ASSIGNMENT 6 - GROUP 6 - SDG214

TOOLS AND METHODS TO PREVENT BYCATCH

Bycatch means the accidental capture/harvest of a non-target species in fisheries. Fisheries bycatch is considered a major threat to 67% of marine megafauna species (Žydelis et al., 2009). Bycatch can have an ecological impact by affecting protected species, can negatively contribute to population declines, and may have negative socioeconomical impacts to fishermen and communities who benefit from marine capture (NOAA, 2016).

In 2011, the Food and Agriculture Organization proposed an international guide to ensure management and good fishing practices (FAO, 2011). Some specific measures are installing bycatch reduction devices (e.g., turtle excluder devices), the appropriate use of integrated vessel and fishing gear position monitoring and habitat mapping systems, and the use of adaptive spatial closures to reduce bycatch problems. In this paper we are reviewing different bycatch reduction methods. The methods are divided into four groups according to the types of measures used: chemical compounds, sound and vision, mechanical methods and changing fishing practices.

CHEMICAL COMPOUNDS

The release of chemicals into the ocean ideally deters potential bycatch due to either an unpalatable taste or scent. Theoretically, these chemicals can be specifically engineered to repulse individual species or larger groups of marine animals without hindering the fishing operation.

Sharks are a species who rely heavily on scent, and they illustrate the difficulties of scent based chemical compounds. Scientists have still not discovered a chemical compound that is repulsive to all species of sharks, let alone, all species of possible bycatch (Jordan et al., 2013). This highlights the difficulty, and perhaps impossibility, of finding a compound which effectively deters all potential bycatch whilst still appealing to the target species.

However, if a chemical composition can be utilised to discourage a significant amount of potential bycatch, that is only positive. Ideally, if this method was paired with another strategy which compliments its shortcomings, then chemical compounds could be highly valuable.

SOUND AND VISION

Within the sensory ecology study of gillnet fisheries, the main bycatch issue comes from the low visibility of the net (Martin and Crawford, 2015). A solution would therefore be to add sensory cues to the net.

Warning panels with a contrasting pattern added to the headrope of the gill net is one method developed to reduce the bycatch of seabirds, sea turtles, pinnipeds, and cetaceans (Martin and Crawford, 2015). This method is not dependent upon the underwater light environment. It is easily implemented, cost-efficient and not species-specific. It reduces the catch area of the net close to the head rope, but not more than approximately 2.5% (Martin and Crawford, 2015). Cetaceans use echolocation when light is not sufficient, therefore having warning panels with high acoustic reflection surfaces could potentially reduce the bycatch of cetaceans (Martin and Crawford, 2015). One limitation related to the warning panels is the differences in behaviour

among species. Pinnipeds and cetaceans might approach the warning panel due to curiosity, which increases the chance of being caught in the net.

Light-emitting diodes (LED) placed at the headrope of the gillnet have resulted in reduced bycatch rate of 63.9 percent during a study on green turtles (*Chelonia mydas*), with only 2% reduction in target species (Ortiz *et al.*, 2016). However, most species use sight when foraging underwater and have developed an adaptable retina to the surrounding light level (Martin and Crawford, 2015). When exposed to a light source within a low-light-level environment, it can cause a reduced retina adaption in a nontarget species, which increases the chance of the species not seeing the surrounding net (Martin and Crawford, 2015). The cost of introducing LED is calculated to be 3003 USD per vessel (Ortiz *et al.*, 2016). Not all fisheries can afford this extra cost, but there is a potential to reduce bycatch for some species using this method.

Pingers are sound-emitting devices developed to reduce bycatch. The use of pingers has resulted in reduced bycatch of porpoises within gill net fisheries (Dawson *et al.*, 2013). Porpoises most often have a far home range, and due to this, the sound emitted has not resulted in habituation. For bottlenose dolphins, the use of pingers has not resulted in a significant reduction in bycatch due to habituation (Dawson *et al.*, 2013). The use of pingers is a species-specific method and results in extra operational costs with an increased handling time of the net.

MECHANICAL METHODS

Mechanical methods consist of physical barriers that can be adapted to both nets and fishing vessels. They have a high efficiency in terms of species such as mammals, sea turtles and marine birds. One example is quick-release metal wire, a metal wire attached to an outrigger clip on a troll line which is activated when the fish is captured. This wire can dissuade dolphin predation (Werner *et al*. 2006). Underwater setting funnels also offers a significant reduction in seabird mortality and could increase fishing efficiency. It was demonstrated that the bycatch rates using the underwater setting funnel were three times lower than when the funnel was not used (Werner *et al*. 2006).

The electromagnetic deterrents are used to prevent the interaction of non-target species with fishing gear such as baits. This “electro-trawl” can stimulate some species into moving upward from the seafloor into the path of the trawl mouth. This is a useful technique because the space between the ground rope and benthos could be increased without reducing target catch levels while decreasing the contact that the trawl net may have with some non-target invertebrates and bottom fish.

Finally, two methods can be useful for reducing sea turtle's bycatch. Circle hooks are a set of hooks designed and arranged in a circular shape. These hooks are used in many recreational and commercial fisheries and have recently been shown to reduce the mortality of turtles caught in pelagic longline gear (Werner *et al*. 2006). Excluder devices, which are metal bar grid/mesh that is usually placed inside the neck of a trawl and has an opening to escape at the top or bottom. Animals can hit the exit of the bar through the opening, while smaller target species pass through the bars and are caught in the net. Examples include the turtle exclusion device (TED) and the sea lion exclusion device (SLED).

CHANGING FISHING PRACTICES

Another bycatch prevention method is to change the way we fish, rather than modifying fishing gear or using additional tools. This could for example be to change when or where we fish or how

we use the fishing gear. This includes area closures, time/area closures and night setting. Area closures, or static closures, are conservation areas. Time/area closures, or dynamic closures, is a bycatch prevention method which works like a weather report for bycatch species. The technology gives near-real-time probability of specific species, so fishing vessels can avoid areas with high risk of bycatch (Armsworth et al., 2010; Hazen et al., 2018; Smith et al., 2021).

Changing fishing practices as a bycatch prevention method does not result in additional expenses due to gear modification. However, it might cause extra expenses related to changing the fishing practices. Night setting is a method to prevent bycatch of seabirds specifically in longline fishing, where the longline is set at night to reduce visibility of the line (Jiménez et al., 2019). This is proved an efficient bycatch method, specifically to reduce bycatch of albatrosses (Jiménez et al., 2020). However, night setting may not be favoured as a bycatch prevention method by the fishing crew or companies, because of extra cost to pay workers at night or for the difficulties of working at night.

Other measures within changed fishing practice may result in reduced expenses, for example reduced soaking time. Soak time is the length of time that fishing gear is submerged between hauls; reducing it changes bycatch probabilities (Werner et al., 2006). Different species have different mean capture times, therefore reducing soak time may prevent bycatch of specific species. One study found reduced soak time of less than an hour to significantly reduce shark bycatch with minimal or no loss in target catch (Foster et al., 2017). Reducing soak times also gives the possibility of more sets per day, which can give more catch and more profit (Foster et al., 2017).

Compared to area closures, time/area closures can be economically beneficial for the fishing communities, as it could open more area to be utilized for fishing. Time/area closures can be 2-10 times smaller, and still give adequate protection of endangered nontarget species (Hazen et al., 2018). However, time/area closures are not a very efficient bycatch prevention method on its own, with only a moderate level of bycatch reduction (30-50%) (Smith et al., 2021). This is also true for the group as a whole, and there would likely by higher coverage if changes in fishing practices were combined with other methods, for example gear change.

CONCLUSION

There are many and diverse methods and instruments available to prevent bycatch. However, much remains to be done to reach the goal level of reduced bycatch. None of the methods we have investigated can guarantee zero bycatch, and many are species specific. To improve efficiency and cover a broader range of species, more measures should be combined (FAO, 2019). There is also a need for further research on bycatch: how it affects the ecosystem and how to prevent it. With better ecological understanding and knowledge of consequences, management plans can be tailored for the specific areas and vessels: considering target catch, fishing method and probable bycatch. There is also a need for incentive for the individual fishermen, for example through legal measures. Lastly, raising awareness and promoting the bycatch issue are key pillars in combating the problem. Only with public awareness, scientific advancement and legal measures, can bycatch be a problem of the past.

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