

SHORT NOTES

HERPETOLOGICAL JOURNAL, Vol. 15, pp. 201-203 (2005)

INTERACTION OF THE STATIC NET FISHERY WITH LOGGERHEAD SEA TURTLES IN THE MEDITERRANEAN: INSIGHTS FROM MARK-RECAPTURE DATA

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Comparison of mark-recapture data collected using different fishing methods suggests that in the Mediterranean the interaction of sea turtles with the static net fishery is very important and comparable to other fisheries. Given the high mortality rate observed in this and other studies, static nets are likely to represent a serious threat to Mediterranean sea turtle populations.

Key words: *Caretta caretta*, Mediterranean sea fishery interaction, static nets

Loggerhead sea turtles (*Caretta caretta*) are listed as Endangered in the IUCN Red List of threatened species (Hilton-Taylor, 2000). In the Mediterranean Sea, the probable population sub-structure and genetic isolation from the Atlantic – at least at the female level – (Laurent *et al.*, 1998), make loggerhead turtles particularly vulnerable to the serious threats affecting them in the basin. One of the most important threats is the mortality associated with interaction with fishing equipment (see Gerosa & Casale, 1999, for a review). Thus, it is of the utmost importance to improve our knowledge of the impact of fisheries on sea turtle populations.

Trawl nets and drifting longlines have been recognized as methods that capture thousands or tens of thousands of turtles in the Mediterranean (see Gerosa & Casale, 1999, for a review; Casale *et al.*, 2004; Casale *et al.*, in press), thus representing a serious threat in this basin as well as in other areas (e.g. National Research Council, 1990; NMFS, 2001). However, the possible impact of other fishing methods has not been adequately addressed, especially for artisanal and amateur fisheries that may use static nets (trammel and gill nets anchored to the sea bottom in shallow waters).

Typically, the net is put in place at sunset and retrieved the next morning, and this theoretically suggests

a high mortality rate, because captured turtles are likely to be forced underwater for an unsustainable period of time. In some Mediterranean countries, mortality induced by static nets was estimated through reports by – or inquires to – fishermen. Although this method potentially gives low-biased estimates, high mortality was reported in most cases: 77.7% (Balearic Islands, Spain; *n*=45; Carreras *et al.*, 2004); 94.4% (Corsica, France; *n*=18; Delaugerre, 1987); 53.7% (Continental France; *n*=149; Laurent, 1991); 54.9% (Croatia; *n*=51; Lazar & Tvrtkovic, 2003); while in Tunisia only 5.2% (*n*=58; Bradai, 1993). Such a high mortality rate may represent a serious threat to the populations if a large number of turtles is caught.

Catch rate per static net vessel is probably low. For instance, inquiries to fishermen provided estimates of 0.5-2.1 turtles per vessel per year in Tunisia (Bradai, 1993) and 0.17 turtles per vessel per month in the Balearic Islands, Spain (Carreras *et al.*, 2004). This represents another problem for the study of this interaction, because it hides the phenomenon if compared with other fishing methods that have much higher catch rates. However, even low catch rates can result in high numbers of captures if associated with a high number of vessels.

On the basis of inquiries to fishermen, about 920 turtles per year may be captured by static nets in Tunisia (calculated from Bradai, 1993) and about 200 in the Balearic Islands (Carreras *et al.*, 2004). It should be taken into account that being based on inquiries, these figures may be underestimates, while the opposite is improbable.

Apart from these specific cases, it is difficult to gain a reliable estimate at the Mediterranean scale, because this is an artisanal and amateur fishery comprising very small vessels dispersed along many small ports, and usually not included in the country register, making official statistics unreliable (Di Natale, 2002): a realistic census is therefore difficult to obtain. However, Di Natale (2002) estimates that artisanal fishing vessels in the 21 Mediterranean countries number more than 200,000. Of these, about half may be static netters, if the proportion found in some countries (Lamboeuf, 2000; Alarcón Urbistondo, 2001) can be generalised.

Our data were collected in the period 1981-2000 in the framework of a sea turtle tagging programme carried out in Italy in collaboration with professional fishermen (Argano, 1992). Turtles were originally incidentally captured by fishing methods, landed, and then tagged and released by project personnel with monel tags (style 49 or 681, National Band and Tag, Kentucky, USA), attached to front flippers. Tags provided a postal address and the words "reward premio remite". Except for the text on the tags, no particular emphasis was given to rewards for reporting recaptures, and rewards usually consisted of project T-shirts. Recaptures were reported by fishermen directly to personnel involved in the tagging programme (if operating in the area and known by the fisherman) or by mail. We classified fishing methods

TABLE 1. Proportion of recaptured turtles out of all the turtles captured in Italy by different fishing methods.

Fishing method	%	N
Longline	0.8	1095
Static net	6.3	95
Unspecified 'net'	3.3	153
Trawl net	3.0	296
Other	2.2	46
Unknown	5.6	72
Total	1.9	1757

as: drifting longline, bottom trawl, static net, unspecified net (these records reported just 'net', which can mean either trawl, drifting, or static net), other or unknown gears (Table 1).

We received reports of 105 turtles captured or recaptured by static net fishermen (collaborating or not with our programme) from Italy and other Mediterranean countries. Measured turtles ranged from 21 to 80 cm Curved Carapace Length notch-to-tip (mean = 45.8; SD=13.0; $n=70$). The condition was unknown for five of them and 11 specimens out of the other 100 died as a consequence of the capture. However, fishermen probably preferentially reported the capture of live specimens, either to avoid providing evidence of the impact of their activity on protected species, or because they believed dead specimens to be less interesting for our study. In this respect it is interesting that when fishermen had an additional reason to report a capture (i.e. a turtle with a tag), the proportion of dead turtles was higher (five out of 11) than among turtles without a tag (six out of 89; Fisher exact test; $P<0.005$; $n=100$). Hence, the mortality rate estimated from fishermen reports should be considered with caution, while the one based on recaptures only is expected to be more representative of the actual mortality. High mortality rates were reported by another mark-recapture programme too: of six tagged specimens found in Croatian static nets five were dead (Lazar *et al.*, 2000).

Recaptures of tagged turtles were probably underreported by Italian static net fishermen in compari-

TABLE 2. Percentage of turtles recaptured by different fishing methods in the Mediterranean. For Italy, recaptures reported by fishermen not directly involved in the project are also shown (see text).

	Italy All vessels ($n=34$)	Italy Non-collab. vessels ($n=19$)	Other countries ($n=14$)
Longline	26.5	0.0	0.0
Static net	17.6	31.6	57.1
Unspecified 'net'	14.7	26.3	21.4
Trawl net	26.5	15.8	7.1
Other	2.9	5.3	0.0
Unknown	11.8	21.1	14.3
Total	100.0	100.0	100.0

son to other countries, for two reasons: first, our research program focused particularly on longline and trawl, and second, Italian fishermen might prefer not to report to Italian authorities the death of a protected species (Argano *et al.*, 1992), which is often the case, given the high mortality rates above. Even so, static net Italian fishermen reported the highest proportion of recaptured turtles of the total number of reports (Table 1) and static nets are well represented among the fishing methods recapturing tagged specimens in Italy (Table 2). Furthermore, when recaptures reported by Italian fishermen directly involved in the project (working with longline and trawl) are excluded, so reducing the bias towards longline and trawl, static nets are the main fishing method by which tagged turtles were recaptured, as it is the case for recaptures from other countries unaffected by the suspected Italian biases (Table 2). A similar result was observed in Croatia, where static net fishermen reported six out of nine turtles recaptured (Lazar *et al.*, 2000).

Longline fishermen rarely take aboard a captured turtle (and so they cannot see a tag), and this may explain the low number of specimens recaptured by this method, known to interact with a large number of turtles (see Gerosa & Casale, 1999). On the other hand, both static net and trawl fishermen have the opportunity of a close look at the turtle. Hence, although alternative explanations cannot be excluded, the relative proportions of recaptures reported by trawl and static net fishermen suggest that in the Mediterranean the overall interaction between sea turtles and the static net fishery may be as important as – or even more important than – the interaction with the trawl fishery.

This scenario underscores the urgent need to obtain reliable estimates of fleet size in different countries, and related turtle catch and mortality rates, in order to assess the impact static nets have on the Mediterranean sea turtle populations.

Acknowledgements. We thank the many fishermen and all the persons who participated in the "Progetto Tartarughe" (Univ. Roma/WWF Italy).

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Accepted: 1.10.04