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STUDIES ON THE ETIOPATHOGENESIS OF FISH DISEASES IN THE BALTIC SEA*

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An invasion of microsporidia from the genus *Pleistophora* was discovered in cod, herring, sprat and flounder, The invasion was very intensive and it was considered as one of the reasons of fish diseases in the Baltic Sea. Accompanying infection of mixed bacterial flora complicated and enhanced the disease process. Development of the disease was also induced by weak natural resistance of the fishes, this being due to pollution of the Baltic Sea.

INTRODUCTION

In view of the fact that since mid-seventies fish health in the Baltic Sea is deteriorating, studies were undertaken on this phenomenon. At first, pestis anguillarum was observed in eel (Einszporn-Orecka 1976, Eiszporn-Orecka and Dziadziul 1976) which in 1981 developed into extensive epizootics, causing mass fish kills (Grawiński 1982, Waluga 1982). According to the report by the Sea Bureau in Gdynia (1982), the disease spread also to herring, flounder, sprat, and most of all cod. As regards the fish catch, 3.6–18% of all cod showed disease symptoms (fishes with external changes). Most exploited fish species showed disease symptoms, i.e. the disease might have had a negative effect on the

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fish catch. It was also suspected that the disease might be dangerous for humans, so the fishes were not qualified as suitable for consumption.

MATERIAL AND METHODS

E xaminations were made of 140 cods (*Gadus morhua*), 32 herrings (*Clupea harrengus*), 19 fl ounders (*Platichthys flesus*) and 37 sprats (*Sprattus sprattus*). Basic biometric parame te s of the examined fishes were as follows:

Species	Length in cm (l.t.)	Weight in g
Cod	18.0–57.0	50–2170
Herring	16.0–25.5	70– 145
Sprat	8.5–15.0	10– 20
Flounder	23.5–31.0	180– 400

The materials were obtained from deep-sea fishing in course of two research cruises of the r/v "Profesor Siedlecki", in the periods 16 May – 1 June 1982 and 25 August – 14 September 1983. Catches were performed at the following rishing grounds: Gulf of Gdańsk, Gdańsk Deep, Kłajpedy ground, Gotland Deep, Słupsk ground, Bornholm Deep, Kołobrzeg-Darłowo grounds, Pomeranian Gulf and Ustka-Łeba grounds.

Fishes with external disease symptoms were selected for the examinations (skin changes, emaciation). Fishes with no disease symptoms were used as the control. Overall parasitological examinations were made. Parasites were classified to species or genus, using the key edited by Bychowski (1962), and the key by Putz et al. (1965). During the second cruise materials were also collected for microbiological studies: 19 cods, 13 herrings, 12 sprats and 7 flounders. Material were collected directly after fish catching, from healthy skin and from places showing disease changes, as well as from gills, heart blood, kidneys and intestine content. Cultures were performed on a number of media, ensuring development of aerobic and anaerobic forms as well as microphilic microorganisms. Media were also used for the development of bacteria characterized by high nutritive requirements. Incubation was performed in 18° and 37°C. The cultures obtained were used to prepare slides stained with the method of Gram and MGG. Isolated strains were classified according to Bergey (Breed and Murray, 1948, Buchanan and Gibbons, 1974), and in some cases – according to Toplea (Wilson 1975) and Krassilnikov (1949). Microbiological studies of sea water were also carried out (quantitative and qualitative analyses) on 50 stations. Quantitative studies were made according to the method by Koh, using media corrected for the salinity of the Baltic Sea.

Fishes were subjected to pathomorphological examinations. Anatomo-pathological changes were determined from total fish dissection, histopathological changes were determined from microscopic examinations of the preparates made from skin, gills, digestive

Table 1

Parasites of cod (*Gadus morhua* L.) in South Baltic

Parasite	Fishing grounds							
	Off Klaipeda	Gulf of Gdańsk	Gdańsk Deep	Gotland Deep	Słupsk Trough	Ustka–Łeba	Bornholm Deep	Kołobrzeg Darłowo
Trichodina borealis (Dogiel)	–	–	–	–	–	–	–	P* / 14.3
Ichthyobodo necatrix (Henneguy)	–	–	–	N–S / 10	–	–	–	N–S / 12
Hexamita sp.	–	–	N / 0.8	–	N–L / 10	–	–	N–S / 0.5
Pleistophora sp.	U–L / 79.5	L–M / 100	L–M / 96	U–M / 84.5	L–M / 88.3	L–M / 92	U–M / 79.7	U–M / 87.5
Eimeria macroresidualis Schulman – et Zaika	–	–	U / 0.8	–	P–L / 50	–	U–L / 20	L / 14.3
Rhabdospora thelohani Henneguy	–	N / 25	–	–	U–L / 1.2	–	N / 5.0	U–L / 9.5
Diplostomum spathaceum (Rud.) metacercaria	–	–	0.43(0–3)** / 14.3	–	0.25(0–1) / 25	–	–	–
Thynnascaris adunca (Rud.) larwa	–	–	–	–	–	–	–	0.14(0–1) / 14.3
Echinorhynchus gadi Müller	23.0(4–85) / 100	1.0 (1) / 100	18.1 (4–34) / 100	15.6 (0–50) / 80	33.5 (9–66) / 100	30.6 (9–47) / 100	3.0 (0–9) / 50	30.0 (1–81) / 100

Extensiveness of invasion in %

M – mass
BL – very numerous
L – numerous
U – moderate numbers
DL – fairly numerous

N – rare
P – single
S – sporadic

* – invasion intensiveness for mass parasites, ** – invasion intensiveness for countable parasites – range and average

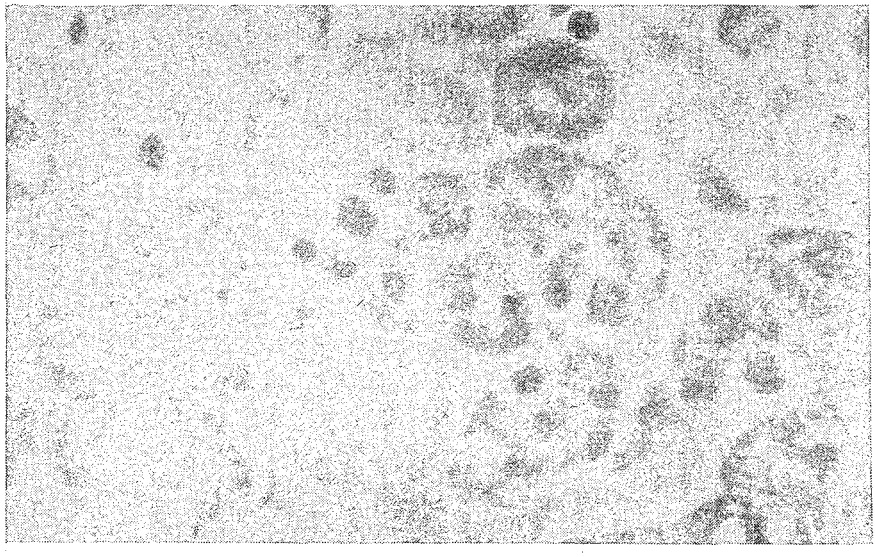

Fig. 1. Schizonts of *Pleistophora sp.* in skin epithelial cells of cod. Prep. from live material, KF, magn. 1600x (phot. J. Waluga)

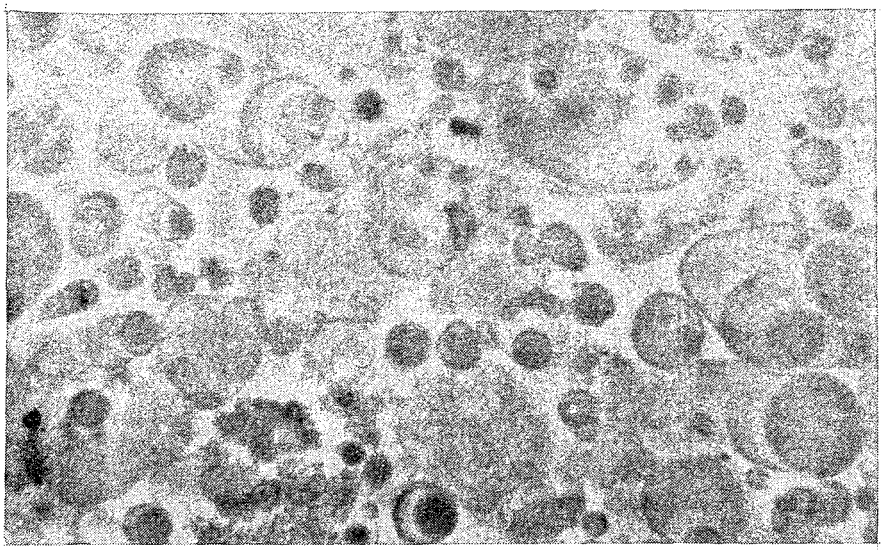

Fig. 2. Sporonts filled with sporoblasts and spores of *Pleistophora sp.* from wall or cod air-bladder. Prep. from live material, KF, magn. 1600x (phot. J. Waluga)

tract, excretory and reproductive system. Moreover, microscopic examinations were made of fresh preparates (scraps cut thin enough to allow for cytological assessment) of the organs under study. These preparates were examined in light microscope, using phase contrast and magnification up to the highest possible.

RESULTS

Parasitological studies

Parasites belonging to various systematic groups were found in the fishes under study. Intensiveness and extensiveness of the infestation with parasites of the fishes originating from particular fishing grounds are presented in Tables 1 to 4. From among *Protozoa, Ciliata* and *Flagellata* were sporadic or occurred in moderate numbers, extensiveness of the infestation being low. *Sporozoa* were quite popular, the invasion being caused mostly by microsporidia from the genus *Pleistophora (Microspora).* In cod, extensiveness of the invasion reached 100%, while intensiveness varied but usually was fairly high, especially in fishes showing general symptoms of a disease or emaciated. Intensiveness of the invasion was higher in spring and early summer, and decreased in late summer. Intensive invasion was observed in the fishes from coastal zones of the Gulf of *Gdańsk* and Gdańsk Deep, as also from western coast.

Presence of an intracellular protozoan, i.e. of *Pleistophora*, was stated basing on the presence of sporonts. These were surrounded by their own membrane and contained oval-shaped spores and circular sporoblasts. Number of spores in one sporont reached several or more, this serving for their classification to the genus (Putz et al. 1965). Usually each host cell was filled with a single sporont, sporadically with two to three. This increased cell volume and induced structural and destructive changes (Fig. 1 and 2). Invasion of *Pleistophora* sp. was observed in many tissues, most of all in the epithelial ones. Most frequently, the parasite was present in the cells of the mucous membrane, especially in the posterior intestine section, in kidneys, internal layer of the air-bladder (Fig. 2), and bladder, as well as in the cells of gill epithelium. The parasite also invaded cells of the muscle tissue – skeletal muscles, smooth muscles (especially of the intestines) and heart. Moreover, it was present in the connective tissue: in skin, subepithelial connective tissue, submucosa of the food tract.

Invasion caused by microsporidia from the genus *Pleistophora* was observed also in other fish species. Its extensiveness was usually high, while intensiveness varied from low to fairly high.

The parasite occurred in masses in flounder and herring caught in the Gulf of Gdańsk. In these fishes, similary as in cod, the invasion was more intensive in spring and early summer. The parasite invaded all organism, but most of all the digestive tract, kidneys, air-bladder, and in flounder – also skin, skeletal muscles and gonads.

Table 2

Parasites of herring (*Clupea harengus* L.) in South Baltic

Parasite	Fishing grounds					
	Gulf of Gdańsk	Gdańsk Deep	Gotland Deep	Słupsk Trough	Bornholm Deep	Off Władysławowo
Pleistophora sp.	L–M / 90.4	L / 85.5	U–L / 77.8	L / 86.8	U–L / 67.4	L / 87.7
Eimeria macroresidualis Schulman et Zaika	P / 25	P / 17	–	L / 100	–	–
Rhabdospora thelohani Henneguy	L–M / 100	L / 34	U–BL / 75	U–L / 100	U–L / 100	P–L / 100
Diplostomum spathaceum (Rud.) metacercaria	–	1,0 (0–4) / 34	–	–	–	0.5 (0–1) / 50

Denotations as in Tab. 1

A sporozoan *Rhabdospora thelohani* was also frequently found. Systematic position of this parasite is not clear (Morrison and Odense, 1978). Herring was infested most intensively; extensiveness of the invasion reached 100% at varying intensiveness – from low to fairly high, especially in the Gulf of Gdańsk. The parasite was present in epithelial tissues, most of all in skin and gill epithelium, but also in submusoca of the intestines and in kidneys. Occurrence of this parasite was accompanied by degenerative and necrotic changes. Another sporozoan, *Eimeria macroresidualis (Apicomplexa)* was found in gonads of all fishes except flounder. Its occurrence was very intensive in cod and herring from some fishing grounds. Extensiveness of the invasion was also fairly high (Tab. 1 and 2).

As regards parasites belonging to higher systematic groups, *Echinorhynchus gadi* was found in cod, extensiveness of the invasion reaching almost 100%. This parasite was found in all cods originating from most fishing grounds, the only exception being Deep of Gotland (80% extensiveness) and Deep of Bornholm (50%). Intensiveness of the invasion differed (Tab. 1). Cods most infested with *E chinorhynchus* originated from Kłajpedy grounds, Słupsk grounds, Ustka-Łeba grounds and the neighbouring Kołobrzeg-Darłowo grounds. Invasion by this parasite was accompanied by symptoms of catarrhal inflammation of the intenstines, and guts of the fishes were usually less filled with food. Cods with noticeable disease symptoms were usually more infested with *E. gadi*.

Bacteriological studies of fishes and of sea water.

Cultures of the material collected from the fishes did not differ for particular fish species. 10 genera of bacteria were isolated from skin surface. They were represented by Gram-positive cocci and Gram-negative rods. Microorganisms isolated most frequently belonged to the genera *Micrococcus, Staphylococcus, Flavobacterium* and *Aeromonas*. The following species were found within these genera: *Aeromonas salmonicida, Aeromonas hydrofila, Micrococcus varians, Flavobacterium tirrenicum*. Isolated strains of

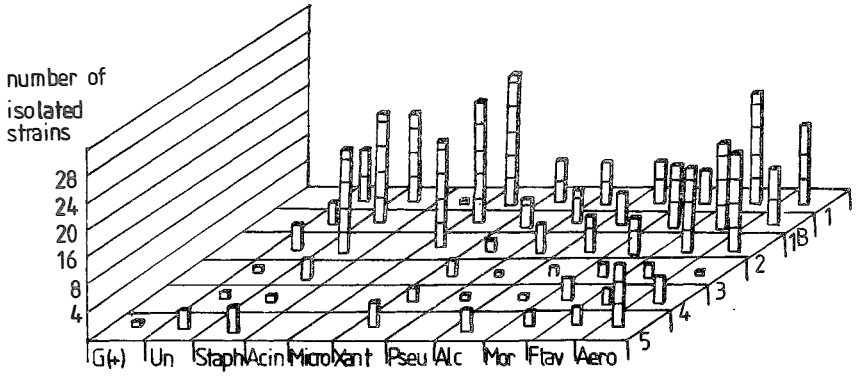

Fig. 3. Quantitative list of microorganisms isolated from the material subjected to microbiological analyses.
1 – skin with no disease symptoms, 1b – Places with disease symptoms, 3 – heart blood, 4 – kidneys, 5 – intestine content

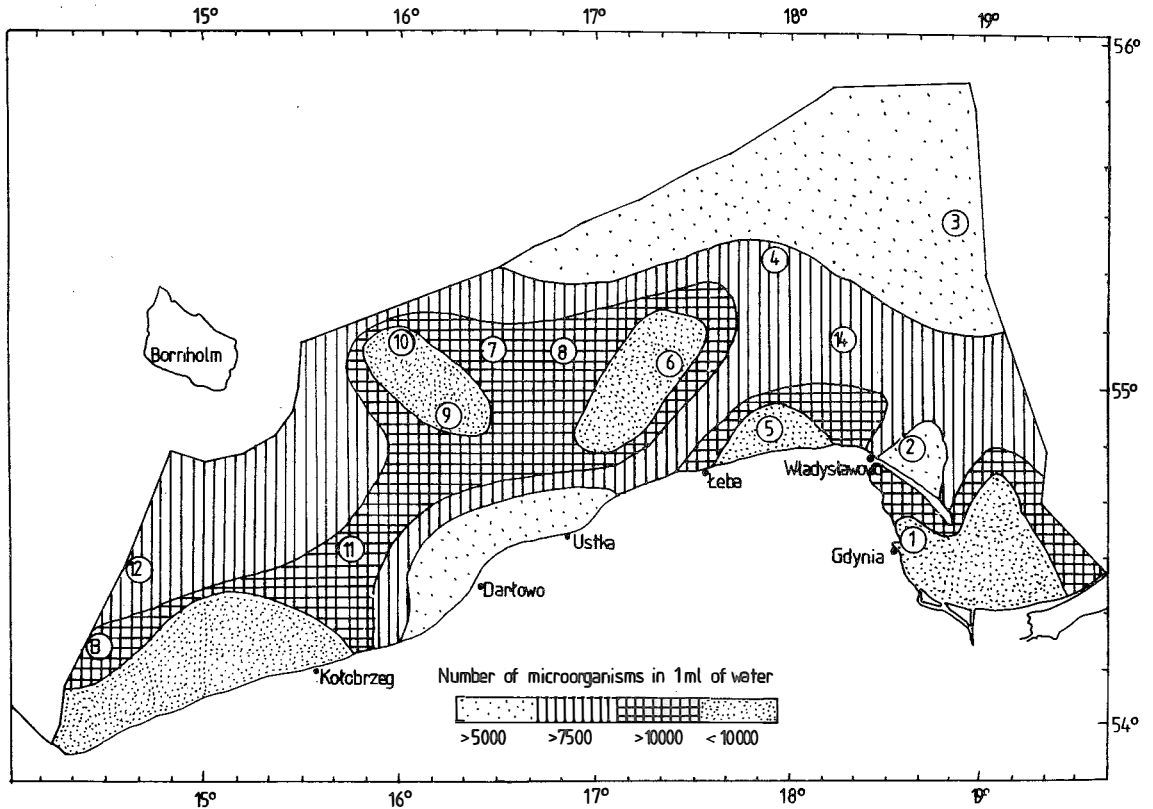

Fig. 4. Bacteria cell counts in waters of South Baltic, with consideration given to particular fishing grounds.

Table 3

Parasites of sprat (*Sprattus sprattus* L.) in South Baltic

Parasite	Fishing grounds					
	Gulf off Gdańsk	Gdańsk Deep	Gotland Deep	Słupks Trough	Bornholm Deep	Kołobrzeg Darłowo
Pleistophora sp.	L–M / 93.6	L–M / 87.2	L / 62	P–M / 71	L–M / 65	L / 86.4
Eimeria macroresidualis Schulman et Zaika	–	–	–	P / 20	L / 17	P / 33
Rhabdospora thelohani Henneguy	–	L / 25	U–L / 33	P / 20	P / 33	L / 33
Diplostomum spathaceum (Rud.) metacercaria	–	–	–	–	0.17 (0–3) / 17	–

Denotations as in Tab. 1.

Staphylococci did not produce coagulasis, and some of them were characterized by beta-haemolytic properties. Bacteriological studies of skin lesions did not reveal any other bacteria apart from those found on healthy skin. *Micrococcus* and *Staphylococcus* predominated. In some fishes (6 cods, 6 herrings and 3 sprats) positive cultures were obtained from blood and kidney samples. These were predominated by microorganisms belonging to non-fermenting, aerobic, Gram-negative rods. *Aeromonas salmonicida* was isolated in 5 cases. Rich bacterial flora was found in the intestines. Gram-negative rods from the genus *Aeromonas* predominated. At the same time, numerous Spirillum and Vibrio were observed, but these were not isolated due to methodical difficulties, Fig. 3 presents microbiological composition of the material collected from the fishes.

Table 4

Parasites of flounder (*Platichthys flesus* L.) in South Baltic

Parasite	Fishing grounds	
	Kołobrzeg – Darłowo	Ustka – Łeba
Trichodina borealis (Dogiel)	P–L / 100	P / 100
Pleistophora sp.	P–M / 100	P–M / 93
Rhabdospora thelohani Henneguy	P / 14	–
Diplostomum spathaceum (Rud.) metacerkaria	1.0 (0–14) / 14	–
Cucullanus minutus (Rud.)	0.57 (0–4) / 14	–
Cucullanus cirratus Müller	0.14 (0–1) / 14	–
Pomphorhynchus laevis (Müller)	1.4 (0–6) / 42	1.5 (0–3) / 50

Denotations as in Tabl. 1

Studies of water from South Baltic showed that it contained rich bacterial flora. The highest concentration of bacteria was found in the Gulf of Gdańsk, in coastal waters between Władysławowo and Łeba, in the region of Słupsk ground, in coastal waters between Kołobrzeg and Swinoujście, and in the region north of Kołobrzeg (Fig. 4). Quantitative relations were determined by prototrophic and auxotrophic forms (Fig. 5). It was found that higher total bacteria counts in 1 ml of water correlated with the predomination of heterotrophic forms, of high nutritive requirements. Qualitative analyses revealed presence of bacteria from the following genera: *Aeromonas, Flavobacterium, Moraxella, Pseudomonas, Micrococcus, Planococcus*, and aerobic Gram-positive rods. It was found that fishes with changes in external integuments were usually caught in the regions where bacteria concentration in water was high. It was also found that bacteria isolated from sick fishes were present in water in places where these fishes were caught.

Pathomorphological studies

Non-specific changes were mostly observed, of different intensity in particular fish species. Most intensive changes were observed in cod and flounder. Exudative inflammation was most common, especially in external integuments. It was frequently coupled with tissue necrosis. Other frequent changes consisted mostly of proliferative inflammation.

Changes in external integuments were most frequent in cod. They were observed in 5.5% of all fishes caught. Percentage of diseased fishes differed at particular fishing grounds, being usually higher in coastal waters (Gulf of Gdańsk – 14.1%). In flounder, these changes were also frequent, but only in samples originating from two fishing grounds. As regards herring and sprat, only a few individuals showed changes in external integuments.

Early stages of the disease in cod were manifested by local swellings with scale protrusion, or by infiltrations, usually located in posterior part of the body. More intensive changes consisted of an inflammation process, reflected by haemorrhages, often coupled with necrosis. Lesions were also observed resembling mechanical damages, or even deep ulcers, extending to skeletal muscles or to the skeleton itself (Fig. 6). In herring and sprat, skin lesions were usually circular in shape, penetrating deep into skeletal muscles, although lesion edges were still covered with scales. Number of lesions varied from single in herring and sprat, to numerous, especially in cod and flounder. In cod and sprat they were frequently accompanied by proliferative changes in form of tubers (Fig. 7), with crater-like central part surrounded by a belt of swollen tissue. These changes showed sometomes symptoms of healing or cicatrization.

Microscopic picture of inflammed tissues was characterized by numerous cell infiltrations of different type, acidophilic and heterophilic granulocytes being most frequent. These cells were sometimes mixed with erythrocytes. Cell hypetrophy was observed in

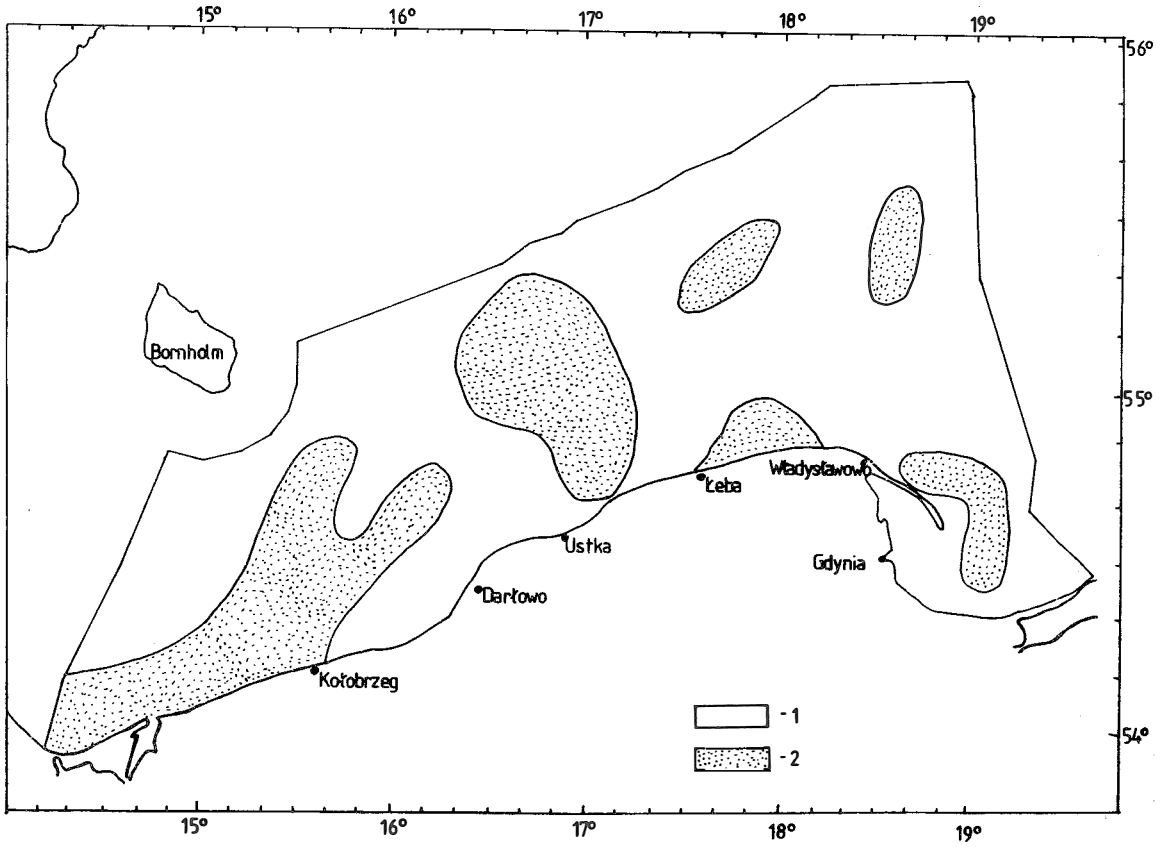

Fig. 5. Regions with predomination of auxotrophic psychrophilic microorganisms in South Baltic. 1 – prototrophic forms, 2 – auxotrophic forms

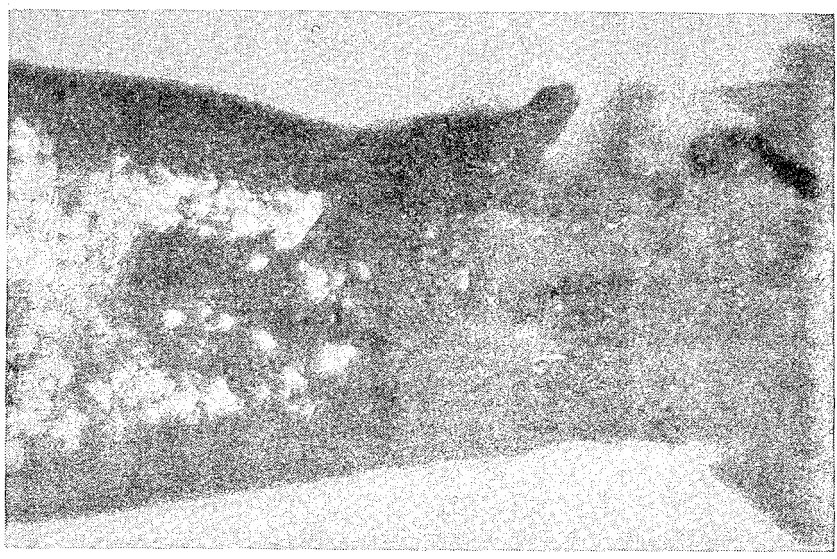

Fig. 6. Lesion penetrating skeletal muscles in cod (phot. A. Świątecki)

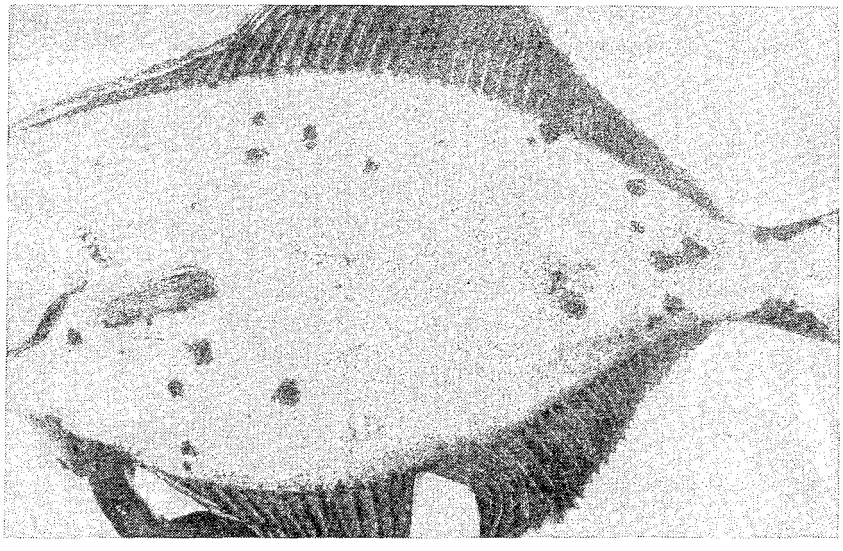

Fig. 7. Numerous haemorrhagic infiltrations and lesion penetrating skeletal muscles in caudal part of flounder (phot. A. Swiątecki)

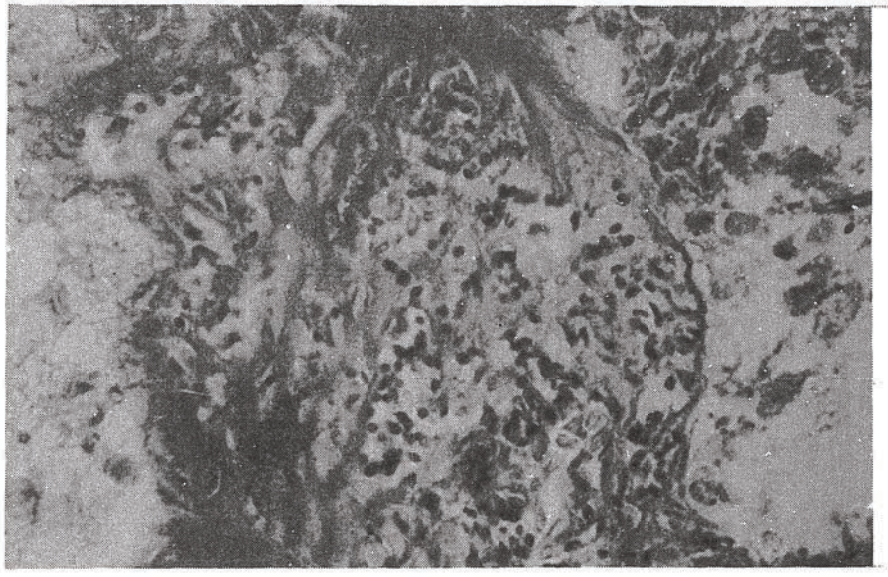

Fig. 8. Necrotic changes in cod skin in course of *Pleistophora sp.* invasion. Preserved mat., HE, magn. 800 x (phot. J. Waluga)

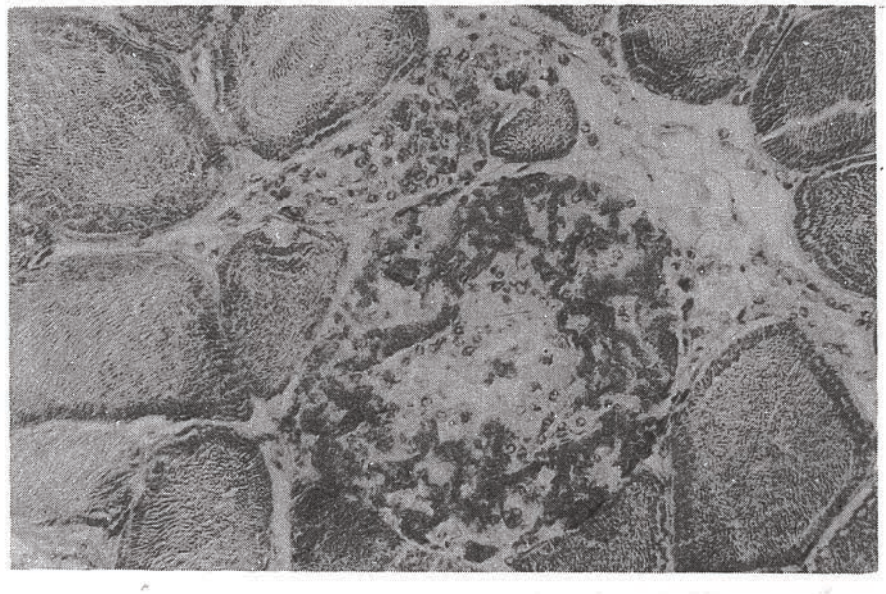

Fig. 9. Necrosis of a bundle of cod skeletal muscles in course of *Pleistophora sp.* invasion. Preserved mat., HE, magn. 320x (phot. J. Waluga)

the epithelium, induced by the presence of sporonts and achizonts of an intracellular parasite *Pleistophora sp.* in cell cytoplasm. The parasite induced also regressive changes in nuclei of host cells, as also desintegration of whole cells. Changes of this type were observed also in deeper skin layers and in skeletal muscies (Fig. 8 and 9). Pigment accumulated around the parasites, this being a defence reaction of the infected organism. Moreover, various strains of bacteria were observed in microscopic pictures of the tissues, sometimes very numerous. Usually, more bacteria were present close to necrotic tissues.

Changes were observed in other organs, in this also in fishes with no external symptoms. Gills were frequently swollen, with serous, or serous-haemorrhagic infiltrations, less frequently with focal hypaeremia or haemorrhages. Large lesions were also observed, some in course of healing. However, proliferative changes predominated. These were in form of an excessive growth of the gill epithelium, resulting in deformation of gill blades and rakers. Excessive growth of the epithelium was accompanied by cell hypetrophy induced by microsporidia.

Organs of the abdominal cavity were inflammed, this being especially noticeable in emanciated cod with external lesions. Inflammation of these organs was accompanied by exudates to body cavity – usually serous or sero-fibrinous. Most intensive changes were observed in the digestive tract: catarrhal inflammation with exodates, sometimes in form of jelly-like rods. Cases of catarrhal-haemorrhagic inflammation was also observed, usually in the posterior intestine section. Hypertrophy of epithelial cells and microsporidia were observed in microscopic pictures of the intestine mucosa. Intestine light was filled with various bacteria. Kidneys were usually most affected, showing regressive changes in nephrons and especially in ureters. Changes were also noted in fish gonads: sero-haemorrhagic inflammation of ovaries, diffused or focal, sometimes accompanied by oocyte necrosis. Swim bladder and its walls contained haemorrhages and showed hyperemia. Cases of abundant accumulation of infiltrations were also found. Microscopic examination of these organs usually confirmed inflammation symptoms and revealed presence of a parasitic protozoan *Pleistophora sp.*

DISCUSSION

Our studies allowed for assessing the role of some biotic factors in etiopathogenesis of fish diseases in the Baltic Sea. The results of parasitological studies showed that from among the parasites, microsporidia from the genus *Pleistophora (Microspora)* were fairly important. This was reflected in common occurrence of these parasites as well as in high intensiveness of the invasion. These parasites are known to be highly pathogenic (Lom 1970, Putz and McLaughlin 1970, Summerfelt and Warner 1970, Grabda 1981, Hauck 1984). Intensive infestation was observed in cod and flounder. This might have been connected with feeding habits of the two species, so that the parasite might have invaded the fish organism also through digestive tract, and not only in a transovarian way, the latter being the case of pelagic fishes – herring and sprat. Moreover, analyses of fishes

caught at various fishing grounds of South Baltic revealed that higher intensiveness of the disease was observed in fishes from coastal waters of the west coast and from the Gulf of Gdańsk, i.e. from more polluted regions. Most probably, water pollution decreased fish resistance, and at the same time induced development of sporozoans.

Pathological changes observed in course of the invasion were directly related to the presence of the parasites. Intracellular microsporidia caused cell enlargement, destruction of cytoplasm and nucleus, and cell necrosis. The invasion was accompanied by inflammation with melanin and cyto-reaction, excessive growth of epithelium, this being an immunological reaction of the organism. On the other hand, inflammatory changes observed in some fishes, in form of skin lesions penetrating as deep as skeletal muscles, were not caused by microsporidia only. This was confirmed by bacteriological studies. They revealed presence of rich bacterial flora. Bacteriological picture did not differ in particular fish species. Bacteria from the genera *Aeromonas, Flavobacterium, Micrococcus* and *Staphylococcus* were always present. Other bacteria strains were isolated in single cases. Microbiological analyses of the material collected from selected organs did not reveal any bacteria connected with one organ only (Fig. 3). This points to non-selective role of the isolated bacteria, and suggests that diseases of Baltic fishes are directly related to ecological status of the Baltic, affecting negatively condition of organisms living in this environment. This suggestion is supported by qualitative and quantitative microbiological studies, carried out upon Polish fishing grounds. Strong bacterial pollution was observed, exceeding standards established for highly polluted waters (Cabejszek et al. 1960, Liebmann 1962, Rheinheimer 1975). Importance of microorganisms in inducing external disease symptoms is suggested by the results of tests on biochemical and physiological properties of the isolated bacteria. Gram-negative rods from the genera *Aeromonas, Pseudomonas* and *Flavobacterium* as well as Gram-positive cocci from the genera *Micrococcus* and *Staphylococcus* are characterized by high nutritional requirements. Many strains from the genera *Aeromonas, Micrococcus* and *Staphylococcus* are characterized by alfa- and beta-haemolytic ability. These properties are characteristic of pathogenic microorganisms. Pathogenic character of the isolated strains may become especially important when natural resistance of the organisms is weak due to the negative effect of environmental factors.

Cultures were obtained from blood of 12% of all fishes, and from kidneys of 30% of the fishes. This fact confirms the suggestion on general bacterial infection and points to the possibility of "viremia" symptoms, so that the fishes were not suitable for consumption.

As regards bacteriological studies of sea water, numerous auxotrophic, mesopsychrophilic bacteria were isolated close to sewage discharge, suggesting possibility of human infection as well. Rods from the family *Enterobacteriaceae* are usually numerous in domestic sewage. Their lack in sea water was probably due to limited survival of these bacteria at higher salinity (Bondo 1967).

Our studies did not embrace all potentially pathogenic factors. Nevertheless, the results point to importance of biotic factors in etiopathogenesis of fish diseases in the

Baltic Sea, most of all of microsporidia from the genus *Pleistophora*. These induced the disease, while rich bacterial flora (mostly pathogenic) complicated the disease course and induced disease symptoms in the tissues. Coexistance of both pathogenic factors – microsporidial invasion and bacterial infection – enhanced disease symptoms. It is also probable that pollution of the Baltic Sea weakens natural fish resistance, and stimulates development of sporozoans.

At present, health of the fishes caught in the Baltic Sea necessitates examination of their suitability for consumption. It has not been established whether microsporidia are dangerous for humans, but it is generally thought that metabolic products of these parasites might be toxic, and that fishes invaded by microsporidia producing cysts should not be eaten.

The results of our studies showed that fishes with disease symptoms should not be consumed, as these symptoms may be coupled with general bacterial infection, the latter being dangerous for humans.

CONCLUSIONS

1. Parasitic fauna predominated by parasitic protozoans was found in cod, herring, sprat and flounder caught in South Baltic. Intracellular sporozoan from the genus *Pleistophora (Microsporidia)* was most frequent.

2. Invasion of the fishes by *Pleistophora sp.* was characterized by considerable extensiveness and intensiveness, this being especially true of cod and flounder originating from the Gulf of Gdańsk and coastal waters of west coast.

3. Invasion caused ny highly pathogenic *Pleistophora sp.* was considered as an important factor inducing the disease symptoms. These were: complex changes of inflamatory and degenerative character as well as progressive lesions in external integuments and internal organs.

4. The invasion was accompanied by mixed bacterial flora, predominated by relatively pathogenic microorganisms. These complicated and enhanced the disease.

5. Unfavourable environmental conditions in the Baltic Sea might weaken natural fish resistance, enhance development of sporozoans as well as activate bacterial flora.

6. Fishes with disease symptoms (external changes of skin, emanciation) should not be consumed as they might be dangerous for human health.

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STRESZCZENIE

Przeprowadzono badania nad etiopatogenezą bliżej nieznanego schorzenia ryb bałtyckich a sygnalizowanego nasilaniem się zewnętrznych zmian chorobowych. Badaniami objęto dorsze, śledzie,

szproty i stornie pozyskiwane w trakcie pełnomorskich połowów (16 maja do 1 czerwca 1982 i 25 sierpnia do 14 września 1983 r.) na obszarze południowego Bałtyku. U ryb przeprowadzono całościowe badania parazytologiczne, badania bakteriologiczne oraz patomorfologiczne makro- i mikroskopowe.

Badania parazytologiczne wykazały, że wśród parazytofauny dominował wewnątrzkomórkowy pierwotniak z rodzaju *Pleistophora (Microspora)*, znany z silnej patogeniczności. Pasożyt wywoływał inwazję o wysokiej intensywności i ekstensywności, zwłaszcza u dorszy i storni, szczególnie u pochodzących ze stref przybrzeżnych zachodniego wybrzeża i Zatoki Gdańskiej, charakteryzujących się silnym stopniem zanieczyszczenia z aglomeracji przemysłowo-miejskich.

Powszechność i wysoka intensywność stwierdzanej inwazji sporowcowej wskazywała na znaczącą rolę *Pleistophora sp.* w powstawaniu i przebiegu schorzenia. Inwazji towarzyszyły uogólnione zmiany zapalne wraz z odczynem melaninowym, traktowane jako reakcja obronna organizmu ryby. Współwystępująca z inwazją pasożytniczą bogata i zróżnicowana flora bakteryjna, przeważnie względnie chorobotwórcza komplikowała i pogłębiała proces chorobowy, szczególnie u ryb o osłabionej kondycji pod wpływem niekorzystnych warunków środowiskowych w Bałtyku. Wyniki badań bakteriologicznych wskazały również na konieczność eliminowania ryb ze zmianami chorobowymi jako surowca spożywczego z uwagi na możliwość zagrożenia zdrowia człowieka.

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ИССЛЕДОВАНИЯ ЭТИОПАТОГЕНЕЗА ЗАБОЛЕВАНИЙ РЫБ В БАЛТИКЕ

Р е з ю м е

Проведены исследования этиопатогенеза неизвестного заболевания балтийских рыб, которое проявляется усилением внешних болезненных изменений. Исследовались треска, сельдь, шпроты и камбала, взятые из промысловых уловов (с 16 мая по 1 июня 1982 и с 25 августа по 14 сентября 1983) района южной Балтики. У рыб проведены полные паразитологические, бактериологические, а также патоморфологические макро- и микроскопические исследования.

Паразитологические исследования показали, что среди паразитов фауны доминировали внутриклеточные простейшие вида Pleistophora (Микроспора), известные сильной патогеничностью. Этот паразит вызывал инвазию высокой интенсивности и экстенсивности особенно у трески и камбалы, в основной происходящих из прибрежных вод западного побережья и Гданьского залива, харак-

теризующихся высокой степенью загрязнения промышленно-городскими агломерациями.

Повсеместность и высокая интенсивность обнаруженной инвазии споровиков указывает на значительную роль Pleistophora в возникновении и протекании заболевания. Инвазии сопутствовали обобщённые воспалительные изменения вместе с меланеновой реакцией, которая считается оборонительной реакцией организма рыб. Богатая и разнородная бактерийная флора, выступающая вместе с инвазией паразитов, относительно болезнетворная, осложняла и углубляла протекание болезни, особенно у рыб, кондиция которых ослабена неблагоприятной окружающей средой в Балтике. Результаты бактериологических исследований показали также необходимость удаления рыб с болезненными изменениями, которые являются пищевым сырьём, опасным для человека.

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