NATIONAL CENTER FOR CASE STUDY TEACHING IN SCIENCE

Lost? Ask a Turtle: Navigation and Migration in Loggerheads

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Prelude

Loggerhead sea turtles hatch on the east coast of the United States. From the time they hatch to their death they are in constant migration, avoiding predators, feeding, and laying their eggs. Males rarely venture back onto land and females only do so when laying their eggs.

This case study outlines the lives of two loggerhead sea turtle hatchlings, Bro and Flo, and their epic journey that covers thousands of miles in the Atlantic Ocean.

Part I – Danger on the Beach

Narrator: It's dark and warm under the beach sand. Thousands of hatchling loggerhead turtles are about to emerge from under the cover of darkness on a beach in North Carolina. Little do they know of the dangers awaiting them, or how hard their first few days of life will be; that is, if they make it that far.

A hatchling turtle: "What's happening? Huh? Where am I? Boy is it warm and dark in here."

Another turtle: "Hey, keep it down over there, I'm trying to get out of this shell and I can't concentrate with you talking.

The first turtle: "Shell, what shell?"

The second turtle: "Dude, where have you been? Just formed or something? I guess so… My name is …. um, actually I don't have a name since I am a juvenile loggerhead turtle. Tell you what, call me Bro and I'll call you Flo."

Flo: "Where are we?"

Bro: "We are buried beneath a pile of sand on a beach. Don't ask me how, call it instinct, but I know that our mother laid us here two months ago and now we're ready to hatch. We have to dig ourselves out and quickly make our way to the sea."

Flo: "Why?"

Bro: "Didn't I just say not to ask me how? I can see that you and I will have to talk later. For now just do what I say and try and break through your shell—and hurry before you run out of air."

Flo: "Okay but it's hard. This is going to take some time."

Bro: "I didn't say it was going to be easy. Start pushing on the wall of your shell with your head. I did and I've made enough of a crack that I can see dirt."

… 10 hours later …

Bro: "I'm free. What about you Flo? Flo? Flo, where you?"

Flo: "Shhh, I'm right behind you. It's dark, remember? Let's head for the surface. Start digging upward."

Bro: "I'll lead the way, just stay close behind me."

Bro: "Hey Flo, I'm through. Now let me take a peek."

Narrator: The tiny turtle takes its first look at its environment above ground. Although it is 2am, there is a moonlit sky that illuminates the surface of the ocean to the east.

Bro: "Hey Flo. After I break through the sand, I think we should head towards the light, which is directly in front of us. I can see other creatures walking around out here. I don't like the look of this. It's a good thing that it's nighttime, perfect to make our escape. Now be very, very quiet and we should be ……"

Bro: "What's that rumbling noise?"

Flo: "That's the sound of other hatchling turtles digging through the dirt who don't seem to know that we need to make our way into the sea quietly."

Narrator: The noise intensifies.

Bro: "Oh no, our cover is blown. Flo, run for it! It's every turtle for himself or herself at this point. I'll see you in the ocean, I hope."

Photo 1. Hatchling Loggerhead sea turtles *(Caretta caretta).*

Question

1. How do hatchlings navigate to the ocean? Make a list of the dangers they face on their way along the beach. Search online databases such as PubMed and find journal articles for answers. Provide your references.

Narrator: Bro and Flo both make it into the ocean. Many other hatchlings were not so lucky. Researchers have discovered that once in the water, hatchlings swim toward deeper water.

Question

2. Read the article by Lohmann et al. (2008). Once in the water, how do Bro and Flo know to make their way out to sea? What mechanisms do researchers believe guide hatchlings toward deeper water?

Part II – A Slow Ride

Flo: "That was a close call. A lot of the other turtles never made it into the water. It was a massacre. I saw many of them being picked off one by one. Horrific, and this is only the first week!"

Bro: "I hear you. Come on, I have the urge to swim to deeper water. Let's go..

Flo: "Me too, but I have no idea how to get there."

Bro: "Something tells me we will find out soon. It will come to us. Just keep paddling."

Flo: "Even if we make it to deep water, then where do we go?"

Bro: "Like I said, something will come to us, just keep moving."

Photo 2. Swimming Loggerhead sea turtle.

Narrator: Once in deep water the turtles follow a set migratory pathway around the Sargasso Sea that takes them years to complete.

Questions

3. Using the lecture material and the paper by Lohmann et al. (2008), outline this migratory pathway in detail.
4. Once in the open ocean, how do hatchling loggerheads such as Bro and Flo migrate in the North Atlantic gyre? Does this differ from adult sea turtles? Describe the experiment used by researchers to come to this conclusion.

Narrator: With a maximum swimming speed of about ½ mile per hour and unable to dive at this early stage in their development, hatchlings are easy prey for any passing flying or swimming predator. Most do not survive. Research has shown that only about 1 in 4,000 Florida hatchlings survive to reach adulthood. We now pick up their story when the turtles are six years of age.

Flo: "Hey Bro, I can dive. It's great how we only have to come to the surface for just a few seconds every five minutes or so to breathe. It makes being eaten much more difficult. I had a close call though earlier today."

Bro: "Wow, what happened?"

Flo: "Well, I was coming up for air and this huge bird swooped down on me and tried to carry me off. Must have thought I was an easy meal. I showed him though. I am now large and heavy enough and not so easy to swallow. I fought him off with my sharp mouth."

Bro: "I hear you Flo. When I come up for air during the day I see a lot of birds flying overhead. Do you have any idea where they go, or how they got this far out in the ocean in the first place?"

Flo: "Sorry Bro, I can't help you."

Bro: "I wonder how they navigate this far out to sea?"

Question

5. Help answer Bro's question by reading the paper by Nevitt & Bonadonna (2005). Research has shown that birds might use environmental markers such as dimethyl sulphide (DMS) to navigate. What produces DMS? Briefly describe the methodology used by Nevitt and Bonadonna to determine whether birds can detect DMS. In what oceans and regions have DMS concentrations been measured?

Narrator: Birds are not the only form of life that the turtles encounter on their epic journey.

Bro: "Sorry to hear about the predation mishap Flo. Last week I was minding my own business, swimming slowly as usual, when two fast swimming seals darted in front of me. I lost my balance and started spinning uncontrollably. They are incredibly fast and seem to have no regard for slow moving swimmers like you and me. I would swear that one of them even tried to bite me as he passed. He must have thought I was meal, just like that bird you encountered."

Questions

6. Examine other transoceanic migrators such as seals. Why do researchers think that seals use visual cues to navigate?
7. Why did the researchers discount the possibly of geomagnetic, celestial, acoustic, and olfactory cues as navigational tools in seals?

Narrator: By now you will have gathered that many animals navigate in the open ocean and that it is far more challenging than migrating on land.

Question

8. Describe the challenges faced by sea migrants such as birds and marine mammals and how they differ from land migrants.

Part III – Egg-Laying Time

23 years later after their initial hatching.

Narrator: The turtles live out the rest of their lives in the ocean, with females only coming onto land every few years after mating to lay their eggs.

Photo 3. Loggerhead sea turtle laying eggs in nest.

Narrator: Interestingly, Flo makes her way to the same beach she hatched on at night. She digs a hole, deposits her eggs, and covers them back up with sand and dirt. She then heads safely into the water.

This cycle will continue for another 20 or so years or until she dies. Thus is the life of a sea turtle.