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Parasitology

OCCURRENCE OF THE PARASITE *CLAVELLA ADUNCA*
(STRØM, 1762) (COPEPODA PARASITICA: LERNAEOPODIDAE)
ON THE COD (*GADUS MORHUA* L.) FROM NORTH ATLANTIC WATERS

WYSTĘPOWANIE PASOŻYTA *CLAVELLA ADUNCA*
(STRØM, 1762) (COPEPODA PARASITICA: LERNAEOPODIDAE)
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The studies of the infestation state of the cod (*Gadus morhua* L.) by the *Clavella adunca* (Strøm, 1762) parasite were carried out in North Atlantic waters over the years 1970, 1974 and 1975. Totally 7168 cod specimens have been subjected to detailed ichthyological analysis, 4454 cods originating from Labrador and New Founland fishing grounds and 2714 from Spitsbergen Island fishing grounds.

The results of observations of the parasite occurrence on the particular parts of cod body are presented in the work. The observations of differences in body-build proportions of female parasite and forms of bullae originating from different locations of attachment to the host were made as well.

By the use of Student's test t the significance of differences in infestation of cods from different regions was estimated.

INTRODUCTION

The copepod *Clavella adunca* (Strøm, 1762) is the most frequently and abundantly occurring parasite of the cods. It is often described in a literature under the name of

Clavella uncinata (Müller, 1776). Female is an invasive form attaching itself to a host by the means of bulla. It is occurring mainly in the gill cavity, on the fins, and in an anal region. It takes food through the mouth organ placed on the end of mobile cephalothorax and devours host's blood and slime.

Body build of the parasite was described by a number of researchers: Leigh-Sharpe (1918-1933), Gurney (1934), Poulsen (1939), Heegard (1947), Gusiev (1951), Kabata (1960-1969), Shotter (1971) and Nunes-Ruivo (1957), whose observations are consistent at this point. On the other hand, the morphometrical differences of female body according to the attachment place to a host, and shape of the bulla were considered as species determinants (Leigh-Sharpe, 1918-1933; Nunes-Ruivo, 1957). But finally, it was accepted (Kabata, 1963), that all the forms of *Clavella* occurring on the cods from North Atlantic belong to *Clavella adunca* species.

Over the years 1970, 1974, and 1975, during cruises of commercial vessels, there were carried out observations on parasite *Clavella adunca*, comprising its distribution, body proportions, incidence, and intensity of parasitic invasion.

MATERIAL AND METHOD

Materials for survey were collected at two regions of North Atlantic:

- a) at the waters of Labrador and New Foundland (ICNAF¹ Region 2J and 3K) over the winter months (February and March) of 1970 and 1974,
- b) at the waters of Spitsbergen and Bear Island (Bjørnøya) (ICES² Region IIb) at 1974 (September and October), and 1975 (June and July).

Research work was done aboard of factory-trawlers belonging to Deep Sea Fishing Company "Dalmor". Totally, 7168 cod specimens were studied, 4454 originating from 2J and 3K Region, and 2714 from Region IIb. (Fig. 1).

Fishes were picked out at random, their total length (*longitudo totalis*) was measured with 1 cm accuracy, they were weighed with accuracy of 5 g (1970), and 10 g (1974 and 1975). Sometimes weighing was disturbed by rough weather, so why, at 1970 out of 2767 examined fishes only 1896 were weighed.

Fishes were thoroughly inspected for the presence of parasite, number and distribution of *Clavella adunca* on gills, gill cover, dorsal, pelvic, pectoral, anal, and caudal fins, as well as in anus, were noted. Parasites were taken randomly from the particular parts of fish body together with host's tissue, and subsequently preserved in 10% formaldehyde solution for further exact determination of species. For the age determination otolithes were taken from fishes, accordingly to Meier's scale (8 points) maturity of gonads was determined, sex was noted, and degree of stomachs' filling was recorded. In the course of survey geographical position and the depth of trawl were registered.

¹ International Commission for the Northwest Atlantic Fisheries.

² International Council for the Exploration of the Sea.

- n — number of samples,
s — standard deviation.

BODY BUILD AND PROPORTIONS OF *Clavella adunca*

1. Female of *Clavella adunca*

Body of mature parasite consists of cephalothorax, trunk, genital appendage, and egg sacs (Fig. 2).

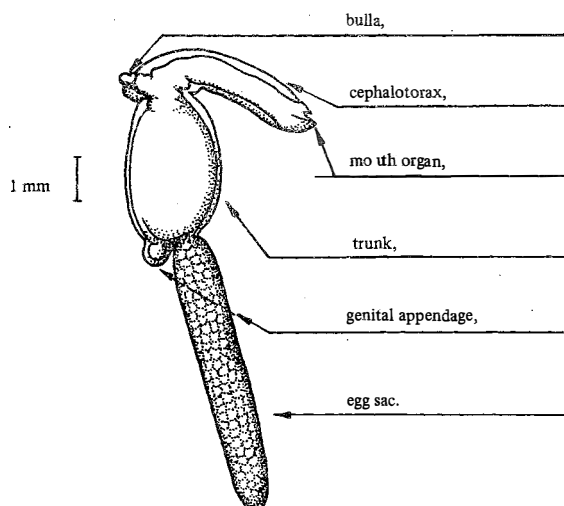


Fig. 2. Body build of *Clavella adunca* female

At the base of cephalothorax, there is placed climbing organ in the form of bulla being the terminal part of maxillae. As was mentioned in the introduction, body build and development of parasite had been described in details by a number of researchers whose opinions are consistent at this point. Therefore, this work was limited to studying of morphometrical differences, form of parasite body, and shape of bulla dependent on region of catch and places of attachment to the host. Trunk, cephalothorax, genital appendage, egg sacks and width of parasite trunk were measured. Parasites collected from gills, gill cover and out of dorsal, anal, pectoral, pelvic fins and anus, were separately measured.

Leaning on Nunes-Ruivo's (1957) division, as well as on own author's observations the studied parasites were pooled into three groups, collected from:

- a) gills and gill cover,
- b) all fins,
- c) anus.

Mean length of the particular parts of *Clavella adunca* female bodies are displayed in Table 1. Virtually, they are consistent with Nunes-Ruivo's (1957) observations.

Clavella sponging on the fins has the cephalothorax distinctly longer than trunk, in contrary to Nunes-Ruivo opinion that their dimensions should be almost equal. The only morphometrical differences between *Clavella* from fins and out of gills seems to be definitely smaller genital appendage of parasite found on fins, and smaller differences between the lengths of cephalothorax and trunk.

No considerable differences were ascertained between the results of measurements carried out at Northwest Atlantic regions 2J and 3K, and Northeast Atlantic region IIb.

Results of measurements indicate the distinct differences of lengths and proportions of body of *Clavella adunca* depending upon attachment place to the host. Parasites fastened to fins are exposed on quick flow of water and violent motions during movement of fish, therefore, probably their trunk is more slender than in parasites from gills or anus. Trunk of *Clavella* out of anus vicinity is almost square with slight predominance of width over the length. The longest genital appendages were noted in parasites from gills while the shortest, characterized parasites from anus vicinity. On Fig. 2 have been shown forms of *Clavella adunca* female bodies, originating from different regions of survey and place of attachment to hosts. Drawings were made by means of microfilm reading projector with 12.5 x magnification.

The pair of transformed maxillae terminated by bulla* form a climbing organ of parasite, attaching it to the host. Differences in form of bulla and distribution of ducts inside of it were widely discussed quite a long time and Leigh-Sharpe (1925, 1933) regarded bulla as one of species determinants. Poulsen (1939) and later Kabata (1963) who thoroughly studied bullae from different places of attachment, ascertained that form as well as distribution and number of ducts inside bulla are dependent exclusively on the place of parasite attachment to host (Fig. 3).

There was ascertained on the ground of own observations that distinct difference exists between bullae from gills and from fins. Bulla from fins is much larger and has cylindrical form, while on the other hand bulla from the gills and anus is smaller and has spherical form. The ducts in the bullae from gills and anus diverge radially which is probably caused by a form of bulla, exclusively. None characteristic differences were noted between forms of bullae of *Clavella* from Labrador and New Founland waters, and Spitsbergen and Bear Island waters (Fig. 4).

INCIDENCE AND INTENSITY OF PARASITIC INVASION

Samples were collected from Labrador and New Foundland waters at 1970 and 1974 during cod spawning season (February–March). No substantial differences were found between incidence of invasion from different regions and depths of catch. Mean incidence

* Accordingly to Kabata (1970) these are jaws of II-nd pair (maxillae II).

Table 1

Average lengths of the particular body parts of *Clavella adunca* females according to the region of catch and place of attachment to the host (millimeters)

Place of attachment	Parts of female body	Region		
		2J. 3K	IIb	IIb
		rok		
		1974	1974	1975
GILLS	Length of trunk	2.67	2.99	2.71
	Width of trunk	2.17	2.35	2.25
	Length of caphalothorax	4.27	4.40	4.49
	Genital appendage	0.60	0.64	0.66
	Egg sacs	4.16	4.56	3.81
	Number of the measured females	120	35	46
	Number of the males	43	17	25
FINS	Length of trunk	3.07	3.08	2.91
	Width of trunk	2.15	2.25	2.26
	Length of caphalothorax	3.58	3.56	3.66
	Genital appendage	0.42	0.35	0.40
	Egg sacs	4.22	4.75	4.93
	Number of the measured females	35	20	60
	Number of the males	3	—	7
ANUS	Length of trunk	2.13	2.16	1.91
	Width of trunk	2.25	2.39	2.99
	Length of caphalothorax	3.23	3.57	3.46
	Genital appendage	0.48	0.49	0.49
	Egg sacs	2.80	2.70	2.48
	Number of the measured females	19	28	19
	Number of the males	7	12	5



Region IIb – 1974
1 st anal fin

1 mm



Region 2J and 3K – 1974
Juvenile stage from the cod anus



Region 2J and 3K – 1974
Right gill



Region IIb – 1975
1 st dorsal fin

Fig. 3. Forms of the *Clavella adunca* female body from the different places of attachment to cod and regions of catch

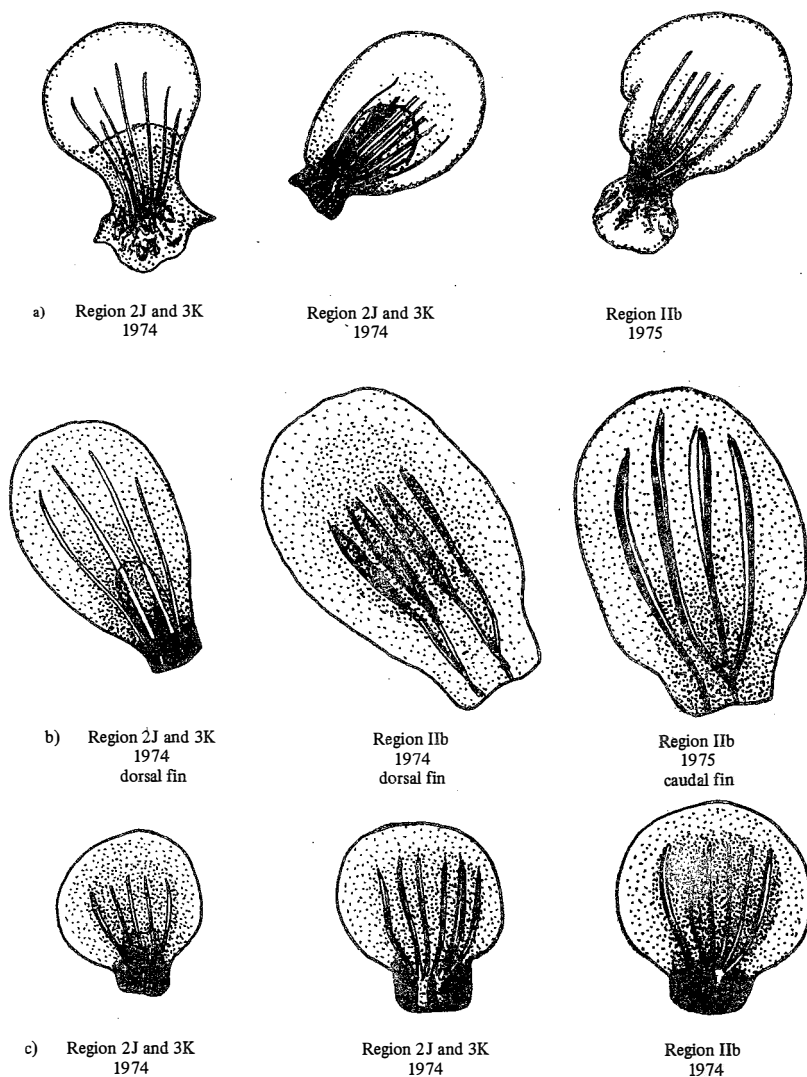


Fig. 4. Forms of bullae and distribution of grooves according to region of catch and parasite attachment place: a) – from the gills, b) – from the fins, c) – from anus

of invasion were also approximate during particular years and amounted at 1970–57.8%, and at 1974 – 61.2% (Table 2).

Out of 4454 examined cods from mentioned area, 2633 were infected at different degree by *Clavella adunca* parasite. Parasites occurred in gill cavity, on the fins, and near anus. Totally, 5806 variously localized specimens were recorded.

Table 2

Number and distribution of the parasites on the cods, and incidence and intensity of invasion of the particular parts of fish body in region 2J and 3K at 1970, and 1974

Place of attachment	Number of parasites (pcs)	Number of infested fishes (pcs)	Intensity of invasion, range (pcs)	Mean intensity of invasion (pcs)	Incidence of invasion* (percent)
Gill cavity					
1970	1706	480	1-30	3.55	17.35
1974	1191	344	1-33	3.46	20.39
Fins					
1970	423	263	1-4	1.61	9.50
1974	352	221	1-5	1.59	13.10
Anus					
1970	1322	1287	1-3	1.03	46.51
1974	812	181	1-2	1.04	46.30
Total					
1970	3451	1600	1-36	2.16	57.82
1974	2355	1033	1-33	2.28	61.23

* Number of examined fishes at 1970 — 2767 specimens
at 1974 — 1686 „

Intensity of invasion of individual body parts was similar at particular years and mean intensity of invasion was slightly higher at 1974 (2.28 of parasite per one infected fish) than at 1970 (2.16 of parasite).

Incidence of gill cavity and fins invasion was slightly higher at 1974 while anus was invaded to the same extent.

All the fishes of up to 68 cm length (1970) and up to 65 cm (1974) were grouped into 3 cm length classes while bigger fishes were treated as single class. For each of these groups extensiveness and intensity of parasitic invasion were evaluated. The results from both periods are coincident. Incidence of invasion has increased relatively fast together with fish size, reaching mean invasion rate approximately near 45 cm length. It was followed by slower increase of incidence which after reaching its maximal value for 49 cm (1970) and 58 cm (1974) specimens shown lessening tendency (Table 3 and 4).

Intensity of invasion also increased with fish length and after reaching its maximal value has grown smaller.

Changes of incidence and intensity of parasitic invasion occurring with age of fish were analogical to length distribution. As composition of year class of fishes comprises several

Table 3

Incidence and intensity of parasitic invasion upon cods according to the length of fishes caught in region 2J and 3K at 1970

Age class (cm)	Number of studied cods (pcs)	Infested cods		Number of para- sites (pcs)	Intensity	
		pcs.	per cent		from - to (pcs)	average (pcs)
18-20	1	—	—	—	—	—
21-23	34	5	14.70	5	1	1.00
24-26	44	10	22.70	11	1-2	1.00
27-29	47	8	17.00	19	1-8	2.40
30-32	59	19	32.20	54	1-19	2.80
33-35	85	30	35.30	52	1-4	1.70
36-38	106	54	50.90	141	1-21	2.60
39-41	147	78	53.10	154	1-10	2.00
42-44	171	99	57.90	207	1-14	2.10
45-47	225	135	60.00	321	1-18	2.40
48-50	284	188	66.20	395	1-19	2.10
51-53	399	251	62.90	541	1-23	2.20
54-56	394	255	64.70	591	1-22	2.30
57-59	301	191	63.50	395	1-36	2.10
60-62	223	127	57.00	267	1-20	2.10
63-65	127	75	59.10	159	1-12	2.10
66-68	51	33	64.70	66	1-9	2.00
68	69	42	60.90	70	1-3	1.70
Total	2767	1600	57.82	3451	1-36	2.16

length classes those changes are more conspicuous. The 4 and 5 years old fishes reached high rate of extensiveness and intensity of invasion, and after that these quantities increased rather slowly getting maximal values for 8 years old fishes. The incidence as well as intensity decreased among older fishes.

Carried out computations considering invasion on cods according to fish sex, have shown that during two surveyed years, the incidence of invasion on cod males and females was approximate.

Higher intensity of invasion was noted among females than among males (respectively, 2.29 and 2.04 parasites per fish at 1970, and 2.41, and 2.16 at 1974).

In Spitsbergen and Bear Island waters (Region IIb) samples were collected in the autumn 1974 and spring 1975. During this period 2714 cods were tested for the presence of parasite *Clavella adunca*. Part of cods surveyed at 1974 originated from halibut catches carried out much deeper where cod occurred occasionally.

Table 4

Incidence and intensity of parasitic invasion upon cods
according to the length of fishes caught in region 2J and 3K at 1974

Age class (cm)	Number of studied cods (pcs)	Infected cods		Number of parasites (pcs)	Intensity	
		pcs.	per cent		from – to (pcs)	average (pcs)
27–29*	1	–	–	–	–	–
30–32*	5	1	–	1	–	–
33–35	20	11	55.00	25	1–7	2.30
36–38	48	24	50.00	30	1–9	1.30
39–41	133	78	58.70	153	1–14	2.00
42–44	235	135	57.50	241	1–12	1.80
45–47	263	169	64.30	406	1–33	2.40
48–50	295	172	58.30	399	1–24	2.30
51–53	223	142	63.70	383	1–30	2.70
54–56	163	106	65.00	295	1–25	2.80
57–59	122	86	70.50	193	1–24	2.20
60–62	86	54	62.80	122	1–18	2.30
63–65	41	28	68.30	55	1–6	2.00
65	52	27	51.90	51	1–13	1.90
Total	1687	1033	61.23	2355		2.28

* in consideration of small number of individuals calculations were not carried out.

Incidence of invasion on cods was approximate at 1974 and 1975, amounting respectively 45.8 and 46.8%. The cods caught together with blue halibuts were infested to much lesser degree (37.1%) (Table 5).

Out of 2714 cod specimens, 1211 were infested with parasite to various extent. Totally, 1588 specimens of *Clavella adunca* were noted, out of this number most parasites, as many as 1086 were found near anus of cod, however, mean intensity of invasion on this part of body was lowest during both surveyed years varying from 1.02 to 1.06 of parasite per one infested fish. The intensity of invasion on particular parts of fish body in Spitsbergen and Bear Island waters was slight but for gills it reached 5 specimens of *Clavella adunca*.

The incidence as well as intensity of invasion determined dependently on host's sex did not show steady tendencies and these quantities were approximate.

Evaluation of the incidence and intensity of parasitic invasion has been made analogically to procedure applied in Northwest Atlantic e.g. by grouping the fishes into 3-centimeters length classes.

The number of surveyed cods from fishing grounds of Spitsbergen and Bear Island was

Table 5

Number and distribution of parasites on the cods, and incidence and intensity of invasion of the particular parts of fish body in region 2J and 3K at 1974 and 1975

Place of attachment	Number of parasites (pcs)	Number of infested fishes (pcs)	Intensity of invasion range (pcs)	Mean intensity of invasion (pcs)	incidence of invasion (percent)
Gill cavity					
1974a	68	25	1-5	2.72	4.35
b	9	5	1-3	1.80	1.14
1975	131	76	1-4	1.72	4.47
Fins					
1974a	21	10	1-4	2.10	1.74
b	2	2	1	1.10	0.46
1975	271	151	1-3	1.79	8.88
Anus					
1974a	254	246	1-2	1.03	42.80
b	171	161	1-3	1.06	36.70
1975	661	648	1-3	1.02	38.12
Total					
1974a	343	269	1-5	1.28	46.80
b	182	163	1-3	1.12	37.10
1975	1063	779	1-4	1.36	45.82

a - samples from cod catches

b - samples where cod was by catch in blue halibut catches.

smaller and fishing was focused on the two fertile generations 3 and 4 years old. Therefore, it is more difficult to investigate the variations of invasion occurring with fish growth, none the less, tendencies of invasion variations are resembling situation noted on Labrador and New Foundland fishing ground (Tables 6 and 7).

STATISTICAL ANALYSIS OF SIGNIFICANCE OF VARIATIONS IN CODS INFESTATION BETWEEN DIFFERENT REGIONS AND YEARS OF CATCH

It was assumed that samples for studies were collected at random from population characterized by normal distribution. To see clearly whether differences in cods infestation exist between years and regions of surveys, the mean infestation per 1000 cods specimens was calculated as well as variance and standard deviation. Obtained results are shown in Table 8.

To test whether actual mean (\bar{x}) infestations are identical at particular regions and years, the following zero hypothesis was formulated:

$$H_0 : U = U_2 = U_3 = U_4$$

Table 6

Extensiveness and intensity of parasitic invasion upon cods according to the length of fishes caught in region IIb at 1974

Age class (cm)	Cods caught at the average depth of 193 m					Cods caught at the average depth of 488 m				
	Number of exa- mined cods	infested cods		Number of para- sites (pcs)	Average intensi- ty (pcs)	Number of exa- mined cods	infested cods		Number of para- sites (pcs)	Average intensi- ty (pcs)
		(pcs)	(per cent)				(pcs)	(per cent)		
33-35	1	—	—	—	—	—	—	—	—	—
36-38	1	—	—	—	—	—	—	—	—	—
39-41	5*	2	—	2	—	—	—	—	—	—
42-44	32	12	37.50	15	1.30	1	—	—	—	—
45-47	76	25	32.90	32	1.30	2	—	—	—	—
48-50	99	44	44.40	54	1.20	4*	3	—	3	—
51-53	92	47	51.10	72	1.50	20	9	45.00	11	1.20
54-56	88	41	46.60	54	1.30	26	9	34.60	11	1.20
57-59	43	28	55.10	30	1.10	32	10	31.30	13	1.30
60-62	30	20	66.70	30	1.50	32	7	21.90	7	1.00
63-65	25	16	64.00	17	1.10	38	13	34.20	14	1.10
66-68	24	11	45.80	11	1.00	56	22	39.30	22	1.00
> 68	59	23	39.00	26	1.10	47	19	40.40	19	1.00
72-74	—	—	—	—	—	53	18	34.00	22	1.20
75-77	—	—	—	—	—	40	14	35.00	17	1.20
78-80	—	—	—	—	—	29	16	55.20	18	1.10
> 80	—	—	—	—	—	59	23	39.00	25	1.10
Total	575	269	46.78	343	1.28	439	163	37.13	182	1.12

* in consideration of the small number of specimens calculations were not carried out

Table 7

Extensiveness and intensity of parasitic invasion upon cods accordingly
to the length of fishes caught in the region IIb at 1975

Age class (cm)	Number of studied cods (pcs)	Infested cods		Number of para- sites (pcs)	Intensity	
		(pcs)	per cent		from- tc (pcs)	average (pcs)
30-32	4*	2	—	5	—	—
33-35	114	47	41.20	65	1-9	1.40
36-38	190	91	47.90	141	1-8	1.50
39-41	184	84	45.70	127	1-7	1.50
42-44	175	62	35.40	93	1-7	1.50
45-47	226	96	42.50	146	1-7	1.50
48-50	267	132	49.40	176	1-7	1.50
51-53	204	93	45.60	111	1-9	1.20
54-56	131	61	46.60	71	1-4	1.20
57-59	102	59	57.80	66	1-3	1.10
60-62	38	22	57.90	24	1-2	1.10
> 62	65	30	46.10	38	1-3	1.20
Total	1700	779	45.82	1063	1-9	1.36

* in consideration of the small number of specimens the calculations were not carried out.

For this purpose, the Student's t distribution was used on significance the level of 0.01 for binomial test.

The following results were obtained for particular regions and years of survey:

- between Region 2J and 3K at 1970 and Region 2J and 3K at 1974 — $t = 0.864$; $t_{0.01} = 2.756$ $t < t_{0.01}$ — zero hypothesis has been accepted — differences of infestation are insignificant;
- between Region 2J and 3K at 1970 and Region IIb at 1974 — $t = 6.659$; $t_{0.01} = 2.771$ $t > t_{0.01}$ — zero hypothesis has been rejected — differences of infestation are significant;
- between Region 2J and 3K at 1974 and Region IIb at 1974 — $t = 12.192$; $t_{0.01} = 2.845$ $t > t_{0.01}$ — zero hypothesis has been rejected — differences of infestation are significant;
- between Region 2J and 3K at 1974, and Region IIb at 1975 — $t = 12.254$; $t_{0.01} = 2.771$ $t > t_{0.01}$ — zero hypothesis has been rejected — differences of infestation are significant;

Table 8

Average infestation of the cods by the parasite *Clavella adunca* at the different years and regions of survey

	Regions			
	2J and 3K	2J and 3K	I Ib	I Ib
	years			
	1970	1974	1974	1975
mean infestation \bar{x}	1 299.7	1 398.5	489.0	625.3
variance S^2	126 089.0	32 773.0	22 592.9	21.424.9
standard deviation S	355.1	181.0	150.3	146.4
number of samples n	19	12	10	17

e) between Region I Ib at 1974 and Region I Ib at 1975 – $t = 2.226$; $t_{0.01} = 2.787$ $t < t_{0.01}$ – zero hypothesis has been accepted – differences of infestation are insignificant;

f) between Region I Ib at 1975 and Region 2J and 3K at 1970 – $t = 7.091$; $t_{0.01} = 2.727$ $t > t_{0.01}$ – zero hypothesis has been rejected – differences of infestation are significant.

It proceeds from obtained data that differences of the rates of cod infestations between region of Labrador and New Foundland, and region of Spitsbergen and Bear Island were significant. On the other hand, changes of the infestation rates over the same regions but different years were proved insignificant.

SUMMARY

The morphometrical measurements of *Clavella adunca* female body have shown marked differences of lengths of its particular parts dependent on the place of attachment to the host. It confirms an opinion that shape and proportions of parasite body are depending on conditions created by the place of attachment to the fish.

Marked differences were also noted in shape and size of the bullae originating from the different places of attachment to cod. Bulla from fins is bigger and has more elongated form while the bullae from gills and anus are smaller and spherical.

Those observations refer to parasites from Northwest and Northeast Atlantic to the same extent.

No essential differences were noted in the incidence of parasitic invasion from different

places and depths of catch over the Labrador and New Foundland regions. At the particular years mean intensity of invasion was approximate. It was found that incidence of invasion expands together with fish size reaching mean infestation rate at the age of 4–5 years, then increases slower, and after attaining maximal value among 7–8 years old specimens shows decreasing tendency.

At the Spitsbergen and Bear Island regions, the incidence as well as intensity of invasion was lower than at Region of Labrador and New Foundland. It resulted from the much lower concentrations of cods at the first two regions. It has been clearly demonstrated at the time of blue halibut fishing when cod made only small fraction of total catch. Besides, characteristics of parasitic invasion was similar to observed at North Atlantic region.

When analysed by means of Student's *t* test, the differences in the rates of cod infestation were found insignificant for fishes sampled in the same Region but originating from the different years. On the other hand, the differences between mean infestation rates of cods from different regions of survey were proved significant.

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WYSTĘPOWANIE PASOŻYTY *Clavella adunca* (Strøm, 1762)
(Copepoda parasitica: Lernaepodidae)
NA DORSZACH (*Gadus morhua* L.) WÓD PÓŁNOCNEGO ATLANTYKU

Streszczenie

W latach 1970 i 1974 przeprowadzono badania nad stanem zarażenia dorszy (*Gadus morhua* L.) z wód północno-zachodniego Atlantyku (łowiska Labradoru i Nowej Fundlandii) przez pasożyta *Clavella adunca* (Strøm, 1762). Ogółem szczegółowej analizie ichtiologicznej poddano 4454 sztuki dorszy.

W pracy przedstawiono wyniki obserwacji nad różnicami w kształtach bulli i proporcjach ciała samicy pasożyta, pochodzących z różnych miejsc przyczepu na żywicielu. Obliczono ekstensywność i intensywność inwazji pasożytniczej w poszczególnych latach i rejonach połowów. Ekstensywność inwazji była zbliżona w 1970 i 1974 r. i wynosiła odpowiednio 57,8 i 61,2%, a średnia intensywność inwazji 2,2 i 2,3 osobników na jedną rybę zarażoną. Ekstensywność inwazji wzrastała szybko wraz z długością ryby a po osiągnięciu maksimum wykazywała tendencję malejącą.

Tego samego rodzaju obliczenia przeprowadzono dla dorszy poławianych w rejonie północno-wschodniego Atlantyku (łowiska Spitsbergenu i Wyspy Niedźwiedziej) w latach 1974 i 1975, gdzie przebadano ogółem 2714 sztuk dorszy. Ekstensywność inwazji była niższa niż w północno-zachodnim Atlantyku i wynosiła 46,8% w 1974 r. i 45,8% w 1975 r. a dla dorszy stanowiących przyłów w połowach halibuta niebieskiego w 1974 r. tylko 37,1%. Średnia intensywność wynosiła w 1974 r. 1,3 a w 1975 r. 1,4 pasożyta na jedną rybę zarażoną.

Przy pomocy testu t Studenta zbadano istotność różnic w zarażeniu dorszy z badanych lat i rejonów. Okazało się, że różnice w stopniu zarażenia ryb z północno-zachodniego a północno-wschodniego Atlantyku są istotne, natomiast zmiany w stopniu zarażenia w tych samych obszarach Atlantyku a różnych latach nie są istotne.

Ежи Януш

ПАРАЗИТ *CLAVELLA ADUNCA* (STRØM, 1762)
(COPEPODA PARASITICA LERNAEPODIDAE) НА ТРЕСКЕ
(*GADUS MORHUA* L.) ИЗ СЕВЕРНОЙ АТЛАНТИКИ

Р е з ю м е

В 1970 и 1974 годах провели исследования состояния заражения трески (*Gadus morhua* L.) из северо-западной Атлантики (районы лова: Лабрадор и Ньюфаундленд) паразитом *Clavella adunca* (Strøm, 1762). Исследовали методом частного иктиологического анализа 4454 экз. трески. В работе пред-

ставили результаты наблюдений над различиями в форме буллы и пропорциях тела самок паразита, взятых из разных мест прикрепления на кормильце. Подсчитали экстенсивность и интенсивность инвазии паразитов в определенные годы и в определенных районах лова. Экстенсивность инвазии была похожа в 1970 и 1974 годах и составляла соответственно 57,8 и 61,2% а средняя интенсивность инвазии 2,2 и 2,3 особей на одну зараженную рыбу. Экстенсивность инвазии возростала быстро вместе с длиной рыбы и после достижения максимума экстенсивности, проявляла склонность к уменьшению. Такие же подсчеты провели для трески вылавливаемой в районе северо-восточной Атлантики (районы лова: Шпицберген и остров Медвежий) в 1974 и 1975 годах. Здесь исследовали в общем 2714 экз. трески. Экстенсивность инвазии была на более низком уровне чем в северо-западной Атлантике и составляла 46,8% в 1974 году и 45,8% в 1975 году а для трески составляющей прилов в уловах синего палтуса в 1974 году только 37,1%. Средняя интенсивность инвазии составляла в 1974 году 1,3 а в 1975 году 1,4 паразита на одну зараженную рыбу.

При помощи теста t по Студенту исследовали существенность различий в заражении трески по исследованым годом и районом лова. Оказалось, что различия в степени заражения рыб из северо-западной и северо-восточной Атлантики являются существенными. Изменения в степени заражения в этих же районах в разные годы являются несущественными.

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