DOI https://doi.org/10.34331/cpops.2023-F-001 J-STAGE Advance published date: June 17, 2025

RARE SIGHTINGS OF THE PYGMY RIGHT WHALE (*CAPEREA MARGINATA*) DURING THE 2022/2023 JASS-A CRUISE IN THE SOUTHWESTERN PACIFIC

Yujin KIM*, Taiki KATSUMATA, Tatsuya ISODA and Koji MATSUOKA

Institute of Cetacean Research, 4–5 Toyomi-cho, Chuo-ku, Tokyo 104–0055, Japan
**Corresponding author: kim.cetacean@gmail.com*

Abstract

On 14 February 2023, during the 2022/2023 Japanese Abundance and Stock-structure Surveys in the Antarctic (JASS-A) cruises, two individual whales were sighted in the Southwestern Pacific. These whales were identified as pygmy right whales (*Caperea marginata*) by their prominently arched jawline, relatively narrow rostrum, dorsal fin located two-thirds of the way from the tip of the snout, and small body size. This species is one of the most mysterious whales, with few sightings at sea. Several measurements were taken from aerial videography using a small uncrewed aerial vehicle (UAV) for 9 min and 49 s. One individual swam slowly for 128.9 m in 53 s, with a swimming speed of 4.7 knots. A comparison of the external measurements of the whale in this study with those of whales reported to have a similar body length indicated no significant differences between photogrammetric and manual measurements. These sightings represent the second and third recorded occurrences of this species in the Southwestern Pacific, in highly pelagic waters near the northern boundary of the Subtropical Convergence Zone. This region is known for its high primary productivity, where whale prey species are concentrated.

Key words: Pygmy right whale, *Caperea marginata*, sighting survey, aerial videography, photogrammetry, JASS-A.

Introduction

The pygmy right whale (*Caperea marginata*, Grey 1846) is one of the smallest baleen whales. This species has been found only in the Southern Hemisphere and has rarely been observed at sea (Jefferson *et al.*, 2015). Fifteen sightings have been reported in the waters around Australia and New Zealand, while four sightings have been recorded off southern Africa (reviewed in Ross *et al.*, 1975; reviewed in Kemper, 2002; Gill *et al.*, 2008; reviewed in Kemper *et al.*, 2013). Reports of strandings, both live and dead, are more common. There have been 180 stranding reports from the Australia and New Zealand region, six from South Africa, and one from Chile (reviewed in Ross *et al.*, 1975; Cabrera *et al.*, 2005; reviewed in Kemper, 2002; reviewed in Kemper *et al.*, 2013). Stranded individuals have been used to study aspects of this species' biology, including external morphology, diet, osteology, genetics, and phylogeny (Ross *et al.*, 1975; Munday *et al.*, 1982; Sekiguchi *et al.*, 1992; Kemper, 2002; Bisconti, 2012; Fordyce and Marx, 2013; Tsai and Fordyce, 2014; Wolf *et al.*, 2023). Little is known about the life history of pygmy right whales in the wild due to the relative paucity of sightings at sea.

This paper reports two new sightings from the Southwestern Pacific recorded during the 2022/2023 Japanese Abundance and Stock-structure Surveys in the Antarctic (JASS-A) cruise. These new data are compared with previous records to expand information on this species' life history in the wild.

Author contributions were Kim: Conceptualization, visualization, validation, data curation. Katsumata: visualization, data curation, software. Isoda: Conceptualization, project administration, Matsuoka: data curation, supervision.

Materials and Methods

The JASS-A cruises began in 2019/2020 as a comprehensive effort to study large whales and ecosystem dynamics in the Indo-Pacific region of the Antarctic. These surveys utilized dedicated sighting methods and a range of non-lethal techniques to assess whale abundance, population trends, and stock-structure (Government of Japan, 2019a, 2019b, 2019c).

The 2022/2023 JASS-A cruises were conducted from 5 December 2022 to 14 March 2023 as the fourth year of surveys in the eight-year plan (Isoda *et al.*, 2023). The research area was set in Area VIE, south of 60°S, one of the areas managed by the International Whaling Commission (IWC). The sighting surveys were conducted by two research vessels: *Yushin-Maru No.2* (*YS2*) (747 GT) and *Yushin-Maru No.3* (*YS3*) (742 GT) (Fig. 1; Table 1). Both research vessels have a top barrel platform (TOP), an independent observer platform (IOP), and an upper bridge platform (UBP) (Fig. 1). Transit sighting surveys were conducted between Japan and the Antarctic research area using the Passing mode (NSP), with searching effort undertaken only when weather conditions were suitable for whale observations: visibility better than 1.5 nautical miles, wind speed less than 21 knots, and a searching vessel speed of 11.5 knots. During the searching effort, two primary observers on the TOP and two

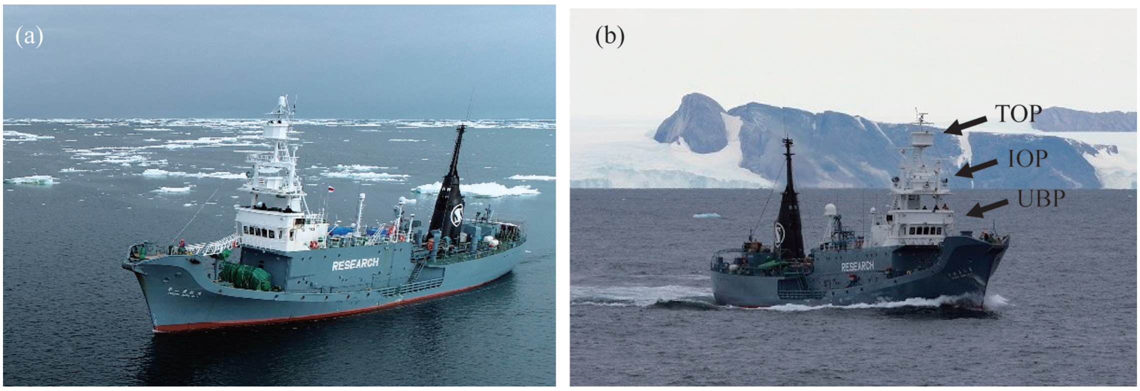

Fig. 1. Photographs of the two research vessels used in the 2022/2023 Japanese abundance and stock-structure surveys in the Antarctic (JASS-A) cruise (Isoda *et al.*, 2023). (a) *Yushin-Maru No.2*. (b) *Yushin-Maru No. 3*. From top to bottom: top barrel platform (TOP), independent observer platform (IOP), and upper bridge platform (UBP).

Table 1. Specifications of the research vessels used in the 2022/2023 Japanese abundance and stock-structure surveys in the Antarctic (JASS-A) cruise (Isoda *et al.*, 2023).

	Yushin-Maru No.2	*Yushin-Maru No.3*
Call sign	JPPV	7JCH
Length overall [m]	69.61	69.61
Molded breadth [m]	10.8	10.8
Gross tonnage [GT]	747	742
Top barrel height [m]	19.5	19.5
IO platform height [m]	13.5	13.5
Upper bridge height [m]	11.5	11.5
Bow height [m]	6.5	6.5
Engine power [PS/kW]	5,280/3,900	5,280/3,900

other primary observers (captain and helmsman) on the UBP conducted searches (IWC, 2008, 2012).

When a sighting was made, the whales were approached to determine their species, group size, and other observations. Species identification followed the guidelines used in the Southern Ocean Whale and Ecosystem Research (IWC-SOWER) survey (Matsuoka *et al.*, 2003; IWC, 2008, 2012). Depending on the progress of the survey, various experiments were conducted using the following non-lethal survey techniques: photo-identification, biopsy sampling, and satellite tagging (Isoda *et al.*, 2023).

Results

Sightings

On 14 February 2023, both *YS2* and *YS3* made whale sightings while conducting a transit survey from the research area to Japan (Fig. 2). A whale accompanied by a large number of seabirds was sighted by the top man of *YS2* at 43°59′S, 160°45′W, at 09:46 (UTC+13.0 h). Hereafter, this whale is referred to as #001 (Fig. 2 and Fig. 3). Weather conditions at the time were clear, with few clouds, a westerly wind of 4 knots, and a Beaufort sea state of 3. Visibility exceeded 7 nautical miles, with an air temperature of 19.0°C and a sea surface temperature (SST) of 16.4°C.

The second whale sighting occurred at 43°40′S, 161°26′W by *YS3* at 16:16 (UTC+12.0 h), only 35 nautical miles from the first sighting (Fig. 2). A single individual with a cued whale body was sighted. Hereafter, this whale is referred to as #002. Weather conditions at the time of the second sighting were also clear, with an east-northeast wind of 2 knots, a Beaufort sea state of 1, and visibility exceeding 7 nautical miles. The air temperature and SST were 21.3°C and 17.7°C, respectively.

Both vessels approached within 0.02 nautical miles of each sighting to observe external morphol-

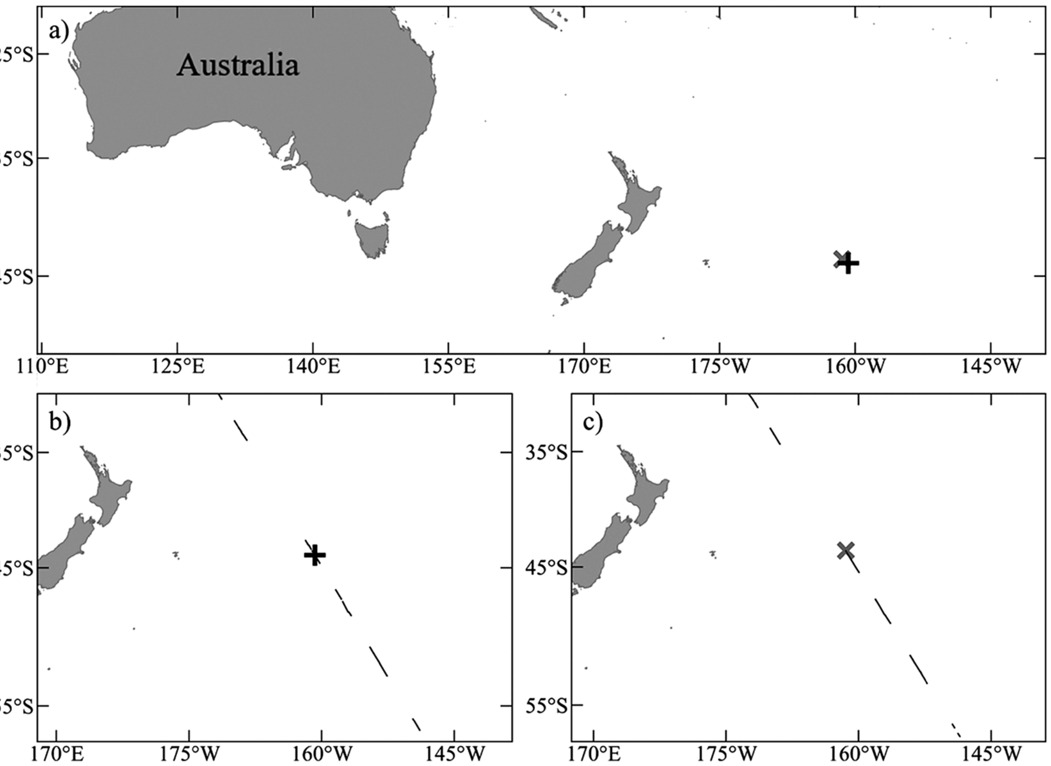

Fig. 2. The sighting locations of the pygmy right whales on 14 February 2023. (a) Wider area map. Black cross: location of whale (#001 sighted by *Yushin-Maru No. 2* (YS2). Gray cross: location of whale #002 sighted by *Yushin-Maru No.3* (YS3). (b) Search tracks (black lines) of YS2 and the sighting location of #001. (c) Search tracks of YS3 and the sighting location of #002.

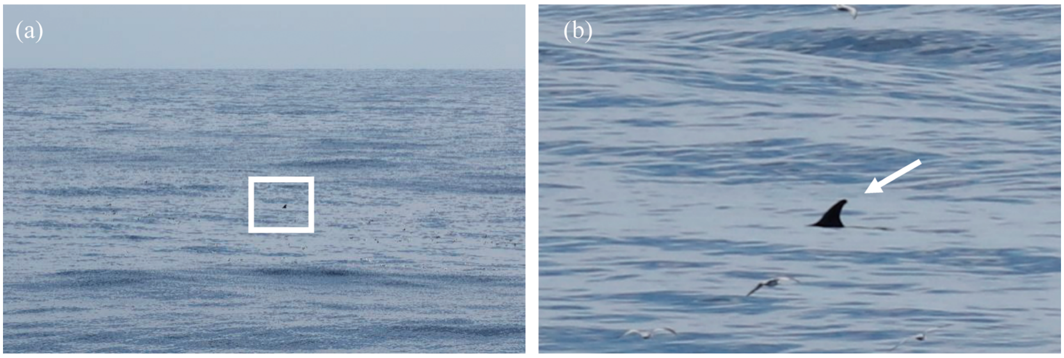

Fig. 3. Photographs of the pygmy right whale (#001). (a) Photograph during the approach of YS2 to the whale. Seabirds were seen around the whale. (b) A close-up of the white rectangular area in (a). The dorsal fin of the whale is clearly visible.

ogy and behavior for species identification. The individuals were identified as pygmy right whales (*C. marginata*) based on their prominent arched jawline, relatively narrow rostrum, dorsal fin located two-thirds of the way from the tip of the snout, and small body size.

Photo-identifications of #001 and #002 were taken using a Canon EOS 7D Mark II camera with a 100–400 mm image-stabilized lens and built-in GPS. Aerial observation and videography were also conducted for #002 using a small UAV. The DJI Inspire 2 was equipped with a Zenmuse X5S camera (DJI, China) featuring a Micro Four Thirds (Micro 4/3) sensor and an Olympus M. Zuiko Digital ED 14–42 mm f3.5–5.6 EZ lens (Olympus, Japan). The focal length of the UAV lens was fixed at 14 mm during flight. Additionally, the UAV was equipped with a laser rangefinder (Lightware SF11/C), GPS (Globalsat EM506), and an inertial measurement unit (IMU) (Pololu MiniIMU-9 v5) to collect data for photogrammetry (Dawson *et al.*, 2017). Whale #001 was observed for approximately 44 min, while whale #002 was observed for approximately 58 min after the initial sighting.

External morphology

Both whales were relatively small, with estimated body lengths of 5.8 m (#001) and 5.3 m (#002). These estimates were made by the boatswain of each vessel, an experienced and trained observer, and were agreed upon by the researchers and captains. The external morphology of the whales was observed from the head to the dorsal fin as they surfaced to breathe. Fig. 4 shows the heads of these whales. In the lateral head view, the rostrum displayed a dorsally arched jawline. This characteristic jawline curved upward from the tip of the rostrum to the front of the blowhole before curving downward. When the whales surfaced, the dorsal fin was visible simultaneously with the blowhole (Fig. 5). The dorsal fin was falcate, relatively narrow compared to its height, and its tip lacked a strong caudal curvature.

For the whale sighted by *YS3* (#002), aerial videography for photogrammetry was captured using a small UAV. From the aerial footage, four photographs were cropped in which the whale's body axis was straight as it surfaced to breathe (Fig. 5). These photographs were corrected for distortion caused by the wide-angle lens using the video editing software Defishr (Ver.1.0), and photogrammetry was conducted using MorphoMetriX (Ver.2.1.2) (Torres *et al.*, 2020). Seven external measurements, including body length, were taken by photogrammetry, based on previous studies (Mackintosh and Wheeler, 1929; Ohsumi, 1960; Amano and Miyazaki, 1993; Kim *et al.*, 2021) (Table 2): body length (*BL*), tip of snout to center of eyes (*TCE*), tip of snout to center of blowhole (*TCB*), tip of snout to anterior insertion of flipper (*TAF*), tip of snout to anterior insertion of dorsal fin (*TAD)*, total span of flukes (from left tip to right tip) (*TSF)*, and depth of flukes (anterior insertion to notch) (*DF*). Table 2 presents the mean measurements and the relative ratios of each body part to body length. The *BL* measured from the photographs was 5.6±0.2 m (mean±SD). The *TCE* measured 1.1±0.1 m, while the

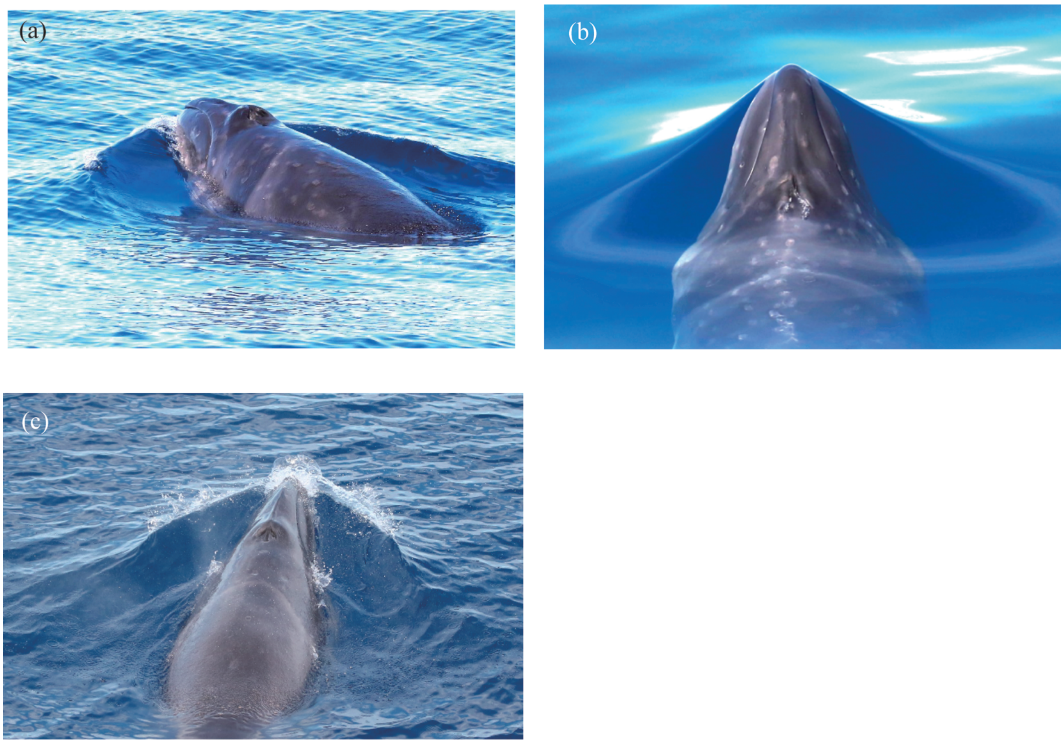

Fig. 4. Photographs of the heads of two pygmy right whales. (a) Lateral view of #001. (b) Dorsal view of #001. (c) Dorsal view of #002. The arched jawline and medially narrowing upper jaw are characteristic features. The chevron behind the blowhole is clearly visible, along with oval scars caused by cookie-cutter sharks (*Isistius* sp.). A single ridge and two slits in the blowhole were also observed.

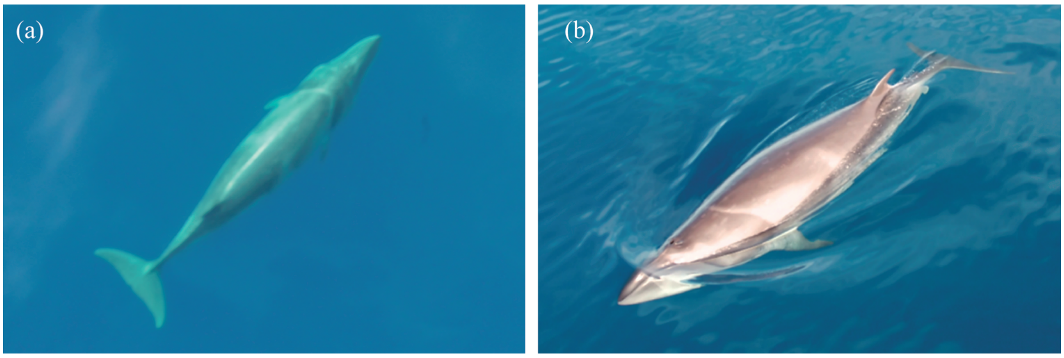

Fig. 5. Photographs of the pygmy right whale (#002) cropped from aerial videography taken using a small uncrewed aerial vehicle (UAV)). (a) Just before the whale surfaces to breathe. (b) The whale breaks the surface. The double chevrons are clearly visible. The blowhole and dorsal fin are on the surface simultaneously.

TCB measured 0.6±0.1 m. The *TAF* and *TAD* measurements were 1.9±0.0 m and 3.6±0.3 m, respectively. The two fluke measurements—*TSF* and *DF*—were 1.6±0.0 m and 0.5±0.0 m, respectively. The positions of each body part, based on the relative ratios of external measurements to body length, were as follows: The blowhole and eyes were positioned at 11.0±0.9% and 18.9±1.1% of the body length, respectively. The flippers were positioned from the tip of the snout (*TAD*) at 32.7±0.8%, approximately one-third of the body length. The dorsal fin was positioned at 64.6±2.5% of the body length, approximately two-thirds from the tip of the snout. The *TSF* measured 29.2±1.6% of the body length, while the *DF* measured 8.4±0.2%.

The coloration of the dorsal surface was generally dark gray, fading to light gray ventrally (Fig. 4 and Fig. 5). Two light gray bands, called chevrons, were observed on the lateral surface of the body and

Table 2. External measurements of the pygmy right whale (#002) obtained by photogrammetry. Measurement points were derived from previous studies (Mackintosh and Wheeler, 1929; Ohsumi, 1960; Amano and Miyazaki, 1993; Kim *et al.*, 2021). Ratios indicate the relative proportions of each body part to total body length. N denotes the number of aerial photographs used for each measurement.

	Measurement point	*N*	Measurement (m)		Ratio (%)	
			Range	Mean (SD)	Range	Mean (SD)
1	Body length (*BL*)	4	5.3–5.8	5.6 (0.2)	—	—
2	Tip of snout to center of eyes (*TCE*)	4	1.0–1.2	1.1 (0.1)	17.8–20.0	18.9 (1.1)
3	Tip of snout to center of blowhole (*TCB*)	4	0.5–0.7	0.6 (0.1)	10.0–12.2	11.0 (0.9)
4	Tip of snout to anterior insertion of flipper (*TAF*)	2	1.9–1.9	1.9 (0.0)	31.9–33.4	32.7 (0.8)
5	Tip of snout to anterior insertion of dorsal fin (*TAD*)	4	3.3–3.9	3.6 (0.3)	61.7–67.6	64.6 (2.5)
6	Total span of flukes (*TSF*)	4	1.6–1.7	1.6 (0.0)	27.2–31.3	29.2 (1.6)
7	Depth of flukes (*DF*)	4	0.5–0.5	0.5 (0.0)	8.1–8.7	8.4 (0.2)

were clearly distinguishable from the surrounding body color. The anterior chevrons swept dorsally from the flipper insertions on each side and met behind the blowhole. The posterior chevrons extended from the ends of the anterior chevrons, following a similar ventral-to-dorsal sweep but did not meet on the dorsal surface. There was a difference in brightness between the two chevrons, with the anterior chevron appearing brighter than the posterior one.

The body coloration of the flippers was light gray at the base and darkened toward the tip, though it remained lighter than the dorsal body coloration (Fig. 5). The coloration of the eyelids on both sides was the lightest of all observed body parts (Fig. 4). Dozens of pale gray oval scars, likely caused by cookie-cutter sharks (*Isistius* sp.), were observed on the dorsal surface (Fig. 4). No fresh scars were detected.

Behavioral observations

The whale's blow was small in width, low in height, and weak, making it difficult to detect from a distance. When surfacing, the tips of both jaws emerged first, followed by the blowhole and dorsal fin. Upon submerging, the whale did not arch its back or expose its flukes above the water.

The whale (#002) was observed from the air by a small UAV for 9 minutes and 49 s. During this time, six consecutive breaths followed by a single dive and resurfacing to breathe were recorded, providing insight into its respiratory rhythm. Surface time was defined as the period from when the whale surfaced to breathe until its exposed body parts disappeared below the surface. The interval between consecutive breaths was the time between the disappearance of the body below the surface and its reappearance. Dive time referred to the duration between consecutive breaths when the whale dived to a given depth, disappeared below the surface, and resurfaced. The whale spent 3–4 s at the surface. The shortest interval between six consecutive breaths was 22 s, while the longest was 53 seconds, with an average of 36 s. The dive time was recorded as 3 min and 5 s.

The whales normally swam calmly and slowly. When the vessels first approached, the whales were observed rolling and milling near the surface. However, as the vessels came within 30 m, the whales changed their swimming direction, seemingly attempting to move away. They also increased their swimming speed and began leaping out of the water. Once the vessels moved away, the whales resumed swimming at their natural speed and appeared to calm down. Initially, the whales swam slowly at approximately 4–5 knots, but as the ships approached, their speed increased to 7–8 knots. According to UAV video measurements, #002 moved 128.9 m in 53 s, maintaining a speed of 4.7 knots.

Based on external morphological characteristics, particularly the distinctive arched jawline, and behavioral observations, the whales sighted by *YS2* and *YS3* were identified as pygmy right whales. Additionally, a comparison of photographs of each individual revealed distinct bite marks from cookie-cutter sharks, confirming that the two whales were different individuals.

Discussion

Pygmy right whales are often confused at sea with Antarctic minke whales (*Balaenoptera bonaerensis*) due to their similar body shape (Ivashin *et al.*, 1972; Ross *et al.*, 1975; Jefferson *et al.*, 2015). The two pygmy right whales sighted in this study were identified by their arched jawline, relatively narrow rostrum, dorsal fin position, and small body size. As their name suggests, pygmy right whales exhibit a distinct dorsally arched jawline when viewed laterally, similar to right whales (*Eubalaena* sp.), whereas the jawline of Antarctic minke whales is relatively flat (Jefferson *et al.*, 2015). In dorsal view, the upper jawline of pygmy right whales curves medially and narrows, while that of Antarctic minke whales curves laterally (Jefferson *et al.*, 2015). The position of the dorsal fin also distinguishes the two species. In pygmy right whales, the dorsal fin is located two-thirds of the way back from the tip of the snout, whereas in Antarctic minke whales, it is positioned three-quarters of the way back (Matsuoka *et al.*, 1996, 2005; Kemper *et al.*, 1997; Kato and Fujise, 2000; Gill *et al.*, 2008). Another distinguishing characteristic is body length. Pygmy right whales reach a maximum length of 6.5 m (Kemper and Leppard, 1999; Gill *et al.*, 2008; Jefferson *et al.*, 2015), while Antarctic minke whales have a mean body length of 8.5–9.0 m (Jefferson *et al.*, 2015). However, identifying species based on body size alone may lead to confusion, particularly with smaller Antarctic minke whales. Therefore, it is recommended that arched jawline and other external morphological features be used to identify pygmy right whales, rather than body size alone.

The body colors of the two pygmy light whales observed in this study were consistent with those reported in previous studies (Ross *et al.*, 1975; Matsuoka *et al.*, 1996, 2005; Gill *et al.*, 2008; Jefferson *et al.*, 2015). However, there were some inconsistencies among previous studies regarding chevrons. Matsuoka *et al.* (1996), one of the authors of this study, reported double chevrons in his sightings of this species, as observed in this study. He described the first chevron as sweeping dorsally from the anterior surface of the flipper, with the second chevron positioned posterior to the first. However, other authors (Gill *et al.*, 2008; Jefferson *et al.*, 2015) contended that most whales have only a single chevron, located on the anterior part of the dorsum, with only a few whales showing a posterior chevron. The two whales sighted in this study both had double chevrons. These two chevrons differed in the amount of surface area they occupied (Fig. 5). The anterior chevrons swept up from the flipper insertions to the area behind the blowhole and were visible from both the lateral and dorsal views. The posterior chevrons, however, extended only about two-thirds of the way along the lateral body surface, making them impossible to observe from the dorsal view. The two chevrons also differed in brightness, with the anterior chevrons being brighter than the posterior chevrons depending on the viewing angle, the posterior chevrons may not be visible at all.

External measurements of pygmy right whales have been reported for stranded and captured individuals (reviewed in Ross *et al.*, 1975; Munday *et al.*, 1985). A total of 10 individuals have been recorded, with body length distributions as follows: 2.0 m range-1 individual, 3.0 m range-4 individuals, 5.0 m range-1 individual, 6.0 m range-4 individuals, with no reports in the 4.0 m range. Table 3 presents the external measurements reported in this study and previous studies. We compared the relative ratios of body parts in whales with similar body lengths (5.5 m) to the 5.6-m whale in this study. The length from the tip of the snout to the center of the eye (*TCE*) was 18.9% of body length in this study and 21.0% in the previous study (Ivashin *et al.*, 1972; reviewed in Ross *et al.*, 1975). The length from the tip of the snout to the blowhole (*TCB*) was 11.0% in this study and 14.4% in the previous study. The length from the tip of the snout to the anterior insertion of the flipper (*TAF*), which indicates flipper position, was 32.7% for the 5.6 m whale in this study and 33.1% for the 5.5 m whale in the previous study. The length to anterior insertion of dorsal fin (*TAD*) was 64.6% and 66.7%, respectively. The *TSF* in this study was 29.2% of body length, compared to 31.4% in the previous study. As a result, a comparison of proportions from two external measurement methods on two individuals of similar body length showed no significant differences between the two methods, suggesting that

Table 3. External measurements of the pygmy right whales recorded in this study and reported in previous studies (Modified from Ross *et al.*, 1975; Munday *et al.*, 1982). Measurements, except for body length, show the relative proportions of each body part to total body length.

Source	Measurement points (%)						
	BL (m)	*TCE*	*TCB*	*TAF*	*TAD*	*TSF*	*DF*
Present paper	5.6	18.9	11.0	32.7	64.6	29.2	8.4
Hale (1931)	2.8	—	—	—	—	19.7	—
Hale (1931)	3.3	21.5	—	—	66.9	—	—
Davies and Guiler (1957)	6.4	—	—	—	—	28.3	—
Guiler (1961)	6.4	15.1	11.9	—	—	—	—
Hale (1964)	3.1	22.5	—	35.1	73.1	20.0	—
Ivashin *et al.* (1972)	5.5	21.0	14.4	33.1	66.7	31.4	—
Ivashin *et al.* (1972)	6.2	21.4	13.9	31.9	67.0	—	—
Ross *et al.* (1975)	3.0	23.0	14.5	34.1	67.0	—	—
Ross *et al.* (1975)	3.4	—	—	—	—	—	—
Munday *et al.* (1982)	6.5	19.8	14.0	29.3	71.5	31.0	7.4

photogrammetry is as effective as manual measurement. In this study, we successfully obtained external measurement data for this species using photogrammetry, a non-lethal survey method employing a small UAV. This marks the first photogrammetric measurement of this species and the first attempt on a live whale sighted at sea. For future surveys of rare species such as this, photogrammetry using small UAVs will enable multiple external measurements to be obtained non-lethally, contributing to the accumulation of scarce biological data on this species.

Aerial observations using a small UAV have provided insights into the respiratory rhythms of this species. According to Ivashin *et al.* (1972), pygmy right whales typically spend 4–5 s at the surface for respiration (surface time). The interval between consecutive breaths has been reported to average 49 s, or even longer at 60 seconds (Ross *et al.*, 1975). Dive times of 3–4 min have also been documented by several authors (Ivashin *et al.*, 1972; Ross *et al.*, 1975; Matsuoka *et al.*, 1996, 2005; Jefferson *et al.*, 2015). In contrast, the whale (#002) observed in this study spent 3–4 s at the surface, a duration slightly shorter than previously reported. The Interval between consecutive breaths were also short, averaging 36 seconds. The duration of an observed dive (dive time) was 3 minutes and 5 seconds, consistent with the results of the previous study. The variation in these times compared to previous studies may be due to differences in the swimming conditions of the whales at the time of observation. The respiratory rhythm of Antarctic minke whales observed during this cruise ranged from 2 to 5 s for surface time, with intervals between consecutive breaths varying from 11 to 50 s, depending on swimming conditions. When swimming speed increased due to vessel approach, surface time ranged from 2 to 3 s, and intervals between consecutive breaths shortened to 11–22 seconds. Conversely, under stable and normal swimming conditions, the respiratory rhythm ranged from 3 to 5 seconds for surface time and 40–50 s for breath intervals. Previous studies (Ross *et al.*, 1975; Matsuoka *et al.*, 2005) have observed respiratory rhythms in pygmy right whales when their swimming speed was between 3 and 4 knots. This species is known to reach speeds of 6–8 knots or more when swimming fast (Jefferson *et al.*, 2015), suggesting that earlier observations were made under relatively calm conditions. In this study, respiratory rhythm was recorded when the whale's swimming speed increased due to vessel proximity and later returned to normal. Therefore, the respiratory rhythm reported here may reflect a fast-swimming condition for this species.

Sightings and strandings of pygmy right whales reported in previous studies have been concentrated between 30°S and 55°S (Kemper *et al.*, 2013; Jefferson *et al.*, 2015), and the sightings of the two whales in this study also fall within this range. This suggests that the primary distribution of the spe-

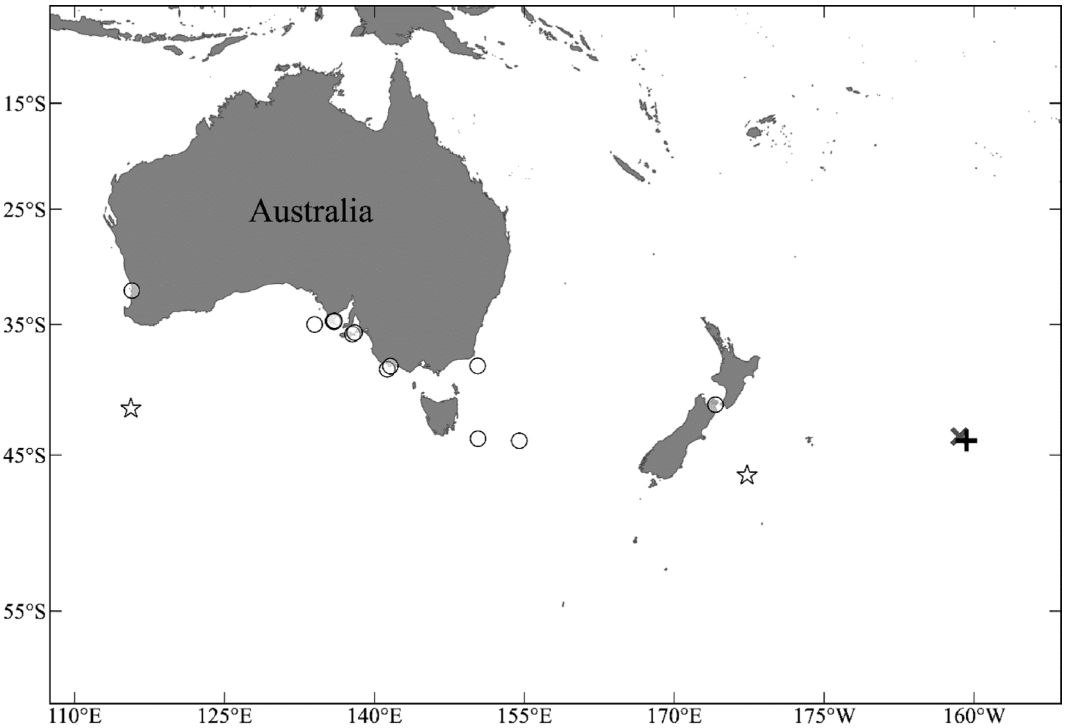

Fig. 6. Sighting locations of the pygmy right whales recorded in this study an reported in previous studies (Modified from Matsuoka *et al.*, 1996, 2005; Gill *et al.*, 2008; Kemper *et al.*, 2013). Black and gray crosses: sightings in this study. Stars: sightings reported by Matsuoka *et al.* (1996, 2005). Open circles: other sightings in previous studies. The sightings in this study represent the second and third records in the Southwestern Pacific and the most pelagic to date.

cies remains consistent. Previously reported sightings of this species have occurred in coastal areas of Australia, New Zealand, and South Africa (reviewed in Ross *et al.*, 1975; Gill *et al.*, 2008; reviewed in Kemper *et al.*, 2013). However, the two whales in this study were sighted in pelagic waters approximately 1,120 n.miles from Christchurch, New Zealand (Fig. 6). These sightings represent the second and third records of this species in the Southwestern Pacific and the most pelagic to date (Matsuoka *et al.*, 2005).

The Japanese government has conducted sighting surveys in the southern hemisphere for about 30 years, from 1987/1988 to the present. During this period, a total of 62,291.9 nautical miles were surveyed between 30°S and 55°S. In addition to pygmy right whales, other baleen whale species recorded include blue whales (*B. musculus*), fin whales (*B. physalus*), humpback whales (*Megaptera novaeangliae*), and Antarctic minke whales (*B. bonaerensis*). The number of sightings and the Density Index (DI) (schools of primary sightings/100 n.miles searched) of each whale species in this area during the study period are shown in Table 4. The fin whale had the highest number of sightings (92), followed by Antarctic minke whales (71), humpback whales (48), and blue whales (17). Only four sightings of pygmy right whales have been recorded, including two in this study and two reported by Matsuoka *et al.* (1996, 2005). Assuming that the detectability is similar between these species, the DI of pygmy right whales was 0.006, which is 25 times lower than that of fin whales (0.148), the most abundant species (Table 4). It was also about one-fifth of the DI of blue whales (0.027), a species with relatively few sightings. The relatively low number of sightings in this area, despite it being within the species' main distribution range, may be due to low abundance or the possibility that high-density areas have not yet been discovered. However, due to the lack of information on this species, no abundance estimates have been conducted (Jefferson *et al.*, 2015).

This species, with such a low DI, was sighted during this cruise in two groups of one individual each on the same day, in close proximity to each other (Fig. 2). A key environmental factor in the area

Table 4. Summary of sighting surveys conducted by the Government of Japan over 30 years (1987/1988–present) between 30°S and 55°S. The Density Index indicates the number of primary schools sighted/100 n.miles searched.

Survey period	Survey area	Searching Effort in n. miles	Species	Number of sightings	Density Index
1987/88–2022/23	30°S–55°S	62,291.9	Blue whale	17	0.027
			Fin whale	92	0.148
			Humpback whale	48	0.077
			Antarctic minke whale	71	0.114
			Pygmy right whale	4	0.006

where these sightings occurred is the Subtropical Convergence Zone (Deacon, 1937; Longhurst, 2006; Garcia-Rojas *et al.*, 2018). The Subtropical Convergence Zone, marking the northern boundary of the Southern Ocean, is where subantarctic and subtropical waters—with significant differences in nutrient concentrations—meet, creating a highly productive marine ecosystem (Deacon, 1937; Longhurst, 2006; Garcia-Rojas *et al.*, 2018). SSTs in this convergence zone are typically 9–13°C during the austral summer (Deacon, 1937; Kawamura, 1974). Copepod patches, which serve as prey for many baleen whales, often occur where SSTs range from 13 to 14°C (Kawamura, 1974). Copepods are a primary dietary component of pygmy right whales, along with sei whales (*B. borealis*) and southern right whales (*E. australis*) (Ivashin *et al.*, 1972; Kawamura, 1974; Sekiguchi *et al.*, 1992; Kato *et al.*, 1996; Kemper, 2002). Historically, the whaling grounds of sei whales have been closely associated with the Subtropical Convergence Zone due to the abundance of copepods (Kawamura, 1974). The two pygmy right whale sightings recorded by Matsuoka *et al.* (1996, 2005) also occurred within the Subtropical Convergence Zone. Matsuoka *et al.* (2005) reported that copepod patches were observed near the whales at the time of the sighting. While direct feeding behavior was not observed, numerous defecations were recorded. Based on this evidence, Matsuoka *et al.* (2005) suggested that pygmy right whales may concentrate in the Subtropical Convergence Zone to feed during the austral summer.

The SSTs recorded at the sighting locations in this study were 16.4°C and 17.7°C, respectively, which are higher than the mean SSTs in the Subtropical Convergence Zone during the austral summer. Additionally, we did not observe patches of copepods, the primary prey species of pygmy right whales, near the sighting locations, nor did we observe direct feeding or defecation behaviors, as reported in previous studies (Matsuoka *et al.*, 2005). Based on these SSTs and the absence of feeding-related observations, these sightings were likely outside the Subtropical Convergence Zone. However, a large number of seabirds were observed flying around the first sighting location (#001, Fig. 3). Additionally, some copepod patches have historically formed outside the northern boundary of the Subtropical Convergence Zone (Kawamura, 1974), and that area coincides with the sighting locations of this study. This suggests that prey species may be present in this area, albeit on a smaller scale.

Although we were unable to observe behaviors directly related to the life history of this species (e.g., feeding, reproduction) in this area, the fact that two sightings of this elusive species occurred on the same day in the same area by two vessels suggests that this region may play a role in the species' life history. Given the environmental and biological factors reported in previous studies (Deacon, 1937; Kawamura, 1974; Longhurst, 2006; Kemper, 2002; Matsuoka *et al.*, 2005; Gill *et al.*, 2008; Garcia-Rojas *et al.*, 2018), this area may be related to the feeding grounds of this species.

We report two new sightings of this poorly understood species, representing the most pelagic records to date and the first photogrammetric measurements of this species at sea using a small UAV. Further regular sighting surveys in this area, combined with experiments using various non-lethal methods, will contribute to the accumulation of knowledge on the life history and biology of this species.

Acknowledgements

We thank Captains Hidenori Kasai, Nobuo Abe and their officers and crew for their hard work and dedication that led to the successful sightings reported in this paper. We express our deep gratitude to Dr. Yoshihiro Fujise and the staff of the Institute of Cetacean Research and Kyodo Senpaku Co. Ltd. for their assistance in arrangements and support for the cruise. Finally, we thank Dr. Hidehiro Kato (Professor Emeritus of Tokyo University of Marine Science and Technology) for his assistance in preparing this paper. We appreciate the useful comments and suggestions of the anonymous reviewers and the careful handling of the manuscript by the editors, which helped us to improve this manuscript.

References

Amano, M. and Miyazaki, N. 1993. External morphology of Dall's porpoise (*Phocoenoides dalli*): Growth and sexual dimorphism. *Can. J. Zool.* 71(6): 1124–1130. doi: 10.1139/z93-153.

Bisconti, M. 2012. Comparative osteology and phylogenetic relationships of *Miocaperea pulchra*, the first fossil pygmy right whale genus and species (Cetacea, Mysticeti, Neobalaenidae). *Zool. J. Linn. Soc.* 166(4): 876–911. doi: 10.1111/j.1096-3642.2012.00862.x.

Cabrera, E., Carlson, C., Vernazzani, B. G., Cardenas, J. C. and Brownell Jr., R. L. 2005. A pygmy right whale (*Caperea marginata*) from Chiloé Island, Chile. Paper SC/57/O20 presented to the IWC Scientific Committee, 2005 (unpublished). 5 pp. [Paper available from the Office of the IWC].

Dawson, S. M., Bowman, M. H., Leunissen, E. and Sirguey, P. 2017. Inexpensive aerial photogrammetry for studies of whales and large marine animals. *Front. Mar. Sci.* 4(366). doi: 10.3389/fmars.2017.00366.

Deacon, G. E. R. 1937. The Hydrology of the Southern Ocean. *Discovery Rep.* 15: 1–124.

Fordyce, R. E. and Marx, F. G. 2013. The pygmy right whale *Caperea marginata*: The last of the cetotheres. *Proc. R. Soc. B.* 280(1753): 20122645. doi: 10.1098/rspb.2012.2645.

Garcia-Rojas, M. I., Jenner, K. C. S., Gill, P. C., Jenner, M. N. M., Sutton, A. L. and McCauley, R. D. 2018. Environmental evidence for a pygmy blue whale aggregation area in the Subtropical Convergence Zone south of Australia. *Mar. Mamm. Sci.* 34(4): 901–923. doi: 10.1111/mms.12494.

Gill, P. C., Kemper, C. M., Talbot, M. and Lyons, S. A. 2008. Large group of pygmy right whales seen in a shelf upwelling region off Victoria, Australia. *Mar. Mamm. Sci.* 24(4): 962–968. doi: 10.1111/j.1748-7692.2008.00220.x.

Government of Japan. 2019a. Outline of a research program to investigate the abundance, abundance trends and stock-structure of large whales in the Indo-Pacific region of the Antarctic, including a survey plan for the 2019/20 austral summer season. Paper SC/68a/ASI8 presented to the IWC Scientific Committee, May 2019 (unpublished). 16 pp. [Paper available from the Office of the IWC].

Government of Japan. 2019b. Outline of a research program to investigate the abundance, abundance trends and stock-structure of large whales in the Indo-Pacific region of the Antarctic, including a survey plan for the 2019/20 austral summer season. Paper WG-EMM-2019/68 presented to CCAMLR meeting of Working Group on Ecosystem Monitoring and Management, June–July 2019 (unpublished). 16 pp.

Government of Japan. 2019c. Outline of a research program to investigate the abundance, abundance trends and stock-structure of large whales in the Indo-Pacific region of the Antarctic, including a survey plan for the 2019/20 austral summer season. Paper SC/26/NPR-JP presented to the 26th meeting of the NAMMCO Scientific Committee, October–November 2019 (unpublished). 16 pp.

International Whaling Commission. 2008. IWC SOWER Cruise 2008/09, Information for Researchers. https://iwc.int/private/downloads/-m4RVc06JhBVw3ymd3oPcw/Guide%20%20for%20Researchers%202008-09.pdf.

International Whaling Commission. 2012. Requirements and Guidelines for Conducting Surveys and Analyzing Data within the Revised Management Scheme. *J. Cetacean Res. Manage.* (Suppl.) 13: 509–517.

Isoda, T., Katsumata, T. Kim, Y. and Matsuoka, K. 2023. Results of the Japanese Abundance and Stock structure Survey in the Antarctic (JASS-A) during the 2022/2023 austral summer season. Paper SC/69A/ASI/13 presented to the IWC Scientific Committee, April–May 2023 (unpublished). 31 pp. [Paper available from the Office of the IWC].

Ivashin, M. V., Shevchenko, V. I. and Yuchov, V. L. 1972. The pygmy right whale *Caperea marginata* (Cetacea). *Zool. Zhurnal.* 51: 1715–1723.

Jefferson, T. A., Webber, M. A. and Pitman, R. L. 2015. Marine Mammals of the World: A Comprehensive Guide to Their Identification. Second Edition. Academic press, London. 608 pp.

Kato, H., Bannister, J., Burton, C., Ljungblad, D., Matsuoka, K. and Shimada, H. 1996. Report on the Japan/IWC blue whale cruise 1995–96 off the southern coast of Australia. Paper SC/48/SH9 submitted to the Scientific Committee of the International Whaling Commission (unpublished). 35 pp. [Paper available from the Office of the IWC].

Kato, H. and Fujise, Y. 2000. Dwarf minke whales; morphology, growth, and life history with some analyses on morphometric variation among the different forms and regions. Paper SC/52/OS3 presented to the Scientific Committee of the International Whaling Commission (unpublished). 35 pp. [Paper available from the Office of the IWC].

Kawamura, A. 1974. Food and feeding ecology in the southern sei whale. *Sci. Rep. Whales Res. Inst.* 26: 25–144.

Kemper, C. M. 2002. Distribution of the pygmy right whale, *Caperea marginata*, in the Australasian region. *Mar. Mamm. Sci.* 18(1): 99–111. doi: 10.1111/j.1748-7692.2002.tb01021.x.

Kemper, C. M., Dutton, J., Forster, B. and Mcguire, R. 1997. Sightings and strandings of the pygmy right whale *Caperea* *marginata* near Port Lincoln, South Australia and a review of other Australasian sightings. *Trans. R. Soc. S. Aust.* 121: 79–82.

Kemper, C. M. and Leppard, P. 1999. Estimating body length of pygmy right whales (*Caperea marginata*) from measurements of the skeleton and baleen. *Mar. Mamm. Sci.* 15(3): 683–700. doi: 10.1111/j.1748-7692.1999.tb00836.x.

Kemper, C. M., Middleton, J. F. and van Ruth, P. D. 2013. Association between pygmy right whales (*Caperea marginata*) and areas of high marine productivity off Australia and New Zealand. *N. Z. J. Zool.* 40(2): 102–128. doi: 10.1080/03014223.2012.707662.

Kim, Y., Nishimura, F., Bando, T., Fujise, Y., Nakamura, G., Murase, H. and Kato, H. 2021. Fetal development in tail flukes of the Antarctic minke whale. *Cetacean Popul. Stud.* 3: 231-238. doi: 10.34331/cpops.2020S001.

Longhurst, A. R. 2006. The Southern Ocean. pp. 443–475. *In*: Longhurst, A. R. (eds.). *Ecological geography of the sea* (Second Edition). Academic press, London. 556 pp.

Mackintosh, N. A. and Wheeler, J. F. G. 1929. Southern blue and fin whales. *Discovery Rep.* 1: 257–540.

Matsuoka, K., Fujise, Y. and Pastene, L. A. 1996. A sighting of a large school of the pygmy right whale, *Caperea marginata*, in the southeast Indian Ocean. *Mar. Mamm. Sci.* 12(4): 594–597. doi: 10.1111/j.1748-7692.1996.tb00072.x.

Matsuoka, K., Ensor, P., Hakamada, T., Shimada, H., Nishiwaki, S., Kasamatsu, F. and Kato, H. 2003. Overview of minke whale sightings surveys conducted on IWC/IDCR and SOWER Antarctic cruises from 1978/79 to 2000/01. *J. Cetacean Res. Manage.* 5(2): 173–201. doi: 10.47536/jcrm.v5i2.817.

Matsuoka, K., Pitman, R. L. and Marquez, F. F. C. 2005. A note on a pygmy right whale (*Caperea marginata*) in the southwestern Pacific Ocean. *J. Cetacean Res. Manage.* 7(1): 71–73. doi: 10.47536/jcrm.v7i1.760.

Munday, B. L., Green, R. H. and Obendorf, D. L. 1982. A pygmy right whale *Caperea marginata* (Grey, 1846) stranded at Stanley, Tasmania. *Pap. Proc. R. Soc. Tasman.* 116: 1–4. doi: 10.26749/rstpp.116.1.

Ross, G. J. B., Best, P. B. B. and Donnelly, B. G. 1975. New records of the pygmy right whale (*Caperea marginata*) from South Africa, with comments on distribution, migration, appearance and behavior. *J. Fish. Res. Board Can.* 32(7): 1005–1017. doi: 10.1139/f75-120.

Sekiguchi, K., Best, P. B. and Kazcmaruk, B. Z. 1992. New information on the feeding habits and baleen morphology of the pygmy right whale *Caperea marginata*. *Mar. Mamm. Sci.* 8(3): 288–293. doi: 10.1111/j.1748-7692.1992.tb00411.x.

Torres, W. and Bierlich, K. 2020. MorphoMetriX: A photogrammetric measurement GUI for morphometric analysis of megafauna. *J. Open Source Softw.* 5(45): 1825. doi: 10.21105/joss.01825.

Tsai, C. H. and Fordyce, R. E. 2014. Juvenile morphology in baleen whale phylogeny. *Sci. Nat.* 101(9): 765–769. doi: 10.1007/s00114-014-1216-9.

Wolf, M., Zapf, K., Gupta, D. K., Hiller, M., Árnason, Ú. and Janke, A. 2023. The genome of the pygmy right whale illuminates the evolution of rorquals. *BMC. Biol.* 21(79). doi: 10.1186/s12915-023-01579-1.

Received: December 14, 2023
Accepted: March 19, 2025
Published online: June 17, 2025