Chapter 40. Sharks and Other Elasmobranchs

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Sharks and rays are among the most endangered group of marine animals and include many species for which there is little information on abundance and distribution. There are no global abundance trends for elasmobranchs as a group, and very few robust regional trend indicators. Population-level stock assessments, which provide the most reliable index of abundance, are available for only about 10 per cent of 1,088 chondrichthyan species (FAO 2012).

global shark catches are on the order of 1.7 million mt in recent years (Clarke et al.

basis oftime series of catch and fisheries development, and species life histories traits (Costello et al., 2012). This isindicative of overfishing.

1.1 Conservation status

A comprehensive analysis of 1,041 chondrichthyan species on the IUCN Red List (www.redlist.org8 w r 0 (

2.2 Fishing

Mortality due to fishing is almost entirely responsible for the worldwide declines in shark and ray abundance. Although directed shark fishing is still practised in some countries, a much larger proportion of overall shark mortality is associated with by-catch in non-shark fisheries (Lewison et al., 2004).

2.2.1 By-catch

Sharks have typically been exploited as a by-catch of commercial fisheries targeting more valuable bony fishes, especially tuna and billfish (ICCAT, 2005) and in trawl fisheries exploiting groundfishes and shrimps (Shepherd and Myers, 2005). In many countries, shark by-catch is partially or primarily retained for the fin and/or food trade. But even where living sharks are released at sea because they are considered unwanted catch, post-release mortality rates can exceed 18 per cent for some species (Campand s

2.2.3 Shark fishing for fins

In recent decades, an increasing demand for shark fins from the Asian market stimulated the conversion of many industrial fisheries from bony fishes to sharks (Amorim et al., 1998; Aires-da-Silva et al., 2008). For countries in central America and in southeastern Asia, shark finning has become an important source of income (Dell'Apa et al., 2014).

The commercial trade in shark fins has been a primary driver of shark mortality. With prices of up to 2,000 United States dollars per kg, and a total estimated market value of about 350 million dollars, the fin trade is a strong motivator for retaining shark bycatch (Worm et al., 2013). The fin trade (which also includes fins of landed sharks) has been linked to a median annual estimate of 38 (IQI: 26–73) million sharks landed, resulting in fishing mortality rates which are unsustainable for some species (Clarke et al., 2006, 2013).

explained most of the declining patterns in abundance and diversity (Ferretti et al., 2013).

2.4 Pollution

Persistent bioaccumulation of toxins and heavy metals have been documented in sharks feeding at high trophic levels, at concentrations which can be toxic to human consumers, but their effect on the host shark remains unclear (Storelli and Marcotrigiano, 2001; Mull et al., 2012).

3. Ecosystem effects of shark depletion

3.1 Community changes through predator or competitor release

Sharks are very abundant and diverse in unperturbed ecosystems (Nadon et al., 2012; Ferretti et al., 2010). However, because of their slow population productivity, low levels of fishing mortality may rapidly deplete these communities, with consequent pervasive effects on the structure and functioning of marine ecosystems. The overfishing of sharks can trigger community changes because of changing interspecific interactions among shark species and between sharks and other marine animals. Thus overfishing of large sharks triggered range expansions of more prolific broad-ranging competitors in coastal and offshore areas (Baum and Myers, 2004; Dudley and Simpfendorfer, 2006; Myers et al., 2007), and increases in small elasmobranchs released from shark predation (van der Elst, 1979; Myers et al., 2007; Ferretti et al., 2010). Sharks are often the sole consumers of small mesopredators, such as small sharks and rays (Ea

4.2 By-catch mitigation options

Reduced by-catch of sharks is usually the preferred option, since it results in both reduced shark mortality and reduced loss of fishing gear and bait (and therefore increased profits) by fishermen.

4.3 Spatial or seasonal closures

In principle, by-catch can be reduced by restricting access to "hot-catch hotspots" through spatial or seasonal closures, although this approach is complicated by the similar habitat preferences of the target species and the shark by-catch. To this point, there is still little evidence of the effectiveness of large sanctuaries for sharks (mainly because of the absence of empirical data), although analyses of shark abundance and distribution along spatial gradients suggest that these might be effective management options (Ferretti et al., 2013).

Closure of shark mating and pupping grounds to fishing increases the protection of sensitive life-history stages (i.e. Campana et al., 2008). By-catch can also be reduced through modifications to fishing gear; for example, the introduction of the circle hook has reduced shark hooking mortality relative to the traditional J hook (Kaplan et al., 2007). However, other attempts to reduce shark catchability through use of rare earth metals and electrical fields have had [illegible]

thus fin sales (Eilperin, 2011). Fisheries regulations requiring that the entire shark carcass be landed, and not just the fins, would also reduce shark mortality, as capacity is much more limited by the presence of entire sharks than by the much smaller fins. In some countries there is a fin-to-carcass ratio regulation which requires fishers to land no more than a given percentage of fin weight relative to total landings (Davidson et al., 2015).

4.7 Implementation of international policies

In response to the perception that many of the world's elasmobranch species are severely depleted, several international organizations have moved to actively conserve some shark and ray species. The Food and Agriculture Organization of the United Nations (FAO) released an International Plan of Action for the Conservation and Management of Sharks urging immediate action to better document and conserve shark and ray species (FAO 1998). The Convention on the Conservation of Migratory Species of Wild Animals[1] (CMS) has listed eight shark species for international conservation and protection (CMS 2014; http://www.cms.int/en/species). Finally, the Shark Specialist Group of the International Union for Conservation of Nature (IUCN) provides information and guidance to governments and non-governmental organizations associated with the conservation of threatened shark species and populations. The SSG released their report on the Global Status of Oceanic Pelagic Sharks and Rays in 2009. As a final step of protection, the international Convention on International Trade in Endangered Species of Wild Fauna and Flora[2] (CITES) attempts to protect endangered species through international trade regulations, such as restrictions on import and export. To this point, CITES has listed 18 shark and ray species under their Appendi I and II trade restrictions (CITES 2014; http://checklist.cites.org), which will remain in place until it can be demonstrated that the population is being managed sustainably. CITES trade restrictions appear to have tangible effects on the trade of listed shark species, and thus reduce the demand (Wells and Barzdo, 1991). However, it is yet to be seen if CITES listings can be implemented in time to protect species, which have already reached the brink of extinction (e.g., sawfish).

5. Ecotourism

Ecotourism in the form of shark diving has become a booming industry generating millions of dollars for local economies worldwide (Musick and Bonfil, 2005; Gallagher and Hammerschlag, 2011). One estimate suggests that shark ecotourism currently generates more than 314 million US dollars per year and supports about 10,000 jobs. Projections suggest that this figure could double in the next 20 years and thus surpass

[1] United Nations Treaty Series, vol. 1651, No. 28395.
[2] United Nations Treaty Series, vol. 993, No. 14537.

the landed value of global shark fisheries (Cisneros-Montemayor et al., 2013). Indeed, in terms of individual value, sharks in some localities may be worth more alive than if landed and marketed. In the Maldives, it has been estimated that an individual free swimming grey reef shark is worth 33,500 dollars per year compared to 32 dollars for the same individual sold dead by local fishermen. In the Bahamas, shark diving generates annual revenues of 78 million dollars (Gallagher and Hammerschlag, 2011). In the Maldives (where shark fishing has been banned), ecotourism contributed >30 per cent of the Maldivian GDP (Gallagher and Hammerschlag, 2011).

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