Lesson 4: Bolus Analysis
Lesson 4 Presentation Content

Engage – Albatross Chicks
Explore – Albatross Boluses
Explain – Class Data
Elaborate – Marine Debris
Evaluate – Albatross Bolus Model
Engage

Albatross Chicks
Meeting on the Colony

- Adult albatross meet at the colony and engage in elaborate mating dances

- Albatross pairs attempt to mate for life and have to find each other at the colony, year after year…
The Albatross Mating Dance

The species-specific calls and dances help albatross recognize birds of the same species and to pick a good mate.

Sometimes birds of closely related species mate and produce a hybrid.
Laying and Incubating a Single Egg

Albatross females lay a single egg between November and December. Both parents incubate for about 66 days, and take turns finding food at sea.
After 2 months, the chick hatches in January or February
Foraging Far Away to Feed the Chick

- The albatross parents feed the chick for 6 months
- They “go to work” as far away as California and Alaska
Feeding the Chick

Video in Lesson 1
Learning to Fly and Fledging

Video in Lesson 1
Albatross Chicks Regurgitate a Bolus

• Boluses contain indigestible material: hard parts from fish and squid, seeds, wood, feathers, rocks and human trash

• Boluses provide a record of a chick’s diet
Albatross Chick Regurgitating a Bolus

*Video provided on website for download*
Extension:

Albatross Necropsy Video
“306 Punches”

Video provided on website for download
Explore
Albatross Boluses
Boluses Collected and Cleaned

- Researchers collect, rinse and dry these boluses in the field.

- Dissecting the boluses provides a record of what albatross ingest.
Boluses - Different Shapes and Sizes

Kure Atoll, Black-footed Albatross
Boluses - Different Shapes and Sizes

Kure Atoll, Black-footed Albatross
Bolus Measurements
Bolus Categories

© David Liittschwager, HPU, Oikonos
Bolus Analysis

© David Liittschwager, Oikonos, HPU, USFWS
Quantifying the Composition of Boluses
4 Plastic Categories

Fragments
- Rigid & Hard

Foam
- Compressible
- Aerated Cells

Line
- Round Filaments
- Bendable

Sheets
- Flat & Thin
- Bendable
Describing the Fragments in the Boluses

- Fragments categorized by size and color

- The source of some items can be identified
Close-up of a Squid Beak

© David Liittschwager
Mystery Item

[Image of a brown, star-shaped object held between fingers, labeled "Oikonos"]
Explain

Class Data Comparisons
Comparing the Bolus Data – 2 Species

- Laysan Albatross
- Black-footed Albatross
Comparing the Bolus Data – 2 Colonies
Tern Island, National Wildlife Refuge
Let’s analyze our data

Albatross Bolus Contents Bolus: Class Totals

- Squid beaks
- Plastic fragments
- Styrofoam
- Wood
- Rope
- Metal
- Recognizable whole plastic items

Bar chart showing the number of items for natural prey items and non-natural prey items.

Graph showing the distribution of items by category for boles of five boluses.
Data Analysis – From Scientists

Result: Kure Boluses are heavier

- Weighed 25 boluses per species and colony
- Total sample size = 100

(Unpublished Data - HPU & Oikonos)
Result: Kure Black-footed chicks are fed the most plastic

• Sorted the boluses and calculated proportion of their mass that was plastic

• On average, Black-footed boluses are 75% plastic on Kure, only 25% on Tern
Data Summaries – From Scientists

Result: Tern Black-footed Albatrosses have proportionally more beaks than Kure Black-footed Albatrosses.

- Proportion of mass that was squid beaks
- On average, Black-footed boluses are 15% beaks on Kure and 40% beaks on Tern.

(Unpublished Data - HPU & Oikonos)

Sample: 25 boluses per species/site
Elaborate

Marine Debris
Map of Major Surface Ocean Currents
Map of Wind Speed and Direction

July SCOW Vector Averaged Wind Speed (m s⁻¹) and Direction
The Wind Pushes the Ocean Water

• And everything else floating on it or drifting in it

Macro Marine Debris

- Including many organisms

Man-o-war

Micro Marine Debris

Porpita
The Wind Concentrates Floating Material

Wind from the west

Floating Stuff

Sinking Water

Wind from the east
Currents where North Pacific Albatrosses live
Plastic Debris Washes Up on Remote Atolls
Albatross Encounter Concentrations of Floating Organisms and Trash
Prey (Barnacles and Flying Fish Eggs) on Trash
Other Seabirds Ingest Plastic Too

Photo courtesy of David Liittschwager

Tristram’s Storm Petrel

Sarah Youngren
Compare Plastic Between Species

Scaled Ingested Plastic Mass (% Body Mass)

- BFAL (n = 13)
- LAAL (n = 49)
- TRSP (n = 8)
Extension:

Running the OSCURS Model Online

Ocean Surface Current Simulator (OSCURS)

Drag marker to choose
OSCURS Model trajectory start
Current location: 185 E, 45 N

Tools:
- Run Model
  - Choose track color
  - Optional Parameters
  - Remove all tracks

Quick Start:
Just click on “Run Model” without changing anything else
WINGED AMBASSADORS

OCEAN LITERACY THROUGH THE EYES OF ALBATROSS
Use Agreement

This presentation was developed for Cordell Bank National Marine Sanctuary and Papahānaumokuākea Marine National Monument by Meghan Marrero of Mercy College and Oikonos - Ecosystem Knowledge.

Teachers, educators, researchers and students may incorporate these materials into their lesson plans, presentations, and worksheets in hard copy and digital format for internal educational use only, not into any publication for external distribution.

All photos, art, video and data have been contributed free of charge to create this product for educational use. Content may be copyrighted and/or owned by individuals and entities other than, and in addition to, NOAA and Oikonos. Credits for all the media are embedded or included, please retain credits when reproducing.

No organization or person (whether an educational body or not) may incorporate this material into any media for promotional or commercial purpose whatsoever.

Please contact Oikonos or NOAA to request further use of any images, art, video, data or text included in this presentation – we will contact contributing authors.

Contact: WingedAmbassadors@oikonos.org

All resources for this curriculum are available at:

www.cordellbank.noaa.gov/education/teachers.html
www.papahanaumokuakea.gov/education/wa.html
www.oikonos.org/education
<table>
<thead>
<tr>
<th><strong>Engage – Albatross Chicks</strong></th>
<th><strong>Explain - Class Data Comparisons</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Meeting at the Colony</td>
<td>1. Comparing the Bolus Data – 2 Species</td>
</tr>
<tr>
<td>2. Albatross Mating Dance</td>
<td>2. Comparing the Bolus Data – 2 Colonies</td>
</tr>
<tr>
<td>4. Hatching to Fledging</td>
<td>4. Data Analysis – From Scientists (Bolus Mass)</td>
</tr>
<tr>
<td>5. Foraging Far Away to Feed the Chick</td>
<td>5. Data Analysis – From Scientists (Proportion Plastic)</td>
</tr>
<tr>
<td>6. Feeding the Chick</td>
<td>6. Data Analysis – From Scientists (Proportion Beaks)</td>
</tr>
<tr>
<td>7. Learning to Fly and Fledging</td>
<td></td>
</tr>
<tr>
<td>8. Albatross Chicks Regurgitate a Bolus</td>
<td></td>
</tr>
<tr>
<td>9. Video of Albatross Chick Regurgitating a Bolus</td>
<td></td>
</tr>
<tr>
<td>10. Extension: Video of an Albatross Necropsy</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Explore – Albatross Boluses</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Boluses are Collected and Cleaned</td>
</tr>
<tr>
<td>2. Bolus Shapes and Sizes</td>
</tr>
<tr>
<td>3. Bolus Measurements</td>
</tr>
<tr>
<td>4. Bolus Categories</td>
</tr>
<tr>
<td>5. Student Analysis</td>
</tr>
<tr>
<td>6. Close up of a Squid Beak</td>
</tr>
<tr>
<td>7. Quantifying the Composition of Boluses</td>
</tr>
<tr>
<td>8. Describing the Fragments in the Boluses</td>
</tr>
<tr>
<td>9. Mystery Item</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Elaborate – Marine Debris</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Map of the Major Ocean Currents</td>
</tr>
<tr>
<td>2. Map of Wind Speed and Direction</td>
</tr>
<tr>
<td>3. The Wind Pushes the Ocean Water</td>
</tr>
<tr>
<td>4. The Wind Concentrated Floating Material</td>
</tr>
<tr>
<td>5. Currents where Pacific Albatrosses Live</td>
</tr>
<tr>
<td>6. Albatross Encounter These Concentrations</td>
</tr>
<tr>
<td>7. Distinguishing Food and Trash can be Difficult</td>
</tr>
<tr>
<td>8. Extension: Running the OSCURS Model Online</td>
</tr>
</tbody>
</table>