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Omura's whale *Balaenoptera omurai* Wada, Oishi & Yamada, 2003 stranding on Qeshm Island, Iran, Persian Gulf: further evidence for a wide (sub)tropical distribution

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Abstract
A small, juvenile rorqual live-stranded on Qeshm Island, Iran, in the northern Strait of Hormuz (Persian Gulf) in September 2007. Cause of stranding is unknown but the whale (QE22.09.2007) showed no severe traumatic injuries nor was emaciated. Based on at least seven morphological features, considered diagnostic in combination, allowed a positive identification as Omura's whale *Balaenoptera omurai*. Features included diminutive body size (397 cm); a large number of ventral grooves (n=82) extending caudad of the umbilicus; a strongly falcate dorsal fin; asymmetric colouration of the head (especially lower jaws) reminiscent of fin whale, including unilateral dark eye, ear and flipper-to-flank stripes; faint/incomplete lateral rostral ridges; and record low number of short, broad baleen plates (204 in right jaw). The likelihood for the existence of a local *B. omurai* population in the eastern Persian Gulf or northern Arabian Sea seems higher than the wandering of a very young animal or mother/calf pair from any of the known distant distribution areas in the eastern Indian Ocean or Madagascar. This is the first record of *B. omurai* in Iran, the Persian Gulf and in the NW Indian Ocean.

Keywords: Rorquals; Balaenopteridae; zoogeography; external morphology; NW Indian Ocean

Introduction

A small rorqual (*Balaenoptera* sp.) with a body length of 397 cm was found on the east coast of Qeshm Island, Iran, in the northern Strait of Hormuz, Persian Gulf. The diminutive rorqual, evidently a calf or a small juvenile, stranded alive on 21 September 2007 at an indeterminate time. During the night of 21-22 September, a team of local volunteers attempted to rescue the whale by keeping it wet with the plan to refloat it with rising tide, actions which were filmed by Mr. Besharati Asghar. Predictably the rescue failed and the whale died *in situ*.
Based on external morphological characteristics we here identify the Qeshm rorqual as an Omura's whale *Balaenoptera omurai* Wada, Oishi & Yamada 2003. This recently described, small rorqual species, with an adult size of barely 11.7m, was until 2015 thought to be distributed exclusively in tropical and subtropical waters of the southwestern Pacific and the eastern Indian Ocean (Wada *et al.* 2003; Jefferson *et al.* 2008; Reilly *et al.* 2008a). Cerchio *et al.* (2015) extended the known range to the Southwestern Indian Ocean when reporting on a population resident in coastal waters off northern Madagascar. These authors documented external morphology and colouration in some detail from underwater photography, new insights which were essential in the present analysis. Simultaneously, Jung *et al.* (2015) demonstrated at least occasional distribution of *B. omurai* into the Northeast Atlantic Ocean, following the genetic identification of a 398 cm juvenile stranded on an Mauritanian beach in 2013. Jung *et al.* (2015) advanced two hypotheses to explain the unusual location, either an unrecognised Atlantic population or, less likely, an inter-oceanic vagrant.
The main significance of the Qeshm specimen resides in the fact that *B. omurai* has not before been documented in the Persian Gulf, Iran and the Northwest Indian Ocean. The possible occurrence of this species off Iran was suggested by Braulik *et al.* (2010).

Material and Methods

On 22 September, two of us (SR, MSD) examined, measured and photographed the freshly dead carcass of the small Omura's whale, henceforth referred to as specimen QE22.09.2007. The stranding location (N26°56.298', E56°16.701') consisted of a low-sloping sandy beach “Shahrak Sahely” at Qeshm City, a few hundred meters from the island's main port. Multiple shallow cuts and skin abrasion injuries, apparently linked to the stranding event, were

present but there was no externally visible indication of a major trauma, nor did the whale appear emaciated. Without necropsy and no collected tissue samples, the cause of the stranding is unknown. Nonetheless, with the stranding location so close to the port, the likelihood of an anthropogenic factor is suggested. Considering that it was initially thought to be a relatively common Bryde's whale, the carcass was buried on the beach for later retrieval but, washed out during a spring tide, it eventually was lost. Numerous photographs (n=124) and a video of both the live and freshly dead (<12 hours) whale were deposited at the Qeshm Environment Administration at Qeshm City. Back-up copies are archived at the Peruvian Centre for Cetacean Research, Lima.

As to positively identify QE22.09.2007 based on its distinctive morphology and colour pattern, an inferential process is followed in which at least seven features of external morphology and colouration described for *B. omurai* (Wada *et al.*, 2003; Jefferson *et al.*, 2008; Cerchio *et al.*, 2015), combined deemed diagnostic, were demonstrated to be present. Specimen QE22.09.2007 was also distinguished (through a differential diagnosis) from the other seven known rorqual species (genus *Balaenoptera* Lacépède, 1804), discarding blue whale, *B. musculus* (Linnaeus, 1758); fin whale, *B. physalus* (Linnaeus, 1758); sei whale, *B. borealis* Lesson, 1828; Bryde's whale, *B. brydei* Olsen, 1913; Eden's whale, *B. edeni* Anderson, 1879; Antarctic minke whale, *B. bonaerensis* Burmeister, 1867; and common minke whale, *B. acutorostrata* Lacépède, 1804, for presenting morphologic features incongruent with these species.

Although increasing evidence (e.g. Wada *et al.*, 2003; Sasaki *et al.*, 2006) suggests that large-sized Bryde's whales *B. brydei* Olsen, 1913 form a clade distinct at specific level from the smaller-sized Eden's whale *B. edeni* Anderson 1879, several authors continue to defend a conservative view of conspecificity where *B. brydei* is considered a junior synonym of *B. edeni,* comprising two subspecies, namely *B. edeni edeni* and *B. edeni brydei* (e.g. Best, 2007; Reilly *et al.*, 2008b; Kershaw *et al.*, 2013). Although we tend to agree with dual species (Wada *et al.*, 2003), we recognize inconclusiveness and in practical terms it remains difficult to assign individual specimens to *brydei* or *edeni* forms since most published ranges in external morphometrics, meristics, colouration and other phenotypic features span the pooled intraspecific variation of both large and small forms of Bryde's whales (*sensu lato).*

We counted the throat (ventral) grooves from high-resolution photographs at the cross-section of the pectoral fins over an ½ exposed throat, i.e. from the ventral midline up to one flipper's axilla. Next, we added the count of the few grooves lateral to one pectoral fin, visible from a side view photo. Throat grooves were counted several times independently, then averaged. Finally, we multiplied by 2 to provide the total number of throat grooves.

Results and Discussion

Below we discuss the diagnostic external morphological features and colour pattern which distinguish *B. omurai* specimen QE22.09.2007 from some, most or all other balaenopterid species.

Diminutive body size

Standard body length of QE22.09.2007 measured 397 cm. Interestingly, a *B. omurai* calf, positively identified by sequencing (barcoding techniques) of three mt-DNA regions, which stranded in Mauritania measured an almost identical 398 cm (Jung *et al.*, 2015; Mullié *et al.*, 2015). As in the latter, the fully healed umbilicus of QE22.09.2007 (Figure 2) indicated, at the very least, a post-neonatal age class but probably was considerably older. The Mauritanian individual was considered a juvenile which may or may not have been weaned (Jung *et al.*, 2015). QE22.09.2007 was significantly smaller than neonate length for blue whale (*B. musculus*), fin whale (*B. physalus*) and sei whale (*B. borealis*), (respectively 7-8 m, 6-6.5 m, 4.5-4.8 m), which definitively discards the three larger balaenopterids as candidates. In comparison, neonate size for Bryde's whales ranges 3.81-3.96 cm (Best, 2007). Neonatal Antarctic minke (*B. bonaerensis*) and common minke whales (*B. acutorostrata*), smaller still, range respectively 2.7-2.9 m (Best, 2007) and 2.0-2.8 m (Jefferson *et al.*, 2008) and cannot be excluded based on body size.

Large number of ventral grooves that extend caudad of umbilicus

From photographs it was determined that specimen QE22.09.2007 had about 82 narrow throat grooves which extended caudad of the umbilicus (Figure 2). This exceptionally large number is consistent with the 80-90 throat grooves reported for *B. omurai* (Wada *et al.*, 2003) and the 'minimum of 70' in the juvenile specimen from Mauritania (Jung *et al.*, 2015) similar to QE22.09.2007. Moreover, the lengthy throat grooves extended markedly caudad to the pectoral fin tips, also evident in the Mauritanian individual (Jung *et al.*, 2015).

Such a high number, and far caudad extension, of throat grooves distinguish QE22.09.2007 from *B. bonaerensis* which, on average, has merely some 65 grooves (range= 44-76) that extend in the midline from the tip of the lower jaw to just anteriad of the umbilicus (Best, 2007). These features reliably distinguish QE22.09.2007 also from dwarf minke whale (*B. acutorostrata* subsp.) which has even less throat grooves, namely 44-66 at the cross-section of the flippers (Kato and Fujise, 2000) and grooves that extend only anteriad of the umbilicus (Best, 2007). Ventral groove characteristics by

itself exclude both minke whale species. In Bryde's whales the major ventral grooves number 42-54 and extend from the chin as far back as the umbilicus (Olsen, 1913; Best, 2007). Jefferson *et al.* (2008) indicated a higher upper range (40-70) for *B. brydei* but even that maximum does not compare positively with the 82 grooves observed in QE22.09.2007.

Strongly falcate dorsal fin.
Omura's whales have a strongly falcate and pointed dorsal fin (Wada *et al.*, 2003; Jefferson *et al.*, 2008; Cerchio *et al.*, 2015), probably more consistently backswept than in any other rorqual species (Figure 3), especially in adults. As in many other cetaceans some growth variation likely exist. Indeed, in several Omura's whales, the often elongated tip points backwards at a 90° angle from vertical (e.g., photo on p.58, by T. Yamada *in* Jefferson *et al.*, 2008; and supplementary material of Cerchio *et al.*, 2015). This results in a very low dorsal fin height/length-at-base (H/L) ratio, for instance, 0.41 in the Yamada specimen. In QE22.09.2007, the dorsal fin was also strongly falcate and formed a 90° angle (Figure 3). Height and length at base measured, respectively, 7.5 cm and 18.0 cm, also resulting in a low H/L ratio of 0.42.

Asymmetric colouration pattern
Overall the colouration pattern of *B. omurai* resembles that of the fin whale *Balaenoptera physalus* (Wada *et al.* 2003; Jefferson *et al.*, 2008). In QE22.09.2007 (Figure 2), as in *B. omurai*, the left side of the throat is darkly pigmented while much of the remaining ventral surface is mostly lightly coloured, including the right side of the throat (Wada *et al.*, 2003). However the lower lips, i.e. the skin covering the mandibula were a slightly darker grey (Figure 4), also clearly visible, albeit not discussed, in an adult female *B. omurai* from Madagascar (Cerchio *et al.*, 2015, see first row of their figure 3).
In summary, all features of colouration reported for *B. omurai* by Cerchio *et al.* (2015) were also evident in QE22.09.2007: (i) asymmetrical colouration of the lower jaws, with lightly pigmented right jaw (Figure 4) and darkly pigmented left jaw (Figure 5); (ii) asymmetrical colouration of the gape (inner lower lip) with light left gape (Figure 5) and darkly pigmented right gape; (iv) dark eye and ear stripes on the right side (Figure 4); (v) a third dark stripe (flipper-to-flank). A lightly pigmented chevron anterior to the dorsal fin and a blaze anterior to the right eye, as reported by Cerchio *et al.* (2015), were not noticeable on photos of QE22.09.2007 and may, or may not, have been present. We must consider also the possibility of ontogenetic variation, as published descriptions are from subadults and adults, while QE22.09.2007 was evidently a calf. Whether the leading edge of the pectoral fins was white from tip to shoulder (Cerchio *et al.*, 2015) neither could be ascertained, due to peeling skin in QE22.09.2007.

Faint indications of lateral rostral ridges
In contrast with the prominent lateral ridges on the rostrum in Bryde's whales, commonly characterized as diagnostic (Best, 2007), the lateral rostral ridges are faint in Omura's whales (Wade *et al.*, 2003; see figure 3 in Cerchio *et al.*, 2015). In QE22.09.2007 a faint left lateral ridge was formed between two parallel grooves present on the left side of the rostrum, while on the right side, relief of the rostral integument was visible only proximally in the form of two very short parallel grooves (Figure 6). Actually these sets of parallel grooves appeared to be responsible for the faint lateral ridges aspect, as there seemed to be no markedly raised lateral ridges as occur in all forms of Bryde's whales. More *B. omurai* specimens will be necessary to better document the extent of individual and ontogenetic variation in rostral ridges, and grooves as seen here. However, it is evident that both minke whale species which have a single strongly raised central ridge on the rostrum, and laterally show no relief whatsoever of the rostral integument, are not concordant with the limited relief (grooves) observed in QE22.09.2007.

Low number of baleen plates.
An approximate count of 204 baleen plates in the right jaw, determined from several close-up photographs of the head of QE22.09.2007 (Figure 7) agrees with baleen plate counts reported for *B. omurai* : 203 (right side) in one whale and 208 (left side) in another whale, while 181-190 (right side) in a third specimen (Wada *et al.*, 2003). Baleen counts in *B. omurai* are markedly lower than those for the other *Balaenoptera* species (Wada *et al.*, 2003). There exists no overlap even with the lower extreme of the range in Bryde's whales (276-289 baleen plates per jaw) (Best, 2007) and Antarctic minke whales (215-310 plates per jaw) (Best, 2007).

Conclusion
The combination of seven main morphological features is considered diagnostic evidence for the positive identification of QE22.09.2007 as *B. omurai.* With no evidence of emaciation or any external trauma other than minor cuts and abrasions associated to the event of running ashore, the cause of stranding is unknown. However, the event was strongly reminiscent of the recent stranding of a similarly sized juvenile *B. omurai* in Mauritania (Jung *et al.*, 2015), 11,400 km away from its closest known regular distribution area (northern Madagascar). As the latter, QE22.09.2007 was also

thought to be either an unweaned calf or a recently weaned one, and an adult female (mother) may have occurred in the relative vicinity. The likelihood for the existence of a local *B. omurai* population either in the Strait of Hormuz off Qeshm Island, or generally in the Persian Gulf, or even in the contiguous Gulf of Oman, seems higher than the wandering of a very young individual or mother/calf pair from any of the known distant distribution areas in the eastern Indian Ocean or the SW Indian Ocean (Madagascar).
Earlier reported Bryde's whale records from the Persian Gulf (Baldwin *et al.*, 1999) deserve verification. A whale stranded on Abu Island, Saudi Arabia, in March 1995 (Baldwin *et al.*, 1999) and another at Port Umm Qasr, southern Iraq, on 5 February 1967 (Mahdi, 1967; Al-Robaae, 1969) are beyond suspicion due to their large body size (respectively 14.5 m and 12.5 m), larger than an *B. omurai* adult (11.7 m). Other records are more difficult to confirm as Bryde's whales for lack of data. Braulik *et al.* (2010) listed 10 records for Iranian waters, 9 for the Persian Gulf and one for the Gulf of Oman. Any specimens will have to be studied closely.

Kershaw *et al.* (2013), based on mt-DNA control region sequences of 18 Bryde's whales stranded or struck by ships along the southern coast of Oman (Dhofar coast and Gulf of Masirah), found no evidence of Omura's whale. Indeed, to date "there are no confirmed records of Omura's whales from Oman's coasts, neither in the Sea [Gulf] of Oman nor the western Arabian Sea" (Robert Baldwin, Environment Society of Oman, pers. comm. to KWW, 17 March 2016), however only a brief period has elapsed since the description and distinction of *B. omurai*. Bryde's type rorquals are commonly seen throughout the region year-round in coastal and offshore waters (Baldwin *et al.* 1999; Baldwin, 2003; K. Van Waerebeek, pers. observations), and in retrospect some of the smaller rorquals, conceivably, could have been Omura's whales.

We suggest that the global distribution of Omura's whale may be far wider in tropical and subtropical waters than the currently confirmed records (reviewed in Cerchio *et al.*, 2015) seem to suggest. In the northeast Indian Ocean, there are specimens from the west coast of Thailand (Yamada *et al.*, 2006; Adulyanukosol, 2012) and graphic evidence from the eastern Andaman Sea. The species occurs also on the west side of the Malay Peninsula, in Malaysia (Ponnanpalam, 2012) and off the Cocos Islands (Wada *et al.*, 2003). However genetic sampling of Bryde's whale populations in the northern Indian Ocean, including the Arabian Sea, Bay of Bengal, the Maldives and south of Java, have not yet revealed evidence of *B. omurai* (Kershaw *et al.*, 2013). The suggestion by Cerchio *et al.* (2015) that the species distribution may be discontinuous and that the Madagascar population in the southwest Indian Ocean may be relatively isolated from the eastern populations is certainly possible but as yet unconfirmed. These authors admitted however that it is conceivable that other populations have gone undetected, with accounts from the Cocos Islands and Madagascar suggesting that populations occur around oceanic islands. Boat surveys should be undertaken off Qeshm Island in search of a potential Iranian population of Omura's whale. It is adamant also that stranded whales in Iran, and generally the Persian Gulf, be systematically examined, sampled, and photographed. We know for instance that from March to October 2015 at least four whales stranded on Iran's Persian Gulf coasts (S. Ranjbar, unpublished data), but none have been studied for lack of dedicated personnel and resources.

The unexpected successive findings of *B. omurai* in three formerly unrecognised and widely dispersed ocean provinces (Madagascar, Mauritania, Iran) within the span of a few years, hint at a likely scenario of a much wider tropical and subtropical distribution than hitherto assumed. Whether their distribution is continuous or discontinuous remains entirely unknown. Other specimens may have been incorrectly identified in the past as Bryde's whales due to certain morphologic similarities and considering that most diagnostic features of *B. omurai* have been documented only in the past few years (Wada *et al.*, 2003; Yamada *et al.*, 2006; Cerchio *et al.*, 2015; Jung *et al.*, 2015; this paper). This case once again demonstrates the continued relevance of stranding programmes as useful sources for distributional data.

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FIGURE CAPTIONS

Figure 1. Map showing the stranding location of specimen QE22.09.2007 (yellow star) on the eastern tip of Qeshm Island, Iran, located at the Strait of Hormuz which links the Persian Gulf to the Gulf of Oman in the Northeast Indian Ocean.

Figure 2. Ventral view of specimen QE22.09.2007, showing diagnostically large number of throat grooves (n=82) extending caudad of the (fully healed) umbilicus. Note also the asymmetric ventral colouration pattern (see text).

Figure 3. The strongly falcate, relatively low, dorsal fin of QE22.09.2007, with tip pointing backwards seems a consistent characteristic for *B. omurai*. Indications are that the recurvedness accentuates with growth.

Figure 4. Right side of QE22.09.2007 while still alive, showing lightly pigmented, almost white throat, with light grey right mandible. Note three head stripes (dark grey): (1) wide eye stripe; (2) narrow ear stripe; and (3) wide flipper-to-flank stripe. Visible are also the central rostral ridge and two faint partial accessory ridges.

Figure 5. Overal dark pigmentation of the left body side of specimen QE22.09.2007, and in particular the uniformly darkly pigmented throat and left mandible contrasts with its paler right side (see Figure 4). However note lighter pigmented left gape.

Figure 6. Dorsal view of head of QE22.09.2007 showing peculiar configuration of a relatively low central rostral ridge, a faint left lateral ridge and, proximally only, a system of two short grooves, on the right side of the rostrum, providing a general aspect of incomplete, faint lateral ridges. The rostrum was largely flat and not slightly arched in cross-section as in minke whales. It also lacked the markedly triangular aspect of minke whale rostra.

Figure 7. Right side view of the head (upside down) of specimen QE22.09.2007 showing the low number of short but broad baleen plates, with greyish-white baleen fringes, as reported for *B. omurai* (Wada *et al.*, 2003). The colour of the baleen plates varied with their anteroposterior position in the baleen row and displayed asymmetry.

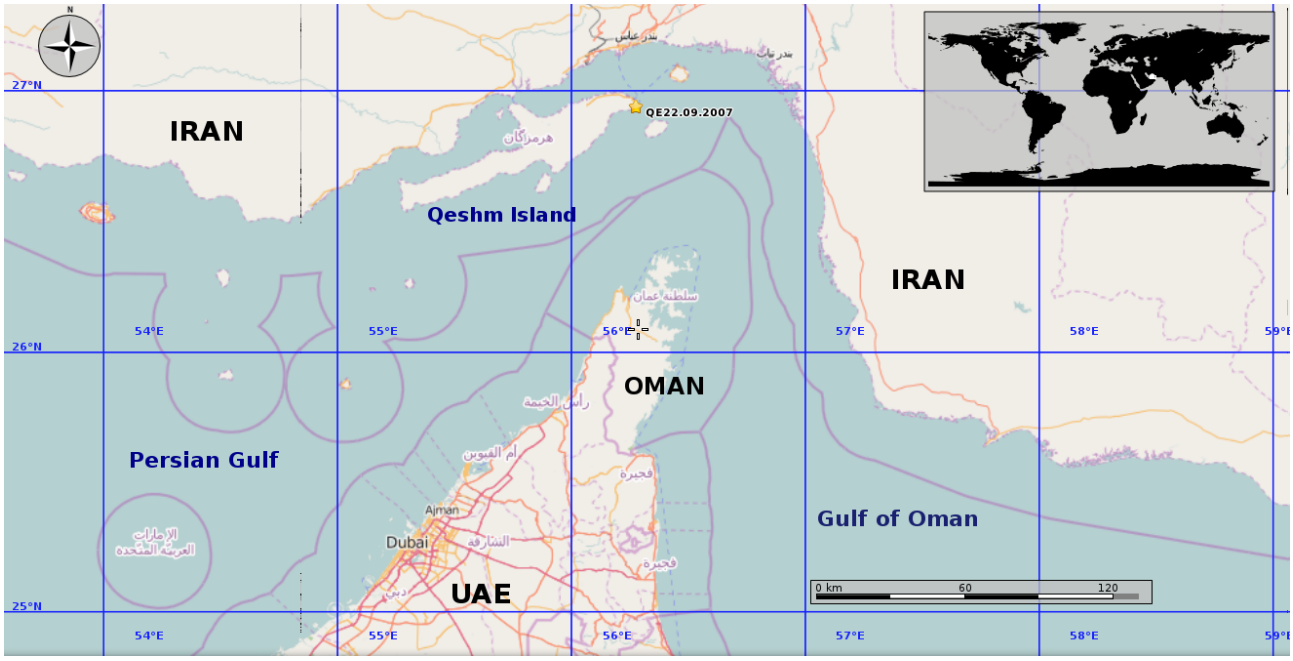

Figure 1.

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