Evaluation of the impacts on endangered, threatened, and protected species from bycatch in fisheries that supply Asda Stores Ltd.

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Introduction

Bycatch, defined here as the incidental take of non-target species, has been identified as one of the most significant issues affecting both the management and conservation of marine fisheries. The type and amount of bycatch associated with individual fisheries depends on several things, including gear design (e.g., hook type), fishing method (e.g., time of day of setting), and the spatial overlap between fishing effort and individual species distribution.

Sharks, sea turtles, sea birds, and marine mammals, all ecologically important taxa in ocean habitats, are highly susceptible to incidental capture in most forms of commercial fisheries. Many of these species are distributed across large geographic areas and therefore have a large overlap with many fisheries, and also have life-history characteristics (late age of sexual maturity, long reproductive cycles, produce small number of young) that make them especially vulnerable to the impact of fishing-associated mortality.

The bycatch of these species is of great concern; many populations are at very low levels and are highly vulnerable to further mortality.

For example, it is currently estimated that 11 species (1.1 percent) of shark assessed by the International Union for the Conservation of Nature (IUCN) are listed as Critically Endangered, 15 species (1.4 percent) are Endangered, 48 species (4.6 percent) are Vulnerable, and 67 species (6.4 percent) are Near Threatened.[1]

Green sea turtles and Kemp's ridley sea turtles are currently listed by the IUCN as Endangered and Critically Endangered, respectively. Leatherback, olive ridley, and loggerhead sea turtles are all listed as Vulnerable by the IUCN.

In addition, 15 of the 22 species of albatross are threatened with extinction, with bycatch identified as a key risk factor for the majority of species (IUCN.org).

Of the 13 critically endangered cetacean populations, 11 are declining due to bycatch in gillnets.[2]

[1] Dulvy, N.K., Fowler, S.L., Musick, J.A., Cavanagh, R.D., Kyne, P.M., et al., 2014. Extinction risk and conservation of the world's sharks and rays. eLife DOI:10.7554/eLife.00590.

[2] Brownell, R.L., Reeves, R.R., Read, A. J., Smith, B.D., et al., 2019. Bycatch in gillnet fisheries threatens Critically Endangered small cetaceans and other aquatic megafauna. Endangered Species Research, 40, 285-296.

The bycatch of ETP species in fisheries also presents a major challenge to retailers that sell seafood and have commitments regarding sustainable sourcing or the protection of biodiversity. Participating in a trade that leads to the decline of vulnerable marine species will breach these commitments, as well as generate significant concern among seafood consumers who do not wish to be associated with these kinds of impacts. It is therefore imperative that retailers take action to identify bycatch problems in their own supply chains and promote measures that will eliminate lethal impacts on marine ETP species.

Asda Stores Ltd. (Asda) is a major retailer in the United Kingdom and has demonstrated significant leadership in addressing issues of marine sustainability, including participation in the Ocean Disclosure Project (ODP). The ODP identifies the wild fisheries that provide the seafood sold in Asda stores and is a useful starting point for evaluating the sustainability of marine products.

Asda is now addressing issues around the impacts of seafood production on endangered, threatened, and protected (ETP) species and whether the supply chains that provide seafood to the business can be mobilized to reduce the impacts of fishing on marine wildlife. Consequently, Asda and Sustainable Fisheries Partnership (SFP) are partnering to conduct research that can assess the risk to ETP marine species from the fisheries that supply the business and then identify the changes required in those fisheries to reduce impacts.

Methodology

Sustainable Fisheries Partnership, Birdlife International and Whale and Dolphin Conservation have collaborated to develop criteria that could be used to identify priority fisheries in the Asda supply chain that are interacting with ETP species from four taxa (elasmobranchs, marine mammals, seabirds, and sea turtles). For this analysis, we have used these criteria to identify known high-risk fisheries for each taxa, based on the Asda profile in the Ocean Disclosure Project. The following brief includes:

- A definition of the criteria
- Background on bycatch issues for each of the taxa
- The identified high-risk fisheries per taxa and recommended monitoring and mitigation methods
- General recommendations to Asda on ways to reduce the impacts of source fisheries on ETP species.

The following criteria were used to assess which fisheries should be considered as high risk for marine ETP species:

- The conservation status of bycatch species as determined by the IUCN
- Available evidence of bycatch/rate and evidence of effects at a population level (or high likelihood of bycatch based on gear type and overlap with susceptible species)
- Scale of the problem (taxa specific), e.g., across the world versus limited to one fishery
- Fisheries that impact species with a very small range
- Fisheries that include cross-taxa bycatch
- Fisheries where Marine Stewardship Council (MSC) certification had been suspended due to non-compliance with elements of Principle 2 in the standard.

Results

Elasmobranchs

While sharks are primarily caught as bycatch in pelagic longline fisheries, large numbers are also caught in purse seine fisheries, where they can become entangled in fish aggregating devices (FADs)[3,4] and in gillnets, particularly in some regions such as the Indian Ocean.[5,6]

High levels of shark bycatch have been reported in pelagic longline fisheries that target tuna and swordfish, and this is considered a major source of mortality for many species worldwide.[7,8,9] Up to one-quarter of the total catch in some pelagic longline tuna fisheries are shark species. The most commonly caught shark species is typically the blue shark, which has a healthy population status in most of its range, though the situation is different for other commonly caught species such as shortfin mako.[10] Many species, such as thresher and hammerhead species, are listed as Vulnerable and Endangered (respectively) by the IUCN or other national measures.

In purse seine fisheries, the predominant bycatch species of shark is the silky shark, followed by the oceanic whitetip shark.[3] Bycatch of these two species in purse seine fisheries can be substantial in both the Indian and Pacific Oceans, and this mortality is negatively impacting their populations.[24,5] The IUCN has listed the silky shark as Near Threatened and the oceanic whitetip as Vulnerable.

Information on bycatch of sharks in gillnet fisheries is often limited, due to poor data collection. Analysis from some fisheries has shown sharks to be a large component of gillnet bycatch.[11] Many species of sharks can be incidentally captured in gillnet fisheries (i.e. shortfin mako, thresher), due to the indiscriminate way in which gillnets are used.[12]

[3] Gilman, E., 2011. Bycatch governance and best practice mitigation technology in global tuna fisheries. Marine Policy 35:590-609.
[4] Rice, J. and Harley, S., 2013. Updated stock assessment of silky sharks in the Western and Central Pacific Ocean. WCPFC-SC9-2013/SA-WP-03.
[5] Murua, H., Santos M.N., Chavance, P., et al., 2013. EU project for the provision of scientific advice for the purpose of the implementation of the EUPOA sharks: a brief overview of the results for Indian Ocean. In: Ninth Session of the IOTC Working Party on Ecosystems and Bycatch La Réunion, France, 12–16 September, 2013. IOTC, La Reunion, France, p. 21.
[6] IOTC, 2016. Composition and abundance of pelagic shark caught by drift gillnet in Cilacap oceanic fishing port, Indonesia. IOTC-2016-WPEB12-17.
[7] Gilman E., Clarke, S., Brothers, N., et al., 2008. Shark interactions in pelagic longline fisheries. Marine Policy 32:1–18. doi: 10.1016/j.marpol.2007.05.001.
[8] Mandelman, J., Cooper, P.W., Werner, T.B. and Lagueux, K.M., 2008. Shark bycatch and depredation in the US Atlantic pelagic longline fishery. Reviews in Fish Biology and Fisheries 18:427-442.
[9] Gilman, E., Chaloupka, M., Swimmer, Y., and Piovano, S., 2016. A cross-taxa assessment of pelagic longline bycatch mitigation measures: conflicts and mutual benefits to elasmobranchs. WCPFC-SC12-EB-IP-04, Bali, Indonesia.
[10] ICCAT, 2017. Report of the 2017 ICCAT shortfin mako assessment meeting. International Commission for the Conservation of Atlantic Tunas.
[11] Shahid, U., Khan, M.M., Nawaz, R., Razzaq, S. and Ayub, S., 2016. Bycatch analysis of tuna gillnet fisheries of Pakistan: an analysis of bycatch data from 2013-2015. World Wide Fund for Nature.
[12] Novianto, D., Nugroho, A.F., and Zedta, R.R., 2016. Composition and abundance of pelagic shark caught by drift gillnet in Cilacop Oceanic Fishing Port, Indonesia. IOTC-2016- WPEB12-17. Indian Ocean Tuna Commission, Victoria.

The loss of sharks has been shown to negatively impact ecosystems. For example, the loss of sharks can lead to changes in the abundance of their prey species, which can lead to a cascade of other trophic-level impacts (i.e., abundance of predators can decrease, or prey behavior can be altered, thereby releasing lower-trophic-level species from predation) in the ecosystem.[13,14,15]

High-risk Fisheries

1. Indian Ocean, South Korea, longline, yellowfin tuna:

South Korea has reported interactions with several species of sharks in its longline fishery, including blue, mako, and porbeagle sharks. Information on shark catches in the Indian Ocean is sparse, and stock assessments have only been conducted for a few species, meaning the status of most is unknown.

Observer coverage of the longline fishery is very low. During 2018, only three observers were deployed on three Korean longline vessels, for a coverage rate of 4 percent. This is below the IOTC-mandated 5 percent coverage rate. Observer coverage rates have ranged between 4 and 5.9 percent since 2014.

The Indian Ocean Tuna Commission (IOTC) has some shark-related management measures in place to prohibit the retention of some species and requires fishers to report interactions. However, there are no shark bycatch-mitigation measures in place, and observer coverage rates are so low they cannot provide an accurate representation of shark bycatch in the fishery.

Priority recommendations:

a) Increase observer coverage on vessels to at least the minimum of 5 percent now, with a goal of achieving 100 percent (human and electronic) coverage within the next three years.

b) Adopt best practice bycatch-mitigation measures for vessels.

c) Require that all vessels collect and provide accurate data on shark captures to the IOTC, according to IOTC guidelines.

d) Require that vessel captains and crews attend shark identification workshops and workshops on best practices for safe handling and release.

[13] Duffy, J.E., 2003. Biodiversity loss, trophic skew and ecosystem functioning. Ecology Letters 6:680-687.
[14] Ferretti, F., Worm, B., Britten, G. L., Heithaus, M. R., and Lotze, H. K., 2010. Patterns and ecosystem consequences of shark declines in the ocean. Ecology Letters, 13: 1055–1071.
[15] Ruppert, J.L.W., Travers, M.J., Smith, L.L., Fortin, M-J., and Meekan, M.G., 2013. Caught in the Middle: Combined Impacts of Shark Removal and Coral Loss on the Fish Communities of Coral Reefs. PLoS ONE 8(9): e74648. https://doi.org/10.1371/journal.pone.0074648.

2. **Western and Central Pacific Ocean, Indonesia, longline, yellowfin tuna:**

There are significant issues with the collection and dissemination of data in this fishery. Indonesian longline vessels have reported the incidental capture of a number of shark species. Currently, there is no mandate for the use of best practice mitigation measures to reduce these interactions.

Data collection on ETP interactions is limited, due to low observer coverage rates, which are far below the mandated 5 percent. During 2018, no observers were deployed on longline vessels. There is no required electronic monitoring on longline vessels. Therefore, there is a lack of data related to the full extent of shark interactions in this fishery.

There is limited information on the status of sharks that are released, which is needed for proper management. A National Indonesian Longline Tuna FIP was initiated during 2019, but this FIP only includes vessels with licenses from the national government and does not include small (<30gt) vessels under the provincial governments.

Priority recommendations:

a) Request vessels <30 GT to participate in the Indonesian National Longline Tuna FIP.

b) Increase observer coverage on vessels to at least the minimum of 5 percent now, with a goal of achieving 100 percent (human and electronic) coverage within the next three years.

c) Require vessels to adhere to the measures in the Western and Central Pacific Fishery Commission WCPFC shark management plan.

d) Require best practice bycatch-mitigation measures be adopted by vessels.

3. **Indian Ocean, Mauritius, purse seine, skipjack tuna:**

Mauritius reports the incidental capture of sharks in its fleet. Mauritius has a National Plan of Action for Sharks (NPOA) in place, which needs monitoring to ensure it is complied with. The NPOA does include a need for improved data collection, but does not appear to push for increased bycatch-mitigation measures.

Mauritius reports about a 15 percent observer coverage rate on its purse seine fleet. Purse seine fleets in other regions typically have 100 percent observer coverage rates.

The IOTC has some shark-related management measures in place to prohibit the retention of some species and requires fishermen to report interactions. However, there are no shark bycatch-mitigation measures in place, and observer coverage rates are so low, they cannot provide an accurate representation of shark bycatch in the fishery.

Priority recommendations:

a) Increase observer coverage on vessels to 100 percent (human and electronic) coverage within the next three years.

b) Require best practice bycatch-mitigation measures be adopted by vessels.

c) Require compliance with measures outlined in the NPOA for sharks.

d) Require that all vessels collect and provide accurate data on shark captures to the Commission, according to IOTC guidelines.

e) Continue providing shark identification workshops and workshops on best practices for safe handling and release.

Seabirds

Seabirds are vulnerable to bycatch impacts from a range of fishing gears. Gillnet fisheries, in the form of driftnets, were among the first to be recognized as problematic for diving seabirds.[16] The global scale of bycatch in all types of this gear was not quantified until 2013, when a figure of 400,000 was conservatively estimated,[17] with the Baltic Sea, North Atlantic (particularly Iceland), and Northwest Pacific identified as hotspots.

Bycatch in longline fisheries has been identified as a key driver in the decline of albatrosses since the late 1980s and early 1990s.[18,19] Longlines continue to drive albatross declines, and also catch smaller petrel and shearwater species.[20] Longlines alone are estimated to kill at least 160,000 seabirds per year, and particular fisheries of concern are those that operate south of 20 degrees latitude (particularly Japanese and Taiwanese tuna vessels on the high seas, and the domestic Brazilian tuna fleet). Other fisheries of concern include North Atlantic demersal longline fisheries for whitefish (e.g., hake targeted by Spanish vessels operating to the west of the UK and Ireland; and cod/haddock targeted in Norwegian, Faroese, and Icelandic waters).

A global estimate of seabird bycatch in trawl fleets is not presently available, but it is likely to be of a similar order of magnitude to longline fisheries.[21,22] Trawl fisheries tend to affect longer-winged species more (i.e., albatrosses), through collisions with the warp cables or entanglements in the nets as birds forage for discards behind vessels.[23] Again, fisheries operating south of 20 degrees latitude (i.e., overlapping with albatross) are of particular concern.

[16] Tull, C.E., Germain, P., and May, A.W., 1972. Mortality of Thick-billed Murres in the West Greenland Salmon fisheries. Nature 237: 42-44.
[17] Žydelis, R., Small, C., and French, G., 2013. The incidental catch of seabirds in gillnet fisheries: A global review. Biological Conservation, 162, 76-88.
[18] Brothers, N.P., 1991. Albatross mortality and associated bait loss in the Japanese longline fishery in the Southern Ocean. Biol Conserv 55:255–268.
[19] Weimerskirch, H., Brothers, N., and Jouventin, P., 1997. Population dynamics of wandering albatross (Diomedea exulans) and Amsterdam albatross (D. amsterdamensis) in the Indian Ocean and their relationship with long-line fisheries: conservation implications. Biol. Cons. 79, 257–270.
[20] Anderson, O.R.J., Small, C.J., Croxall, J.P., Dunn, E.K., Sullivan, B.J., Yates, O., and Black, A., 2011. Global seabird bycatch in longline fisheries. Endang Species Res 14:91-106.
[21] Bartle, A.J., 1991. Incidental capture of seabirds in the New Zealand and sub-Antarctic squid trawl fishery, 1990. Bird Conserv Int 1:351–359.
[22] Birdlife International, 2013. Longline fishing effort overlaps with foraging hotspots for seabirds and causes significant bycatch. Birdlife International.
[23] Sullivan, B.J., Reid, T.A., Bugoni, L., 2006. Seabird mortality on factory trawlers in the Falkland Islands and beyond. Biol Conserv 131:495–504.

In recent years, seabird mortality in purse seine fisheries, particularly of shearwaters, has been recorded in Portugal[24] and Chile[25] and is receiving increased attention, though it has not been quantified on a global scale.

High-risk Fisheries

1. Northeast Atlantic Ocean, Iceland, and Norway, gillnet, cod, and haddock:

Iceland, cod: In a recent review of performance against the MSC standard in relation to bycatch, the ISF Icelandic cod gillnet fishery received an "amber" rating, because, despite having been through at least two MSC certifications, bycatch has not been adequately considered in the certification.[26] The total number of seabirds caught in cod nets was estimated at around 2,500 individuals per year between 2014 and 2016. Northern fulmar was reported to be the most commonly captured bird, at an average of 1,700 individuals per year, followed by common guillemot and common eider, with an average of 450 and 140 individuals per year respectively.[27]

Norway, cod: In the same review of MSC performance in relation to bycatch, the Norway Northeast Arctic cod/haddock gillnet fishery received a "red" rating, as it had failed to implement bycatch-reduction measures.[25] Seabird bycatch per unit of effort in the Norwegian gillnet cod fishery is lower than in the lumpfish fishery (another gill net fishery of concern): 0.002 vs. 0.038 individuals/net/day.[28] However, due to greater effort in the cod fishery (2,500 cod vessels vs. 310 lumpfish vessels in 2009), the total numbers of seabirds caught in both fisheries is very similar, at around 3,100-3,400 individuals for the cod fishery, dominated by auk species.

Priority recommendations:

a) Increase observer coverage on vessels to at least 5 percent now, with a goal of achieving 100 percent (human and electronic) coverage within the next three years and annual presentation of bycatch data to calculate a bycatch rate from each fishery.

b) Require implementation of best practice mitigation measures and demonstrate continual reductions in the bycatch rate.

[24] Oliveira, Nuno and Henriques, Ana & Miodonski, Joana & Pereira, Joana & Marujo, Débora & Almeida, Ana & Barros, Nuno & Andrade, Joana & Marçalo, Ana & Santos, Jorge Manuel & Oliveira, Isabel & Ferreira, Marisa & Araújo, Hélder & Monteiro, Silvia & Vingada, José & Ramírez, Iván & Spea, A & Portugal, 2015. Seabird bycatch in Portuguese mainland coastal fisheries: An assessment through on-board observations and fishermen interviews. Global Ecology and Conservation. 3. 51-61. 10.1016/j.gecco.2014.11.006.

[25] Suazo, Cristián & Cabezas, Luis & Moreno, Carlos & Arata, Javier & Luna-Jorquera, Guillermo & Simeone, Alejandro & Adasme, Luis & Azocar, Jorge & García, Marcelo & Yates, Oliver & Robertson, Graham, 2014. Seabird bycatch in Chile: A synthesis of its impacts, and a review of strategies to contribute to the reduction of a global phenomenon. Pacific Seabirds. 41. 1-12.

[26] Crespo, J.P. and Crawford, R., 2019. Bycatch and the Marine Stewardship Council (MSC): A review of the efficacy of the MSC certification scheme in tackling the bycatch of non-target species. BirdLife International.

[27] Marine and Freshwater Research Institute., 2017. Bycatch of Seabirds and marine mammals 2014-2016. Meðafli fugla og sjávarspendýra 2014-2016.

[28] Fangel, Kirstin & Aas, Øystein & Vølstad, Jon & Bærum, Kim & Christensen-Dalsgaard, Signe & Nedreaas, Kjell & Overvik, Modulf & Wold, Line & Anker-Nilssen, Tycho., 2015. Assessing incidental bycatch of seabirds in Norwegian coastal commercial fisheries: Empirical and methodological lessons. Global Ecology and Conservation. 14. 10.1016/j.gecco.2015.06.001.

c) Consider changing gear types and avoiding gill nets if this delivers an overall reduction in bycatch incidents.

2. North Pacific, Alaska/Pacific Canada, gillnets, salmon (chum, pink, and sockeye):

The species of most concern are diving seabirds – known to be particularly at risk of bycatch in gillnets – such as the marbled murrelet, which is listed under the US Endangered Species Act and listed as Endangered on the IUCN Red List. Overall, the data used in the MSC assessment for this fishery are highly variable both in time and space and do not specifically address the different fishing practices nor question the data accuracy of the test fisheries that were used to predict bycatch levels. Some data used in the assessment were not exploited to their full extent and/or contained limitations, which may have resulted in an underestimation of bycatch.

Priority recommendations:

a) Increase observer coverage on vessels to at least the minimum of 5 percent now, with a goal of achieving 100 percent (human and electronic) coverage within the next three years (including lower-cost alternatives for small vessels).

b) Ensure research and mitigation trials to reduce bycatch are conducted. The fishery does have a new MSC condition to do this, but it will be important to ensure that it is delivered in a satisfactory fashion.

3. Southern Indian Ocean, South Korea, longline, albacore:

There is a need for Korea to start using electronic monitoring (EM) on its vessels, to demonstrate use/compliance with seabird bycatch-mitigation measures. Korea reports that vessels are using bird-scaring lines and line weights, and reported seabird bycatch rates are low (e.g., Korea's annual report to the IOTC Scientific Committee in 2019 which reports observed seabird bycatch for the period 2014-2018[29]), but this relies on data collected by observers, which only have about 4 percent longline coverage.

Priority recommendations:

a) Increase observer coverage on vessels from at least the minimum of 5 percent now, with a goal of achieving 100 percent (human and electronic) coverage within the next three years, with a specific aim of being able to determine compliance with seabird mitigation measures.

[29] Kim, D., Lee, S., Lee, M., and Kwon, Y., 2019. Korea national report to the Scientific Committee of the Indian Ocean Tuna Commission, 2019. IOTC-2019-SC22-NR13.

Marine mammals, including seals and cetaceans (whales, dolphins, and porpoises)

Marine mammal bycatch data are poor in most fisheries. The latest scientific assessment (2006) calculated that many hundreds of thousands of marine mammals are killed in fisheries each year,[30] although this contains caveats and is likely to be an underestimate. For example, a recent review of the Indian Ocean tuna gillnets determined that 4 million dolphins have been bycaught since 1950.[31] Static net fisheries (gill nets, tangle nets, etc.) are widely reported to have the biggest global impact on marine mammals.[32]

Static rope gear using pots and traps is also a problem for a range of marine mammals, particularly for baleen whales and especially for the endangered North Atlantic right whale and humpback whale. Lethal entanglements of baleen whales are, arguably, one of the worst forms of human-caused mortality in any wild animal,[33] often lasting for long periods of time and causing immense suffering.

Purse seine fisheries can also incidentally capture marine mammals. Population-level impacts have been associated with the deliberate setting of purse seine nets around dolphins in tuna fisheries in the Eastern Tropical Pacific since the 1960s.[34] Despite reduced mortality rates of dolphins, to fewer than 1,000 per year in recent decades, the populations of dolphins are not showing signs of recovery,[35,36] and the rate of calf production has been declining since the 1980s.[37] In US purse seine fisheries, species most commonly captured include bottlenose dolphins and humpback whales.[38]

Marine mammals can become entangled by trawl gear when swimming to forage or migrate, with risks differing widely between species. Species that forage on or near the sea floor are at risk of being captured or entangled in netting or tow lines. Pilot whales and common dolphins in the Atlantic are particularly susceptible to being caught in bottom trawls.[39]

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[30] Read, A. J., Drinker, P., and Northridge, S., 2006. Bycatch of marine mammals in U.S. and global fisheries. *Conservation Biology* 20:163–169.

[31] Anderson, R., Herrera, M., Moazzam, M., Ilangakoon, A., Mustika, P., and Sutaria, D., 2020. Cetacean bycatch in Indian Ocean tuna gillnet fisheries. *Endang Species Res* 41: 39–53.

[32] Reeves, R.R., McClellan, K., and Werner, T.B., 2013. Marine mammal bycatch in gillnet and other entangling net fisheries, 1990 to 2011. *Endangered Species Research* 20: 71– 97.

[33] Cassoff, R.M, Moore, K.M., McLellan, W.A., Barco, S.G., Rotstein, D.S., and Moore, M.J., 2011. Lethal entanglement syndrome in baleen whales. *Diseases of Aquatic Organisms* 96: 175– 185.

[34] Wade, P. R., Watters, G. M., Gerrodette, T., and Reilly, S. B., 2007. Depletion of spotted and spinner dolphins in the eastern tropical Pacific: modeling hypotheses for their lack of recovery. *Marine Ecology Progress Series* 343: 1-14.

[35] Gerrodette, T. and Forcada, J., 2005. Non-recovery of two spotted and spinner dolphin populations in the eastern tropical Pacific Ocean. *Marine Ecological Progress Series* 291: 1–21.

[36] Wade, P. R., Reilly, S.B., and Gerrodette, T., 2002. Assessment of the population dynamics of the northeastern offshore spotted and the eastern spinner dolphin populations through 2002. SWFSC Admin. Rep., La Jolla, LJ-02-13.58 p.

[37] Cramer, K. L., Perryman, W.L., and Gerrodette, T., 2008. Declines in reproductive output in two dolphin populations depleted by the yellowfin tuna purse-seine fishery. *Marine Ecology Progress Series* 369:273–285.

[38] NOAA. FIshing Gear: Purse Seines. https://www.fisheries.noaa.gov/national/bycatch/fishing-gear-purse-seines.

[39] Rossman, M.C., 2010. Estimated bycatch of small cetaceans in northeast US bottom trawl fishing gear during 2000–2005. *J. Northw. Atl. Fish. Sci.*, **42**: 77–101. doi:10.2960/J.v42.m650.

Longline fisheries have very poor data on marine mammal interactions, but have been noted as a concern by some studies.[25]

Hook and line, and handline fisheries are not considered further, as they have minimal bycatch, although other impacts are possible.

High-risk Fisheries

1. North Atlantic Ocean, pots and traps, American lobster:

The North Atlantic right whale population, in its range off the US and Canadian east coast, is estimated to number approximately 400 individuals,[40] and there are now only about 95 breeding-age females in this small population. The population has been in decline since 2010, due to entanglement or ship strike.[42] Since April 2017, 30 dead stranded whales have prompted an "Unusual Mortality Event."

Any fishing gear that is fixed in the water column and is marked or hauled using a vertical line poses a risk to right whales. Given the high volume of trap/pot and gillnet fisheries in the waters where right whales feed, calve, and transit, the highest risk comes from these fisheries. This is supported by the evidence collected from right whales that have been observed or disentangled.[42]

Examination of large baleen whale entanglement mortalities has shown a variety of chronic impacts for persistent terminal entanglements. Entangled right whales have a lower probability of survival than unaffected individuals,[41] although 85 percent of right whales show scars of entanglement. Protracted causes of death include impaired foraging during entanglement, resulting in emaciation through reduced mobility and foraging ability, and energy budget depletion leading to starvation after many months or years; systemic infection arising from open, unresolved entanglement wounds; and hemorrhage or debilitation due to severe gear-related damage to tissues.

Priority recommendations:

a) Require robust gear marking to identify lines both regionally and by fishery.

b) Adopt measures that reduce risk to right whales, including substantial reductions in the number of traps, gear modifications, and the adoption of closed areas, such that the cumulative effect reduces right whale entanglement to zero.

c) Conduct pilot projects with ropeless technologies to establish alternative fishing methods that present zero risk to whales, with a view to rolling out such gear fleet-wide.

[40] Pettis, H.M., Pace, R.M. III., and Hamilton, P.K., 2019. 2019 Annual Report Card. North Atlantic Right Whale Consortium.

[41] Robbins, J., Knowlton, A.R., and Landry, S., 2015. Apparent survival of north Atlantic right whales after entanglement in fishing gear. Biological Conservation 191:421-427.

2. Northeast Atlantic Ocean, Iceland and Norway, gillnet, cod, and haddock:

In the recent review of MSC performance in relation to bycatch (see seabird section above), the Norway Northeast Arctic cod/haddock gillnet fishery received a "red" rating, as it had not implemented bycatch reduction measures; and the ISF Icelandic cod gillnet fishery received an "amber" rating because, despite having been through at least two MSC certifications, bycatch has not been adequately considered in the certification.[25]

Harbour porpoises are the most common marine mammal bycatch in the Norwegian fishery, with an average of 1,841 individuals caught per year. The cod fishery also catches harp seals, harbour seals, and ringed seals. As noted for the Icelandic lumpfish fishery, which lost its MSC certification and has high levels of harbour porpoise and harbour seal bycatch, humpback whales have been recorded with scarring linked to entanglements in gillnets in Icelandic waters.[42]

Bycatch mortalities in the Norway cod gillnet fishery are estimated to range from 2,211 to 3,218 for harbour porpoises, from 424 to 600 for harbour seals, and from 68 to 128 for grey seals.[43] A recent letter from Norway to the US government gave annual bycatch estimates of 3,000 harbour porpoises, 555 harbour seals, and 466 grey seals for the cod and monkfish gillnet fisheries combined.[44]

Priority recommendations:

a) Increase observer coverage on vessels to at least 5 percent now, with a goal of achieving 100 percent (human and electronic) coverage within the next three years.

b) Require an annual presentation of bycatch data to calculate a bycatch rate from each fishery.

c) Require implementation of best practice mitigation measures (alongside evidence of efficacy, e.g., spatiotemporal closures for both seabirds and cetaceans, where appropriate and evidence based), to demonstrate continual reductions in the bycatch rate.

d) Consider changing gear types and avoiding gill nets.

[42] Basran, C., Bertulli, C., Cecchetti, A., and Rasmussen, M., 2014. First estimates of entanglement rate of humpback whales Megaptera novaeangliae observed in coastal Icelandic waters. Endangered Species Research 38:66-77.
[43] Moan, A., 2017. Bycatch of harbour porpoise, harbour seal and grey seal in Norwegian gillnet fisheries. Master Thesis, University of Oslo.
[44] Bjorge, A. and Moan, A., 2017. Revised estimates of harbour porpoise (Phocoena phocoena) bycatches in two Norwegian coastal gillnet fisheries. SC/24/BYCWG/08.

Sea Turtles

Sea turtles are restricted to temperate and tropical seas, with loggerhead and leatherback turtles ranging into high latitudes such as Northern Europe and the northern coastline of the US, and leatherbacks ranging into Canadian waters.[45] Fisheries in high latitudes that impact other taxa will therefore be less relevant for sea turtles.

All seven species of sea turtles have a similarly complex life cycle, at the various stages of which they are subject to different threats, the most significant of which is generally considered to be fisheries bycatch. All sea turtle species are considered ETP. Rates of development vary between and within species; for many populations, age at maturity is unclear, but is often estimated as being between 20 and 50 years.[46,47] These uncertainties, along with low or non-existent fisheries observer coverage, confound our ability to understand the population-level impacts of fisheries mortality at the different life stages (e.g., pelagic juvenile, pelagic adult, neritic juvenile, neritic adult) of the various populations.[48]

There is no robust estimate for sea turtle bycatch worldwide because of a global paucity of data, specifically observer information, especially for small-scale fisheries. However, in the Mediterranean Sea alone, a conservative estimate is more than 44,000 deaths annually.[49] Sea turtles can be caught and incidentally killed in most fisheries, with bottom trawls, gillnets/trammel nets, demersal, and pelagic longlines being the biggest contributors.

Bycatch reviews[49,50,51] used the limited available fisheries data to assess the relative importance of global fisheries bycatch on sea turtles. These reviews highlight the Eastern Pacific, Northwest and Southwest Atlantic, and Mediterranean regions as those with the most sea turtle captures, with the majority of captures (60 percent) on longlines, although observer data have notably been low for gillnets overall.

Longlines had high capture rates, but their impacts (considering life stages and populations of turtles affected, fishing effort, and mortality rate) were significantly lower than in set nets/gillnets and trawls.[53,49] Specific fisheries implicated are gillnets, longlines, and trawls in the Mediterranean Sea, and longlines in the Northwest Atlantic and Eastern Pacific Oceans.

[45] Hamelin, K. M., James, M. C., Ledwell, W., Huntington, J., and Martin, K., 2017. Incidental capture of leatherback sea turtles in fixed fishing gear off Atlantic Canada. Aquatic Conservation: Freshwater and Marine Ecosystems, 27, 631-642.
[46] Casale, P., 2011. Sea turtle bycatch in the Mediterranean. *Fish and Fisheries*, 12, 299-316.
[47] Scott, R., Marsh, R., and Hays, G. C., 2011. Life in the really slow lane: loggerhead sea turtles mature late relative to other reptiles. *Functional Ecology*, 26, 227-235.
[48] Wallace, B.P., Heppell, S.S., Lewison, R.L., Kelez, S., and Crowder, L.B., 2008. Impacts of fisheries bycatch on loggerhead turtles worldwide inferred from reproductive value analyses. *Journal of Applied Ecology*, 45, 1076-1085.
[49] Wallace, B.P., Lewison, R.L., McDonald, S.L., McDonald, R.K., Kot, C.Y., Kelez, S., Bjorkland, R.K., Finkbeiner, E.M., Helmbrecht, S., and Crowder, L.B., 2010. Global patterns of marine turtle bycatch. *Conservation Letters,* 3, 131-142.
[50] Wallace, B.P., Kot, C.Y., DiMatteo, A.D., Lee, T., Crowder, L.B., and Lewison, R.L., 2013. Impacts of fisheries bycatch on marine turtle populations worldwide: toward conservation and research priorities. *Ecosphere*, 4, 1-49.
[51] Lewison, R.L., Crowder, L.B., Read, A.J., and Freeman, S.A., 2004. Understanding impacts of fisheries bycatch on marine megafauna. *TRENDS in Ecology and Evolution*, 19, 598-604.

High-risk Fisheries

Overall, most fisheries used by the Asda supply chain are outside of the Mediterranean, Eastern Pacific, and Western Atlantic regions, which have been highlighted as the regions of greatest concern for sea turtle bycatch. However, towed dredges targeting Atlantic surf clams in the Gulf of St. Lawrence in Canada have very limited information and could be interacting with critically endangered leatherback turtles.[52]

Focus should therefore be directed to the pelagic longline fisheries of East and Southeast Asian countries, where there is considerable concern over sea turtle captures in fisheries targeting tunas in the Central, Northern, and Western Pacific.

1. Western and Central Pacific Ocean, Indonesia, Japan, South Korea, longline, yellowfin tuna:

The Western and Central Pacific region supports a high number of sea turtle Regional Management Units (RMUs). RMUs are distinct marine turtle sub-populations, individually assessed based on the risk of extinction and threat levels. Many (13 to 20, depending on the area of operation) ETP sea turtle species overlap in this region and could be interacting with tuna longline fisheries. Included in this region are 1) loggerhead turtles of the Northern Pacific, which are considered to be under high risk and high threat, 2) Western Pacific olive ridley turtles, which are under high threat, and 3) leatherback sea turtles in the Western Pacific, which are under high risk.[53] In addition, these fisheries have low observer coverage rates (~5 percent), which makes it difficult to accurately estimate sea turtle interactions.

Priority recommendations:

a) Require the use of fish rather than squid as bait.

b) Require the use of wide circle hooks to reduce the proportion of caught turtles that are deep hooked, to improve their chances for post-release survival.

c) Train crew and put procedures in place for safely bringing turtles on board, handling them, and removing hooks, while minimizing damage. There are many guideline documents and training materials available that are generally transferable between fisheries. Equipment (e.g., scoop net, steel cutters/dehookers/line cutters; see guidelines below) must be maintained and ready to use.

d) Require that vessels adhere to the Western and Central Pacific Fisheries Commission (WCPFC) management measures for sea turtles.

e) Increase observer coverage on vessels to at least 5 percent now, with a goal of achieving 100 percent (human and electronic) coverage within the next three years.

[52] Fisheries and Oceans Canada, 2012. Assessment of leatherback turtle (*Dermochelys coriacea*) fishery and non-fishery interactions in Atlantic Canadian waters. Canadian Science Advisory Secretariat Science Advisory Report 2012/041 (https://waves-vagues.dfo-mpo.gc.ca/Library/347525.pdf).
[53] Wallace, B.P., DiMatteo, A.D., Bolten, A.B., and Chaloupka, M.Y., 2011. Global Conservation Priorities for Marine Turtles. *PLoS one*, e24510.

2. Northern Pacific Ocean, South Korea, longline, albacore:

These fisheries operate in the ranges of 1) loggerhead sea turtles in the Northern Pacific, 2) olive ridley sea turtles in the Western Pacific, and 3) leatherback sea turtles in the Western Pacific, which are of particular concern.[56] In addition, these fisheries have low observer coverage rates (~5 percent), which makes it difficult to accurately estimate sea turtle interactions.

Priority recommendations:

a. Increase observer coverage on vessels to at least 5 percent now, with a goal of achieving 100 percent (human and electronic) coverage within the next three years.

General recommendations for Asda to minimize bycatch impacts on ETP species in source fisheries

The risk assessment above demonstrates a wide range of potential bycatch impacts to ETP species from the fisheries that supply Asda. However, there are a number of common themes that emerge from this analysis:

- Levels of bycatch monitoring are generally poor, and there is a need to adopt higher levels of observer coverage.
- There is an urgent need for a significant increase in the levels of bycatch incident reporting (which should be regular, detailed, and standardized). Data on bycatch need to be placed in the public domain, to be available to all stakeholders.
- There is minimal effort to continuously improve bycatch reduction. Bycatch mitigation activities, such as they are, seem to be focused on achieving minimum requirements.
- There is a clear need for a systematic examination of alternative gear options in fisheries where there are high bycatch risks.

The partners in this project would recommend that all retailers adopt a common procedure for addressing issues of ETP bycatch in their seafood supply chains**:**

1. Identify high-risk fisheries in the supply chain that pose the greatest danger to ETP species (as Asda has done with this report).

2. Adopt a formal procurement policy that commits to only sourcing seafood from fisheries that 1) use best practices for minimizing ETP bycatch or are taking clearly measurable steps toward that goal and 2) have effective independent observer coverage (whether in-person or electronic) or to be taking measurable steps toward that goal.

3. Communicate the requirements of your procurement policy to your suppliers and ask for reports on how that policy will be implemented down the supply chain.

4. Ask source fisheries to switch or amend gear types when less-damaging gear options are both practical and available.

5. After bycatch problems in high-risk fisheries are being effectively addressed, retailers should proceed to examine medium-risk fisheries, to ensure effective monitoring is in place and any necessary mitigation measures adopted.

Increasing observer coverage and implementing best practices in bycatch mitigation takes time, and it may be the work of several years to fully implement. In the meantime, there are short-term measures that can be adopted which may yield positive benefits. Examples of good practice can be seen in the SFP guide to best practices in tuna longline fisheries and in the NGO Tuna Forum guide to best practices in tuna purse seine fisheries.

Some other possible options are described in the table below:

Gear	Sharks	Sea turtles	Sea birds	Marine mammals	General
Gillnets	Avoid if safer alternative available	Avoid if safer alternative available	Avoid if safer alternative available	Avoid if safer alternative available	Avoid if safer alternative available
Longline	Prohibit the use of wire leaders	Use large circle hooks	Use hook-shielding devices	Avoid known hotspots	Require safe handling and release practices
Purse seine	Require non-entangling and biodegradable FAD design	Require non-entangling and biodegradable FAD design	Use modified purse seines	Prohibit intentional setting on marine mammals	Require safe handling and release practices

Conclusions

This review of the potential bycatch impacts of the fisheries that supply Asda on ETP species demonstrates that there are significant risks to marine biodiversity that need to be addressed. Asda is a sector leader in adopting sourcing commitments regarding sustainable seafood and is to be commended for commissioning this report to inform future action. The question therefore is how best to secure action to protect ETP species in source fisheries in the future.

One potential option for retailers seeking to take action on the bycatch of ETP species is to source product that has been certified to a standard for sustainable fisheries. However, sourcing from certified fisheries is unlikely to deliver improvements at the scale required, because:

a) Current certifications do not provide adequate protection from bycatch for ETP species, as they do not clearly insist on best practices in mitigation and effective observer coverage.

b) Many of the high-risk fisheries are not certified to any particular standard.

Consequently, sustainability certifications are unlikely to prove effective in delivering the necessary mitigation for vulnerable ETP species.

The alternative approach is for retailers to engage their suppliers in directly requesting action from source fisheries through the adoption of best practices in bycatch mitigation (including enhanced observer coverage, different gear types, and adapted fishing procedures). This request will be more powerful if delivered by a large number of businesses within the seafood supply chain (for example, retailers, food service, suppliers, etc.) and if existing institutions that promote a sustainable seafood industry are effectively engaged.

If a large number of members of the seafood supply chain follow Asda's lead and adopt commitments to address the bycatch of ETP species in their source fisheries, it will create a significant force for change with very large benefits for marine biodiversity.