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MORPHOMETRICS OF YOUNG KITEFIN SHARKS, *DALATIAS LICHA* (BONNATERRE, 1788), FROM NORTHEASTERN AEGEAN SEA, WITH NOTES ON ITS BIOLOGY

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ABSTRACT

Biological information on five kitefin sharks, Dalatias licha *(Bonnaterre, 1788), three neonates and two post-neonate individuals, captured in October 1999 off the northern coast of Gökçeada (northeastern Aegean Sea) at a depth of 380 m, are given. Morphometric measurements of these specimens are presented. Capture of these neonates and post-neonate individuals near Gökçeada, suggesting that this region may be a nursery area for* D. licha.

Key words: kitefin shark, *Dalatias licha*, morphometrics, stomach contents, reproduction, Aegean Sea

DATI MORFOMETRICI DI GIOVANI ESEMPLARI DI SCIMNORINO *DALATIAS LICHA* (BONNATERRE, 1788) DELL'EGEO NORD-ORIENTALE, CON NOTE SULLA LORO BIOLOGIA

SINTESI

L'articolo fornisce informazioni biologiche su cinque esemplari di scimnorino Dalatias licha *(Bonnaterre, 1788), dei quali tre neonati e due post-neonati, catturati in ottobre 1999 al largo della costa settentrionale di Gökçeada (Egeo nord-orientale) ad una profondità di 380 metri. L'autore presenta i dati morfometrici per tali esemplari. La cattura di questi individui neonati e post-neonati in prossimità di Gökçeada fa presupporre che la regione sia area di nursery* per D. licha.

Parole chiave: scimnorino, *Dalatias licha*, morfometria, contenuti stomacali, riproduzione, mar Egeo.

INTRODUCTION

Kitefin shark, *Dalatias licha* (Bonnaterre, 1788) (Fig. 1), is a common but sporadically distributed deepwater, warm-temperate and tropical shark of the outer continental and insular shelves and slopes from 37 to at least 1800 m depth, but commonest below 200 m (Compagno, 1984). In the Mediterranean Sea, kitefin shark is primarily known from the western part of the area (McEachran & Branstetter, 1984), but several references, indicating its presence in the eastern part, are also available (e. g. Akşıray, 1987 from Turkish seas; Meriç, 1995 from the Sea of Marmara; Papaconstantinou, 1988 from Greek seas). No information is available on the biological characteristics of this squaliform shark and the only verified record of the kitefin shark in the seas of Turkey is from the Sea of Marmara based on male specimen caught on the northern continental slope at a depth of 270 m on July 1991 (Meriç, 1995).

In October 1999, a bottom trawler haul at some 380 m off the northern coast of Gökçeada (northeastern Aegean Sea) included five specimens of *D. licha*. The present paper aims to provide additional data on the biology of this squaliform shark.

MATERIAL AND METHODS

Five male specimens of *D. licha* were captured by means of an otter-trawl with a cod-end mesh opening of 22 mm from knot to knot, towed on a muddy-sandy bottom off the northern coast of Gökçeada (40°17'01'' N, 25°52'15'' E; depth 380 m; Fig. 2). Specimens were fixed and preserved in 5 percent seawater-formalin solution. Total lengths (TOT) and forty-seven morphometric measurements of the specimens were measured with a vernier calliper to the nearest 0.05 mm. Morphometric measurements are according to Compagno (1984). Stomachs of the specimens were dissected and their contents identified to the lowest possible taxon, counted and weighed to the nearest 0.5 gram. Counts and weights of the stomach contents were used to calculate the percent by number (PN%), percent by weight (PW%), percent frequency of occurrence (PO%) and Index of Relative Importance (I.R.I.) of each prey organism consumed by the kitefin sharks (Cailliet *et al.*, 1986). I.R.I. of each prey organism was calculated according to the formula (Cailliet *et al.*, 1986) below, and its maximum value would be 20,000:

I.R.I. = (PN% + PW%) x (PO%).

Identification of the species and taxonomic nomenclature follows Compagno (1984). Specimens are kept in the authors' personal collection.

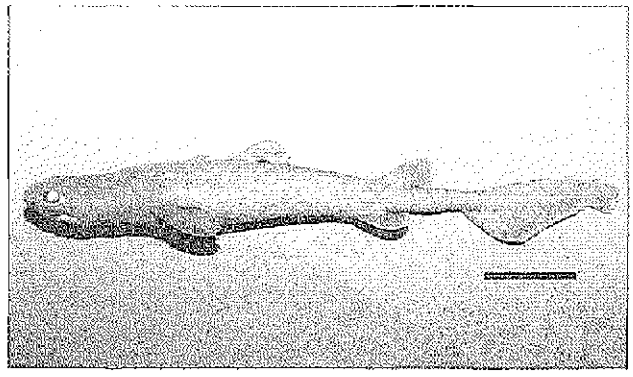

Fig. 1: Kitefin shark, Dalatias licha (Bonnaterre, 1788), scale bar = 50 mm (photo: H. Kabasakal & E. Kabasakal).
Sl. 1: Temni morski pes, Dalatias licha (Bonnaterre, 1788), merilna lestvica = 50 mm (foto: H. Kabasakal & E. Kabasakal).

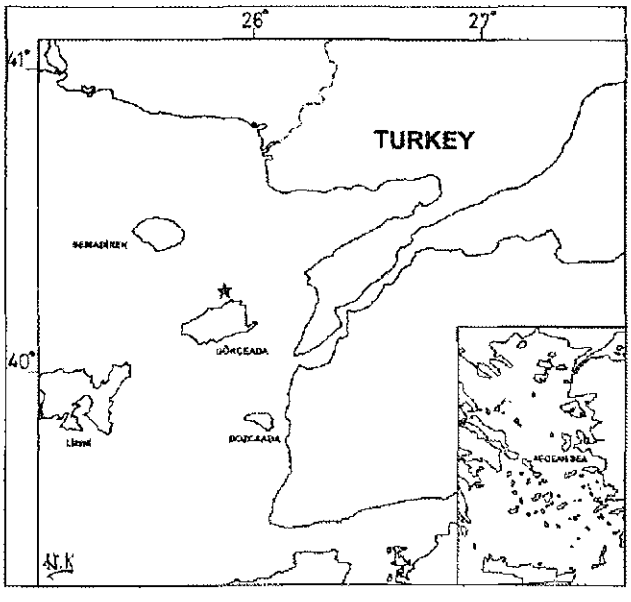

Fig. 2: Sampling location in the northeastern Aegean Sea (drawing by H. Kabasakal).
Sl. 2: Vzorčišče v severovzhodnem Egejskem morju (risba: H. Kabasakal).

RESULTS

Total lengths of the examined kitefin sharks, all males, were 338 mm, 344.2 mm, 372.5 mm, 419.1 mm and 470.2 mm. In the freshly caught specimens, the body was uniformly brownish-grey; the rear margins of dorsal, pectoral and pelvic fins, and the ventral lobe of caudal fin were whitish-edged (Fig. 1); the tips of the claspers were white (Fig. 3). Lateral-line was prominent. The second dorsal fin was slightly larger than the first (Tab. 1, Fig. 1). First dorsal origin somewhat behind free rear tips of pectoral fins, second dorsal origin over about the middle of pelvic bases; both dorsal fins without spines. Gill slits were moderately broad; in the exam-

***Tab. 1: Morphometric measurements of the examined specimens of** D. licha.*
***Tab. 1: Morfometrični podatki pregledanih primerkov** D. licha.*

Specimen Nos	1	2	3	4	5	Mean	TOT % of mean
Sex	♂	♂	♂	♂	♂		
Measurements (in mm)							
TOT	338	344.2	470.2	372.5	419.1	388.8	—
Snout tip to							
1-outer nostrils	3.75	4.7	4.8	4.45	4.8	4.5	1.15
2-eye	9.55	11.35	13.95	12.2	13.55	12.12	3.11
3-spiracle	33.05	34.3	38.55	35.9	38	35.96	9.24
4-mouth	18.6	18	25	22.6	22.35	21.31	5.48
5-1st gill opening	55.4	60.9	69.35	61.05	67.6	62.86	16.16
6-3rd gill opening	64.35	69.85	78.5	71.25	80.15	72.82	18.72
7-5th gill opening	69.45	77.1	86.5	78.65	88.5	80.04	20.58
8-pectoral origin	70.25	78	86.8	78.75	88.55	80.47	20.69
9-pelvic origin	179.55	192.8	228.35	198	226.4	205.02	52.73
10-cloaca	194	200.1	251.45	216.2	249.45	222.24	57.16
11-1st dorsal origin	116.65	124.6	147.4	128.85	145.75	132.65	34.11
12-2nd dorsal origin	197.75	206.75	251.7	219.3	253.6	225.82	58.08
13-dorsal caudal origin	252.65	262.4	326.2	279.4	324.15	288.96	74.32
14-ventral caudal origin	241.85	245.05	316	266.5	315.45	276.97	71.23
Distance between bases							
15-1st and 2nd dorsal fins	68.4	68.3	86.8	76.85	90.25	78.12	20.09
16-2nd and caudal fins	36.7	35.9	50	40.05	44.9	41.51	10.67
17-pectoral and pelvic fins	95.25	97.5	124.9	103.9	120.45	108.4	27.880
Nostrils: distance							
18-between inner corners	11.85	12.55	13.6	12.45	14.35	12.96	3.34
Mouth							
19-width	24.05	25.1	33.75	28.8	32.65	28.87	7.42
Gill opening lengths							
20-1st	4.7	4.9	5.5	5.45	7.25	5.56	1.43
21-3rd	4.35	4.65	4.95	5.45	6.75	5.23	1.34
22-5th	5.35	5.8	7.6	6.1	8.15	6.6	1.69
23-Spiracle: maximum width	5.4	5.5	6.6	6.25	7.1	6.17	1.58
Eye							
24-horizontal diameter	14.6	15.85	15.25	14.8	16.65	15.43	3.96
25-vertical diameter	7.75	7.65	8.3	6.6	8.05	7.67	1.97
26-interorbital width	21.05	22.8	26.5	23.6	26.35	24.06	6.18
1st dorsal fin							
27-overall length	33.85	33.15	42.05	36.3	42.35	37.54	9.65
28- length base	9.65	14.05	18.1	16.95	18.95	15.54	3.99
29-length posterior margin	12.3	13.5	18.2	16.9	17.05	15.59	4.01
30-height	13.2	14	18.65	17.65	15.35	15.77	4.05
2nd dorsal fin							
31-overall length	34.45	35.1	46.85	40.55	48.15	41.02	10.55
32-length base	19.75	19.4	26.8	23.85	26.3	23.22	5.97
33-length posterior margin	16.45	16.25	20.85	19.95	20.35	18.77	4.82
34-height	16.95	16.9	21.1	20.3	20.8	19.21	4.94
Pectoral fin							
35-length base	15.75	16.3	21.65	17.6	19.1	18.08	4.65
36-length anterior margin	42.2	46.3	51.5	45.95	51.65	47.52	12.23
37-length distal margin	17.6	20.85	24	20.95	24.8	21.64	5.56
38-length posterior margin	18.05	24.1	29.85	25.2	26.7	24.78	6.37
Pelvic fin							
39-overall length	38.1	41.55	51.45	44.4	51.15	45.33	11.65
40-length base	21.55	25.4	32.1	27.45	31.1	27.52	7.07
41-length anterior margin	26	31.75	34.7	34.1	33.8	32.07	8.24
42-length clasper	11.85	14.35	21.45	14.8	18.8	16.25	4.17
Caudal fin							
43-length dorsal lobe	83.05	85.7	101.4	98.85	106.1	95.02	24.43
44-length ventral lobe	42.4	42.6	47.95	44.45	46.25	44.73	11.5
45-dorsal tip to notch	16.05	21.1	26.1	23.55	30.2	23.4	6.01
46-depth notch	13.95	16.25	18.25	15.8	17.9	16.43	4.22
Trunk at pectoral origin							
47-height	34.25	33.15	40.05	35.6	43.45	37.3	9.59

***Tab. 2: Composition of the stomach contents of the examined specimens of** D. licha.*
***Tab. 2: Struktura hrane v želodcih pregledanih primerkov** D. licha.*

PREY	PN%	PO%	PW%	I.R.I.
CEPHALOPODA				
Sepietta spp.	18.18	20	21.78	799.36
Loligo vulgaris	9.09	20	4.57	273.32
Cephalopoda (unidentified)	9.09	20	2.17	225.39
Total Cephalopoda	36.36	60	28.54	3894.23
CRUSTACEA				
Parapenaeus longirostris	9.09	20	4.57	273.32
PISCES				
Galeus melastomus	9.09	20	9.15	364.82
Chlorophthalmus agassizii	9.09	20	8.06	343.03
Myctophidae (unidentified)	9.09	20	8.93	360.46
Merluccius merluccius	9.09	20	38.12	944.34
Teleostei (unidentified)	18.18	40	2.61	831.84
Total Pisces	54.54	100	66.88	12143

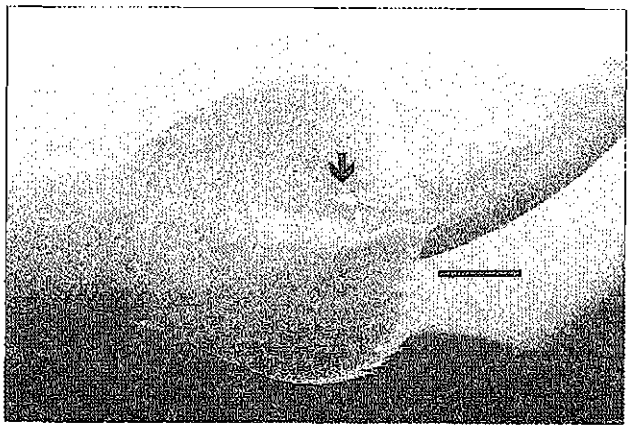

Fig. 3: Claspers of male** D. licha; **arrow indicates the white tips of the claspers, scale bar = 10 mm (photo: H. Kabasakal & E. Kabasakal).
Sl. 3: Spolni organ samca** D. licha; **puščica označuje beli konici spolnega organa, merilo = 10 mm (foto: H. Kabasakal & E. Kabasakal).

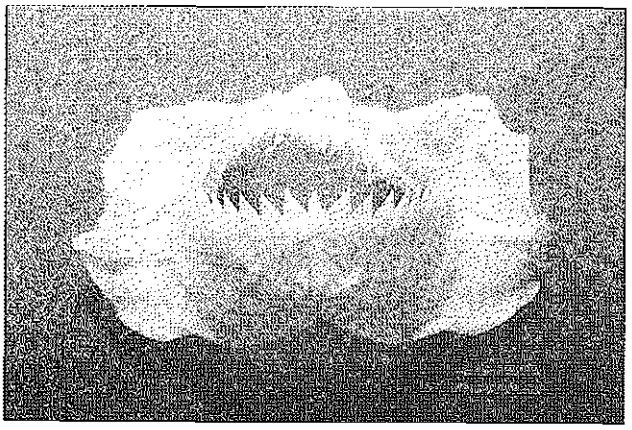

Fig. 4: Dentition in the upper and lower jaws of** D. licha, **scale bar = 10 mm (photo: H. Kabasakal & E. Kabasakal).
Sl. 4: Zobovje v gornji in spodnji čeljusti** D. licha, **merilo = 10 mm (foto: H. Kabasakal & E. Kabasakal).

ined specimens, the 5th gill slits were slightly larger than the remaining gill slits (Tab. 1). Body surface covered by low flat, ridged, unicuspid dermal denticles. Upper teeth were small, slender-cusped and lower teeth large with erect, triangular, blade-like serrated cusps (Fig. 4). Morphometric measurements of the examined specimens are given in Table 1.

Claspers of the examined specimens were uncalcified, soft and clearly shorter than the pelvic fins (Fig. 3). Moreover, sperm were not observed in seminal vesicles of the specimens.

All stomachs of the examined specimens were found to contain food. Prey organisms contained in the stomachs and their numerical data are given in Table 2 and Figure 5.

The three specimens (Nos: 1, 2 and 4; 338 mm, 344.2 mm and 372.5 mm in TOT, respectively) were found to bear healing umbilical scars on ventral surface between their pectoral fins (Fig. 6).

DISCUSSION

Compagno (1984) and McEachran & Branstetter (1984) stated that the common maximum length of *D. licha* is about 159 cm, but it can possibly grow to 182 cm. According to Akşiray (1987), maximum length of this shark in the seas of Turkey is 150 cm. Total length of the largest examined specimen was 470.2 mm and, therefore, specimens of the present study represent only juveniles of the northern Aegean Sea population of *D. licha*. Due to the insufficient morphometric study concerning kitefin sharks captured in the seas of Turkey, it was not possible to compare our data with those of the previous studies. Meriç (1995) reported some undetailed

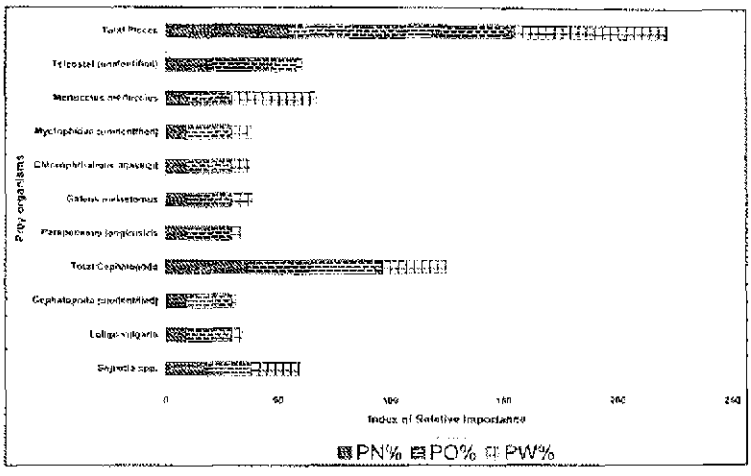

Fig. 5: I.R.I. diagram of the prey organisms and their numerical (PN%), weight (PW%), and frequency of occurrence (PO%) values.
Sl. 5: Diagram I.R.I. (Index relativne pomembnosti plena) in vrednosti, kar zadeva njihovo številčnost (PN%), težo (PW%) in frekvenco pojavljanja (PO%).

morphometric data of a male kitefin shark (345 mm TOT) captured in the Sea of Marmara. According to this author, total length / head length (TOT / HL) ratio of the Marmara specimen was 5.07 and head length / pectoral fin length (anterior edge) (HL / PL) ratio was 1.62 (Meriç, 1995). In the examined specimens, same ratios were as follows: TOT / HL was 4.83 and HL / PL 1.69. The latter ratios (HL / PL) of the present study and of Meriç (1995) are quite similar, but the former ratios (TOT / HL) are clearly different. Standard morphometric measurements of the Marmara specimens of *D. licha* have not been recorded by Meriç (1995), thus it was not possible to make a comparison between the specimens of kitefin shark captured in two different seas.

Macpherson (1980) examined 31 specimens of *Scymnorhinus licha* (= *D. licha*) and recorded primarily fishes, decapod and natantid crustaceans and cephalopods in the stomachs. The lengths of the examined specimens of *D. licha* by Macpherson (1980) varied between 32 to 100.8 cm and the main prey organisms consumed by those specimens, in the order of importance, were teleosts *Notoscopelus elongatus elongatus*, *Trachyrhynchus trachyrhynchus* and *Phycis blennoides*, blackmouth cat shark *Galeus melastomus*, and decapod *Aristeus antennatus*. In the present study, stomach contents of the examined kitefin sharks were found to contain mainly fishes, followed by cephalopods and decapod *Parapenaeus longirostris* (Tab. 2, Fig. 5). *G. melastomus* was the only chondricthyan consumed by the examined kitefin sharks. In the study area, numerous juveniles of *G. melastomus* were observed in the trawling hauls and it is one of the sharks that co-exist with *D. licha* (*personal observation by both authors*). Clarke & Merrett (1972) reported that the high incidence of empty stomachs (90%) of deep sea fishes captured particularly by long-line fishery may be due to the frequent loss of food during their ascent from great depths. However, the examined male kitefin sharks of the present study captured by otter-trawling and their stomachs were completely full. This suggests that, due to the compression in the cod-end the food was not washed out of the stomachs or that the sharks preyed on food in the net. Furthermore, Compagno (1984) stated that for some reason male *D. licha* have full stomachs more commonly than females.

According to Compagno (1984), male *D. licha* reaches maturity at a total length between 77 to 121 cm. Reported size at birth of this species is about 30 cm (Tortonese, 1956; Compagno, 1984; McEachran & Branstetter, 1984). The presence of uncalcified, soft clas-

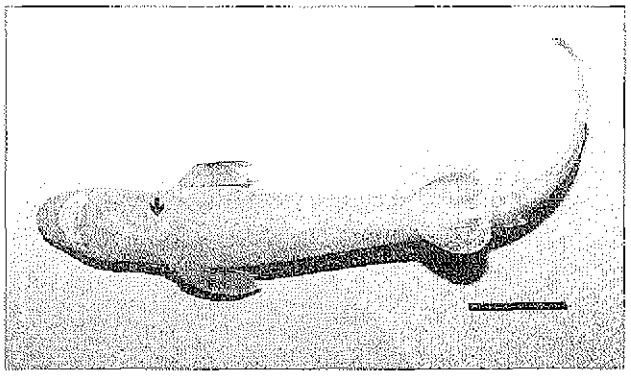

Fig. 6: Healing umbilical scar (arrow) in the male** D. licha, **scale bar = 50 mm (photo: H. Kabasakal & E. Kabasakal).
Sl. 6: Celeča se poporodna brazgotina (puščica) pri samcu** D. licha, **merilo = 50 mm (foto: H. Kabasakal & E. Kabasakal).

pers showed that our specimens were hence juveniles. The lengths of our specimens were also smaller than the reported maturing size of *D. licha*. *D. licha* is an ovoviviparous shark and according to Castro (1993) in the aplacental or ovoviviparous species, neonates are the individuals at or near the birth size, bearing fresh, unhealed or healing umbilical scars. It was observed that three of the examined specimens (Nos: 1, 2 and 4; 338 mm, 344.2 mm and 372.5 mm TOT, respectively) bore umbilical scars (Fig. 6) and were therefore considered neonates. Castro (1993) also stated that the neonatal period terminates with the healing (closure) of the umbilical scar. Thus, the remaining two specimens (Nos: 3 and 5; 470.2 and 419.1 mm TOT, respectively) were post-neonatal individuals because no evidence of umbilical scars was observed in those specimens. Tortonese (1956) stated that the breeding season of *D. licha* in the Mediterranean Sea is in autumn. The capture of the neonates and post-neonatal individuals in October suggests that the breeding season of *D. licha* in the northern Aegean Sea is also in autumn.

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MORFOMETRIČNI IN BIOLOŠKI PODATKI O MLADIH TEMNIH MORSKIH PSIH, *DALATIAS LICHA* (BONNATERRE, 1788), IZ SEVEROVZHODNEGA EGEJSKEGA MORJA

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POVZETEK

Avtorja navajata biološke podatke o petih temnih morskih psih, Dalatias licha *(Bonnaterre, 1788) - treh novoskotenih in dveh malce starejših osebkih - ujetih oktobra 1999 v bližini severne obale Gökçeade (severovzhodno Egejsko morje) v globini 380 m. Predstavljeni so tudi njihovi morfološki podatki. Glede na dejstvo, da so bili ti mladi temni morski psi ujeti v bližini Gökçeade, je verjetno, da je območje razmnoževalno okolje za vrsto* Dalatias licha.

Ključne besede: temni morski pes, *Dalatias licha*, morfometrični podatki, struktura hrane v želodcih, razmnoževanje, Egejsko morje

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