

## The stomach content of a Mediterranean Monk Seal (*Monachus monachus*): finding of Green Turtle (*Chelonia mydas*) remains

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The stomach contents of an adult Mediterranean Monk Seal (*Monachus monachus*) found stranded on the Turkish eastern Mediterranean coast near Antalya in May 2013 were analysed. In total, 69 individual food items were counted and nine taxa were identified to species or family level. Of the identified taxa, Sparidae was the most highly represented family of prey fish, and one cephalopod species, *Octopus vulgaris*, was found. *Ariosoma balearicum* and *Argyrosomus regius* were encountered for the first time in the diet of a Monk Seal in the Mediterranean. Several body parts (three heads, six forelimbs, neck bones and fractured upper forelimb bones) of Green Turtles (*Chelonia mydas*) were also identified, which is the first record of this species in the Monk Seal's diet.

**Keywords:** Mediterranean Monk Seal; stomach content; Green Turtle; eastern Mediterranean

### Introduction

The Mediterranean Monk Seal (*Monachus monachus*) is an opportunistic predator whose diet varies with location, season and age, as well as with the availability of prey species (Gilmartin & Forcada, 2009). Mediterranean Monk Seals feed in Turkish and Greek coastal waters, primarily on bony fishes and cephalopods (Cebrian, Fatsea, & Mytilineou, 1990; Salman, Bilecenoglu, & Güçlüsoy, 2001; Karamanlidis, Kallianiotis, Psaradellis, & Adamantopoulou, 2011; Pierce et al., 2011; Karamanlidis et al., 2014). Observations of aggressive and predatory interactions with loggerhead turtles (*Caretta caretta*) have been reported by Margaritoulis, Karavellas, & Irvine (1996) and Margaritoulis & Touliatou (2011). Here we provide evidence of predation by Mediterranean Monk Seals on an additional sea turtle species – the Green Turtle (*Chelonia mydas*).

### Material and Method

An adult male Mediterranean Monk Seal was found stranded on the coast of Antalya, Turkey on 2 May 2013, with an evidence of deliberate killing by shooting (Danyer, Özgür Özbek, Aytemiz, & Tonay, 2013). Decomposition Code was 2, according to Rowles, Van Dolah, & Hohn (2001). During the necropsy on the same day, the stomach was collected and stored in a freezer at -20°C until further examination. In the laboratory, the stomach was thawed, and its contents were removed, washed with tap water and sieved in a 200µ-mesh sieve. The stomach contents were

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Table 1. Food items found in the Mediterranean monk seal stomach. *n*: total number of each prey in the stomach. \* = minimum no. of individuals inferred from the fragments counted.

Species	<i>n</i>	%
OSTEICHTHYES		
Sparidae	31	44.9
<i>Dentex</i> sp.	11	15.9
<i>Dentex marrocanus</i>	6	8.7
<i>Pagellus</i> sp.	7	10.1
<i>Pagellus erythrinus</i>	7	10.1
Congridae		
<i>Ariosoma balearicum</i>	1	1.5
Sciaenidae		
<i>Argyrosomus regius</i>	1	1.5
Group totals (bony fishes)	64	
CEPHALOPODA: Octopodidae		
<i>Octopus vulgaris</i>	2	2.9
Group totals (cephalopods)	2	
TESTUDINES: Cheloniidae		
<i>Chelonia mydas</i>	3*	
Group totals (sea turtles)	3	4.4
TOTALS	69	100

sorted, and turtle parts, cephalopod beaks, otoliths and bones of fishes were identified (Schmidt, 1968; Clarke, 1986; Pritchard & Mortimer, 1999; Wyneken, 2001; Campana, 2004; Tuset, Lombarte, & Assis, 2008). The number of fish prey in the stomach contents was assumed to be half the number of otoliths found. Turtle parts found in the stomach were stored in formalin, and the rest of the stomach contents were stored in 70% ethanol.

The nibbled turtle parts found in the stomach contents, including heads and forelimbs were measured as accurately as possible in their condition according to Kamezaki and Matsui (1997). To estimate straight carapace length (SCL), the equation of  $SCL = 1.83 \times FLL - 22.1$  was used (N. Kamezaki, pers. comm., 22 November 2014) and to convert SCL to curved carapace length (CCL) the equation of  $SCL = 0.94 \times CCL - 0.0515$  (Goshe, Avens, Scharf, & Southwood, 2010) was used.

## Results and Discussion

The diversity of prey species and the percentage of each species' contribution to the Monk Seal's diet are presented in Table 1. The stomach contents consisted of fish, cephalopods, and sea turtles. Additionally, the Monk Seal stomach contents also contained five pieces (totalling 331 cm<sup>2</sup>) of nylon multifilament gill net with the mesh size of 40 mm (PA-210D/2).

In total, nine taxa of fish, cephalopods and reptiles were identified to species or family levels and 69 individual food items were counted. Fish in the family Sparidae were the most numerous prey item, comprising 90% of total number of prey. This finding is similar to the fish components of the Monk Seal diet reported by Pierce et al. (2011). Two individuals of *Octopus vulgaris* represented the only cephalopod species present.



Figure 1. Green Turtle heads and forelimbs found in the stomach contents of a Mediterranean Monk Seal near Antalya, Turkey.

Of the four bony fish species identified, *Ariosoma balearicum* (Congridae) and *Argyrosomus regius* (Sciaenidae) had not previously been recorded in the diet of the Mediterranean Monk Seal, although Monk Seals are known to consume other species in these fish families.

Prey remains in the stomach content consisted principally of several body parts (three heads, six forelimbs, neck bones, fractured upper forelimbs bones – ulnas, pectoral girdles- and pieces of plastron) of Green Turtles (Figure 1). Based on the similarities of size and shape of Green Turtles' body parts, it is possible that these remains belonged to three individual turtles. According to the measurement of the green turtle parts in the stomach contents, Straight Carapace Length (SCL) and Curved Carapace Length (CCL) of the three turtles were estimated as 254-304 mm and 260-323 mm, respectively. Based on these estimates, the turtles were most likely immature juveniles at the late oceanic stage or pre-neritic stage (cf. Türkozan et al. 2013). Pieces of marine algae found in the throat of one of the turtles were identified as Rhodophyta *Gelidium spinosum* var. *hystrix* (J. Agardh) Furnari 1997, which is common in the intertidal zones of the Antalya region (Okudan & Aysel, 2005).

Although Monk Seal predation on the Loggerhead Turtle, *Caretta caretta*, have been reported (Margaritoulis et al., 1996; Margaritoulis & Touliatou, 2011), no previous reports of sea turtles in the stomach contents of Monk Seals have been published. From Zakynthos Island, Greece (eastern Ionian Sea), eight cases of predation on Loggerhead Turtles were reported by Margaritoulis et al. (1996). And the occurrences of 21 similar cases suggested that this is not behaviour of one specific Monk Seal (Margaritoulis & Touliatou 2011). The reason for the predation on turtles was speculated as the reduction of marine resources in that area (Margaritoulis et al., 1996; Margaritoulis & Touliatou, 2011). Likewise in the Mediterranean coast of Turkey, in spite of the increasing fishing pressure, total production shows negative trend as a sign of overfishing (Gökçe, 2012).

The eastern Mediterranean coast of Turkey is the most important nesting ground for Green Turtles and provides important foraging areas (Kasperek & Baran, 1989; Kasperek, Godley, & Broderick, 2001; Oruç, 2001), especially the Bay of Antalya (Godley et al., 2002; Broderick, Coyne, Fuller, Glen, & Godley, 2007; Türkecan & Yerli, 2011).

At the same time, the rate of sea turtle bycatch in set nets is higher in Turkey than any other Mediterranean country (Casale, 2011). The pieces of gill net found in the stomach of the Monk Seal suggest that it was obtaining part of its diet from fishing nets, a behaviour that has commonly been observed throughout their range (Cebrian et al., 1990; Salman et al., 2001; Karamanlidis et al., 2011).

Considering the size of the body parts found and the absence of any turtle carapaces in the stomach contents, it is unlikely that this seal preyed on the whole turtles, but rather bit off body parts from turtles entangled in fishing nets. In light of this information, we suspect that the Monk Seal was deliberately killed (Danyer et al., 2013) during or after feeding on turtles bycaught in fishing nets. The most likely scenario is that both endangered species, the Monk Seal and the Green Turtle, were killed due to interaction with fishermen – one as bycatch, the other due to competition for dwindling fish resources. This can be interpreted as a bad sign for the vulnerable biodiversity of the Mediterranean Sea.

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### Disclosure Statement

No potential conflict of interest was reported by the authors.

### References

- Broderick, A. C., Coyne, M. S., Fuller, W. J., Glen, F., & Godley, B. J. (2007): Fidelity and overwintering of sea turtles. *Proceedings of the Royal Society B: Biological Sciences*, 274, 1533–1538.
- Campana, S. E. (2004): *Photographic Atlas of Fish Otoliths of the Northwest Atlantic Ocean*. Canadian Special Publication of Fisheries and Aquatic Sciences 133. Ottawa, Ontario: NRC Research Press.
- Casale, P. (2011): Sea turtle by-catch in the Mediterranean. *Fish and Fisheries*, 12, 299–316.
- Cebrian, D., Fatsea, H., & Mytilineou, C. (1990): Some data on biometry and stomach content of a Mediterranean monk seal found in Santorini Island (Greece). *Rapports et Proces-Verbaux des Reunions Commission Internationale pour l'Exploration Scientifique de la Mer Mediterranee Monaco*, 32, 237.
- Clarke, M. R. (1986): *A Handbook for the Identification of Cephalopod beaks*. Oxford: Clarendon Press.
- Danyer, E., Özgür Özbek, E., Aytemiz, I., & Tonay, A.M. (2013): Preliminary report of a stranding case of Mediterranean Monk Seal *Monachus monachus* (Hermann, 1779) on Antalya coast, Turkey, April 2013. *Journal of the Black Sea/Mediterranean Environment*, 19, 181–185.
- Gilmartin, W. G., & Forcada, J. (2009): Monk Seals. pp. 741–744. In: W. F. Perrin, B. Würsig & J. G. M. Thewissen (Eds.), *Encyclopedia of Marine Mammals*. San Diego, CA: Academic Press.
- Godley, B. J., Richardson, S., Broderick, A. C., Coyne, M. S., Glen, F., & Hays, G.C. (2002): Long-term satellite of the movements and habitat utilisation by green turtles in the Mediterranean. *Ecography*, 25, 352–362.

- Goshe, L. R., Avens, L., Scharf, F. S., & Southwood, A. L. (2010): Estimation of age at maturation and growth of Atlantic green turtles (*Chelonia mydas*) using skelotochronology. *Marine Biology*, 157, 1725–1740.
- Gökçe, G. (2012): Fisheries of the Mediterranean Part of Turkey. pp. 242-250. In: A. Tokaç, A. C. Gücü, & B. Öztürk (Eds.), *The State of the Turkish Fishery*. Istanbul: Turkish Marine Research Foundation.
- Kamezaki, N., & Matsui, M. (1997): Allometry in the loggerhead turtle, *Caretta caretta*. *Chelonian Conservation and Biology*, 2, 424–425.
- Karamanlidis, A. A., Kallianiotis, A., Psaradellis, M., & Adamantopoulou, S. (2011): Stomach contents of a subadult Mediterranean monk seal (*Monachus monachus*) from the Aegean Sea. *Aquatic Mammals*, 37, 280–283.
- Karamanlidis, A. A., Curtis, P. J., Hirons, A. C., Psaradellis, M., Dendrinis, P., & Hopkins III, J. B. (2014): Stable isotopes confirm a coastal diet for critically endangered Mediterranean monk seals. *Isotopes in Environmental and Health Studies*, 50, 332–342.
- Kasperek, M., & Baran, I. (1989): On the whereabouts of immature sea turtles (*Caretta caretta* and *Chelonia mydas*) in the eastern Mediterranean. *Zoology in the Middle East*, 3, 31–36.
- Kasperek, 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.
- Margaritoulis, D., & Touliaou, S. (2011): Mediterranean monk seals present an ongoing threat for loggerhead sea turtles in Zakynthos. *Marine Turtle Newsletter*, 131, 18–23.
- Margaritoulis, D., Karavellas, D., & Irvine, C. (1996): Predation of adult loggerheads by Mediterranean monk seals. In: J. A. Keinath, D. E. Barnard, J. A. Musick & B. A. Bell (Eds.), Proceedings of the 15th Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum, NMFS-SEFSC-387, 193-196. Miami, FL: National Marine Fisheries Service.
- Okudan, E. Ş., & Aysel, V. (2005): Marine algae and seagrasses of Antalya coastline (Mediterranean, Turkey). *Journal of Black Sea/Mediterranean Environment*, 11, 303–325.
- Oruç, A. (2001): Trawl fisheries in the eastern Mediterranean and their impact on marine turtles. *Zoology in the Middle East*, 24, 119–125.
- Pierce, G. J., Hernandez-Milian, G., Begoña Santos, M., Dendrinis, P., Psaradellis, M., Tounta, E., Androukaki, E., & Edridge, A. (2011): Diet of the monk seal (*Monachus monachus*) in Greek waters. *Aquatic Mammals*, 37, 284–297.
- Pritchard, P. C. H., & Mortimer, J. A. (1999): Taxonomy, external morphology, and species identification. pp. 21–40. In: K. L. Eckert, K. A. Bjorndal, F.A. Abreu-Grobois, & M. Donnelly (Eds.), *Research and management techniques for the conservation of sea turtles*. Washington (DC): IUCN/SSC Marine Turtle Specialist Group.
- Rowles, T. K., Van Dolah, F. M., & Hohn, A. A. (2001): Gross necropsy and specimen collection protocols. pp. 449–470. In: L. A. Dierauf & F. M. D. Gulland (Eds.), *CRC Handbook of Marine Mammal Medicine*. Boca Raton (Florida): CRC Press.
- Salman, A., Bilecenoğlu, M., & Güçlüsoy, H. (2001): Stomach contents of two Mediterranean monk seals (*Monachus monachus*) from the Aegean Sea, Turkey. *Journal of the Marine Biological Association of the United Kingdom*, 81, 719–720.
- Schmidt W. (1968): Vergleichend morphologische studie über die otolithen mariner Knochenfische. *Archiv für Fischereiwissenschaft*, 19, 1–96.
- Tuset, V. M., Lombarte, A., & Assis, C. A. (2008): Otolith atlas for the western Mediterranean, north and central eastern Atlantic. *Scientia Marina*, 72(S1), 7-198.
- Türkecan, O., & Yerli, S. V. (2011): Satellite tracking of adult green sea turtles from Turkey: a long distance diary. *Marine Turtle Newsletter*, 131, 38–41.
- Türkozan, O., Özdilek, Ş. Y., Ergene, S., Uçar, A. H., Sönmez, B., Yılmaz, C., Kaçar, Y., & Aymak, C. (2013): Strandings of loggerhead (*Caretta caretta*) and green (*Chelonia mydas*) sea turtles along the eastern Mediterranean coast of Turkey. *Herpetological Journal*, 23, 11–15.
- Wyneken, J. (2001): *The anatomy of sea turtles* (NOAA Technical Memorandum NMFS-SEFSC-470). Miami: U.S. Department of Commerce National Oceanic and Atmospheric Administration.