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SHEPHERD'S BEAKED WHALE (*TASMACETUS SHEPHERDI*): INFORMATION ON APPEARANCE AND BIOLOGY BASED ON STRANDINGS AND AT-SEA OBSERVATIONS

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Shepherd's beaked whale (*Tasmacetus shepherdi*), one of the least known cetaceans in the world (Mead 1989, 2002), is currently represented by approximately 42 stranding records and 5 unconfirmed live sightings. Most of the strandings have been from New Zealand (including the Chatham Islands—24 records), but also the Juan Fernandez Islands (2), Argentina (7), Tristan da Cunha (6), and Australia (3) (Fig. 1). A stranding reported from the South Sandwich Islands (Mead 2002) was actually a "probable" at-sea sighting near Shag Rocks (position of sighting: 53°45′S, 42°30′W) reported by Laughlin (1996, see below), and purported strandings from South Africa (*e.g.*, Rice 1998, Reeves *et al.* 2002) are in error and probably refer instead to records from Tristan da Cunha. Based on stranding records and the known habitat preferences of beaked whales in general, *T. shepherdi* is assumed to have a circumpolar distribution in deep, cold temperate waters of the Southern Ocean (Mead 1989, 2002).

Although there have been five published accounts of possible live sightings of *T. shepherdi*, all lack convincing details. Gaskin (1972) reported that a beaked whale "which appeared to be this species" swam close to his boat a few miles from Kaikoura Peninsula, New Zealand, sometime prior to 1972; it was 15–20 ft long and "a fleeting glimpse of the head left the impression of small teeth along the edge of the lower jaw." A single *T. shepherdi* was reportedly viewed from a cliff top in New Zealand swimming 150 m offshore (Watkins 1976), but the description provided does not rule out any of several beaked whale species known from that region. A "possible" sighting from the Seychelles (Mead 2002) refers to a group of four unidentified beaked whales photographed from the air and shown in figure 6 of Keller *et al.* (1982). They were

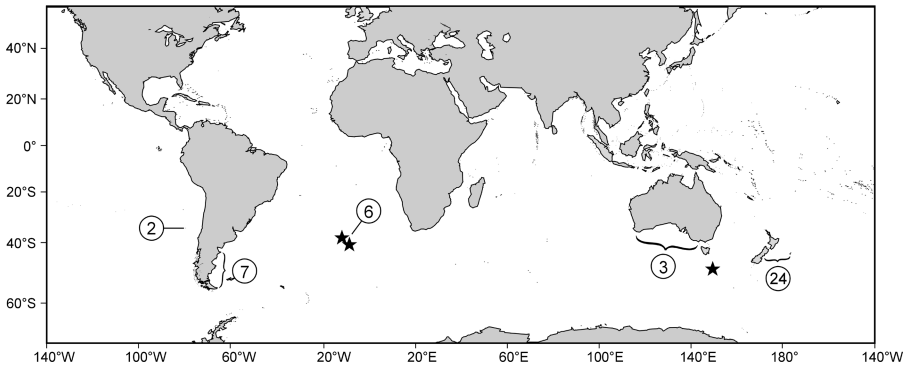


Figure 1. Known stranding locations of *Tasmacetus shepherdi* (number of individual records in circles), and four at-sea sightings from this study (stars; two are from the same location). Sources for stranding data: New Zealand Whale Stranding Database (New Zealand); Brownell *et al.* (1976), Mead (2002) (Juan Fernandez Islands); Mead and Payne (1975), Goodall (1978), E. Crespo,[1] N. Goodall[2] (Argentina); P. Best (this study) (Tristan da Cunha); How *et al.* (2001), Ling and Aitken (1981), R. Gales[3] (Australia).

clearly not *T. shepherdi* (compare with our aerial photographs below); more likely they were the superficially similar tropical bottlenose whale (*Indopacetus pacificus*), a warm water species whose external appearance has only recently been described also (Pitman *et al.* 1999, Dalebout *et al.* 2003). Three beaked whales tangled in fishing gear and subsequently released alive in Western Australia in January 1989 were also identified as *T. shepherdi* (table 3 in Anonymous 1991). RLP and AvH reviewed a videotape of these animals and concluded they are in fact an unidentified but distinctly patterned species of *Mesoplodon*. Laughlin (1996) reported a "probable sighting" of a pair of *T. shepherdi* in the South Atlantic, and although the animals were close enough to see that they had full rows of teeth in the upper and lower jaws (an otherwise diagnostic character for this genus of ziphiid), and even the eye color was recorded, the animals reportedly had "no melon" and the distinctive color pattern that we describe below was not noted, raising some doubts about the identification.

To add to the confusion, there have been discrepancies in the published accounts about the color patterning of *T. shepherdi*. Mead and Payne (1975) noted that a badly decomposed specimen that stranded in Argentina had what appeared to be a light area "on the anterodorsal surface of the head" and another light area "anterior and dorsal to the flipper." They also referenced Oliver (1937) who quoted a newspaper account that described the color of the holotype as "black on the back, *striped* with grayish yellow on the flanks and white underneath" (emphasis ours). Mead and Payne (1975) noted what also appeared to be a striping pattern in a photograph of a bloated

[1] Personal communication from E. Crespo, Laboratorio de Mamíferos Marinos, Centro Nacional Patagónico (CONICET), Blvd. Brown 3600, 9120 Puerto Madryn, Chubut, Argentina, February 2005.

[2] Personal communication from N. Goodall, Sarmiento 44, 9410 Ushuaia, Tierra del Fuego, Argentina, November 2005.

[3] Personal communication from R. Gales, Nature Conservation Branch, DPIWE, Box 44, Hobart 7001, Tasmania, Australia, July 2005.

and blackened specimen published by Sorenson (1940), and a similar pattern possibly present on their Argentina specimen. Based on this, they provided a tentative sketch of what the *T. shepherdi* color pattern might look like (Mead and Payne 1975). The same sketch was reproduced in Mead (1989), embellished upon in Carwardine (1995), and reworked again in Shirihai (2002). Reeves *et al.* (2002) published, without any qualifying remarks, an illustration of *T. shepherdi* with a completely different color pattern; this latter illustration was also reproduced in Mead (2002) and Kiefner (2002).

Over the years, the number of stranded specimens has gradually increased, including the occasional fresh individual, and from this it has become clear that *T. shepherdi* has a distinctive and unique color patterning. Below we describe some of the salient features of *T. shepherdi* color patterning and external morphology, based on descriptions and photographs of fresh-stranded individuals, as well as the first confirmed live sightings at sea. We also discuss some features that will aid in the future identification of this elusive species in the field.

Stranding no. 1 (Fig. 2, 4A) was a physically mature male: the epiphyses were completely fused but the testes were small (24.6 cm and 25.5 cm, left and right, respectively), and the sternum was not fully fused. The total body length was 5.96 m, and the terminal teeth had erupted. It stranded alive but died shortly afterward on Haulashore Island, Port of Nelson, South Island, New Zealand, on 20 April 1994. The skeleton is housed at the Museum of New Zealand Te Papa Tongarewa (NMNZ 2183).

The rostrum was robust and tapered toward the tip; the gape formed almost a straight line toward the eye. The prominent melon rose steeply from a point about halfway along the line of the gape.

The overall color pattern was essentially dark above and light below, but with a dark blue-gray/brown dorsal coloration that dipped down low on the sides, and formed a conspicuous cape (terminology from Perrin 1972). The trailing edge of the cape swept up and terminated at about the middle of the dorsal fin. The leading edge of the cape curved up from below and behind the insertion of the pectoral flipper,

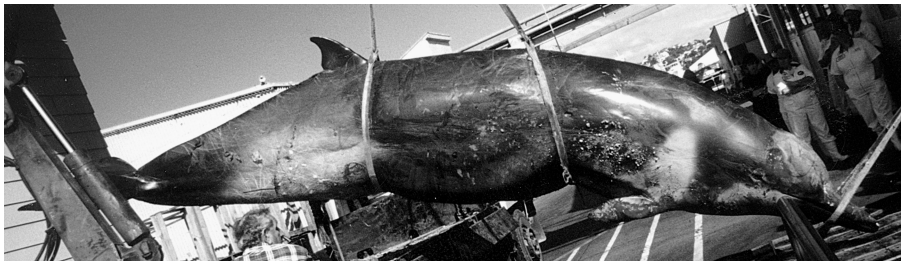


Figure 2. A physically mature male *Tasmacetus shepherdi* staranded in New Zealand in 1994; total length 5.96 m; NMNZ 2183 (Stranding No. 1). Evident is a medium-long, tapered beak; prominent, pale melon; white blaze behind flipper and white throat setting off a dark flipper stripe; white flank patch; trailing edge of dorsal cape terminates at dorsal fin (see also Fig. 4A). Photo by R. Wearing.

to a point above and just anterior to the flipper. Forward of the anterior margin of the cape, the dark dorsal pigmentation formed a wide band that extended backward and downward toward the insertion of the flipper, forming a broad "flipper stripe" (Perrin 1972). The area between the cape and the flipper stripe was an extension of the white belly that formed a broad, pale gray blaze that became whiter ventrally. Forward of the flipper stripe, the white of the belly swept up to just below the level of the eye, forming a conspicuous white throat. The coloration below and behind the cape was medium gray/olive brown and noticeably lighter than the cape. Posterior to the cape, the white of the belly swept up to form another conspicuous, whitish patch on the lower flanks. The peduncle was dark gray-brown, and the flukes were dark blue-gray/brown above, and a medium blue-gray below.

The beak was dark blue-gray/brown, with the lower jaw paler posteriorly, rapidly grading into the white of the throat. The upper jaw was dark to the base of the conspicuously pale, blue/gray melon. The paleness of the melon extended along the mid-dorsal line only as far as the blowhole, but laterally, the paleness swept around and just beyond the blowhole, so that from the side, the paleness appeared to extend posteriorly, beyond the blowhole. Laterally, the trailing edge of this pale area swept downward and forward, to just above the level of the eye, where it formed a boundary between the rostrum and the melon. There was a noticeably darkened patch around the eye.

The body had numerous pairs of parallel, linear scars, presumably tooth rake marks from interactions with other adult males (Heyning 1984). Although some of the scars were white, most were fairly fine and evident only on close inspection. Also present were oval scars usually attributed to healed bites of the cookie-cutter sharks (*Isistius* spp.; Shevchenko 1970, Jones 1971).

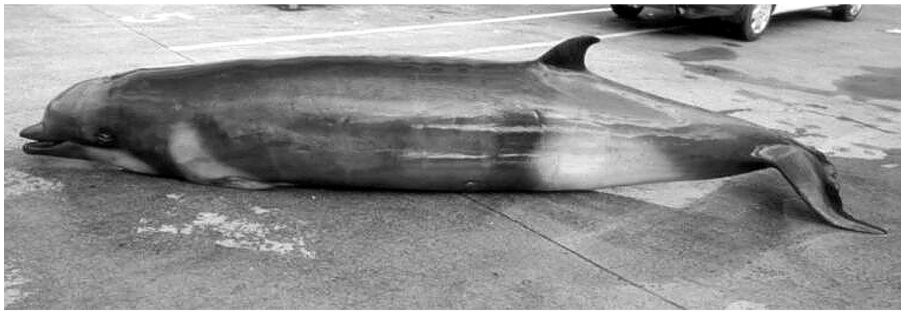
Stranding no. 2 was a fresh dead, male calf measuring 3.40 m, found on 18 July 1994 at Kai-iwi Beach, Castlecliff, Wanganui, North Island, New Zealand (NMNZ 2184; Fig. 3, 4B), which was also the type locality for *T. shepherdi*. Although it still had fetal fold lines on its flanks (see Fig. 4B), and was presumably still a dependent calf, the overall coloration and patterning was very similar to the adult male described above. The main color pattern elements (*i.e.*, dorsal cape, flipper stripe, pale melon, white throat and flank patch, and white blaze above the flipper) were all present, although sharpness of detail was lacking, and the overall patterning appeared muted. Also, while the adult male appeared to be blue-gray/brown, the juvenile was more olive brown.

Live sightings nos. 1 and 2 were photographed by PBB from a helicopter attached to the M/V *Agulhas,* from an altitude of about 250 m, using a handheld, 35-mm film camera and a 100–300-mm lens. On 17 November 1985, PBB was flying between Nightingale and Inaccessible Islands, Tristan da Cunha group, in the South Atlantic. The first sighting included four, medium-sized whales (estimated length "*ca*. 25′" = *ca*. 7.6 m), with white heads, small bushy blows, and a dorsal fin positioned far back on the body. They blew several times then sounded. The position was 37°18′S, 12°32′W.

A few minutes later, approximately 3.5 km closer to Inaccessible Island, PBB photographed another group of six beaked whales, including a calf (Fig. 5). In addition

to having white heads and dark beaks, every animal, including a presumed cow and calf pair (see Fig. 5), was dark on the back forward of the dorsal fin and pale gray behind it, with a fairly sharp boundary in between. This boundary corresponds to the trailing edge of the cape illustrated in Figure 4. All of the larger animals also appeared to have whitish tips to their flukes (Fig. 5). The water depth was approximately 500 m for the first sighting and 350 m for the second.

Sighting no. 3 was made by AP while acting as a naturalist aboard the cruise ship M/S *Explorer* as it was nearing Quest Bay, Gough Island, in the South Atlantic Ocean on 27 October 2002. The position was 40°19′S, 09°53′W; the sea surface temperature was 11°C. A group of 4–5 whales were first seen surfacing approximately 60 m in front of the vessel and heading rapidly away. The length of one of the animals was estimated to be approximately 6 m. The melon of the lead animal was pale and contrasted sharply with the dark back; the paleness extended to about the region of the blowhole. The melon of another individual was not as pale, although it was lighter than the back. The lead animal surfaced regularly, bringing its beak up and out of the water at about a 40° angle, showing a steep forehead and a prominent



A

B

Figure 3. A male calf *Tasmacetus shepherdi* stranded in New Zealand in 1994; total length 3.40 m; NMNZ 2184 (Stranding No. 2). A. Color pattern elements include dark flipper stripe with white blaze behind the flipper; pale melon and prominent white flank patch; notice stubby beak compared to adult in Figure 2. B. Same animal showing flipper stripe and dorsal cape against white ventral field; this view makes the beak appear longer (see also Fig. 4B). Photos by M. Hall, © Museum of New Zealand Te Papa Tongarewa.

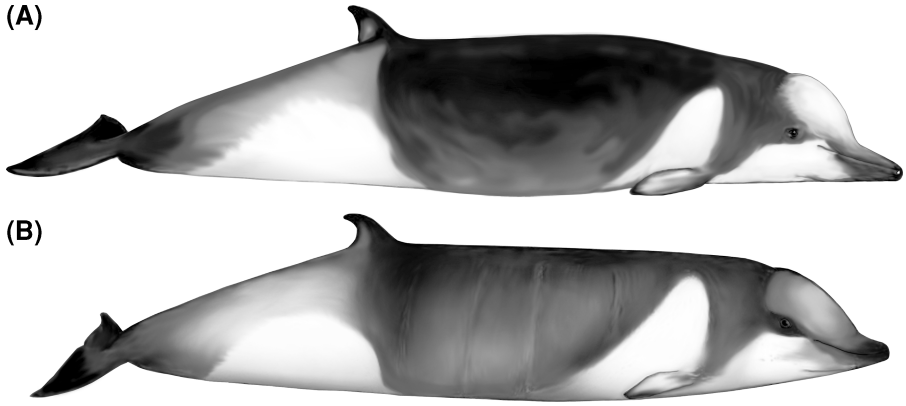


Figure 4. Illustrations of the two animals in Figures 2 and 3 showing details of color patterning (drawings not to scale). Above is an adult male (Fig. 2), showing erupted tooth at the tip of the lower jaw; below is a male calf (Fig. 3) with fetal folds (vertical lines in mid-section). Note that when viewed from above, these animals will show white heads, a black back from about the blowhole to the dorsal fin, and then pale gray further back (see Fig. 5). Illustration by A. L. van Helden.

melon. The beak was long, all dark, and comparable in shape and appearance to that of, say, a long-beaked common dolphin (*Delphinus capensis*). The dorsal fin was small and falcate. At no time were the sides of the body seen, nor were the blows visible.

Sighting no. 4 was made by RLP on 12 December 2004 while en route to McMurdo Station, Antarctica, from Hobart, Australia, aboard the US Coast Guard icebreaker *Polar Star*. The sighting was just south of the Tasman sea at 48°50′S, 150°06′E; the sea surface temperature was 10.8°C, and the water depth was approximately 3,600 m.

Initially, there were three animals rolling slowly at the surface, approximately 900 m directly in front of the vessel as it traveled at 15 kn. The whales rolled 3–4 times as the vessel moved to within *ca.* 400 m. Before they arched up for the final dive, they showed only dark backs, and the dorsal fins looked like those of most ziphiids: smallish, wide-based, low, pointy, quite falcate, and placed far back on the body. There was no visible blow during the entire sighting. As they arched for the final dive, one animal lifted its head and beak up, out of the water. It had a fairly prominent melon, similar to *Indopacetus pacificus* (see Pitman *et al.* 1999, Dalebout *et al.* 2003), and unlike mesoplodonts that tend to have smallish melons. The beak was moderately long and fairly narrow, tapering slightly at the tip. It was set off from the melon quite clearly, giving it an appearance more similar to a bottlenose whale than the lower, sloping profile of a mesoplodont.

A second animal that rolled up high showed some paleness about the melon, although the size and area covered by this feature was not specifically noted. The most conspicuous pigmentation feature on this animal, however, was a distinctive pale patch at the shoulder directly above where the insertion of the flipper should have been. The patch was off-white or buff in color and it stood out in sharp contrast to the animal's darker gray sides. The patch appeared circular in shape and was perhaps

Figure 5. *Tasmacetus shepherdi* photographed from the air at Tristan da Cunha in the south Atlantic, on 17 November 1985 (sighting nos. 1 and 2). The calf associated with a presumed adult female was among a group of six animals all showing the same color pattern; the same pattern as the male calf and adult male shown in Figures 2–4. Photo by P. Best.

20–25 cm across. We assume that this "patch" was actually the top of the pale blaze that juts up from the white belly (see Fig. 2–4).

The descriptions of live and fresh-stranded animals and the at-sea observations reported here provide significant new insights into the appearance and biology of Shepherd's beaked whale. Based on stranding locations, its at-sea range has historically been inferred to include oceanic water between latitudes 33°S and 50°S (Mead 1989, 2002), and our sightings (Fig. 1) fall within that range. Sightings and stranding data presented here also suggest that, in addition to New Zealand, *T. shepherdi* commonly occurs in the waters around Tristan da Cunha and associated islands. Strandings there have been recorded 6 mo apart (Table 1), suggesting it may also be resident there. Although one of our sightings was in deep water (*ca.* 3,600 m), the other two were in shallower slope waters (*i.e.*, 350–500 m) among the Tristan da Cunha group, indicating that it may inhabit a fairly wide range of water depths. Although Mead (1989) reported that *Tasmacetus* "seems to be ichthyophagous," the stomach of the 1995 animal in Table 1 contained only cephalopod remains: single buccal masses from *Todarodes filippovae* and *Teuthowenia pellucida*, single beaks from *Ancistrocheirus lesueuri* and *Histioteuthis* (?*corpuscula*), and one unidentified cephalopod beak; all the eye lenses present were from cephalopods, not fish.

Tasmacetus is a monotypic genus with some dolphin-like features not found in other beaked whales. For example, it is the only ziphiid with a full set of functional

Table 1. Records of *Tasmacetus shepherdi* stranded on Tristan da Cunha, South Atlantic.

Date	Locality	Length*	Sex	Material	South Africa Museum catalogue no.
15 April 1983	Beach S of Anchorstock Point	7 m	"Bull"	Photograph, measurements	—
15 April 1983	Beach S of Anchorstock Point	7.35 m	"Bull"	Measurements, tooth count	—
13 October 1984	Dead Man's Beach, Stony Hill Point	22 ft	?	Photos, skull, incomplete post-cranial skeleton	ZM 40484
9 December 1987	Runaway Beach	10–14 ft	?	Photos, skull, incomplete post-cranial skeleton	ZM 41116
9 December 1987	Runaway Beach	20–24 ft	?	Photos, 5 teeth	ZM 41113
1995	Noisy Beach	Adult	?	Skull, incomplete post-cranial skeleton	ZM uncat.

*Lengths are shown as they were given; endpoints used and the accuracy of these measurements are unknown (see text).

teeth in the upper and lower jaws (Oliver 1937). The color patterning is also similar to typical delphinids in having what appears to be a generalized dorsal cape on a lighter background, and a flipper stripe. It is also similar to dolphins, and unique among beaked whales so far examined, in that males and females share the same, well-marked color pattern. PBB saw and photographed a total of 10 individuals in sightings 1 and 2, and all of the animals, including an apparent cow and calf pair, had pale melons, dark beaks, and a cape that terminated at the dorsal fin. We infer from this, and from the descriptions of stranded animals above, that both sexes and all age classes are monomorphic with respect to color patterning (although the pattern may be somewhat muted on younger animals, as it is in most dolphin species). How these putative "dolphin-like" features functionally relate to *Tasmacetus* ecology and behavior is unknown.

Zoogeographically, *T. shepherdi* belongs to a cetacean community that includes a number of rare or little-known species (pygmy right whale, *Caperea marginata*, hourglass dolphin, *Lagenorhynchus cruciger*, spectacled porpoise, *Phocoena dioptrica*, and perhaps several species of *Mesoplodon*), although currently it is still not known if these species are actually rare or just rarely encountered. Part of the reason they are seldom encountered is because they are all offshore forms that inhabit latitudes of notoriously bad weather (*e.g.*, "the roaring 40s" and "the furious 50s"), and they strand so infrequently because of the reduced land area in the Southern Ocean at those latitudes (*i.e.*, fewer beaches to strand on). But perhaps the single most important reason there have been no credible previous sightings of *T. shepherdi* to date is because the distinctive color pattern of this species has never been adequately described. Reeves *et al*. (2002) presented a fairly accurate illustration of *Tasmacetus* (based as it was on the photographs presented here), but they did not substantiate the validity of the novel color patterning they presented, and in fact, their text description seems to refer back to the sketch of Mead and Payne (1975). Now that the distinctive color pattern of *Tasmacetus* is known, we expect observations will become more common in the future.

Below is a brief summary of the comparative features that will assist in identifying *T. shepherdi* at sea.

Body size— This is a medium-sized beaked whale: the largest specimen accurately measured to date was a sexually mature female at 6.6 m (Mead and Payne 1975); almost 1 m longer than most *Mesoplodon* species, but about the size of *Ziphius cavirostris*. Although the maximum length for *T. shepherdi* is usually cited as 7.0 m (*e.g.*, Mead 2002), all recorded lengths greater than 6.6 m have come from non-specialists (Sorensen 1940 and Table 1), and require confirmation.

Rostrum— *Tasmacetus* has a fairly long beak that apparently grows relatively longer with age: the calf in Figure 3 has a stubby beak, the 5.96-m male in Figure 2 has a longer beak, and the 6.6-m female in Mead and Payne (1975), appears to have the longest of all. The beak of *Tasmacetus* is relatively longer than that of either *Ziphius* or *Hyperoodon*, and comparable to *Indopacetus*, although with a more tapered tip (see photos in Mead and Payne 1975, Ling and Aitken 1981, Baker 1990). *Mesoplodon* has a range of beak lengths, including some that are longer (*e.g.*, *M. grayi*, *M. bidens*), and some that are shorter (*e.g.*, *M. densirostris*, *M. carlhubbsi*) than *T. shepherdi*, and other

features (listed below) will be needed to distinguish *Tasmacetus* from mesoplodonts with similar length beaks.

Melon— The melon of adult *Tasmacetus* appears to be more prominent than *Berardius* or any *Mesoplodon* species (see photos in Mead and Payne 1975, Ling and Aitken 1981, Baker 1990); mesoplodonts in particular often have an especially flat-headed appearance. The relative size of the *Tasmacetus* melon is similar to that of *Ziphius* and, especially, *Indopacetus*, but smaller than the bluff or even over-hanging melon of *Hyperoodon*. Among males of some ziphiids (*e.g.*, *Hyperoodon* spp., *Ziphius,* possibly *Indopacetus*), the melon becomes more prominent (bluff) with age; from the specimens examined to date, this does not appear to be the case for *Tasmacetus*.

Dorsal fin— The dorsal fin of *Tasmacetus* is relatively small and falcate; considerably smaller (relatively) than that of *Hyperoodon* or *Indopacetus* (Pitman *et al.* 1999), and different from the very low, wide-based and often rounded fin of *Berardius* (especially older individuals of the latter). The size, shape, and location of the *Tasmacetus* fin are, however, similar to *Ziphius* and several species of *Mesoplodon*.

Blow— In sightings 1 and 2, blows were visible (and photographed) from a helicopter, but none was observed by shipboard observers during sightings 3 and 4. Whether or not this species has a visible blow when viewed from a vessel will need to be confirmed by further observations, but for now it is safe to say that it is probably fairly inconspicuous. By contrast, bottlenose whales (*Berardius*, *Hyperoodon*, *Indopacetus*) are all large enough to have clearly visible blows. *Ziphius*, especially when it first surfaces, sometimes shows a low, rather inconspicuous, puffy blow, but most of the time none is evident. *Mesoplodon* has no visible blow under normal conditions.

School size— The school sizes we observed ranged from 3 to 6 ($n = 4$). If our small sample is typical, average school size for *T. shepherdi* may be slightly larger than that of most mesoplodonts and *Z. cavirostris* which usually number 1–3 animals (Wade and Gerrodette 1993, RLP's personal observation).

Color pattern— Under normal field conditions, the rather dolphin-like color pattern of *Tasmacetus* will be difficult to discern, but for shipboard observers, the combination of a pale shoulder "patch," conspicuous pale melon, and long, dark beak is diagnostic for this species. Most of the time, however, only the pale melon and perhaps long beak will be visible at sea. *Hyperoodon*, *Indopacetus, Ziphius*, and *Berardius* (at least young *B. arnuxii*) all have a pale melon, at least at times, but to our knowledge, no *Mesoplodon* species has an extensively pale melon, although the color patterns of several species are not known. *M. carlhubbsi* (only in the North Pacific) has a white "beanie" (Leatherwood and Reeves 1983, RLP's personal observation), but it is restricted to just the top of the melon. The more tropical *Indopacetus* is similar morphologically, but the paleness of the melon in younger animals appears to decrease with age. Also in *Indopacetus*, the white on the belly arches up high on the sides, mid-body, so that no cape is formed, and because there is no cape, the back does not appear darker in front of the dorsal fin and paler behind, as it does in *Tasmacetus*.

For aerial observers, the combination of a white melon, black back extending from about the blowhole to the mid-dorsal fin region, then with a paler gray back posterior to the dorsal fin, makes *T. shepherdi* relatively easy to identify from the air (Fig. 5). Although the contrasting boundary where the trailing edge of the dark cape meets

the pale gray flanks is clearly visible from the air, this feature was not specifically noted by shipboard observers during sightings 3 and 4; it should, however, be visible from a ship in good light, especially on a terminal dive as the animal arches up. By contrast, the pale shoulder patch seen from the ship was not apparent in the aerial photographs.

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