Moving Westwards in a Warming Sea: Additional Nests of the Green Turtle *Chelonia mydas* on Crete, Greece

Aliki Panagopoulou[1], Michalis Dretakis[2], David S de Haan[1], Dimitris Margaritoulis[1#]

[1]*ARCHELON, the Sea Turtle Protection Society of Greece, Athens, Greece (#margaritoulis@archlelon.gr)*
[2]*Natural History Museum of Crete, Heraklion, Crete, Greece*

In the Mediterranean, the green turtle *Chelonia mydas* (L.) breeds traditionally in its easternmost basin – Levantine Sea – with most nests being recorded in Türkiye, Cyprus and Syria, and with fewer nests in Israel, Lebanon and Egypt (Kasparek et al. 2001).

Until 2007, the westernmost limit of green turtle nesting in the Mediterranean was Patara beach (approx. coordinates of middle of beach: 36.288°N, 29.266°E), Türkiye, where two green turtle nests were recorded for the first time in 2000 (Erdogan et al. 2001).

In 2007, an exceptional green turtle nest was discovered in Rethymno, along the north coast of Crete (Margaritoulis et al. 2019) (Fig. 1, inset map). This represented the westernmost record of green turtle nesting in the Mediterranean (Casale et al. 2018) until 2019, when a green turtle nest was found in Tunisia (Ben Ismail et al. 2022). During the same year (2019), a green turtle nested in Messaras Bay, southern coast of Crete (Margaritoulis et al. 2023) (Fig. 1, inset map), and in 2021 another nest was laid in Libya (Saeid et al. 2023). Further, in 2024, a green turtle nest was confirmed in Rhodes Island, Greece (Teneketzis et al. 2024) (Fig. 1, inset map).

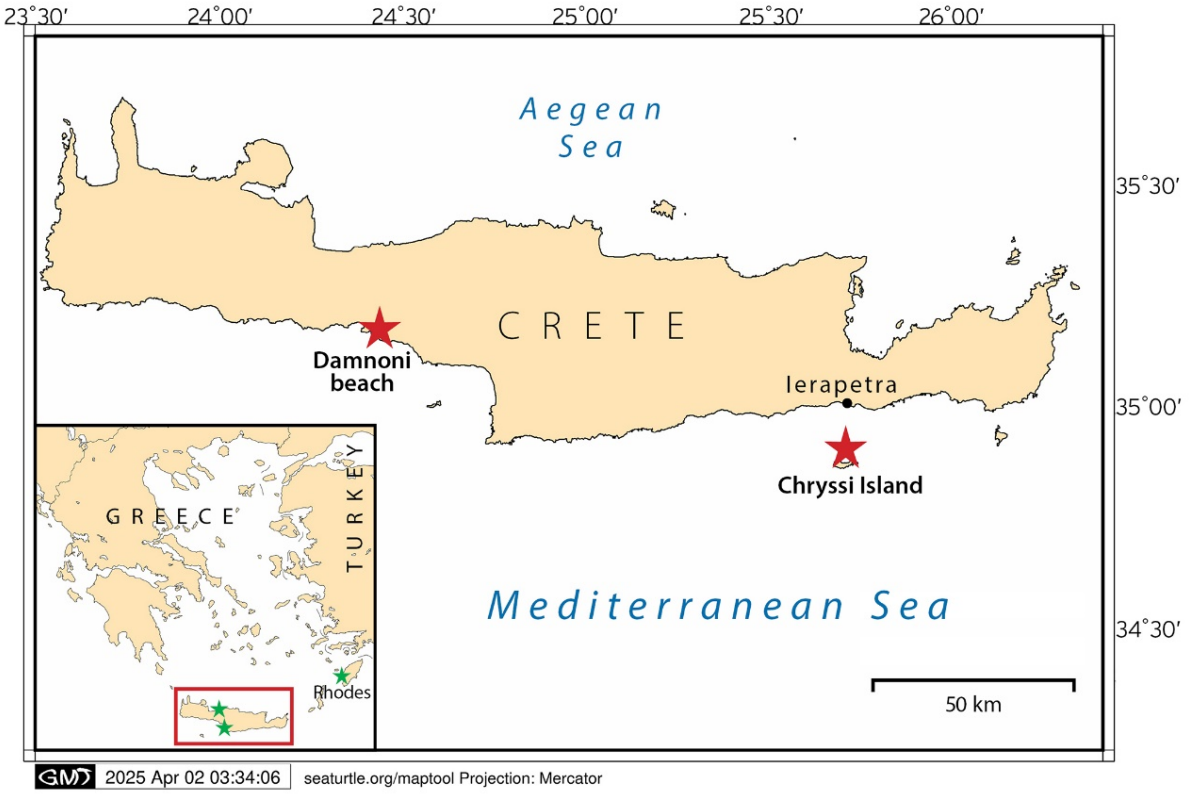

Figure 1. Map showing the locations of the two green turtle nests laid on Crete during 2024 (red stars). Green stars in the inset map show the previously recorded three green turtle nests in Greece (see text for details).

Figure 2. The green turtle laying eggs in Damnoni beach, southern Crete (photo: G. Kefalas).

Here, we report the discovery of two additional green turtle nests in 2024 on the Island of Crete, Greece. The first nest was reported from the beach of Damnoni (35.174°N, 24.417°E), southern Crete (Fig. 1). On 25 June 2024, ARCHELON was informed by the local Coast Guard Station about a nest being laid in Damnoni beach. A local resident working at a nearby hotel, documented the nesting event by taking photos of the turtle, and safeguarded the nest until it was fenced the following day in accordance with ARCHELON's guidelines in such cases. The photos of the nesting female were then sent to ARCHELON, indicating that it was in fact a green turtle (Fig. 2). On 20 August 2024, a citizen posted a video on social media filmed in Damnoni beach showing emerged hatchlings going to sea. The hatchlings clearly belonged to the *Chelonia mydas* species, suggesting that the green turtle nest ARCHELON had been notified about had hatched. AP, while on mission in Crete, visited Damnoni along with DSdH, ARCHELON's field leader in Crete, located the hatched nest and excavated it on 24 August 2024. Excavation results showed that clutch size was more than 150 eggs, of which 126 had hatched. Five live hatchlings were helped on their way to the sea (Fig. 3). The bottom of the egg chamber was 78 cm from beach surface.

The second nest was located by MD on Chryssi, an uninhabited island (34.876°N, 25.719°E) located approximately 15 kilometers south of Crete, close to Ierapetra (Fig. 1). The nest was identified during a program monitoring the Natura 2000 site on the island, implemented by the Natural History Museum of Crete, University of Crete, during 2022-2024 ("Implementation of measures of the action plan of the island of Chryssi, Region of Crete"). On 27 August 2024, while surveying the island beaches for the presence of loggerhead turtle (*Caretta caretta*) nesting activity, an old female track different from the others (wider and with symmetrical crawl marks) was identified. On 28 August 2024, MD explored the sand dunes in search of a nest and found a dead green turtle hatchling (Fig. 4) close to the junipers (*Juniperus macrocarpa*) typically found on the island. Following the hatchling track led to the exact location of the nest, among the sand dune vegetation. The nest was excavated and found to contain 73 eggs of which 55 had hatched (Fig. 5). A total of 10 hatchlings were located trapped in roots, four of which were still alive and helped to reach the sea.

Figure 3. Alive green turtle hatchlings found during post-hatch excavation of the nest in Damnoni beach, southern Crete (photo: D. Tsaparli/ARCHELON).

These two new records raise the total number of documented green turtle nests on the island of Crete to four since 2007, which, combined with the recent green turtle nest recorded in Rhodes, indicate a possible westward expansion of the green turtle's traditional breeding range in the Mediterranean.

Figure 4. Dead green turtle hatchling in Chryssi Island, southern Crete (photo: M. Dretakis).

Although the green turtle nests in Rethymno and Messaras Bay were discovered at known loggerhead nesting areas monitored by ARCHELON, the recently identified three nests in Crete and Rhodes were found on beaches not regularly monitored. This indicates that more green turtle nests may have been laid on unmonitored beaches and remained undetected. Of note, the beaches of Damnoni, Chryssi and Rhodes frequently attract sporadic nesting events of loggerhead turtles (Margaritoulis et al. in press).

Genetic studies (genomics) revealed that the two previously found green turtle nests on Crete belonged to the Mediterranean green turtle population (RMU) (Marín-Carpuz et al. 2025). This suggests that the Mediterranean green turtle is gradually expanding its breeding range westwards in a similar manner as the well-documented westward expansion of the loggerhead turtle breeding range in the western Mediterranean (Hochscheid et al. 2022). Interestingly, the green turtle that nested in Tunisia originated from the South Atlantic RMU (Marín-Carpuz et al. 2025). It is therefore possible that the sea water temperature increase, noted in the Mediterranean in the last years (Pastor et al. 2018), started to create suitable conditions for green turtle breeding in the region even from distant non-Mediterranean populations. Surprisingly, a recent model revealed that, in response to climate change induced warming, potential nesting habitats in the western Mediterranean basin may become more suitable for green turtle nesting than the currently known ones in the eastern Mediterranean (Mancino et al. 2023).

Figure 5. The contents of the excavated green turtle nest in the dunes of Chryssi Island, southern Crete (photo: M. Dretakis).

Acknowledgements

We thank Giorgos Kefalas for his valuable assistance in protecting the green turtle nest as well as for the photos of the nesting female used in this article. We also thank Nikolaos Deres for uploading the video of the emerged hatchlings from Damnoni nest at the social media. Special thanks are due to ARCHELON's volunteers present at the excavation who provided information to the attending public. Thanks are also due to Rafaella Panteleri, Katerina Chatzikyriakidou and Manolis Roukounakis who were part of the monitoring team in Chryssi Island. Lenio Margaritouli made the graphics on a map provided through the MapTool program, a product of seaturtle.org. We thank a reviewer for constructive comments provided on the draft manuscript.

Literature cited

Ben Ismail M, Jribi I, Kaska Y, Ben Nakhla L, Ben Fradj A, Dibej M, Souki A et al. (2022) The westernmost green turtle (*Chelonia mydas*) nest recorded in the Mediterranean from Tunisia. MedTurtle Bulletin 1: 19-23

Casale P, Broderick AC, Camiñas JA, Cardona L, Carreras C, Demetropoulos A, Fuller WJ et al. (2018) Mediterranean sea turtles: current knowledge and priorities for

conservation and research. Endangered Species Research 36: 229-267

Erdogan A, Öz M, Kaska Y, Düen S, Aslan A, Yavuz M, Tunç MR, Sert H (2001) Marine turtle nesting at Patara, Türkiye, in 2000. Zoology in the Middle East 24: 31–34

Hochscheid S, Maffucci F, Abella E, Bradai MN, Camedda A, Carreras C, Claro F et al. (2022) Nesting range expansion of loggerhead turtles in the Mediterranean: phenology, spatial distribution, and conservation implications. Global Ecology and Conservation 38: e02194

Kasparek M, Godley BJ, Broderick AC (2001) Nesting of the Green Turtle, *Chelonia mydas*, in the Mediterranean: a review of status and conservation needs. Zoology in the Middle East 24: 45–74

Mancino C, Hochscheid S, Maiorano L (2023) Increase of nesting habitat suitability for green turtles in a warming Mediterranean Sea. Scientific Reports 13: 19906

Margaritoulis D, Fytilis D, Manias N, Panagopoulou A, Theodorou P (In press) Sporadic nesting records of the loggerhead sea turtle *Caretta caretta* along the Greek shores of the Aegean Sea. Herpetological Bulletin 172: 13-15

Margaritoulis D, Johnson SK, Panagopoulou A, Paxinos O (2023) Update of green turtle nesting in Greece: A second nest recorded on Crete Island. MedTurtle Bulletin 3: 2-4

Margaritoulis D, Panagopoulou A, Proctor S (2019) First green turtle nest in Greece and the westernmost record in the Mediterranean. In: Mangel JC, Rees A, Pajuelo M, Córdova F, Acuña N (compilers) Proceedings of the Thirty-Six Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NOAA NMFS-SEFSC-734, p 286

Marín-Capuz G, Crespo-Picazo JL, Demetropoulos S, Garrido L, Hardwick J, Jribi I, Margaritoulis D, et al. (2025) Incipient Range Expansion of Green Turtles in the Mediterranean. Molecular Ecology: e17790

Pastor F, Valiente JA, Palau JL (2018) Sea surface temperature in the Mediterranean: Trends and spatial patterns (1982–2016). Pure and Applied Geophysics 175: 4017–4029

Saeid A, Almunstasri M, Bellrahal K, Essghaieer M (2023) First green turtle nest recorded in Libya. MedTurtle Bulletin 3: 5-8

Teneketzis K, Margaritoulis D, Panagopoulou A, Louizidou P, Kalaentzis K, Kondylatos G, Mavrouleas D (2024) The first green turtle nest documented in Rhodes Island, Greece. MedTurtle Bulletin 6: 54-58