

# Analysis of stranded sea turtles in the Gargano coast: has the Gargano promontory an importance for the ecology of the turtle *Caretta caretta* (Linnaeus, 1758) in the Adriatic Sea?

T. Scirocco\*, R. D'Adamo, O. Di Matteo & P. Ventrella

CNR, Institute of Marine Science, section of Lesina (FG)  
Via Pola, 4 – 71010 Lesina (FG), Italy

\* Corresponding author: [tommaso.scirocco@fg.ismar.cnr.it](mailto:tommaso.scirocco@fg.ismar.cnr.it)

*During the period 2001-2004, 89 stranded individuals of *Caretta caretta* (Linnaeus, 1758) have been recorded along the Gargano coast, 58 of which were alive, and 31 dead; in particular, 57% of these former animals have been rescued along two thin strips of land at the Lesina and Varano Lakes. The greatest number of strandings (n=48), has been recorded during the 2002, in particular in January (n=31), a fact which seems to correspond to an abrupt drop of water temperature. The great number of stranded turtles reported in this area depends on its geographical position: the northern shore of Gargano entraps objects carried by the sea currents from the northern and the middle Adriatic Sea to the southern one.*

Key words: loggerhead turtle, strandings, Gargano coast, Adriatic Sea

Introduction . . . . .	371
Materials and Methods . . . . .	373
Results . . . . .	375
Discussion and Conclusion . . . . .	377
References . . . . .	378

## INTRODUCTION

The Gargano promontory is a little peninsula, located almost halfway along the Italian coast of the southern Adriatic Sea. Its coasts extend for about 160 km and consist of alternating of sandy littorals and high cliff-like coasts. Most of the low sandy littoral is localized along the northern shore, about 60 km long; the most important

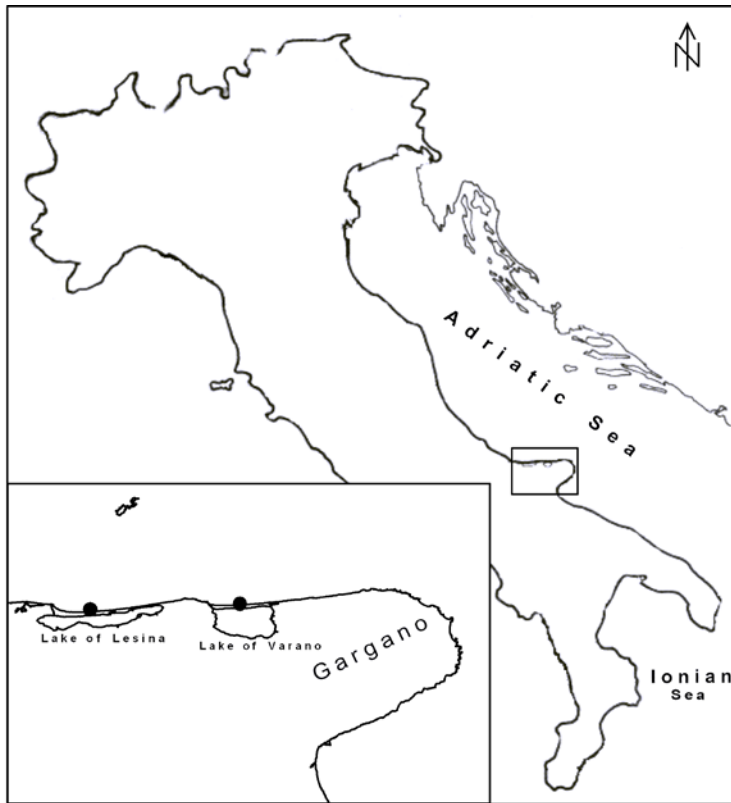


Figure 1. Location of the Gargano promontory and of the Lesina and Varano Lakes on the Italian Adriatic coasts.

habitat of this area is the continuous coastal dune that separates the Lesina and Varano coastal lakes from the Adriatic Sea (Figure 1). This thin strip of land includes a number of habitats and species of scientific interest; moreover, the coastal dune is included in the List of Sites of Community Importance (pSIC) (IT 9110001, coastal dune and Lake of Varano and IT 9110015, coastal dune and Lake of Lesina-Fortore River's mouth) and in the Gargano National Park. The Adriatic is a shallow sea, with a large continental bed; its water shows a certain degree of eutrophication, resulting from the high river effluents; the physical and chemical parameters are strongly affected by the meteorological conditions which also have an impact on the life cycle of the marine species. Additionally, the northern shore of Gargano is on the crossroads of two major sea water currents: the first descends southwards along the Italian coastline and the latter crosses the Adriatic Sea from the Dalmatian coast. The loggerhead turtle *Caretta caretta* (Linnaeus, 1758) one of the largest living turtles, is an endangered species (Storelli *et al.*, 1998; Russo *et al.*, 2003; Zucca *et al.*, 2003; Casale *et al.*, 2004; Kitsos *et al.*, 2005), and is protected by international legislation (Washington Convention, 1973; Berna 1979, Directive 92/43/CEE). Since 1996 it has been included on the list of endangered species by the Barcelona protocol of the EU (1995).

In the Adriatic Sea, loggerhead turtle strandings are not exceptional cases, in particular during the winter (Affronte & Ravanelli, 2001; Centro Studi Cetacei, 2000, 2001). This work shows the distribution of *C. caretta* individuals stranded along the Gargano shore during the period 2001-2004.

## MATERIAL AND METHODS

The Institute of Marine Science - Section for the Study of Coastal Ecosystems (National Research Council, CNR) of Lesina (Foggia, Italy) is directly linked to the monitoring of the marine animals stranding at the Gargano coasts, and its professional staff is always ready for rescue operations. For each stranded turtle, alive or dead, biometric parameters, such as weight, carapace width, and minimum straight-line carapace length (MSCL) were analyzed (Gerosa, 1996; Bolten, 1999). On the basis of their MSCL, animals were grouped into four life stages, i.e. juvenile, immature sub-adults, benthonic sub-adults and adults, sexually mature adults, according to the dimensional classification modified by Dodd (1988) and based on the size distribution of Mediterranean loggerheads (Margaritoulis, 1988; Argano *et al.*, 1992; Lazar *et al.*, 2000) (Table 1). The stranding locality was also registered and, if possible, any factors which may have contributed to the stranding. A Spearman's rank correlation coefficient was applied to compare the monthly numbers of the stranded individuals with the monthly mean seawater temperature. Surviving animals were housed at the CNR of Lesina for first aid and, if necessary, were transferred to the Stazione Zoologica "Anton Dohrn" in Naples, until they fully recovered. Turtles successfully rehabilitated were set free in the area of the stranding. The number of stranded animals was compared with the meteorological parameters that could influence the life cycle of the species. Data for air and water temperature were obtained from the web site <http://apat.idromare.com>.

Table 1. Size distribution of the loggerhead turtles (*Caretta caretta*) on the basis of their MSCL stages.

MSCL range (cm)	Life stage	% Individuals
9-32	juvenile	16
32-51	immature sub-adults	46
51-70	benthonic sub-adults and adults	30
> 70	sexually mature adults	8

Table 2. Yearly distribution of the loggerhead turtle individuals (*Caretta caretta*).

Stranded loggerhead turtles	2001	2002	2003	2004
alive	9	40	6	3
dead	8	8	8	7

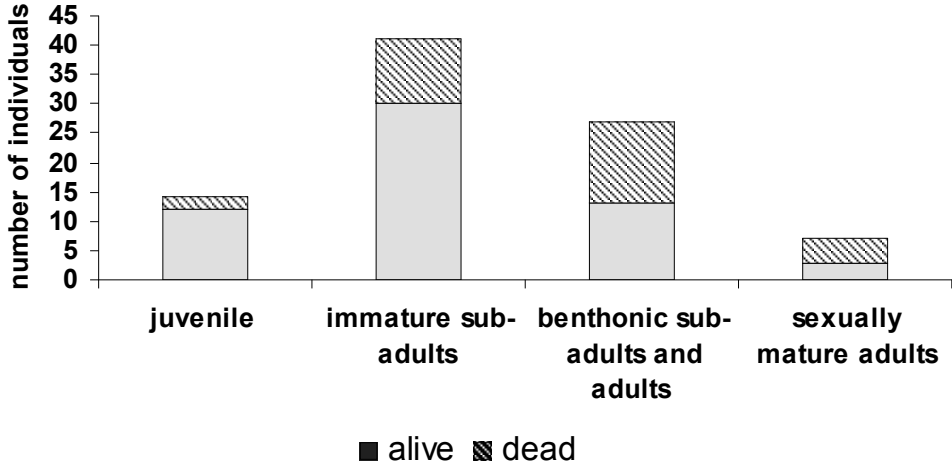


Figure 2. Frequency distribution of life stages of stranded turtles during the period 2001-2004 (n=89).

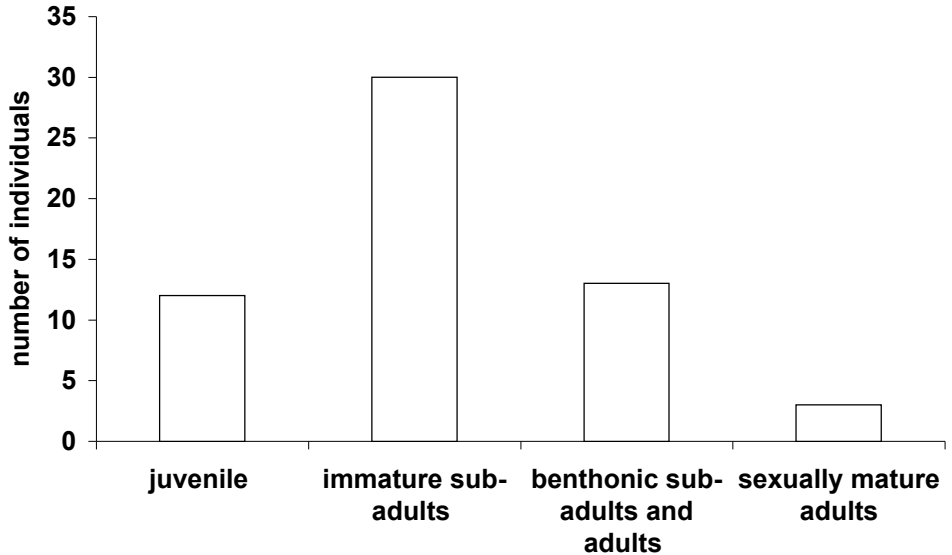


Figure 3. Frequency distribution of life stages of alive stranded turtles during the period 2001-2004 (n=58).

## RESULTS

During the period 2001-2004, along the Gargano shore, 89 stranded individuals of *C. caretta* were recorded. As shown in Table 2, 58 of them were alive, while 31 were found dead. Most of the turtles (73%) weighed between 0.12 and 20 kg (mean = 9.15 kg), and only 5 individuals with a body mass between 50 and 80 kg were found. The MSCL of our sample ranged from 9.5 cm to 85 cm (mean =  $46.89 \pm 16.96$ ). According to the Dodd (1998) classification in life stages, 92% of the stranded animals were sexually immature (Table 1). A more detailed analysis of the MSCL sizeclass frequency shows that the immature sub-adult stage represents the highest-frequency class (46%,  $n = 41$ ), while juveniles and sexually mature adults accounted only for a smaller proportion of the total (16%,  $n = 14$ , and 8%,  $n = 7$  respectively, Table 1). In Figures 2 and 3, the frequency classes of the alive and dead animals respectively are shown. In the first case the highest frequency class (52%) is represented by the immature sub-adults; the latter (46%) is represented by sub-adult and adult turtles, with an MSCL ranged between 51 cm and 70 cm. The greatest number of strandings ( $n = 48$ ), was recorded in 2002 with 8 animals dead, and 40 alive (Table 2). The 20% ( $n = 8$ ) of them were juvenile; the 62.5% ( $n = 25$ ) were immature sub-adults; the 15% ( $n = 6$ ) were benthonic sub-adults and adults; the 2.5% ( $n = 1$ ) were sexually mature adults. Moreover, during this year 31 animals were reported in January, and only 4 of them were found dead. Among the alive turtles, 74% ( $n = 20$ )

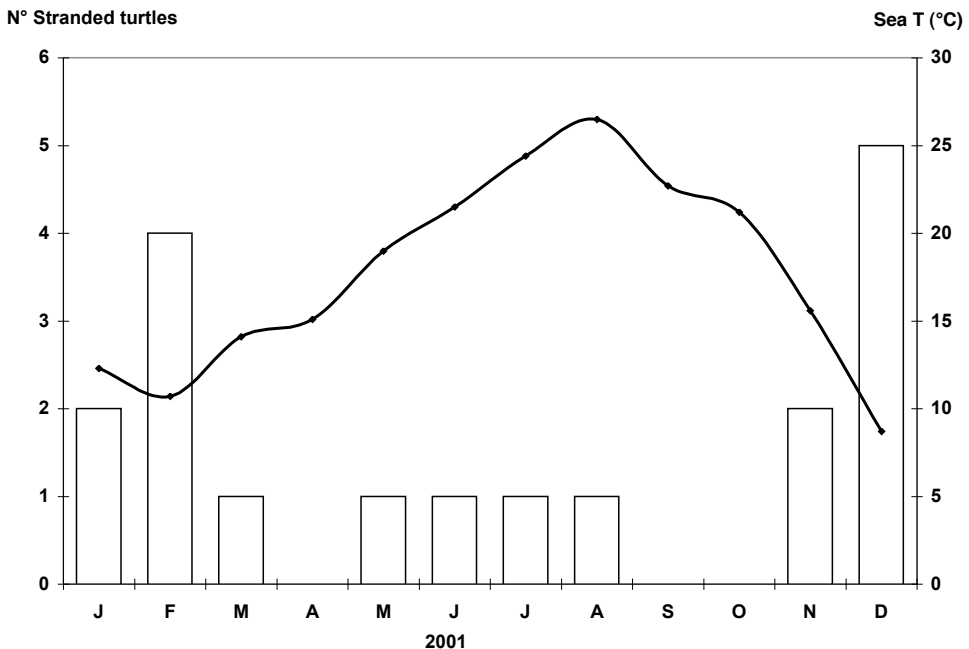


Figure 4. Number of individuals stranded in 2001, with the sea temperature values superimposed.

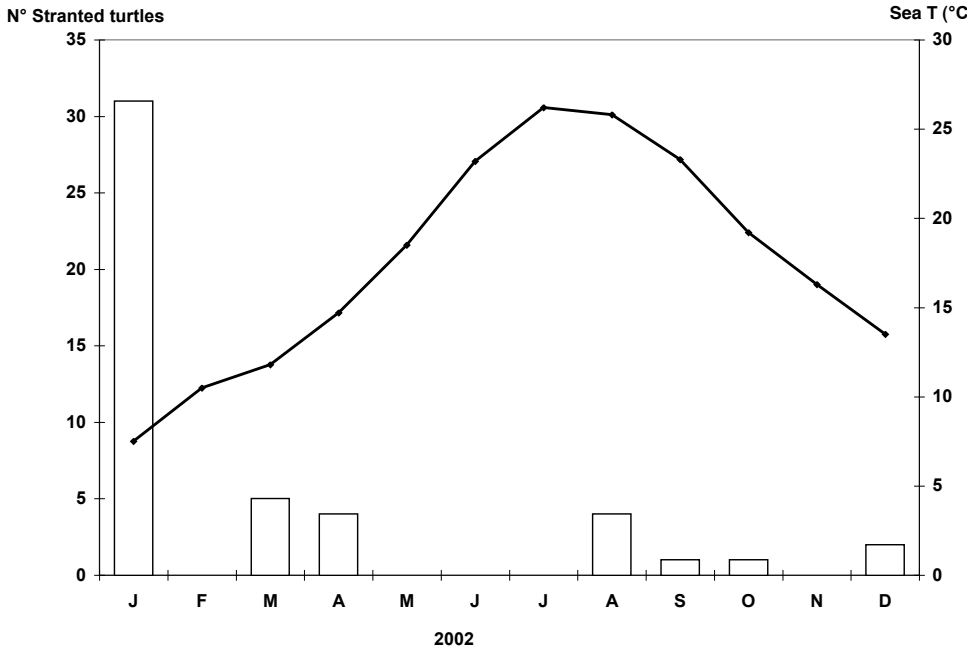


Figure 5. Number of individuals stranded in 2002, with the sea temperature values superimposed.

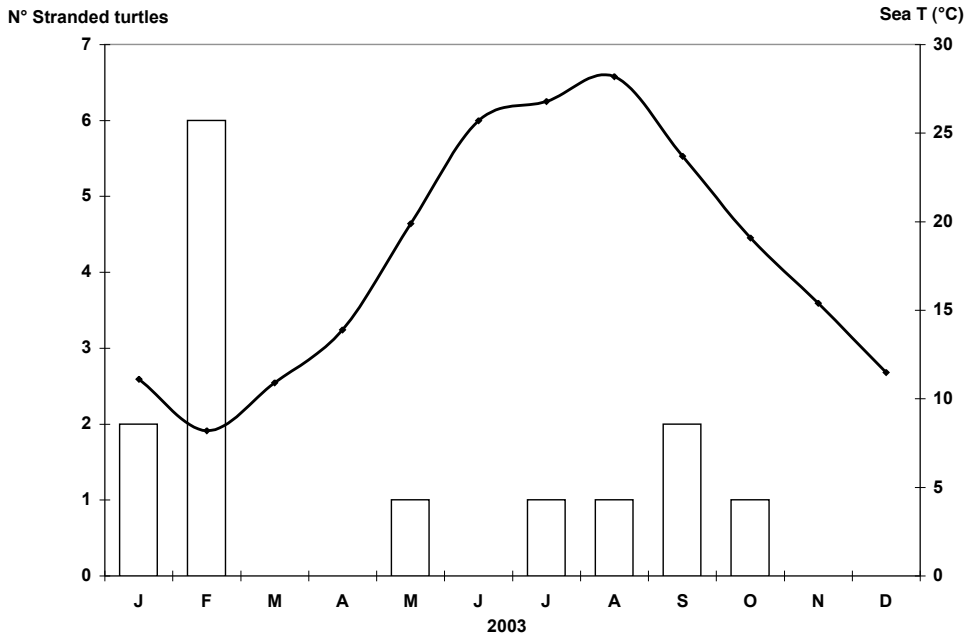


Figure 6. Number of individuals stranded in 2003, with the sea temperature values superimposed.

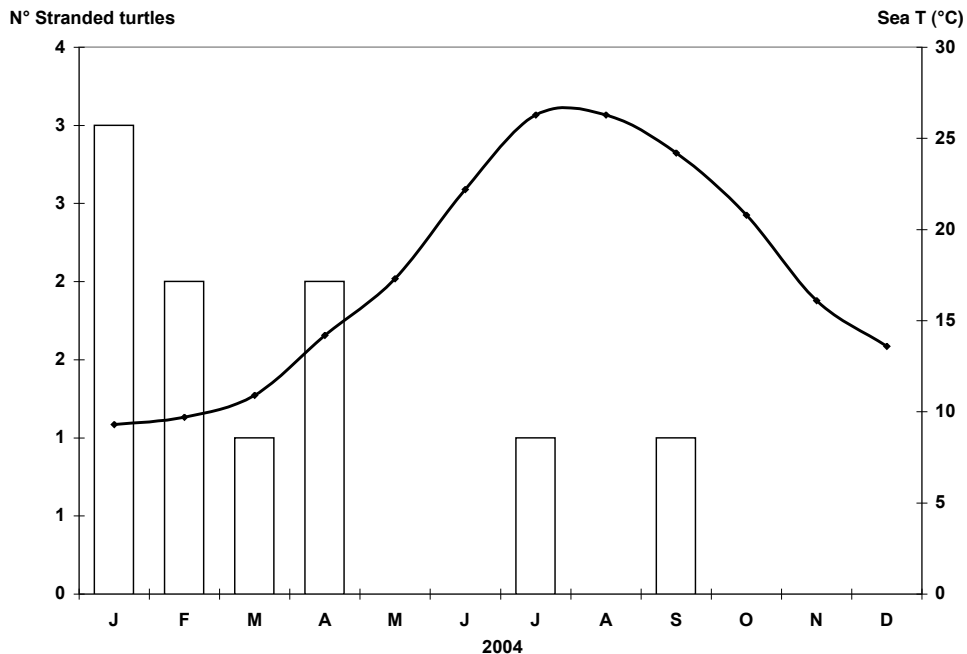


Figure 7. Number of individuals stranded in 2004, with the sea temperature values superimposed.

were immature sub-adults, 15% (n = 4) were benthonic sub-adults and adults; 11% (n = 3) were juveniles. Among the dead 50% (n = 2) were immature sub-adults; with only 1 juvenile, as were benthonic sub-adults and adults. During this extraordinary year the highest frequency class amongst the alive turtles was that of immature sub-adults (62% of the total). On the contrary, among the dead animals, the highest frequency class (46%) was that of the benthonic sub-adult and adult stage. Figures 4-7 show the number of stranded animals per month, with the water temperature values superimposed. It is clear that the reported strandings occurred mostly in Autumn and Winter, when the meteorological conditions were more variable. Analysis of the number of stranded animals and the location at which they were found shows that 57% of stranded animals was localized in the northern Gargano littoral, in particular along the strip of land that parts the Lesina and Varano coastal lakes from the Adriatic Sea.

## DISCUSSION AND CONCLUSIONS

The strandings were more localized along the northern Gargano shores and probably the most important reason for this were the meteorological conditions. The winter low temperatures, the prevailing NE and NNW winds and the southwards currents

along the Italian coastline may have caused turtles, already weakened by low temperatures and swimming, to drift passively on to the Gargano promontory (Bentivegna *et al.*, 2002). The extraordinary strandings recorded in January 2002, were probably caused by a cold stunning in the animals as a consequence of an unexpected and prolonged fall in sea temperature, and the lowest mean sea temperature (7.5 °C) among the four years 2001-2004 has been recorded during this month. A Spearman's rank correlation coefficient was applied to compare the monthly numbers of the stranded individuals and the corresponding mean seawater temperature showed a monotonic (reverse) relationship between these two variables ( $r = -0.339$ ;  $p < 0.018$ ). Only a small part of the total stranded turtles were dead. Although the sample was not large ( $n = 89$ ), these results demonstrate the presence of the loggerhead turtles *C. caretta* in the marine zone in front of the Gargano littoral. This zone is also characterized by the presence of extensive mussel beds which represent a potential grazing area for the turtles (Dame, 1996; Kitsos *et al.*, 2005). A surprising finding was the recovery in that area of the small size juvenile turtles (weigh 0.12 kg, MSCL 9.5 cm); as the small turtles remain in the hatchling area for some years after the birth, this littoral could be a potential site for the *C. caretta* reproduction (Affronte *et. al.*, 2001). For the better understanding of the *C. caretta* ecology and of the causes of these frequent strandings along the northern Gargano, the data available on the marine biocenotic features as well as on the anthropogenic activities along the coastal littoral should be explored. This should preferably be a part of a Project for the protection and the management of the coastal marine habitats.

## REFERENCES

- AFFRONTI M., MONTANARI C. & DOMINICI A. 2001. Tartarughe marine: biologia e conservazione. *CTS-Edi.tur.*
- AFFRONTI, M & RAVANELLI D. 2001. Analysis of stranded sea turtles in the north-wester Adriatic Sea. *Zoology in the Middle East* 24:101-108.
- ARGANO R., BASSO R., COCCO M. & GEROSA. G. 1992. New data on loggerhead (*Caretta caretta*) movements within Mediterranean. *Bollettino Museo Istituto Biologia Università Genova* 56-57: 137-163.
- BENTIVEGNA F., BREBER P. & HOCHSCHEID S. 2002. Cold stunned loggerhead turtles in the South Adriatic Sea. *Marine Turtle Newsletter* 97.
- BOLTEN A.B. 1999. Techniques for measuring sea turtles. In: Eckert K.L., Bjornodal K.A., Abreu-Grobois F.A. & Donnelly M., Edits. Research and Management Techniques for the Conservation of Sea Turtles, pp. 110-114. *IUCN/SSC Marine Turtle Specialist Group Publication 4.*
- CASALE P., LAURENT L. & DE METRIO G. 2004. Incidental capture of marine turtles by the Italian trawl fishery in the north Adriatic Sea. *Biological Conservation* 119: 287-295.
- CENTRO STUDI CETACEI (a cura di). 2000. Tartarughe marine recuperate lungo



- le coste italiane. In: F. Bentivegna I Rendiconto 1998 (Reptilia). *Atti Società Italiana Scienze Naturali Museo civico Storia Naturale Milano* 141: 145-158.
- CENTRO STUDI CETACEI (a cura di). 2001. Tartarughe marine recuperate lungo le coste italiane. In: F. Bentivegna. II Rendiconto 1999 (Reptilia). *Atti Società Italiana Scienze Naturali Museo civico Storia Naturale Milano*.
- DAME R.F. 1996. Ecology of marine bivalve: an ecosystem approach. *CRC Press*.
- DODD C.K. JR 1988. Synopsis of the biological data on the loggerhead sea turtle *Caretta caretta* (Linnaeus, 1758). *U. S. Fish Wildl. Serv., Biol. Rep.* 88: 1-110.
- GEROSA G. 1996. Manual on marine turtle tagging in the Mediterranean. *NEP/ MAP/RAC/SPA, unis, Tunisia*: <<http://apat.idromare.com>> [11/05]
- KITSOS M.S., CHRISTODOULOU M., ARVANITIDIS C., MAVIDIS M., KIRMITZOGLOU I. & KOUKOURAS A. 2005. Composition of the organismic assemblage associated with *Caretta caretta*. *J. Mar. Biol. Ass. UK* 85: 257-261.
- LAZAR B., MARGARITUOULIS D. & TVRTKOVIC N. 2000. Migrations of the loggerhead sea turtle (*Caretta caretta*) into the Adriatic Sea, pp 101-102. In: Abreu-Grobois F.A., Briseno-Duenas R., Marquez R. & Sarti L., Edits. Proceedings of the 18th International Symposium on Sea Turtle Biology and Conservation. *NOAA Tech Memo NMFS-SEFSC-436. U.S. Department of Commerce*.
- MARGARITUOULIS D. 1988. Observations on loggerhead turtle *Caretta caretta* activity during three nesting seasons (1977-1979) in Zakynthos, Greece. *Biological Conservation* 24: 193-204.
- RUSSO G., DI BELLA C., LORIA G.R., ISACCO G., PALAZZO P., VIOLANI C. & ZAVA B. 2003. Notes on the influence of human activities on sea chelonians in Sicilia water. *J. Mt. Ecol.*, 7 (Suppl.).
- STORELLI M.M., CECI E. & MARCOTRIGIANO G.O. 1998. Distribution of heavy metal residues in some tissues of *Caretta caretta* (Linnaeus) specimen beached along the Adriatic Sea (Italy). *Bull. Environ. Contam. Toxicol.* 60: 546-552.
- ZUCCA P., FRANCESE M., ZUPPA F., SPOTO M. & OBEROSLER R. 2003. Interventi Medico Veterinari su tartarughe marine comuni spiaggiate nel nord Adriatico. *J. Mt. Ecol.* 7 (Suppl.).