Expert Group A

Why do we only find shark's teeth and not much else in the fossil shark record?

- ❑ Sharks are a type of fish with an internal skeleton made of cartilage, so they are called cartilaginous fishes. The only hard parts of their bodies are their teeth and dermal denticles. (Instead of scales, sharks have small tooth-like structures on their skin). *Denticle* means *tooth*—the dermal denticles are actually modified teeth all over their skin!
- ❑ Cartilage is the soft connective tissue inside the body that gives support to the body. It's the same type of cartilage that you have in the tip of your nose and top of your ears. Because it is a soft tissue, cartilage does not fossilize like bones do, so we usually do not find it in the fossil record. However, in very rare cases, the skeleton can form an imprint in soft rock like shale.
- ❑ Shark teeth are made of the same material as human teeth. Because they are hard, they are the most common part of the shark to fossilize.
- ❑ Adult white sharks have about 300 teeth arranged in rows. The first two rows of teeth are used to grab and cut, while the teeth in the other rows replace the front teeth when they are broken or worn down, or when they fall out. While biting activity could cause damage, the jaw holding the teeth is made of cartilage, making it easier for teeth to fall out. Sharks are able to replace teeth, one at a time. The front teeth are fully replaced every few weeks, giving the shark a constant supply of teeth.

Fun Fact: White sharks go through about three different patterns of teeth throughout their lifetime. They have one tooth shape before they are born (small blunt teeth), a second shape when they are young and eat fish (thin and pointy), and a third, more triangular shape with serrated edges when they are older and can prey on larger animals like sea lions.

Sources: Helfman, G. & Burgess, G. H. (2014) and University of Florida (2018)

Expert Group B

How do shark teeth become fossilized?

It's been estimated from sharks in captivity that a shark may lose and regrow as many as 30,000 teeth in its lifetime. In order for these teeth to fossilize, conditions have to be just perfect. Teeth that sink to the seafloor must be buried fast! Being quickly covered by sediment is important in order for teeth to turn into fossil teeth.

- ❑ The sediment cover protects the teeth by keeping them in place and hidden from other animals, and by helping avoid the damaging effects of moving water (similar to weathering).
- ❑ The sediment cover also helps prevent decomposition due to its lower oxygen and bacteria levels.

Fossilizing a shark tooth takes a long time. Over thousands of years, various minerals in the water that seeps through the sediment are left behind in tiny spaces in the tooth. Different minerals account for the different colors we see in fossil shark teeth. This long process of turning the tooth into a fossil is called *permineralization*.

Fun Fact: Shark poop sometimes fossilizes! It is called *coprolite*!

Sources: Helfman, G. & Burgess, G. H. (2014) and University of Florida (2018)

Expert Group C

Where can you find fossil shark teeth and why are they important?

Because of the process by which they form, fossils are commonly found in marine sediments like sand and mud, and in rocks formed by marine sediments. The earliest sharks lived in freshwater habitats, so those fossils are found in river sediments.

There have been constant fluctuations in Earth's climate over time and this leads to expansion and retraction of the sea levels, depending on temperature and glacial activity. Because of this, some marine sediments and marine sedimentary rock may be found inland. It's also possible that in some places these sediments are still under water.

Some popular places in California where there are inland marine sediments with fossil shark teeth include Bakersfield (Kern County) and Scotts Valley (Santa Cruz County).

It's more common to find such fossils in areas that were once shallow marine environments. In the case of Bakersfield, the teeth were preserved during a time when the Central Valley of California was a shallow inland sea. Such shallow seas can be ideal places for some sharks, offering warmth and protection, and making it easier to catch prey.

Fossil shark teeth are important because they give us a record of ancient shark history spanning more than 400 million years. The record indicates that evolutionary change in sharks is very slow and gradual. That slow speed can be a challenge to capture detail in the record. It's also challenging to use fossil teeth as a marker of species because distinctions in the teeth aren't always preserved in the fossil, making it hard to tell one species from another. Scientists, however, have managed to gather enough information to learn some big ideas about the history of sharks.

Sources: Helfman, G. & Burgess, G. H. (2014), Sanders, R. (2009), and University of Florida (2018)

Expert Group D

How can you determine if a shark tooth is modern or a fossil?

There are a few clues scientists use to determine if a shark tooth is modern or a fossil:

1. Because of the process by which it forms, color can sometimes be a good indicator of the age of a tooth. Modern teeth tend to retain that "pearly white" coloration. In contrast, fossil teeth that are made of minerals usually have other colors that make them appear darker.
2. Where the tooth is found can also be a good indicator of modern vs. fossil. If the tooth is found further inland in marine sediments, it's probably not a modern tooth and is a fossil. If the tooth is found inland in freshwater sediments, it's likely a fossil that is very ancient. If the tooth is found at the beach it may be modern.
3. Perhaps the best way to answer the question is to find out the age of surrounding sediments. Other species found in the same layer as the shark tooth can give a clue to age. If the tooth is found among shells of modern clams, the tooth is likely modern. If the tooth is in sediments or rock with shells of ancient clams, the tooth is probably also ancient and a fossil.

Of course, being able to identify the species of shark can also answer the question. But even this can be tricky because teeth from the same individual shark can look different. There is a lot of variability in tooth shape and size depending on the age of the shark and where in the mouth the tooth came from: there can even be variability between males and females.

Sources: Helfman, G. & Burgess, G. H. (2014), Martin, R. A. (2003), and University of Florida (2018)