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The copepod *Sphyrion lumpi* (Kroyer) as a biological marker in population studies of the deepwater redfish (*Sebastes mentella*)

Sphyrion lumpi (Kroyer), a parasitic copepod of the family Sphyriidae, is fairly widespread in North Atlantic fish species. Its hosts include redfish, grenadiers, wolffishes, hake, lumpfish, and others species [5, 7, 9, etc.].

This copepod is characterized by its mode of attachment to the host. The females of *S. lumpi* become embedded in the muscles of fish with their cephalothorax which functions like an anchor; a part of the neck and the trunk with its processes and egg sacs remain "free". Around this forms a fairly large connective-tissue capsule which remains on the body of the fish even after the parasite dies, and contains the decomposed tissue of the copepod. Therefore, the fish becomes "marked" for life.

The possibility of using *S. lumpi* as a natural marker in population surveys of fish has already been discussed in the literature [2, 3, 8, etc.]. This copepod has been used quite successfully to study the distribution of redfish off the Atlantic coast of North America [2, 7], and it has proved useful in similar research in the eastern North Atlantic [8].

We undertook to study the possibility of using *S. lumpi* in population surveys of one of the most widely distributed species of the North Atlantic, the deepwater [or pelagic] redfish *Sebastes mentella* Travin, 1951. This species is predominantly confined to the continental slopes and banks; however, in the Iceland-Greenland area, it has long been noted in the deep pelagic zone of the Irminger Sea [1, 4, 6].

Material and method

Our material to study the infestation of the deepwater redfish by *S. lumpi* was collected during 1980–1982 within the area of 55-61°N and 30-39°W. The depth of the ocean in the study area varies from 1250 to 4300 m; our specimens of redfish were caught in the 50-350 m layer. We recorded not only the live copepods found in the fish, but also the capsules that had formed around the cephalothorax and remained on the body of the fish after the parasites died.

Results and discussion

When studying the occurrence of *S. lumpi* in the pelagic redfish of the Irminger Sea, we found that the average annual infestation of the fish by this parasite was equal to 10-14%, varying significantly depending on the age and sex of the fish, the season, the depth and the geographical location of the fishing area.

Dynamics of redfish infestation depending on the sex of the fish

Throughout the year, the females of the redfish are constantly infested to a higher degree than the males, this tendency being observed in all the size groups (see tables 1-3). Consequently, the dominance of females will naturally increase the average infestation of the fished grouping, and vice versa, the predominance of males will result in lower infestation. The cause of these differences should apparently be sought in the characteristics of the seasonal cycle of the males and females of this species.

The males usually congregate during the mating period in autumn, at which time the sex ratio in the fished groupings is usually 0.9-1.6:1. In winter and summer, the sex ratio changes in favour of the females (1:1.7-2.5). The latter form large concentrations not only during the mating period, but also at spawning time in March–April. During this period, there are 4–4.5 times more females than there are males. Therefore, the probability of female infestation is much higher than in males, which leads to a higher incidence of infestation among the female redfish.

Dynamics of redfish infestation depending on age

To determine the age-related variability of infestation, the fish examined from March 1981 to January 1982 were grouped by size with an interval of 4 cm (see tables 1–3). We found that infestation increased gradually with the size, and therefore age, of the fish both in the males and females. Initial infestation was noted in 26 cm redfish; it gradually increased and reached its

maximum values in 40–47 cm females and 36–43 cm males. Fish larger than 47 cm were not examined, and therefore the tendencies of age-related changes in redfish infestation are not known.

On the strength of its relatively long life span, the redfish has a number of chances to come in contract with the parasite, and the characteristic of the copepods to remain in the body of the fish after they die in the form of capsules with the remains of the cephalothorax contributes to their accumulation in older fish.

The age-related increase in infestation manifests itself in the redfish during all the seasons and throughout the year, which points to the regular nature of this phenomenon.

Seasonal dynamics of infestation in the deepwater redfish

Periods of increase (summer and winter) and decrease (spring and autumn) in *S. lumpi* infestation of the redfish have been established (table 4). To understand the cause of these fluctuations, the infestation of male and female redfish over a one-year period should be examined separately.

The frequency of occurrence of *S. lumpi* in male redfish remains practically at the same level from autumn to summer, and then it increases during the summer months. The biological characteristics of the males are such that they congregate mainly during the mating period in autumn, and that is when new individuals become infected. Consequently, the reproductive period of the female parasites must fall within the same period. The absence of an increase in infestation during the winter–spring period is due to the fact that, during this period, the new generation of copepods consists of small (less than 2 mm in length), completely transparent female parasites attached under the epidermis of the redfish. The period of growth of the copepods ends by summertime, and they become large and easy to count, which is why the frequency of their occurrence goes up in summer. We should have observed the same incidence of infestation in autumn as well, but it was during this period that we noted a drastic decrease in the occurrence of sphyrion-infected redfish due to the arrival of less infested males at the breeding places in September, which ultimately cut the summer incidence of infestation by one-half.

Judging by the changes in infestation among the male redfish of different size groups, mainly 28–35 cm (less frequently 36–39 cm) fish arrive at the breeding places in September, and 32–39 cm fish, which have for the most part mated and therefore may have been infected, arrive in October, and the number of infected males increases.

As in the male redfish, the summer rise in infestation among the females is the result of the autumn attack of the parasite, and the observed winter increase in the occurrence of *S. lumpi* is due to infection in spring, at the time when the female redfish congregate at the spawning grounds and the parasite reproduces anew.

Table 1. Variability of *Sphyrion lumpi* infestation of male pelagic redfish of the Irminger Sea in relation to body length

Season (months)	26-27 cm		28-31 cm		32-35 cm		36-39 cm		40-43 cm		44-47 cm	
	examined	infested	examined	infested	examined	infested	examined	infested	examined	infested	examined	infested
Spring (Mar-May 1981)	22	2	280	14 (5.3%)	706	52 (7.4%)	314	43 (9.6%)	49	12 (24.5%)	12	-
Summer (Jun-Aug 1981)	3	2	122	14 (13.1%)	499	51 (12.1%)	224	41 (19.2%)	3	-	-	-
Autumn (Sept-Nov 1981)	12	2	426	19 (4.0%)	1286	78 (7.1%)	535	51 (9.5%)	38	2 (5.3%)	8	2
Winter (Dec '81-Jan '82)	1	-	15	-	67	3 (4.5%)	46	8 (17.4%)	41	3 (7.3%)	26	2 (7.7%)
Average annual	38	6	843	47 (5.6%)	2558	184 (7.2%)	1119	143 (12.8%)	131	17 (13.0%)	46	4 (8.7%)

Table 2. Variability of *Sphyrion lumpi* infestation of female pelagic redfish of the Irminger Sea in relation to body length

Season (months)	26-27 cm		28-31 cm		32-35 cm		36-39 cm		40-43 cm		44-47 cm	
	examined	infested	examined	infested	examined	infested	examined	infested	examined	infested	examined	infested
Spring (Mar-May 1981)	21	3	224	16	2844	266	2281	386	618	200	29	11
			(8.4%)		(9.9%)		(17.8%)		(32.4%)		(38.0%)	
Summer (Jun-Aug 1981)	11	-	83	12	887	136	906	255	260	86	8	2
			(13.5%)		(15.2%)		(28.9%)		(34.3%)			
Autumn (Sept-Nov 1981)	12	-	132	8	1131	138	990	193	199	44	22	8
			(4.0%)		(6.5%)		(11.8%)		(18.7%)			
Winter (Dec '81-Jań '82)	1	-	5	1	79	11	131	26	65	26	47	19
					(13.9%)		(19.8)%)		(40.0%)		(41.2%)	
Average annual	45	3	444	37	4941	551	4308	860	1142	356	106	40
	(6.7)		(8.3%)		(11.2%)		(20.0%)		(31.2%)		(37.7%)	

Table 3. Variability of *Sphyrion lumpi* infestation of the pelagic redfish of the Irminger Sea in relation to body length

Season (months)	26-27 cm		28-31 cm		32-35 cm		36-39 cm		40-43 cm		44-47 cm	
	examined	infested	examined	infested	examined	infested	examined	infested	examined	infested	examined	infested
Spring (Mar-May 1981)	43	5	504	30 (5.9%)	3550	318 (8.6%)	2595	429 (16.5%)	667	212 (31.7%)	41	11 (27.0%)
Summer (Jun-Aug 1981)	14	2	205	26 (12.7%)	1385	187 (13.5%)	1130	296 (26.2%)	263	86 (32.3%)	8	2 (25.0%)
Autumn (Sept-Nov 1981)	24	2	558	27 (4.8%)	2416	216 (8.9%)	1525	244 (16.0%)	237	46 (19.4%)	30	10 (33.0%)
Winter (Dec '81-Jan '82)	4	-	21	1 (5.0%)	147	14 (9.6%)	179	34 (19.2)%)	107	29 (27.4%)	75	21 (28.0%)
Average annual	85	9	1288	84 (6.5%)	7498	735 (9.8%)	5429	1003 (18.5%)	1274	373 (29.3%)	154	44 (29.0%)

Since females dominated in the fished groupings of the pelagic redfish, the overall incidence of redfish infestation by *S. lumpi* manifested the same seasonal variations expressed by two rises and two falls.

Therefore, in *S. lumpi* infesting the pelagic redfish of the Irminger Sea, we observe a positive correlation between the reproductive condition [of the parasite] and the physiological condition of the fish.

Table 4. Seasonal variability of infestation of male and female pelagic redfish of the Irminger Sea by *Sphyrion lumpi*

Season (months)	Females			Males			Total infestation		
	examined	infested	%	examined	infested	%	examined	infested	%
Autumn (Sept-Nov 1980	5995	839	14.0	9276	649	7.0	15747	1575	10.0
Winter (1980-1981)	no data available								
Spring (Mar-May 1981)	6017	882	14.6	1383	123	8.9	7400	1005	13.4
Summer (Jun-Aug 1981)	2154	490	22.7	851	108	12.7	3005	598	19.9
Autumn (Sept-Nov 1981)	2485	390	15.7	2305	155	6.7	4790	545	11.4
Winter (Dec 1981-Jan 1982)	335	84	25.0	198	18	9.1	533	100	18.8

Variability of infestation in the pelagic redfish depending on the depth of the water

Our study of the occurrence of *Sphyrion lumpi* in the deepwater redfish in relation to fishing depth has shown that the incidence of infestation up to a depth of 200 m is higher than in fish caught at depths greater than 200 m. We compared groupings of fish examined from the same location and on the same day. For example, on 20 September 1981 at 60°10' N and 35°10' W, 4.1% of the male redfish and 15.4% of the females from depths of 90-160 m, and 0% of the males and 7.7% of the females from depths of 230-270 m were found to be infested. Altogether, infestation in September amounted to 4.2% in male redfish (28 of the 669 fish caught) and 14.6% in females (107 out of 737) at depths less than 200 m, and 2.8% in males (57 out of 2038) and 9.6% in females (92 out of 962) at depths greater than 200 m.

Apparently, the less infested or non-infested redfish that arrive at the breeding places from those areas where the infestation level is low or non-existent become concentrated in the deep layers at first. The males dominate here, their abundance more than doubling that of the females. With a decrease in depth, the number of infested fish increases, and therefore repeat breeders

predominate here. The smaller size of the fish is indirect proof that young fish dominate at the deeper levels. In the above example, the mode of the fish caught up to depths of 200 m was 35 cm in both male and female redfish, and was 32 and 33.3 cm respectively at depths greater than 200 metres.

Geographical variability of infestation in the deepwater redfish

Our analysis of the material from 1981 showed significant differences in the infestation numbers for redfish caught in different areas. For example, the incidence of infestation in redfish from stations 19–20 and 24–25 located 40–50 miles from each other differed 4–5-fold in September. At the same time, the redfish at stations 5 and 19 located more than 200 miles from each other were equally infested (table 5). The same "variegated" pattern of *S. lumpi* distribution in redfish is noted for other months as well.

Table 5. Geographical variability of *Sphyrion lumpi* infestation of the pelagic redfish of the Irminger Sea in September 1981

Station	Coordinates	Extensity of infestation, %		
		females	males	total
5	56°41'N-38°30'W	3.3	0	1.4
4	57°13'N-38°42'W	9.3	0	4.9
1, 2, 3	57°11'-57°30'N, 37°14'-37°47'W	5.2	0	3.1
12	58°09'N-37°11'W	36.2	25.6	31.1
7, 8, 9, 10, 11	58°24'-58°57'N, 36°06'-36°45'W	10.4	4.0	8.6
6	58°41'N-35°44'W	1.8	2.8	2.2
13, 14, 15	59°09'-59°31'N, 35°37'-35°54'W	8.0	3.3	5.8
21, 22, 23	59°10'-59°53'N, 36°04'-36°34'W	14.0	5.5	11.0
19, 20	60°07'-60°15'N, 35°38'-35°37'W	3.2	0.9	1.7
24, 25	60°11'N-34°57'W	10.4	2.7	5.0
26	61°30'N-34°03'W	4.5	8.0	6.0

It is possible that the local increases in infestation are partly due to the reserve populations of the parasites on host fish of other species. As we know, *S. lumpi* is encountered quite frequently in coastal waters in lumpfish, wolffish and grenadier which can transmit the parasite to the redfish. Unfortunately, we do not have this type of information for the open waters of the North Atlantic. Furthermore, it is believed that the depth of the water and ambient temperature also affect the distribution of *S. lumpi* [8].

On the whole, we can say that the geographical variability of redfish infestation in the Irminger Sea is the end result of the above-discussed infestation characteristics of the fish related to their sex and age, the season and the fishing depth.

Frequency of occurrence of *Sphyrion lumpi* in the deepwater redfish of the North Atlantic

Analysis of our own data and the literature has shown that *S. lumpi* occurs nonuniformly in the pelagic redfish throughout its range. However, we have nowhere in the North Atlantic encountered such a high incidence of infestation of the redfish as in the open part of the Irminger Sea; during certain months, it exceeded 35% at a number of stations. In all likelihood, the centre of *Sphyrion lumpi* infection is located in this area, and the fact that such a high level of infestation continues to exist here may be due to the weak interrelations of this grouping of redfish with those from other parts of the ocean. If we compare the degree of infestation in redfish from the open part of the Irminger Sea and those from the Iceland area [8], we shall find that it differs. In Icelandic waters, the parasite has been recorded in 1.41% of the fish, and the female and male redfish are equally infested; a different seasonal dynamics of infestation is also noted here. Apparently, the interrelations of the redfish from these areas are not so significant as to result in uniform infestation of the redfish throughout its area of distribution.

Summary

1. The incidence of infestion of the deepwater [pelagic] redfish by the copepod *Sphyrion lumpi* was studied during 1980–1982 in the open part of the Irminger Sea, and was found to be equal to an average annual 10-14%.

2. The female redfish were found to have a higher incidence of infestation than the males throughout the year. An age-related increase in infestation was noted in both sexes. Its seasonal dynamics manifests itself in periods of increase (summer and winter) and decrease (spring and autumn). The possible causes of the observed phenomena were also examined.

3. It was found that the frequency of occurrence of *Sphyrion lumpi* was nonuniform throughout the range of the deepwater redfish. It is presumed that the centre of *S. lumpi* infection is located in the Irminger Sea. The possible interrelations between the pelagic redfish of the Irminger Sea and that of other areas were also discussed in brief.

Bibliography

1. Zakharov G.P. The redfish above the ocean depths. Rybn. khoz., 1963, No. 4, p. 12-15.

2. Yanulov K.P. Parasites as locality indicators of redfish stocks. In: Soviet Fishery Research in the North Atlantic. Moscow: Rybnoye khozyaistvo, 1962, p. 273-283.

[References 3-9 are English ones]