

## DIET COMPOSITION OF A GREEN TURTLE, *CHELONIA MYDAS*, FROM THE ADRIATIC SEA

BOJAN LAZAR<sup>1,2,3\*</sup>, ANTE ŽULJEVIĆ<sup>4</sup> & DRAŠKO HOLCER<sup>1,2</sup>

<sup>1</sup>Department of Zoology, Croatian Natural History Museum, Demetrova 1, HR-10000 Zagreb, Croatia

<sup>2</sup>Blue World Institute of Marine Research and Conservation, Kaštel 24, HR-51551 Veli Lošinj, Croatia

<sup>3</sup>Present address: Department of Biology, Faculty of Science, University of Zagreb, Rooseveltov trg 6, HR-10000 Zagreb, Croatia

<sup>4</sup>Laboratory for Benthos, Institute of Oceanography and Fisheries, Šetalište Ivana Meštrovića 63, HR-21000 Split, Croatia

Lazar, B., Žuljević, A. & Holcer, D.: Diet composition of a green turtle, *Chelonia mydas*, from the Adriatic Sea. *Nat. Croat.*, Vol. 19, No. 1, 263–271, 2010, Zagreb.

The green sea turtle (*Chelonia mydas*) is a foraging specialist, with strong tendency towards herbivory of neritic-stage individuals. Due to lack of data on the feeding ecology of this species in the Mediterranean, we analysed diet composition of one juvenile green turtle with the curved carapace length of 40.0 cm, found dead in the eastern Adriatic Sea (Croatia) in December 2001. The turtle has dominantly feed upon benthic polychaetes *Chaetopterus variopedatus* (69.8%), while seagrass (*Cymodocea nodosa*) and algae accounted for 11.1% of the total wet mass. Species composition and their vertical distribution showed that the turtle was in the post-pelagic stage and has foraged in the shallow coastal waters. We discuss our results in the light of recent recoveries of *C. mydas* juveniles in Albania and Greece, and suggest the existence of an Ionian-Adriatic developmental pathway of green turtles from reproductive habitats in the eastern Mediterranean Sea.

**Key words:** sea turtles, *Chelonia mydas*, diet, development, Adriatic Sea, Mediterranean

Lazar, B., Žuljević, A. & Holcer, D.: Analiza ishrane zelene želve, *Chelonia mydas*, iz Jadranskog mora. *Nat. Croat.*, Vol. 19, No. 1, 263–271, 2010, Zagreb.

Zelena želva (*Chelonia mydas*) je specijalist u ishrani, sa snažnom tendencijom neritičkih stadija prema herbivornosti. Zbog potpunog nedostatka podataka o ekologije ishrane ove vrste u Sredozemlju, proveli smo analizu sadržaja probavila jedne zelene želve zakriviljene dužine karapaksa 40 cm, nađene uginule u istočnom Jadranu (Hrvatska) u prosincu 2001. Dominantan plijen predstavljao je pridneni mnogočetinaš *Chaetopterus variopedatus* (69.8%), dok su morske cvjetnice (*Cymodocea nodosa*) i alge sačinjavale 11.1% ukupne mokre mase sadržaja probavila. Sastav vrsta i njihova vertikalna

\* corresponding author; E-mail: Bojan.Lazar@hpm.hr

raspodjela pokazali su da je kornjača bila u post-pelagičkoj razvojnoj fazi, hraneći se u plitkim obalnim vodama. Rezultati su raspravljani u svjetlu novih nalaza juvenilnih primjeraka *C. mydas* u Albaniji i Grčkoj, što ukazuje na postojanje jonsko-jadranskog razvojnog puta zelenih želvi iz reproduktivnih staništa u istočnom Sredozemlju.

**Ključne riječi:** morske kornjače, *Chelonia mydas*, ishrana, razvoj, Jadransko more, Sredozemlje

The green turtle, *Chelonia mydas* (Linnaeus, 1758), belongs to a group of sea turtle species with the oceanic-neritic developmental pattern, characterized by an early juvenile phase occurring in the oceanic zone and latter shift to near shore neritic waters (BOLTEN, 2003; ARTHUR *et al.*, 2008). This shift in habitat use during ontogeny is followed by shifts in the diet, from epipelagic omnivorous or carnivorous feeding strategy of the oceanic juveniles to a strong tendency towards herbivory of the neritic stage green turtles (BJORNDAL, 1980, 1997; MORTIMER, 1981; HIRTH, 1997; LÓPEZ-MENDILAHARSU *et al.*, 2005; RUSSELL & BALAZS, 2009; CARRIÓN-CORTEZ *et al.*, 2010). The diet composition at different neritic feeding habitats depends on the composition and availability of local plant communities, and to some extent by foraging preferences, especially for certain species of red algae (FUENTES *et al.*, 2006; LÓPEZ-MENDILAHARSU *et al.*, 2008; ARTHUR & BALAZS, 2008; RUSSELL & BALAZS, 2009; CARRIÓN-CORTEZ *et al.*, 2010).

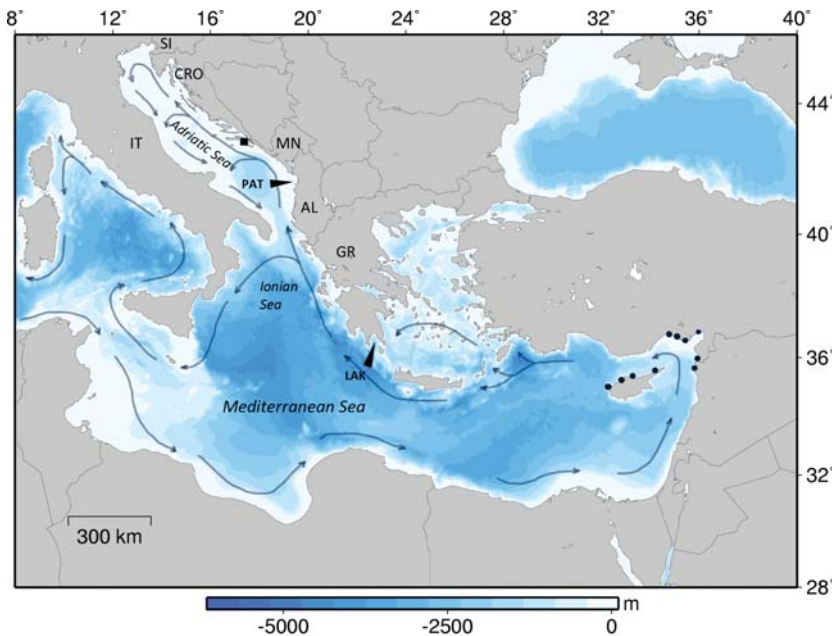
The recruitment to neritic habitats in green turtles generally occurs at small sizes, between 30 and 40 cm in the carapace length (MUSICK & LIMPUS, 1977; BJORNDAL & BOLTEN, 1988; HIRTH, 1997), with duration of the oceanic stage of one to 10 years (MORTIMER, 1995). Age at sexual maturity is estimated at 26 (FRAZER & LADNER, 1986) to 40 years (LIMPUS & CHALOUPIKA, 1997), after which they commence breeding migrations between foraging grounds and nesting areas that are undertaken every few years (HIRTH, 1997). During non-breeding periods adults reside at coastal neritic feeding areas which are sometimes shared with juvenile developmental habitats (LIMPUS *et al.*, 1994; LÓPEZ-MENDILAHARSU *et al.*, 2005; CARRIÓN-CORTEZ *et al.*, 2010), and for which they exhibit strong site fidelity (BRODERICK *et al.*, 2007).

The green turtles are listed as Endangered throughout their range (IUCN, 2010). In the Mediterranean Sea green turtles form genetically distinct population (BOWEN *et al.*, 1992; ENCLADA *et al.*, 1996) that suffered heavy exploitation over the past century (SELLA, 1995). BRODERICK *et al.* (2002) estimated that 339 – 360 green turtles nest annually in the Mediterranean, with rookeries in Turkey and Cyprus accounting for about 99% of the regional nesting effort (KASPAREK *et al.*, 2001). If a recently discovered population in Syria is added (104 nests laid in 2004; REES *et al.*, 2008), than Mediterranean green turtle population counts between 1116 and 1185 nesting females, assuming the clutch frequency of 1.9 – 3.5 clutches per season and 3-years remigration interval (BRODERICK *et al.*, 2002).

Although the major nesting areas of green turtles in the Mediterranean are well known (KASPAREK *et al.*, 2001; REES *et al.*, 2008), there is a lack of data on the biology and distribution of this species in marine habitats. Post-nesting satellite tracking of adult females has shown that the waters of Cyprus, Israel, Egypt and Libya host neritic foraging and wintering habitats for adults (GODLEY *et al.*, 2002; BRODERICK *et al.*, 2007). Juvenile green turtles have been recorded throughout the Mediterranean (MARGARITOUIS *et al.*, 1992; LAURENT *et al.*, 1997; GODLEY *et al.* 1998a,b; GIANGUZZA

*et al.*, 2000; MESCHINI, 1997; ORUÇ, 2001; LAZAR *et al.*, 2004a), but the locations of developmental habitats are not clearly defined. Their existence have been documented only in the eastern Mediterranean, in Lakonikos Bay in the Peloponnesus, Greece (MARGARITOULIS & TENEKETZIS, 2003), in the waters off the Fethiye beach in Turkey (TÜRKOZAN & DURMUS, 2000), and along the southeastern coast of Turkey near Syria (YALÇIN-ÖZDILEK & AUREGGI, 2006). No study addressed the issue of feeding ecology of green turtles in the region, beside observations by DEMETROPOULOS & HADJICHRISTOPHOROU (1995).

With this paper we present analysis of diet composition of one juvenile green turtle (notch-tip Curved Carapace Length, CCL = 40.0 cm), reported in LAZAR *et al.* (2004a). The turtle was found dead, incidentally captured in gillnet, 1 km east from the City of Trpanj, along the northeastern coast of the Pelješac Peninsula in Croatia (eastern Adriatic Sea; Fig. 1), on the 14th December 2001. We performed general necropsy (WYNEKEN, 2001) and isolated content of the whole digestive tract (oesophagus, stomach and intestines) by rinsing in the clear water on a 1 mm mesh sieve (FORBES, 1999). The whole digestive sample was preserved in 76% ethanol and latter examined under the stereomicroscope. Taxonomic identification was preformed to the lowest taxon possible (ERCEGOVIĆ, 1957; RIEDEL, 1963); the nomenclature used follows the European Register of Marine Species (COSTELLO *et al.*, 2008). We



**Fig. 1.** The eastern Mediterranean Sea with the locations of two developmental habitats of green turtle *Chelonia mydas* (PAT, Patok Bay; LAK, Lakonikos Bay) along the Ionian – Adriatic developmental pathway [■ finding of the specimen from this paper; ●, nesting beaches of green turtles in the Mediterranean, after CASALE & MARGARITOULIS (2010); →, direction of prevailing surface sea currents, simplified from MENNA & POULAIN (2010); IT, Italy; SI, Slovenia; CRO, Croatia; MN, Montenegro; AL, Albania; GR, Greece].

determined wet mass (w.m.) of identified taxonomic groups by weighing to  $\pm 0.1$  g and calculated their mass percentage in the diet. Abundance of identified species of algae was visually estimated and expressed as the relative contribution (%) of each species within the algae group.

The wet mass of digestive tract content was 172.3 g. The turtle has dominantly feed upon animal matter (69.8%), while marine plants, both algae and seagrass, accounted for 11.1% of the total w.m. (Tab. 1). Within animal prey we recorded only benthic polychaetes, represented with a tube worm *Chaetopterus variopedatus*. This species lives permanently in tough flexible tubes with open end protruding slightly from the substratum. In the Adriatic Sea, it inhabits soft bottoms between one and 400 m in depth (ZAHILTA, 1995), and is common in the meadow of *Cymodocea nodosa*. Digestive tract contained only fragments of tubes up to 3 cm in length, which made counting of ingested individuals impossible. However, according to appearance and composition, unidentified organic remains found in the guts were most likely of animal origin, possibly belonging to digested bodies of *C. variopedatus*; hence, the proportion of animal matter in the diet is most likely underestimated. The second highly ranked prey in terms of wet mass was seagrass *C. nodosa*, which was identified upon fragments of leaves of about 2 cm in length, found in the stomach. In the south-eastern Adriatic *C. nodosa* grows on sandy bottoms up to 10 m in depth (RIEDEL, 1963; BAKRAN-PETRICIOLI, 2007), forming small meadows from a few square meters to maximum of one hectare. *C. variopedatus* and *C. nodosa* accounted together 78.7% of turtle diet and were the most important dietary items. Contribution of marine algae was low, with the prevalence of red algae, mostly *Rhodymenia ardissoni* (Tab. 1). All identified algae belonged to epilithic species with communities developed on the rocky bottom of the infralittoral zone.

In most neritic habitats green turtles exhibit very specialised diet, feeding primarily on macroalgae and/or seagrass (BJORNDAL, 1980; MORTIMER, 1981; SEMINOFF *et al.*, 2002; LÓPEZ-MENDILAHARSU *et al.*, 2005; FUENTES *et al.*, 2006; RUSSELL & BALAZS,

**Tab. 1.** Diet composition of a juvenile green turtle, *Chelonia mydas*, from the eastern Adriatic Sea, Croatia. The numbers in parentheses refer to estimated relative abundance (%) of identified species within the algae group.

Diet component	Wet Mass (g)	Mass %
Vascular plants	15.3	8.9
Plantae, Magnoliidae		
<i>Cymodocea nodosa</i> (Ucria) Ascherson		
Algae	3.8	2.2
Rhodophyta, Florideophyceae		
<i>Rhodymenia ardissoni</i> Feldmann		(80.0)
<i>Chylocladia verticillata</i> (Lightfoot) Bliding, 1928		(10.0)
Chromista, Phaeophyceae		
<i>Dictyota linearis</i> (C. Agardh) Greville		(10.0)
Animal matter		
Polychaeta	120.3	69.8
<i>Chaetopterus variopedatus</i> Cuvier, 1827		
Unidentifiable organic remains	32.9	19.1

2009; CARRIÓN-CORTEZ *et al.*, 2010). Likewise, seagrass (*C. nodosa*) was also reported as the only component in the diet of three juvenile green turtles (CCL = 30–50 cm) from Mediterranean (Cyprus; DEMETROPOULOS & HADJICHRISTOPHOPOULOS, 1995). However, at many sites this sea turtle species also consume marine invertebrates (SEMINOFF *et al.*, 2002; CARRIÓN-CORTEZ *et al.*, 2010), with the highest contribution of animal prey (tunicates, crustaceans and molluscs) being recorded so far in the Colombian waters (71.1%, calculated from AMOROCHO & REINA, 2007). The existence of such differences in the prey composition within and between different marine regions, including the Mediterranean, supports a conclusion by CARRIÓN-CORTEZ *et al.* (2010) according to which post-pelagic green turtles have the capability to adopt different feeding strategies, possibly in response to local abundance and type of available benthic resources.

Vertical distribution of species recorded in the diet, especially of *C. nodosa* which develops on maximum 10 m deep bottoms, showed that a green turtle in our study foraged in the shallow coastal waters. If all benthic taxa recorded are pooled together, 80.9% of the diet was based upon benthic species, indicating that the turtle was in the post-pelagic stage. The CCL of this individual coincides with the distribution of size-at-ontogenetic habitat shift recorded in other populations of green turtles (MUSICK & LIMPUS, 1977; BJORN DAL & BOLTEN, 1988; HIRTH, 1997). Based upon the size distribution, LAZAR *et al.* (2004a) hypothesized about possible role of the southern Adriatic Sea as an oceanic habitat for green turtles in the Mediterranean. This pelagic zone of the Adriatic, with the mean depth of 449 m and the maximum depth of 1330 m (CUSHMAN-ROISIN *et al.*, 2001), seems to host critical habitats for some large pelagic vertebrates like Cuvier's beaked whale (HOLCER *et al.*, 2007) and leatherback sea turtle (LAZAR *et al.*, 2008), or their oceanic developmental stages, such as green and loggerhead sea turtles (LAZAR *et al.*, 2004a; CASALE *et al.*, 2005). Certainly, the number of Adriatic green turtle records is low in comparison to loggerhead turtle (PASTORELLI *et al.*, 1999; LAZAR & TVRTKOVIĆ, 1995; LAZAR *et al.*, 2004a; HAXHIU, 2005). This is the result of depleted and small nesting population (BRODERICK *et al.*, 2002) and possible misidentification of juvenile greens as loggerhead turtles (LAZAR *et al.*, 2004a), as well as of possible preferences of turtles for the warmer waters of southern Mediterranean. Nonetheless, subsequent findings of juvenile green turtles in the Patok Bay in Albania (CCL < 50 cm; HAXHIU, 2005, 2010), together with discovery of a developmental habitat in the Ionian Sea, Greece (mean CCL = 36.4 cm, range = 30.0–67.0 cm; MARGARITOULIS & TENEKETZIS, 2003), suggest the existence of an Ionian-Adriatic developmental pathway of green turtles from reproductive habitats in the eastern Mediterranean (Fig. 1), most likely influenced by direction of the prevailing sea currents (MENNA & POULAIN, 2010). In both Albania and Greece juvenile green turtles were recovered in the shallow bays. Our dietary analysis showed that such small juveniles are already in the post-pelagic stage and feed on the sea floor. In case of loggerhead turtles, juveniles show fidelity to neritic areas, and once settled to one area, change to other neritic areas is unlikely (CASALE *et al.*, 2007). If juvenile green turtles follow the same fidelity pattern which is shown to exist in adult females of both species (BRODERICK *et al.*, 2007), then the southern Adriatic may also host neritic developmental habitats for this endangered species.

Identification of critical habitats and connections between rookeries and foraging grounds is underlined as one of the research priorities for sea turtles on the global

level (BJORN DAL, 1999; HAMANN *et al.*, 2010). Although the Adriatic Sea is recognized as a key critical habitat for Mediterranean loggerheads (LAZAR & TVRTKOVIĆ, 2003; MARGARITOU LIS *et al.*, 2003; CASALE *et al.*, 2004; LAZAR *et al.*, 2004b), recent body of evidence suggest that it might also play a role in the life history of green turtles in the region. Despite relatively rare records, more effort should therefore be given to research into *at-sea* biology of this species in the Adriatic, as well as in other critical marine habitats throughout the Mediterranean Sea.

## ACKNOWLEDGEMENTS

This study was carried out within the research projects Nos. 183-1193080-0891 and 183-1193080-0831 of the Ministry of Science, Education and Sport of Croatia, under the permit No. 531-06/1-02-2 of the Ministry of Environmental Protection and Physical Planning of Croatia. For help in collection of material we are thankful to Dr. Pero Tutman and Dr. Nikša Glavić. First draft of the manuscript was improved thanks to constructive comments of two anonymous reviewers. We also acknowledge the use of the Maptool program for graphics in this paper. Maptool is a product of SEATURTLE.ORG.

*Received March 12, 2010*

## REFERENCES

- AMOROCHO, D. & REINA, R., 2007: Feeding ecology of the East Pacific green sea turtle *Chelonia mydas agassizii* at Gorgona National Park, Colombia. *Journal of Endangered Species Research* **3**, 42–51.
- ARTHUR, K. & BALAZS, G. H., 2008: A comparison of immature green turtle's (*Chelonia mydas*) diets among seven sites in the main Hawaiian Islands. *Pacific Science* **62**, 205–217.
- ARTHUR, K., BOYLE, M. & LIMPUS, C., 2008: Ontogenetic changes in diet and habitat use in green sea turtle (*Chelonia mydas*) life history. *Marine Ecology Progress Series* **362**, 303–311.
- BAKRAN-PETRICIOLI, T., 2007: Morska staništa. Priručnik za inventarizaciju i praćenje stanja. Državni zavod za zaštitu prirode, Zagreb.
- BJORN DAL, K. A., 1980: Nutrition and grazing behaviour of the green turtle *Chelonia mydas*. *Marine Biology* **56**, 147–154.
- BJORN DAL, K. A., 1997: Foraging ecology and nutrition of sea turtles. In: MUSICK, J. A. & LUTZ, P. L. (eds.), *The Biology of Sea Turtles*. CRC Press, Boca Raton. p. 199–231.
- BJORN DAL, K. A., 1999: Priorities for research in foraging habitats. In: ECKERT, K. L., BJORN DAL, K. A., ABREU-GROBOIS, F. A. & DONNELLY, M. (eds.), *Research and Management Techniques for the Conservation of Sea Turtles*. IUCN/SSC Marine Turtle Specialist Group, Publication No. 4. p. 12–14.
- BJORN DAL, K. A. & BOLTEN, A. B., 1988: Growth rates of immature green turtles, *Chelonia mydas*, on the feeding grounds in the southern Bahamas. *Copeia* **3**, 555–564.
- BOLTEN, A. B., 2003: Variation in sea turtle life history patterns: neritic vs. oceanic developmental stages. In: LUTZ, P. L., MUSICK, J. A. & WYNEKEN, J. (eds.), *The Biology of Sea Turtles*, Volume 2. CRC Press, Boca Raton. p. 243–257.
- BOWEN, B. W., MEYLAN, A. B., ROSS, J., LIMPUS, C., BALAZS, G. & AVISE, J. C., 1992: Global population structure and natural history of the green turtle (*Chelonia mydas*) in terms of matrilineal phylogeny. *Evolution* **46**, 865–991.



- BRODERICK, A. C., GLEN, F., GODLEY, B. J. & HAYS, G. C., 2002: Estimating the number of green and loggerhead turtles nesting annually in the Mediterranean. *Oryx* **36**, 227–236.
- BRODERICK, A. C., COYNE, M. S., FULLER, W. J., GLEN, F. & GODLEY, B. J., 2007: Fidelity and over-wintering of sea turtles. *Proceedings of the Royal Society* **274**, 1533–1538.
- CARRIÓN-CORTEZ, J. A., ZÁRATE, P. & SEMINOFF, J. A., 2010: Feeding ecology of the green sea turtle (*Chelonia mydas*) in the Galapagos Islands. *Journal of the Marine Biological Association of the United Kingdom*. (*in press*) doi: 10.1017/S0025315410000226.
- CASALE, P. & MARGARITOU, D. (eds.), 2010: *Sea Turtles in the Mediterranean*. IUCN, Gland.
- 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.
- CASALE, P., FREGGI, D., BASSO, R. & ARGANO, R., 2005: Oceanic habitats for loggerhead turtles (*Caretta caretta*) in the Mediterranean Sea. *Marine Turtle Newsletter* **107**, 10–11.
- CASALE, P., FREGGI, D., BASSO, R., VALLINI, C. & ARGANO, R., 2007: A model of area fidelity, nomadism, and distribution patterns of loggerhead sea turtles (*Caretta caretta*) in the Mediterranean Sea. *Marine Biology* **152**, 1039–1049.
- COSTELLO, M. J., BOUCHET, P., BOXSHALL, G., ARVANTIDIS, C. & APPELTANS, W., 2008: European Register of Marine Species. <http://www.marbef.org/data/erms.php>. Consulted on 10 March 2010.
- CUSHMAN-ROISIN, B., GAČIĆ, M., POULAIN, P. M. & ARTEGANI, A. (eds.), 2001: *Physical Oceanography of the Adriatic Sea. Past, present and future*. Kluwer Academic Publishers, Dordrecht.
- DEMETROPOULOS, A. & HADJICHRISTOPHOPOULOU, M., 1995: *Manual on Marine Turtle Conservation in the Mediterranean*. UNEP(MAP)SPA/IUCN/CWS/Fishery Department MANRE, Cyprus.
- ENCALADA, S. E., LAHANAS, P. N., BJORN DAL, K. A., BOLTEN, A. B., MIYAMOTO, M. M. & BOWEN, B. W., 1996: Phylogeography and population structure of the Atlantic and Mediterranean green turtle (*Chelonia mydas*): a mitochondrial DNA control region sequence assessment. *Molecular Ecology* **5**, 473–484.
- ERCEGOVIĆ, A., 1957: La flore sous-marine de l'îlot de Jabuka. *Acta Adriatica* **8**, 132 pp.
- FRAZER, N. B. & LADNER, R. C., 1986: A growth curve for green sea turtles, *Chelonia mydas*, in the U. S. Virgin Islands, 1913–14. *Copeia* **1986**, 798–802.
- FORBES, G., 1999: Diet sampling and diet component analysis. In: ECKERT, K. L., BJORN DAL, K. A., ABREU-GROBOIS, F. A. & DONNELLY, M. (eds.), *Research and Management Techniques for the Conservation of Sea Turtles*. IUCN/SSC Marine Turtle Specialist Group, Publication No. 4. p. 144–155.
- FUENTES, M. P., LAWLER, I. R. & GYURIS, E., 2006: Dietary preferences of juvenile green turtles (*Chelonia mydas*) on a tropical reef flat. *Wildlife Research* **33**, 671–678.
- GIANGUZZA, P., RUSSO, G., VIOLANI, C. & ZAVA, B., 2000: Ascertained record of the green sea turtle, *Chelonia mydas* (L., 1758) in the Tyrrhenian Sea (Testudinata, Cheloniidae). *Atti della Società italiana di scienze naturali e del Museo civico di storia naturale di Milano* **141**, 19–22.
- GODLEY, B. J., FURNESS, R. W. & SOLOMON, S. E., 1998a: Patterns of mortality in marine turtles in the eastern Mediterranean. In: BYLES, R. & FERNANDEZ, Y. (comps.), *Proceedings of the Sixteenth Annual Symposium on Sea Turtle Biology and Conservation*. NOAA Technical Memorandum NMFS-SEFSC-412, Miami. p. 59–61.
- GODLEY, B. J., GÜCÜ, A. C., BRODERICK, A. C., FURNESS, R. W. & SOLOMON, S. E., 1998b: Interaction between marine turtles and artisanal fisheries in the eastern Mediterranean: a probable cause for concern? *Zoology in the Middle East* **16**, 49–64.
- GODLEY, B. J., RICHARDSON, S., BRODERICK, A. C., COYNE, M. S., GLEN, F. & HAYS, G. C., 2002: Long-term satellite telemetry of the movements and habitat utilisation by green turtles in the Mediterranean. *Ecography* **25**, 352–362.
- HAMANN, M., GODFREY, M. H., SEMINOFF, J. A., ARTHUR, K., BARATA, P. C. R., BJORN DAL, K. A., BOLTEN, A. B., BRODERICK, A. C., CAMPBELL, L. M., CARRERAS, C., CASALE, P., CHALOUKPA,

- M., CHAN, S. K. F., COYNE, M. S., CROWDER, L. B., DIEZ, C. E., DUTTON, P. H., EPPERLY, S. P., FITZSIMMONS, N. N., FORMIA, A., GIRONDOT, M., HAYS, G. C., I-JUNN, C., KASKA, J., LEWISON, R., MORTIMER, J. A., NICHOLS, W. J., REINA, R. D., SHANKER, K., SPOTILA, J. R., TOMÁS, J., WALLACE, B. P., WORK, T. M., ZBINDEN, J. & GODLEY, B. J., 2010: Global research priorities for sea turtles: informing management and conservation in the 21st century. *Endangered Species Research* 11, 245–269.
- HAXHIU, I., 2005: Conservation project of sea turtles in Patok (Albania). Book of Abstracts, the Second Mediterranean Conference on Marine Turtles. Barcelona Convention – Bern Convention – Bonn Convention (CMS). p. 24.
- HAXHIU, I., 2010: Albania. In: CASALE, P. & MARGARITOU, D. (eds.), *Sea Turtles in the Mediterranean*. IUCN, Gland. p. 15–28.
- HIRTH, H. F., 1997: Synopsis of the biological data on the green turtle, *Chelonia mydas* (Linnaeus 1758). United States Fish and Wildlife Service Biological Report, USA.
- HOLCER, D., NOTARBARTOLO DI SCIARA, G., FORTUNA, C. M., LAZAR, B. & ONOFRI, V., 2007: Occurrence of Cuvier's beaked whale in the southern Adriatic Sea: evidence of an important Mediterranean habitat. *Journal of the Marine Biological Association of the United Kingdom* 87, 359–362.
- IUCN, 2010: IUCN Red List of Threatened Species. Version 2010.1. <[www.iucnredlist.org](http://www.iucnredlist.org)>. Downloaded on 10 March 2010.
- KASPAREK, M., GODLEY, B. J. & BRODERICK, A. C., 2001: Nesting of the green turtle, *Chelonia mydas*, in the Mediterranean: a review of status and conservation needs. *Zoology in the Middle East* 24, 45–74.
- LAURENT, L., OLIVIER, G., NOUGARÈDE, J. P., GROUL, J. M., ROBERT, P., CHEYLAN, M., FINELLI, F., BOMPAR, J. M. & DHERMAIN, F., 1997: Observations de tortues marines en Méditerranée Française: Données anciennes inédites, années 1996 et 1997. *Faune de Provence (C.E.E.P.)* 18, 95–101.
- LAZAR, B. & TVRTKOVIĆ, N., 1995: Marine turtles in the eastern part of the Adriatic Sea: preliminary research. *Natura Croatica* 4, 59–74.
- LAZAR, B. & TVRTKOVIĆ, N., 2003: Corroboration of the critical habitat hypothesis for the loggerhead sea turtle *Caretta caretta* in the eastern Adriatic Sea. In: MARGARITOU, D. & DEMETROPOULOS, A. (eds.), *Proceedings of the First Mediterranean Conference on Marine Turtles*. Barcelona Convention – Bern Convention – Bonn Convention (CMS). p. 165–169.
- LAZAR, B., CASALE, P., TVRTKOVIĆ, N., KOŽUL, V., TUTMAN, P. & GLAVIĆ, N., 2004a: The presence of green sea turtle *Chelonia mydas* in the Adriatic Sea. *Herpetological Journal* 14, 143–147.
- LAZAR, B., MARGARITOU, D. & TVRTKOVIĆ, N., 2004b: Tag recoveries of the loggerhead sea turtle, *Caretta caretta*, in the eastern Adriatic Sea and implications for conservation. *Journal of the Marine Biological Association of the United Kingdom* 84, 475–480.
- LAZAR, B., LIPEJ, L., HOLCER, D., ONOFRI, V., ŽIŽA, V., TUTMAN, P., MARČELJA, E. & TVRTKOVIĆ, N., 2008: New data on the occurrence of leatherback turtles, *Dermochelys coriacea*, in the eastern Adriatic Sea. *Vie et Milieu* 58, 237–241.
- LIMPUS, C. J. & CHALOUPIKA, M., 1997: Nonparametric regression modeling of green sea turtle growth rates (southern Great Barrier Reef). *Marine Ecology Progress Series* 149, 23–34.
- LIMPUS, C. J., COUPER, P. J. & READ, M. A., 1994: The green turtle, *Chelonia mydas*, in Queensland: population structure in a warm temperate feeding area. *Memoirs of the Queensland Museum* 35, 139–154.
- LÓPEZ-MENDILAHARSU, M., GARDNER, S. & SEMINOFF, J. A., 2005: Identifying critical foraging habitat of the green turtle (*Chelonia mydas*) along the Pacific coast of the Baja California Peninsula, México. *Aquatic Conservation: Marine and Freshwater Ecosystems* 15, 259–269.
- LÓPEZ-MENDILAHARSU, M., GARDNER, S., RIOSMENA-RODRÍGUEZ, R. & SEMINOFF, J. A., 2008: Diet selection by immature green turtles (*Chelonia mydas*) at Bahía Magdalena foraging ground in the Pacific Coast of the Baja California Peninsula, México. *Journal of the Marine Biological Association of the United Kingdom* 88, 1–7.



- MARGARITOULIS, D. & TENEKETZIS, K., 2003: Identification of a developmental habitat of the green turtle in Lakonikos Bay, Greece. In: MARGARITOULIS, D. & DEMETROPOULOS, A. (eds.), Proceedings of the First Mediterranean Conference on Marine Turtles. Barcelona Convention – Bern Convention – Bonn Convention (CMS). p. 170–175.
- MARGARITOULIS, D., KOUSIAS, N., NICOLOPOLOU, G. & TENEKETZIS, K., 1992: Incidental catch of sea turtles in Greece: the case of Lakonikos Bay. In: SALAMON, M. & WYNEKEN, J. (comps.), Proceedings of the Eleven Annual Workshop on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-302, Miami. p. 168–170.
- MARGARITOULIS, D., ARGANO, R., BARAN, I., BENTIVEGNA, F., BRADAI, M. N., CAMIÑAS, J. A., CASALE, P., DE METRIO, G., DEMETROPOULOS, A., GEROSA, G., GODLEY, B. J., HADDOUD, D. A., HOUGHTON, J., LAURENT, L. & LAZAR, B., 2003: Loggerhead turtles in the Mediterranean: present knowledge and conservation perspectives. In: BOLTEN, A. & WITHERINGTON, B. (eds.), Ecology and Conservation of Loggerhead Sea Turtles. Smithsonian Institution Press, Washington and London. p. 175–198.
- MENNA, M. & POULAIN, P. M., 2010: Mediterranean intermediate circulation estimated from Argo data in 2003–2010. *Ocean Science* **6**, 331–343.
- MESCHINI, P., 1997: Prima segnalazione di una cattura accidentale di *Chelonia mydas* (Linneo, 1758) lungo il litorale livornese (secche della Meloria). In: Fauna del Mediterraneo. Immagini e note di ecologia marina. Quaderni dell'acquario 3. Acquario di Livorno, Livorno. p. 5–11.
- MORTIMER, J., 1981: The feeding ecology of the West Caribbean green turtle (*Chelonia mydas*) in Nicaragua. *Biotropica* **13**, 49–58.
- MORTIMER, J. A., 1995: Feeding ecology of sea turtles. In: BJORN DAL, K.A. (ed.), Biology and Conservation of Sea Turtles. Revised Edition. Smithsonian Institution Press, Washington and London. p. 103–109.
- MUSICK, J. A. & LIMPUS, C. J., 1997: Habitat utilization and migration in juvenile sea turtles. In: LUTZ, P. L. & MUSICK, J. A. (eds.), The Biology of Sea Turtles. CRC Press, Boca Raton. p. 137–163.
- ORUÇ, A., 2001: Trawl fisheries in the eastern Mediterranean and its impact on marine turtles. *Zoology in the Middle East* **24**, 119–125.
- PASTORELLI, A. M., ROSITANI, L., VLORA, A. & ZIZZO, N., 1999: Segnalazioni di tartarughe lungo le coste Pugliesi nel periodo 1978-1998: caratteristiche morfometriche. *Rivista di Idrobiologia* **38**, 129–139.
- REES, A. F., SAAD A. & JONY, M., 2008: Discovery of a regionally important green turtle *Chelonia mydas* rookery in Syria. *Oryx* **42**, 456–459.
- RIEDEL, R., 1963: Fauna und Flora des Mittelmeeres. Verlag Paul Parey, Hamburg und Berlin.
- RUSSELL, D. & BALAZS, G., 2009: Dietary shifts by green turtles (*Chelonia mydas*) in the Kane'ohe Bay Region of the Hawaiian Islands: a 28-year study. *Pacific Science* **63**, 181–192.
- SELLA, I., 1995: Sea turtles in the eastern Mediterranean and northern Red Sea. In: BJORN DAL, K. A. (ed.), Biology and Conservation of Sea Turtles. Revised Edition. Smithsonian Institution Press, Washington and London. p. 417–423.
- SEMINOFF, J. A., RESENDIZ, A. & NICHOLS, W., 2002: Diet of east Pacific green turtles (*Chelonia mydas*) in the central Gulf of California, México. *Journal of Herpetology* **3**, 447–453.
- TÜRKOZAN, O. & DURMUS, S. H., 2000: A feeding ground for juvenile green turtles, *Chelonia mydas*, on the western coast of Turkey. *British Herpetological Society Bulletin* **71**, 1–5.
- WYNEKEN, J., 2001: The anatomy of sea turtles. U.S. Department of Commerce Miami, USA. NOAA Technical Memorandum NMFS-SEFSC-470.
- YALÇIN-ÖZDİLEK, S. & AUREGGI, M., 2006: Strandings of juvenile green turtles at Samandag, Turkey. *Chelonian Conservation and Biology* **5**, 152–154.
- ZAHTILA, E., 1995: Ekološka i biogeografska analiza faune mnogočestinaša (Annelida, Polychaeta) Jadranskog mora. Doktorska disertacija. Prirodoslovno-matematički fakultet, Sveučilište u Zagrebu, Zagreb. 483 pp.