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Embracing conservation success of recovering humpback whale populations: Evaluating the case for downlisting their conservation status in Australia

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ABSTRACT

Optimism and hope in conservation biology are supported by examples of endangered species recovery, such as the population growth observed in humpback whales in several of the world's oceans. In Australia, monitoring data suggest rapid recovery for both east and west coast populations, which are now larger than 50% of their pre-whaling abundance. The measured growth rates exceed known species trends worldwide and have no indication of diminishing. Under Australian Commonwealth legislation and regulations, these populations should be considered for downlisting, as they are not eligible for listing as a threatened species against all statutory criteria. A change in conservation status will produce new challenges for the conservation and management of a recovered species, especially with the Australian economic landscape experiencing large-scale growth and development in recent years. More importantly, a recovered humpback whale population may bring a positive shift in the research goals and objectives throughout Australia by ensuring other endangered species an equal chance of recovery while delivering hope, optimism, and an opportunity to celebrate a conservation success.

1. Introduction

Marine mammals exhibit many of the characteristics of Ehrenfeld's [1] hypothetical most endangered animal, including large size, long lifespans, late reproductive age, few offspring, commercial value, distributions that cross international boundaries, and behaviors that place them at risk from a number of anthropogenic activities [2,3]. These vulnerabilities manifested in historic extinctions (e.g. Steller's sea cow (*Hydrodamalis gigas*) [4]), modern extinctions (e.g. Yangtze river dolphin or *baiji* (*Lipotes vexillifer*) [5–7]), and the plight of critically endangered species that may go extinct within a generation (e.g. vaquita (*Phocoena sinus*); [8–10]). Despite the vulnerability of marine mammals to negative human impacts (intentional or otherwise), there is room for optimism.

Optimism and hope in conservation biology will always be important factors for species recovery and success [11–14]. While some debate the semantic differences between hope and optimism [12], we purposely conflate the two, as one can lead to the other regardless of initial state. Optimism and hope in conservation biology are essential, as the relentless communication of conservation problems does not always encourage politicians, policy makers, and the public to solve them [15]. The plight of many marine mammal populations remains of concern globally, and conservation biologists should not detract from these cases. However, opportunities to illustrate and promote success must also be highlighted, thus providing hope and optimism that ongoing conservation actions can prevail. Ultimately, conservation biologists seek to juxtapose the long litany of sobering conservation concerns with inspirational examples that motivate people to use resources wisely and take sustainable and effective actions.

Presented here is an argument to revise the conservation status of the population of humpback whales (*Megaptera novaeangilae*) that inhabit Australian waters under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), thus providing a sensible and suitable opportunity to celebrate the recovery of an iconic species, without dismantling existing legislative protections from new and existing threats. Downlisting their conservation

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status is consistent with recent decisions made internationally by government agencies and conservation organizations to re-assess the status of other humpback whale populations worldwide. Furthermore, under the current management rationale, the Australian humpback whale populations would unquestionably surpass the justification to warrant downlisting. Taken collectively, these decisions provide evidence of successful marine mammal conservation that will encourage and justify future management actions, and the allocation of future funding to species and ecosystems at greater risk of extinction.

2. International context

The International Union for Conservation of Nature (IUCN) downlisted the global status of humpback whales from a Red List Category of Vulnerable to Least Concern. This decision was based on trends in data and the likelihood that current abundance estimates (>60,000 whales worldwide) are greater than 50% of the species' abundance in 1940 [16]. However, the IUCN acknowledge a global concern for discrete and smaller sub-populations of humpback whales from the Arabian Sea, western North Pacific, west coast of Africa, and South Pacific subpopulations in portions of Oceania [16]. While these smaller populations remain data deficient and potential threats to recovery still exist, the IUCN determined that the humpback whale global status is not significantly impacted by current levels of anthropogenic mortality, but rather is recovering strongly.

Humpback whale recovery has also led to downlisting in other regions. In April 2014, the Canadian government reclassified the North Pacific population of humpback whales in British Columbia from threatened to species of special concern [17]. Based on an annual rate of increase of 4.9–6.8% [18] with no signs of declining, this population was determined to be recovering, despite the current population estimate (~2145 whales) being less than pre-exploitation abundance (~4000 whales) in 1905. In the USA, humpback whales are listed as Endangered under the *Endangered Species Act* and Depleted under the U.S. *Marine Mammal Protection Act* [19]. Based on 2004–2006 data, the best available abundance estimate for the entire North Pacific region included 20,800 humpback whales [19]. While still considered to be an under-estimate of actual abundance, the estimate exceeds pre-exploitation population values of 15,000 humpback whales throughout the North Pacific [20]. In 2010, the USA National Marine Fisheries Service (NMFS) initiated a global humpback whale status review to ensure that the species conservation listing is accurate and based on the best scientific and commercial data available [21], and a final report was published in March 2015 [22]. Based on distribution, ecological situation, genetics, and other factors, 15 humpback whale distinct population segments worldwide were identified, among which nine were determined to not be at risk of extinction with high certainty: the West Indies, Hawaii, Mexico, west Australia, east Australia, Colombia, Brazil, Gabon/Southwest Africa, and Southeast Africa/Madagascar [22]. Consequently, in 2013 and 2014, petitions requested that NMFS reclassify and remove two of the three North Pacific humpback whale populations from the List of Endangered and Threatened Species. NMFS responded with a positive finding that the petitions warranted action [23].

3. Exploitation and recovery of Australian humpback whales

The International Whaling Commission (IWC) recognizes seven major breeding populations of humpback whales in the Southern Hemisphere [24], of which two (D and E1) have their primary calving areas in waters off north-western and north-eastern Australia, respectively [25,26]. The historical exploitation of these populations began in the 19th century, with whaling logbook records of humpback whales sighted and caught along northern and southern coasts of Western Australia [27]. Modern whaling in Australian waters began in 1912 [28,29]. Although right and sperm whales (*Eubalaena australis* and *Physeter macrocephalus*, respectively) were the preferred species, humpback whales that calved in Australian waters were killed at both ends of their geographic range: on their Antarctic feeding grounds and along their migratory pathways to their breeding grounds. The modernization of whaling techniques resulted in industrial advancements (e.g. steam powered boats and explosive harpoons), and catches were achieved efficiently from the Australian, shore-based whaling stations [28,29]. From 1935–1939, whaling records listed more than 12,000 humpback whales taken from Breeding Stock D (Group IV), with substantially less (~200 whales) from Breeding Stock E1 (Group V). The catch levels from 1949 to 1962 reported higher catch numbers, including greater than 18,000 and 15,000 whales from Breeding Stocks D and E1, respectively [28].

Furthermore, unreported and illegal whaling operations by the former USSR removed substantial numbers of humpback whales from the Southern Hemisphere [30]. After the 1961 IWC Antarctic restrictions, unreported catches of humpback whales from the Antarctic area were suggested as a likely explanation of high mortality rates observed [28]. Later revealed in 1993, illegal Soviet whaling operations continued throughout the Southern Hemisphere until 1972 and caused the greatest decline to humpback whale populations inhabiting Australian waters, as more than 48,000 whales were taken [31–33]. Without whaling competition and disregarding IWC regulations, the illegal catches dramatically impacted the already depleted populations from the east coast of Australia and New Zealand [33].

Despite the devastation caused by whaling, recent monitoring data suggest a rapid recovery of both Australian humpback whale populations. Early abundance estimates indicated that Breeding Stock E1 (Group V) was reduced to approximately 500 humpback whales by the end of 1962 [28]. However, recent population assessments incorporated a more comprehensive catch dataset, including the illegal catches from Soviet Antarctic whaling operations, and those models presented a likely minimum estimate of 1230 (median) humpback whales in 1968 [34]. Since 1986, annual, shore-based observations documented population estimates with consistent rates of increase from 9.7% in 1987 (1100 whales) to 11.7% in 1992 (1896 whales [35,36]). In 2004, land-based surveys determined that the population recovered to 7090 whales (95% CI 6430–7750 [37]) and to 9683 whales (95% CI 8556–10,959) in 2007 [38]. The corresponding long-term rate of increase was estimated at 10.9% per year. In 2010, the same stock was estimated at 14,552 whales (95% CI 12,777–16,504) with no evidence of a decline in the growth rate [39].

The lowest population estimate for Breeding Stock D was 268 whales in 1968 [29]. From 1982 to 1994, Bannister [40] estimated this stock increased to 4000–5000 whales. In 1999, 2005 and 2008, three surveys were undertaken on this population on their migratory route near Dirk Hartog Island. These surveys suggested a 9.7% (CV=0.25) rate of increase [41]. Unlike the surveys off eastern Australia, the necessary corrections for availability and perception bias were difficult to estimate due to challenges in establishing a suitable land-based observation platform [41]. Therefore, absolute abundance estimates for Breeding Stock D were difficult to derive and considered to be highly speculative by the authors [41]. Mindful of the data limitations, Hedley et al. [42] reported 11,500 whales (95% CI 9200–14,300) in 2006 and 33,850 whales (95% CI 27,340–50,260) in 2008. Similarly in 2008, Salgado-Kent et al. [43] conducted an aerial survey off the North West Cape and reported 26,100 whales (95% CI 20,152–33,272). Again, the final results did not include reliable estimates of

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availability bias and were also likely to be adversely affected by north and southbound milling whales overlapping in their migration paths [44].

Using these and other survey data, the IWC Scientific Committee continually assesses the recovery of the Australian populations based on various techniques, such as Bayesian logistic population dynamic models that require information on life history parameters, catch history, feeding, and breeding ground mixing and distribution, as well as absolute or relative abundance estimates [34]. These models also assume that the carrying capacity of the population has not changed since before exploitation [45]. While the general understanding of some of these parameters and assumptions remains poorly documented, the modeling process accommodates uncertainty and includes sensitivity runs to assess how changes to certain parameters affect the outcome. The results of the 'base model' suggested that the abundance of Breeding Stock D was 19,200 (17,553–24,012; 90% probability interval PI), while Breeding Stock E1 contained 16,366 whales (14,674–18,034; 90% PI). In addition, the model suggested that in 2012, western and eastern Australian populations were increasing at 9% and 10% per year, and were 90% (74–98; 90% PI) and 63% (56–73; 90% PI) of the pre-whaling population sizes, respectively [46].

Both available survey data and modeling predictions are limited by the knowledge of certain biological parameters. As such, maximum rates of increase may never be accurately or reliably estimated, and the most realistic, theoretical values based on the best available scientific data may not include maximum values. Life history parameters will modify as humpback whales respond to environmental changes, such as reduced exploitation levels and inter-specific competition. Abundance estimates and observations collected from breeding areas may present different birth and mortality rates than those measured from feeding grounds [47]. While estimating population abundance can be inherently difficult, it is apparent that both the east and western Australian populations are recovering rapidly and are now larger than 50% of their pre-whaling abundance.

Scientific evidence continues to reveal that Australian humpback whale populations are increasing at remarkable rates. For the Southern Hemisphere humpback whales, the IWC set an upper limit for growth rate at 12.6% [48], very similar to the 12.7% rate of increase from 2008 [42], which the authors acknowledge to be biologically implausible but sufficiently robust. Thus, the observed rates of increase for Breeding Stock D meet the IWC maximum limit. For Breeding Stock E1, the long-term rate of increase (10.9% from 1984 to 2010 [39]) was under the IWC limit but still sufficiently high. Based on biological parameters of humpback whales from the Northern Hemisphere, the maximum annual rate of increase was estimated at 11.8%, with accepted limitations in demographic parameters, environmental changes and other natural factors [47].

While some of the documented species trends (e.g. survival rate, calving rate, age at sexual maturity) from the Northern Hemisphere populations are not applicable, the Australian humpback whale populations' growth near maximum net productivity was expected for depleted stocks [49,50], providing optimism for future recovery. Recent population assessment models submitted to the IWC attempted to clarify the high growth rates observed for these populations of humpback whales. The results revealed further uncertainty regarding customary Antarctic stock boundaries [50] as well as absolute abundance estimate [51], and provided initial platforms on which further discussion and analysis will be developed.

Additionally, it has been proposed that recent shifts in the species' biological parameters are a possible explanation for observed rapid population growth, which is reasonable to presume when exploitation and competition are removed. Currently, the density-dependent calving interval is accepted as a minimum possible value of two years and was used to calculate the Breeding Stock D 12% rate of increase from 1982 to 1994 [52]. If this interval decreased to one year between calves, a possible 14% rate of increase would be expected [52]. Therefore, if Breeding Stock D is in fact experiencing a 12.7% rate of increase [42], it would seem probable that the calving interval may be reduced and that a change in the species biological characteristics may be occurring.

Finally, another recent explanation for the recovery of the Australian humpback whale populations introduced the possibility that observed rates of increases may be overestimated and influenced by immigrations to the breeding grounds in response to social mating behaviors and natural instincts to aggregate [53]. However, confirming the actual and true biological forces that are driving the growth of these populations will never be resolved without more demographic data.

4. Revising the conservation status of humpback whales in Australia

In Australia, the primary legislation that protects humpback whales is the EPBC Act, which conserves the biodiversity of the environment and promotes ecologically sustainable development. The EPBC Act protects all cetaceans within the Australian Whale Sanctuary that encompasses all Commonwealth waters, from the state limit (three nautical miles) to the Australian Exclusive Economic Zone boundary (200 nautical miles). Killing, injuring or interfering with a cetacean within the Australian Whale Sanctuary is a criminal offense and subject to severe penalties. Currently, humpback whales are a threatened species (vulnerable status) as well as a migratory species, both of which are identified by the EPBC Act as a Matter of National Environmental Significance (MNES). Any action that is likely to have an environmental impact on an MNES must be assessed for approval under the EPBC Act. Thus, any activity within Australian waters that is likely to have an impact on a humpback whale requires government approval and permits.

Assessments of the conservation status of native species under the EPBC Act are made against statutory criteria, which are established under the *EPBC Regulations 2000* [Table 1]. A species may be considered for removal or downlisting if eligible against all five criteria. First, the Australian populations of humpback whales have undergone substantial abundance reductions during the last century but are not likely to undergo similar reductions in the immediate future (Criterion 1). Criterion 2 requires that the population's geographic distribution is precarious for the survival of the species, with the extent of occurrence estimated to be less than 20,000 km^2 or an area of occupancy estimated to be less than 2000 km^2. The current geographic distributions of Australian humpback whale populations exceed these limits, is not severely fragmented, does not exist at limited locations, and is not observed, inferred or projected to be declining. Extreme fluctuations do not exist in terms of occurrence, occupancy, locations, subpopulations or number of mature individuals of Australian humpback whales. In reference to an estimate of mature individuals (Criterion 3), the population's total number is unknown but presumed to be not 'limited' (< 10,000 individuals), and all scientific evidence to date suggests that these populations are not in decline but rather recovering strongly. The estimated number of mature individuals is substantially greater than the low value for a vulnerable species (< 1000 individuals; Criterion 4). Finally, while quantitative analysis on the probability of extinction in the wild for the Australian humpback whale populations has not been published, the available data do not support or suggest that these populations have a 10% chance of extinction

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Table 1
Eligibility criteria for removing a species from any category in the list of threatened species under the EPBC Act.

Criterion	Description
Criterion 1	Population size reduction (reduction in total numbers) Population reduction (measured over the longer of 10 years or 3 generations)
Criterion 2	Geographic distribution is precarious for either extent of occurrence AND/OR area of occupancy
Criterion 3	Small population size and decline
Criterion 4	Very small population (mature individuals): • Critically Endangered (extremely low) <50 • Endangered (very low) <250 • Vulnerable (low) <1000
Criterion 5	Quantitative analysis indicating the probability of extinction in the wild: • Critically Endangered (immediate future) $\geq 50\%$ in 10 years or 3 generations, whichever is longer (100 years max) • Endangered (near future) $\geq 20\%$ in 20 years or 5 generations, whichever is longer (100 years max) • Vulnerable (medium term future) $\geq 10\%$ in 100 years

within 100 years (Criterion 5). In fact, recent abundance assessments submitted to the IWC (as stated above) demonstrate that the chance of extinction within 100 years is highly unlikely.

Based on the criteria above [Table 1], available scientific evidence does not support the listing of humpback whale populations on the EPBC Act list of Threatened species. However, it is important to remember that irrespective of the Australian humpback whale populations' presence on or absence from the Threatened species list, they are still protected under the EPBC Act as an MNES based on their qualification as a migratory species.

5. Conclusions

A change in recovery status will inevitably produce new challenges for species conservation and management. A marine environment with recovered humpback whale populations will present new and diverse management challenges and require alternative approaches to ecological sustainability. The Australian humpback whales are an exemplary model of recovery, especially within a marine environment experiencing rapid and concurrent expansion in industrial and exploration activities. The economic landscape for Western Australia experienced large-scale growth and development in recent years, for which environmental assessments and baseline surveys were routinely dedicated to humpback whales and dugongs [54]. The most probable concerns for future environmental management will be sustaining the recovery in a viable marine ecosystem in the midst of human and economic expansion around Australia and possible fishery expansion in the Southern Ocean, neither of which presents signs of imminent population decline. An increase in humpback whale interactions with maritime users is an expected consequence of recovery, including acoustic disturbance from anthropogenic noise, collisions with vessels, entanglements in fishing gear, habitat destruction from coastal development, and cumulative interactions with the whale-watch industry.

Scientific data present justifiable evidence to support downlisting the level of legislative protection of humpback whales that breed in Australian waters. The recovery of Australian humpback whales demonstrates conservation and management success for a species that was severely over-exploited. While this success rests ultimately upon the ongoing moratorium on commercial whaling and the limited expansion of special permit whaling, the recovery of humpback whales in Australian waters would not be evident without the support of conservation science directed at establishing the species' modern range, abundance, and demography. A recovered humpback whale population could bring a positive shift in the research goals and objectives throughout Australia. Should reclassification occur for humpback whales, one of the most beneficial consequences for conservation biology would be to continue research and management funding to enhance the survival of other species and ecosystems that are in danger of extinction and to ensure an equal chance of success as demonstrated by the humpback whales.

The recovery of the iconic humpback whales of Australia and elsewhere delivers both hope and optimism, as well as an opportunity to celebrate success at two levels: (1) the successful implementation of contentious international management actions to protect marine species; and (2) the wise and significant investment in conservation science, illustrating how human activity can respond to strong conservation interventions to achieve outcomes that are not simply for immediate, human material gains. Worldwide, humpback whale numbers appear to be increasing across a range of populations. While significant (and often times seemingly insurmountable) obstacles stand in the face of conserving many marine species and ecosystems, humpback whales provide an opportunity to embrace a conservation success.

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