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A CONTRIBUTION TO THE KNOWLEDGE OF THE VARIATIONS IN THE LARVAE OF OYSTER, *OSTREA EDULIS* L., IN THE AREA OF THE BAY OF MALI STON

PRILOG POZNAVANJU KRETANJA LARVI KAMENICE, *OSTREA EDULIS* L. U PODRUČJU MALOSTONSKOG ZALJEVA

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The paper deals with the results af the attachment of oyster larvae in the Bay of Mali Ston in the 1971—1976 period. The most appropriate time for their attachment is indicated. The influence of some environmental factors on the atachment of larvae is also shown (temperature, salinity, plankton).

INTRODUCTION

The studies of the variations in the oyster larvae in the Bay of Mali Ston were carried out in 1971—1976 period. These studies aimed to obtain the data on the maximum quantities of larvae in the plankton, i.e. to establish the as optimum attachment as possible of these larvae to collectors. The data on temperature and salinity were also collected to establish the correlation between these two factors and spawning in a long-term cycle of sampling.

The prectice has so far been such as that the stacks for the reception of oyster larvae have been placed into the sea in June and October (to receive the spring and autumn spawn respectively), particularly in the second half of the month, taking no account of either the number of oyster spawners or of the quantity of larvae in the sea. Due to the neglection of these factors and basing only upon their long-term experience, the breedera very often threw the stacks into the sea too late. Therefore, our studies were directed to these problems. However, our abilities were limited and we succeded for the time being to give only a more defined explanation concerning these problems.

Since the study areas of Krstac and Bistrinski most proved to give the maximum values of larvae they were taken as permanent stations and studied more intensively than the others.

Oyster larvae were caught by plankton net (scantlings: 1 m in length, 35 cm mouth opening diameter, 145 μ mesh size). Number of larvae was calculated on the basis of counting and recomputed for the cubic metre of the sea water.

RESULTS AND DISCUSSION

Results show that the whole area from the island Otok života to the small village Duba is suitable for placing of stacks for the reception of larvae. However, the Krstac position gave the best results as far as the number of received larvae throughout the period of investigations is concerened, as well as the largest number of larvae found there.

As to the size of larvae the measurements show that the size of black larvae of oysters is, on an average, 149 μ. However, that of the younger larvae, i.e. white larvae, is considerably lower, on an average 104 μ. The biggest larva found in the sea was 238 μ. These sizes agree with those reported by a number of authors (Marteil, 1976).

Our studies show differences in variations of the maximum numbers of larvae between the investigated stations (Tables 1—6). Maximum number recorded from station Krstac in May 1974 was 75513 larvae in a cubic metre of the sea water. Maximum number recorded from the station Bistrina in September was 27210 larvae per cubic metre. If these date are compared to those from the oyster farms in the Northern Adriatic, where in the cove Vela Draga over 800 harvae per cubic metre were recorded, in the Pomer Bay 80 larvae per cubic metre (Hrs—Brenko, 1977) and in the Lim Channel over 600 larvae per cubic metre (Hrs—Brenko, 1977), it may be seen what extraordinary potentialities the Bay of Mali Ston offers. The investigations carried out in 1976 were more intensive. Therfore, they may be more reliable as to the occurrence of larvae. They show that the maximum quantity of larvae is recorded during the first days of September, but that larger quantities may be found in June and July, as vell (Table 6).

It may be of importance to mention that the variations in the number of larvae in the Bay of Mali Ston show that the maximum occurs in the first days of September and the minimum at both stations in August. The causes

Table 1.

Oyster larvae

Date	Position	Depth	Number or larvae per m³ of water	T°C		Sal‰	
				Surface	Bottom	Surface	Bottom
24 August 1971	Krstac	15	1,592	21.80	17.40	36.96	38.39
24 September 1971	„	„	1,194	19.40	19.60	36.02	38.13
24 March 1971	Bistrinski most	8	0	13.30	12.00	36.51	37.59
20 August 1971	„	„	10,483	25.20	19.20	34.16	38.12
21 August 1971	„	„	5,175	25.40	18.40	34.45	38.12
23 August 1971	„	„	4,512	23.40	17.50	36.58	38.31
24 August 1971	„	„	1,194	23.00	17.60	36.94	38.33
25 August 1971	„	„	1,062	23.00	18.80	35.26	38.39
9 September 1971	„	„	42,065	20.60	20.80	36.37	36.91
10 September 1971	„	„	38,482	20.60	20.20	36.80	36.82
11 September 1971	„	„	10,085	20.80	19.20	36.83	38.33
23 September 1971	„	„	30,201	19.20	19.40	36.89	37.59

Table 2.

Oyster larvae

Date	Position	Depth	Number or larvae per m³ of water	T°C Surface	T°C Bottom	Sal‰ Surface	Sal‰ Bottom
1 June 1972	Krstac	15	3,963	19.40	16.40	35.21	37.70
22 September 1972	„	„	9,979	20.60	20.40	34.29	37.74
5 May 1972	Bistrinski most	8	7,400	17.40	15.60	30.50	37.50
31 May 1972	„	„	14,150	19.50	18.00	35.37	37.07
1 June 1972	„	„	14,980	19.40	17.70	36.09	37.29
28 June 1972	„	„	28,264	22.60	22.10	35.28	35.97
10 August 1972	„	„	21,000	24.20	21.40	34.74	37.27
28 August 1972	„	„	32,643	22.20	20.60	34.58	37.68
29 August 1972	„	„	16,985	22.60	20.50	34.90	37.68
30 August 1972	„	„	17,340	21.80	19.80	33.44	37.84
21 September 1972	„	„	20,170	19.60	20.80	33.78	37.25
22 September 1972	„	„	26,141	20.20	20.90	34.11	37.34

Table 3

Oyster larvae

Date	Position	Depth	Number or larvae of water per m³	T°C Surface	T°C Bottom	Sal‰ Surface	Sal‰ Bottom
16 June 1973	Krstac	15	3,680	21.20	17.60	32.88	37.19
18 July 1973	„	„	25,407	16.60	14.80	37.84	38.35
16 August 1973	„	„	21,939	24.20	16.00	35.37	38.06
10 October 1973	„	„	5,166	21.40	21.30	37.57	37.81
12 May 1973	Bistrinski most	8	2,128	16.00	15.00	31.69	36.96
16 June 1973	„	„	14,734	21.00	18.10	33.58	37.01
20 July 1973	„	„	9,308	20.60	17.80	36.92	38.15
15 August 1973	„	„	5,984	25.00	19.30	35.26	37.61
13 October 1973	„	„	9,468	20.20	21.20	35.73	37.54

Table 4

Oyster larvae

Date	Position	Depth	Number or larvae of water per m³	T°C Surface	T°C Bottom	Sal‰ Surface	Sal‰ Bottom
9 May 1974	Krstac	15	75,513	14.80	14.20	36.76	37.97
31 May 1974	„	„	57,643	19.20	16.20	30.66	37.38
29 July 1974	„	„	11,556	23.00	17.60	34.43	37.36
8 February 1974	Bistrinski most	8	0	13.20	13.60	35.93	36.67
15 March 1974	„	„	0	11.80	13.20	36.40	36.96
10 May 1974	„	„	21,218	15.20	14.80	34.51	37.83
28 May 1974	„	„	19,620	18.60	18.00	32.72	33.82
30 May 1974	„	„	13,535	19.20	16.80	33.64	37.05
31 May 1974	„	„	16,587	19.20	18.40	34.34	34.90
30 July 1974	„	„	3,200	23.20	22.60	34.65	36.08
12 September 1974	„	„	27,210	23.40	23.20	36.42	36.53
22 November 1974	„	„	0	17.00	17.40	36.83	37.56

Table 5

Oyster larvae

Date	Position	Depth	Number or larvae of water per m³	T°C Surface	T°C Bottom	Sal‰ Surface	Sal‰ Bottom
13 May 1975	Krstac	15	28,309	16.20	14.80	35.99	37.90
16 May 1975	„	„	69,000	17.40	16.20	35.01	36.02
12 August 1975	„	„	20,240	23.80	16.60	36.11	38.58
14 August 1975	„	„	19,980	20.40	16.40	37.34	38.39
22 April 1975	Bistrinski most	8	8,493	15.00	14.60	32.50	34.97
13 May 1975	„	„	18,975	16.80	15.20	34.58	37.65
16 May 1975	„	„	17,250	17.60	16.20	35.08	37.86
19 June 1975	„	„	18,046	21.20	17.40	36.33	38.15
9 August 1975	„	„	24,890	23.40	23.20	36.24	36.83
11 August 1975	„	„	25,080	24.00	22.20	36.35	36.55
12 August 1975	„	„	17,649	23.80	17.40	36.11	38.35
7 November 1975	„	„	1,400	16.60	20.20	—	—

Table 6

Oyster larvae

Date	Position	Depth	Number of larvae per	T°C Surface	T°C Bottom
		m	m³ water		
10 June 1976	Krstac	15	12,173	19.80	17.00
17 June 1976	„	„	15,924	17.40	17.40
9 July 1976	„	„	13,022	23.60	18.00
16 July 1976	„	„	20,247	25.40	17.60
23 July 1976	„	„	17,763	23.60	16.80
30 July 1976	„	„	11,464	20.80	20.00
8 August 1976	„	„	1,529	22.80	18.40
16 August 1976	„	„	5,590	23.20	18.20
2 September 1976	„	„	34,387	20.40	17.40
17 September 1976	„	„	13,184	19.00	18.00
8 October 1976	„	„	12,831	20.20	19.60
7 June 1976	Bistrinski most	8	35,960	19.00	17.00
8 June 1976	„	„	40,472	—	—
9 June 1976	„	„	30,000	19.00	16.80
11 June 1976	„	„	24,682	19.80	18.20
17 June 1976	„	„	31,582	21.30	18.00
27 June 1976	„	„	14,331	24.20	19.00
2 July 1976	„	„	10,218	24.20	19.40
23 July 1976	„	„	25,079	22.80	19.20
30 July 1976	„	„	17,250	19.60	21.40
8 August 1976	„	„	9,819	21.60	22.00
16 August 1976	„	„	6,900	23.60	19.00
2 September 1976	„	„	51,834	21.60	19.00
17 September 1976	„	„	34,368	18.80	18.00
7 October 1976	„	„	22,691	19.40	19.80
18 October 1976	„	„	32,506	19.20	19.40

of the decrease in the number of larvae in individual months could not be established. Stjepčević (1974) states that the intensity of the outgoing current in the Bay of Boka Kotorska may be the cause why an enormous quantity of larvae leave the waters of the bay even before they have completed their metamorphosis.

We also observed the variations in the percentage of oyster spawners opened for commercial purposes. On the basis of comparison of the date obtained by observations of the number of larvae in the sea and the percentage of oyster spawners it was established, as expected, that the number of larvae in the sea reflects the percentage of oyster spawners. The only exception is the May 1973 (Table 3) when the number of larvae in the sea (2128/m^3 of water) did not reflect the percentage of oyster spawners (7% in the black roe and 3% in the white one). This is probably due to that, while sampling the plankton larvae in May we missed the water current which carried larvae. The intervals between individual samplings were sometimes too long. due to objective difficulties. Even though not frequently, on some occasions the intervals between individual samplings were short. Thus it may be assumed that some maxima of larvae were not recorded i.e. that we missed the current which carried larvae and the number of larvae obtained was considerably lower than the actual one.

On the basis of the data obtained by observations in the sea (Table 1—6) and on the basis of comparison with the commercial pieces, we placed also the stacks into the sea, marked thus as to distinguish them from those of the oyster farmers which were put into the sea on the basis of their long-term experience. Thus we were able to observe the relation between the number of larvae in the sea and the number of larvae which took hold of the stacks.

A survay of the stacks established that the appropriate time for placing the stacks into the sea begins when there is about 5% of oyster spawners in the black roe i.e. when the number of larvae in the sea reaches the quantity of 15000 per cubic metre of the water. It was also observed that throughout the period of phytoplankton bloom, in spite of the favourable conditions concerning the number of larvae in the sea and the percent of oyster spawners, the attachment of larvae was very poor. This may be due to that during the bloom the enormous quantity of plankton is present in the bay as a mucous mass. This hinders larvae from settling to the pure base.

The long-term investigations included also the collection of data on temperature and salinity. These aimed to establish the relation between these two factors and the number of larvae. It was established that the largest number of larvae was recorded at temperature range 14.8—24.2°C at the surface and 14.2—22.1°C at the bottom. At temperature 11.8°C to 13.3°C at the surface and 12.0 to 13.2°C at the bottom no one individual of oyster larvae was established from the plankton samples. According to Peruško, (1970) the optimum spawning temperature varies between 10°C and 15°C in dependence of the temperature conditions during the gonad maturation. At temperature lower than 14°C the growth of larvae within the mantle space is decclerated (Hrs—Brenko, 1971).

Salinity of the sea water was not found to affect the number of larvae in the sea. This is agreement with the data of Marteil (1976) who established that salinity changes had practicaly no effect on the larval development.

CONCLUSIONS

1. The whole of the area between the island Otok života and the small village Duba is suitable for the placing of stacks for the reception of oyster larvae.

2. Larvae of oyster occur in the plankton from April to December with maximum in the warmer part of the year i.e. in May, June, July, August and September.

3. The number of larvae in the sea reflects the percentage of oyster spawners.

4. The time suitable for placing the stacks into the sea begins when there is 5% of oyster spawners in the black roe, i.e. when the number of larvae in the sea reaches the qaantity of 15000 per cubic metre of water.

5. Even though the conditions for placing the stacks into the sea are favourable during the plankton bloom, the attachment of larvae is poor.

6. It was established that there was no oyster larvae in the plankton at temperatures lower than 14°C. Throughout the period of investigations, salinity changes in the Bay of Mali Ston varied within the limits optimum for the survival of larvae.

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KRATAK SADRŽAJ

U radu se iznose šestogodišnji (1971—1976) rezultati ispitivanja kretanja larvi kamenice u Malostonskom zaljevu. Dati su također i podaci za temperaturu i salinitet i odnos ovih dvaju faktora spram mriješćenja. Larve kamenice lovljene su planktonskom mrežom (dimenzije: dužina 1 m, promjer otvora 35 cm, veličina oka mreže 145 mikrona). Broj larva izračunat je na temelju brojenja i preračunat je na 1 m^3 vode.

Rezultati istraživanja su pokazali da je čitavo područje od otoka Života prema mjestu Duba povoljno za polaganje snopića za prihvat larvi. Ipak od svih najbolje rezultate je pokazala pozicija Krstac i to po broju prihvaćenih larvi kamenice u Malostonskom zaljevu. Dati su također i podaci za temperanađenih larvi (75513 komada larvi u m^3 vode). Larve kamenice dolaze u planktonu od travnja do prosinca s maksimumima u toplije doba godine tj. u svibnju, lipnju, srpnju, kolovozu ili rujnu. Na temelju komparacije podataka dobivenih promatranjem broja larvi u moru i postotaka mrijesnih kamenica utvrdili smo, što je bilo i za očekivati, da je broj larva u moru odraz postotka mrijesnih kamenica. Pregledom snopića utvrđeno je da povoljno vrijeme za polaganje snopića u moru počima kada već imamo 5% mrijesnih kamenica u crnom sjemenu, odnosno kada broj larva dostigne količinu od 15000 komada na 1 m^3 vode. Primjećeno je također da za vrijeme sve dok traje cvatnja planktona, iako postoje povoljni uvjeti za polaganje snopića u smislu broja larva u moru i broja mrijesnih kamenica, da je prihvat larva jako loš. Također je utvrđeno da kod temperatura nižih od 14°C nije bilo larvi kamenice u planktonu. Promjene saliniteta u Malostonskom zaljevu, u vrijeme istraživanja, kretale su se unutar optimalnih granica za preživljavanje ličinki.