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## Postmortem attentive behaviour in Indian Ocean humpback dolphins (*Sousa plumbea*)

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**Postmortem attentive behaviour (PAB) has been recorded across several mammalian species. Here, we document two instances of PAB in the Indian Ocean humpback dolphin (*Sousa plumbea*) along the Sindhudurg coast in Maharashtra, India. We describe the subsequent behaviours displayed by the care-giving individuals and other group members. In both cases, an adult ‘postmortem attender’, was observed to support and erratically move around a dead calf. In the second case, the adult–calf pair was escorted by a second adult individual. An examination of the carcass in the first instance revealed blunt force trauma under the right flipper of the calf. These findings suggest that closely associated group members may be distressed by injury to or death of an offspring and stress the importance of long-term behavioural studies. We also discuss the evolutionary significance of PAB in the larger context of social behaviour across mammalian groups and the importance of cataloguing these incidents.**

**Keywords:** Epimeletic care, mammalian species, post-mortem attentive behaviour, social behaviour, *Sousa plumbea*.

SEVERAL species of animals, other than humans, exhibit complex, often ritualistic responses towards dead or dying conspecifics<sup>1</sup>. These responses range from aggression, sexual display and play (in pilot whales<sup>2</sup> and chimpanzees<sup>3</sup>), to curiosity and exploration (in chimpanzees<sup>3</sup>), removal of the carcasses (in rats<sup>4</sup>), group distress (in chimpanzees<sup>5,6</sup>), cannibalism (in orangutans<sup>7</sup>), and epimeletic care (in chimpanzees<sup>3,6,8</sup> and marmosets<sup>9</sup>). Epimeletic behaviour, is defined as the care or attention directed towards an enfeebled or a dead conspecific<sup>10</sup>. It has been recorded across a range of terrestrial and marine mammalian species, including non-human primates<sup>6,11</sup>, giraffes<sup>12</sup>, elephants<sup>13</sup>, canids<sup>14</sup>, otters<sup>15</sup>, manatees<sup>16</sup> and

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cetaceans<sup>17</sup>. Caldwell and Caldwell<sup>18</sup> further classified epimeletic behaviour into 'nurturant' behaviour, where mothers care for their offspring and newborn calves and 'succorant' behaviour, where care is extended to weak or injured group members. Though Bearzi *et al.*<sup>19</sup> argued that these terms have inherent altruistic and empathic implications and may be presumptive, and coined the terminology 'postmortem attentive behaviour' (PAB) when referring to behaviour directed at a dead conspecific, 'postmortem attender' (PA) as an individual displaying these responses and 'bystanders', viz. conspecifics in the immediate vicinity, but not engaged in PAB<sup>19</sup>.

In cetaceans, PAB has been previously recorded in 20 of 88 extant species and is reportedly more prevalent in odontocetes (toothed cetaceans) than in mysticetes (baleen whales)<sup>19</sup>. Of the 78 reported cases in cetaceans, most records of this behaviour (92%) are from delphinids, of which two genera, viz. *Sousa* and *Tursiops* make for more than half (55%) the cases<sup>19</sup>.

Here, we document two events of PAB in the Indian Ocean humpback dolphins (*Sousa plumbea*), off the Sindhudurg coast in Maharashtra on the west coast of India (Figure 1). Though previously reported in this genus, to the best of our knowledge there are no previous records of PAB for this species.



**Figure 1.** Map of the study area with location of the two observations.

The Indian Ocean humpback dolphins are found along the west coast of India in shallow inshore and estuarine areas<sup>20</sup>. Along the Sindhudurg coast, humpback dolphins occur in group sizes ranging from 1 to 120 individuals (mean group size 13.1, MS *et al.* unpublished). The behavioural observations described here were made during line transect and photo-identification surveys to record inshore cetacean diversity, abundance and distribution in Sindhudurg between November 2014 and May 2017.

A 12 m boat with an on-board 32 HP diesel engine was used for these surveys. At each sighting of a dolphin group, the location relative to the line transect was recorded. The survey then went off effort to follow the group for photo-identification. The vessel approach was restricted to a distance of 20–30 m from and parallel to the group. During photo-identification, behavioural observations were collected *ad libitum* to understand overall group activity<sup>21,22</sup>. Focal group follows were conducted between 10 and 15 min on an average, and behavioural events were recorded every 2 min by continuous scan sampling.

Case I: An adult individual with a dead calf was observed off the coast of Talashil (N16 06.906, E73 27.066) (Figure 1) on 20 October 2014 at 14:29 h (duration: 11 min, off transect effort). The calf was spotted afloat about 700 m from the shore and at a depth of 9.2 m. An adult individual was seen swimming erratically and surfacing intermittently within about 10 m of the calf. The adult took short dives and resurfaced close to the calf continually. A sub-group of about 24 individuals (minimum 21, maximum 24) was observed ~100 m north of the calf. At 14:40 h, the adult was observed to move away from the carcass and towards the rest of the pod. We waited for 15 min to observe if the adult would reappear near the carcass and as the group was observed heading away, the calf was retrieved for a necropsy.

The carcass showed little signs of decomposition. The calf was male, 125 cm in length and 17 kg in weight. The teeth were unerupted, and milk was observed in the gastrointestinal tract showing it was still a dependent<sup>23</sup>. There was haemorrhaging on the lateral side of the body under the right flipper (Figure 2 a), probably from a blunt force trauma and could have been the cause of death. An internal examination showed a perforated left lung with some scar tissue and haemorrhaging of the pericardium, corresponding to the external discoloration of the skin. The flippers, snout and fluke showed multiple shallow rake marks (Figure 2 b and c). It could not be clearly determined if the rake marks were antemortem, perimortem or postmortem.

The presence of scar tissue on the left lung suggested that the calf had survived for some time after the injury and may have had difficulty in breathing. The rake marks on the rostrum, dorsal fin, tail fluke and flippers may have resulted from other group members trying to assist the calf to stay afloat<sup>24,25</sup>. Another possibility could be

that the dead calf was being moved away from the mother by other members of the group, as has been observed in many other cetaceans<sup>26</sup>. Based on the haemorrhaging patterns, the calf could also have been a victim of intraspecific male aggression<sup>27</sup>, either harassed or attacked by other adult male dolphins within the group, or caught in a fight between two adult males<sup>28,29</sup>.

Case II: On 6 December 2014, at 12:31 h, the carcass of a calf was seen floating about 20 m away from a group of 32 dolphins, dispersed in four sub-groups of 7–8 individuals each (minimum 32, maximum 38). This group was sighted at a depth of 8.8 m and a distance of 1.31 km from shore near Shiroda (N15 45.595, E73 38.946) (Figure 1). One adult individual was observed to move erratically around the calf, trying to raise it to the surface on its back, rostrum and melon (Figure 3 a) (duration: 22 min, off transect effort). A second adult was then seen swimming around this pair, surfacing intermittently, escorting the other adult individual. The two adults were later swimming on either side of the calf (Figure 3 b). The ventral portion of the carcass was exposed, and showed signs of slight decomposition and gas build-up with a distended body cavity. The penis was seen protruding out of the genital slit, confirming the sex of the calf. Four tightly associated sub-groups of about 7–8 animals each were scattered around these three individuals. These sub-groups were composed of adults with two calves and three juveniles. Two of the sub-groups, within 10 m of the calf, were engaged in intense surface activity. Mating chases and sexual display behaviour were observed in one of the closer sub-groups. Courtship or mating-like behaviour was observed in the second sub-group, where 4–5 individuals were seen engaged in continued bodily contact with almost half of their bodies above water, rolling vigorously on the surface. The carcass was not retrieved for a postmortem examination to avoid disturbing the group, as the group members were within close proximity to the calf throughout the duration of observation.

In both these instances, PAB was observed in the adult–calf pairs. In case II, a second PA was associated with the adult–calf pair (Ritter<sup>30</sup> described such individuals as an ‘escort’), swimming in tandem and intermittently in contact with the other adult near the calf. Intense socializing was observed in the two sub-groups of ‘bystanders’ in this case. Such social activity among conspecifics elicited by epimeletic care has been noted earlier by Caldwell and Caldwell<sup>18</sup>. Sexual activity has also been observed directed towards dead individuals in bottlenose dolphins<sup>31</sup>.

The sex of the PAs in both these instances could not be confirmed. In cetaceans, in cases of PAB with calves, the PAs are assumed to be the mothers, due to the relatively prolonged periods of parental care and juvenile development<sup>32–34</sup>. However, males have also been reported to be PAs in certain species (short-finned pilot whales<sup>35</sup> and bottlenose dolphins<sup>36</sup>). Given that both the individuals in

these cases reported above were calves, and that crèche groups are common in the waters of Sindhudurg (K.J., pers. obs.), the probability of the PAs being females is high.

The evolution of PAB in mammals still remains rather unclear<sup>19,37</sup>. It can be argued that PAB appears maladaptive, in that, prolonged contact with carcasses could increase the risk of infections and, in cases of multiple progeny, it could also lead to the surviving offspring being ignored<sup>38</sup>. Such a response may also reduce individual fitness via reallocation of time and energy that might have been otherwise utilized in feeding or other beneficial purposes<sup>39</sup>. On the other hand, where conspecifics may be uncertain of the condition of the afflicted group member and whether to abandon it or not, such a ‘wait and see’ strategy<sup>14</sup> could be advantageous if



**Figure 2.** Case I: *Sousa plumbea* carcass observed on 20 October 2014. **a**, Haemorrhaging observed under the right flipper. **b**, **c**, Rake marks on the snout and tail fluke respectively.



**Figure 3.** Case II: *S. plumbea* carcass observed on 6 December 2014. **a**, Adult individual raising the calf on its back. **b**, A second adult individual, ‘escort’, joining the adult–calf pair.

weakened individuals sometimes recover and to ensure their safety from predators<sup>40</sup>.

In Japanese macaques (*Macaca fuscata*) the age of the infant was seen to be a major factor in determining if PAB was shown by the mother<sup>39</sup>. PAB was significantly more likely for infants that had survived between 1 and 30 days than for those that died on the day they were born, or for those survived for more than 30 days. On an average, the duration of PAB was 3.3 days (minimum 1; maximum 17; SD 2.7).

In cetaceans, such detailed observations are rare<sup>17,19,35</sup>. The duration of PAB can only be inferred depending on the state of the carcass. Some odontocetes have been observed to carry calves in an advanced state of decomposition, sometimes even flaccid remains beyond recognition or body parts, therefore leading to the conjecture that this duration may be several weeks<sup>35</sup>. The reasons for this protracted PAB is speculated to be due to the strong mother–calf bonds, high mortality rates of calves, buoyancy and small size of the carcasses, density of water making carcasses energetically easy to carry, and the perceived lack of olfactory and taste receptors in cetaceans<sup>17,19,30,35</sup>.

Most cetacean species exhibiting PAB are gregarious, exhibit strong social attachments, particularly mother–infant bonds<sup>19,41</sup>, and display alloparental care<sup>19,42</sup>. Often non-parent females have been seen interacting with the carcass, despite the presence of the mother of the deceased in the vicinity<sup>19,24</sup>. PAB could therefore be an extension of kin recognition<sup>43</sup> and kin survival<sup>35,44</sup>. Evolutionarily, PAB could also be an emotional response of mothers unable to comprehend the death of their offspring<sup>19,45</sup>. This argument is supported by observations in captivity where upon the removal of a dead infant from the enclosure the mothers have taken an inanimate surrogate<sup>46,47</sup>. Behavioural responses to death could therefore be a form of mourning, an artefact of the complex social structures in gregarious and highly cooperative mammalian species<sup>48</sup>.

These observations, although anecdotal in nature, highlight the importance of long-term studies on the behaviour of humpback dolphins. Both these cases suggest that the resident humpback dolphin population along the coast of Sindhudurg probably lives in a complex society with nuanced social behaviours and strong associations among pod members. Moreover, it appears that closely associated individuals may be affected or distressed by injury to or death of a newborn. Mother–infant dependence and alloparental care could be the drivers of the observed behavioural responses to death. A detailed long-term photo-identification study, sex ratio estimation and social structure analysis would help us better understand their society, behavioural patterns and particularly the role of adults in the larger context of evolving social behaviour. Understanding the proximate and ultimate causes of this phenomenon and comparing this behaviour

across marine mammal species would provide insights into its evolution.

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## Occurrence of a cyprinid fish (Leuciscinae) from latest Neogene (?Pliocene) sediments of Chotanagpur plateau, eastern India

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**A compressed fossil fish bearing close resemblance to sub-family Leuciscinae (family: Cyprinidae) is reported from latest Neogene (?Pliocene) sediments of Chotanagpur plateau, eastern India. The recovered fossil fish contains exceptionally well-preserved skeleton. It**

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