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THE SECOND EXPLORATION OF ANTARCTICA BY POLISH BIOLOGISTS 1971–1972

The expedition was organized by the Nencki Institute of Experimental Biology of the Polish Academy of Sciences, Warsaw, under the leadership of Professor R. Klekowski. The group of Polish explorers was headed by Dr. S. Rakusa-Suszczewski, oceanologist from the Nencki Institute. The members taking part in the expedition were: Dr. M. Rembiszewski — ichthyologist and mgr A. Piasek — biochemist.

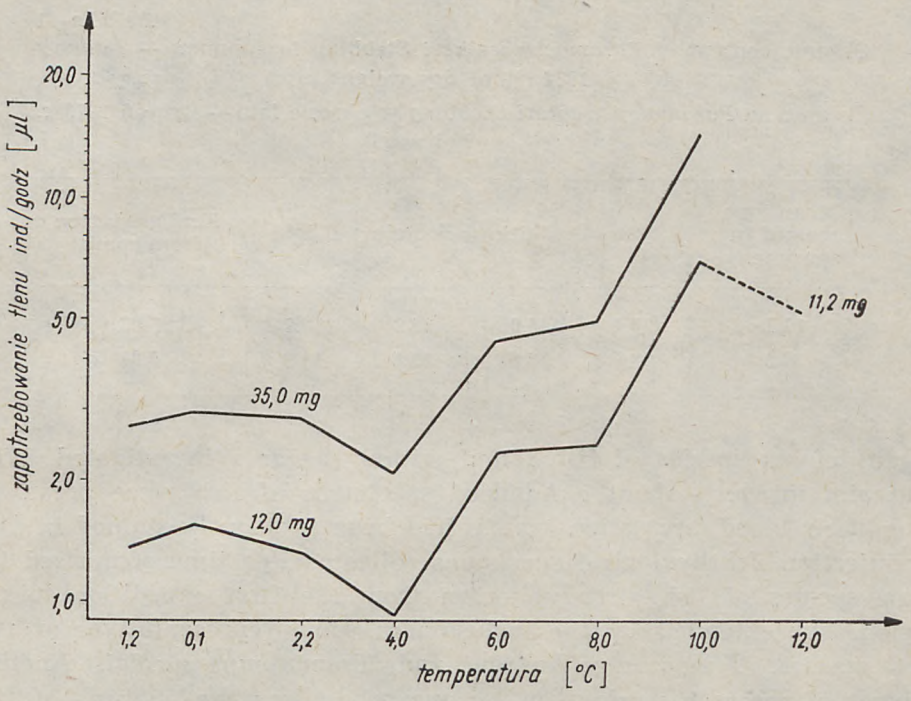
The Polish group joined the 17th Soviet Antarctic Expedition. The aim of this second voyage to Antarctica was the continuation of research commenced by Dr. S. Rakusa-Suszczewski and Mr. K. Opaliński in 1968 whilst conducting studies on board Soviet vessels and at the Molodezhnaya Antarctic Station for a period of 15 months as participants of the 14th S.A.E.

This time embarkation was at Gdańsk, where on November 14, 1971, the Soviet scientific research survey vessel m.s. „Profesor Viese" entered the port at Poland's request and picked up the group on its way to Antarctica. There was a three-day break in the voyage at Las Palmas. On 16 December we transferred to the icebreaker R/S „Ob" which took us into the region of the Alasheyev Bight, a distance of about 90 Km from Molodezhnaya Station. On 20 December we completed the last stretch of our voyage by flying over to the Station by plane. We continued our research until the beginning of March 1972, i.e. during the Antarctic summer. Our work consisted of some projects that could only be performed and accomplished by on-the-spot experimentation, as well as the accumulation of material and collections which could later be worked on, on returning home. In continuance of our studies of the feeding habits of various species of Antarctic fishes, initiated during our first expedition, this time we were interested, in particular, in the adaptation mechanism in the biochemical processes of the digestion of

food in fish. As the object of detailed investigation two species of fishes were selected — *Trematomus newnesii* and *Trematomus bernacchii*. They differ from each other by their habits and diet. The former is a pelagic plankton-eater, the latter, living at the bottom of the sea, is a benthos eater. The experiments were carried out in order to determine the catalytic action of enzymes decomposing proteins in food substance in the two species investigated. As they live in waters with a temperature below 0°C we were interested in the enzymatic activity in the optimal temperature. For the experiments, enzymes were taken from live fishes by squeezing out the contents of the pyloric processes together with the contents of a section of intestines about 1 cm below their vent. Casein was used as substratum. Tests were carried out in thermostats with temperatures ranging from — 2°C to 60°C. Decomposition of proteins was determined by the Lowry method of colour reaction by means of a photocolorimeter. The highest intensity of the action of enzymes was found to be similar in both Trematomus species and it occurs in temperatures from 3°C to 50°C which corresponds to the optimal temperature for the action of trypsin. Comparison of the action of enzymes at the survival temperature (— 2°C) and their action at a temperature of 6°C which is mentioned in literature as lethal for fish of the *Trematomus* species, has shown a slightly less than double increase of the intensity of action of enzymes with the increase of temperature.

In order to investigate the process of absorption of nutrient material in different sections of the alimentary tract of fish, about a hundred samples of nutrient contents from the intestines of both of the examined fish species were preserved for biochemical analysis. Furthermore, measurements of temperature were carried out inside the stomachs of live fish. The measurements showed a slightly higher temperature in the range of 0.26°C to 0.94°C relative to the temperature of the sea water at the time of measuring.

The second subject of our experimental studies covered research on the metabolism of *Paramoera walkeri (Amphipoda)* and its biology. Our stay in Antarctica in the summer season made it possible to accomplish a full annual cycle of research by completing the observations started in winter 1969 by the first group of Polish biologists. *Crustacea* living in a very limited range of temperature gradient were cultured and gradually acclimatized to higher temperatures. As the result of about a hundred series of experiments carried out in the temperature range from — 1.2°C to 12°C, with measurements taken every 2°C, it was found that metabolic processes had increased with the rise in temperature to between 01.2°C and 0.1°C and decreased at a temperature of 4°C corresponding to the metabolic compensation. It then in-



creased again at 10°C and decreased at 12°C which is close to the lethal temperature for those species (Fig. 1). The oxygen consumption per unit of mass increased by different degrees at different temperatures, but always along a straight line on a double logarithmic scale. The effect of the salinity of water was also investigated and it was found that the usual decrease of salinity in the summer season did indeed accelerate the metabolic processes of *P. walkeri*. Our information on the biology of *P. walkeri* in the summer season was also completed. Some samples of the *Crustacea* collected were preserved by lyophylization in order to complete the materials from the 1969 winter season and to be able to study the seasonal differences in the chemical composition of the investigated *Crustacea* (Tab. 1). We also collected hemo-lymph for the cryoscopic tests. For *P. walkeri* freezing point was — 2.6°C.

In order to complete our research on metabolism we also carried out some experiments on the respiratory processes of unfertilized eggs of *Trematomus borchgrevinki*. A considerable increase in oxygen consumption was noted in eggs kept at temperatures ranging from 6°C to 11°C. In the temperature range of — 1°C to 6°C no essential differences in oxygen consumption were noted.

The physio-morphological subject matter that can be studied at home, thanks to the material collected, is the analysis of the respiratory

Table 1

Organic content of *Paramoera walkeri Stebbing* in summer — January 1972 (% of dry weight)

Organiczna *Paramoera walkeri Stebbing* w okresie lato — styczeń 1973 r. (% suchej wagi)

Mean wet weight of specimens	Ash	Chitin	Protein	Lipid	Kcal/g ash free from bomb
11.1	28,4	5,0	38.3	12.7	5.03
37.3	28.1	8.6	38.6	14.8	5.01

organs of six species of fish found within the area investigated. With that aim in view, about a hundred specimens of fish were preserved after their blood circulation system had been previously stained in vivo by injection. Ichthyological specimens collected this time comprised the same species of fish already known from the first expedition to the region, but extended by the inclusion of some representatives of two new species: *Trematomus hansoni* and *Trematomus nicolai*. Another subject of research worked on by our group was the analysis of fish blood. We counted and measured the erythrocytes in the blood of *Trematomus newnesii, T. bernacchii, T. hansoni, T. nicolai* and *T. borchgrevinki,* as well as *Gymnodraco acuticeps,* on the spot. Distinet differences of shape, size and number of erythrocytes were found. The smallest number of erythrocytes was found in the blood of. *G. acuticeps* (Tab. 2) which is the closest relative to the family of white-blooded fishes. Thanks to the material collected and preserved it will be possible to make analyses of the constituent substances of haemoglobin and serum.

Continuing the research started by Polish biologists from the first expedition our group carried out measurements of temperature, salinity and oxygen contents of the water off the coastal region of Alasheyev Bight, as well as limnological observations in inland bodies of fresh water situated in an oasis. Materials and collections of didactical and exhibitory character were carefully accumulated.

On 5th March, 1972, our group with our equipment was taken by plane to the Soviet vessel m.s. "Nadieżda Krupskaja" which next day set sail from the embankment near the Molodezhnaya Station. On our way home we called at the port of Abidjan on the Ivory Coast and Las Palmas, to arrive at Gdynia (Poland) on 3rd April.

Table 2

Erythrocyte and haemoglobin counts for six Antarctic fishes

Liczba erytrocytów i hemoglobiny dla sześciu gatunków ryb antarktycznych

Species Gatunek	Mean* No of erythrocytes (mil/mm³) Liczba erytrocytów	Mean** Diameter μ Średnice	Haemoglobin Mean* g/100 ml. Hemoglobina
1. Gymnodraco acuticeps Boul.	0.53(11)	13.8(100)	2.2(3)
2. Trematomus bernacchii Boul	0.64(13)	13.6(52)	2.1(2)
3. Trematomus hansoni Boul.	0.64(10)	13.9(64)	3.4(3)
4. Trematomus borchgrevinki Boul.	0.71(9)	13.9(71)	5.0(2)
5. Trematomus nicolai Boul.	0.71(3)	12.9(39)	—
6. Trematomus newnesi Boul.	0.99(9)	12.1(97)	4.5(5)

* Number of fishes examined ** Number of erythrocytes measured
* Liczba badanych ryb; ** liczba erytrocytów.

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WYPRAWA POLSKICH HYDROBIOLOGÓW NA ANTARKTYDĘ

Streszczenie

Wyprawa została zorganizowana przez Instytut Biologii Doświadczalnej PAN im. Nenckiego w Warszawie, pod kierunkiem naukowym prof. dr. R. Z. Klekowskiego. W wyprawie wzięła udział 3-osobowa grupa polskich badaczy: dr S. Rakusa-Suszczewski (kierownik grupy), dr M. Rembiszewski oraz mgr A. Piasek.

Badania przeprowadzano wraz z siedemnastą radziecką wyprawą antarktyczną. Pierwszy etap podróży na Antarktykę przebyto na radzieckim statku badawczym PROFESOR VIESE, który zabrał polskich badaczy na swój pokład w Gdańsku 14.XI.1971 r. Dnia 16.XII przekazał ich na lodołamacz „OB", którym dopłynięto do Zatoki Alaszejewa, skąd ostatni odcinek trasy do Stacji Mołodzieżnaja odbyto samolotem (20.XII). Prace badawcze prowadzono aż do marca 1972 r., tzn. w okresie antarktycznego lata. Badania stanowiły kontynuację prac rozpoczętych w 1969 r. podczas pierwszej wyprawy na Antarktykę (sprawozdanie opublikowano w Oceanologii Nr 2 — dop. red.). Szczególną uwagę zwrócono na mechanizm adaptacji w procesie trawienia u ryb; przeprowadzono również badania ciepłoty wnętrz żołądków rybich. Przedmiotem badań były także prace nad metabolizmem *Paramoera walkeri* (*Amphipoda*) i nad ich biologią. W wyniku około stu serii badań (*Crustacea*), przeprowadzonych w temperaturze rzędu od —1,2°C do +12°C, ustalono wahanie temperatury dochodzące do +10°C i opadające do +12°C tzn. w granicach temperatury krytycznej dla tych gatunków (ryc. 1, s. 107). Celem skompletowania materiałów z pierwszej wyprawy zebrano między innymi także materiały dla badań kriometrycznych (tabl. 1, s. 108) dla określenia sezonowych wahań w składzie chemicznym badanych skorupiaków. Stwierdzono duże różnice w składzie wielkości i liczbie erytrocytów. Najmniejszą ich liczbę znaleziono we krwi *G. acuticeps* (tab. 2), których krew jest najbardziej zbliżona do krwi ryb z rodziny „białokrwistych". Kontynuowano także badania temperatury, zasolenia i zawartości tlenu w wodzie rejonów przybrzeżnych Zatoki Aleszejewa, jak też przeprowadzono badania limnologiczne cząstek świeżej wody z oaz lądowych. Starannie zbierano materiały i kolekcję dla celów dydaktycznych i wystawowych.

Dnia 5.III.1972 r. wyprawa opuściła Stację Mołodzieżnaja, a następnie, radzieckim m/s „Nadieżda Krupskaja", powróciła do Gdyni 3.IV.1972 r.