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Re-identification of the Bryde's whale (*Balaenoptera edeni*) and the Gervais' beaked whale (*Mesoplodon europaeus*) on the Mediterranean coast of Egypt "Updating, Strandings in opposite to climatic and anthropogenic impacts

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ABSTRACT

This study updates the fin whale (*Balaenoptera physalus*) stranded on the Egyptian coast of the Mediterranean Sea during 2021, emphasizing the reidentification of the previously reported fin whale (*B. physalus*) vs. the misidentified Bryde's whale ***(B. edeni)*** and Cuvier's beaked whale (*Ziphius cavirostris*) vs. Gervais' beaked whale (*Mesoplodon europaeus*) during 2018, considering the remarkable features for the correct identification and actual conservation. Data on the newly stranded fin whale were reported from Ghalion zone, Metobus, Kafr El-Sheikh province in February 2021, and data for the reidentification were taken from documents during 2019 and 2020 adding new photographs for description again and confirm the reidentified whales.The present stranded specimen was confirmed as the fin whale using unique features such as a single longitudinal ridge on the head above, front third of the right baleen is white, and a short dorsal fin that is not curved sufficiently. Secondly, for whale reidentified again vs. Bryde's whale, the confirmation, a comparison with other similar whales using photographs and features have confirmed that the reidentified species is the fin whale *B. physalus*.The genetic analysis for Bryde's whale had missed some scientific key two major aspects, that were providing clear GenBank identifres and relying on a single genetic marker of a mitochondrial nature for species identification. Moreover, the provided record based on an unclear photograph, which caused some confusion. Hence, the detailed description using photographs have considered it as fin whale not the Bryde's whale. Gervais' beaked whale has been reidentified also as the Cuvier's beaked whale using clearer photographs based on the position of teeth on the lower lips, length of the upper jaw relative to the lower jaw, and faint strips on the body. This study recommends paying more attention to marine mammals in Egypt and their identification using both morphological and genetic features, in addition to osteological features. For conservation and management, the climatic and anthropogenic activities should be considered through the current and future.

INTRODUCTION

Climate changes have increased globally and have become obvious in all countries; such changes may directly or indirectly affect on the biodiversity in increasing or

decreasing the population of flourishing animals or even those being sighted occasionally, also affect on the migration and transfer of species from one place to another, and large animals such as mammals may experience stranding together due to shipping and anthropogenic activities **(Farrag *et al*., 2019).** The Mediterranean Sea is an aquatic basin undergoing several alterations due to high levels of anthropogenic pressure and synergistic interactions with the effects of climate changes on marine biodiversity **(Lejeusne *et al*., 2010; Micheli *et al*., 2013; Farrag *et al*., 2019).**

Marine mammals comprise an important topic among vulnerable species. Several cases of stranding were observed particularly in the eastern part of the Mediterranean Sea, especially during the past few decades, possibly due to the occurrence of climate changes combined with increasing anthropogenic activities. However, only a few marine mammalian species, particularly cetaceans such as the fin whale and sperm whale, were found over a wide range across the Mediterranean Sea **(Frantzis *et al*., 2011; Panigada *et al*., 2017; Farrag *et al* 2019)**, and combined with their vulnerability of the anthropogenic pressures **(David *et al*., 2011; Castellote *et al*., 2012; Caadas and Vzquez 2014).** Modern studies on cetaceans in the Mediterranean basin began in the late 1980s **(Notarbartolo di Sciara and Bearzi, 2005**). Approximately 18 cetacean species were recorded in the Mediterranean Sea by **William (1998)** and were included in the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea, and Contiguous Atlantic Area (ACCOBAMS). The International Union for Conservation of Nature (IUCN) in collaboration with ACCOBAMS has listed 21 species and three subspecies of cetaceans in the Mediterranean Sea and Black Sea **(IUCN, 2012)**. This list was first prepared by experts in Monaco in March 2006 and updated in 2010 as the Mediterranean Red List assessment of resident cetacean species.

Egypt is a country along the eastern part of the Mediterranean Sea, the gap in studies on marine mammals, with only limited updated and documented knowledge has been detected. In the past few decades, several marine mammalian species, mostly belonging to Odontocete such as bottlenose and striped dolphins and few species belonging to Mysticeti such as fin whale, had visited the Egyptian coast of the Mediterranean Sea, and a large proportion of them ended up being stranded **(Farrag *et al*., 2019)**. The later authors reported six marine mammalian species namely; fin whale (*Balaenoptera physalus* Linnaeus, 1758), sperm whale (*Physeter microcephalus*), Gervais' beaked whale (*Mesoplodon europaeus* Gervais, 1855), bottlenose dolphin (*Tursiops truncatus*), rough-toothed dolphin (*Steno bredanensis*), and even a California sea lion (*Zalophus californianus* Lesson, 1828), an exotic species likely escaped from a ship during exportation and transportation. Among the popular species are the common bottlenose dolphin and the fin whale, which were sighted frequently along the Egyptian coast of the Mediterranean Sea during the past 10 years (**Farrag *et al*., 2019**). Marine mammals in Egypt have received insufficient attention because the Egyptian coast of the Mediterranean Sea was not considered as an area for whales in the past probably due to the presence of a shallow delta and poor fisheries stocks for feeding. Hence, scientists and

managers have been encouraged to report the presence of marine mammals in this region. A recent study had identified a Bryde's whale (*Balaenpptera edeni* Anderson, 1879) from the Egyptian coast of the Mediterranean Sea **(Abo- Taleb *et al.*, 2020**). However, the same specimen was reported previously as a fin whale, creating a confusion in differentiating the two species. Subsequently, some fin whales were recently stranded in 2021 as a result of the continuous impact of anthropogenic activities and climate changes. These data encouraged us to update and report the undocumented fin whale stranding cases that occurred and emphasize the possibility of reidentifying previously misidentified Bryde's whale vs fin whale and Cuvier's beaked whale (*Ziphius cavirostris*) vs misidentified Gervais' beaked whale (*M. europaeus*) during 2018, considering the remarkable features for the correct identification and actual conservation along the Egyptian Mediterranean coast in association with anthropogenic and climate changes.

MATERIALS AND METHODS

The stranded fine whale (*B. physalus*) was reported along the Egyptian coast of the Mediterranean Sea. Fig. 1 shows a map of the historical changes and the location of its recent sighting/stranding as well as the cases previously reported by **Farrag *et al.* (2019)**.

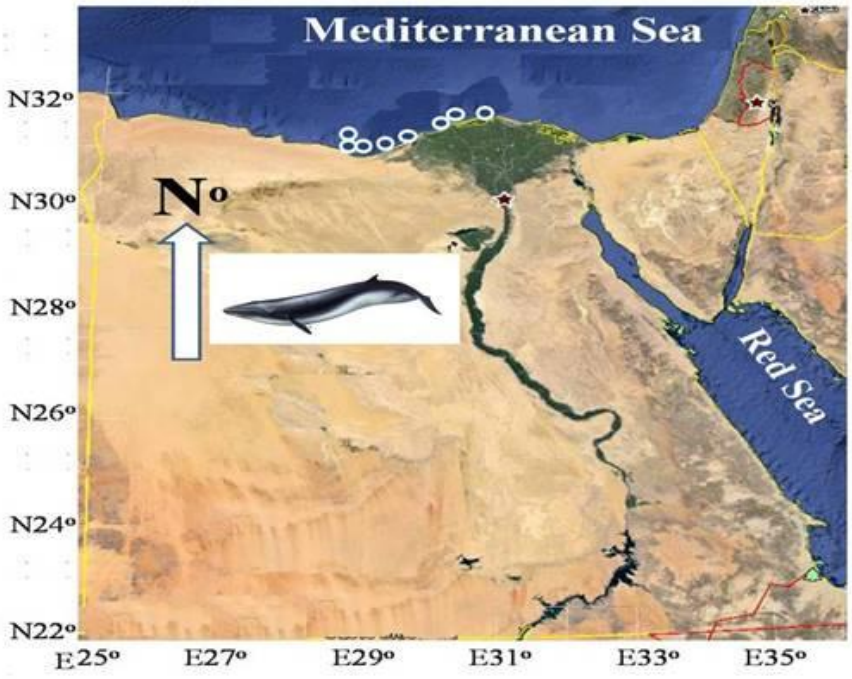

Figure 1. Locations of stranded fin whale *B. physalus* along the Mediterranean Coast, Egypt.

Data regarding the recent stranding cases of the fin whale were collected from the beach at 30° 25′ 585″ N, 31° 905′ 27″ E in the Ghalion zone, Metobas, Kafr El-Sheikh province, in February 2021. The species was described and identified using identification keys (**Mizroch *et al.*, 1984; Jefferson *et al.*, 1993; Shirihai and Jarrett, 2006; IUCN, 2012; Farrag *et al.*, 2019).** Measurements such as the total length, caudal fin length, and jaw length were measured.

We also attempted to the recorrective probability of identifying previously misidentified Bryde's whale during 2018 by **Abo-Taleb *et al.* (2020)**, which will be considered again for reidentification in this study through description and examination of the photographs of the same stranded whale taken by **Farrag *et al*. (2019)**; moreover, additional photographs will be added in the present study to confirm and provide the detailed features. Reidentification was done using the abovementioned identification keys for the fin whale and also by comparison with studies of other authors (**Mizroch *et al*., 1984; Wada *et al*., 2003; Jefferson *et al*., 2008; Cerchio *et al*., 2015; Ranjbar *et al*., 2016; de Vos, 2017)** who reported different baleen whales during comparison between the fin whale and Bryde's whale. In addition, the reidentification was applied on the Cuvier's beaked whale (*Z. cavirostris*) vs misidentified Gervais' beaked whale (*M. europaeus*) during 2018 using more clear photographs and compariscon with other studies.

RESULTS

1. Strandings and observations of fin whale.

2. The fin whale *B. physalus* (Linnaeus, 1758) was found stranded on the Egyptian coast of the Mediterranean Sea for the first time in 1936 (Table 1). This document has update and report the recent stranded fin whale that observed on February 17, 2021, in the Ghalion zone, Kafr El-Sheikh province, Mediterranean coast, Egypt as an extension of the continuous stranding. The whale was a female measuring 12.6 m in total length and had an estimated weight of 9 tonnes; its description is presented in **Fig. (2)**. It was cylindrical in shape, smooth, and colored dark above and sides but slightly creamy-to-white ventrally, with no white patches, and had a V-shaped head (**Fig. 2.1)**. The body was wide and flattened. The jaws colouration was asymmetric; the left lower jaw was dark gray, while it has a white mandible patch on the right side. A white blaze, a dark eye stripe, a white inter-stripe wash, and white chevron on the back were slightly detected in faint appearence **(Fig. 2.1).** The rostrum of the head or above head had one longitudinal ridge extending from the blowholes to the tip of head; it had two rows of baleen plates, with twin blowholes with a low splashguard to the front. On each side, the plates were dark, often striated with bands of gray, and fringed with slightly yellowish-white horizontal lines **(Fig. 2.1).** The baleen plates had an asymmetrical coloration where the front third on the right side was clear white, while all the remaining plates on the back were black, whereas on the left side, all plates were dark gray or black**.** The pectoral fin was slightly large with white anterior margins and inner surface **(Fig. 2.2)**. The dorsal fin was short and located in the last and third part of the body; it was not pointed and curved **(Fig. 2.3).** Flukes were wider with a slightly deep-notched median and a thick tall stock; tail flukes were white below with dark margins **(Fig. 2.4)**. The remaining features are presented in **Table 2**. The available morphometric measurements were as follows: total length TL 12.6 m, upper jaw length 2.10 m, lower jaw length 2.30 m, pectoral fin length 1.5 m, pectoral fin width 35 cm, genital opening length 68 cm, anal opening length 12 cm, blowhole opening length 35 cm, and eye width 12 cm.

Table 1. Sighting \ stranding locations with dates of fin whale *B. physalus* along the Egyptian coast, Mediterranean Sea.

Species	location	Area	Date	status	Author
Fin Whale *Balaenoptera physalus*	31° 481′ 187″ N 30° 379 ′ 576″ E	Rosetta (Rashid), Mediterranean Sea, Egypt	1936	Beached & stranded	Farrag *et al.* (2019)
	31° 578 ′ 653″ N 30° 949 ′ 858″ E	Baltim, Medit. Sea, Egypt	2008, 2014	Beached & stranded	Farrag *et al.* (2019)
	30° 842 ′ 515″ N 29° 228 ′ 279″ E	Al-Alamain, Medit. Sea, Egypt	2014, 2015	Beached & stranded	Farrag *et al.* (2019)
	31° 289 47″ N, 30° 021 909″ E	Marina, Medit., Sea, Egypt	June, 2016	Live	Farrag *et al.* (2019)
	31° 234 ′ 522″ N 29° 949 ′ 516″ E	Azur beach, Alexandria, Medit., Sea, Egypt	Jan., 2018	Beached & stranded	Farrag *et al.* (2019)
	31° 234 ′ 522″ N 29° 949 ′ 516″ E	Azur beach, Alexandria, Medit., Sea, Egypt	Jan., 2018	Beached & stranded	Abo-Taleb *et al*. (2020) (Identified as bryde whale)
	31° 234 ′ 522″ N 29° 949 ′ 516″ E	Azur beach, Alexandria, Medit., Sea, Egypt	Jan., 2018	Beached & stranded	Present study (Reidentified again as fin whale not bryde whale)
	30° 25 ′ 5**85**″ N **31**° 9**05** ′ **27**″ E	Ghalion zone, Metobus, Kafr El-Sheik	Feb. 2021	Beached & stranded	Present study

Figure 2.1. Head:v-shaped of fin whale *B. physalus* shows the single longitudinal ridge on the above with clear white front third of right baleen and right white lower jaw; while the left side showed both dark lower jaws and dark grey to black of all baleens (Present study) (Stranded in.Feb. 2021, Ghalion zone, Kafr El-Sheik, Medit. Sea, Egypt).

Figure 2.2. Flipper of fin whale *B. physalus* is slightly large with faint white anterior margine at the last portion and inner surface. (Present study) (Stranded in.Feb. 2021, Ghalion zone, Kafr El-Sheik, Medit. Sea, Egypt).

Figure 2.3. Short dorsal fin of fin whale *B. physalus* on dark smooth body with no scattered white spots: right-up is the female organ (Present study) (.Stranded, in.Feb. 2021, Ghalion zone, Kafr El-Sheik, Medit. Sea, Egypt)

Figure 2.4. Flukes of fin whale *B. physalus* are wider, white below with a gray border, slightly deep notched median and thick tall stock (Present study) (Stranded, in Feb. 2021, Ghalion zone, Kafr El-Sheik, Medit. Sea, Egypt).

3.2. Recorrective remarkable features of misidentified species

3.2.1. Fin whale vs. Bryde's whale

The distinguishable features of the fin whale in the Egyptian Mediterranean Sea have been previously reported by **Farrag *et al.* (2019)** at stranding event during 2018. Then, the same species in the same stranding event was identified again but as Bryde's whale based on DNA analysis with no clear description. The present study updated and revised its identification to be fin whale again using additional new photographs and description compared with Bryde's whale, which may be a misidentified species (Table 2; Fig. 3). The remarkable features of misidentified whale are summarized as follows: V-shaped head, smooth and dark body dorsally with no scattered white spots as in Bryde's whale; the head rostrum has a single longitudinal ridge extending from the blowholes to the tip of the head unlike that in Bryde's whale, which has three ridges on the head above (Fig. 3.1). The left side of jaws is dark, but the right side, which has been included among the features, is not clear those pictures due to the absence of photographs. The baleen plates are dark gray, striated with gray bands, and fringed with yellowish-white horizontal lines (Fig. 3.1). Two narrow dark stripes originate from the eye and ear, with the former widening into a large dark area on the shoulder; there are twin blowholes with a low splashguard to the front (Fig. 3.2). The flipper or pectoral fin is slightly large with white anterior margins and inner surface; sometimes, the white border is faint and does not complete the entire fin as in the above mentioned description of the fin whale (Fig. 3.3). The dorsal fin located in the last and third parts of the body; it is not sharp-pointed

and curved as in Bryde's whale (Fig. 3.4). Flukes are wider with a slightly deep-notched median and a thick tall stock; the underside of the tail flukes is white with a gray border (Fig. 3.5). Other features were unclear due to the poor status of the whale after its sighting and the absence of additional photographs. The remaining features are shown in Table 2.

Figure 3.1. Head:v-shaped of fin whale *B. physalus*, showing single longitudinal rige on the above head; the left side showing both dark lower jaws and dark grey to black of all baleens (Stranded in Jan, 2018,. Azur beach, Alexandria, Medit. Sea, Egypt) (the same photos in Farrag *et al*. (2019) for fin whale; Abo-Taleb *et al*. (2020) for Bryde's whale and in the Present study again to be, reidentified as fin whale)

Figure 3.2. Left side of the head in dark with dark lower jaw of fin *whale B. physalus* showing two narrow dark stripes originate from the eye and ear, into a large dark area on the shoulder separated by a light area called the "interstripe wash". (Stranded in Jan, 2018,. Azur beach, Alexandria, Medit. Sea, Egypt) (Present study, reidentified as fin whale instead of Bryde's whale, photos were added in the present study)

Figure 3.3. Pectoral fin of fin whale *B. physalus* in oval shaoe with faint white margin on the margin; ventral grooves extended before amblicus. (Stranded in Jan, 2018,. Azur beach, Alexandria, Medit. Sea, Egypt; photos in Farrag *et al*. (2019) (Present study, reidentified as fin whale instead of Bryde's whale)

Figure 3.4. Short dorsal fin on dark smooth body of fin whale B. physalus with no scattered white spots on the body: right-up is the male organ (Stranded in Jan, 2018,. Azur beach, Alexandria, Medit. Sea, Egypt; photos in Farrag *et al.* (2019) (Present study, reidentified as fin whale instead of Bryde's whale).

Figure. 3.5. Flukes of fin whale *B. physalu*s are wider, white below with a gray border in the right photo, slightly deep notched median and thick tall stock in the left photo (Stranded in Jan, 2018,. Azur beach, Alexandria, Medit. Sea, Egypt) photos in Farrag *et al.*, 2019) (Present study, reidentified as fin whale instead of Bryde's whale, the right photo was added her).

3.2.2. Cuvier's beaked whale vs Gervais' beaked whale .

The Gervais' beaked whale *M. europaeus* (Gervais, 1855) was previously reported by **Farrag *et al.* (2019)** based on the close resemblance in the photographs. It was observed in September 2018 on the beach, northern coast of Matrouh Province (31° 39′ 35.8″ N, 27° 30.4′ 59″ E). It is an Odontoceti (toothed whales) belonging to the family Ziphiidae. The following morphometric measurements were recorded: standard length (SL) 5.3 m, pectoral fin length 50 cm, lower jaw length 35 cm, upper jaw length 27 cm, and weight ~900 kg; the caudal fin was lost. Furthermore, the body was elongated and laterally compressed, the mouth line was somewhat straight, and the head was overall small and tapering in outline. The whale was dark gray on top and lighter gray on the bottom. The present study describes the same species again with additional and clearer photographs that were missed previously, and the details led us to reidentify it as the Cuvier's beaked whale *Z. cavirostris* instead of the Gervais' beaked whale *M. europaeus*. According to the photographs, the major remarkable features were mostly based on the profile of the head in the small inset on the bottom right. There were scattered stripes that appeared slightly clear on the ventral body and a wavy mouth with a lower jaw that was longer than the upper jaw, which might be considered as an identification mark (Fig. 4). The additional photographs revealed the presence of teeth on the tip of the lower mandible erupting from the gums unlike those in *M. europaeus* in which they erupted one-third of the distance from the tip of the mandible. This feature was more reliable for classification and was distinctive for *Z. cavirostris.*

Figures 4a,b,c. Photos of the stranded Cuvier's beaked Whale *Z. cavirostris*; from the Mediterranean coast, Egypt (a; shows the faint stripes, b; mouth profile shows the upper and lower jaws, c: teeth on the tip of the lower mandible erupt from the gums.

Table 2. Remarkable features of four baleen whale species (Fin whale *B. physalus*, Omura's whale *B. omurai*, Bryde's whale *B. edeni* and Sei whale *B. borealis*).

Remarkable features	**Fin whale** ***B. physalus***	**Omura's whale** ***B. omurai***	**Bryde's whale** ***B. edeni***	**Sei whale** ***B. borealis***
Body	Cylindrical, smooth, dark above, creamy-to-white ventrally, no white patches; maximum length of female (24 m)	Smooth, dark, smaller size, no white patches	Gray with scattered white patches, especially for tropical species, caused by tropical shark *Isistius brasiliensis;* (Female: 16.5 m)	Gray with scattered white patches caused by cookie-cutting shark and/or lamprey
Head	Head: V-shaped, more flat with a single longitudinal ridge above and absence of lateral ridges. The left side is dark gray, and the right side exhibits a complex pattern of contrasting light and dark markings. It has paired blowholes.	The same features with a slightly smaller head, less flat, with a prominent single medial ridge and absence of lateral ridges	Three longitudinal ridges, clear central ridge, and lateral ridges	Slightly smaller, has one longitudinal smaller ridge
Jaws	The left lower jaw is dark gray, and the right jaw is white with a white mandible patch, a dark eye stripe, as well as a white chevron on the back. A light "blaze" laterally and dorsally unto the upper jaw and back to just behind the blowholes.	Similar to those of the fin whale	Dark gray lower jaws	Gray to dark lower jaws as in Bryde's whale
Baleens	Asymmetrical coloration: the unique feature is that the front third on the right side is white, the intermediate 100 plates are bicolored (dark on the outer side and yellowish-white on the inner side), the remaining plates on the back were all black, but on the left side, all were black. 260-480 plates per side	Baleens generally dark unlike the fin whale that had between 204 and 246 pairs of baleen plates. Other stated the yellowish-white at the front and black in the rear, with 180-210 baleens (Jefferson *et al*., 2015)	Lighter gray or white bristles, shorter plates (40 cm long by 20 cm wide), had 203–208 pairs of plates.. Other stated 250-370 plates per side (Jefferson *et al*., 2015)	Longer, black or dark gray baleen plates with short, curling, wool-like bristles. 219-402 plates per side
Pectoral fin (Flipper)	Small and slender with pointed tip; dark on the top, white anterior margins and inner surface.	Slightly smaller with clear white margins extended to the upper and inner surface	Small, slender, and darker	Small, slender, and darker
Caudal fin (Flukes)	Flukes wider with slightly deep-notched median and thick tall stock, white below with dark margins	Similar to those in the fin whale	Similar in smaller size with creamy white ventral	Similar in smaller size with little darker ventral
Ventral grooves	Extending after the pectoral fin along the body bottom from the tip of the chin to just before or reached the umbilicus (56–100 No.).	Extending beyond the umbilicus (40-70 No.)	Extending past the umbilicus (45–95 No.)	Extending just behind the pectoral fin to end far a head of the umbilicus , occupying 45%–47% of the body length.

Dorsal fin	Short dorsal fin, not pointed, and not curved enough, with slightly gradual sloping insertion, a height of 26–75 cm, lying approximately three-quarters of the way along the back.	Short; strongly hooked or curved; very falcate with more slopes forming sharp right angle into the back compared with the fin whale.	Tall and falcate Sharper angle of insertion, more acute angle.	Slightly hookedWith more acute angle as that of Bryde's whale
Gape	White left gape and a dark right gape vs jaws; coloration or pigmentation on the lower jaw.	Generally white on both sides. Other stated the same as fin whale.	It is not clear	It is not clear
Blaze	A light blaze	The right side displays a lightly blaze that starts from the jaw anterior to the eye; posterior to this blaze, there is a dark eye strip, and a light inter-stripe wash (bisected by three additional dark stripes)	It is not clear	It is not clear
Chevron	The chevron, begins behind the head and blowholes and extends back and then forward again. a white on the back, prominent on the right.	More clear than fin whale, it is a white on the back, more prominent on the right; with a double banded pattern that sweeps forward from mid-back in a V-shape .	-------	Is not clear
Reference	Mackintosh and Wheeler, (1929) Mizroch *et al*. (1984) Shirihai, and Jarrett. (2006). Jefferson *et al*. (2008) Farrag *et al*. (2019) San Martin *et al*. (2021) Present work	Wada *et al*. (2003). Jefferson *et al*. (2008) Cerchio *et al*. (2015) Jefferson *et al*. (2015) Ranjbar *et al*. (2016) de vos, (2017)	Mackintosh and Wheeler (1929) Best (1977). Ohsumi (1980) Best (2001). Wada *et al*. (2003) Steiner *et al*. (2008) Yamada (2009) Smultea *et al*. (2010) Bando *et al*. (2017).	Best (1977) Best (2001) Steiner *et al*.. (2008) Smultea *et al*. (2010)

DISCUSSION

Updating and correct identification of species are crucial for biodiversity and conservation. The present study identified fin whales based on the single longitudinal ridge on the head, which is the major feature consistent with the description and characteristics of those reported by the IUCN (2012) and San Martin et al. (2021).The fin whale has been recorded several times along the Egyptian Mediterranean coast (Table 1). The earlier record from the area of Marsa Matruh was given by Flower (1932) in a cinfuse as it was *Balaenoptera musculus* or *B. physalus*, then observed on the Rosetta (Rashid) beach during 1936 and the its skeleton is preserved at Museum of the National Institute of Oceanography and Fisheries, Alexandria (Farrag *et al.*, 2019). After more than 70 years, this species has been observed again in different regions during a short period (Farrag *et al*., 2019). Although several studies have indicated that fin whales do not go far in the eastern Mediterranean Sea (Laran and Gannier, 2008; Panigada et al.,

2017), except very limited studies made on the eastern part particularly the northern areas far from Egypt (Notarbartolo di Sciara *et al*., 2003). their repeated visits to the eastern Mediterranean Sea in Egypt may indicate that this area became familiar to such species unlike before, and this may have also occurred because of climatic effects. Furthermore, the stranding conditions indicate its vulnerability due to different reasons, such as dying of hunger or collision of ships and the topography of the Nile Delta region that shifted the huge region of the Egyptian coast toward shallower water.

The same stranded fin whale observed during 2018 was reported twice by **Farrag *et al.* (2019)** as the fin whale and subsequently identified again as Bryde's whale by **Abo-Taleb *et al.* (2020)** for the first time in the area. Adding a new or a first record of Bryde's whale in the eastern Mediterranean Sea, particularly Egypt, is important, considering the lack of sufficient studies on marine mammals in this region. However, the latter authors showed only one photograph of the head of the whale in an irregular situation, which required additional photographs and clear descriptions. **Farrag *et al.* (2019**) reported its identification by showing various photographs and detailed description where they observed the stranding event on the beach. Furthermore, in this study, the photographs were redescribed again, adding more pictures with careful notifications and comparison with others to confirm their differentiation. **Figures (2, 3, 5,6)** and the photographs indicate that the head rostrum has one longitudinal ridge extending from the blowholes to the tip of the head; it has two rows of baleen plates, and the dorsal fin is short and located in the last and third parts of the body. Only the same head photograph was reported by **Abo-Taleb *et al.* (2020)** for identifying Bryde's whale despite the presence of one ridge on the rostrum, which is considered as a remarkable feature for the fin whale as mentioned by different authors (table 2).

The remarkable features of Bryde's whales consisted of three prominent ridges on the rostrum as reported by **Steiner *et al.* (2008)** who identified Bryde's whale from the Azores coast; its dorsal fin is tall and falcate, body is elongated, the maximum height of the body is one-seventh of its total length compared to 1/6.5 to 1/6.75 in fin whales and only 1/5.5 in sei whales, which have one median ridge on the head similar to the fin whale. However, based on the characteristics reported by different authors (Table 2 and **Figs. 5-8),** the present specimen was also different from the sei whale. Further remarkable features for differentiating Bryde's whale and sei whales have also been reported in Table 2 and **Figures 7-10**. The among main remarkables are ventral grooves and presence of longitudinal ridges on the head. Bryde's whales ventral grooves extending to or past the umbilicus, occupying approximately 58% and 57% of the total length, while in contrast, sei whales have the ventral grooves extending only halfway between the pectoral fins and umbilicus, occupying only 45%–47% of the total body length. Both species are often covered with white or pink oval scars caused by bites from cookiecutter sharks *Isistius brasiliensis* or lamprey *Petromyzon marims* (**Steiner *et al.*, 2008; Smultea *et al.*, 2010; Bando *et al.*, 2017)**. From the table 2, and present photographs, it was noticed that the features were consistent with fin whales not Bryde's whale and Sei whales. The current reidentification of the fin whale again vs Bryde's whale based on the detailed features and additional photographs compared with those

reported by different authors **(Best, 1977, 2001; Wada *et al.*, 2003; Steiner *et al.*, 2008; de vos, 2017)** for Bryde's whales.

The recently sighted whale mentioned in the present study **(Fig. 2)** was described as the fin whale based on clear features in the photographs, which were also mentioned previously by **Farrag *et al.* (2019)**, particularly in terms of the dorsal fin, ridge on the rostrum, smooth body, and caudal fin, as shown in Table 2. The additional features such as the white right mandible, white front third of baleen plates, which are not found or observed in Bryde's whale or other whales has confirmed the current identification and reidentification of fin whale vs Bryde's whale. Furthermore, the description of the whales in the present study was consistent with those reported by **Mizroch *et al.* (1984), Shirihai and Jarrett (2006), de vos (2017), Farrag *et al.* (2019),** and **San Martin *et al.* (2021).**

To go away far from the confused species in our target to the fin whale, the Omura's whale has been discussed here as it also somewhat similar to fin whale and their characteristics are presented in Table 2. According to **Cerchio *et al.* (2015)** and **de vos (2017)**, Omura's whales have an unusual pigmentation pattern (laterally asymmetrical), which is similar to that of the fin whale *B. physalus*, with the lower jaw being white on the right side and dark on the left side, along with a light blaze and chevron that are prominent on the right. The gape is also asymmetrically pigmented but in reverse of the jaw **(Figs 11,12).** The dorsal fin tends to be strongly falcate anteriorly with a gradual slope as opposite to a sharp right angle (**Fig. 11G, 12f),** whereas *B. edeni* or *B. borealis* have a sharper angle of insertion. The dorsal fin of *B. physalus* is proportionally smaller and less upright than that of other species. These findings confirmed that the current sighted and reidentified whale is the fin whale.

Sometimes, Omura's whale may appear similar to Bryde's whale, which is misidentified instead as the fin whale. This confusion may occur in other studies using morphology and even genetic analysis. Eight specimens of Omura's whales (six from the Solomon Sea in 1976 and two from Cocos-Keeling Islands in 1978) were not differentiated from the 118 other "ordinary" Bryde's whales collected from the eastern Indian Ocean, south of Java. However, they had been judged as Omura's whale (**Wada and Numachi 1991**). In addition to the lack of detailed osteological studies and the absence of "conclusive data," the International Whaling Commission decided to consider them only as a regionally distinct group of ""small-form" Bryde's whales. Despite this declaration, the specific status of the Solomon Sea specimens was supported by a mitochondrial DNA test (**Wada and Numachi, 1991; Yoshida and Kato, 1999; Hashimoto and O'Neill, 2004; Yamada *et al.*, 2006; Cerchio *et al.*, 2015; Cooke and Brownell, 2019).** By 1998, these whales were confirmed through osteology examinations as Omura's whale after their death due to fishing boats. This implies that it is important to use the combination of morphological identification in detail, DNA sequencing tests, and osteology examinations to identify specimens.

Based on the genetic analysis performed on the stranded fin whale, by **Abo-Taleb *et al.* (2020)** and changed it to be Bryde's whale, it was noticed certain scientifically

missing or non-clear aspects. These include the absence of clear genetic identifier, i.e. the accession number for the obtained sequences in the GenBank database, they also created some confusion regarding its reliability to Bryde's whale or fin whale, which was identified by **Farrag *et al.* (2019)** who used several clear pictures and was in agreement with several authors studies fin whale as reported in table 2. Furthermore, use of single genetic marker of mitochondrial origin can only reveal the maternal origin of the species, not the clear identity for that one, especially if the genetic template is available and plausible for amplification of unclear markers by PCR for futher species confirmation. **Abo-Taleb *et al.* (2020)** had used an unclear photograph of the same specimen (only head with irregular position and no clear ridge on head above) combined with weak points of genetic analysis using a single sample with incomplete genome and incomplete analysis.This leads to increase of its debating to thecorrect identification. Hence, the details of morphological features are useful in whale identification despite the ecological actions that may change some of these features. Similar to the misidentification case, **LeDuc and Dizon (2002)** analyzed mtDNA cytochrome b sequences using a single genetic sample of Omura's whales from Philippine and reported the phylogenetic position based on *B. edeni* and *B. borealis*. After that, this Philippine sample was separately deduced to be *B. omurai* **(Wada *et al.*, 2003** ; **Sasaki *et al.*, 2006).** Hence, several molecular systematic studies focusing on relationships among Bryde's whales (*B. edeni edeni* and *B. edeni brydei*) have independently affirmed the above-described phylogenetic relationships using the same *B. omurai* sequences available on GenBank and expanded the geographical sampling of Bryde's whales using varied reconstruction methods and sets of markers **(Kershaw *et al.*, 2013; Rosel and Wilcox, 2014)**. This also give us sign to ensure the sequences available on GenBank and probability to find some similarity that causing probability for misidentification.

A phylogenetic reconstruction that would make this a parsimonious explanation would place *B. physalus* nested outside and basal to the Bryde's/sei/Omura's whale clade, **(Cerchio *et al*., 2015).** However, in most phylogenetic hypotheses, there are other species grouped with *B. physalus* (*Megaptera novaeangliae* or *B. musculus*) or nested in between *B. physalus* and *B. omurai* (primarily *B. musculus*) **(Wada *et al*., 2003; Sasaki *et al*. 2006, Rosel and Wilcox, 2014; Marx and Fordyce, 2015).** In the present study, we investigated several pictures (documented pictures and additional photographs) depicting clear morphological and osteological features to confirm the differentiation between the whale species. The current recorrection with the agreement of different authors, shown in Table 2, indicates a satisfactory decision to consider it as a fin whale instead of the misidentified Bryde's whale. Therefore, the osteological features such as skull has confirmed a single longitudinal ridge above the head, which is not a characteristic of Bryde's whale as reported by different authors shown in Table (2) for both Bryde's and fin whales. **Wada *et al.* (2003)**, **Yamada *et al.* (2006)**, **Yamada *et al.* (2008)**, and **Ponnampalam (2012)** established a set of diagnostic skeletal features, particularly involving skull characters, which were subsequently used to identify species using remains from whaling operations and strandings. For another example, the examination

of 23 skulls of the Omura's whales collected from the Bohol Sea, Philippine shore during the 1980s suggested that the specimens were atypically smaller than the skulls of *B. edeni* (**Perrin *et al.* 1995)**. This support the usage of osteology in the whales identification. Researchers must follow the details of identification, including morphological, osteological, and genetic features, to collect data for appropriate conservation and management. Some suggestions

On the same way of the present objectives toward the reidentification of misidentified species, the Gervais' beaked whale (*M. europaeus* (Gervais, 1855)) was stranded in September 2018 on the beach of the northern coast at Matrouh Province (31° 39′ 35.8″ N, 27° 30.4′ 59″ E) and identified using unclear photographs. The present review using clearer photographs of the same stranded whales that was missed before and illustrated that the whale was misidentified, and the correct identification was attributed to *Z. cavirostris* based on the above mentioned remarkable features. To confirm this identification, the remarkable features were compared with those reported in other studies particularly regarding the position of teeth on the lower jaw and the presence of scattered stripes on its body. The teeth in *Z. cavirostris* are apical (on the tip of the mandible), whereas in *M. europaeus*, they erupt one-third of the distance from the tip of the mandible, as shown in **Fig. 4**. In the Mesoplodon species, the rostrum is more elongated. The present characteristics were consistent with those reported by **Blackmer *et al*. (2002)**, **Auger-Méthé and Whitehead (2007)**, **Rosso *et al*. (2011)**, and **Karaa *et al*. (2021)** for *Z. cavirostris* but inconsistent with those reported by **Podesta *et al*. (2006)**, **Notarbartolo di Sciara and Birkun (2010)**, and **IUCN (2012)** for other species. In cetaceans, natural markings used for individual identification may result from injuries caused by accidents, parasites, predators, and other intraspecific or interspecific interactions **(McCann 1974, Lockyer and Morris 1990).** From the other point of view, the only beaked whale species frequently found in the Mediterranean Sea is the Cuvier's beaked whale (*Z. cavirostris*, G. Cuvier 1823) (e.g., **Notarbartolo di Sciara and Birkun (2010)**). In the Mediterranean basin, this species is generally observed in waters deeper than 500 m, with a distinctive preference for depths ranging from 1000 to 2000 m (**Moulins *et al.*, 2007, 2008; Tepsich *et al.*, 2014)**. These data indicated that the present species is *Z. cavirostris.*

The scientific suggestion for the reidentified species is their transformation/migration from the Red Sea to Mediterranean via Suez canal which may confuse with the presence of Bryde's whale in the Egyptian Mediterranean coast. **Notarbartolo di Sciara *et al*. (2017)** reported the Bryde's whale from the red sea, however they stated that the migratory pattern via suez canal allowed several species to migrate but not large species such as whales due to the intensive shipping operations and the narrow route that result in a high probability to be sighted before their arrival to the Mediterranean Sea. This was supported by **Kerem *et al.* (2001) and Notarbartolo di Sciara (2016),** they stated that the cetacean migrations through the Suez Canal appear to be rare; the only certain record of small sized cetaceans such as Indo-Pacific humpback dolphins, subsequently sighted in the eastern part of the Mediterranean Sea. In opposite to

other species migrated to the Mediterranean sea or even large animals moved from Atlantic to Mediterranean or from west to east of Mediterranean may due to climatic changes which help in increase of the temperature in Mediterranean Sea. It was in agreement with **Lejeusne *et al*. (2010**) who illustrated that the migration of animals from the warm waters of the Red Sea (warm waters) to the Mediterranean Sea (relatively cold waters) might be due to its warming as a result of climate change.

On the sidelines of the research essence, which aims to update the registration of stranded whales and reidentify some species. The climatic changes and its effect on biodiversity made the scientists expected every thing such as coming/ leaving species in areas. The global attention and wider range of climate changes and hydrology have contributed to the co-occurrence and survival of both temperate and subtropical organisms, particularly marine mammals, in the Mediterranean Sea (**Sara, 1985; Bianchi and Morri, 2000; Farrag *et al.*, 2019**). Nevertheless, numerous cases of stranded and beached whales such as the sperm whale and fin whale during the past few years may have occurred due to pollution, seismic activity, fishing operation, and shipping activity, as well as the unique topography of the Nile Delta as a shallower area, which obviously influences the survival of whales (**Farrag *et al.*, 2019**). The Mediterranean Sea has its own set of emblematic species of conservation, such as sea turtles, cetaceans, and the endangered monk seal *Monachus monachus* (Hermann, 1779). It is considered as an important spawning region of for the Atlantic bluefin tuna (*Thunnus thynnus*) **(Bearzi *et al.*, 2004; MacKenzie *et al*., 2009).** The bluefin tuna attracts visitors such as killer whales (*Orcinus orca*) in populations of approximately 32 whales to feed on (ACCOBAMS). In Egypt and due to the limited knowledge on marine mammals, the further investigations are required in this context to delineate the factors affecting biodiversity and suggest recommendations for their conservation using additional detailed features to ensure the correct identification as far as possible. Moreover, the effects of climate changes that will be among the reasons for the arrival or sighting of whales and their effect on feeding behavior and food-seeking should be considered and monitored.

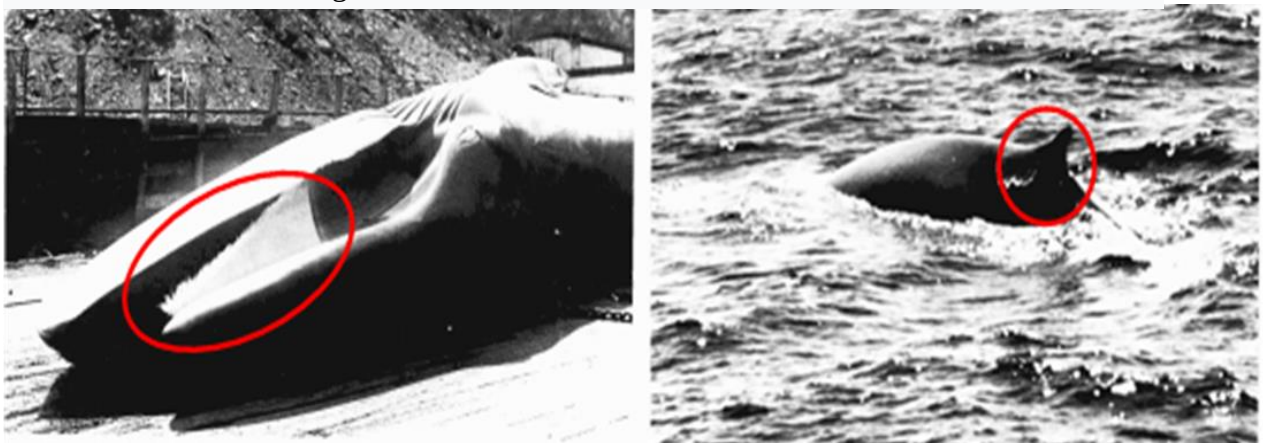

Figure 5. Head:v-shaped of fin whale *B. physalus*,showing clear white front third of right baleen and right white lower jow in the right photo; while the left photo showed the short dorsal fin with dark smooth body **(Mizroch *et al.*, 1984)**

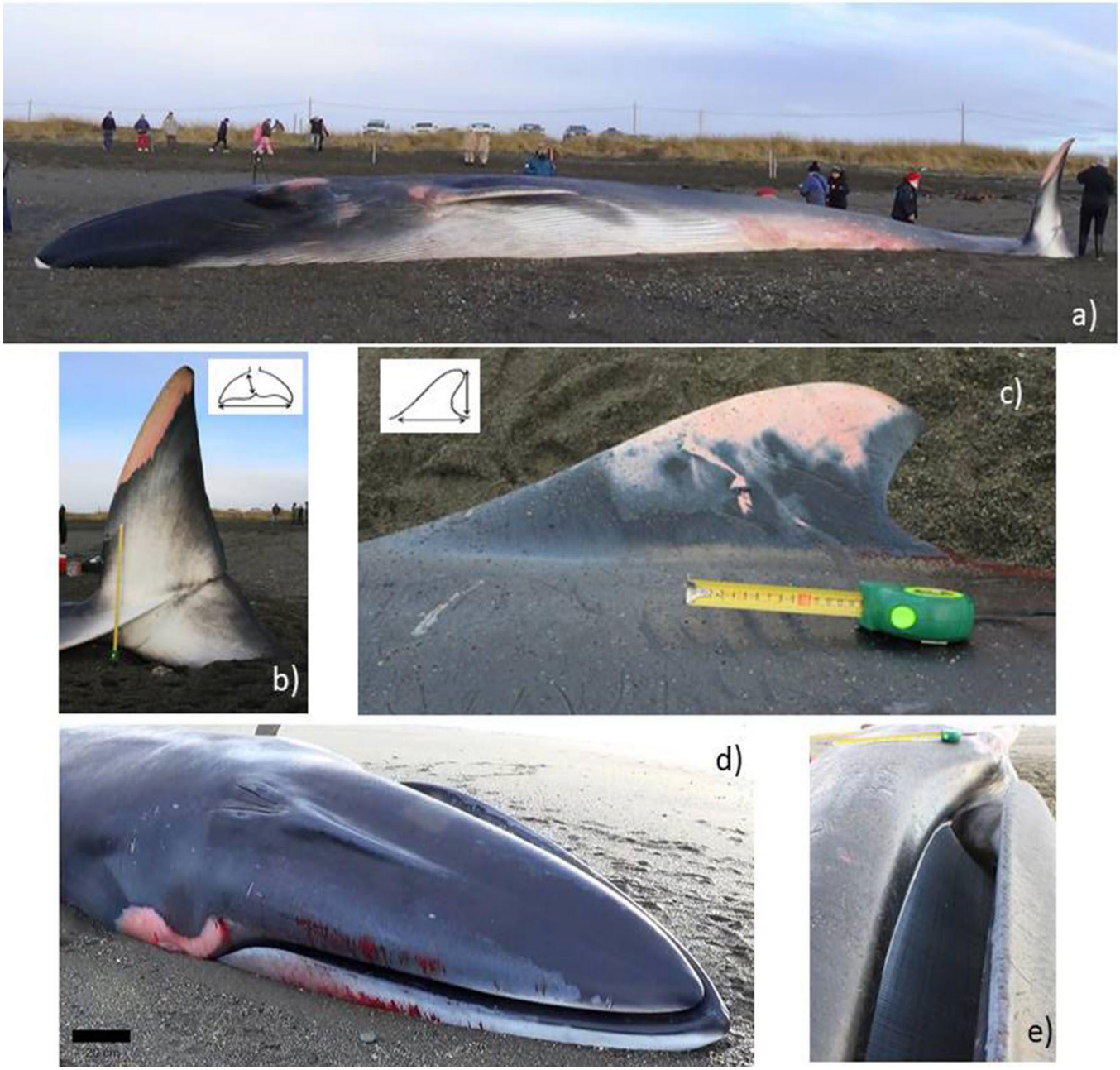

Figure 6. External features of the fin whale stranded at Tierra del Fuego in 2016: showing the asymmetric coloration pattern; b ventrally light-colored flukes with dark-gray streaking towards edges and tips; c low-sloping dorsal fin; d dark-gray head with (diagnostic) white right lower jaw and single, short rostral ridge; e baleen plates are dark gray **(San Martin *et al.*, 2021).**

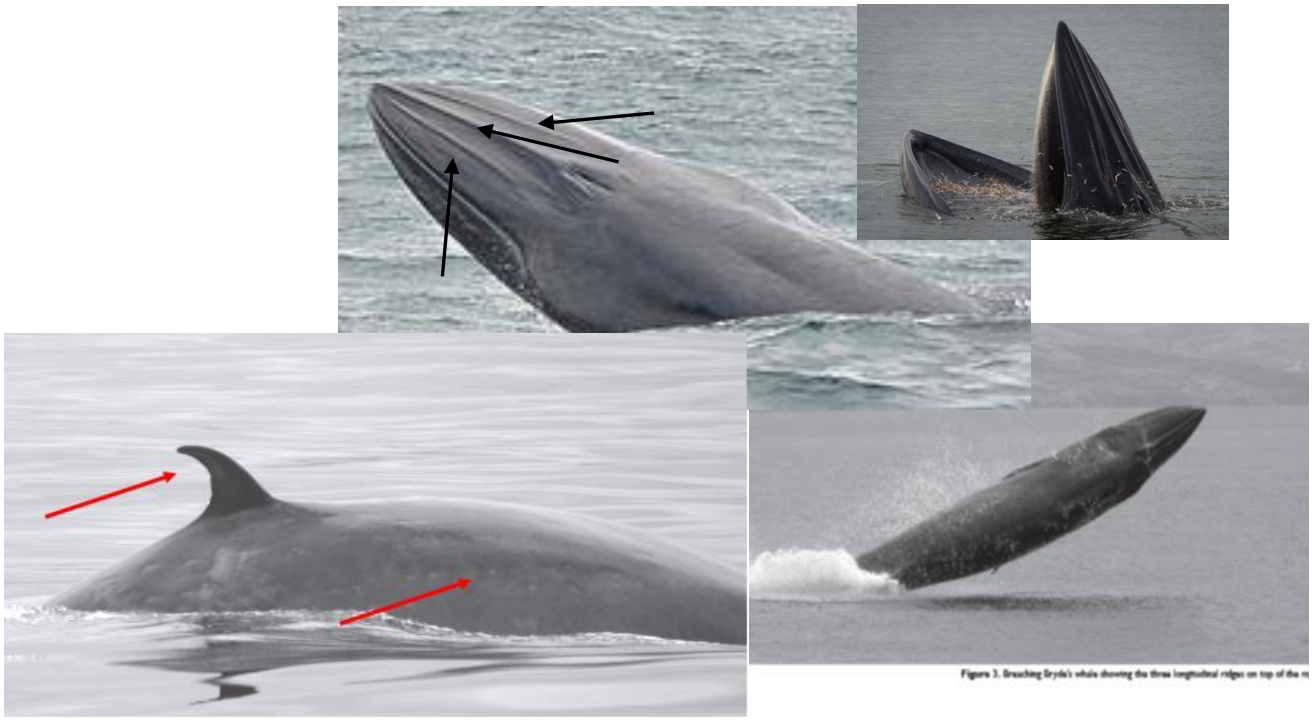

Figure 7. Head:v-shaped of Bryde's whales *B. edeni* in Azores, showing clear three longitudinal ridge, the median one is clear and extended to the tip of mouth; smaller head, above right photo with open mouth showed no white lower jaw, it is grey to dark Also, the left down photo showed taller, curved and pointed dorsal fin on the body which filled with scattered white botches **(Steiner *et al*., 2008).**

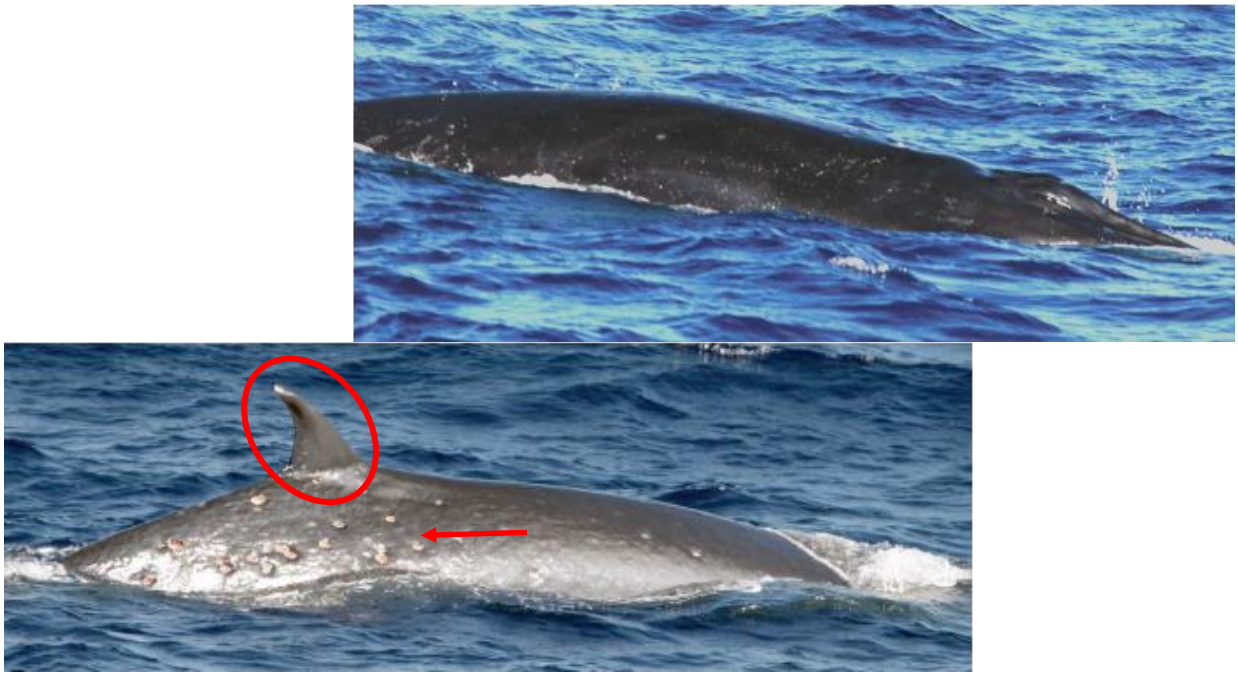

Figure 8. Photo of a Bryde's whale *B. edeni* seen 13 November 2007 showing the presence of auxiliary rostral ridges, a diagnostic characteristic unique to this species in the above right photo, while the left down one showed curved and pointed dorsal fin on the body which filled with scattered white botches (**Smultea *et al*., 2010).**

Figure 9 Sei whale, *B. borealis* by Enrico Villa, Azores Note the absence of lateral ridges – only one clear, middle ridge (**Steiner *et al*., 2008).**

Figure 10 Photo of a subadult sei whale *B. borealis* seen 16 November 2007 showing the lack of auxiliary rostral ridges. Several apparent cookie-cutter shark bite marks; the left down photo showed the jointed shape of the dorsal fin (**Smultea *et al.*, 2010**)

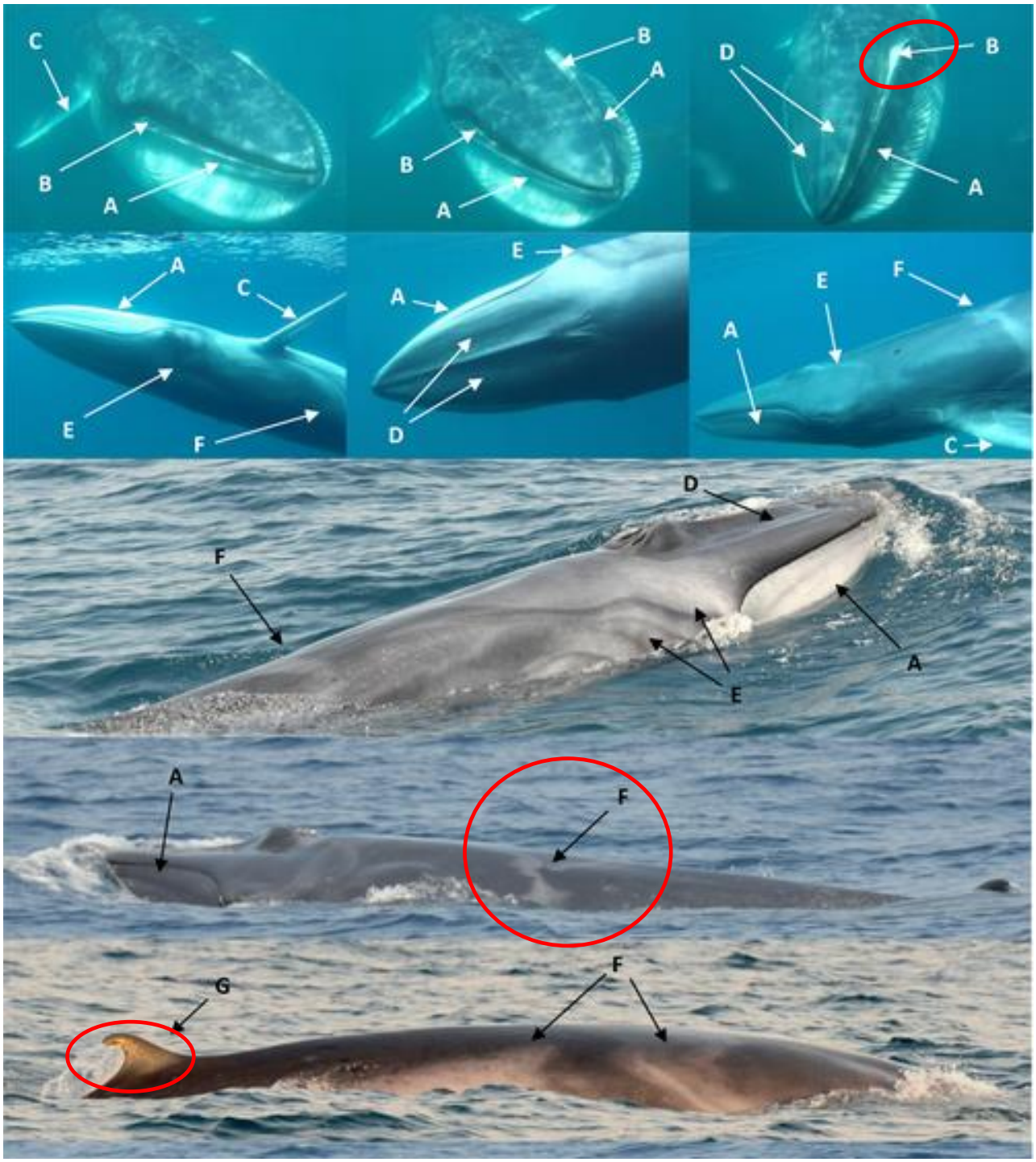

Figure 11 Photos of omuras whale *B. omurai* from Madagascar during December 2012-November 2013, 2014 displaying the external appearance: (A) asymmetrical coloration of the lower jaw, with lightly pigmented right jaw and darkly left jaw; (B) asymmetrical coloration of the gape, with lightly pigmented left gape and dark right gape; (C) white edge of pectoral fin from tip to shoulder; (D) faint to absennce of lateral rostral ridges; (E) lightly pigmented blaze anterior to the eye, (only on the right side); (F) lightly chevron anterior to dorsal fin, present on both sides but asymmetrical, most prominent on right where it displays a double banded pattern; (G) dorsal fin falcate with gradual sloping insertion into dorsum. (**Cerchio *et al*., 2015**)

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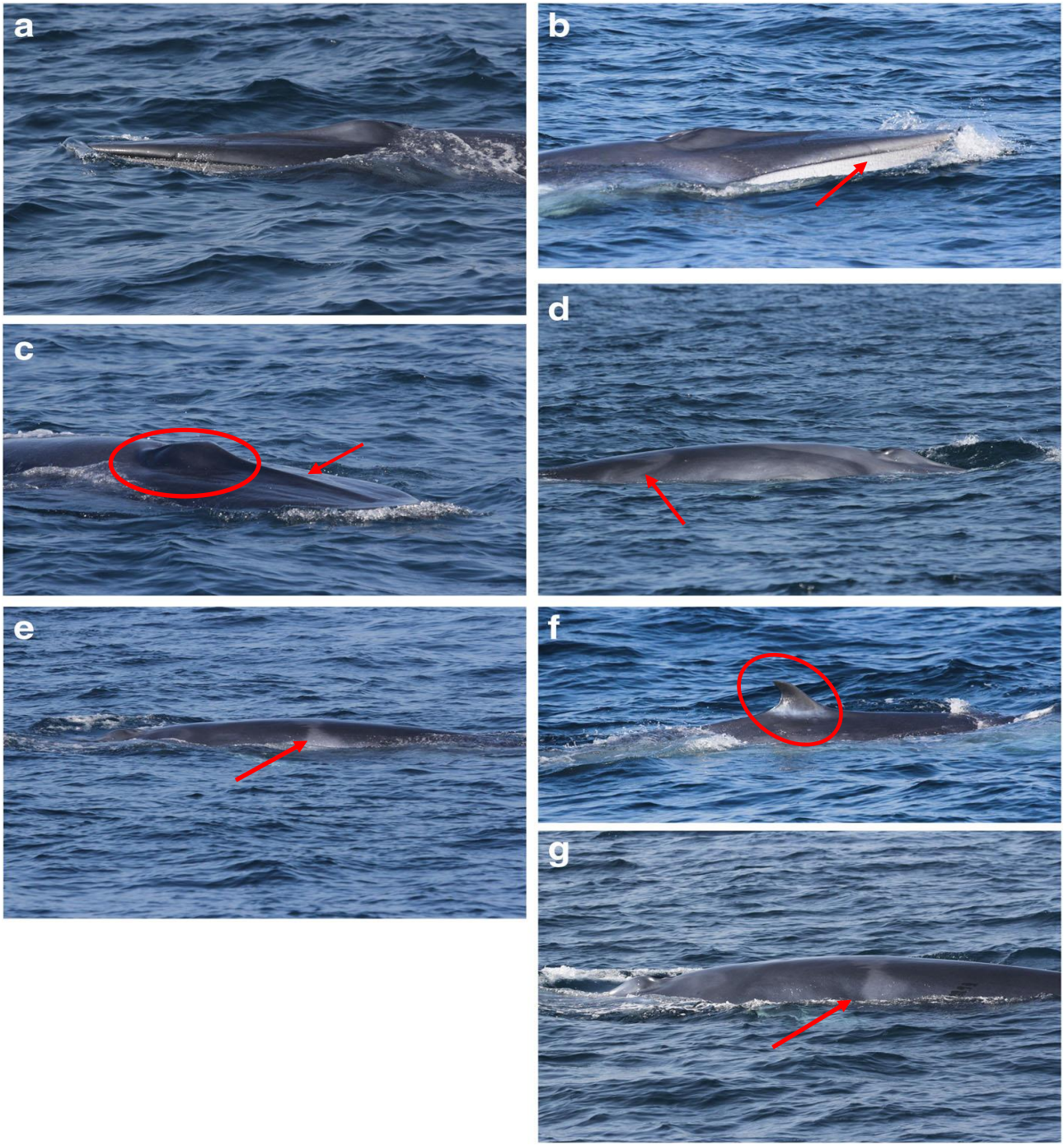

Figure 12. Photos of omuras whale *B. omurai* documented off southern Sri Lanka on 5 February 2017, these images distinguish this individual from Bryde's whales by Jaw asymmetry with a left jaw being dark in colour compared to the b) right jaw which is light in colouration; c) prominent single ridge on rostrum and weak lateral ridges on each side; Chevron on d) right (more prominent) and e) left sides; and f) strongly falcate dorsal fin. Other markings of note include g) 'tyre mark' on left dorsal flank **(de Vos 2017)**

CONCLUSION

This work updated and reported the stranded fin Whale (*Balaenoptera physalus*) on the Egyptian coast of the Mediterranean Sea during 2021, updating its historical sightings with with reidentification probability of previous reported fin whale vs. misidentified stranded Bryde's whale and Cuvier's beaked whale vs misidentified Gervais' beaked whale M. europaeus during 2018 considering remarkable features for the correct identification and actual conservation. This work recommends paying more attention to marine mammals in Egypt and their correct identification using both detailed morphology and genetics beside the osteological features for further iams that serve the environmental and biological conservation and the effects of climatic changes and anthropogenic activities.

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