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A Recent Stranding of Omura's Whale (*Balaenoptera omurai*) in Western Australia

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Abstract

Omura's whale (*Balaenoptera omurai*), described in 2003, is a putatively rare rorqual species known mostly from waters in the lower latitudes of the Indo-Pacific. A small (5.68 m) baleen whale that stranded near Exmouth on the northwestern coast of Australia in March 2015 was initially thought to be a small Omura's whale (although unknown for the area) or a Bryde's whale (*B. brydei*). Morphological assessment showed the whale had a strongly falcate, steeply angled dorsal fin characteristic of Omura's whale and a slightly prominent single median ridge but was smaller in size than was typical for Omura's whale. Phylogenetic analysis of mitochondrial control region sequences from the whale against other reference baleen species showed our specimen nested within sequences from Omura's whale with high bootstrap support and was clearly separate from sequences of Bryde's whale, thus confirming the limited morphological identification of the specimen as Omura's whale. The carcass was in good condition with no obvious signs of trauma, and assessment revealed the animal was recently deceased. Lack of decomposition and no injury suggested it was likely to have been alive at the time of stranding and to have been occupying inshore waters prior to being washed ashore. Confirmation of an Omura's whale in Western Australian waters extends knowledge of its distribution southwards in the eastern Indian Ocean, suggesting further survey in these waters may provide more information on this poorly known species.

Key Words: strandings, DNA fingerprinting, distribution, D-loop, genetic, Omura's whale, *Balaenoptera omurai*

Introduction

The most recently described living species of baleen whale, Omura's whale (*Balaenoptera omurai*), is a putatively rare species known from only a limited number of specimens and sightings. The current oceanic distribution of the species is believed to be the tropical to subtropical lower latitudes of the Indo-Pacific region, but its full distribution remains unclear. Omura's whale was formally described in 2003 from a specimen captured in the Sea of Japan, with additional specimens described from the Solomon Sea and the eastern Indian Ocean near the Cocos Islands (Wada et al., 2003). The currently known distribution further includes records from Indonesia, the Philippines, Madagascar, and a deceased whale found in St Vincent's Gulf, South Australia (Yamada et al., 2008; Cerchio et al., 2015). Currently, the type locality in the Sea of Japan (34° 21' N) and the South Australian record (34° 37' S) are the northern and southern extremes, respectively, of this whale's known distribution (Yamada et al., 2008; Cerchio et al., 2015).

In the past, specimens of Omura's whale have been identified as pygmy/dwarf Bryde's whales (*B. brydei*/*B. edeni*), but morphological and molecular evidence obtained by Wada et al. (2003) identified Omura's whale as a distinct species not closely related to Bryde's whale. Omura's whale differs from Bryde's whale in that it has a single median ridge along the top of the rostrum whereas Bryde's whales have an additional lateral ridge on either side of the median ridge (Yamada et al., 2008). In addition, the number of throat pleats (80 to 90) in Omura's whale is greater than in Bryde's whale (maximum 70; Jefferson et al., 2008). Omura's whale is similar in appearance to the fin whale (*B. physalus*), with asymmetrically pigmented lower jaws and throat; however, in the

fin whales the dorsal fin is not as strongly hooked as has been observed for Omura's whale (Jefferson et al., 2008; Cerchio et al., 2015). The number of its baleen plates is less than any other species in the family Balaenopteridae (180 to 210 on each side) (Jefferson et al., 2008), and there are several skull characters that also distinguish this whale from other balaenopterids (Wada et al., 2003). Adults of Omura's whales reach approximately 11.5 m, and physical maturity occurs at about 9.0 m (Wada et al., 2003).

On 13 March 2015, a deceased balaenopterid was found on a remote beach (21° 49' 3.6" S, 114° 11' 14.86" E) near Exmouth on Western Australia's northern coast. The specimen was observed above the high water mark following a storm surge associated with the passage of tropical cyclone Olwyn that passed over the region at 0200 h on 13 March 2015. Initial observations suggested it was possibly an Omura's whale or perhaps a small Bryde's whale. In order to make a definitive identification, photographs were taken for morphological identification, and tissue samples for DNA analysis were taken prior to autopsy.

Methods

Morphological assessment of the carcass was undertaken *in situ*, and photos were taken to record the features of the animal. The carcass was examined and classified according to the condition codes of Pugliares et al. (2007) in which the animal is alive (Code 1); less than 24 h *postmortem* (Code 2); decomposition with mild characteristic odour, dry mucous membranes, and sunken eyes, with possible bloating and cracked and sloughing of skin (Code 3); advanced decomposition with strong odor, collapsed carcass, and liquefied internal organs (Code 4); or the carcass is mummified or there are skeletal remains (Code 5). A full internal autopsy was undertaken before burial of the carcass.

A cube of skin and blubber was collected, frozen (-20º C) and transported to the Department of Parks and Wildlife laboratories in Perth for DNA analysis, with subsamples registered at the Western Australian Museum (WAM M63349).

Whole genomic DNA was extracted from two replicate samples of the skin tissue using a standard "salting out" procedure (Sunnucks & Hales, 1996).The mitochondrial control region (D-loop) gene was amplified by Polymerase Chain Reaction (PCR) using forward and reverse primers described in Wada et al. (2003). PCR was conducted in 25 µl reactions containing ~20 ng genomic DNA, 1x PCR buffer, 2 µM dNTPs, 2.5 mM $MgCl_2$, 0.5 µM each F/R primer, and 1 U Taq polymerase, with the following cycling profile: initial denaturation 95° C for 3 min; followed by 35 cycles of 94° C for 30 s, 55° C for 45 s, and 72° C for 1 min; and a final extension step of 72° C for 7 min. PCR products were then purified and sequenced using a commercial service (Australian Genome Research Facility, Perth). Replicate samples produced identical DNA sequences which were edited to produce a consensus sequence using the program *Sequencher* (Gene Codes Corporation, Ann Arbor, MI, USA). This yielded 938 bp of clean DNA sequence that was aligned against representative control region sequences from all known *Balaenoptera* species available on Genbank (www.ncbi.nlm.nih.gov/genbank) using *Clustal W* in *MEGA*, Version 6 (Tamura et al., 2013).

Phylogenetic analysis of the sequence from the Omura's whale along with additional *Balaenoptera* sequences from Genbank were undertaken in *MEGA*, using maximum likelihood and the Tamura 3-parameter model of nucleotide substitution, and using bootstrapping (a statistical resampling technique) to determine branch support (1,000 bootstraps). Sequences of the humpback whale (*Megaptera novaeangliae*) were included as an outgroup. We calculated pairwise genetic distances (net nucleotide substitutions per site) between our specimen and the three *B. omurai* sequences generated in Wada et al. (2003) using *MEGA*, Version 6. We also included in this analysis representative sequences from *Balaenoptera* species sharing some morphological features with *B. omurai* and with which *B. omurai* may be confused with in the field (i.e., *B. brydei*, *B. edeni*, and *B. physalus*).

Results

Examination of the carcass determined it to be fresh with no autolysis or decomposition; therefore, it was classified as Code 2 (less than 24 h *postmortem*; Pugliares et al., 2007). The specimen measured 5.68 m and was confirmed to be a female from the physical examination—likely a young juvenile to subadult animal based upon its size (approximately 50% that of adult Omura's or Bryde's whales). The carcass was resting on its ventral surface, and there were no signs of external trauma (Figures 1a & 1c). The skin was in good condition, although all external pigmentation was darkened from recent *postmortem* changes, preventing analysis of diagnostic coloration patterns. Further autopsy results showed the whale was in good body condition and not suffering from malnutrition, evidenced by healthy subcutaneous fat stores in the post-cranial area, the scapular region, and the lateral flanks (Bradford et al., 2012).

The dorsal fin was very hooked, rising to a steep angle, and small but noticeably falcate, rising abruptly out of the back (Figure 1b). There was a slightly prominent median ridge on the top of the

rostrum (Figure 1d), with only faint right lateral rippling when viewed at an appropriate angle, which is unlikely to be clearly visible if observed at a distance. Due to the ventral recumbent positioning of the specimen, throat pleats were not able to be counted (80 to 90 throat pleats are considered diagnostic for *B. omurai* compared to 42 to 54 for *B. brydei*; Jefferson et al., 2008). The shape of the dorsal fin and the single ridge on the rostrum were characteristic of Omura's whale, and the absence of additional lateral rostral ridges (characteristic of Bryde's whale) further supports the specimen's identification as Omura's whale (Wada et al., 2003).

Phylogenetic analysis of control region (D loop) sequences gave a tree showing clear resolution of samples to species except for a sample designated as *B. edeni* that was basal to a cluster of *B. brydei* (Figure 2). The samples of *B. omurai* were clustered together with high bootstrap support, distinct from *B. brydei*, *B. edeni*, and *B. borealis*. The sequence from the stranded carcass nested with 100% bootstrap support with other sequences of *B. omurai* generated by Wada et al. (2003) in their taxonomic description of the species (Figure 2). Similarly, pairwise genetic distances between our specimen and other *B. omurai* were low (D_A = 0.001 to 0.005) compared to distances with other *Balaenoptera* species with which *B. omurai* may be confused (D_A = 0.071 to 0.083; Table 1), supporting its affiliation with *B. omurai*. Our specimen also appeared to be more closely related to *B. omurai* from the Sea of Japan than to other *B. omurai* from the Solomon and Cocos Islands.

Discussion

Morphological inspection of the stranded carcass suggested the animal was a juvenile, female Omura's whale, and species identification was confirmed by phylogenetic analysis. Identification of this specimen as Omura's whale represents only the second validated record of this species in Australian waters and extends its known distribution in the Indian Ocean approximately 10° latitude further southwards from other documented records in the Cocos Islands.

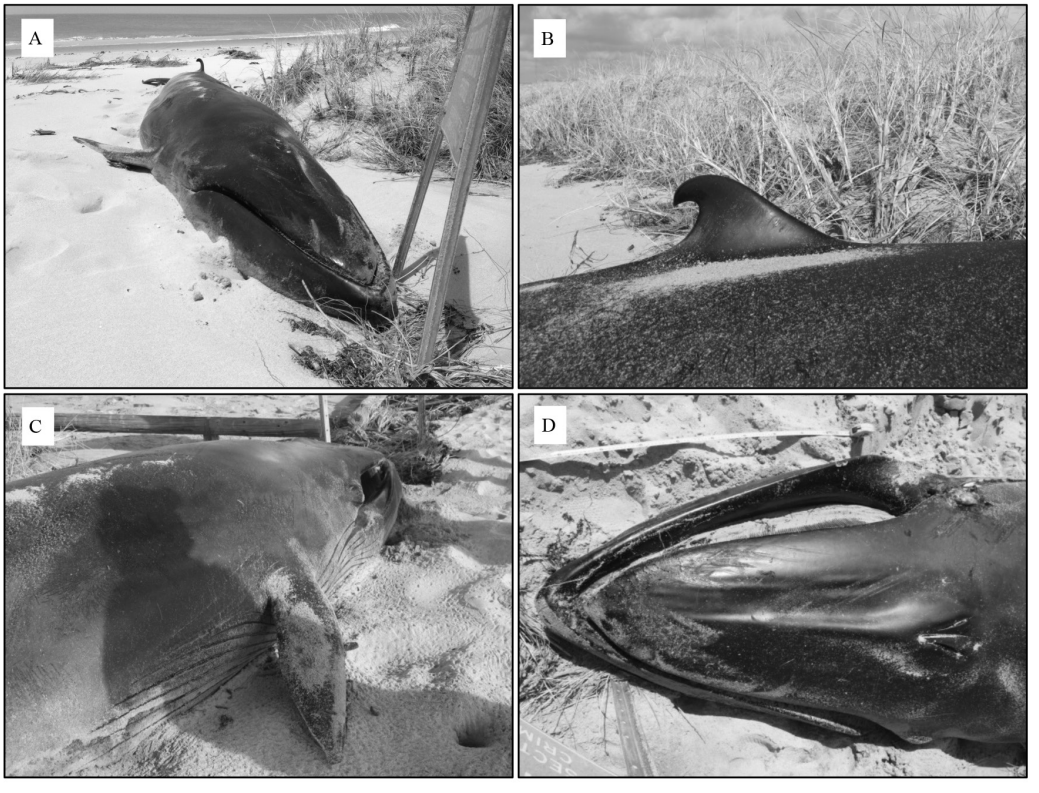

Figure 1. External appearance of the juvenile Omura's whale (*Balaenoptera omurai*) stranded near Exmouth, Western Australia: (A) antero-lateral view of carcass showing lack of apparent decomposition or trauma; (B) lateral view of distinctive dorsal fin shape; (C) postero-lateral view showing throat pleats; and (D) dorsal view of the head showing single prominent ridge on the rostrum. (Photo credits: Geof Parry, Channel 7 [A], Department of Parks and Wildlife [B & C], and Lyn Irvine [D])

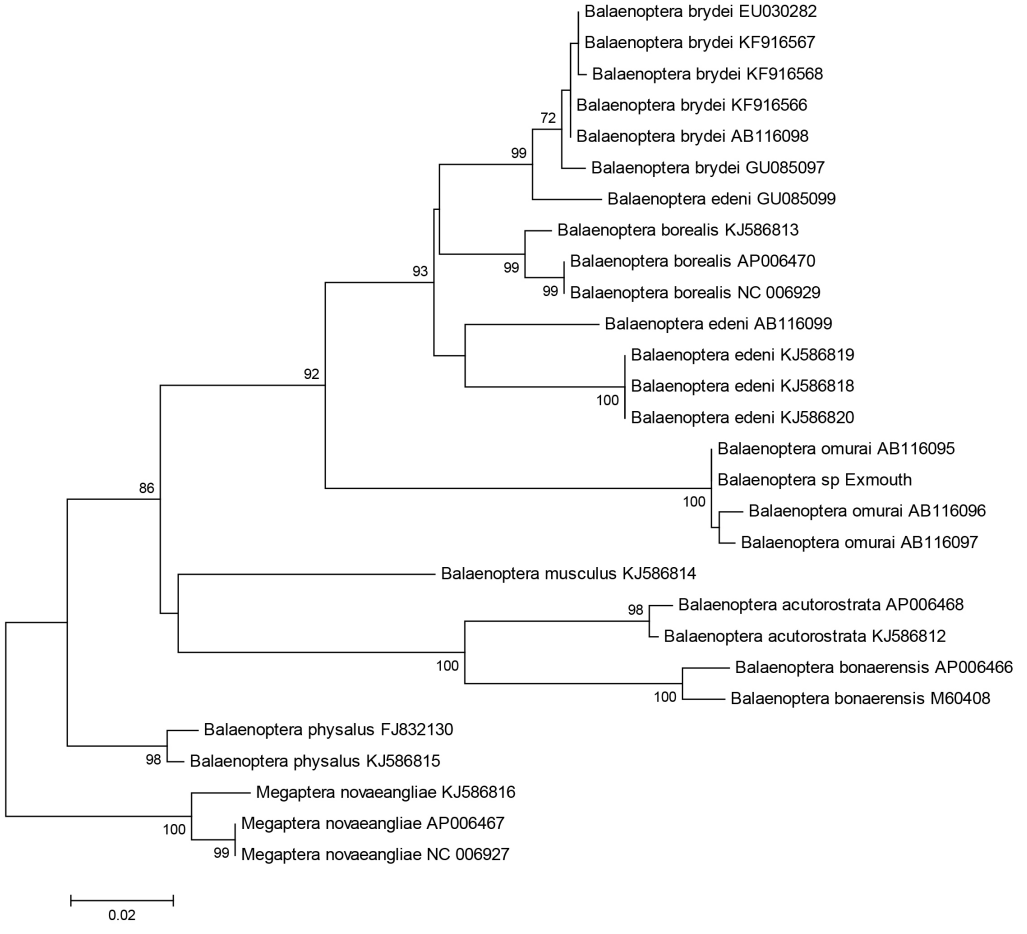

Figure 2. Maximum likelihood analysis of phylogenetic relationships of all of the known *Balaenoptera* species and our unknown specimen, *Balaenoptera* sp. Exmouth, using sequences available on Genbank (accession numbers listed after species names). Bootstrap support values > 70% are shown adjacent to nodes. The Genbank accession number for *Balaenoptera* sp. Exmouth is KT757371.

While it is not possible to know the location of the animal prior to being washed ashore, it is reasonable to suggest it was alive and frequenting the near inshore waters of the stranding site prior to the arrival of the cyclone that led to it becoming stranded. The lack of decomposition, which is quite rapid in whales (occurring within hours to days), the absence of epidermis separation, and the lack of damage to the carcass strongly suggest the animal may have been alive at the time of stranding or that death occurred within close proximity of the shore. A most likely cause of death is from misadventure at the time of the arrival of the cyclone as there are few other disturbances in this area, and there was no evidence at necropsy of ship strike, entanglement, or predatory damage, which would be other potential sources of mortality. It is, therefore, the opinion of the authors that this whale was most probably migratory or transitory in Australian waters close to the northwestern coast and was not adrift as a bloated, decomposing carcass from the central range of this species, many hundreds of nautical miles north in Indonesian waters.

This new record suggests the presence of Omura's whale in Western Australian waters; however, further investigative research is required to understand the spatial and temporal distribution of this species, particularly to inform its abundance, ecology, and behavior in this region. Anecdotal evidence such as a live sighting of Omura's whale in Lacepede Islands, northwest

Table 1. Pairwise sequence differences (net nucleotide substitutions per site, D_A) between mitochondrial control region sequences from *Balaenoptera* sp. Exmouth; all *Balaenoptera omurai* from Wada et al (2003); and *Balaenoptera* sharing similar morphological features to *B. omurai*, *B. brydei*, *B. edeni*, and *B. physalus*.

	B. sp. Exmouth	*B. omurai* (Japan)	*B. omurai* (Solomon Is.)	*B. omurai* (Cocos Is.)	*B. brydei*	*B. edeni*
B. omurai (Japan)	0.001					
B. omurai (Solomon Is.)	0.004	0.005				
B. *omurai* (Cocos Is.)	0.003	0.004	0.005			
B. brydei	0.072	0.071	0.077	0.076		
B. edeni	0.071	0.070	0.076	0.075	0.039	
B. physalus	0.083	0.082	0.088	0.087	0.076	0.075

Genbank accession numbers: *B.* sp. Exmouth (KT757371), *B. omurai* Japan (AB116095), *B. omurai* Solomon Is. (AB116096), *B. omurai* Cocos Is. (AB116097), *B. brydei* (AB116098), *B. edeni* (AB116099), and *B. physalus* (KJ586815)

Australia (corroborated in Cerchio et al. [2015]), and morphologically similar whales unable to be identified by experienced observers in aerial surveys of the area (L. Irvine, pers. comm.) suggest there is potential that Omura's whale may be more common in the southeastern Indian Ocean than currently recognized. Further research also will be required to determine the affinity of this population with other known populations of *B. omurai*.

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