Hands Off My Gill Plates! The Overexploitation of Manta Rays
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The manta ray, an acrobatic of the sea, their twists, turns, and somersaults make them easily one of the most majestic creatures in the ocean. Not only do these maneuvers help them maximize their prey intake, but these movements have captured the hearts of many humans as well. With the rise of ecotourism, many individuals flock to warm, tropical environments to view their acrobatic demonstration whilst they feed on their prey, often taking night swims with them, and learning about the conservation of the species from their tour guides. Although often mistaken for stingrays, manta rays do not have barbs on their tails making them the oceans gentle giants. Despite their increasing popularity, there was little published information on them due to their circumglobal distribution around tropical and subtropical pelagic waters (Couturier et al., 2012). The main threats that are imposed onto the manta ray is the overexploitation of their gill plates and the consequences of bycatch, this post will discuss this threat as well as the strategies that scientists/governments have begun to employ to aid in the conservation of these wonderful creatures (Bucair et al., 2021).

Manta Ray Background:

According to the IUCN Red List, reef manta rays are considered a vulnerable population, whereas the giant manta ray are an endangered population, with both population trends decreasing (IUCN Red List, 2023). The distribution of the manta ray differs depending on what species is being looked at. The manta ray belongs to the genus *Mobula,* consisting of two manta species, the Giant Oceanic Manta Ray (*Mobula birostris*) and the Reef Manta Ray (*Mobula alfredi).* The species name speaks for itself; reef mantas spend most of their time near coastal reef habitats, and oceanic mantas spend most of their time offshore. Their difference in distribution yields different scientific research abundance, with reef mantas being the best studied out of the two species due to the more accessible coastal distribution near the continental shelves (Strike et al., 2022). Moreover, the offshore pelagic habitats of the giant manta ray make it much more difficult for scientists to research because of vast and open it is (Strike et al., 2022). Moreover, manta rays don't look like your average fish. Their physical attributes are quite different from the 'traditional' idea of we think fish may look like. Instead, they are characterized by their large pectoral wings, flattened disc-diamond shaped body, and two protruding 'horns' sticking out from the front of their heads (See Figure 1). These large wings are responsible for their graceful glide throughout the sea. Manta rays move through an oscillatory mode of locomotion, where it may flap its pectoral wings and propel itself through the ocean with efficiency (Fish et al., 2018). This is beneficial to the organism since they are obligate ram ventilators, where they need to be in constant swim to gain oxygen and move water pass their gills. They do not always possess this mode of respiration however, during the embryonic stage, the embryo takes in uterine fluid through buccal pumping, where the ray pumps water through its mouth. Manta rays are the few species of fish that can give live birth to its pups, since there is no umbilical cord or placenta to provide it oxygen like how mammals do when giving birth, or how some carcharhinid sharks embryos obtain oxygen from their egg case, manta rays resort to this mode of respiration (Tomita et al., 2012). Furthermore, manta rays have extremely low fecundity, with only one or two live pups being born after a 12-month gestation period, every one to two years. This leaves their population parameters to be vulnerable if their rates of death are faster than their rate of reproduction (Graham et al., 2012).

International Trade: Hands Off My Gills!

Manta rays are greatly threatened by their overexploitation with many incidental and intentional captures to these gentle giants. The gill plates from manta rays enter the market from a variety of different ways, in some countries this is done through legal fisheries, but more often than not, the gill plates come from illegal, unreported and unregulated (IUU) fisheries, and bycatch (Steinke et al., 2017).

In a study conducted by O'Malley et al (2016), scientists aimed to investigate the driving force behind this marketplace. From this, it was estimated that the gill plate trade had an approximate revenue of $10.7 million USD (in 2011). Based on the study, O'Malley et al (2016) determined that the primary factor driving this trade is through word-of-mouth recommendation from friends and relatives. Additionally, the gill plates are easy to access and available over the counter for individuals to purchase, driving the trade further. However, these medical claims are not supported by medical research, nor are they documented in traditional Chinese medicine scriptures. The introduction to the idea that gill plates are a useful health tonic began to appear in Chinese literature around 1976, this is around the same time that gill plates were initially introduced/imported into China (O'Malley et al., 2016).

The spread of the misinformation benefits not only promotes a huge risk to the manta ray population, but to the humans consuming these products as well. It was found that there are a number of health risks involved with the consumption of unregulated animal products. In a study done by Li et al (2012), the gill plates and tissues that were sampled from the trade were tested, it was found that there was 20x more arsenic, than what was considered safe for human consumption.

In some countries, manta rays are not of commercial interest. But, they are still caught from bycatch or illegal fishing operations and die as a result of these fishing gear entanglements or get sold to the gill plate trade industry (Bucair et al., 2021). Many target species that the fishing industry primarily goes for shares this distribution with the rays, for instance, Tuna is incredibly popular in the fishing industry, and they aggregate in the same areas as mantas do. This increases the risk of bycatch on manta rays. Furthermore, since manta rays are pelagic swimmers, fishing gear that enters the depths and get raised, may capture manta rays as well (Stewart et al., 2018). There is a variety of fishing gear that mantas may be caught in, but the highest reporting bycatch rate of manta rays is reported from gillnets and purse (See Figure 3) (Croll et al., 2012). The entanglement in fishing gear may lead to death by asphyxiation since being ram ventilators, they need to constantly be swimming to respire as well as leaving them injured from the harsh wires of the gear.

Unfortunately, it doesn't stop simply at bycatch and fishing entanglements. It is not uncommon to find manta rays scarred nor severed in the sea. In a sample of 2803 manta rays, it was found that 277 of the rays had scars and injuries related to fishing equipment entanglements (Harty et al., 2022). The post-release of the manta rays after initial capture has been proven to be difficult given their lack of rigid skeleton, making them challenging to handle out of water. Previously, fishermen would punch holes into the bodies of the rays that left the rays with high stress physical and physiological responses and contribute to the post-release mortality rates of the manta rays (Poisson et al., 2014).

In all, the anthropogenic effects that manta rays face leave the population extremely vulnerable, with how slow growing the species is, and its low fecundity, it may be difficult for the population to recover if these effects continue to occur at the same rate (Steinke et al., 2017).

What Are Some Solutions?

There is a vast amount of effort put in by scientists, governments, and fishermen alike in the conservation of the manta ray species. Booth et al (2020) notes the regulation and trade of species is currently being done through a multi-lateral environmental agreement. One of them is known as the Convention on the International Trade of Endangered Species (CITES). This database aims to ensure that the international trade of wild species does not threaten their survival, and it may lead to the successful increase of wild species. Although this solution has been considered successful, Booth et al (2020) suggests modes of improvement through the incorporation of an integrated framework to assess the impact of wildlife trade more thoroughly. This is because CITES relies on annual reports, submitted by consenting parties, leaving room for biases and inconsistencies in their reports. Booth et al (2020) suggests that the wildlife regulation is classified in three categories: Supply, transaction, and demand. These may differ based on the regulations adopted by different countries and suggest that with a multi-stage assessment protocol, countries may be able to measure their species trade with more validity and honesty, improving the biases and inconsistencies in CITES.

Additionally, scientists have demonstrated a solution to the unwanted bycatch and fishing entanglements that may occur when fishing. They have proposed a collaborative research mode between both fishermen and scientists alike, increasing the trust and decreasing the divide between the two parties (Hartley & Robertson, 2008). The experience-based knowledge that fishermen have is equally as important as the scientific knowledge that scientists have. For a while, the fishermen knowledge was considered inadequate to the scientific community, this disconnect in the community results in a further divide, more distrust, and rejection (Hartley & Robertson, 2008). With the integration the two modes of knowledge, the two groups can work together to identify practical solutions in changes to their fishing gears. The fishermen will be able to let the scientists know what is required to keep their business going, and the scientists will be able to introduce them to ideas for sustainability. For instance, scientists have demonstrated a technique to reduce bycatch is by eliminating shallow hooks and changing the depth that shallow hooks may go down to. In a study done by Beverly et al (2009) they demonstrated that the target catches of tuna are maximized deeper in the sea than most of the bycatch. With increasing depth of the gear, fishermen can maximize their target catches and reduce the bycatch rates (See Figure 4). The study identified the target species as bigeye tuna, and the bycatch species as the epi-pelagic species. It was found that both the experimental hook and control hook, caught the same amount of bigeye tuna, but the experimental hook caught fewer bycatch species (Beverly et al., 2009).

Finally, Poisson et al (2014) has demonstrated a solution to decreasing post-release mortality rates. They highlight that the ray involved with a bycatch situation is increasingly stressed and often are wounded once released, due to their lack of a rigid skeleton and fragility. They outline steps to take to decrease lethal wounding and stress. If the ray is smaller, it should be handled by two to three fishermen and never carried by their cephalic lobes. If the ray is extremely large, it should be released directly from the brailer or returned to the ocean using a canvas sling that would be gentler than a wire being wrapped around their body (Poisson et al., 2014).

Figures

Figure 1. Giant Oceanic Manta Ray (*Mobula birostris)* swimming alongside a diver and two remoras (*Echeneidae*) attached alongside near its tail. Notice the "t-shaped" markings alongside its back, one of the defining characteristic differences between the reef manta ray (*Mobula alfredi*). Image taken from oceanographicmagazine.com

Figure 2. Gill plate removed from a manta ray. Characterized by its feathery filament, is made by cartilage used to filter plankton during feeding. Image taken from mantatrust.org

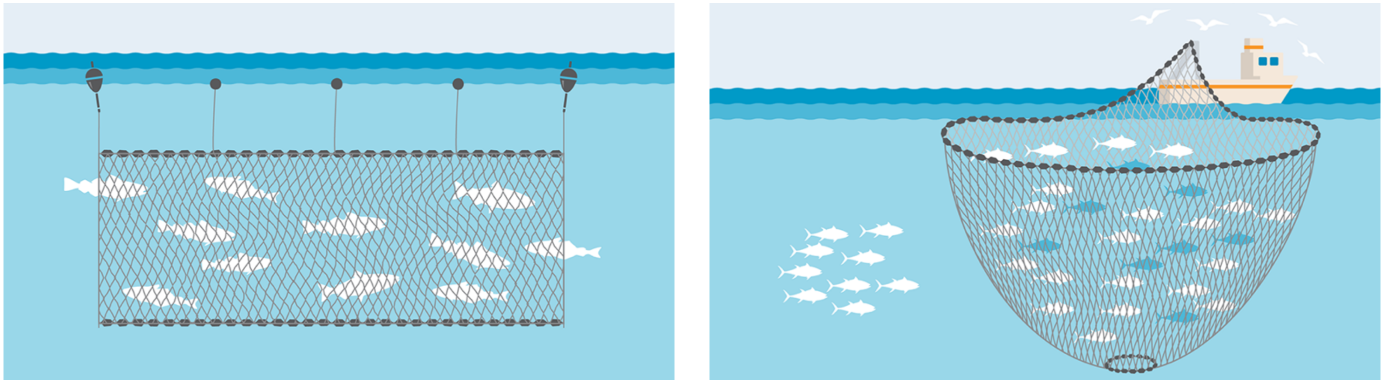

Figure 3. The left side depicting the method of using gillnets for fishing, they lay vertically in the water catching the gills of the fish once they try to escape. The right side depicting purse seine fishing gear where a large net surrounds a school of fish and encloses around them. Image collected by the Marine Stewardship Council

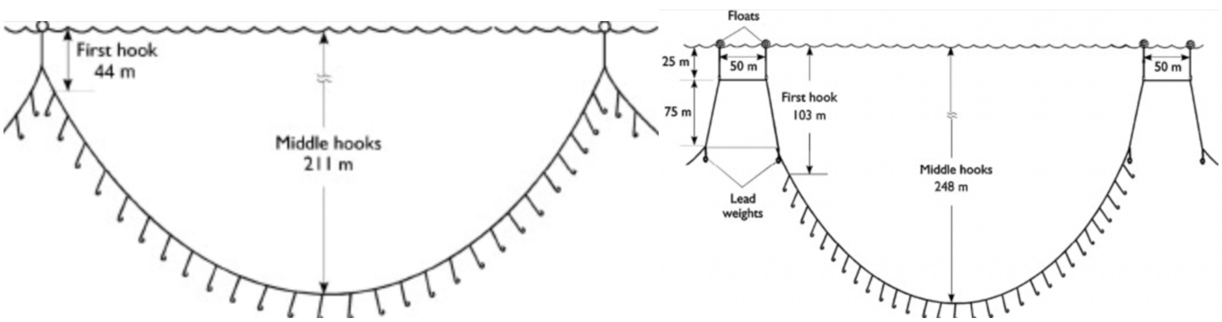

Figure 4. Demonstration of experimental hook on the right side to reduce bycatch rates, the control hook is on the left side. The experimental hook is lowered much deeper into the ocean compared to the control hook. Image taken from study done by (Beverly et al., 2009)

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