Entanglement in fishing gear is identified as a major threat for several oceanic species (IUCN, 2019). Other interactions with fisheries, such as catch depredation and bait stealing by false killer, killer and sperm whales can result in deterrent actions, such as shooting and subsequent mortality (Tixier and others, 2019; Werner and others, 2015; Hamer and others, 2012). Pg154

Bycaught marine mammals ~~can~~ often complement fishery catches for human consumption. This practice can be further complemented by hunting or the use of stranded animals in some countries (Robards and Reeves, 2011). Such use of marine mammals has been termed "aquatic wild meat"[1] or "marine bushmeat". This is an analogy with 'bushmeat' in supporting food security in deprived regions (Cosentino and Fisher, 2016; Clapham and Van Waerebeek, 2007). Catch and consumption of coastal species in lower latitudes is likely to have increased (Robards and Reeves, 2011), particularly in south-east Asia and west Africa (Porter and Lai, 2017; Liu and others, 2019; Mintzer and others, 2018; Van Waerebeek and others, 2017), where the sustainability of such practices is often unknown. As habitat change associated with climate change redistributes species and potentially impacts population abundances (Moore and Reeves, 2018), communities relying on the harvesting of marine mammals for food are also likely to be impacted, resulting in future food security challenges (Brinkman and others, 2016). The Convention on the Conservation of Migratory Species of Wild Animals (CMS) established in 1979 began working on this issue in 2017.
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Marine mammals continue to be a key feature of marine tourism (see also Chapter 24 of the present assessment), which has increased and diversified (Hoyt, 2018). There is anecdotal evidence of expansion of tourism focused on marine mammals in novel locations or of increased sighting rates in mature touristic activity locations as a result of distributional shifts associated with population recovery and climate change (e.g., Accardo and others, 2018; Halliday and others, 2018). Tourism is now listed as a conservation threat for 11 cetacean and 13 pinniped species (Figure 2; IUCN, 2019). Tourism activities offer the opportunity of income generation for coastal communities as long as appropriate management schemes are developed to ensure that marine mammal populations are not overexploited (Christiansen and Lusseau, 2015; Pirotta and Lusseau, 2015), investment is responsible, and profits remain in the community (Higham and others, 2016). The Convention on the Conservation of Migratory Species of Wild Animals (CMS) and the International Whaling Commission have separately[2] and jointly[3] produced guidelines on such

[1] CMS Resolution 12.15 Aquatic Wild Meat, available at https://www.cms.int/en/document/aquatic-wild-meat-1
[2] CMS Resolution 11.29 (Rev COP12) Sustainable Boat-based Marine Wildlife Watching available at https://www.cms.int/en/document/species-specific-guidelines-boat-based-wildlife-watching
[3] IWC and CMS Whale Watching Handbook, https://wwhandbook.iwc.int/en/

Field Code Changed

Global initiatives are required to develop comprehensive management plans for far-ranging species. The Convention on the Conservation of Migratory Species of Wild Animals (CMS) covers the entire range of its listed species, including the high seas and currently has~~d~~ seven legally binding and 19 non-binding regional or global agreements for single or multiple species

tourism activities. Quantification of the socio-ecological contribution of marine mammal related tourism to global coastal communities remains outstanding.

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- Significant gaps remained in establishing and reaching consensus on management practices for sustaining healthy fish stocks, including: disputed jurisdictions in the Central Pacific and South-West Atlantic (Harrison, 2019); less than fully effective management of high-seas fisheries on deep ocean shelves and seamounts (ICES, 2018b); limited progress in conservation of potential fish stocks in the Central Arctic Ocean (a temporary 16-year moratorium on unregulated fishing awaited entry into force); and absence of management of prospective fisheries in the mesopelagic zone, where regulation was either nascent or non-existent (Priede, 2017; Hidalgo and Browman, 2019; Remesan and others 2019).
- There is increasing evidence from several regions, especially in the high latitudes, that use of marine wildlife as "aquatic wild meat" or "marine bushmeat" is increasing, which can lead to overexploitation and unsustainable consumption, posing a significant and immediate threat to species survival (McCauley et al., 2015; Benítez-López et al., 2017; Ripple et al., 2019).

Pg. 666

Benítez-López, A., Alkemade, J.R.M., Schipper, A.M, Ingram, D.J., Verweij, P.A., Eikelboom, J. & Huijbregts, M.. (2017). The impact of hunting on tropical mammal and bird populations. Science, 356, 180-183.

Pg 674

McCauley, D.J., Pinsky, M.L., Palumbi, S.R., Estes, J.A., Joyce, F.H., Warner, R.R. 2015. Marine defaunation: animal loss in the global ocean. *Science*, 347, 1255641

Pg 677

Ripple, W.J., Wolf, C., Newsome, T.M., Betts, M.G., Ceballos, G., Courchamp, F., Hayward, M.W., Van Valkenburgh, B., Wallach, A.D. & Worm, B. (2019) Are we eating the world's megafauna to extinction? *Conservation Letters*, e12627.

Pg 678

Recent advances in supercomputing and Full Waveform Inversion (FWI) technology are transforming resource estimation. FWI, a new kind of processing technique applied to existing seismic data using

deemed in special need of a cooperative response.

supercomputers, creates a model of the subsurface rock layers in rich detail (Advisors, 2019). Similarly, advances in 4-D seismic technology, coupled with superior computing power, now provide new insights into hydrocarbon reservoir characteristics, thus offering greater certainty to prospective resource developers.

A major concern is the noise generated by exploration for hydrocarbons, which has significant negative effects on marine wildlife, affecting the entire marine ecosystem (Prideaux, 2017).
Pg 726

Offshore oil and gas exploration and development practices have evolved significantly in terms of minimizing impacts on the surrounding environment, but operational and accidental discharges and other environmental impacts, still occur. Operational discharges include chemicals that arise from drilling activities, produced water, drilling muds and cuttings, and small amounts of treated domestic and sanitary wastes. Noise, sea-bed disturbance, and impacts on biodiversity are other ~~potential~~ significant environmental impacts. Additionally, the installation of pipelines and related infrastructure also contributes to certain discharges into the marine environment. Decommissioning of installations can also be accomplished with more or less severe environmental impacts, depending on removal methodologies and subsequent environmental monitoring.
Pg 728

There have been significant improvements in oil spill forecasting, response, and understanding of impacts. Improvements in oil spill forecasting has been achieved through better visualization of the trajectory and fate of oil using expanded modelling suites such as the General NOAA Operational Modelling Environment (GNOME) in the US (NOAA 2019). Similarly, project GRACE (integrated oil spill response actions and environmental effects) in the EU is investigating the hazardous impacts of oil spills and the environmental impacts of oil spill response technologies in cold climate conditions such as the North Atlantic (Jørgensen et al., 2019). There are also advances in the use of satellites and other techniques for oil spill surveillance and monitoring, methods to evaluate the toxic effects of the spilled oil, and understanding impacts on corals, marine mammals, and sea turtles to uncover best ways to protect, rescue, and restore marine wildlife and ecosystems impacted by oil (NOAA 2020).

Noise generated especially during the exploration phase is a major contributor to overall noise levels in the marine environment, which have increased significantly over the past century (André et al 2010, Hildebrand 2009). Physical, physiological and behavioural impacts have been observed in a wide range of species including fish, crustaceans and cephalopods, pinnipeds (seals, sea lions and walrus), sirenians (dugong and manatee), sea turtles, the polar bear, marine otters and cetaceans (whales, dolphins and porpoises)~~.~~ (Southall et al 2007, Prideaux, 2017).
Pg 729

André, M Morell, M Alex, M Solé Carbonell, M Connor, M Van der Schaar, RM Houégnigan, L Zaugg, SA. and Castell Balaguer, JV. 2010. 'Best practices in management, assessment and control of underwater noise pollution' (Barcelona, LAB, UPC)

732

Hildebrand JA. 2009, 'Anthropogenic and natural sources of ambient noise in the ocean', Marine Ecology Progress Series, 395 (5).

733

Prideaux G, 2017, 'Technical Support Information to the CMS Family Guidelines on Environmental Impact Assessments for Marine Noise-generating Activities', Convention on Migratory Species of Wild Animals, Bonn.

Southall BL Bowles AE Ellison WT Finneran JJ Gentry RL Greene Jr CR Kastak D Ketten DR Miller JH. and Nachtigall PE. 2007. 'Marine mammal noise-exposure criteria: initial scientific recommendations', Bioacoustics, 17 (1-3), 273-75

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Sound is a form of energy, so its introduction into the marine environment, is regarded by many as a form of contamination because it can cause deleterious effects. The United Nations Environment Programme and the Convention on the Conservation of Migratory Species of Wild Animals (CMS)[4] explicitly recognize the importance of the impact of underwater noise on marine species and encourage further study and mitigation of these issues, [5] and CMS Parties have endorsed Guidelines on Environmental Impact Assessments for Marine Noise-generating Activities. Accompanying Technical Support Information (Prideaux, 2017) provide specific information on the effects of underwater noise on different species groups, including commercially important fish species.

Pg 747

Prideaux G, 2017, 'Technical Support Information to the CMS Family Guidelines on Environmental Impact Assessments for Marine Noise-generating Activities', Convention on Migratory Species of Wild Animals, Bonn.

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In this assessment, we have concentrated on management approaches that alter some aspect of human use. Other tools, such as the description of Ecologically or Biologically Significant Marine Areas (EBSAs)[6] under the Convention on Biological Diversity (CBD)[7] do not change use but provide information that may play a role in decision-making processes. They should be

[4] Ibid., vol. 1651, No. 28395.
[5] See UNEP/CMS/Resolution 12.14; available at https://www.cms.int/en/documents/cop-resolutions.
[6] See https://www.cbd.int/ebsa/.
[7] United Nations, *Treaty Series*, vol. 1760, No. 30619.

distinguished, however, from “decision making processes”, such as fisheries stock assessments, Integrated Ecosystem Assessments (IEA) and Strategic Environmental Assessments (SEA), as EBSAs are a purely scientific and technical process exercise and do not include management measures, even though they have the potential to inform policy and management decisions. The same applies to other tools, such as Important Marine Mammal Areas (IMMAs).

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