Some Aspects of the Biology of Norway Lobster, *Nephrops norvegicus*, in the N. Euvoikos Gulf (Greece)

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INTRODUCTION

Norway lobster (Nephrops norvegicus) is one of the most important species of Crustacea, with a high commercial value. However, no informations is available about its biology in the Greek Seas. Various topics of the life history of the species have been studied, but only few references are cited for the Mediterranean Sea. This work deals with the length-frequency distribution, age determination, the growth, the mortality and the reproduction of Norway lobster in the N. Euvoikos Gulf.

MATERIAL AND METHODS

A total of 3649 individuals of Norway lobster (1912 females, 1745 males) was collected at three month intervals, between September 1987 and June 1988, by a 400HP fishing trawler with a cod-end mesh size of 14mm between streched knots, in the N. Euvoikos Gulf. Total and carapace length to the nearest mm, weight to the nearest g, sex and berried females, were recorded. All analyses have been made separately for each sex. Age was determined from length-frequency distribution, using the method of BHATTACHARYA (1967). Growth parameters from length distribution and mortality from catch curve, have been estimated using respectively the Elefan I and II computer programs (GAYANILO et al., 1988).

RESULTS

The length-frequency diagram of Norway lobster was based on the carapace length separately for each sex (Fig. 1). The female carapace length range was 17-63mm, and the male 16-72mm. Young-of-the-year, of both sexes appeared as recruits in February and remained present till September. The September length frequency distribution of females was used for age determination, according to the Bhattacharya method and applying the Compleat Elefan computer program. The above identified year classes could be considered as age groups. Table I shows the age groups of female and male Norway lobster, their mean length and the separation index, necessary to indicate that the groups are meaningfully different. Eight and nine age groups respectively for females and males were identified.

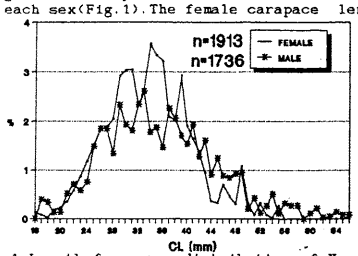

Fig. 1 Length-frequency distribution of Norway lobster in N. Euvoikos Gulf between September 1987 and June 1988.

The carapace (CL) and total length (TL) relationship was found for female: CL= 0.11+0.3XTL and male: CL=-1.88+0.32XTL. The length-weight relationship was calculated for female: $W=0.00083XCL^{2.962}$ and male: $W=0.00052XCL^{3.095}$, (where W in g). The growth parameters of the von BERTALANFFY equation, estimated by the Elefan I computer program were:
Female: $L_{\infty}=71/258*$ mm, k=0.13/0.11*, t_o=-1.39/-1.6*, Rn=0.27/0.36*
Male: $L_{\infty}=84/317*$ mm, k=0.06/0.1*, t_o=-2.98/-0.88*, Rn=0.26/0.42*
where Rn: is the goodness of fit index ranging between 0<Rn<1, (*): estimation has been done in TL. The GULLAND (1969) formula was used to calculated t_o. The estimtion of total (Z), natural (M) and fishing (F) mortality, based on TL, gave for female: Z=0.904, M=0.293, F=0.611 and for male: Z=0.928, M=0.263, F=0.665. The mortality estimations, based on CL, did not provide representative values of the fisheries status of the area.

TABLE I. Age groups of female and male Norway lobster determined by the BHATTACHARYA method.

	Female		Male	
Group	Separation index	Mean length(mm)	Separation index	Mean length(mm)
1	-	20.17	-	16.50
2	2.79	25.39	4.11	21.87
3	3.37	29.81	4.04	26.34
4	3.71	34.16	3.00	29.77
5	3.64	37.74	3.43	32.94
6	3.21	40.86	4.37	37.91
7	5.79	46.19	3.17	42.69
8	2.70	49.64	2.63	46.70
9			3.87	50.88

Norway lobster in the N. Euvoikos Gulf, appearing in waters deeper than 60m, showed its maximum presence in 100-200m depth range. The analyses of the sex ratio in the total sample of the Norway lobster, showed that female had almost the same proportions with male (o:o=1:1.01). However, the above sex ratio presented seasonal fluctuations. The distribution of sex ratio related with length showed that the proportion of both sexes remained about 1:1. After 42 mm (CL) the percentage increase in favor of the male, while after 56mm the female disappeared. The maximum percentage of berried females was observed in September and December, while the minimum in June. Berried females appeared from 29mm and the length at first maturity was 39mm (CL).

CONCLUSIONS

The Norway lobster sampled in the N. Euvoikos Gulf presented a slow growth pattern. Futhermore, differences between sexes were observed. Eight age groups for female and nine for male were determined. During the first year of life, females reached greater lengths than males. Males presented a higher longevity than females, as proved by the larger observed lengths, as well as the estimated asymptotic length.

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Note on the Autecology of the Spider Crab *Macropodia rostrata*

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The spider crab *Macropodia rostrata* (Linnaeus, 1761) is a quite common species in the northern Adriatic Sea. However, little has been published on its ecology. There exists only very little information concerning its vertical and horizontal distribution, substrate preference and reproductive period (GRAEFFE, 1902; PESTA, 1918; VATOVA, 1928). The main reason for the lack of information is due to its dispersion in the area. It was sampled constantly, but usually in a small number of specimens so that intensive autecological investigations were not possible. During my studies of decapod fauna in some bays in the Rovinj area (Saline, Leso, Ruja) I sampled a sufficient number of specimens to provide some inferences on species autecology. The crabs were collected monthly by a mušular (local type of dredge), preserved in 4% solution of formol and later studied in the laboratory.

Measurements. Maximum carapace length in the male was 24.5 mm and width 12.6 mm. The female maximum carapace length was 24.9 and width 13.2 mm. The minimum size of ovigerous females was 11.0 mm for carapace length, and 7.4 mm for carapace width.

Sex ratio. Among 196 sampled specimens 104 were males and 92 females. Thus, the sex ratio is 1.12.

Colour. The carapace and pereiopods of captured specimens were yellowish -brown, greyish-brown or greenish-brown. The specimens were usually not camouflaged with algae.

Occurrence. In the study area the crabs were variously abundant in season samples. They are frequent from November to April-May, with a maximum abundance during February and March. On the other hand, during summer months they were only rarely sampled, whereas in July and August were completely absent. However, the observations of VATOVA (1928) as well as our investigations show that the crab can be found, in particular during summer, throughout the entire area. From these data it can be concluded that *Macropodia rostrata* performs seasonal inshore-offshore migrations.

Substrate. In the studied localities the crab occurs in sea-grass (*Zostera, Cymodocea*) beds together with several algal species. In summer it can be found on various bottom types. VATOVA (1928) established that it preferes the stony bottom covered with algae and avoids soft mud. Being a migratory species it passes various types of substrate.

Depth. In the above-mentioned bays where it was collected the depth varied from about 1.5 to 4 metres, also in very shallow water. VATOVA (1928) reported the species from 10 to 36 metres. In the Adriatic Sea it was recorded from tidal flats down to 190 metres.

Reproduction period. PESTA (1918) reported that ovigerous females can be found from February to June. In the present research the ovigerous females were collected from the beginning of January to the mid of June. The number of larvae hatching has not been established.

Moulting period. The moulting period was estimated indirectly according to the hardness of the exoskeleton. Crabs with soft integument have been recorded from November to March, in particular in January, and only once in June.

Foregut fullness. From 142 specimens which foregut (stomach) was examined, 23 foreguts were empty. In the remaining 119 specimens the degree of fullness expressed in percentages is presented in the following table:

Percentage of fullness	No	Percentage of fullness	No
01-10	9	51- 60	8
11-20	20	61- 70	11
21-30	26	71- 80	13
31-40	13	81- 90	9
41-50	9	91-100	1

Thus, the majority of specimens at the time of capture were with a low percentage of foregut fullness.

Food composition. The analysis of food types eaten shows that crabs feed on various food items. It is noteworthy that the composition of the foregut contents is very difficult to identify because the content of the foregut is reduced to small fragments by the action of mouth parts and gastric mill. The most frequent component of the foregut content are sand particles (62 times), which in all probability are not used directly as a food. From the matter used for food by the crab for the great part (58 times) it was impossible to identify the origin. It refers to organic remnants including unrecognizable tissue or only amorphous particles of plant or animal origin. Algae (mostly filamentous green and others) were recorded 47 times. Thereafter follow the Crustaceans (mostly Natantia, and rarely also Anomura, Ostracoda, Mysidacea and Amphipoda) found 17 times. According to frequency next are higher plants (in particular marine Potamogetonaceae) 14 times, Polychaeta 12 times and Bivalvia 11 times. Unrecognizable, very finely destructed organic particles like detritus were recorded 11 times. Finally, the remnants of fishes were found only twice. From the mentioned components it is clear that *Macropodia rostrata* is an opportunistic omnivore, which feeds on benthic macroflora and macrofauna, predominantly on sessile or slow-moving organisms and only exceptionally on more active animals such as Crustaceans. This property is in accordance with its slow motion. According to RASMUSSEN (1973) the species feeds also on planktonic organisms. In the present research it was not possible to identify the remnants of holoplanktonic organisms in the stomach.
It is worthy to note that our results mostly agree with those obtained in other areas of distribution (MORI and MANCONI, 1987).

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