

**1993 RAPANA THOMASIANA STOCK ASSESSMENT AND CATCH PROJECTION ALONG BULGARIAN BLACK SEA COAST**

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The carnivorous sea snail *Rapana thomasiana* Grosse (Gastropoda) immigrated in Black Sea during the early forties, from the Japan Sea. Registered for the first time in Novorossiysk Bay in 1946 it spread along the Caucasian coast, Crimea, North-Western Black Sea, Bulgarian coast (1956) and Turkey (1959) (KONSULOVA, 1992). The investigation along Bulgarian Black Sea coast in 1976 established that the mussel (*Mytilus galloprovincialis* Lam.) abundance has undergone about 10 fold reduction, the main reason being the *Rapana* invasion together with the oxygen deficiency at the bottom water layers in the "post blooming" periods. According the latest investigations from 1984 *Rapana thomasiana* inhabits mainly the shallow zone (up to 20 m depth) and has average shell length of 71.1 mm. The decrease of the predator press with depth results in a progressive restoration of the mussel populations. During last 4 years *Rapana* became an object of commercial exploitation. The threat of overcatch necessitates the accomplishment of stock assessments and catch projections of *Rapana thomasiana*.

According to the 1992 experience from scuba diving catching of the *Rapana*, ten regions for investigation were selected (Table 1).

No	Region Name	Area Km <sup>2</sup>	Points
1	Kaliakra	4.56	15
2	Baltchik	101.71	60
3	Aladja	27.66	35
4	Euxinograd	7.77	27
5	Galata	13.21	33
6	Kamtchia	2.07	12
7	Shcorpilovtsi	7.83	26
8	Byala	12.16	20
9	Nesebar	7.44	28
10	Pomorie	30.49	27
Grand Total		214.90	283

Table 1

The number and the location of the sampling points are chosen so that a representative statistical extract from *Rapana* population is obtained. Stock assessment of *Rapana* is calculated by the square method. The curve of yield per recruitment is estimated by the RICKER'S method (1975):

$$Y/R = F \sum_{t_c=3}^{t_l=12} Bt [exp(Gt - Zt) - 1] / (Gt - Zt)$$

The optimum value of F (F<sub>0.1</sub>) is estimated by GULLAND and BOEREMA'S method (1973). The results of the stock assessment of *Rapana* are given in Table 2.

No	Region Name	Total Biomass [Tons]	Meat/Total weight ratio [%]
1	Kaliakra	27.50	22.58
2	Baltchik	548.07	18.40
3	Aladja	652.04	20.47
4	Euxinograd	35.35	19.69
5	Galata	45.62	20.73
6	Kamtchia	109.95	20.53
7	Shcorpilovtsi	204.94	20.83
8	Byala	154.01	20.10
9	Nesebar	37.24	17.74
10	Pomorie	593.45	17.80
Grand Total		2408.16	19.89

Table 2

According to yield per recruitment curve (Y/R) Fopt (F<sub>0.1</sub>) is 0.6. Therefore TAC should be 1035.5 tons. The above mentioned figures are lower than the real ones because of the specific hydrological conditions at the time of the investigations (2-16 June 1993), unusually low water temperature. That is why considerably amount of *Rapana* population was still buried in the ground, because of which it could not be accounted. Having in mind the data about catch development during the previous years, a projection could be given that if the investigations were carried out in July or August the commercial stock and TAC would increase with 3500 and 1505 tons respectively (SLABACOV *et al.*, 1993). Besides, the given assessments concern a restricted area of the Bulgarian Black sea coast. If the uninvestigated, but promising regions with total area of 120 sq.km approximately, are taken into consideration, the assessments would increase with 1574.4 and 677 tons respectively. According to the above considerations total prognosis of *Rapana* stock and TAC along Bulgarian Black sea coast during 1993 would be as follows:

Sources	Commercial stock [Ton]	Meat biomass	Allowable catch [ton]	Total	Meat
Observed regions	2408.2	465.4	1035.5	200.1	200.1
Not observed regions	1574	313.2	677.0	100.2	100.2
Probably buried part of <i>Rapana</i> population	3500.0	700.0	1505.0	224.1	224.1
Total prognosis	7482.6	1478.6	3217.5	524.4	524.4

The commercial stock biomass (individuals with fresh weight above 60 g) and TAC of *Rapana thomasiana* along Bulgarian Black Sea coast during 1993 are about 7482.6 and 3217.5 or 1478.6 and 524.4 tons respectively. The most suitable period of doing such assessments is July.

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**GROWTH RATE OF RAPANA THOMASIANA (GASTROPODA) ALONG BULGARIAN BLACK SEA COAST**

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*Rapana thomasiana* is introduced into Black sea probably by ships from Japan sea. This far-sea species is now the biggest of the Black sea snails, which predominantly are characterized with small sizes. More detailed investigations on the life cycle of *Rapana thomasiana* (feeding, growth, age, reproduction) are carried out along the ICC (Ukraine) Black sea coast (ZENKEVICH, 1947; CHUKHCHIN, 1961; IVANOV, RUDENKO, 1969). For the Bulgarian Black sea coast, this species is reported by KANEVA-ABADJIEVA, 1957).

Each sample of *Rapana thomasiana* was separated in size groups according to the shell length (the distance from the top of the shell to the end of the siphon channel) at 5 mm interval. The length is measured by slide-gauge. After that the following parameters of each size group are measured: total number, total fresh weight (g), total boiled useful meat weight (after 5 minutes boiling), total shell weight (g), age of each specimens. The investigations of growth rate of *Rapana thomasiana* are based on 283 samples from 10 regions and total of 3031 specimens.

The relationship between length and total fresh weight is estimated according the equation:

$$(1) W = a.L^n$$

Growth parameters of *Rapana thomasiana* are obtained by von Bertalanffy's equations:

$$(2) Lt = Linf [ 1 - exp [ - k ( t - t_0 ) ] ]$$

$$(3) Wt = Winf [ 1 - exp [ - k ( t - t_0 ) ] ]^n$$

where: k = growth coefficient, t = age, Linf and Winf are maximum values of length and weight respectively.

The mean value of natural mortality coefficient is established by the methods of KUTTY, QUASIM (1965), ALVERSON, CARNEY (1975), RICHTER, EFANOV (1976).

$$(4) t_c = [ \ln ( n.k + M ) - \ln M ] / k + t_0 \quad \text{Kutty, Quasim}$$

$$(5) M = 3.k / [ \exp ( T_{mb}.k ) - 1 ] \quad \text{Alverson, Carney}$$

$$(6) M = 1.521 / X^{0.720} - 0.155 \quad \text{Richter, Efanov}$$

From total investigated area (214.9 sq.km.) the greatest weight and meat density (t/sq.km.) was registered in Kamchia region (19.9 tons), followed by Shcorpilovtsi (5.45 tons) and Aladja (5.04 tons) regions. The length and weight compositions varied from 40 to 115 cm. and from 18.39 to 309.58 g. respectively. The mean length and weight values ranged from 70 (Kaliakra region) to 92 cm (Shcorpilovtsi) and from 80 to 172 g. respectively.

The parameter values in equation (1) are: a = 0.0005114 n = 2.8135208.

The age composition of *Rapana thomasiana* is given in Table 1

Length [mm]	Weight [g]	AGE GROUPS								Total
		2	3	4	5	6	7	8	9	
40	18.38		2							2
45	23.24	4	28	10	1					43
50	28.82	4	47	45	5					101
55	35.33	11	44	47	5					107
60	45.61	4	53	46	12					115
65	59.64	4	40	75	34					153
70	75.22	2	34	121	37	16	1			211
75	91.70	1	21	15	96	21	1			255
80	110.35		10	90	183	42	7			332
85	134.80		2	61	176	100	13	1		353
90	159.06			24	155	154	58	6	1	398
95	185.58			9	68	130	94	15	2	318
100	211.59			1	26	88	82	30	2	229
105	242.43				9	21	52	14	1	97
110	272.12				1	9	27	12	4	53
115	309.58						3	5	4	12
Total		30	281	644	808	581	338	83	14	2779
%		1.08	10.11	23.17	29.08	20.91	12.16	2.99	0.50	100.00
Mt		56.67	59.84	70.68	82.86	90.81	97.87	101.40	106.10	
Mg		42.00	50.70	82.70	128.30	165.20	199.80	221.40	262.40	

According to these data, the parameters of Bertalanffy's equations was established:

$$Linf = 123.98 \quad Winf = 423.75$$

$$k = 0.2142202 \quad k = 0.1988782$$

$$t_0 = -0.0822087 \quad t_0 = -0.2202925$$

The values of natural mortality coefficient (M) was estimated by the above mentioned methods (equations 4-6). The mean value is about 0.5.

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