ORIGIN AND MIGRATION PATTERN OF THE LOGGERHEAD TURTLE IN THE WESTERN MEDITERRANEAN

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Abstract

Genetic composition of loggerhead sea turtles occurring off Balearic Islands was assessed using a mitochondrial DNA marker. The haplotype composition indicated a contribution from Atlantic nesting sites, while evidence for contribution from the eastern Mediterranean was weaker. Genetic separation was found between Formentera population and the Majorca and Minorca group, suggesting different migration inputs. Majorca and Minorca populations were not different from the Azores or Madeira ones, supporting its Atlantic origin. Formentera population was not different from the Lampedusa one, suggesting a mixed origin. It is proposed that such differences reflect migratory patterns associated to prevailing currents in western Mediterranean.

Keywords: loggerhead, migration, mitochondrial DNA

Previous genetic studies have shown that loggerhead turtles present in the western Mediterranean come from nesting beaches located both in the western Atlantic and eastern Mediterranean (1), although basin heterogeneity was not considered. On the other hand, a fisheries based study (2), identified several migratory routes within the western Mediterranean, suggesting a heterogeneous contribution of Atlantic and eastern Mediterranean nesting beaches to different areas. The aim of this paper was to test the latter hypothesis.

Blood and tissue samples were collected from turtles in three islands of the Balearic archipelago: Majorca, Minorca and Formentera. A 391 bp of the control region of the D-loop of the mitochondrial DNA was sequenced using the BigDye® technology. A chi-square test was performed in order to test whether haplotype frequencies of the three islands were homogenous. Furthermore, they were compared to those reported for other immature populations found between the above mentioned putative nesting sites. Genetic distance ($Gamma_{ST}$) was estimated for each pair of populations using the programme DnaSP v3.99. Chi-square tests were used to detect differences between populations.

58 samples were analysed and 9 haplotypes were found, one of them not previously described. No significant (chi-square; $p>0.5$) differences were observed between Majorca and Minorca haplotype frequencies. Hence the two populations were grouped. Formentera differed from this group (chi-square; $p<0.01$), suggesting a different contribution of Atlantic and Mediterranean nesting beaches to both turtle populations. $Gamma_{ST}$ values between pairs of populations (Table 1) cluster them in two groups, one formed by Azores, Madeira and Majorca and Minorca and the other one by Formentera and Lampedusa. Chi-square results supported such grouping (Table 1) suggesting that Majorca and Minorca populations, as reported from Azores and Madeira (3), have an extremely limited contribution of eastern Mediterranean nesting beaches. Finally, Formentera, as reported from Lampedusa (1), might have a higher contribution from the eastern Mediterranean.

Table 1. $Gamma_{ST}$ values (above) and p-values of the chi-square test (below) between pairs of locations. ns = not significant; * = p<0.05; ** = p<0.01; *** = p<0.001.

	Formentera	Majorca & Minorca	Azores	Madeira	Lampedusa
Formentera		*0.0559*	*0.0189*	*0.0298*	*0.0046*
Majorca & Minorca	**		*0.0055*	*0.0034*	*0.0770*
Azores	**	ns		*0.0007*	*0.0462*
Madeira	*	ns	ns		*0.0586*
Lampedusa	ns	***	***	***	

Immature turtles drift passively with prevailing currents (4). Hence Atlantic juveniles enter the Mediterranean through the Gibraltar strait following the Atlantic current (Fig 1) until they reach Balearic Islands. This would explain the high similarity between Gimnesies and the Atlantic Islands. On the other hand, juveniles from the eastern Mediterranean enter the western Mediterranean through the Messina strait (5) and drift counter-clockwise with prevailing currents (Fig. 1). As Formentera is closer to the Iberian Peninsula, it is more influenced by these currents than the northern and more distant Majorca and Minorca (6). Lampedusa, as Formentera, is also influenced by both currents. This would explain the similarity and the higher contribution of Mediterranean turtles to both populations.

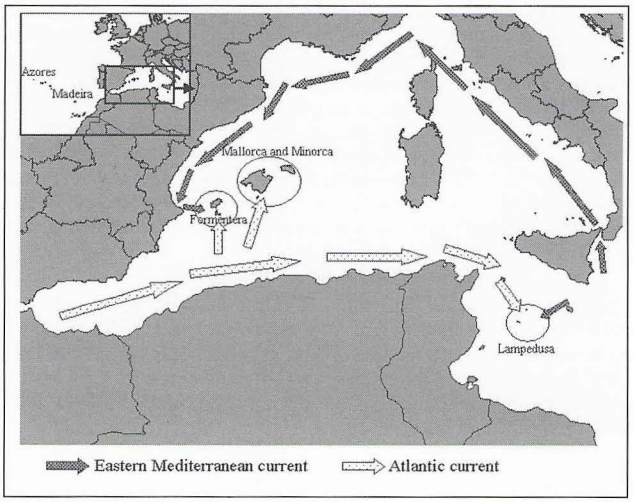

Fig 1. Map showing the major currents of the western Mediterranean and the proposed migration routes.

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