

Short Note

Neonatal Facial Pigmentation of Pygmy Killer Whales (*Feresa attenuata*): A Description from Repeated Observations of Individuals in the Wild

Sabre D. Mahaffy,¹ Uko Gorter,² and Robin W. Baird¹

¹*Cascadia Research Collective, 218½ W. 4th Avenue, Olympia, WA 98501, USA*

E-mail: mahaffys@cascadiaresearch.org

²*Natural History Illustration, Kirkland, WA 98033, USA*

Pygmy killer whales (*Feresa attenuata*) are rare throughout their range, and little is known about their life history or early development. The first records of this species came from two skulls obtained by the British Museum and reported by Gray (1827, 1874), but the external appearance was not described until Yamada (1954) used a freshly flensed skeleton from Japan and eyewitness accounts to graphically reconstruct an adult female specimen taken in a local drive fishery. Yamada's illustration and basic color description of a light gray body with uneven white lips matches observations of individuals captured off Japan and Hawai'i in 1963 that were taken into captivity (Nishiwaki et al., 1965; Pryor et al., 1965). There are several more recent descriptions of the external appearance of free-swimming pygmy killer whales in the literature; however, the only detailed descriptions or images of color or pigmentation in neonates have come from bycaught or stranded individuals (Table 1). Color is known to quickly fade in stranded or frozen cetaceans, making accurate descriptions of coloration or pigmentation patterns after death challenging (Perrin & Hubbs, 1969; Perrin, 2018).

Changes in pigmentation patterns and coloration between neonates or calves and adults are common in cetaceans (Perrin, 2018); however, the reason for these changes is poorly understood. Phenotypic changes in cetaceans vary by species, but neonates and calves generally have a more muted appearance compared to adults, with color contrast or pattern complexity increasing with age (reviewed in Krzyszczyk & Mann, 2012). This muted appearance is thought to aid in crypsis by providing protection from predators through camouflage with the surrounding environment or with conspecifics, though it may also serve a communication function such as enhancing individual recognition or signaling age/maturity (Krzyszczyk &

Mann, 2012). Documenting ontological changes in patterns and coloration can provide insight into the environmental threats young animals face and can also inform how they associate with conspecifics at different stages of development.

Herein, we use a 35-year photographic dataset of individual pygmy killer whales resident to the islands of Hawai'i and O'ahu (Baird et al., 2024) to describe a novel mask-like facial pigmentation pattern only seen in neonates and young calves. To increase sample size, all available surface and underwater photos and videos of neonates and young calves were reviewed regardless of quality. Photos and video were taken from directed research effort (see McSweeney et al., 2009; Baird et al., 2024) and contributions from citizen scientists, other researchers, and tour companies. Neonates were identified by the presence of fetal folds, while young calves lacked visible fetal folds but were in constant association with the presumed mother and were roughly 50% of her length at their largest (McSweeney et al., 2009; Figure 1a & 1b). The timing of photographs and associations with distinctive individuals thought to be the mother were used to confirm the individual identity of neonates and young calves (see McSweeney et al., 2009, for photo ID methodology).

Photos and/or video of the head were available for six different neonates and four different young calves; of these, each exhibited a clearly demarcated bilateral oblique band of white pigmentation extending from the gape to the apex of the rostrum, which is shown in Figure 1a to 1g and illustrated in Figure 2. White pigmentation below the mouthline, when visible, was more extensive and included the lower jaw and throat area (Figures 1a–1g & 2). The uniformly white pigmentation that is visible on the upper and lower jaws is hereafter referred to as a face mask. There

Table 1. Publications referencing external appearance of pygmy killer whale (*Feresa attenuata*) neonates or young calves

Publication	Location of specimen or sighting	Specimen acquisition	Age class*	Length (cm)	Original author notes (if any) on coloration of the fetus or neonate followed by our comments in italics
Nishiwaki et al., 1965	Izu Peninsula, Futo, Japan	Two pregnant females live-caught and transported to Ito Aquarium where they died within a week; fetuses removed postmortem.	Fetus	20.5 & 53.0	<i>Plate 1 shows the lateral view of two fetuses measuring 20.5 and 53 cm, respectively. The 20.5 cm fetus does not appear to have any discernible coloration; however, the 53 cm fetus has distinct, white mask-like pigmentation on the upper and lower jaw, extending above and below the anterior part of the eye at the gape. The white stripe extending below the gape toward the pectoral flipper could indicate a flipper stripe.</i>
Perrin & Hubbs, 1969	Eastern Pacific Ocean, 300 to 400 nmi off Costa Rica	Bycaught during tuna purse-seining operation and immediately frozen at sea	Neonate (fetal folds)	82.2	“White markings edged each jaw, the upper the more conspicuously and the more extensively. On the upper jaw the whitish areas broadened anteriorly, but these were separated by a blackish area on the midline and tended to grade above into the blackish snout, whereas posteriorly the coal-black and pure-white areas contrasted fully along the line of contact. The white margin on the lower jaw was much narrower, and was largely confined to the front of the mouth” (p. 300). <i>A distinct white face mask is visible in Figure 1; however, it is confined to the upper and lower jaws. The throat area has an uneven appearance, with darker pigmentation at the gape and under the eye area but mottled white pigmentation extending from the throat to the anterior insertion of the pectoral flipper.</i>
Bryden, 1976	New South Wales, Australia	Reported alive and alone in surf water; died in the water 30 min after being caught.	Young calf	110.5	“The dolphin was described as grey-black, but no details of markings were noted. Photographs (Figs 1–3) show that it was almost uniformly dark in colour, apart from a definite crescent-shaped white patch immediately caudal to the blowhole, and lighter coloration round the lips and beneath the chin. There is no photograph showing the ventral side, so it is not possible to comment on ventral markings” (p. 22). <i>Figure 1 shows white, mask-like pigmentation on the upper and lower jaws, and some light coloration in front of the leading edge of the left pectoral fin. There is not an obvious flipper stripe, but the coloration from eye/gape to anterior pectoral insertion is diffuse and uneven. Figure 2 shows a much darker mask, highlighting how sensitive this pigmentation is to lighting conditions.</i>
Ross & Leatherwood, 1994	Trincomalee, Sri Lanka	Pregnant female bycaught in a gill net; fetus removed postmortem.	Fetus	~70	“The upper and lower lips are edged with variable amounts of white at all ages, from late term onwards (Figs 4 and 5)” (p. 392). <i>A distinct white face mask and throat area is visible in Figure 5 along with a flipper stripe (interrupted by a dark patch below the eye).</i>
Berrow et al., 2020	São Filipe, Fogo Island, Cabo Verde	Live sighting of free-swimming group; no measurements available.	Neonate (fetal folds)	NA	Fig. 1D “One of the two calves recorded in the group, exhibiting relatively smaller size and characteristic pale neonatal folds (photo by S. Berrow)” (p. 40). <i>A faint, yellowish mask is visible, appearing as a wider band on the upper jaw and a thin band on the lower jaw with darker pigmentation below; the yellow coloration could be due to lighting or evidence the mask pigmentation is fading. A faint stripe is visible below the gape, possible evidence of a flipper stripe.</i>

*Determined using established length at birth measurement of 80 cm (Ross & Leatherwood, 1994) and presence or absence of fetal folds



Figure 1. (a) Neonate with faint fetal folds visible as light-colored vertical bands on the side of the body, white facial mask-like pigmentation, and evidence of a flipper stripe; (b) young calf (top) roughly 50% the length of the presumed mother (bottom) but with no fetal folds visible and reduced white face mask area; (c) neonate (fetal folds not visible in photo) with white facial mask-like pigmentation and flipper stripe possibly interrupted by dark patch below eye; (d) young calf showing more faint mask-like facial pigmentation with more diffuse boundaries compared to neonates; (e & f) left and right sides of the same young calf showing white facial mask-like and white pigmentation on throat and flipper stripe with diffuse boundary; (g) neonate (fetal folds not visible in photo) with white facial mask-like pigmentation and flipper stripe interrupted by dark patch below eye; and (h) first follow-up photo with head visible of the neonate pictured in the foreground of (g), showing that the facial mask has largely blended with surrounding head coloration after 113 d.

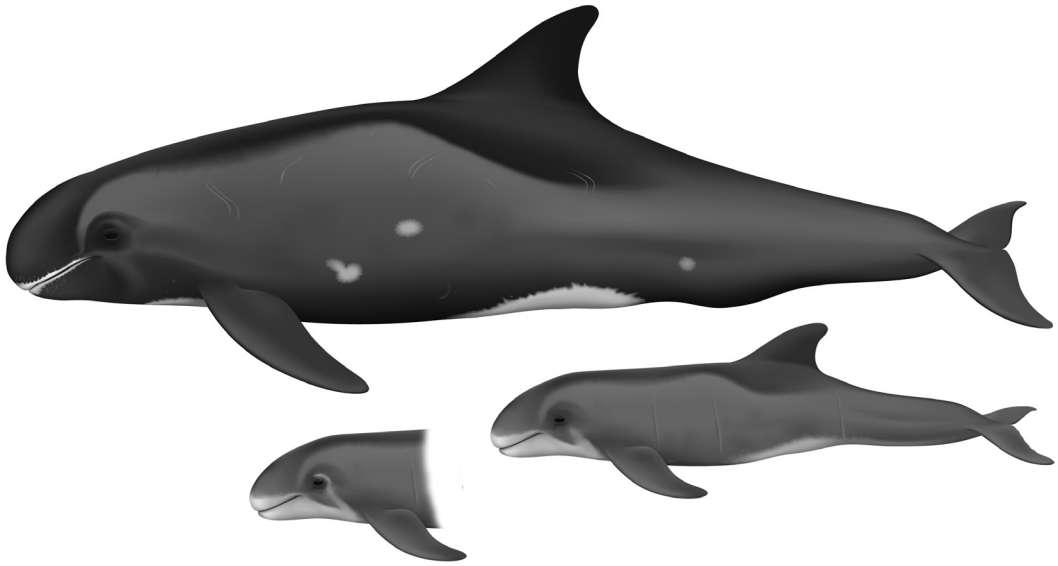


Figure 2. Illustrations of a pygmy killer whale (*Feresa attenuata*) adult male (top) and neonate (bottom right showing the dominant pigmentation pattern seen in Hawai'i and bottom left showing head detail with postocular extension or lighter arch over the eye observed in one individual off the island of Hawai'i). Neonate illustrations are based on a compilation of photos of free-swimming individuals seen off the islands of Hawai'i and O'ahu. Fetal folds (vertical creases on the body, a legacy of the position of the individual in the womb) are visible in the figure and indicate the individual was recently born. Adult male illustration is provided for comparison and shows acquired paired white linear scars from tooth rakes and oval white markings from healed cookiecutter shark (*Isistius* spp.) bite wounds. Illustrations are not to scale.

was evidence of a flipper stripe extending from the gape to the anterior insertion of the pectoral fin (visible or partially visible in four neonates); however, photo quality limited the extent ventral pigmentation could be observed. The white throat area (when visible) showed individual variation such as the following: the flipper stripe was interrupted by a dark patch below the eye in one neonate (Figure 1g); one neonate had a dark patch below the eye that appeared to merge with the flipper stripe and white mottled pigmentation above the flipper stripe but posterior to the eye (Figure 1c); one young calf had a flipper stripe with a diffuse boundary that extended beyond the anterior flipper insertion (Figure 1f); and another neonate had a modified flipper stripe with a white pigmentation blaze extending dorsally from the throat area and arching over the dorsal posterior part of the eye (this postocular extension is not pictured due to photo quality but is illustrated at the bottom left of Figure 2).

Follow-up photos showing the head were available for three neonates and three young calves (range: 75 to 270 d after initial sighting) and generally showed a faint mask visible, with a more diffuse boundary and less vibrant white coloration (transitioning to gray) covering less area. Lighting

conditions made assessing the timeline for when the mask disappeared challenging; however, facial pigmentation appeared to have almost completely blended in with the surrounding gray head coloration after 106 and 113 d for two neonates, respectively, but was still faintly visible after 263 d for the third neonate and all three young calves (75, 109, and 270 d), suggesting some individual variability. Evidence of the facial mask fading and blending with surrounding coloration is shown for one individual (photographed as a neonate in Figure 1g and after 113 d in Figure 1h).

The facial pigmentation seen on free swimming calves and neonates in Hawai'i is consistent with early reports from around the world of stranded or bycaught pygmy killer whales (Table 1). Photos of a fetus in Japan from 1963 show a faint mask on the upper and lower jaws with a possible flipper stripe and another stripe of white extending from the gape over the dorsal anterior part of the eye that was not seen in any of the Hawai'i individuals (Nishiwaki et al., 1965). Perrin & Hubbs (1969) described a specimen with visible fetal folds as having more extensive white markings on the upper rather than lower jaw, with the white pigmentation on the lower jaw limited to the "front of the mouth" (p. 300). Photos from

the publication do show a white face mask and splotchy white pigmentation around the throat area most similar to Figure 1b, though, as Perrin & Hubbs (1969) noted, “repeated freezing and thawing of our specimen no doubt obscured some of the more labile features of the pigmentary pattern” (p. 300). Pigmentation seen in published photos and/or described for a neonate that stranded on the east coast of Australia in 1973 by Bryden (1976) shows a well-defined mask on the upper and lower jaws; lighting conditions make it difficult to assess pigmentation for the throat area, but it appears to be a mottled lighter gray with a possible (though very diffuse) flipper stripe. A photo of a fetus from an adult female killed in a gill net off Sri Lanka in 1985 shows white mask-like pigmentation on the face and throat, including a flipper stripe and dark pigmentation patch under the eye as seen in Figure 1c and 1f (Ross & Leatherwood, 1994). Finally, a photo taken of a neonate off Cabo Verde, West Africa, in 2020 shows a faint mask visible mostly on the upper (and to a limited extent on the lower) jaw that has a yellow or cream-colored cast (similar to Figure 1d), with faint pigmentation extending down from the gape which could be evidence of a flipper stripe (Berrow et al., 2020).

A review of photos and video taken of neonates and young calves in Hawai‘i (Figure 1) and around the world (Table 1) suggests that this white, mask-like pigmentation appears to be a common developmental trait of neonatal pygmy killer whales. However, sightings of neonates and young calves from additional areas are needed to confirm how much variation exists (both within and among populations) and how long this mask-like pigmentation persists. Changes to pattern, location, and intensity of coloration or speckling between neonates and adults are highly variable in cetaceans and have been used as a proxy for age determination in several species (e.g., Bertulli et al., 2016; Hartman et al., 2016). The presence of ephemeral white facial pigmentation in pygmy killer whale neonates and young calves is unexpected given the more subtle coloration reported for these age classes in other species (Krzyszczuk & Mann, 2012); however, similar white, mask-like facial pigmentation has been seen in neonates in several other species of odontocetes, including Risso’s dolphins (*Grampus griseus*; also note the postocular extension in Nachtigall et al., 2005; Hartman et al., 2016), Indo-Pacific finless porpoises (*Neophocaena phocaenoides*; Jefferson et al., 2015), and white-beaked dolphins (*Lagenorhynchus albirostris*; present in all age classes but referred to as a “yellow wash” [p. 7] in neonates in Bertulli et al., 2016). In pygmy killer whales, the genital patch of adults is also white, suggesting the white facial mask and throat area described in neonates

and young calves could provide camouflage when suckling, serve a counter-shading function for individuals at the surface, or enhance visual recognition of dependents (Caro et al., 2011). Therefore, more research is needed into the evolutionary significance of ontological changes to coloration and pigmentation patterns in neonates.

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