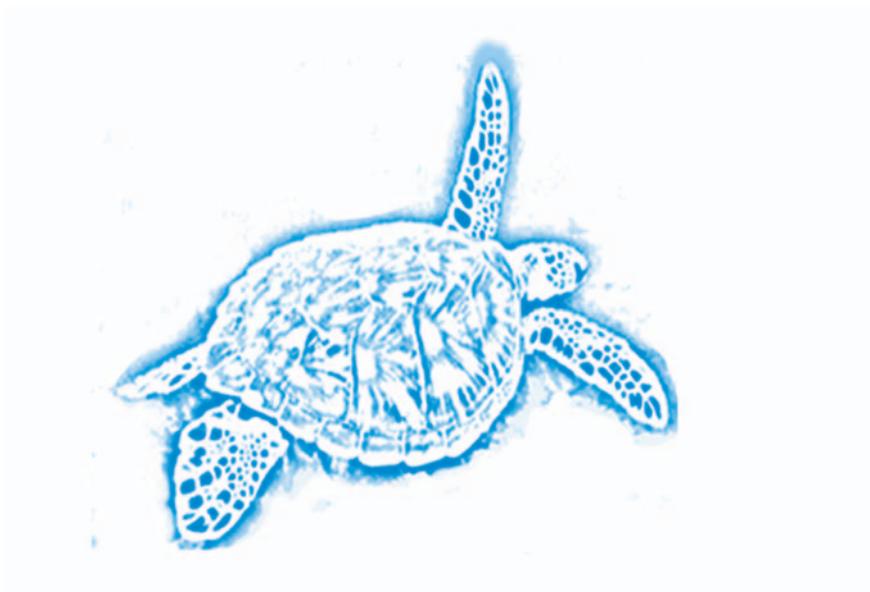


# **PROCEEDINGS OF THE FIRST MEDITERRANEAN CONFERENCE ON MARINE TURTLES**

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## **ASSESSING MARINE TURTLE BYCATCH IN THE TRAWL FISHERIES OF GREECE**

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### **INTRODUCTION**

A primary threat for marine turtles is incidental catch during fishing operations. Trawl fishing is a major method of commercial fishing in Greece. However, its impact on marine turtles has been only studied locally and in a rather non-systematic way (Margaritoulis et al. 1992). A possibility for a more overall and reliable assessment of marine turtle bycatch and subsequent mortality has been provided through the so-called European Marine Turtle Project (EMTP). Based on a conservation biology approach, including stock composition assessment and life history stage distribution analysis, the EMTP project (98/008) was designed to investigate turtle bycatch in European fisheries that appear to have the greatest impact on population dynamics. These fisheries included (a) drifting longlines in Spain, Italy (Ionian Sea) and Greece, and (b) trawl fisheries in Italy (northern Adriatic) and Greece. Herewith we present the main results of the EMTP work concerning turtle bycatch in the trawl fisheries of Greece.

### **MATERIALS AND METHODS**

The Greek trawler fleet is composed of 427 vessels (1998 data), which are widely distributed in different ports throughout the country. The fishing technique is bottom trawling and its target is fish. Trawling in Greece is forbidden in less than 1 mile from the coast but in some sensitive areas this prohibition extends to 3 miles. A closed season for trawling is imposed annually from 1 June until 30 September.

During the project two major fishing areas (and three ports) have been sampled, the Thracian Sea (ports of Kavala and Alexandroupoli) in the northern Aegean Sea and the Ionian Sea (port of Patra). Sample allocation per port was proportional to the number of trawlers at each port. As trawl fishing in Greece is closed during summer, three calendar quarters were used for sampling: January through March (winter), April through May

(spring) and October through December (autumn). The primary sampling unit was the boat trip, regardless of the number of days of a trip. The units were sampled according to a random extraction giving a sequence of boats belonging to the collaborating pool by port. Data were collected by trained onboard observers. The gear, haul and turtle parameters were taken following a common protocol.

Captured turtles were double tagged, at the trailing edge of front flippers, with monel tags No 681. Straight and curved carapace lengths were taken by using aluminium calipers and flexible tape, respectively. The standard carapace length (SCL) was taken from the nuchal scute (at midline) to the distal tip of the longest supracaudal (notch to tip) and the minimum carapace length (MCL) was taken from the nuchal scute (at midline) to the notch between supracaudals (notch to notch). The physical condition of the turtles was noted as healthy, injured, in comatose state or dead (after Poiner and Harris 1996).

## RESULTS AND DISCUSSION

During the two-year project 641 hauls were observed (254 in 1999 and 387 in 2000). Of these, 421 hauls were sampled in the Thracian Sea (193 from the port of Alexandroupoli and 228 from the port of Kavala) and 220 in the Ionian Sea. Some overall statistics of the trawl operation, deducted from the monitored trips, are the following: haul duration (mean: 201.8 min, range: 20-1,005), depth of trawl (mean: 81.5 m, range 5.5-773), speed of trawl (mean: 2.8 knots, range: 1.6-4.1) and haul frequency (mean: 3.6 hauls/day, range: 1-9). However, there is great variability of the above statistics per fishery and port.

In total four turtles (three *Caretta caretta* and one *Chelonia mydas*) were captured during the project (Tab. 1). All captured turtles were in good condition and were released after being measured and tagged. Capture depths ranged from 9 to 49 m, confirming the fact that these turtle species are rarely found in waters deeper than 50 m (Epperly et al. 1995, Poiner and Harris 1996). No turtles were caught during the "winter" quarter (Jan.-Mar.). Because of their size all captured turtles were classified as immature. The size of the smallest loggerhead specimen (CSCL: 34.5 cm), comparable with the smallest loggerheads caught by trawlers in other parts of the Mediterranean (Laurent et al. 1996), probably reflects the minimum size of loggerheads establishing themselves in a demersal phase. The capture of a green turtle (Tab. 1) confirms previous evidence of developmental habitats of this species in Greece (Margaritoulis et al. 1992). It is interesting to note that this turtle was captured in a substrate of sea grass (Tab. 1).

Turtle catch rates, with 95% confidence intervals, ranged in 1999 from zero (Ionian Sea) to  $0.06250 \pm 0.08521$  turtles/day or  $0.01219 \pm 0.01685$  turtles/haul (Thracian Sea) and in 2000 from  $0.01851 \pm 0.03630$  turtles/day or  $0.00769 \pm 0.01508$  turtles/haul (Ionian Sea) to  $0.01851 \pm 0.03630$  turtles/day or  $0.00389 \pm 0.00763$  turtles/haul (Thracian Sea).

	<i>Caretta caretta</i>	<i>Caretta caretta</i>	<i>Chelonia mydas</i>	<i>Caretta caretta</i>
Year	1999	1999	2000	2000
Area	Thracian Sea	Thracian Sea	Ionian Sea	Thracian Sea
Quarter	Spring	Autumn	Spring	Autumn
Capture depth (m)	32.5-38	42-49	9-11	43.5-45.5
Haul start time	15:22	4:35	8:02	5:34
Haul duration (min)	185	175	93	68
H/rope length (m)	27.15	36	43	30
Bottom type	Sand-Gravel	Sand-Mud	Sea grass	Sand
CSCL (cm)	45.0	34.5	47.0	48.0
CMCL (cm)	43.0	33.0		46.5
SSCL (cm)	42.5	31.5	45.0	44.0
SMCL (cm)	40.5	30.5		42.0

**Tab. 1.** Related parameters of captured turtles in trawl fisheries of Greece.

The catch rates per fishing duration and headrope length (standardised for one hour's fishing and a 30.5 m headrope) get highly variable values, depending on the monitored port fleet. In 2000, the year to which the greater observed effort was allocated, catch rates ranged from  $0.00336 \pm 0.00062$  (95% CI) in the Thracian Sea (Alexandroupoli) to  $0.00092 \pm 0.00182$  in the Ionian Sea (Patra). Such a result indicates the occurrence of specific zones where turtle density is higher, as reported previously in Lakonikos Bay (Margaritoulis et al. 1992). For the total project period (1999-2000) the catch rate in the fleet of Alexandroupoli (mean: 0.00631) is comparable to catch rates reported for the Gulf of Mexico (Henwood and Stunz 1987) and northern Australia (Poiner and Harris 1996) and lower to those reported for the southern North Atlantic (Henwood and Stunz 1987) (Tab. 2).

Areas	<i>Caretta caretta</i>	Source
Thracian Sea (Alexandroupoli)	0.00631	Present study
USA southern North Atlantic	0.0456	Henwood and Stunz 1987
USA Gulf of Mexico	0.0025	Henwood and Stunz 1987
Northern Australia	0.0011	Poiner and Harris 1996

**Tab. 2.** Turtle catch rates (per 30.5 m headrope net and hour) in bottom trawl fisheries.

Turtle catch rates in combination with the available fishing effort statistics (Tab. 3) yield an estimation of the total turtle catch per year for the two study areas (Tab. 4). Taking into account the data of 2000, because of the largest sample size, the total number of turtles caught per year are estimated from 0 to 418 individuals in the Thracian Sea and from 0 to 448 individuals in the Ionian Sea. Such estimation is of low accuracy due to the very small number of turtles caught in each fishing area (only one turtle).

	Thracian Sea		Ionian Sea	
	1999	2000	1999	2000
Year	1999	2000	1999	2000
No of vessels (operating)	32	43	84	48
No of fishing days	5817.6	7632.5	14868.0	8179.2
No of hauls	33609.9	34238.3	34057.0	27487.2

**Tab. 3.** Fishing effort statistics (provided by the Institute of Marine Biology of Crete).

	Thracian Sea		Ionian Sea	
	1999	2000	1999	2000
Year	1999	2000	1999	2000
Total turtle catch (days)	364±496	141±277	0	151±297
Total turtle catch (hauls)	410±566	298±261	0	211±415

**Tab. 4.** Total turtle catch (per 30.5 m headrope net and hour) with 95% confidence.

Direct mortality, i.e. the proportion of turtles found dead in the trawl nets due to drowning or injury, was estimated to be 0% (N=4) and none of the captured turtles was found injured or in a comatose state. Again the results should be taken with caution because of the small number of turtles caught. Turtle mortality because of trawl activities seems generally low in the Mediterranean (Delaugerre 1987, Laurent 1991, Laurent and Lescure 1994, Lazar and Tvrtković 1995, Laurent et al. 1996, Oruç et al. 1996) in contrast to other areas (Henwood and Stunz 1987). Reasons for this, especially for the Greek waters, are probably the shorter haul duration and the lower temperatures during the trawling periods, where the decreased turtle metabolism makes them endure longer periods of apnea (see also Gerosa and Casale 1999).

On the scale of the Greek seas, within the framework of a Mediterranean marine turtle conservation approach, the priority is to locate possible zones with high turtle catch rates by bottom trawlers. If such zones are identified a management option that does not lead to a reduction of the fishing effort would be the use of the Turtle Excluder Device (TED). However, the use of this device, initially developed for shrimp trawlers, might be hindered by the fact that Greek trawlers target almost exclusively fish, including large-sized ones, which would also be excluded from the trawl net by the TED. Therefore a substantial technology effort is required to improve such a device in order to reduce turtle captures without substantial reduction in fish catch.

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