

## Underreported In-water Behaviours of the Loggerhead Sea Turtle: Getting Buried in the Sand

Kostas Papafitsoros<sup>1,2</sup>

<sup>1</sup>ARCHELON, the Sea Turtle Protection Society of Greece, Athens, Greece

<sup>2</sup>Queen Mary University of London, London, UK (kostaspf@yahoo.gr, k.papafitsoros@qmul.ac.uk)

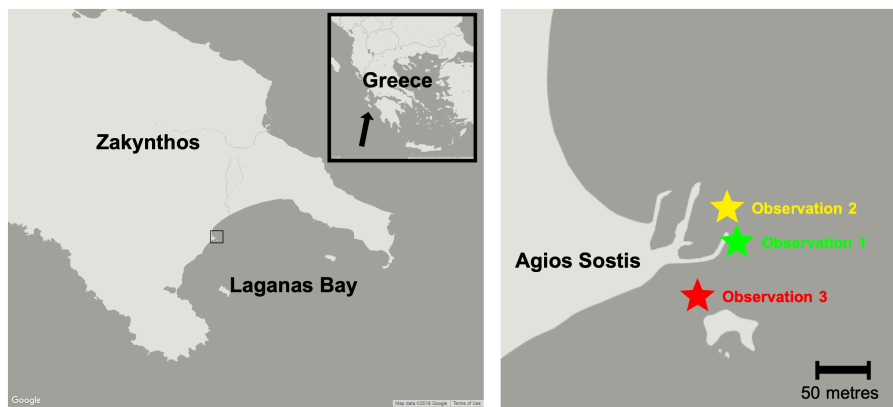
### Introduction

In-water behaviours of sea turtles have been well described in the literature, using a variety of means such as direct observations (Booth & Peters 1972; Schofield et al. 2006; Bennett & Keuper-Bennett 2008), animal-borne cameras (Seminoff et al. 2006; Thomson et al. 2015), remotely operated vehicles (Smolowitz et al. 2015; Dodge et al. 2018), static sea floor cameras (Zamzow 2000) and drones (Schofield et al. 2017b). The majority of the studies typically examine standard in-water behaviours like mating (Booth & Peters 1972; Schofield et al. 2006; Schofield et al. 2017a), foraging (Smolowitz et al. 2015; Wallace et al. 2015; Papafitsoros & Schofield 2019; Schofield et al. 2022), predator avoidance (Hounslow et al. 2021), cleaning (Zamzow 2000; Sazima et al. 2004; Schofield et al. 2017b), and intraspecific interactions (Thomson et al. 2015; Gaos et al. 2021; Schofield et al. 2022). However, most animals are observed over small time scales, e.g., due to the limited battery life of animal-borne

cameras, and as a result, other non-standard and rare behaviours might remain undetected.

The present note initiates a series of short articles, aiming to describe in-water behaviours of loggerhead sea turtles (*Caretta caretta*) that are underreported in the literature or not reported at all. These observations have resulted from the author's long-term in-water study and photo-identification of the loggerhead sea turtles of Laganas Bay, Zakynthos Island, Greece. We refer to Schofield et al. (2020) for methods and general context.

Here we report cases of three male loggerhead sea turtles which, after obtaining a resting position on a sandy spot at the sea bottom, they actively performed digging and stirring movements with their front flippers, resulting in sand getting raised in the water column. When the sand settled the turtles ended up half-buried and camouflaged. To the author's current knowledge, this self-burying behaviour has not been reported in the literature.



**Figure 1.** Left: Map of Greece and Laganas Bay, Zakynthos. Right: Map which corresponds to the area enclosed by the small square on the left map, showing the approximate location of the three observations near Agios Sostis area at the northwest part of Laganas Bay.



### Observation details

All the observations took place in the Agios Sostis area, at the northwest part of Laganas Bay, Zakynthos, see Fig. 1 for the approximate locations. All the male turtles involved have been long-term residents of Laganas Bay, and they were, to a certain degree, accustomed to human presence, since they have been regularly observed by tourists (Papafitsoros 2015; Papafitsoros et al. 2021). The first two turtles were adult males (they have been recorded mating), while the third one was a juvenile male, based on its very short tail which had been nevertheless observed growing during the previous years (Schofield et al. 2020). None of the turtles had any external tags and the ID names below, refer to ID numbers corresponding to an existing photo-database maintained by the author (Schofield et al. 2020).

#### Observation 1 (self-burying behaviour)

This observation took place on 2 October 2016. It began when an adult male loggerhead turtle (ID name “t033”) was approached at 16:44 by a second male that was up to that point being observed. Turtle “t033” had been resting on the sea floor (approximate depth 6 m) and the presence of the second male triggered an aggressive interaction, with “t033” attacking the second male. The fight lasted approximately 1.5 minutes with the second male fleeing the area. After the fight, “t033” was swimming in the area for about 10 minutes also taking several breaths. At about 16:56, the turtle approached a sandy spot at the sea floor next to a large rock, on which dead seagrass leaves *Posidonia oceanica* were also deposited. The sand was also mixed with oil, something that was inferred from its black colour. This is attributed either to pollution caused by tourist boats that dock at the nearby port or due to some natural oil secretion spots which are common in Laganas Bay. The turtle performed digging and stirring movements with its front flippers for at least 20 seconds, see top part of Fig. 2. During that time, the turtle was covered by the cloud-like raised sand and it was essentially not visible. The turtle

remained still as the sand settled down and it ended up with its head buried under the seagrass leaves. Sand and debris were deposited on top of its carapace and flippers. The turtle remained still at this position, even upon repeatedly close approaches by the observer (<1 metre), at least until the end of the observation at about 17:00.

#### Observation 2 (self-burying behaviour)

This observation took place on 4 July 2022, at an area only a few metres away from the one of Observation 1. The adult male loggerhead “t023” was initially observed swimming in that area at 06:33, trying to forage from the sea floor without success for about 10 minutes. It continued swimming around the area for about 20 minutes. At about 07:11, the turtle approached a spot at the black, again presumably oily, sandy bottom (approximate depth 7 m) and initiated the same digging and stirring movements for at least 20 seconds, see middle part of Fig. 2. Similarly to Observation 1, the turtle was barely visible during that stage and remained still as the sand settled. The turtle remained at this position with its carapace, head and flippers covered in sand, at least until the end of the observation at about 07:20.

#### Observation 3 (attempted self-burying behaviour)

This observation took place on 26 July 2015, also at an area close to the ones of the previous observations but at shallower waters (approximate depth 2 m). Observation of the male “t048” started at 16:36. The turtle was intermittently foraging for sponges until 16:56 where the first part of the observation ended. During that period, it also attacked another foraging male in the area, see Schofield et al. 2022 for the nature of these aggressive interactions. The observation resumed at 17:19 and the turtle was swimming around the area until 17:24. At about 17:24 the turtle approached the sea bottom and performed the same front flipper movements as the turtles in Observations 1 and 2. Since the sea bottom consisted of a mix of sand and seagrass, the amount of raised sand was not enough to cover the

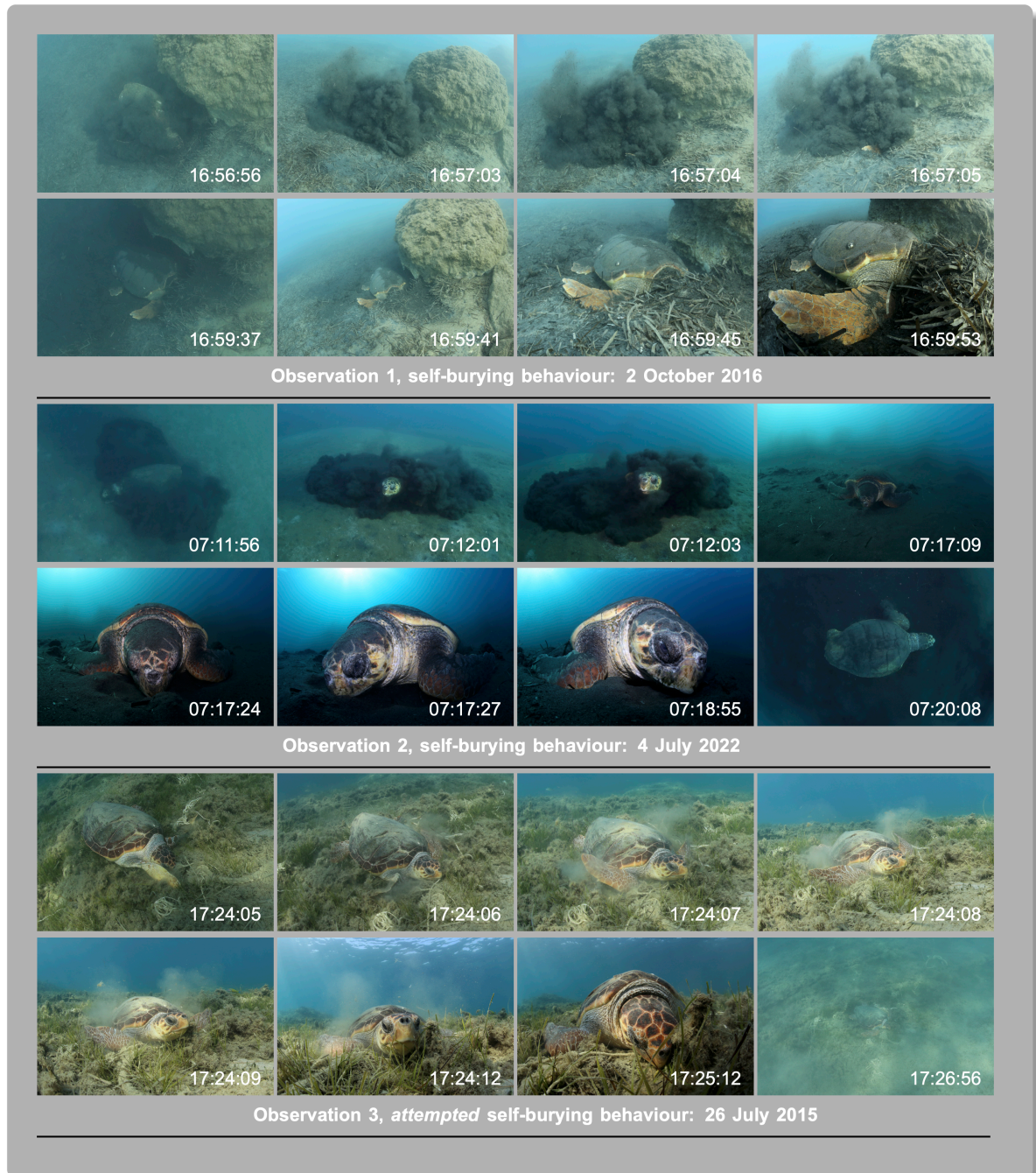


turtle as much as in the previous cases. Nevertheless, the turtle remained still until 17:32 when it came to water surface to breath after which the observation ended. As for Observation 2, the turtle did not react in an observable manner even after repeatedly close approaches by the observer (<1 metre), but perhaps the last

approach at 17:32 triggered the breathing bout.

### Discussion

Getting buried in mud is a well-known behaviour for freshwater turtles during overwintering (Carroll & Ehrenfeld 1978; Carr 2018). Sea turtles have also been described to be (half)-buried in sea bottom



**Figure 2.** Successive photographs of all the three observations. The times on the bottom left represent the local times that each photograph was taken, as it was internally recorded by the camera.





sediment while being lethargic especially when sea temperature falls below certain thresholds (Felger et al. 1976; Carr et al. 1980; Ogren & McVea 1995). In particular, Carr et al. (1980) noted that loggerhead sea turtles stuck in the firm sandy clay of Port Canaveral Ship Channel, East Florida, USA, could only be the result of the turtle's own activity. On the other hand, Lamont et al. (2021) suggested that sea turtles being buried in sediment is rather a result of them resting on the sea floor for extended periods of times (Hochscheid et al. 2005) perhaps facilitated by turbulent water, rather than them actively being buried in the sand. Here we provide direct evidence that loggerhead sea turtles are indeed capable of getting themselves partially buried in the sand by actively moving their front flippers and stirring the sea bottom sediment. We note that a similar behaviour has also been observed for green turtles (*Chelonia mydas*) in red sea, Egypt (Micol Montagna, Turtlewatch Egypt, personal communication). Sea turtles use their flippers for a variety of purposes other than swimming (Fujii et al. 2018), and our present observations constitute an additional unreported function.

Since sea temperatures in Zakynthos remain well above 20°C from June until October, the observed behaviours reported here cannot be attributed to low temperatures like in the cases mentioned in the references above. Furthermore, the three observed individuals had been generally quite active, e.g., foraging and interacting with other turtles, during the summer periods (author's personal observations), and also immediately before exhibiting this behaviour. We speculate that self-burying might be a camouflaging behaviour that leads to a decreased chance of getting spotted by other turtles and thus being attacked by them as it is typically observed in that site (Papafitsoros & Schofield 2019; Schofield et al. 2022) and/or prevent them from being spotted by predators. Uninterrupted resting behaviour can provide an opportunity to conserve energy between

foraging events and this self-burying behaviour might just facilitate this.

### Literature cited

Bennett P, Keuper-Bennett U (2008) The book of Honu: Enjoying and learning about Hawaii's sea turtles. University of Hawaii Press

Booth J, Peters JA (1972) Behavioural studies on the green turtle (*Chelonia mydas*) in the sea. *Animal Behaviour* 20(4): 808-812

Carr A (2018) Handbook of turtles: the turtles of the United States, Canada, and Baja California. Cornell University Press

Carr A, Ogren L, McVea C (1980) Apparent hibernation by the Atlantic loggerhead turtle *Caretta caretta* off Cape Canaveral, Florida. *Biological Conservation* 19(1): 7-14

Carroll TE, Ehrenfeld DW (1978) Intermediate-range homing in the wood turtle, *Clemmys insculpta*. *Copeia* (1): 117-126

Dodge KL, Kukulya AL, Burke E, Baumgartner MF (2018) TurtleCam: A "smart" autonomous underwater vehicle for investigating behaviors and habitats of sea turtles. *Frontiers in Marine Science* 5: 90

Felger RS, Clifton K, Regal PJ (1976) Winter dormancy in sea turtles: Independent discovery and exploitation in the Gulf of California by two local cultures. *Science* 191(4224): 283-285

Fujii JA, McLeish D, Brooks AJ, Gaskell J, Van Houtan KS (2018) Limb-use by foraging marine turtles, an evolutionary perspective. *PeerJ* 6: e4565

Gaos AR, Johnson CE, McLeish DB, King CS, Senko JF (2021) Interactions among Hawaiian hawksbills suggest prevalence of social behaviors in marine turtles. *Chelonian Conservation and Biology* 20(2): 167-172

Hochscheid S, Bentivegna F, Hays GC (2005) First records of dive durations for a hibernating sea turtle. *Biology Letters* 1(1): 82-86

Hounslow JL, Jewell OJD, Fossette S, Whiting S, Tucker AD, Richardson A, Edwards D, Gleiss AC (2021) Animal-borne video from a sea turtle reveals novel anti-predator behaviors. *Ecology* 102(4): e03251

Lamont MM, Johnson D, Catizone DJ (2021) Movements of marine and estuarine





turtles during Hurricane Michael. *Scientific Reports* 11: 1577

Ogren L, McVea C (1995). Apparent hibernation by sea turtles in North American waters. *Biology and conservation of sea turtles*. Ed. by K.A. Bjorndal. Washington: Smithsonian Institution Press, pp 127-132

Papafitsoros K (2015). In-water behaviour of the loggerhead sea turtle (*Caretta caretta*) under the presence of humans (*Homo sapiens*) in a major Mediterranean nesting site. Book of Abstracts of the 35th Annual Symposium on Sea Turtle Biology and Conservation, Dalaman, Turkey

Papafitsoros K, Panagopoulou A, Schofield G (2021) Social media reveals consistently disproportionate tourism pressure on a threatened marine vertebrate. *Animal Conservation* 24(4): 568-579

Papafitsoros K, Schofield G (2019) Focal photograph surveys: Foraging resident male interactions and female interactions at fish-cleaning stations. Mangel JC, Rees A, Pajuelo M, Córdova F, Acuña N (Comps.). *Proceedings of the 36th Annual Symposium on Sea Turtle Biology and Conservation*, Lima, Peru. NOAA Tech Memo NMFS-SEFSC-734, 364p

Sazima I, Grossman A, Sazima C (2004) Hawksbill turtles visit moustached barbers: cleaning symbiosis between *Eretmochelys imbricata* and the shrimp *Stenopus hispidus*. *Biota Neotropica* 4: 1-6

Schofield G, Katselidis KA, Dimopoulos P, Pantis JD, Hays GC (2006) Behaviour analysis of the loggerhead sea turtle *Caretta caretta* from direct in-water observation. *Endangered Species Research* 2: 71-79

Schofield G, Katselidis KA, Lilley MKS, Reina RD, Hays GC (2017a) Detecting elusive aspects of wildlife ecology using drones: New insights on the mating dynamics and operational sex ratios of sea turtles. *Functional Ecology* 31(12): 2310-2319

Schofield G, Klaassen M, Papafitsoros K, Lilley M, Katselidis KA, Hays GC (2020) Long-term photo-id and satellite tracking reveal sex-biased survival linked to movements in an endangered species. *Ecology* 101(7): e03027

Schofield G, Papafitsoros K, Chapman C, Shah A, Westover L, Dickson LCD, Katselidis KA (2022) More aggressive sea turtles win fights over foraging resources independent of body size and years of presence. *Animal Behaviour* 190: 209-219

Schofield G, Papafitsoros K, Haughey R, Katselidis K (2017b) Aerial and underwater surveys reveal temporal variation in cleaning-station use by sea turtles at a temperate breeding area. *Marine Ecology Progress Series* 575: 153-164

Seminoff JA, Jones TT, Marshall GJ (2006) Underwater behaviour of green turtles monitored with video-time-depth recorders: what's missing from dive profiles? *Marine Ecology Progress Series* 322: 269-280

Smolowitz RJ, Patel SH, Haas HL, Miller SA (2015) Using a remotely operated vehicle (ROV) to observe loggerhead sea turtle (*Caretta caretta*) behavior on foraging grounds off the mid-Atlantic United States. *Journal of Experimental Marine Biology and Ecology* 471: 84-91

Thomson JA, Gulick A, Heithaus MR (2015) Intraspecific behavioral dynamics in a green turtle *Chelonia mydas* foraging aggregation. *Marine Ecology Progress Series* 532: 243-256

Wallace BP, Zolkewitz M, James, MC (2015) Fine-scale foraging ecology of leatherback turtles. *Frontiers in Ecology and Evolution* 3: 15

Zamzow JP (2000). Cleaning symbioses between Hawaiian reef fishes and green sea turtles, *Chelonia mydas*. Abreu-Grobois FA, Briseño-Dueñas R, Márquez R, Sarti L (Comps). *Proceedings of the 18th International Sea Turtle Symposium*, Mazatlán, Sinaloa, Mexico. NOAA Tech Memo NMFS-SEFSC-436, 293p

