No Place Like Home: Records of a Male Loggerhead Sea Turtle in a Greek Foraging Ground Spanning 18 Years

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Introduction

Amvrakikos Gulf is a relatively shallow (max ~60 m) almost enclosed marine basin of ~400 km^2 with a mainly east to west axis. The southern coast is mainly formed of rocky shores leading to deeper water, whereas the northern part is bordered by lagoons and comprises substantial shallow areas fronting wetlands that are fed by several rivers. ARCHELON's programme in the gulf commenced with a specific project to track loggerhead turtles in 2002 and 2003 (see Rees et al. 2013), as the area was known as a foraging site with no sea turtle nesting taking place. During this time the importance of the location, in terms of abundance, density and accessibility of the turtles became increasingly apparent and led to the initiation of a dedicated ongoing capture-mark-recapture (CMR) programme in 2004. Seasonal effort has varied since 2004 but some fieldwork has been carried out in the gulf every year since 2002. From genetic analyses, flipper tagging, and satellite telemetry we have been able to link loggerheads present in the gulf to breeding areas across Greece and as far away as Türkiye (Rees et al. 2017).

From the early years of the programme, we realised that turtles showed fidelity or were long-term residents of the field site as we were obtaining multiple inter-year recaptures (Rees et al. 2013). Through these recaptures we are generating growth and maturation histories and evidence of anthropogenic impacts affecting the local population of turtles that help us better understand the biology and conservation needs of turtles in Greece. This article presents the history of one of the remarkable turtles, *Alaniaris,* that has been repeatedly encountered in the gulf with a history spanning 18 years.

Methods

Alaniaris' captures were achieved using the 'rodeo' technique in shallow water (< 2 m depth) in a restricted area of the northeast of Amvrakikos Gulf (39.02°N, 21.06°E). Capture locations were recorded from a hand-held GPS unit. Once caught he was hauled onto the boat for data collection and tagging. He was flipper tagged (Monel type No. 681; National Band & Tag Co., USA) so that he was released with two tags, old or new. To counter tag-loss and improve retention of his identity, *Alaniaris* was PIT tagged in 2019. Carapace measurements, such as straight carapace length notch-to-tip (SCLn-t; Bolten 1999) were recorded along with tail measurements (TLC) from the anterior part of the notch between the supracaudal scales at the rear of the carapace and the tip of the tail. Additionally photographs of the head, flippers, carapace and distinguishing marks were taken to further aid reidentification in case of lost tags and to document the evolution of body condition at each recapture.

A Kiwisat 202 (Sirtrack Ltd) Argos satellite transmitter was attached to *Alaniaris* using 2-part epoxy on the second vertebral scute of the carapace that had been prepared by sanding away flaking scute and scrubbing away any epibionts. Argos location data are divided into distinct location classes (LCs) based on estimated accuracy. Due to *Alaniaris'* lack of movement and inherent errors in Argos locations, no attempt was made to define a track line but instead we simply excluded LCs of the lowest accuracy (LCB and LC0). We further excluded locations from the remaining LCs (LC3, LC2, LC1, LCA) that were tens of kilometres away from the core foraging location, but we retained

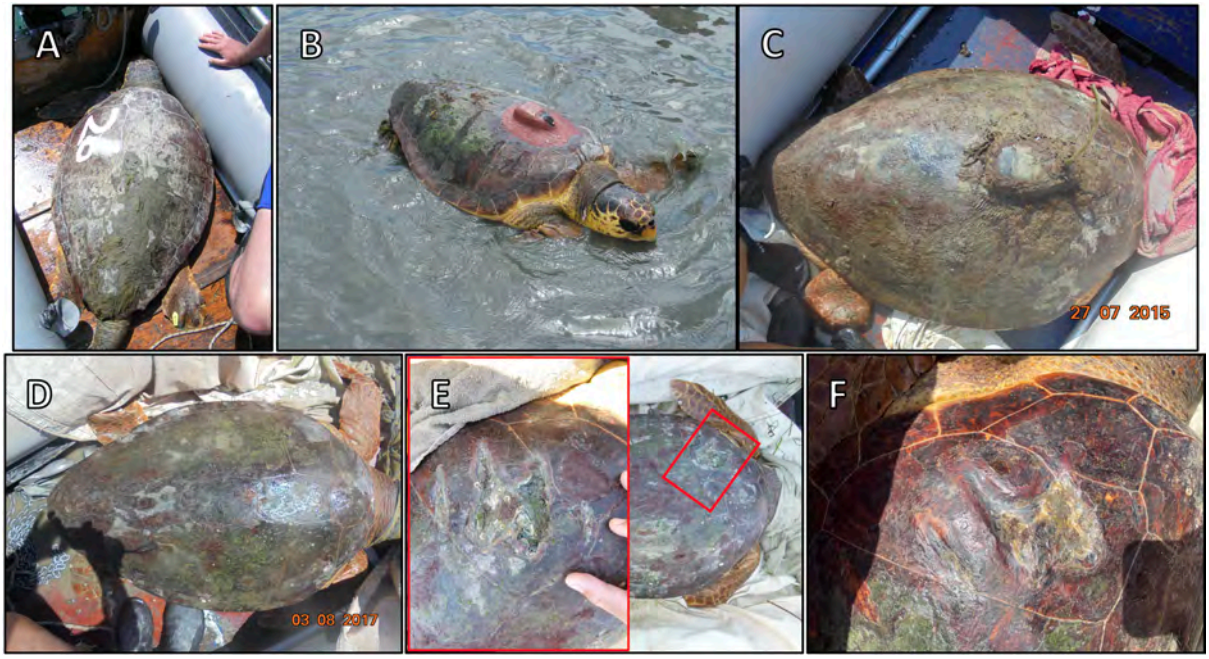

Figure 1. Visual capture records of *Alaniaris*. A) Initial capture in 2005. In that year we trialled painting numbers on the turtles' carapaces to simplify recording reobservations. B) Released with satellite transmitter after capture in 2013. C) Recaptured with functioning transmitter still in place in 2015. D) Recapture with no sign of the transmitter in 2017. E) Recapture with evidence of healing propellor injury in 2022. F) Recapture with the same injury almost healed in 2023.

locations on land to not bias their distribution seaward. Residency hotspot from tracking data was determined using the Heatmap symbology function in QGIS (v3.36.2) using a 5 km radius for smoothing.

Results

Alaniaris was first captured in May 2005 (Fig. 1A; Table 1). With a carapace length of 80 cm and long tail extending more than 20 cm past the rear of his carapace the turtle was assessed to be male and probably adult. We subsequently recaptured him in the study area in 7 separate years between 2007 and 2023 (Fig. 2A; Table 1). On 14 June 2013 he had lost both his flipper tags, but we were able to reidentify him using our diagnostic photo archive (Fig. 3; Table 1). We attached a transmitter to his carapace which remained operational for 1,021 days, until 31 March 2016. We retained 952 locations after the stated filtering regime. During that time, he remained in Amvrakikos Gulf, not migrating to a nesting area to mate, as might be expected, and showed strong site specificity to the capture area (Fig. 2B, 2C). There was no evidence of him having had a transmitter when he was recaptured in August 2017 (Fig. 1D), however he was reidentified from his flipper tags (Table 1). At some point between that capture in 2017 and his recapture in 2022 his carapace was damaged by collision with a boat propellor (Fig. 1E), however in 2023 the injury had almost completely healed (Fig 1F). Noting some variability in measurements (Table 1), *Alaniaris* carapace has grown no more than ~1 cm over his 18-year recapture period, and his tail likewise.

Discussion

Using a single individual as an example, we show that male loggerhead sea turtles in Greece may show a high degree of site fidelity, in their foraging area, over periods approaching two decades, which has been shown elsewhere (e.g., Shimada et al. 2020). This duration is likely to be extended as the monitoring programme continues to recapture turtles in the coming years. Such a long-term CMR dataset is unique in a foraging area within

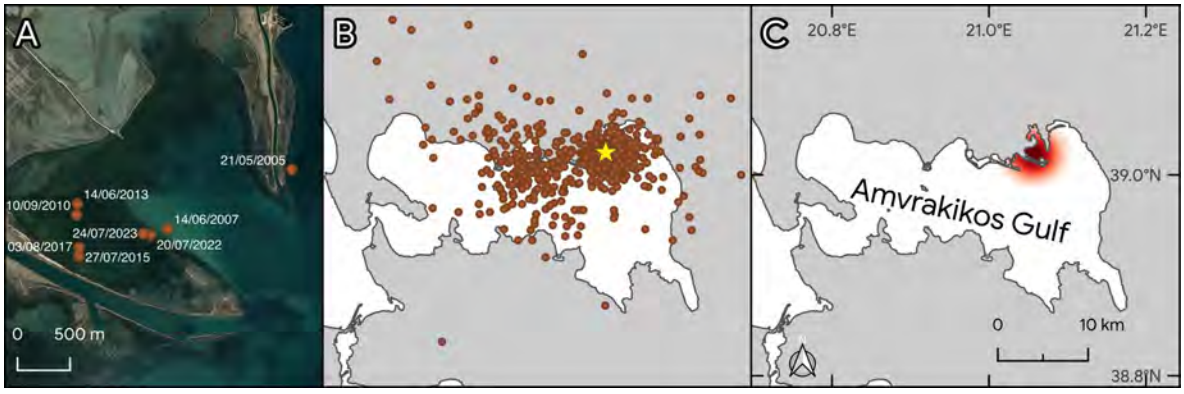

Figure 2. *Alaniaris*' 18-year history in Amvrakikos Gulf. A) Capture locations 2005 – 2023. B) Filtered locations obtained from satellite tracking between June 2013 and March 2016. Yellow star = capture location. C) Residency hotspot derived from the tracking locations. Darker colours indicate more intense use.

the Mediterranean and exploration of the full dataset is likely to provide many novel biological and conservation-relevant facts.

We show the utility of a diagnostic photographic archive supplementing traditional flipper tagging methods. We were able to reidentify *Alaniaris* using imagery after he had lost both his external flipper tags and hence generate an 18-year long history for an individual rather than having records for apparently two individuals lasting five and 10 years. Furthermore, using photography we were able to record details of injuries sustained and their rate of healing that can be used for conservation purposes. Indeed, a long-term photographic dataset has been used to great effect with turtles present in Laganas Bay, Zakynthos, Greece (e.g., Papafitsoros et al. 2021).

Relating to the injury first observed as a healing wound in 2022 and then almost healed in 2023, we can assume that the individual received no veterinary care relating to the trauma and hence establish how resilient turtles may be to similar types of injury in the wild. Again, exploring the full dataset will give us a strong indication of causes of injuries in the project location and the rate and likelihood of healing from these injuries.

Alaniaris is assumed to be an adult male turtle, based on carapace size, tail length and limited growth over an 18-year period (Table 1). Between 2014 and 2016 when his location was tracked by satellite telemetry, he made no reproductive migrations to nesting areas. It is generally considered that mating takes place near nesting beaches (Miller 1997) and that males make these reproductive migrations more regularly than females (Hays et al. 2014). *Alaniaris*' lack of migrating for three breeding seasons suggests that either he is not sexually mature or that some of the other assumptions about sea turtle reproductive behaviour are less rigid. It is possible that mating might regularly also take place at foraging areas, and in this instance the gulf as it has been reported previously that mating takes place there (Teneketzis et al. 2003). Indeed, mating has also been reported from another foraging area in Greece (Witzmann et al. 2024), however that site is located only ~10 km away from nesting beaches, which may classify it as 'near the nesting beach'. Another possibility is that *Alaniaris* is of an age where he has reached reproductive senescence and is no longer capable of successfully mating with females. However, testudines are generally thought to display only slow or negligible senescence (Da Silva et al. 2022). It is unproven in male sea turtles and understudied for females (Glen et al. 2023), thus senescence is unlikely to be the reason for lack of migrations.

We presented the long-term history of one individual turtle in the foraging area of Amvrakikos Gulf that showed a behaviour

Figure 3. Reidentification, using photographic records, of *Alaniaris* in 2013 after he had lost all flipper tags. Upper images: Photographs prior to 2013. Lower images: Identity-confirming images from 2013. Note the scale patterns on both head and flipper and the location of dark spots on certain flipper scales.

challenging existing knowledge on reproductive traits. Further research of our extensive time-series can reveal other behaviours as well as possible threats and resilience to injuries of turtles in foraging areas. Such results can only be elucidated from long-term monitoring projects such as the ongoing in-water program of ARCHELON in Amvrakikos Gulf. The wealth of data collected over more than 20 years is expected to benefit our knowledge on loggerhead traits at foraging areas, their behaviours and their conservation needs.

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Table 1. Recapture events, carapace and tail length measurements, and tagging history of *Alaniaris* (2005 – 2023). SL = straight carapace length (cm). TLC = length of tail (cm). * = tag removed.

Date	SL	TLC	External Tags	PIT	Comment
21/05/2005	80.0	23.0	D7369 RE321		
14/06/2007	79.9	21.0	D7369 RE321		
10/09/2010	80.1	22.0	R9427 RE321		
14/06/2013	80.2	22.0	R9892 R9891		Re-identified from photographs. Received satellite transmitter (resident for rest of 2013)
2014					Resident whole year (tracking)
27/07/2015	80.5	22.0	R9892 R9891		Captured and resident whole year (tracking)
31/03/2016					Last transmission - still resident
03/08/2017	80.4	23.5	R9891* M9055 M9056		
20/07/2022	81.0	25.0	M9055 Y7306	0007E4D1DA	First evidence of a propellor injury to carapace
24/07/2023	80.8	24.0	M9055 Y7306	0007E4D1DA	

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