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FOOD AND FEEDING OF THE SPURDOG (*Squalus acanthias* LINNAEUS, 1758) IN THE SOUTHEASTERN BLACK SEA

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Abstract
This study has been carried out for the identification of natural food and feeding of spurdog (Squalus acanthias) collected from the Northeastern Black Sea coast of Turkey. It was found that this species is an indiscriminate feeder. Their natural diet was mainly composed of teleost fishes, followed by Crustaceans, Nematodes and Actinarians (= sea anemones). Whiting was the predominant prey item among their fish diet. Demersal fishes formed the majority of the diet, and there was no difference ($p>0.05$) among the food items of immature, maturing and mature individuals of both sexes.

Keywords*: Southeastern Black Sea, Spurdog (Squalus acanthias), Food and Feeding*

1. INTRODUCTION

The spurdog is commonly distributed along the Boreal Zone in all world oceans e.g. northwestern and northeastern Atlantic and Pacific Oceans in the north hemisphere; Indian Atlantic and Pacific Oceans of the southern hemisphere. This species is also frequently found in the Atlanto Mediterranean water system [1]. The mean annual landing of the spurdog by the riparian countries of the Black Sea was at a rate of 8400 metric tons during the last decade [2]. After that period, it dropped off 3.928 metric tons due to the catastrophic changes in the Black Sea ecosystem. As it is well known that the anchovy (*Engraulis engrasicolus*) is being the most abundant stock in the Black Sea, and this stock was totally depleted during the second half of 1980 years. It is most probable that the spurdog, which is the main predator of the Black Sea anchovy [3] has been decreased accordingly. In the Black Sean territorial waters of Anatolia, the feeding of the

spurdog is primarily depends on the other economically important species like sprat (*Sprattus sprattus phalericus*), twaite shad (*Alosa fallax nilotica*), whiting *(Merlangius merlangus euxinus*) and striped mullet (*Mullus barbatus*) (Personnel observation). As it mentioned above, while the existing a considerable potential for spurdog fisheries in the Black Sea, there are a little bit comprehensive studies on this species. Among them, Svetovidov [4] and Avsar [5] have mentioned some population dynamical parameters such as maximum age and length; sex, age and growth of this species respectively, while Ivanov & Beverton [6] reported bio-ecological peculiarities of this species and Slastanenko [3] mentioned their some biological characteristics. The distribution and abundance of this species along the western and middle Black Sea Coast of Asia Minor, has been carried out by Kutaygil & Bilecik [7; 8], who found that the spurdog consisted the second and/or third order among the demersal fishes in studied area. The other studies are only related to the distribution [9], and abundance of spurdog along the Turkish Black Sea Cost [10]; [11]; [12]; [13].

All of these studies carried out in the Black Sea are more comprehensive, but to date no similar work has been reported from all around the Black Sea. Therefore this present study provides information concerning food and feeding of the spurdog sampled from the southeastern Black Sea waters as a contribution to the prey-predator relationship of the fishing exploiting those stocks (e.g. whiting, sprat, striped mullet and anchovy).

2. MATERIAL AND METHODS

Sampling was carried out from 21 stations located territorial waters of the eastern Black Sea coast of Turkey (Figure 2.1). The expedition was performed along the northeastern coastal strip of Anatolia using a depth range of 0-100m. A deep trawl net with a 28mm mesh size in stretched form was used for the sampling. Trawling time was restricted to a 30 minutes period or less due to the unsuitability of the bottom topography.

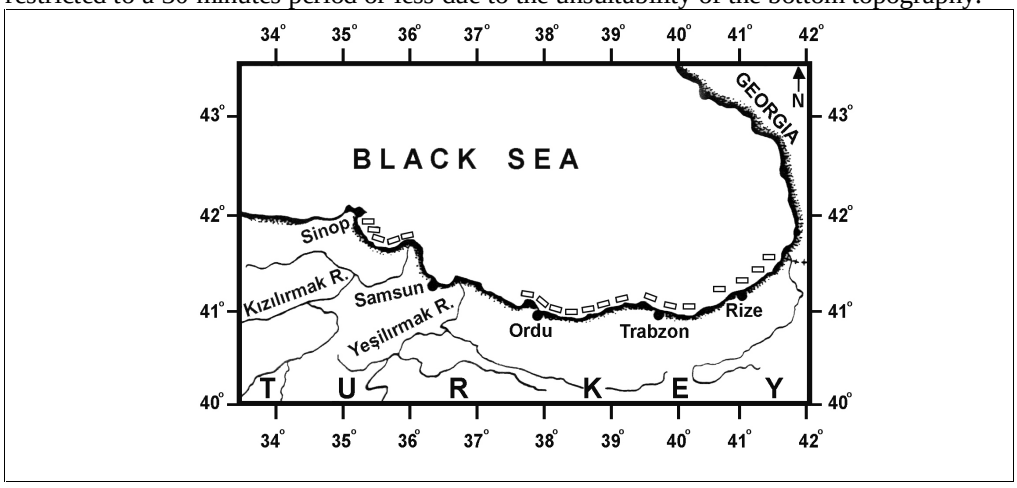

Figure 2.1 Location of the sampling stations along the territorial waters of the southeastern Black Sea coast

The trawled fish were sorted by species. Sex was differentiated by direct examination of the claspers of males with the naked-eye. The total length of each fish was measured to the nearest centimeter, and weighing was made by using a balance with accuracy to the nearest 1g. The fish abdomen was cut with a knife from anus to throat after which the gonad and stomach were removed.

The external appearance and description of ovarian eggs, and the development of claspers in relation to pelvic fins were identified for the assessment of maturity. Maturity stages of both sexes were divided into three categories, namely immature, maturing and mature as described by Jones & Geen [14] and Holden & Raitt [15].

Stomach was preserved in a 10% formalin solution and transported to the laboratory. Stomach contents were then directly examined under a stereoscopic binocular-microscope with a magnification of 20 by immersing the food items in distilled water in a back-lighted watch glass. Prey items from the stomach contents were identified to the lowest possible taxon. The following references were used for the identification of food items: [16]; [17]; [18]; [19]; [20]; [21]; [22].

The dietary components of a species change with size and sex [15]. Based on this idea, the length intervals for both sexes were divided into three major categories considering the length range of immature, maturing and mature individuals. So, the Dominancy Method as described by Hyslop [23] was performed separately for each sex and their major length groups:

$D\% = (100 * (S / \sum S))$

(2.1)

where:

S: The number of stomachs with contain i'th prey category.

$\sum S$: The total number of stomachs including empty ones.

The number of specimens analyzed for each length category and sex are given in Table 2.1.

Sex	Immature			Maturıng			Mature			Examıned
	Min	Max	(n)	Min	Max	(n)	Min	Max	(n)	Fısh
Males	32	66	28	65	95	21	69	121	119	168
Females	37	70	37	71	100	33	75	136	90	160
Overall	32	70	65	65	100	54	69	136	209	328

Table 2.1 The minimum (Min) and maximum (Max) total length measurements (cm) and number of specimens examined (n) for each length category and sex.

3. RESULTS AND DISCUSSION

3.1. STOMACH CONTENT

The number of male and female spurdogs examined for the identification of their food items was nearly equal (168 and 160 respectively), and they ranged in size from 32 to 121 cm for males and 37 to 136 cm for females. The list of stomach contents identified and their order of importance in the diet are given in Table 3.1.

SEX	MALES				FEMALES				POOLED DATA			
Length Groups	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**
STOMACH CONTENTS												
FISH (PISCES)												
M. merlangus euxinus	35	50	40	40	39	53	50	52	38	60	41	44
Mullus barbatus	9	14	45	35	8	28	39	28	8	26	43	34
Gobius niger	13	14	17	16	15	23	29	23	14	11	18	16
S. Sprattus phalericus	17	7	13	6	15	17	21	17	16	9	17	16
Spicera flexuosa	0	0	1	1	0	2	2	1	0	0	1	1
Syngnathus acus	0	0	4	3	0	1	6	3	0	0	3	2
CRUSTACEA												
Carcinus aestuarii	13	0	4	5	0	0	7	3	8	0	3	3
Crangon crangon	0	43	21	19	8	12	13	12	3	29	18	17
Gebia littoralis	12	14	6	9	10	4	5	4	14	9	5	7
Stenosoma capita	0	1	2	1	3	3	3	3	2	3	3	3
ANTHOZOA (ACTINARIA)												
Sea anemones	5	7	0	2	0	0	2	1	5	2	1	3
NEMATODA												
Unidentified nematode	3	7	0	2	1	0	4	2	3	3	1	2
NON LIVING MATERIAL												

Bird wing	0	1	0	1	0	0	0	0	0	0	0	1
DIGESTED MATERIAL	4	7	0	1	9	9	8	9	6	8	4	5

Table 3.1 The dominancy of food items in all major length groups of each sex and their pooled data (A: Immature; B: Maturing; C: Mature and D: represents pooled data for each sex and overall.

To study the differences between the dominance of food items for the major length groups, the One-Way Anova Test was applied, where no significant differences were found for either sex between length groups or pooled data ($p>0.05$). Therefore the results given in the present study were based on the overall pooled data and it may be concluded that all length groups of both sexes of spurdog are feeding on the same food items at any one time. However resulting could not be obtained for the composition of food items at different time periods of the year due to restricted data used in this study.

Thirteen different food types were identified in the stomach (Table 3.1). Of the 328 spurdog examined, 5% were found to have digested material in their stomachs. From the results summarized in Table 3.1, it may be seen that fish forms the main diet component with a mean value of 19% among the identified food items of the spurdog examined. Of the full stomachs; demersal fishes like whiting (*Merlangius merlangius euxinus*), red mullet (*Mullus barbatus*) and black goby (*Gobius niger*) were by far the commonest, occurring in 94% of all full stomachs. Among them the whiting was the predominant prey item (=44%).

While demersal fish formed the majority of the diet the spurdog examined in this study would also appear to feed to a considerable extend near the bottom or on pelagics. The four bird wings (=1% of stomachs) recorded were almost certainly picked up as debris on the bottom or swallowed accidentally. Crustaceans form the second highest order of importance in the food items, with the common shrimp (*Crangon crangon*) present in highest numbers with a value of 17%. Crustaceans were apparently eaten alive, for while the exoskeletons were partially digested, the animals themselves were still intact. These items, together with others such as the demersal fishes, sea anemones, unidentified nematodes and bird wings, suggest that the spurdog is an indiscriminate feeder being mainly dependant on benthic organisms whilst occasionally feeding on pelagic items. However according to Whitehead et al., [20], the spurdog is a mainly bathypelagic fish and a sluggish, inactive swimmer. The present study has shown that spurdog is mainly feeds on fish followed by crustaceans and other benthic species and non living things. Due to the information given by Aksiray [9] and Slastenenko [3], these locally abundant schooling fishes such as whiting, striped mullet, black goby, sprat and benthic invertebrates are most readily distributed along the neritic waters of the studied area. Therefore the occurrence of pelagic and demersal items and also non-living material in their stomachs suggests that spurdog from the southeastern Black Sea may not select specific foods but rather swallow whatever they find in their surroundings whether of high nutritional value or not.

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