Turk J Vet Anim Sci
29 (2005) 613-619

Research Article

Reproductive Biology of the Common Cuttlefish *Sepia officinalis* L. (Sepiida: Cephalopoda) in the Aegean Sea

Bahadır ÖNSOY
Department of Biology, Faculty of Science, Celal Bayar University, Muradiye, Manisa - TURKEY
Alp SALMAN*
Department of Hydrobiology, Faculty of Fisheries, Ege University, 35100 Bornova, İzmir - TURKEY

Received: 13.03.2003

Abstract: The common cuttlefish (*Sepia officinalis*) is known as one of the economically important species in the classis Cephalopoda. In this study, from October 2000 to April 2002, 674 cuttlefish were collected monthly from the surroundings of Homa lagoon (in the Aegean Sea).

In order to determine reproductive behaviors and spawning season of *S. officinalis* species, the gonad stages of both sexes and the seasonal gonadosomatic index values were determined. It was observed that the spawning period of *S. officinalis* covers the whole year with two maximum peaks in March and June.

Key Words: *Sepia officinalis*, reproductive biology, Aegean sea, Homa lagoon

Ege Denizi'nde Mürekkep Balığı *Sepia officinalis*'in (Sepiida:Cephalopoda) Üreme Biyolojisi

Özet: Yaygın mürekkep balığı (*Sepia officinalis*), cephalopoda sınıfının ekonomik türlerinden biri olarak bilinmektedir. Bu çalışmada Ekim 2000 - Nisan 2002 tarihleri arasında Ege Denizi'ndeki Homa lagünü çevresinden 674 adet mürekkep balığı aylık olarak örneklenmiştir.

S. officinalis türünün yumurtlama mevsimini ve üreme davranışlarını belirlemek amacıyla, her iki cinsiyetin gonad safhaları ve mevsimsel gonadosomatik indeks değerleri belirlenmiştir. Elde edilen sonuçlara göre *S. officinalis*'in üreme periyodunun tüm yılı kapsadığı Mart ve Haziran aylarında iki maksimum pik oluşturduğu tespit edilmiştir.

Anahtar Sözcükler: *Sepia officinalis*, üreme biyolojisi, Ege denizi, Homa lagünü

Introduction

Distribution area of the common cuttlefish, *Sepia officinalis* L. is the eastern Atlantic from the North Sea to the Cape of Good Hope, through English Channel and eastern coast of Africa to Mozambique. It is also distributed widely in the Mediterranean Sea to a depth of 200 m and it has a commercial value in the countries that have coasts on the Mediterranean Sea (1). Reproductive cycle of the cuttlefish has two peaks per year, in the year-round spawning (2-3) and its maturation takes longer in cold waters than in warmer ones (3). Their mean mantle lengths are between 15 and 25 cm, whereas the maximum mantle length of males is 30 cm; that of females is 25 cm in the Mediterranean Sea (4-5). Egg size of this species varies between 6 and 9 mm in diameter and larger females produce relatively larger eggs (4,6). In an investigation about fecundity of this species in the Aegean Sea, females (94-247 mm in mantle length-ML) have both mature and ovulated eggs in numbers between 130 and 839 that increase with increasing body weight (7). Potential fecundity was found between 3700 and 8000 eggs in mature and mature pre-spawning animals in the same study. *S. officinalis* is an intermittent spawner and it dies after spawning (8). This paper aims to evaluate the present data on the reproductive biology of the common cuttlefish around Homa Lagoon in the Aegean Sea and to compare these findings with those which belong to other parts of the Mediterranean Sea.

* e-mail: salman@sufak.ege.edu.tr

Materials and Methods

Specimens were monthly obtained from fishermen near the Homa lagoon in the Aegean sea (Figure 1) from October 2000 to April 2002. 674 animals were investigated. Total weights and dorsal mantle lengths (ML) were measured in fresh animals. After dissecting, gonads of both sexes were weighed; in females, one of the pair of nidamental glands were weighed and their lengths were taken. In order to estimate the diameters of ripe eggs, 10 of them were measured along their major axes; in males, lengths of 10 spermatophores were measured. All measurements were within 0.1 mm and weights were taken within 0.01 g.

Sum of the measurements, maturity stages and gonadosomatic index (GSI=(GW/BW)x100)* values were calculated in both sexes. To identify whether there were relations between values of reproductive organs and somatic values, correlation was calculated. Maturity stages were identified following descriptions of Mangold-Wirz (4).

Results

Length distribution

Mantle length (ML) values were between 68 and 241 mm in 350 females, and 63 and 213 mm in 324 males. Mean value of ML in females was 121 mm and in males it was 116 mm.

The graph was made according to the distribution of mean ML of both sexes, monthly, it shows that larger females and males appear in the first peak of the reproduction cycle (March) (Figure 2).

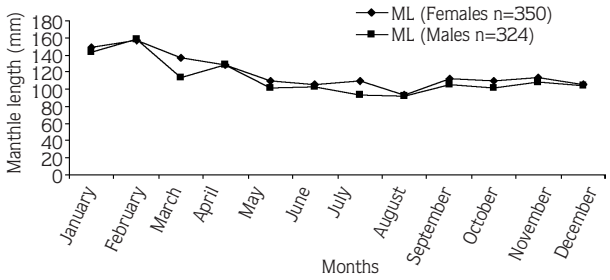

Figure 2. Distribution of mean mantle lengths of females and males monthly.

Interval of ML of *S. officinalis* in the first period (March) is in higher values than in the second period (June) (Figure 3).

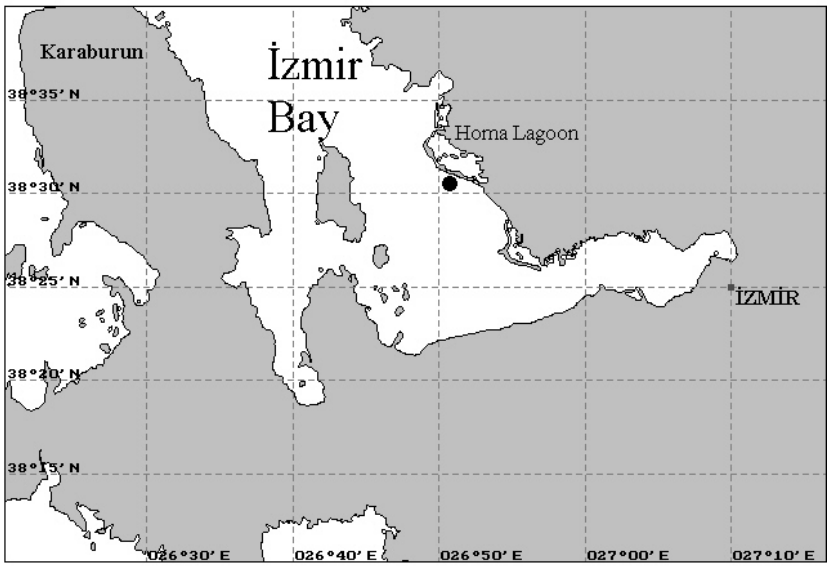

Figure 1. The location of Homa lagoon and sampling point around it.

* GSI: Gonadosomatic index, GW: Gonad weight, BW: Body weight.

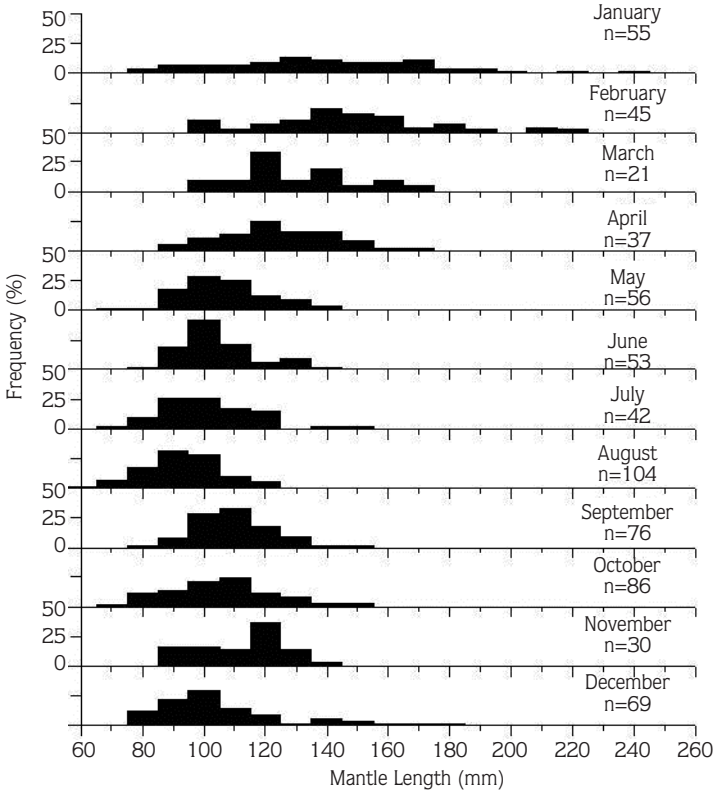

Figure 3. Monthly distributions of mantle lengths of common cuttlefish.

Maturity stages

Females

There was no female in the first stage, so all females investigated, had nidamental glands. 152 females (between 68 and 140 mm ML) were in the second stage. In the third stage, 3 females were in 120, 130 and 150 mm ML and they had eggs in their ovaries, which were between 2.1 mm and 4 mm in diameter. Minimum ML of the females that were in the fourth stage was 80 mm. Total number of the animals in this stage was 122 and it included females as long as 200 mm ML. In the final stage, which is the fifth stage of maturity, there were 73 females (90-241 mm ML). Therefore, the first sexual maturity was observed when females attained 90 mm ML, and 50% of the females in 130 mm ML were sexually mature (Table 1).

Males

There were three maturity stages identified for the males and first of these included specimens between 65 and 75 mm ML. Minimum ML value was 70 mm and the maximum was 140 mm in the second stage. In the last third stage, males had ML values from 70 mm to 214 mm and were described as sexually mature. 50% of the male cuttlefish were mature, when they had 90 mm ML (Table 1).

Gonadosomatic Index (GSI)

Results of GSI are important for determining the reproductive cycle of *S. officinalis* in Homa Lagoon. GSI is the ratio of gonad weight to body weight. The graph of gonadosomatic indices (Figure 4) shows that the females have two peaks in the year-round spawning period. First of these is in March (9.8%) and the second is in June (12.7%). On the other hand, the males have homogeneous GSI values throughout the cycle.

Gonad development

Relationships between gonad development and other parameters were investigated as calculated correlations. Results are given in Table 2. There was no relationship

Table 1. Percentage distribution of female and male cuttlefish according to mantle lengths in maturity stages and age groups.

Mantle lengths (mm)	Females						Males			
	N	I	II	III	IV	V	N	I	II	III
60							1	100		
70	5		100				5	20	60	20
80	13		92.3		7.7		31	3.2	61.3	35.5
90	37		81.1		13.5	5.4	59		35.6	64.4
100	73		52		37	11	81	1.2	26	72.8
110	66		42.4		45.5	12.1	51	2	25.5	72.5
120	57		54.4	1.8	21	22.8	39		25.6	74.4
130	29		24.1	3.5	24.1	48.3	17			100
140	22		4.6		63.6	31.8	17		15.8	84.2
150	17			5.9	58.8	35.3	9			100
160	9				55.6	44.4	8			100
170	9				66.7	33.3	2			100
180	5				80	20	1			100
190	4					100	1			100
200	1				100					
210				2		100				
220	2					100				
230										
240	1					100				
250										
Total:	350						324			

Table 2. Correlation values of both sexes (ML: Mantle length, BW: Body weight, GW: Gonad weight, Ni.W: Nidamental gland weight, Ni.L: Nidamental gland length, SP.L: Spermatophore length, ED: Egg diameter).

Male	BW	GW		SP.L	
ML	0.941	0.885		0.501	
BW		0.897		0.438	
GW				0.571	
Female	**BW**	**GW**	**Ni.W**	**Ni.L**	**ED**
ML	0.937	0.775	0.813	0.768	0.344
BW		0.816	0.874	0.741	0.323
GW			0.953	0.848	0.477
Ni.W					0.485
Ni.L					0.646

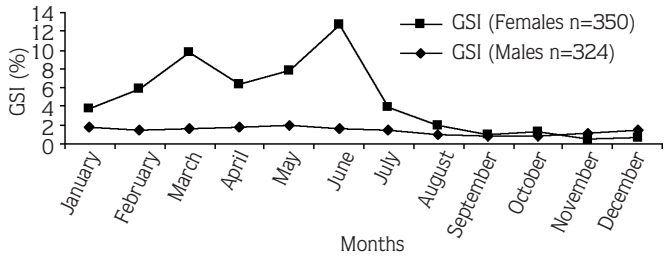

Figure 4. Monthly gonadosomatic indices of both male and female *Sepia officinalis* specimens.

Table 3. Monthly percentage distribution of spermatophore lengths according to age groups.

Months	Spermatophore lengths (mm)										
	N	5.0-5.9	6.0-6.9	7.0-7.9	8.0-8.9	9.0-9.9	10.0-10.9	11.0-11.9	12.0-12.9	13.0-13.9	14.0-14.9
January	25			8	12	24	16	24	8	8	
February	20				5	25	25	15	15	15	
March	17					11.8	35.2	41.2	11.8		
April	14					21.4	64.3	14.3			
May	16					6.2	37.5	37.5	18.8		
June	15						26.7	53.3	13.3		6.7
July	20				25	20	30	20	5		
August	31		6.5	3.2	16.1	61.3	9.7		3.2		
September	27	3.7	7.4	29.6	29.6	18.6	7.4	3.7			
October	34	14.7	32.4	17.6	8.8	20.6	5.9				
November											
December	10	20	30	10	10	20	10				
Total:	229										

between egg diameter (ED) and mantle length (ML), body weight (BW), gonad weight (GW), nidamental gland weight in females, spermatophore length (Sp.L) and other parameters in males.

Spermatophore lengths were between 5 and 14 mm. Table 3 shows that Sp.L increases with reproduction periods of common cuttlefish (March and June).

Discussion

As there were mature animals in every month throughout the year, reproduction period of *S. officinalis* covers the whole year (Table 4) with two peaks observed in GSI values. First of these was in March and the second was in June. Mature females were more frequent in these months (Table 4).

According to Mangold-Wirz (4), the first sexual maturity of the females (80-250 mm ML) of *S. officinalis* had been observed at 110 mm ML and 50% of the females had achieved maturity when they were in 200 mm ML stage. Males, between 80 and 170 mm ML, had attained maturity when they had 80 mm ML. Egg diameters were between 7 and 9 mm; spermatophore lengths were between 7 and 16 mm, according to Mangold-Wirz (4).

In this study, ML of females were between 68 and 241 mm and first sexual maturity was observed at 90 mm ML. 50% of the females were mature when they had 130 mm ML. On the other hand, in males, first sexual maturity was observed at 70 mm ML and 50% of total males in the population were mature at 90 mm ML. According to Mangold-Wirz (4), *S. officinalis* attains

Table 4. Percentage of distribution of female and male cuttlefish according to maturity stages per month.

Months	Females						Males			
	N	I	II	III	IV	V	N	I	II	III
January	28		25		14.3	60.7	27		3.7	96.3
February	25				52	48	20			100
March	15				53.3	46.7	22		22.7	77.3
April	7				28.6	71.4	14			100
May	30				50	50	26		38.5	61.5
June	32				62.5	37.5	21		28.6	71.4
July	21		4.76		85.7	9.52	21		4.76	95.2
August	50		64		30	6	54	3.7	38.9	57.4
September	45		73.3	2.22	17.8	6.67	31		12.9	87.1
October	37		78.4		16.2	5.41	49	2.04	28.6	69.4
November	23		91.3		8.7		7		100	
December	37		78.4	5.41	13.5	2.7	32	3.13	65.6	31.3
Total:	350						324			

Table 5. Reproductive strategies in *Sepia officinalis.*

	Winter	Spring	Summer	Autumn
1st year	Winter	Spring	Summer	Autumn
2nd year	Winter	Spring	Summer	Autumn

sexual maturity at larger ML values than our observation. This may occur because of the temperature differences according to different environments. Actually, common cuttlefish, which live in warm waters, are maturing earlier than those that live in cold waters, according to Boletzky (3). In addition, egg diameters and spermatophore lengths of *S. officinalis* from Homa lagoon were smaller than those mentioned in Mangold-Wirz (4), for the same reason.

In *S. officinalis,* which is characterized by quite a long spawning period in west Mediterranean, juveniles are born early in spring, and breed at the end of the following year at 15 months of age. On the other hand, the animals hatched at the beginning of summer do not mature in the following year and breed when they are at 18-20 months of age in early spring (2-3).

These two reproduction periods were seen in our observations and the GSI graph shows that two periods with two peaks in females. Also, monthly distribution of mean ML values graph (Figure 4) shows that animals in the first period (March) have the largest ML values than in the second period (June). Therefore, it indicates that animals in the first period get older (approximately 20 months of age) than those in the second period (approximately 15 months of age) (Table 5). These findings are in accord with the view of Mangold (2) and Boletzky (3).

According to Richard (9), mature cuttlefish exposed to a light period of more than 9.5 hours a day are stimulated for spawning. In this study, it was seen that common cuttlefish from the vicinity of Homa Lagoon start spawning at the beginning of spring when the daylight period gets longer.

Data on the reproductive biology of this species are very important for preserving their stocks and regulating their fishing strategies. These data would help in

estimating their hunting seasons. The present study has a further importance in being the first work on the reproductive biology of *Sepia officinalis* from the Bay of Izmir, the Aegean Sea.

References

1. Roper, C.F.E., Sweeney, M.J., Nauen, C: Cephalopods of the World. An Annotated and Illustrated Catalogue of Species of Interest to Fisheries. FAO Fish. Synop. Rome, 1984 ; 277 p.
2. Mangold, K.: *Sepia officinalis* de la mer Catalane. Vie Millieu, 1966; 17: 961-1012.
3. Boletzky, S.V.: A new record of long-continued spawning in *Sepia officinalis* (Mollusca: Cephalopoda). Rapp. Comm. Int. Mer Médit., Athens. 1988; 31: p.257.
4. Mangold-Wirz, K.: Biologie des céphalopodes Bentiques et Nectoniques De La Mer Catalane. Vie Millieu, 1963; Suppl. 13: 1-285.
5. Nesis, K.N.: Cephalopod of the World. Squids, Cuttlefishes, Octopuses and Allies, translated from Russian by B.S.Levitov, ed. L.A. Burges. Neptune City, NJ:TFH Publications, 1987.
6. Boletzky, S.V.: *Sepia officinalis*. In: P.R. Boyle, ed. Cephalopoda Life Cycles. Academic Press London 1983; 31-52.
7. Laptikhovsky, V., Salman, A., Önsoy, B., Katağan, T.; Fecundity of the common cuttlefish *Sepia officinalis* L. (Cephalopoda, Sepiida): A new look on the old problem. Sci. Mar., 2003; 67: 279-284.
8. Rocha, F., Guerra, A., Gonzales, A.F.: A review of reproductive strategies in cephalopods. Biol. Rev., 2001; 76: 291-304.
9. Richard, A.: Mise en évidence de l'action de la lumière dans le déterminisme de la ponte chez le *Céphalopode Sepia officinalis* L. C.R. Acad. Sci. Paris, 1968; 267: 2360-2363.