Advantages of an oddly-shaped head

Bonnethead sharks are one species in a group of sharks easily identified by their unique head shapes – hammerhead sharks, also known as sphyrnid sharks. There are 8 species of sphyrnid sharks found around the world, each one with slight variations.

From a wider angle of viewing to more ventral surface area to detect prey, these unusual head shapes bring some interesting benefits that help the sharks survive.

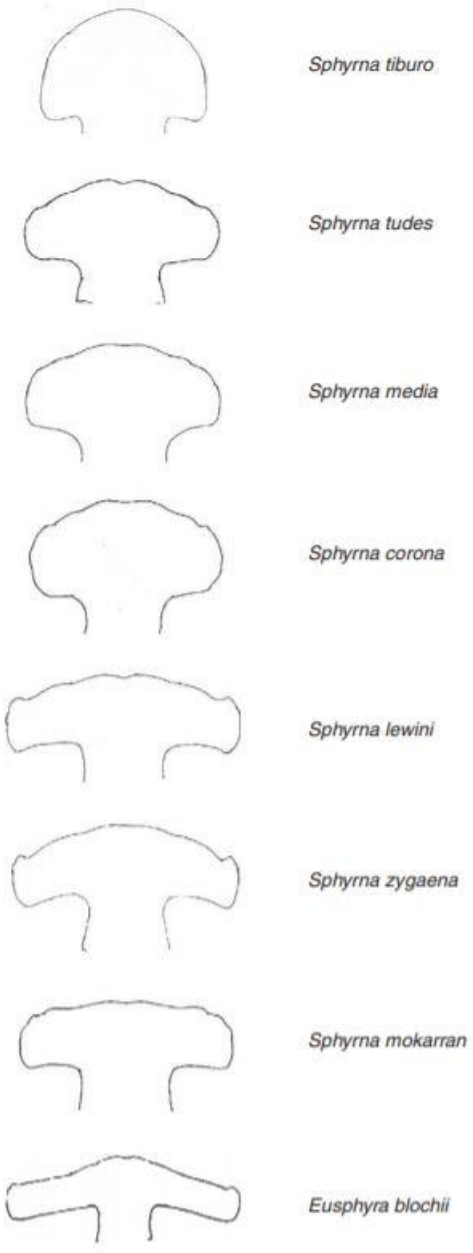


Fig. 1. Head morphology of the eight species within the family Sphyrnidae depicting the gradation in cephalofoil lateral expansion. Line drawings modified from Compagno (Compagno, 1984).

In the diagram at left, match the species with the common name below. A quick internet search will help confirm your answers.

Scoophead shark

Smooth hammerhead shark

Scalloped hammerhead shark

Bonnethead shark

Great hammerhead shark

Winghead shark

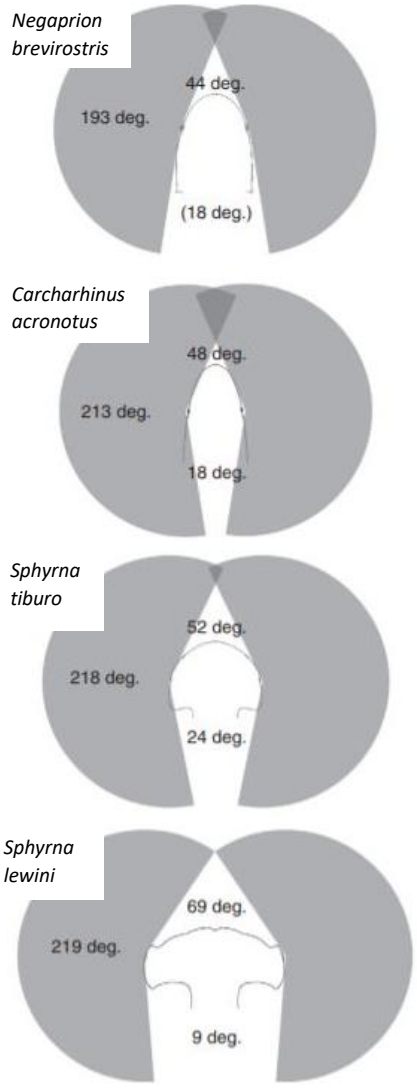
Smalleye hammerhead shark

Scalloped bonnethead shark

The better to see you with

All sharks have their eyes placed on the sides of the head, but hammerheads take this to the extreme. With the extra space between the eyes, one might think they would not have very good binocular vision, or be able to see directly in front of them. Instead, these sharks have better viewing angles than other sharks. They make up for the gap with movement of the eye in the socket and head yaw, or swinging their head side-to-side, as part of their normal swimming action.

Looking at the diagram at right, the differing amounts of vision are compared between two species of hammerheads and two shark species with a typically shaped head.
The shaded areas and the numbers within are the viewing range each eye can see - monocular vision. Where these shaded areas overlap is where the two eyes come together - binocular vision - and the range is the number at the front or back of the head. If the number appears in parentheses, it indicates the size of a blindspot.



Using the diagram, answer the following:

1. Which species has the widest range of view?

   _____

2. Which species has a blindspot?

   _____

3. Do both hammerhead species have greater binocular vision at the front of their head than the two typically shaped sharks?

   _____

4. Do either of the typically shaped sharks have binocular vision behind their head?

   _____

The better to find you with

Another advantage sphyrnid sharks have is a better sense of electricity on the lower surface of their hammer-shaped heads. All sharks can sense electricity with special gel-filled pores called ampullae of Lorenzini, but hammerheads have more of these pores on the ventral, or bottom, side of their head than typically shaped sharks.

How does sensing electricity help a shark? If you find the spot on your wrist or neck where you can feel your pulse, you are sensing the consequences of an electrical current – your heartbeat. Each time your heart beats, it was started by an electrical signal. This is true of all muscle movements, whether it is in your chest, arm, leg, finger, or toe. Even your thoughts are electrical pulses. Just being alive means you are producing electricity, and sharks can sense this electricity.

This sense is especially helpful when one of the favorite prey animals is one that likes to hide under sand. Stingrays use this behavior to avoid detection by predators, but hammerhead sharks are better equipped to find them since they are more sensitive to the electricity of the stingray below the sand.

Looking closely at the image of the hammerhead below, locate the little freckle-like spots scattered around the bottom surface of the head. These are the ampullae of Lorenzini.

The better to smell you with

You may know that sharks have an excellent sense of smell. In fact, as much as 70% of their brain is devoted to the olfactory sense, smelling. What you may not realize is that a shark's high definition sense can smell in stereo! This means that they can determine the direction a smell is coming from.

Humans do not have this ability, but the activity below can help you understand how this works.

Materials:

- Two straws or tubes of rolled paper per participant
- A spice like cinnamon, basil, cumin, etc.

Instructions:

1. Each participant will take two straws or rolled pieces of paper and gently insert one into the opening of each of their nostrils.
2. Participants should close their eyes, and a second person will place a container of the chosen spice below one of the tubes, being careful not to bump the straw.
3. The participant with their eyes closed then inhales and guesses which side of their nose is smelling the spice.

Discussion questions:

- Was it easy to determine which side you could smell the spice?
- Looking at the picture of the hammerhead in the above section, can you find the closest nostril? It is the indent just to the right of the eye. Can you determine where the other nostril is located?
- With the wider spread in nostrils found on hammerhead sharks than other sharks, do you think they have a better directional sense of smell?
- What additional advantages do you think hammerhead sharks have over other sharks?

Resource:

McComb, D.M., Tricas, T.C., and Kajiura, S.M. (2009). Enhanced visual fields in hammerhead sharks. *Journal of Experimental Biology.* **212**, 4010-4018.
https://jeb.biologists.org/content/jexbio/212/24/4010.full.pdf