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Epimeletic Behavior in Bottlenose Dolphins (*Tursiops truncatus*) in the South of Portugal: Underwater and Aerial Perspectives

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Numerous species of cetaceans are known to engage in epimeletic (caregiving) behavior towards injured or distressed conspecifics (Harzen & dos Santos, 1992; Howells et al., 2009; Bearzi et al., 2018). This behavior refers to the help given by one or more healthy individuals towards a sick, injured, or dead individual (Caldwell & Caldwell, 1966; Bearzi et al., 2017) and can be directed towards adults, designated as "succorant," or towards infants, designated as "nurturant" (Caldwell & Caldwell, 1966). Caldwell & Caldwell (1966) divided succorant behavior into three broad categories: (1) *standing by* (where despite not directly aiding the distressed animal, healthy individuals stay with it, even if it entails remaining in a dangerous area), (2) *excitement* (where companions of the afflicted individual appear extremely disturbed as well and may attempt to protect it from a perceived source of danger), and (3) *supporting* (where the struggling mammal is directly assisted by the succorants, who support it at the surface to breathe). Reports of succorant behavior are uncommon, albeit existent for both wild and captive cetaceans (Kuczaj et al., 2015). On the other hand, nurturant behavior, typically provided by adult females, appears to be more commonly observed in cetaceans (Cockcroft & Sauer, 1990).

Epimeletic care is usually provided to live, struggling conspecifics and is considered adaptive because it may determine the animal's survival (Harzen & dos Santos, 1992; Dudzinski et al., 2003). However, it is sometimes extended to perished animals and, therefore, appears maladaptive (Bearzi et al., 2017). Several reports document adult females carrying deceased, sometimes even decomposing, calves (Fertl & Schiro, 1994). The persistence of this behavior for long periods of time can result in high energetic expenditure, which can lead them to linger behind the rest of the pod and spend less time foraging and socializing, as reported in killer whales (*Orcinus orca*) by Shedd et al. (2021). Additionally, disease transmission from the cadaver poses a risk for the carrier's health (Bearzi et al., 2017).

Common bottlenose dolphins (*Tursiops truncatus*) display one of the highest rates of reported epimeletic behavior among cetacean species (Reggente et al., 2018; Pedrazzi et al., 2022), and the genus *Tursiops* is second only to the genus *Sousa* in the frequency of recorded behavior directed towards dead conspecifics (Bearzi et al., 2018). The amount of observations is likely influenced by the sporadic nature of these events combined with the higher accessibility to study more abundant and widely distributed species, such as bottlenose dolphins, relative to others (Bearzi et al., 2017). Epimeletic behavior also appears to be correlated with their comparatively higher encephalization quotient (Bearzi et al., 2018). Indeed, epimeletic care reflects a high degree of sociality (Pilleri, 1971, as cited in Bearzi et al., 2018), which has been associated with intelligence in cetaceans (Fox et al., 2017).

In this paper, we describe an opportunistic observation of both types of epimeletic behavior in wild common bottlenose dolphins off the Algarve, Portugal. Nurturant behavior by an adult female towards a dead calf, presumably its offspring, and apparent succorant behavior from other adult dolphins towards the distressed female were recorded through direct observation and documented with photographs as well as underwater and aerial footage. We aim to contribute new evidence towards epimeletic behavior in *Tursiops truncatus*.

On 11 November 2021, a field survey was conducted by the Associação para a Investigação do Meio Marinho (AIMM) research team off the south coast of mainland Portugal. The survey was conducted on board the research vessel *Ketos*, a 6.7-m-long rigid hull inflatable boat powered by a single 135 hp outboard engine, from 1018 to 1527 h, lasting 5 h 9 min. At around 1215 h, a

group of bottlenose dolphins (*Tursiops truncatus*) was sighted 12.6 km from the coast of Albufeira in an area with a depth of 295 m (Figure 1). This group was composed of 50 to 60 individuals and contained adults, juveniles, and calves. The sighting lasted 1 h 12 min.

During the sighting, an adult dolphin was observed carrying a deceased calf (Figure 2A-C), and several other adults were present during the event. Digital single-lens reflex (DSLR) cameras paired with telephoto lenses were used to obtain photographs, including dorsal fin photographs for individual identification. A waterproof VIZU Extreme X6S camera was used to record underwater footage from the boat. A Mavic 2 Pro Unmanned Aerial Vehicle (UAV) equipped with a Hasselblad digital camera (1" CMOS sensor, 4K: 3,840 × 2,160 24/25/30p) and paired with a tablet was used to collect aerial video footage (video footage for this paper is available in the "Supplemental Material" section of the *Aquatic Mammals* website: https://www.aquaticmammalsjournal.org/index.php?option=com_content&view=article&id=10&Itemid=147). Underwater and aerial footage were analyzed *post hoc* using *VLC media player*. We used a still image taken from the UAV footage to measure the calf's body length in relation to the length of the female displaying nurturant behavior. This female was assumed to be 2.5 m long as compared with female bottlenose dolphins in the northern Atlantic (Mead & Potter, 1990).

According to definitions in Bearzi et al. (2018), the carrier dolphin is hereby referred to as "post-mortem attender" (PA), and the individuals that remained in the same area as the PA are referred to as "bystanders." The PA was manipulating the carcass, constantly maneuvering around it, lagging behind the main group. However, at least seven other adult dolphins were observed in close proximity (mostly ≤ 10 m) to the PA.

A total of 1,056 photographs, 17:12 min of aerial video footage, and 03:53 min of underwater footage were collected. We selected the relevant footage, excluding the segments during which the PA was not visible, and thus analyzed 06:40 min of aerial footage (38.8% of the total) and 02:21 min of underwater footage (60.5% of the total). The individuals involved in the event were identified through photo-identification using photographs taken from the boat. Although analysis of the aerial and underwater videos did not allow us to track the individuals associated with the PA throughout the footage, we were able to determine the sex of four dolphins involved through photographs of their genital area. The PA was identified as a female with a distended abdominal area (Figure 3A & B). The dead calf was identified as male (Figure 4A) with a body length estimated at 117.5 cm. The carcass was not visibly decomposed and exhibited moderate scarring in the form of tooth rake marks laterally and ventrally around its pectoral fins (Figure 4A & B). It displayed fetal folds (Figure 4C), had no erupted teeth, and the rostral whiskers were no longer visible (Figure 4D). Finally, two of the seven bystanders were identified as adult males.

The behavior of the group was continuously monitored during the sighting. The majority of the group was traveling and socializing (based on Castro et al., 2021). On the other hand, the PA spent most of the time directly interacting with the calf's body, carrying it with the rostrum and/or head both at the surface and during dives (Figure 2B & C). When surfacing

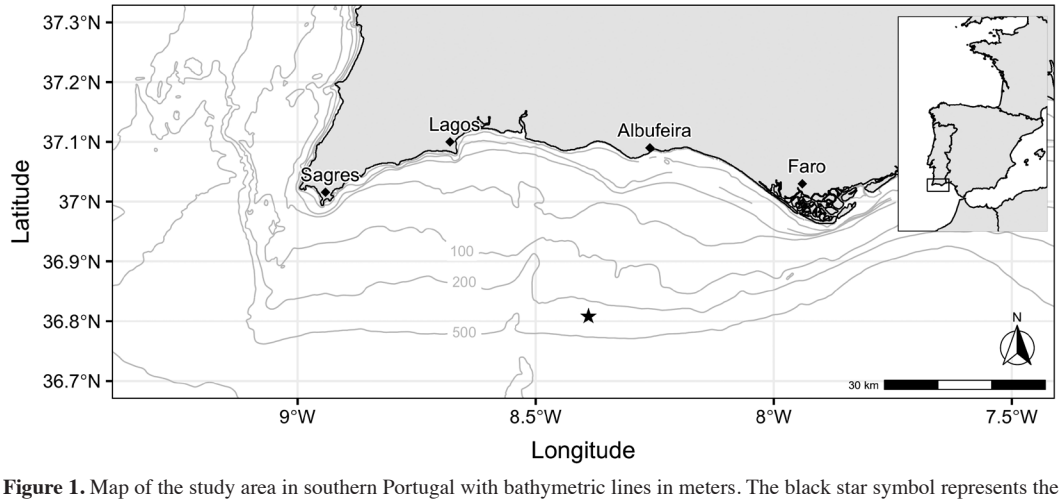

Figure 1. Map of the study area in southern Portugal with bathymetric lines in meters. The black star symbol represents the common bottlenose dolphin (*Tursiops truncatus*) sighting.

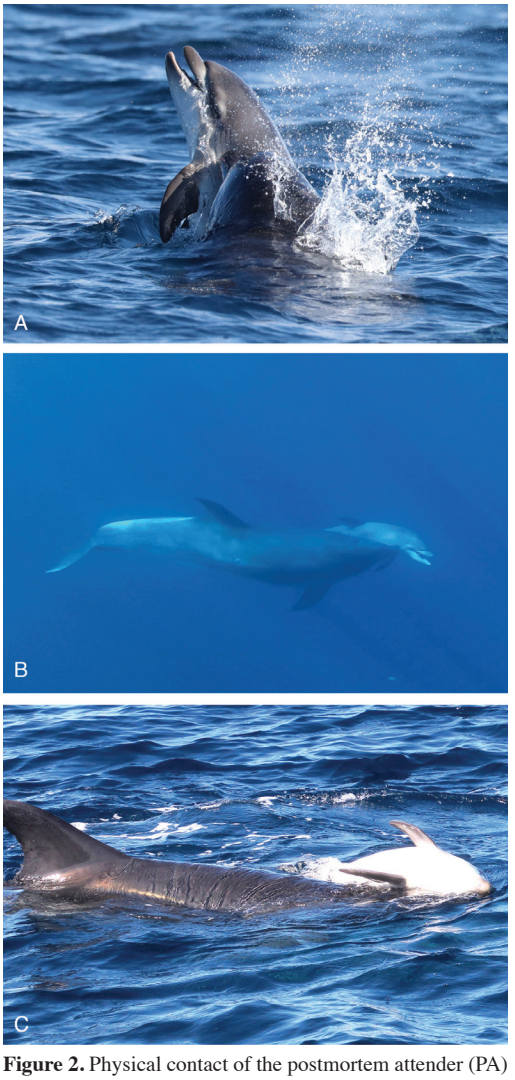

Figure 2. Physical contact of the postmortem attender (PA) with the calf's body: (A) "launching" the body out of the water, (B) underwater carrying, and (C) carrying at the surface. (Photos courtesy of AIMM – Associação para a Investigação do Meio Marinho)

Figure 3. Ventral area of the PA: (A) genital slit and sex (female) visible, and (B) distended abdominal region. (Photos courtesy of AIMM – Associação para a Investigação do Meio Marinho)

or near the surface, the PA was observed repeatedly nudging the calf's body upwards, even "launching" it out of the water on two occasions (Figure 2A). While diving, the PA used the rostrum to push the body deeper and manipulated it, performing twisting and rolling motions before returning to the surface. The PA displayed this carrying behavior throughout our observation, including when our team left the area, possibly continuing beyond that point. The bystanders displayed a calm behavior, mainly swimming after, alongside, and ahead of the PA at varying distances. PA–bystander interactions were observed in three instances and appeared to be instigated by the PA. Shortly after releasing the calf's body (which subsequently sank), the PA swam towards one or more nearby bystanders, prompting at least one to change direction and swim towards the calf's body with her. Additionally, there was a fourth similar instance when the PA was out of view for 15 s, and the moment of contact with the bystanders was not recorded. The bystanders were never observed providing physical support to the PA or physically interacting with the calf's body. Further, no interactions among the bystanders were observed, with the exception of one brief socio-sexual display where a bystander exposed its ventral area to another.

We estimated the dead calf's age at around 3 wks by comparison with the physical development (e.g., absence of rostral whiskers and teeth, presence of fetal folds) of a captive bottlenose dolphin calf described by Cockcroft & Ross (1990), as well as infant length measurements by Biancani et al. (2021) and Noren et al. (2006). The absence of visible teeth also indicates that it was less than 3 mo old (Cockcroft & Ross, 1990). Simultaneously, the distended abdominal region observed in the female may indicate a recent pregnancy due to the prolonged period

Figure 4. Detailed images of the calf's body: (A) ventral area displaying tooth rake marks and the genital slit (male), (B) tooth rake marks on the flank, (C) visible fetal folds, and (D) visible lower jaw with no erupted teeth and without rostral whiskers. (Photos courtesy of AIMM – Associação para a Investigação do Meio Marinho)

during which the genital tract remains extended after delivery (Sheldon, 2004; Noakes, 2009). Considering this, along with the estimated age of the dead calf, the observed female was likely its mother. Motherhood in cetaceans is characterized by an intense dedication towards the dependent offspring (Mann, 2018; Rendell et al., 2019), particularly so for bottlenose dolphins in which the connection between mother and infant can persist for up to 11 y (Triossi et al., 1998). The loss of offspring is therefore expected to induce physical and emotional responses in these animals.

One explanation for the observed nurturant behavior is that it may represent grief. Grief, initially expressed as distress, anxiety, and depression (Parkes, 1998), is a set of reactions to loss such as a sudden interruption in a very intense tie to another individual (Bearzi et al., 2017). Although animal emotions are difficult to assess and are an overall controversial topic, they have been particularly associated with intelligent animals such as cetaceans (Simmonds, 2006). The general behavior exhibited by the female, consisting of swimming around the body, compulsively pushing and carrying it, is consistent with the characteristic reactions considered as mourning in humans and other mammals (Bearzi et al., 2017).

Our observations of the PA launching the calf's body out of the water could demonstrate an effort to stimulate it, with the purpose of resuscitation. In terrestrial mammals, this type of vigorous handling of an inanimate body may lead to its revival; however, it is unknown if similar manipulation has the same effect on cetaceans (Bearzi et al., 2017). Apparent resuscitation attempts among cetaceans have been suggested by Harzen & dos Santos (1992) to result from a difficulty in understanding that the inanimate animal has already passed away. Since the calf's body observed during this encounter was fresh (corresponding to decomposition stage 1 [Early & Goff, 1986] and decomposition condition code 1 [IJessldijk & Brownlow, 2016]), the female PA may have misinterpreted it as being alive. However, reports of cetacean mothers carrying decomposing bodies of their offspring—or even objects when the body was unavailable (see Kilborn, 1994)—suggest that this behavior is not limited to a lack of understanding of death since, in both situations, the carrier is unlikely to misinterpret the circumstances.

The PA appeared to display stereotypic behavior (Bearzi et al., 2018), fixating on the body, carrying it for the entire duration of our observation, and thus potentially also inflicting the observed scars. The PA only left the calf's body for short periods

of time for a brief interaction with the bystanders and immediately returned to it. The hypothesis that this behavior represents a way for the PA to elicit assistance from the nearby dolphins should not be ruled out. Kuczaj et al. (2015) reported a case in which a struggling bottlenose dolphin obtained help from other members of the group in response to its emitted signals of distress (i.e., distress calls and bubble streams). During our observation, the bystanders did react to the female's approach and swam along with her towards the carcass; however, we did not observe them interacting with the carcass. This behavior as well as the general proximity to the PA are consistent with the *standing by* category of succorant epimeletic behavior defined by Caldwell & Caldwell (1966), and the behavior contrasts with the behavior from the rest of the group members who did not appear to be influenced by the event reported here.

If the unconfirmed-sex bystanders were females, they might have been close associates of the PA. In bottlenose dolphins, female–female affiliations are predominantly influenced by a shared reproductive state and kinship (Diaz-Aguirre et al., 2020). Mothers benefit from these bonds for communal calf rearing (Rendell et al., 2019), and other females may be strongly involved in postmortem attendance behavior when a calf dies (Quintana-Rizzo & Wells, 2016).

Alternatively, the bystanders may have been motivated by reproductive purposes as suggested by the brief belly-up event between two of these dolphins. This interaction can indicate socio-sexual behavior, and sexual interactions have been observed around dead conspecifics (e.g., Dudzinski et al., 2003; Jog et al., 2020). Since females from multiple species of mammals recur to a sexually receptive state shortly after losing their offspring (Hrdy, 1979), the bystanders may benefit from remaining in close proximity to the PA to facilitate mating access. It is further possible that the bystanders were involved in the death of the calf, which also could have caused the observed scars. Male-perpetrated infanticide can function to improve male reproductive fitness by accelerating the mother's resumption to breeding condition, subsequently allowing the males to mate with her and father their own offspring (Bearzi et al., 2017; López et al., 2018). Although these possibilities cannot be excluded, they warrant information about the sex of all bystanders, and more socio-sexual displays would be expected if their behavior had solely reproductive purposes.

In this paper, nurturant epimeletic behavior of a female bottlenose dolphin towards a deceased calf and apparent succorant epimeletic behavior of multiple adult individuals in the south of Portugal are discussed. Our observations are consistent with postmortem bereavement and thus suggest that the primary motivation of the female to carry out this behavior was grief, particularly because she was the supposed mother of the dead newborn.

Aerial and underwater footage provide a rare spatial perspective of this event. Reports and detailed observations of epimeletic behavior in wild cetaceans are scarce and limited to sporadic events. Therefore, the case described in this paper contributes towards the understanding of this type of behavior in cetaceans, particularly in *T. truncatus*, and furthers our knowledge on the social behavior of this species in mainland Portugal.

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