Ziphiidae – Beaked whales

Berardius arnuxii Meike Scheidat

These cryptic, deep-diving species appear to be substantially more vulnerable to the effects of marine noise pollution, compared to other cetacean species, which has resulted in a number of mass stranding events worldwide (Dalebout et al. 2005).

All beaked whale assessments are presented together due to lack of species-specific information.

	Regional Red List status (2016)	National Red List status (2004)	Reasons for change	Global Red List status	TOPS listing (NEMBA) (2007)	CITES listing	Endemic
Berardius arnuxii	**Data Deficient*†**	Data Deficient	No change	Data Deficient (2008)	None	Appendix I (1983)	No
Hyperoodon planifrons	**Least Concern†**	Least Concern	No change	Least Concern (2008)	None	Appendix I (1983)	No
Indopacetus pacificus	**Data Deficient*†**	Data Deficient	No change	Data Deficient (2015)	None	Appendix II (2003)	No
Mesoplodon densirostris	**Data Deficient*†**	Data Deficient	No change	Data Deficient (2008)	None	Appendix II (2003)	No
Mesoplodon grayi	**Data Deficient*†**	Data Deficient	No change	Data Deficient (2008)	None	Appendix II (2003)	No
Mesoplodon hectori	**Data Deficient*†**	Data Deficient	No change	Data Deficient (2008)	None	Appendix I (2003)	No
Mesoplodon layardii	**Data Deficient*†**	Data Deficient	No change	Data Deficient (2008)	None	Appendix II (2003)	No
Mesoplodon mirus	**Data Deficient*†**	Data Deficient	No change	Data Deficient (2008)	None	Appendix II (2003)	No
Ziphius cavirostris	**Data Deficient*†**	Data Deficient	No change	Least Concern (2008)	None	Appendix II (2003)	No

*Watch-list Threat †Conservation Dependent

Taxonomy

Berardius arnuxii (Duvernoy 1851)

Hyperoodon planifrons (Flower 1882)

Indopacetus pacificus (Longman 1926)

Mesoplodon densirostris (Blainville 1817)

Mesoplodon grayi (Von Haast 1876)

Mesoplodon hectori (Gray 1871)

Mesoplodon layardii (Gray 1865)

Mesoplodon mirus (True 1913)

Ziphius cavirostris (Cuvier 1823)

ANIMALIA - CHORDATA - MAMMALIA - CETARTIODACTYLA - ZIPHIIDAE

Synonyms: *Indopacetus pacificus*: *Mesoplodon pacificus* (Longman 1926)

Common names:

- *Berardius arnuxxi*: Arnoux's Beaked Whale, Large Beaked Whale, Southern Four-toothed Whale, (English), Arnoux se Snoetwalvis (Afrikaans)
- *Hyperoodon planifrons*: Southern Bottlenose Whale, Antarctic Bottle-nosed Whale, Flatheaded Bottlenose Whale (English), Suidelike stompneuswalvis (Afrikaans)

Recommended citation: Relton C, Cockcroft V, Hofmeyr G. 2016. A conservation assessment of Ziphiidae. In Child MF, Roxburgh L, Do Linh San E, Raimondo D, Davies-Mostert HT, editors. The Red List of Mammals of South Africa, Swaziland and Lesotho. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.

- *Indopacetus pacificus*: Longman's Beaked Whale, Indo-Pacific Beaked Whale, Tropical Bottlenose Whale (English)
- *Mesoplodon densirostris*: Blainville's Beaked Whale, Atlantic Beaked Whale, Dense Beaked Whale (English), Blainville se Snoetwalvis (Afrikaans)
- *Mesoplodon grayi*: Gray's Beaked Whale, Scamperdown Whale, Southern Beaked Whale (English), Gray se Snoetwalvis (Afrikaans)
- *Mesoplodon hectori*: Hector's Beaked Whale, New Zealand Beaked Whale, Skew-beaked Whale (English), Hector se Snoetwalvis (Afrikaans)
- *Mesoplodon layardii*: Strap-toothed Whale, Layard's Beaked Whale (English), Layard se Snoetwalvis (Afrikaans)
- *Mesoplodon mirus*: True's Beaked Whale (English), True se Snoetwalvis (Afrikaans)
- *Ziphius cavirostris*: Cuvier's Beaked Whale, Goose-beaked Whale, Goosebeak Whale (English), Cuvier se Snoetwalvis (Afrikaans)

Taxonomic status: Species

Taxonomic notes: The family Ziphiidae, often described as the least known of all cetacean families, contains a group of 21 species, nine of which occur within the assessment region. Although Arnoux's Beaked Whale (*B. arnuxii*) of the southern oceans and Baird's Beaked Whale (*B. bairdii*) of the northern Pacific are almost morphologically indistinguishable, and have been suggested to be members of the same species (see Kasuya 2002), recent mitochondrial data confirmed that they are in fact separate species (Dalebout 2002). Using mitochondrial DNA to assess the taxonomy of beaked whales, Dalebout et al. (1998) found that the Southern Bottlenose Whale (*H. planiforns*), exhibits substantial intraspecific variation, even greater than the variation between the two *Berardius* species. This result could be attributed to either an effectively large population size, or multiple evolutionary significant units (Moritz 1994). Longman's Beaked Whale, *I. pacificus*, in the Indo-Pacific was frequently misidentified as the Southern Bottlenose Whale, *H. planifrons*, due to the similarity in their external morphology (Pitman et al. 1999; Dalebout et al. 2003). A new genus, *Indopacetus*, was established for Longman's Beaked Whale (initially classified as *Mesoplodon pacificus*), based predominantly on its cranial morphology (Moore 1968; Rice 1998). Although phylogenetic analyses failed to confirm the legitimacy of this genus, osteological features, including rib count, number of fused cervical vertebrae and cranial characteristics, may be sufficient to afford the Longman's Beaked Whale its own separate genus (Dalebout et al. 2003). The majority of species within the family Ziphiidae fall under the genus *Mesoplodon*, five of which are located in South African waters (Best 2007). Aside from male tooth form, the morphological variation between *Mesoplodon* species is somewhat limited (Mead 1989). Recent mitochondrial DNA evidence revealed that specimens of *M. hectori* from the North Pacific and the southern hemisphere do not, in fact, represent the same species, and as a result the North Pacific population has been reclassified as *M. perrini* (Dalebout et al. 2002). Similarly, the disparate distribution of *M. mirus* between the northern and southern hemispheres may also prove to be separate species or subspecies, although this theory is yet to be confirmed. Cuvier's Beaked Whales represent the single, global species of the monotypic genus *Ziphius* (Rice 1998; Dalebout et al. 2005). Substantial variation in morphology has been recorded across the range of the Cuvier's Beaked Whale (Heyning 1989), inferring the existence of locally distinct populations.

Assessment Rationale

There is no information pertaining to the population abundance of beaked whales within the assessment region, and they are generally considered to be naturally rare. However, there appear to be no current major threats to these species, although marine noise pollution, usually in the form of seismic surveys, navy operations and marine construction, as well as plastic pollution, have been identified as emerging and escalating threats to beaked whales. Anecdotal evidence suggests that beaked whales are more vulnerable to marine noise (particularly mid-frequency active sonar) than other cetaceans. The compounding influences of these threats, in association with other low-level threats, such as anthropogenic climate change, could potentially cause beaked whale population declines. With the exception of the Southern Bottlenose Whale, beaked whales in the assessment region are listed as Data Deficient, hich highlights the need for additional research, specifically on assessments of abundance, changes in abundance, distribution and anthropogenic threats, including marine noise pollution. In other parts of the world there have been repeated instances of mass strandings of Cuvier's Beaked Whales associated with mid to low frequency active sonar. It has been suggested that these sonar effects could extend to seismic surveys (applicable to all beaked whale species). Within the assessment region, only 26 strandings have been recorded. Thus, although this species is presumably common and abundant in South African waters, we list as Data Deficient until abundance and the effects of marine noise pollution can be investigated. Reassessments should follow when new data are available. The Southern Bottlenose Whale is the most abundant of all Ziphiidae species within South African waters, and is the second most commonly sighted whale. Data from the IWC circumpolar surveys places the national population at between 50,000 and 70,000 individuals with an estimated stable population trend and no major threat that could cause population decline. Although, similarly for the other beaked whales, marine noise pollution is considered a major emerging and intensifying threat, it is not projected to cause significant population decline of this abundant species. Thus, we list this species as Least Concern.

Regional population effects: Beaked whales are considered to be wide-ranging, seasonally migrating species. Those present within South African waters in summer presumably spend winters in the southern oceans, thus there are no barriers to dispersal, and rescue effects are possible.

Distribution

Beaked whales are widely distributed across both the northern and southern hemisphere, but are seldom seen, due to their low population abundance, remote deep-water distribution and deep-diving behaviour, thus the precise extent of their ranges remain uncertain. They are most commonly located in open waters beyond the edge of the continental shelf. Of the Ziphiidae species, only Cuvier's Beaked Whale (*Z. cavirostris*) and Blainville's Beaked Whale (*M. densirostris*) have widespread global

distributions. True's Beaked Whale (*M. mirus*) has a disjunct distribution across both the northern and southern hemisphere, and Longman's Beaked Whale (*I. pacificus*) is limited to the tropical and subtropical Indo-Pacific region. Arnoux's Beaked Whale (*B. arnuxii*) (Ross 1984) and the Southern Bottlenose Whale (Mead 1989; Jefferson et al. 1993) have circumpolar distribution in mid- to high latitudes in the southern hemisphere. Finally, Gray's Beaked Whale (*M. grayi*) and Hector's Beaked Whale (*M. hectori*) are predominantly restricted to the cool temperate waters of the southern hemisphere, and the Strap-toothed Beaked Whale (*M. layardii*) to the cold temperate regions.

Berardius arnuxii have been sighted and collected from a range of localities throughout the southern oceans, from approximately 78°S off the coast and ice edges of Antarctica north to about 34°S off the coast of South Africa, Brazil, Argentina and Australia (Paterson & Parker 1994; Kasuya 2002; Culik 2004) (Figure 1). However, most of the documented sightings of this species are from the New Zealand area, south of 40°S (Balcomb 1989; Jefferson et al. 1993). Although their migration routes are largely unknown, this species may spend winter within Antarctic waters, moving northwards into warmer latitudes to mate and calve in summer (McCann 1975). Although there are few sighting data of this species within the assessment region (Best 2007), it is known from South African waters from a few observations at sea, three strandings of single individuals on beaches between 32°S and 34°S during summer, and from one stranding event involving four individuals (all successfully re-floated) at St Helena Bay in January 1998 (Findlay et al. 1992; Best 2007).

Hyperoodon planifrons occurs predominantly south of 30°S (Ross 1984) in the southern oceans off Chile, South Africa, New Zealand, the Falkland Islands and extensively throughout Antarctic waters (Figure 1). Their range extends south to the South Shetland Islands (65°S), but they have also been frequently sighted between 60°S and the ice edge (Kasamatsu et al. 1988). A number of sighting records were documented from the south-western Indian Ocean off the coast of South Africa between 35°S and 40°S in summer (Gambell et al. 1975), but appear consistently absent from this region in winter. Peak sightings records off the coast of Durban in February may indicate a northward migration route from the Antarctic region in summer

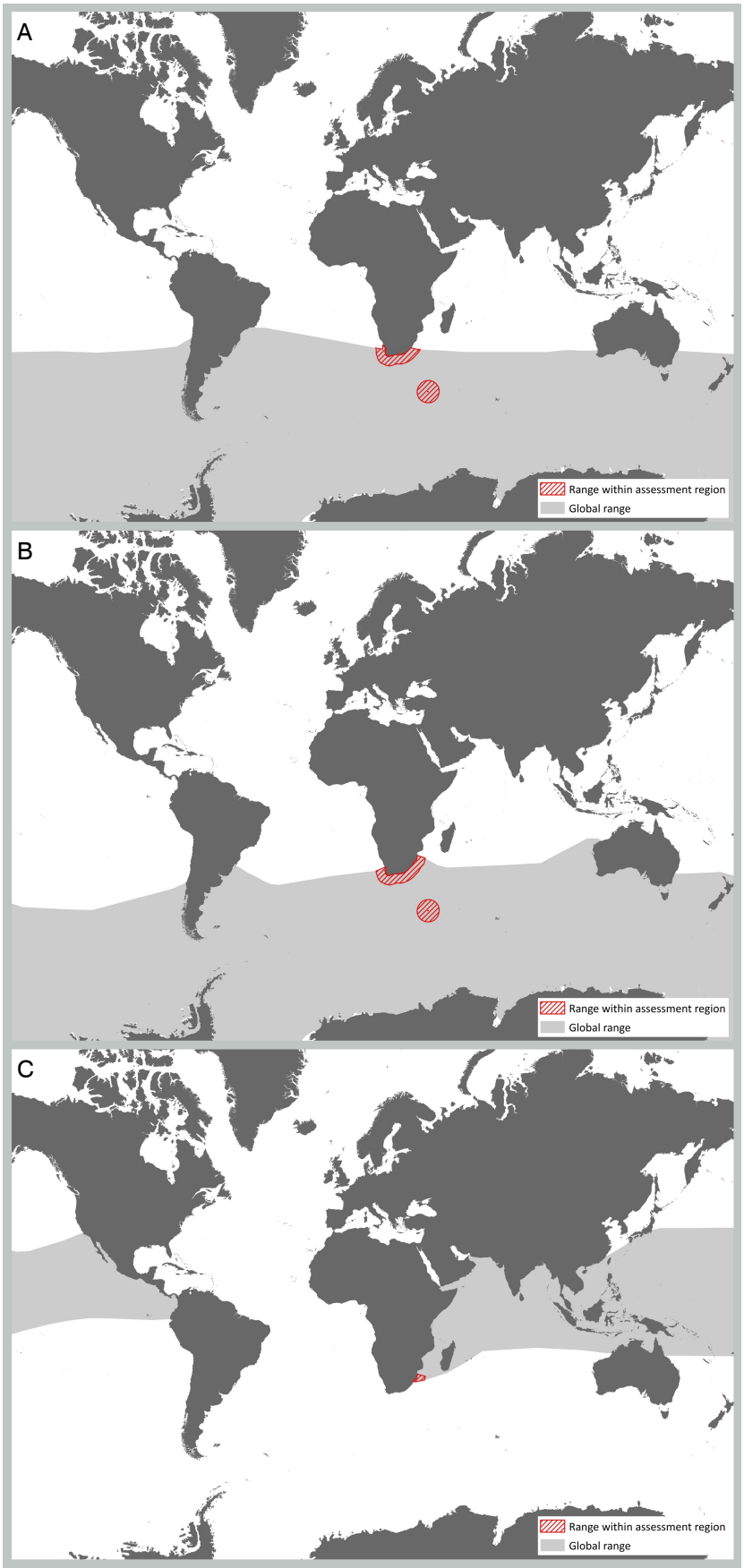

Figure 1. Distribution ranges for (A) Arnoux's Beaked Whale (*Berardius arnuxii*; IUCN 2012a), (B) Southern Bottlenose Whale (*Hyperoodon planifrons*; IUCN 2012b) and (C) Longman's Beaked Whale (*Indopacetus pacificus*; IUCN 2012c)

(Sekiguchi et al. 1993). Very few strandings of this species have been recorded on the South African coast (Hofmeyr et al. 2014).

Indopacetus pacificus has a widespread distribution across the tropical Pacific and Indian Oceans (Dalebout et al. 2003) from the Arabian Sea to

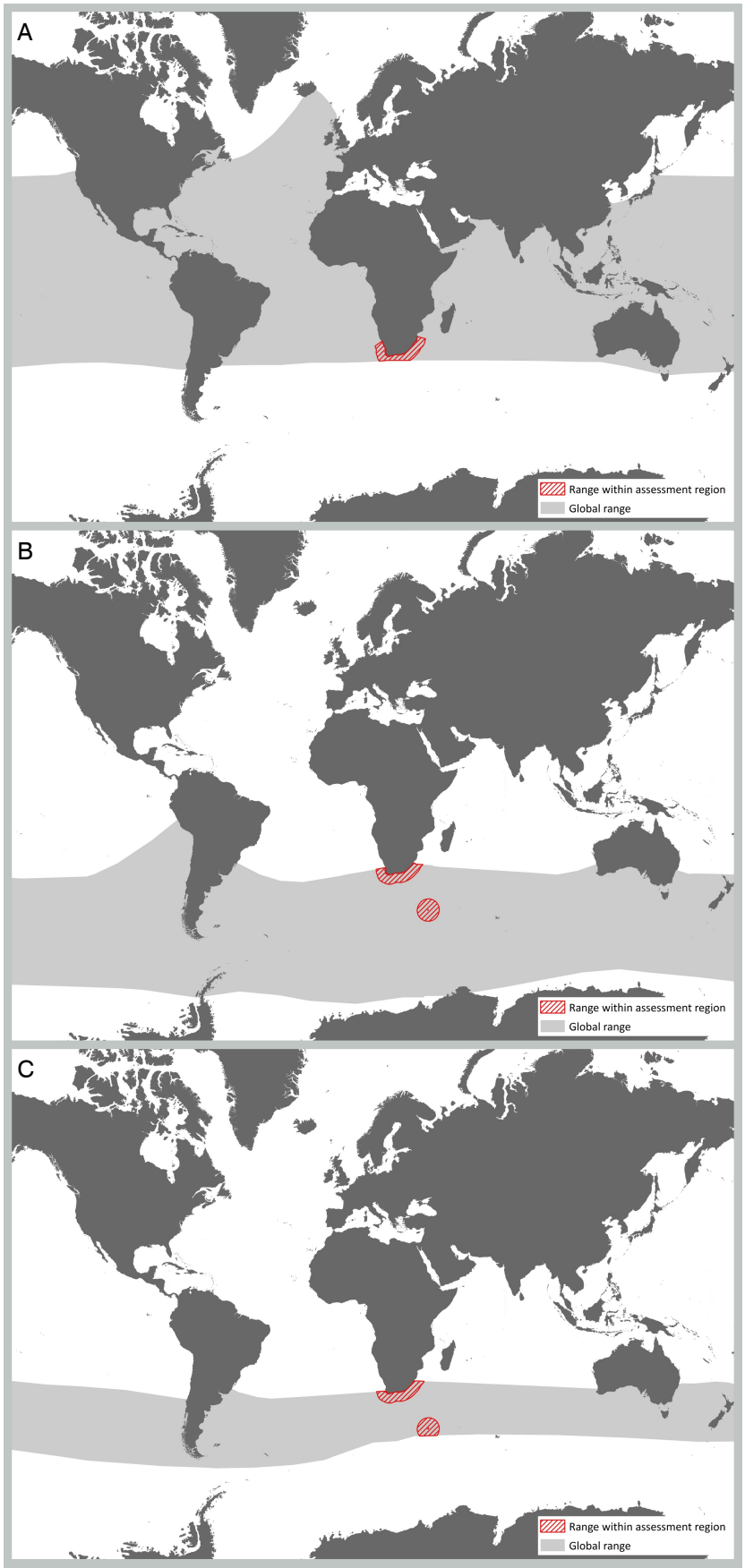

Figure 2. Distribution ranges for (A) Blainville's Beaked Whale (*Mesoplodon densirostris*; IUCN 2012d), (B) Gray's Beaked Whale (*Mesoplodon grayi*; IUCN 2012e) and (C) Hector's Beaked Whale (*Mesoplodon hectori*; IUCN 2012f)

Mexico (Pitman et al. 1999), but is probably most common in the western Pacific and western Indian Ocean, especially near the Maldives (Anderson et al. 2006) (Figure 1). Specimens of this species have been collected from Australia, Somalia, Kenya, the Philippines, Japan, Taiwan, the Maldives, as well as from the KwaZulu-Natal Province of South Africa (Best 2007). This species has unknown migration routes.

Mesoplodon densirostris is considered the most widely distributed species of this genus (Pitman 2002; Macleod et al. 2006), occurring across both temperate and tropical waters of the Atlantic, Pacific and Indian Oceans (Mead 1989) (Figure 2). Sightings and strandings are common around oceanic islands and archipelagos, for example Hawaii, the Society Islands, Mauritius and the Seychelles. As one of the most tropical beaked whales, this species often occurs within enclosed, deep, warm waters, including the Caribbean Sea, the Sea of Japan and the Gulf of Mexico. Within the assessment region, this species may utilise the warm waters of the Agulhas Current as a channel to the coast from tropical waters (Ross 1984). It is the beaked whale most commonly recorded stranded on the South African coastline, these events having a primarily warm temperate distribution (Hofmeyr et al. 2014).

Mesoplodon grayi has a circumpolar distribution within the cold temperate waters of the south Pacific, Indian and Atlantic Oceans (Mead 1989; Macleod et al. 2006) (Figure 2). This species is predominantly restricted to the region between 30°S and 53°S (Ross 1984), with the exception of the cold Benguela Current, where its range extends northwards beyond these latitudes (Findlay et al. 1992). There is a solitary extralimital stranding record of this species in the northern hemisphere, in the Netherlands (Boschema 1950). Along with stranding records from New Zealand, Argentina, Chile, Peru and southern Australia, specimens of this species have been confirmed from along the South African and Namibian coasts (Meester et al. 1986; Best 2007). Due to the seasonal trend associated with strandings data, this species is expected to exhibit definite migrations from wintering grounds in Antarctic waters, northwards to lower latitudes in summer (Ross 1984).

Mesoplodon hectori has been documented (mostly via strandings data) within temperate waters from southern South America, New Zealand, Tasmania, southern Australia, the Falkland Islands and South Africa (Figure 2). Their distribution is expected to be continuous in the Atlantic and Indian Oceans, although there appears to be a discontinuity in their range from the central and eastern Pacific Ocean. Previous stranding records of this species in the eastern North Pacific (Mead 1981; Rice 1998), have now been

reclassified as *M. perrini* (Perrin's Beaked Whale), thus it is no longer considered present within the northern hemisphere (Dalebout et al. 2002). Within the assessment region, the only formally documented records are from two immature individuals from the Lottering River mouth, near Plettenberg Bay (Ross 1970), and a stranding on Sedgefield beach in April 1987 (V. Cockcroft unpubl. data).

Mesoplodon layardii is predominantly located between 32°S and 60°S in a continuous distribution within the cold temperate waters of the southern hemisphere with the range reaching lower latitudes in the cold Benguela system along the Namibian coast (Figure 3). Additionally, they have been reported as far north as 20.3°S off the southern coast of Australia (Dixon 1980; Paterson & van Dyck 1990). They have been reported from a number of localities in South America, as well as Australia, New Zealand, the Kerguelen Islands, Heard Island, the Falkland Islands and South Africa (Macleod et al. 2006; Best 2007). In South Africa, most stranding have been reported from cool temperate waters. Sightings of the Strap-toothed Whale have been reported off the coast of KwaZulu-Natal in waters more than 2,000 m deep. Five strandings of this species were reported at Marion Island in March 1989 (Best 2007). Again, a bias in strandings to late summer and autumn indicates that this species conducts seasonal migratory movements (Best 2007; Hofmeyr et al. 2014).

Mesoplodon mirus is seemingly the only species of this genus with isolated populations within the northern and southern hemisphere, including the temperate North Atlantic, the Atlantic coast of South America, southern Australia and southern Africa (Macleod et al. 2006)(Figure 3). In general, this species is absent between 30° North and South. Within the assessment region, stranding records of this species have been widely recorded along the coasts of the Western and Eastern Cape (Hofmeyr et al. 2014) but is typically associated with the region off the southern Cape coast where the warm Agulhas and cold Benguela Currents mix (Ross et al. 1985).

Ziphius cavirostris is distributed most extensively of all Ziphiidae species (Heyning 1989, 2002), occuring within all oceans from the tropics to cold temperate and the lower-latitude polar regions across both the northern and southern hemisphere (Jefferson et al. 1993), predominantly within deep, open waters (Figure 3). They are only absent from shallow waters and the high-latitude polar regions. They have also been recorded within enclosed seas, including the Gulfs of California and Mexico, the Mediterranean (Podesta et al. 2005) and Caribbean Seas, as well as the Sea of Okhotsk and the Sea of Japan. Within southern Africa,

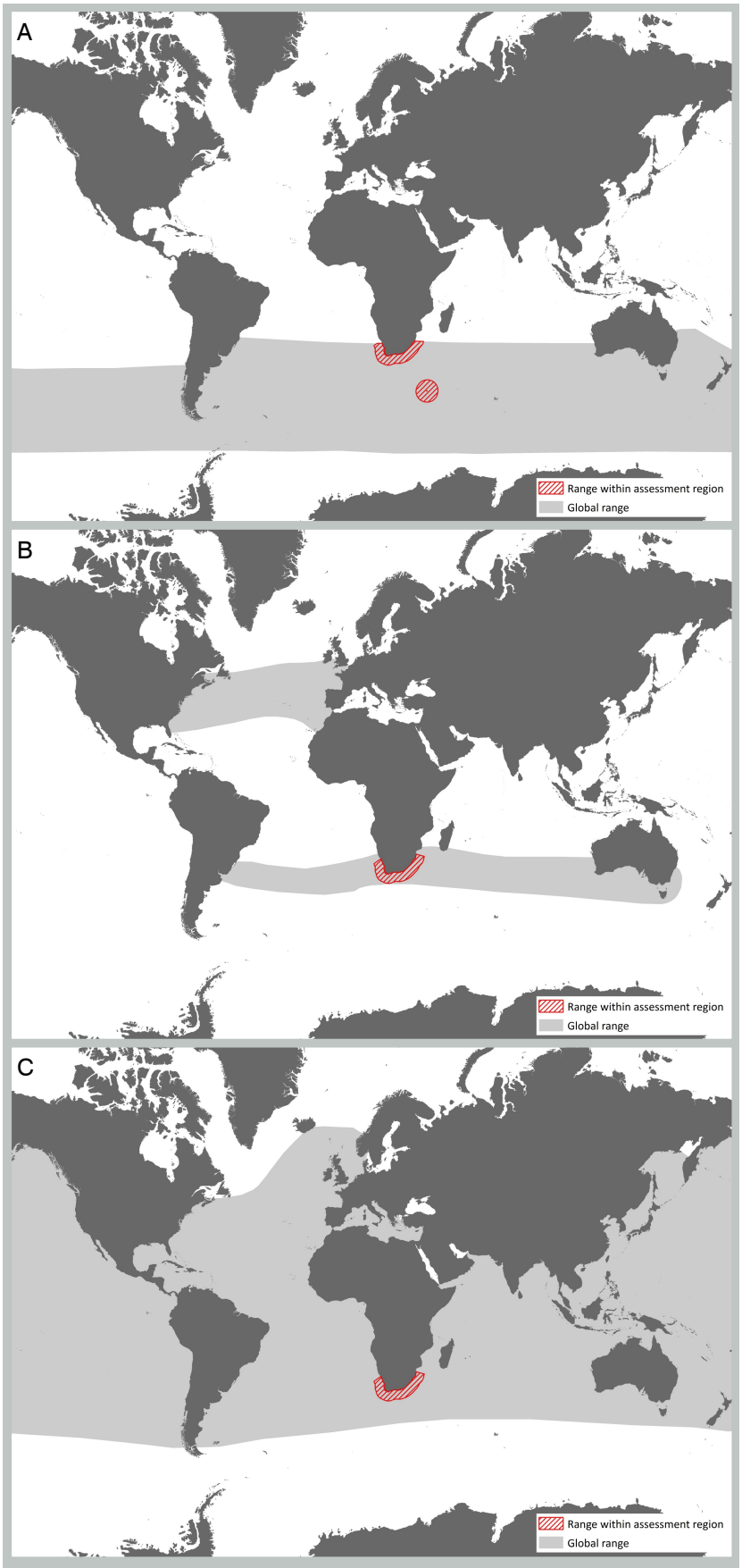

Figure 3. Distribution ranges for (A) Strap-toothed Whale (*Mesoplodon layardii*; IUCN 2012g), (B) True's Beaked Whale (*Mesoplodon mirus*; IUCN 2008) and (C) Cuvier's Beaked Whale (*Ziphius cavirostris*; IUCN 2012h)

this species has been documented from Namibia, and the Western and Eastern Cape. Additionally, Ross (1984) recorded two individuals taken by whalers from the Durban land station in waters deeper than 1,000 m, as well as a sighting of this species 372 km due south of Cape St Blaise, South Africa in 1975, where the ocean depth exceeds 3,000 m.

Population

Due to their wide distribution, affiliation with deep water habitats, and cryptic nature, there are very little data pertaining to the population abundance and trends of Ziphiidae species in South African waters.

Although no population estimates exist for *B. arnuxii* (Kasuya 2002), in comparison to the sympatric *H. planifrons*, this species is known to be uncommon. *Berardius arnuxii* may be naturally rare across the southern hemisphere, aside from the waters around New Zealand in summer. It is only known within the assessment region from four stranding records, during one of which four individuals were successfully re-floated.

Hyperoodon planifrons is the most commonly sighted Ziphiidae species in Antarctic waters, and is believed to be fairly abundant. In fact, of 599,300 (CV = 15%) beaked whales estimated south of the Antarctic Convergence in summer, the majority of these were probably Southern Bottlenose Whales (Kasamatsu & Joyce 1995). Furthermore, Barlow (1999) suggests that this abundance estimate is more than likely an underestimate, considering that the methods used for this estimate did not consider the deep-diving behaviour of this species nor their inconspicuous nature when surfacing. Within the assessment region, there are many records of this species in Durban, from whaling data and aerial sighting data (1972-1975). The IWC circumpolar surveys estimated an Antarctic population size of 55,000 in 1997/98. This species is thought to be the most abundant Ziphiid within the assessment region and the second most frequently sighted whale globally.

The only abundance estimates available for *I. pacificus* include an estimate of 1,007 (CV = 126%) and 291 (CV = 100%) individuals within the waters around Hawaii (Barlow 2006), and the eastern North Pacific (Ferguson & Barlow 2001), respectively. Although, Longman's Beaked Whale is not considered the rarest of all Ziphiidae species, the lack of recent sightings suggest that this species is certainly not particularly common either.

Mesoplodon densirostris is the most common species of its genus, and is considered fairly common within tropical waters (Reeves et al. 2003), however, no abundance estimates are available for this species within the assessment region. Similarly, there is also very little information pertaining to the population abundances and trends of *M. grayi*, *M. hectori*, *M. grayi* and *M. layardii* as they are rarely sighted at sea. Both *M. grayi* and *M. hectori* are, however, considered fairly common in New Zealand waters, but uncommon elsewhere in the southern hemisphere.

Ziphius cavirostris is considered the most common of all beaked whales world-wide (Heyning 2002); however, sightings at sea are still rare in comparison to other cetaceans and little is known about the population structure of this species. Estimates of abundance are available for a number of regions, but these may be somewhat unreliable considering the rarity of sightings and their ability to dive to extreme depths (Caretta et al. 2004). Dalebout et al. (2005) estimate a global population abundance of between 456,000 and 916,000 breeding adults, however, these results should be treated with caution. It is inferred that Cuvier's Beaked Whales show little movements between ocean basins, and local populations may be fairly distinct (Dalebout et al. 2005).

Current population trend: Unknown

Continuing decline in mature individuals: Unknown

Number of mature individuals in population: Unknown

Number of mature individuals in largest subpopulation: Unknown

Number of subpopulations: Unknown

Severely fragmented: No

Habitats and Ecology

Little is known about the key behavioural and ecological characteristics of beaked whales. Typically, these species occur in deep, offshore waters, and are considered to have long, deep-diving capabilities. Their occurrence is generally associated with topographic features, including slopes, escarpments, canyons and oceanic islands (Macleod et al. 2006). The stomach contents of stranded beaked whales suggest that their primary food source includes deep-water, mesopelagic cephalopods, although MacLeod et al. (2003) found that benthic fish and crustaceans also constitute important prey items for these species. *Ziphius* and *Hyperoodon* spp. prey upon significantly larger species, compared to *Mesoplodon* spp. (MacLeod et al. 2003).

Berardius arnuxii are commonly associated with regions beyond the edge of the continental shelf within cold temperate and subpolar waters (Kasuya 2002), but have been occasionally sighted within shallower waters, along continental slopes, or around seamounts (Jefferson et al. 1993). This species may be one of the most proficient deep-water divers of all marine mammals, capable of diving for over an hour, to depths of 1,000 m, and swimming under sea ice for at least 7 km on a single breath (Hobson & Martin 1996). Although there are no data specific to the diet of *B. arnuxii*, the closely related *B. bairdii* was found to consume mostly deep-sea fish and squid. Additionally, *B. bairdii* males were found to mature younger and at shorter body lengths than females, and have a much lower rate of mortality than females (Kasuya et al. 1997). Female and male *B. bairdii* may live to 54 and 84 years of age, respectively (Kasuya et al. 1997). *Berardius arnuxii* have occasionally been reported trapped within pack ice, more than 60 km from open water, which may account for some natural mortality of this species (Taylor 1957).

During the summer, *H. planifrons* is associated most frequently with regions within 100 km of the Antarctic ice edge. Generally, they prefer deep waters beyond the continental shelf, usually more than 1,000 m deep, and are considered rare in waters shallower than 200 m. They have also been documented in the steep thermocline, where the Agulhas Current and Antarctic waters meet (Cockcroft et al. 1990). Analyses of the stomach contents of this species have revealed that squid forms the major constituent of their diets (Ross 1984; Sekiguchi et al. 1993; Slip et al. 1995). Sekiguchi et al. (1993) found the remains of four Antarctic squid and four subantarctic

squid in the stomachs of two individuals washed up in January, which indicated a recent migration from the Southern Ocean to South African waters in summer. Sightings of calves, approximately 3.5 m long, in January suggests that calving may take pace during the early summer months (Ross 1984).

Indopacetus pacificus has been observed in schools of up to 100 individuals, and in association with other cetaceans, such as Short-finned Pilot Whales (*Globicephala macrorhynchus*) and Bottlenose Dolphins (*Tursiops truncatus*). This species favours tropical and subtropical regions of the Indo-Pacific, with surface water temperatures between 21–31 °C. No information is available regarding their feeding habits, aside from the stomach contents from a specimen in Japan, demonstrating their consumption of cephalopods (Yamada 2002). Little data are available regarding the reproductive seasonality of this species.

Mesoplodon species occur commonly in deep-waters and along continental slopes, where prey availability may be enhanced by the interactions between ocean currents and topography (MacLeod & Zuur 2005). Beaked whales are believed to be suction feeders (Heyning & Mead 1996), feeding predominantly on squid and deep-water fish. *Mesoplodon densirostris* is no exception. Sekiguchi et al. (1992) and Ross (1984) reported stomach contents containing the remains of Buttersnoek (*Lepidopus caudatus*) and lanternfish (*Lampanyctus* spp.). Off Hawaii, schools of between three and seven Blainville's Beaked Whales were observed by Shallenberger (1981). Having documented groups of up to six individuals, Gambell et al. (1975) suggested that *M. grayi* form small schools. *Mesoplodon grayi* calves may be born in spring and summer, at lengths of approximately 2.1 m (Baker 1983). Sekiguchi et al. (1996) reported that the diet of *M. layardii* consisted primarily of squid in South African and New Zealand waters, with small numbers of fish and crustaceans. Stable isotope analyses revealed that *M. mirus* feed at a similar trophic level to other species of this genus, but may feed on smaller prey than *H. ampullatus* (Northern Bottlenose Whale), and at a lower trophic level than that of *Z. cavirostris* (MacLeod 2005).

Similar to other beaked whales, *Z. cavirostris* is most frequently associated with deep waters for feeding. Dive durations of 30 minutes (Miyazaki & Wada 1976) and 40 minutes have been recorded. Using suction techniques (Heyning & Mead 1996), they consume mostly deep-sea squid, but also fish and crustaceans (MacLeod et al. 2003), feeding both within the water column as well as near the bottom. Sexual maturity is reached at lengths of over 5.5 m (Omura et al. 1955; Nishiwaki & Oguro 1972), and breeding and calving of this species may span over a number of months (Ross 1984). Calves are born at lengths of approximately 2.6 m.

Ecosystem and cultural services: Marine mammals integrate and reflect ecological variation across large spatial and long temporal scales, and therefore they are prime sentinels of marine ecosystem change; migratory whales may be used to investigate broad-scale shifts in ecosystems (Moore 2008).

Use and Trade

In general, beaked whales in the southern hemisphere are not utilised or traded commercially, although some small-scale subsistence utilisation of Blainville's Beaked Whale by artisanal fisheries has been recorded. Additionally, a limited number of *B. arnuxii* and *H. planifrons* specimens have been taken for the purpose of scientific research (Jefferson et al. 1993). Historically, *Z. cavirostris* was hunted opportunistically off the coast of Japan during hunts specifically aimed at Baird's Beaked Whales (*Berardius bairdii*) (Omura et al. 1955; Nishiwaki & Oguro 1972). Although commercial hunting of Cuvier's Beaked Whales has ceased, products pertaining to this species are still for sale in certain Asian markets, suggesting that this species is either susceptible to accidental bycatch, or may be subject to unreported direct exploitation. Small-scale hunting of this species has also occurred in other regions, but there are no records of this within the assessment region.

Threats

There appear to be no widely distributed major threats to beaked whales. The impact of potential threats are unknown but, considering that most Ziphiidae species are naturally rare, especially within the assessment region, they may have unsustainable impacts on local populations and further research is required. Potential threats are discussed below:

1. Anthropogenic noise pollution has become an increasing and well-known threat to beaked whales, as they appear to be more vulnerable to noise pollution than other cetacean species (Dalebout et al. 2005). A number of mass stranding events involving beaked whales have been attributed to seismic exploration and high-powered navy sonar (Simmonds & Lopez-Jurado 1991; Mignucci-Giannoni 1996; Frantzis 1998, 2004; Balcomb & Claridge 2001; Jepson et al. 2003; Cox et al. 2006). Although the exact mechanistic causes are not clearly understood, the formation of gas bubbles (Fernández et al. 2005), appears to be attributed to sonar activities and noise pollution (Cox et al. 2006). Jepson et al. (2003) described the physiological damage, including acute and chronic tissue damage, inflicted on beaked whales by the deployment of military sonar at the Canary Islands. Although other beaked whale species were impacted, Cuvier's Beaked Whale was affected most severely. Due to the evidence of "bubble-like lesions", the live stranding of a mother and calf *I. pacificus* in Taiwan may have been attributed to unidentified anthropogenic noise activities (Yang et al. 2008). Mass strandings of Cuvier's Beaked Whales attributed to the use of active sonar by navy vessels has been documented on a number of occasions during the late 1990s and early 2000s in the Mediterranean (Frantzis 1998), the Bahamas (Balcomb & Claridge 2001), and Japan (Brownell et al. 2004). Additionally, a seismic survey is thought to be responsible for the stranding of two individuals in the Gulf of California (Malakoff 2002). It is believed that loud sounds may cause animals to panic and surface rapidly, thus resulting in rapid decompression; alternatively, the mid-frequency sonar activity may cause vibrations that form air bubbles in the individual's tissues (Jepson et al. 2003). In 2004 a moratorium on naval activities in the Canary Islands was enforced by the Spanish government, and since then no mass stranding events have occurred in this area (Fernández et al. 2013). Within the assessment region, marine noise pollution is intensifying due to coastal industrial development,

shipping traffic and energy exploration, and thus represents a potentially severe threat.

2. Plastic pollution is a large-scale and increasing problem in all marine environments. The ingestion of plastic marine pollution has been documented in several species of beaked whales, and may eventually lead to mortality as a result of choking, a reduction in appetite or starvation (e.g. Scott et al. 2001). A dead adult Blainville's Beaked Whale found on a beach in southern Brazil in 1993 was found to contain a bundle of blue plastic threads within its primary stomach chamber (Secchi & Zarzur 1999). Based on the lack of food and parasites within its stomach and gut, it is likely that this individual had not fed for some time. Stranded True's Beaked Whales have also been found to have consumed plastic pollution.

3. Accidental entanglement of beaked whales in fisheries is widespread, particularly in deep-water gillnets, although the number of recorded mortalities is not high. However, Southern Bottlenose Whales have been caught as bycatch in driftnet fisheries in the Tasmanian Sea (Jefferson et al. 1993). Extensive gillnet and longline fishing practises throughout the ranges of many beaked whales may become an increasing risk to these species as a result of accidental entrapment and drowning. Deep water gillnets, especially those for billfish and tuna, are probably the most substantial threat to True's Beaked Whale. Julian & Beeson (1998) documented the annual mortality of Cuvier's Beaked Whales as between 22 and 44 individuals accidentally caught in drift gillnets off California.

4. The expansion of high-latitude fisheries, such as those directed at Antarctic Toothfish (*Dissostichus mawsoni*), which are largely unregulated and illegal, threaten the food stocks available for large cetaceans such as beaked whales. There is substantial evidence of large-scale reductions in many predatory fish populations (Baum et al. 2003, 2005; Polacheck 2006; Sibert et al. 2006), over-fishing and the collapse of several important "prey" fish stocks world-wide (e.g. Jackson et al. 2001). Although the effects of anthropogenic fish exploitation and the subsequent ecosystem changes on beaked whales is considered to be fairly low in comparison to other cetaceans in the Pacific Ocean (Trites et al. 1997), the degree of impact associated with high-latitude fisheries world-wide is largely unknown and could result in population declines.

5. The marine-related threats associated with global climate change may pose unquantified and complex threats to beaked whales, particularly within cool temperate and cold Antarctic habitats (Learmonth et al. 2006). Increasing ocean temperatures may result in range shift or contraction (Learmonth et al. 2006); however, no direct predictions pertaining to the direction or size of these shifts in range are currently known.

6. Unlike many whale species, beaked whales have not experienced large-scale historic or recent exploitation for meat or other products. This may be attributed to their general scarcity and inconspicuous nature, deep-sea distributions and/or deep-diving behaviour. Small-scale opportunistic takes from Sri Lanka of a species identified as "Bottlenose Whales" are probably

Table 1. Threats to the family Ziphiidae ranked in order of severity with corresponding evidence (based on IUCN threat categories, with regional context)

Rank	Threat description	Evidence in the scientific literature	Data quality	Scale of study	Current trend
1	*9.6.3 Noise Pollution*: marine noise pollution through seismic surveys and navy sonar operations. Current stresses *2.1 Species Mortality* and *2.2 Species Disturbance*.	Jepson et al. 2003 Koper & Plön 2012	Empirical Indirect	International National	Beaked Whales may be especially vulnerable to physiological damage and strandings associated with sonar activities and increasing marine noise pollution.
2	*9.4 Garbage & Solid Waste*: plastic bag ingestion. Current stresses *2.1 Species Mortality* and *2.2 Species Disturbance*.	Secchi & Zarzur 1999	Empirical	Local	Increasing
3	*5.4.4 Fishing & Harvesting Aquatic Resources*: entanglement in deep sea fisheries e.g. deep-water gillnets. Current stresses *2.1 Species Mortality* and *2.2 Species Disturbance*.	Julian & Beeson 1998	Anecdotal	Regional	Unknown
4	*5.4.4 Fishing & Harvesting Aquatic Resources*: high latitude fisheries competition. Current stresses *2.3.2 Competition*.	-	Anecdotal	-	Increasing
5	*11.1 Habitat Shifting & Alteration:* due to climate change. Current stresses: 2.3.8 Indirect species effects on food resources and 1.2 Ecosystem degradation.	Learmonth et al. 2006	Indirect	International	Unknown
6	*5.4.1* and *5.4.3 Fishing & Harvesting Aquatic Resources*: intentional and unintentional: small-scale opportunistic whaling.	Dayaratne & Joseph 1993	Indirect	Local	Small-scale minor, manageable threat to *I. pacificus*.

I. pacificus (Dayaratne & Joseph 1993). Additionally, Cuvier's Beaked Whales have been caught opportunistically by Japanese whaling operations directed at *Berardius* species, as well as in the Caribbean, Indonesia, Taiwan and South America as bycatch in other direct fisheries (Heyning 1989; Jefferson et al. 1993). Between 3 and 35 *Z. cavirostris* individuals are reported to have been caught annually in Japan during the 1950s (Omura et al. 1955); however, no direct takes of this species were reported two decades later (Nishiwaki & Oguro 1972).

Current habitat trend: Unknown

Conservation

More research into the distribution, abundance, migration patterns, bycatch rate and diet of beaked whales is essential for the effective development of species-specific mitigation measures for these species in South African waters. Mitigation measures associated with anthropogenic marine noise is probably most vital for Ziphiidae species locally and world-wide. The Parties to the UNEP Convention on the Conservation of Migratory Species of Wild Animals (CMS) Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS) suggested in 2004 that anthropogenic activities that produce high-intensity marine noise pollution should be avoided in areas of high Cuvier's Beaked Whale concentration. Due to their cryptic nature, mitigation of noise pollution based on observation is likely to be ineffective for these species. Additionally, avoidance of beaked whale habitats in South African waters is currently challenging due to their wide distribution, and the lack of data pertaining to habitat preferences and geographical extent across this region.

Passive acoustic monitoring is a valuable technique used to detect marine mammals in order to modify marine activities so as to avoid the animals, decrease the amplitude or temporarily stop the source of sound when animals are within a critical distance (Barlow & Gisiner 2006). Although beaked whales are acoustically difficult to detect, all species are assumed to give off echolocation clicks, some may also produce whistles (Dawson et al. 1998; MacLeod & D'Amico 2006). However, Cuvier's and Blainville's Beaked Whales have been found to only produce echolocation clicks when they are several hundred metres deep. Generally, the clicks of Ziphiidae species are more narrow-banded than those of other marine mammals of a similar frequency, thus electronic filtering methods may be more effective than other methods (Barlow & Gisiner 2006).

Maintaining sightings records of beaked whales, during ship-based surveys directed at other species, is a valuable means with which to monitor the distribution and abundance of these cryptic and unknown species in South African waters.

All Ziphiidae species within the assessment region are listed either on Appendix I or II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Recommendations for managers and practitioners:

- Critical beaked whale habitats, and areas of high beaked whale concentration should be identified, so as to effectively mitigate the effects of noise pollution.
- Although species-specific monitoring is deemed unnecessary for Ziphiidae species in the assessment region, sightings data should be recorded during systematic monitoring of other cetacean species.
- Establish a nationwide strandings network and databases (comprised of whale-watching operators, coastal protected areas, police stations, hotels, etc.) to gather and pool information.

Research priorities:

- Population size and trend estimates.
- Effects of marine noise pollution and plastic pollution on beaked whale populations.
- The identification of high concentration areas in South African waters, including distributional limits, seasonal movements and diving behaviour.
- Diet, reproduction and general biology.

Table 2. Conservation interventions for the family Ziphiidae ranked in order of effectiveness with corresponding evidence (based on IUCN action categories, with regional context)

Rank	Intervention description	Evidence in the scientific literature	Data quality	Scale of evidence	Demonstrated impact	Current conservation projects
1	*3.1 Species Management*: passive acoustic monitoring to identify the presence of beaked whales in order to limit or interrupt the creation of noise pollution.	Barlow & Gisiner 2006	Anecdotal	International	Limit or discontinue use of sound sources when beaked whales are identified.	-
2	*3.1 Species Management*: observer mitigation to identify the presence of beaked whales in order to limit or interrupt the creation of noise pollution.	Barlow & Gisiner 2006	Anecdotal	International	Limit or discontinue use of sound sources when beaked whales are identified.	-
3	*1.2 Resource & Habitat Protection*: reduction or prevention of noise pollution in high beaked whale concentration areas, or during seasons of high concentration.	Fernández et al. 2013	Empirical	Local	Since the moratorium on naval activities in the Canary Islands no mass stranding events have occurred in this area.	2004 moratorium in the Canary Islands. The 2004 Parties to the UNEP CMS Agreement in ACCOBAMS.

Encouraged citizen actions:

- Report strandings east of Mossel Bay to the Port Elizabeth Museum, and west of Mossel Bay to Iziko Museums, Cape Town.
- Report sightings on virtual museum platforms (for example, iSpot and MammalMAP) to help with mapping geographical distribution.
- Avoid using plastic bags.
- Save electricity and fuel to mitigate CO_2 emissions and hence the rate of climate change.

Data Sources and Quality

Table 3. Information and interpretation qualifiers for the beaked whales (Family Ziphiidae) assessment

Data sources	Museum records, indirect information (expert knowledge) *H. planifrons* – field study (unpublished), indirect information (expert knowledge)
Data quality (max)	Suspected *H. planifrons* – inferred
Data quality (min)	Suspected
Uncertainty resolution	Expert consensus
Risk tolerance	Evidentiary

References

Anderson RC, Clark R, Madsen PT, Johnson C. 2006. Observations of Longman's beaked whale (*Indopacetus pacificus*) in the Western Indian Ocean. Aquatic Mammals **32**:223.

Baker AN. 1983. Whales and Dolphins of New Zealand and Australia. An Identification Guide. University Press, Wellington, Victoria.

Balcomb KC. 1989. Baird's beaked whale *Berardius bairdii* Stejneger, 1883: Arnoux's beaked whale *Berardius arnuxii* Duvernoy, 1851. Pages 261–288 in Ridgway SH, Harrison R, editors. Handbook of Marine Mammals. Volume 4: River Dolphins and the Larger Toothed Whales. Academic Press, New York, New York, USA.

Balcomb KC, Claridge DE. 2001. A mass stranding of cetaceans caused by naval sonar in the Bahamas. Bahamas Journal of Science **8**:2–12.

Barlow J. 1999. Trackline detection probability for long-diving whales. Pages 209–221 in Garner GW, Amstrup SC, Laake JL, Manley BJF, McDonald LL, Robertson DG, editors. Marine Mammal Survey and Assessment Methods. Balkema Press, Netherlands.

Barlow J. 2006. Cetacean abundance in Hawaiian waters estimated from a summer/fall survey in 2002. Marine Mammal Science **22**:446–464.

Barlow J, Gisiner R. 2006. Mitigating, monitoring and assessing the effects of anthropogenic sound on beaked whales. Journal of Cetacean Research and Management **7**:239–249.

Baum JK, Kehler D, Myers RA. 2005. Robust estimates of decline for pelagic shark populations in the northwest Atlantic and Gulf of Mexico. Fisheries **30**:27.

Baum JK, Myers RA, Kehler DG, Worm B, Harley SJ, Doherty PA. 2003. Collapse and conservation of shark populations in the Northwest Atlantic. Science **299**:389–392.

Best PB. 2007. Whales and Dolphins of the Southern African Subregion. Cambridge University Press, Cape Town, South Africa.

Boschema H. 1950. Maxillary teeth in specimens of *Hyperoodon rostratus* (Muller) and *Mesoplodon grayi* Von Haast stranded on the Dutch coasts. Koninklijke Nederlandse Akademie Wetenschappen **53**:775–786.

Brownell RL, Yamada T, Mead JG, Van Helden AL. 2004. Mass strandings of Cuvier's beaked whales in Japan: US Naval acoustic link. Paper SC/56/E37 presented to the IWC Scientific Committee.

Caretta JV, Price T, Petersen D, Read R. 2004. Estimates of marine mammal, sea turtle, and seabird mortality in the California drift gillnet fishery for swordfish and thresher shark, 1996–2002. Marine Fisheries Review **66**:21–30.

Cockcroft VG, De Kock AC, Ross GJB, Lord DA. 1990. Organochlorines in common dolphins caught in shark nets during the Natal "sardine run." South African Journal of Zoology **25**:144–148.

Cox TM, et al. 2006. Understanding the impacts of anthropogenic sound on beaked whales. Journal of Cetacean Research and Management **7**:177–187.

Culik BM. 2004. Review of small cetaceans: distribution, behaviour, migration and threats. Marine Mammal Action Plan / Regional Seas Reports and Studies No. 177. UNEP / CMS Secretariat, Bonn, Germany.

Dalebout ML. 2002. Species identity, genetic diversity, and molecular systematic relationships among the Ziphiidae (Beaked Whales). Ph.D. Thesis. University of Auckland.

Dalebout ML, Baker CS, Anderson RC, Best PB, Cockcroft VG, Hinsz HL, Peddemors V, Pitman RL. 2003. Appearance, distribution, and genetic distinctiveness of Longman's beaked whale, *Indopacetus pacificus*. Marine Mammal Science **19**:421–461.

Dalebout ML, Mead JG, Baker CS, Baker AN, Helden AL. 2002. A new species of beaked whale *Mesoplodon perrini* sp. n. (Cetacea: Ziphiidae) discovered through phylogenetic analyses of mitochondrial DNA sequences. Marine Mammal Science **18**:577–608.

Dalebout ML, Robertson KM, Frantzis A, Engelhaupt DAN, Mignucci-Giannoni AA, Rossario-Delestre RJ, Baker CS. 2005. Worldwide structure of mtDNA diversity among Cuvier's beaked whales (*Ziphius cavirostris*): implications for threatened populations. Molecular Ecology **14**:3353–3371.

Dalebout ML, Van Helden A, Van Waerebeek K, Baker CS. 1998. Molecular genetic identification of southern hemisphere beaked whales (Cetacea: Ziphiidae). Molecular Ecology **7**:687–694.

Dawson S, Barlow J, Ljungblad D. 1998. Sounds recorded from the Baird's Beaked Whale, *Berardius bairdii*. Marine Mammal Science **14**:335–344.

Dayaratne P, Joseph L. 1993. A study on dolphin catches in Shri Lanka. Bay of Bengal Programme. Madras, India.

Dixon JM. 1980. A recent stranding of the strap-toothed whale, *Mesoplodon layardii* (Gray) (Ziphiidae) from Victoria and a review of the Australian records of the species. Victorian Naturalist **97**: 34–41.

Ferguson MC, Barlow J. 2001. Spatial distribution and density of cetaceans in the eastern tropical Pacific Ocean based on summer/fall research vessel surveys in 1986-96. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Science Center.

Fernández A, Arbelo M, Martín V. 2013. Whales: No mass strandings since sonar ban. Nature **497**:317–317.

Fernández A, Edwards JF, Rodriguez F, De Los Monteros AE, Herraez P, Castro P, Jaber JR, Martin V, Arbelo M. 2005. "Gas and fat embolic syndrome" involving a mass stranding of beaked

whales (family Ziphiidae) exposed to anthropogenic sonar signals. Veterinary Pathology Online **42**:446–457.

Findlay KP, Best PB, Ross GJB, Cockcroft VG. 1992. The distribution of small odontocete cetaceans off the coasts of South Africa and Namibia. South African Journal of Marine Science **12**:237–270.

Frantzis A. 1998. Does acoustic testing strand whales? Nature **392**:29.

Frantzis A. 2004. The first mass stranding that was associated with the use of active sonar (Kyparissiakos Gulf, Greece, 1996). ECS Newsletter **42**:14–20.

Gambell R, Best PB, Rice DW. 1975. Report on the International Indian Ocean whale marking cruise, 24th Nov 1973 - 3rd Feb 1974. Pages 240–252. 25, Reports of the International Whaling Commission.

Heyning JE. 1989. Cuvier's beaked whale *Ziphius cavirostris* G. Cuvier, 1823. Pages 289–307 in Ridgway SH, Harrison R, editors. Handbook of Marine Mammals. Volume 4: River Dolphins and the Larger Toothed Whales. Academic Press, New York, New York, USA.

Heyning JE. 2002. Cuvier's beaked whale *Ziphius cavirostris* G. Cuvier, 1823. Pages 305–307 in Perrin WF, Wursig B, Thewissen JGM, editors. Encyclopedia of Marine Mammals. Academic Press, San Diego, California, USA.

Heyning JE, Mead JG. 1996. Suction feeding in beaked whales: morphological and observational evidence. Natural History Museum of Los Angeles County.

Hobson RP, Martin AR. 1996. Behaviour and dive times of Arnoux's beaked whales, *Berardius arnuxii*, at narrow leads in fast ice. Canadian Journal of Zoology **74**:388–393.

Hofmeyr GJG, Findlay KP, Cockcroft VG, Kotze G, Meyer M, Plön S, Thornton M, Best PB. 2014. Spatial and temporal distribution of beaked whale strandings on the South African coast. South African Marine Sciences Symposium, Stellenbosch.

IUCN (International Union for Conservation of Nature). 2008. *Mesoplodon mirus*. The IUCN Red List of Threatened Species. Version 3.1. http://www.iucnredlist.org. Downloaded on 21 February 2016.

IUCN (International Union for Conservation of Nature). 2012a. *Berardius arnuxii*. The IUCN Red List of Threatened Species. Version 3.1. http://www.iucnredlist.org. Downloaded on 21 February 2016.

IUCN (International Union for Conservation of Nature). 2012b. *Hyperoodon planifrons*. The IUCN Red List of Threatened Species. Version 3.1. http://www.iucnredlist.org. Downloaded on 21 February 2016.

IUCN (International Union for Conservation of Nature). 2012c. *Indopacetus pacificus*. The IUCN Red List of Threatened Species. Version 3.1. http://www.iucnredlist.org. Downloaded on 21 February 2016.

IUCN (International Union for Conservation of Nature). 2012d. *Mesoplodon densirostris*. The IUCN Red List of Threatened Species. Version 3.1. http://www.iucnredlist.org. Downloaded on 21 February 2016.

IUCN (International Union for Conservation of Nature). 2012e. *Mesoplodon grayi*. The IUCN Red List of Threatened Species. Version 3.1. http://www.iucnredlist.org. Downloaded on 21 February 2016.

IUCN (International Union for Conservation of Nature). 2012f. *Mesoplodon hectori*. The IUCN Red List of Threatened Species. Version 3.1. http://www.iucnredlist.org. Downloaded on 21 February 2016.

IUCN (International Union for Conservation of Nature). 2012g. *Mesoplodon layardii*. The IUCN Red List of Threatened Species. Version 3.1. http://www.iucnredlist.org. Downloaded on 21 February 2016.

IUCN (International Union for Conservation of Nature). 2012h. *Ziphius cavirostris*. The IUCN Red List of Threatened Species. Version 3.1. http://www.iucnredlist.org. Downloaded on 21 February 2016.

Jackson JB, et al. 2001. Historical overfishing and the recent collapse of coastal ecosystems. Science **293**:629–637.

Jefferson TA, Leatherwood S, Webber MA. 1993. Marine Mammals of the World: FAO species identification guide. Marine mammals of the world. United Nations Environment Programme and Food and Agricultural Organization of the UN.

Jepson PD, et al. 2003. Gas-bubble lesions in stranded cetaceans. Nature **425**:575–576.

Julian F, Beeson M. 1998. Estimates of marine mammal, turtle, and seabird mortality for two California gillnet fisheries: 1990-1995. Fishery Bulletin **96**:271–284.

Kasamatsu F, Hembree D, Joyce G, Tsunoda L, Rowlett R, Nakano T. 1988. Distribution of cetacean sightings in the Antarctic: results obtained from the IWC/IDCR minke whale assessment cruises, 1978/79 to 1983/84. Report of the International Whaling Commission **38**:449–473.

Kasamatsu F, Joyce GG. 1995. Current status of odontocetes in the Antarctic. Antarctic Science **7**:365–379.

Kasuya T. 2002. Giant beaked whales *Berardius bairdii* and *B. arnuxii*. Pages 519–522 in Perrin WF, Wursig B, Thewissen JGM, editors. Encyclopedia of Marine Mammals. Academic Press, San Diego, California, USA.

Kasuya T, Brownell Jr RL, Balcomb III KC. 1997. Life history of Baird's beaked whales off the Pacific coast of Japan. Report of the International Whaling Commission **47**:969–979.

Koper RP, Plön S. 2012. The potential impacts of anthropogenic noise on marine animals and recommendations for research in South Africa. EWT Research & Technical Paper No. 1. Endangered Wildlife Trust, South Africa.

Learmonth JA, MacLeod CD, Santos MB, Pierce GJ, Crick HQP, Robinson RA. 2006. Potential effects of climate change on marine mammals. Oceanography and Marine Biology **44**:431.

MacLeod CD. 2005. Niche partitioning, distribution and competition in North Atlantic beaked whales. University of Aberdeen, Aberdeen, UK.

Macleod CD, et al. 2006. Known and inferred distributions of beaked whale species (Cetacea: Ziphiidae). Journal of Cetacean Research and Management **7**:271–286.

MacLeod CD, D'Amico A. 2006. A review of beaked whale behaviour and ecology in relation to assessing and mitigating impacts of anthropogenic noise. Journal of Cetacean Research and Management **7**:211–221.

MacLeod CD, Santos MB, Pierce GJ. 2003. Review of data on diets of beaked whales: evidence of niche separation and geographic segregation. Journal of the Marine Biological Association of the UK **83**:651–665.

MacLeod CD, Zuur AF. 2005. Habitat utilization by Blainville's beaked whales off Great Abaco, northern Bahamas, in relation to seabed topography. Marine Biology **147**:1–11.

Malakoff D. 2002. Suit ties whale deaths to research cruise. Science **298**:722–723.

McCann C. 1975. A study of the genus *Berardius*. Scientific Reports of the Whales Research Institute **27**:111–137.

Mead JG. 1981. First records of *Mesoplodon hectori* (Ziphiidae) from the northern hemisphere and a description of the adult male. Journal of Mammalogy **62**:430–432.

Mead JG. 1989. Beaked whales of the genus *Mesoplodon*. Pages 349–430 in Ridgway SH, Harrison R, editors. Handbook of Marine Mammals. Volume 4: River Dolphins and the Larger Toothed Whales. Academic Press, New York, New York, USA.

Meester JAJ, Rautenbach IL, Dippenaar NJ, Baker CM. 1986. Classification of southern African mammals. Transvaal Museum **5**:359.

Mignucci-Giannoni AA. 1996. Marine mammal strandings in Puerto Rico and the United States and British Virgin Islands. Ph.D. Thesis. University of Puerto Rico, Puerto Rico.

Miyazaki N, Wada S. 1976. Observation of Cetacea during whales cruise in the western tropical Pacific. Scientific Reports of the Whales Research Institute **30**:179–195.

Moore JC. 1968. Relationships among the living genera of beaked whales. Fieldiana Zoology **53**:209–298.

Moore SE. 2008. Marine mammals as ecosystem sentinels. Journal of Mammalogy **89**:534–540.

Moritz C. 1994. Defining'evolutionarily significant units' for conservation. Trends in Ecology and Evolution **9**:373–374.

Nishiwaki M, Oguro N. 1972. Catch of the Cuvier's beaked whales off Japan in recent years. Scientific Reports of the Whales Research Institute **24**:35–41.

Omura H, Fujino K, Kimura S. 1955. Beaked whale *Berardius bairdi* of Japan, with notes on *Ziphius cavirostris*. Scientific Reports of the Whales Research Institute **10**:89–132.

Paterson RA, Parker AE. 1994. Aerial observations of large ziphiid whales, possibly *Berardius arnuxii*, off the southern coast of New South Wales. Memoirs of the Queensland Museum **37**:301–306.

Paterson RA, van Dyck S. 1990. Records of beaked whales in Queensland. Scientific Reports of Cetacean Research **1**:63–77.

Pitman RL. 2002. Indo-Pacific beaked whale *Indopacetus pacificus*. Pages 615–617 in Perrin WF, Wursig B, Thewissen JGM, editors. Encyclopedia of Marine Mammals. Academic Press, San Diego, California, USA.

Pitman RL, Palacios DM, Brennan PL, Brennan BJ, Balcomb KC, Miyashita T. 1999. Sightings and possible identity of a bottlenose whale in the tropical Indo-Pacific: *Indopacetus pacificus*? Marine Mammal Science **15**:531–549.

Podesta M, D Amico A, Pavan G, Drougas A, Komnenou A, Portunato N. 2005. A review of Cuvier's beaked whale strandings in the Mediterranean Sea. Journal of Cetacean Research and Management **7**:251.

Polacheck T. 2006. Tuna longline catch rates in the Indian Ocean: Did industrial fishing result in a 90% rapid decline in the abundance of large predatory species? Marine Policy **30**:470–482.

Reeves RR, Smith BD, Crespo EA, Notarbartolo di Sciara G. 2003. Dolphins, Whales and Porpoises: 2002-2010 Conservation Action Plan for the World's Cetaceans. IUCN SSC Cetacean Specialist Group. Gland, Switzerland and Cambridge, UK.

Rice DW. 1998. Marine mammals of the world: systematics and distribution. Society for Marine Mammalogy.

Ross GJB. 1970. The occurrence of Hector's beaked whale *Mesoplodon hectori* (Gray) in South African waters. Annals of the Cape Provincial Museums (Natural History) **8**:195–204.

Ross GJB. 1984. Smaller cetaceans of the south east coast of southern Africa. Annals of the Cape Province Museum (Natural History) **16**:309–319.

Ross GJB, Cockcroft VG, Cliff G. 1985. Additions to marine faunas of South Africa and Natal. Lammergeyer **35**:36–40.

Scott MD, Hohn AA, Westgate AJ, Nicholas JR, Whitaker BR, Campbell WB. 2001. A note on the release and tracking of a rehabilitated pygmy sperm whale (*Kogia breviceps*). Journal of Cetacean Research and Management **3**:87–94.

Secchi ER, Zarzur S. 1999. Plastic debris ingested by a Blainville's beaked whale, *Mesoplodon densirostris*, washed ashore in Brazil. Aquatic Mammals **25**:21–24.

Sekiguchi K, Klages N, Findlay K, Best PB. 1993. Feeding habits and possible movements of Southern Bottlenose Whales (*Hyperoodon planifrons*) (14th Symposium on Polar Biology). Pages 84–97 in Proceedings of the NIPR Symposium on Polar Biology.

Sekiguchi K, Klages NTW, Best PB. 1992. Comparative analysis of the diets of smaller odontocete cetaceans along the coast of southern Africa. South African Journal of Marine Science **12**:843–861.

Sekiguchi K, Klages NTW, Best PB. 1996. The diet of strap-toothed whales (*Mesoplodon layardii*). Journal of Zoology **239**:453–463.

Shallenberger EW. 1981. The status of Hawaiian cetaceans. Marine Mammal Commission. MMC-77/23 (NTISPB82-109398).

Sibert J, Hampton J, Kleiber P, Maunder M. 2006. Biomass, size, and trophic status of top predators in the Pacific Ocean. Science **314**:1773–1776.

Simmonds MP, Lopez-Jurado LF. 1991. Whales and the military. Nature **351**:448–448.

Slip DJ, Moore GJ, Green K. 1995. Stomach contents of a southern bottlenose whale, *Hyperoodon planifrons*, stranded at Heard Island. Marine Mammal Science **11**:575–584.

Taylor RJF. 1957. An unusual record of three species of whale being restricted to pools in Antarctic sea-ice. Proceedings of the Royal Society of London **129**:325–331.

Trites AW, Christensen V, Pauly D. 1997. Competition between fisheries and marine mammals for prey and primary production in the Pacific Ocean. Journal of Northwest Atlantic Fishery Science.

Yamada TK. 2002. On an unidentified beaked whale found stranded in Kagoshima. Paper from the National Science Museum, Tokyo, December **25**.

Yang W, et al. 2008. Unusual cetacean mortality event in Taiwan, possibly linked to naval activities. Veterinary Record **162**:184.

Assessors and Reviewers

Claire Relton[1], Victor Cockcroft[2], Greg Hofmeyr[3]

[1]Endangered Wildlife Trust, [2]Nelson Mandela Metropolitan University, [3]Port Elizabeth Museum at Bayworld

Contributors

Simon Elwen[1], Ken Findlay[1], Mike Meÿer[2], Herman Oosthuizen[2], Stephanie Plön[3], Matthew F. Child[4]

[1]University of Pretoria, [2]Department of Environmental Affairs, [3]Nelson Mandela Metropolitan University, [4]Endangered Wildlife Trust

Details of the methods used to make this assessment can be found in *Mammal Red List 2016: Introduction and Methodology.*