Rose Atoll Marine National Monument – Sea Turtles

Grade Level

- 7-12

Timeframe

- 60 minutes in the classroom

Materials

- Computer with internet access
- Turtle observation and tracking worksheets how many?
- Audio Visual Materials: Sea Turtle videos

Key Words

- Carapace
- Clutch
- Omnivore
- Herbivore
- Analogous structures

Activity Summary

There are seven species of sea turtles that exist globally, six of those species exist in the waters of the United States; ten populations are endangered and an additional six are listed as threatened. Loss of nesting habitat is a big threat to sea turtles and is what makes protected areas, like Rose Atoll, very valuable nesting ground. In this lesson, students will explore the life history of sea turtles and the importance of Rose Atoll as a nesting ground. Using Google Street view they will explore the beach at the atoll and they will learn about sea turtle migrations by investigating how sea turtles are tracked using satellite tags.

Learning Objectives

- Experience the beach at Rose Atoll and visualize how nesting sea turtles might use this area.
- Make observations and use those to develop questions, hypotheses and predictions about turtle behavior.
- Discuss how turtles have become adapted for their environment.
- Interpret data about satellite tagged and tracked sea turtles.

If you need assistance with this document, please contact NOAA Fisheries at (808) 725-5000.

Outline

ENGAGE – Use Google Street View to explore the beach of Rose Atoll

EXPLORE – Watch some sea turtle videos and use observations from those videos to develop predictions and hypotheses.

EXPLAIN – Discuss the observation and compare and contrast sea turtles with other marine organisms.

ELABORATE – Introduce the satellite tagging research.

EVALUATE – Complete the turtle tracking worksheet.

Vocabulary

CARAPACE – the name of the shell of sea turtles, as well as crustaceans

CLUTCH – the eggs laid in a single nest by a sea turtle

OMNIVORE – an organism that eats both animals and plants

HERBIVORE – an organism that eats only plants

ANALOGOUS STRUCTURES – similar structures on different species that serve a related function but do not come from the same evolutionary origin. Examples include the flippers of sea turtles, dolphins, and penguins, or the wings of bats and birds.

Background Information

Rose Atoll, part of the territory of American Samoa, is the easternmost Samoan Island and the southernmost area that is part of the United States. In the Samoan language, the atoll is known as *Motu o Manu* or "Island of Seabirds" and *Nu'u o Manu* or "Village of Seabirds." One of the dominant reef-building species is coralline algae which gives the reef a pink hue. It is one of the world's smallest atolls and made up of Rose and Sand Islands. Despite the small size, the atoll is an important nesting ground for green sea turtles. Since the availability of undisturbed beaches for turtles to nest has been decreasing throughout the region, the isolation of Rose Atoll and the protection that it provides to the turtles is very valuable. Endangered hawksbill sea turtles are known to be present in the waters of the atoll as well, but it is not clear if they nest there as well.

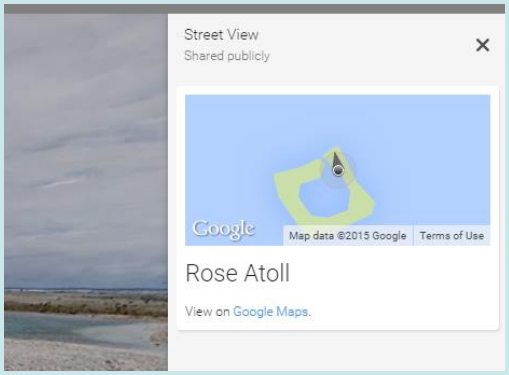
Green turtles mate in the lagoon and near-shore ocean and then will come ashore and lay 50-100 eggs. At Rose Atoll the breeding season is August through March; a female may lay five clutches of eggs in a season but will only nest every 4-5 years. It is estimated that 24 – 36 sea turtles nest annually on the atoll (Tuato'o-Bartley et al., 1993). Some other green turtle facts:

- They get their name from the color of their subdermal body fat.
- They grow to be 3 – 4 feet in length and can weigh 135 – 160 kgs.
- Adult sea turtles are herbivores; they eat only plants, including seagrasses.
- Juvenile sea turtles are omnivores and eat plants, like seagrasses, as well as animals, like crustaceans and worms.

Sea turtles have lived on Earth for roughly 100 million years. These reptiles evolved from land animals and the first sea turtles appeared in the late Jurassic period. Fossil records indicate the ancestors of the sea turtles could have been almost 4 meters long. Today there are seven species of sea turtles: leatherback, green, loggerhead, Kemp's ridley, hawksbill, flatback, and olive ridley. The leatherback is the largest of the sea turtles and the only one without a hard shell. Instead, it has a series of bony plates under its skin. Leatherbacks can grow to be 2 to 3 meters while the rest of the species are smaller and typically between 0.5 and 1.2 meters.

Preparation

- Familiarize yourself with the Google Street View of Rose Atoll
- Read through the background information on Rose Atoll
- Print out the Turtle Tracking worksheets



Learning Procedure

Engage

While sea turtles spend most of their lives at sea they come ashore to lay their eggs. The first challenge for a newly-hatched sea turtle is to make its way from the nest to the ocean. Open up Google Street View of the channel at Rose Atoll - https://www.google.com/maps/streetview/#remote-islands-of-the-world/rose-atoll. Acquaint your students with the orientation and what they are seeing; the overhead animation of the atoll in the top right corner of the screen shows which way the view is facing as it rotates around. It rotates from facing the inner lagoon, to the channel, and then open ocean (image at right). Let your students drive your exploration of the beach, and tell them to make some observations about what they see as you move around. Ask them to think about comparing and contrasting the ocean side of the atoll to the lagoon side and obstacles that turtles may face. Have them also think about issues that turtles may have when they mate in more populated areas. Light pollution from people can confuse hatchlings because they are attracted to light reflecting off the ocean. Fortunately, there is nothing at Rose Atoll that would cause light pollution. Note the abundance of birds in the air; even though adult sea turtles are large, hatchlings are only 5 centimeters long and weigh just 23 grams. Hatchlings are prey for seabirds while they make their way from the nest to the ocean. Once in the ocean they are vulnerable to seabirds and fish while still small. After you have "walked" around the beach for a while, ask you students close their eyes and think of what it would be like to be just 5 centimeters long and making your way from the nest to the ocean.

Mark Sullivan, NOAA

Note – if you do not plan on doing the other lessons on Rose Atoll which include Google Underwater View, take a moment to also explore the channel of Rose Atoll. The Channel at Rose Atoll, Google Underwater View. Even if you have already looked at this with your class you may want to look at it again briefly.

Explore

Today, despite advanced technology, one of our best tools we have as scientists is the power of observation. Pass out the turtle observation worksheets to your students. Depending upon their science background, they will have differing levels of understanding of the scientific method. Explain or remind your students about observations, questions, hypotheses and predictions and their role in scientific research. Watch some turtle videos. As you watch the videos have your students write down some observations about turtle behavior, movement, and other thoughts.

Suggested Sea Turtle videos

- NOAA – Endangered Ocean: Sea Turtles http://oceantoday.noaa.gov/endoceanseaturtles/
- NOAA – Saving Sea Turtles http://oceantoday.noaa.gov/savingseaturtles/
- NOAA Southwest Fisheries Science Center – Crittercam on Green Turtles (several short clips from a turtles perspective) https://swfsc.noaa.gov/textblock.aspx?id=11678&parentmenuid=448
- See Turtles – Sea Turtle Migration (good intro for turtle tracking worksheet) http://www.seeturtles.org/sea-turtle-migration/

You can find many more videos on the internet by searching sea turtle videos. When your students hand in their observations worksheets you should evaluate them on completeness, quality of observations, and correctly forming predictions and hypotheses.

Explain

Discuss some of the observations that your students made while watching the sea turtle videos. Compare and contrast sea turtles with other marine creatures. Some discussion suggestions include:

- What adaptations do sea turtles have that make them well-suited to live in the water?
    - Hydrodynamic shape allows them to move easily through the water, powerful flippers instead of legs like land turtles propel them through the water, and though they normally breathe several times an hour they can stay submerged for hours at a time.

- What other types of animals have those same features?
    - Marine mammals and fish are also typically have streamlined shapes and have developed fins or flippers to help them swim well. Marine mammals also have lungs like sea turtles, while fish use gills to breathe underwater.
- Do these similar features mean anything as far as relatedness between these animals?
    - No, the flippers of marine mammals like dolphins and the front flippers of sea turtles are an example of **convergent evolution**. Because the trait of flippers is advantageous when living in the aquatic environment, it arose separately in both mammals and reptiles that live in the ocean. Their flippers are an example of **analogous structures**.
    - Depending on your class age and focus, you can use this as an introduction into a greater conversation about evolution and genetics if you'd like.
- What other physiological features separate mammals and reptiles?

Mammals	**Reptiles**
Have hair or fur	Have scales
Most have three-chambered heart	All have four-chambered heart
Oviparous – lays eggs, little care of young	Viviparous – young develop internally, placenta, live birth, and high level of maternal care

- What features of Rose Atoll make it such a good nesting place for green sea turtles?
    - The atoll is relatively pristine and free from human impacts that can provide a challenge for nesting sea turtles.

Elaborate

One of the life history traits just discussed was that reptiles, like sea turtles, lay eggs. The only time that adult sea turtles come ashore is to lay eggs on the beach. Since they spend the rest of their lives at sea, following nesting patterns is one method to try and learn about sea turtles and put effort towards their conservation. All populations of sea turtles found in U.S. waters are listed under the Endangered Species Act, ten populations are endangered and six are threatened.

The NOAA Pacific Islands Fisheries Science Center has a Turtle Research Program dedicated to conducting scientific research on sea turtles with the goal of helping recover endangered populations. One of the ways that they conduct sea turtle research is by tracking turtles using satellite tags attached to their shells. There are on-going efforts by scientists to study sea turtles that have nested at Rose Atoll using satellite tags. Use the PowerPoint slide of a tagged turtle as a visual to briefly explain how the process of tagging and monitoring sea turtles works. Notes are found with the slides.

Evaluate

Pass out the turtle track maps and turtle tracking worksheet to your students. Students can work alone or in small groups.

Closing

Even though the land area of Rose Atoll is very small it is very important for the sea turtles that nest there. The pristine environment and lack of disturbance from people makes Rose Atoll and ideal place for turtle nesting. While it might be ideal for nesting, it does not have the preferred foraging habitat for green sea turtles which is why they migrate for food and return to nest.

Extending the Lesson

- Investigate more turtles that are being tracked with satellite tags http://www.conserveturtles.org/seaturtletracking.php?page=currentsatelliteturtles
- Investigate and map migratory routes of animals that pass nearby where you live. Where are they from and where are they going?

Connections to Other Subjects

- Ecology
- Biology
- Conservation

Related Links

Google Underwater View of Rose Atoll
NOAA Fisheries Rose Atoll
NOAA Fisheries Pacific Islands Regional Office

For More Information

NOAA Fisheries Pacific Islands Regional Office
NOAA Marine National Monument Program
1845 Wasp Blvd., Building 176
Honolulu, HI 96818
(808) 725-5000, (808) 725-5215 (fax) pirohonolulu@noaa.gov

Acknowledgement

This lesson is one in a series exploring the geology, biology, oceanography, and ecology of the Pacific Marine National Monuments. It was developed for the NOAA Fisheries Pacific Islands Regional Office.

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Thank you to all the reviewers for their feedback and assistance.

Education Standards

Next Generation Science Standards	• MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological ecosystem affect populations. • MS-ESS3-4. Construct an argument supposed by evidence for how increases in human population and per capita consumption of natural resources impact Earth's systems. • HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
Ocean Literacy Principles	• 1D. Sea level is the average height of the ocean relative to the land, taking into account the differences caused by tides. Sea level changes as plate tectonics cause the volume of ocean basins and the height of the land to change. • 5D. Ocean biology provides many unique examples of life cycles, adaptations, and important relationships among organisms (symbiosis, predator-prey dynamics, and energy transfer) that do not occur on land. • 5H. Tides, waves, predation, substrate, and/or other factors cause vertical zonation patterns along the coast; density, pressure, and light levels cause vertical zonation patterns in the open ocean. Zonation patterns influence organisms' distribution and diversity • 6D. Humans affect the ocean in a variety of ways. Laws, regulations, and resource management affect what is taken out and put into the ocean. Human development and activity leads to pollution (point source, nonpoint source, and noise pollution), changes to ocean chemistry (ocean acidification), and physical modifications (changes to beaches, shores, and rivers). • 6E. Changes in ocean temperature and pH due to human activities can affect the survival of some organisms and impact biological diversity. • 7E. Use of mathematical models is an essential part of understanding the ocean system.

Rose Atoll Marine National Monument: Turtle Observations

Name_____ Date_____

Even with all of the technology we have today, one of the best tools we have as scientists is our power of observation. Observations of the natural world are the first step of the scientific method, a process where observations and questions lead to creating and testing hypotheses. As you are watching the turtle videos, write down three observations about the actions and behavior of the turtles. Use those observations to think of questions and hypotheses and predictions about those questions.

Example:

1. **Observation** – anything interesting that you see while watching the turtles in action
   Sea turtles seem to
2. **Question** – formulate a question that you would like to answer to explain the observation you made
3. **Hypothesis** – your explanation to answer your question
4. **Prediction** – if your hypothesis is correct then you expect to see this result when you test it

First Observation

1. Observation:

2. Question:

3. Hypothesis:

4. Prediction:

Second Observation

1. Observation:

2. Question:

3. Hypothesis:

4. Prediction:

Third Observation

1. Observation:

2. Question:

3. Hypothesis:

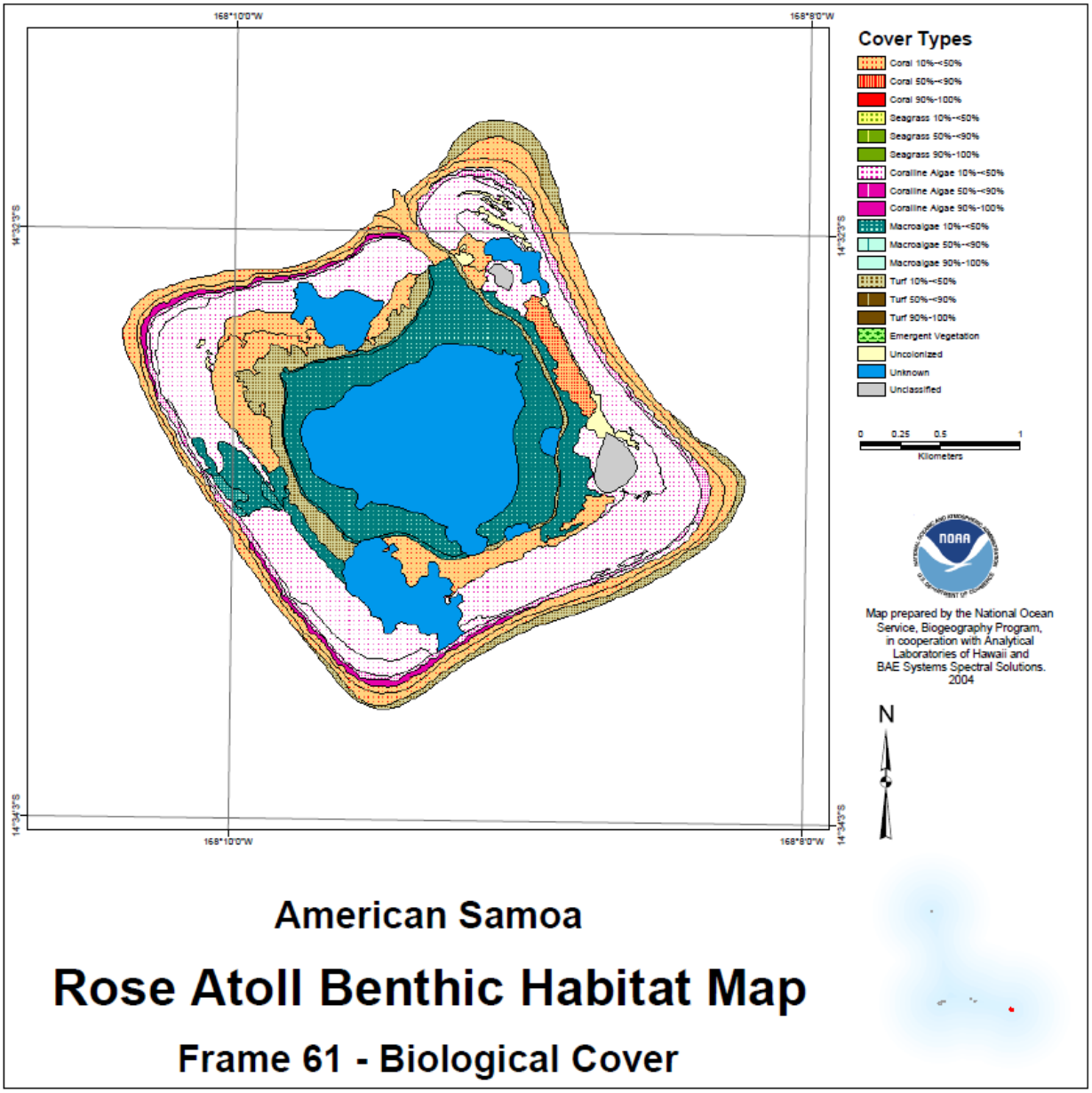
4. Prediction:

Any other observations or questions?

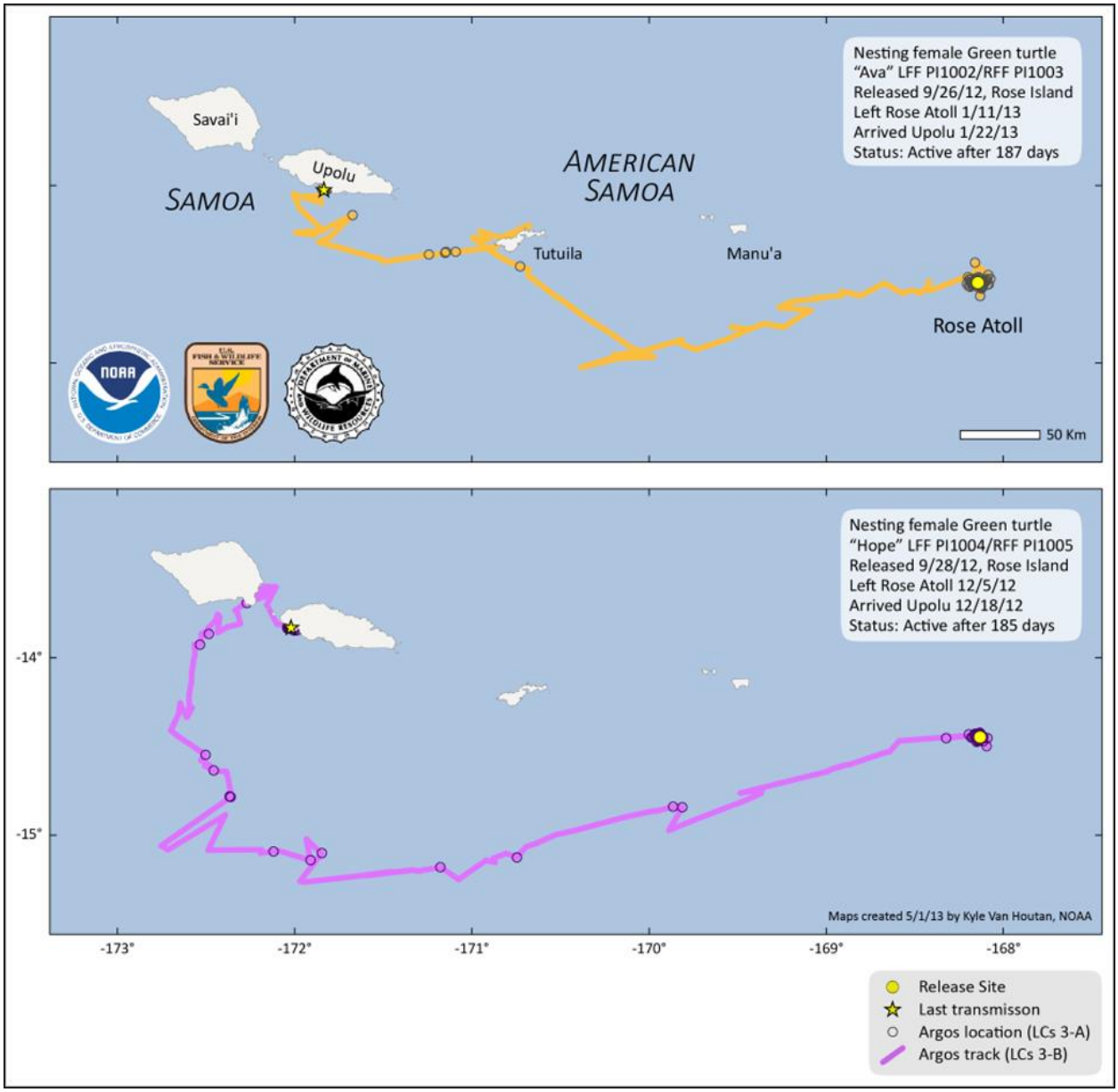
National Park Service and NOAA staff with a tagged green turtle at Rose Island, Manua, American Samoa. NOAA photo by Kyle Van Houtan.

Rose Atoll Marine National Monument: Turtle Tracking Maps

Turtle Tracking Maps



http://ccma.nos.noaa.gov/ecosystems/coralreef/us_pac_terr/html/maps/default.aspx



Satellite tracks from two green turtles leaving Rose Atoll National Wildlife Refuge, American Samoa. The turtles were tagged after nesting on Rose Island in September 2012.

http://www.pifsc.noaa.gov/qrb/2013_06/article_07.php

Rose Atoll Marine National Monument: Turtle Tracking

Name_____ Date_____

Rose Atoll provides valuable nesting beaches for sea turtles, but those same green sea turtles that nest on Rose Atoll do not stay in its waters all of the time. Since the 1990s sea turtles have been tracked during their migrations to and from feeding grounds and nesting beaches. Use the resources provided and what you have learned during the lesson to complete the following activity.

1. Use the provided information to fill in the blanks in the table below. This is real data from sea turtles that were tracked from Rose Atoll in the 1990s, the same research that continues today. Remember to pay attention to units.

Sea Turtle	Size (curved carapace length in cm)	Days before departure	Days in transit	Speed (km/h)	Distance	Endpoint
1	100.00	73	37	1.7		Fiji, Lau Group
2	107.0	48	30	2.0		Fiji, Vanua Levu
3	96.5	54	44	1.7		Fiji, Vanua Levu
4	100.0	93	53	2.2		French Polynesia
5	113.0	60	31	1.8		Fiji, Taveuni
6	104.5	72	35	1.8		Fiji, Vanua Levu
7	109.5	75	50	1.5		Fiji, Viti Levu
Average						

Data from P. Craig et al. / Biological Conservation 116 (2004) 433–438

2. Consider the Rose Atoll benthic habitat maps on the turtle tracking maps handout. Given the habitat types at Rose Atoll, create a hypothesis and prediction about why the green turtles migrate to other islands instead of just staying around the atoll.

3. Ava and Hope were two female green sea turtles tagged at Rose Atoll in 2012 after they nested on the atoll. Look at the map of their tracks to get information to answer the following questions.

	Days before Departure	Days in Transit	Speed (km/h)	Distance (km)	Endpoint
Ava					
Hope					
Average					

4. How did Ava and Hope compare to the averages of the turtles tracked in the 1990s?

Rose Atoll Marine National Monument: Turtle Tracking

We have learned that Rose Atoll provides valuable nesting beaches for sea turtles. But those same green sea turtles that nest on Rose Atoll do not stay in its waters all of the time. Sea turtles migrate to and from feeding grounds and nesting beaches and have been tracked since the 1990s. Use the resources provided and what you have learned during the lesson to complete the following activity.

1. Use the provided information to fill in the blanks in the table below. This is real data from sea turtles that were tracked from Rose Atoll in the 1990s, the same research that continues today. Remember to pay attention to units and round to the nearest whole number.

Sea Turtle	Size (curved carapace length) (cm)	Days before departure	Days in transit	Speed (km/h)	Distance	Endpoint
1	100.00	73	37	1.7	*1510*	Fiji, Lau Group
2	107.0	48	30	2.0	*1440*	Fiji, Vanua Levu
3	96.5	54	44	1.7	*1795*	Fiji, Vanua Levu
4	100.0	93	53	2.2	*2798*	French Polynesia
5	113.0	60	31	1.8	*1339*	Fiji, Taveuni
6	104.5	72	35	1.8	*1512*	Fiji, Vanua Levu
7	109.5	75	50	1.5	*1800*	Fiji, Viti Levu
Average	*104.4*	*68*	*40*	*1.8*	*1742*	

Data from P. Craig et al. / Biological Conservation 116 (2004) 433–438

2. Consider the Rose Atoll benthic habitat maps on the turtle tracking maps handout. Given the habitat types at Rose Atoll, create a hypothesis and prediction about why the green turtles migrate to other islands instead of just staying around the atoll.

Adult green sea turtles eat primarily seagrasses, a habitat that is not found at Rose Atoll. The turtles leave Rose Atoll in search of better foraging grounds in the islands that have better seagrass habitat.

Hypothesis: Sea turtles leave Rose Atoll in to head to places with better foraging grounds.

Prediction: If sea turtles leave Rose Atoll in search of food, then their final destination should have good foraging grounds.

3. Ava and Hope were two female green sea turtles tagged at Rose Atoll in 2012 after they nested on the atoll. Look at the map of their tracks to get information to answer the following questions.

	Days before Departure	Days in Transit	Speed (km/h)	Distance (km)	Endpoint
Ava	*108*	*11*	*3.2*	*About 850 km*	*Upolu, Samoa*
Hope	*69*	*13*	*2.7*	*About 850 km*	*Upolu, Samoa*
Average	*88.5*	*12*	*2.95*	*850*	

Distance will be a rough estimate given the scale on the map. Average speed with vary slightly with different distances.

4. How did Ava and Hope compare to the averages of the turtles tracked in the 1990s? All of those turtles were tagged in November, do you think that makes a difference in the data?

   Ava and Hope did not travel as far or long as the other turtles. Environmental conditions in those years may have affected the turtles' patterns or it could just be chance. Since the first turtle study was tagged later in the year it is not surprising that their average time before departure is shorter. Also, since Ava and Hope did not travel as far it is understandable that they might swim faster over that shorter distance.