Laura Rumeo March 21st, 2023

The Impacts of Bycatch on Hammerhead Sharks: Why They Should Fear Us More Than We Fear Them

Brief Overview

It is well known that human activities can greatly impact ecosystems and particular species, and that this is true for both terrestrial and aquatic ecosystems. While sharks may be large, intimidating top predators, they are definitely not impervious to the impacts of human activities. Hammerhead sharks are one of the many groups of aquatic organisms that are endangered and are increasingly being threatened by human activity (Stanhope *et al.,* 2023). These unique sharks have experienced unprecedented population declines within the past century, being targeted by fishers for food, but also being caught as bycatch by fisheries (Stanhope *et al.,* 2023, Raoult *et al*., 2019). This blog post will provide background information into the hammerhead shark, detail the issues they face, why we should care, and provide a possible solution to these issues. Through addressing these topics, it should become clear why even top predators such as the hammerhead shark should fear humans more than we fear them.

Introduction to Hammerhead Sharks

Hammerhead sharks are one of the most unique groups of sharks in terms of appearances. By looking at figure 1, it is clear that hammerhead sharks stand out from any other groups of sharks with their distinctive head shape. One of the main characteristics that set hammerhead sharks apart from other sharks is their large hammer shaped head known as the cephalofoil. Their hammer shaped heads are in fact not designed for any carpentry related tasks, rather one main reason that they have evolved is to maximize the shark's ability to handle and dine on their prey (Chapman & Gruber, 2002). The hammerheads can pin their prey down, specifically rays, using the cephalofoil, immobilizing the ray and giving the hammerhead a chance to bite as seen in figure 2 (Chapman & Gruber, 2002). Along with helping with feeding, the cephalofoil is also hypothesized to help hammerhead sharks maneuver in the water and detect prey better (Lim *et al.,* 2010). What is currently known about the diet of hammerheads is that it consists mainly of rays and mesopredator sharks, as well as occasionally teleost's (Raoult *et al*., 2019).

Hammerhead sharks have a complex life history, and the impacts of human activity in hammerhead habitats complicate matters even more (Harry *et al.,* 2011). Hammerhead sharks are typically found in warmer waters, being distributed within tropical and temperate waters globally, and their proximity to shallow inshore habitats vary depending on age (Harry *et al.,* 2011). While they may be distributed globally, their life-history is characterized by slow growth, late sexual maturity, and low reproductive rates, each of which makes them more vulnerable to population declines (Gallagher *et al*., 2014). Young sharks spend most of their time in shallow inshore habitats, and migrate to deeper waters as they get older, with the age in which they migrate depending on the sex of the shark (Harry *et al*., 2011). Lifespan can be impacted by different factors including the specific species, however a study conducted by Harry *et al*. (2011) found that in scalloped hammerheads, the maximum age for males was 21 years, and the maximum age for females was 39.1 years.

There are nine known species of hammerheads sharks that make up the family Sphyrnidae: the Great hammerhead (*Sphyrna mokarran*), the Smooth hammerhead (*Sphyrna zygaena*), the Scalloped hammerhead (*Sphyrna lewini*), the Scalloped bonnethead (*Sphyrna corona*), the Scoophead shark (*Sphyrna media*), the Bonnethead shark (*Sphyrna tiburo*), the Smalleye hammerhead shark (*Sphyrna tudes*), the Winghead shark (*Eusphyra blochii*), and as of 2013, the Carolina hammerhead (*Sphyrna gilberti*) (Pérez-Jiménez, 2014, Pinhal *et al.,* 2020). Each species exhibits distinctive cephalofoil and body size (Lim *et al.,* 2010). There is an approximately two-meter difference between the body size maximums of the smallest and largest hammerhead species, ranging from a one meter maximum in smaller hammerheads to greater than three meters in the largest hammerheads (Lim *et al.,* 2010). Furthermore, the average length of cephalofoil for each species varies, with the winghead shark having the widest cephalofoil, reaching widths nearly half the length of its body, and the bonnethead shark having the narrowest cephalofoil, only reaching widths of around 18% of its body length (Lim *et al.,* 2010).

The status of each of these species varies, with some species such as the great hammerhead, the scalloped hammerhead, and the smalleye hammerhead, being listed as critically endangered, and others such as the smooth hammerhead being listed as vulnerable by the IUCN Red List (Rigby *et al.,* 2019). One thing that is constant across each species however is that they are all experiencing some degree of decreasing population trends and the future of each species is reliant on our success in implementing conservation measures (Rigby *et al.,* 2019).

The Impacts of Bycatch on Hammerhead Sharks

Bycatch is one of the most pressing issues facing hammerhead sharks and is contributing to their dramatic and ongoing population declines (Gallagher *et al*., 2014). Hammerhead sharks along with many other large aquatic animals are often caught unintentionally by fisheries using fishing nets or trawlers meant to target a different species (Zeeberg *et al.,* 2006). This is known as bycatch and can leave the sharks severely injured or often times dead (Zeeberg *et al.,* 2006). While many aquatic organisms are impacted by being caught as bycatch, hammerhead sharks have been shown to be particularly vulnerable (Gallagher *et al*., 2014). In their 2014 study, Gallagher *et al.* found that hammerhead sharks showed to be the most vulnerable to bycatch compared to 11 other shark species. It is estimated that the hammerhead shark populations have declined greater than 90% in parts of the world, mainly due to bycatch and overexploitation (Gallagher *et al*., 2014).

For those who don’t particularly care too much about wildlife or animals in general, it may not seem like a big issue to have species of hammerhead sharks become critically endangered or even extinct, however being as they are a top predator, even minor fluctuations in their abundance can greatly disrupt marine ecosystems by both directly and indirectly affecting species abundance and distribution (Ferretti *et al*., 2012). These effects can impact fish populations that humans rely on for food, thus directly influence our food availability (Ferretti *et al*., 2012).

How to Protect Hammerhead Sharks from Bycatch

To help solve the issue of bycatch, some of the most promising solutions have been to improve fishery management by the implementation of species-selective fishing gear (Zeeberg *et al.,* 2006). There have been studies that investigate how changing the certain aspects of the fishing process may help reduce the impacts on specific species who are particularly vulnerable. Sensory related studies have shown to be especially promising as they specialize on the sharks electrosensory system and thus will not interfere with the target species of the fisheries. In a study conducted by Hutchinson *et al*. (2012), it was found that the presence of lanthanide metals on the hooks of longline fishing gear was able to significantly reduce the number of scalloped hammerhead sharks caught as bycatch. The researchers chose lanthanide metals for this study because they produce electrochemical fields when exposed to water (Hutchinson *et al.*, 2012). Hammerhead sharks are able to detect weak electric fields due to their extensive electrosensory system, and thus they were able to sense the electrochemical fields and be deterred from the fishing gear (Hutchinson *et al.*, 2012). This method would not impact the number of target species caught by the fisheries since the target species of fish do not have the same electrosensory system and will thus not be deterred by the lanthanide metals (Hutchinson *et al.*, 2012). In a similar study, Rigg *et al*., (2009) investigated how placing magnets onto the fishing gear could impact bycatch of 5 different species including the scalloped hammerhead. The researchers were able to conclude that the magnetic fields produced by the magnets deterred scalloped hammerheads and could be implemented to reduce bycatch of this species (Rigg *et al.,* 2009).

Through reviewing the literature regarding the usage of species-selective fishing gear to help with conserving hammerhead shark populations, there are many strategies we can take to protect hammerhead shark species from the impacts of bycatch. There is however still a need for more research to be conducted. In their 2018 study, Santos & Coelho investigated habitat use of the smooth hammerhead shark and found where overlap occurred between these hammerhead shark's habitat preferences (both adult and juvenile) and the operation depth of pelagic long line fishing gear. Studies such as this one conducted by Santos & Coelho (2018) can help us inform conservation efforts by understanding the behaviours of the various species of hammerhead sharks and minimizing bycatch. Therefore, not only should we start implementing conservation and management measures immediately based on the current data we have, but we should also never stop conducting research into hammerhead sharks, since any new information we learn about the species can allow us to improve conservation strategies even more.

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Appendix

Figure 1: *Sphyrna mokarran* (Great Hammerhead). Underside of the front half of a Great Hammerhead shark. Note the cephalofoil, making the shark a more efficient hunter. (Source: Karl Dietz, retrieved from https://www.iucnredlist.org/species/39386/2920499

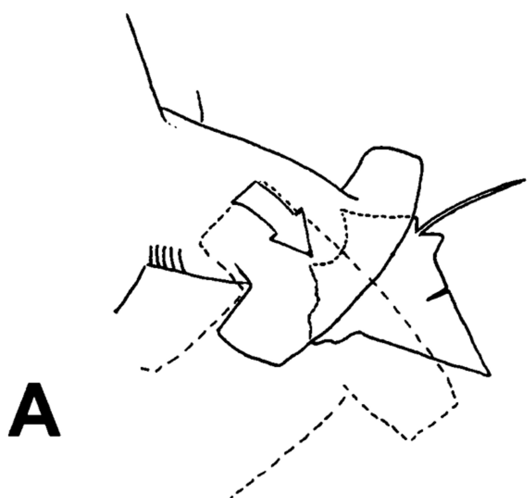

Figure 2: Illustration of a hammerhead shark performing the 'pin and pivot' behaviour in which they pin their prey down using their cephalofoil, pivot to the side, and begin to eat their prey (Chapman & Gruber, 2002).