

# Lab 12. Explanations for Animal Behavior: Why Do Great White Sharks Travel Over Long Distances?

## Introduction

Shark populations worldwide are declining in areas where they were once common. As a result, the International Union for Conservation of Nature (IUCN), has classified many species of shark as threatened with extinction. One species of shark that is currently on the IUCN “Vulnerable” list is the great white shark (*Carcharodon carcharias*). The great white shark is found in coastal surface waters of all the major oceans. It can grow up to 6 m (20 ft.) in length and weigh nearly 2,268 kg (5,000 lb). The great white shark reaches sexual maturity at around 15 years of age and can live for over 30 years. Great white sharks are apex predators (see the figure to the right).

A great white shark



An apex predator is an animal that, as an adult, has no natural predators in its ecosystem and resides at the top of the food chain. These sharks prey on marine mammals, fish, and seabirds.

Great white shark conservation has become a global priority in recent years. However, our limited understanding of their behavior has hindered the development of effective conservation strategies for this species. For example, little is known about where and when great white sharks mate, where they give birth, and where they spend their time as juveniles. We also know that some great white sharks travel long distances, such as from Baja California to Hawaii or from South Africa to Australia, but we do not know why they make these journeys. There are, however, a number of potential explanations that have been suggested by scientists. For example, great white sharks might travel long distances because they need to do one or more of the following:

- Find and establish a territory (an area that they defend that contains a mating site and sufficient food resources for them and their young) once they reach sexual maturity or after losing a territory to other great white sharks.
- Migrate between a foraging site and a mating site on an annual or seasonal basis.
- Forage for food—slowly traveling over long distances allows the sharks to find, capture, and consume new sources of food along the way without expending a great deal of energy.
- Find a foraging site with other sharks in it and cooperate with them to capture prey and minimize the amount of energy required to capture and consume food.
- Follow their prey as the prey migrates on an annual or seasonal basis.
- Move between several different foraging areas because they quickly deplete their food source in a given area and must move onto new foraging areas to survive.

All of these potential explanations are plausible because they can help a great white shark survive longer or reproduce more. It is difficult, however, to determine which of these potential explanations is the most valid or acceptable because we know so little about the life history and long-range movements of the great white shark. Most research on this species has been carried out at specific aggregation sites (such as the one near Dyer Island in South Africa). Although this type of research has enabled scientists to learn a lot about the feeding behaviors and short-range movements of the great white shark, we know very little about how they act in other places. A group called OCEARCH ([www.ocearch.org](http://www.ocearch.org)), however, is trying to facilitate more research on their life history and long-range movements so people can develop better conservation strategies to help protect the great white shark.

This group of researchers has been catching and tagging great white sharks to document where they go over time. To tag and track a great white shark, OCEARCH places a SPOT tag on the shark’s dorsal fin. These tags emit a signal that is picked up by global positioning satellites. Unfortunately, the signal can only be detected when the shark’s dorsal fin breaks the surface of the water and a satellite is directly overhead. Researchers at OCEARCH call these signals “pings.” The time span between pings can vary a great deal (from once an hour to once in a three-week period) because of individual shark behavior and the orbit of a satellite.

OCEARCH has created the Global Shark Tracker database ([www.ocearch.org](http://www.ocearch.org)) and a companion app for mobile devices (visit the Apple App Store or Google Play to download the free app) to share the real-time data they collect (see the figure below). This database allows users to see the current location of all the sharks that the OCEARCH researchers have tagged. It also allows users to track the movement of each shark over time. Users can also search for sharks by name, sex (male or female), and stage of life (mature or immature).

**A screen shot of Global Shark Tracker from the OCEARCH website**



## Your Task

Use the OCEARCH Global Shark Tracker database to identify patterns in the long-range movements of the great white shark, and then develop an explanation for those patterns.

The guiding question of this investigation is, **Why do great white sharks travel over long distances?**

## Materials

You will use an online database called Global Shark Tracker to conduct your investigation. You can access the database by going to the following website: [www.ocearch.org](http://www.ocearch.org).

## Safety Precautions

1. Use caution when working with electrical equipment. Keep away from water sources in that they can cause shorts, fires, and shock hazards. Use only GFI-protected circuits.
2. Wash hands with soap and water after completing this lab.
3. Follow all normal lab safety rules.

## Getting Started

Your first step in this investigation is to learn more about what is already known about the great white shark. To do this, check the following websites:

- Animal Diversity Web ([http://animaldiversity.ummz.umich.edu/accounts/Carcharodon\\_carcharias](http://animaldiversity.ummz.umich.edu/accounts/Carcharodon_carcharias))
- MarineBio (<http://marinebio.org/species.asp?id=38>)
- The Smithsonian National Museum of Natural History Ocean Portal (<http://ocean.si.edu/great-white-shark>)

You can then use the OCEARCH Global Shark Tracker database to identify patterns in the long-range movement of great white sharks. To accomplish this task, it is important for you to determine what type of data you will need to collect and how you will analyze it.

To determine *what type of data you will need to collect*, think about the following questions:

- What data will you need to determine if there are patterns in the long-range movements of great white sharks?
- What data will you need to determine if there are sex-related, age-related, or geographic region-related differences in the long-range movements of great white sharks?

To determine *how you will analyze your data*, think about the following questions:

- How can you identify a pattern in the ways great white sharks move over long distances?
- How can you determine if there are patterns in the way great white sharks move over long distances based on sex, age, or geographic region?
- What type of table or graph could you create to help make sense of your data?

Once you have identified patterns in the ways great white sharks move over long distances, you will then need to develop an explanation for those patterns. You can develop one of your own or see if one of the explanations outlined in the “Introduction” section of this investigation is consistent with the patterns you identified. These explanations stem from what scientists know about the behavior of other animals and reflect some of the theories that scientists currently use to explain animal behavior.

**Investigation Proposal Required?**    Yes         No

### **Connections to Crosscutting Concepts and to the Nature of Science and the Nature of Scientific Inquiry**

As you work through your investigation, be sure to think about

- the importance of identifying patterns,
- the importance of identifying the underlying cause for observations,
- the importance of examining proportional relationships,
- how scientific knowledge can change over time, and
- how the methods used by scientists depend on what is being studied and the research question.

### **Argumentation Session**

Once your group has finished collecting and analyzing your data, prepare a whiteboard that you can use to share your initial argument. Your whiteboard should include all the information shown in the figure to the right.

To share your argument with others, we will be using a round-robin format. This means that one member of your group will stay at your lab station to share your group’s argument while the other members of your group go to the other lab stations one at a time to listen to and critique the arguments developed by your classmates.

The goal of the argumentation session is not to convince others that your argument is the best one; rather, the goal is to identify errors or instances of faulty reasoning in the arguments so these mistakes can be fixed. You will therefore need to evaluate the content of the claim, the quality of the evidence used to support the claim, and the strength of the justification of the evidence included in each argument that you see. In order to critique an argument, you will need more information than what is included on the whiteboard. You might, therefore, need to ask the presenter one or more follow-up questions, such as:

- Why did you decide to focus on those data?

### **Argument presentation on a whiteboard**

The Guiding Question:	
Our Claim:	
Our Evidence:	Our Justification of the Evidence:

- What did you do to analyze your data? Why did you decide to do it that way? Did you check your calculations?
- Is that the only way to interpret the results of your analysis? How do you know that your interpretation of your analysis is appropriate?
- Why did your group decide to present your evidence in that manner?
- What other claims did your group discuss before you decided on that one? Why did your group abandon those alternative ideas?
- How confident are you that your claim is valid? What could you do to increase your confidence?

Once the argumentation session is complete, you will have a chance to meet with your group and revise your original argument. Your group might need to gather more data or design a way to test one or more alternative claims as part of this process. Remember, your goal at this stage of the investigation is to develop the most valid or acceptable answer to the research question!

## **Report**

Once you have completed your research, you will need to prepare an investigation report that consists of three sections that provide answers to the following questions:

1. What question were you trying to answer and why?
2. What did you do during your investigation and why did you conduct your investigation in this way?
3. What is your argument?

Your report should answer these questions in two pages or less. This report must be typed, and any diagrams, figures, or tables should be embedded into the document. Be sure to write in a persuasive style; you are trying to convince others that your claim is acceptable or valid!