

Long-term changes (1990–2012) in the diet of striped dolphins *Stenella coeruleoalba* from the western Mediterranean

Francisco J. Aznar*, R. Míguez-Lozano, B. Ruiz, A. Bosch de Castro, J.A. Raga, C. Blanco

*Corresponding author: francisco.aznar@uv.es

Marine Ecology Progress Series 568: 231–247 (2017)

Table S2. Bathymetric distribution and habitat of prey consumed by striped dolphins, *Stenella coeruleoalba*, in the western Mediterranean based on bibliographic references. Depth: 1. Upper shelf; 1.5 Upper shelf / Lower shelf; 2 Lower shelf; 2.5 Lower shelf / upper slope; 3. Upper slope; 3.5 Upper / middle slope; 4. Middle slope / oceanic. The symbol ‘?’ indicates that the taxon cannot be clearly assigned to a depth score.

Species	Depth	Habitat	References
<i>Abralia veranyi</i>	3.5	Pelagic	20, 7, 21
<i>Abraliopsis morisii</i>	4	Pelagic	27, 23, 20, 26
<i>Alloteuthis</i> spp.	1.5	Demersal	8, 23, 20, 9, 6
<i>Ancistrocheirus lesueurii</i>	4	Pelagic	8, 21
<i>Ancistroteuthis lichtensteinii</i>	4	Pelagic	8, 20, 7, 26
<i>Arctozenus risso</i>	4	Pelagic	27, 5, 15, 17
<i>Argentina / Glossanodon</i> spp.	3.5	Pelagic / Demersal	27
<i>Arnoglossus</i> spp.	1.5	Benthic	27, 2, 15, 6
<i>Benthoosema glaciale</i>	4	Pelagic	27, 5, 15, 17
<i>Boops boops</i>	1.5	Pelagic	27, 4, 15
<i>Brachioteuthis riisei</i>	4	Pelagic	23, 20, 7, 26
<i>Cepola macrophthalma</i>	1.5	Demersal	27, 4, 15, 6
<i>Ceratoscopelus maderensis</i>	3.5	Pelagic	27, 12, 5, 15, 17
<i>Chiroteuthis veranii</i>	4	Pelagic	8, 20, 3, 26, 21
<i>Citharus linguatula</i>	1.5	Benthic	27, 13, 15, 6
Species of Clupeidae	1.5	Pelagic	27
Species of Cranchiidae	4	Pelagic	8
<i>Diaphus/Lobianchia</i> spp.	4	Pelagic	27, 15, 25, 17
<i>Electrona risso</i>	4	Pelagic	27
<i>Eledone cirrhosa</i>	2.5	Benthic	7, 13, 6
<i>Eledone moschata</i>	1.5	Benthic	27, 20, 7, 13
<i>Engraulis encrasicolus</i>	1	Pelagic	15, 18, 6
<i>Epigonus</i> spp.	4	Demersal	27, 16, 5, 14, 15, 25
<i>Gadiculus argenteus</i>	3.5	Demersal	27, 16 2, 15, 6
Gadiidae spp.	?	Demersal	27
<i>Gaidropsarus</i> spp.	?	Demersal	15
<i>Galiteuthis armata</i>	4	Pelagic	8
Gobiidae spp.	1.5	Benthic / Demersal	27

<i>Gobius</i> spp.	1.5	Benthic / Demersal	27, 1
<i>Heteroteuthis dispar</i>	4	Pelagic	8 20, 26, 21
<i>Histioteuthis bonnellii</i>	4	Pelagic	8, 20, 7, 26, 21
<i>Histioteuthis reversa</i>	4	Pelagic	20, 7, 26, 25, 21
<i>Hygophum hygomii</i>	4	Pelagic	27, 15, 25, 17
<i>Illex coindetii</i>	2	Pelagic	8, 24, 20, 7, 11, 19
<i>Lampanyctus</i> spp.	4	Pelagic	27, 15, 25, 17
<i>Lepidopus caudatus</i>	2.5	Pelagic / demersal	14, 27
<i>Lepidorhombus</i> spp.	3.5	Benthic	27, 16, 5, 13, 15
<i>Lestidiops</i> spp.	3.5	Pelagic	27, 17
<i>Lesueurigobius</i> spp.	1	Demersal	27, 4, 1, 15
<i>Loligo</i> spp.	?	Demersal	27, 20, 2, 13
<i>Macroramphosus scolopax</i>	2.5	Demersal	27, 2, 14, 6
<i>Maurolicus muelleri</i>	3	Pelagic	27, 15, 6, 17
<i>Merluccius merluccius</i>	2	Pelagic / demersal	27, 22, 15
<i>Micromesistius poutassou</i>	3.5	Pelagic / demersal	27, 16 2, 12, 5, 13, 14, 15, 6
<i>Myctophum punctatum</i>	4	Pelagic	27, 5, 15, 17
<i>Notoscopelus</i> spp.	3.5	Pelagic	27, 5, 15, 17
<i>Ocythoe tuberculata</i>	4	Pelagic	8, 26, 21
<i>Ommastrephes bartrami</i>	4	Pelagic	8, 3
<i>Onychoteuthis banksii</i>	4	Pelagic	20, 11, 26, 21, 8
<i>Ophidion</i> spp.	1.5	Demersal	27, 10
<i>Paralepis</i> spp.	4	Pelagic	5, 27
<i>Phycis blennoides</i>	3.5	Demersal	27, 16, 2, 12, 5, 14, 15, 6, 25
<i>Sardina pilchardus</i>	1	Pelagic	27, 15, 18, 6
<i>Sardinella</i> spp.	1.5	Pelagic	27, 18
<i>Sepia</i> spp.	2	Demersal	8, 20, 6
<i>Sepietta</i> spp.	?	Pelagic / demersal	8, 20, 6
<i>Sepiola</i> spp.	2	Demersal	8, 6
Species of Sepioliidae	?	Pelagic / demersal	8
<i>Sprattus sprattus</i>	1	Pelagic	27, 18
<i>Symbolophorus veranyi</i>	4	Pelagic	27, 15, 25, 17
<i>Teuthowenia megalops</i>	4	Pelagic	8
<i>Todarodes sagittatus</i>	3.5	Pelagic / demersal	23, 20, 7, 12, 13, 26, 6
<i>Todaropsis eblanae</i>	3.5	Demersal	23, 8, 20, 21
<i>Trachurus</i> spp.	1.5	Pelagic	2, 14, 15, 6
<i>Trigla/ Lepidotrigla</i> spp.	?	Benthic / demersal	27, 13, 15, 6
<i>Trisopterus minutus</i>	2	Demersal	27, 2, 15, 6

References:

1. Ahnelt, H., Dorda, J. (2004). Gobioid fishes from the north eastern Atlantic and the Mediterranean: new records and rarely found species. *Annalen des Naturhistorischen Museums in Wien* 105: 5-19.
2. Biagi, F., Sartor, P., Ardizzone, G.D., Belcari, P., Bellusco, A., Serena, F. (2002). Analysis of demersal assemblages off the Tuscany and Latium coasts (north-western Mediterranean). *Scientia Marina* 66: 233-242
3. Cuccu, D., Mereu, M., Masala, A., Jereb, P. (2009). *Chiroteuthis veranii* and *Ommastrephes bartramii* (Cephalopoda: Teuthida) in the Sardinian waters. *Biologia Marina Mediterranea*, 16: 334-335.
4. Demestre, M., Sánchez, P., Abelló, P. (2000). Demersal fish assemblages and habitat characteristics on the continental shelf and upper slope of the north-western Mediterranean. *Journal of the Marine Biological Association of the United Kingdom* 80: 981-988.
5. D'Onghia, G., Poltou, C.Y., Bozzano, A., Lloris, D., Rotllant, G., Sion, L., Mastrototaro, F. (2004). Deep-water fish assemblages in the Mediterranean Sea. *Scientia marina* 68: 87-99.
6. García-Rodríguez, M., Abelló, P., Fernández, A., Esteban, A. (2011). Demersal Assemblages on the soft bottoms off the Catalan Levante Coast of the Spanish Mediterranean. *Journal of Marine Biology* 2011: 16 pp.
7. González, M., Sánchez, P. (2002). Cephalopod assemblages caught by trawling along the Iberian Peninsula Mediterranean coast. *Scientia Marina* 66: 199-208.
8. Guerra, A. (1992). Fauna Ibérica. Vol. 1. *Mollusca. Cephalopoda*. Pp. 327, in: Ramos M.A. (Ed.), Fauna Ibérica, Vol.1. Museo Nacional de Ciencias Naturales. Consejo Superior de Investigaciones Científicas, Madrid.
9. Hastie, L.C., Nyegaard, M., Collins, M.A., Moreno, A., Pereira, M.F., Piatkowski, U., Pierce, J.G. (2009). Reproductive biology of the loliginid squid, *Alloteuthis subulata*, in the north-east Atlantic and adjacent waters. *Aquatic Living Resources* 22: 35-44.
10. Hernández M.R., Ribas D., Muñoz M., Casadevall M., Gil de Sola, L. (2006). Depth records of *Ophidion barbatum* (Ophidiiformes, Ophidiidae) in western Mediterranean. *Cybium* 30: 85-86.
11. Lefkaditou, E., Mytilineou, Ch., Maiorano, P., D'Onghia, G. (2003). Cephalopod species captured by deep-water exploratory trawling in the Northeastern Ionian Sea. *Journal of Northwest Atlantic Fishery Science* 31: 431-440.
12. Massuti, E., Guijarro, B., Pomar, B., Fliti, K., Reghis, M., Zaghdoudi, S., Bouaicha, M., Aitferroukh, B., Zereb, N. (2003). Informe de la campaña Argelia 0203-DP para la evaluación de recursos demersales profundos en las costas de Argelia (Mediterráneo sud-occidental). IEO-MPRH-SGPM, 108 pp.
13. Massuti, E., Reñones, O. (2005). Demersal resource assemblages in the trawl fishing grounds off the Balearic Islands (western Mediterranean). *Scientia Marina* 69: 167-181.
14. Menezes, G.M., Sigler, M.F., Silva, H.M., Pinho, M.R. (2006). Structure and zonation of demersal fish assemblages off the Azores Archipelago (mid-Atlantic). *Marine Ecology Progress Series* 324: 241-260.
15. Mérigot, B., Bertrand, J.A., Gaertner, J.C., Durbec, J.P., Mazouni, N., Manté, C. (2007). The multi-component structuration of the species diversity of groundfish assemblages of the east coast of Corsica (Mediterranean Sea): Variation according to the bathymetric strata. *Fisheries Research* 88: 120-132.
16. Moranta, J., Stefanescu, C., Massuti, E., Morales-Nin, B., Lloris, D. (1998). Fish community structure and depth-related trends on the continental slope of the Balearic Islands (Algerian basin, western Mediterranean). *Marine Ecology Progress Series* 171: 247-259.
17. Olivar, M.P., Bernal, A. Molí, B., Peña, M., Balbín, R., Castellón, A., Miquel, J., Massuti, E. (2012). Vertical distribution, diversity and assemblages of mesopelagic fishes in the western Mediterranean. *Deep-Sea Research I* 62: 53-69.
18. Palomera, I., Olivar, M.P., Salat, J., Sabatés, A., Coll, M., García, A., Morales-Nin, B. (2007). Small pelagic fish in the NW Mediterranean Sea: an ecological review. *Progress in Oceanography* 74: 377-396.
19. Perdichizzi, A., Pirrera, L., Giordano, D., Perdichizzi, F., Busalacchi, B., Profeta, A., Bottari, T., Rinelli, P. (2011). Distribution patterns and population structure of *Illex coindetii* (Cephalopoda: Ommastrephidae) in the Southern Tyrrhenian Sea: Historical series of 14 years trawl survey. *Fisheries Research* 109: 342-350.
20. Quetglas, A., Carbonell, A., Sánchez, P. (2000). Demersal continental shelf and slope cephalopod assemblages from Balearic Sea (north-western Mediterranean). Biological aspects of some deep-sea species. *Estuarine, Coastal and Shelf Science* 50: 739-749.
21. Quetglas, A., Ordines, F., González, M., Zaragoza, N., Mallol, S., Valls, M., De Mesa, A. (2013). Uncommon pelagic and deep-sea cephalopods in the Mediterranean: new data and literatura review. *Mediterranean Marine Science* 14: 69-85.
22. Relini, L.O., Papaconstantinou, C., Jukic-Peladic, S., Souplet, A., De Sola, L.G., Piccinetti, C., Kavadas, S., Rossi, M. (2002). Distribution of the Mediterranean hake populations (*Merluccius merluccius smiridus* Rafinesque, 1810) (Osteichthyes: Gadiformes) based on six years monitoring by trawl-surveys: some implications for management. *Scientia Marina* 66: 21-38.
23. Roper, G.F.E., Young, R.E. (1975). Vertical distribution of pelagic cephalopods. *Smithsonian Contributions to Zoology* 209, 51pp.
24. Sánchez, P., Martín, P. (1993). Population dynamics of the exploited cephalopod species of the Catalan Sea (NW Mediterranean). *Scientia Marina* 57: 153-159.
25. Tecchio S., Ramírez-Llodra E., Sardà F., Company, J.B. (2011). Biodiversity of deep-sea demersal megafauna in Western and Central Mediterranean basins. *Scientia Marina* 75: 341-350.
26. Vecchione, M., Young, R.E., Piatkowski, U. (2010). Cephalopods of the northern Mid-Atlantic Ridge. *Marine Biology Research* 6: 25-52.
27. Whitehead, P.J.P., Bauchot, M.-L., Hureau, J.-C., Nielsen, J., Tortonese E. (1986). *Fishes of the North-eastern Atlantic and the Mediterranean*. Vols. I-III UNESCO, Paris.

Table S3. Percent frequency of occurrence (%F), average number per dolphin (N), percent number (%N), and percent weight (%W), with the 95% C.I. in parentheses, of prey taxa consumed by striped dolphins *Stenella coeruleoalba* in the western Mediterranean in different periods. ‘n’ is the sample size of dolphins. ‘E’ and ‘NE’ are labels for ‘epizootic’ and ‘non-epizootic’ periods.

Prey	Period				
	1990 (E1)	1991-1999 (NE1)	2000-2006 (NE2)	2007-2008 (E2)	2009-2012 (NE3)
%F	(n= 42)	(n= 27)	(n= 28)	(n= 15)	(n= 25)
<i>Merluccius merluccius</i>	2.4 (0.1-12.7)	14.8 (5.2-33.1)	53.6 (35.5-71.8)	46.7 (22.2-70.6)	52.0 (31.7-70.4)
<i>Illex coindettii</i>	14.3 (6.4-28.4)	18.5 (7.6-36.9)	53.6 (35.5-71.8)	53.3 (29.4-77.8)	56.0 (35.8-74.4)
<i>Todarodes sagittatus</i>	45.2 (30.8-60.8)	29.6 (14.8-50.0)	10.7 (3.0-28.2)	0.0 (0.0-22.2)	12.0 (3.4-30.3)
Neritic fish	7.1 (2.0-19.0)	29.6 (14.8-50.0)	53.6 (35.5-71.8)	33.3 (14.2-60.3)	56.0 (35.8-74.4)
Neritic cephalopods	14.3 (6.4-28.4)	22.2 (10.2-41.5)	46.4 (28.2-64.5)	20.0 (5.7-46.7)	28.0 (13.4-48.0)
Oceanic fish	35.7 (22.4-51.2)	25.9 (12.4-46.2)	42.9 (25.8-61.9)	60.0 (33.3-80.9)	32.0 (16.1-52.0)
Oceanic cephalopods	88.1 (74.1-95.2)	55.6 (36.9-73.1)	35.7 (19.3-55.4)	33.3 (14.2-60.3)	40.0 (22.2-60.2)
N					
<i>Merluccius merluccius</i>	0.1 (0.0-0.2)	3.2 (0.6-11.4)	22.3 (11.8-39.5)	33.6 (3.0-107.8)	14.8 (6.1-29.3)
<i>Illex coindettii</i>	0.4 (0.1-0.9)	1.5 (0.3-5.0)	1.9 (1.1-3.5)	1.6 (0.7-2.7)	12.0 (3.2-43.2)
<i>Todarodes sagittatus</i>	1.6 (0.7-4.8)	29.6 (14.8-50.0)	10.7 (3.0-28.2)	0.0	12.0 (3.4-30.3)
Neritic fish	0.4 (0.0-1.6)	19.7 (5.0-52.4)	25.8 (9.7-61.5)	3.1 (1.1-6.8)	20.6 (8.2-48.0)
Neritic cephalopods	0.5 (0.1-1.9)	4.8 (1.5-11.4)	5.8 (2.4-13.7)	0.6 (0.1-1.9)	1.3 (0.5-3.3)
Oceanic fish	13.0 (7.1-23.7)	25.9 (12.4-46.2)	42.9 (25.8-61.9)	122.9 (16.5-522.3)	32.0 (16.1-52.0)
Oceanic cephalopods	27.7 (13.7-39.0)	4.7 (2.0-11.8)	2.4 (0.8-5.6)	4.6 (0.8-18.1)	3.2 (0.7-12.6)
%N					
<i>Merluccius merluccius</i>	0.2 (0.0-0.7)	5.9 (0.3-17.4)	14.2 (5.1-41.1)	20.2 (1.0-73.2)	13.1 (4.4-29.2)
<i>Illex coindettii</i>	1.0 (0.2-2.3)	2.7 (0.2-8.3)	1.2 (0.4-3.8)	1.0 (0.3-5.3)	10.6 (1.8-28.2)
<i>Todarodes sagittatus</i>	4.2 (1.4-9.6)	5.4 (0.7-16.5)	0.2 (0.0-0.9)	0.0	0.2 (0.0-0.7)
Neritic fish	1.0 (0.0-3.0)	36.3 (3.1-64.5)	16.5 (4.0-47.5)	1.9 (0.3-11.1)	18.3 (5.3-39.8)
Neritic cephalopods	1.3 (0.1-3.7)	4.8 (1.5-11.4)	3.7 (0.9-12.7)	0.4 (0.0-2.4)	1.2 (0.3-3.2)
Oceanic fish	34.6 (18.5-51.8)	32.2 (3.0-60.4)	62.6 (9.5-83.8)	73.8 (12.6-94.9)	53.7 (16.9-74.8)
Oceanic cephalopods	57.7 (40.1-74.3)	8.7 (2.5-21.3)	1.5 (0.3-5.4)	2.8 (0.2-18.3)	2.9 (0.4-9.0)
%W					
<i>Merluccius merluccius</i>	0.1 (0.0-0.3)	31.3 (3.2-58.34)	60.4 (37.9-77.7)	76.3 (17.6-90.0)	42.1 (17.7-64.0)
<i>Illex coindettii</i>	1.6 (0.3-4.2)	6.0 (0.9-15.4)	4.0 (1.6-8.5)	6.9 (2.5-27.1)	17.4 (5.8-33.9)
<i>Todarodes sagittatus</i>	16.0 (5.4-33.8)	8.5 (1.1-24.4)	3.8 (0.0-9.3)	0.0	3.7 (0.0-10.4)
Neritic fish	0.8 (0.0-2.8)	26.1 (1.4-53.1)	12.9 (4.0-26.0)	5.6 (0.6-24.6)	15.6 (2.9-33.2)
Neritic cephalopods	0.1 (0.0-0.3)	1.0 (0.0-3.0)	0.8 (0.2-1.8)	0.1 (0.0-0.4)	0.1 (0.0-0.3)
Oceanic fish	1.7 (0.7-3.6)	2.8 (0.1-9.1)	14.5 (0.2-32.2)	6.2 (1.3-25.0)	16.6 (1.0-36.7)
Oceanic cephalopods	79.8 (60.7-91.2)	24.2 (6.0-50.5)	3.6 (0.9-7.9)	4.9 (0.2-21.8)	4.4 (1.0-9.9)