Addressing ghost gear in Drini Bay

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ABSTRACT

The estimated 640,000 tons of fishing gear lost, abandoned, or discarded annually exerts a large but uncertain impact on marine species. Many turtles become entangled when they use the ghost net mats as shelter and as a food source, experiencing a long and painful death. The aim of this study was to determine the positions of ghost gear in Drini Bay, and then their removal where possible. To achieve this goal, three modules have been developed: (1) underwater survey, (2) removal of located ghost gear and (3) raising fishermen's awareness. A 39.8% reduction in the amount of ghost gears in Drini Bay has caused 24% of turtles to be saved from getting stuck in lost nets. Based on the results, the effect of ghost gears on sea turtles populations is obvious. It is almost impossible to remove all the ghost gears from the seabed, but we can focus on awareness campaigns which have a very positive effect on fishermen, showing the very harmful effects of ghost gears on marine life, the sense of responsibility has been strengthened among fishermen to eliminate the intentional throwing of damaged nets into the sea.

Keywords: Ghost gear, sea turtle, entanglement, underwater survey

INTRODUCTION

Abandoned, lost, or discarded fishing gear (ALDFG), collectively known as ghost gear, is one of the most pervasive forms of marine debris. According to FAO (2020) approximately 640,000 tons of ghost gear are added to the oceans annually, representing 10% of all marine litter by volume. However, its disproportionate impact on marine ecosystems far exceeds this percentage due to its persistence, mobility, and lethal nature. Unlike other types of marine debris, ghost gear continues to "fish" autonomously – a phenomenon termed *ghost fishing*, causing the entrapment, injury and death of countless marine species, including fish, invertebrates, marine mammals, seabirds, and sea turtles.

Ghost gear has particularly devastating effects on endangered species like sea turtles. All seven species of sea turtles worldwide are threatened by entanglement, with ghost nets and longlines accounting for a significant portion of mortality (Duncan *et al.*, 2017). Studies in the Mediterranean and elsewhere have demonstrated that sea turtles are often attracted to ghost gear due to the food debris or algae encrusting it, mistaking the gear for

suitable habitats or feeding grounds. However, this interaction often results in severe injuries, reduced mobility, exhaustion, starvation or drowning. For instance, research conducted by Duncan *et al.* (2017) in the Indian Ocean highlighted that over 80% of olive ridley turtles observed in certain regions were entangled in ghost nets. Similarly, Stelfox *et al.* (2016) documented over 1,000 sea turtle deaths in ghost gear recovered in the Maldives.

Drini Bay, situated along Albania's Adriatic coast, is an ecologically significant area that supports various marine species, including the critically endangered loggerhead turtle, *Caretta caretta* (Linnaeus, 1758) and green turtle, *Chelonia mydas* (Linnaeus, 1758). The bay is a hotspot for fishing activity, including artisanal, semi-industrial and illegal fishing practices, making it particularly susceptible to ghost gear accumulation. Previous reports from local fishers and conservation organizations have highlighted the presence of ghost nets, lines, and traps in the bay, yet systematic data on their distribution, impacts, and mitigation remains scarce.

MATERIALS AND METHODS

Drini Bay is located along the northern Adriatic coast of Albania, characterized by a mix of sandy seabed, rocky outcrops and seagrass meadows. The bay supports a diverse range of marine life, including the critically endangered loggerhead and green sea turtles. Drini Bay is also an active fishing area, with artisanal and semi-industrial fisheries operating in its waters. These activities contribute to the accumulation of ALDFG. Combatting sea turtle bycatch in ghost gears implements in three synergic modules:

Underwater survey in order to locate the exact positions of ghost gears on seabed of Drini Bay. The data about the location and the type of ghost gear are presented on Figure 1;

Removal of ghost nets on some shallower locations by diving and returning to the recycling centers (Figure 2);

Code of conduct and awareness campaigns by discussion with fishermen for ways to minimize the loss and abandonment of fishing gear. Awareness campaigns at the local port, to raise awareness among fishermen on the impact of ghost gear, and to promote the correct discard of used fishing gears, were carried out.

Data collection and analysis

The amount and type of ghost gear removed

During underwater surveys, detailed records were kept on the type, size, and condition of ghost gear recovered. The equipment was categorized into specific types such as gillnet, trawl net, and static net. Divers and teams measured the weight and length of each piece of gear to estimate the total scale of debris.

Observed marine life entanglements before and after removal efforts

Sea turtles entanglements were recorded both during initial surveys and after ghost gear removal efforts. These data were compared pre- and post- removal to evaluate the immediate ecological benefits of clearing ghost gear. Additionally, follow-up observations of previously affected zones highlighted improvements in biodiversity and habitat quality.

Changes in fisher behavior and awareness levels, assessed via surveys conducted pre- and post- campaign

Local fishers were surveyed before and after the awareness campaigns to gauge their knowledge and attitudes toward ghost gear.

Pre-campaign surveys focused on their understanding of ghost gear impacts, disposal practices, and willingness to participate in mitigation efforts. Post-campaign surveys evaluated shifts in these parameters, including reductions in intentional gear dumping and adoption of preventative measures. Qualitative feedback from fishers, such as their perceived economic losses due to ghost gear or newly adopted best practices, was also collected and categorized for analysis. These changes were quantified to assess the effectiveness of the awareness initiatives.

RESULTS AND DISCUSSION

From the underwater survey and from fishermen questionnaire, 83 ghost nets were located in Drini Bay were located. The combined length of ghost gear located is 24.9 km, categorized into specific types such as: 10.3 km gillnet, 7.9 km trawl net and 6.7 km static net. Operations to extract ghost nets from the bottom of the sea in the Drini Bay area have been carried out by 11 dives from the Herpetofauna Albanian Society. During diving, the number of ghost gears was reduced from 83 to 50. The combined length of ghost gear removed from seabed is 5.45 km, were 2.15 km were gillnet, 1.2 km trawl net and 2.1 km static net. The combined mass of ghost gear removed is 656.8 kg. It is well documented that ALDFG has negative impact on benthic habitats (Consoli *et al.*, 2020) and endangered species (Lively & Good, 2019). According to the Kim *et al.* (2016), set gillnets, driftnets, trammel nets and pots are likely the most problematic type of ALDFG.

From the surveys, the number of turtles stuck in ghost gears during 2019 was 117, and in 2022 that number was reduced to 89. In other words, cleaning the seabed by 5.45 km of ghost nets has led to a decrease in the number of sea turtles trapped in ghost nets by 24%.

Sea turtles are one of the most endangered marine reptiles in the world, and highly affected by ALDFG (FAO, 2009).

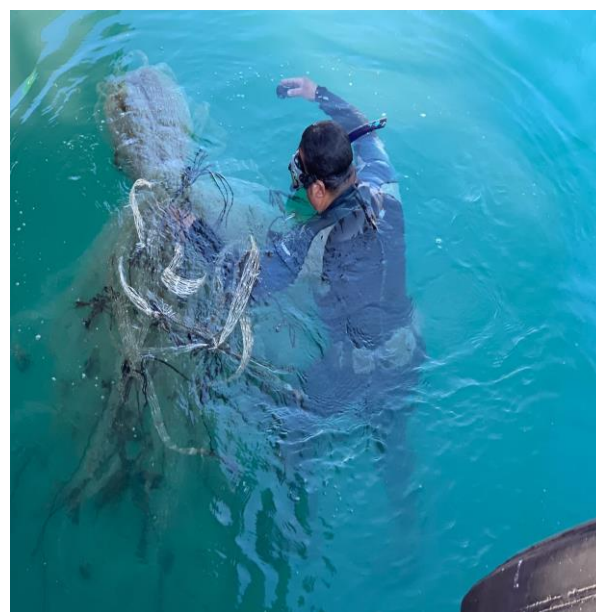Figure 1. Ghost gear located on Drini Bay

Figure 2. Removal of ghost gear from seabed in Drini Bay

There were 219 fishermen interviewed before and after the awareness campaigns, and resulted that 13.8% of fishermen are aware of the impact that ghost gears have on marine life. Also before the awareness campaign it resulted that 13% of fishers discard gears at the sea, and after the awareness campaigns there were 6% of fishers who discard gears at the sea. Raising awareness of the ALDFG problem is a cross-

cutting measure. It can target fishermen themselves, port operators, marine users or the general public through local, national regional or international campaigns. Education can, if effective, facilitate a change in behavior and result in self-policing by stakeholders, and it has the potential to extend beyond those directly targeted, to change behavior in society (FAO, 2009).

CONCLUSION

In order to measure the effect that the removal of a part of ghost nets had on sea turtles, we compare the number of reports from fishermen of sea turtles found stuck on ghost nets before and after the removal. A 39.8% reduction in the amount of ghost gears in Drini Bay has caused 24 % of turtles to be saved from getting stuck in lost nets. And 13.8 % of fishermen are aware of the impact of ghost gear on marine life, impacting also their own business.

Based on the results, the effect of ghost gears have on sea turtles populations is obvious. It is almost impossible to remove all the ghost gears from the seabed, but we can focus on awareness campaigns which have a very positive effect on fishermen, showing the very harmful effects of ghost gears on marine life, the sense of responsibility has been strengthened among fishermen to eliminate the intentional throwing of damaged nets into the sea.

Future initiatives should prioritize expanding awareness campaigns, encouraging fishers to adopt preventative measures, and developing innovative solutions such as biodegradable fishing gear or tracking systems. By fostering a collective effort between environmental organizations, local stakeholders, and regulatory bodies, we can work toward reducing the impact of ghost gear on marine ecosystems and ensuring the long-term health of our oceans.

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Osvrt na napuštene ribarske mreže u zalivu Drima

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SAŽETAK

Procijenjenih 640,000 tona ribolovne opreme koja je izgubljena, napuštena ili odbačena godišnje ima veliki, ali neizvjestan uticaj na morske vrste. Mnoge morske kornjače se zapetljaju kada koriste napuštene mreže kao sklonište i kao izvor hrane, što ih vodi u dugo i bolno ugibanje. Cilj ove studije je bio da se utvrdi položaj napuštenih mreža u zalivu Drima, i da se one uklone gde je bilo moguće. Da bi se postigao ovaj cilj, razvijena su tri modula: (1) podvodno istraživanje, (2) uklanjanje lociranih napuštenih mreža i (3) podizanje svijesti ribara. Smanjenje količine napuštenih mreža u zalivu Drima za 39.8% dovelo je do toga da se 24% kornjača spasi od zapetljavanja u izgubljenim mrežama. Rezultati pokazuju očigledan efekat napuštenih mreža na populaciju morskih kornjača. Skoro je nemoguće ukloniti sve napuštene mreže sa morskog dna, ali se možemo usredsrediti na kampanje podizanja svijesti koje, pokazujući veoma štetne efekte napuštenih mreža na morske organizme, imaju veoma pozitivan efekat na ribare te pojačavju njihov osećaj odgovornosti i zaustavljaju namjerno bacanje oštećenih mreža u more.

Ključne riječi: napuštene mreže, morske kornjače, upetljavanje, podvodno istraživanje