Hybridization Between a Green Turtle, *Chelonia mydas,* and Loggerhead Turtle, *Caretta caretta*, and the First Record of a Green Turtle in Atlantic Canada

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The Green Turtle (*Chelonia mydas*) principally occupies tropical and subtropical waters, although juveniles are known to occur seasonally in temperate coastal waters. Collaboration with commercial fishers in eastern Canada yielded the most northerly records of this species in the northwest Atlantic. Here we report on the first confirmed record of a Green Turtle in eastern Canada and on the occurrence of a rare Green Turtle–Loggerhead Turtle (*Caretta caretta*) hybrid. Hybridization between the Carettini and Chelonini is extraordinary given that these groups have been genetically distinct for 50 million years or more.

Key Words: Green turtle, *Chelonia mydas*, hybrid, Loggerhead Turtle, *Caretta caretta*, Atlantic Canada.

The Green Turtle (*Chelonia mydas*) has a broad range in the Atlantic, which includes waters off the continental United States. Presence in temperate waters of the northeastern United States is seasonal, with turtles retreating to more southerly latitudes when water temperatures decline (Epperly et al. 1995). During summer and fall, this species regularly occurs as far north as New York (Morreale et al. 1992); however, records of Green Turtles at higher latitudes of the United States are rare. While both Leatherback Turtles (*Dermochelys coriacea*) and Loggerhead Turtles (*Caretta caretta*) are commonly encountered in waters off Atlantic Canada (e.g., Bleakney 1965), with leatherbacks occupying both nearshore and offshore waters (James et al. 2005) and loggerheads mainly offshore waters, there were no previous confirmed reports of the Green Turtle in this region. Here we report on photo-documented records of a Green Turtle and a Green Turtle-Loggerhead Turtle hybrid in nearshore waters off Nova Scotia, Canada. These exist as the most northerly confirmed records of *Chelonia mydas* in the northwest Atlantic.

Notification about both turtles initially came through calls to a toll-free phone line established for fishing community members in Atlantic Canada to report sea turtle sightings (Martin and James 2005). A small, live cheloniid turtle was reported on 8 August 1999. The turtle was found in Chedabucto Bay, Nova Scotia (at 45º20'37"N, 61º15'36"W, Figure 1) and was photographed and released shortly before the call was placed. The turtle was not measured; however, curved carapace length (CCL) was estimated to be between 30 and 40 cm and its mass approximately 4-5 kg. Species identification was confirmed as *C. mydas* (juvenile) upon receipt of several excellent photographs that depicted carapacial scute configuration and scale patterning on the head (Figure 2).

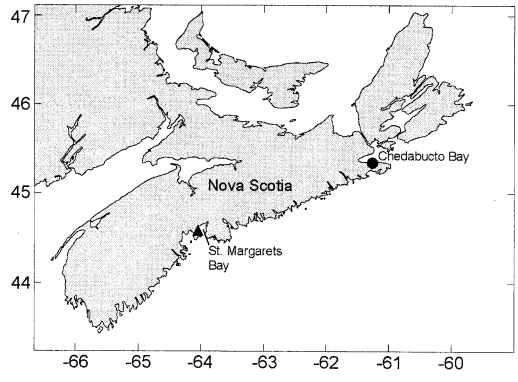

FIGURE 1. Capture locations of juvenile Green Turtle (solid circle) and juvenile Green Turtle × Loggerhead Turtle hybrid (solid triangle).

The second turtle, also live, was reported on 2 October 2001. It was found in St. Margarets Bay, Nova Scotia (at 44º34'56"N, 64º03'06"W, Figure 1). The animal

FIGURE 2. Juvenile Green Turtle (*Chelonia mydas*) found in Chedabucto Bay, Nova Scotia, on 8 August 1999.

was considered unusual by the inshore commercial fishers who encountered it because they had never seen a cheloniid turtle before. Therefore, they collected it and brought it to shore for examination.

One of us (MCJ) responded to the report and examined the turtle (CCL 34 cm; mass 4.07 kg), tentatively identifying it as a juvenile *C. mydas*. The plastron of the turtle was cream coloured, the cutting edge of the lower tomium was mildly serrated, and it had a pair of large prefrontal scutes on its head (Figure 3), all features characteristic of a Green Turtle. However, while the number and arrangement of carapacial scutes was consistent with those of a Green Turtle, there were two claws on the anterior margin of each front flipper, the costal and vertebral scutes overlapped considerably, and the marginal scutes were strongly serrated (Figure 3), which suggested that the turtle was possibly a hybrid.

At the time of examination, the turtle's movements were sluggish and it was judged to be mildly hypothermic. Small juvenile cheloniid turtles foraging in coastal areas of the temperate north Atlantic in the fall are particularly vulnerable to developing hypothermia, as water temperatures can rapidly drop below 20ºC (Davenport 1997). This animal was recovered from an area where the sea surface temperature was 16.2°C. Given the turtle's compromised physical condition and the declining water temperatures along the coast of Nova Scotia, the turtle was moved to the animal care facilities at Dalhousie University in Halifax, where it was warmed and rehydrated for approximately 60 hours in a freshwater bath at 24ºC. It was then transported south by air on the evening of 4 October 2001 for release in Bermudian waters.

Subsequent genetic analysis at the U.S. National Marine Fisheries Laboratory in La Jolla, California, confirmed that this turtle was a hybrid. This was determined by sequencing a 391 bp fragment of the control region of mitochondrial DNA (mtDNA) extracted from a blood sample (Dutton 1996). The results revealed that this turtle had Loggerhead Turtle mtDNA, while phenotypically it was principally a Green Turtle. Since mtDNA is maternally inherited, we conclude that this animal was the progeny of a female Loggerhead Turtle and a male Green Turtle.

Discussion

The extent to which natural hybridization in sea turtles occurs has not been determined. However, as genetic techniques like the ones employed here are increasingly applied, hybridization may prove to be more common than previously thought. Molecular genetics have confirmed hybridization between the Loggerhead Turtle and Kemp's Ridley Turtle (*Lepidochelys kempii*) (Karl et al. 1995; Barber et al. 2003), Loggerhead Turtle and Hawksbill Turtle (*Eretmochelys imbricata*) (Karl et al. 1995; Witzell and Schmid 2003), and Green Turtle and Hawksbill Turtle (Wood et al. 1983; Karl

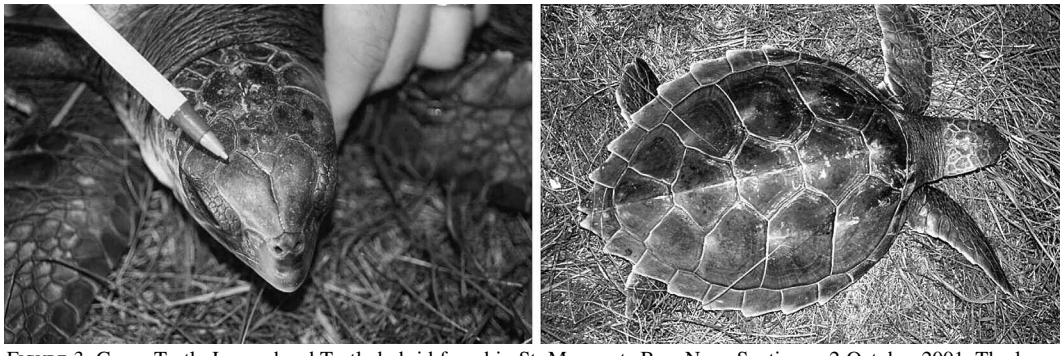

FIGURE 3. Green Turtle-Loggerhead Turtle hybrid found in St. Margarets Bay, Nova Scotia, on 2 October 2001. The large pair of prefrontal scutes on the head (left) are characteristic of *Chelonia mydas*. However, overlapping costal and vertebral scutes and strongly serrated marginal scutes (right) are not characteristic of *Chelonia mydas.*

et al. 1995). In addition to the results presented here, there is only one previous report of hybridization between a Loggerhead Turtle and a Green Turtle (Karl et al. 1995). Hybridization between the Carettini and Chelonini is extraordinary given that these tribes have been genetically separated for 50 million years or more (Bowen et al. 1993; Dutton et al. 1996). It has been suggested that these may be the oldest vertebrate lineages known to hybridize in nature (Karl et al. 1995).

The reproductive status of marine turtle hybrids is not known; however, the identification of potential second-generation hybrids (Karl et al. 1995) suggests that at least some hybrids may be fertile. Reproductive viability in hybrids could have important biological consequences for the conservation of marine turtles (Karl 1996).

Both turtles reported here were of the size class typical of neritic foraging populations of Green Turtles (i.e., straight carapace length >25 cm) (Musick and Limpus 1997). Therefore, these animals likely arrived in eastern Canadian waters from coastal foraging habitat off the northeastern United States, rather than from pelagic areas.

Our current understanding of juvenile Green Turtle distribution in the northwest Atlantic suggests that these turtles occupy areas where sea surface temperature is normally higher than that of coastal Atlantic Canada. In the case of the hybrid turtle, the Loggerhead Turtle component of its genotype may have been responsible for directing the animal to higher latitudes for foraging, as Loggerhead Turtles are commonly encountered in Atlantic Canadian offshore waters. However, the animal's presence in nearshore waters off Nova Scotia remains puzzling. Loggerhead Turtles are rarely encountered in coastal areas of Atlantic Canada because sea surface temperatures are normally at or below the lower thermal tolerance limits of this species.

There was no formal attempt in eastern Canada to specifically promote the reporting of marine turtle sightings until 1998, when a broad public education program and toll-free reporting line were established for this purpose (Martin and James 2005). Continued collaboration with commercial fishers will be key to determining if the records reported here represent accidental occurrences of the Green Turtle in this region, or if small numbers of this species regularly forage along the Scotian Shelf in summer and early fall when inshore water temperatures are highest.

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