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Habitat use of *Delphinus delphis* (Linnaeus, 1758) in the southern waters of Samos island (Aegean Sea, Greece)

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Abstract – **The Mediterranean short-beaked common dolphin, *Delphinus delphis* (Linnaeus, 1758) is classified as "Endangered" by the IUCN Red List. Living in coastal waters, *D. delphis* is often exposed to human activities. In the southern water of Samos Island (Aegean Sea, Greece). *D. delphis* population is less exposed with anthropogenic activities. For that reason, it is important to have a better understanding of the critical habitats in this area to implement effective measures of protection. The analysis of distribution and behavioural data allow to determine the presence of 2 feeding areas, 1 traveling area, and 1 socializing area. The traveling area corresponds to a zone where dolphins move among the other areas. The analysis of dolphin behaviour shows that *D. delphis* interacts positively to boat presence in all areas. Particularly. Having a better understanding of the environmental data in this area could allowed a better comprehension of the *D. delphis* behaviour.**

I. INTRODUCTION

The short-beaked common dolphin, *Delphinus delphis* (Linnaeus, 1758) is a pelagic species occurring over the continental shelf and beyond [1]. But its habitat preferences change following the area where it lives. In the Mediterranean Sea, the short-beaked common dolphin is found in pelagic and neritic waters [2]. In Greek waters, it is found in coastal areas, straits, gulfs, semi-closed eutrophic waters and steep coasts with no continental shelf [2]. In the Aegean Sea, the most important habitat in terms of number of animal present seems to be the Thracian Sea. Short-beaked common dolphins seem to be present in most of the shallow (<200 m) coastal waters of the Aegean, north of the Cyclades. They are present in Saronikos Gulf, Hydra Island and neighbouring islets and Northern Sporades. They have been recorded in the northern Dodecanese. In the Southern Samos region, the distribution for short-beaked common dolphins occurs primarily in depth from about 40-100 m, indicating populations to prefer coastal or shallower waters [3].
By this repartition, it often overlaps with human activities such as fisheries or tourism activities. Moreover, it is shown that vessel presence is influencing *D.delphis´* behaviour [4].
Unfortunately, this species has faced a dramatic numerical decline during the last decades and has almost completely disappeared from a large portion of the Mediterranean Sea [2]. For that reason *D.delphis* is classified as "Endangered" in the Mediterranean Sea by IUCN experts [5]. Overfishing has caused a continuous decline of fish biomass in the Greek Seas since the mid-90s [6]. Therefore, the population trend is likely negative in many or most parts of the Greek Seas. The rate of population decrease may vary from one area to another. In any case, if this rate is similar to the one recorded for the population unit of the inner Ionian Sea during the last decade [7], then the species could rapidly disappear from the Greek Seas.
Moreover, the short-beaked common dolphin is a poorly known species [2]. For that reason, studying animal behaviour has a significant role to play in conservation [8]. Changes in behavioural pattern can be used as an early indicator of the impact of human activities and can help wildlife management adopt appropriate conservation measures to reduce the consequences of disturbance and population vulnerability [9].
It is within this framework that this study is implemented. Indeed, waters off the south of Samos Island are an eligible habitat for *D. delphis* with encounter rates values higher than the Alborán Sea, in the waters off Ischia Island, in the Inner Ionian Sea Archipelago, and in the Thracian Sea [10]. The aim of this study is to determine the habits of common dolphins and how they interact with human activities in the waters in the south of Samos island in Greece.

II. METHODS

From February 2017 to November 2018, surveys are realized in the southern waters of Samos Island an Aegean-Septentrional district of Greece. The starting point of each survey is the Marina Bay of Pythagorio located latitude 37°41'N and longitude 26°57'E. This area is particular as, it has a gentle slope between 0% and 8% (General Bathymetric Chart of the Oceans data, 2014). This area also has shallow waters, with a depth up to 90 meters (GEBCO data, 2014).

Fig. 1. Map of Samos area and study areas. The black star represents the starting point.

The boat traffic is also light during the entire year and there are no tour boats to see dolphins. A research vessel is used. The mean speed of the boat was around 7-8 knots during the survey which is reduced in the presence of dolphins. Sudden speed or directional changes are avoided.
A random line transect method is adopted. Surveys are conducted during standard weather conditions: wind intensity and sea state not exceeding 3 on the Beaufort and Douglas scale. When dolphins are spotted, the observer in charge of taking data, fills out the data sheet each 3 minutes and performs a scanning. A scanning includes to check: behavioural states, behavioural events, reaction with boats, dolphin distance to boats, diving time, dolphins speed, group number, boats around dolphins and season.

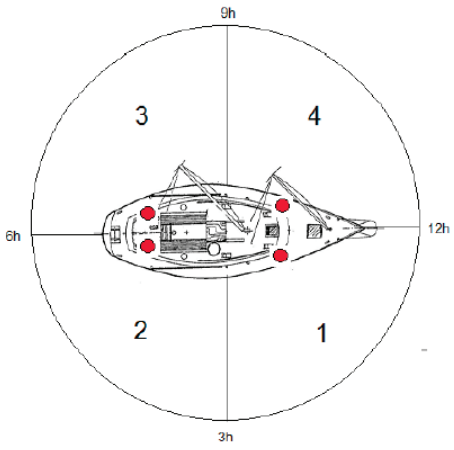

Fig. 2. Schema of the disposition of the observers on the boat. Red dots represent an observer.

Concerning dolphin reaction, according to [11], short-term behavioural reactions to the presence of a vessel can be categorized as positive (animals stop their current activity to approach the boat), negative (animals change their behaviour moving away from the source of disturbance) and neutral (animals continue their current activity or their route without notable changes. A class of the distance of boats to the dolphins is indicated. Close (C) if boats are between 0 and 200 m to the dolphins or far (F) if boats are more than 200 m to the dolphins as suggested by [12].
An ethogram of behavioural states and events is used to describe the behaviour of common dolphin. According to [13], a behavioural event is a short duration behaviour in which the most common measure is the occurrence of each event. Under this classification, several events may occur inside a single behavioural state. A behavioural state is a long duration behaviour in which the most common measure is the duration of this behaviour.
Here are the definitions suggested by [14] for the different behavioural states used during the scanning.
Resting: The dolphins stay close to the surface and close to each other. They surface at regular intervals in a coordinated fashion, either not propelling themselves at all, or moving very slowly forward.
Traveling: The dolphins propel themselves along at a sustained speed, all are headed in the same direction, and they make noticeable headway along a consistent compass bearing.
Feeding: The dolphins are seen either capturing fish or pursuing fish. The herding of fish is also included in this category as it is invariably followed by at least some fish captures.
Socialising: Any physical interactions that took place among the members of a group (except mothers and calves). These vary from chasing each other, to body contact and copulation. This is often accompanied by aerial behaviour.

III. RESULTS AND DISCUSSION

A. Habitat use and behaviour

A total of 150 surveys are carried out in an area of 1834 km^2. 84 sightings are realised. Three different type of area are defined by the observed behavioural contexts: 1 traveling zone (300 km^2), 2 feeding zones (11 and 7 km^2), 1 socialising area (37 km^2). This study shows that *D. delphis* is more observed in traveling (64%, n=47) and feeding (25%, n=19). Comparable results are found in the study of [13] with dolphins spending 54.8% their time traveling and 17% feeding. He explains that seasonal and daily distribution of the dolphin is governed by the availability and the distribution of prey. As food resources are not uniformly distributed throughout the environment, dolphins have to travel from one place to another to find a feeding area. This may explain the importance of the traveling state. However, as few information are available concerning the foraging activity of *D.delphis* [2], it could be interesting to study more in detail these two feeding areas in order to determine with this species select these areas. Socialising (5%, n=4) and resting (5%, n=4) are less observed. As suggest [15], other activities can be assumed to become more frequent, only after nutritional needs have been satisfied.

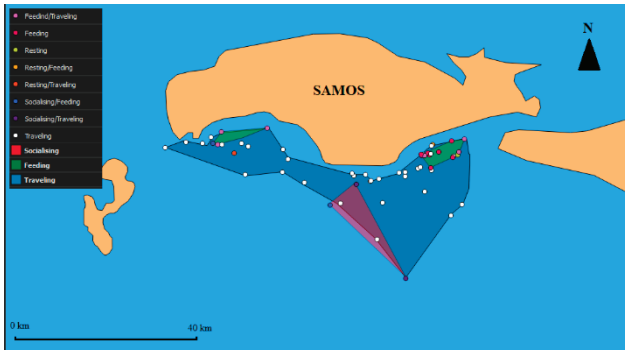

Fig: 3. Habitat use of D. delphis *in the southern waters of Samos Island (Aegean Sea, Greece).*

B. Group size and behaviour

Short-beaked common dolphin groups vary from 1 to 20 individuals. During the traveling state, group size varies from 1 to 20 individuals (μ= 7, sd=4.75). During the feeding state, group size varies from 2 to 20 individuals (μ= 9, sd=5.44). During the socialising state, group size varies from 4 to 20 individuals (μ= 8, sd=7.04). During the resting state, group size varies from 2 to 7 individuals (μ=4, sd=2.08).

A Shapiro-test is realized to check the normality of each states. For the traveling state, data are not normally distributed (W= 0.88 - α= 0.00019). For the feeding state, data are not normally distributed (W=0.87 - α= 0.0198). For the socialising state, data are normally distributed (W=0.83 - α= 0.1887). For the resting state, data are normally distributed (W=0.998 - α=0.995).

A Kruskal-Wallis test is realized to check if there is a significant difference in the group size during each state. Results show not significant differences between each state (χ^2= 5,7761 – df=3 - α=0.123). With more data it could be interesting to check if seasonality change group size of the short-beaked common dolphin

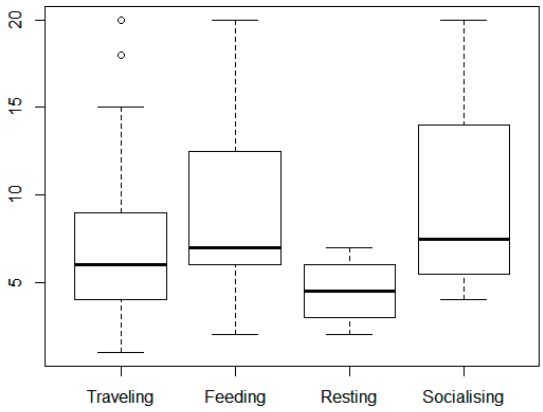

Fig. 4. Boxplot of the short-beaked common dolphin group size during each state.

C. Boat interactions

Concerning boat interactions, positive (49%) and neutral (41%) interactions are the most observed, whereas negative interactions are observed just in 10% of the sightings. The analysis of interaction with boats within each area shows that: 1) in the traveling zone, 50% of the interactions are positive, 44% are neutral and 6% are negative; 2) in the feeding zones, 53% of the interactions are positive, 42% are neutral and 5% are negative; 3) in the socialising zone, 100% of the interactions are positive. When dolphins are close to the research boat, more positive reactions were observed compared to negative reactions. This behaviour is most common with curious and playful juveniles [16] or with dolphins following fishing boats to take prey easily [17]. In [3] study, areas of high vessel presence for the short-beaked common dolphins occurred near the South-eastern region of Samos, near the marina. Here, this positive effect could be due to a familiarization of their environment. Animals show an ability to adapt to many phenomena, particularly if these appear gradually, like that suggested by [11]. However, different species do not all react in the same way to stimuli, and these reactions change gradually over time, constantly, with increased exposure to these activities [11]. Cumulative short-term responses to boats, either positive or negative, could have impacts on long term dolphin survival [18]. By either approaching or avoiding boats, dolphins may reduce the time they would spend socializing, feeding or resting causing decreased energy acquisition and increased energy expenditure [19], potentially leading to lower individual fitness, reproductive success and thus a less viable population.

IV. CONCLUSIONS

This study has shown that the short-beaked common dolphin spends most of their time feeding and traveling in the south of Samos Island and enlightens the presence of

two feeding areas. In order to have a better understanding of the food preferences of *D. delphis*, it could be interesting to study more in details the environmental characteristics of these feeding areas.

The short-beaked common dolphin group size does not change for each behavioural. Resting and socialising observation are very scares. Collecting more of these behavioural data could make this result stronger.

Concerning dolphin's reaction to boats, results are opposite to our expectations. Indeed, there is more positive interactions than negative with the research boat and others. This behaviour is probably due to a habituation by dolphins towards the research boat. Furthermore, boat presence still has a considerable impact on *D. delphis´* behaviour. Indeed, they are interrupting their current behavioural state to interact with boats in 49% of the cases. A further study should consider the impact of these interactions on the *D. delphis´* fitness.

REFERENCES

[1] Gaskin D.E (1992): Status of the common dolphin, *Delphinus delphis*, in Canada. Canadian Field Naturalist 106:55-63.

[2] Bearzi G., Reeves R.R., Notarbartolo Di Sciara G., Politi E., Canadas A., Frantzis A., Mussi B. (2003). Ecology, status and conservation of short- beaked common dolphins (*Delphinus delphis*) in the Mediterranean Sea. Mammal Review, 33(34): 224-252.

[3] Inch KM., Pietroluongo G., Hepburn LJ. (2018). Population Abundance, Distribution, and Socioeconomic Analysis of Delphinus delphis and Tursiops truncatus in Relation to Vessel Presence in the Eastern Aegean Sea. Journal of Marine Biology and Oceanography 7:2.

[4] Notarbartolo Di Sciara G., (2002). Cetacean species occuring in the Mediterranean and Black Seas: state of knowledge and conservation strategies. A report to the ACCOBAMS Secretariat, Monaco, February 2002. Section 3, 17 p.

[5] Bearzi G. (2012). *Delphinus delphis*, The IUCN Red List of Threatened species.

[6] Frantzis A, Alexiadou P, Paximadis G, Politi E, Gannier A and Corsini-Foka M (2003). Current knowledge of the cetacean fauna of the Greek Seas. Journal of Cetacean Research and Management 5: 219-232.

[7] Bearzi G, Politi E, Agazzi S and Azzellino A (2006). Prey depletion caused by overfishing and the decline of marine megafauna in eastern Ionian Sea coastal waters (central Mediterranean). Biological Conservation (127**)**: 373–382.

[8] Sutherland W.J (1998). The importance of behavioural studies in conservation biology. Animal behaviour 56 (4): 801-809.

[9] Arcangeli A, Crosti R del Leviatano A and Rome I (2009). The short-term impact of dolphin-watching on the behaviour of bottlenose dolphins (*Tursiops truncatus)* in western Australia. Journal of Marine Animals and their Ecology 2 (1): 3-9.

[10] Pietroluongo, G., Cipriano, G., Ashok, K., Antichi, S., Carlier, H., Miliou, A., Maglietta R., Fanizza C. Carlucci, R. (2020). Density and Abundance of Delphinus delphis in Waters South of Samos Island, Greece (Eastern Mediterranean Sea). *Journal of Marine Science and Engineering*, *8*(3), 218.

[11] David L (2002). Disturbance to Mediterranean cetaceans caused by vessel traffic. Report prepared for the ACCOBAMS Secretariat, Monaco.

[12] Papale E, Azzolin M, and Giacoma C (2011). Vessel traffic affects bottlenose dolphin (*Tursiops truncatus*) behaviour in waters surrounding Lampedusa Island, south Italy. Journal of the Marine Biological 92 (8): 1877-1885.

[13] Altman J (1974). Observational study of behavior: sampling methods. Behavior 49 (3-4): 227-267.

[14] Neumann D.R and Orams M (2005). Behaviour and ecology of common dolphins (*Delphinus delphis*) and the impact of tourism in Mercury Bay, North Island, New Zealand. Science and Technical Publishing, Department of Conservation.

[15] Neumann D.R. (2001). Activity budget of free-ranging common dolphins (*Delphinus delphis*) in the northwestern Bay of Plenty, New Zealand. Aquatic Mammals 27(2): 121-136.

[16] Constantine R, Brunton D.H and Dennis T (2004). Dolphin-watching tour boats change bottlenose dolphin (*Tursiops truncatus*) behaviour. Biological Conservation 117 (3): 299-307.

[17] Ansmann I.C, Parra G.J, Chilvers B.L and Lanyon J.M. (2012). Dolphins restructure social system after reduction of commercial fisheries. Animal Behaviour, 84 (3): 575-581.

[18] Miller L.J, Solangi M. and Kuczaj S.A (2008). Immediate response of Atlantic bottlenose dolphins to high-speed personal watercraft in the Mississippi Sound. Journal of the Marine Biological Association of the United Kingdom 88 (06): 1139-1143.

[19] Richardson H (2012). The effect of boat disturbance on the bottlenose dolphin (*Tursiops truncatus*) of Cardigan Bay in Wales. Doctoral dissertation, MSc thesis, Department of Geography, University College London.