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NEW DATA ON THE OCCURRENCE OF LEATHERBACK TURTLES *DERMOCHELYS CORIACEA* IN THE EASTERN ADRIATIC SEA

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ABSTRACT. – We review the occurrence of leatherback turtle (*Dermochelys coriacea*) in the eastern Adriatic Sea based upon museum collections and published literature, and present six new records. Eight out of 13 records (61.5 %) derived from fishery bycatch, with gillnets being a dominant threat to leatherbacks in the region. Findings were concentrated between July and September, with a peak (83.3 %) in the summer. In total, 30 leatherback records exist for the entire Adriatic Sea. The specimens for which data on the size (carapace length, CL) were available were all large immatures and adults (CL > 120 cm). Most turtles (70.4 %) were found in the summer, in the oceanic zone of the southern Adriatic (63.3 %). The number of records in this sub-basin represents 4.5 % of the recorded specimens in the entire Mediterranean. Comparing that percentage to the extent of the area relative to the Mediterranean, the occurrence of the leatherback recorded in the southern Adriatic is up to 1.5 fold higher to that of the entire Mediterranean Sea. That suggests possible relevance of the southern Adriatic Sea as a summer foraging habitat for leatherbacks within the Mediterranean. Bycatch estimates for the Mediterranean and critically endangered status of the species, coupled with the lack of data on the natal origin of the populations emphasize the need for systematic monitoring and data collection in the entire region.

INTRODUCTION

The leatherback sea turtle *Dermochelys coriacea* (Vandelli 1761) is a circumglobal species, with the widest range of all reptiles. Nesting colonies are distributed mainly in the tropics, but it regularly utilizes temperate seas during its trans-oceanic journeys (Hays *et al.* 2004, James *et al.* 2005). With the exception of the reproductive season, this species spends its entire life in the open oceans (Bolten 2003) feeding upon pelagic invertebrates, and undertakes one of the longest migrations in the animal kingdom (Bjorndal 1997).

Pan-oceanic movements and shallow diving, coupled with a life history characterized by delayed maturity, make these long-lived marine reptiles particularly vulnerable to high seas pelagic fisheries (Hays *et al.* 2004). At present, pelagic long-lining is considered the major source of leatherback mortality worldwide (Spotila *et al.* 2000, Lewison *et al.* 2004). Incidental catch and mortality in fisheries, along with egg harvest, have resulted in the severe reduction of populations and the global listing of the species as critically endangered (Hilton-Taylor 2000). The alarming decline of over 90 % on nesting beaches in

the Pacific Ocean over the last two decades (Chan & Liew 1996, Eckert & Sarti 1997, Spotila *et al.* 2000) has brought Pacific leatherbacks to the verge of extinction, with the adult female population of less than 2,300 individuals (Crowder 2000).

Besides the two sea turtle species that reproduce in the Mediterranean, the loggerhead (*Caretta caretta*) and green turtle (*Chelonia mydas*), leatherbacks regularly frequent these waters, most likely originating from Atlantic populations (Lescure *et al.* 1989, Casale *et al.* 2003). Although smaller in number, this species has also been recorded in the Adriatic Sea, with most findings deriving from the southern Italian coast (Casale *et al.* 2003). In the eastern Adriatic, leatherbacks have been recorded in Albania (Haxhiu 1995), Montenegro, and Croatia (Lazar & Tvrtković 1995). Most data have been published in local journals, being therefore unavailable to the wider scientific community. Furthermore, the Adriatic was never considered to be of any relevance in the life history of leatherbacks within the Mediterranean. With this paper we therefore review information on *D. coriacea* in the Adriatic Sea based upon bibliographic data and our findings, and discuss the role of the Adriatic

ic as a marine habitat for this critically endangered species in the region.

MATERIALS AND METHODS

Data on the size of individuals, condition at the time of recovery, method of the recovery and sex are presented as given in either the literature or reported by fishermen or estimated from photo or video documentation. It is often unknown what precisely was measured, hence these data should be considered just as an indication of the size class. Turtles with a carapace length (CL) less than 145 cm were considered juveniles (Eckert 2002). We compared our data for the eastern Adriatic with data from the western part, listed within the review of Mediterranean leatherback records (Casale *et al.* 2003), available as an electronic supplement to the paper (<http://biology.bangor.ac.uk/~bss166/HJ/>). All records were carefully examined in order to avoid duplication of data.

RESULTS

We report seven literature and six new records on leatherbacks in the eastern Adriatic Sea (Table I and references therein; Fig. 1). The number of records in the first years of this century (2001–2007) is almost doubled in comparison to the previous period of more than 100 years. Most records (77 %) are supported by physical evidences, either by preserved specimens in museum's collections, or by photo/video documentation. However, even in cases where the findings were not documented we can be reasonably secure in the accurate identification of the species

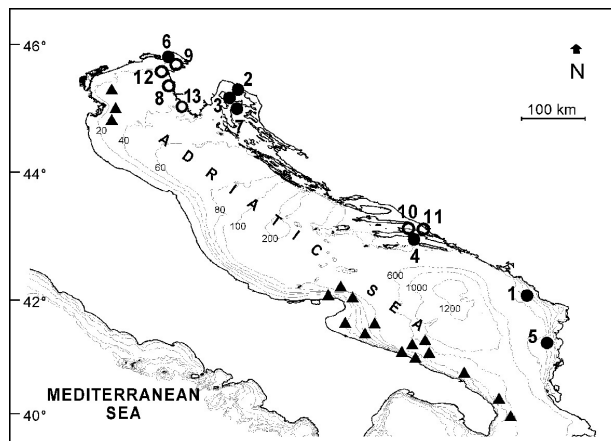


Fig. 1. – Distribution of recoveries of leatherback turtle, *Dermochelys coriacea*, in the Adriatic Sea. Number of the record refers to respective record numbers (N°) in Table I. (circles - records in the eastern Adriatic; filled circles-data from literature; open circles - new data; triangles - records in the western Adriatic according to Casale *et al.* 2003).

due to the distinct external morphology of leatherbacks.

The first specimen we have recorded (N° 8, Table I) was incidentally captured alive in a trawl, taken onto the deck of the vessel, photographed, and immediately released. Following two sightings (listed as finding N° 9) originate from locations only 20 km apart (Fig. 1) and within one week period, so we presume it was the same animal. The first sighting was made in the Gulf of Trieste in Slovenian coastal waters. The sighting of this turtle was reported by the crew of a midwater trawl, who saw the leatherback just near the fishing vessel, while dragging the net out of the water. The second sighting of this pre-

Table I. – Records of the leatherback turtle, *Dermochelys coriacea*, in the eastern Adriatic Sea (N° - number of the record; SMG - Serbia and Montenegro; CRO - Croatia; ALB - Albania; IT - Italy; SLO - Slovenia; Con - condition at the time of recovery; CL - carapace length; NHMD - Natural History Museum in Dubrovnik; CNHM - Croatian Natural History Museum; NHMR - Natural History Museum in Rijeka; MNST - Museum of Natural Sciences in Tirana; Key to references: 1 - Kosić 1896, 2 - Kosić 1899; 3 - Babić 1920; 4 - Crnković 1957, 5 - Cvitanić 1956, 6 - Haxhiu 1995, 7 - Casale *et al.* 2003, 8 - Lazar & Tvrtković 1995, 9 - new data); * - total length, † - estimation.

N°	Date	Locality	Con.	CL (cm)	Sex	Method	Remark	Reference
1	1894: SEP 24	Budva, SMG	alive	162	♂	Hand caught	preserved, NHMD	1,2
2	1920: SEP 12	Kraljevica, CRO	alive	136	♀	Tuna gillnet	preserved, CNHM	3
3	1956: SEP 05	Omisalj, Krk Isl., CRO	alive	206*	?	Tuna gillnet	preserved, NHMR	4
4	1956: SEP 06	btw. Pelješac and Korčula, CRO	alive	160	♂	Gillnet	photo-documentation	5
5	before 1985	?, ALB	?	?	?	?	preserved, MNST	6
6	1988: JUL 17	Miramare, IT	alive	?	?	Sighting		7
7	1990: JUL	Valbiska, Krk Island, CRO	alive	180†	?	Gillnet	photo-documentation	8
8	2001: AUG	Umag, CRO	alive	150-160†	?	Trawl net	photo-documentation	9
9	2001: AUG	Gulf of Trieste, SLO Waters off Izola, SLO	alive alive	170-180† 170-180†	? ?	Sighting Sighting	first record in SLO	9
10	2005: OCT 31	Pelješac, CRO	dead	160	♀	Gillnet	preserved skull, CNHM	9
11	2005: NOV 12	Pelješac, CRO	alive	> 150†	?	Sighting		9
12	2006: AUG 08	Waters off Izola, SLO	alive	≈150†	?	Gillnet	video-documentation	9
13	2007: SEP 12	Duga uvala, CRO	alive	≈120†	?	Gillnet	photo-documentation	9

sumably same animal also came from Slovenia, from the surroundings of Izola about a week after. Based upon similar CL (as reported by fishermen), it is likely that this turtle took a temporary residency in this region, thus giving rise to multiple records. Therefore, we conservatively considered these two sightings as a record of one individual (N° 9, Table I). Two records from a similar locality in short period (12 days) also came from the waters off the Pelješac Peninsula (N° 10 & 11). However, in this case the first record was of a dead-stranded turtle, and the second one was in-water sighting of a live leatherback; hence these records surely referred to two different animals.

Eight out of 13 records presented (61.5 %) derived from incidental capture in fisheries. Seven out of these eight turtles were captured in gillnets. Although only one capture resulted in direct dead, gillnets seems to be a dominant threat to leatherbacks in the study region. It should be also noted that the first three captured leatherbacks (N° 1-3), although recovered alive, were all killed and preserved for collections of natural history museums in Croatia (Table I and references therein).

When the recovery date was available (N = 12), the findings were all distributed between July and December, with a peak in summer (83.3 %, Fig. 2). Size-class analysis based upon animals with known carapace length (N = 11) showed that all leatherbacks were large immatures and adults (CL > 120 cm) of both sexes (Table I).

DISCUSSION

Due to their impressive size and rare occurrence, records of leatherbacks are considered as an exceptional event since the first animal was recovered in the Adriatic in 1894 (Kosić 1896, 1899). It is worth noting that the fishermen who captured turtle N° 3 (Table I) suspected that another leatherback was encircled by the same tuna gillnet, but it managed to escape while closing the net (Crnković 1957). Until now, leatherbacks have never been recorded in Slovenian waters (Kryštufek & Janžeković 1999); hence our finding of turtle N° 9 (Table I) represents the first record of this species for the Slovenian fauna.

Due to our new findings within the past seven years, the number of leatherback records in the eastern Adriatic is significantly increased. However, this increase should probably not be attributed to an increased number of turtles frequenting these waters. It is most likely a result of the recent systematic collection of data on sea turtles in Croatia and Slovenia, and increased public awareness due to educational campaigns carried out in both countries.

In total, at least 13 records of leatherbacks exist for the eastern Adriatic Sea. Along with 17 records from its western part (Casale *et al.* 2003), 30 occurrences are documented of leatherback turtle in the whole Adriatic Sea (Fig. 1), with a temporal peak in the summer (Fig. 2). The

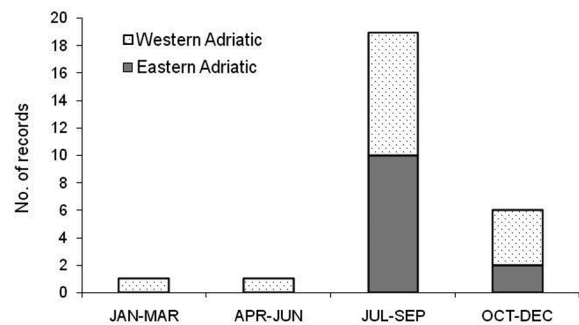


Fig. 2. – Seasonal occurrence of the leatherback turtle records in the Adriatic Sea; only the data with known date (month) of the recovery are shown (eastern Adriatic: N = 12, western Adriatic: N = 15; data for western Adriatic according to Casale *et al.* 2003).

size of turtles in our study and the results of Casale *et al.* (2003) showed that the Adriatic is exclusively frequented by large immatures and adults. Based on the size distribution analysis, Eckert (2002) suggested that leatherbacks spend their early juvenile stage (until reaching CL of about 100 cm) in tropical waters, probably because of thermal constraints. Immigrations into the Mediterranean and Adriatic Sea thus take place during large juvenile and/or adult stages, most likely for feeding reasons (Casale *et al.* 2003).

If we compare the number of records in the northern to the southern Adriatic, the majority of records come from the southern part (11:19, respectively). The distance from the Atlantic is suggested to be one of the factors determining leatherback distribution in the Mediterranean (Casale *et al.* 2003), thus fewer records can be expected in the distant northern Adriatic waters. Furthermore, the southern Adriatic, opposite to shallow northern and central sub-basins (maximum depth of 273 m), is much deeper (maximum depth of 1330 m) and constitute an oceanic zone. Leatherbacks are known to exhibit an oceanic developmental pattern, with both juvenile and adult stages occurring in that zone (Bolten 2003). Hence, a higher number of records in the southern Adriatic may also be explained by a preference of the species for pelagic, oceanic habitats. If we consider that the southern Adriatic with a surface area of about 76 230 km² represents about 3 % of the total surface of the Mediterranean Sea (about 2.5 million km²), and that the number of leatherbacks recorded represents about 4.5 % of the entire Mediterranean leatherback records (based upon 411 individual records from Casale *et al.* 2003, and six new records presented here), the occurrence of leatherback is in this small area is up to 1.5 fold higher than that of the entire Mediterranean Sea. Although a bias due to the difference in fishing and/or research effort cannot be totally excluded, such analysis suggests that the southern Adriatic Sea is potentially relevant as a summer foraging habitat for leatherbacks within the Mediterranean, as it seems to be an important habitat for other large pelagic vertebrates (e.g. Cuvier's beaked

whale, Holcer *et al.* 2007) or their oceanic developmental stages, like for green and loggerhead sea turtles (Lazar *et al.* 2004, Casale *et al.* 2005).

The majority of Mediterranean leatherback records derived from incidental captures in fisheries, resulting in considerable mortality, the highest being documented in the set/drift gillnets (at least 36.0 %, Casale *et al.* 2003). Yet, based upon low Catch Per Unit Effort (CPUE) of leatherbacks in the Mediterranean in comparison to Atlantic, Casale *et al.* (2003) considered bycatch in Mediterranean fisheries to have a negligible impact on the population. Conversely, Lewison *et al.* (2004) estimated that only longline fishery bycatch of leatherback in the Mediterranean may range from 250 up to 10 000 individuals per year. Although the Atlantic rookeries as natal nesting grounds of Mediterranean immigrants are reported to be stable or even increasing (Hughes 1996, Chevalier & Girondot 2000, Dutton *et al.* 2000, 2005), and despite the low CPUE, the problem of leatherback bycatch in the Mediterranean should not be neglected, for two particular reasons: first, it targets large immatures and adults, the size-classes with the highest reproductive potential, and second, it is still unknown to which natal population (or populations) these leatherbacks belong. If they originate from a single nesting population, the impact of fisheries in the Mediterranean may still be an issue for conservation, depending on the population size and trend.

Although the Adriatic Sea was never considered as a high-use critical habitat for leatherback turtles in the Mediterranean, our analysis suggests possible relevance of its southern sub-basin as a summer foraging habitat for the species that has not been considered before. Therefore, systematic data collection and enhancement of education and awareness programs, particularly among professional fishermen, can help building a more realistic picture of the role of the Adriatic Sea in the life history of leatherbacks in the Mediterranean basin.

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