MEDWELL PUBLISHING
Journal of Animal and Veterinary Advances 8 (1): 51-58, 2009
ISSN: 1680-5593

Ecology and Distribution of the Veined Rapa Whelk *Rapana venosa* (Valenciennes, 1846) in Sinop Peninsula (Southern Central Black Sea), Turkey

[1]Mehmet Culha, [1]Levent Bat, [2]Alper Dogan and [2]Ertan Dagli
[1]Department of Hydrobiology, Faculty of Fisheries, University of Sinop, Sinop 57000, Akliman, Sinop, Turkey
[2]Department of Hydrobiology, Faculty of Fisheries, University of Aegean, 35100, Bornova, Izmir, Turkey

Abstract: *Rapana venosa* (Valenciennes, 1846) is the only Prosobranch gastropod species which is of significant economic value on the coasts of the Black Sea and which is regularly collected in certain periods. This species, known to be of indo-pacific origin, was introduced to the Black Sea in the 1940s and it has spread over the coasts of the Caucasus, the Crimea and the Azov Sea over a period of 10 years. Subsequently, it has expanded its distribution towards the Turkish and Bulgarian coasts of the Black Sea and the coasts of Romania during 1959-1972. *Rapana venosa* has been reported from South-Eastern coasts of South America and also from the Red Sea and many localities of the Adriatic Sea for 20-25 years. It has been reported to be incidentally introduced into these areas probably by vessels. In this study, the ecology and distribution of *Rapana venosa* (Valenciennes, 1846), an invader species of the Sinop peninsula is discussed. In this context, the seasons, stations, depths and various biotopes and also the growth parameters (width-length) of the individuals were investigated depending on seasons and stations. As a result of the statistical evaluations, it was found that noticeable differences existed among the parameters examined.

Key words: The veined rapa whelk, ecology, distribution, growth parameters, sinop peninsula, Black Sea

INTRODUCTION

The extensive anoxic conditions which exist throughout the Black Sea make it unique among the world seas. Although, it is a deep sea, due to H_2S gas which is present at depths below 150-200 m, the numbers of deep sea organisms are limited. Despite its low biodiversity, resulting from it being an enclosed sea, in which territorial organic material transported by rivers accumulates, the Black Sea is among the leading seas concerning the biological product formed per unit area.

Only about 20-25% of zoobenthos in the Mediterranean Sea is shared with the Black Sea, due to low salininty, which is unfavorable for most Atlantic and Mediterranean species and to the restriction of suitable habitats to the upper water layers caused by anoxic conditions in deeper levels (Mutlu *et al*., 1993).

There have been many studies on Mollusca in the Black Sea (Anistratenko, 1991, 1997; Anistratenko and Starobogatov, 1999; Anistratenko and Anistratenko, 2001; Zenkevicth, 1963). Among these, in one study concerning benthic fauna (Zenkevicth, 1963), 36 mollusc species were reported from the Black Sea coasts of Russia (Ukraine, Russia, Georgia). In the following years, a similar study was conducted concerning the gastropod fauna of the Ukraine coasts (Butakov *et al*., 1997) where 57 Prosobranch species were reported in the country.

As far as Turkey is concerned, investigations on the Black Sea Prosobranchia species are quite scanty and limited to information depth of finding and other details, except the Russian and Romania coasts of the Black Sea (Bacescu, 1977; Butakov *et al*., 1997; Kaneva-Abagjieva and Marinov, 1966; Zenkevicth, 1963). At present time, 51 species of marine Prosobranchia-Gastropods (Mollusca) are known to occur along the Black Sea coast of Turkey (Culha, 2004).

The objective of the present study, was to investigate some ecological and distributional features of the muricid gastropod so called Rapa whelk. Thus, the ecology, distribution and some growth parameters of the invader sp. *Rapana venosa* are reported according to its local environment. The aim of the present study, is to report

Corresponding Author: Mehmet Culha, Department of Hydrobiology, Faculty of Fisheries, University of Sinop, Sinop 57000, Akliman, Sinop, Turkey

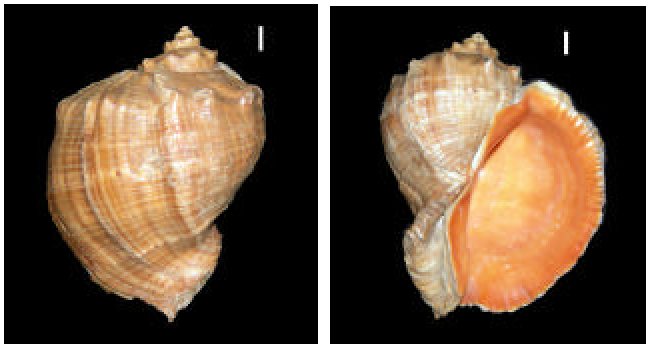

Fig. 1: The general appearance of a *Rapana venosa* shell: a-dorsally, b-from aperture, Scale: 10 mm (Picture by Culha, M)

distribution, ecological (seasons, biotope typology, depth) and some population structural features such as growth parameters (shell width-length) of the Rapa whelk in Sinop Peninsula.

General features of *R. venosa*: *Rapana venosa* (Valenciennes, 1846):

- *Rapana marginata* Valenciennes, 1846: Houart, 2001:101, Fig. 439.
- *Rapana thomasiana* Crosse, 1861: Clemam, (p.176 (original description)/type locality.
- Sea of Japan); Houart, 2001: 101, Fig. 439; Zenetos *et al*. (2003): 101, Fig. 97.
- *Rapana pechiliensis* Grabau and King, 1928: Clemam; Houart, 2001:101, Fig. 439.

Examined material:

1B-4; 1C-8; 1D-10; 2A-1; 2B-1; 2C-8; 2D-31; 3A-5; 3B-7; 3C-10; 3D-9; 4B-4; 4C-6; 4D-18; 5B-2; 5C-10; 5D-11; 6A-2; 6B-5; 6C-7; 6D-15; 7D-8; 8A-5; 8B-2; 8C-6; 8D-9; 9B-6; 9C-3; 10B-2; 10C-2; 11B-2; 11C-9; 11D-3; 12B-6; 12C-13; 12D-5 specimen (Fig. 1) (Depth:0-0.5 (A), 5 (B), 10 (C) and 15 (D) meters).

Ecology: *R. venosa* which is generally encountered in areas to depths of 30 m in the Black Sea was found in all the stations of the study area, on sandy bottoms of 15 m covered by *Zostera* sp. and *Cymodocea nodosa* (Butakov *et al*., 1997) meadows. The largest specimen found in a study conducted along the Black Sea coasts is 125×95 mm. Also, it was found on rocky and mudy habitat (Culha, 2004).

Distribution: *R. venosa* is a species of indo-pacific origin (Koutsoubas *et al*., 1997). It was introduced from the Caucasus to the Black Sea in 1930-1940 and spread to other areas in a short period of time (Bilecik, 1990). It also exists, in the Mediterranean system in the north areas of the Northern Adriatic Sea and Aegean Sea (Koutsoubas *et al*., 1997). *Rapana venosa* was first reported by from the Trabzon area of the Black Sea coasts of Turkey and then was also reported in various studies performed along these coasts (Albayrak, 2003; Fischer-Piette, 1960). Today, although it is also known to exist in the Northern Aegean Sea, it was only reported from the Sea of Marmara except the Black Sea (Demir, 2003; Zenetos *et al*., 2003).

MATERIALS AND METHODS

Sampling: *Rapana venosa* specimens were obtained by seasonal sampling (two samplings within each season) between July 2006-April 2007 in 12 stations along the Sinop peninsula coast, Five sampling stations were located between Akliman (west) and Gerze (east) in the outer bay, while 7 were located in the inner bay (Fig. 2 and Table 1).

Samplings was performed both by free diving and scuba diving in three biotopes (soft bottom, hard bottom and seagrass meadows) for each stations and at different depths: 0-0.5, 5, 10 and 15 m. A 50×50 cm quadrate method (by hands and scraping with spatula) was utilized with four replicate. The material collected was immediately fixed in 4% formaldehyde solution. In the laboratuary, samples were washed by a two steps method (Kocatas, 1978) using 0.5 mm and 1 mm mesh sized sieves and then conserved in alcohol (70%). Firstly, samples were sortend into major taxonomical groups, using a stereo microscope if necessary, while identification of Prosobranchia down to species level was made in a second moment. Species identification was carried out according to morphological characteristics of the shell, using the following literature (Butakov *et al*., 1997; Barash and Danin, 1992; Cachia *et al*., 1996, 2001; Graham, 1971; Nordsieck, 1968, 1982).

Table 1: Ecological characteristics and geographic coordinates of each sampling station (S: Sand; R: Rock; M: Mud; MS: Muddy-Sand; SM: Sandy-Mud; Z: *Zostera* sp., C:*Cymodocea nodosa*, Cys: *Cystoseira* sp., U: *Ulva* sp.; E: *Enteromorpha* sp.; D: Detritic) (Depths (m); 0-0.5: A; 5: B; 10: C; 15: D)

Station No	Sampling period*	Depth (m)	Biotop	Sampling method	Position
		0-0.5	R,Cys	Quadrat	35°02'03″E
					42°03'06″N
1	July 2006	5	(C+Z), MS	Quadrat	35°02'05″E
	October 2006				42°03'04″N
	February 2007	10	(C+Z), S	Quadrat	35°03'00″E
	April 2007				42°03'02″N
		15	S, SM	Quadrat	35°03'06″E
					42°02'00″N
		0-0.5	S, R, Cys	Quadrat	35°02'05″E
					42°02'05″N
2	July 2006	5	S	Quadrat	35°02'06″E
	October 2006				42°02'05″N
	February 2007	10	S	Quadrat	35°03'07″E
	April 2007				42°02'05″N
		15	SM	Quadrat	35°03'08″E
					42°02'05″N
		0-0.5	S	Quadrat	35°03'06″E
					42°02'00N
3	July 2006	5	S	Quadrat	35°03'07″E
	October 2006				42°02'03″N
	February 2007	10	S	Quadrat	35°04'08″E
	April 2007				42°02'04″N
		15	SM	Quadrat	35°04'09″E
					42°02'05″N
		0-0.5	S	Quadrat	35°05'11″E
					42°01'03″N
4	July 2006	5	(C+Z), S	Quadrat	35°05'11″E
	October 2006				42°01'04″N
	February 2007	10	MS	Quadrat	35°05'12″E
	April 2007				42°01'05″N
		15	SM	Quadrat	35°05'12″E
					42°02'04″N
		0-0.5	(U+E), R, S	Quadrat	35°08'18″E
					42°01'03″N
5	July 2006	5	S	Quadrat	35°08'17″E
	October 2006				42°01'04″N
	February 2007	10	MS	Quadrat	35°08'16″E
	April 2007				42°02'00″N
		15	SM	Quadrat	35°08'15″E
					42°02'04″N
		0-0.5	R, S, Cys	Quadrat	35°11'23″E
					42°01'02″N
6	July 2006	5	(C+Z), S	Quadrat	35°11'23″E
	October 2006				42°01'00″N
	February 2007	10	(C+Z), S	Quadrat	35°11'23″E
	April 2007				42°01'01″N
		15	D, SM	Quadrat	35°11'23″E
					42°00'01″N
		0-0.5	(U+E), R, S	Quadrat	35°09'20″E
					42°01'02″N
7	July 2006	5	(C+Z), MS	Quadrat	35°09'19″E
	October 2006				42°01'00″N
	February 2007	10	(C+Z), MS	Quadrat	35°09'18″E
	April 2007				42°00'01″N
		15	D, SM	Quadrat	35°09'17″E
					42°00'01″N
		0-0.5	(U+E), S, R	Quadrat	35°06'14″E
					42°00'01″N
8	July 2006	5	S	Quadrat	35°06'15″E
	October 2006				42°00'01″N
	February 2007	10	(C+Z), S	Quadrat	35°06'16″E
	April 2007				42°00'01″N
		15	D, SM	Quadrat	35°06'17″E
					42°00'01″N

Table 1: Continued

Station No	Sampling period*	Depth (m)	Biotop	Sampling method	Position
		0-0.5	M, R	Quadrat	35°05'00″E 41°57'55″N
9	July 2006 October 2006	5	M	Quadrat	35°05'11″E 41°57'55″N
	February 2007 April 2007	10	M	Quadrat	35°05'12″E 41°57'55″N
		15	M	Quadrat	35°05'13″E 41°57'55″N
		0-0.5	M, R	Quadrat	35°04'09″E 41°54'00″N
10	July 2006 October 2006	5	M	Quadrat	35°06'13″E 41°54'00″N
	February 2007 April 2007	10	M	Quadrat	35°06'14″E 41°55'00″N
		15	M	Quadrat	35°07'15″E 41°55'00″N
		0-0.5	R, S, Cys	Quadrat	35°07'15″E 41°51'52″N
11	July 2006 October 2006	5	(C+Z), MS	Quadrat	35°08'00″E 41°52'00″N
	February 2007 April 2007	10	(C+Z), MS	Quadrat	35°08'17″E 41°52'00″N
		15	SM	Quadrat	35°09'19″E 41°52'01″N
		0-0.5	R, S, Cys	Quadrat	35°12'25″E 41°48'00″N
12	July 2006 October 2006	5	(C+Z), MS	Quadrat	35°12'00″E 41°47'00″N
	February 2007 April 2007	10	(C+Z), MS	Quadrat	35°12'25″E 41°47'01″N
		15	SM	Quadrat	35°13'00″E 41°47'01″N

*Two samplings within each seasons

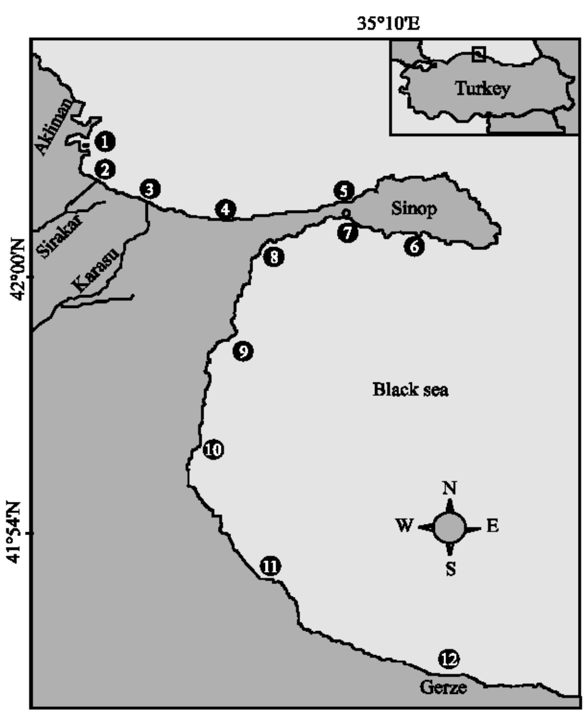

Fig. 2: Study area and sampling stations

Three major referenced publications were considered to review the systematic of *Rapana venosa* (Clemam, 2007; Sabelli *et al*., 1990, 1992).

As far as *R. venosa* specimens are concerned, their relative abundance in the samples were assessed and shell dimensions of all individuals collected were measured.

Measurements were performed either by an electronic compass or micrometric oculars. Identification keys were also, prepared in addition to information on taxonomy, ecological characteristics and distribution patterns of this species.

RESULTS

Ecological findings: As a result of the examinations carried out on the samples collected, 255 specimens were counted from 4 different depths in 12 stations.

Several statistical measurements were implemented concerning the relationships with seasons, stations, depths and biotopes and also the width and length of the specimens.

Distribution of *R. venosa* specimens according to sampling stations: The highest number of individuals (N. 31) was found at 15 m depth (D) of station 2; 18

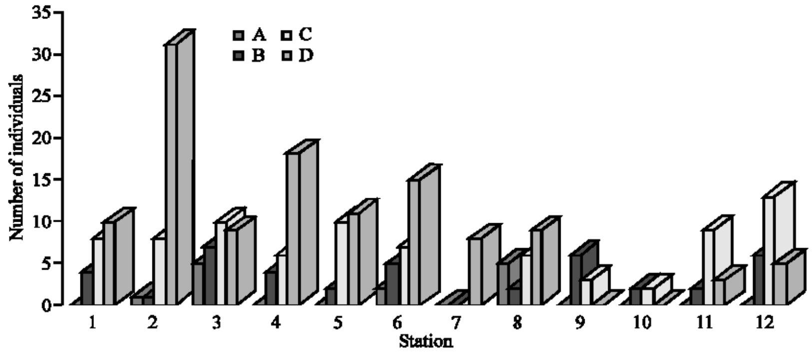

Fig. 3: Distribution of *R. venosa* individuals according to sampling stations (A: 0-0.5, B: 5, C: 10, D: 15 m)

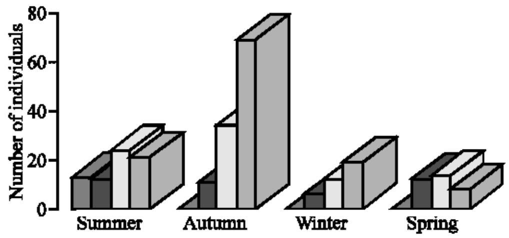

Fig. 4: Distribution of *R. venosa* individuals according to seasons (A: 0-0.5, B: 5, C: 10, D: 15 m)

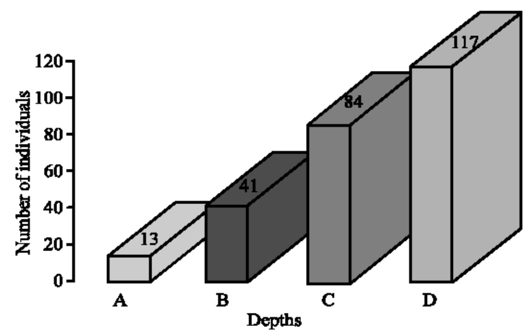

Fig. 5: Distribution of *R. venosa* individuals according to depths (A: 0-0.5, B: 5, C: 10, D: 15 m)

specimens at depth D of station 4; 15 specimens at depth D of station 6. As the stations 1 and 4 present a characteristic of an open bay and station 6 is located in a closed bay, it appears as though these organisms prefer biotopes like sand and Zostera and Cymodocea meadows. The lowest number of individuals were encountered at stations 9 and 10, which are of a muddy characteristic (Fig. 3).

Distribution of *R. venosa* specimens according to season: The largest number of specimens was collected in autumn at 15 (69 ind.) and 10 m depth (34 ind.). During winter only 6 specimens have been collected at lower depth (5 m) (Fig. 4).

Distribution of *R. venosa* specimens according to depth: When the *Rapana venosa* specimens collected from 4 different depths in the research area were counted, it was found that the depth D (15 m) had the highest number with 117 individuals followed by 41 individuals at depth B (5 m) and by 13 individuals at depth A (0-0.5). Throughout the study, it was observed that the water activities of *Rapana venosa* were more stable compared to the other depths and that they mostly preferred depth D (15 m) (Fig. 5).

Distribution of the individuals according to the biotopes: It was established that *Rapana venosa* mostly distributed in Sandy-Muddy (SM: 57 individuals) biotopes (Fig. 6). This was followed by Muddy-Sandy (MS) bottoms with 48 individuals and then by *Zostera* sp. and *Cymodocea nodosa* biotopes (Z+C) with 47 individuals. The lowest number of specimens were observed at rocky biotopes (R: 1 individual), *Cystoseria* sp. (Cys: 2 individual) and *Ulva* sp. and *Enteromorpha* sp. (U+E: 5 individuals) from the group another.

Width-Length measurements of *R. venosa* specimens according to seasons and stations: As a result of evaluations performed on the whole sample, it was found that an obvious difference existed among the specimens' average width-length measurements according to seasons (Fig. 7). Summer was the leading period for presenting specimens with the highest width-length measurements (width: 55.94 mm; length: 75.80 mm). It was followed by spring (width: 44.30 mm; lenght: 62.50 mm), autumn (width: 21.20 mm; length: 30.10 mm) and winter (width: 7.77 mm; length: 11.91 mm), respectively. It was observed, that the growth rate of *Rapana venosa* increased in spring

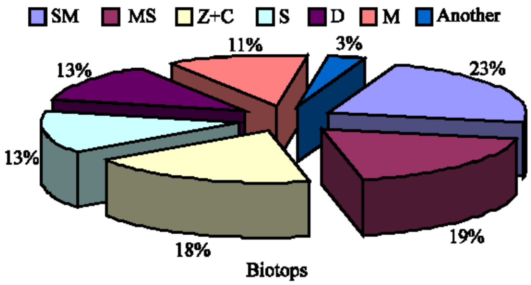

Fig. 6: Distribution of *R. venosa* individuals according to biotopes (S: sand, M: mud, MS: muddy-sand, SM: sandy-mud, Z+C: *Zostera* sp. and *Cymodocea nodosa*, D: detritic)

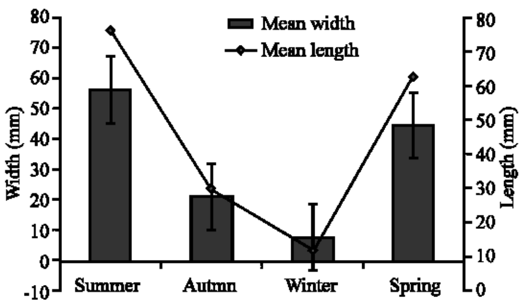

Fig. 7: Average width-length measures of *R. venosa* specimens according to seasons

and summer compared to the other seasons due to the warming of water to its highest levels.

DISCUSSION

Rapana venosa (Valenciennes, 1846) is the only prosobranch gastropod species possessing a comparatively high economic value and hunted during particular periods along the Black Sea coasts. This indo-pacific originated species was introduced to the Black Sea in the 1940s and spread along the Caucasian, Crimean and Azov coasts over a 10 year period before expanding its distribution towards Turkish and Bulgaria shores of the Black Sea and also the Romanian coasts (Butakov *et al*., 1997; Koutsoubas *et al*., 1997; Bilecik, 1990; Fischer-Piette, 1960; Houart *et al*., 2001). *Rapana venosa* was also recorded from the south-eastern coasts of South America and furthermore it was noticed to exist in many localities of the Red Sea and the Adriatic for 20-25 years due to accidental introduction by ships (Houart, 2001). Several discrepancies stand out for the systematic position of this species. For example, while many authors include *R. venosa* in the family Rapanidae, some others propose that the Rapanidae should be a subfamily of Muricidae as Rapaninae (Houart, 2001; Poppe and Goto, 1991). Although, this species prefer fine sandy bottoms it could dig itself in, it may be observed in other biotopes including also, hard substratum that would serve during feeding or reproducing. *Rapana venosa* is noted to reveal a migrating behavior during winter to warmer deep waters and in summer to warmer coastal regions. This species is ecologically versatile and can tolerate low salinities and environmental conditions with poor oxygen and pollution at wide-ranging levels. *Rapana venosa* specimens were detected at various depths (0-15 m) of the stations investigated. Especially, in summer, several egg capsules were observed to be attached to all kinds of hard substratum in the research area. Despite its commercial value in the region, this species was reported to be harmful for mussels, oysters and some other benthic organisms serving as food for it and therefore it has been accused of breaking the ecological balance (Bilecik, 1990). Thus, *Rapana* fishing should be systematically performed (Culha, 2004).

In the scope of this study, conducted in order to determine the ecology and distribution of *Rapana venosa* distributed in the Sinop peninsula and its vicinity, 4 depths belonging to 12 stations and seasonal samplings from various biotopes were evaluated.

As a result, the highest number of individuals were encountered at stations 2 (31 ind. at 15 m) and 4 (18 ind. at 15 m) in autumn. Stations 2 and 4 possess a sandy biotope inhabited by large populations of the bivalves *Chamelea gallina* and *Lentidium mediterraneum* (Ozturk *et al*., 2004). The higher number of individuals found in autumn in the Sinop peninsula and its vicinity was attributed to favorable reproductive conditions and sea water temperature, for the highest water temperatures were observed in summer (25°C) and autumn (24°C) (Ozturk *et al*., 2004). When the distribution of *Rapana venosa* specimens were examined depending on depths and biotopes, the highest number of individuals were found to prefer depth D (15 m) followed by Sandy-Mud (SM) and Muddy-Sand (MS) biotopes.

Average width-length measurements of the individuals were measured depending on seasons and stations. As this result, significant disparity was evident in width-length measurements depending on the seasons. Accordingly, it was assigned that the width-length measurements in spring and summer were at their maximum level and in contrast, in autumn and winter when the water cooled they reduced. This discrepancy among the seasons supports the idea that the larger individuals withdrew to deeper waters as the water cools (Harding and Mann, 1999). Also, when the stations were taken into account, it was found that the highest width-length measurements were obtained in summer and autumn when the water temperatures were relatively high. In spring, when growth and development of organisms is elevated, it was noticed that length measurements were higher than width measurements.

Additional studies related to this species are needed for understanding ecological balance and changes in the marine ecosystems, especially in the Black Sea ecosystem.

ACKNOWLEDGEMENT

We wish to thank to the crew of the R/V Arastirma I of Sinop University Fisheries Faculty for their kind assistance during the samplings. Also, thanks to Dr. Bilal Ozturk for confirmation of this and another species.

REFERENCES

Albayrak, S., 2003. On the mollusca fauna of the black sea near Istanbul. Zool. Middle East, 30: 69-75.

Anistratenko, V.V., 1991. Mollusks of hydrobia sensu lato group from the black and azov seas. Moscov Nat. Expr. Bull., 96 (6): 73-81.

Anistratenko, V.V., 1997. Molluscs of the genus *Cerithium* Bruguière, 1789 (Gastropoda, Cerithiidae) of the Black Sea. *Ruthenica*. 7: 69-72.

Anistratenko, V.V. and I. Starobogatov Ya, 1999. Molluscs of the genera Tritia and Cyclope (Gastropoda, Bucciniformes, Nassariidae) of the Black and Azov Seas. Vestnik Zool., 33: 23-33.

Anistratenko, V.V. and O.Y. Anistratenko, 2001. Fauna of Ukraine. Vestnik Zool., 29 (1): 1-240.

Bacescu, M., 1977. Les biocenoses benthiques de la mer Noire. Biologie des eaux saumatres de la mer Noire Premiere Partie. Inst. Roumain Recher. Mar., pp: 128-134.

Barash, A. and Z. Danin, 1992. Fauna Palestina, Mollusca I, Annotated list of Mediterranean Molluscs of Israel and Sinai. Isr. Acad. Sci. Human. Jerusalem, pp: 405.

Bilecik, N., 1990. Distributions of Sea Snail, *Rapana venosa*, at the Black Sea Coasts and effects on fishery of the Black Sea. Minister of Agriculture and For. Inst. Fish. Res., Bodrum, B: 1: 34.

Butakov, E.A., V.D. Chuhchin, M.B. Cherkasova and S.G. Lelekov, 1997. Determinator of Gastropoda of the Black Sea. Ibss., N.A.S.U., pp: 127. http://www.ibss.org.ua/Sevastopol.

Cachia, C., C. Misfud and P.M. Sammut, 1996. The marine mollusca of the maltese islands. Part. 2. Neotaenioglossa. Backhuys Publishers. Leiden, Netherlands, pp: 228.

Cachia, C., C. Misfud and P.M. Sammut, 2001. The marine mollusca of the maltese islands. Part 3. Sub-class Prosobranchia to sub-class Pulmonata. Order Basommatophora. *Backhuys Publishers*. Leiden, Netherlands, pp: 266.

Clemam, 2007. Unitas malacologica check list of european marine mollusca. Réalisé par J. LE RENARD, B.I.M.M., M.N.H.N, Paris. http://www.mnhn.fr/base/malaco.html.

Culha, M., 2004. Taxonomical and Ecological Characteristics of Prosobranchia (Mollusca-Gastropoda) Species Distributed Around Sinop. E. U. Graduate School of Natural and Applied Sci. Thesis of PhD, pp: 150.

Demir, M., 2003. Shells of Mollusca Collected from the Seas of Turkey. Turk. Jr. Zool., 27: 101-140.

Fischer-Piette, E., 1960. *Rapana bezoar* L sur la côte turquie de la Mer Noire. Hydrobiol., 5 (1-2): 51.

Graham, A., 1971. British Prosobranch and other Operculate Gastropod Molluscs. Acad. Press, London, pp: 112.

Harding, J.M. and R. Mann, 1999. Observations on the biology of the veined rapa whelk, *Rapana venosa* (Valenciennes, 1846) in the Chesapeake Bay. J. Shellfish Res., 18 (1): 9-17.

Houart, R., 2001. A review of the recent mediterranean and northeastern atlantic species of muricidae. Evolver, Rome, pp: 227.

Kaneva-Abagjieva, V. and T.M. Marinov, 1966. Distribution of zoobenthos in the Sand Biocenosis of Bulgarian Black Sea shore. Izv. Tsentr. Nauch. Inst. Po ribov, I ribol., 3: 117-161.

Kocatas, A., 1978. Qalitative and qantitative research on benthic forms of rocky coasts of the Izmir Bay. Eagean University, Graduate School of Natural and Applied Sci., 12: 1-93.

Koutsoubas, D., A. Koukouras and E. Voultsiadou-Koukoura, 1997. Prosobranch molluscs of the Aegean Sea: New information, checklist, distribution. Isr. J. Zool. Jerusalem, 43: 19-54.

Mutlu, E., M. Unsal and F. Bingel, 1993. Faunal community of soft-bottom molluscs along the Turkish black sea. Tr. J. Zool., 17 (2): 189-206.

Nordsieck, F., 1968. Die Europaischen Meeres-Gehauseschnecken (Prosobranchia) von Eismeer bis Kapverden und Mittelmeer. Gust. Fisch. Verl. Stuttgard., pp: 71-77.

Nordsieck, F., 1982. Die europaischen meeres-gehauseschnecken (Prosobranchia) von eismeer bis kapverden, mittelmeer und schwarzes meer. Gust. Fisch. Verl., Stuttgart., pp: 539.

Ozturk, B., M. Culha and D. Urkmez, 2004. Bivalvia fauna of the sinop peninsula and its vicinity. Turk. J.Aqua. Life. Ist Nat. Malacol. Symp. (With International Participation), Izmir, 2 (2): 71-80.

Poppe, T. and Y. Goto, 1991. European Seashells: V: 1. Polyplacophora, Caudofoveata, Solenogastra, Gastropoda. Verlag Christa Hemmen, Germany, pp: 352.

Sabelli, B., R. Giannuzzi-Savelli and D. Bedulli, 1990. Catalogo annotato dei molluschi marini del mediterraneo. Librer. Nat. Bolog. Bologna, 1: 348.

Sabelli, B., R. Giannuzzi-Savelli and D. Bedulli, 1992. Catalogo Annotato dei Molluschi Marini del Mediterraneo. Librer. Natur. Bolog. Bologna, 2: 150.

Zenetos, A., S. Gofas, G. Russo and J. Templado, 2003. CIESM atlas of exotic species in the mediterranean: 3. Molluscs. C.I.E.S.M. Publishers. ISBN: 92-990003-3-6. Monaco. 376.

Zenkevicth, L., 1963. Biology of the Seas of U.S.S.R. The Southern Seas of the U.S.S.R. George Allen Unwin Ltd., London, pp: 353-465.