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SOME BIOLOGICAL STUDIES ON THE EGYPTIAN CRAB *PORTUNUS PELAGICUS* (LINNAEUS, 1766)

IZUČAVANJE BIOLOGIJE PELAGIČNE RAKOVICE, *PORTUNUS PELAGICUS* (LINNAEUS, 1766) U VODAMA EGIPTA

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The fishery of the Egyptian red crab *Portunus pelagicus* (Linnaeus, 1766) has grown considerably and now is commercially well exploited. Maturity of both sexes was determined. Five stages of ovary maturation (immature, maturing, late mature, berried and spent stages) were determined for female. Breeding season of the crab was found to be during winter-spring and continues to the end of summer. All females of the studied species were found fully ripe at 14.5 cm carapace width and can lay viable eggs after reaching 9.0—10.0 cm carapace width. The puberty molt i.e transition from pre-puberty to post-puberty phase occurs at 9.5 cm carapace width for both sexes; and females can spawn at least two times a year.

A linear relationship between fecundity and carapace width was noted. The lowest number of eggs per female observed was 75167 from a 11.1 cm carapace width specimen and the highest was 812738 from a female with 13.6 cm carapace width... The crab feeds on a wide variety of food items, and its diet includes many kinds of marine plants, as well as molluscs and crustaceans. The most intensive feeding activity occurs during the April—June period.

INTRODUCTION

The crab *Portunus pelagicus* (Linnaeus, 1766) is one of the larger edible species of swimming crabs (Porunidae). It is wide spread throughout the Indian and Pacific Oceans and Red Sea and now is very common along the Mediterranean coast of Egypt having immigrated through the Suez Canal. At present the fishery of *P. pelagicus* has grown considerably in Alexandria fishing centers and is being exploited commercially well but mostly below the size of sexual maturity. With increasing catch efficiency and effort, the

breeding stock is declining. The short term effect of this might be progressive lowering of the maximum sustainable yield, while the long term result might be more catastrophic, e.g. complete collapse of the fishery.

It is therefore important that an accurate estimate of the size at sexual maturity and breeding season be used for management of its commercial fishery.

No informfation is available on the reproductive capabilities and fecundity of females. A limited research was conducted on *P. pelagicus* (L.) in the Egyptian waters. The biology of *Lupa pelagica,* the junior syno. of our sp. was studied Al-Kholy and El-Hawary, 1970 with notes on its spawning season and feeding habit, while its chemical composition was studied by Badawi, 1971.

The purpose of this paper is to discuss in some detail, the breeding, maturity and fecundity of *P. pelagicus* with notes on its food and feeding habits.

MATERIAL AND METHODS

The material for the present study, which covered the period 1978—1979 and 1985—1986 was obtained regularly from the catches landed at Maadia-Abu kir and El-Anfushy fishing centers, Alexandria. Samples of *P. pelagicus* (L.) were taken biweekly from these centers to determne sexual maturity, fecundity and its food and feeding habits. Sex of crab was easily recognized by difference in shape of the abdomen or apron and the abdominal appendages. The morphometric measurements were made using precision vernier calipers to the nearest mm. Different maturity stages of female *P. pelagicus* during the present study was determined using only the external visible changes in the ovary such as follows:

Immature stage can be recognized from the triangular shape of the abdomen with no sign on the ovaries.

Maturing stage in which the ovary is still very small ,pale, short and slender. Seminal receptacles, however, become very large after receiving semen from male.

Late-mature stage has bright oragne ovaries that are from three to four times the volume of the maturing ovary.

Berried stage where the female becomes ovigerous, carrying eggs on the abdomen attached to the pleopods. Newly extruded eggs are bright orange in colour and change to pale yellow then nearly black before hatching.

Spent stage starts after extruding eggs, haching and releasing the offspring in water. This stage can be distinguished from the immature or maturing stage as the ovary is more flaccid and greyish in colour.

In males, the (T) shaped apron does not change at maturity and carries two appendages used in mating. The maturity in males was based on the development of the anterior and middle vasa deferentia. In the immature male the vasa deferentia are small and the middle vas deferens is white while in the mature male the vasa deferentia are convoluted with large prominent

ducts and the middle vas deferens is bright pink. Size at first maturity was estimated for males using changes in the size of gonads and by the changes in the relative growth of chelipeds. Monthly gonosomatic index was calculated for both sexes depending on the weight of their gonads as

$$\frac{\text{Gonad weight (gm)} \times 100}{\text{total body weight}}$$

Food and feeding: Quantitative and qualitative analyses of food were done using about 150 stomachs collected during the period from April to October, 1978 and January, 1979.

RESULTS

Breeding season

To determine the breeding season of *P. pelagicus*, monthly percentage of ovaries at different maturity stages were calculated for about 880 females and plotted in Fig. 1. It is seen that crabs exclusively in immature and maturing

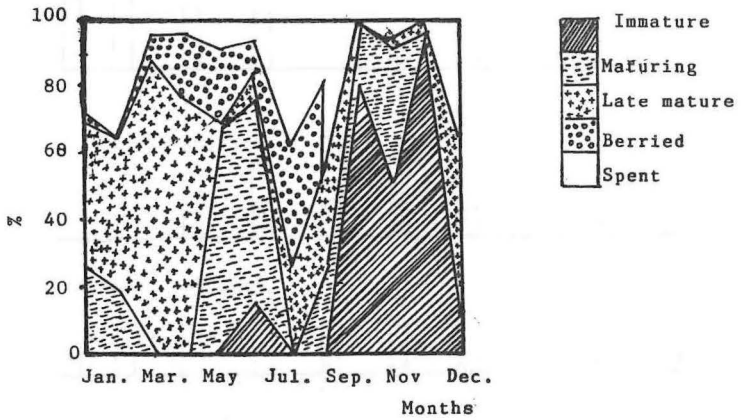

Fig. 1. Monthly distribution of maturity stages in females of *Portunus pelagicus* (L.)

stages were observed in the months September-November, and there was a complete absence of berried stages in that period. The maturing stages also make their appearance in January, February and May-June. Thereafter stages of late mature crabs predominate from January-April and were observed also from June-August with some occurring in December. Breeding females were encountered from March until August while spent stages observed all the year round except in September and November. This indicates that *P. pelagicus* has a prolonged breeding season commencing nearly from March and terminating by August. It may, however, be mentioned that a large number of late-mature specimens were observed in January and February which might suggest an early spawning in these months.

The gonosomatic index, (the ratio of gonad weight / total weight) which is another indicator of the breeding season and time is depicted in Fig. 2. As shown, the seasonal distribution of G. S. I. describes a constant presence of two spawner groups as indicated by its high values of G. S. I. througout a year. This is an evidence that females of *P. pelagicus* may spawn two times a year with higher activity during winter, spring and summer.

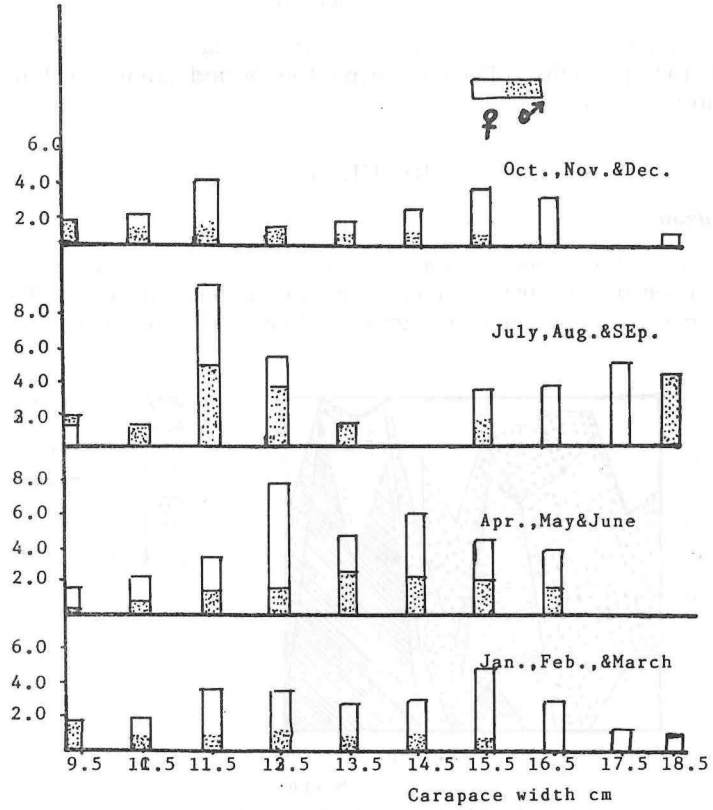

Fig. 2. Distribution of G.S.I. of *Portunus pelagicus* (L.)

Size at first sexual maturity

The size at sexual maturity is needed for managing the population of a crab species. Although maturity can be determined by either histological examination of the gonads or by inspection of secondary sexual characteristics, these techniques seem to be time consuming and difficult to apply in the field. Consequently, many investigators have recognized that crabs (Brachyura) may change in shape at maturity. In female, the abdomen, pleopods, and thoracic sterna become greatly changed. In male the shape and size of the chela are often modified. The female carapace width of *P. pelagicus* at the onset of maturity was identified from data analysis of 875 females relevent

to all stages of ovary maturation. Fig. 3. compares the percentage of ripe females (Late maturing stage) at each length unit (10 mm interval). The curve indicates that none of the crabs below 9.5 cm were found ripe, 50% were ripe at 14.5 cm.

The incidence of egg bearing females per carapace width class interval as shown in the histogram in Fig. 4, indicates that female of *P. pelagicus* can be regarded as sexually mature and produce viable eggs after reaching 9.0—10.0 cm carapace width.

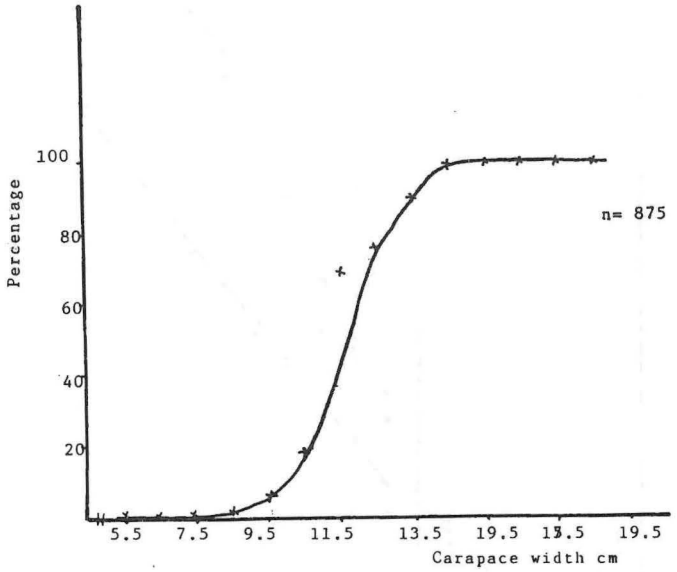

Fig. 3. Percentage of females in berry/carapace width class of *Portunus pelagicus* (L.)

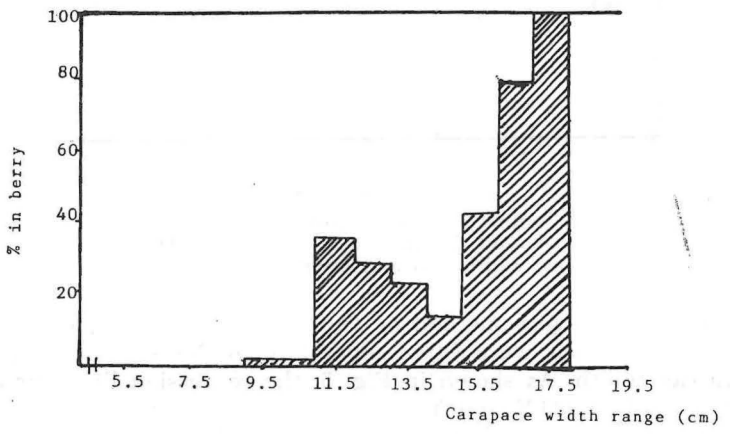

Fig. 4. Length at first maturity of *P. pelagicus* as indicated by the percentage of female specimens maturing at each length unit (10.0 cm interval)

The linear growth in *P. pelagicus* is used also as a method for determining sexual maturity as reported by Hartonell (1974) that the chela may coincide with maturity and this takes place at the molt of puberty. Fig 5. describes the relation between carapace width and right chela length for 880 females and 968 males. A discontinuity in the slopes of the regressions occurs after 9.5 cm of carapace width for both sexes.

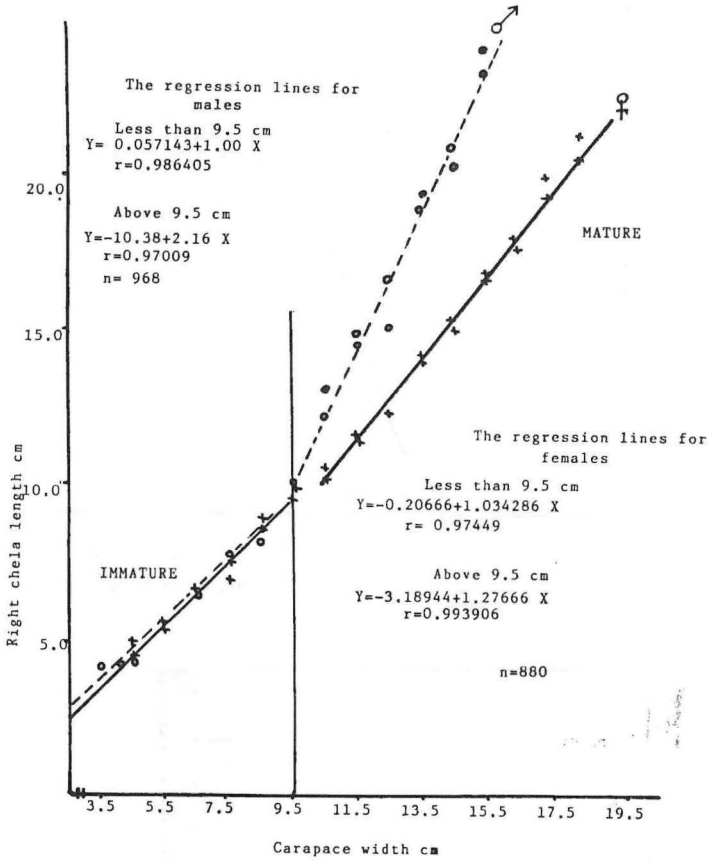

Fig. 5. Fitted regression lines for right chela of male (o....o) and female (x....x) *P. pelagicus* with carapace width less and greater than 9.5 cm

By using the intersect method of George and Morgan (1970) least square linear regressions were fitted separately to the data above and below 9.5 cm carapace width. As shown in Fig. 5. the regression lines for data are: $Y = -0.20666 + 1.034286\,X$ and $Y = -3.18944 + 1.27666\,X$ for females below and above 9.5 cm carapace width respectively and $Y = 0.0577143 + 1.00\,X$ and $Y = -10.38 + 2.16\,X$ for males below and above 9.5 cm carapace width respectively. (Y = carapace with and X = right chela length).

This method provides estimates in close agreement with those determined above. Whereas the absolute gonad weight gives an useful indication of the size at which initial gonad development takes place, i. e. about the stage at which sexual maturity is attained. In Fig. 6 the scatter diagram represents the relation between carapace width and weight of vasa deferentia of *P. pelagicus* using about 170 males. A positive relationship exists between increase in the size of the animal and the weight of its gonads. Besides, most of the mature individuals with a large vasa deferentia were observed after 9.5 cm carapace width as a size at which animal showed a sudden change in body dimension due to physical maturation.

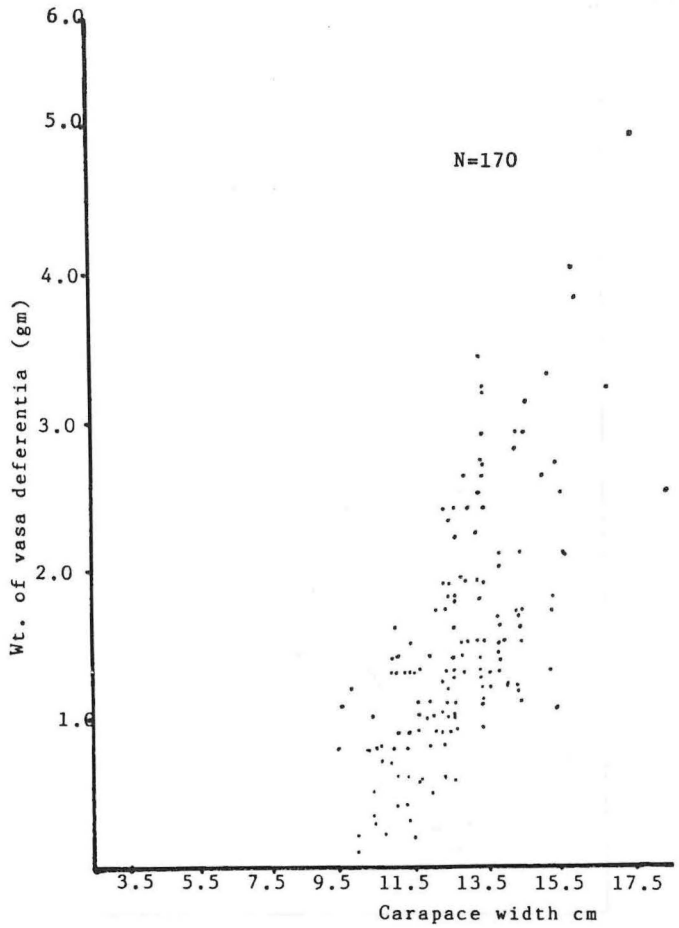

Fig. 6. Relation between carapace width and weight of the vasa deferentia of *P. pelagicus* (L.)

Fecundity

The relation between fecundity as expressed by the egg number of ripe ovary per female and the carapace width is shown in the scatter diagram (represented as dots) in Fig. 7. This linear relationship arises from 26 fully ripe females collected during the peak of breeding season just before releasing their eggs. The lowest number of eggs per female observed was 75167 from a 11.1 cm carapace width specimen ad the highest was 812738 from a female 13.6 cm carapace witdh. On the other hand, the number of eggs released per female showed that some crabs had a considerably fewer eggs than others, although they are of the same carapace width. This variation may be attributed to losses during netting, subsequent handling or due to mortality during the period of incubation.

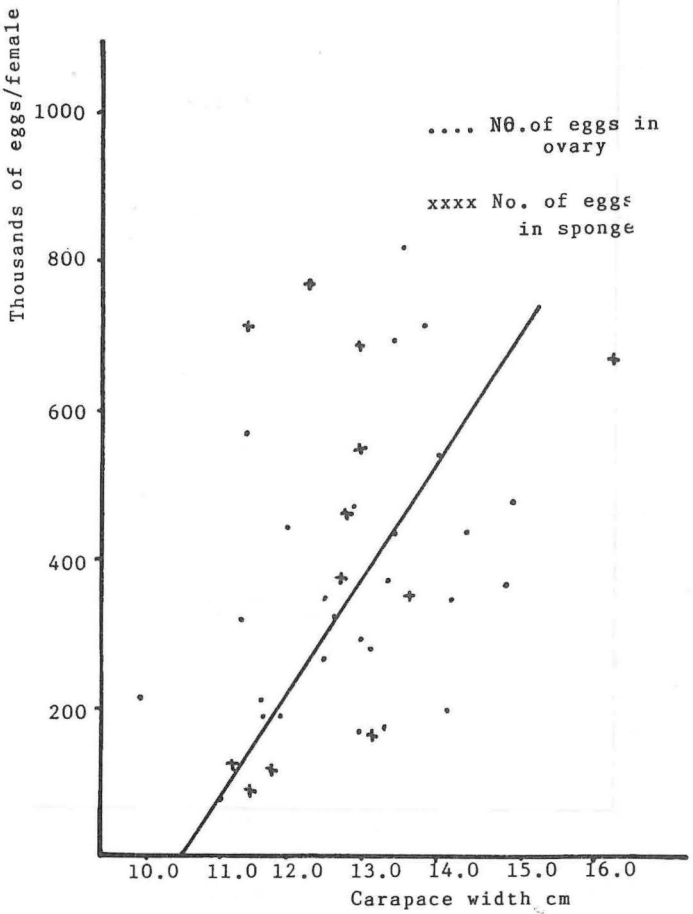

Fig. 7. Relationship between fecundity and carapace width of *P. pelagicus* (L.)

Therefore, counts from ovarian or newly exstruded eggs actually reflect the reproductive potential of a female. Moreover, counting of eggs that are close to hatching give more reliable estimates of a females potential contribution of larvae to the population.

Food and feeding

The food items which the crab *P. pelagicus* can consume were found to be mianly from molluscs (clams, mussels and cephalopods), crustaceans (mostly shrimps, small crabs, amphipods and some barnacles), and to a lesser degree fishes and algae (fragments of brown alage, sea weeds).

A large amount of stomach contents consisted of decomposed organic material in advanced stages of digestion which could not be identified. Also sand and mud were incidentally taken by crabs in feeding.

A great proportion of sand, relative to food content, was found in smaller crab stomachs. The relative abundance of these different food items in stomachs showed that most of the molluscs eaten were *Danax trunculus* (L.) and various species of sepia and octopus as these were predominant in the studied area with parts of their shells, suckers, and flesh. From the crustacea, *Gamarus sp.* was also taken as an important food item by different sizes of *P. pelagicus*. Remains of other crustaceans were also found. Fish was mostly infrequent in the crab stomachs but in some individuals it was a major item, especially in larger crabs. Ingested fish parts such as bones, spine, scales and fles with some eggs were recognized. Various algae and sea weeds were frequently obtained in the stomach of the present crab.

Feeding intensity in the present species was studied by classifying the stomachs according to the degree of fullness into full, half full and empty. The monthly variations in their relative number were then reported as in Table 1. in an attempt to determine the season of heavy feeding. The period from April-June was charactarized by the abundance of half full stomachs with higher percentage than empty stomachs.

Month	Percentage of stomach condition		
	Full	Half-full	Empty
April	18%	41%	41%
May	28	24	48
June	38	24	43
August	9	21	70
September	25	—	75
October	21	16	63
January	—	10	90

This may be attributed to the abundance of food items preferable by crabs during the spring and early summer. From August to October and January the frequency of empty stomachs was higher than that of other types. This may be due to the high growth activity and maturation processes which was revealed from the presence of large number of newly moulted specimens as well as from the growth curve (Abdel Razek, 1986).

DISCUSSION AND CONCLUSION

The crab *Portunus pelagicus* (L.) is one of the large edible species of Portunnidae and its fishery has grown considerably and is now commercially well exploited. Females of *P. pelagicus* may spawn twice a year and spawning activity occurs during winter, spring and continues until the end of summer when the maximum occurrence of ripe and berried females was observed. This agrees with the result of Al-Kholy and El-Hawary (1970) that breeding of *Lupa pelagica* the Syn of *P. pelagicus* (L.) from the Suez Gulf extends the whole year. April is the peak period while the female ovaries become well developed and mature in winter. Moreover, Pillay and Nair (1973) reported that the period of maximum gonad activity of *P. pelagicus* collected from Cochin area, India, extends from December and January to March. This closely resembles the situation in the present work.

Most of the mature individuals of both sexes were observed after 9.5 cm carapace width as a size at which animal showed a sudden change in body dimensions due to physical maturation and female can produce viable eggs.

The food items which the crab *P. pelagicus* can consume were found to be of a great variety and its diet includes many types of aquatic vegetation as well as molluscs and cructaceans. This resembles the blue crab *Callinectes sapidus* (R.) as reported by Tagatze (1963).

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KRATKI SADRŽAJ

Ulov rakovice *Portunus pelagicus* (Linnaeus, 1776) značajno se povećao i danas je ekonomski dobro eksploatirana. Određivana je zrelost oba spola. Ustanovljeno je pet stadija sazrijevanja jajnika kod ženki. Sezona mriješćenja traje tokom zime, proljeća i proteže se do kraja ljeta. Sve ženke koje su dosegle 14.5 cm širine karapaksa bile su spolno zrele. Prelaz iz pre-puberteta u post-pubertet nastupa kod širine karapaksa od 9.5 cm kod oba spola. Ženke legu jaja najmanje dva puta godišnje.

Nađen je linearni odnos između fekunditeta i širine karapaksa. Najmanji broj jaj po ženki iznosio je 75167 i nađen je kod primjerka širine karapaksa 11.1 cm a najveći broj jaja od 812 738 kod ženke širine karapaksa 13.6 cm.

Ova rakovica se hrani raznovrsnom hranom, raznim vrstama morskog bilja, mekušcima i rakovima. Najintenzivnije se hrani tokom perioda travanj—lipanj.