



Where Are the Whales?

Teacher Guide

Students interpret maps and Argos satellite tracking data to locate where blue whales are found and make recommendations for how to help keep whales safe.

Grade Level: Upper elementary

Learning Objectives

- Students learn where the most blue whales are in the northeast Pacific by interpreting maps of whale habitat and the locations of blue whales tracked with Argos satellite tags.
- Students recommend which times of year ships should slow down to keep whales safe.

Educational Standards

- NGSS 5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

Time:

- 50 minutes

Materials

- Projector and computer with Internet access
- *Where Are the Whales? Student Page* pages 5-6
- *Tracked Blue Whales Map* page 7
- *Whale Habitat Maps* pages 8-9
- Video: *A Voice for Whales: Using Satellite Data to Protect Marine Mammals* <https://www.youtube.com/watch?v=B9uGFvBBfqk>
- Video: *Argos-4: Tracking from Space* https://www.youtube.com/watch?v=aBc_MeKRMNc
- Video: *Blue Whales Lunge for Dinner* <https://www.youtube.com/watch?v=cbxSBDopVyw>

Preparation

- Prepare to project the *Tracked Blue Whales Map* and videos.
- Place *Whale Habitat Maps* at stations around the classroom (either printed or on computers/tablets).
- Print student pages.

Directions

Introduction

1. Introduce the lesson by asking students what they know about whales. If it's not mentioned, add that whales are marine mammals and are very large. The largest whale (and the largest animal on Earth) is the blue whale. Tell students that blue whales may be huge, but they need our help to stay safe.
2. To learn about problems that blue whales face and how people are helping to keep them safe, have students watch two videos:
 - From 0:28 to 3:28 min of the video, *A Voice for Whales: Using Satellite Data to Protect Marine Mammals*
 - The three-minute video, *Argos-4: Tracking from Space*, explains how satellites are used to track animals, including whales.
3. Sensemaking:
 - Ask students to define the problem. (Whales are getting hit by ships and tangled in nets.)
 - Ask how people are trying to solve the problem. Two solutions are mentioned in the videos:
 - People are tracking whales to know where they are so that ships can avoid them.
 - They are finding blue whale habitats so that ships can avoid those areas or slow down.
 - Tell students that in this lesson, they will explore maps of tracked whales and blue whale habitat and figure out when and where blue whales need our help.



Part 1: Where Are the Whales?

1. Project the *Tracked Blue Whales Map*.
 - Orient students to the geography (the Pacific Ocean and the U.S. West Coast) and explain that this map shows where blue whales tagged with Argos satellite tags swam. If the geography is unfamiliar, you may wish to project a map of the world and indicate the NE Pacific region to provide context.
 - Ask students what they notice about this map. (They may notice that a few whales have unique paths, but most travel close to the coast. Also, the whales travel roughly north and south. Some students might recognize that the whales are migrating.)
 - Have the class create a question about the whale paths and why the whales stay in this part of the ocean. Write the question on the board. (Students will be exploring the answer to this question in the next part of the activity.)

Part 2: Find the Blue Whale Habitat.

1. Show students the National Geographic video, *Blue Whales Lunge for Dinner* (90 seconds).
 - The brownish clouds in the water are krill (small shrimp-like animals). An adult blue whale needs to eat 40 million krill each day. They spend a lot of time finding and eating krill.
 - Researchers tracking blue whales found that each “meal” lasts more than 3 hours. In locations with lots of krill, blue whales eat all day long.
2. Tell students that, in order to predict when the whales are, scientists made maps of whale habitat.
 - Explain that an animal’s habitat includes what it needs to survive. Blue whales need krill, so a good blue whale habitat has lots of krill. Krill live in warmer water where there are lots of phytoplankton, which they eat. Places in the ocean that are not good blue whale habitat have colder water, less phytoplankton, and less krill.
 - Scientists track ocean temperature and phytoplankton using satellites and then map the information to show places that have good blue whale habitat. They’ve found that the amount of whale habitat in this region changes throughout the year.
3. Introduce the map analysis activity.
 - Hand out the student page and show students the map stations around the classroom.
 - Tell students that they are going to look at maps of whale habitat in the Pacific from each month to answer the question: At what time of year are the most blue whales near the west coast of the United States?
 - Introduce students to the habitat map key. (Orange and red colors indicate good habitat. Green and blue colors indicate poor habitat.)
4. Allow students time to rotate between map stations and record their observations and predictions.
 - On their student page, they will record their observations about the habitat in each map and then make a prediction about the amount of blue whales. (Student observations of habitat will differ depending on the month, but should include whether there is good or poor habitat for blue whales.)
5. Return to the question that students developed during Part 1 about why whales stay in this part of the ocean. Ask students to answer the question based on what they saw in the maps. (Students should recognize that whales stay near the coast because that’s where they can find good habitat.)

Part 3: Keep Blue Whales Safe.

1. Indicate the locations of Los Angeles and San Francisco on a habitat map. There are a lot of large ships that come and go from those ports.
2. Tell students that the research shows when ships slow down (to under 10 knots or 11.5 mph, which is less than half the top speed of most container ships), there is less danger to whales.
3. **Ask students:** What time of year should ships in this area travel slower? Have students write their answers as an exit ticket so that you can assess their understanding of the maps and how whales migrate seasonally with habitat.
 - Based on their analysis of the habitat maps, students should know that there would be the most whales on the West Coast of the United States between May and November. Requirements to keep ships at slow speeds during those months are a good idea.



Extensions:

- Have students make posters to communicate to ships how they can slow down to keep whales safe and when the best time of year is to go slow.
- Have students explore the Whale Safe interactive map to learn about the Santa Barbara channel, which is both a whale habitat and a shipping channel. <https://whalesafe.com/explore-the-problem/>
- Have students investigate the WhaleWatch website: <https://www.fisheries.noaa.gov/west-coast/marine-mammal-protection/whalewatch>

Background

About Blue Whales

Blue whales are the largest of all whale species. They weigh as much as 400,000 pounds. Even baby blue whales are large, weighing about 8,000 pounds as newborns, which is about as heavy as an average adult elephant. They may be the largest animal to ever live on Earth. From head to tail, blue whales are longer than long-necked sauropod dinosaurs and they are much heavier.

Like all baleen whales, they filter seafood from water using a special structure in their jaws called baleen. While other baleen whales eat all the seafood they filter, blue whales typically only eat shrimp-like crustaceans called krill. Because blue whales are so large, they need a krill.

Human Threats To Blue Whales And What's Being Done to Help

Blue whales are an endangered species. There are between 5,000 and 15,000 blue whales living in the ocean, which is a fraction of what the population was before whales were hunted. However, hunting whales (also called whaling) is banned in most countries, and the population has been increasing in recent years. Whales still face other threats. The table below outlines threats to blue whales and efforts to help solve these problems.

Threats	Solutions
<ul style="list-style-type: none"> • Ship strikes: Collisions with ships are often deadly for whales. Because whales are typically at or near the sea surface, they are in harm's way. Blue whales are particularly vulnerable because they stick close to shore. 	<ul style="list-style-type: none"> • Track whales and the habitat they prefer to understand the seasonal patterns. • Have ships avoid areas with whales and/or travel more slowly. • Sailors can keep a lookout for whales at the bow of the ship.
<ul style="list-style-type: none"> • Noise: Whales are sensitive to noise pollution because they rely on hearing to communicate with other whales, find food, and navigate. 	<ul style="list-style-type: none"> • Most noise pollution comes from ships, so the same solutions listed above for ship strikes will help with noise pollution.
<ul style="list-style-type: none"> • Fishing gear: whales can get tangled in fishing nets or fishing lines and have no way to get out. Being tangled in nets and lines can restrict a whale's ability to swim and find food. It can also harm the whale over time. 	<ul style="list-style-type: none"> • Workshops help people learn about entanglement issues. • Changes in fishing technology could minimize the amount of fishing line that ends up in the water.

Steps To Help Whales Off The U.S. West Coast

Ships traveling to and from busy ports on the U.S. West Coast, such as those in Los Angeles and Oakland, are dangerous to blue whales, whose habitat extends along the coast during the summer and fall months. Thousands of commercial ships, such as container ships, travel through this area each year. Between 2007 and 2011, nine blue whales were killed, and one was severely injured by ships off the California coast.

Researchers studying whales and ships in this area found that when ships travel at slower speeds and avoid areas with the highest probability of blue whales, there's less risk of collisions. In recent years, shipping lanes have been narrowed and adjusted to avoid the areas with the most whales, and programs that encourage ships to slow down have helped.

WhaleWatch, a project funded by NASA and coordinated by NOAA, is working to help keep blue whales in the northeast Pacific near the U.S. West Coast safe. Several technologies are used to create maps showing where blue whales are likely to be found. In this activity, students explore maps of data collected with these technologies.



- The map of tracked whale paths that students analyze in Part 1: Where Are the Whales? was created by scientists at NOAA and Oregon State University with data about the locations of whales with Argos satellite tags.
- The monthly maps of habitat that students analyze in Part 2: Find the Blue Whale Habitat were created by NASA and NOAA based on data from satellites that take measurements from the ocean, such as the sea surface temperature and chlorophyll (which indicates how much plankton is in the water). These maps are created daily from satellite data. To simplify the data analysis, students look at the map from the 15th of each month so that they can focus on the annual pattern. The maps in this lesson include 2016 data.

Links To Learn More

- Argos celebrates World Whale Day (<https://www.argos-system.org/argos-celebrates-world-whale-day/>)
- WhaleWatch (<https://www.fisheries.noaa.gov/west-coast/marine-mammal-protection/whalewatch>)
- Argos Tracking from Space video (https://youtu.be/aBc_MeKRMNc)
- Blue whale information from the NOAA Fisheries Species Directory (<https://www.fisheries.noaa.gov/species/blue-whale>)
- Blue whale information at the International Union for Conservation of Nature's Red List of Threatened Species (<https://www.iucnredlist.org/species/2477/156923585>)
- Blue Whale Hot Spots (NOAA Fisheries) (<https://www.fisheries.noaa.gov/west-coast/marine-mammal-protection/blue-whale-hot-spots>)

NOAA and CNES have been partners in the Argos data collection system since 1978. For NOAA's latest contribution to the Argos system, NOAA has partnered with CNES to host their Argos-4 instrument aboard a commercial satellite. NOAA is working with USSF to utilize their hosted payload solutions contract and selected General Atomics and their Orbital Ted Bed-3 satellite to host the Argos-4 instrument.

This activity was developed at the UCAR Center for Science Education as an outreach effort of the Argos program under award NA21OAR4310383 from the National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Commerce. The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of NOAA or the U.S. Department of Commerce.

Name: _____



Student Activity Sheet

Where Are the Whales?

Question: At what time of year are the most whales off the west coast of the United States?

Month	Observations of whale habitat on the map (Is there good habitat?)	Predictions about the amount of blue whales
January		<input type="checkbox"/> None <input type="checkbox"/> Few whales <input type="checkbox"/> Some whales <input type="checkbox"/> Lots of whales
February		<input type="checkbox"/> None <input type="checkbox"/> Few whales <input type="checkbox"/> Some whales <input type="checkbox"/> Lots of whales
March		<input type="checkbox"/> None <input type="checkbox"/> Few whales <input type="checkbox"/> Some whales <input type="checkbox"/> Lots of whales
April		<input type="checkbox"/> None <input type="checkbox"/> Few whales <input type="checkbox"/> Some whales <input type="checkbox"/> Lots of whales
May		<input type="checkbox"/> None <input type="checkbox"/> Few whales <input type="checkbox"/> Some whales <input type="checkbox"/> Lots of whales
June		<input type="checkbox"/> None <input type="checkbox"/> Few whales <input type="checkbox"/> Some whales <input type="checkbox"/> Lots of whales
July		<input type="checkbox"/> None <input type="checkbox"/> Few whales <input type="checkbox"/> Some whales <input type="checkbox"/> Lots of whales
August		<input type="checkbox"/> None <input type="checkbox"/> Few whales <input type="checkbox"/> Some whales <input type="checkbox"/> Lots of whales



Month	Observations of whale habitat on the map (Is there good habitat?)	Predictions about the amount of blue whales
September		<input type="checkbox"/> None <input type="checkbox"/> Few whales <input type="checkbox"/> Some whales <input type="checkbox"/> Lots of whales
October		<input type="checkbox"/> None <input type="checkbox"/> Few whales <input type="checkbox"/> Some whales <input type="checkbox"/> Lots of whales
November		<input type="checkbox"/> None <input type="checkbox"/> Few whales <input type="checkbox"/> Some whales <input type="checkbox"/> Lots of whales
December		<input type="checkbox"/> None <input type="checkbox"/> Few whales <input type="checkbox"/> Some whales <input type="checkbox"/> Lots of whales

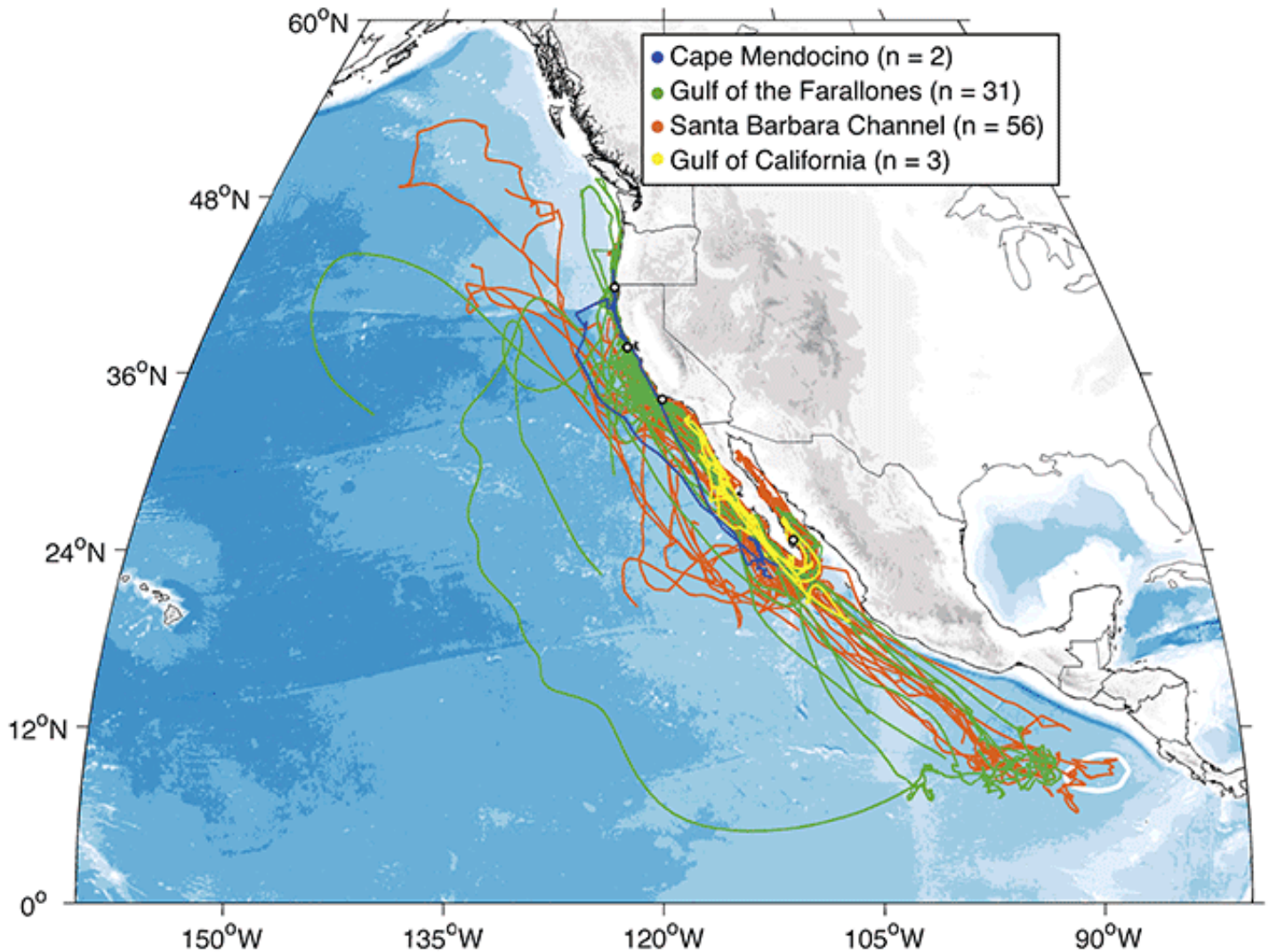
1. During which months do you predict that there would be the highest number of blue whales near the U.S. West Coast?

2. During which months do you predict that there would be the lowest number of blue whales near the U.S. West Coast?



Tracked Blue Whales Map

Part 1: Where Are the Whales?



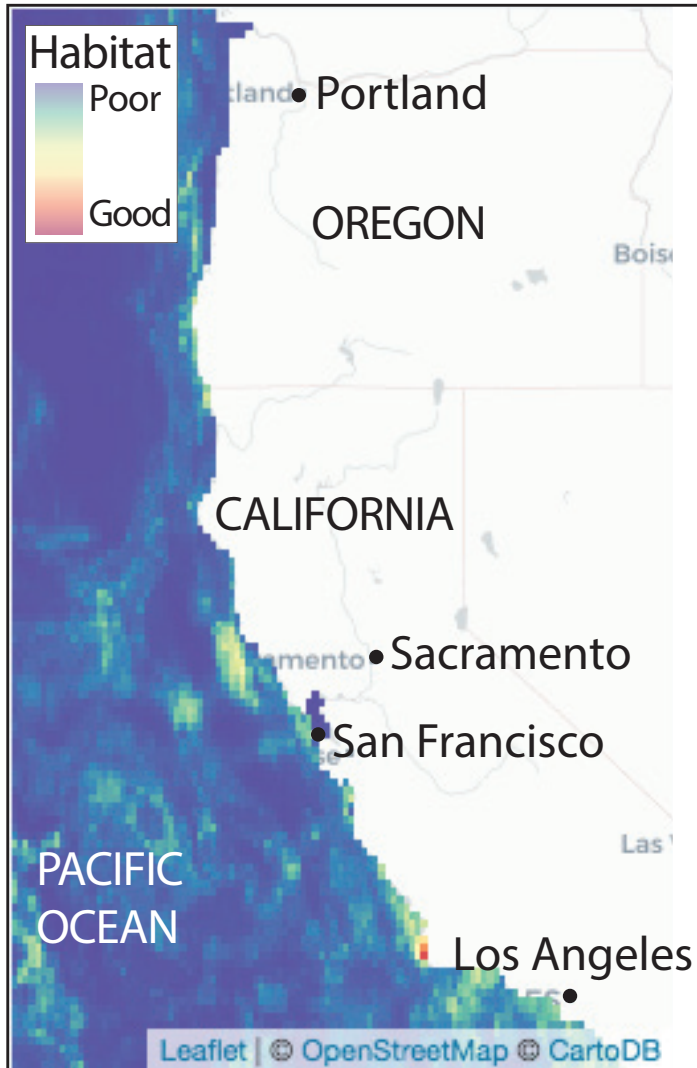
The map above shows blue whale tracks in the northeast Pacific Ocean. Scientists at NOAA and the Marine Mammal Institute (at Oregon State University) attached Argos satellite tags to blue whales off the coast of California and in the Gulf of California between 1994 and 2007. They tracked 92 whales via satellites. The colors in the map above relate to where whales were tagged (multiple whales were tagged at each location).



Whales Habitat Maps

Part 2: Where Are the Whales?

January



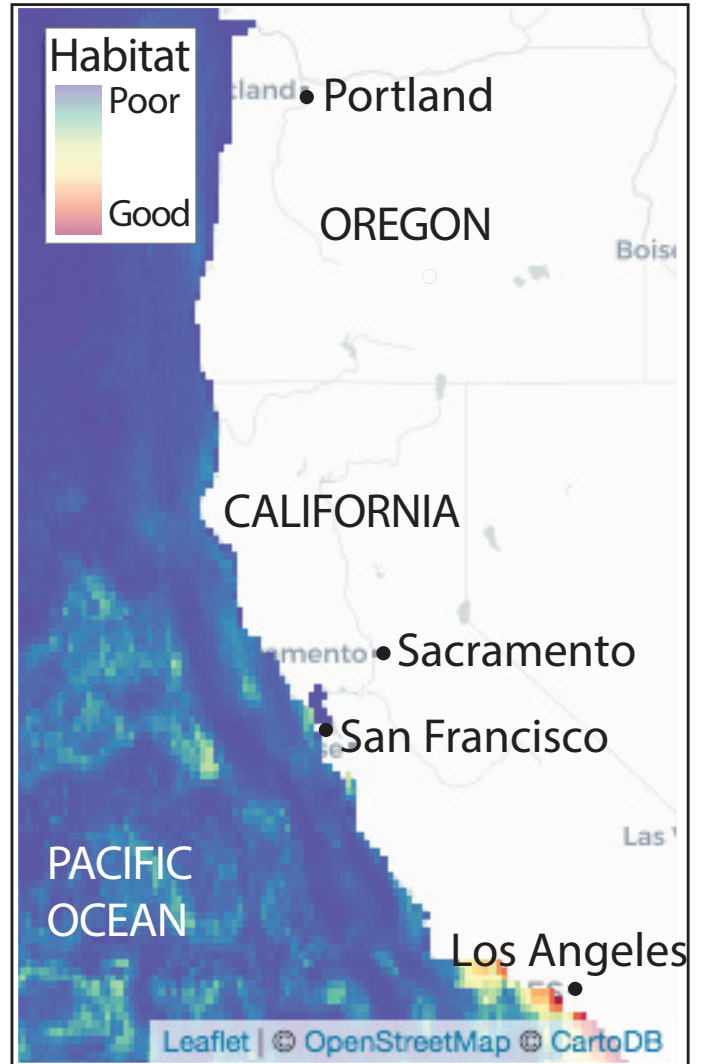
February





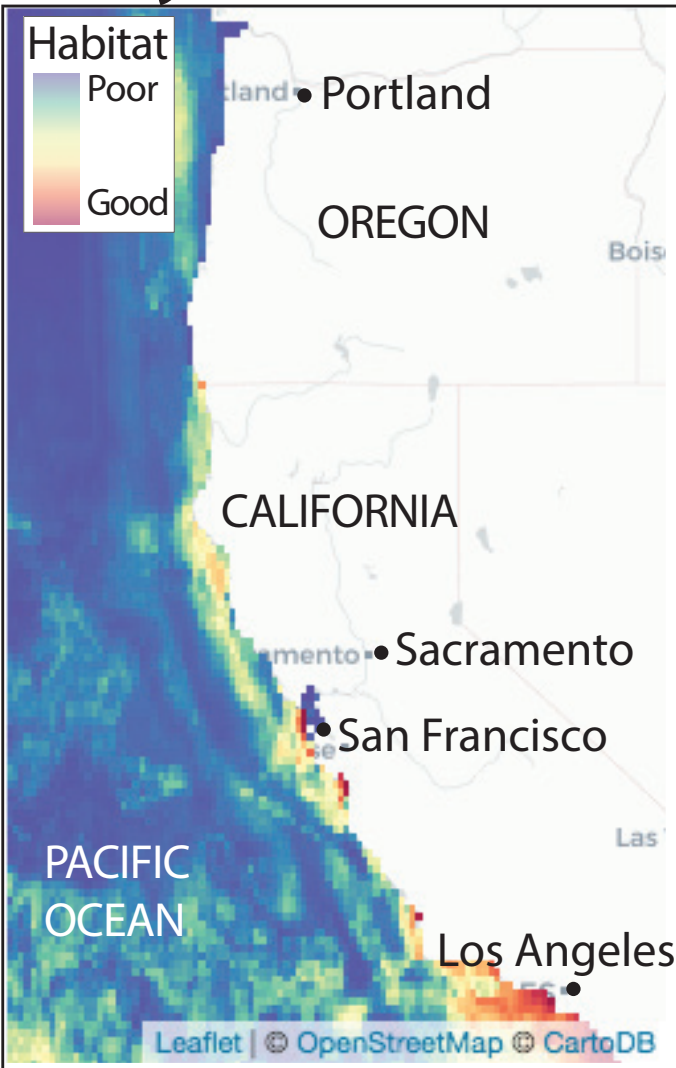
March

April

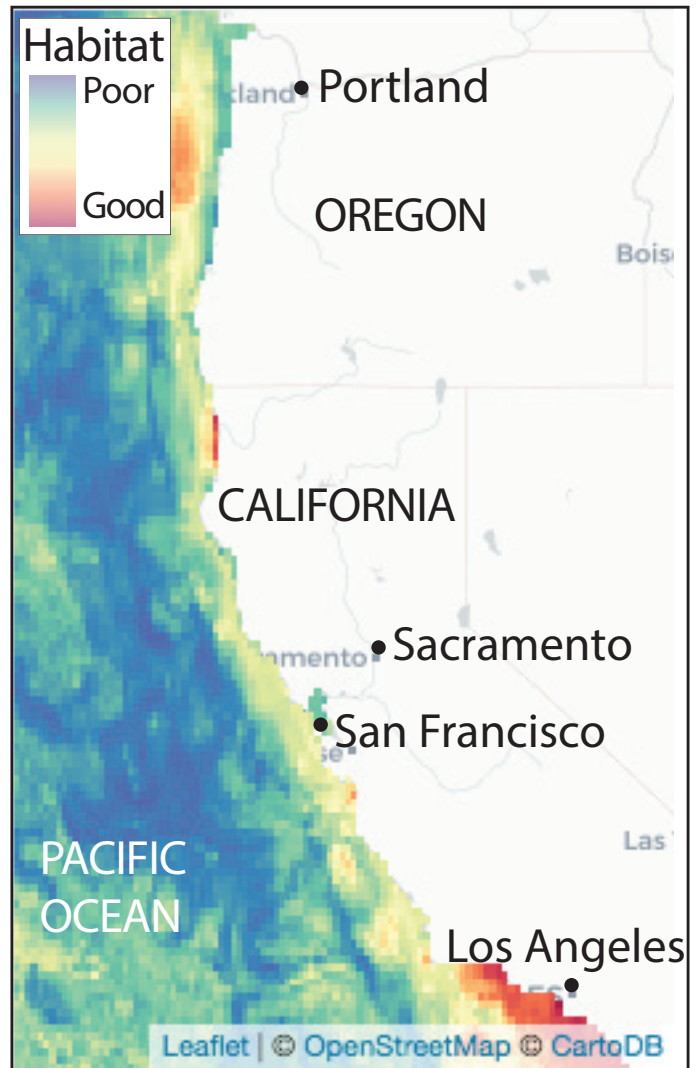




May



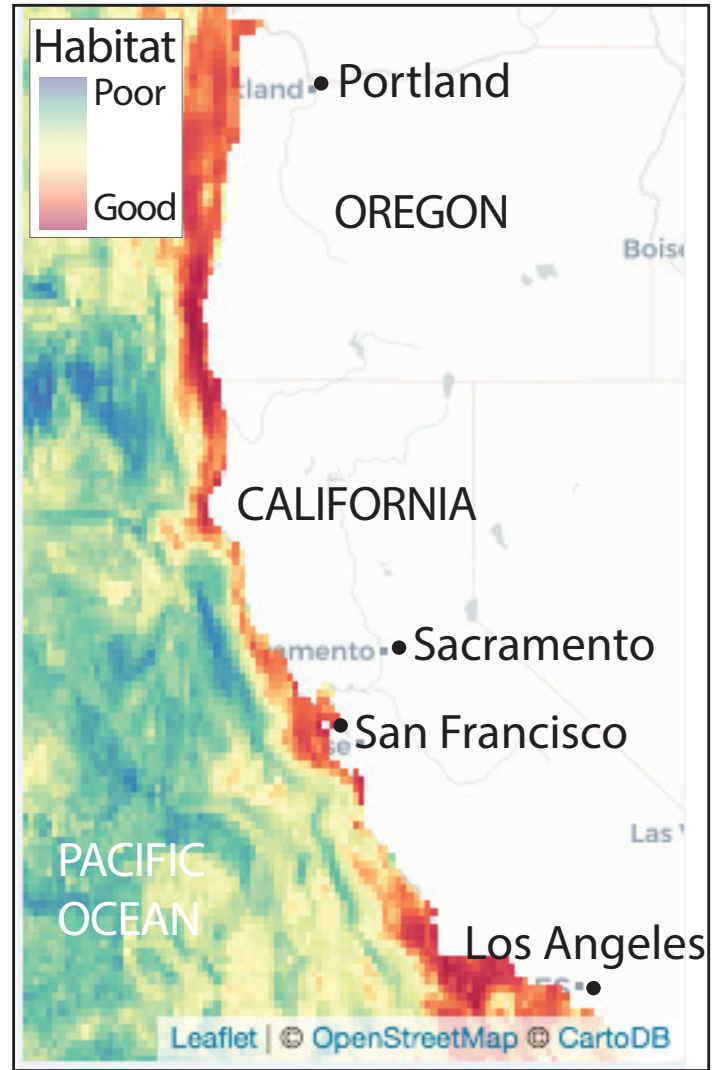
June





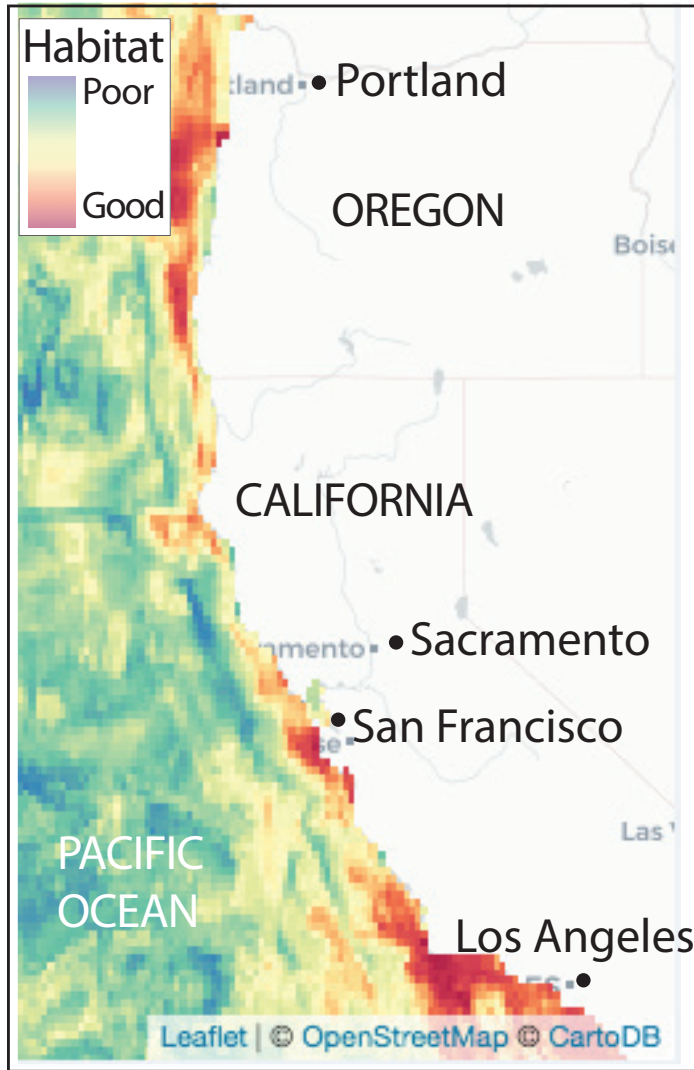
July

August

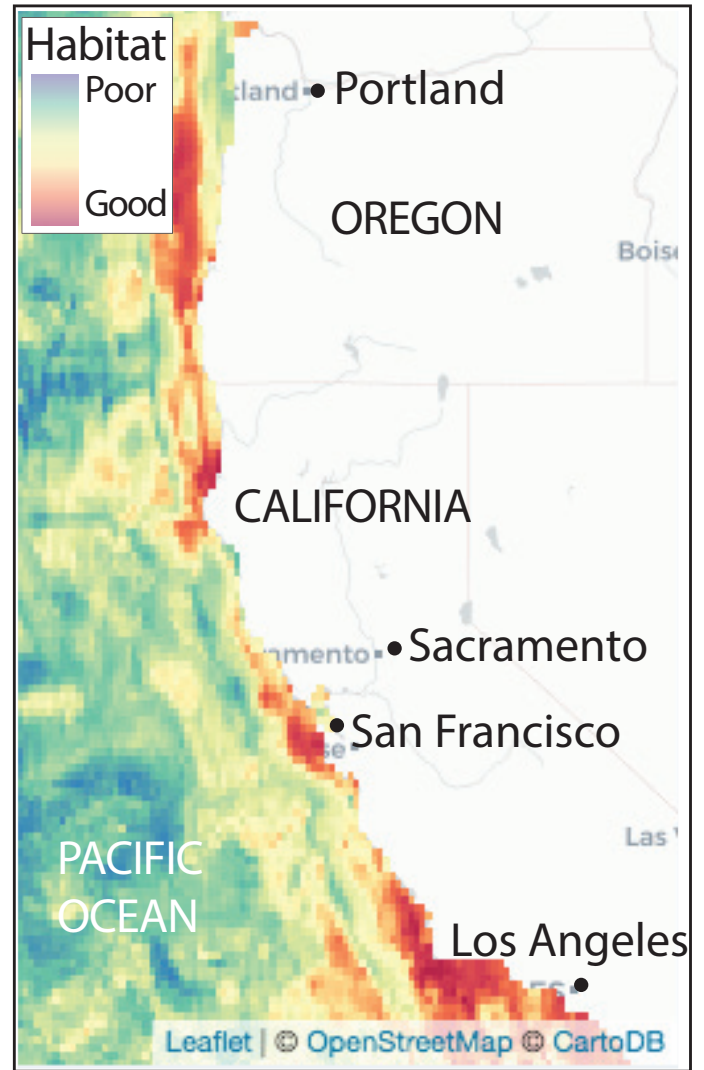




September

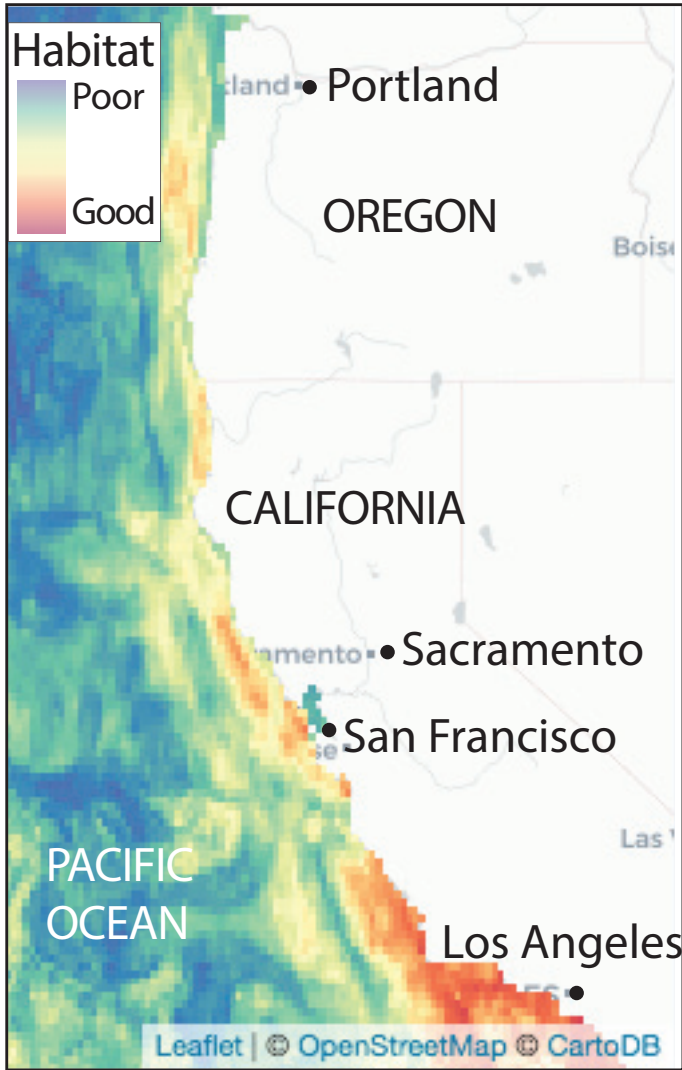


October





November



December

