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Ecological-faunistic review of parasitic fauna of some Macrouridae in the Northwest Atlantic

by

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Abstract

In 1974-1979 in different parts of the area Coryphaenoides rupestris, Macrourus berglax, Nezumia bairdii and Chalinura brevibarbis were examined, and 32 species of parasites were found. The data obtained indicate that in C.rupestris and N.bairdii these species with which fish are infested during feeding on pelagic animals and also parasites obtained by fish directly in water are dominant. In M.berglax parasites which infest fish feeding on benthic animals and fish (typical benthophages) are found more often.

Parasitic fauna of M.berglax and N.bairdii examined in various areas and depths has substantial differences. It indicates a high degree of isolation of fish examined and allows to make a conclusion on existence of, at least, two populations of M.berglax and N.bairdii. On the other hand, parasitic fauna of C.rupestris from different areas has no significant qualitative and quantitative differences; all variations in infestation by some species in different periods have a regular character. All this allows to affirm that all the examined groupings of C.rupestris are interrelated to each other.

Introduction

Considerable depths of dwelling of Macrouridae are a substantial obstacle for this species comprehensive study. Because of this, apparently, up to the present time there are only random pieces of information on parasites of this group of fish from the Northwest Atlantic. The first information relates to 1920 when Wilson (1920) found copeped Chondracantus radiatus in Coryphaenoides rupestris. Later on Dolichoenterum sp., Gonocerca crassa (Szuks, 1975), Myxidium melanostigmum, M.melanocetum, M.profundum, Zschokkella hildae,

Auerbachia sp ., Diclidophora macruri, Bothriocephalus sp., Scolex pleuronectis l., Hemiurus macrouri, Derogenes various, Gonocerca macrouri, Aporocotyle simplex, Contracaecum aduncum, Anisakis sp.l., Copepoda gen.sp. were also found in this species of fish (Zubchenko, I976; Zubchenko, Krasin, I980; Zubchenko, I98I). Parasitic fauna of Macrourus berglax in which Sphyrion lumpi (Templeman, Squires, I960), Clavellomimus macruri (Kabata, I969), Eimeria sp., Glugea berglax, Myxidium melanostigmum, M.melanocetum, Auerbachia pulchra, Davisia newfoundlandia were found is studied less comprehensively (Yoshino, Noble, I973; Lom, Noble, Laird, I975; Lom, Laird, I976; Noser, I977; Noser, Noble, I977a; Zubchenko, Krasin, I980; Gaevskaya, Kovalyova, Umnova, I980). Besides these two species of Macrouridae the parasitic fauna of Nezumia bairdi for which Auerbachia pulchra and Zschokkella globulosa are indicated was also studied in the Northwest Atlantic (Moser, Noble, I977 a,b).

All the papers mentioned above are, mainly, of systematic character, they hardly touch ecologic aspects which, to our mind, are of the greatest interest.

Material and methods

The material for the present paper was collected during I974-79 in different parts of the Northwest Atlantic (Davis Strait, Labrador, Northern Newfoundland Bank, Flemish Cap Bank). 353 specimens of fish (Coryphaenoides rupestris - 300, Macrourus berglax - 30, Nezumia bairdi - 23) were examined by the method of complete parasitologic dissection. In the Flemish Cap Bank area one specimen of Chalinura brevibarbis was dissected, spores of mixosporidia Auerbachia pulchra were found in its gall bladder. The material was treated in accordance with generally adopted methods. Differential diagnosis of parasites was made in the PINRO laboratory of parasitology and also in similar laboratories of the USSR A.S. Institute of Zoology and Atlant-NIRO.

Results

In fish examined 32 species of parasites related to seven taxonomic groups were found: Myxosporidia-7, Monogenoidea-2, Cestoda-4, Trematoda-I0, Nematoda-4, Acanthocephala-I, Crustacea-4.

Roundnose grenadier (Coryphaenoides rupestris Gunneris).

I8 species of parasites were found (Table I). Eight of them (Myxidium melanostigmum, M.melanocetum, Auerbachia pulchra, Zschokkella hildae, Diclidophora macruri, Chondracantus radiatus, Clavella adunca) are the parasites with a direct cycle of development. Myxosporidia and Trematoda (5 species of each) were widely presented qualitatively. Fish infestation by Myxidium melanostigmum and Auerbachia pulchra (35.2 - 4I.I% and 46.7 - 86.7%, respectively) is marked out quantita-

tively. Among the parasites found - 4 species (M.profundum, D.macruri, Glomericirrus macrouri, Gonocerca macrouri) are specific for Macrouridae. Four more species (M.melanostigmum, M.melanocetum, A.pulchra, Philobythos atlanticus) are specific for deep-water fish only. These eight parasites characterize as a whole the roundnose grenadier parasitic fauna. The rest IO species of parasites are specific for fish dwelling in upper layers of water. In their majority they have a large circle of hosts and are widely spread. Infestation of roundnose grenadier by these parasites was insignificant and occured, apparently, in the process of diurnal vertical migrations into the zone of the thermocline. Probably in this area grenadier are infested by Scolex pleuronectis l., Derogenes varicus, Contracaecum aduncum l., Anisakis sp.l. the cycle of development of which is connected with different pelagic animals (plankton copepods, euphausiides, sagittae, ctenophora, jellyfish, cephalopoda). But it may not be excluded that fish infestation by the last three species took place during feeding on benthos and nectobenthos, as the intermediate hosts of these parasites were also Amphipoda, Decapoda and Polychaeta.

In general, judging by fish infestation by parasites with a complex cycle of development the food of the fish examined consisted of both, pelagic animals feeding on which fish were infested also by Philobythos atlanticus, Glomericirrus macrouri, and benthic animals which are connected with Trematode Gonocerca macrouri development. Moreover, grenadier's food contains more pelagic organisms than benthic, and this is pointed out by not only qualitative and quantitative domination of the first over the second but also by a variety of Mixosporidia which fish are infested by during swallowing food in water.

The results obtained completely correspond to the data on roundnose grenadier feeding (Podrazhanskaya,I969; Savvatimsky,I969,I970; Konstantinov, Podrazhanskaya,I972), and the comparative analysis of food components occurence frequency described by Savvatimsky (I970) in accordance with the results of investigations in the same areas in October-November,I967, and fish infestation by parasites with a complex cycle of development completely confirms all the above mentioned.

Roughhead grenadier (Macrourus berglax Lacepede) . Twenty species of parasites were found (Table 2), 7 of them (Zschokkella kudoi, Auerbachia pulchra, Davisia newfoundlandia, Cyclocotyloides pinguis, Sphyrion lumpi, Clavella adunca, Clavellomimus macruri) had a direct cycle of development. Trematoda (6 species) were presented qualitatively most widely. Quantitatively on the Flemish Cap Bank we may point out infection of fish by Contracaecum aduncum (73.3%) , Echinorhynchus gadi (46.6%), C.adunca (46.6%) and in the South Labrador area - A.pulchra (46.6%), Gonocerca crassa (53.3%), Genolinea laticauda (53.3%), C.aduncum (66.6%),E.gadi (73.3%), C.adunca (46.6%). Among the parasites found there were species specific for roughhead grena-

dier (Z.kudoi, D.newfoundlandia, C.pinguis, C.macrouri). Two species (A.pulchra, Philobythos atlanticus) are specific for deepwater fish. The other parasites have a large circle of hosts and are widely spread. As it can be ssen from the table the infestation of fish in the two areas investigated is absolutely unequal. This is related, apparently, to differences in the conditions of their dwelling, because in the South Labrador area fish were caught at depths 400-600 m and in the Flemish Cap area - at depths 1200-1300 m. Such a substantial impoverishment of the fish parasitic fauna on the Flemish Cap Bank indicates a poor diet of roughhead grenadier; in this diet Amphipoda (intermediate hosts of Echinorhynchus gadi) and the fish related to nematode Contracaecum aduncum cycle of development are dominant. Among the parasites found in fish of this area the species characteristic for lesser depths are almost absolutely absent but, nevertheless, they are variously presented in the same species of fish in the South Labrador area. Only one species Derogenes varicus may be excluded; fish infestation by this parasite was minimal and occured, probably, during feeding on Amphipoda, Polychaeta or fish infested by mature forms of this Trematode. Poorness and significant differences in the parasitic fauna of roughhead grenadier from this area indicate also a high degree of isolation of this group of fish.

The parasitic fauna of the South Labrador roughhead grenadier is considerably richer. There are various Trematoda (6 species) and other groups of parasites with a complex cycle of development which indicates broad trophic relations of fish dwelling in this area. Benthic animals (Amphipoda, Polychaeta) and fish are of the first-rate importance in the roughhead grenadier diet, as they are the intermediate hosts for Lepidapedon elongatum, Gonocerca crassa, Genolinea laticauda, Echinorhynchus gadi, Contracaecum aduncum and possibly Derogenes varicus. According to Savvatimsky the diet of roughhead grenadier (examined approximately in the same areas) consists of: fish - 11.7-14.0%, Amphipoda - 13.4%, Polychaeta - 4.5%, and according to Geistdoerfer (1976) a portion of Polychaeta in the diet of grenadier is 16.7% and that of Amphipoda - 20.4%. The portion of pelagic animals in the roughhead grenadier diet is insignificant because despite the presence of some parasites (Philobythos atlanticus, Scolex pleuronectis l., Hemiurus levinseni, Anisakis sp.l.) related in their development to this group of animals the extensity and intensity of infestation by them is not severe and it has, apparently, an accidental character. Considering all this we may affirm that roughhead grenadier are benthophages and predators.

Marlinspike (Nezumia bairdi Goode and Bean). Eleven species of parasites were found (Table 3). Only two of them (Myxidium profundum, Auerbachia pulchra) have a direct cycle of development. Trematoda and Nematoda are the most various qualitatively (3 species of each). Quantitatively we may distinguish the infestation of fish by Contra-

caecum aduncum l. (56.3%) on the Flemish Cap Bank and Scolex pleuronectis l. (in all 7 fish dissected) in the South Labrador area. Just similarly to the above mentioned species the parasitic fauna of N.bairdi in the two areas investigated differs significantly but in roughhead grenadier caught at depths II00-II30 m in the Flemish Cap area the qualitative composition of parasites was richer (8 species) than that in the South Labrador area (5 species) where fish were caught at depths 400-450 m. It is peculiar in this case that in the South Labrador area fish were infested only by those parasites the cycle of development of which is related to plankton organisms. On the Flemish Cap Bank plankton is also a very important part of N.bairdi diet, according to their being severely infested by Contracaecum aduncum l.But besides plankton marlinspike in this area feed also on benthos which is comfirmed by the occurence of E.gadi in fish bodies. It is quite possible that a decrease of plankton biomass at considerable depths makes marlinspike to be less "fastideous" in food and this, in its turn, makes the species composition of parasites to be more various. In general, according to their parasitic fauna marlinspike may be considered as typical planktophages.

Discussion

The materials obtained make it possible to discuss the question on the locality of the examined fish groupings. In this aspect roundnose grenadier forming commercial aggregations in these areas are of great interest. According to the differences in the degree of fish infestation by parasites in the North Atlantic waters we may mark out 3 main groups of fish: the northern group dwelling in the area between the Greenland-Canadian Threshold and the southern edge of the Baffin Island; the central group - dwelling in the Labrador area, and the southern - dwelling in the area of the Grand Newfoundland Bank and Flemish Cap Bank (names of the groups are given conditionally). Fish from the northern grouping were not infested by Myxidium melanocetum but they were severely infested by Auerbachia pulchra (86.7%), moderately by Myxidium melanostigmum (36.2%) and weakly - by Genocerca macrouri (I2.4%) and by other parasites. Fish of the southern grouping were less infested by Auerbachia pulchra (5I.I%) but they were more infested by M.melanostigmum (4I.I%) than those in the North and also by Genocerca macrouri (26.7%). In fish of this grouping spores of M.melanocetum (I8.9%) and trematoda Glomericirrus macrouri (I3.3%) were found. Due to its degree of infestation the central grouping takes an intermediate position. The infestation of fish by Auerbachia pulchra (46.7%) is similar to that in fish from the southern grouping and the infestation by M.melanostigmum (35.2%) is similar to that in the northern fish. There were found (in small number) also spores of M.melanocetum (3.8%).

While examining roundnose grenadier from these areas it turned out that fish infestation by Auerbachia pulchra was the most severe in the northern areas (from 73.3 to 100% in separate samples) and espesially fish from 42 to 70 cm in length were severely infested. To the South where fish infested by Auerbachia pulchra were 65-85 cm in length the infestation was less severe. Mainly sporadic spores were found, tens and hundreds of spores were observed very rarely. In fish infested by trematoda Genocerca macrouri and myxosporidia M.melanostigmum the picture was contrary. Here the fish invasion increased in the direction from the North to the South. Big fish (65 cm and longer) were infested more severely. In the southern areas fish were infested by M.melanocetum and Glomericirrus macrouri. All these differences have, at first sight, the age character which first and foremost relates to the parasites developing with the change of intermediate hosts. But having taken duplicated samples first after 1-1.5 months and then a year after there were no changes in the degree of infestation of fish from the northern grouping by the main parasites with the only one exception - cestoda Phillobythes atlanticus (from 40 to 13.3%) (Table 4). Similar changes were observed in fish from the central and southern groupings. Besides, fish had a decreased incidence of attacks by parasites. For instance, fish infestation by Auerbachia pulchra decreased from 60% to 40% and their infestation by Ph. atlanticus increased from 13.3% to 33.3%. These facts show that the observed differences in parasites distribution are not only of the age character. The observed changes of quantitative indices of fish infestation by a group of parasites during short periods of time are related, to our mind, to migration of fish as they grow from the northern areas to the southern ones. This supposition is indirectly confirmed by the fact that fish from the southern grouping are in general larger (mode 69-74 cm) than those from the northern one (mode 62-65 cm). A great number of parasites common for these three areas (50%) also indicates the relations between these groups in which 7 from 8 species specific for roundnose grenadier are presented (excluding only Myxidium melanocetum). Thus, the previously formulated opinion (Zubchenko, 1976) concerning the existence of a single population of roundnose grenadier in the investigated area was confirmed.

If to consider from this point of view the parasitic fauna of Macrurus berglax and Nezumia bairdii we will have quite another picture. As it was mentioned above the parasitic fauna of these two species of fish examined in two different areas had substantial quantitative and qualitative differences. For instance, in roughhead grenadier 7 (35%) parasites common for the two areas were found; only 2 species from 6 (A.pulchra, Clavellomimus macruri) are characteristic for the fish species mentioned (Table 2). In this case the extensivity of fish infestation has substantial differences (13.3 and 46.6%, respectively, for the first species; 40 and 6.6% - for the se-

cond one). In marlinspike only two (I8.I%) common species were found (Table 3), one of which (Contracaecum aduncum) occures on the Flemish Cap Bank more often (56.9%) than in the South Labrador area (in I from 7 fish examined). These substantial qualitative and quantitative differences in roughhead grenadier and marlinspike infestation by parasites allow to suppose that in the areas investigated there are, at least, two populations - Macrurus berglax and Nezumia bairdii.

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Table 1.

Parasitic fauna of Coryphaenoides rupestris

Parasite	Davis Strait (105 spec.)					Labrador (105 spec.)					North Newfoundland Bank (90 spec.)				
	Specimens infected		Intensity of infection			Specimens infected		Intensity of infection			Specimens infected		Intensity of infection		
	No	%	Min	Max	Mean	No	%	Min	Max	Mean	No	%	Min	Max	Mean
1.Myxidium melanostigmum	38	36.2	+	+	+	37	35.2	+	+	+	37	41.1	+	+	+
2.Myxidium melanocetum	-	-	-	-	-	4	3.8	+	+	+	17	18.9	+	+	+
3.Myxidium profundum	16	15.2	+	+	+	14	13.3	+	+	+	16	17.8	+	+	+
4.Auerbachia pulchra	91	86,7	+	+	+	49	46.7	+	+	+	46	51.1	+	+	+
5.Zschokkella hildae	-	-	-	-	-	1	1.0	+	+	+	-	-	-	-	-
6.Diclidophora macruri	15	14.3	1	3	0.2	28	26.7	1	5	0.5	1	1.1	1	1	+
7.Philobythos atlanticus	34	32.4	1	2	0.4	25	23.8	1	3	0.3	18	20.0	1	2	0.3
8.Scolex pleuronectis l.	7	6.6	1	2	0.1	2	1.9	1	2	+	-	-	-	-	-
9.Pseudophyllidea gen.sp.l.	3	2.9	1	1	+	-	-	-	-	-	-	-	-	-	-
10.Aporocotyle simplex	-	-	-	-	-	3	2.9	1	1	+	-	-	-	-	-
11.Glomericirrus macrouri	8	7.6	1	2	0.1	9	8.6	1	2	0.1	12	13.3	1	2	0.2
12.Derogenes varicus	-	-	-	-	-	1	1.0	1	1	+	-	-	-	-	-
13.Gonocerca macrouri	13	12.4	1	3	0.2	21	20.0	1	84	1.2	24	26.7	1	12	0.8
14.Gonocerca macroformis	-	-	-	-	-	1	1.0	1	1	+	-	-	-	-	-
15.Contracaecum aduncum	1	1.0	1	1	+	-	-	-	-	-	-	-	-	-	-
Contracaecum aduncum l.	1	1.0	1	1	+	4	3.8	1	2	+	3	3.3	1	2	+
16.Anisakis sp.l.	1	1.0	1	1	+	16	15.2	1	3	0.2	3	3.3	1	2	+
17.Chondracantus radiatus	-	-	-	-	-	1	1.0	1	1	+	-	-	-	-	-
18.Clavella adunca	-	-	-	-	-	9	8.6	1	1	0.1	3	3.3	1	1	+

Table 2.

Parasitic fauna Macrurus berglax

Parasite	Flemish Cap Bank (15 spec.)					South Labrador (15 spec.)				
	Specimens infected		Intensity of infection			Specimens infected		Intensity of infection		
	No	%	Min	Max	Mean	No	%	Min	Max	Mean
1. Zschokkella kudoi	-	-	-	-	-	4	26.6	+	+	+
2. Auerbachia pulchra	2	13.3	+	+	+	7	46.6	+	+	+
3. Davisia newfoundlandia	-	-	-	-	-	1	6.6	+	+	+
4. Cyclocotyloides pinguis	2	13.3	1	2	0.2	-	-	-	-	-
5. Philopythos atlanticus	-	-	-	-	-	2	13.3	1	1	0.1
6. Scolex pleuronectis l.	-	-	-	-	-	3	20.0	1	20	2.3
7. Pseudophyllidea gen.sp.l.	-	-	-	-	-	1	6.6	3	3	0.2
8. Lepidapedon elongatum	-	-	-	-	-	2	13.3	1	1	0.1
9. Hemiurus levinseni	-	-	-	-	-	1	6.6	1	1	0.1
10. Derogenes varicus	2	13.3	1	1	0.1	2	13.3	1	2	0.2
11. Gonocerca crassa	-	-	-	-	-	8	53.3	1	6	1.5
12. Lecithophyllum bothriophoron	-	-	-	-	-	1	6.6	1	1	0.1
13. Genolinea laticauda	-	-	-	-	-	8	53.3	1	24	3.7
14. Contracaecum aduncum	11	73.3	1	4	1.1	10	66.6	1	64	11.1
Contracaecum aduncum l.	-	-	-	-	-	6	40.0	1	75	5.4
15. Anisakis sp.l.	-	-	-	-	-	2	13.3	1	6	0.5
16. Capillaria kabatai	-	-	-	-	-	3	20.0	2	63	6.5
17. Echinorhynchus gadi	7	46.6	2	8	2.0	11	73.3	1	48	11.8
18. Rebelula bonvieri	1	6.6	1	1	0.1	1	6.6	1	1	0.1
19. Clavella adunca	7	46.6	1	2	0.5	7	46.6	1	4	0.8
20. Clavellomimus macruri	6	40.0	1	2	0.5	1	6.6	6	6	0.4

Table 3.

Parasitic fauna Nezumia bairdii

Parasite	Flemish Cap Bank (16 spec.)					South Labrador (7 spec.)				
	Specimens infected		Intensity of infection			Specimens infected		Intensity of infection		
	No	%	Min	Max	Mean	No	%	Min	Max	Mean
1. Myxidium profundum	6	37.5	+	+	+	-	-	-	-	-
2. Auerbachia pulchra	1	6.2	+	+	+	-	-	-	-	-
3. Grillotia erinaceus l.	3	18.8	1	6	0.8	-	-	-	-	-
4. Scolex pleuronectis l.	-	-	-	-	-	7	-	12	83	34.4
5. Glomericirrus macrouri	1	6.2	1	1	0.1	-	-	-	-	-
6. Derogenes varicus	1	6.2	1	1	0.1	-	-	-	-	-
7. Genolinea laticauda	-	-	-	-	-	2	-	1	2	0.4
8. Contracaecum aduncum l.	9	56.3	2	9	2.9	1	-	1	1	0.1
9. Terranova decipiens	-	-	-	-	-	3	-	1	3	0.9
10. Capillaria kabatai	4	25.0	2	8	1.2	3	-	1	7	1.4
11. Echinorhynchus gadi	1	6.2	2	2	0.1	-	-	-	-	-

Table 4. Quantitative and qualitative changes in parasite fauna or Coryphaenoides rupestris in different perious or investigations

Parasite	November–December 1974						January 1975						November–December 1975					
	Davis Strait (45 spec.)		Labrador (45 spec.)		North Newfoundland Bank (30 spec.)		Davis Strait (30 spec.)		Labrador (30 spec.)		North Newfoundland Bank (30 spec.)		Davis Strait (30 spec.)		Labrador (30 spec.)		North Newfoundland Bank (30 spec.)	
	%	Mean intensity of infestation	%	Mean intensity of infestation	%	Mean intensity of infestation	%	Mean intensity of infestation	%	Mean intensity of infestation	%	Mean intensity of infestation	%	Mean intensity of infestation	%	Mean intensity of infestation	%	Mean intensity of infestation
1.Myxidium melanostigmum	40.0	+	33.3	+	46.7	+	33.3	+	33.3	+	36.6	+	33.3	+	40.0	+	40.0	+
2.Myxidium melanocetum	-	-	4.4	+	16.7	+	-	-	-	-	20.0	+	-	-	6.6	+	20.0	+
3.Myxidium profundum	8.9	+	8.9	+	13.3	+	20.0	+	20.0	+	20.0	+	10.0	+	13.3	+	20.0	+
4.Auerbachia pulchra	86.7	+	48.8	+	60.0	+	93.3	+	40.0	+	40.0	+	80.0	+	50.0	+	53.3	+
5.Zschokkella hildae	-	-	2.2	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.Diclidophora macruri	15.6	0.2	26.6	0.5	3.3	+	13.3	0.2	26.6	0.6	-	-	13.3	0.1	26.6	0.4	-	-
7.Philobythos atlanticus	40.0	0.4	17.8	0.2	13.3	0.1	40.0	0.5	33.3	0.5	33.3	0.4	13.3	0.1	23.3	0.4	13.3	0.2
8.Scolex pleuronectis l.	2.2	+	-	-	-	-	13.3	0.2	-	-	-	-	6.6	0.1	6.6	0.1	-	-
9.Pseudophyllidea gen.sp.l.	2.2	+	-	-	-	-	6.6	0.1	-	-	-	-	-	-	-	-	-	-
10.Aporocotyle simplex	-	-	2.2	+	-	-	-	-	3.3	+	-	-	-	-	3.3	+	3.3	+
11.Glomericirrus macrouri	6.6	0.1	6.6	0.1	3.3	+	6.6	0.1	13.3	0.2	16.6	0.2	10.0	0.1	6.6	0.1	20.0	0.3
12.Derogenes varicus	-	-	2,2	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13.Gonocerca macrouri	13.3	0.2	26.6	2.5	33.3	1.3	6.6	0.1	13.3	0.2	13.3	0.2	16.6	0.2	16.6	0.2	33.3	0.9
14.Gonocerca macroformis	-	-	2.2	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15.Contracaecum aduncum	2.2	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Contracaecum aduncum l.	2.2	+	4.4	+	3.3	+	-	-	-	-	-	-	-	-	13.3	0.2	6.6	0.1
16.Anisakis sp.l.	2.2	+	17.8	0.2	3.3	+	-	-	26.6	0.3	-	-	6.6	0.1	-	-	6.6	0.1
17.Chondrocanthus radiatus	-	-	2.2	+	-	-	-	-	-	-	3.3	+	-	-	-	-	-	-
18.Clavella adunca	4.4	+	6.6	0.1	3.3	+	6.6	0.1	13.3	0.1	-	-	6.6	0.1	6.6	0.1	6.6	0.1