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A concept note on the need to develop an IOTC identification guide for marine mammals

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ABSTRACT

There is a need to develop ‘IOTC identification cards’ for identification of marine mammals which interact with IOTC-managed fisheries. A total of 32 species of cetaceans are suggested for inclusion in the identification cards. Estimated cost of development and production is $US 17,000.

Introduction

The interaction of fishing gears and vessels with marine species, which are not targeted by fishermen but co-occur together with wanted species, are currently a major issue in the fisheries management and ecosystem conservation (Northridge, 1984, 1991a, b; Alverson et al., 1994; Kock et al., 1996; Wickens, 1995; Brothers et al., 1999; Hall et al., 2000; Tasker et al., 2000; Jackson et al., 2001; Gilman et al., 2006, 2007, Reeves et al., 2013, Žydelis et al., 2013, Moore, 2014). Worldwide development of fisheries and degradation of marine habitats through overfishing or more complex interplays on ecosystem scales have given rise to growing concerns for the sustainability of current approaches to the management of marine living resources and ecosystems. Interactions of fisheries with non-target species can be complex, and may occur in several principal forms: as bycatch (catch of unwanted species, either lethal for them or not), habitat alteration, animal disturbance, and depredation (damage of the catch or fishing gears by unwanted species).

The Indian Ocean tuna fisheries, internationally managed by IOTC, are commonly facing three types of interactions with cetaceans: bycatch, animal disturbance and depredation (Romanov, 2002, Romanov et al., 2008; Anderson, 2014). In the same time whole of the Indian Ocean area is covered by the Indian Ocean Sanctuary (IOS, sometimes referred to as the Indian Ocean Whale Sanctuary, IOWS) established by the International Whaling Commission (IWC) to protect several large cetacean species from intentional harvesting (Holt, 2012).

Most marine mammal species are long-living animals with slow reproduction rate (Barlow, Clapham, 1997; Lubetkin et al., 2012). Any interaction that produces additional mortality or potential decrease in the reproduction rate may result in detrimental effects on their populations. In particular many stocks of whales that experienced excess whaling pressure during the last century have still not recovered and their potential recovery remains questionable (Branch et al., 2007, Schipper et al., 2008).

Species

In recent years cetacean taxonomy has undergone something of a revolution, with the discovery of several ‘cryptic’ species and the recognition of taxa with uncertain status (species/sub-species/races etc.). With much uncertainty remaining, it will be impossible to produce a definitive guide at present, however, we suggest following the most up-to-date taxonomy (Jefferson et al., 2008; Committee on Taxonomy, 2014; Perrin, 2014).

Classic morphological taxonomy indicate that a total number of marine mammals in the Indian Ocean region is equal to 54 species: 8 species of baleen whales, 36 species of toothed whales (including 8 whales and 28 dolphins and porpoises), 1 sirene species (dugong), and 9 pinnipeds (Annex I) (Jefferson et al., 1983, 2008).

Interactions

Here we summarize interactions reported for major tuna and tuna-like species fisheries in the Indian Ocean.

Purse seine fisheries

Intentional or non-intentional sets on whales. Intentional sets on cetaceans are prohibited by EU regulation (EC, 2007) and by IOTC Resolution (IOTC, 2013). Whale-associated tuna fisheries were documented in the past for several PS fleets (Cort, 1992; Stretta et al., 1997; Romanov, 2002; Anderson, 2014) and may reach 9% of fishing effort in certain seasons (Romanov, 2002, Capieto et al., 2012). Currently such fishing practice remains 'cryptic' due to legislative collisions with regulations listed above. Rare documented sets on whales are mostly declared as 'non-intentional'. Identification and reporting even such minor 'non-intentional' interaction would be important step in evaluation of cetacean interactions with PS fisheries.

Past studies identified the following species associated with PS tuna fisheries:

Baleen whales: Bryde's whale *B. edeni*, sei whales *Balaenoptera borealis*, fin whale *B. physalus*, minke whales *B. acutorostrata*, and pygmy blue whales *B. musculus brevicauda* (Romanov, 2002). Note that the most frequent interactions are likely to be with Bryde's whales, and the taxonomy of this taxon is uncertain (Anderson, 2014).

Large toothed whales: sperm whale (*Physeter macrocephalus* Linnaeus, 1758), while not associated with tuna, is common species and is commonly recorded in the areas of the tuna purse-seine fishery. Encounters with common species should be considered to distinguish interactions from simple presence in the area (Romanov, 2002).

Delphinids or small toothed whales: It is known that tuna associates with dolphins worldwide (Donahue, Edwards, 1996; Hall, Roman, 2013) and in particular in the Western Indian Ocean (de Silva and Boniface, 1991, Romanov, 2002; Adam and Jauharee, 2009; Anderson, 2014). Such associations are commonly used by purse seine fleet (Perrin, 1969; Joseph, 1991, 1994; Hall, 1998) to catch tuna. In offshore regions of the WIO tuna-dolphin associations have been reported to be rare, and purse seining on them is reported to be uncommon (Romanov, 2002; Anderson, 2014; Escalle et al., 2014 in press). However several delphinid species (known for their associations with tuna schools) might potentially be involved in tuna fisheries-dolphins interactions: spinner dolphin *Stenella longirostris*, pantropical spotted dolphins *Stenella attenuata*, common dolphin *Delphinus delphis*, common bottlenose dolphin *Tursiops truncatus*, and rough-toothed dolphin *Steno bredanensis* (Escalle et al., 2014 in press). The latter species is also known as FAD-associated species (Hall, Roman, 2013).

Longline fisheries

Baleen whales and large toothed whales: Rare accidental non-lethal interactions (entanglement) have been observed. Entanglements were documented for at least one species: humpback whale *Megaptera novaeangliae* (our non-published data), while all species of baleen whales occurs in the regions as well as sperm whale are potentially susceptible to such type of interaction. While sperm whale depredation is well-known phenomenon for demersal longline (Kock et al., 2006), no sperm whale depredation are ever reported for pelagic longline fisheries.

Delphinids or small toothed whales: are commonly involved in two interactions with longlines gear both as depredating fish caught or bait (sometimes resulting in catch and foul hooking) or by simple entanglement non-associated with depredation. The following species are known (or supposing to be known) in interactions with longline gear: killer whale *Orcinus orca*, false killer whale *Pseudorca crassidens*, pygmy killer whale *Feresa attenuata*, pilot whales *Globicephala*

macrorhynchus, Risso's dolphin *Grampus griseus*, bottlenose dolphin *Tursiops truncatus* (Romanov et al., 2008). Other species like melon-headed whale *Peponocephala electra* and smaller species like delphinids are apparently also vulnerable to interaction with longline gear.

Estimated cryptic mortality of target species boosted by depredations may reach in average 12% of longline CPUE for tuna targeting fisheries (Romanov et al., 2008) and even higher values for swordfish targeting fisheries (Bach et al., 2011).

Gillnet fisheries

High risk of cetacean mortality was one of the principal reasons of the development of the Wellington Convention[1], that established a limit of 2.5 km of legal length of driftnet and UN ban of large-scale driftnetting using the nets that exceed legal limit (UN, 1991). However gillnet fisheries are still considered the primary gear responsible for cetacean mortality (Waugh et al., 2011, MRAG, 2012; Anderson, 2014).

Baleen whales and large toothed whales: Accidental entanglement of baleen whales and sperm whales in drifting gillnets is known worldwide (Northridge, 1984, 1991a, 1991b, Moore, 2014) and in the Indian Ocean in particular (Fonteneau, 2011).

Delphinids or small toothed whales: Mortality of delphinds in gillnets is known and well documented. All species of delphinids inhabiting area of IOTC responsibility are vulnerable to gillnets (Northridge, 1984, 1991a, 1991b, Kiszka et al., 2009; Anderson, 2014).

Collateral damage: needs on quantification and identification

Below is a list of principal interactions affecting marine mammals and pelagic fisheries in the area of IOTC responsibility.

- **Bycatch:**
  - cetacean mortality **GILL**,
  - cetacean injures or (rare) mortality **LL**, **PS**.
- **Disturbance:**
  - physical interactions **PS** (baleen whales),
  - physical interactions (to less extend) **LL**, **GILL**,
  - acoustic interactions, use of acoustic pingers, dolphin dissuasive devices **LL**, **GILL,**
  - chasing disturbance **PS**, apparently **PL**.
- **Depredation:**
  - loss of catch and profit **LL**, **GILL**. Ecological impacts due to hypothetical alteration of natural chasing and feeding behavior. In other oceans known also for **PL/TROLL**, not documented for Indian Ocean.

Such wide range of potential interactions including losses is poorly documented and quantified in major tropical fisheries and in the Indian Ocean in particular. In the need to quantify marine mammals interaction with fishing gears (including depredation) and evaluate their impact has

[1] Large-scale driftnets were defined as nets over 2.5 Km in length under the Convention for the prohibition of fishing with long driftnets in the South Pacific (Wellington Convention); Wellington, 24 November 1989, which entered into force on the 17th May 1991.
http://www.ecolex.org/server2.php/libcat/docs/TRE/Full/En/TRE-001043.txt ;
http://www.ecolex.org/server2.php/libcat/docs/TRE/Full/En/TRE-001132.txt ;
http://www.ecolex.org/server2.php/libcat/docs/TRE/Full/En/TRE-001133.txt

been clearly expressed earlier (Romanov, Bach, 2009, Romanov et al., 2009, Anderson, 2014; Escalle et al., 2014 in press). However any quantification is impossible without correct identification of species involved in interaction (Moazzam, 2013). While numerous guides of marine mammals identifications are available globally and regionally (e.g. Jefferson et al., 1993, Berggren, 2009) none of them are developed for using in extreme field conditions and not adapted to non-experienced in marine mammal studies persons such as fishermen or scientific observers.

Concept:

To cover all species that are potentially exposed to interaction with principal fishing gears used in the Indian Ocean tuna fisheries.

Gears: PS, LL, GILL, PL/TROLL.

Species: According to Jefferson et al. (1993, 2008) among ~55 species of marine mammals a total of 42(?) occur in the IOTC area of responsibility. In addition some of them like sirene and pinnipeds are coastal species that have very limited probability to interact with tuna fisheries. Therefore we suggest to focus on 32 species of cetaceans (Annex I). For comparison most extended IOTC identification cards set (shark identification cards) consists of 45 species pages, ranging from 6 to 33 species pages for other groups (Table 2).

Card concept: similar to other IOTC cards: colour printing, plastic, spiral binding.

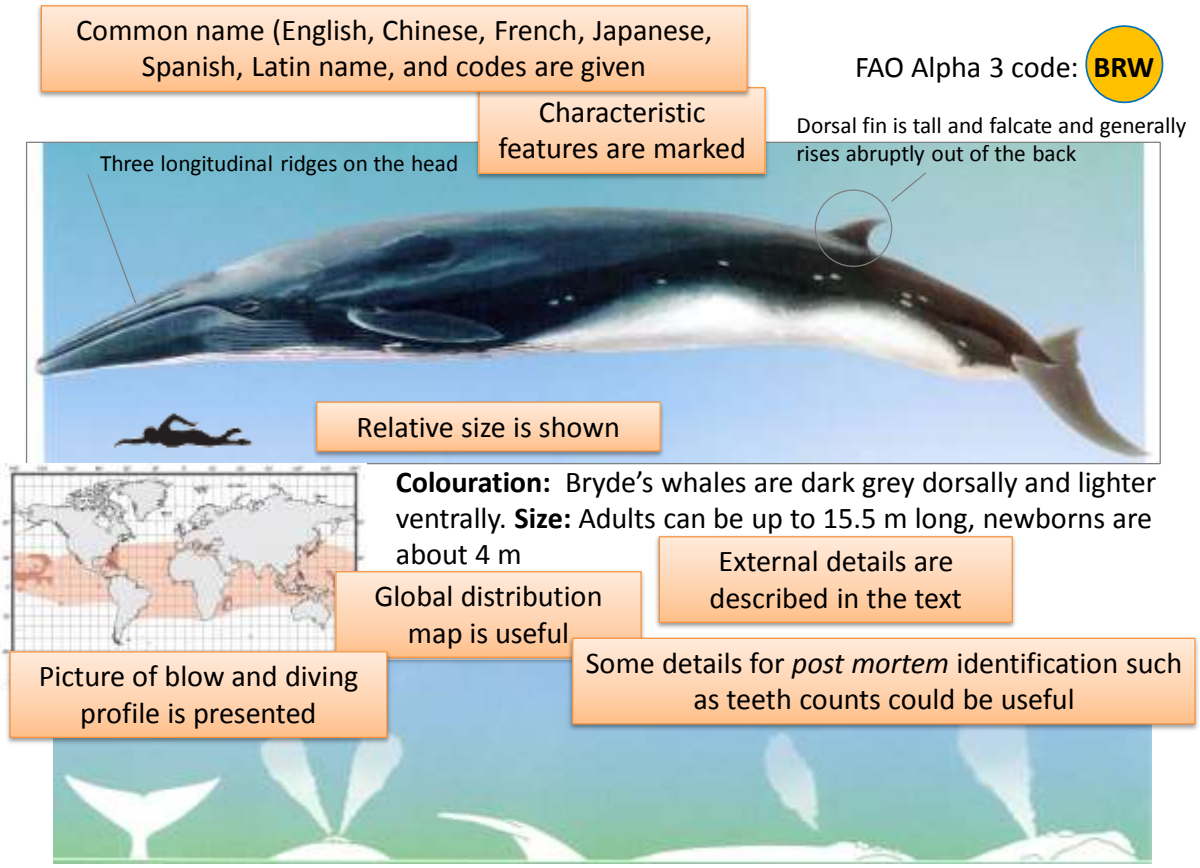

Fig. 1. A conceptual view of IOTC marine mammals identification cards.

Costs:

Estimated card production cost is presented below (17,700 $US).

Table 1.

Estimated production and printing costs for 1000 sets of Marine Mammalidentification cards for fishing vessels operating in the Indian Ocean

Description	Unit price	Units required	Total
Purchase images	US$ 100	32	3,200
Contract days	US$ 350	20	7,000
Printing plates/plate	US$ 100	20	2,000
Printing/1000 sets	US$ 5500	1	5,500
Total estimate	(US$)		**17,700**

Table 2.

Volume and production costs of IOTC identification cards (in **bold estimated** expenses)

IOTC Identification cards	Species / ID pages	Pages total	Cost	Status
Seabird identification cards for fishing vessels operating in the Indian Ocean	33	40	?	Developed and printed
Marine turtles identification cards	12	20	?	Developed and printed
Shark and ray identification in Indian Ocean pelagic fisheries	45	48	?	Developed and printed
Billfish identification in Indian Ocean pelagic fisheries	6	12	?	Developed and printed
Identification of tuna and tuna-like species in Indian Ocean fisheries	24	30	16,200	Developed and printed
Terminal gear identification cards for longline fishing vessels operating in the Indian Ocean	**?**	**?**	**16,200**	**Recommended by WPEB and SC**
Marine mammals identification cards for fishing vessels operating in the Indian Ocean	**32**	**~40**	**17,700**	**To be discussed**

Funding:

Option 1: Regular budget IOTC. Not before … 2016?

Options 2. Extra-budgetary funding. Potential funding sources:

- IUCN – International Union for Conservation of Nature,
- IWC – International Whaling Commission,
- WWF - World Wide Fund for Nature,
- ISSF – International Seafood Sustainability Foundation
- Others…?

References

Adam MS, Jauharee AR, 2009. Handline large yellowfin tuna fishery of the Maldives. Indian Ocean Tuna Commission, IOTC-2009-WPTT-15: 1-14.

Alverson DL, Freeberg MH, Pope JG, Murawski SA, 1994. A global assessment of fisheries bycatch and discards. FAO, Rome (Italy). FAO Fish. Tech. Pap. (339) 233 pp.

Anderson RC, 2014. Cetaceans and tuna fisheries in the Western and Central Indian Ocean. International Pole-and-line Foundation, London. 139 pages.

Bach P, Romanov E, Rabearisoa N, Sharp A, 2011. Note on swordfish catches collected during commercial operations and research cruises onboard pelagic longliners of the La Reunion fleet from 2006 to 2010. IOTC–2011–WPB09-INF11.

Barlow J, Clapham PJ, 1997. A new birth-interval approach to estimating demographic parameters of humpback whales. Ecology, 78:535-546.

Berggren P, 2009. Whales and dolphins: A field guide to marine mammals of East Africa. East Publishing Limited, Norwich, UK. 130 p.

Branch TA, Stafford KM, Palacios DM, Allison C, Bannister JL, Burton CLK, Cabrera E, Carlson CA, Galletti Vernazzani B, Gill PC, Hucke-Gaete R, Jenner KCS, Jenner M-N, Matsuoka K, Mikhalev YA, Miyashita T, Morrice MG, Nishiwaki S, Sturrock VJ. Tormosov D. Anderson RC, Baker AN, Best PB, Borsa P, Brownell RL Jr., Childerhouse S, Findlay KP, Gerrodette T, Ilangakoon AD, Joergensen M, Kahn B, Ljungblad DK, Maughan B, McCauley RD, McKay S, Norris TF, Rankin S, Samaran F, Thiele D, van Waerebeek K, Warneke RM, 2007. Past and present distribution, densities and movements of blue whales *Balaenoptera musculus* in the southern hemisphere and northern Indian Ocean. Mammal Review, 37:116-175.

Brothers NP, Cooper J, Løkkeborg S, 1999. The incidental catch of seabirds by longline fisheries: worldwide review and technical guidelines for mitigation. FAO Fisheries Circular. No. 937. Rome, FAO. 1999. 100p.

Capietto A, Pianet R, Delgado De Molina A, Murua H, Floch L,. Damiano A, Chavance P, Merigot B, 2012. Interactions between marine mammals and the European tropical tuna purse seine fishery in the Indian and Atlantic Oceans. IOTC-2012-WPEB08-41: 1-14.

Committee on Taxonomy. 2014. List of marine mammal species and subspecies. Society for Marine Mammalogy, www.marinemammalscience.org, consulted on 15.09.2014.

Cort JL, 1992. Estudio de las asociaciones de tunidos, en especial la denominada “atun-delfín.” Su integración en la biología de estos peces migradores. In International Commission for the Conservation of Atlantic Tunas (ICCAT) Coll. Vol. Sci. Pap. 39 (1):358–384.

de Silva J, Boniface B, 1991. The study of the handline fishery on the west coast of Sri Lanka with special reference to the use of dolphin for locating yellowfin tuna (*Thunnus albacares*). In Indo-Pacific Tuna Development and Management Programme (IPTP) Coll. Vol. Work. Doc TWS/90/18., Vol. 4, p. 314–324. Food and Agriculture Organization of the United Nations (FAO), Viale delle Terme di Caracalla, 00100, Rome, Italy.

Donahue MA, Edwards EF, 1996. An annotated bibliography of available literature regarding cetacean interactions with tuna purse-seine fisheries outside of the eastern tropical Pacific Ocean. Report LJ-96-20. Southwest Fisheries Science Center - NOAA, National Marine Fisheries Service. 46 pp.

EC, 2007. Council Regulation (EC) No 520/2007 of 7 May 2007 laying down technical measures for the conservation of certain stocks of highly migratory species and repealing Regulation (EC) No 973/2001. L123 3-13.

Escalle L, Capietto A, Chavance P, Dubroca L, Delgado de Molina A, Murua H, Gaertner D, Romanov E, Spitz J, Kiszka J, Floch L, Damiano A, Merigot B, 2014 in press. Marine mammals and tuna fishery in the Atlantic and Indian Oceans: interaction but few mortalities. Submitted: Marine Ecology Progress Series.

Fonteneau A, 2011. Potential impact of gillnets fisheries on Indian Ocean ecosystems? Slide presentation at IOTC Working Party on Ecosystems and Bycatch, Lankanfinolhu, North Malé Atoll, Republic of Maldives, 24-27 October 2011.

Gilman E, Brothers N, McPherson G, Dalzell P, 2006. A review of cetacean interactions with longline gear. Journal of Cetacean Research and Management. 8:215-223.

Gilman E, Clarke S, Brothers N, Alfaro-Shigueto J, Mandelman J, Mangel J, Petersen S, Piovano S, Thomson N, Dalzell P, Donoso M, Goren M, Werner T, 2007. Shark depredation and unwanted bycatch in pelagic longline fisheries: industry practices and attitudes, and shark avoidance strategies. Western Pacific Regional Fishery Management Council, Honolulu, USA. 203 p.

Hall MA, 1998. An ecological view of the tuna-dolphin problem: impacts and tradeoffs. Rev. Fish Biol. Fish. 8:1-34

Hall MA, Alverson DL, Metuzals KI, 2000. By-catch: Problems and solutions. Mar. Pollut. Bull. 41:204-219.

Hall M, Roman M, 2013. Bycatch and non-tuna catch in the tropical tuna purse seine fisheries of the world. FAO Fisheries and Aquaculture Technical Paper No. 568. FAO, Rome (Italy), 249 p.

Holt S, 2012. Negotiating the Indian Ocean Whale Sanctuary. Journal of Cetacean Research and Management, 12:145-150.

IOTC, 2013. Resolution 13/04, On the conservation of cetaceans.

Jackson JBC, Kirby MX, Berger WH, Bjorndal KA, Botsford LW, Bourque BJ, Bradbury RH, Cooke R, Erlandson J, Estes JA, Hughes TP, Kidwell S, Lange

CB, Lenihan HS, Pandolfi JM, Peterson CH, Steneck RS, Tegner MJ, Warner RR, 2007. Historical overfishing and the recent collapse of coastal ecosystems. Science, 293:629-638.

Jefferson TA, Leatherwood S, Webber MA, 1993. FAO species identification guide. Marine mammals of the world. UNEP/FAO, Rome, Italy. 320 pp.

Jefferson T, Webber M, Pitman R, 2008. Marine mammals of the World: A comprehensive guide to their identification. Academic Press. 592 p.

Joseph J, 1991. The conservation ethic and its impact on tuna fisheries. In: Tuna 91 Bali papers of the 2nd world tuna trade conference Bali, Indonesia, 13–15 May, 1991 (Henri de Saram. ed.), p. 12-18. INFOFISH, Kuala Lumpur, Malaysia.

Joseph J, 1994. The tuna-dolphin controversy in the Eastern Tropical Pacific Ocean: biological, economic, and political impacts. Ocean Development and International Law 25:1-30.

Kiszka J, Berggren P, Rosenbaum HC, Cerchio S, Rowat D, Drouot-Dulau V, Razafindrakoto Y, Vely M, Guissamulo A, 2009. Cetaceans in the southwest Indian Ocean: a review of diversity , distribution and conservation issues. IWC SC: [np].

Kiszka J, Muir C, Poonian C, Cox TM, Amir OA, Bourjea J, Razafindrakoto Y, Wambitji N, Bristol N, 2009. Marine mammal bycatch in the Southwest Indian Ocean: review and need for a comprehensive status assessment. Western Indian Ocean Journal of Marine Science, 7: 119-136.

Kock K-H, Purves MG, Duhamel G, 2006. Interactions between cetacean and fisheries in the Southern Ocean. Polar Biology, 29:379-388.

Lubetkin SC, Zeh JE, George JC, 2012. Statistical modeling of baleen and body length at age in bowhead whales (*Balaena mysticetus*). Canadian Journal of Zoology, 90:915-931. doi:10.1139/z2012-057.

Moazzam M, 2013. Proposal for species identification guide for cetaceans (whale and dolphins) occurring in the Indian Ocean. IOTC Working Party on Ecosystems and Bycatch (WPEB), La Réunion, France, 12–16 September, 2013. IOTC-2013-WPEB09-29. 8 p.

Moore MJ, 2014. How we all kill whales. ICES Journal of Marine Science, 71:760-763.

MRAG, 2012. A review of bycatch in the Indian Ocean gillnet tuna fleet focussing on India and Sri Lanka. ISSF Technical Report 2012--05. International Seafood Sustainability Foundation, Washington, D.C., USA.

Northridge SP, 1984. World review of interactions between marine mammals and fisheries. FAO Fish. Tech. Pap., (251):190 p.

Northridge SP, 1991a. An updated world review of interactions between marine mammals and fisheries. FAO Fisheries Technical Paper. No. 251, Suppl. 1. Rome, FAO. 58p.

Northridge SP, 1991b. Driftnet fisheries and their impact on non-target species: a world-wide review. FAO, Rome (Italy). FAO Fish. Tech. Pap. (320) 115 pp.

Perrin W, 1969. Using porpoise to catch tuna. World Fishing, 18:42-45.

Perrin W, 2004. Chronological bibliography of the tuna-dolphin problem, 1941-2001. NOAA Technical Memorandum. NMFS-SWFSC-356. La Jolla, USA, NOAA. 194 pp.

Perrin WF, 2014. World Cetacea Database. Accessed at http://www.marinespecies.org/cetacea on 2014-09-15

Ramos-Cartelle A, Mejuto J, 2008. Interaction of the false killer whale (*Pseudorca crassidens*) and depredation on the swordfish catches of the Spanish surface longline fleet in the Atlantic, Indian and Pacific Oceans. ICCAT Col. Vol. Sci. Pap., 62: 1721-1738.

Reeves RR, McClellan K, Werner TB, 2013. Marine mammal bycatch in gillnet and other entangling net fisheries, 1990 to 2011. Endangered Species Research, 20:71-97.

Robineau D. 1982. Distribution des grands cétacés dans l'Ocean Indien occidental. In Annales de la Société des Sciences naturelles de la Charente-Maritime, Actes du V, pp. 17-23.

Robineau D. 1991. Balaenopterid sightings in the western tropical Indian Ocean (Seychelles Area), 1982-1986. In Cetaceans and Cetacean Research In The Indian Ocean Sanctuary Marine Mammal Technical Report Number 3, pp. 171–178. Ed. S. Leatherwood and G. P. Donovan. UNEP, Nairobi, Kenya.

Romanov EV, 2002. Bycatch in the tuna purse-seine fisheries of the western Indian Ocean. Fishery Bulletin, 100:90-105.

Romanov E, Gaertner D, Bach P, Romanova N, 2008. Depredation on pelagic longlines in the Indian Ocean: an analysis of the Soviet historical database (1961-1989) on tuna research. Proceedings of the international workshop on the depredation in the tuna longline fisheries in the Indian Ocean, Seychelles, 9-10 July 2007. IOTC-2007-DWS-A1-11, 31 p.

Romanov E, Bach P, 2009. Depredation. Improvement of the information flow within IOTC. 2. On the IOTC resolution 08/04 "Concerning the recording of the catch by longline fishing vessels in the IOTC area": how to incorporate depredation information and improve shark catch statistics? IOTC Working Party on Ecosystems and Bycatch (WPEB) Mombasa, Kenya 12-14 October, 2009. IOTC-2009-WPEB-05. 22 p.

Romanov E, Bach P, Rabearisoa N, 2009. Depredation. Improvement of the information flow within IOTC. 1. Draft IOTC information sheet, reporting form, and webpage. IOTC Working Party on Ecosystems and Bycatch (WPEB) Mombasa, Kenya 12-14 October 2009. IOTC-2009-WPEB-04. 13 p.

Schipper J, Chanson JS, Chiozza F, Cox NA, Hoffmann M, Katariya V, Lamoreux J, Rodrigues ASL, Stuart SN, Temple HJ, Baillie J, Boitani L, Lacher TE,

Mittermeier RA, Smith AT, Absolon D, Aguiar JM, Amori G, Bakkour N, Baldi R, Berridge RJ, Bielby J, Black PA, Blanc JJ, Brooks TM, Burton JA, Butynski TM, Catullo G, Chapman R, Cokeliss Z, Collen B, Conroy J, Cooke JG, da Fonseca GAB, Derocher AE, Dublin HT, Duckworth JW, Emmons L, Emslie RH, Festa-Bianchet M, Foster M, Foster S, Garshelis DL, Gates C, Gimenez-Dixon M, Gonzalez S, Gonzalez-Maya JF, Good TC, Hammerson G, Hammond PS, Happold D, Happold M, Hare J, Harris RB, Hawkins CE, Haywood M, Heaney LR, Hedges S, Helgen KM, Hilton-Taylor C, Hussain SA, Ishii N, Jefferson TA, Jenkins RKB, Johnston CH, Keith M, Kingdon J, Knox DH, Kovacs KM, Langhammer P, Leus K, Lewison R, Lichtenstein G, Lowry LF, Macavoy Z, Mace GM, Mallon DP, Masi M, McKnight MW, Medellín RA, Medici P, Mills G, Moehlman PD, Molur S, Mora A, Nowell K, Oates JF, Olech W, Oliver WRL, Oprea M, Patterson BD, Perrin WF, Polidoro BA, Pollock C, Powel A, Protas Y, Racey P, Ragle J, Ramani P, Rathbun G, Reeves RR, Reilly SB, Reynolds JE, Rondinini C, Rosell-Ambal RG, Rulli M, Rylands AB, Savini S, Schank CJ, Sechrest W, Self-Sullivan C, Shoemaker A, Sillero-Zubiri C, De Silva N, Smith DE, Srinivasulu C, Stephenson PJ, van Strien N, Talukdar BK, Taylor BL, Timmins R, Tirira DG, Tognelli MF, Tsytsulina K, Veiga LM, Vié J-C, Williamson EA, Wyatt SA, Xie Y, Young BE, 2008. The status of the world's land and marine mammals: diversity, threat, and knowledge. Science. 322:225-230. doi: 10.1126/science.1165115.

Stretta JM, Delgado de Molina A, Ariz J, Domalain G, Santana JC, 1997. Les espèces associées aux pêches thonières tropicales. ICCAT Col. Vol. Sci. Pap., 46:250-254.

Tasker ML, Camphuysen CJK, Cooper J, Garthe S, Montevecchi WA, Blaber SJM, 2000. The impacts of fishing on marine birds. ICES Journal of Marine Science 57:531-547.

UN, 1991. United Nations General Assembly. Large-scale pelagic drift-net fishing and its impact on the living marine resources of the world's oceans and seas. A/RES/46/215.

Waugh SM, Filippi DP, Blyth, Filippi PF, 2011. Report to the Convention on Migratory Species assessment of bycatch in gill net fisheries 30 September 2011. Wellington: Sextant Technology. 146 pp. UNEP/CMS/Inf.10.30.

Wickens PA, 1995. A review of operational interactions between pinnipeds and fisheries. FAO, Rome (Italy). FAO Fish. Tech. Pap. (346). 85pp.

WoRMS Editorial Board (2014). World Register of Marine Species. Available from http://www.marinespecies.org at VLIZ. Accessed 2014-08-25

Žydelis R, Small C, French G, 2013. The incidental catch of seabirds in gillnet fisheries: A global review. Biological Conservation, 162:76-88.

Marine mammals of the Indian Ocean and their potential of interactions with IOTC managed fisheries (list of species is based on Jefferson et al., 1993, 2008, Kiszka et al., 2009)

	FAO code	Species	Common name	Gear, interaction (**observed**, **observed mortality**, *potential)*	Conservation status[2] (IUCN score)[3]	References
		Balaenidae				
1.	EUA	*Eubalaena australis*	Southern right whale	*PS, LL, GILL*	LC	
		Balaenopteridae				
2.	BLW	*Balaenoptera musculus*	Blue whale	**PS (disturbance)**, *LL, GILL*	EN	2,
3.	FIW	*Balaenoptera physalus*	Fin whale	**PS (disturbance)**, *LL, GILL*	EN	2,
4.	SIW	*Balaenoptera borealis*	Sei whale	**PS (disturbance, entanglement)**, *LL, GILL*	EN	2,
5.	BRW	*Balaenoptera edeni (brydei)*	Bryde's whale	**PS (disturbance)**, *LL, GILL*	DD	2,
6.	BFW	*Balaenoptera bonaerensis (acutorostrata)*	Antarctic minke whale	**PS (disturbance)**, *LL, GILL*	DD (LC)	2,
7.	HUW	*Megaptera novaeangliae*	Humpback whale	*PS,* **LL (entanglement)**, **GILL (entanglement)**	LC (EN, Arabian Sea)	This note, 1,
		Physeteridae				
8.	SPW	*Physeter macrocephalus*	Sperm whale	*PS, LL,* **GILL (entanglement)**	VU	3,
		Kogidae				
9.	PYW	*Kogia breviceps*	Pygmy sperm whale	*PS, LL,* **GILL (entanglement)**	DD	1,
10.	DWW	*Kogia sima*	Dwarf sperm whale	*PS, LL,* **GILL (entanglement)**	DD	1,
		Ziphiidae				
11.	BCW	*Ziphius cavirostris*	Cuvier's beaked whale	*PS, LL, GILL (entanglement)*	LC	
12.	BBW	*Mesoplodon densirostris*	Blainville's beaked whale	*PS, LL, GILL (entanglement)*	DD	
13.	TGW	*Mesoplodon ginkgodens*	Ginkgo-toothed beaked	*PS, LL, GILL (entanglement)*	DD	

[2] IUCN, 2014.
[3] EX –extinct, EW – extinct in the wild, CR – critically endangered, EN – endangered, VU – vulnerable, NT – near threatened, LC – least concern, DD – data deficient, NE – not evaluated (IUCN, 2012).

	FAO code	Species	Common name	Gear, interaction (**observed**, **observed mortality**, *potential)*	Conservation status[2] (IUCN score)[3]	References
			whale			
14.	BTW	Mesoplodon mirus	True's beaked whale	*PS, LL,* **GILL (entanglement)**	DD	1,
15.	BNW	? *Indopacetus (Mesoplodon) pacificus*	Longman's beaked whale	*PS, LL,* **GILL (entanglement)**	DD	1,
		Delphinidae				
16.	IRD	*Orcaella brevirostris*	Irrawaddy dolphin	*LL, GILL (entanglement)*	VU	
17.	KIW	*Orcinus orca*	Killer whale	*LL (depredation), GILL (entanglement)*	DD	9,
18.	SHW	*Globicephala macrorhynchus*	Short-finned pilot whale	**LL (depredation)**, **GILL (entanglement)**	DD	1, 9,
19.	FAW	*Pseudorca crassidens*	False killer whale	**LL (depredation)**, **GILL (entanglement)**	DD	1, 7, 8
20.	KPW	*Feresa attenuata*	Pygmy killer whale	*LL (depredation),* **GILL (entanglement)**	DD	1, 7
21.	MEW	*Peponocephala electra*	Melon-headed whale	*LL (depredation),* **GILL (entanglement)**	LC	1, 7
22.	DHI	*Sousa chinensis*	Indo-Pacific hump-backed dolphin	*LL (depredation), GILL (entanglement)*	NT	7
23.	RTD	*Steno bredanensis*	Rough-toothed dolphin	PS (disturbance)*, LL,* **GILL (entanglement)**	LC	1, 4, 7
24.	DRR	*Grampus griseus*	Risso's dolphin	**LL (depredation)**, *GILL (entanglement)*	LC	
25.	DBO	*Tursiops truncatus*	Bottlenose dolphin	PS (disturbance)*,* **LL (depredation)**, **GILL (entanglement)**	LC	1, 4, 7, 10
26.	DBZ	*Tursiops aduncus*	Indo-Pacif. bottlenose dolphin	PS (disturbance)*, LL, GILL*	DD	4, 7
27.	DPN	*Stenella attenuata*	Pantropical spotted dolphin	PS (disturbance)*, LL,* **GILL (entanglement)**	LC	1, 4, 7
28.	DSI	*Stenella longirostris*	Spinner dolphin	PS (disturbance) , **LL (depredation), GILL (entanglement)**	DD	1, 4, 7, 10
29.	DST	*Stenella coeruleoalba*	Striped dolphin	PS (disturbance)*, LL,* **GILL (entanglement)**	LC	1, 4, 7
30.	DCO/DCZ	*Delphinus*	Common	*PS (disturbance), LL*	LC/DD	1, 4, 7

	FAO code	Species	Common name	Gear, interaction (**observed**, **observed mortality**, *potential)*	Conservation status[2] (IUCN score)[3]	References
		delphis/capensis	dolphin	*(depredation),* **GILL** *(depredation,* **(entanglement)***)*		
31.	FRD	*Lagenodelphis hosei*	Fraser's dolphin	*PS, LL (depredation),* **GILL (entanglement)**	LC	1, 7
32.	PFI	*Neophocaena phocaenoides*	Finless porpoise	*PS, LL (depredation), GILL (entanglement)*	VU	7

References used in for Appendix 1.

1. **Anderson RC, 2014.** Cetaceans and tuna fisheries in the Western and Central Indian Ocean. International Pole-and-line Foundation, London. 139 pages.
2. **Romanov EV, 2002.** Bycatch in the tuna purse-seine fisheries of the western Indian Ocean. Fishery Bulletin, 100:90-105.
3. **Fonteneau A, 2011.** Potential impact of Gillnets fisheries on Indian Ocean ecosystems? Slide presentation at IOTC Working Party on Ecosystems and Bycatch, Lankanfinolhu, North Malé Atoll, Republic of Maldives, 24-27 October 2011.
4. **Escalle L, Capietto A, Chavance P, Dubroca L, Delgado de Molina A, Murua H, Gaertner D, Romanov E, Spitz J, Kiszka J, Floch L, Damiano A, Merigot B, 2014 in press.** Marine mammals and tuna fishery in the Atlantic and Indian Oceans: interaction but few mortalities. Submitted: Marine Ecology Progress Series.
5. **IUCN, 2012.** IUCN Red List Categories and Criteria: Version 3.1. Second edition. Gland, Switzerland and Cambridge, UK: IUCN. iv + 32pp.
6. **IUCN 2014.** The IUCN Red List of Threatened Species. Version 2014.2. <http://www.iucnredlist.org>. Downloaded on 24 September 2014.
7. **Kiszka J, Muir C, Poonian C, Cox TM, Amir OA, Bourjea J, Razafindrakoto Y, Wambitji N, Bristol N, 2009.** Marine mammal bycatch in the Southwest Indian Ocean: review and need for a comprehensive status assessment. Western Indian Ocean Journal of Marine Science, 7: 119-136.
8. **Ramos-Cartelle A, Mejuto J, 2008.** Interaction of the false killer whale (*Pseudorca crassidens*) and depredation on the swordfish catches of the Spanish surface longline fleet in the Atlantic, Indian and Pacific Oceans. ICCAT Col. Vol. Sci. Pap., 62: 1721-1738.
9. **Romanov E, Gaertner D, Bach P, Romanova N, 2008.** Depredation on pelagic longlines in the Indian Ocean: an analysis of the Soviet historical database (1961-1989) on tuna research. Proceedings of the international workshop on the depredation in the tuna longline fisheries in the Indian Ocean, Seychelles, 9-10 July 2007. IOTC-2007-DWS-A1-11, 31 p.
10. **Rabearisoa, N. 2013.** Etude d'un mode d'interaction entre les odontocètes et les requins et la pêche à la palangre dérivante dans la région sud-ouest de l'Océan Indien: la déprédation. Thèse de Doctorat présentée pour obtenir le grade de Docteur Biologie - Ecologie marine. Université de La Réunion. 241 p.