Can we Turtle-y Restore Leatherback Populations? – *the Impact of Bycatch on Leatherback Turtle Populations*

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Introduction:

As Earth's population increases, so does our demand for food. Consequently, fish populations are in severe decline as they try to keep up with rapid economic and human population growth (Limburg et al., 2011). However, heightened fishing efforts can result in numerous unintended consequences! For example, increased fishing will raise instances of unintended bycatch. Bycatch refers to the incidental capture of a non-target species (Ferraroli et al., 2004), and it can be detrimental to populations of endangered species such as leatherback turtles (*Dermochelys coriacea*). Shockingly, leatherback turtle populations have declined by >90% in the eastern Pacific from 1990-2008, largely due to bycatch mortality (Shillinger et al., 2008). What can we do to mitigate the effects of fisheries on leatherback turtles? Keep reading to find out!

Some Background Information:

What makes leatherback turtles stand out among other sea turtles? – their striking size! Growing more than two meters in length and weighting up to 900kg, leatherbacks are the largest living species of sea turtles (Paladino et al., 1990; Tucker & Fraser, 1991; Price et al., 2004). As can be seen in Figure 1, another defining feature of leatherbacks are their dark, elongate, and scaleless shells. Leatherbacks get their name from their lightly spotted leathery skin that covers their seven longitudinal ridges on their shells (Eckert et al., 1999; Eckert & Network, 2001). Their head is rather triangular, and their forelimbs are extremely long relative to their hindlimbs, which helps to generate more thrust and speed for swimming across long distances in the ocean (Eckert et al., 1999).

Leatherback turtles are world travellers – they are found in all oceans except for the Arctic and Antarctic (Ferraroli et al., 2004). They nest in topical or subtropical beaches and are often found in pelagic waters as they hunt for jellyfish (Houghton et al., 2006). Leatherbacks tend to target jellyfish blooms for predation, taking on the important role of keeping jellyfish populations in check within marine ecosystems. However, plastic bags that litter our oceans can be easily mistaken as jellyfish, as sea turtles locate their food visually (Mrosovsky, 1981). Incidences of plastic ingestion by leatherbacks have been observed since the 1960s and remains a common occurrence today (Figure 2; Mrosovsky et al., 2009). Mrosovsky et al. (2009) estimated that at least one third of adult leatherbacks have ingested plastic in their lifetime! This is a huge problem to leatherback turtles, as their gastronomical tract is at risk of getting blocked up from plastic accumulation.

Plastic pollution is not the only anthropogenic problem that leatherbacks are facing. Leatherback turtles naturally tend to have low reproductive success due to low hatchling success, bacterial/pest infestation, and egg loss from tidal inundation (Bell et al., 2004). However, anthropogenic influences such as egg poaching and offshore fishing are dramatically decreasing the reproductive success of leatherbacks by killing adults, juveniles, and eggs of leatherbacks (Bell et al., 2004). The combined effect of natural and anthropogenic disturbances severely impacts leatherback turtle populations. Currently, the International Union for Conservation of Nature (IUCN) lists leatherback turtles as vulnerable, but some subpopulations (such as the Southwest Atlantic and Pacific) are listed as critically endangered (Seminoff & Shanker, 2008).

Impact of Fisheries on Leatherback Turtles:

Wherever there is fishing, there is also bycatch (Ferraroli et al., 2004). A major anthropogenic player in the dramatic decline of leatherback turtles are pelagic longline fisheries, as leatherbacks are often entangled as bycatch (Garrison, 2003). Bycatch in pelagic longline fisheries don't always result in death, since the turtles can still swim to the surface to breathe, but post-release mortality rates are unknown (Garrison, 2003). Lewison et al. (2004) analyzed fishery data from 13 countries and estimated that globally, longline fisheries took 50 to 60,000 leatherbacks in the year 2000. Specifically, leatherback bycatch rates were 0 to 2.4 per 1000 hooks that were cast by fishers (Lewison et al., 2004). This is a global issue: as seen in Figure 3, leatherback turtles are caught as bycatch over most of the oceans, with particularly high numbers in the Pacific and Atlantic Ocean (Lewison et al., 2004).

Additionally, leatherbacks can be entangled in gillnets or trawl fisheries. These fisheries cast their nets significantly deeper than the ocean surface to catch tuna, flounder, shrimp, etc. Due of this, entangled leatherbacks cannot swim to the surface to breathe, resulting in higher mortality rates (Lee Lum, 2005). Lee Lum (2005) estimated that around 3000 leatherbacks were entangled in artisanal gillnet fisheries off Trinidad in 2000. Of these individuals, mortality rates were between 28 and 34% (Lee Lum, 2005). These are devastating numbers for a species that is vulnerable/critically endangered!

Conservation Strategies:

Although it is discouraging to hear how anthropogenic activities have contributed to the steep decline of leatherback turtle populations, it's not too late for us to amplify our conservation efforts! Many leatherback subpopulations are being closely monitored, and there are ongoing global conservation efforts to restore leatherback turtle populations. Luckily, they are already protected under the Endangered Species Act, so international conservation efforts are possible (Valdivia et al., 2019). International cooperation is especially important for a species like the leatherback turtle, which occupies such a large geographic range (Lewison et al., 2004).

So, what can be done to protect these turtles? Firstly, designating the migratory routes of leatherback turtles as a marine protected area (MPA) is an important step. MPAs have been proven to be a preferred area in related species, due to their higher quality habitats and lower threats. For example, Scott et al. (2012) found that 35% of all green turtles (*Chelonia mydas*) foraged in MPAs, which is a number that is significantly greater than what is expected by chance. Shillinger et al. (2008) investigated the migratory routes of leatherback turtles in the eastern Pacific (Shillinger et al., 2008). As seen in Figure 4, the researchers found that leatherback turtles headed southward after completing nesting by following a persistent migration corridor (Shillinger et al., 2008). This is a convenient behavioural pattern from a conservation perspective, since most sea turtles have highly variable dispersal patterns (Shillinger et al., 2008). If these migration corridors can be designated as an MPA, the reduced activities of fisheries will greatly benefit leatherback turtle populations, as instances of bycatch will be reduced. However, this will require international management collaboration, which may be time-consuming and costly to achieve.

Secondly, fishing gear should be regulated to reduce the likelihood of leatherback turtle bycatch. There have been several studies that have tested innovative fishing gear to reduce sea turtle bycatch. To deter leatherback turtles from being entangled in gillnets, Bielli et al. (2020) attached LED lights on floatlines of paired gillnets to act as a visual cue for sea turtles. This reduced the bycatch probability of sea turtles by up to 74.4% because sea turtles locate their food visually, and LED lights are easily identifiable (Bielli et al., 2020). Additionally, Gilman et al. (2012) researched fishing practices in longline tuna fisheries in Hawaii and found that using wide, circular hooks reduced leatherback turtle interactions rather than J-shaped hooks. This is likely because leatherbacks tend to be entangled from being foul-hooked on the body by narrow hooks; circular hooks are not too narrow so this is not as big of a risk (Gilman et al., 2012). Overall, enforcing fishers to use fishing gear that reduces leatherback turtle bycatch is an important step in the conservation of leatherbacks.

Figure 1. A mature leatherback turtle swims through the ocean (Nature Canada, 2019).

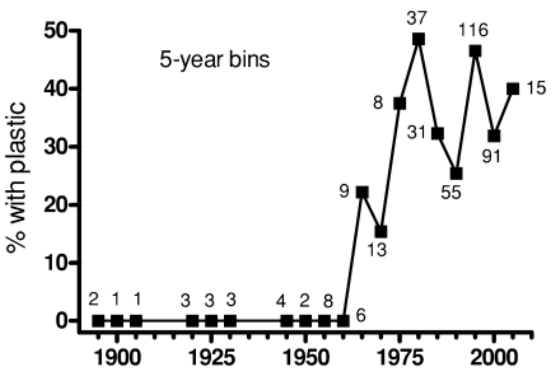

Figure 2. Autopsies of leatherback turtles in which plastic was found in their GI tract. The values beside each point represents the number of individuals autopsied. (Mrosovsky et al., 2009)

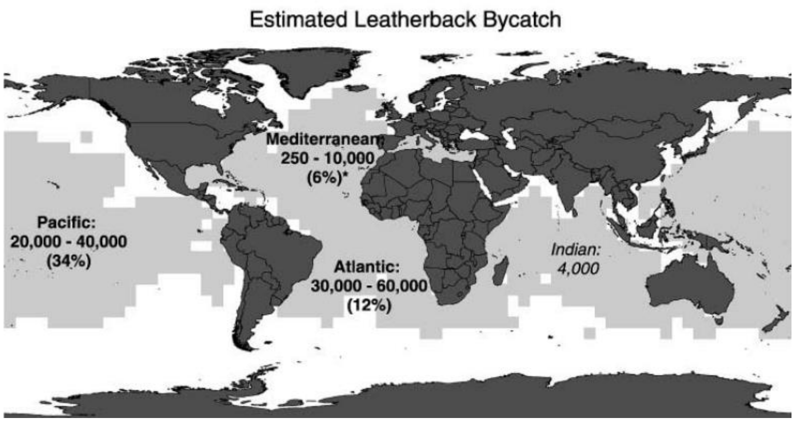

Figure 3. Estimates of leatherback turtles caught as bycatch by the pelagic longline fishery in 2000 (Lewison et al., 2004)

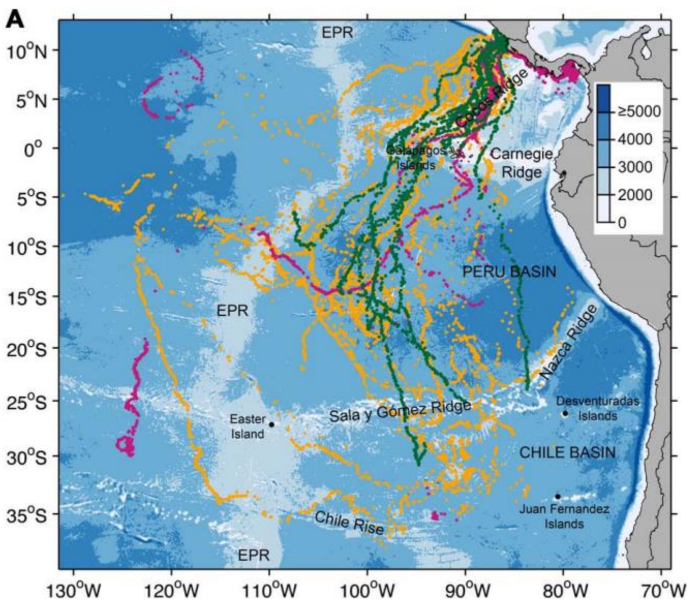

Figure 4. Satellite view of leatherback turtle ranges from 2004 (n = 27, orange), 2005 (n = 8, purple), and 2007 (n = 11, green). Turtles were tagged at Playa Grande, Costa Rica. (Shillinger et al., 2008)

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