

Stomach contents of two Mediterranean monk seals (*Monachus monachus*) from the Aegean Sea, Turkey

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This study provides a description of the Mediterranean monk seal (*Monachus monachus*) diet from the Aegean Sea coast of Turkey. A total of 23 prey items belonging to five species were identified from the two stomachs examined. Cephalopods constitute the dominant prey group by weight (94.01%). *Sarcotragus* sp. (Porifera) and *Posidonia oceanica* (Magnoliophyta) are assumed to be incidental prey. Of the cephalopods identified, *Eledone moschata* and *Bathypolyypus sponsalis* were encountered for the first time in a monk seal stomach.

The Mediterranean monk seal, *Monachus monachus*, is Europe's most endangered marine mammal. The species formerly occupied the entire Mediterranean and the Atlantic coasts of north-west Africa, but during the past half century the population has depleted throughout its range, primarily due to deliberate killing, human disturbance, loss of habitat and lack of food as a result of overfishing (Johnson & Lavigne, 1998). Less than 500 individuals are estimated to inhabit the Mediterranean Sea (Reijnders et al., 1993), with ~40 individuals known from Turkish coasts (A.C. Gucu, personal communication). This has raised considerable concern over the future of the species and has led to the implementation of several action plans (Israëls, 1992).

This study provides a first examination of the diet of the Mediterranean monk seal from the Aegean Sea coast of Turkey.

The stomach contents of two monk seals from the Aegean Sea coast of Turkey were analysed. The first specimen was found dead on 7 March 1999, in the vicinity of Cesme town at Cesme Peninsula. It was a sub-adult female of 116 kg in weight and 200 cm in total (nose to the end of tail) length. The specimen was dissected the following day and stomach contents fixed in 10% formalin for further analysis in the laboratory. The second specimen, a juvenile female of 176 cm in total length and 70 kg in weight, was found stranded at Kumburnu beach (Mordogan, Izmir Bay) on 2 February 2001, probably a week after its death. Signs of net entanglement were conspicuous on the nape. The whole stomach was collected immediately and its contents washed through a 1-mm sieve in order to separate hard parts from the remaining flesh. Prey items were sorted by naked eye and substantially preserved in 70% alcohol. Each prey item was identified to the lowest possible taxon. Lower beaks were used as the primary means of classification of cephalopods, and beak identity was established by methods described by Clarke (1986). Hood length (*HL*) of large sized lower beaks were measured to the nearest 0.1 mm by a dial calliper (0.02 mm accuracy), whereas small sized beaks were measured under the reflected light of stereomicroscope at $\times 20$ magnification. Cephalopod wet weights (*W*, g) and dorsal mantle lengths (*DML*, mm) were estimated from *HL*s by the following allometric equations:

Sepia officinalis: $\ln(W) = -2.09 + 4.06 * \ln(HL)$, $DML = -2.14 + 21.89 * HL$ (Clarke, 1986);

Eledone moschata: $\ln(W) = 3.08 + 1.97 * \ln(HL)$ ($N=16$, $r=0.83$), $DML = 20.209 + 16.84 * HL$ ($N=16$, $r=0.81$) and

Bathypolyypus sponsalis: $\ln(W) = 1.034 + 2.54 * \ln(HL)$, $DML = -35.52 + 21.88 * HL$ ($N=4$, $r=0.84$) (A. Salman, unpublished data).

Although the sample sizes of *E. moschata* and *B. sponsalis* used to obtain the formula is low, they provide a rough estimation of wet weight.

The stomach of the sub-adult female monk seal examined includes 22 individuals belonging to five species (all at early stages of digestion), whereas the stomach of the juvenile specimen consisted only of a cephalopod lower beak, identified as *E. moschata*. A small piece of gill net (32 mm mesh size) was also present in the stomach of the sub-adult female. Of all prey items identified (Table 1), cephalopods constitute the largest component by weight (94.01%). *Sarcotragus* sp. and *Posidonia oceanica* were prey of minor proportion and assumed to be consumed incidentally. Of those species of cephalopods, for which wet weight were estimated, *Sepia officinalis* appeared to be the most important diet in terms of the total amount consumed. The estimated dorsal mantle lengths ranged from 85.42 to 217.19 mm for *S. officinalis*, 67.15–123.48 mm for *E. moschata* and 39.31–102.33 mm for *B. sponsalis*.

Although the diet composition of two monk seals from the Aegean Sea reveals the species to be probably a teuthophagous mammal, Mediterranean monk seal proved to be an opportunistic predator with the diet differing from region to region according to the availability of food species (Israëls, 1992). The most frequently reported prey species in the diet of *M. monachus* are bony fishes and cephalopods (Sergeant et al., 1978; Cebrian et al., 1990; Neves, 1998).

Of the three cephalopod species identified, *E. moschata* and *B. sponsalis* are encountered for the first time in the monk seal diet in the Mediterranean. The most striking finding was the presence of the bathybenthic cephalopod, *B. sponsalis*, in the stomach. This species inhabits depths down to 1835 m in the Mediterranean Sea, with main distribution between 400 and 700 m (Villanueva, 1992). Although there are not enough hard data on the feeding depth of *M. monachus*, it is generally accepted that monk seals are poor divers not going beyond a depth of 100 m (Sergeant et al., 1978).

The unexpected presence of sponge (*Sarcotragus* sp.) and sea grass (*P. oceanica*) species in the stomach of the sub-adult female maybe attributed to the poor condition of the seal that is probably suffering from a chronic lack of food (see Kompanje et al., 2000). There is a clear evidence of the association between

Table 1. Prey species and number in stomach of *Monachus monachus*.

Prey item	N	TW (g)	W%
Magnoliophyta			
Posidoniaceae			
<i>Posidonia oceanica</i> (L.) Delile, 1813	2 (roots)	56.4	1.11
Porifera			
Irciniidae			
<i>Sarcotragus</i> sp.	1	89.9	1.77
<i>Sarcotragus</i> sp.	1	158.7	3.12
Cephalopoda			
Sepiidae			
<i>Sepia officinalis</i> Linnaeus, 1758	6	1919.5	37.69
Octopodidae			
<i>Eledone moschata</i> (Lamarck, 1798)	8	1889.2	37.10
<i>Bathypolypus sponsalis</i> (Fischer & Fischer, 1892)	5	978.8	19.22
Total	23	5092.5	100

N, number of specimens; TW, total wet weight (estimated wet weight for cephalopods, based on linear equations); W%, percentage of the total weight of all food items.

Sarcotragus sp. and *P. oceanica* in the Aegean Sea (Cinar & Ergen, 1998), explaining the occurrence of both species in the stomach at the same time.

The piece of gill net found in the stomach was not surprising; it is a known fact that seals in search of food often damage nets and collect food from the fishing gear (Cebrian et al., 1990). This fact can be explained by opportunistic foraging behaviour of monk seals.

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REFERENCES

- 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 Procès-verbaux des Réunions. Commission Internationale pour l'Exploration Scientifique de la Mer Méditerranée. Paris*, **32**, 237.
- Cinar, M.E. & Ergen, Z., 1998. Polychaetes associated with the sponge *Sarcotragus muscarum* Schmidt, 1864 from the Turkish Aegean Coast. *Ophelia*, **48**, 167–183.
- Clarke, M.R., 1986. *A handbook for the identification of cephalopod beaks*. Oxford: Clarendon Press.
- Israëls, L.D.E., 1992. Thirty years of Mediterranean monk seal protection: a review. *Mededeelingen*, no. 28, 65 pp. [Netherlands Commission for International Nature Protection.]
- Johnson, W.M. & Lavigne, D.M., 1998. *The Mediterranean monk seal conservation guidelines*, 2nd ed. International Marine Mammal Association Inc.
- Kompanje, E.J.O., Güclüsoy, H. & Bree, P.J.H. van, 2000. Osteoporosis in an adult female monk seal, *Monachus monachus*, from Cesme, Turkey. *The Monachus Guardian*, **3**, 27–28.
- Neves, C., 1998. Preliminary findings on the feeding behaviour and general ecology strategy of the Mediterranean monk seal *Monachus monachus* (Pinnipedia: Monachinae) on the Desertas Islands. *Boletim do Museu Municipal do Funchal*, **5**, 263–271.
- Reijnders, P., Brasseur, S., Toorn, J., Wolf, P., Boyd, I., Harwood, J., Lavigne, D. & Lowry, L., 1993. *Seals, fur seals, sea lions and walrus*. Gland, Switzerland: Status Survey and Conservation Action Plan, IUCN Specialist Group, Kelyvn Press.
- Sergeant, D., Ronald, K., Boulva, J. & Berkes, F., 1978. The recent status of *Monachus monachus*, the Mediterranean monk seal. *Biological Conservation*, **14**, 259–287.
- Villanueva, R., 1992. Deep-sea cephalopods of the north-western Mediterranean: indications of up-slope ontogenetic migration in two bathybenthic species. *Journal of Zoology*, **227**, 267–276.

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