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MOVEMENTS OF THREE LOGGERHEAD SEA TURTLES IN TUSCANY WATERS

Abstract - The coastal waters along Tuscany (Central Italy) are thought to represent a good foraging ground for loggerhead turtles (*Caretta caretta*), especially, but not only, during the juvenile phase. We describe the movements of three juvenile loggerheads released along the Tuscany coast after having been accidentally caught by fishermen and rehabilitated by recovery centres of the region. The turtles were tracked by satellite for 20-125 days, displaying two main movement patterns. Two turtles remained in neritic coastal waters for the whole duration of tracking, while the third one moved north soon after release, reaching the northern Ligurian Sea with an open-sea route. These findings show that loggerheads can use Tuscany waters both as a profitable long-term foraging site and as a transit area during their movements towards other destinations.

Key words - Satellite telemetry, *Caretta caretta*, juveniles, rehabilitation.

Riassunto - *Movimenti di tre tartarughe comuni nelle acque toscane.* Le acque costiere della Toscana sono note costituire un'area di foraggiamento delle tartarughe comuni (*Caretta caretta*), soprattutto, ma non esclusivamente, durante la loro fase giovanile. In questo lavoro sono descritti i movimenti di tre giovani di tartaruga comune che erano state pescate accidentalmente e sono state riabilite da centri di recupero della regione. I movimenti delle tartarughe sono stati ricostruiti tramite telemetria satellitare per 20-125 giorni, durante i quali gli animali hanno mostrato due tipi diversi di movimento. Due di esse sono rimaste nelle acque neritiche della Toscana per tutta la durata del tracking, mentre la terza si è diretta verso nord poco dopo il rilascio muovendosi prevalentemente in mare aperto fino a raggiungere le acque antistanti la Liguria occidentale. Questi risultati mostrano che la costa toscana è usata dai giovani di tartaruga comune sia come una zona di foraggiamento a lungo termine che come una zona di passaggio verso altre destinazioni.

Parole chiave - Telemetria satellitare, *Caretta caretta*, giovani, riabilitazione.

INTRODUCTION

Tuscany waters are frequented by loggerhead sea turtles (*Caretta caretta*), at least during some of their life stages and every year a relatively large number of loggerheads is incidentally caught by fishing gears or found stranded along the Tuscany coast (Meschini *et al.*, 2007). Because of this, rescue and recovery centres specifically dedicated to sea turtles have been set up within the aquaria of Leghorn and Grosseto.

Since accidentally caught or stranded turtles are found in every period of the year (Meschini *et al.*, 2007), it may be hypothesized that the Tuscany coast represents a good loggerhead feeding ground as well as an area suitable for wintering, although this does not exclude that loggerheads can use the coast of Tuscany as a pathway during their extended movements between different residential areas (Godley *et al.*, 2008). Also, the fact that rescued loggerhead turtles belong to different size classes (Meschini *et al.*, 2007), substantiates the idea that the Tuscany coastal waters are systematically exploited by these animals for their vital needs during various stages of their life cycle (Bolten, 2003). Since practically nothing is known about the movements of loggerhead turtles frequenting the Tuscany coast, satellite telemetry can be profitably employed to identify the areas mostly frequented by sea turtles, to investigate the presence of long-distance movements and to assess the degree of fidelity of individual turtles to specific feeding areas. In this paper we describe the movements, reconstructed by satellite telemetry, of three juvenile loggerhead turtles that were accidentally caught by fishermen and rehabilitated by turtle rescue centres in Tuscany.

MATERIALS AND METHODS

The three turtles were equipped with satellite transmitters (Platform Transmitter Terminals - PTTs) linked to the Argos satellite system (www.argos-system.org). The animals had all been accidentally caught by trawl nets in Tuscany coastal waters and were rehabilitated by the rescue centres of Grosseto and Leghorn aquaria. While they were not physically injured (e.g. by hooks), they had respiratory problems of variable entity as a result of prolonged submergence during the capture, and so needed a rehabilitation period in captivity of a few months (see below). According to their size at release, tracked turtles were late juveniles. The first turtle (turtle A, Curved Carapace Length, CCL, 51 cm) was captured in the Gulf of Follonica on 13 May 2005 and was released from a beach in the Maremma Regional Park on 19 July 2005, after 67 days of captivity. The second turtle (turtle B, CCL 52 cm) was caught on 1 December 2006 offshore Leghorn harbour and stayed in the rehabilitation Centre of the Leghorn Aquarium

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for 160 days. It was then released from the Calambrone beach, close to the capture site, on 10 May 2007. The third turtle (turtle C, CCL 57 cm) was captured north of Giglio Island on 4 January 2010 and was released on 19 June 2010 from a boat offshore the Argentario promontory, after 166 days in captivity at the Rescue Centre of Grosseto Aquarium.

The PTTs used to track the animals were Telonics (Mesa, AZ, USA) ones, A-410 model for turtles A and B and A-210 for turtle C and were attached by epoxy resin (Power-Fast Plus, Netherlands) to the top of the carapace by means of standard methods. The carapace was first cleaned thoroughly with acetone and sandpaper before the PTT was firmly embedded into the epoxy. The release was performed once the resin was completely hardened and dry. Original Argos data were

filtered by disregarding erroneous locations which were on land or that inferred a movement speed exceeding a predetermined individually-specific threshold, determined from high-accuracy (Argos location classes 1 to 3) locations only (3.0 km/h for turtle A; 3.6 km/h for turtle B; 5.2 km/h for turtle C). This resulted in the elimination of 142 out of 387 locations for turtle A, 104 out of 217 ones for turtle B and 61 out of 209 ones for turtle C.

RESULTS AND DISCUSSION

Turtles A and B (Fig. 1) frequented the neritic shelf waters of Tuscany for the whole duration of their tracking (124 and 125 days, respectively). Turtle A first

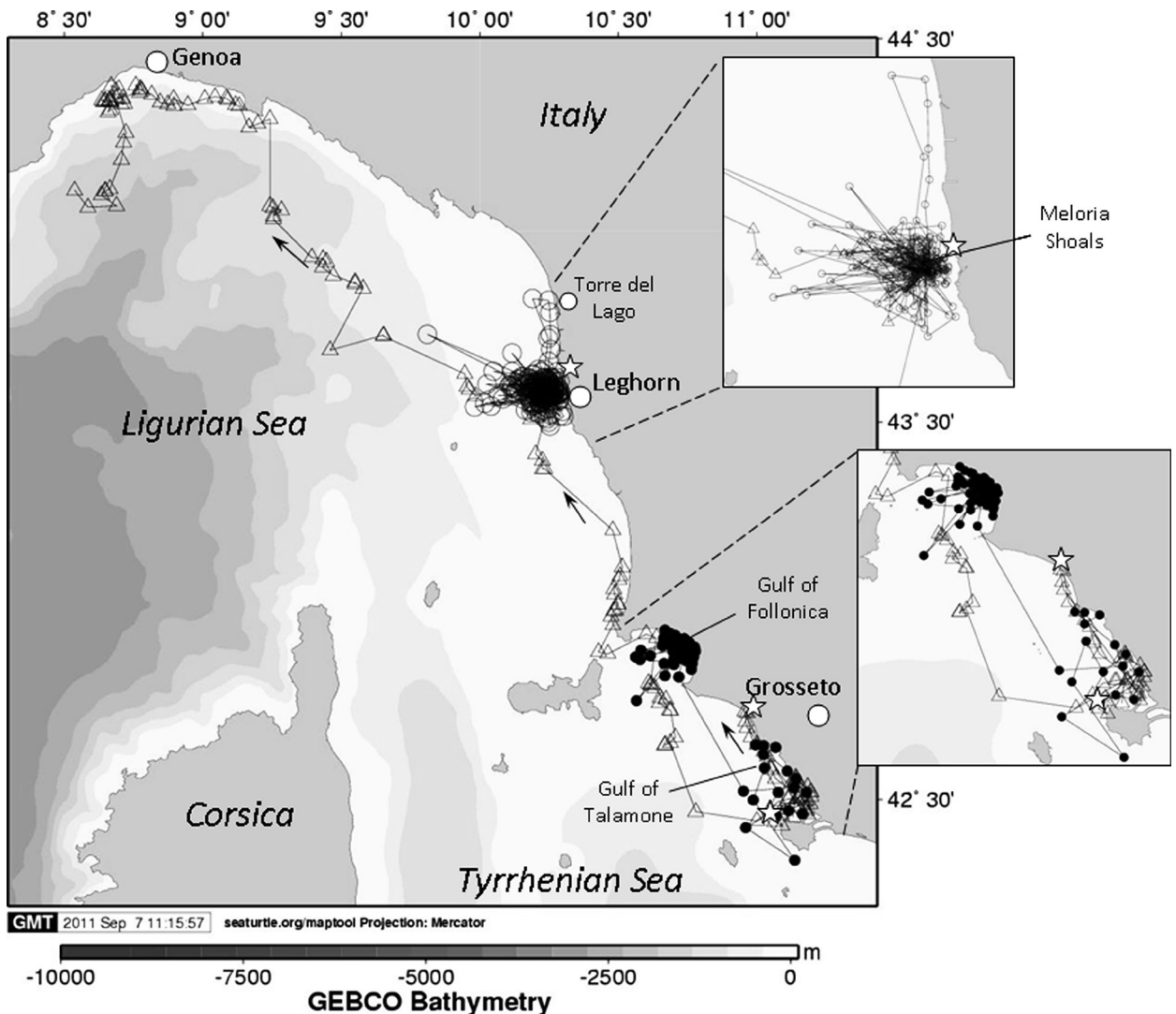


Fig. 1. Reconstructed movements of the three juvenile loggerheads (*Caretta caretta*) released from the Tuscany coast. Turtle A: black circles; turtle B: open circles; turtle C: open triangles. The inserts show details of the short-range movements performed. The stars indicate the release sites; the arrows the movement direction.

moved quickly (mean speed 1.6 km/h) southwards from the release site, arriving on the following day to the Gulf of Talamone, where it remained until 7 August 2005. It then headed north along the coast and reached the Gulf of Follonica on 11 August 2005, remaining for the following three months in this area wandering at a very low speed (mean speed 0.4 km/h). On 20 November 2005, the turtle was found dead entangled in a rope used by fishermen to catch octopuses. Turtle B displayed a similar behaviour, with even more limited movements (Fig. 1). Soon after release, it moved to the Meloria Shoals, a shallow water area about 5 km offshore the release site, which is known to be frequented by feeding turtles (Meschini *et al.*, 2007). Except for a brief northward excursion to the coastal waters off Torre del Lago, made three days after release, turtle B remained in this circumscribed area during the four months of tracking, which ended on 12 September 2007.

Differently from the other turtles, turtle C did not remain for long in Tuscany waters but headed north, spending long time in the open sea (Fig. 1). Only in the week following the release it wandered in the neritic waters between Orbetello and Marina di Grosseto, but then it headed north, first along the coast and then also swimming in open sea. This fast northward movement (mean speed 1.9 km/h), made it to visit quickly to the Meloria Shoals and then to reach the Ligurian coastal waters, where however it did not stop in any site for more than a few hours. Transmissions ended for unknown reason after 20 days, on 9 July 2007, when the turtle was again in open sea waters offshore Savona.

The reconstructed routes show how the three loggerheads displayed different movement patterns, even if they were in the same juvenile stage of their lives. These results additionally show that the Tuscany waters are used by some juvenile loggerheads either as a long-term foraging ground or as a pathway towards other destinations. While these findings have to be interpreted with caution, being based on a limited sample size, we think that the movement pattern displayed can be considered representative of the behaviour of juvenile loggerheads inhabiting Tuscany waters, with no evident alterations due to capture and sojourn in captivity. All turtles spent at least some days in neritic coastal waters, where turtles A and B sojourned for the whole tracking period, showing a prolonged residence in limited sites. Also, turtle A returned to the same area where it had been caught (the Gulf of Follonica), thus resuming her habits before capture and displaying fidelity to this foraging site. Permanence in neritic waters is a behaviour typically expected for late juvenile loggerheads, that are known to mainly feed on neritic prey, having already shifted from their earlier pelagic developmental stage (Musick & Limpus, 1997; Bolten, 2003; Casale *et al.*, 2008). The present data however constitute one of the first record of such a pattern in Mediterranean loggerheads, since the tendency to remain predominantly in neritic (often coastal) waters has so far been only shown in a few Mediterranean juveniles (Cardona *et al.*, 2009; Hochscheid *et al.*, 2010; Casale *et al.*, 2012).

Turtle C left the southern neritic areas to move north, apparently in search of other foraging areas, yet without

seemingly finding a suitable site where to remain, at least during the 20 days of tracking. A similar movement pattern has been shown in a satellite-tracked juvenile released in southwestern Italy, that too left a neritic area to move northward until reaching the Ligurian waters (Hochscheid *et al.*, 2010). The reasons leading to such a behaviour are unknown. Turtle C was slightly larger than the other two ones, and so it was even more likely to be in the neritic stage of development, when loggerheads usually settle in specific feeding sites (Musick & Limpus, 1997; Casale *et al.*, 2008). Also, the waters of the northern Ligurian Sea are not commonly considered as a popular foraging area for loggerheads (Casale & Margaritoulis, 2010), although several different kinds of evidence indicate that loggerheads turtles can frequent Ligurian waters (e.g. Casale *et al.*, 2010; Hochscheid *et al.*, 2010; Lauriano *et al.*, 2011). Turtle C's permanence for some days in offshore oceanic waters indicate that it was able to feed also epipelagically on oceanic prey, thus showing a behavioural plasticity similar to that recently illustrated for Atlantic juveniles (Mc Clellan & Read, 2007; Mc Clellan *et al.*, 2010).

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