Short Communication

# Franciscana's (Pontoporia blainvillei) Diving and Surface Times Through Drone Monitoring

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**The franciscana dolphin (*Pontoporia blainvillei*), a small cetacean native to the Southwestern Atlantic Ocean (SAO), is critically threatened by bycatch in gillnet fisheries and habitat degradation. The Franciscana Management Area (FMA) Ia, located in Espírito Santo, Brazil, harbors the most endangered population of small cetaceans in the SAO. The Doce River region represents a vital habitat for this species, particularly following the 2015 mining waste spill, which further disrupted local ecosystems. Through drone-based monitoring, this study investigates the diving and surface behavior of franciscana dolphins, providing valuable insights for refining population estimates and advancing conservation strategies. The average surface time was 17 seconds (±15s), and the average dive time was 64 seconds (±26s). The diving time was almost four times longer than the surface time. These findings underscore the importance of ongoing monitoring to support effective management of this vulnerable population.**

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The franciscana dolphin (*Pontoporia blainvillei*) is a small cetacean species endemic to the Southwestern Atlantic Ocean (SAO), specifically found in Brazil, Uruguay, and Argentina (Crespo, 2009), and in coastal waters and estuarine habitats up to 30 meters deep[1]. The species is considered the most threatened small cetacean in the SAO, primarily due to bycatch in gillnet fisheries[2][3].

Habitat degradation also poses a significant threat to the survival of franciscana[4], which are classified as 'vulnerable' on the IUCN Red List of Threatened Species[5] and Critically Endangered on the Brazilian Red List (MMA, 2014).

Four management areas were established across its distribution to regulate human activities and protect this species, known as Franciscana Management Areas (FMAs). The population in Espírito Santo is referred to as FMA I[6], representing the species' northernmost distribution. Mitochondrial DNA (mtDNA) analysis indicates that individuals from this region form a genetically isolated population, further classified as FMA Ia.[7]. Recently, it has been proposed that this population should be classified as a new subspecies: *Pontoporia blainvillei pukusi*[3]. Population estimates indicate that the FMA Ia consists of 1,183 franciscana individuals, primarily concentrated south of the Doce River[8][9]. However, information regarding its behavioral ecology remains scarce due to the considerable difficulty in observing this species in its natural environment (Crespo, 2009).

The marine area adjacent to the mouth of the Doce River in Linhares, located on the northern coast of Espírito Santo (ES), is considered a priority area for biodiversity conservation, with extremely high biological importance[10][11]. It is the habitat of several endangered species[12][13][14]. In 2015, over 50 million cubic meters of mining waste were discharged into the Doce River basin[15], exacerbating the ecological damage experienced by species inhabiting the region[16][17]. Due to the heightened vulnerability of this population, primarily resulting from low genetic variability, which makes it more susceptible to impacts, it is essential to understand the patterns of use of the Doce River estuary by franciscana dolphins. This study provides novel information on the species' dive and surface times, contributing valuable data for population estimates in FMA Ia.

Drone flights (n = 1,655) were conducted between October 2018 and June 2023. Data collection was part of the Aquatic Biodiversity Monitoring Program of Environmental Area I – Capixaba Portion of the Doce River and Adjacent Marine and Coastal Region[18]. For the surveys, fixed points were established for drone take-off to capture aerial footage of franciscana dolphins in coastal environments. The drone monitoring sampling design covered a 3 km radius, with a sweep area of 4 $km^2$ per flight. With monthly sampling, 30 systematic flights were carried out at three designated locations: Doce, Comboios, and Piraquê-Açu. The flight pattern was designed to maximize the detectability of marine megafauna, covering the largest sweep area possible[19].

Video samples were collected in 4k 30fps format using a drone and analyzed in the laboratory by at least two experienced researchers. During the monitoring period, 106 franciscana dolphin groups were recorded. Videos were selected in which franciscana specimens were observed for at least one full dive or surface cycle, allowing the same individual to be observed from emersion to submersion or vice versa. Among the groups monitored, 217 surface times and 59 dive times were evaluated. The minimum time spent by an individual at the surface was 2 seconds, with a maximum of 83 seconds. The average surface time was 17 seconds (±15s). For dives, the minimum time was 7 seconds, with a maximum of 124 seconds, and the average dive time was 64 seconds (±26s). Dive time was nearly four times longer than surface time.

Despite the wide variation in values observed during diving and surface behaviors, the time franciscana dolphins spend diving is significantly greater than at the surface ($p \leq 0.05$), according to the non-parametric Mann-Whitney test. Figure 1 shows the probability distribution of times, illustrating how the durations are distributed across different intervals. The widest portion of the violin plot indicates where data points are most concentrated, surrounding a statistical summary (box plot). The central line represents the median dive times (blue) and surface times (green), with the box edges representing the lower and upper quartiles, or the 25%-75% range of recorded values. The whiskers extending from the box show the entire data range, displaying the minimum and maximum times for diving and surface intervals, excluding outliers.

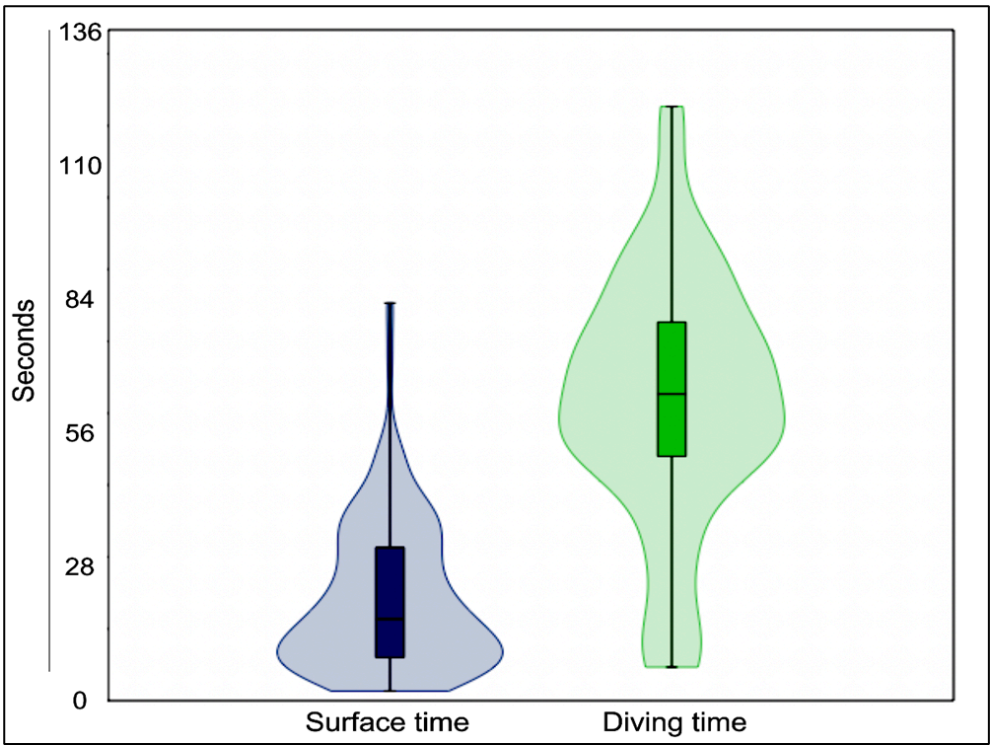


**Figure 1.** Time allocation for franciscana dolphin activities at the Doce River estuary, FMA Ia, on Brazil's southeastern coast. The violin plot outline (blue for Surface time and green for Diving time) indicates the density distribution of times (in seconds). The median, quartiles, and whiskers are displayed within the plot as a box plot.

This graph allows for comparing the distribution and variability of surface and dive times, with dive times being more dispersed and generally longer than the time spent at the surface. Franciscana dolphins exhibit a limited behavioral repertoire, especially at the surface, and their dives are typically brief, becoming longer during foraging activities[20][21]. In a study by Bordino et al.[20], conducted in colder waters off the coast of Argentina, the average dive time observed was 21.7 seconds (±19.7). In contrast, Sucunza et al.[22] found longer dive times along Brazil's southeastern coast, with an average dive time of 39.77 seconds (±29.06) in the turbid waters of Babitonga Bay and 77.26 seconds (±19.98) in the more transparent waters of Ubatuba. Small groups engaged in foraging behavior tend to spend more time at the surface[20][21], which may have contributed to the longer dive times observed in groups at the mouth of the Doce River (64 seconds), as these groups are often small and foraging[23][19]. The dive time pattern observed in ES was similar to that of Babitonga[22], and perhaps the explanation could also be related to the similarity of the water, both with high levels of turbidity.

For the first time, dive times for franciscana dolphins have been documented using high-resolution video sample analysis, a key feature of drone monitoring[24]. This information is crucial for determining species availability rates with greater reliability in the collected data, especially for population estimates conducted through systematic drone monitoring. Additionally, the study of the diving and surface cycle is essential as a basis for obtaining bioenergetic information and, consequently, population health data, considering that the management of submerged time is directly related to oxygen reserves and metabolic rates, factors that influence foraging efficiency and habitat use[25]. Based on the results obtained in this study, we intend to estimate the abundance of franciscana dolphins in FMA Ia through drone-assisted surveys in all seasons to better understand the seasonal patterns of use of the Rio Doce estuary, which has already been observed in this region (Barreto et al., submitted).

## Statements and Declarations

**Author contributions**: Conceptualization: A.M., J.B., A.J.V. Data curation: A.M., J.B., A.J.V. Formal analysis: J.B., A.J.V. Funding acquisition: A.M. Investigation: J.B., A.M., A.J.V, C.X., C.R., V.T., M.E.R., L.S.H., N.B., A.G., J.B.T. Methodology: A.M., J.B., A.J.V. Project administration: A.M., J.B.T., Supervision: A.M., J.B.T. Validation: A.M., J.B.T. Writing – original draft: J.B., A.J.V., A.M. Writing – review & editing: J.B., A.M., A.J.V, C.X., C.R., V.T., M.E.R., L.S.H., J.B.F., D.V., S.A.

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## Declarations

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