acta ethologica
https://doi.org/10.1007/s10211-023-00417-5

SHORT COMMUNICATION

Epimeletic behavior in a free-ranging female Risso's dolphin (*Grampus griseus*)

Séverine Methion[1] · **Olga Mosca**[1] · **Bruno Díaz López**[1]

Received: 17 October 2022 / Revised: 21 February 2023 / Accepted: 25 February 2023

Abstract
Here, we describe the epimeletic behavior of an adult Risso's dolphin towards a deceased newborn calf of the same species across several days with photographs, acoustic monitoring, and video recordings. Boat-based observation surveys were conducted from April 2014 to October 2021 along the southern coast of Galicia (northwest Spain) as part of a longitudinal study on the ecology of cetacean species. On September 21, 2020, an adult Risso's dolphin was observed carrying a dead newborn calf in coastal waters. This presumed mother was further sighted with her deceased calf on September 23 and 24 (20 km and 40 km from the first observation site, respectively) and with other adult individuals on September 30, probably after having lost or finally abandoned the carcass. The presumed mother supported the corpse for at least 5 days, which may have had potential consequences for the female health. As direct observations are scarce in the wild, this type of report provides valuable information to better document the occurrence of care-giving behavior in highly mobile marine top predators.

Keywords Cetacean · Grief · Nurturing behavior

Introduction

Epimeletic behavior refers to altruistic behavior in which a healthy individual cares for an injured, ill, or dead one (Scott 1958). This behavior can be directed to an individual of the same species or a different species (Watts 2020) and can also be towards a young (known as nurturing behavior) or an adult (Bearzi et al. 2017). Epimeletic behavior has been observed in a number of mammals including hippos (Inman and Leggett 2019), giraffes (Bercovitch 2013), elephants (Douglas-Hamilton et al. 2006), chimpanzees (Watts 2020), and several cetacean species (Bearzi and Reggente 2018). Some motives for this behavior have been hypothesized to be kin altruism or reciprocal altruism (Ashton et al. 1998). Observations of reactions to recently deceased conspecifics in non-human mammals are highly valuable, as they can give insights into important behavior patterns. Yet, these patterns towards loss are poorly understood, as records of epimeletic behavior in the wild are occasional and unpredictable (Bearzi et al. 2017). Further documentation of such epimeletic events would therefore contribute to a better understanding of their characteristics, their drivers and the potential physiological implications on the individuals involved.

Epimeletic behavior has been documented in at least 21 cetacean species (Bearzi et al. 2018). Most studies refer to kin altruism events, describing a female carrying a deceased calf (presumably its offspring), helping it to stay afloat or carrying it away from a source of danger for protection (e.g., Díaz López et al. 2018; Shedd et al. 2020; Xianyan et al. 2017). Risso's dolphin (*Grampus griseus*) has been studied in different parts of the world (Hartman 2018), yet only two reports from the Pacific and Indian oceans document epimeletic behavior in this species (Galápagos Islands (Palacios and Day 1995) and south Maldivian waters (Reggente et al. 2016)). Both observations were of an adult Risso's dolphin carrying a dead calf in an advanced state of decomposition. These observations were, however, of short duration (< 20 min), and no images or behavioral descriptions were provided.

In this study, we provide a thorough description of the epimeletic behavior of an adult Risso's dolphin towards a deceased newborn calf of the same species across several days.

✉ Séverine Methion
severine@thebdri.com

[1] Bottlenose Dolphin Research Institute (BDRI), Avenida Beiramar 192, 36980 O Grove, Pontevedra, Spain

Published online: 06 March 2023

Methods

Between 2014 and 2021, the Bottlenose Dolphin Research Institute (BDRI; www.thebdri.com) conducted 581 boat-based observation surveys along the southern coast of Galicia (northwest Spain) to monitor cetacean species (Methion and Díaz López 2018, 2019). Upon sighting a cetacean group, the date, time, and position were recorded, and the group size and composition were estimated. Photographs and videos were taken for photo identification and behavioral analysis purposes using digital single-lens reflex cameras. Throughout the study, 13 Risso's dolphin groups were observed between the months of August to October. Group size ranged from 1 to 11 (mean = 6.5 ± SE 0.80), and groups were composed of 24% of dependent calves. Fifty-three individuals were photo identified of which 10 were recaptured on different years.

During the epimeletic event, we monitored the acoustic behavior of the care-giver dolphin with an omnidirectional hydrophone (frequency response of 0.02–100 kHz) and a digital recorder (sampling rate of 96 kHz) when the research vessel was between 10 and 20 m away from the dolphin, with the engine turned off (following Díaz López 2011). Following Díaz López and Shirai (2010), the acoustic recordings were analyzed using Spectrogram 6.2.3 software. During the epimeletic event and on a subsequent sighting, the time elapsed between two breaths and the time spent floating at the surface by the care-giver dolphin was also recorded.

Opportunistic observers, aboard recreational vessels, provided the BDRI with additional information (location, date, time, video recordings, and photographs) of the same dolphin with the deceased calf taken on September 23 and 24, 2020, south of Ons Island and the Ría de Vigo, respectively.

Results

On September 21, 2020, at 19:35 UTC, the corpse of a newborn Risso's dolphin was observed floating at the surface in the Ría de Arousa (Fig. 1). Given the external body conditions (i.e., bloated body and skin coloration), the calf had most likely been dead for less than 48 h (Geraci and Lounsbury 2005) (Fig. 2). Only one live adult Risso's dolphin (identified as GGR019) was present in the area, carrying the corpse. GGR019 had first been observed on September 26, 2018, in tight association with another dependent calf and had therefore been categorized as a female.

The behavior of GGR019 was monitored continuously for 90 min, and videos were taken on several occasions (video in Supplementary Information). GGR019 performed shallow dives only (< 1 m below the surface) of short duration (mean dive duration = 23 ± SE 1.7 s; minimum = 4 s; maximum = 62 s; $n = 76$) and was mostly observed floating at the surface (16 floating events, total floating time = 20 min, 38% of the total monitoring time). During the floating time, GGR019 breathed 32 times (minimum floating time = 10 s; maximum = 200 s, average = 70 s ± SE 15.3 s; $n = 16$). GGR019 was always either in direct body contact or in close proximity (< 0.5 m) to the corpse. On several occasions, GGR019 was observed pushing the calf's body away from any motor boats within a 50-m radius or carrying the body over her melon and lifting the body out of the water (Fig. 2).

Six acoustic recordings (min = 107 s, max = 759 s; total recording time = 1740s) were collected. No acoustic vocalizations (pulsed or frequency-modulated sounds) were detected, indicating a lack of sound production from GGR019 during the recordings.

The research vessel left the area at 21:05 UTC, and GGR019 was still carrying the deceased calf.

GGR019 was observed and filmed by opportunistic observers aboard recreational vessels on two different days after this first sighting: on September 23, 2020, at 9:30 UTC, south of the Island of Ons, and on September 24, 2020, at 16:00 UTC in the Ría de Vigo (20 km and 40 km from the first sighting location, respectively) (Fig. 2). During these events, GGR019 was still seen carrying the deceased calf.

On September 30, 2020, at 10:50 UTC, the BDRI research team observed GGR019 in the Ría de Arousa (40 km from the last sighting in the Ría de Vigo) accompanied by six adults and one dependent calf (including one adult already observed with GGR019 in 2018, and other newly identified dolphins) (Fig. 2). In this event, the deceased calf was not present. The breathing pattern of GGR019 was recorded for 39 min and included sequences of regular dives followed by flukes-up dives (mean dive duration = 33 ± SE 8.3 s; minimum = 3 s; maximum = 382 s; $n = 66$). The dives observed during this sighting were significantly longer than during the epimeletic event (mean dive duration = 33 ± SE 8.3 vs. 23 ± SE 1.7 s) (Mann–Whitney $z = -2.65$, $P = 0.008$), and no floating behavior was observed.

The deceased calf was last observed by the opportunistic observers on September 24, and the corpse was not retrieved.

Discussion

This study provides further evidence for epimeletic behavior in Risso's dolphins. This supporting behavior suggests a strong affective bond and reflects a well-developed sense of protection towards the calf. The period of infant dependency in Risso's dolphins is indeed characterized by intense maternal involvement and lasts for several years (Hartman et al. 2008). The presumed mother cared for her deceased calf by pushing the body to the

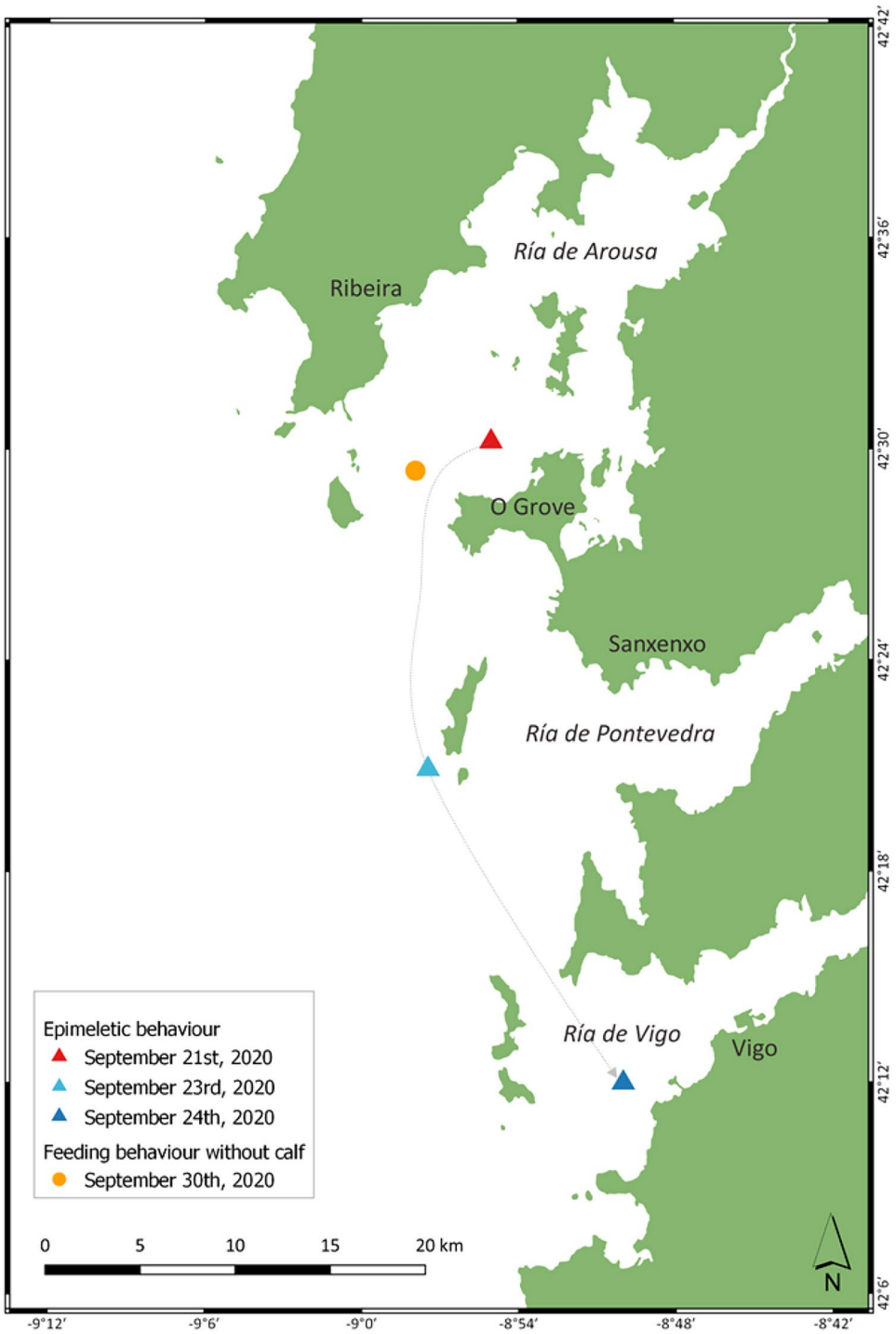

Fig. 1 Position and date of the sightings of the presumed mother with the deceased newborn calf (colored triangles) and after having lost or abandoned the deceased calf (orange dot)

surface, possibly to facilitate breathing (Krasnova et al. 2014), as the fitness cost of abandoning a temporarily unresponsive offspring would be high (Gonçalves and Biro 2018). We assumed that the adult carrying the carcass was the mother as this individual (i) was the only individual present in the area during the epimeletic event, (ii) was previously classified as an adult female due to its association with another calf 2 years earlier, and (iii) remained with the carcass for several consecutive days.

In cetaceans, the duration of epimeletic events has been reported to vary, lasting between less than a day (Alves et al. 2015) to 17 days (Shedd et al. 2020). Here, the presumed mother remained with her deceased calf for at least 5 consecutive days and then joined the group once more, probably after losing or finally abandoning the carcass. Postpartum amenorrhea in the Delphinidae family generally lasts around 6 to 32 months, but may be significantly shortened after a calf's death (Towers

Fig. 2 Presumed mother Risso's dolphin with a deceased newborn calf. **a** Floating in close proximity from the deceased calf. **b** Floating in physical contact with the deceased calf. **c** Pushing the deceased calf while swimming. **d** Carrying the deceased calf over the melon

et al. 2018). Because lactation ceases once an offspring dies, the mother's reproductive cycle returns. Such hormonal changes, which prepare the mother for the arrival of a new calf, may have contributed to the loss or abandonment of the calf remains.

Upon analyzing the acoustic recordings, no sounds (echolocation clicks or social signals) were detected that could be attributed to the dolphin exhibiting the epimeletic behavior. Contact calls are of particular importance between mothers and offspring to ensure proper parental care (Smolker et al. 1993). The lack of acoustic sounds directed at the dead calf during the recording could be attributed to the time elapsed since the calf died. Gonçalves and Biro (2018) indeed state that animals with large brains, complex social societies, and extended parental care share similar thanatological responses to dead individuals and may have a heightened awareness of death.

Grieving may have significant implications for the survival of the supporting individual due to an increase in energy expenditure, stress, increased exposure to predation risk, and lower foraging opportunities (Bearzi et al. 2017). Here, the presumed mother supported the carcass for at least 5 days without any observed feeding, which may have had potential consequences for her fitness. Likewise, swimming while carrying a dead calf represents a considerable energetic cost and most likely affected the energy budget (Noren et al. 2008). Lastly, the prolonged contact with the decomposing and potentially diseased carcass may be another example of the maladaptive aspects of the epimeletic behavior.

As direct observations are scarce in the wild, this study offers valuable information to better understand the occurrence of care-giving behavior in highly mobile marine top predators (Bearzi et al. 2017). Further information on the fitness of the care-giver and about the variability within species, populations, or individuals would be useful to better understand the socio-behavioral context of such events.

Acknowledgements The authors thank all the BDRI staff members and students who assisted with field observations and data transcription and also thank the persons that provided information about the observation of the adult Risso's dolphin carrying the deceased calf on September 23 and 24, 2020. Finally, the authors would like to thank the anonymous reviewers and the editor Emanuel Gonçalves for their constructive comments that helped improve the manuscript. Data collection complies with the current laws of Spain, the country in which it was performed. This research was conducted under various research permits, issued by the sub-directorate general for the protection of the sea in the Spanish Ministry for Ecological Transition and Demographic Challenge.

Author contribution Séverine Methion and Bruno Díaz López obtained the funding, designed the study, and collected the data in the field. Olga Mosca assisted with the field data collection in 2020 and 2021. Séverine Methion analyzed the data and wrote the manuscript. Bruno Díaz López and Olga Mosca reviewed the manuscript. Séverine Methion, Bruno Díaz López, and Olga Mosca read and approved the final manuscript.

Funding This research is part of a long-term study supported by the funding from the Bottlenose Dolphin Research Institute (www.thebdri.com).

Data availability Data will be provided under request.

Code availability Not applicable.

Declarations

Ethics approval and consent to participate This is an observational study, and no ethical approval was required. Consent to participate is not applicable.

Consent for publication All authors consent to publish.

Competing interests The author declares no competing interests.

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