Week 7 and 8: Dissecting an Albatross Bolus

Read: Article on Marine Debris

Hook:

Albatross Chick Stomach Demonstration
Present the students with the empty jar, which represents the albatross stomach. Place a piece of plastic at a time into the jar, asking the students how one more piece might affect the albatross, keeping in mind that an albatross chick is unable to produce a bolus until it fledges. As the ‘stomach’ fills, there is less and less room for actual food. Many albatross check stop foraging, grow slowly, and many die due to starvation and dehydration, as theirs stomachs are too full of trash to make any room for food.

Background:

Show powerpoint on the Albatross

http://www.oikonos.org/ftp/outgoing/wingedambassadors/lesson_1/L1_Presentation_Introduction_to_Seabirds_highres.ppt

Activity 1:

Materials:

- Magnifying glass
- Colored pictures of albatross bolus
- Data sheets

Have students practice making observations on albatross bolus with colored images. Have them fill in the data sheet

Activity 2:

Have students dissect the real albatross bolus and record data

Going further: Create a poster board presentation of one of the bolus dissections to highlight the impact of plastics on our wildlife. Include the following on your poster:

a. Albatross Species -- check bag and see if it says LAAL (Laysan's Albatross) or BFAL (Black-footed Albatross). Write the name on the sheet of paper.
b. Collection Location is: KURE Atoll.
c. Collection Year is listed on your bag, write it on this line.
and how much is man-made, non-natural products.
f. In the comments section, then write any important findings.

Resources:

http://www.downloadwingedambassadors.org/
Marine Debris

What Is Marine Debris?

The National Oceanic and Atmospheric Administration defines marine debris as any persistent solid material that is manufactured or processed and directly or indirectly, intentionally or unintentionally, disposed of or abandoned into the marine environment or the Great Lakes. Since the 1960s, the world's dependence upon natural materials has been largely replaced with durable, highly buoyant synthetic items. Once they enter the ocean environment these products, such as cigarette filters, food wrappers, beverage bottles and cans, grocery and trash bags, and fishing line, nets and gear, can travel for hundreds of thousands of miles on ocean currents, posing a threat to ocean ecosystems and wildlife along the way. Consequently, marine debris has become one of the most widespread pollution problems facing the world's oceans and waterways.

Where Does It Come From?

While the types of debris are as diverse as the products found around the world, it all shares a common origin — people. Since trash can travel long distances before settling on shorelines or the ocean floor, determining exactly how debris reaches the ocean can be difficult. In an effort to understand the activities that cause debris, researchers traditionally classify marine debris as coming from land- or ocean/waterway-based sources.

Land-based sources

People's mishandling of waste materials and a host of other items while on land constitutes a good portion of the marine debris we see on shorelines. Debris is also blown into the water or carried by creeks, rivers, storm drains, and sewers into the ocean.

Sources of land-based debris include:

- Inappropriate disposal of trash from many land-based activities, including picnicking, beachgoing, fishing, and waterside sporting events;
- Debris items from lawns, parking lots, streets, and storm drains being blown, swept or washed out to sea;
- Inappropriate handling of packaging materials;
- Inadvertent or intentional release of waste from shore-based solid waste disposal and waste processing facilities; and
- Sewage overflows.

Ocean/waterway-based sources

People also generate debris while at sea. Like land-based debris, much of the ocean/waterway-based debris reaches the ocean through people's failure to properly dispose of or stow their trash while onboard their boats and vessels. Ocean-based debris also includes derelict (lost or abandoned) fishing gear. Natural disasters, such as hurricanes and storms, can also deposit debris into the ocean.

Sources of ocean/waterway-based debris include:

- Abandoning or losing fishing gear, including line, nets, ropes, bait boxes, fish tags, and trawl floats;
- Intentional or inadvertent discharge of trash, galley waste and boating materials, including oil lube bottles, engine cleaning and maintenance products; and
- Inappropriate handling of undersized exploration and oil and gas extraction items, including hard hats, sheeting and tarps, computer equipment and survey materials.
Impacts of Marine Debris

In addition to being unsightly, marine debris poses significant threats to ocean ecosystems, wildlife, and human health and safety.

**Effects on ocean ecosystems**
- Abandoned nets, plastic tarps, fishing gear and other debris can smother and crush sensitive coral reef and seagrass bed ecosystems and their benthic (bottom-dwelling) species.
- Cigarette filters, food bags, pieces of plastic, and packaging look like food to many animals. Once ingested, these materials can cause starvation and possibly even death.

**Effects on marine wildlife**
- Fishing line, nets, rope and grocery and trash bags can entangle, maim, and even drown many wildlife species, including sea turtles, marine mammals, seabirds, and other species.

Effects on people
- Medical and personal hygiene debris can enter waterways when sewer systems fail or overflow. These items often contain harmful bacteria and pathogens.
- Syringes, broken glass and other hazardous items pose obvious dangers to bare-footed beachgoers.
- Grocery and trash bags, fishing line, nets, rope, and other debris can wrap around boat propellers and clog seawater intakes, causing costly damage and becoming a safety hazard.

Working Toward Solutions

While an important first step, physically removing existing debris only provides temporary relief to the problem. The only way to truly manage the marine debris pollution issue is through prevention - changing the behaviors that cause marine debris to enter the environment. Consequently, multiple organizations and local, state, and federal agencies are collaborating on outreach projects designed to bring awareness to and alleviate the problem of marine debris. Several efforts are focusing on monitoring the behaviors and activities that result in marine debris and developing prevention strategies that educate people on marine debris issues, their role in the problem and how to prevent it.

For more information on programs that are working to foster change, visit www.MarineDebris.noaa.gov.

What You Can Do

Here are some steps that you can take to help solve the marine debris problem:

- Reduce, reuse, recycle. Choose reusable items and use fewer disposable ones (e.g., use fewer disposable bags when shopping, or bring your own reusable bags).
- Retain all pieces of fishing line, net, or other litter for proper disposal in trash containers.
- Keep streets, sidewalks, parking lots, and storm drains free of trash – remember our land and ocean are connected.
- Stow all trash on your boat for proper disposal on land. At the beach, park or playground, dispose of all trash in the proper receptacles or take your trash home with you. Pick up any debris you see while out.
- Serve as an example to others. Get involved in cleanups in your area and encourage others to help keep the beaches and oceans clean.
- Learn about the problem of marine debris and its impacts then tell your friends and family!
Lesson 4: Bolus Analysis

Engage

Read the following information:

*Albatross* parents are incredibly invested in raising their chicks. On the Northwestern Hawaiian Islands, adult albatross meet on breeding islands in the late summer and fall. They perform elaborate mating dances as they court and then produce an egg. The egg is laid in a nest on the ground. During this time, two parents take turns keeping the egg warm, allowing the chick inside to develop for two months.

Once the chick hatches, it stays on or near the nest for 5-6 months. During this time, the parents take turns flying thousands of miles to gather food for their chicks. Depending on the species, favorite food items include squid, fish eggs, and fish that they catch near the water's surface. Large albatross cannot dive underwater very far so most of their food comes from the sea surface. Chicks stay at the nest waiting for their meals.

As the chicks grow, they lose their fluffy, downy feathers and begin to look more like the adults. They begin testing their wings in the wind and are finally ready to take off to the sea and fend for themselves. Before they leave the nest, or **fledge**, the chicks regurgitate a mass of undigested material from their stomach. This mass is called a **bolus**.

Watch the video of a chick on Kure Atoll regurgitating a bolus.

Black-footed Albatross chick, almost fully grown, begging for food from its parent on Kure Atoll, Northwestern Hawaiian Islands.
Explore

Your teacher will give your group one or more photographs/projections of dissected albatross boluses. Answer the questions below to guide your analysis.

1. Carefully observe the photographs and describe a whole bolus. Describe what you observe.

2. Observe the close-up photograph of the squid beak. Write a very detailed description of it.
Next, you will analyze a bolus that a scientist has dissected.

3. Record the species and colony (where your dissected bolus was found) in the data table.
   - BFAL = Black-footed Albatross
   - LAAL = Laysan Albatross
   - Kure = Kure Atoll Colony
   - Tern = Tern Island Colony

4. Observe your dissected bolus carefully. Describe what you see.

   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________

Sort and categorize your bolus and record your findings in the data tables.

Category descriptions:

**Plastic Items:**
- Plastic Fragments – Rigid and hard complete or broken pieces in any shape (caps, broken bottles, toys)
- Plastic Foams – Compressible and aerated plastic in any shape (packing foam, rubber)
- Plastic Sheets – Flexible, flat and thin sheet of plastic (pieces of plastic bags or tarps)
- Plastic Lines - Round single or multi-filament line or rope (unraveled fishing nets)

**Prey Items – Hard parts from the food they eat**
- Squid Beaks – Hard upper and lower beaks of squid
- Lenses – Hard eye lenses from fish and squid

**Other Items (Non-plastic and Non-prey):**
- Seeds, Wood, Pumice, or other items that may float (not plastic)

5. a. Count the number of plastic items. Count by type (fragments, foam & rubber, and sheets) or combine all plastic as time allows. Analyze plastic line using a different method described below because it cannot be counted.

   b. Count the number of squid beaks and eye lenses. If this is difficult, devise a way to count in smaller sections or grids (quadrats).

   c. Count the number of “other” items that are not plastic or from an animal.
<table>
<thead>
<tr>
<th>Colony:</th>
<th>Species:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Partner or Quadrat</th>
<th>Plastic Items</th>
<th>Prey Items</th>
<th>Other Items</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data A</td>
<td>Fragments, Foam, Rubber, Sheets *use different method for line count</td>
<td>Beaks, Lens</td>
<td>Seeds, Pumice, Others</td>
<td>Count</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data B</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data D</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Count Entire Bolus</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% of Total</td>
<td></td>
<td></td>
<td></td>
<td>100%</td>
</tr>
</tbody>
</table>
8. Using the class data, calculate the percentage of prey vs. non-prey items in all of the boluses the class observed. Create a data table below in which you record your findings.

9. Using the class data, compare the area/size of plastic line in all the boluses.
10. Why do you think there are so many plastic items?

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________


11. Where do you think the plastic items are coming from?

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

Elaborate

12. How would you explain what marine debris is, and where it comes from, to a 2nd grader?

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________
13. What are the major sources of marine debris and plastic?

Observe the slides showing large-scale movement of water in the North Pacific. Large masses of continuously moving ocean water are known as currents. At the ocean’s surface, winds drive these currents. In the North Pacific, these currents include the Kuroshio Current and the California Current, which are shown on the map below.

As you can see in this example, the ocean currents form several large circulations, gyres, around the North Pacific basin. The winds push the water, and everything floating in it, around the ocean in this circular path. The materials traveling around the ocean unfortunately include our trash.

14. How would you describe a gyre to a 2nd grader?
15. How would you suggest addressing the marine debris problem? Use scientific evidence to support your suggestion.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

16. In several scientific studies since 2008, biologists found that 100% of boluses thrown up by albatross chicks in the Northwestern Hawaiian Islands contained plastic trash and 52–66% of the bolus weight was plastic.

   a. How do these findings compare to your data? Use evidence from your data tables to support your comparison.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

   b. How might eating and storing plastic inside the stomach affect a seabird chick?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
Lesson 1: Biological Impacts

Station 6: Albatross Bolus Activity – Instructions

Laysan albatross feed primarily on squid, but they also eat fish, fish eggs, and crustaceans. Just before they fledge, albatross chicks regurgitate a compacted mass of indigestible material called a bolus. Even though plastic is not a natural part of the birds’ diet, every single albatross bolus found today contains plastic.

The intact and dissected samples are actual albatross boluses, collected from Midway and Kure Atolls in the Northwestern Hawaiian Islands. Follow the instructions below to determine how much plastic is present in an albatross bolus relative to other materials.

1. Before starting, look at the intact and dissected boluses. As a group, form a hypothesis about what percentage of the total number of bolus items consists of plastic. Write the names of your group members and your hypothesis at the top of the ALBATROSS BOLUS ACTIVITY – DATA SHEET.

2. In your group, assign one person to record the data. Remaining group members will sort the bolus.

3. Open the container labeled “Dissected Bolus” and empty its contents onto the paper towel.

4. These items came out of the stomach of a bird and are not clean. Using the forceps, carefully sort items into separate piles: squid beaks, non-natural prey items, and fishing line. If you need to handle the bolus contents, do not touch your face until after you have washed your hands.

5. Sort the non-natural prey items into the categories listed on the ALBATROSS BOLUS ACTIVITY – DATA SHEET.

6. Record the number of each item type on the ALBATROSS BOLUS ACTIVITY – DATA SHEET.

7. Compute subtotals for natural prey items and plastic items, and compute the total number of bolus items. Record your data on the data sheet.

8. Compare the relative percentages of natural prey items and plastic present in the bolus.
   a. To calculate the percentage of natural prey items, divide the subtotal of natural prey items by the grand total and multiply by 100%.
   b. To calculate the percentage of plastic, divide the subtotal of plastic items by the grand total and multiply by 100%.

9. Answer the remaining questions on the data sheet.

10. Clean up your work area by replacing all of the bolus contents in the container, then wash your hands.

11. If time permits, watch the video called “306 Punches” on the computer located at this station.
ALBATROSS BOLUS DISSECTION – Instructions & Questions

NAMES: ________________________________________________________________

*** Read all instructions below from beginning to end and answer ALL questions.

Pre-Bolus Dissection
1) After getting into a group of 6, write each member of the group’s full name on the top of this paper. At your table, you should have a bolus, pair of scissors, pair of tweezers, ruler, and magnifying glass. If not, then ask Rachel for any of these pieces of equipment.

2) What is the number/letter of your albatross bolus (it is written on a piece of paper in the plastic bag)? __________

3) Now take the albatross bolus out of the plastic bag and place it on your lab tables. BEFORE pulling it apart:
   a. Measure the bolus with the ruler. Length: __________ Width: __________

   b. What do you see/observe before beginning the dissection? What does it look like? Do you see any materials right away? Plastic? __________________________

   c. Is this what you expected the bolus to look like? Why or why not? __________________________

Bolus Dissection
4) Now begin CAREFULLY and DELICATELY pulling apart the bolus. Begin sorting the pieces into the following categories. If you do not know what something is, then look at it under the microscope or ask Rachel.
   a. CATEGORIES to sort materials into piles:
      i. Squid beak parts
      ii. Grass and Dirt – natural products
      iii. Fishing Line and Rope – non-natural products
      iv. Plastics
      v. Shell parts and Rocks
      vi. Unidentifiable

5) Sort completely and thoroughly into piles. Once sorted, fill out data sheet completely. Count pieces, if there are a lot of pieces, then guesstimate the amount.

6) Were the items you found expected or unexpected? Why? __________________________

7) Was there more or less plastic than expected? Why? __________________________

→ → → MORE ON BACK!
8) Use the ruler and guesstimate the average size of plastic found in the bolus? 
   a. What do you think determines the size of plastic albatross can swallow? 

9) What is the most common color of non-natural materials? 

Post Bolus Dissection

10) Combine your bolus dissection piles with the other group who has the other half. Make sure you are matching numbers (example: 1a with 1b).

11) Once you have combined dissections, you are now ready to frame the dissection. You will obtain a frame and take off the glass. Then you will lay the pieces in nice, artistic piles on the matting. Leave room for a small sheet of paper and a small photo at the bottom.

12) Fill out the small sheet of paper (ask Rachel for this). With the following information:
   a. Albatross Species – check bag and see if it says LAAL (Laysan’s Albatross) or BFAL (Black-footed Albatross). Write the name on the sheet of paper.
   b. Collection Location is: KURE Atoll.
   c. Collection Year is listed on your bag, write it on this line.
   d. Dissection Date is today and Location is your high school/class.
   e. Looking at the WHOLE bolus dissection guesstimate how much is natural products and how much is man-made, non-natural products.
   f. In the comments section, then write any important findings.

13) Once framed, then place cover back on.

After Framing

14) Clean up area. Bring all forceps, tweezers, scissors, and magnifying glass to front and put in Tupperware. Sweep left over dirt/debris into garbage. Re-fold large dissecting piece of paper and put into Tupperware.
   a. Make sure this paper is COMPLETELY filled out and place in one of your folders.
   b. Make sure Rachel gets your COMPLETELY filled out data sheets.

15) Place your framed bolus dissection at the front of the room.
Lesson 1: Biological Impacts
Station 6: Albatross Bolus Activity – Data Sheet

Driving question: How much of the bolus consists of plastic items?

Investigators:

Hypothesis:

<table>
<thead>
<tr>
<th>NATURAL PREY ITEMS</th>
<th>(NUMBER)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Squid beaks</td>
<td>a)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NON-NATURAL PREY ITEMS</th>
<th>(NUMBER)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole plastic items (incl. toothbrushes, lighters, etc.)</td>
<td>b)</td>
</tr>
<tr>
<td>Plastic fragments (incl. wrappers, film, Styrofoam, etc.)</td>
<td>c)</td>
</tr>
<tr>
<td>Wood or other vegetation</td>
<td>d)</td>
</tr>
<tr>
<td>Pieces of rope</td>
<td>e)</td>
</tr>
<tr>
<td>Metal</td>
<td>f)</td>
</tr>
<tr>
<td>Rocks/pumice</td>
<td>g)</td>
</tr>
</tbody>
</table>

FISHING LINE – CIRCLE ONE OF THE FOLLOWING:
- Absent
- Present in low abundance
- Makes up ~1/2 of the bolus contents
- Makes up most of the bolus contents

<table>
<thead>
<tr>
<th></th>
<th>TOTAL NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subtotal of natural prey items (a)</td>
<td></td>
</tr>
<tr>
<td>Subtotal of plastic items (b–c)</td>
<td></td>
</tr>
<tr>
<td>GRAND TOTAL of all bolus contents (a–g)</td>
<td></td>
</tr>
</tbody>
</table>

DATA ANALYSIS:
What percentage of the total bolus items consist of natural prey items? _________
What percentage of the total bolus items consist of plastic? _________

DATA INTERPRETATION: Of the items that you found in the bolus, which would you predict takes the longest to degrade?

CONCLUSION: Compare your data with your hypothesis. Do your data generally support your hypothesis?