

Marine mammals foraging around fishing gear or preying upon fishing catch and bait: it may not be “depredation”

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Some populations of marine mammals (particularly odontocete cetaceans, and pinnipeds) have responded to the expansion of fisheries by modifying their behaviour to take advantage of the foraging opportunities provided by fishing. This has led to interactions that include forms of “depredation”, referring to the removal of, or damage to, marketable organisms as well as bait from fishing gear. The current scientific and technical usage of depredate or depredation appears inconsistent with some of the meanings found in dictionaries, such as to plunder (typically using force), pillage, ravage, lay waste, despoil, destroy, commit waste, or ransack. We suggest that the use of “depredation” when referring to marine mammal behaviour could strengthen misperception and misunderstanding, hardening notions that they are unfairly taking or destroying what is ours. Though most contemporary researchers do not mean to imply that predators are “stealing our fish”, continued reference to the mammals’ behaviour as depredation may reinforce, at least in some minds, the belief that fish and other marine resources “belong” only to humans. Alternative wording would help to prevent ambiguity in communications, especially outside the scientific community, and preserve recognition of the ecological roles that large marine predators play.

Keywords: bycatch, cetaceans, depredation, fisheries, foraging, odontocetes.

As fisheries expanded in coastal and pelagic habitats, large marine predators came into contact with fishing and aquaculture gear, where prey could be concentrated predictably and is easier to catch (Würsig and Gailey, 2002; Powell and Wells, 2011; Tixier *et al.*, 2018, 2021; Bonizzoni *et al.*, 2022). Some populations (primarily of odontocete cetaceans, pinnipeds, and sharks; Mitchell *et al.*, 2018; Tixier *et al.*, 2021) have responded by modifying their behaviour to take advantage of the new foraging opportunities provided by fishing (Northridge and Hofman, 1999; Whitehead *et al.*, 2004; Read, 2008; Hamer *et al.*, 2012; Bearzi *et al.*, 2019; Tixier *et al.*, 2021). These behavioural modifications have led to interactions that include forms of “depredation”, a word commonly used by fishery scientists and managers to refer to the removal of, or damage to, marketable organisms caught in fishing gear or farmed (Würsig and Gailey, 2002; Read, 2005; Mitchell *et al.*, 2018; Jog *et al.*, 2022) as well as to the removal of bait from fishing lines (Zollett and Read, 2006; Powell and Wells, 2011; Weir and Nicolson, 2014; Kumar *et al.*, 2016). In this context, the use of “depredation/depredate” has come to prevail over the alternative “predation/predate”; this may be due in part to “predating” having another definition as “pre-dating”, i.e. occurring previously in time (as noted by Hanson, 2006). With reference to marine mammals, Northridge (2018) described depredation as a parasitic type of behaviour, and likened it to kleptoparasitism. In the scientific literature, the word depredation is sometimes used to encompass damage to and loss of fishing gear as well as loss of fishing time or opportunity (e.g. Zollett and Read, 2006; Brotons *et al.*, 2007; Lauriano *et al.*, 2009;

Powell and Wells, 2011; Hamer *et al.*, 2012). Also, depredation can be applied to situations that involve mortality or injury of marine predators resulting from interactions with fishing gear (bycatch), often including consideration of how to mitigate such mortality and injury, and to reduce the extent of catch removal and gear damage (Gilman *et al.*, 2006; Hamer *et al.*, 2012; Dawson *et al.*, 2013; Götz and Janik, 2013; Werner *et al.*, 2015; Mitchell *et al.*, 2018; Dahlheim *et al.*, 2022).

In the context described above, we investigated the formal and literal meanings of “depredation” and compared those with usage in regard to fishery interactions. Dictionaries are a primary source of information, considering that words are defined by lexicographers and cognitive linguists based on data-driven analyses of use and meaning in human society (Landau, 1984; Sealey and Carter, 2004; Fuertes-Olivera, 2017; Stamper, 2017). We started by consulting accepted language sources, extracted from the comprehensive list posted at the Wikipedia page “Comparison of English dictionaries” (see en.wikipedia.org). We focused on “full-size” dictionaries that were freely available online and which are quick and easy to consult and promptly accessible to anyone. Because our focus on these resources excluded a few authoritative dictionaries by Oxford University Press listed in the above-mentioned Wikipedia page, we added to our sources (Table 1) an online dictionary called Lexico, which provides a collection of dictionaries produced by Oxford. We also checked several fishery/fisheries glossaries available online to see if they provided definitions of depredate or depredation, but no such definitions were found (Table 2).

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Table 1. Meanings given to “depredate” and “depredation” in nine major formal English-language dictionaries that were freely available online.

Dictionary	Depredate	Depredation
1 American Heritage dictionary ahdictionary.com	to ransack, plunder; to engage in plundering	a predatory attack, a raid; damage or loss, ravage
2 Cambridge dictionary dictionary.cambridge.org	<i>not listed</i>	(an act causing) damage or destruction
3 Chambers dictionary chambers.co.uk	<i>not listed</i>	damage, destruction, or violent robbery
4 Collins dictionary collinsdictionary.com	to plunder or destroy; pillage	the act or an instance of plundering; robbery; pillage
5 Longman dictionary of contemporary English ldoceonline.com	<i>not listed</i>	an act of taking or destroying something
6 Macmillan dictionary macmillandictionary.com	<i>not listed</i>	damage or harm that is done to something
7 Macquarie dictionary (Australian English) macquariedictionary.com.au	to prey upon, plunder, lay waste; to prey, make depredations	a preying upon or plundering; robbery; ravage
8 Merriam-Webster dictionary merriam-webster.com	to lay waste, plunder, ravage; to engage in plunder	<i>not listed</i>
9 Oxford-powered Lexico dictionary lexico.com	steal from, typically using force; plunder	an act of attacking or plundering

All sources last accessed 24 June 2022.

Table 2. Examples of fishery/fisheries glossaries available online that do not provide definitions of “depredate” or “depredation”.

Source	Link
1 FAO term portal, Food and Agriculture Organization of the UN	fao.org/faoterm/en/
2 Wikipedia glossary of fishery terms	en.wikipedia.org/wiki/Glossary_of_fishery_terms
3 FishBase glossary	fishbase.se/Glossary/Glossary.php
4 NOAA fisheries glossary, US National Oceanic and Atmospheric Administration	repository.library.noaa.gov/view/noaa/12856
5 NEFMC glossary of fisheries management and science terms, New England Fishery Management Council	nefmc.org/glossary
6 Fisheries New Zealand glossary, Ministry for Primary Industries	fs.fish.govt.nz/Page.aspx?pk=77&tk=316
7 A glossary of marine nature conservation and fisheries, Countryside Council for Wales	vliz.be/imisdocs/publications/119773.pdf
8 Fisheries glossary, Government of W Australia, Dept. of Primary Industries and Regional Development	fish.wa.gov.au/About-Us/Glossary/
9 ICCAT glossary of fishery terms, International Commission for the Conservation of Atlantic Tunas	iccat.int/Documents/SCRS/Other/glossary.pdf

All sources last accessed 24 June 2022.

One of the problems in communication is that people can use the same word to mean different things, and unless the author makes the meaning clear, the reader is left to infer and guess. More specifically, the current scientific and technical usage of depredate or depredation in the context of marine mammal interactions with fisheries often appears inconsistent with at least some of the literal and formal meanings given in the sources we checked. While definitions vary, several contemporary formal English dictionaries state that to depredate can mean to plunder, i.e. to *steal* goods from (a place or person), typically using force and in a time of war or civil disorder, or that the term can refer to the violent, dishonest, or illegal acquisition of property. Other possible meanings mentioned in the dictionaries include to pillage, ravage, lay waste, despoil, destroy, commit waste, or ransack (Table 1). The implication of most of these meanings is that the possessor of the goods or resources at issue is being deprived of them unjustly. Only a few of the dictionaries listed in Table 1 include the milder “to prey upon” or “to damage” as meanings of depredate, or refer to depredation more generically as a “an act of taking

or destroying something”. The Merriam-Webster dictionary reports that, “dating to the 17th century, the word [depredate] most commonly appears in contexts relating to nature and ecology, where it is often used to describe the methodical, almost automatic destruction of life”. The Cambridge dictionary includes examples referring to depredation by troops during wartime (“the entire area has suffered the depredations of war”) and human destruction of biodiversity (“depredation of the environment is destroying hundreds of species each year”).

We suggest that the continued and generalized (actually nearly ubiquitous) use of the term depredation in the scientific literature and public discourse, with reference to marine mammals preying, or attempting to prey, on catch or bait, could reinforce misperceptions and misunderstandings, hardening widespread notions that these animals are taking or destroying something that is ours. Here, for simplicity, we confine our comments on use of the word depredation to instances involving cetaceans (whales, dolphins, and porpoises), our primary professional interest and

one of the main groups of marine mammals reported to depredate catch, bait, or gear. We question whether depredation, as often defined in dictionaries, is a good way to characterize the wide variety of cetacean interactions with fisheries, considering that many of them would not qualify as theft or plundering or ransacking, and some of the interactions reported as depredation actually do not result in significant loss or damage to the fishers. For instance, (1) cetaceans reported to be depredate could have been foraging primarily outside the fishing gear, or on damaged prey sticking out of nets that is already of less (if any) market value (e.g. in the case of odontocetes foraging behind trawlers; Greenman and McFee, 2014; Santana-Garcon *et al.*, 2018; Bonizzoni *et al.*, 2022); (2) in many cases, the true level of economic impact of catch or bait removal by cetaceans may be modest or economically negligible (e.g. Lauriano *et al.*, 2004; Wise *et al.*, 2007; Bearzi *et al.*, 2011; Cruz *et al.*, 2014; Rechimont *et al.*, 2018)—though we do not deny that there *are* impacts, and they can be substantial, particularly in the case of longline fisheries (e.g. Roche *et al.*, 2007; Hamer *et al.*, 2012; Tixier *et al.*, 2021) and some trammel and gill net fisheries (e.g. Waples *et al.*, 2013; Snape *et al.*, 2018); (3) some reports suggest that the economic value of catches increases following incursions by dolphins (e.g. when these have the effect of herding fish into the nets, or the damaged organisms attract more valuable species that end up being caught), thereby offsetting at least some of the cost of depredation to the fishers (Silva *et al.*, 2002; Rocklin *et al.*, 2009; D’Lima *et al.*, 2014); (4) reported depredation can be conflated or confused with predation on wild fish (e.g. in the case of dolphins foraging near finfish aquaculture facilities; Díaz López, 2012), or extend to cases of sport fishers or tourists intentionally provisioning dolphins (Weir and Nicolson, 2014); and (5) cases where predators reduce or prevent catches by driving away (scattering, displacing) fish that otherwise might have been caught may loosely be characterized as depredation even though these cases would not, strictly speaking, fit any of the definitions in Table 1 (Hamer *et al.*, 2012).

Beyond cases such as those reported above, there are compelling philological and even philosophical reasons to advocate caution in the use of words such as depredation, especially when the meaning is implied rather than clearly defined. Outside the scientific realm and in some circles, the term still carries a connotation that cetaceans and other large marine predators *intend* to harm humans, i.e. that they have a deliberate will to cause damage (as implied by most of the definitions in Table 1). For instance, a recent scientific article reporting “depredation” behaviour by killer whales *Orcinus orca* (Amelot *et al.*, 2022) was interpreted by various articles in the popular media as evidence that the cetaceans were “stealing” fish (TWC, 2022), they were “coming for our seafood supply” (Pagán, 2022), and even had “crime in mind” (Randall, 2022). These intentions were arguably unlikely (though perhaps not impossible; e.g. Notarbartolo di Sciara, 1978; Gabay, 2021; Gilbert and Byard, 2021; Ram *et al.*, 2021).

Today’s accounts of marine mammals described as thieves, particularly in the mass media (e.g. Albanese, 2017; Chen, 2017; Cecco, 2022), derive in part from outdated attitudes and beliefs. For example, Mediterranean dolphins were once depicted as “ichthyophagous monsters”, “phony and noxious pirates”, and “man’s worst enemies” (Del Rosso, 1905). Into the 1960s and even the 1970s, in at least some quarters, dolphins and other toothed cetaceans were consistently regarded as vermin and were massively and wantonly culled (Bearzi

et al., 2004, 2008; Mazzoldi *et al.*, 2019; Meliadó *et al.*, 2020). In this context, it should be noted that the right to sovereignty over nature (epitomized by the English philosopher and statesman Francis Bacon in 1609) is part of the cognitive foundation of the Western world, and has long provided a justification for unfettered exploitation of living “resources” and extermination of animals (Ceballos *et al.*, 2017; Bar-On *et al.*, 2018), including large marine predators that, for centuries, were regarded as either prey or competitors (Hatton *et al.*, 2021). Such a conceptual framework, which regards the whole of nature as a commodity, is still ingrained into modern science and into most human cultures (White, 1967; Lent, 2017; Bearzi, 2020).

(...) man seems to be the thing in which the whole world centres, with respect to final causes (...) for all things are made subservient to man, and he receives use and benefit from them all (...) and the vegetables and animals of all kinds either afford us matter for houses and habitations, clothing, food, physic, or tend to ease, or delight, to support, or refresh us: so that everything in nature seems not made for itself, but for man.

—Francis Bacon, *The Wisdom of the Ancients*, 1609

It is clear to us that the vast majority of contemporary researchers and communicators making use of the word depredation do not consciously mean to imply that marine predators are plundering, pillaging, ravaging, despoiling, destroying, wasting, ransacking, or stealing “our fish”. Some authors may be relying on dictionary definitions that emphasize predatory behaviour (rather than acts of violence or theft that are inconsistent with ecological knowledge). For example, the American Heritage dictionary published in 1981 described depredate as “to prey upon, plunder”—a meaning replaced by “to ransack, plunder” in the present online edition (American Heritage fifth edition of 2022; Table 1). Other authors may be simply unaware of or inattentive to language technicalities, fine points, or semantic change, and inclined to simply accept and conform to the widespread and consolidated usage of depredation in the fisheries literature. We have done this ourselves, repeatedly, and such practice has already led to formal definitions that arguably accommodate the common usage of depredation with reference to wildlife preying on fish catch, bait, and gear. For example, the open-source, real-time editable Wikipedia (which is *not*, however, a formal dictionary compiled by recognized experts or language authorities) defines depredation not only as military raiding for the purpose of pillage, and grave or tomb robbing, but also as damage to agriculture attributed to pests, which could easily be interpreted to include large marine predators (“pests”) that damage fisheries.

It is possible that, over time, more dictionaries will adapt their definitions of “depredation/depredate” to take into account the common and intended use within the context of animal behaviour and fisheries management. Until that happens, or in case it doesn’t, ensuring scientific accuracy and preventing misunderstanding seems like a sensible interim objective. If scientists and managers were to at least qualify and take more care in how they use such potentially loaded terms (either because of the way they are defined, or because of their other meanings), this might lessen the chances of unintentionally implying that marine predators are acting with intent, to steal from or cause harm to humans. More careful,

scientifically precise, and accurate wording may help to refine how we perceive and manage fishery interactions with large marine predators.

While language is continually evolving and adapting to common usage (Pinker, 2015), we emphasize that the use made of language conveys our *Weltanschauung*, or understanding of the world that surrounds us (Lakoff and Johnson, 1980). When a word such as depredation is used out of context or as a catch-all for a range of interactions, it may contribute, however slightly or subtly, to an entrenched, knee-jerk assumption on the part of people, especially those outside the fishing community, that foraging by marine predators in the proximity of fishing gear is somehow illegitimate, and represents actual robbery. In other words, misunderstanding of what fishery scientists mean when they use the term “depredation” could reinforce the belief that all fish and other marine resources belong to humans first, with natural marine predators entitled only to the leftovers. This obsolete, Garden-of-Eden understanding is completely contrary to a central tenet of modern ecology, which regards humans as plain members rather than as owners of “the Creation” (in the broad ecological sense described by Wilson, 2006).

Much of the behaviour of free-ranging marine predators interacting with fisheries might be better described as “removing prey from fishing gear”, “foraging around fishing gear”, “foraging inside fishing gear”, or, when relevant, “preying on” whatever organisms they are attempting to secure for themselves. Such wording, however cumbersome, would help to preserve recognition of the predators’ ecological role, while avoiding any implication that humans are the preeminent and only legitimate possessors or “managers” of all forms of marine life. This could be especially important in contexts outside the scientific community, such as marine resource management bodies, political fora where management decisions are made and regulations are issued, and the mass media where stakeholder and public perceptions are shaped and communicated (Albanese, 2017; Chen, 2017; Casselberry *et al.*, 2022; Cecco, 2022; Rahaim, 2022; Randall, 2022).

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Giovanni Bearzi: Conceptualization, Writing—original draft.
Randall R. Reeves: Writing—review and editing.

Conflict of interest statement

The authors have no conflict of interest to declare.

Data availability statement

There are no new data associated with this article.

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