



Consultation Document on Eligibility for Delisting

***Megaptera novaeangliae* (Humpback Whale)**

You are invited to provide your views and supporting reasons related to:

- 1) the eligibility of *Megaptera novaeangliae* (Humpback Whale) for removal from the EPBC Act threatened species list.

Evidence provided by experts, stakeholders and the general public are welcome. Responses can be provided by any interested person.

Anyone may nominate a native species, ecological community or threatening process for listing under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) or for a transfer of an item already on the list to a new listing category. The Threatened Species Scientific Committee (the Committee) undertakes the assessment of species to determine eligibility for inclusion in the list of threatened species and provides its recommendation to the Australian Government Minister for the Environment.

Responses are to be provided in writing either by email to: species.consultation@awe.gov.au

or by mail to:

The Director
Migratory Species Section
Biodiversity Conservation Division
Department of Agriculture, Water and the Environment
PO Box 858
Canberra ACT 2601

Responses are required to be submitted by 26 March 2021.

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General background information about listing threatened species

The Australian Government helps protect species at risk of extinction by listing them as threatened under Part 13 of the EPBC Act. Once listed under the EPBC Act, the species becomes a Matter of National Environmental Significance (MNES) and must be protected from significant impacts through the assessment and approval provisions of the EPBC Act. More information about threatened species is available on the department's website at:

<http://www.environment.gov.au/biodiversity/threatened>.

Public nominations to list threatened species under the EPBC Act are received annually by the department. In order to determine if a species is eligible for listing as threatened under the EPBC Act, the Threatened Species Scientific Committee (the Committee) undertakes a rigorous scientific assessment of its status to determine if the species is eligible for listing against a set of criteria. These criteria are available on the Department's website at:

<http://www.environment.gov.au/system/files/pages/d72dfd1a-f0d8-4699-8d43-5d95bbb02428/files/tssc-guidelines-assessing-species-2018.pdf>

As part of the assessment process, the Committee consults with the public and stakeholders to obtain specific details about the species, as well as advice on what conservation actions might be appropriate. Information provided through the consultation process is considered by the Committee in its assessment. The Committee provides its advice on the assessment (together with comments received) to the Minister regarding the eligibility of the species for listing under a particular category and what conservation actions might be appropriate. The Minister decides to add, or not to add, the species to the list of threatened species under the EPBC Act. More detailed information about the listing process is at:

<http://www.environment.gov.au/biodiversity/threatened/nominations>.

To promote the recovery of listed threatened species and ecological communities, conservation advices and where required, recovery plans are made or adopted in accordance with Part 13 of the EPBC Act. Conservation advices provide guidance at the time of listing on known threats and priority recovery actions that can be undertaken at a local and regional level. Recovery plans describe key threats and identify specific recovery actions that can be undertaken to enable recovery activities to occur within a planned and logical national framework. Information about recovery plans is available on the department's website at:

<http://www.environment.gov.au/biodiversity/threatened/recovery-plans>.

Privacy notice

The Department will collect, use, store and disclose the personal information you provide in a manner consistent with the Department's obligations under the Privacy Act 1988 (Cth) and the Department's Privacy Policy.

Any personal information that you provide within, or in addition to, your comments in the threatened species assessment process may be used by the Department for the purposes of its functions relating to threatened species assessments, including contacting you if we have any questions about your comments in the future.

Further, the Commonwealth, State and Territory governments have agreed to share threatened species assessment documentation (including comments) to ensure that all States and Territories have access to the same documentation when making a decision on the status of a potentially threatened species. This is also known as the '[common assessment method](#)'. As a result, any personal information that you have provided in connection with your comments may be shared between Commonwealth, State or Territory government entities to assist with their assessment processes.

The Department's Privacy Policy contains details about how respondents may access and make corrections to personal information that the Department holds about the respondent, how respondents may make a complaint about a breach of an Australian Privacy Principle, and how the Department will deal with that complaint. A copy of the Department's Privacy Policy is available at: <http://environment.gov.au/privacy-policy>.

Information about this consultation process

Responses to this consultation can be provided electronically or in hard copy to the contact addresses provided on Page 1. All responses received will be provided in full to the Committee and then to the Australian Government Minister for the Environment.

In providing comments, please provide references to published data where possible. Should the Committee use the information you provide in formulating its advice, the information will be attributed to you and referenced as a 'personal communication' unless you provide references or otherwise attribute this information (please specify if your organisation requires that this information is attributed to your organisation instead of yourself). The final advice by the Committee will be published on the department's website following the listing decision by the Minister.

Information provided through consultation may be subject to freedom of information legislation and court processes. It is also important to note that under the EPBC Act, the deliberations and recommendations of the Committee are confidential until the Minister has made a final decision on the nomination, unless otherwise determined by the Minister.

Megaptera novaeangliae

Humpback Whale

Taxonomy

Conventionally accepted as *Megaptera novaeangliae* (Humpback Whale) (Borowski, 1781).

Species/Sub-species Information

Description

Humpback Whales can be distinguished by their long pectoral fins (up to 5 m in length), tail fluke shape and pigmentation patterns (Winn & Reichley 1985). The tail fluke shape and pigmentation pattern are unique to each individual and are used by researchers to reliably identify individuals for studies of population distribution, migratory patterns and population structure. Mature Humpback Whales are between 15-18 m and can weigh up to 40 tonnes (Winn & Reichley 1985). Humpback Whales are filter feeders and have 14-22 widely spaced throat grooves and 270- 400 baleen plates that enable effective prey capture (Clapham & Mead 1999). Another characteristic of Humpback Whales are the protuberances or tubercles on the head, jaws and pectoral fins.

Distribution

Humpback Whales are found in all ocean basins worldwide. Across this range there are multiple subpopulations. Note that the terminology here follows (IUCN Standards and Petitions Committee 2019): all individual whales within Australian waters constitute the *population* while genetically and demographically distinct units are *subpopulations*. These subpopulations are recognised by the International Whaling Commission (IWC) which refers to them as *stocks* (Gales et al. 2011). Within Australian waters there are two such subpopulations: one that migrates from the Southern Ocean northwards along the West Australian coast in winter to breed in the region between North West Cape (Exmouth) and the Kimberley, and; one that migrates along the east of Australia to breed in the Great Barrier Reef region.

Different names have been used for these subpopulations in the scientific literature. These are outlined in the paragraphs that follow, but for readability for a broad audience this document will continue to refer to the Western Australian or Eastern Australian subpopulations.

Initially, the terminology used to distinguish between subpopulations reflected usage by the commercial whaling industry and thus centred on the subpopulations in the feeding grounds in the Southern Ocean where they were hunted. Broadly, the Western Australian subpopulation was referred to as those whales feeding in Area IV (70°E to 130°E), while the Eastern Australian subpopulation was that of Area V (130°E to 170°W). However, the feeding areas are not completely distinct. There is some overlap of individuals from the two subpopulations during the summer feeding season but it is limited and the subpopulations remain separate in most years (Chittleborough 1965). Schmitt et al. (2014) showed that there are low levels of genetic differentiation between the two subpopulations but that the level of genetic exchange is insufficient to suggest demographic independence. They concluded that considering the two subpopulations as separate management units is appropriate.

More recently, naming terminology has focused on where breeding takes place and the IWC uses the terms Breeding Stock D (or BSD) for the Western Australian subpopulation and Breeding Stock E1 (or BSE1) for the Eastern Australian subpopulation. The addition of the numeral "1" is a later recognition that Breeding Stock E extends across the Western Pacific Islands and is further subdivided, such that the Australian component of the subpopulation is demographically distinct from other parts of Oceania (Baker et al. 2011): E2 and E3, found in New Caledonia and Tonga respectively (Garrigue et al. 2011; Garland et al. 2018).

Cultural Significance

Several Indigenous groups regard whales as totemic species (Cahir et al. 2018; Darkinjung LALC 2019). It appears that Indigenous Australians did not hunt Humpback Whales, but would opportunistically take advantage of strandings (Cahir et al. 2018). Historically, Indigenous people in the Twofold Bay area of south-east NSW would encourage Killer Whales (*Orcinus orca*) to bring their Humpback Whale prey to the shore where they may feast on the meat (the Killer Whales eating only the tongue and lips)(Mathews 1904 in Clarke (2018)). This association was later capitalised upon by shore-based commercial whalers (Wellings 1944).

Relevant Biology/Ecology

Humpback Whales principally feed on *Euphausia superba* (krill) in the Southern Ocean (Chittleborough 1965) and migrate annually to the northern coastlines of Australia to breed. However, a study indicated a significant male bias in the sex ratio of migrating Humpback Whales (Brown et al. 1995), and it concluded that not all females migrate every year due to resource limitations (Paton & Kneist 2011). It has recently been suggested that the sex ratio of migrating groups can be used as an indicator of relative inter-annual population fecundity (Druskat et al. 2019).

Humpback Whales become sexually mature at approximately six years. Gestation generally takes 11.5 months, calves start to wean at approximately 6 months and are independent from their mothers after their first year (Clapham & Mead 1999). The mean inter-birth interval is 2.36 years and they cease reproducing at approximately 55 years of age (Taylor et al. 2007). The estimated generation time for Humpback Whales is 21.5 years (Taylor et al. 2007).

During the northern part of their migrations, whales of both Australian subpopulations travel over Australia's continental shelf. In some places this means that they come sufficiently close to land that they can be observed and counted from land-based platforms. In Western Australia these surveys have been conducted from Dirk Hartog Island, Shark Bay (Bannister & Hedley 2001; Hedley et al. 2011). In Eastern Australia key locations are at Point Lookout on Stradbroke Island and Peregian Beach on the Sunshine Coast (Paterson & Paterson 1989; Paterson et al. 1994, 2004; Noad et al. 2019). Data for the eastern subpopulation has been collected more frequently and is more robust because of ease of access to a location with high cliffs, wide-field of view at a point where almost all the whales migrate close to shore. These data provide a reliable estimate of population size and trend. Conversely, the data are less extensive and more variable for the Western Australian subpopulation because the available surveys sites are less suitable (these data are discussed in detail under Criterion 1 below).

The IWC estimates that the size of the Western Australian subpopulation prior to exploitation was 21,686 (19,016 - 29,383 90% Probability Interval [hereafter PI])(IWC 2015). This was reduced to 800-1000 whales by 1962 (Chittleborough 1965; IWC 2015). The Eastern Australian subpopulation prior to exploitation was estimated to be 26,133 (21,605, 29,033 90% PI)(IWC 2015) and reduced to 200-500 whales in 1962 (Chittleborough 1965; IWC 2015). Because populations of several whale species were also severely depleted by whaling, it is considered that there was little competition for food resources and thus that Humpback Whale subpopulations have been recovering at close to their maximum possible rate since the cessation of whaling. The estimated maximum plausible rate of increase is 11.8% per year (Zerbini et al. 2010). This recovery has led to calls for the species to be removed from the threatened list (Bejder et al. 2016). It should be noted here that the Humpback Whale is the exception in comparison to the response of other whale species to the cessation of Antarctic whaling. No other whale species has recovered as strongly, and several have shown little or highly uncertain recovery.

Threats

The threats described below should be considered in the context of a species that has been recovering strongly for at least five decades now from intense exploitation during the period of commercial whaling. As this advice shows, both subpopulations are close to, or greater than, their estimated levels pre-whaling and continuing to increase. Consequently, the processes

below should be considered as past threats, current *impacts* (not threatening or preventing population growth), or as potential future threats.

Table 1: Threats impacting the Humpback Whale in approximate order of severity of risk, based on available evidence

Number	Threat factor	Threat type and status	Evidence base
1.0	Exploitation		
	Commercial whaling	Known past	<p>The severe impacts from commercial whaling on the Australian Humpback Whale subpopulations have been well documented. Most commercial whaling of the species ceased in 1963, and they were protected worldwide in 1965 after recognition of a dramatic global decline in numbers. In 1994 the IWC established the Southern Ocean Whale Sanctuary, where no commercial whaling of any species is allowed (although Japan is exempt from any restriction on Minke Whales). Commercial whaling is currently suspended globally under the 1986 moratorium on commercial whaling, however some countries have continued commercial whaling under a reservation to the moratorium.</p> <p>Article VIII of the International Convention for the Regulation of Whaling (ICRW) allows member states to issue special permits to kill, take and treat whales for purposes of scientific research. Since the 1986 moratorium on commercial whaling Special Permits for 'scientific whaling' have been issued by Japan, Iceland, Norway and the Republic of Korea for various species including humpbacks, and Japan conducted successive lethal research programs in the Southern Ocean well into the 2000's.</p> <p>In 2019, Japan withdrew from the ICRW and commenced commercial whaling in its Exclusive Economic Zone, but publicly stated that they would stop whaling in the Southern Ocean. It is possible that as humpback subpopulations recover, there may be increased risk of whaling resuming in the Southern Ocean by countries other than Australia.</p>
2.0	Climate and Oceanographic Variability and Change		
		Potential current /future	<p>Potential impacts of climate change include increasing sea surface temperatures, decreasing sea ice cover, rising sea levels, changes to ocean circulations, ocean acidification and changes in salinity (Learmonth et al. 2006). Climate change may lead to changes in species abundance, migration timing and range, species distribution, changes to prey/predator relationships, prey availability and reproductive timing and success, which could impact on the health and survival of species (IWC 2006).</p>

			Ocean acidification is of concern for marine species with the increased levels of atmospheric carbon dioxide leading to increased absorption of carbon dioxide into the ocean and a subsequent decrease in the pH of sea water (Levitus et al. 2000). Research has shown that ocean acidification can be detrimental to Antarctic krill reproduction (Kawaguchi et al. 2010).
3.0	Overharvesting of Prey		
		Potential future	Depletion of Antarctic krill through over-harvesting may be a potential future threat. The abundance of krill is affected by many key factors including: fisheries, predator-prey nutrient cycling, and climate change. Antarctic krill is the primary Southern Hemisphere species of krill harvested by the krill fishery. The Commission established under the Convention of the Conservation of Antarctic Marine Living Resources (CCAMLR) manages the krill fishery catch limits using a precautionary, ecosystem-level sustainable approach that aims to prevent or minimise negative impacts of the krill fishery on natural krill predators. Nevertheless, there is an inevitable strong overlap in where the fishery is active and feeding aggregations of Humpback Whales. As both vary over time, and in response to climatic changes, particularly areas of ice-free water, this needs ongoing monitoring and adaptive management (Weinstein et al. 2017).
4.0	Noise Interference		
		Known current	<p>The impacts of anthropogenic noise sources on marine mammals is an area of increasing concern. Anthropogenic noise sources identified as potential problems include seismic exploration, industrial noise (pile driving, some forms of dredging, use of explosives, blasting and drilling), shipping noise, and sonar systems. The potential impacts of increasing anthropogenic ocean noise can include hearing impairment, organ damage or mortality, masking of vocalisations, change in call frequency or amplitude and behavioural disturbance (Nowacek et al. 2007; Southall et al. 2007). Underwater noise can act as a stressor to marine mammals, which may impact on individual health, and population viability (Wright et al. 2007). The extent to which behaviour is impacted may depend on a number of factors such as distance from the source, prior exposure (habituation), behavioural state, health, gender and age (Nowacek et al. 2007; Dunlop et al. 2017).</p> <p>Australian Humpback Whale subpopulations are facing a projected increase in coastal development and shipping traffic (Clifton et al. 2007; Bureau of Resources and Energy Economics 2012); particularly due to increasing oil and gas exploration and new port developments. These activities will undoubtedly increase the levels of noise in the marine environment and may have adverse effects on the seasonal use,</p>

			displacement from these areas, or the alteration of behaviour by Humpback Whales.
5.0	Habitat degradation including coastal development and port expansion		
		Potential future	<p>Habitat degradation and modification to the coastal region in areas of importance to Humpback Whales may result in reduced occupancy, compromised reproductive success and even mortality. If there are enough habitats impacted there may be wider reaching implications for the health and growth of populations. This would be more likely to arise where activities that cause habitat degradation occurred cumulatively or intensively. At this time, both subpopulations of Humpback Whales using Australian waters are increasing at, or close to, the maximum biological rate (Hedley et al. 2011; Salgado Kent et al. 2012; IWC 2015; Noad et al. 2019). This suggests that to date habitat degradation has not had a negative impact on population or species recovery. Nevertheless, as the population grows and competition for habitat increases this may become a greater issue, and ongoing monitoring and management are required.</p> <p>Coastal development often includes dredging, blasting, alteration and removal of sediments and alteration to local currents when building or decommissioning structures such as ports, marinas, aquaculture facilities and mining or drilling infrastructure (Bannister et al. 1996). These activities may impact species in the short term through increased acoustic noise, sedimentation or pollution during construction, and in the long term through degradation of habitat suitability or availability</p>
	Pollution	Potential future	Pollution of the ocean is increasing globally. While there a few data to indicate a current threat to Australian Humpback Whales, as filter feeders they are susceptible to the accumulation of smaller particles of contaminants (Germanov et al. 2018).
6.0	<p>Entanglement An entanglement occurs when a whale is caught in fishing equipment, shark nets, or marine debris and is unable to free itself. Entanglements can cause serious injury and distress to whales, and in some cases lead to the death of the animal. The increased reports of entanglements in Australian waters coincide with an increase in Humpback Whale subpopulations. There has also been an increase in entanglements in the WA rock lobster fishery since a move to year round fishing (and thus fishing occurring during the whale migration)(Stoklosa 2013). Currently eastern and western Australian subpopulations are increasing strongly and therefore the impacts from these factors may be minor in terms of overall species recovery. Nonetheless, as Humpback Whale subpopulations and coastal development increases, and fisheries activities continue around Australia, there will be an increased chance for negative impacts on individuals</p>		

	Commercial fisheries or aquaculture equipment	Known current	<p>Many of the commercial fisheries (pot / trap) and aquaculture farming sites around Australia are a potential threat to large whales as the nets, cages and lines used for fishing provide opportunities for entanglements. The Australian government is working closely with commercial fishing industries to ensure that all equipment used limits the risk of entanglements of whales.</p> <p>There have been an increased number of entanglements reported in rock lobster pot lines, and the Commonwealth, state agencies and industry are working to reduce whale entanglements through changes to fishing gear and practices.</p>
	Shark Safety Equipment	Known Current	<p>A number of States use shark safety equipment at popular swimming beaches to reduce the number of large sharks present in the area. This equipment can consist of both drumlines and/or nets depending on local tidal and marine conditions. There have been a number of whales, including humpback whales, entangled in shark nets over the past few years.</p>
	Marine Debris	Known Current	<p>Marine debris is of human origin and includes plastic garbage such as bags, bottles, ropes etc., derelict fishing gear and non-biodegradable floating materials lost or disposed of at sea. The interaction between marine species and marine debris is listed as a key threatening process under the EPBC Act and Humpback Whales were identified as an EPBC Act listed species adversely impacted by marine debris (DOEE 2019). Marine debris has the potential to cause negative impacts through entanglement or ingestion. There have been 104 records of cetaceans in Australian waters impacted by plastic debris through entanglement or ingestion since 1998. The vast majority (92.2%) of cetacean incidents relate to entanglement (Ceccarelli 2009), and Humpback Whales dominated the available records, with around 48 entanglement incidents recorded.</p>
7.0	Vessel disturbance and strike		
		Known current	<p>Collisions with vessels are one of the main (known) causes of mortality to baleen whales (Vanderlaan & Taggart 2007). There has been a significant increase in the number of commercial, industrial and recreational vessels in coastal waters. Thus, the threat of ship strikes to whales may also increase (Smith et al. 2020). Laist et al. (2001) showed that high speed vessels, travelling faster than 14 knots, were involved in 15% of the 40 accounts of ship strikes reported worldwide. Humpback Whales are one of the most frequently reported whale species involved in vessel strikes worldwide (Laist et al. 2001). The increase in vessel numbers (Silber & Bettridge 2012) is not only a threat to Humpback Whales in relation to vessel strikes but also in disturbance and displacement from key habitats.</p>

			<p>Whale watching – Commercial and Recreational The popularity of the whale watching industry has steadily increased in recent years and is of growing economic importance worldwide. The whale watching operators are focused seasonally on Humpback Whales between June and November on the east and west coasts of Australia. The Australian National Guidelines for Whale and Dolphin Watching 2017 are currently being reviewed to ensure best practice.</p> <p>Whale watching in general is beneficial for the conservation of species through education and observation of animals in their natural habitat, however, there is increasing concern about the number of whale watch operators and recreational vessels interacting with whales within certain times and areas, and the potential for cumulative impacts on individuals as the whales migrate.</p>
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Assessment of available information in relation to the EPBC Act Criteria and Regulations

Criterion 1. Population size reduction (reduction in total numbers)			
Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4			
	Critically Endangered Very severe reduction	Endangered Severe reduction	Vulnerable Substantial reduction
A1	≥ 90%	≥ 70%	≥ 50%
A2, A3, A4	≥ 80%	≥ 50%	≥ 30%
<p>A1 Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.</p> <p>A2 Population reduction observed, estimated, inferred or suspected in the past where the causes of the reduction may not have ceased OR may not be understood OR may not be reversible.</p> <p>A3 Population reduction, projected or suspected to be met in the future (up to a maximum of 100 years) [(a) cannot be used for A3]</p> <p>A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.</p>	<p><i>based on any of the followin</i></p> <p>(a) direct observation [except A3]</p> <p>(b) an index of abundance appropriate to the taxon</p> <p>(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat</p> <p>(d) actual or potential levels of exploitation</p> <p>(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites</p>		

Evidence:

The appropriate criterion against which to assess the Humpback Whale is criterion A1 as the principal cause of the decline was commercial whaling which has ceased under the moratorium by the IWC, is well understood and, as the strong recovery to date indicates, is reversible.

The generation time for Humpback Whales is estimated to be 21.5 years and thus the relevant three generation period for assessment under Criterion A1 is 1955 to 2019. This covers the period of the minimum post-whaling estimates of the mid-1960s and subsequent recovery.

This assessment under the EPBC Act, considers the status of Humpback Whales that calve within Australian waters irrespective of other populations of the same species elsewhere in the

Southern Hemisphere. Because the two subpopulations of Humpback Whales that calve within Australian waters (Western Australian and Eastern Australian) are demographically distinct, they are first considered separately and then the results combined to for the overall Australian population.

Western Australia

Estimates of absolute subpopulation size are summarised in Figure 1 and described in detail below. Most of the surveys were undertaken offshore of Shark Bay via aerial survey, some in combination with land-based observation from Dirk Hartog Island (Bannister & Hedley 2001; Hedley et al. 2011; Paxton et al. 2011). Additional surveys were conducted further north at North West Cape/Exmouth (Salgado Kent et al. 2012).

It should be noted that the data are considerably more variable for Western Australia than for the Eastern Australian subpopulation. A key contributor to this is that on the east coast a large majority of whales pass key observation points close to the shore and thus can be observed reliably and cheaply from shore-based observation points (Noad et al. 2019). Cross-validation of aerial and land-based estimates is facilitated in such circumstances (Noad et al. 2019). In contrast, in Western Australia the aerial surveys demonstrated that a substantial proportion of whales pass land-based observation points beyond where they were visible (Hedley et al. 2011). Under such circumstances there are difficulties in estimating appropriate correction factors to derive estimates of absolute abundance from measures of relative abundance, hence the large error bars in Figure 1 (cf Figure 2). Estimates of absolute abundance of Humpback Whales in Western Australia should be treated with some caution (Jackson et al. 2015).

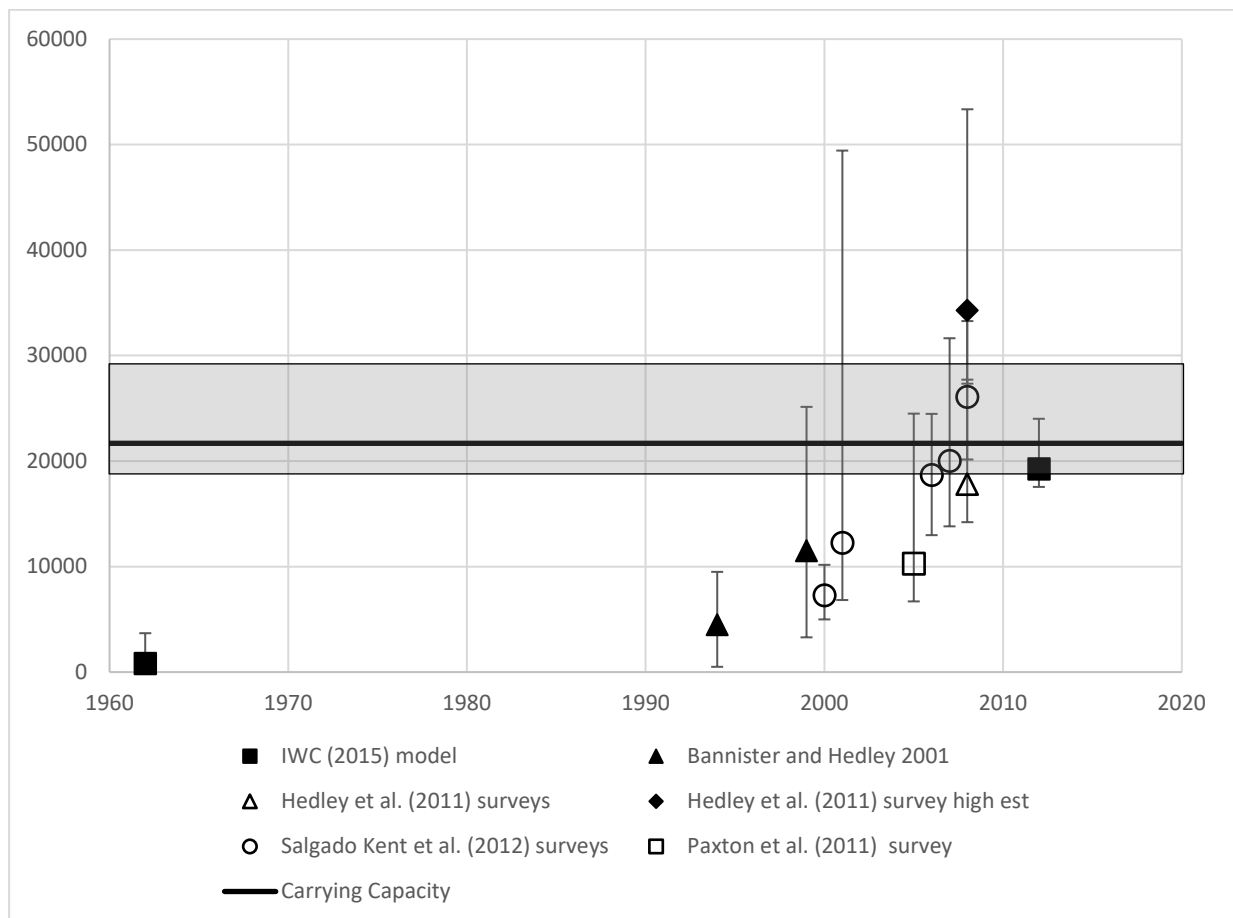


Figure 1. Estimates of absolute abundance of Humpback Whales in Western Australia. The shaded box shows the 90% PI of the estimated carrying capacity.

Partly as a function of the problems noted above, IWC estimates for minimum subpopulation size 824 (461-3,685 90% PI) and carrying capacity 21,686 (19,016 - 29,383 90% PI)(IWC 2015) of the Western Australian subpopulation were derived from Bayesian models developed using

the data on relative abundance (Bannister & Hedley 2001; Hedley et al. 2011). The absolute estimate of Hedley et al. (2011) was excluded from the model (IWC 2015). Estimates of the pre-whaling carrying capacity are based on a back projection informed by the known take of whales from Australia and the Southern Ocean. There is uncertainty about the allocation of take to particular populations particularly because they mix off Antarctica. Thus all estimates are based on assumptions about the geographic distribution of mixing during the whaling period.

The models were tested for consistency against earlier data from Chittleborough (1965). Figure 1 includes the estimated minimum size of the subpopulation and also a point estimate for 2012 provided by IWC (2015). The latter figure may underestimate subpopulation size as it assumes the subpopulation is approaching carrying capacity and thus that the population growth rate is slowing. There are currently no data to indicate this is occurring (see further discussion under the Eastern Australian subpopulation below).

The Western Australian subpopulation (Breeding Stock D) was reduced to an estimated 824 (461-3,685 90% PI) whales by 1962. The subpopulation increased rapidly following the cessation of whaling in 1963, with growth at approximately 10% per year between 1982 and 1991 to a subpopulation size of 4,000-5,000 (Bannister & Hedley 2001). A mark-recapture study for 1991-92 returned an estimate of 3,878 (1,319-14,108 95% CI)(Jenner & Jenner 1994). Paxton et al. (2011) provided an estimate for 2005 of 10,300 (6,700-24,500) that they considered an underestimate as the survey period did not cover the entire migration period. Hedley et al. (2011), using a combination of aerial and land-based surveys in the Shark Bay region, estimated that the annual rate of increase between 1999 and 2008 was 12.9%, but conceded that this was above the established plausible maximum rate such that either earlier estimates of subpopulation size had been too low, or their 2008 estimate too high. They estimated the subpopulation in 2008 to be 34,290 whales (27,340-53,350 95% CI) but considered this may be an overestimate due an error in estimating the sighting availability of whales on the survey line (a parameter referred to in the literature as $g(0)$).

Hedley et al. (2011) provided an adjusted $g(0)$ which reduced the estimate to 17,810 (14,210–27,720 95% CI)). It should be noted that that the higher estimate cited above is considerably greater than the carrying capacity estimated by the IWC (21,686 (19,016 - 29,383 90% PI)(IWC 2015))(Figure 1). However, a recent assessment of sources of heterogeneity in detection probabilities lends support to the original $g(0)$ estimate (Dudgeon et al. 2018), and thus the larger subpopulation estimate. In any case, it is clear that the size of the Western Australian subpopulation has increased at close to its maximum biological rate for most of the period since the cessation of whaling.

An additional set of survey data is available from North West Cape, approximately 500 km north of Shark Bay (Salgado Kent et al. 2012). Aerial survey methods were used over eight years: 2000, 2001, 2006, 2007 and 2008. The estimated subpopulation sizes were broadly in agreement with those of Hedley et al. (2011)(Figure 1) and the estimated trend was again close to that estimated from the Shark Bay surveys.

The IWC estimated that in 2012 the Western Australian subpopulation had recovered to 90% (74-98% 90% PI) of its pre-whaling levels and projected that by 2020 it would have reached 98% (88-100% PI)(IWC 2015). However, Noad et al. (2019) in discussing the similar circumstances of the Eastern Australian subpopulation (discussed in detail below), note that the recent observations of continuing rapid increase suggest that the absence of detectable density dependent effects suggest the subpopulation may overshoot the previously estimated carrying capacity. Unfortunately, for the Western Australian subpopulation there have not been subpopulation estimates made since 2008, and thus there is less resolution on the trend. Coughran et al. (2013) examined a spike in recorded mortality of Humpback Whales in Western Australia in 2009, including a hypothesis that the spike represented the subpopulation approaching carrying capacity. They rejected that hypothesis on the basis that the high rate of

strandings would be expected to continue or increase and that had not been the case in the years following.

Eastern Australia

The Eastern Australian subpopulation was also severely depleted by whaling to approximately 237 whales (203-272 90% PI)(IWC 2015) in the early 1960s and has regrown rapidly since the cessation of whaling and is now expected to be close to carrying capacity of 26,133 ([21,605-29,033 90% PI)(IWC 2015) (Figure 2). Surveys of the subpopulation commenced in 1978 (Patterson and Patterson 1984 in Noad et al. 2019) and soon began to report a rapidly increasing subpopulation. In 1987 the subpopulation was reported to be approximately 1,100 whales and increasing at 10% per year (6-13% 95% Confidence Interval)(Paterson & Paterson 1989). By 1992 this was estimated to have increased to 1,900 whales with a rate of increase of 11.7% per year (9.6-13.8% 95% CI)(Paterson et al. 1994) and by 2002 was estimated to be approximately 4,900 whales (Paterson et al. 2004). From 2004 surveys were continued by Noad and colleagues who undertook surveys in 2004, 2007, 2010 and 2015. In 2004 the subpopulation was estimated to be 7,090 (6430-7750 95% CI) with annual rate of increase of 10.6 (10.1-11.195% CI)(Noad et al. 2011). The 2004 estimate was updated, to adjust for underestimation due to sighting heterogeneity, to be 7808 (6911-8727 95% CI)(Dudgeon et al. 2018). The later estimates are 10,679 whales (9,381–12,156 95% CI) in 2007, 14,522 whales (12,777–16,504 95% CI) in 2010 and 24,545 whales (21,631–27,851 95% CI) for 2015 (Figure 2).

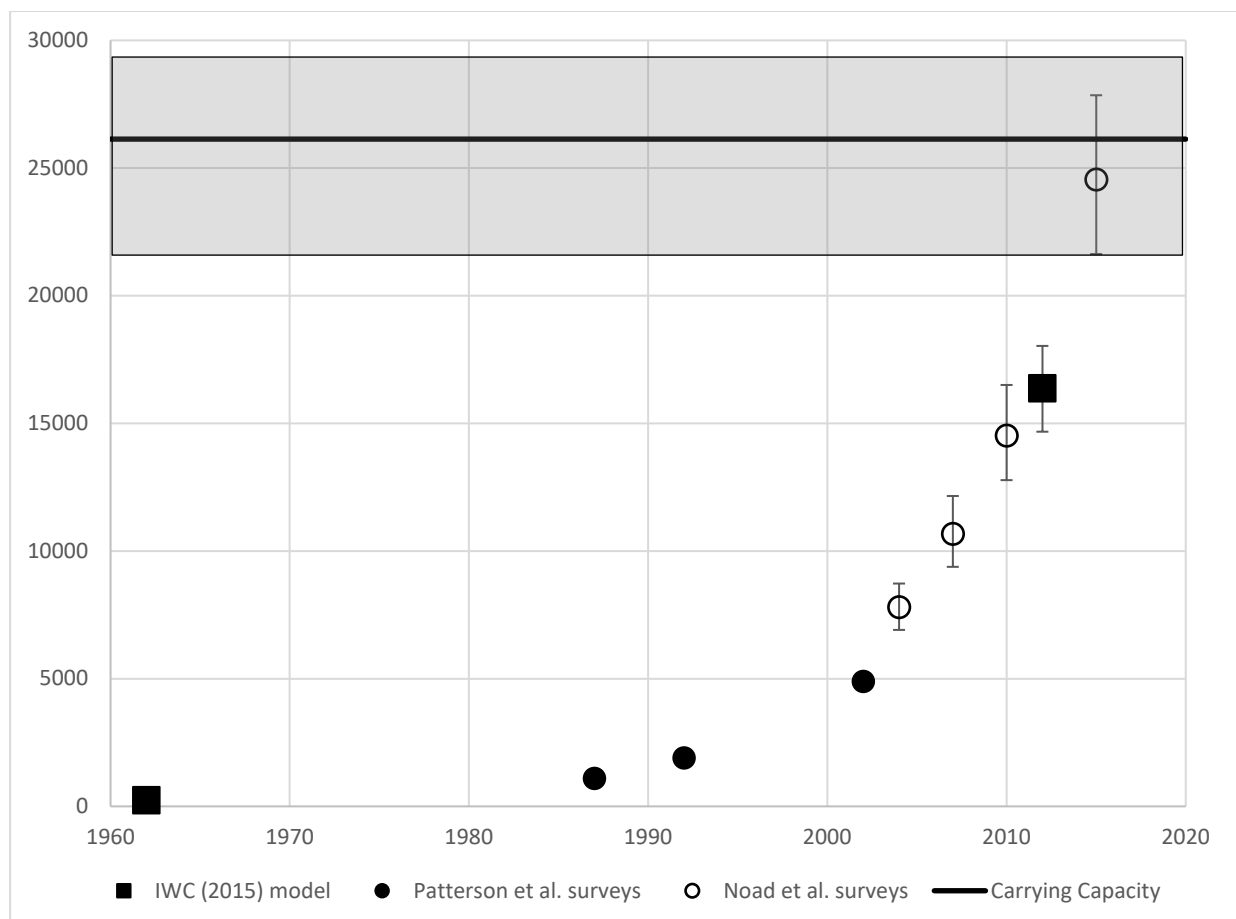


Figure 2. Estimates of absolute abundance of Humpback Whales in Eastern Australia. The shaded box shows the 90% PI of the estimated carrying capacity.

Noad et al. (2019) used the data from the Eastern Australian subpopulation to model the likely subpopulation trajectory into the future. Importantly, to date there has not been a decline in the rate of subpopulation growth recorded, nor have there been observations consistent with density-dependent effects occurring (e.g. a consistently increasing number of stranded,

emaciated calves, increased inter-calving period or greater age at maturation). Given the current high rate of growth, a simple logistic model, in which subpopulation growth slows as it approaches carrying capacity, is only realistic if the carrying capacity is substantially greater than that estimated for the pre-whaling period (at least 40,000 whales for the Eastern subpopulation alone)(Noad et al. 2019). This may be feasible if either the pre-whaling estimates of carrying capacity are underestimates, or carrying capacity is truly higher because whaling removed so many individuals of multiple species that competition for food resources is reduced. In the latter context, it is notable that other species of baleen whales (e.g. blue whales) were depleted in the Antarctic due to whaling and have not shown a similarly strong recovery. Neither of these hypotheses about the carrying capacity of Humpback Whale populations can currently be effectively evaluated. Alternative models that allow for a current food surplus and a carrying capacity close to that of the pre-whaling period all generate an expected over-shoot, where the subpopulation grows past carrying capacity, then mortality increases due to food shortage to bring the subpopulation back to carrying capacity over a series of reducing increase/decline cycles (Noad et al. 2019).

Conclusion (Eastern and Western subpopulations combined)

Both the Western Australian and Eastern Australian subpopulations of Humpback Whales were severely depleted by whaling. Since the cessation of whaling, both subpopulations have grown continuously at close to the estimated maximum biologically plausible rate and the most recent surveys for each suggest they continue to do so. Both are very close to, or above, their estimated carrying capacity.

The data presented above appear to demonstrate the species is not eligible for listing under this criterion. However, the purpose of this consultation document is to elicit additional information to better understand the species' status. This conclusion should therefore be considered to be tentative at this stage, as it may be changed as a result of responses to this consultation process.

Criterion 2. Geographic distribution as indicators for either extent of occurrence AND/OR area of occupancy			
	Critically Endangered Very restricted	Endangered Restricted	Vulnerable Limited
B1. Extent of occurrence (EOO)	< 100 km ²	< 5,000 km ²	< 20,000 km ²
B2. Area of occupancy (AOO)	< 10 km ²	< 500 km ²	< 2,000 km ²
AND at least 2 of the following 3 conditions indicating distribution is precarious for survival:			
(a) Severely fragmented OR Number of locations	= 1	≤ 5	≤ 10
(b) Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals			
(c) Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals			

Evidence:

IUCN Guidelines advise that “In the case of migratory species, EOO (and AOO) should be based on the minimum of the breeding or non-breeding (wintering) areas, but not both...” For the Humpback Whale this is the calving areas in the northern parts of their range in Australia (both Western and Eastern).

The extent of occurrence of Humpback Whale in Australia is at least 2,844,816 km². Area of Occupancy has not been estimated precisely, but for the Eastern Australian subpopulation alone the breeding area in the Great Barrier Reef World Heritage Area is over 30,000 km² (Smith et al. 2012; Smith et al. 2020) and the breeding range of the Western Australian subpopulation extends

1,000km² along the coast (Irvine et al. 2018). Area of Occupancy for Australian Humpback Whales is substantially in excess of 2,000 km²

The species is found in two locations, as per the two breeding subpopulations. There is no indication of continuing decline (see above under Criterion 1) and the species does not show extreme fluctuations.

The data presented above appear to demonstrate the species is not eligible for listing under this criterion. However, the purpose of this consultation document is to elicit additional information to better understand the species' status. This conclusion should therefore be considered to be tentative at this stage, as it may be changed as a result of responses to this consultation process.

Criterion 3. Population size and decline			
	Critically Endangered Very low	Endangered Low	Vulnerable Limited
Estimated number of mature individuals	< 250	< 2,500	< 10,000
AND either (C1) or (C2) is true			
C1 An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future)	Very high rate 25% in 3 years or 1 generation (whichever is longer)	High rate 20% in 5 years or 2 generation (whichever is longer)	Substantial rate 10% in 10 years or 3 generations (whichever is longer)
C2 An observed, estimated, projected or inferred continuing decline AND its geographic distribution is precarious for its survival based on at least 1 of the following 3 conditions:			
(a) (i) Number of mature individuals in each subpopulation	≤ 50	≤ 250	≤ 1,000
(a) (ii) % of mature individuals in one subpopulation =	90 – 100%	95 – 100%	100%
(b) Extreme fluctuations in the number of mature individuals			

Evidence:

As described above under Criterion 1, the estimated population size for Humpback Whales (combined Western and Eastern subpopulations) is well in excess of 40,000 whales and is not continuing to decline.

The data presented above appear to demonstrate the species is not eligible for listing under this criterion. However, the purpose of this consultation document is to elicit additional information to better understand the species' status. This conclusion should therefore be considered to be tentative at this stage, as it may be changed as a result of responses to this consultation process.

Criterion 4. Number of mature individuals			
	Critically Endangered Extremely low	Endangered Very Low	Vulnerable Low
Number of mature individuals	< 50	< 250	< 1,000

Evidence:

As described above under Criterion 1, the estimated population size for Humpback Whales (combined Western and Eastern subpopulations) is well in excess of 40,000 whales.

The data presented above appear to demonstrate the species is not eligible for listing under this criterion. However, the purpose of this consultation document is to elicit additional information to better understand the species' status. This conclusion should therefore be considered to be tentative at this stage, as it may be changed as a result of responses to this consultation process.

Criterion 5. Quantitative Analysis			
	Critically Endangered Immediate future	Endangered Near future	Vulnerable Medium-term future
Indicating the probability of extinction in the wild to be:	≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)	≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)	≥ 10% in 100 years

Evidence:

No quantitative analysis has been undertaken.

The data presented above appear to demonstrate the species is not eligible for listing under this criterion. However, the purpose of this consultation document is to elicit additional information to better understand the species' status. This conclusion should therefore be considered to be tentative at this stage, as it may be changed as a result of responses to this consultation process.

Consideration for delisting

The principal cause of the decline of the Humpback Whale was commercial whaling. This practise is now outdated and has largely ceased as a result of the global moratorium. While there is no expectation that commercial whaling will commence again if the species is removed from the EPBC Act threatened species list, Australia actively manages this risk through strong international policy on cetaceans and engagement with the IWC.

The species is subject to a number of impacts, as detailed above in the threats section and Table 1. As noted there, these are currently not threatening the species as evidenced by its continuing strong recovery.

Importantly, despite removal from the threatened species list, the Humpback Whale will remain a matter of national environmental significance under the EPBC Act as a cetacean and as a listed migratory species.

All cetaceans are protected in all Australian waters under the Australian Whale Sanctuary (see: <https://www.environment.gov.au/marine/marine-species/cetaceans/australian-whale-sanctuary>)

Plans that act to protect the Humpback Whale include:

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Department of the Environment and Energy (2018). Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (2018). Canberra, ACT: Commonwealth of Australia. Available from: <http://www.environment.gov.au/biodiversity/threatened/publications/tap/marine-debris-2018>. In effect under the EPBC Act from 21-Jul-2018.

Department of the Environment, Water, Heritage and the Arts (2008) EPBC Act Policy Statement 2.1 – Interaction between offshore seismic exploration and whales. Available from: <http://www.environment.gov.au/resource/epbc-act-policy-statement-21-interaction-between-offshore-seismic-exploration-and-whales>

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) (2012). Marine bioregional plan for the South-west Marine Region. Prepared under the Environment Protection and Biodiversity Conservation Act 1999. Available from: <http://www.environment.gov.au/topics/marine/marine-bioregional-plans/south-west>. In effect under the EPBC Act from 27-Aug-2012.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) (2012). Marine bioregional plan for the North-west Marine Region. Prepared under the Environment Protection and Biodiversity Conservation Act 1999. Available from: <http://www.environment.gov.au/topics/marine/marine-bioregional-plans/north-west>. In effect under the EPBC Act from 27-Aug-2012.

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Collective list of questions – your views

1. Do you have any additional information on the size or trend in either the Eastern Australian and/or Western Australian subpopulation of Humpback Whale?
2. Do you have any additional information that can be used to evaluate the level of current or future impact of any of the processes identified in Table 1?
3. Can you identify any additional threats impacting on Humpback Whale populations that are not included in Table 1?
4. Do you agree with the synthesis of survey data? If not, can you suggest alternative analyses or interpretation?
5. Do you have any additional information that you believe is relevant to the consideration of Humpback Whales for removal from the Threatened Species List? Please note that the species will remain a matter of national environmental significance as a cetacean and listed migratory species under the EPBC Act.

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