching prey. Albatross have a hooked bill to catch prey such as squid. Prions have filters (lamellae) that filter plankton from the mouthful of water.



Northern fulmar. © Ryan Shaw, via Creative Commons.

Northern fulmar

- Breeds in subarctic regions of N. Atlantic and N. Pacific
- Two color morphs: Light (almost white), and Dark (grey, as in photo)
- A tubenose (family Procellariidae)
- Produces stomach oil that is a fatty meal for their chick and can be used against predators (vile smelling and oily)
- Starts breeding between 8-12 years

2) PURSUIT DIVING

Some species swim underwater in pursuit of prey. These species have the advantage of accessing a greater area to find food than the surface feeders or plunge divers.

Many also have **specialized adaptations for conducting long, deep dives**.

The emperor penguin can dive to depths of more than 1500 ft. Scientists have shown that they can lower the rate of their heartbeat when diving in order to conserve oxygen and allow longer dives. During one 18 minute dive, one penguin decreased its' heart-rate to 3 beats per minute!

Pursuit divers swim underwater either using:

LESSON TWO SEABIRD FEEDING

(a) **Foot propulsion** (cormorants, grebes, loons)

Double-crested cormorant. © James St. John, via Creative Commons

Double-crested cormorant

- Found in freshwater lakes, rivers, as well as along the coast
- Eats mainly fish
- Uses feet for propulsion through the water
- Dive depths recorded to 7.5 meters
- Like all cormorants, feathers are not waterproof and they must spend time drying them out after diving

(b) **Wing propulsion** (penguins, auks, diving petrels)

Feet and wings that are specially adapted for underwater travel are usually less efficient for other uses.

The legs of loons are located far back on their body (near the tail) for efficient swimming under water, and they have a hard time walking on land. And, puffins have short, narrow wings (like flippers) that are excellent for swimming underwater, but they have to work very hard when flying.

Tufted puffin. © JDurston2009, via Creative Commons.

Tufted puffin

- Breeds in North Pacific
- Nests in burrow (dug with feet and bill) or crevice between rocks
- Carries whole fish back to chick, held crosswise in the bill
- Bill adapted to hold fish; raspy tongue holds fish against spines on the palate (top of the bill)
- May dive deeper than 80 feet to catch fish!

LESSON TWO | SEABIRD FEEDING

3) PLUNGE DIVING

These species dive into water from flight to catch prey. They include the gannets, boobies, tropic birds, and some terns. This is the most specialized form of feeding, and it can take years for individuals to learn efficient foraging. Some plunge-divers are dependent on marine mammals (such as dolphins) and predatory fish (tuna) to push prey to the surface.

Gannet plunge diving. © Mike Pennington, via Creative Commons

Gannet

- Hunt fish by diving into the ocean
- Dive from heights of 30 meters at speed of 100 km/hr (62 mph)
- Adapted for diving: no external nostrils, air sacs in face and chest cushion the body, and eyes forward on face allowing them to judge distances very accurately

4) KLEPTOPARASITISM

Kleptoparasites (frigate birds and Jaegers) steal food from other seabirds. This method of hunting usually supplements other methods of foraging.

Parasitic Jaeger chasing a common tern. © Wendy Miller, via Creative Commons

Parasitic jaeger

- "Jaeger" comes from German word "jäger" meaning hunter
- Lays 1-3 eggs in shallow depression on the ground
- Chases other birds and forces them to drop their catch
- Also catches fish, and eats small birds, eggs, rodents, insects, and berries

LESSON TWO | SEABIRD FEEDING

5) SCAVENGING

Some birds, such as gulls, feed on seabird and marine mammal carrion, and many species have learned to scavenge offal or bycatch from commercial fishing boats and processors.

Southern giant petrel feeds on carcass of Southern Fur Seal. © JDurston2009, via Creative Commons.

Southern giant petrel

- Breeds in Southern Hemisphere
- Aggressive predator and scavenger; whalers used to call them "gluttons"
- Feeds on carrion (especially seals and penguins)
- Capable of killing other birds
- Also eats squid, krill, offal, and discarded fish from commercial fishing boats

6) LAND PREDATION

Gulls, skuas, and giant petrels will often take eggs, chicks and even small adults from seabird colonies. The great skua will often take adult puffins and gulls, and the giant petrel will even tackle an albatross! Yikes!

Greater black-backed gull eating a razorbill chick.
© Paul Hobson/naturepl.com

Greater black-backed gull

- The largest gull in the world
- Will eat fish, but also hunts any prey on land smaller than itself
- Will attack and kill chicks, and even some adult birds (such as the Atlantic puffin)
- Most prey are swallowed whole

LESSON TWO | SEABIRD FEEDING

HOW DO THEY FEED THEIR CHICK?

All seabirds catch food out at sea, and then have to carry the food back to their chick at the nest-site. They carry their food using four main methods:

1) **Whole prey:**

   Many species carry whole prey in their bill. These species maximize the value of the meals by choosing large and nutritious prey species. Murres and many species of tern carry single prey items back to their chick, whereas puffins may carry over 30 items in their bill!

Arctic tern. © 2009 Patrick Mayon (http://flickr.com/photos/patrickmayon) , via Creative Commons.

Arctic tern

- Circumpolar distribution
- Plunge-dive (from heights of about 3-10 ft), and dive no deeper than 50 cm underwater
- Has the longest migration of any bird
- Travelling from the Arctic to spend winters in the Antarctic (11,000 miles of more!)

2) **Regurgitation:**

   Some species of seabird, such as kittiwakes, regurgitate the content of their stomach or crop (pouch near the throat) for their chick.

Black-legged kittiwake. © Brandon Birder, via Creative Commons.

Black-legged kittiwake

- Breeds in the North Atlantic and North Pacific
- Breed in large colonies, on cliffs
- Nest is made of mud, their own guano, seaweed, and moss
- Lays 1-3 eggs
- Often feeds in flocks
- Catches food at the surface, or just below the surface of the water

LESSON TWO SEABIRD FEEDING

3) **Throat or gular pouch:**

Some species have a pouch (or sac) under their tongue or in their throat that they store whole prey for their chick. Least auklets can carry more than 700 individual zooplankton in their pouch.

Dovekie (little auk) gular pouch, see page 93; studies on seabird diet. © Ann Harding

4) **Stomach oil:**

Some species feed their chick stomach oil (albatrosses, petrels, prions, and shearwaters). This oil is created from partly digested prey. It is very energy rich, about 9,600 calories per gram. In comparison, most cheeses only have 3 to 4.5 calories per gram! These incredibly high-energy meals are important to small birds, such as the storm petrel, that only feed their chick once every 24 hours (at nighttime).

Albatross feeding chick. © USFWS

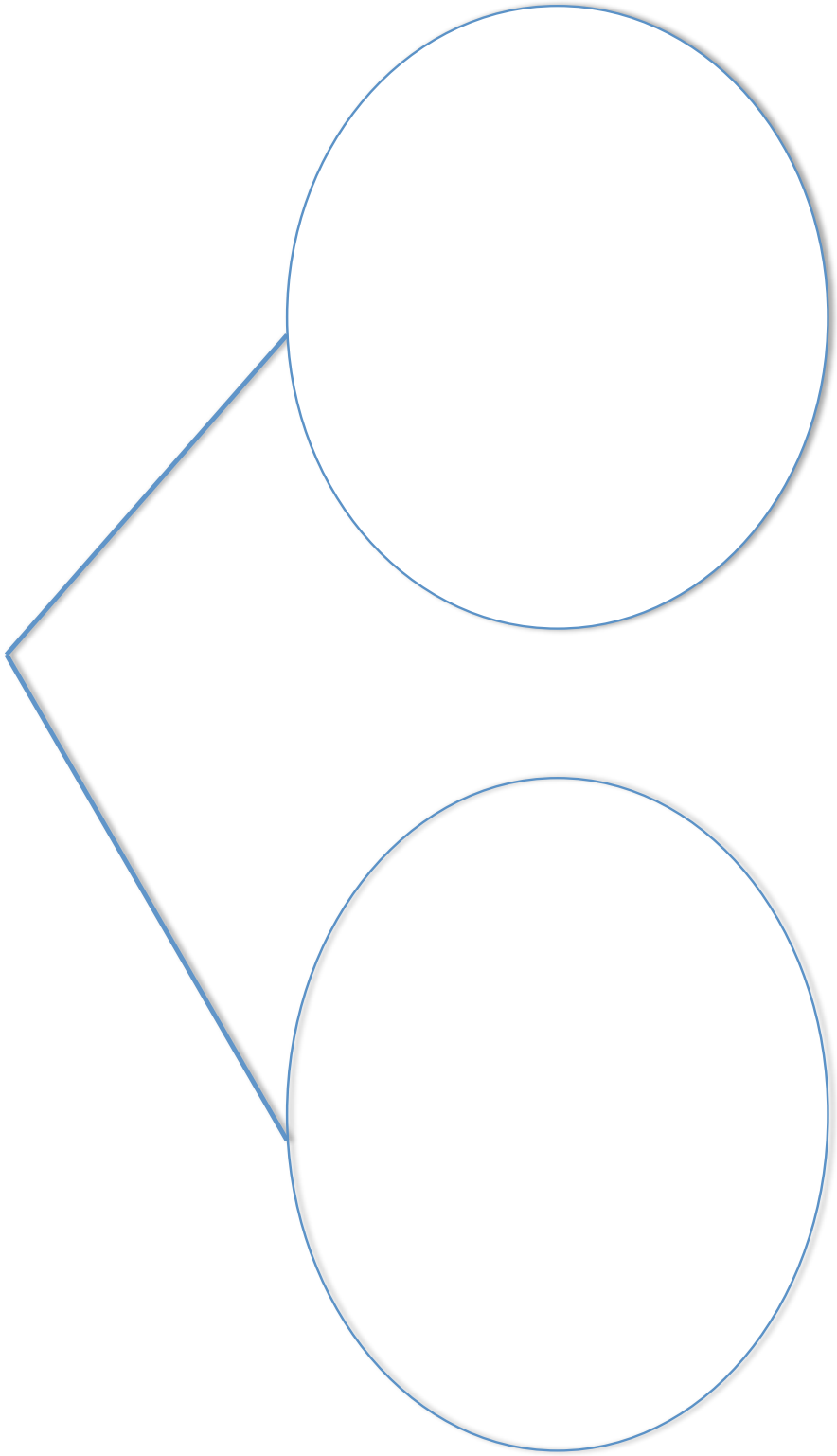
LESSON TWO | WORKSHEET 2.1: SEABIRD FEEDING

SEABIRD FEEDING STRATEGIES

Name:_____ Date:_____

Instructions: Use the Graphic Organizer below to have students take notes as the class discusses ideas of feeding strategies.

DIETARY RANGE



SEABIRD FEEDING STRATEGIES

Name:_____ Date:_____

Instructions: Use the Graphic Organizer below to have students take notes as the class discusses ideas of feeding strategies.

DIETARY RANGE

Specialist: an animal That eats one or very few types of food.

Generalist: eating a variety of prey, depending on what's available

LESSON TWO	WORKSHEET 2.2: CATCHING FOOD

HOW DO BIRDS CATCH FOOD?

Name:_____ Date:_____

Instructions: Use the Catch Food Notes page below to note the key words or phrases presented during the PowerPoint and Lesson. Also, include one example species for each category.

Aquilina Lestenkof

Surface Feeders

Pursuit Diving

Plunge Diving

Kleptoparasitism

Scavenging

Land Predation

LESSON TWO	WORKSHEET 2.2: TEACHER KEY

HOW DO BIRDS CATCH FOOD?

Name:_____ Date:_____

Instructions: Use the Catch Food Notes page below to note the key words or phrases presented during the PowerPoint and Lesson. Also, include one example species for each category.

Aquilina Lestenkof

Surface Feeders

Dips head in water
Swim or fly
Example: skimmer, storm petrel

Pursuit Diving

Swim underwater
Use feet or wings
Access large area of water for food
Example: puffins, cormorants, penguins

Plunge Diving

Dive bomb into water
Specialized behavior
Example: gannets, boobies

Kleptoparasitism

Steal prey
Example: frigate birds, jaegers (skuas)

Scavenging

Dead prey
Offal and fishery bycatch
Example: gulls, giant petrel

Land Predation

Live prey on-land
Eggs, chicks, small mammals, sometimes other adult birds
Example: many gulls, great skua

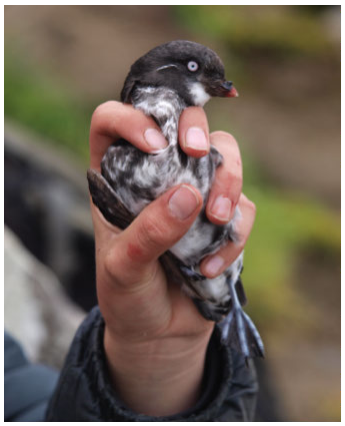
LESSON TWO | WORKSHEET 2.3: CHICK FEEDING

HOW DO BIRDS FEED THEIR CHICKS?

Name:_____ Date:_____

Instructions: Using the information presented during this lesson, record the type of feeding strategy each bird uses.

Arctic tern. © 2009 Patrick Mayon (http://flickr.com/photos/patrickmayon) , via Creative Commons.



Least auklet. © John Gibbens

Copepod (*Calanus marshallae*). © Hopcroft/NOAA

Black-legged kittiwake. © Brandon Birder, via Creative Commons.

LESSON TWO	WORKSHEET 2.3: TEACHER KEY

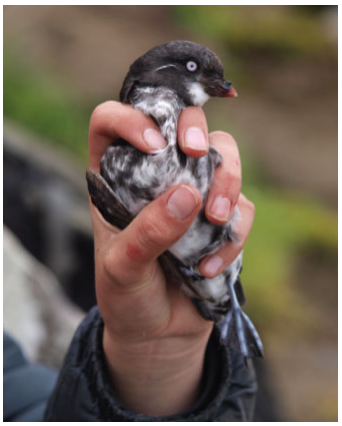
HOW DO BIRDS FEED THEIR CHICKS?

Name:_____ Date:_____

Instructions: Using the information presented during this lesson, record the type of feeding strategy each bird uses.

Arctic tern. © 2009 Patrick Mayon (http://flickr.com/photos/patrickmayon) , via Creative Commons.

Feed whole prey



Least auklet. © John Gibbens

Copepod (*Calanus marshallae*). © Hopcroft/NOAA

Throat or gular pouch

Regurgitation

Black-legged kittiwake. © Brandon Birder, via Creative Commons.

LESSON TWO	WORKSHEET 2.4: PUFFIN CHICK FEEDING

HORNED PUFFIN CHICK FEEDING

Name:_____ Date:_____

Instructions: Use the puffin chick diet samples data tables to complete this exercise. Each sample represents one bill load (a load of fish carried cross-ways in the bill by the parent puffin and delivered to the chick). The prey species, and lengths and weights of each individual fish are provided.

CAN YOU ANSWER THE FOLLOWING QUESTIONS?

1. What is the average (mean) number of prey per bill-load?

2. What is the minimum number of prey per bill-load?

3. What is the average (mean) weight of a bill load?

4. Chicks were being fed an average of 3 times per day. Take the average (mean) weight of a bill-load, and calculate how much food (in grams) chicks were receiving a day.

LESSON TWO ACTIVITY 2.4: PUFFIN CHICK DIET SAMPLES

Horned puffin chick meals collected on Duck Island in 1997. Data collected by the USGS Alaska Science Center.

Horned puffins. © Norio

Sample #	Species	Length (cm)	Weight (grams)
1	Sand lance	96	2.59
1	Sand lance	110	4.86
1	Sand lance	106	3.75
1	Sand lance	96	3.03
1	Sand lance	95	2.62
1	Sand lance	116	4.83
2	Sand lance	97	2.81
2	Sand lance	94	2.39
2	Sand lance	102	3.16
2	Sand lance	104	3.26
2	Sand lance	98	2.8
3	Sand lance	128	6.48
3	Sand lance	84	2.22
3	Sand lance	86	2.18
3	Sand lance	93	2.73
3	Sand lance	89	2.54
3	Sand lance	87	2.42
3	Sand lance	88	2.22
3	Sand lance	82	1.8
4	Sand lance	86	2.28
4	Sand lance	82	2.06
4	Sand lance	85	2.27
5	Sand lance	88	2.32
5	Sand lance	72	1.17
5	Sand lance	94	2.64
5	Sand lance	94	2.71
5	Sand lance	83	1.6
5	Sand lance	77	1.41
5	Sand lance	96	2.77
5	Sand lance	91	2.32

LESSON TWO ACTIVITY 2.4: PUFFIN CHICK DIET SAMPLES

Horned puffin chick meals collected on Duck Island in 1997. Data collected by the USGS Alaska Science Center.

Sample #	Species	Length (cm)	Weight (grams)
6	Sand lance	91	2.45
6	Sand lance	90	2.18
6	Sand lance	97	2.83
6	Sand lance	89	1.92
7	Sand lance	99	3.16
7	Sand lance	90	2.34
7	Sand lance	95	2.77
7	Sand lance	105	3.99
8	Sand lance	71	1.19
8	Sand lance	76	1.6
8	Sand lance	66	1.11
8	Sand lance	69	1.22
8	Sand lance	63	0.98
8	Sand lance	72	1.11
8	Sand lance	68	1.18
8	Sand lance	72	1.16
8	Sand lance	66	0.96
8	Sand lance	77	1.27
8	Sand lance	83	1.46
8	Sand lance	74	1.21
8	Sand lance	73	1.18
8	Sand lance	78	1.57
8	Sand lance	87	1.94
8	Sand lance	75	1.26
8	Sand lance	71	1.27
8	Sand lance	75	1.31
8	Sand lance	76	1.36
8	Sand lance	76	1.43
8	Sand lance	70	1.19
8	Sand lance	95	2.64
8	Sand lance	100	3.24

LESSON TWO	WORKSHEET 2.4: TEACHER KEY

HORNED PUFFIN CHICK FEEDING

Name:_____ Date:_____

Instructions: Use the puffin chick diet samples data tables to complete this exercise. Each sample represents one bill load (a load of fish carried cross-ways in the bill by the parent puffin and delivered to the chick). The prey species, and lengths and weights of each individual fish are provided.

CAN YOU ANSWER THE FOLLOWING QUESTIONS?

1. What is the average (mean) number of prey per bill-load?

Sum the number of prey for each sample and divide by the number of samples (**8**).

Sample 1: **6** prey Sample 2: **5** prey Sample 3: **8** prey Sample 4: **3** prey

Sample 5: **8** prey Sample 6: **4** prey Sample 7: **4** prey Sample 8: **23** prey

6 + **5** + **8** + **3** + **8** + **4** + **4** + **23** = **61** Average = **61/8 = 7.6** prey per sample

2. What are the minimum and maximum number of prey per bill-load?

The minimum number of prey per bill is **3**.

The maximum number of prey per bill is **23**.

3. What is the average (mean) weight of a bill load?

Sample 1: (2.59 + 4.86 + 3.75 + 3.03 + 2.62 + 4.83)/6 = **3.613**

Sample 2: (2.81 + 2.39 + 3.16 + 3.26 + 2.8)/5 = **2.884**

Sample 3: (6.48 + 2.22 + 2.18 + 2.73 + 2.54 + 2.42 + 2.22 + 1.8)/8 = **2.824**

Sample 4: (2.28 + 2.06 + 2.27)/3 = **2.203**

Sample 5: (2.32 + 1.17 + 2.64 + 2.71 + 1.6 + 1.41 + 2.77 + 2.32)/8 = **2.118**

Sample 6: (2.45 + 2.18 + 2.83 + 1.92)/4 = **2.345**

Sample 7: (3.16 + 2.34 + 2.77 + 3.99 = **3.065**

Sample 8: (1.19 + 1.6 + 1.11 + 1.22 + 0.98 + 1.11 + 1.18 + 1.16 + 0.96 + 1.27 + 1.46 + 1.21 + 1.18 + 1.57 + 1.94 + 1.26 + 1.27 + 1.31 + 1.36 + 1.43 +1.19 + 2.64 + 3.24) = **1.428**

4. Chicks were being fed an average of 3 times per day. Take the average (mean) weight of a bill-load, and calculate how much food (in grams) chicks were receiving a day.

Sample 1: **3.613*3 = 10.84** Sample 2: **2.884*3 = 8.652** Sample 3: **2.824** *3 = **8.471**

Sample 4: **2.203*3 = 6.61** Sample 5: **2.118*3 = 6.353** Sample 6: **2.345*3 = 7.035**

Sample 7: **3.065*3 = 9.915** Sample 8: **1.428*3 = 9.195**

LESSON THREE SEABIRD BREEDING

Seabird Youth Network

OBJECTIVES:

- Students will be able to identify typical nesting habitats for Pribilof seabird species.
- Students will be able to discuss advantages and disadvantages of different nesting habitats/sites.
- Students will be able to evaluate strategies that birds and chicks have for survival.

FOCUS QUESTIONS:

- Where do seabirds nest?
- What are the advantages and disadvantages of the different nesting areas?
- How many chicks do seabirds raise each year and how does this compare to land birds?

WHERE DO SEABIRDS LAY THEIR EGGS?

NEST OR NO NEST?

- Some species use no nesting material. The white tern lays a single egg on an open branch.
- Some species use a very little bit of nesting material. The tufted puffin may use a few pieces of grass and a couple of feathers.
- Some species build more substantial nests. Kittiwakes cement their nests onto small cliff shelves by trampling mud and guano to form a base. And, some cormorants build large nests in trees from sticks and twigs.

White tern. © Pillot, via Creative Commons.

White tern

- Also called fairy tern.
- Tropical seabird species.
- Lays egg on branch or fork in tree. No nest.
- Newly hatched chicks have well developed feet to hang onto the nesting-site.

LESSON THREE SEABIRD BREEDING

ON THE COAST OR INLAND?

- Most seabird species breed on the coast and offshore islands.
- Some species breed fairly far inland, but still commute to the ocean to feed. Kittlitz's murrelets nest on scree slopes on coastal mountains, and parents may travel more than 70 km to their feeding grounds.
- Other species breed far inland and never travel to the ocean. Double crested cormorants breed on the coast, but also on lakes in many States such as Minnesota.

NESTING HABITAT

1) **Ground**

   Some species breed on the ground. These species tend to breed in areas with little or no predation, such as offshore islands (terns and gulls) or in the Antarctic (penguins, albatross).

Grey albatross and **Campbell albatross**, Campbell Island, New Zealand. ©Rachael Orben

King penguins, Volunteer Point, Falkland Islands. ©Rachael Orben

LESSON THREE SEABIRD BREEDING

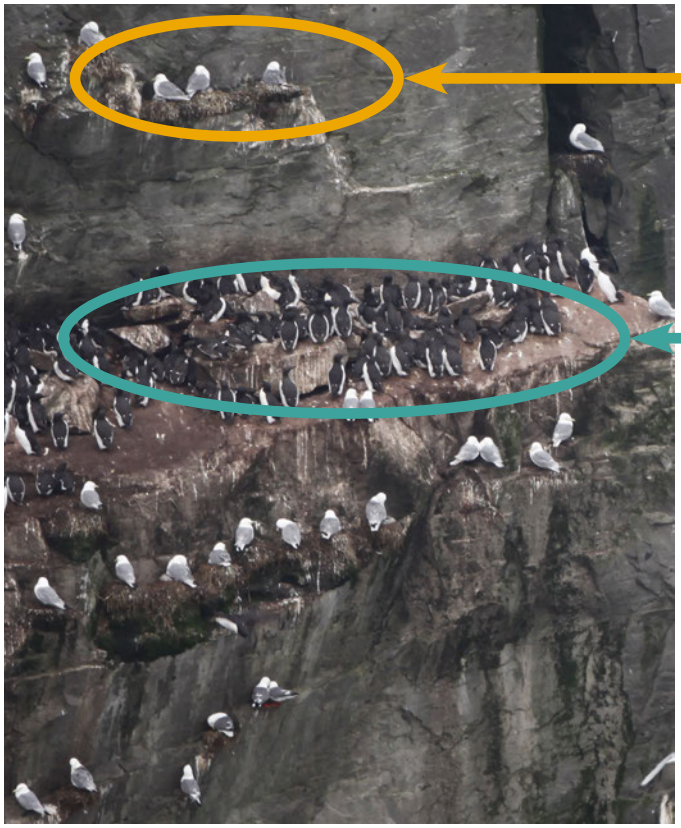
2) **Cliffs**

Many species of seabird breed on steep cliffs.

Advantages: (a) few predators, (b) wind and air space to help birds land and depart.

Disadvantages: (a) easy to lose eggs (some species of seabird, like murres, have pear-shaped eggs so that their don't roll off the ledge), (b) hard for fledglings to leave the nest, murre chicks may have to jump more than 1000 m when they leave the colony!

Species breeding on cliffs are often stratified or grouped.



Cliff nesting seabirds grouped by species.
©Ram Papish

Cliff nesting seabirds. ©Ram Papish

LESSON THREE SEABIRD BREEDING

3) **Burrows/crevices**

Good strategy against many predators, and egg/chick is protected from bad weather.

Some species dig their own burrow (some storm petrels), others nest in natural crevices among rocks (least auklets).

Crevice nesting **horned puffin**. © Ann Harding

Horned puffins lay their egg in a rock crevice. If you look closely in the photo above, you can see a sand lance (a common prey species) by the newly hatched chick. One of the parents delivered the meal for the chick.

LESSON THREE SEABIRD BREEDING

4) **Trees**

Many species of seabirds build a nest in trees: fairy terns, red-footed boobies, black noddies. In Alaska, the marbled murrelets build nests on the mossy branches of old growth trees. Their numbers are decreasing as old growth forests are logged.

Marbled murrelets nest in old growth forests.

Marbled murrelet

- Member of the Alcid family
- Nests in old growth forests or on the ground in high latitudes where there are no trees
- First nest only found in 1974!
- One of the **last** North American bird species to have its' nest discovered
- Chick fed for about 40 days, until chick is able to fly to sea unaccompanied

LESSON THREE SEABIRD BREEDING

MOST SEABIRDS BREED IN COLONIES

- 95% of seabirds are colonial breeders.
- Nests can be widely spaced (albatross colony) or densely packed (common murres).
- Many seabirds show incredible site fidelity, returning to the same burrow or nest-site for many years.
- Colonies are often located on cliffs, islands, or headlands that are hard for land mammals to access.
- Many colonies have more than one species. Each species nesting in it's own preferred habitat (see illustration on page 57). Some prefer nesting among rocks (auklets), some prefer wide ledges that can hold many birds (murres), and some prefer narrow ledges (fulmars).

Sooty tern colony. © twiga swala, via Creative Commons.

SIZE OF COLONIES

- Colonies vary greatly in size. Emperor penguin colonies range from 2,000 to 500,000 breeding pairs.
- Colony size is usually limited by available nesting space and food.

ADVANTAGES OF COLONIAL LIVING

- Anti-predation strategy (more eyes on the look-out, and more individuals to scare the predator away).
- Colonies may act as information centers – seabirds can find out where their prey is out at sea by watching other individuals return to the colony.

LESSON THREE SEABIRD BREEDING

DISADVANTAGES OF COLONIAL LIVING

- Large numbers of birds are vulnerable to disturbances (such as storms).
- Large numbers of birds may attract predators.
- Spread of disease.

HOW MANY CHICKS DO SEABIRDS HAVE?

- Seabirds have fairly small families compared to some other species of birds. Most species lay 1-2 eggs. A couple of species (such as the black-legged kittiwake) may lay three eggs when there is enough food to support a large family.
- Seabirds start breeding at a relatively old age; the larger albatross species can live for over 50 years, and don't start breeding until they are 5-10 years old.
- Some species breed every year. Other species may breed every other year, especially if the parents look after chicks for a long time at the colony. The larger albatross species can take over 9 months to rear their chicks, and these species only breed every other year.

Nazca booby. © Robert-Bannister, via Creative Commons.

SIBLICIDE (CHICK IS KILLED BY A SIBLING).

Siblicide happens in some seabird species, sometimes because there is not enough food to feed more than one chick. In some species, such as the Nazca booby, it happens even if there is enough food for parents to rear more than one chick.

RE-LAYING

Some species (like murres) will lay another egg if theirs is lost (maybe by predation), especially if the egg is lost early on in the season.

LESSON THREE SEABIRD BREEDING

DO BOTH PARENTS LOOK AFTER THEIR OFFSPRING?

- Yes, both parents incubate the egg and look after the offspring in most species of seabird. Looking after the chick includes brooding (keeping it warm and safe from predation), providing food, and protection from predators.
- Most seabird chicks are independent after they leave the colony, so parental care is restricted to the colony. A few species continue to care for their offspring after they have left the colony (murre fathers continue to feed their chick out at sea, after fledging.)
- Compared to many other bird species, seabird parents spend a lot of time and energy raising their chicks.
- Parents of some species take parental duties to the extreme! Emperor penguin dads deserve a medal-- the emperor penguin breeds in Antarctica, the coldest place on Earth (72 degrees below Fahrenheit!). After Mom lays her single egg, it's Dad's job to keep it warm. While mum leaves for 2 months to feed, the dad stays with the egg… balancing the egg on his feet to keep it warm, and huddling with the other dads for warmth until hatching time. The dad doesn't feed for these 2 months, and even gives the chick it's first meal (a milky-type substance) until the mum returns with fish.

HOW OLD ARE CHICKS WHEN THEY LEAVE THEIR NEST?

There is a huge range in age when chicks leave their nest. For example:

- Ancient murrelets. Chicks leave the nest when they are only 2 days old! They are not fed at the colony, but both parents continue to feed the chick out at sea until full grown.
- Common murres. Chicks leave the nest when they are about 3 weeks old. They are escorted from the colony by the dad, and continue to be fed out at sea.
- Tufted puffin. Chicks leave their nest when they are about 50 days old, and are completely independent out at sea.
- Large albatross species: Albatross chicks take a long time to fledge (up to 280 days… which is over 9 months!). Chicks have no further help from their parents after fledging.

LESSON THREE	WORKSHEET 3.1: SEABIRD NESTING HABITATS

Alaska Seabird Nesting

Name:_____ Date:_____

Instructions: Below is a list of the seabirds that nest on the Islands of Alaska. Use the illustration on page 58 to assign each seabird a nesting habitat.

- red-faced cormorant
- Cassin's auklet
- tufted puffin
- ancient murrelet
- black-legged kittiwake
- crested auklet
- glaucous winged-gull
- common murre
- rhinocerous auklet
- least auklet
- parakeet auklet
- horned puffin
- northern fulmar

FLAT GROUND

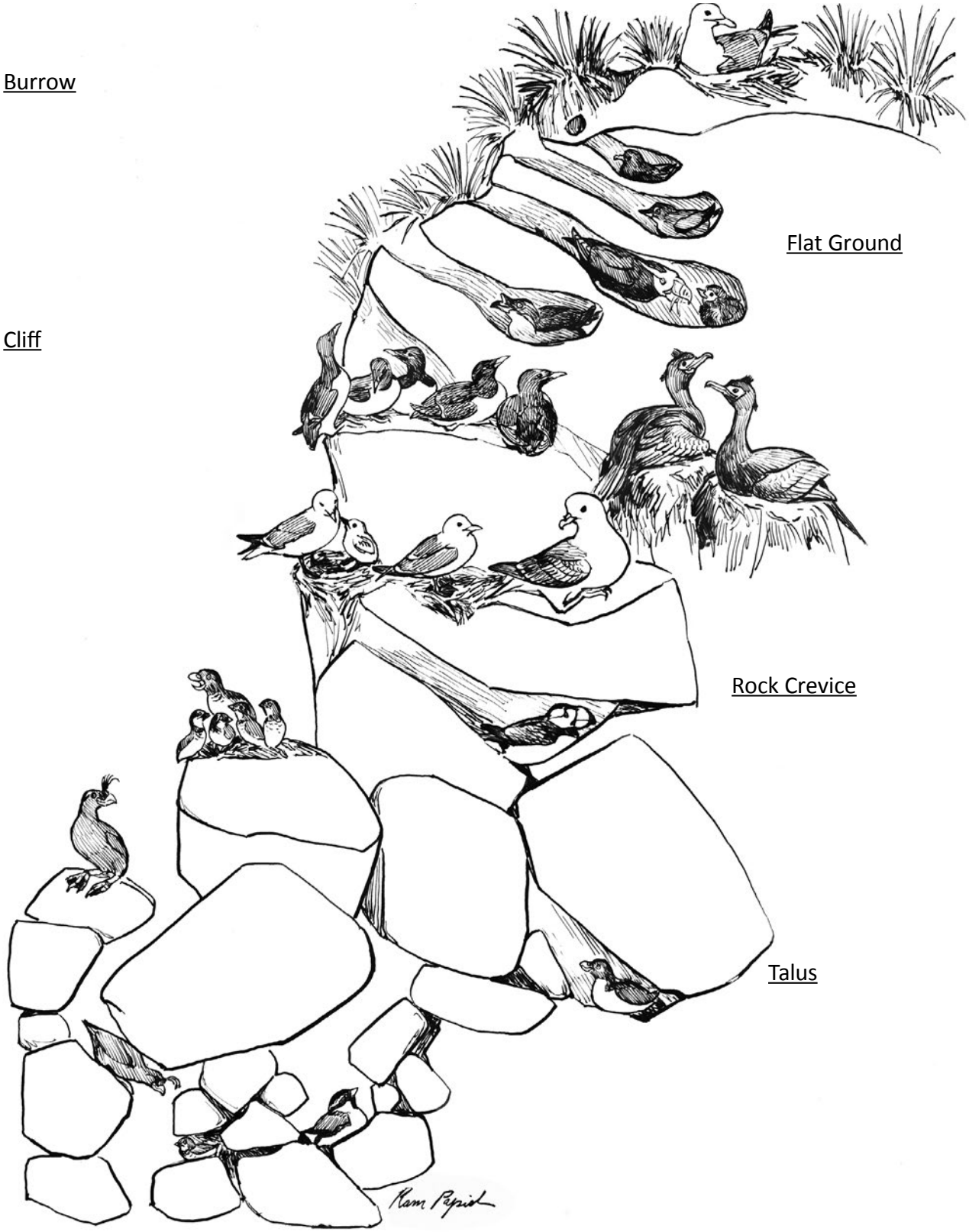
BURROW

CLIFF

ROCK CREVICE

TALUS

LESSON THREE WORKSHEET 3.1: SEABIRD NESTING HABITATS



LESSON THREE	WORKSHEET 3.1: TEACHER KEY

Alaska Seabird Nesting

Name:_____ Date:_____

Instructions: Below is a list of the seabirds that nest on the Islands of Alaska. Use the illustration on page 58 to assign each seabird a nesting habitat.

- red-faced cormorant
- Cassin's auklet
- tufted puffin
- ancient murrelet
- black-legged kittiwake
- crested auklet
- glaucous winged-gull
- common murre
- rhinoceros auklet
- least auklet
- parakeet auklet
- horned puffin
- northern fulmar

FLAT GROUND

glaucous-winged gull

BURROW

tufted puffin
Cassin's auklet
rhinoceros auklet

CLIFF

black-legged kittiwake
northern fulmar
red-faced cormorant
common murre

ROCK/CREVICES

horned puffin

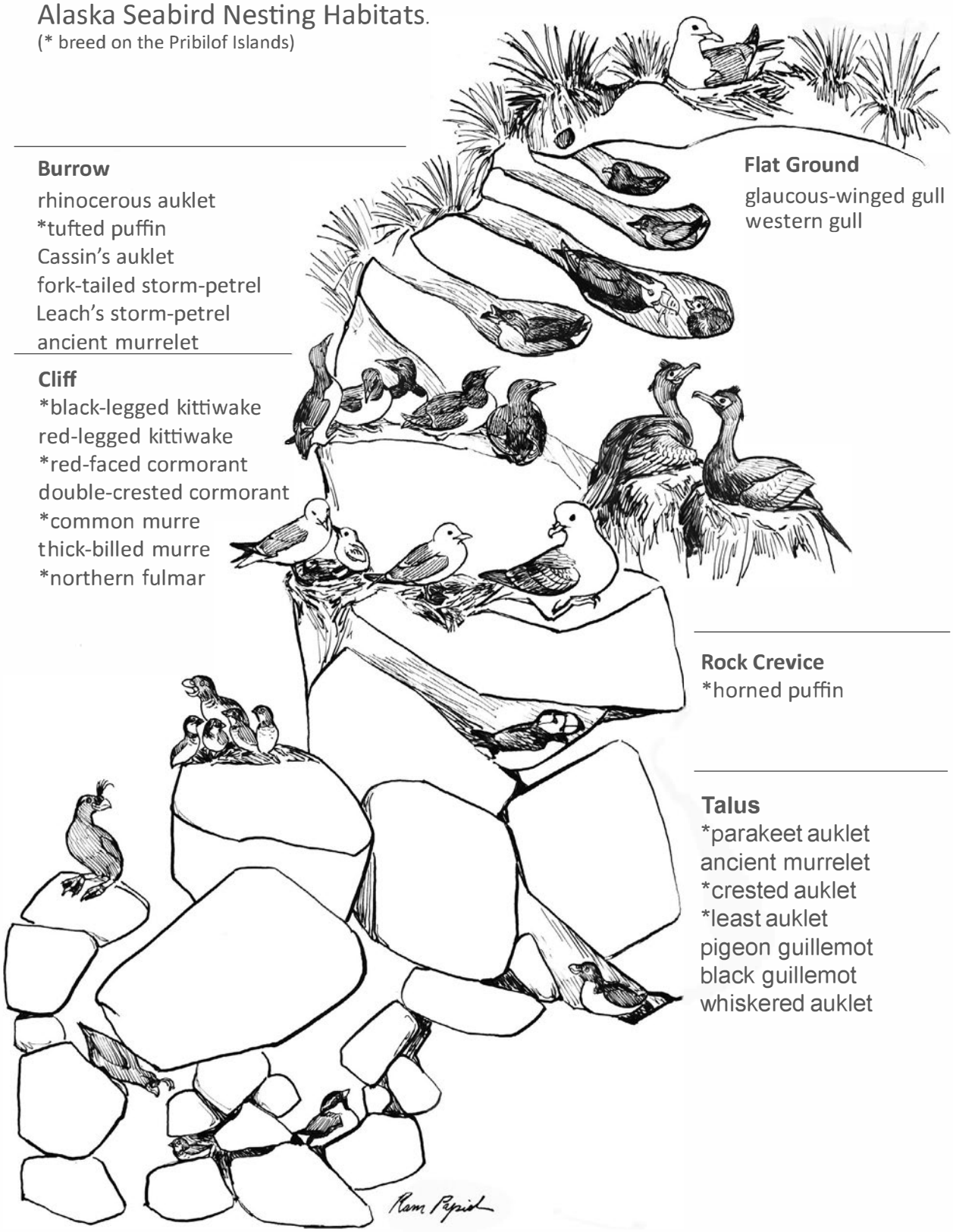
TALUS

parakeet auklet
ancient murrelet
crested auklet
least auklet

LESSON THREE | WORKSHEET 3.1: TEACHER KEY

Alaska Seabird Nesting Habitats.

(* breed on the Pribilof Islands)



Burrow
rhinocerous auklet
*tufted puffin
Cassin's auklet
fork-tailed storm-petrel
Leach's storm-petrel
ancient murrelet

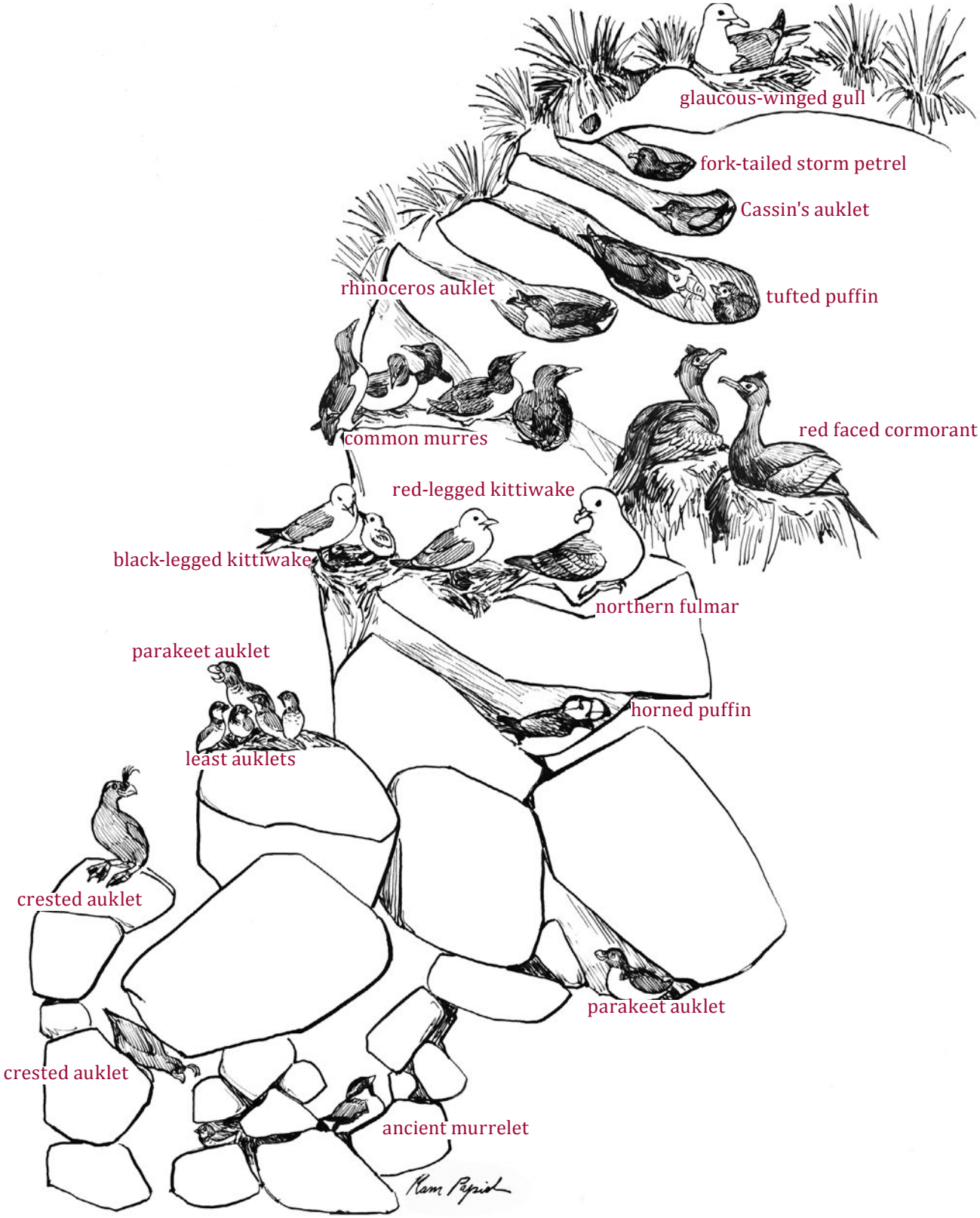
Cliff
*black-legged kittiwake
red-legged kittiwake
*red-faced cormorant
double-crested cormorant
*common murre
thick-billed murre
*northern fulmar

Flat Ground
glaucous-winged gull
western gull

Rock Crevice
*horned puffin

Talus
*parakeet auklet
ancient murrelet
*crested auklet
*least auklet
pigeon guillemot
black guillemot
whiskered auklet

LESSON THREE WORKSHEET 3.1: TEACHER KEY



LESSON FOUR

SEABIRD CONSERVATION

Seabird Youth Network

OBJECTIVES:

- Students will be able to list and discuss threats to seabird populations.
- Students will research and discuss one to three methods to prevent human impacts on seabirds.

FOCUS QUESTIONS:

- What threats are causing some seabird populations to decline?
- What methods are used to reduce the number of seabirds killed by fisheries?
- What species of seabirds have gone extinct?
- How do invasive species present a risk to seabirds?

SEABIRDS FACE A RANGE OF DANGERS, AND THEY MAY BE ONE OF THE MOST THREATENED GROUPS OF BIRDS ON EARTH. DANGERS INCLUDE:

1) **Pollution**

(a) Crude Oil

Oil clogs plumage, and kills birds through chilling (destroyed feather insulation) and stress.

Oiled common murre. © Buzzie82, via Creative Commons.

LESSON FOUR SEABIRD CONSERVATION

There are some historically large oil spills, including the Exxon Valdez oil spill in Alaska. The Exxon Valdez oil spill occurred in Prince William Sound in 1989, when the oil tanker hit Bligh Reef and spilled 260,000 to 750,000 barrels of crude oil. Immediate effects included the deaths of 100,000 to as many as 250,000 seabirds (at the best estimates), and there are still lingering ecological effects of the oil spill today.

(b) Ingested Plastic

The oceans are full of floating plastic debris. Seabirds mistake these plastic items as food, and eat them or ingest plastic secondarily when they eat fish that have consumed plastic.

Albatross chicks on Midway Island (Hawaii) are often fed plastic by their parents and may die because their stomachs are full of plastic and they have no room for real food. Read more at: http://www.cnn.com/interactive/2016/12/world/midway-plastic-island/. Many plastics also contain harmful chemicals, such as phthalates, that can interfere with the reproduction system of the birds that eat them.

Plastic eaten by albatross chick. © ecogreen4us, via Creative Commons.

LESSON FOUR SEABIRD CONSERVATION

2) **Invasive Species**

Invasive species are plants and animals that are not native in an ecosystem. Invasive species, such as rats and cats, have been responsible for almost half of all bird extinctions in the last five centuries. They can have huge effects on seabirds, and this problem is even more pronounced on isolated islands where species have evolved without predators and have little protection. Seabirds are threatened by a range of species including rats, cats, dogs, mongoose, and snakes.

Norway rat. © Roland and Sonja, via Creative Commons

WHAT CAN WE DO?

(a) **Prevention**

- Shipwreck Response: Rats can swim several miles. Nearby shipwrecks are monitored closely by the local community.
- Rats make a run for land when ships are in harbor. A response team goes to the site in sensitive areas to prevent "rat spills".
- Provide tips and kits for vessels entering harbors.
- Place bait traps around the harbor and local marina.
- Education events for the local community.

LESSON FOUR SEABIRD CONSERVATION

High school students learn about local rats traps designed by the Ecosystem Conservation Office on St. Paul Island. © Pam Goddard, Thalassa.

(b) **Removal**

A Norway rat eradication on 6,861 acre Rat Island in the Aleutian Islands, Alaska, took place in the fall of 2008. No rats were found on the island in the summer of 2009, and the island was declared rat-free in 2010.

Learn more with the middle-school curriculum "Seabirds and Invasive Species", available for free download at: http://seabirdyouth.org/invasive-species-and-seabird-curriculum/

3) **Commercial Fishery Bycatch:**

Fisheries bycatch is the greatest threat to many seabird populations, especially albatrosses. In commercial fishing, bycatch is the incidental capture of marine species that the fisherman do not want or they are not allowed to keep.

Seabirds are attracted to fishing boats because of the bait and discarded offal (fish waste), and are at risk of getting tangled in the fishing gear and drowning. The tubenoses (shearwaters, albatross, fulmars) are the most common group of seabirds caught in fishing gear because they overlap with many fisheries and they are surface feeders/scavengers. Pursuit diving feeders (birds that swim underwater to catch their food, such as puffins) are more likely to be caught in gillnets which sit under the surface of the water.

LESSON FOUR SEABIRD CONSERVATION

It's been estimated that an average of 5000 seabirds were killed each year in Alaska Bering Sea long-line fisheries (between 2002-2006). The most common species killed were the northern fulmar, glaucous-winged gull, short-tailed shearwater, black-footed albatross, and Laysan albatross.

Seabird Bycatch in long-line fisheries: Seabirds are at risk of getting caught on the fishing hooks between the time the hooks leave the fishing boat and the time they sink below the diving depth of the foraging seabird. Prevention methods are designed to prevent contact between the birds and the hooks during this critical period.

Long liner with seabirds. © Kim Dietrich

Seabird Bycatch in Trawl-fisheries: Seabirds can be killed by collisions with fishing cables or entangled in the net itself.

Long liner with streamers. © Ed Melvin, WA Sea Grant.

LESSON FOUR SEABIRD CONSERVATION

What can we do?

There are several simple (mitigation) methods that can reduce the number of seabirds killed in long-line and trawl fisheries.

Methods for trawl fisheries either focus on deterring birds from making contact with cables or reducing the attractiveness of the fishing boat by managing the discharge of the offal differently.

Methods for long-line fisheries can be divided into four main categories

(a) Avoid fishing in areas and at times when seabird interactions are most likely and intense (conduct commercial fishing at night).

(b) Limit bird access to baited hooks (underwater setting funnel).

(c) Deter birds from taking baited hooks (streamer (bird-scaring) lines).

(d) Reduce the attractiveness or visibility of the baited hooks (using colored or artificial baits).

Learn more at:

http://www.birdlife.org/seabirds/bycatch/albatross.html

http://www.afsc.noaa.gov/refm/reem/Seabirds/Default.php

4) **Commercial fishery competition**

Commercial over-fishing can reduce fish stocks and impact seabird populations.

The Peruvian anchovy fishery led to population declines of many seabird species.

Learn more at:
http://www.sciencedaily.com/releases/2012/02/120228123852.htm

5) **Habitat destruction**

Humans have destroyed the breeding habitat of many seabirds through development and the exploitation of natural resources. The most famous example in Alaska is the marbled murrelet, a small seabird belonging to the Auk family that nest in old-growth trees. The first marbled murrelet nest was found by a tree-climber in 1974! The marbled murrelet population has declined since humans started logging old-growth forests in the late 19th century.

LESSON FOUR SEABIRD CONSERVATION

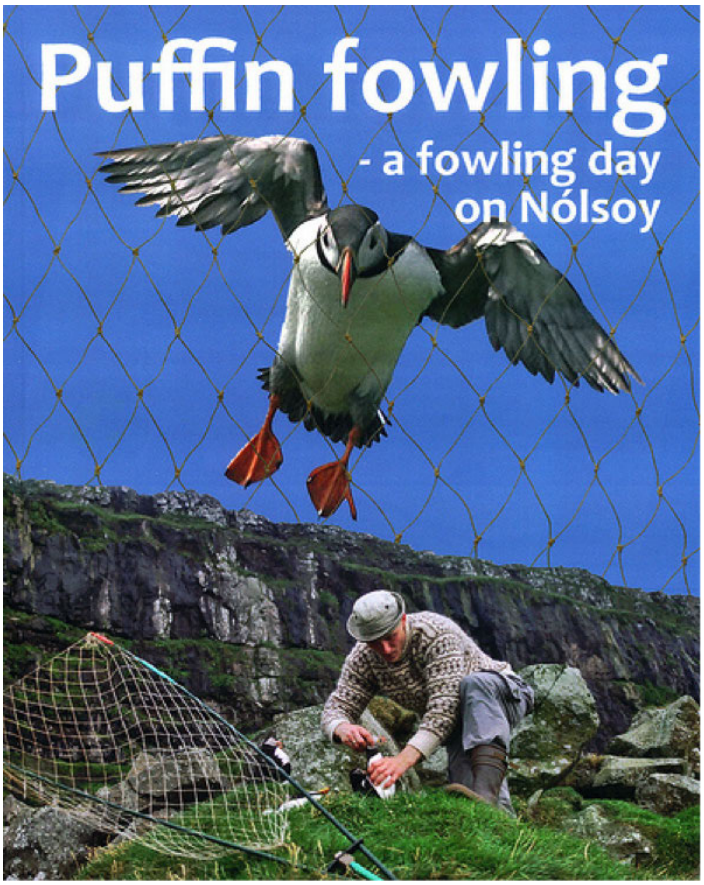
6) **Seabirds as human food**

Seabird bones have been found in historic sites in the North Atlantic, North Pacific and Southwestern Pacific, and many cultures are based around seabird harvesting. Although many harvests are regulated to conserve population levels, there are historic records of extinctions and large population declines due to over-harvesting.

For example:

(a) St. Kilda is an island off Scotland, and many traditions and sports are based on the heroic acts of climbing steep cliffs to hunt fulmars and gannets.

(b) Hundreds of thousands of Atlantic puffins are still harvested on the Faroe Islands and in Iceland each year.



Puffin hunting in the Faroe Islands. © Marita Gulklett, via Creative Commons.

LESSON FOUR SEABIRD CONSERVATION

(c) Muttonbirding. Muttonbirding is the seasonal harvesting of the chicks of tubenose seabirds (especially shearwaters) for food, oil and feathers. Today, 'muttonbirding' usually refers to a regulated harvesting of shearwaters in Australia and New Zealand.

(d) Short-tailed albatross almost became extinct due to over-harvesting for their feathers in the later half of the 19th century. Some estimate that over 5 million birds were killed. By the 1940s there were no birds left to hunt and the species was thought to be extinct. Eventually, about 50 subadults, who were presumably at sea during the last harvests, returned to Torishima Island, Japan and continued to breed. The population is now protected and numbers have been increasing.

Read more at: https://www.fws.gov/alaska/fisheries/fieldoffice/anchorage/endangered/pdf/factsheet_stal.pdf

(e) The great auk was a large (about 11 lbs in weight), flightless bird belonging to the Alcid family. Humans had hunted the great auk for more than 100,000 years, and they were also harvested for down. The last two known living individuals were hunted on Eldey, an island off the coast of Iceland, in 1844.

Great auk. © Mike Pennington via Creative Commons.

LESSON FOUR SEABIRD CONSERVATION

7) **Climate change**

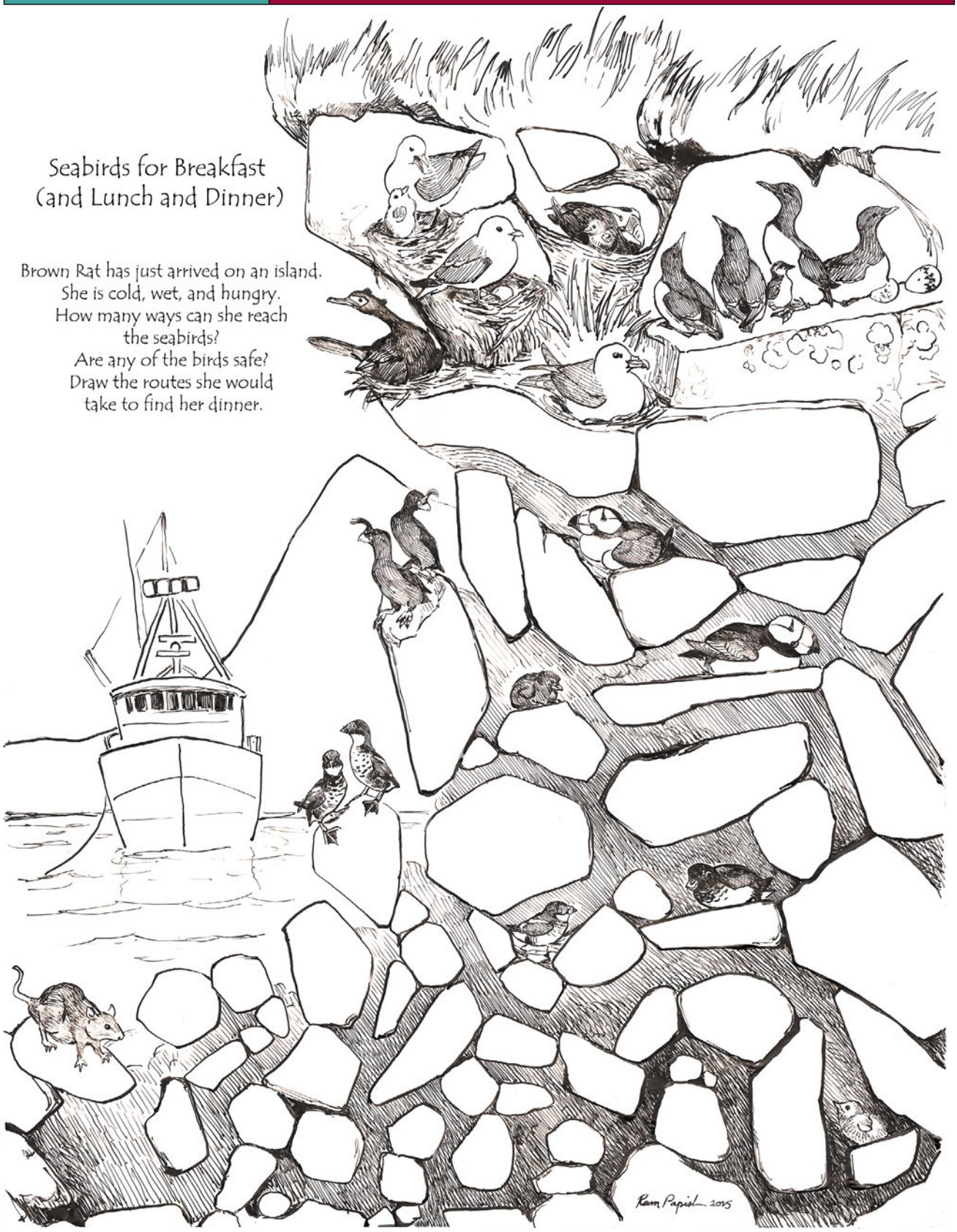
Change in ocean water temperature and sea-ice extent can influence the distribution and abundance of zooplankton and fish species, which in turn will affect the seabirds that rely on these species for food. Rising sea levels and increased storm activity is changing breeding habitats.

For example:

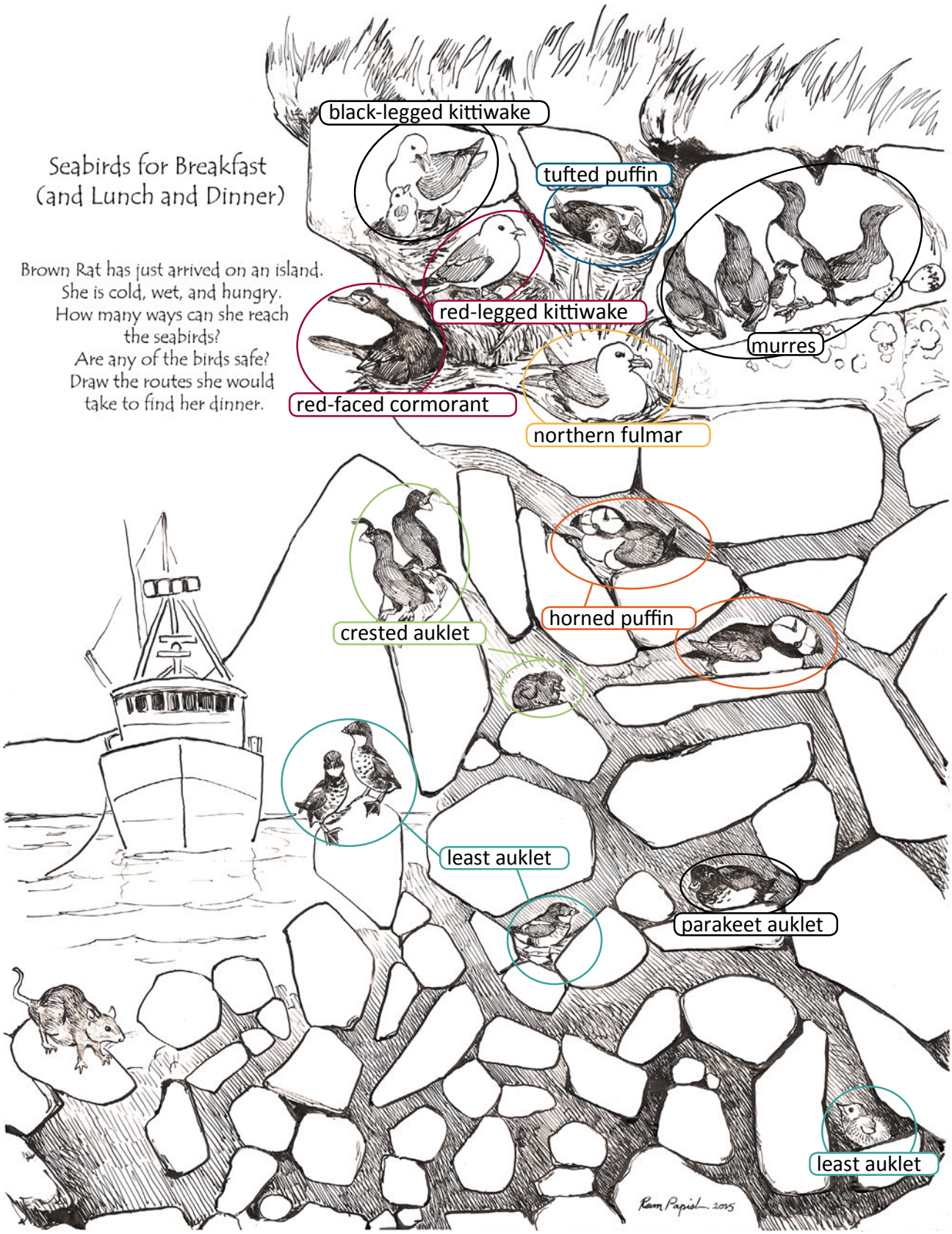
(a) Black guillemots breeding in an Arctic Alaska colony (off Point Barrow) feed their chicks on polar cod. These small fish are associated with the polar pack ice, and may become in short supply for breeding guillemots as local sea-ice extent retreats.
Read more at: http://www.bbc.co.uk/nature/20498368

(b) Black-footed and Laysan albatrosses that breed on very low, sandy atolls in the Northwest Hawaiian Islands are being affected by changes in their breeding habitat.

LESSON FOUR | WORKSHEET 4.1: RAT MAZE

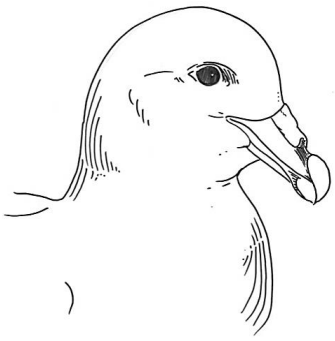


LESSON FOUR | WORKSHEET 4.1: TEACHER KEY

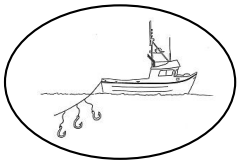
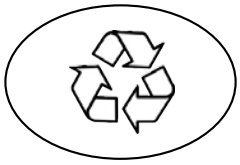
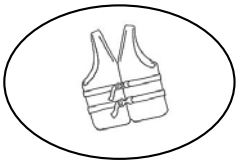
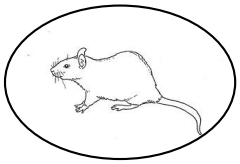
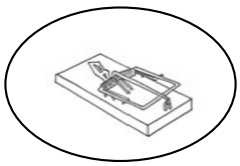


LESSON FOUR WORKSHEET 4.2: N. FULMAR THREATS

Name:_____ Date:_____



Northern fulmars breed in Alaska and can migrate as far south as California. As a result, they encounter many of the threats faced by seabirds, including the threats below. Connect the threats with possible ways to avoid them.

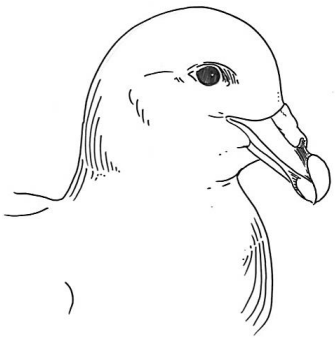
Threats		How to avoid	
Bycatch in fisheries			*Recycling*
Plastic pollution			*Preventing overfishing*
Starvation			*Boat safety*
Invasive Species			*Streamer lines*
Oil Spills			*Prevent "rat spills"*

Illustrations by Oikonos with the exception of starved fulmar by A. Gronert

Activity provided by Oikonos (www.oikonos.org). Funding for this activity was funded by NPRB grant 1714-93.

LESSON FOUR | ACTIVITY 4.2: TEACHER KEY

Name:_____ Date:_____



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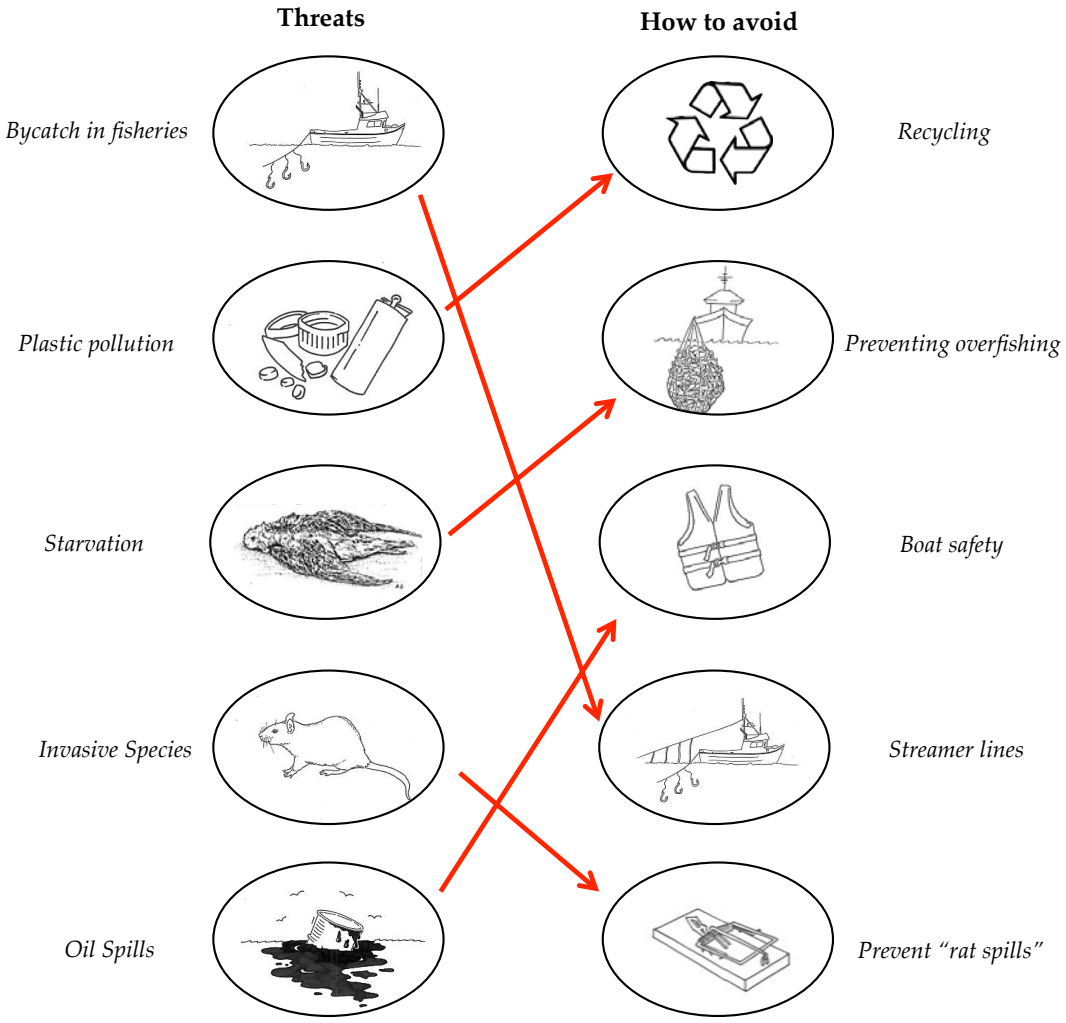
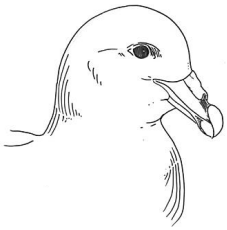


Illustrations by Oikonos with the exception of starved fulmar by A. Gronert

Activity provided by Oikonos (www.oikonos.org). Funding for this activity was funded by NPRB grant 1714-93.

LESSON FOUR WORKSHEET 4.3: N. FULMARS AND BYCATCH

Name:_____ Date:_____

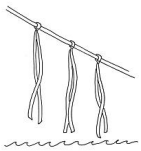


Northern Fulmars and Bycatch Prevention

More northern fulmars are caught in U.S.–based fisheries than any other seabird (3,920 each year [average from 2007-2015]). Since fulmars can't dive very deep, the most dangerous areas during fishing operations are at the surface of the water and the first 10 feet below. Circle the most dangerous areas for seabirds of each boat. Then explain how some of the mitigation techniques in the toolkit can reduce these hazards for each type of fishery.

Mitigation Techniques

Weighted lines



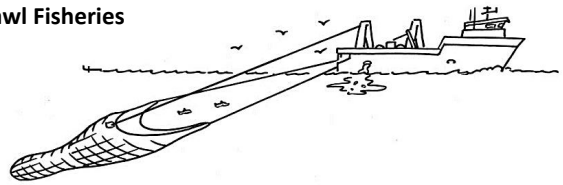
Paired streamers

Discharging offal during non-haulback periods

Setting gear at night

Underwater line setting chute

1. Trawl Fisheries



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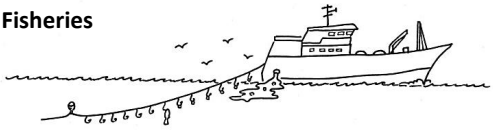
2. Longline Fisheries



_____

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_____

3. Purse-seine Fisheries

_____

_____

_____

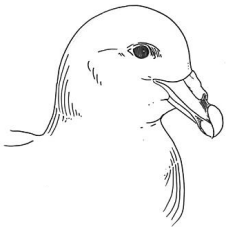
_____

Activity provided by Oikonos (www.oikonos.org). Funding for this activity was funded by NPRB grant 1714-93.

LESSON FOUR | ACTIVITY 4.3: TEACHER KEY

Name:_____ Date:_____

Northern Fulmars and Bycatch Prevention



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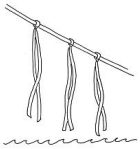

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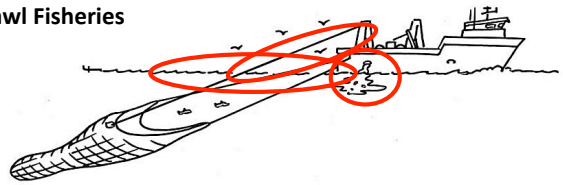
Discharging offal during non-haulback periods

Setting gear at night

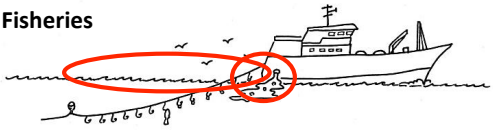
Underwater line setting chute

1. Trawl Fisheries



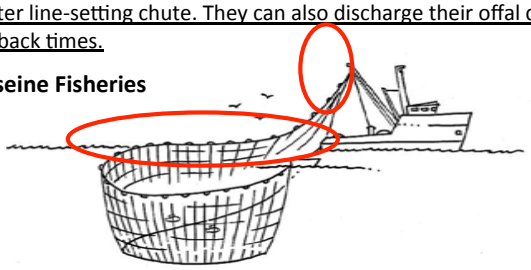
In trawl fisheries, paired streamers can be used to alert seabirds to the cables, which they can fly into and break their wings. Fisherman can also discharge their offal during non-haulback times and set their nets at night. .

2. Longline Fisheries



In longline fisheries, paired streamers can be flown over the area where the hooks are at the surface to discourage the birds from diving for the baited hooks. They can also use weighted lines so that they sink faster, out of the fulmars' diving range. The line can be set at night, when it's harder for the fulmars to see it, and the fishermen can use an underwater line-setting chute. They can also discharge their offal during non-haulback times.

3. Purse-seine Fisheries

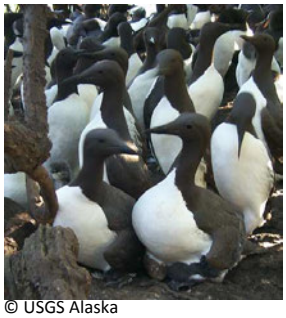


In purse-seine fisheries, weighted lines can be used to help the gear sink faster. They can wait to discharge the offal until non-haulback times. Occasionally, they can also set their nets at night.

Activity provided by Oikonos (www.oikonos.org). Funding for this activity was funded by NPRB grant 1714-93.

LESSON FOUR WORKSHEET 4.4: N. FULMARS HABITAT/FISHING

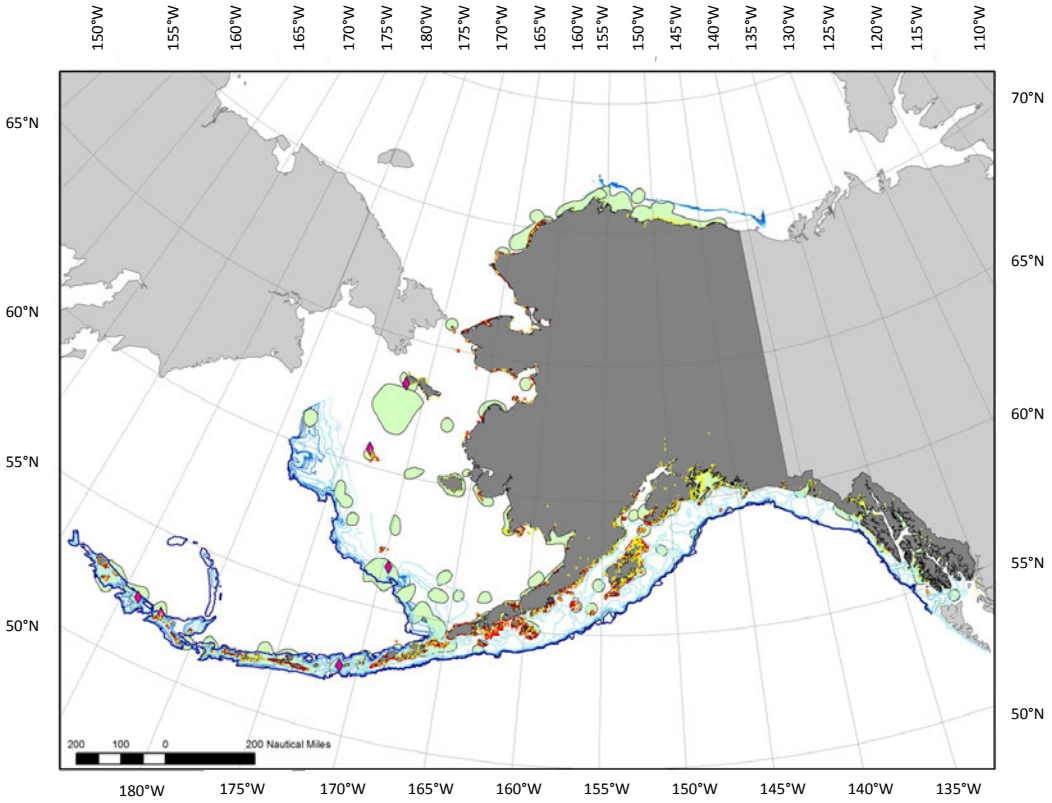
Name:_____ Date:_____



© USGS Alaska

Overlap of Seabird Habitat and Fishing Areas
Over 80 million seabirds occur in Alaska every year, and many of them breed there. In the map below, important bird areas in marine ecosystems are in green and seabird breeding habitat is in red, with the largest colonies depicted by red dots and purple diamonds.

Some fisheries are conducted along the continental shelf where there is greater productivity and more abundance of fish. But seabirds also use some of the same areas. In the summer when most seabirds breed, what are some areas that the fisheries could use that avoid areas around seabird colonies? (Use latitude and longitudes).

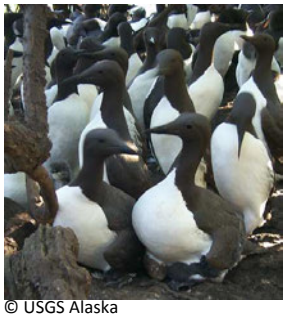


Map and data from: Eich, A.M., K.R. Mabry, S.K. Wright, and S.M. Fitzgerald. 2016. Seabird Bycatch and Mitigation Efforts in Alaska Fisheries Summary Report: 2007 through 2015. U.S. Dep. Commer., NOAA Tech. Memo

Activity provided by Oikonos (www.oikonos.org). Funding for this activity was funded by NPRB grant 1714-93.

LESSON FOUR ACTIVITY 4.4 TEACHER KEY

Name:_____ Date:_____


© USGS Alaska

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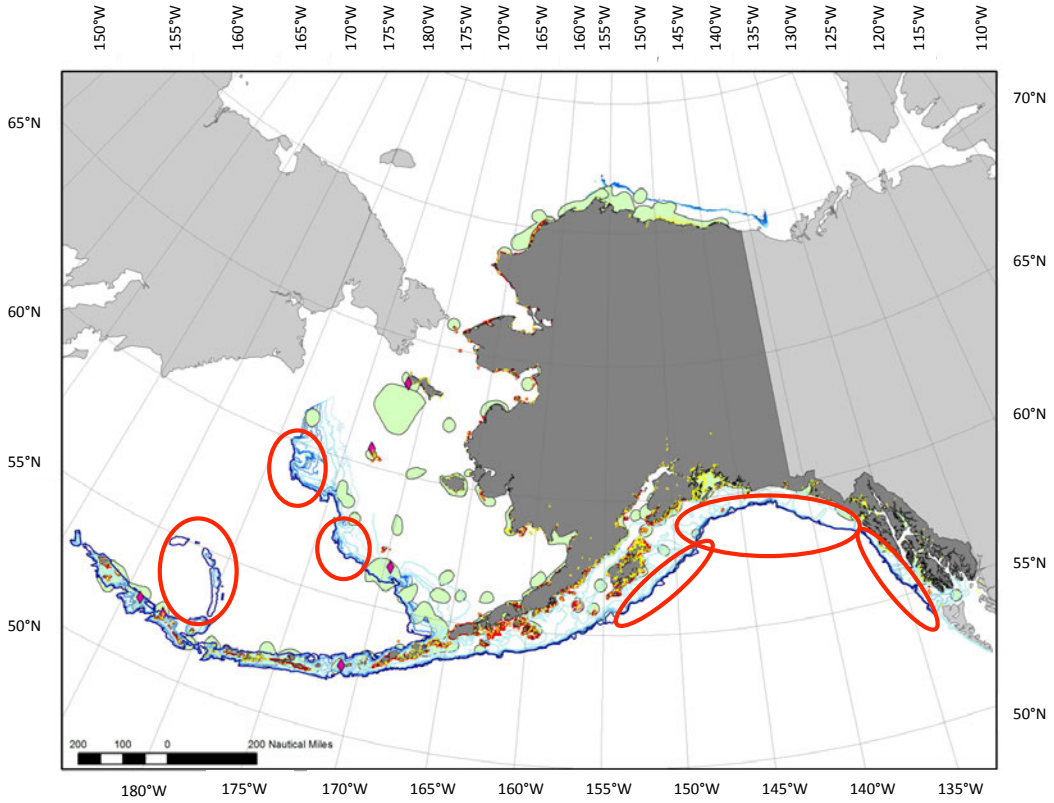
But seabirds also use some of the same areas. In the summer when most seabirds breed, what are some areas that the fisheries could use that avoid areas around seabird colonies? (Use latitude and longitudes).

Answer: Various options include 50°N, 175-180°W; 55°N, 135°W; 55°N, 140°W; 55°N, 145°W; and 55°N, 150°W. Students should identify fishing areas that do not overlap with seabird colonies and important bird areas (in green, red, yellow, and purple) and are not on land. Areas along the continental shelf break (blue contours) are more ideal for fisherman than areas of open ocean (in white).



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Activity provided by Oikonos (www.oikonos.org). Funding for this activity was funded by NPRB grant 1714-93.

LESSON FIVE

CULTURAL IMPORTANCE OF SEABIRDS

Seabird Youth Network

OBJECTIVES:

- Students will be able to state two myths or legends associated with seabirds.
- Students will be able to discuss how humans use seabirds and their cultural importance.

FOCUS QUESTIONS:

- What are the myths or legends associated with seabirds?
- How do humans use seabirds?

CULTURAL IMPORTANCE OF SEABIRDS

There is a close relationship between humans and seabirds in many cultures. For example:

1) **Seabirds in Hawaiian Culture**

- Hawaiians watch the flights of seabirds at sea to help them locate good fishing spots.
- The white (or fairy) tern is sometimes called the navigators best friend, because they occur in higher densities near islands and therefore help "lead" tired sailors home.
- Hawaiian mythology includes stories of frigatebirds and tropicbirds being used as messengers for gods.
- Ancient Hawaiians used to watch seabird behavior to indicate weather patterns.
- Seabirds also appeared in ancient Hawaiian proverbs. For example a Hawaiian proverb for a family that only had one child was based on the Newell's shearwater that only lays one egg.
- Seabird feathers were used in capes and lei making.

SEABIRD SPECIES ESPECIALLY IMPORTANT IN STORIES AND MYTHS:

1) **Albatross**

There are many legends surrounding the albatross.

- The albatross became famous in the poem "the Rime of the Ancient Mariner", written by Coleridge, where an albatross was shot from a boat by the mariner and the crew blamed this act for the bad change in wind and weather.
- The metaphor "albatross around their neck" describes someone who has a burden or obstacle, and comes from the Coleridge poem (the punishment given to the mariner who

LESSON FIVE SEABIRD CULTURAL IMPORTANCE

killed the albatross).

- Albatross have been thought of as souls of lost sailors, therefore, killing them is thought of as bad luck.
- The Maori in New Zealand carved flutes out of the wing bones of the albatross.

2) **Gulls**

Gulls live closely with many people, and play a strong role in many stories and traditions.

(a) **British gull story**: St. Kenneth is supposed to have been raised by black-headed gulls. Kenneth was found floating off the coast of Wales as a baby. Gulls carried him to their breeding colony and built him a feather bed. Kenneth grew up in the gull colony and local people gave him the name St. Kenneth.

(b) **Native American gull myth**: There is a great story about a fishing conflict between Raven and gulls told by the Tsimshian of Alaska: Raven had caught a number of small fish and was cooking them over a fire. When he called the gull, many gulls came and ate all of the fish. Raven was angry and punished the gulls by throwing them into the fire, and that is why many gulls in Alaska have black wing tips.

(c) **A folktale from Utah** tells of a swarm of crickets that were destroying crops. Suddenly a flock of gulls came and ate all the crickets, saving the harvest and giving Utah its state bird: the California gull.

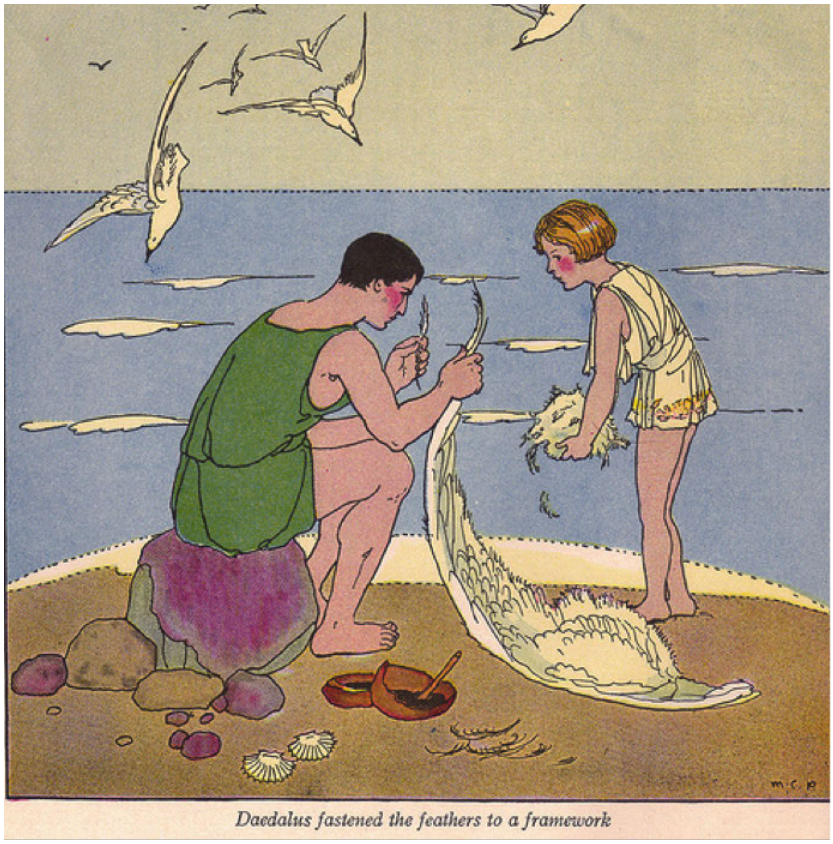
LESSON FIVE SEABIRD CULTURAL IMPORTANCE

3) **Pelicans**

Legend has it that a mother pelican would feed her chicks on blood from her own chest if there was not enough food to feed them. The pelican therefore became a Christian symbol of mercy and self-sacrifice.

Depiction of a pelican with chicks on a stained glass window, Saint Mark's Church, Kent, England.

LESSON FIVE SEABIRD CULTURAL IMPORTANCE



Seabirds even play a role in Greek Mythology Daedalus and Icarus. © katinthecupboard, via Creative Commons.

In Greek mythology, Daedalus made wings for himself and his young son Icarus to escape from where they were imprisoned in Crete. He tied feathers together, and secured the feathers at their midpoints with string and at their bases with wax. Daedalus warned Icarus not to fly too high, because the heat of the sun would melt the wax, nor too low, because the sea would soak the feathers. They flew successfully, but Icarus forgot his father's warning, and flew too close to the sun. The blazing sun softened the wax holding feathers together and they came off. Icarus fell into the sea and drowned.

HUMAN USE OF SEABIRDS

Humans have used seabirds for centuries for food (commercial, subsistence, recreational hunting), ornamentation (feathers), clothing, oil, and guano.

1) **Food**

- Many seabird species were being hunted at the turn of century, and overhunting led to the decline of many species, and the extinction of a few seabird species (great auk).
- Nowadays, the majority of seabird harvests are for subsistence use only, with hunting levels managed to conserve viable populations.

LESSON FIVE SEABIRD CULTURAL IMPORTANCE

- Hunting still however threatens some populations. An estimated 283,000-725,000 murres are hunted annually in Greenland. Populations of murres in Greenland have declined by 80-90%. Overhunting is likely due to increased size of the human population, and use of guns and speedboats that allow access to more distant bird cliffs.
- Egg harvesting used to be conducted on a commercial scale. For example, in 1897 over 700,000 eggs were taken from penguin colonies in South Africa. An estimated four million murre eggs were also commercially harvested on the Farallon Islands in California in the mid 1800s: https://en.wikipedia.org/wiki/Egg_War. Commercial egging continues on a few species, such as murres, but the majority of seabird egging is at a subsistence level.

Pulling the stuffed seal skin from rocks.
© Beresford.michael, via Creative Commons

The smelliest recipe?

Kiviaq is an Inuit dish from Greenland. It is made by stuffing a seal-skin with 300 to 500 dovekies. The full skin is sealed with seal fat and the dovekies are left to ferment for 3 to 18 months under a pile of rocks. The resulting Kiviaq is the consistency of soft cheese, and is eaten during the winter when fresh food is scarce.

LESSON FIVE SEABIRD CULTURAL IMPORTANCE

2) **Feathers**

Many seabirds were hunted heavily for their feathers during the early 20th century. Ornamental feathers were very popular in fashion.

3) **Clothing**

The skins and ornaments of certain seabirds, especially species in the Alcid family, have been used for clothing and decoration. Inuit on St. Lawrence Island and Aleuts in the Aleutian chain sewed parkas out of seabird skins, especially crested auklets and horned puffins. In North West Greenland, dovekie skins were made into undershirts. Dovekie skins had to be softened by chewing. Only elderly women did the chewing, as their teeth were worn smooth enough not to damage the delicate skins. The Aleuts and Inuit of the Bering Sea region also sewed the colorful beaks of puffins and auklets on the outside of the clothing (see below).

University of Alaska, Fairbanks. © graphic goddess, via Creative Commons.
The parka on the left is ornamented with feathers and bills from crested auklets.

4) **Oil**

In the past, penguins were harvested for their high fat reserves used for making oil. In 1867 one company in the Falkland Islands killed 405,000 birds for oil.

LESSON FIVE SEABIRD CULTURAL IMPORTANCE

5) **Guano**

- Waters off the coast of Peru are highly productive and support millions of seabirds. The combination of many seabirds and lack of rain means that seabird guano quickly builds up at the breeding colonies.
- Seabird guano has been harvested commercially for over 150 years, and was even used by pre-Colombian Native Americans for agriculture. The three main species are the Peruvian booby, the Peruvian pelican, and the Guanay cormorant.
- The islands are currently harvested every 7-10 years by up to several hundred laborers who visit the islands between the guano birds' breeding seasons.

Landing stage dock for guano ships in Peru. © Mikey Stephens via Creative Commons.

LESSON FIVE ACTIVITY 5.1 SEABIRD CULTURAL IMPORTANCE

OBJECTIVES:

- Students will be able to state the cultural importance of seabirds in their local community or a community or country they have researched.

MATERIALS:

- Internet access. Notes from Lesson 5 presentation.

PROCEDURES:

- Ask students to take notes in their science notebook or take notes as a class as information is presented for this lesson.
- At the end of the lesson divide the students into small groups and ask them to present information on the cultural importance of seabirds in a specific community or country.
- Students should use the information from this lesson, research a new community, or ask an elder in their community.
- Information can be presented in the format of a poster.

INFORMATION TO PRESENT:

- Location of community
- Source of information
- Seabird species
- Cultural importance: past and present

LESSON SIX SEABIRD RESEARCH TOOLS AND METHODS

Seabird Youth Network

OBJECTIVES:

Students will be able to list three reasons scientists study seabirds.
Students will know the differences between monitoring programs and research.
Students will describe and practice methods for estimating numbers of seabirds present.
Students will describe:

- how/when populations are counted in Alaskan seabird colonies, and relate how this compares/contrasts to gathering data on reproductive success,
- methods used to study seabird movement and will plot tracks using provided GPS (Geographical Positioning System) coordinates,
- methods used to study diet in various species of seabirds, and
- methods for behavioral and physiological studies.

PEOPLE STUDY SEABIRDS FOR MANY REASONS FOR EXAMPLE:

Conservation Questions: What is causing a storm petrel population to decline?

Behavioral Questions: Why does the wandering albatross dance?

Ecosystem Questions: How will murres respond to a decrease in prey availability?

WHAT QUESTIONS ARE YOU MOST INTERESTED IN?

What's the difference between monitoring versus research?

Monitoring: These are studies where individuals, or usually populations, are observed for change over a long period of time. There are long-term monitoring studies of seabirds around the world and on a huge range of species. Most monitoring studies focus on population size and reproductive success (number of chicks fledged per eggs laid); although long-term monitoring of other parameters (such as diet and behavior) are becoming more common and can provide excellent insight into how the relationship between the marine environment and different marine species are changing. The Alaska Maritime National Wildlife Refuge has a long-term seabird monitoring program on both St. George and St. Paul (the Pribilof Islands).

LESSON SIX SEABIRD RESEARCH TOOLS AND METHODS

Research: Research tends to be more focused and driven by a specific question. These questions may be sparked by observations obtained from long-term monitoring data. For example: Why are populations of murres stable on St. George Island and declining on St. Paul Island even though the islands are very close to each other?

Different methods are used on different species and to answer different questions.

Below is a selection of tools and methods used to study seabirds. The list is not complete, and more and more methods are being added each year. Technology is getting more advanced, with smaller and more complicated tags and devices being designed. And, major developments in physiological and genetic analysis are occurring all the time.

POPULATION STUDIES

1) **Population size**

   The size of a seabird population in small colonies is usually estimated from counts of birds and/or active nests. Counts are either conducted from land or by boat.

   Some species, such as least auklets, are more difficult to count because their nests are hidden in crevices. Population methods for these species are being developed, but usually focus on mapping out the perimeter of the colony and making some measure of colony density (counting numbers of droppings or feathers in a given area). Differences in colony area and density can then be tracked over time.

2) **Population change estimated from plot counts**

   This technique is typically used at larger colonies where a full census is not possible because of size of the colony or the inaccessibility of the birds. Annual counts of the number of birds and nests within defined nesting areas (plots) can give researchers a measure of any change in population size over time.

   The Alaska Maritime National Wildlife Refuge has been counting murres and kittiwakes on population plots on both St. George and St. Paul Islands for the last 30 years. Read what these counts have shown us: http://www.seabirdyouth.org/seabird-studies/

3) **Reproductive success**

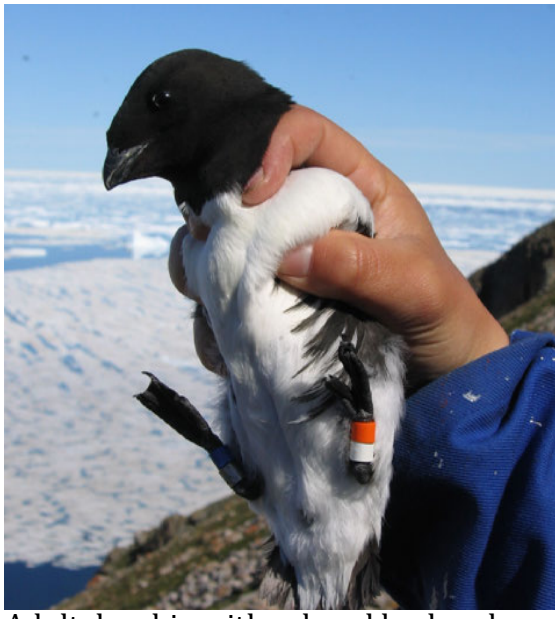
Reproductive success (number of chicks fledged per eggs laid), or components of reproductive success, such as fledging (number of chicks fledged per chicks hatched) or hatching success are usually calculated from tracking known nests at regular intervals throughout the breeding season.

4) **Adult Survival**

John James Audubon was the first known North American to band a bird (by tying yarn around the leg) in the early 1800s. Nowadays, people use lightweight metal bands. Each bird's band has a unique number on it, and an address where it is to be sent if the bird or band is found.

In addition to the metal band, researchers may use colored plastic bands (in a unique combination for each bird) to easily identify individuals from a distance. For example, the dovekie in the image below is banded with color code WO/MB. This code translates to left leg: (W)hite over (O)range band; Right Leg: (M)etal over (B)lue band.

Annual observations (are they present or absent?) of these known color-banded birds can provide information on survival rates (how many birds survive the winter) and movements of birds between colonies.



Adult dovekie with colored leg bands.
© Ann Harding

LESSON SIX SEABIRD RESEARCH TOOLS AND METHODS

STUDIES OF SEABIRD MOVEMENT INCLUDE

1) **Geolocator**

Geolocators are very small devices that record change in light levels at different latitudes and longitudes, and this information is then used to calculate the bird's location (within about 150-200 km, or 93-124 miles, accuracy). Geolocators are attached to the leg bands of seabirds during the breeding season. The bird is caught the following breeding season and the data contained on the geolocator device is downloaded to a biologist's computer for further study.

These devices can provide amazing insight into the wintering movements of seabirds.

Geolocation logger on red-legged kittiwake.
© Rachael Orben

Study example: Geolocators have allowed researchers to track the incredible migration of Arctic terns between the Arctic and the Antarctic. A total round trip of over 70,000 km!

Read more about this incredible journey at: http://news.bbc.co.uk/2/hi/8451908.stm

2) **GPS**

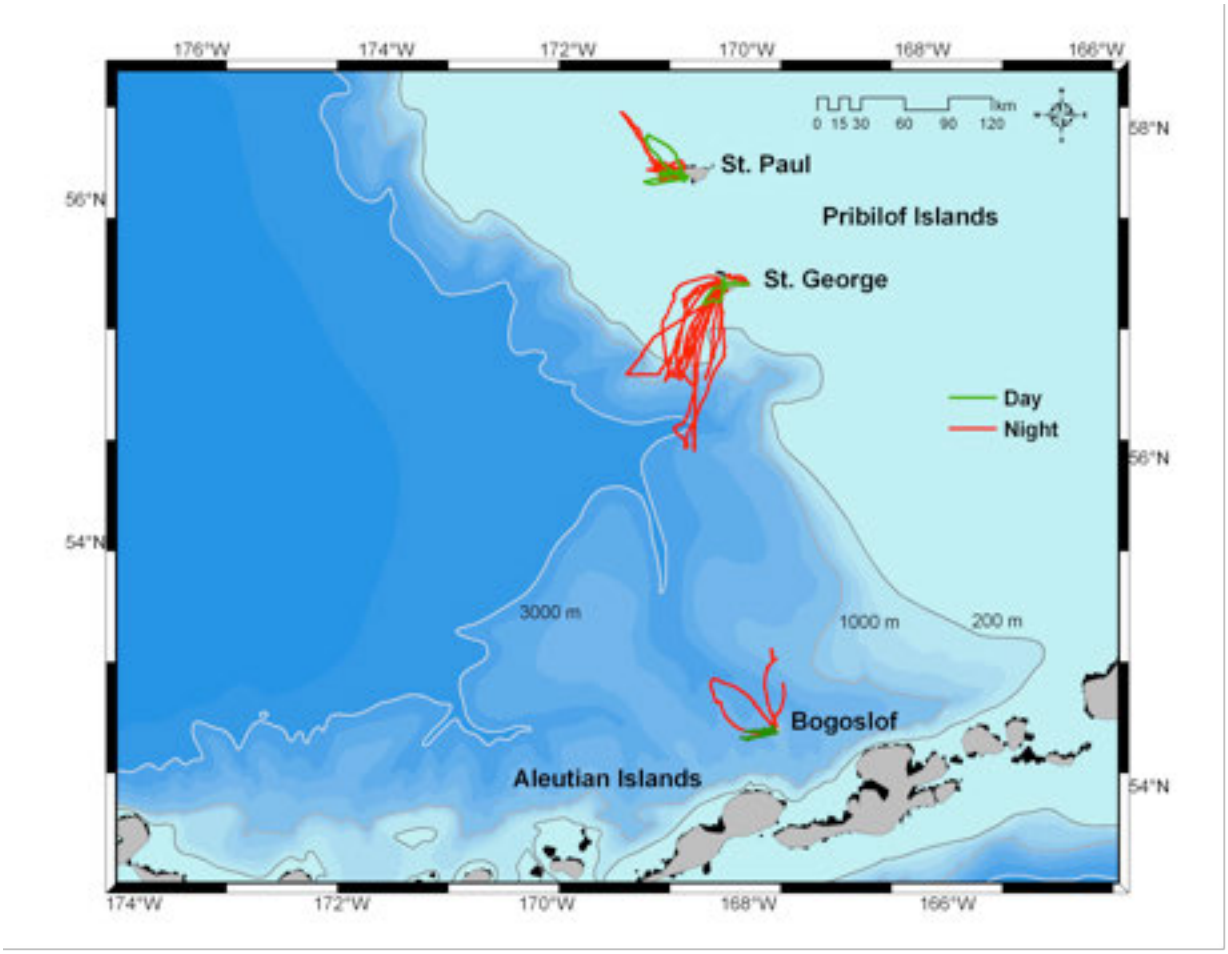
GPS stands for Global Positioning System. Learn more at: https://www.nationalgeographic.org/encyclopedia/gps/

GPS loggers can provide incredibly accurate information about the location of a bird (within 2.5 meters!). Until recently, these loggers were so big that only the larger seabirds (such as penguins) could carry them. Now, they are much smaller and can even be protected in special water- and pressure-proof casing so that deep-diving birds can carry them. Because of size/weight constraints, the battery life of most GPS units is fairly short, and these devices are best

used for calculating very accurate movement data over a relatively short period of one to several days.

Study example: GPS tracking murres on the two Pribilof Islands has shown us that birds from the St. George and St. Paul Island are feeding in different areas.

Read more at:
http://seabirdyouth.org/seabird-science/ Murres Feeding?



Map showing the foraging trips of thick-billed murres breeding on three colonies in the Bering Sea. Day (green) and night (red) foraging trips of thick-billed murres obtained by GPS tracking are shown for each colony (St. George n = 11 individuals, St. Paul n = 15, Bogoslof n = 18). Map taken from: Harding et al. 2013

http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1434&context=usfwspubs

LESSON SIX SEABIRD RESEARCH TOOLS AND METHODS

© Ann Harding

GPS logger and time depth recorder (TDR) attached to a thick-billed murre.

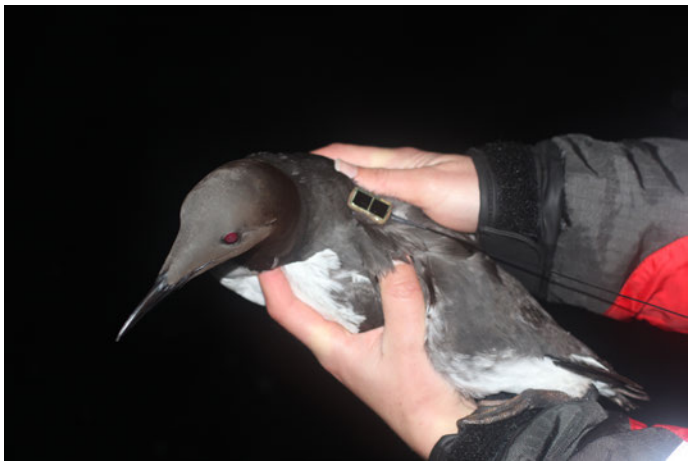
- The GPS logger is attached to the back feathers of the bird with special waterproof tape. The logger will eventually fall off if the bird is not recaught.
- The TDR is attached to the band on the leg.

3) **Satellite**

Satellite tags are amazing because they automatically download data to remote satellites, and so there is no need to re-catch the bird to obtain the data (like most GPS and geolocators). These loggers are usually attached to the back of the bird, and are designed to fall off after a period of time.

Study example: satellite tracking of albatross can tell us about their risk of overlap with long-line fisheries.

Learn more from the Oikonos education program "Winged Ambassadors" lesson #2. www.downloadwingedambassadors.org



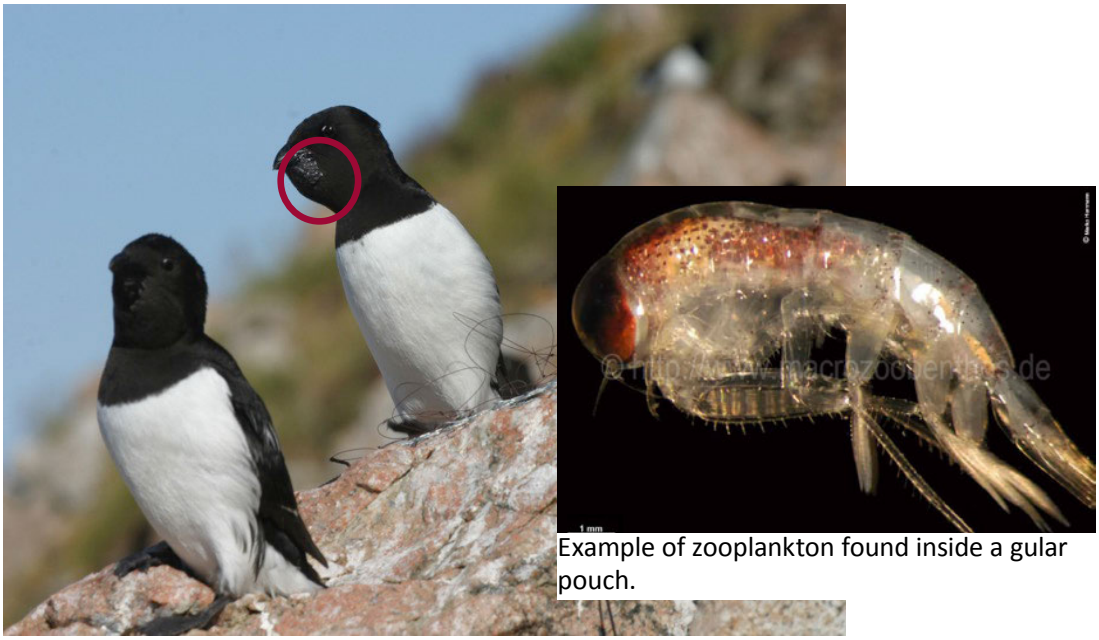
Common murre with satellite tag. © Rob Suryan

LESSON SIX SEABIRD RESEARCH TOOLS AND METHODS

STUDIES ON SEABIRD DIET INCLUDE

1) **Gular Pouch**

Some species in the Alcid family (such as the least auklet) carry food (zooplankton) to their chick in a gular pouch under their tongue. Parents can be easily caught, their mouth opened, and the zooplankton gently stroked out.



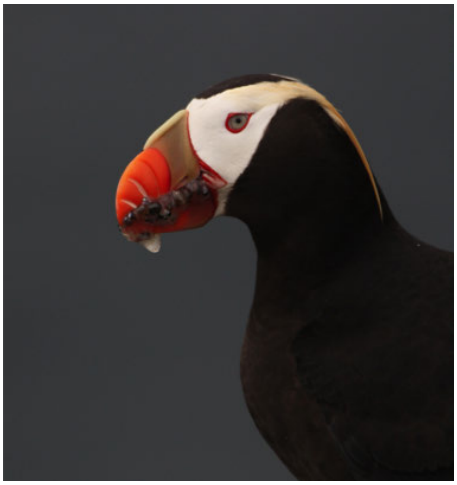
Example of zooplankton found inside a gular pouch.

Dovekie with full gular pouch, see dovekie chick food collection photo on p. 38. © Carsten Eevang

2) **Visual observations**

Many species of seabird (such as puffins, murres and terns) carry food for their young in their bill. With good binoculars or a camera, researchers can often identify the species of these prey items from a distance.

LESSON SIX SEABIRD RESEARCH TOOLS AND METHODS



Tufted puffin with fish.
© Chris Barger

- Puffins hold their chick meals cross-wise in their bill.
- Researchers can often use binoculars, or take photos, to identify the species, number and size of prey carried.
- This tufted puffin is delivering a bill-load of juvenile fish to its' chick.

3) **Fatty acids**

Fatty acids are found in the fat of animals. The fatty acids are made up mostly from what they ate. Fat samples are collected from birds and analyzed for fatty acids in the lab and compared to fatty acids found in what they might be eating. Researchers can get information about animal diets over a period of weeks to months.

4) **Stomach contents**

In the past, the best way for biologists to learn what seabirds eat was by killing birds at sea and identifying the prey in the stomach. More recently, researchers mostly use non-lethal methods to obtain diet samples. The stomach content of many species of seabirds can be obtained non-lethally by stomach flushing. The stomach is filled with water and the ejected water contains prey items that can then be identified.

The problem with calculating seabird diet from stomach contents is that soft-bodied prey (zooplankton) may have been already digested, so diet composition may be biased towards prey species with hard parts such as fish.

BEHAVIORAL STUDIES

1) **Land observations**

Researchers may spend hours watching and recording the behavior of birds at the colony.

There are many reasons to observe seabird behavior on land. For example:

LESSON SIX SEABIRD RESEARCH TOOLS AND METHODS

- Observing basic behaviors (such as feeding rates and the amount of time parents spend out at sea foraging) can provide an indication of local food availability and the amount of time parents need to spend finding food.
- Observations on predation events at the colony may allow researchers to interpret low reproductive success in a given year.
- Observations on color-banded birds (of known sex) have shown scientists that one sex may provide more meals for the chick or conduct longer foraging trips.

© Ann Harding

- Researchers, Ram Papish and Chris Barger, on an Aleutian Island watch breeding murres, and record the number of times parents deliver food to their chick.

2) **Distributions at sea**

Counts and observations of the behavior of birds at sea are usually conducted in line transects from a boat. Using set transects allows scientists to calculate the density of birds at-sea. Knowledge of the number and distribution of seabirds at sea is important for identifying important marine habitat (feeding hotspots), monitoring population trends, and understanding seabird feeding ecology.

3) **Bird-cams**

Video recorders are getting small and light enough to attach to some of the larger seabirds.

Study example: Bird cams have been successfully attached to imperial cormorants. In the below video link, the bird is seen to dive 150 m in 40 seconds, searching for food on the seabed before catching a fish!

http://www.huffingtonpost.com/2012/08/01/imperial-cormorants-superbird-deep-sea-dive_n_1728512.html

LESSON SIX | SEABIRD RESEARCH TOOLS AND METHODS

4) **PIT-tags**

PIT (Passively Integrated Transponder) tags are tiny. They can be injected under the skin of animals, and identified with an antenna. They have a very limited range of detection and require the antennae to be very close to the bird. These microchips are routinely used on dogs and cats to help identification if the animal is lost or hurt.

Study example: Biologists studying penguins in the Antarctic have used PIT tags. A fence was set up around the breeding colony, with only one entrance through which each parent had to pass on the way to and from the ocean. A PIT tag was injected into each parent to allow automatic identification of the individual, and a weighbridge was set up at the gate. Penguin parents essentially checked themselves in at the gate to colony, and provided a weight each time they passed through the gate. These data were used to calculate the mass of food they fed to the chick (by subtracting departure weight from next arrival weight). Read more about this incredible study at:

http://icestories.exploratorium.edu/dispatches/penguins-on-the-scale/

5) **Time-depth-recorders**

Small data loggers (usually called TDRs) that record pressure (a good measure of depth) and temperature can provide incredible data on the diving behavior of seabirds.

Study example: Time depth recorders attached to Emperor penguins have shown that most birds dive to depths of 100-200 m, but one individual was recorded at a depth of 565 m! Read more at: http://www.antarctica.gov.au/about-antarctica/wildlife/animals/penguins/emperor-penguins/how-deep-can-they-dive

PHYSIOLOGICAL STUDIES INCLUDE

1) **Body condition** (structural size/mass)

A simple index or ratio of body mass (weight) divided by a measurement of the structural size of the bird (length of leg and head) can give researchers an idea of the condition of a bird.

2) **Corticosterone**

Corticosterone is a hormone produced in the adrenal gland (located near the kidneys). Corticosterone is released under stress (for example, predation risk, parasite load, challenging weather). Seabirds have been shown to release corticosterone when food availability is poor. The amount of corticosterone in a blood sample can therefore tell researchers something about local foraging conditions. Blood samples are taken in the field (usually at the breeding colony), and later analyzed in the lab.

HOW DO YOU CATCH A SEABIRD?

Many questions require the capture (and often recapture) of seabirds. Less mobile chicks are usually fairly straight-forward to catch, but adults are often tricky and require creative methods and patience! Most researchers have resorted to some military moves like belly crawling and camouflage at some time in their career.

Below are a few examples of catching methods:

1) **Mist net**

Mist nets on Buldir Island, Alaska. © Corey VanStratt

LESSON SIX SEABIRD RESEARCH TOOLS AND METHODS

Mist nets are made of mesh suspended between two poles (similar to a volleyball or badminton net). These nets are hard to see, and flying birds become trapped in the mesh. Mist nets are most commonly used for smaller seabirds, such as storm petrels, but can also be used for Alcids, such as puffins.

2) **Noose pole**

Noose poles are commonly used for species that nest on cliffs. A fishing line noose is attached to the end of a fiberglass, extendable fishing pole, allowing researchers to reach long distances. The noose can be tightened gently around the neck of the bird, and the bird can be slowly lifted towards the researcher. A carefully placed knot prevents the noose from becoming too tight.

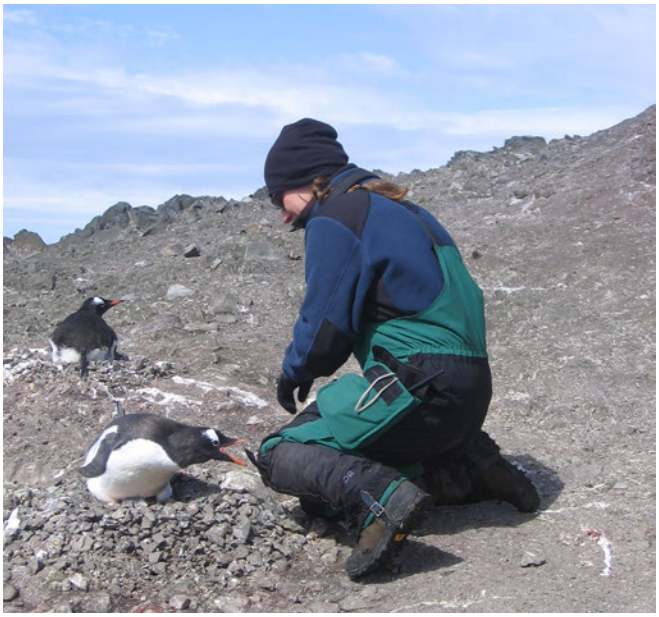
Noose pole, murre capture. © Ram Papish

3) **Noose carpet**

Noose carpets are commonly used for species of seabird that spend time socializing on the surface of a breeding colony. Most species of auklets nest in rock crevices, but spend a lot of time on the top of the rocks. Noose carpets consist of a base material attached securely to a rock or the ground, with one or many nooses attached to its' surface. Seabirds walk over this carpet, and their legs become trapped by the nooses. The watching researcher quickly releases the caught bird.

Noose carpet, dovekie. © Carsten Eevang

4) **By Hand!**



Cape Sheriff Livingstone Island, Antarctic Peninsula region - marking gentoo chicks.
© Sarah Chisholm

Best Case Scenario: Some species of seabird (many species of albatross and penguins) have no risk of predation at the colony, and can be easily caught by hand!

LESSON SIX SEABIRD RESEARCH TOOLS AND METHODS

ETHICS QUESTIONS

All researchers have the responsibility to critically examine the potential and level of disturbance, and the discomfort and stress to their study species before starting a study. Researchers should then evaluate (a) whether the question justifies the level of impact, and (b) use methods that minimize any impact. In most countries, researchers are required to do extensive training and obtain specific permits prior to any study that includes bird capture.

WHAT METHODS WOULD YOU USE TO ANSWER THE FOLLOWING QUESTIONS?

- You notice that kittiwakes at a local colony usually successfully raise two chicks, but one year they all failed. What caused these birds to fail?
- Weekly weighing of puffin chicks show they are gaining more weight than chicks in the previous year. Is this due to parents delivering more meals to their chick? Or, are parents delivering larger or more nutritious meals?
- An oil company is proposing a new off-shore drilling operation. How would you assess the risks of this operation to seabirds?
- The gulls at a local colony raise chicks every year, but the population is declining. Maybe they have a high chance of death at their wintering grounds. How would you find out where the gulls spend their winter?

LESSON SIX | ACTIVITY 6.1 SEABIRD MEASURING

OBJECTIVE:

- Students will be able to discuss why scientists capture and measure birds, then will practice capturing methods on fake birds and then measuring: tarsus, culmen, wing cord, and weight.

MATERIALS:

- Introductory PowerPoint
- 5-10 stuffed-toy &/or dead seabirds
- Noose poles & noose carpets –for comparison of capture method
- Pesola or spring scales (capacity determined by specimen)
- Bird bags
- Wing cord measuring rules
- Calipers
- Data sheets
- Tables for stations
- Pencils
- Electronic balance (optional – could just use Pesolas)

STATION SETUP:

You will need to setup 5 different table stations with stuffed-toy or dead birds. Each table station should go along with the data sheets and have the appropriate tools. Ideally there would be an adult at each station to review the procedure for measuring at each station. (Amounts of birds/tools dependent on size of small groups that will rotate through stations.)

Station 1: Capture: birds, noose poles, bird bags, data sheet, pencil

Station 2: Tarsus: birds, calipers, data sheet, pencil

Station 3: Wing Cord: birds, wing rules, data sheet, pencil

Station 4: Culmen: birds, calipers, data sheet, pencil

Station 5: Weight: birds, Pesola or spring scale, data sheet, pencil

ACTIVITY:

- Introduce the concept of capture and measuring using the PowerPoint provided with this lesson. Demonstrate to whole group each of the following measuring procedures.

LESSON SIX | WORKSHEET 6.1.1 SEABIRD MEASURING

Names:_____ Date:_____

Station 1: At this station you will practice using a **Noose Pole** to capture birds off the "cliffs".

Procedure:

1) "Sneak" up on the bird
2) Slowly raise noose pole up the "cliff"
3) Slowly loop the noose over the bird's neck
4) Gently lift up on the noose pole to close the noose.
5) Carefully swing the bird off the "cliff" and into your partner's waiting hands.
6) Switch places and let your partners try.

Observations: Write one or two sentences each about the differences you would have to deal with if you were a scientist on a **real** cliff with **real** birds.

_____

_____

_____

_____

_____

_____

_____

_____

LESSON SIX | WORKSHEET 6.1.1 SEABIRD MEASURING

Names:_____ Date:_____

Station 2: At this station you will measure part of the bird's leg called the Tarsus using a caliper. The Tarsus is the part of the bird's leg between what looks like a backward-facing knee and what looks like an ankle. Scientists want to measure the tarsus along with the weight to show how large and also how healthy the birds are.

Sample ID number	Partner 1 measurement (mm)	Partner 2 measurement (mm)	Partner 3 measurement (mm)	Average

LESSON SIX | WORKSHEET 6.1.1 SEABIRD MEASURING

Names:_____ Date:_____

Station 3: At this station you will measure the wing cord (from the bend of the wing to the longest primary feather). Scientists measure wing cord length to help understand growth & health of birds. You will use a special ruler for this called a wing rule (a ruler with a stopper at the end). A regular ruler will also work for this exercise.

Sample ID number	Partner 1 measurement (mm)	Partner 2 measurement (mm)	Partner 3 measurement (mm)	Average

LESSON SIX | WORKSHEET 6.1.1 SEABIRD MEASURING

Names:_____ Date:_____

Station 4: At this station you will measure the beak length (called the culmen) using calipers. Scientists measure the culmen of birds to help understand bird growth and health.

Sample ID number	Partner 1 measurement (mm)	Partner 2 measurement (mm)	Partner 3 measurement (mm)	Average

LESSON SIX | WORKSHEET 6.1.1 SEABIRD MEASURING

Names:_____ Date:_____

Station 5: At this station you will measure the weight of a bird using a **Pesola Scale**. Scientists measure the weight of birds to study growth and health of the birds. It is very important to remember to **subtract** the weight of the **bag** holding the bird from the total weight to get the actual bird weight.

Sample ID number	Partner 1 measurement (grams)	Partner 2 measurement (grams)	Partner 3 measurement (grams)	Average bird only
	Bird+bag _____ - bag _____ = bird _____	Bird+bag _____ - bag _____ = bird _____	Bird+bag _____ - bag _____ = bird _____	
	Bird+bag _____ - bag _____ = bird _____	Bird+bag _____ - bag _____ = bird _____	Bird+bag _____ - bag _____ = bird _____	

LESSON SIX | ACTIVITY 6.2 SEABIRD MONITORING

OBJECTIVE:

- Students will be able to discuss why and how scientists monitor seabirds in Alaska.

MATERIALS:

- PowerPoint: Lesson 6 Activity 6-2 Scientists Monitor Seabirds
- **Worksheet 6.2.1 Seabird Monitoring**
- **Worksheet 6.2.2 Seabird Counting**

PROCEDURE:

- **Worksheets 6.2.1**: Go through the PowerPoint with the students. Have them take notes and then complete in groups or as a class.
- **Worksheet 6.2.2**: Divide the class into two groups.
  - **Group 1:** Go the U. S. Fish and Wildlife website: https://www.fws.gov/waterfowlsurveys/forms/guide.jsp?menu=guide and complete the exercise. Answers can be copied to the worksheet provided.
  - **Group 2:** Go to the website Wildlife Counts by Jack Hodges: http://www.wildlifecounts.com/ and complete the exercise.

LESSON SIX | WORKSHEET 6.2.1 SEABIRD MONITORING

Name:_____ Date:_____

Instructions: Use the information given in the PowerPoint presentation **Seabird Capture** to complete the following questions (on a separate sheet of paper, a Google doc, etc.)

1. State at least 2 reasons why people in general should care about seabirds?

2. Describe who might study or monitor seabirds?

3. Name three sites in Alaska where seabirds are monitored in the Alaska Maritime National Wildlife Refuge. What is the difference between an annual site and an intermittent monitoring site?

4. Name one aspect of seabird life that biologists monitor in seabird populations, and describe how these data are collected.

5. Using the graph of the red-legged kittiwake, what can you conclude is happening to the population of these birds. Give two specific examples to support your position.

6. How are “Productivity” and “fledging” interconnected?

LESSON SIX | WORKSHEET 6.2.1 SEABIRD MONITORING

7. Describe at least two ways that seabird diet samples can be collected, and what can scientists learn from these diet samples?

8. What could a scientist learn from putting a “band” on a bird? Should just anyone go out, catch, and band birds?

9. Explain how climate change can affect seabirds. Name two aspects of seabird life that can be easily monitored and could provide a good indication of climate change.

10. Draw an example of a food chain/ web for a seabird. Include at least 3 links from the base of the food chain to a top predator.

Extra Credit: What is a Refuge?

LESSON SIX | WORKSHEET 6.2.2 SEABIRD COUNTING

Name:_____ Date:_____

Instructions: Go to the website listed below and test your counting abilities. Start at the beginner level. When you are finished copy your results to the table below. Share with your classmates and discuss different counting methods.

U. S. FISH AND WILDLIFE SERVICE AERIAL OBSERVER TESTING AND TRAINING RESOURCES

https://www.fws.gov/waterfowlsurveys/forms/guide.jsp?menu=guide

	Your Estimate	Actual Flock Size	% Difference
Flock 1			
Flock 2			
Flock 3			
Flock 4			
Flock 5			
Flock 6			
Flock 7			
Flock 8			
Flock 9			
Flock 10			
Totals			
You either UNDERcounted or OVERcounted flocks in this size range by an average of			

LESSON SIX | WORKSHEET 6.2.3 SEABIRD COUNTING

Name:_____ Date:_____

Instructions: Use the Wildlife counts software to test your counting abilities. Count each group of animals two times. Did you improve the second time?

WILDLIFE COUNTS BY JACK HODGES

This program will only work on computers running a Windows operating system. It will not work on a Mac or Apple computer.
http://www.wildlifecounts.com/

Species Name	Count #1	Count #2	Difference
Swans on a lake			
Snow geese			
Migrating geese			
Salmon in a stream			
Ducks on a pond			
Random points			
Caribou herd			

LESSON SEVEN

SEABIRDS AS MARINE INDICATORS

Seabird Youth Network

OBJECTIVES:

- Student will be able to explain how seabirds inform scientists about ocean conditions.

FOCUS QUESTIONS:

- How do seabirds tell us about the ocean?
- Why are seabirds considered ecological indicators?

SEABIRDS AS INDICATORS OF THE MARINE ENVIRONMENT

Study of the marine ecosystem can be very expensive, with high boat costs.

⇓

Most seabirds rely on the ocean for food, and forage over a range of habitats.

⇓

Seabirds are relatively easy to study on land at their breeding colony.

⇓

Seabirds can therefore be sensitive (and cheaper) indicators of the health of marine ecosystems.

Crested auklet. © Ram Papish

LESSON SEVEN | SEABIRDS AS MARINE INDICATORS

WHAT CAN SEABIRDS TELL US ABOUT THE OCEAN?

Seabirds have been used as indicators of (a) contamination, (b) climate change, (c) commercial fisheries (d) prey, and (e) habitat characteristics. See Table 1 (below) for examples of each category.

Table 1. What Can Seabirds Tell Us? Table based from Piatt *et al*. 2006; Seabirds as indicators of marine ecosystems; an integrated NPRB Science Plan for Alaska.

CONTAMINATION	CLIMATE CHANGE	COMMERCIAL FISHERIES	PREY	HABITAT CHARACTERISTICS
Oil	Global warming	Timing of spawning	Species abundance	Currents, water masses
Plastic debris	Cyclical patterns (like the El Nino)	Size/age class distribution	Distribution of prey	Sea ice extent
Heavy metal concentrations	Unusual events	Prediction of stock size	Energetic value of prey	Hotspots (areas that concentrate prey)

WHAT MAKES A GOOD ECOLOGICAL INDICATOR?

- Respond to change in the environment
- Known/predictable response to change
- Easy to study
- Cost effective
- Easy to understand and interpret

SPECIES SELECTION

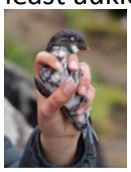
It's useful to study species that:

- Have a widespread range (to be able to examine geographic patterns).
- Have different foraging distances.
- Use different parts of the water column (bottom feeders and surface feeders can tell us different things).
- Have different trophic levels (feed on zooplankton versus fish).
- Have historical data available to compare.

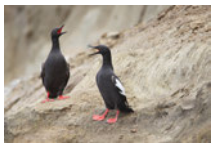
LESSON SEVEN SEABIRDS AS MARINE INDICATORS

The Alaska seabird species that have been recognized to fit these criteria are shown in Table 2 (below).

Table 2. Alaskan seabirds that are good indicator species (taken from Piatt et al. 2006; Seabirds as indicators of marine ecosystems; an integrated NPRB Science Plan for Alaska).

Species	Why they are good indicators
black-legged kittiwake  © USFWS Max Kauffman	Widespread in Alaska, circumpolar distribution; piscivorous (fish-eaters); easy to study; surface feeders; sensitive to fluctuations in prey abundance; feeds on short-lived forage fish
common murre  © Ram Papish	Widespread in Alaska, and from California to Japan, circumpolar distribution; easy to study; chick diet easy to identify; pursuit diver; feeds on short-lived, pelagic schooling fishes
thick-billed murre  © Ram Papish	Widespread in Alaska, circumpolar distribution; easy to study; chick diet easy to identify; pursuit diver; feeds on short lived, pelagic schooling fishes
tufted puffin  © Ram Papish	Good sampler of intact and easily identifiable forage fish; widespread and abundant in North Pacific; historical diet dataset; easy to study and sample prey; highly diverse, generalist diet choices better reflect local prey communities
least auklet  © John Gibbens	Widespread and abundant in Bering Sea and Aleutians; small body size, planktivorous (eat zooplankton), specializes on copepods (low trophic level puts them close to sources of variation in ocean productivity)

LESSON SEVEN SEABIRDS AS MARINE INDICATORS

Species	Why they are good indicators
crested auklet  © Ram Papish	Widespread and abundant in Bering Sea and Aleutians; small body size, planktivorous (eats zooplankton), specializes on euphausiids (low trophic level puts them close to sources of variation in ocean productivity)
fork-tailed storm-petrel  © USFWS	Widespread and abundant in Alaska and North Pacific; nocturnal Procellariform (tubenose); surface feeding; mixed invertebrate/fish feeder especially myctophid and squid; forages long distances from colonies to shelf-edge
rhinoceros auklet  © Andrew Redding	Good sampler of intact and easily identifiable forage fish; widespread in North Pacific; historical diet dataset; easy to study and sample prey; highly diverse, generalist diet choices better reflect local prey communities
pigeon guillemot  © Ram Papish	Widespread and common breeder in Alaska, and ranges from California to Kuriles; relatively easy to census and measure productivity; carries whole prey to chicks so easy to identify
pelagic cormorant  © Ram Papish	Widespread and common in Alaska and North Pacific; easy to observe at colonies and assess productivity, regurgitates prey items
glaucous-winged gull  © Ram Papish	Widespread and common in Alaska, and from Oregon to the Commander Islands; relatively easy to census, measure egg-production, and gather food regurgitations

LESSON SEVEN | SEABIRDS AS MARINE INDICATORS

DATA COLLECTION

Seabirds can be affected directly by the following:

- climate: rainfall and changes in sea levels
- pollution: oil, plastic
- fisheries: bycatch
- habitat alteration: land development, resource extraction
- food supply

Seabirds are also affected indirectly via their food. For example, seabirds are affected indirectly by climate when changes in water temperature change the distribution and availability of prey species. Pollution may also be consumed by zooplankton or fish, and then ingested by seabirds when they eat.

Most changes in the marine environment are indicated indirectly by seabirds through their food.

The best parameters to measure are therefore those that provide direct information on diet and foraging behavior, or are known to be sensitive to variation in prey. These parameters include:

- *Diet composition (species, size, age, energy value of prey eaten by chicks, adults)*
- *Foraging effort and time budgets (forage trip duration, chick- feeding rates, time spent at a colony)*
- *Chick growth, fledging success (number of chicks hatched that successfully fledge)*
- *Breeding phenology (timing of breeding)*
- *Population trends*
- *Density of foraging birds at sea (at-sea observations from a boat, often the most expensive method)*

The sensitivity of all these parameters varies among species.

EXAMPLES/STORIES OF SEABIRDS AS SUCCESSFUL MARINE INDICATORS

1) Seabird Stomach Contents Show Increase In Plastic Marine Debris.
   http://bml.ucdavis.edu/wp-content/pdf/cameos/Seabirds%20and%20Plastics.pdf

LESSON SEVEN | SEABIRDS AS MARINE INDICATORS

2) Breeding Failure Of Seabirds Indicate Change In Wind And Current Patterns Related To Climate Change.

   http://www.npr.org/templates/story/story.php?storyId=11253445

3) Penguin Populations Decline As Temperatures Rise and Sea-Ice Extent Decreases.

   http://www.penguinscience.com/clim_change_ms.php

4) Least Auklet Chick Diet On The Pribilof Islands Shows Increase in Arctic-dwelling Zooplankton Due to Colder Waters in Recent Years.

   http://seabirdyouth.org/seabird-science/

Thick-billed murre © Ram Papish

APPENDIX I GLOSSARY

abundance The number of individuals in a population.

AMNWR Alaska Maritime National Wildlife Refuge

Bering Sea A marginal sea of the North Pacific located north of the Aleutian Islands, west of Alaska, and east of Russia.

biodiversity The degree of variation of life. It is a measure of the variety of organisms present in different ecosystems. This can refer to genetic variation, ecosystem variation, or species variation (number of species) within an area, biome, or planet.

biome A distinct region occupied by plants and animals suited for its climate and vegetation.

bycatch Marine animals caught while fishing that fishermen do not want, cannot sell, or are not allowed to keep.

colonial nesting seabirds (seabird colony) A seabird colony is a large congregation of individuals of one or more species of bird that nest or roost in proximity at a particular location (on an island). Many kinds of birds are known to congregate in groups of varying size; a congregation of nesting birds is called a breeding colony.

commercial fishing Fishing in which harvested fish are sold, bartered, or traded.

competition: A contest between organisms, animals, individuals, and/or groups, for territory, a niche, resources (food, shelter, etc.), mates, or group or social status. Each side of the contest is a competitor.

conservation The act of protecting or preserving natural resources in order to prevent depletion or loss.

DNA Deoxyribonucleic acid is the hereditary material found in all humans and almost all other organisms. It carries the genetic information and hereditary characteristics.

ecological community An assemblage or associations of populations of two or more different species occupying the same geographical area and in a particular time.

ecosystem A community of living organisms and their environment, and the interactions between the two. Humans are an integral part of an ecosystem.

environmental stewardship Protecting the natural environment and using its resources in a sustainable way. It also means practicing conservation: taking actions to ensure that native plant and animal species, and the habitats that they require, continue to survive.

excrement Feces, poop, scat

fledgling Seabird chicks are generally considered to be a fledgling once they leave the nest, even if they cannot fly and are still receiving some care from parents.

forage fish Generally a small schooling fish that feeds on plankton and is preyed upon by larger fish, marine mammals, and seabirds.

foraging The act of searching for food.

guano The excrement of birds, cave-dwelling bats, and marine mammals. Guano is a highly effective fertilizer due to its exceptionally high content of nitrogen, phosphate, and potassium, three nutrients essential for plant growth.

gene A region or segment of DNA that stores the code for determining inherited traits.

gillnet A net suspended vertically in the water with meshes that allow a fishes head to pass through but entangle the gills when withdrawn.

APPENDIX I GLOSSARY

habitat An ecological or environmental area that is inhabited by a particular species of animal, plant, or other type of organism. It is the natural environment in which an organism lives, or the physical environment that surrounds a species population.

invasive species A plant or animal that is not native to a specific location (an introduced species); and has a tendency to spread, which is believed to cause damage to the environment, human economy and/or human health.

kleptoparasites Steal food from other birds.

long line fishing A method of fishing involving a large number of short lines with hooks, which are attached to a longer main line at regular intervals.

monitoring Counting and measuring organisms or their features that are of interest (abundance of seabirds on a colony).

mortality The state of being mortal, or susceptible to death.

native/indigenous species A species is defined as native (or indigenous) to a given region or ecosystem if its presence in that region is the result of only natural processes, with no human intervention. Every natural organism (as opposed to a domesticated organism) has its own natural range of distribution in which it is regarded as native.

natural range The geographical area within which a particular species is commonly found.

natural resources Raw materials obtained from nature that humans cannot make, such as light, water, air, plants, animals, or soil.

NOAA National Oceanic and Atmospheric Administration

offal Waste or by-product from a process such as commercial fishing.

pelagic Inhabiting the water column as opposed to being associated with the sea floor; generally occurring anywhere from the surface to 1,000 meters. Also, relating to or living in the open sea.

pollution The presence or introduction into the environment of something that has a harmful or poisonous effect.

population trends Changes over time in a population's abundance, distribution, or life-history.

predator (predation) An organism that eats another organism.

prey The organism which the predator eats.

salt gland A gland in marine birds that concentrates salt from the blood. Salt is collected near the nostrils and "sneezed" out.

species A group of organisms sharing similar traits that produce viable offspring.

trawl fishing A method of fishing that involves dragging or pulling a net through the water.

USFWS United States Fish and Wildlife Service

wing span The distance between the wing tips of a bird.

APPENDIX II EDUCATIONAL STANDARDS

ALASKA STATE SCIENCE STANDARDS

Science as Inquiry and Process

SC2 Students develop an understanding of the structure, function, behavior, development, life cycles, and diversity of living organisms.

SC3.2 The student demonstrates an understanding that all organisms are linked to each other and their physical environments through the transfer and transformation of matter and energy by analyzing the potential impacts of changes within an ecosystem.

SE1 Students develop an understanding of how scientific knowledge and technology are used in making decisions about issues, innovations, and responses to problems and everyday events.

ALASKA STATE SCIENCE STANDARDS

Statistics and Probability Standards

- Interpreting Categorical and Quantitative Data

NEXT GENERATION SCIENCE STANDARDS: DISCIPLINARY CORE IDEAS

LS2.A: Interdependent Relationships in Ecosystems

- Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS-LS2-1)
- In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. (MS-LS2-1)
- Growth of organisms and population increases are limited by access to resources. (MS-LS2-1)
- Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. (MS-LS2-2)

LS2.B: Cycle of Matter and Energy Transfer in Ecosystems

- Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. (MS-LS2-3)

LS2.C: Ecosystem Dynamics, Functioning, and Resilience

- Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. (MS-LS2-4)
- Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. (MS-LS2-5)

APPENDIX II EDUCATIONAL STANDARDS

NEXT GENERATION SCIENCE STANDARDS: DISCIPLINARY CORE IDEAS

LS4.D: Biodiversity and Humans

- Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—e.g., water purification and recycling. (secondary to MS-LS2-5)

ETS1.B: Developing Possible Solutions

- There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (secondary to MS-LS2-5)

APPENDIX III LESSON RESOURCES

LESSON 1 SEABIRD BASICS

TEXT BOOKS

Seabirds: A Natural History (2004) by Anthony Gaston

Seabirds and Other Marine Vertebrates (1989) by Joanna Burger

Seabirds: An identification Guide (1991) by Peter Harris

The Auks: Alcidae (Bird Families of the World) (1998) by Gaston, Jones, and Lewington

KID'S BOOKS

Seabirds (Zoobooks Series) (1995) by Beth Wagner (Author), Beth Wagner Brust (Author), Tim Hayward (Illustrator)

Looking for Seabirds: Journal from an Alaskan Voyage (2004) by Sophie Webb

Penguins: The Animal Answer Guide (2013) by Gerald Kooyman and Wayne Lynch

Puffins (True Books: Animals) (2007) by Ann Squire

Puffins For Kids (2015) by Rachel Smith and John Davidson

The Little Fox: An Alaska Adventure (2008) by Ram Papish

Far from Shore: Chronicles of an Open Ocean Voyage (2011) by Sophie Webb

Wisdom, The Midway Albatross: Surviving the Japanese Tsunami and other Disasters for over 60 Years (2012) by Darcy Pattison and Kitty Harvill

WEBSITES

Links to detailed accounts on all the seabirds species breeding in Alaska.

http://alaska.fws.gov/mbsp/mbm/seabirds/species_list.htm

All about penguins (for kids): https://www.youtube.com/watch?v=O8qilxaBR20

Resources for students and teachers: http://www.southernseabirds.org/resources/students-teachers/

Learn more about waterproof coats: http://preschoolpowolpackets.blogspot.co.uk/2015/09/penguin-science-experiment.html

APPENDIX III LESSON RESOURCES

LESSON 2 SEABIRD FEEDING

WEBSITES

Gannets feeding: https://www.youtube.com/watch?v=1Cp1n_vPvYY&list=PL3LIPsk_MgMfJvPxhUFNRQX9ks2o8NLQb

Penguins feeding with camera on back: http://www.bbc.co.uk/nature/21130523

Puffins feeding underwater: https://www.youtube.com/watch?v=eRBwmngSlA8

Fulmars feeding: https://www.youtube.com/watch?v=fmYIvWxWm40

Giant Petrel (killing a penguin; may be too graphic?): https://www.youtube.com/watch?v=so6LSuM3BhI

Storm-petrel feeding: https://www.youtube.com/watch?v=DD9ChWrS31w

Frigate-bird kleptoparasitism: https://www.youtube.com/watch?v=CyNHH5l0puY

TEXT BOOKS

Seabirds: Feeding Ecology and Role in Marine Ecosystems (2009) by John Croxall

LESSON 3 SEABIRD BREEDING

WEBSITES

Common Guillemots (murres): http://www.bbc.co.uk/nature/life/Common_Murre

Marbled Murrelets: https://www.youtube.com/watch?v=UOM2utqaDHY

Hatching puffin: https://www.youtube.com/watch?v=tslLSJelCxs

Fledgling murres: https://www.youtube.com/watch?v=5EYXdEsW6xw

Emperor penguin chicks: https://www.youtube.com/watch?v=lf26jtJfL30

World's largest albatross colony: https://www.youtube.com/watch?v=tHCQYIX6Mf4

Eagle attacks kittiwake colony: https://www.youtube.com/watch?v=cG8BfVvtGPQ

Mexican Seabird Colony: https://www.youtube.com/watch?v=FUBX_tlHySc&list=PLEDdH2gr1BEJNz3MZUGP5ALRuDuWkvZ80

APPENDIX III LESSON RESOURCES

LESSON 4 SEABIRD CONSERVATION

WEBSITES

Oil Pollution

http://response.restoration.noaa.gov/about/media/why-are-seabirds-so-vulnerable-oil-spills.html

https://academy.allaboutbirds.org/what-oil-spills-do-to-birds/

https://www.education.com/science-fair/article/effect-of-oil-on-birds/

Ingested plastic

http://news.nationalgeographic.com/2015/09/15092-plastic-seabirds-albatross-australia/

http://www.sciencemag.org/news/2016/11/why-do-seabirds-eat-plastic-they-think-it-smells-tasty

http://oikonos.org/education/

https://ocean.si.edu/slideshow/laysan-albatrosses'-plastic-problem

Invasive species

http://en.wikipedia.org/wiki/Introduced_mammals_on_seabird_breeding_islands

http://seabirdyouth.org/invasive-species-and-seabird-curriculum/

https://www.islandconservation.org/first-global-assessment-of-seabirds-threatened-by-invasive-alien-species-on-islands-released/

http://coastalconservation.ca/invasive-species/

Commercial fishery bycatch

http://www.birdlife.org/seabirds/bycatch/albatross.html

http://www.afsc.noaa.gov/refm/reem/Seabirds/Default.php

http://www.bbc.co.uk/news/science-environment-35778655

Commercial fishery competition

http://www.sciencedaily.com/releases/2012/02/120228123852.htm

Habitat destruction

http://oikonos.org/current-projects/seabird-nests/

Seabirds as human food

https://en.wikipedia.org/wiki/Great_auk

http://www.smithsonianmag.com/science-nature/uncertain-future-puffin-dinner-180961829/

Climate change

http://www.bbc.co.uk/nature/20498368

General Seabird Conservation

http://www.audubon.org/conservation/project/saving-seabirds

http://oikonos.org/what-we-do/

http://wwf.panda.org/what_we_do/endangered_species/albatross/

BOOKS

Seabird Islands: Ecology, Invasion, and Restoration (2011), edited by Christa Mulder, Wendy Anderson, David Towns, and Peter Bellingham.

Project Puffin: The Improbable Quest to Bring a Beloved Seabird Back to Egg Rock (2010) by Stephen W. Kress and Derrick Z. Jackson

APPENDIX III LESSON RESOURCES

LESSON 5 SEABIRD CULTURAL IMPORTANCE

WEBSITES

Seabird myths and legends

Daedalus and Icarus: http://myths.e2bn.org/mythsandlegends/playstory1598-daedalus-and-icarus.html

Tsimshian Gull Myth: http://blogs.evergreen.edu/ebestiary/blog/2012/05/29/american-herring-gull/

Poem: the Rime of the Ancient Mariner: https://en.wikipedia.org/wiki/The_Rime_of_the_Ancient_Mariner

Albatross in folklore: http://www.anta.canterbury.ac.nz/documents/GCAS%20electronic%20projects/GCAS%2010%20Reveiws/Ana%20Pallesen%20Review%20.pdf

Birdman: https://en.wikipedia.org/wiki/Tangata_manu

Seabirds as a human resource

Faroe hunting: https://www.youtube.com/watch?v=7LUv4sEyfcw

Guga hunters in Scotland: https://www.virtualheb.co.uk/guga-hunters-of-ness-isle-of-lewis-western-isles/ and http://www.bbc.co.uk/news/uk-scotland-highlands-islands-25527432

Seabird harvest in the Arctic: http://www.caff.is/assessment-series/98-seabird-harvest-in-the-arctic

Kiviak: https://en.wikipedia.org/wiki/Kiviak

Egg harvesting in the Faroe Islands: https://www.atlanticseabirds.info/skuvoy

Yupik clothing: https://en.wikipedia.org/wiki/Yup'ik_clothing

St. Kilda (Scotland): http://news.bbc.co.uk/earth/hi/earth_news/newsid_9190000/9190062.stm

Summary of bird and egg harvest on St. Lawrence Island (Alaska): https://www.fws.gov/alaska/ambcc/ambcc/Harvest/St%20%20Lawrence%20Is%20%20Bird%20Harvest%20Handout.pdf

Egg Harvest: http://www.npr.org/sections/thesalt/2016/08/15/487644637/the-gold-hungry-forty-niners-also-plundered-something-else-eggs

History of penguin oil harvest: http://www.falklandsconservation.com/wildlife/penguins/history

Guano Harvesting: https://www.youtube.com/watch?v=V-fke7LDuUc

https://www.youtube.com/watch?v=HOq8PKX18A4

APPENDIX III LESSON RESOURCES

LESSON 6 SEABIRD RESEARCH TOOLS AND METHODS

WEBSITES

Mist-netting storm-petrels: https://www.youtube.com/watch?v=cKi0Y_F1fno

Geolocators and arctic terns: http://news.bbc.co.uk/1/hi/8451908.stm

Geolocators: http://www.birdtracker.co.uk

How GPS work: http://www.nationalgeographic.org/encyclopedia/gps/

Study example: satellite tracking of albatross can tell us about their risk of overlap with long-line fisheries. Learn more from the Oikonos education program "Winged Ambassadors" lesson #2: www.downloadwingedambassadors.org

Bird camera on a cormorant: http://www.huffingtonpost.com/2012/08/01/imperial-cormorants-superbird-deep-sea-dive_n_1728512.html

Weigh bridge for penguins: http://icestories.exploratorium.edu/dispatches/penguins-on-the-scale/

Time-depth-recorders and penguins: http://www.antarctica.gov.au/about-antarctica/wildlife/animals/penguins/emperor-penguins/how-deep-can-they-dive

Monitoring seabirds on Aiktak: https://vimeo.com/126965030

Video: tracking gannets: https://www.youtube.com/watch?v=7Enq_Fc0Fm4

Video camera on a gannet: http://www.bbc.co.uk/nature/24898391

Bird Camera in puffin burrow: http://explore.org/live-cams/player/puffin-burrow-cam

Examples of technology companies:

Lotek: http://www.lotek.com/avian.htm

Biotrack: http://www.birdtracker.co.uk

Star Oddi: http://www.star-oddi.com/products/37/bird-geolocator/default.aspx

APPENDIX III LESSON RESOURCES

LESSON 7 SEABIRDS AS MARINE INDICATORS

WEBSITES

Seabird Stomach Contents Show Increase In Plastic Marine Debris: http://www.philly.com/philly/blogs/greenliving/Seabird-stomach-contents-show-plastic-pollution-on-the-rise.html

Breeding Failure Of Seabirds Indicate Change In Wind And Current Patterns Related To Climate Change: http://www.npr.org/templates/story/story.php?storyId=11253445

Penguin Populations Decline As Temperatures Rise and Sea-Ice Extent Decreases: http://www.penguinscience.com/clim_change_ms.php

Fishery management: http://www.pointblue.org/observer/index.php?module=myPrint&browse_issue_num=155&browse_article_num=219

Seabird die-offs: http://www.audubon.org/magazine/march-april-2015/lost-sea-starving-birds-warming-world

Least Auklet Chick Diet On The Pribilof Islands Shows Increase in Arctic-dwelling Zooplankton Due to Colder Waters in Recent Years: http://seabirdyouth.org/seabird-science/#tabid1

Marine litter indicator: https://www.ospar.org/work-areas/eiha/marine-litter/marine-litter-indicators

APPENDIX III LESSON RESOURCES

APPENDIX IV SCIENCE FAIR PROJECT IDEAS

BIRDS, SEABIRDS, MARINE BIOLOGY, AND CONSERVATION; LINKS FOR SCIENCE FAIR PROJECTS IDEAS

How does a chick breathe inside its' shell?

http://www.sciencebuddies.org/science-fair-projects/project_ideas/Zoo_p046.shtml

M&M survival challenge!

http://www.sciencebuddies.org/science-fair-projects/project_ideas/Zoo_p012.shtml

With a little bread as bait, can you make a bird migrate?

http://www.sciencebuddies.org/science-fair-projects/project_ideas/Zoo_p052.shtml

Can you predict birds lifestyle based on its feet?

http://www.sciencebuddies.org/science-fair-projects/project_ideas/Zoo_p050.shtml

The Oil Effect: Removing Oil from Birds Feathers

http://www.usc.edu/CSSF/History/2008/Projects/J1905.pdf

What seeds to birds prefer to eat? (Can you do this with rosy finches?)

http://www.sciencebuddies.org/science-fair-projects/project_ideas/Zoo_p028.shtml

How salty is the sea?

http://www.sciencebuddies.org/science-fair-projects/project_ideas/OceanSci_p009.shtml

Timing the tides

http://www.sciencebuddies.org/science-fair-projects/project_ideas/OceanSci_p008.shtml

How salty does the sea have to be for an egg to float?

http://www.sciencebuddies.org/science-fair-projects/project_ideas/OceanSci_p003.shtml

What are you blubbering about? (marine mammal focused, but applies to seabirds)

http://www.sciencebuddies.org/science-fair-projects/project_ideas/Zoo_p044.shtml

Ocean currents and weather

http://www.sciencebuddies.org/science-fair-projects/project_ideas/Weather_p023.shtml

Whirl-y-bird vs. whale-y-bird

http://www.sciencebuddies.org/science-fair-projects/project_ideas/Aero_p015.shtml

APPENDIX IV SCIENCE FAIR PROJECT IDEAS

The swimming secrets of duck feet

http://www.sciencebuddies.org/science-fair-projects/project_ideas/Aero_p014.shtml

Lets go fly a kite

http://www.sciencebuddies.org/science-fair-projects/project_ideas/Aero_p016.shtml