The problem of ghost fishing in Norway

Introduction

Ghost fishing is an invisible problem that also occurs along the Norwegian coast. Ghost fishing means that lost fishing gear continues to capture animals (NOAA 2021). Lost gear tends to be in the ocean for several years with continued catch of both target and non-target species as well as entanglement marine mammals (Macfadyen et al. 2009). The amount of gear lost as well as the mortality resulting through ghost fishing is hardly estimated, but there are studies done on how much certain gear types may catch when abandoned at sea. In this paper, we elaborate the impacts of ghost fishing by abandoned, lost or otherwise discarded fishing gear (ALDFG) on commercially important species in Norway by looking at the amounts of lost gear and the ghost catch as well as possible solutions.

Lost fishing gear

For about 40 years, The Norwegian Directorate of Fisheries (DOF) has been conducting annual cruises to retrieve lost fishing gear and equipment on commercial fishing grounds along the Norwegian coast to minimize ghost fishing (DOF 2020). The retrieved fishing gears in Norway mostly comprised of pots traps, crab pots and gillnets at various hotspots along from South-eastern part of Oslofjorden to Tromsø (Løset 2019). Approximately 20 000 gill nets have been removed from fishing grounds off the Norwegian coast and the Faroe Islands since 1983 (Grimaldo et al. 2018). The data of the DOF on retrieved ghost fishing gear from annual clean-up expedition from 2014 to 2019 along the North Norwegian coast from Ålesund to Svalbard targeting on commercial fishing gear can be seen in figure 1 as the dark blue and grey bars. Also, the not yet published data of the most recent gear retrieval from August to September 2020 is included. During this, about 100 tonnes of lost and discarded fishery equipment and fishing gear where retrieved, resulting in an estimated ghost catch of about 11,000 kg of fish and 15,000 crabs (DOF 2020). In Norway, both commercial and recreational activities notably contribute to quantity of lost fishing gear and equipment in the ocean (CNO 2017). Therefore, additionally the data from *Fritidsfiskeappen* (DOF 2021) from the DOF into is taken into account. In this app, private fishermen can report the loss of gear so that it can be reported to divers to recollect the lost gear. The data give information on the number of pieces of gear retrieved from 2017 to 2021 which mostly consisted of crab pots. As the app was mainly used along the South Norwegian coast, the two datasets make each other complete as far as possible.

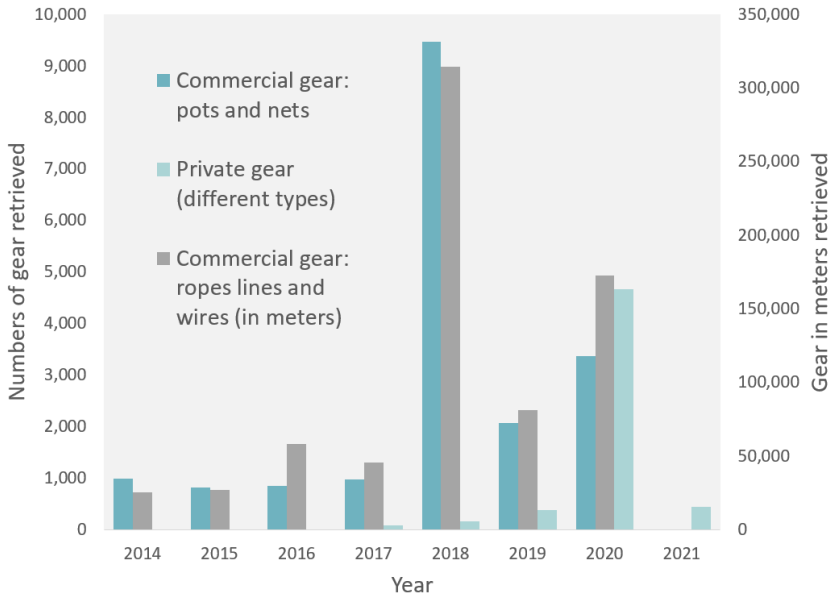

Figure 1: The amount of lost fishing gear retrieved along the Norwegian coast between 2014 – 2021. No bar means no data. (DOF 2020 and 2021)

Lost ghost catch

To only have data on the amount of lost gear shows in fact that there is a huge problem of plastic pollution, but it still does not help to know how big the ghost catch is and thereby the potential loss of fish from ecosystems and the lost potential revenue for fisheries. It is hard to know the exact estimate of animals that is lost to ghost fishing, partly because it varies a lot by gear type. Additionally, the mortality attributed to lost fishing gear is dependent on the species present, species abundance, species vulnerability, and ghost gear status (Brown and Macfadyen 2007). Nevertheless, there are several studies around the world taking on species and gear specific estimates on the amounts of animals lost annually to ghost fishing. Some important species in Norwegian fisheries are for instance Greenland halibut, Atlantic cod, monkfish and snow crab. Biomass of Greenland halibut and cod lost to ghost fishing annually was estimated to be 28-100 kg (20-30% of commercial catches) and 4.9 tonnes per gill net, respectively (Brown et al. 2005; Standal et al. 2020). For snow crab and monkfish estimates in Norwegian fisheries was hard to come by, but studies done in the Gulf of St. Lawrence (snow crab) and Cantabrian Sea (monkfish) estimated an annual loss of 48.2 kg per pot and 18.1 tonnes per 100 meter of gill net, respectively (Hébert et al. 2001, Sancho et al. 2003, Puente et al. 2003).

Mass and financial loss

Table 1: Estimation of financial loss through ghost catch based on gear retrieval numbers. Annual revenue and landings in Norway by species and year found at Statistics Norway (SSB 2021).

	Value mill. NOK 2019	Landings (tonnes)	Price/kg	Kg lost/ gear/ year	NOK lost/ gear/ year	Total mill. NOK lost/ year	% loss mill. NOK
Greenland Halibut	669	17 609	38,0	28-100	1064 - 3800	0,872 - 3,116	0,13 - 0,47
NEA Cod	7486	329897	22,7	4900	111 190	91	1,2
Monkfish	96	3369	28,5	18100	515 761	423	440,5
Snow crab	265	4 049	65,4	48,2	3 155	3,9	1,5

If we use revenue in NOK for each species from the year 2019 to calculate the value per kg and combine it with the estimates of annual ghost catch by gear type, we can calculate lost potential revenue per gear during a year, seen in table 1. Further, we multiply by the number of retrieved pots and gill nets in 2019 from figure 1. The combined lost potential revenue to ghost fishing on the example species in 2019 was 521 million NOK. Thus, for halibut, cod and snow crab the losses is small compared to the annual value (0,13-1,5 %). Note that this is a hypothetical example, the true number of animals lost by ghost fishing is probably different, first the monkfish numbers of ghost catch may not apply for Norway and second for instance because fishing gear tend to catch as well non-target species of crab and fish. Additionally, the calculated numbers are based on the numbers of retrieved gear. The true total financial loss due to ghost fishing is a lot higher than our calculations since not all lost ALDFS is retrieved. For instance, the Norwegian Environmental Agency's estimates of gill nets lost is much higher than the one from the Directory of Fisheries': 500 vs. 13 700 gill nets (Standal et al. 2020).

Ghost fishing and SDGs

It is in the interest of SDG14 "life below water" to address ghost fishing because of the loss of biomass as well as the pollution by the gear itself. Target 14.1 aims to prevent and reduce marine pollution, and this means to significantly reduce the plastic pollution through fisheries. Furthermore, ghost fishing can be categorized as unreported and unregulated fishing, which is addressed in Target 14.4 (UN 2015). Although it is not mentioned by name in SDG14, ghost fishing has to be addressed to achieve the goal. Besides this, ghost fishing in general works against SDG2 "zero hunger" because of the loss of biomass that means that fish, that

could have fed people, is lost, even though marine food is not explicitly mentioned in this goal. Target 12.2 (SDG12 “responsible consumption and production”) refers to the reduction of food loss as well. And it also touches SDG8 “decent work and economic growth”, because the economic loss of the ghost catch stands against the target 8.2 to achieve higher levels of economic productivity (UN 2015).

Present solutions

As ghost fishing is a serious issue to ecosystems and a huge wastage of biomass that is caught but not used economically, there are solutions on their way. The current solutions to counter the ghost fishing in and around the Norwegian coast are mostly relying on voluntary initiatives by locals in cooperation with DOF. They developed the already introduced mobile application called *Fritidsfiskeappen*, which translates to *Recreationalfishingapp* where recreational fishermen can report found or lost gear when on the sea (DOF 2021). This further notifies local diving clubs which volunteer to recover the lost gear, and thus preventing the process of ghost fishing. A solution to the problem is provided by a company leading in the fight against ghost fishing named *Resqunit AS*. They have developed a type of hatch that can be remotely opened if a crab pot trap is lost at sea, releasing the animals stuck inside. In addition to this the hatch is provided with a GPS-transmitter assisting in the recovery process (Resqunit 2021). Further helping counter the problem it is mandatory for commercial fisheries in Norway to report their lost gear to the coast guard, for recreational fishermen it is mandatory to ID your gear with initials and address (CNO 2021).

Outlook

The perfect solution to this problem would of course be to not even lose any gear. But, as seen by the data, loss happens. So, new solutions must be developed to make the lost gear less harmful. An option would be usage of biodegradable fishing gear that ‘disappears’ after a certain time. There is material on the way to be developed for this (Gilman 2016). The suggested challenges here are to make the gear last as long as needed for fishing, but at the same time short enough so that it cannot be harmful for such a long time in the ocean. Until now, this tends to be very expensive and therefore is probably not yet ready for the wide use. To help find gear when lost, there is the as well expensive, but effective and helpful possibility to use underwater drones (Deeptrekker 2020). In any case, the problem of ghost fishing needs more observational research be done to give accurate numbers of gear loss and ghost catches numbers on several species in more places around the world as well as investigating technological research for solutions that easily could be implemented.

Conclusion

The amounts of retrieved gear from the DOF and the estimated amounts of ghost catch possibly caught by these and the high amount of economic loss show that ghost fishing is a serious problem that has to be avoided in the future to minimize the loss and to achieve SDG14. Thankfully we already have some great initiatives in the fight against ghost fishing, the current methods are getting better and more effective, meanwhile the future looks very promising with new types of materials and methods of extracting lost gear which hopefully can solve the issue of ecological and economic levels. Nevertheless, there is more research needed to be able to know the actual loss of biomass and amount of ALDFS.

References

Brown, J. and G. Macfadyen (2007). Ghost fishing in European waters: Impacts and management responses. Marine Policy 31(4), 488-504. DOI: 10.1016/j.marpol.2006.10.007

Brown, J, Macfadyen, G., Huntington, T., Magnus, J. and J. Tumilty (2005). Ghost Fishing by Lost Fishing Gear. Final Report to DG Fisheries and Maritime Affairs of the European Commission. Fish/2004/20. Institute for European Environmental Policy / Poseidon Aquatic Resource Management Ltd joint report. Retrieved from: https://ieep.eu/uploads/articles/attachments/4a24b509-013d-44ca-b26e-47c8f52e29c4/ghostfishing.pdf?v=63664509699. Accessed May 07, 2021.

CNO (2017). Clean Nordic Oceans. [Online]. Retrieved from http://cnogear.org/news/english/successful-retrieval-survey-along-the-coast-of-norway-copy. Accessed May 05, 2021.

Deeptrekker (2020) Retrieved from https://www.deeptrekker.com/news/ghost-fishing. Accessed May 08, 2021.

DOF (2021). Lost and found gear: Fritidsfiskeappen. Retrieved from: https://www.fiskeridir.no/Fritidsfiske/Tal-og-analyse/Tapte-og-funne-reiskap/Oversikt-over-tapte-og-funne-reiskap. Accessed May 03, 2021, 10 am.

DOF (2020). Retrieved from: https://www.fiskeridir.no/English/Fisheries/Marine-litter/Retrieval-of-lost-fishing-gear/Lost-fishery-equipment-removed-from-the-seabed. Accessed May 05, 2021.

FAO (2021). What is ghost fishing? Retrieved from: https://oceanservice.noaa.gov/facts/ghostfishing.html. Accessed May 03, 2021.

Gilman, E. (2016). Biodegradable fishing gear: part of the solution to ghost fishing and marine pollution. Honolulu, Hawaii. DOI: 10.1111/acv.12298

Grimaldo, E., Tveit, G. M., Vollstad, J., Schei, M., & Sullivan, P. (2018). Effect of Using Biodegradable Gill Nets on the Catch Efficiency of Greenland Halibut Bent Herrmann. Wiley Online Library, 10(6), 619–629. DOI: 10.1002/mcf2.10058

Hébert, M., Miron, G., Moriyasu, M., Vienneau, R., and DeGrâce, P. (2001). Efficiency and ghost fishing of snow crab (Chionoecetes opilio) traps in the Gulf of St. Lawrence, Fisheries Research, 52/3, 143-153. DOI: 10.1016/S0165-7836(00)00259-9.

Løset, I.D. (2019). Ghost fishing: the spatial extent of gear loss and effects on marine animal life along the Norwegian coast. Master's thesis. Norwegian University of Life Sciences. Retrieved from: https://nmbu.brage.unit.no/nmbu-xmlui/bitstream/handle/11250/2622431/ Masteroppgave_15.05_IngridL%C3%B8set.pdf?sequence=2&isAllowed=y. Accessed April 30, 2021.

Macfadyen, G., Huntington, T., & Cappell, R. (2009). Abandoned, lost or otherwise discarded fishing gear.

NOAA (2021). What is ghost fishing? Retrieved from https://oceanservice.noaa.gov/facts/ghostfishing. Accessed May 03, 2021.

Resqunit AS (2021). Available from: https://www.resqunit.com/solutions/. Accessed April 23, 2021.

Sancho, G., et al. (2003). Catch rates of monkfish (Lophius spp.) by lost tangle nets in the Cantabrian Sea (northern Spain). Fisheries Research 64(2-3), 129-139. DOI: 10.1016/S0165-7836(03)00212-1

SSB (N.A.). Statistikkbanken. Fiskeri（avslutta i Statistisk sentralbyrå). Retrieved from: https://www.ssb.no/statbank/table/05278/tableViewLayout1/ and https://www.ssb.no/statbank/table/12846/tableViewLayout1/. Accessed May 09, 2021.

Standal, D., Grimaldo, E., and Larsen, R. B. (2020). Governance implications for the implementation of biodegradable gillnets in Norway. Marine Policy, 122, 104238. DOI: 10.1016/j.marpol.2020.10423

UN (2015). Transforming our world: the 2030 Agenda for Sustainable Development, UN General Assembly. A/RES/70/1.