

Northernmost Known Sea Turtle Nesting Activity in NW Atlantic: Nantucket Island, Massachusetts, USA

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Green sea turtles (*Chelonia mydas*) occur in tropical and subtropical waters worldwide and nest in more than 90 countries (Spotila 2004; Turtle Taxonomy Working Group 2021). In the continental USA, nesting has been documented in Texas, Alabama, Florida, Georgia, South Carolina, North Carolina, Virginia, Maryland, and New York (Ernst & Lovich 2009; Shaver *et al.* 2020; Hulslander unpubl. data), although most nesting in the USA occurs in Florida (Turtle Taxonomy Working Group 2021). Off Massachusetts USA, juvenile *C. mydas* forage in coastal, temperate waters during the summer and fall, reflecting the pattern of early development in the oceanic zone and recruitment to the neritic zone (Bolten 2003), at

approximately 30-40 cm curved carapace length (CCL) (Musick & Limpus 1997). Historically, *C. mydas* off Massachusetts have been known primarily from juvenile greens that became cold-stunned and stranded on beaches (Still *et al.* 2005) and were rescued or recovered by the Mass Audubon Wellfleet Bay Wildlife Sanctuary (WBWS) Sea Turtle Rescue and Research Program (Griffin *et al.* 2019). Nearshore waters in Massachusetts appear to be at least part of a developmental habitat for juveniles, but not for adults (Lazell 1980; Shamblin *et al.* 2018).

On 20 September 2022, two beach-walkers on the eastern shore of Nantucket Island, Massachusetts (41.2647 °N, -69.9612 °W) saw



Figure 1. *Chelonia mydas* nesting crawl tracks on Nantucket, showing species-specific characteristics. Photo by P. Meerbergen.



Figure 2. *Chelonia mydas* nesting crawl tracks on Nantucket, showing one body pit. Photo by P. Meerbergen.

what looked to them like sea turtle crawl tracks, having observed sea turtle nesting tracks in Florida. They reported the tracks to Marine Mammal Alliance Nantucket (MMAN) staff, who investigated and reported the occurrence to WBWS, who are the Sea Turtle Stranding and Salvage Network (STSSN) responders in SE Massachusetts. Communications ensued among personnel from MMAN, WBWS, the National Oceanic and Atmospheric Organization (NOAA), and the United States Fish and Wildlife Service (USFWS).

The USFWS is the federal agency that has jurisdiction over sea turtle nesting activity in the USA (USFWS & NOAA 2015). At the request of USFWS, MMAN staff returned to the site to document the tracks. Their photos, measurements and diagrams helped researchers confirm that this track was made by a *C. mydas* (Fig. 1). Species-distinguishing track characteristics included: symmetrical, simultaneous flipper movement, a center tail drag depression, and track width of 95-144 cm (Shigenaka *et al.* 2003; Witherington & Witherington 2015). MMAN staff measured the average crawl track width on Nantucket as 105 cm. The track also exhibited the typical pattern of a nesting sea turtle re-entering the water on a different route than along her emergent track (Carr 1967).

There were three depressions along the crawl track which fit the description of sea turtle body pits (Shigenaka *et al.* 2003). The first was near the surf and two others were high on the beach toward the dunes within sparse beach vegetation (Fig. 2). In accordance with USFWS Nest Protection Protocol for sea turtle nest sites north of Virginia (USFWS unpubl. internal document 2019), USFWS advised MMAN to mark the potential nest to protect it from human activity as management decisions were discussed with the Massachusetts Division of Fisheries and Wildlife (MW). Due to the location of Nantucket (40 km off Cape Cod, Massachusetts) and an approaching storm, MW, in close coordination with USFWS, authorized a Wildlife Research Ecologist from Nantucket Conservation Foundation (NCF) to carefully dig into the body pits to check for eggs. The NCF ecologist excavated two body pits by hand to a depth of approximately 1 m (Najwa-Sawawi *et al.* 2021), but eggs were not found. The sand was compact, appearing undisturbed beyond approximately 60 cm down, with normal stratification of sand layers present. The NCF ecologist and MMAN personnel filled the holes for public safety and then left the site.

No one reported seeing the *C. mydas* during its emergence on the Nantucket beach. This is not surprising, as *C. mydas* typically nest at night (Carr 1967; Shaver *et al.* 2020), and this beach on eastern Nantucket is remote. The turtle's age and exact size was unknown. Compared to all the juvenile, cold-stunned *C. mydas* rescued on Massachusetts beaches (Prescott & Dourdeville unpubl. data), the Nantucket turtle was larger. The largest chelonid species, *C. mydas* mature slowly, with females reaching sexual maturity at 30 to 40 years in Florida, Costa Rica, and Mexican waters (Goshe *et al.* 2010). From a study of nesting *C. mydas* in eastern Florida, 3,401 mature females exhibited a mean straight carapace length of 99.8 cm (SD 5.3), with a range of 81.4-117 cm (Phillips *et al.* 2021).

Prior to the Nantucket occurrence, other NW Atlantic sea turtle nesting activity has been documented north of Virginia, USA. Although not a comprehensive list, in recent years these include: a *C. mydas* nested and deposited eggs in 2011 in Delaware, USA (Shamblin *et al.* 2018; Shaver *et al.* 2019); two occurrences of non-nesting emergence by *C. mydas* were documented in New York, USA, in 1998 and 2011 (Shaver *et al.* 2019); a Kemp's ridley

(*Lepidochelys kempii*) nested and deposited eggs on Long Island, New York, in 2018 (Rafferty *et al.* 2019); and a loggerhead (*Caretta caretta*) nested and deposited eggs in southern New Jersey, USA, in 2022 (USFWS pers comm. 2022).

The presence of an adult *C. mydas* off Massachusetts is highly unusual according to four data sets. WBWS staff have responded to sea turtle strandings since the 1980s, including: (1) hundreds of summer strandings, mostly leatherback (*Dermochelys coriacea*) and *C. caretta*, and (2) thousands of cold-stunned strandings (mostly juvenile *L. kempii* with a smaller percentage of subadult and juvenile *C. caretta* and juvenile *C. mydas*). Throughout these many years of stranding response by WBWS, an adult *C. mydas* has never been found on the Massachusetts coast. (3) WBWS has operated a sea turtle sighting hotline/website for marine vessel operators since 2002, seaturtlesightings.org. From the ensuing database of more than 2,500 vetted sea turtle sightings, there are no credible (documented photographically) adult *C. mydas* (Dourdeville & Prescott 2022). (4) In the NOAA Northeast Fisheries Observer Program, no *C. mydas* with CCL > 90 cm have been documented in commercial fisheries in this region. From 1989 to August 2022, there have been 45 *C. mydas* identified in the observer program data, 26 of which had carapace measurements taken. Since 2000, there have been five *C. mydas* interactions recorded north of 40.0 °N latitude, all of which were under 35 cm CCL; the largest observed *C. mydas* was an estimated 76 cm CCL, at latitude 37.5 °N in 2018 (Harner unpubl. data).

The Nantucket *C. mydas* nesting activity may be considered an outlier occurrence, both temporally and spatially (Shaver *et al.* 2020). Climate change, however, can be expected to bring about shifts in all aspects of sea turtle life history, both at sea and on land, including temporal and latitudinal shifts in ranges of foraging and nesting (Witt *et al.* 2009; Hawkes *et al.* 2010; Patricio *et al.* 2021). For example, *C. caretta* in the western Mediterranean show definitive nesting range expansion northward (Hochscheid *et al.* 2022). Patricio *et al.* (2019) used nine criteria to model climate change resilience of the *C. mydas* nesting population on Poilão Island in the Bijagós Archipelago, Guinea-Bissau, West Africa. Blechschmidt *et al.* (2020) modeled the effect of manipulating nest depth and altering the level of nest shade in *C. mydas* at the northern Great Barrier Reef, Australia. Sönmez *et al.* (2021) projected habitat loss and subsequent nest destruction due to sea level rise for the important *C. mydas* nesting beaches in Samandag, Turkey.

Currently, North Atlantic *C. mydas* are listed as a threatened Distinct Population Segment under the US Endangered Species Act (NMFS & USFWS 2016). Shamblin *et al.* (2018) investigated *C. mydas* turtle nesting range expansion northward in the NW Atlantic from nests in South Carolina, North Carolina and Delaware from 2010 through 2014. From DNA analysis, the authors suggest that these northern nesting females “represent an incipient subpopulation, with need for distinct management unit status;” the authors also found that juvenile *C. mydas* foraging nearshore off North Carolina demonstrated a genetic link to the northward nesting females (Shamblin *et al.* 2018).

Future preparedness for sea turtle nesting range expansion in the NW Atlantic includes increased alertness by researchers and marine animal stranding responders about how to identify sea turtle nesting crawl tracks. It is important to learn characteristics which distinguish sea turtle tracks from seal haul-out tracks on

some beaches, using photographs and descriptions. Cunningham *et al.* (2009) describe how to do so for harbor seal (*Phoca vitulina*) tracks. Raising awareness of sea turtle crawl tracks will help monitor possible nesting and non-nesting emergences (Shaver *et al.* 2020). Further research is also needed for juvenile *C. mydas* that forage off Massachusetts. DNA analysis could reveal how northern foraging juveniles relate at a population level to nesting females. This work could be facilitated by DNA analysis of samples from WBWS's annual necropsies of deceased, cold-stunned juvenile *C. mydas*.

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