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**THE ORIGIN OF OVIGEROUS  
LOGGERHEAD TURTLES  
(*CARETTA CARETTA*) RECORDED IN  
NORTHERN EUROPE**

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Although loggerhead sea turtles (*Caretta caretta*) do not nest in northern Europe, they are occasionally recorded in this area (Brongersma, 1972). Likely possibilities for the area of origin for these specimens are the western Atlantic and the eastern Mediterranean, since major loggerhead rookeries exist in both of these regions (Dodd, 1988). Brongersma (1972) suggested that the juvenile loggerhead turtles found in northern Europe are most probably carried from the western Atlantic on the Gulf Stream and North Atlantic Current. However, since mature loggerhead turtles are capable of strong swimming, their area of origin is less readily resolved. In this study, we use the known difference in the size of mature females from western Atlantic and eastern Mediterranean rookeries to provide evidence for the probable area of origin for ovigerous loggerhead turtles reported in northern Europe.

Two loggerhead turtles were reported by Brongersma (1972) that contained large well developed eggs, indicating that they were mature females. The first was found alive on 27 December 1894 on the coast of the Netherlands and contained 1150 eggs, the largest of which were 35 mm in diameter. The second was reported alive from Scotland on 13 December 1923 and contained 1020 eggs, the largest of which were 28.6 mm in diameter. There are various methods for measuring the carapace length of turtles, with a general dichotomy between measurements made with a flexible tape-measure over the curve of the carapace (curve length or CL) and measurements of the straight line carapace length made with callipers (straight length or SL). The ovigerous loggerhead turtle reported from the Netherlands had a carapace length of 96.5 cm, although whether this referred to CL or SL was not detailed, while the specimen reported from Scotland had a CL of 104.1 cm. We compared the size of these two specimens with the size of nesting loggerhead turtles on two islands in Greece, Cephalonia (Hays & Speakman, 1991, 1992) and Zakynthos (Margaritoulis, 1982), and from Turkey (Erk'akan, 1993) (Fig. 1). The mean CL of nesting loggerhead turtles on Cephalonia was 82.8 cm ( $n = 57$ ,  $SD = 3.7$ ) and hence the individual probabilities of specimens of 96.5 cm and 104.1 cm coming from this population are both  $< 0.001$  ( $Z = 3.7$  and  $5.8$  respectively). Similarly, the mean CL of nesting loggerhead

turtles on Zakynthos was 80.4 cm ( $n = 27$ ,  $SD = 6.2$ ) and hence the individual probabilities of specimens of 96.5 cm and 104.1 cm coming from this population are also both  $< 0.001$  ( $Z = 2.6$  and  $3.8$  respectively). Erk'akan (1993) reported a mean carapace length of 73.1 cm ( $n = 49$ ,  $SD = 5.3$ ) for nesting loggerhead turtles from Turkey, although whether this referred to CL or SL was not stated. We assumed that this measurement refers to SL and, using the relationship between CL and SL observed elsewhere in the Mediterranean (Hays, 1992:  $CL = 1.03(SL + 1.9)$ ), we estimated the mean CL for this population to be 77.3 cm (and by proportional scaling  $SD = 5.6$ ). Hence, as with the Greek populations, we calculated that the individual probabilities of loggerhead turtles of 96.5 cm and 104.1 cm coming from this Turkish population are both  $< 0.001$  ( $Z = 3.4$  and  $4.8$  respectively). In contrast, the length of the two ovigerous specimens recorded in northern Europe lies well within the size range for nesting loggerhead turtles in Florida and Georgia, USA (Fig. 1), suggesting, therefore, that these two specimens originated from the western Atlantic rather than from the Mediterranean.

In our calculations we have assumed that the measurement of the ovigerous loggerhead turtle recorded in the Netherlands refers to CL. In terms of our conclusions regarding the origin of this turtle, this is a conservative assumption, since if the measurement was for SL rather than CL, then the probability that this turtle was of Mediterranean origin would be even less than that calculated.

It has been suggested that some juvenile loggerhead turtles from the western Atlantic may be carried by current systems into the Mediterranean where they may then mature and breed (Groombridge, 1988). In sup-

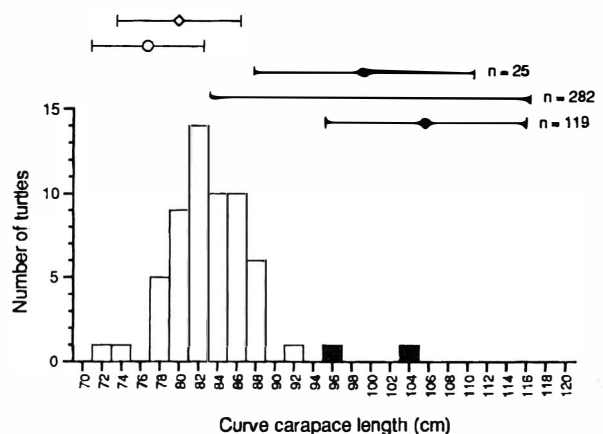


FIG. 1. The size of two ovigerous loggerhead turtles recorded in northern Europe (solid bars) (from Brongersma, 1972); the CL of nesting loggerhead turtles on Cephalonia, Greece (open bars) (from Hays & Speakman 1991, 1992); the mean CL (and range) for nesting loggerhead turtles in Florida and Georgia, USA, (●) (from three studies reviewed by Dodd 1988, the number of turtles measured in each study is indicated); the mean CL (and SD) for nesting loggerhead turtles from Zakynthos, Greece (diamond) (from Margaritoulis, 1982); the mean CL (and SD) for nesting loggerhead turtles from Turkey (open circle) (calculated from Erk'akan, 1993).

port of this suggestion, recent genetic evidence suggests first that some of the juvenile loggerhead turtles found in the Mediterranean are of western Atlantic origin (Laurent *et al.*, 1993) and that interchange between rookeries in Florida and Greece occurs at a rate of about one individual per generation (Bowen *et al.*, 1993). The evidence presented in the current study suggests that, in addition to juveniles, mature female loggerhead turtles may also traverse the Atlantic and hence this may be an additional mechanism by which trans-Atlantic gene flow may be mediated in this species.

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