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INFESTATION OF EUROPEAN FLAT OYSTER *(OSTREA EDULIS)* BY POLYCHAETE *(POLYDORA HOPLURA)* IN THE NORTHERN ADRIATIC SEA

INVADIRANOST EVROPSKE PLOSNATE KAMENICE *(OSTREA EDULIS)* POLIHETOM *(POLYDORA HOPLURA)* U SJEVERNOM JADRANU

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The intensity of infestation of commercial oysters *Ostrea edulis* Linnaeus by the polychaete *Polydora hoplura* Claparède, was studied in two commercial farms located in Limski kanal and Raša Bay (northern Adriatic Sea) in 1985. The percentage of oysters invaded by this polychaete ranged from 0.0 to 88.8% per sample. Despite the high infestation of some samples, the number of the observed live polychaetes per oyster was low with mean values ranging from 1—3 specimens. The highest registered number in one oyster was 5 polychaetes. No relationship exists between the mean number of polychaetes and index of condition of commercial oysters, probably due to the low number of polychaetes per investigated oyster. Negligible differences in the index of condition of oysters among the investigated localities oculd be the result of either of differences in environmental conditions or in the stages of gonad development of oysters in various months.

INTRODUCTION

The cosmopolitan genus *Polidora* (Spionidae, Polychaeta) is represented in Europe by two bivalve — invading species, *P. ciliata* and *P. hoplura*. *P. hoplura* occurs frequently in the shells of oysters in the Mediterranean Sea and in the south Atlantic waters according to several authors (cited by Lauckner, 1983).

In oysters, *Polydora hoplura* produces mud blister; or excavates »U« shaped burrows over the inner shell surface. The literature data indicate a number of morphological, physiological and commercial disturbances of invaded oysters, mussels, and other bivalve mollusc species by *Polydora* species (Lauckner, 1983). The disturbances have been manifested as shell growth

retardation, deformation and breakage, reduction of the shell cavity due to large blisters that cause a decrease in the possibility of exchange of water, oxygen content, available food, and finally even death. Polychaetes can sometimes cause a decrease in commercial value of market oysters when a bad odour appears due to decomposition of mud in the burrows and blisters, especially after damage to the shell surface. Also heavily invaded oyster shells are easily broken during shipment. The magnitude of deleterious effects of *Polydora* infestation depends upon various factors, predominantly of the intensity of infestation, type and number of burrows and on local environmental conditions.

Polydora hoplura has been observed in the shells of cultivated oysters at several locations along the eastern Adriatic Sea; however, intensive study of this polychaete has been undertaken in Boka Kotorska Bay (Stjepčević, 1974). In this paper we describe the intensity of the infestation of commercial oysters by *P. hoplura* from Limski kanal and Raša Bay and its possible effects on the quantity of oyster meat (index of condition).

MATERIAL AND METHODS

Samples (25 to 118 specimens) of the European flat oyster (*Ostrea edulis*, Linnaeus) were taken from plastic boxes submerged from the floating platform and parks at about 2 m depth from commercial farms in Limski kanal and Raša Bay (Blaz A, B, and Risvica inlets) in the northern Adriatic Sea in 1985 (Fig. 1). A total of 989 oysters were examined.

The collected oysters were washed and scrubbed to remove mud and fouling organisms. The length of each oyster was measured using a vernier calipers. According to their lengths oysters from Limski kanal (Nov.) and Raša Bay (Jul.) were distributed into 5 mm class intervals from 33 to 108 mm (Table 2). The oysters of several samples from Limski kanal (Jan.-Apr.) were grouped into three length groups (41—60, 61—80, and $>$ 81 mm) with various estimated mean lengths.

The intensity of *Polydora hoplura*, Claparède, infestation was determined after careful opening the oysters and separating the shells from the meat. The number of blisters and live animals in the burrows from the inside surface of both shells were recorded.

In order to estimate the index of condition of examined oysters and to determine possible effects of invaders, the Hopkins method was used:

$$\text{Index of condition} = \frac{\text{Total tissue — dry weight (g)} \times 1000}{\text{Shell-cavity volume (ml)}}$$

The total tissue of each group of oysters was first dried with filter paper, weighed on a technical balance ($\pm$ 0.01) then dried at 105°C for 48 hours, and reweighed. The volume of shell cavities was obtained by subtracting the volume of empty shells from the volume of whole animals. The volumes of empty shells and whole animals were measured in a graduated cylinder (2000 ml).

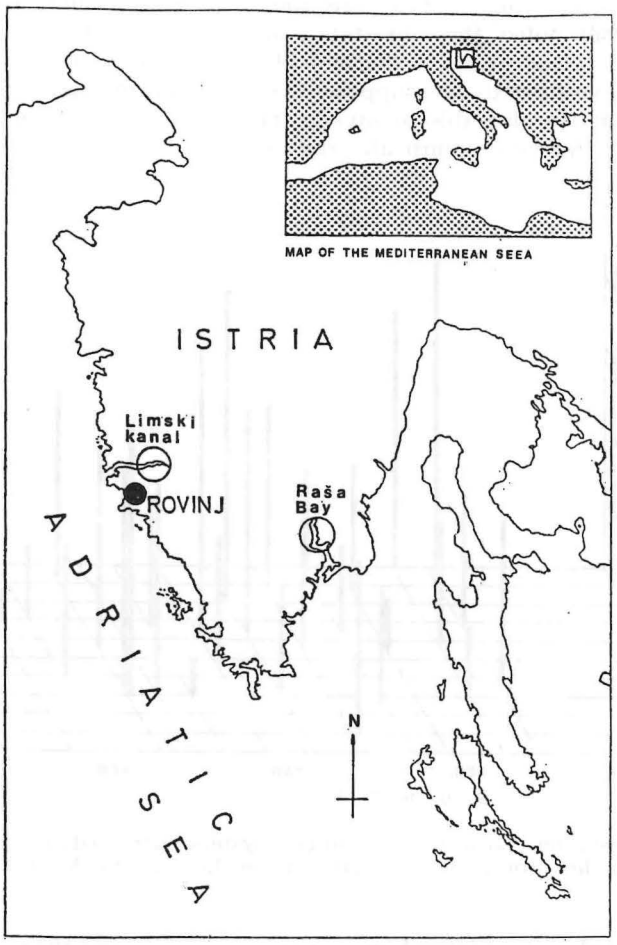

Fig. 1. Location of sample collections: Limski kanal and Raša Bay, Istria, northern Adriatic Sea.

RESULTS AND DISCUSSION

In oysters collected from Limski kanal, between January and April 1985, the percntage of oysters invaded by *Polydora hoplura* ranged from 0.0 to 88.8% per oyster group in the sample, and mean number of polychaetes from 1 to 2 per invaded oyster. The calculated index of condition varied between 31.9 to 98.1 (Fig. 2). Given the wide range of the percentage of invaded oysters in various length group classes (45.3 to 89.6 mm), and the several months duration of observations, it appears that each oyster in the environment has, at any time, the same chance to be invaded. Daro and Polk (1973) indicated that in Belgium the life-cycle of *P. ciliata* lasts about 6 weeks,

and that their planktonic larvae are found all year round. T i n s m a n and M a u r e r (1986) noted that infestation of oysters by *P. websteri* increased with increased temperature in thermal effluents. Therefore, in spite of different species investigated, we suppose that *P. hoplura* has a short life-cycle, and that larvae are also able to invade the oysters in relatively warm waters of the northern Adriatic almost all year round.

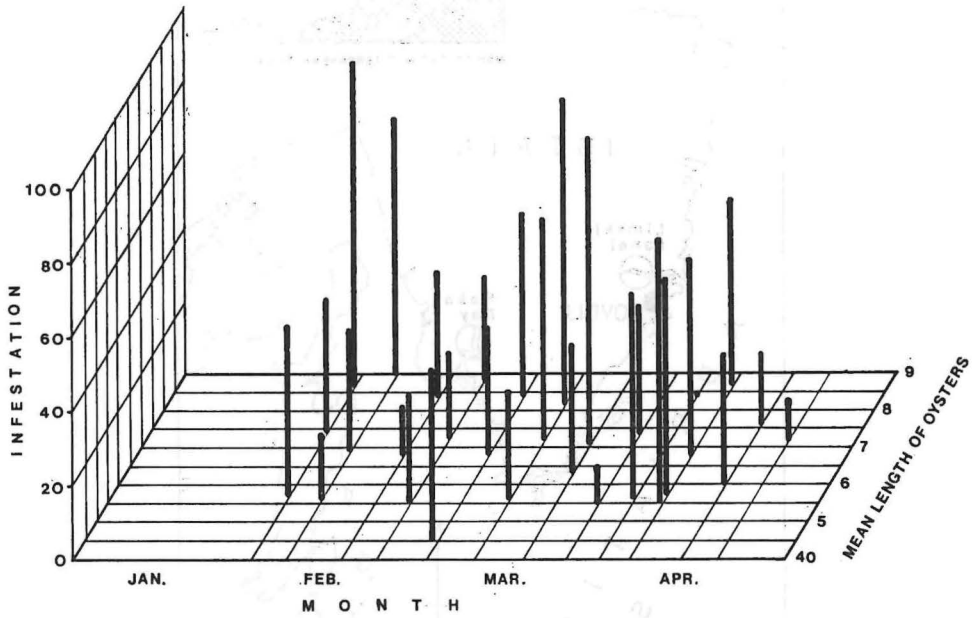

Fig. 2. The infestation (%) of the commercial oysters *Ostrea edulis* by the polychaete *Polydora hoplura* in Limski kanal from January to April 1985.

In the sample taken from Limski kanal in November 1985, the percentage of polychaete infestation was 39.8%. The samples of oysters from Raša Bay were examined in July 1985. About 50.0% of those from Risvica inlet of Raša Bay were invaded. In Blaz inlet an infestation of 74.3% at station Blaz A (not far from the coast), and a 56.6% infestation at station Blaz B (middle part of Blaz) was recorded (Table 1).

In response to the infestation we found that differences in mean length of examined oysters (Limski kanal compared to the inlets of Raša Bay; Table 1) were statistically significant (t raged between 3.10 and 8.75 at $P < 0.05$). For this reason we adopted the x^2-test. Computed x^2-test indicate that there are significant differences between infestation of oysters of Limski kanal and Blaz inlet ($x^2 = 11.51$ at probabilities of 0.05). The differences between Blaz A and Risvica inlets were significant ($x^2 = 4.99$) at a probability level of 0.05, but not at level of 0.01 There were no significant differences between Limski kanal and Risvica ($x^2 = 1.67$) nor between Blaz A and B stations ($x^2 = 0.96$) at probability level of 0.05. According to these x^2 — tests, it appears that

Table 1. The infestation (%) of commercial oysters *Ostrea edulis* by *Polydora hoplura* in Limski kanal (November 1985) and Raša Bay (July 1985).

Locality	Oyster lenght (mm)			No of Oysters Examined		No of Para-sites	Infestation (%) Shell			Range of Lenght Clase	Mean No. of polychaete/ oyster
	mean	SD	Sx		Invaded		Total	Right	Lefc		
Limski kanal	59.69	11.34	1.04	118	47	62	39.8	25.8	74.2	18.2— 55.5	1.0—1.6
Raša Bay											
Blaz A	77.41	11.89	1.75	46	26	44	74.3	11.4	88.6	0.0—100.0	0.0—3.0
Blaz B	67.81	11.66	2.24	27	16	21	56.6	42.9	57.1	0.0—100.0	0.0—2.0
Risvica	65.71	14.38	1.56	42	84	42	50.0	42.6	57.3	25.0—100.0	0.3—2.5

infestation of *P. hoplura* as an environmental factor of cultivated oysters in Limski kanal is closer to that in Risvica inlet than to that in Blaz inlet.

Despite of the fact that infestation of some samples was high (up to 88.8%), the number of observed live polychaetes per oyster was low ranging from 1 to 3 specimens. The highest recorded number in one oyster was 5 polychaetes, which is negligible in comparison to 300 invaders in one oyster from the west coast of Britain, cited by L a u c k n e r (1983) according to C o l e (1956) and C o l e and W a u g h (1958).

In both localities, the percentage of the infestation in cupped (left) shell was always higher (57.1 to 88.6%) and was laso accompanied by more blisters (1—10) than in the flat (right) one (11.4 to 42.9%) (Table 1). This phenomenon could be attributed to fact that the cupped shell is much thicker. In the blisters there were no polychaetes observed, but they were often filled by malodorcus mud.

Fig.3

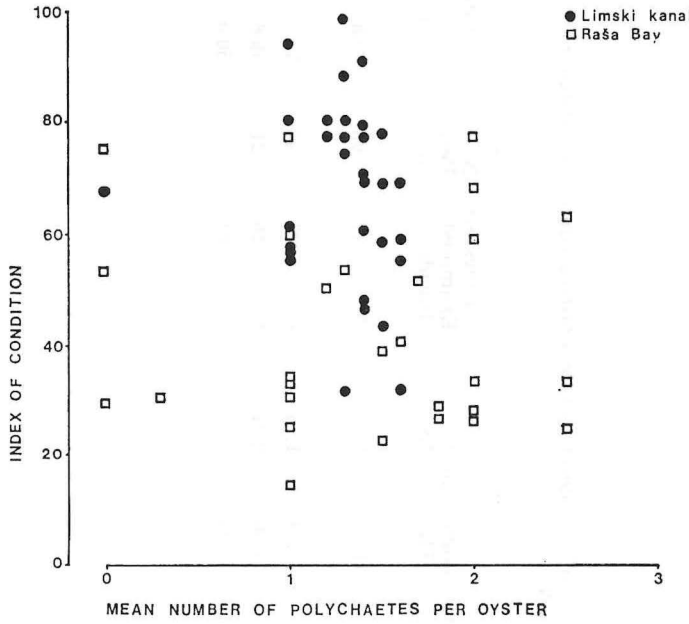

Fig. 3. The relationship between index of condition of the commercial oysters *Ostrea edulis* and mean number of the polychaete *Polydora hoplura* per invaded oyster.

Incidence and intensity of infestation depend of local ecological conditions. S t j e p č e v i ć (1974) reported less intensive infestation of oysters in Boka Kotorska (Morinj, Orahovac) than found here for Limski kanal or Raša Bay. S t j e p č e v i ć (op. cit.) attributed this phenomenon to low salinity, which was

below 25 ppt at a 2 m depth in some months of the year. In Limski kanal and Raša Bay salinity was always over 30 ppt at the same depth, in this and previous observations (Božić, Hrs-Brenko and Marinković, 1964).

No relationship exist between the mean numbers of polychates and the index of conditions of oysters (Fig. 3). Sometimes, in both localities, the index of condition of invaded oysters was higher than in noninvaded specimens. It seems possible that the number of polychaetes per oyster is too low to have any deleterious effect on the host. According to Tinsman and Maurer (1986), Galtsoff (1964) reported that oysters heavily invaded with *Polydora websteri* were usually in good condition. On the other hand Lauckner (1983) cited that Kent (1979) found a decline of condition index in relation to the number of *P. ciliata* per mussel.

Table 2. The index of condition of commercial oysters *(Ostrea edulis)*, and mean number of *Polydora hoplura* per infestated oyster in Limski kanal and Raša Bay in 1985.

Locality	Mean lenght (mm)	Range of Tissue dry weight (g)	Shell-cavity volume (ml)	Index of condition	Mean NO. of polychaete/ oyster
Limski kanal	43— 73	1.1—4.3	20—160	24.6—55.0	1.0—1.6
Raša Bay					
Blaz A	53—108	0.3—2.5	10— 70	30.0—77.2	0.0—3.0
Blaz B	43— 93	0.1—5.3	3—105	14.1—52.6	0.0—2.0
Risvica	33— 93	0.1—9.6	3—180	25.0—77.1	0.3—2.5

We suppose that the observed values of the index of condition for oysters from Limski kanal and Raša Bay could result either from environmental conditions or from differences in the stage of gonad development rather than from polychaete infestation (Table 2). In Limski kanal in November oysters are developing gonad, whereas in July they are spawning or have recovering gonad (Peruško, 1967; Hrs-Brenko, 1969). Spawning activity results in a loss of meat in the shell cavity and a decrease of index of condition (Hrs-Brenko, 1973; Mann, 1978; Lucas and Beninger, 1985).

Our data indicate that, in the northern Adriatic, infestation of oysters by polychaetes is of sufficiently low intensity to have no significant impact on either meat quality of commercial value of cultivated oysters.

CONCLUSIONS

The studies on the intensity of infestation of Europan oyster (*Ostrea edulis*) by the polychaete (*Polidora hoplura*) gave the following results:

The percentage of oysters invaded by polychaete ranged from 0 to 88.8% in Limski kanal; in Raša Bay in the inlet Risvica about 50.0%, and in inlet Blaz 56.6 and 74.3%.

Despite the high infestation of the samples, the number of the observed live polychaetes per oyster was low with mean values ranging from 1 to 3 specimens. The highest registered number in one oyster was 5 polychaetes.

In both localities, the percentage of the infestation in left shell was higher (57.1 to 88.6%), and was also accompanied by more blisters (1—10) than in right uper shell (11.4 to 42.9%).

According to x^2-tests, it appears that infestation of polychaetes as an environmental factor of cultivated oyster in Limski kanal is closer to that in Risvica inlet than to that in Blaz inlet.

No relationship exists between the mean number of polychaetes and index of condition of commercial oysters, probably due to the low number of polychaetes per investigated oyster. Negligible differences in the index of condition of oysters among the investigated localities could be the result of either of differences in environmental conditions or in the stages of gonad development of oysters in various months.

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KRATKI SADRŽAJ

Polihet *(Polydora hoplura)* često invadira evropsku plosnatu kamenicu *(Ostrea edulis)* bušeći hodnike u ljušturama karakteristična oblika. U istraživanim lokalitetima Limski kanal i Zalejv Raša invadiranost komercijalnih kamenica se kretala 0.0 do 88.6% po uzorcima. Usprkos visokoj invadiranosti kamenica broj živih parazita po kamenici bio je nizak sa srednjim vrijednostima od 1 do 3 poliheta. Najviše 5 poliheta nađeno je u jednoj kamenici. Nisu utvrđene razlike u intenzitetu invadiranosti u raznim mjesecima godine kao ni razlike između raznih duljinskih razrednih grupa pamenica. Prema izračunatom x^2-testu izgleda da invadiranost polihetom kao faktor okoline uzgajivanih kamenica u Limskom kanalu je bliži onom u Risvici nego u uvali Blaz. Nije utvrđena korelacija između srednjeg broja poliheta i indeksa kondicije komercijalnih kamenica, vjerojatno zbog malog broja parazita u njima. Neznatne razlike u indeksima kondicije kamenica istraživanih lokaliteta vjerojatno su rezultati razlika u prilikama sredine ili stadija gonadnog razvoja kamenica u raznim mjesecima godine.