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DRONE-RECORDED AGGRESSIVE BEHAVIOR TOWARD A MOTHER-CALF PAIR OF GUIANA DOLPHINS (*SOTALIA GUIANENSIS*) IN SOUTHEASTERN BRAZIL: A RARE BEHAVIORAL OBSERVATION

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Abstract. Cetaceans exhibit complex social behaviors, ranging from cooperation to aggression. In situations of resource scarcity or reproductive competition, males may attack females with calves to induce the return of the estrous cycle, a behavior that has already been documented in several odontocete species. For Guiana dolphins (*Sotalia guianensis*), this type of aggression is rare and has been documented only once in Sepetiba Bay (Rio de Janeiro, Brazil) through direct observation. In April 2024, a new episode was recorded, when four adults chased a mother and her calf, with attempted copulation and physical aggression. The use of drones was essential for obtaining a detailed description of the interaction. This record highlights the need to investigate the ecological factors underlying this behavior in Guiana dolphins, while also demonstrating the

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potential of remote monitoring technologies to expand the knowledge of their behavioral ecology.

Keywords: Agonistic behavior, maternal care, estuarine dolphin, aerial image

Cetaceans have a wide range of intraspecific behaviors underlying their complex social life, which can involve either cooperative or aggressive interactions (Cantor & Whitehead 2013). When the energetic cost of cooperation is lower than the benefit gained, cooperation may tend to persist as an adaptive advantage, e.g., the coordination of feeding tactics and male alliances to access adult females.

On the other hand, when resource availability is scarce, aggressive or competitive behaviors between individuals may occur. A special case where resource availability may be altered by individuals is that of males mating access to reproductive females. While adult females paired with calves are often unavailable for reproduction, the exclusion of calves by infanticide or permanent separation induces the female to resume her estrous cycle sooner than expected considering the time spent with parental care. Under these conditions, sexually active males may exhibit aggression toward females accompanied by newborns (Dunn 2002, Kaplan et al. 2009, Robinson 2014, Da Silva et al. 2021).

This behavior is more commonly reported for odontocetes and is most commonly practiced by bottlenose dolphins (*Tursiops truncatus*) (Ramos et al. 2022), but has been observed in dusky dolphins (*Lagenorhynchus obscurus*) (Orbach et al. 2015), orcas (*Orcinus orca*) (Towers et al. 2018), Amazon river dolphins (*Inia geoffrensis*) (Da Silva et al. 2021) and Pacific white-sided dolphins (*Lagenorhynchus obliquidens*) (Rosser et al. 2022). For bottlenose dolphins (*Tursiops truncatus*), for example, mating access involves complex nested alliances, acoustic coordination between cooperative males and aggressive behaviors toward the mother-calf pair (Connor et al. 2000, Connor et al. 2017, King et al. 2019). This aggression can result in several physical injuries (Robinson 2014), unconsciousness (Ramos et al. 2022) and, in extreme cases, obit, especially for the calf (Parsons et al. 2003). Aggressive behavior directed toward the

mother-calf pair was recorded in 2006 only once for Guiana dolphins, *Sotalia guianensis*, through direct observation and photographic records in Sepetiba Bay, Southeastern Brazil (Nery & Simão 2009).

Sepetiba Bay, located in Rio de Janeiro state, southeast Brazil (23.02059° S, 43.77845° W), is a shallow semi-enclosed estuarine area where the depth reaches 30 m and is composed of islands and islets, rocky cliffs, mangroves and intertidal wetlands (Araújo et al. 2002). This bay harbors one of the largest populations of Guiana dolphins (Simão et al. 2000) and is considered an important nursery area, with groups frequently presenting mother-calves' pairs (Oliveira et al. 2013, Maciel et al. 2023). However, over the past decade, multiple anthropogenic stressors have contributed to a reported reduction of more than 60% in group size, 80% in whistle rates and a sharp reduction in socio-sexual interactions, with some individuals exhibiting poor body condition, aspects measured through monitoring carried out for more than 20 years in Sepetiba Bay, compared with historical data (1998–2007) and current data (2017–2019) (Maciel et al. 2023, Silva et al. 2024).

This study is part of a long-term Guiana dolphin monitoring program in which a 12-meter-long boat was used to search for dolphins, following a pre-established route at an average speed of 15 km/h. We used the 'focal group' protocol to sample groups, recording information on behavioral states and events at 10-min intervals (Mann 1999).

Our behavioral observations were carried out with an Unmanned Aircraft (UA), commonly known as drone, DJI MavicPro (1 / 2,3 CMOS sensor, 4k resolution (3840 x 2160 pixels), at 3 frames per second (fps) and 78.8º field- of-view (FOV). The drone camera was positioned at a 90-degree downward angle, aiming to have a lower distortion of the image and the ability to view the animals on the subsurface. Each 15-minute flight began as soon as a group was seen, and we positioned the drone at a height of 25 meters and always kept it in line of sight (VLOS). The recorded groups were georeferenced using the in-built GPS system of the drone.

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We recorded an aggressive behavior led by four adults, probably males, toward a mother-calf pair on April 4th, 2024, at 9:37 AM. We recorded a 3-minute and 52-second video, during which the pursuit lasted for 30 seconds. Four individuals pursued the pair, with one of the adults remaining at a distance of less than one body distance from the mother-calf pair (Figure 1A). One of the individuals approached the mother-calf pair, trying to hit the fluke on the individual accompanied by the calf, considered from that moment on as a potential mother (Figure 1B).

During the pursuit, we observed at least one attempt of copulation by an adult male, in which the male dives bellow the female with his belly up in a position known as 'belly-to-belly', followed by attempts of lobtailing the water and toward the potential female (Figure 1C). The pair escapes the aggression (Figure 1D) and seconds later, one of these four individuals attacked the calf (Figure 1E), which resulted in its separation from the mother for only two seconds (Figure 1F), as the calf quickly managed to escape the aggression and reunite with the mother again (Figure 1G and H).

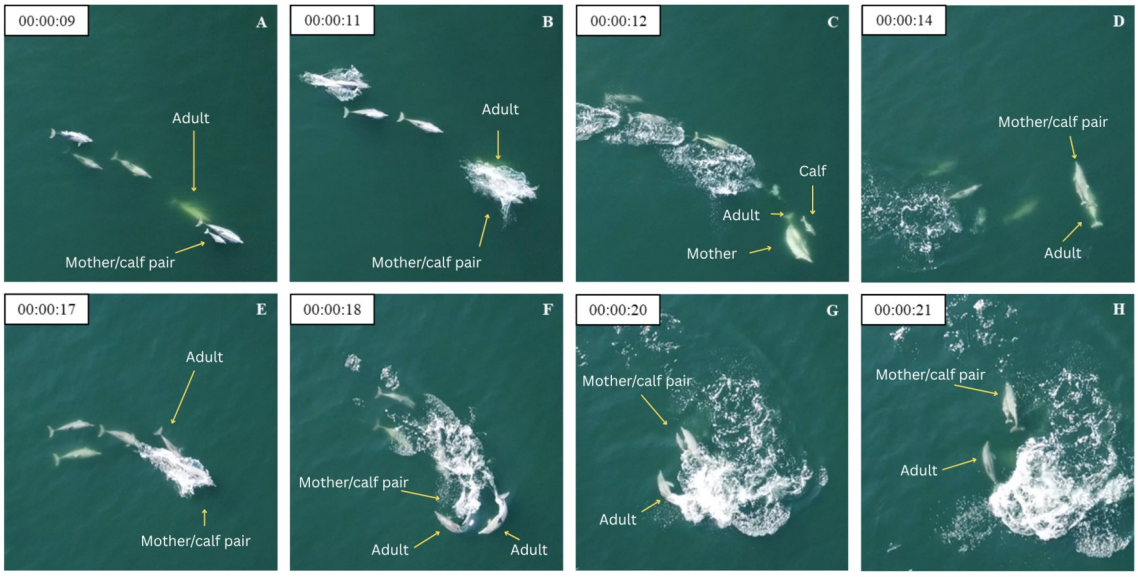

Figure 1. Images captured with an unmanned aircraft at the Sepetiba Bay, Rio de Janeiro state, southeast Brazil. Four Guiana dolphins (Sotalia guianensis), likely adult males, chasing a female with her calf, one male remains within one body length of the pair (A); the same male strikes the female's tail fluke, presumed to be the calf's mother (B); an unsuccessful attempt of copulation with the male positioning himself beneath the female in a "belly-to-belly" orientation, typical of cetacean sexual behavior (C); the pair escapes the aggression and resumes swimming (D); seconds later, one male attacks the calf, briefly separating it from its mother (~2 s) (E); the chase continues with persistent male aggression (F, G); the pair escapes again and is not observed thereafter (H).

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Sexual behavior (Figure 1C), such as belly-to-belly, was recorded on other sampling days in 2024 and other years with no aggressive interactions. This is usually what is described for the species (Flores 2002), and this behavior is most likely understudied and observed for the species, apart from the study of Nery and Simão (2009). Although most of the literature addresses the sexual selection hypothesis as a more plausible explanation for aggressive interactions directed at the mother-calf pair (Dunn 2002, Da Silva et al. 2021, Ronje et al. 2020, Ramos et al. 2022), the causes of this behavior are difficult to determine, whereas such observations in the wild are rare.

Detailed studies of Guiana dolphins' behavioral ecology are necessary to assess the ecological and evolutionary reasons behind this action. With low operational costs and ease of use, drones have become a popular tool for in situ data collection, offering an accessible, safe, and effective means of generating accurate and reliable data (Angliss et al. 2018, Yaney-Keller 2025). This technology enables broader wildlife monitoring and facilitates large-scale data collection (Nowak, Dziób & Bogawski 2018, Barreto et al. 2021). It is a non-invasive tool that does not compromise animal behavior, provided that safety parameters specific to each taxonomic group are respected (Bevan et al. 2018, Oleksyn et al. 2021). The behavior recorded by the drone in this study could not be observed in detail by the scientists on the boat, reinforcing its ability to capture a different perspective of the animal's behavior.

However, drones also present some disadvantages. Adverse environmental conditions, such as strong winds and precipitation, prevent the use of drones in outdoor environments. Additionally, limited battery autonomy results in relatively short flight times (Colefax, Butcher & Kelaher 2018). However, these same conditions would also compromise observers in the boat using cameras and/or binoculars.

The success of using this tool also depends on the behavior of the species being monitored and on water transparency, as animals can be observed whenever they surface; however, detections may be hindered by the animal's position within the water column. Therefore, standardized flight and data collection protocols, as well as the type of image

processing to be used, are essential. The water transparency in Sepetiba Bay is very limited (approximately 3m); however, our study showed that even under these conditions, critical behavioral information can be collected if the animals are at the surface.

This record reinforces the need to continue monitoring Guiana dolphin population using drones, contributing to the filling of gaps in knowledge concerning cryptic behaviors that are not yet fully described, such as courtship interactions, aggression directed at calves, and cooperation among potentially male individuals. Additionally, it is necessary to investigate potential social, environmental, and anthropogenic factors that may be involved in aggressive behaviors.

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