

## Underreported In-water Behaviours of the Loggerhead Sea Turtle: Foraging on Sea Cucumbers

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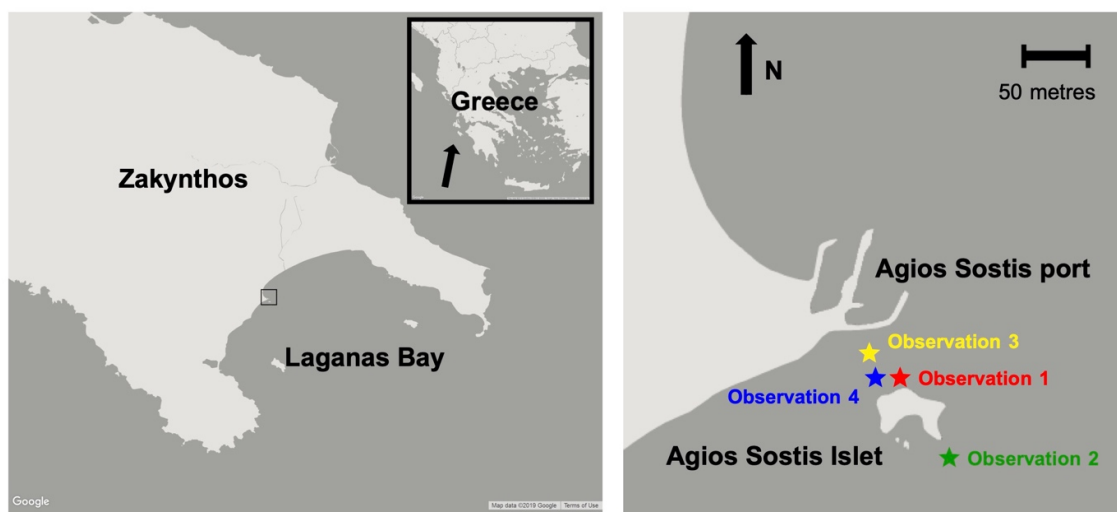
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### Introduction

The present article continues the series of short articles *Underreported in-water behaviours of the loggerhead sea turtle* which was initiated in (Papafitsoros 2022b). The purpose of this series is to describe in-water behaviours of loggerhead sea turtles (*Caretta caretta*) that have been rarely reported in the literature or have not been reported at all. All these reports are the result of the author's long-term (13 years) in-water study and photo-identification of the loggerhead sea turtles of Laganas Bay, Zakynthos, Greece. Laganas Bay hosts one of the most important reproductive grounds for the Mediterranean loggerhead sea turtles (Casale et al. 2018) with about 300 females (Margaritoulis et al. 2022) and 100 males (Schofield et al. 2017) breeding annually. In-water observations, citizen science and photo-identification have also revealed the existence of a small year-round resident population (approximately

40 individuals) consisting mainly of adult males and juveniles (Papafitsoros et al. 2021; Papafitsoros et al. 2023). These individuals can be regularly seen foraging on sponges (*Chondrilla nucula*), molluscs (Papafitsoros & Schofield 2019; Schofield et al. 2022), as well as discarded fishermen bycatch at a small port in Laganas Bay, (Agios Sostis port; Pers. obs.).

Here I report on four observations focusing on three individual turtles foraging on sea cucumbers (*Holothuria* spp.). Even though sea cucumbers have been found in the digestive tract of deceased turtles in multiple occasions, direct observations of loggerhead sea turtles preying on sea cucumbers have only been reported once in the literature (Rogers et al. 2020). This study provides some interesting insights on these foraging events particularly with respect to their rarity, the difficulty of foraging on sea cucumbers as well as potential individual foraging specialisation on such prey.



**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 locations of the four observations near Agios Sostis Port at the northwest part of Laganas Bay.



### Observation details

All four observations took place in Agios Sostis area, around Agios Sostis Islet at the northwest part of Laganas Bay, Zakynthos-Greece (37°43'N, 20°52'E; Fig. 1). The reef around Agios Sostis Islet is a well-known foraging ground in which resident male and juvenile turtles of Zakynthos prey on the sponge *Chondrilla nucula* which is abundant on this reef, (Papafitsoros & Schofield 2019; Schofield et al. 2022). In total, three individuals were recorded foraging on sea cucumbers over four observations. All three turtles in the observations below have been long-term residents and they have been logged in an existing photo-identification database consisting of more than 1500 individuals from this site (Schofield et al. 2020; Papafitsoros et al. 2021). In all observations, the sea cucumber species consumed as food was *Holothuria* spp., possibly *Holothuria poli*.

**Observation 1** This observation took place on 26 August 2017 at the north side of Agios Sostis Islet foraging reef and involved the loggerhead sea turtle with ID name “t217” (possibly juvenile; estimated straight carapace length: 60-70cm). This individual was a regular occupier of the

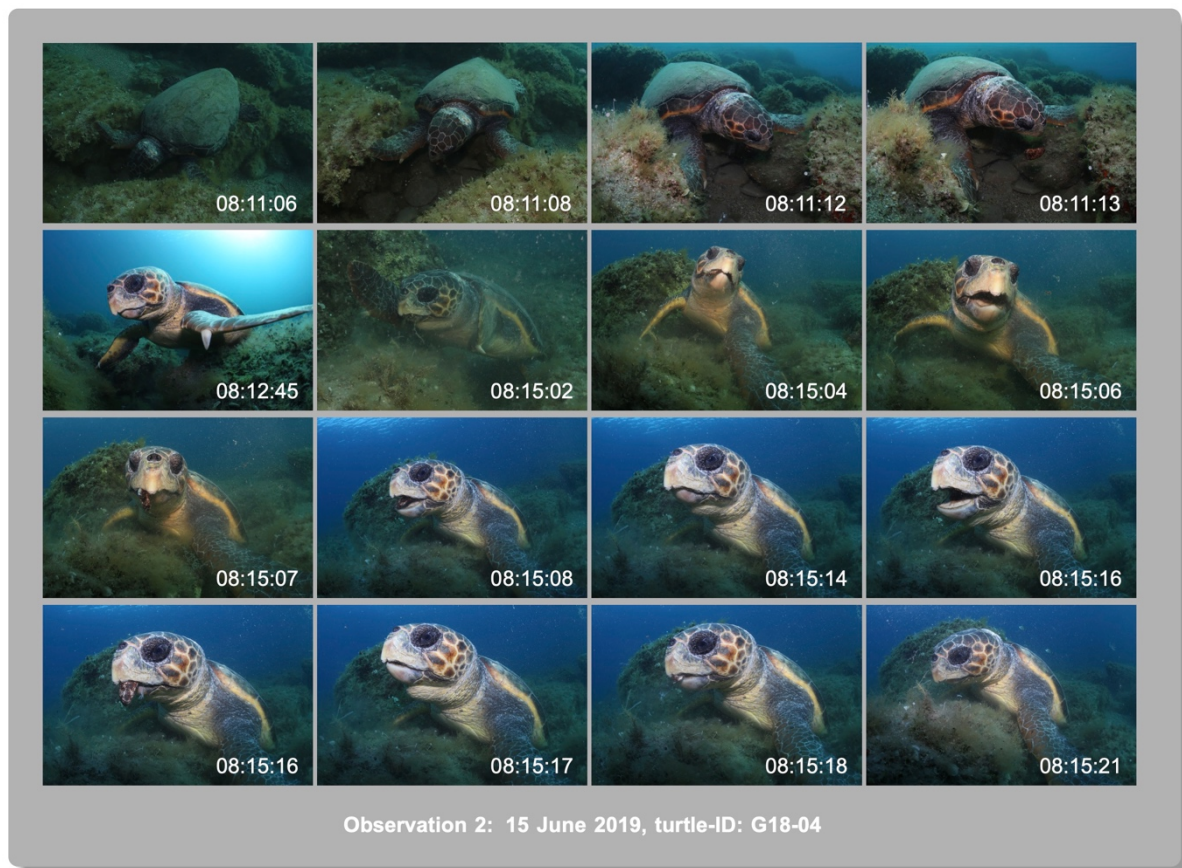
reef from July 2015 until October 2018. It was consistently observed foraging on sponges during that period (June-October) and this constitutes the only time it was observed foraging on a sea cucumber. The turtle was initially observed around 07:36 and at 07:37:56 it spotted a sea cucumber at an approximate depth of 2 metres, see Fig. 2. The turtle began the foraging attempt and used its front flippers and its beak in order to cut it into smaller pieces, albeit without succeeding so. In the process it dropped the sea cucumber twice. The turtle managed to swallow the sea cucumber, most likely in one intact piece in just under two minutes (around 07:39:43) and proceed in foraging on sponges thereafter.

**Observation 2** This observation took place on 15 June 2019 approximately 50m south of the Agios Sostis Islet foraging reef and involved the loggerhead sea turtle with ID name “G18-04” (male, possibly adult; estimated straight carapace length: 70-80cm). The turtle has been a resident of Zakynthos from 2018 until at least the summer of 2022 and while it has been seen around the reef, it has not been observed foraging on sponges like the previous



**Figure 2.** Successive photographs of Observation 1. The times on the bottom right represent the local times that each photograph was taken, as it was internally recorded by the camera.



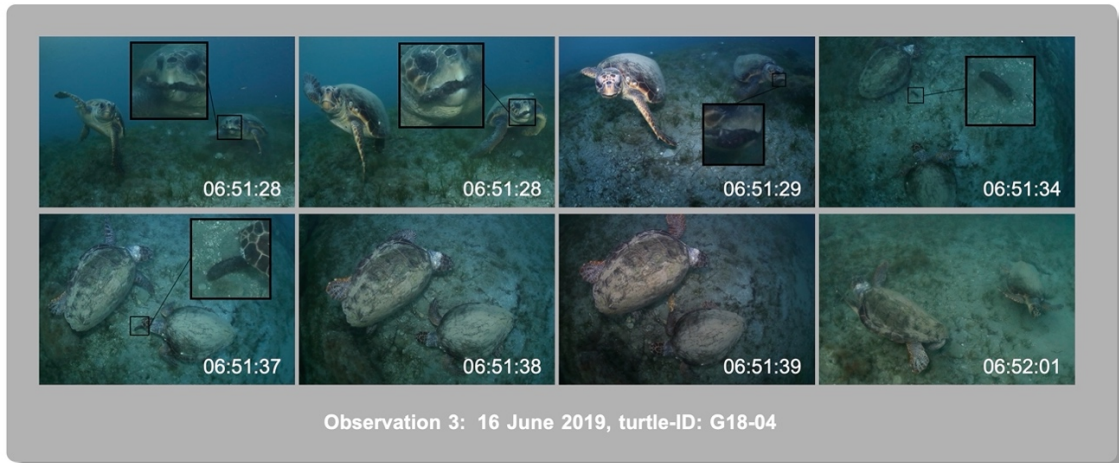


**Figure 3.** Successive photographs of Observation 2. The times on the bottom right represent the local times that each photograph was taken, as it was internally recorded by the camera.

turtle. The turtle was first encountered swimming east of the reef at 07:51 and it spotted and started foraging on a sea cucumber at 08:11:06 at an approximate depth of 8 metres, see Fig. 3. Upon an initial closer inspection, the sea cucumber was observed being cut in half, but it could not be determined whether this was due to turtle’s bite or whether it had been found in this state by the turtle. The turtle dropped the sea cucumber at least once and it could be seen alternately protruding from its mouth and being totally inside, indicating a difficulty from the turtle’s side to bite it and cut it. The turtle managed to swallow the sea cucumber at 08:15:21, just after 4 minutes, most likely again in one intact piece. However, it could not be excluded that it foraged on more than one sea cucumbers during this time period, since the observation was intermittent due to the large depth.

**Observation 3** The third observation took place on 16 June 2019, that is, one day after Observation 2. It involved the same male loggerhead sea turtle with ID name “G18-04”. It was observed at 06:51, on the north side of Agios Sostis Islet foraging reef, near the location of Observation 1. The turtle was initially spotted holding already a sea cucumber in its mouth, at an approximate depth of 2 metres, see Fig. 4. At the same time a second loggerhead sea turtle approached it (ID name “t323”). The second turtle was also a long-term occupant of the reef, foraging consistently on sponges, from 2016 until 2020, see also (Papafitsoros 2022a). The male turtle “G18-04” began making circular avoiding movements, eventually releasing the sea cucumber. No physical contact occurred between the two individuals. The two turtles separated after 2 minutes, after which “G18-04” was briefly followed, swimming away from the spot. I did not check whether the second turtle attempted to forage on the sea cucumber.





**Figure 4.** Successive photographs of Observation 3. The times on the bottom right represent the local times that each photograph was taken, as it was internally recorded by the camera.



**Figure 5.** Successive photographs of Observation 4. The times on the bottom right represent the local times that each photograph was taken, as it was internally recorded by the camera.



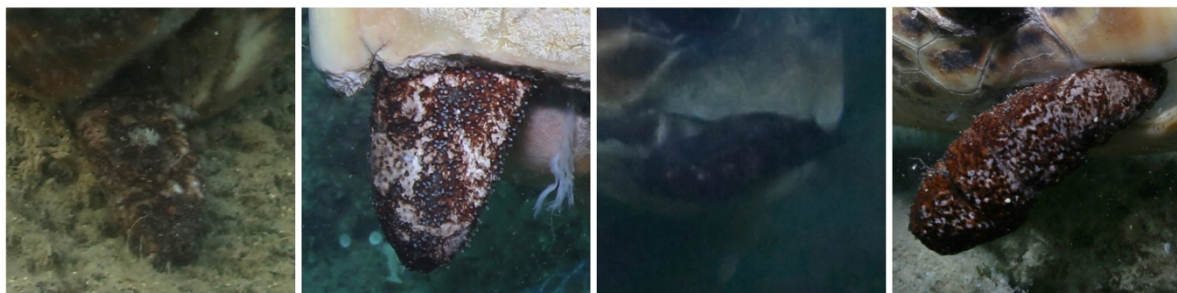
**Observation 4** The fourth observation took place on 8 September 2020, again very close to the location of Observations 1 and 3. It involved the loggerhead sea turtle with ID name “t441” (possibly juvenile; estimated straight carapace length: 55-65cm) who has been an occupier of the reef from July 2019 until at least 2022. This turtle has also been consistently foraging on sponges throughout that period and similarly to the turtle of Observation 1, this was the only time it was observed foraging on a sea cucumber. It was spotted around 18:30 while it was attempting to forage on a sea cucumber, at an approximate depth of 2 metres, see Fig. 5. The turtle was also being observed by a couple of snorkelers, but their presence did not seem to affect its behaviour, see also (Papafitsoros 2015). Similarly, to the turtle in Observation 1, it extensively used its front flippers attempting to cut the sea cucumber, again without success, and it dropped it at least six times during that process. The turtle managed to swallow the sea cucumber, again most likely in one intact piece, after about 3.5 minutes, and proceeded to forage on sponges thereafter. Detailed photographs of all the four sea cucumbers can be found in Fig. 6.

### Discussion

Sea cucumbers have been found in the digestive tract of Mediterranean loggerhead sea turtles during necropsies, but the frequency of their occurrence is relatively low. For instance, Casale et al. (2008) analysed the gut contents of 79 loggerhead sea turtles from the central Mediterranean Sea, and only one

(prevalence 1.3%) had consumed sea cucumbers (*Holothuroidea*). Lazar et al. (2002) performed necropsies on four loggerhead sea turtles from northern Adriatic Sea and sea cucumbers (*Holothuroidea*) represented 3% of the total dry weight of prey items. Similarly, Mariani et al. (2023), examined the gastrointestinal contents of 150 loggerhead sea turtles stranded in the central Adriatic Sea and central Tyrrhenian Sea. The frequency of occurrence of animals of the Phylum Echinodermata (to which sea cucumbers belong) was found to be 8.9% and 3.3% for loggerhead sea turtles from the two areas respectively. Similar frequency for *Holothuroidea* (3.3%) were found by Karaa et al. (2018), after performing necropsies on 132 loggerhead sea turtles from the Gulf of Gabes, Tunisia. Further reports can be also found in Palmer et al. (2021), where also a photograph of an intact *Holothuria* spp. from a loggerhead sea turtle’s digestive tract is provided.

This relatively low frequency (range between 1.3-8.9%) of consumption of sea cucumbers reported in the above studies, reflects the rarity of observations of this consumption in our study site. Indeed, 13 years of in-water surveys in Zakynthos Island, have resulted to only four such observations even though loggerhead sea turtles can be regularly seen foraging on sponges. One simple explanation could be that sea cucumbers are in low abundance in our study site, at least during the summer months when all observations took place. Since, loggerhead sea turtles exhibit opportunistic feeding behaviour



**Figure 6.** Detailed photographs of the four sea cucumbers (*Holothuria* spp., possibly *Holothuria poli*).



(Parker et al. 2005) and have a generalist diet (Thomson et al. 2012), low cucumber abundance can explain the low consumption frequency, as turtles will target other prey as well. Nevertheless, it cannot be excluded that dietary preferences and/or sea cucumber abundance differ during the winter months. Indeed, Seney & Musick (2007) reported that diets of loggerhead sea turtle could differ seasonally. However, we also observed that turtles exhibited difficulties in consuming such a prey, which aligns with the report by Rogers et al. (2020). Even though, sea cucumbers exhibit low mobility and thus can be easy to catch, their soft body makes them hard to swallow. Turtles failed to cut the sea cucumbers into pieces, and they most likely ended up swallowing them intact, a process that can take more than 4 minutes. We observed that this difficulty can lead to unsuccessful attempts, especially due to intraspecific interactions (Observation 3) which are very common in our study site (Schofield et al. 2022). In contrast, Mulochau et al. (2021) reported the case of a juvenile green sea turtle (*Chelonia mydas*) from Reunion Island, which was observed foraging on two specimens of the sea cucumber *Synapta maculata* and it successfully used its beak and flippers to cut its prey into pieces. This was perhaps facilitated by the typical serrated beak that green sea turtles have.

Finally, the fact that two of these rare observations involved the same loggerhead sea turtle “G18-04”, which also avoided foraging on the abundant sponges that the other turtles in the area forage on, could be indicative of potentially specific dietary preferences of this individual. It has been argued that individual loggerhead sea turtles can exhibit long-term foraging specialization (Vander Zanden et al. 2010; Hall et al. 2015; Pajuelo et al. 2016), a specialization that has also been observed in other sea turtle species, e.g., in green sea turtles (Vander Zanden et al. 2013). For instance, as an interesting example, Vicente & Carballeira (1992) reported the gut

contents of six hawksbill sea turtles (*Eretmochelys imbricata*) from Puerto Rico, with one adult only having ingested the sea cucumber *Holothuria cubana*, whereas the stomachs of the other turtles contained only sponges. It has been argued that long-term foraging specialization among others could reduce intraspecific competition (Vander Zanden et al. 2010). This could explain the dietary preferences of the individual “G18-04”, since turtles foraging on sponges on that reef are regularly involved in aggressive interactions (Schofield et al. 2022). For instance, “G18-04” was observed on that reef during the previous year (2018) when it was attacked by the individual “t217” (Observation 1). Notably the latter individual had been the most aggressive turtle of the reef for these two years (2018-2019) (Schofield et al. 2022). Specializing on a less abundant, and difficult to locate prey, like sea cucumbers, could lead to reduced engagement in intense energy demanding intraspecific interactions over foraging resources. Such specialisation indeed seems to occur in the resident population of Zakynthos with some individuals consistently foraging on sponges, whereas others focus on mining for molluscs in nearby submerged sandbanks (Pers. Obs.).

### Acknowledgements

The author would like to thank the anonymous reviewer for the useful remarks that led to the improvement of this paper.

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