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WINGED AMBASSADORS: OCEAN LITERACY THROUGH THE EYES OF ALBATROSS

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OVERVIEW

An albatross soaring above the ocean's waves is truly a sight to behold. These charismatic and threatened seabirds traverse vast regions of the North Pacific searching for food, making them ideal ambassadors to stimulate awareness and stewardship for a clean ocean (see Link #1 on page 29). Along their journeys, they ingest floating plastic trash, which they deliver to their chicks on the nesting colonies. Investigations of plastic ingestion by seabirds, using samples collected at-sea (from incidental mortality in fisheries and scientific collections), and on shore (from beach-cast specimens, and samples from nesting colonies) have revealed that this is a pervasive and growing source of pollution (see Link #2 on page 29). Satellite-tracking technology now allows researchers to follow these birds' foraging trips and far-ranging migrations during the non-breeding phase of their lives, when they range widely across the North Pacific Ocean (see Link #3 on page 29). This research gives resource managers an improved understanding of how albatrosses use protected areas and territorial waters of different nations and overlap with potential threats from fisheries and pollution. In particular, the albatross highlight connectivity between different regions of the basin, with birds ranging from Japan to California, and the shared international responsibility for ocean conservation (see Link #4 on page 29).

In this article, we present an activity package, focusing on albatross and marine debris by providing a brief overview of the Winged Ambassadors program. Please visit the links and additional resources listed at the end of this article to access and use the full package in your classroom or educational programming. Learning through the eyes of these majestic seabirds is an excellent way to engage students in a STEAM-G (science, technology, engineering, art, mathematics, and geography) based mini-unit. The revised curriculum includes a self-contained activity package of five scalable lessons, with handouts and supporting material: teacher guide, student worksheets, slideshows, and photos of boluses to analyze.

OBJECTIVES

Since 2005, Oikonos - Ecosystem Knowledge, a non-profit organization dedicated to increasing knowledge and understanding of threatened ecosystems and partners have worked to create a network of educators, scientists, and artists working together to inspire ocean literacy. This effort is guided by the desire to increase awareness of ocean plastic pollution and its impacts on seabirds, and to use this enhanced consciousness to inform personal choices that improve the health of the ocean and marine wildlife. In particular, this interdisciplinary partnership has succeeded in developing strong research-based ocean stewardship products by establishing synergies between researchers working in the field, federal resource management agencies, and state-mandated curricula for scientific and ocean literacy. In particular, the synergistic roles of the National Oceanic and Atmospheric Administration (NOAA) Cordell Bank National Marine Sanctuary (CBNMS) program and the Papahānaumokuākea Marine National Monument (PMNM) have been critical, both as educational partners and as links to the monitoring and management implications for the wider marine ecosystem.

Between 2006 and 2011, our achievements have included creating and distributing free classroom activities related to marine debris and seabird migrations, providing albatross boluses to 15,000 students from eight U. S. states, Guam, and New Zealand, and creating formal curriculum using marine animal tracking to teach math and science. To read more about the overarching goals and achievements of Winged Ambassadors, visit the website (http://www.oikonos.org/projects/wingedambassadors.htm).

WHAT'S NEW

With funding from NOAA's Office of National Marine Sanctuaries Pacific Islands Region and West Coast Region, including CBNMS and PMNM, we completed the improved classroom activity package "Winged Ambassadors: Ocean Literacy through the Eyes of an Albatross." This package includes a series of five inquiry-based activities aligned with the Essential Principles and Fundamental Concepts of Ocean Literacy, the National Science Education Standards, and the California and Hawai'i state science standards. The lessons are written for middle school (grades 5-8) students and include extensions and differentiation suggestions to use them with students in grades 9-12. As they study albatross, their movements, and their interactions with marine debris, students collect and analyze data, make calculations, support their findings with evidence, and consider the roles of engineering and technology in scientific study. They plot seabird locations and analyze animal movements as they look for patterns and generate new scientific questions. Students make connections between their communities, no matter how far from the ocean, their everyday choices, and albatross far at sea, as they express their new understandings and suggestions for change

through art and writing. Professional artists Sophie Webb and David Liitschwager provided watercolors and photography to inspire students at several levels.

ACTIVITY OVERVIEW

Below, we provide a brief overview of the five lessons, which are available online (Link #5 on page 29).

LESSON 1: INTRODUCTION TO SEABIRDS

Activity Summary: This introductory lesson opens the package by introducing seabirds and highlighting the unique aspects of their natural history and ecology, with special emphasis on albatrosses.

Spending their entire lives at sea, these amazing birds have many adaptations that allow them to live away from land. Their bodies are both similar to and different from those of humans, making them an interesting model for students to consider anatomy and other life functions. Through the art and photography of Sophie Webb and others, videos, and maps displaying authentic scientific data, students will learn about the unique life history and adaptations of albatross. These understandings will prepare them to study these birds more deeply in later lessons.

Figure 1. The black-footed albatross is a charismatic ambassador for ocean stewardship, by virtue of its majesty and far-ranging habits. (Photo: Sophie Webb).

Learning Objectives: After completing this lesson, students will be able to:
- Illustrate the lifecycle of albatross
- Give examples of adaptations that allow seabirds to spend time at sea and fly thousands of miles
- Compare the bodies of albatross with humans
- Analyze a sample albatross food chain and explain that food chains depict the transfer of energy in ecosystems

Outline:
- **Engage** – Introduction to Seabirds
- **Explore** – Wingspan Activity
- **Explain** – Life Cycle & Adaptations
- **Elaborate** – Marine Food Webs
- **Evaluate** – Albatross Adaptations

LESSON 2: MIGRATION CONNECTIONS

Activity Summary: Albatross are seabirds that make long ocean journeys, foraging for food to feed themselves and their chicks. In this lesson, students will practice their map skills as they plot the actual locations of albatross tracked by satellites. These explorations will also give students examples of how science, technology and engineering are closely related, and the dynamic nature of science. Students will begin the lesson by observing some albatross migration routes and then plot authentic satellite tracking data. Next, students will read about satellite tracking and recent advances in seabird biology that have been made thanks to this important technology. They will consider the different areas of the sea through which the birds travel, and ask scientific questions about their paths.

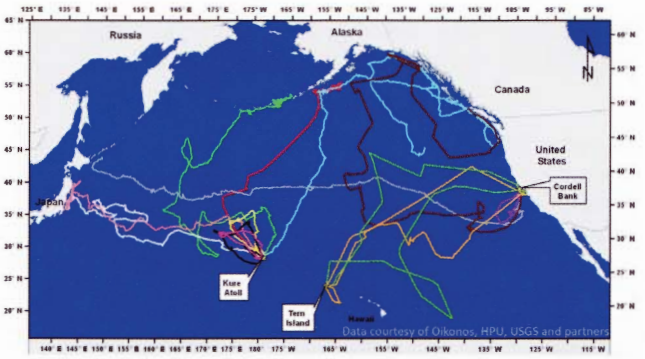

Figure 2. Representative black-footed albatross tracks from satellite data illustrate migratory connections across the North Pacific Ocean (each color is a unique individual route).

Learning Objectives: After completing this lesson, students will be able to:
- Plot authentic seabird location data using latitude and longitude coordinates
- Compare and contrast albatross tracks and ask scientific questions
- Explain the roles of science, technology, and engineering in studying seabirds

Outline:
- **Engage** – Navigating the Ocean
- **Explore** – Plotting Albatross Locations
- **Explain** – Analyzing Albatross Movements
- **Elaborate** – Satellite Tagging
- **Evaluate** – Other Seabird Movements

LESSON 3: PROTECTING OCEAN HOTSPOTS

Activity Summary: Just as on land, the ocean bottom has many diverse features, including mountains, plains, canyons, and hills. Seafloor features, wind, and the shape of the land affect the movement of water, which in turn affects productivity (how much food is in the ocean). In this lesson, students will examine the movements of albatross with respect to bathymetry, the study of ocean depth, and seafloor contours.

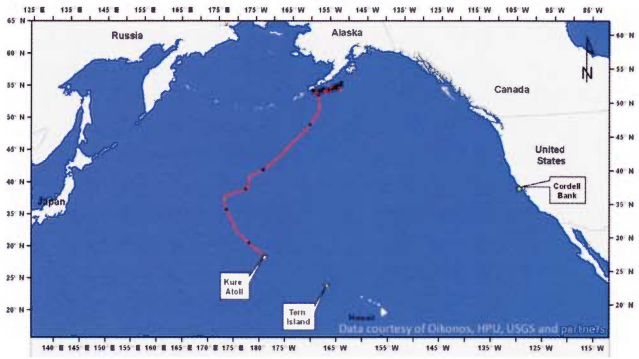

Figure 3. Black-footed albatross satellite track from Kure Atoll to Alaska, with daily locations indicated by black dots, illustrates an activity hotspot along the Aleutian continental slope.

Learning Objectives: After completing this lesson, students will be able to:

- Identify common seafloor features
- Analyze albatross movements in relation to seafloor features
- Explain the concept of a hotspot of animal activity
- Discuss protections in place for areas in the Pacific Ocean

Outline:

- **Engage** – Imagining the Seafloor
- **Explore** – Identifying Seafloor Features
- **Explain** – Upwelling and Marine Food Webs
- **Elaborate** – National Marine Sanctuaries
- **Evaluate** – Seafloor Features and Upwelling

LESSON 4: BOLUS ANALYSIS

Activity Summary: Prior to leaving the nest, albatross chicks regurgitate a mass of indigestible material called a bolus. Boluses give us clues as to the types of food and trash eaten by albatross parents while out at sea. In this lesson, students will use high-resolution photographs of boluses to perform a "virtual dissection," or analysis, in which they will compare the amounts of prey and non-prey items found in several boluses. They will consider the sources of the non-prey materials and create a model of a bolus, with which they can educate others.

Figure 4. Plastic fragments in a bolus from an albatross chick.

Learning Objectives: After completing this lesson, students will be able to:

- Explain that albatross chicks regurgitate a mass of indigestible material called a bolus, which provides a record of their diet and ingested plastic
- Note that nearly all albatross boluses include plastics
- Calculate the percentage of prey and non-prey items found in boluses
- Define the term "marine debris" and indicate its sources
- Create a model of a bolus

Outline:

- **Engage** – Albatross Chicks
- **Explore** – Albatross Bolus Analysis
- **Explain** – Analyzing Class Data
- **Elaborate** – Albatross and Marine Debris
- **Evaluate** – Creating a Model

LESSON 5: CAMPUS DEBRIS SURVEY

Activity Summary: In this lesson, students will go outdoors and examine the potential sources of marine debris on their own school campuses. They will analyze what they find and create a campaign to educate other students about marine debris and our own behaviors.

Figure 5. Recognizable consumer items found in black-footed albatross chick boluses include household items (e.g., styrofoam cup fragment) and debris from fisheries (e.g., a rubber glove).

Learning Objectives: After completing this lesson, students will be able to:

- Collect and analyze debris on their school grounds
- Make connections between campus debris and marine debris
- Define the term 'watershed'
- Create a poster, brochure, or public service announcement to educate other students about how our own behaviors impact the ocean

Outline:

- **Engage** – Litter and Albatross
- **Explore** – Litter on Our School Campus
- **Explain** – Analyzing Results
- **Elaborate** – Our Litter and Albatross
- **Evaluate** – Spreading the Word

CONCLUSION

The overarching ocean stewardship goal of the Winged Ambassadors program is to demonstrate that our behavior and decisions can impact ocean wildlife and habitats far away. As students work through the curriculum unit, they will: (i) explore the connections that exist across the North Pacific, from Japan to the West Coast of North America; (ii) consider the threats that many far-ranging seabirds face from a variety of human activities; and (iii) examine the important management roles of the Papahānaumokuākea Marine National Monument and the U.S. West Coast National Marine Sanctuaries. These three interconnected goals are depicted in the enclosed mind map (Figure 6). We encourage teachers and students to develop their own conceptual and artistic depictions to illustrate the way we are all connected to the albatross.

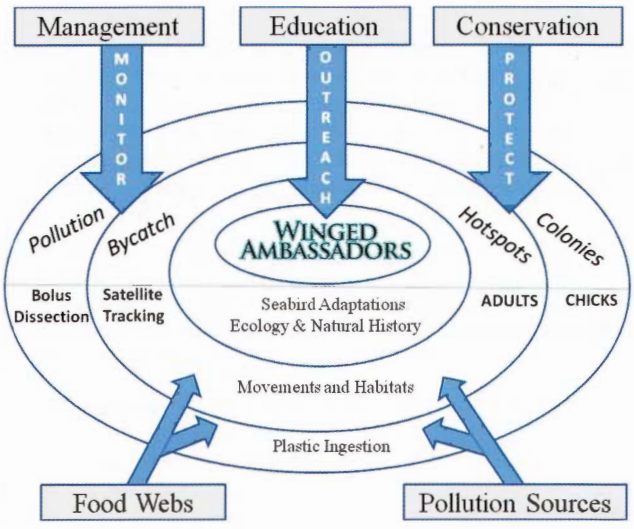

Figure 6. Conceptual diagram of the factors (food webs / pollution sources) influencing albatross plastic ingestion, and the available mitigation measures (management, education, conservation). Note that the different life stages (chicks / adults) are studied using distinct methods (bolus dissection / satellite tracking).

LINKS

#1: Albatross Conservation Status: For updated information on the status of the black-footed albatross, visit the following websites:

- International Union for the Conservation of nature (IUCN): **http://www.iucnredlist.org/apps/redlist/details/106003957/0**
- BirdLife Datazone: **http://www.birdlife.org/datazone/speciesfactsheet.php?id=3957**

#2: Plastic Ingestion by Seabirds: For background information on plastic ingestion by seabirds and plastic pollution impacts for marine wildlife, consult the following documents:

- Nevins, H., C. Keiper, K.D. Hyrenbach, J. Stock, M. Hester, and J.T. Harvey. 2005. Seabirds as indicators of plastic pollution in the north pacific. *Rivers to Sea Conference Proceedings*. September 7-9, 2005, Long Beach, CA. **http://conference.plasticdebris.org/whitepapers/Hannah_Nevins.pdf**
- National Academies of Science. 2008. *Tackling Marine Debris in the XXIst Century.* National Academies Press: **http://www.nap.edu/catalog.php?record_id=12486**

#3: Real-time Tracking Data: *Winged Ambassadors – Race for a Clean Ocean*

- Visit this site showcasing individual black-footed albatross tracks: **http://oikonos.org/race/**

#4: Management Uses of Satellite Tracking Data: For background information on the use of black-footed albatross satellite tracking data to inform management and monitoring actions, please consult the following documents:

- Hyrenbach, D., C. Baduini, M. Hester, C. Keiper, H. Nevins, and J. Adams. 2006. Turning the tide for troubled albatross. *ArcNews Online Newsletter.* **http://www.esri.com/news/arcnews/spring06articles/turning-the-tide.html**
- Keiper, C., M. Hester, and D. Hyrenbach. 2005. Wonderous ocean wanderers in our own front yard. *Hydrosphere* 17(1): 10-11. **http://www.oikonos.org/projects/Article_Hydrosphere_Spring2005.pdf**
- Link to radio interview with David Hyrenbach about tracking albatross: **http://cordellbank.noaa.gov/casts/oc061206.mp3**

#5: Link to download the activities available at three partner websites:

- Oikonos Ecosystem Knowledge **http://www.oikonos.org/education**
- Cordell Bank National Marine Sanctuary **http://cordellbank.noaa.gov/education/teachers.html**
- Papahānaumokuākea Marine National Monument **http://papahanaumokuakea.gov/education/wa.html**

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PHOTO CREDIT

Page 27 (left): Courtesy of Sophie Webb