

### Distribution and Reproduction of *Sepia elegans* in the North Tyrrhenian Sea

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**Abstract** - *Sepia elegans* is relatively abundant south of Livorno between depths of 25 and 285m. During the sampling period about 50% of the specimens were mature, indicating an extended reproductive period.

The population of *Sepia elegans* was sampled over a total of 8475 km<sup>2</sup> between a depth of 12 and 700 m along the Tuscan coast, from the outlet of the Magra River to the northern coast of Elba Island up to the limits of the Corsican territorial waters. Four trawl surveys, each consisting of 30 one-hour daytime hauls, were made in the spring (late March-early May) and summer (late August-early September) between 1985 and 1986, using a drag net with a 20 mm mesh bag. The area was subdivided into homogenous blocks according to the type of bottom and bathymetric range, and the hauls were distributed between the blocks proportionally to the respective areas and positioned randomly. *Sepia elegans* was captured between 25 and 285 m and most frequently between 60 and 120 m. It was most abundant south of Livorno - on sandy muddy bottoms in the circalittoral level related with the VTC biocenosis and with the DL biocenosis (Peres & Piccard, 1964) bathyal layers - and least abundant north of Livorno. This may have been due to the outlets of the Magra, Serchio and Arno rivers which modify the substrate and degree of salinity.

The hauls brought up 991 specimens weighing a total of 8.38 kg. The mantle length (M.L.) of the largest male was 52 mm, that of the largest female 65 mm. Males and females with an M.L. greater than 45 mm and 52 mm, respectively, were collected in the summer when the species was most abundant - about 350 specimens per trawl as compared to about 100 in the spring. Despite the notable difference between the two seasons, the bathymetric preferences of the species can nonetheless be compared. In the spring the cuttlefish were mainly found between 100 and 200 m, while their preference was not so obvious in the summer; in 1985 they were found predominantly between 50 and 100 m and in 1986 between 100-200 m (the springtime depths). In the summer most of the larger cuttlefish preferred the limits of their specific bathymetric range.

The sex and degree of maturity was determined from a subsample equally distributed by size and bathymetric layers. A total of 166 males and 231 females were checked, grading the degree of maturity according to Mangold's (1963) scale. The percentage of immaturity (stage 1) males and females was highest in the summer. In both seasons about 50% of the population was ready to spawn, but the greater percentage of mature males occurs in the spring and the females in the summer. The Table shows the maturity stages (in %) of individuals divided by length classes and season.

PERCENTAGES OF SEXUAL MATURITY STAGES												
M.L.	MALES						FEMALES					
	SPRING			SUMMER			SPRING			SUMMER		
mm	1	2	3	1	2	3	1	2	3	4	5	6
20	70	20	10	86.7	10	3.3	79.7	2.1	3.8	3.1	11.3	100
30	17.2	10.3	72.5	24.4	46.3	29.3	36.4	4	8	15.6	28	8
40	7.1	18.6	74.3	2.4	21.4	76.2	4.2	4.1	16.7	54.2	20.8	59.1
50						100						3.4
60												3.2
												9.7
												33.5
												66.7

The maturity of both sexes is linked more to size than to season, despite the fact that equally mature specimens can differ greatly in size and that beyond a certain size all cuttlefish are mature.

A comparison of equally long small and medium-sized specimens collected in the spring and summer revealed a precocity in the spring specimens. Richard (1966, 1971) observed in reared *Sepia officinalis* that low light intensity and short photoperiod, i.e. a winter-like situation, stimulates sexual maturity, while high temperature, i.e. a summer-like situation, stimulates somatic growth. Our observations may reflect the antagonistic roles of light and temperature as pointed out by Richard.

The degree of maturity of the females was calculated from the size of their largest eggs. Using this method the intermediate stages (2-3-4) of maturity are poorly represented, which could be due to the rapidity with which the eggs develop to their maximum size.

Though our data refer only to the spring and summer, these allow us to conclude that *Sepia elegans* reproduces all year long as Mangold (1963) suggests. They also do not seem to migrate in order to reproduce.

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### Trace metals in three species of Fish of the Mullidae Family from the Mediterranean Coast, Israel

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The Mullidae family is common throughout the Mediterranean. *Mullus barbatus* and *Mullus surmuletus* are Atlantic-Mediterranean species, and *Upeneus moluccensis* is of Red Sea origin (BEN-TUVIA, 1971). These fish inhabit sandy and muddy sea beds, and their prey's habitat is benthic.

To establish a baseline of the existing levels of trace elements (Hg, Cd, Pb, Cu, Zn, Fe) in these commercially important species, their muscle tissue and inner organs were analyzed. Specimens were obtained from trawl catches along the coastline at depths between 10-100 m. Specimens of *Mullus barbatus* (484 specimens; 40 composite samples included 318 fish and 166 individuals), 222 specimens of *Upeneus moluccensis* (18 composite samples included 136 and 56 individuals) and 70 individual specimens of *Mullus surmuletus* were used in this study.

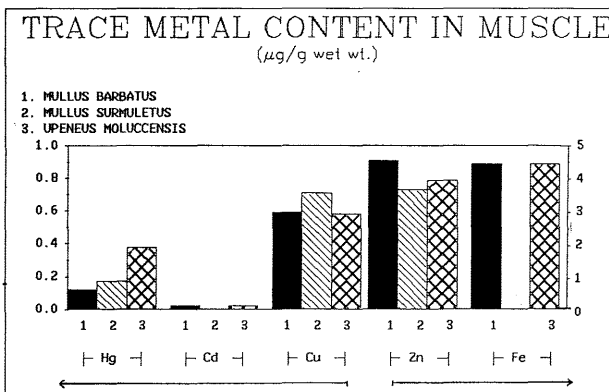
The highest values of total mercury were recorded for *U. moluccensis*, which is known to accumulate higher mercury levels in its muscle than the other Mullidae species, *M. barbatus* and *M. surmuletus*, even though they inhabit similar areas and feed on the same food items. However, levels were low in most cases (see table) and typical for these species, when compared to other areas in the Mediterranean (UNEP, 1986). Mercury content in the muscle correlated significantly with the weight of the fish for *U. moluccensis* ( $r = 0.801$ ), but for *M. barbatus* and *M. surmuletus*, the relationship was poor ( $r = 0.28$  and  $0.27$ , respectively). The highest levels were detected in the liver ( $0.12-0.62 \mu\text{g g}^{-1}$ ) followed by the kidneys ( $0.089-0.56 \mu\text{g g}^{-1}$ ) and the heart (undetectable to  $0.28 \mu\text{g g}^{-1}$ ). Low, undetectable values of mercury were found in the gills, spine, gonads and intestines in all three mullids.

Cadmium levels in the muscle tissue were consistently low and ranged from undetectable to  $0.11 \mu\text{g g}^{-1}$ , with most values below the approximate detection limit of  $0.030 \mu\text{g g}^{-1}$  (see table).

Ranges, averages and standard deviation of trace metal concentrations ( $\mu\text{g g}^{-1}$  wet wt.) in muscle tissue of *Mullus barbatus*, *Mullus surmuletus* and *Upeneus moluccensis* (lead was undetectable).

Species	Year	Hg	Cd	Cu	Zn	Fe
<i>Mullus barbatus</i>	1975-	0.035-0.475	0.007-0.114	0.18-1.29	1.94-10.0	--
	1980a	$0.122 \pm 0.08$	$0.026 \pm 0.02$	$0.60 \pm 0.32$	$4.41 \pm 1.8$	--
	1984-1989b	$0.008-0.313$ $0.108 \pm 0.06$	BDL-0.093 $0.026 \pm 0.02$	$0.20-1.39$ $0.57 \pm 0.29$	$3.01-6.14$ $4.66 \pm 0.77$	$1.89-7.72$ $4.45 \pm 1.44$
<i>Mullus surmuletus</i>	1975-	0.069-0.316	0.005-0.026	0.35-0.66	2.90-3.76	--
	1980a	$0.170 \pm 0.05$	$0.016 \pm 0.01$	$0.50 \pm 0.22$	$3.33 \pm 0.61$	--
	1984-1989b	$0.092-0.164$ $0.135 \pm 0.02$	BDL	$0.71-1.12$ $0.88 \pm 0.15$	$3.07-4.98$ $4.04 \pm 0.59$	--
<i>Upeneus moluccensis</i>	1975-	0.095-1.02	0.002-0.08	0.10-1.34	2.14-7.60	--
	1980a	$0.412 \pm 0.18$	$0.04 \pm 0.02$	$0.52 \pm 0.36$	$3.86 \pm 1.07$	--
	1984-1989b	$0.005-1.12$ $0.240 \pm 0.18$	BDL-0.048 $0.006 \pm 0.01$	$0.20-1.35$ $0.64 \pm 0.30$	$2.75-5.96$ $4.04 \pm 0.68$	$2.48-7.01$ $4.43 \pm 1.03$

- a MED POL - Phase I.  
b MED POL - Phase II.  
c Below detection limit.



The levels of lead were generally below the detection limit of this element and therefore were not recorded.

Copper, zinc and iron are distributed uniformly in the muscle tissue in these species (Fig. 1). The highest values were recorded in the livers and in the food content associated with the feeding habits of these fish.

A comparison of the data for the years 1975-1980 and 1984-1989 shows no differences in the metal content of the muscle tissue in these species. Moreover, there are no significant differences in the values among the three species studied, even though they were collected from different locations along the coast.

This study is part of a comprehensive study on mercury in *M. barbatus* carried out within the framework of the MED POL Phase I and II program and was partly supported by the Mediterranean Trust Fund.

All given values are expressed as  $\mu\text{g g}^{-1}$  wet weight.

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