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Polish exploration and exploitation of Antarctic waters

ABSTRACT: Polish exploration and exploitation of marine resources of Antarctic waters date back to the reconnaissance cruise of the Sea Fisheries Institutes (SFI) *r/v Profesor Siedlecki* in 1974. Since 1975, a co-operation between the Institute of Ecology, Polish Academy of Sciences (PAS) at Dziekanów Leśny, and SFI in Gdynia with participation of the University of Agriculture in Szczecin, Faculty Marine Fisheries and Food Technology (UA) was established. Fishing fleets of the Polish Deep-Sea Fisheries Companies *Odra*, *Dalmor* and *Gryf*, since 1976 were operating in the Atlantic sector of Antarctic waters, south of the convergence.

Key words: Antarctic waters, marine resources, krill and fishes.

Introduction

When coastal states around the world began, in early 1970's, establishing their exclusive economic zones 200 mile wide and thus encompassing the most productive fishing grounds, a search for new, freely accessible fishing ground was started and coincided with a search for new sources of nutrition (Badowski 1977; Czubasiewicz 1977; Rakusa-Suszczewski 1979, 1980). At that time, fishing grounds of the Antarctic were still poorly known and almost unexploited, although the fishing fleet of the then Soviet Union reported, as early as in 1970, catches obtained in the Antarctic which totalled almost 400,000 tonnes. The main targets were notothenids, chaennichthids, myctophids, and the Antarctic krill (*Euphausia superba*). Krill began to be caught commercially as early as in 1973, but the largest catches were effected in 1982 when a total catch of 528,000 tonnes was reported. Apart from the USSR, other countries, *i.e.*, Japan, Poland, GDR, and Chile were, since 1975, involved in intensive exploitation of the Antarctic

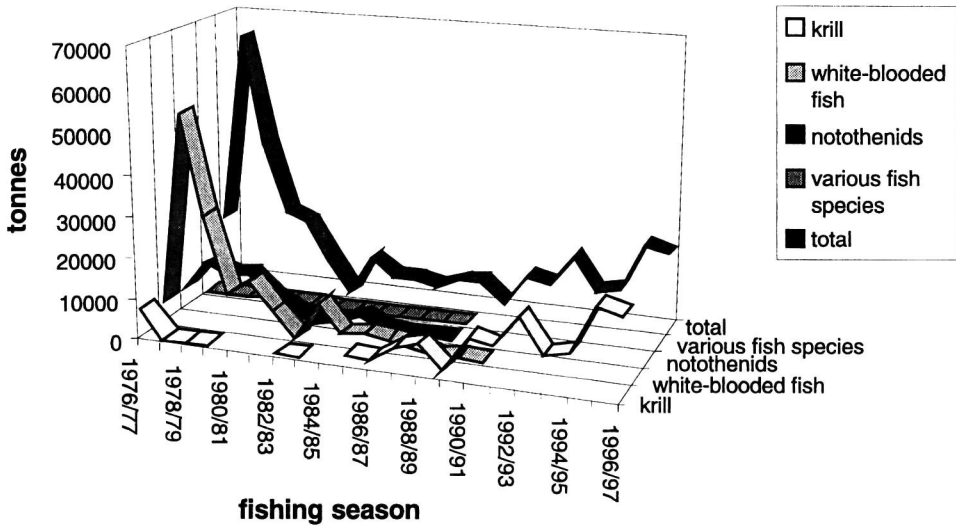


Fig. 1. Polish catches in the Antarctic within 1976–1997 (tonnes).

marine recourses (Sosiński 1994). Fishing fleets operating in the Antarctic waters in the eighties were concentrated south of the Antarctic Convergence, mostly in the Atlantic sector.

The Polish fishing activities in the Antarctic began in 1975, during the reconnaissance cruise of the Sea Fisheries Institute's *r/v Profesor Siedlecki* to waters off Kerguelen Island. During the 1st Polish Marine Antarctic Expedition in 1975/1976, *r/v Profesor Siedlecki* and a commercial trawler, *m/t Tazar* (Deep-Sea Fisheries Company *Odra* in Świnoujście) were the first to capture krill with pelagic trawls (Wolnomiejski *et al.* 1978). Since that time until 1989, *r/v Profesor Siedlecki*, the Sea Fisheries Institute's flagship, effected 9 research cruises to the Antarctic waters. Simultaneously, another ship, *r/v Profesor Bogucki* along with trawlers belonging to the Deep-Sea Fisheries Company *Dalmor* in Gdynia circumnavigated the Antarctic during the 2nd and 3rd Polish Marine Antarctic Expeditions in 1978 (Rakusa-Suszczewski 1979, 1980; Ganowiak and Ślósarczyk 1983).

When brought back to Poland, the Antarctic krill, white-blooded fishes, myctophids, and other Antarctic biological materials became an interesting focus of research carried out at scientific institutes, institutions of higher learning, and at laboratories of fishing companies. The tactics and technology for harvesting krill and Antarctic fish, initial processing, preservation, and processing into marketable products were developed and tested in the Antarctic waters. Stocks of the Antarctic fish which, under conditions of cold Antarctic waters, grow slowly and mature late in life, were soon overfished. In late eighties, the Convention for Conservation of Antarctic Marine Living Resources (CCAMLR) had

to introduce catch limits and even, in 1991/1992, to prohibit fishing. That, in turn, resulted in Polish fishing companies switching over to krill fishery, the 1992/1993 catch amounting to 15,910 tonnes (Fig. 1).

Role of Sea Fisheries Institute (SFI) in Gdynia and the Institute's Świnoujście Branch

Fisheries reconnaissance's and research on polar ecosystems stemmed from a search for fishing grounds for the Polish commercial fishing fleet and were effected by research vessels and laboratories of the Sea Fisheries Institute (SFI) in Gdynia, the Institute's Świnoujście Branch, Institute of Ecology of the Polish Academy of Sciences (PAS) at Dziekanów Leśny near Warsaw, and institutions of higher learning, particularly the University of Agriculture in Szczecin, Faculty of Marine Fisheries and Food Technology (UA). Before the Antarctic waters began to be explored, relevant publications based on world's scientific literature appeared. In May 1975, an all-Polish symposium on krill utilisation in Poland was held at the Sea Fisheries Institute's Świnoujście Branch (Wolnomiejski and Porebski 1975, Wolnomiejski *et al.* 1978, Ganowiak and Ślósarczyk 1983).

The first cruise of the modern Polish vessel, *r/v Profesor Siedlecki*, to the southern polar waters took place in 1974 and was aimed at fisheries research off the Falkland Islands down to 57°S. During the second cruise of that ship in 1975, fishing grounds off Kerguelen Island were explored. The data and expertise collected during the two expeditions were passed on to the Polish fishing fleet owners and were made use of for preparing the 1st Polish Marine Antarctic Expedition. The Expedition, organised by the Institute of Ecology PAS, the Sea Fisheries Institute, and the Deep-Sea Fisheries Company *Odra*, set off in December 1975 to the Scotia Sea to study krill biology, physics and chemistry of the marine environment, development of techniques for detection and harvesting of krill concentrations, and krill processing technologies, with particular reference to mechanisation of processing krill for food and feedstuffs. Simultaneously, studies were carried out on zoo- and ichthyoplankton in selected polar fishing grounds. The expedition involved two vessels: *r/v Profesor Siedlecki* (under Captain-master mariner Miron Babiak) and *m/t Tazar* of Deep-Sea Fisheries Company *Odra* in Świnoujście (under Captain-master mariner Józef Muzia). The expedition was chronicled by well-known journalists: Ryszard Badowski (1977) and Bogdan Czubasiewicz (1977).

The very promising and successful biological, logistic, and technological results of the reconnaissance cruises of *r/v Profesor Siedlecki* in 1974 and 1975 and of the 1st Polish Marine Antarctic Expedition, led jointly by Professors Daniel Dutkiewicz and Stanisław Rakusa-Suszczewski (Rakusa-Suszczewski 1979), provided a stimulus for developing a number of projects dealing with

Table 1. Polish Marine Antarctic Expeditions

Exp. No.	Year	Organisers	Vessels, area	Expedition leaders
I	22 Dec. 1975 – 8 May 1976	Institute of Ecology PAS, SFI in Gdynia, Deep Sea Fisheries Company <i>Odra</i> in Świnoujście	<i>r/v Profesor Siedlecki</i> , <i>m/t Tazar</i> Drake Passage, Scotia Sea	S. Rakusa-Suszczewski, D. Dutkiewicz
II	04 Dec. 1976 – 16 June 1977	SFI in Gdynia, Deep Sea Fisheries Company <i>Odra</i> at Świnoujście, Deep Sea Fisheries Company <i>Gryf</i> in Szczecin	<i>r/v Profesor Siedlecki</i> , <i>m/ts Tazar, Gemini</i> , <i>Manta, Rekin</i> off Antarctic Peninsula and South Georgia	Z. Karnicki
III	October 1977 – April 1978	SFI in Gdynia	<i>r/v Profesor Bogucki</i> <i>m/ts Sagitta, Gemini</i> , <i>Manta, Sirius</i> off Antarctica, Crozet Island, Kerguelen Island	Z. Ziembo
IV	Nov. 1978 – 30 May 1979	SFI in Gdynia	<i>r/v Profesor Siedlecki</i> , <i>Profesor Bogucki</i> Scotia Sea off Antarctic Peninsula, South Georgia, and South Orkney	J. Sosiński, B. Bieniecki
V	12 Jan. 1981 – 26 May 1981	Institute of Ecology PAS, SFI in Gdynia	<i>r/v Profesor Siedlecki</i> , <i>m/s Antoni Garnuszewski</i> Western Antarctic waters (programmes BIOMASS / FIBEX)	S. Rakusa-Suszczewski P. Bykowski

Antarctic ecosystem functioning as well as krill fishing and processing technologies as a novel protein source within the framework of the government-financed so-called central R&D programmes (CPBR) (see Tab. 2).

Antarctic exploration carried out by research vessels belonging to the Sea Fisheries Institute (SFI), as well as by fishing vessels of Deep-Sea Fisheries Companies *Dalmor* (in Gdynia), *Odra* (in Świnoujście), and *Gryf* (in Szczecin) allowed to identify patterns of distribution and conditions for harvesting living resources of the Southern Polar Seas. The research projects which were carried out provided an ample body of data on hydrography, chemistry, and biology of the area. Particular attention was paid to biology, distribution, and utility of fish and krill. The data contributed to setting up criteria for the Antarctic fish protection. From the fisheries standpoint, methods of fishing under polar conditions were developed, involving double trawls; a new pelagic trawl (WP-42+42/94×4) for harvesting krill was designed, constructed, and tested; the trawl has been used by the Polish fishing vessels ever since. Based on research carried out on board the SFI research vessels, commercial trawlers, and shore laboratories, a comprehensive system for Antarctic krill processing and freezing was developed; the system involves technologies for onboard preservation and freezing

of krill, processing for krill meal (Patent No. 134692/86), technology of shelling and production of clean krill meat (Patent No. 155324/1992), as well as chitine and chitosane manufacture technology.

The Institute contributed substantially to organising all the Polish marine Antarctic expeditions aimed at carrying out research projects Institute of Ecology PAS and fulfilling goals set out for the Polish fisheries (Tab. 1).

Table 2. Scientific projects carried out in the Antarctic waters by SFI scientists, 1976–1994

Item	Years	Project title	No of project	Project leader
1.	1979–1981	Biological and fisheries studies, assessment of Antarctic fish resources	I-115, PRK	J. Sosiński
2.	1986–1990	Biological and fisheries reconnaissance in Antarctic waters	I-143, CPBR	R. Długosz, J. Sosiński
3.	1986–1990	Biological and fisheries studies on Antarctic fish and shellfish	I-146, CPBR	J. Sosiński
4.	1986–1987	Krill biomass assessment with hydroacoustic methods in selected Scotia Sea areas	I-149, commissioned by PAS	J. Kalinowski
5.	1989	Assessment of krill biomass off South Shetlands	I-150 commissioned by PAS	J. Kalinowski
6.	1988	Description of hydrological conditions of the Bransfield Strait area studied during BIOMASS	IIIO-117 commissioned by PAS Institute of Ecology	A. Grelowski
7.	1987	Description of hydrological conditions in selected areas of the Scotia Sea	O-115 commissioned by PAS Institute of Ecology	A. Grelowski
8.	1989	Description of hydrographic conditions off pack ice during 1988/1989 Antarctic Expedition	O-118 commissioned by PAS Institute of Ecology	A. Grelowski
9.	1990	Variability of temperature, salinity, and oxygen content in upper Antarctic water mass based on data collected by Polish expeditions in 1980-1989	O-119 commissioned by PAS Institute of Ecology	A. Grelowski
10.	1994	Feeding of Antarctic krill <i>Euphausia superba</i>	O-121 SFI studies	K. Maciejewska
11.	1991–1994	Assessment of fish and shellfish resources in open ocean fishing grounds	NB-3 KBN	J. Sosiński
12.	1978–1979	Distribution and abundance of fish concentrations off South Georgia (Antarctica) against the background of hydrological conditions	SFI studies	Z. Cielniaszek
13.	1977–1980	Description of abiotic conditions affecting the presence of krill and other commercially exploitable animals in the open Antarctic waters	O-92/Swi-9 PRK	J. Porębski

14.	1977–1980	Oceanographic studies during the 2nd krill expedition of <i>tlv Profesor Siedlecki</i>	O-92 PRK	A. Grelowski
15.	1981–1982	Structure and dynamics of Antarctic water masses	O-97	A. Grelowski
16.	1979–1980	Structure and behaviour of krill, <i>Euphausia superba</i> , aggregations	I-123	J. Kalinowski
17.	1981–1984	Studies of krill resources with hydroacoustic methods within the framework of the BIOMASS Programme	I-130	J. Kalinowski
18.	1981	Structure and elements of function of Antarctic pelagic ecosystems	O-98 with PAS	Z. Witek
19.	1983–1984	Hydrodynamic processes affecting distribution of phytoplankton and krill in the Bransfield Strait and off South Shetlands in summer 1984	O-108 jointly with PAS	A. Grelowski
20.	1983	Oceanographic description of the Scotia Sea and identification of most hydrologically dynamic areas	O-110 jointly with PAS	A. Grelowski
21.	1984–1985	Determination and identification of water mass dynamic structures from Lasby's number data within the area operated on by Polish Antarctic expeditions	O-111 commissioned by PAS	A. Grelowski
22.	1982–1985	Biology and state of Antarctic fish resources	I-131 (PR-4)	J. Sosiński
23.	1983–1984	Role of juvenile notothenid fishes in the Antarctic pelagic ecosystem	I-138 jointly with PAS	W. Ślósarczyk
24.	1986–1990	Krill trawls	TR-185 CPBR	R. Grzywacz
25.	1985	Design and testing of a krill trawl	TR-171 PR-4	R. Grzywacz
26.	1976–1980	Development of technology for krill processing and preservation at sea	T-117 PRK	P. Bykowski
27.	1977–1980	Development of technology for krill processing on mael	T-119 PRK	M. Brzeski
28.	1982–1983	Selection of optimal design of krill harvesting system for the Polish fisheries	T-144 PRK	W. Kołodziejcki
29.	1982	Toxicological studies on krill meat	T-145, PRK	A. Zalewski
30.	1982	Improvement of technologies for obtaining and utilising krill meat	IT-146, PRK	P. Bykowski
31.	1982–1984	Assessment of quality of chitosane from krill carapaces as a result of a technology used for obtaining it	T-147, non-commissioned research	M. Brzeski
32.	1978	Organisation of fisheries in the Antarctica, at a substantial distance between fishing grounds and foreign ports	E-173, non-commissioned research	Z. Polański
33.	1978	Economic analysis of catches and studies in the Antarctica in 1975–1977	E-178 SFI studies	Z. Russek
34.	1979–1980	Assessment of conditions of harvesting Antarctic fish and krill in the 1978/1979 season	E-184 SFI studies	T. Lubowiecki
35.	1976–1985	Studies on krill processing equipment	M.-9 SFI studies	D. Dutkiewicz
36.	1976–1979	Studies on adapting a trawler for krill harvesting	St-6 ZGR	H. Czubek

Numerous SFI scientists participated in exploratory cruises of five Polish Marine Antarctic Expeditions (Tab.1), expeditions of the international programmes FIBEX-BIOMASS and SIBEX-BIOMASS, as well as in activities of the Working Group of the International Commission for Exploration and Exploitation of Marine and Oceanic Resources, CCAMLR, and SCOR. Most prominent among the SFI Antarctic explorers are: scientists – Daniel Dutkiewicz, Piotr Bykowski, Henryk Czykieta, Alfred Grelowski, Janusz Kalinowski, Zbigniew Karnicki, Norbert Wolnomiejski, Jerzy Porębski, Józef Sosiński, the late Wiesław Ślósarczyk, Andrzej Koronkiewicz; and skippers – master mariners: Miron Babiak, Ryszard Ludwig, Janusz Olszowy, Zbigniew Ossowski, Jan Sokołowski.

Table 3. SFI scientists engaged in Antarctic research within 1975–1997

Item	Name	SFI ships	Deep-Sea Fisheries Company ships	Marine expedition leaders
1.	Albecki Franciszek	+		
2.	Arndt Andrzej	+	+	
3.	Banaszkiewicz Paweł	+		
4.	Barska Iwona	+		
5.	Barthelke Jerzy	+	+	
6.	Bieniecki Bernard	+		+
7.	Boberski Emil	+		
8.	Borocki Wojciech	+		
9.	Borowy-Borowski Henryk	+		
10.	Boszko Zbigniew	+		
11.	Bykowski Piotr	+	+	+
12.	Chłapowski Kazimierz	+		
13.	Chłapowski Konstanty		+	
14.	Chmielowski Henryk	+		
15.	Chojnacki Juliusz	+		
16.	Chromicz Tadeusz	+		
17.	Cielniaszek Zdzisław	+	+	
18.	Czubek Henryk	+		
19.	Czykieta Henryk	+	+	
20.	Dettlaff Aleksander	+		
21.	Długosz Roman	+		
22.	Dobrosielski Andrzej		+	
23.	Dominiczak Tadeusz	+		
24.	Dowgiało Andrzej	+	+	
25.	Dunst Grażyna	+		
26.	Dutkiewicz Daniel	+		+
27.	Fandrejewski Andrzej	+		
28.	Formeła Zdzisław	+	+	
29.	Fręsko Zenon	+		
30.	Fuławka Stanisław	+		

31.	Furtak Andrzej	+		
32.	Gębiś Stanisław		+	
33.	Góralczyk Andrzej	+		
34.	Górmowicz Dariusz	+		
35.	Grelowski Alfred	+		
36.	Gurbiel Ryszard	+		
37.	Herra Tomasz	+		
38.	Jaczewski Wiesław	+		
39.	Jurczyk Julian	+		
40.	Kaczmarek Michał	+		
41.	Kaleta Leon	+		
42.	Kalinowski Janusz	+		+
43.	Karnicka Barbara	+		
44.	Karnicki Zbigniew	+		+
45.	Kilian Leon	+		
46.	Knurowski Julian	+		
47.	Kocoń Zygmunt	+		
48.	Kołodziej Kazimierz	+		
49.	Kołodziejski Wiktor	+		
50.	Koronkiewicz Andrzej	+		
51.	Korpys Ryszard	+	+	
52.	Kosior Andrzej	+		
53.	Kosmowski Mariusz	+		
54.	Kowalczuk Maria	+		
55.	Kreft Krzysztof	+	+	
56.	Krzeptowski Maciej	+		
57.	Kunde Anna	+		
58.	Kunicki Andrzej	+		
59.	Kuptel Michał	+		
60.	Kurpanty Jerzy		+	
61.	Kurowicki Antoni	+		
62.	Kurzyk Sławomir	+		
63.	Kustusz Florian	+		
64.	Lichterowicz Stanisław	+		
65.	Linkowski Tomasz	+		
66.	Liwoch Marek	+	+	
67.	Łądowska Maria	+		
68.	Matuszak Tadeusz	+		
69.	Miłosz Józef		+	
70.	Moczydłowski Mieczysław		+	
71.	Moderhak Waldemar	+		
72.	Mucha Mirosław	+		+
73.	Nakoneczny Jan	+		
74.	Neugebauer Witold	+		
75.	Nodzyński Jerzy	+		
76.	Ochocki Stanisław	+		
77.	Ociepka Emil	+		

78.	Orłowski Andrzej	+		
79.	Osmólski Roman	+		
80.	Pactwa Romuald	+	+	
81.	Pastuszek Marianna	+		
82.	Piekutowski Leszek	+		
83.	Pielichowski Jan	+		
84.	Pietrzak Stanisław	+		
85.	Piłat Ludwik	+		
86.	Piotrowski Antoni	+		
87.	Polak Lucyna	+		
88.	Popiel Józef	+		+
89.	Porębski Jerzy	+		
90.	Richert Stefan	+		
91.	Rokosz Jerzy	+		
92.	Romer Jerzy	+		
93.	Rutkowska Irena	+		
94.	Sitek Stanisław		+	
95.	Sokołowski Jan	+	+	
96.	Sołoczyk Stanisław	+		
97.	Sosiński Józef	+		+
98.	Strzelecka Danuta	+		
99.	Symczyński Wiesław	+		
100.	Szlakowski Jacek	+		
101.	Szpiganowicz Bogdan	+		
102.	Szymański Mariusz	+		
103.	Szynka Józef	+		
104.	Ślósarczyk Wiesław	+		
105.	Teclaw Piotr	+	+	
106.	Tomaszewska Ewa	+		
107.	Traczyk Ryszard	+		
108.	Trela Wiesław	+		
109.	Warzocha Jan	+		
110.	Wawerek Andrzej	+	+	
111.	Wiktor Krystyna	+		
112.	Witek Zbigniew	+		
113.	Wojewódzki Tadeusz	+		
114.	Wojtasz-Pajak Anna	+		
115.	Wolnomiejski Norbert	+		+
116.	Wołoszyk Wojciech	+		
117.	Wójcik Ireneusz	+		
118.	Włodarczyk Krzysztof		+	
119.	Wysokiński Antoni	+		
120.	Zaporowski Radosław	+	+	
121.	Zaucha Janusz	+		
122.	Zielichowski Mariusz	+		
123.	Ziembo Zbigniew	+		+
124.	Żaczek Krzysztof	+		

Persons from outside SFI, engaged in Antarctic research: Andrzejak Krzysztof, Chojnacki Juliusz, Dobrosielski Andrzej, Dzik Jerzy, Fischer Janusz, Gajowiecki Leszek, Ganowiak Zenon, Godlewska Małgorzata, Jakubiec-Puka Anna, Jazdźewski Krzysztof, Kittel Wojciech, Klusek Zygmunt, Kołakowski Edward, Kompowski Andrzej, Kopczyńska Elżbieta, Krzyszewski Jerzy, Ligowski Ryszard, Lipski Maciej, Łukowski Aleksy, Malinowski Andrzej, Mężykowski Janusz, Neja Zbigniew, Nowakowski Piotr, Opaliński Krzysztof, Palicki Bogdan, Pęcherzewski Kazimierz, Rakusa-Suszczewski Stanisław, Rembiszewski Jan Maciej, Sawicki Jan, Skóra Krzysztof, Sonka Grzegorz, Starck Wojciech, Stolarz Włodzimierz, Szeliga Jan, Szulakowski Marian, Szybowicz Zofia, Tokarczyk Ryszard, Węsierski Witold, Zdanowski Marek, and Żmijewska Maria.

The SFI expeditions, on board the SFI's own vessels as well as those in conjunction with vessels of deep-sea fisheries companies (*Dalmor*, *Odra*, and *Gryf*) to the Antarctic blazed the trail for the Polish fishing fleet to operate in new fishing grounds and laid foundations for utilising the living marine resources, a new source of nutrition.

Contribution of the Deep-Sea Fisheries Company *Odra* at Świnoujście to exploitation of Antarctic waters

The Deep-Sea Fisheries Company *Odra* at Świnoujście entered the exploitation of Antarctic fishing ground on 23 December 1975 by participation of its B-417 trawler, m/t *Tazar*, in the 1st Polish Marine Antarctic Expedition. The *Tazar*, commanded by Captain-master mariner Józef Muzia, had a crew of 80, including chiefs of the processing operations Ryszard Sołtysik, Mieczysław Lewandowski, and Wojciech Dankowski (all graduates of the Faculty of Marine Fisheries, University of Agriculture in Szczecin). Participants of the 1st Polish Marine Antarctic Expedition on board m/t *Tazar* included the expedition leader Maciej Krzeptowski (SFI) and Zbigniew Witek (SFI) as well as fishing gear specialists Marek Szulc (SMA) and Stanisław Cichosz (Deep-Sea Fisheries Company *Odra*). During the 53 days of her operation in the Antarctic waters, m/t *Tazar* harvested 979.9 tonnes of krill. The promising results of the expedition were decisive in incorporating m/ts *Tazar* and *Manta*, commanded – respectively – by captains – master mariners Jan Ginter and Kazimierz Augustyniak, into the 2nd Polish Marine Antarctic Expedition. The crews and skippers participating in that expedition had been tasked with exploring the future fishing grounds for krill and Antarctic fish. The Deep-Sea Fisheries Company *Odra* has been harvesting krill since 1977, the combined 1996 and 1997 catches of the Company's two trawlers: m/t *Rybak Morski* and m/t *Manta* amounted to 8250 and about 6850 tonnes of krill, respectively. During the 1998 fishing season m/t *Manta* is scheduled to harvest krill in the Antarctic waters again.

The persons whose dedication was particularly important for Antarctic exploration include captains-master mariners and the late Juliusz Hebel, former director of the Company, and its former head of the Fisheries Department, Zbigniew Paluch.

Contribution of the Deep-sea Fisheries Company *Dalmor* in Gdynia to exploitation of Antarctic waters

Fishing vessels of the Deep-Sea Fisheries Company *Dalmor* in Gdynia started operating in the Antarctic waters in autumn 1976 as a part of the 2nd Polish Marine Antarctic Expedition. m/t *Gemini*, commanded by Captain-master marine Zbigniew Dzwonkowski, as the first Polish fishing vessel, crossed the Southern Polar Circle on 8 February 1977. During the 1977/1978 fishing season, m/t *Sagitta* commanded by Captain-master mariner Kazimierz Kopański together with r/v *Profesor Bogucki*, completed the first circumpolar fishing cruise (Tab. 1).

Krill processing technologies developed by SFI were given a production-scale tests on board m/t *Arcturus* during a special cruise in 1983; the technologies were later used on board m/t *Lyra* during her regular fishing cruise in 1986. The year 1986 marked also the beginning of the continuing, commercial scale krill harvesting by 2–3 vessels belonging to fisheries companies from Gdynia, Świnoujście, and Szczecin (Fig. 2). It is estimated that more than 100,000 tonnes of krill have been harvested by the Polish vessels since 1986 from waters south of the Antarctic convergence. As assessed by the chief of *Dalmor*'s fisheries division, the company's operations in the Antarctic involved – during peak times – about 1,000 people.

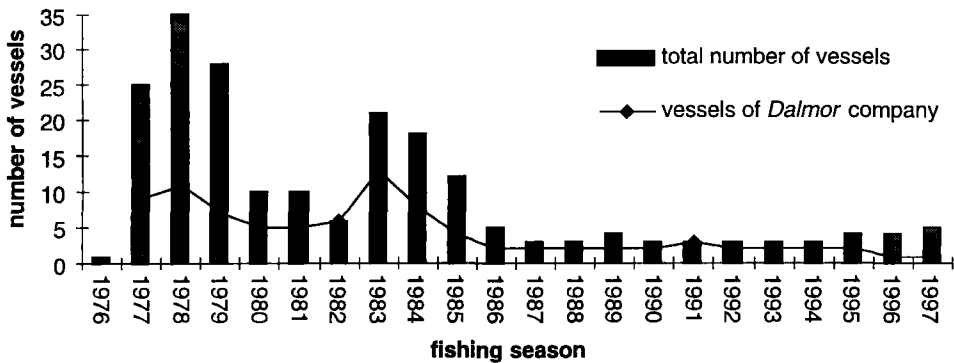


Fig. 2. Polish fishing fleet engaged in Antarctic fishery within 1977–1997.

At present, it is only m/t *Pollux* that fishes for krill in the Antarctic waters for *Dalmor*. The list of *Dalmor* captains – master mariners who particularly deserve mention as explorers of Antarctic waters includes Zbigniew Dzwonkowski, Zenon Krzymiński, Kazimierz Opióła, Leszek Soliński, Krzysztof Wioniewski, Franciszek Pindara, Marian Wróblewski, Ludwik Skorupiński, Andrzej Morziński, Bazyli Baranow, Andrzej Elwardt, Roman Myczkowski, Antoni Balcerzak, and Sławomir Monko.

Contribution of the Deep-sea Fisheries Company *Gryf* in Szczecin to exploitation of Antarctic waters

The Szczecin-based company began its efforts in exploiting Antarctic waters by sending m/t *Rekin* as a vessel participating in the 2nd Polish Marine Antarctic Expedition in 1976/1977. The *Gryf*'s vessels have been active in harvesting Antarctic resources ever since. All the company's B-418/III trawlers (8 vessels) and one B-29 trawler m/t *Bonito* operated in the Antarctic. In 1998, two trawlers: m/ts *Awior* and *Bonito* were dispatched to fish there. At the peak time, in 1977/1978, about 400 *Gryf* fishermen operated off South Orkneys, the number gradually decreasing later on to 220 in the fishing season 1997/1998.

Table 4. Catches of the Deep-sea Fisheries Company *Gryf* in Antarctic waters within 1977–1997

Year	Total catches (tonnes)	Krill catch (tonnes)	Dominant fish species
1977	2626		notothenids
1978	12260		kerkulens
1979	4864		notothenids, kergulens, georgians, antar, borel
1980	598		orkads
1983	172		kerkulens
1984	230		kerkulens, notothenids
1985	5		
1989	1261	1261	
1990	178	178	
1991	781	781	
1992	1858	1858	
1993	792	792	
1994	1207	1207	
1995	4690	4690	
1996	5426	5426	
1997	3706	3706	

Apart from fishing, the Company's vessels tested, in co-operation with the UA (Edward Kołakowski, Leszek Gajowiecki), technologies and equipment for manufacture of blanched krill and krill precipitate. The Company's research and

development efforts in the Antarctic were led by the late Elżbieta Obłamska and the late Bogusław Byrka. A particular mention is due to the following captains of master marines: Zbigniew Barski, Stanisław Dziedziak, Stanisław Grzegorzczak, Mieczysław Jędrzyszek, Zbigniew Kic, Wincenty Kuriata, Jan Kwaśny, Stanisław Nowoszycki, among the most experienced processing engineers are Włodzimierz Predko, Marian Kłuza, and Jerzy Wiszniewski.

Contribution of scientists from the University of Agriculture in Szczecin, Faculty of Marine Fisheries and Food Technology (UA) to Antarctic research

Since the very beginning of Polish Antarctic research in 1975, numerous scientists from the UA, participated in studies and expeditions.

1. The first of them was Juliusz C. Chojnacki, in 1975 employed on a contract basis at the Institute of Ecology PAS for the duration of the 1st Polish Marine Antarctic Expedition, a marine biologist who, on board *t/v Profesor Siedlecki*, studied respiratory metabolism of selected zooplankters, including juvenile stages of Antarctic krill (Chojnacki 1981, 1991). He was also a member of the 2nd Polish Antarctic Expedition PAS, working at the *H. Arctowski* Research Station on King George Island (South Shetlands) during the 1977/1978 season. During that expedition, on board *m/s Antoni Garnuszewski*, he led marine biological studies on krill respiratory metabolism and ecology of polar zooplankton (Chojnacki 1981a, b, 1987, 1988, 1991; Chojnacki and Węgleńska 1983, 1984; Czubasiewicz 1980). He published his findings in a number of papers and supervised several M.Sc. theses based on the data collected (Chojnacki and Palczewski 1980, 1981a, b; Chojnacki and Pietrucha 1980, 1987; Chojnacki, Drozgowski and Jarocki 1979, 1983).
2. Laboratory and technological studies on the Antarctic krill were vigorously pursued by Edward Kołakowski, principal investigator in a number of projects, who participated in the 5th Polish Antarctic Expedition PAS (1980–1981), in a cruise on board *m/t Arcturus* (Deep-Sea Fisheries Company *Dalmor*) in 1983, as well as in the 8th and 10th Polish Antarctic Expedition PAS. Expeditions during which he worked at the *H. Arctowski* Station on King George Island in 1983–1985 and 1985–1987, and in a cruise on board *m/t Bonito* (Deep-Sea Fisheries Company *Gryf*) in 1990. He was the expedition leader during the 10th expedition. His research resulted in a number of very valuable publications (Kołakowski 1982, 1986a, b, 1987, 1989a, b; Kołakowski and Gajowiecki 1991, 1992; Kołakowski and Kołakowska 1992, 1993; Kołakowski and Lachowicz 1982; Kołakowski and Moreno 1987; Kołakowski and Szyper-Machowska 1989, Kołakowski, Gajowiecki and

- Lachowicz 1979; Kołakowski *et al.* 1984; Kołakowski *et al.* 1983; Kołakowski *et al.* 1980a; Kołakowski *et al.* 1979; Kołakowski *et al.* 1980b; Protasowicka and Kołakowski 1979; Samujło *et al.* 1988) and patents.
3. Anna Kołakowska participated in two Polish Antarctic Expedition PAS: the 8th in 1983–1985 and in the 10th in 1985–1987, contributing to research programmes of PAS and SFI and focusing on problems related to composition of and changes in lipids of fresh and frozen krill and in Antarctic fishes. She was the only European woman who stayed for more than a year in an Antarctic station twice. She published her findings in numerous publications, reports (Kołakowska 1985a–c, 1986, 1987, 1988, 1989, 1991a, b; Kołakowska and Szczygielski 1994; Kołakowska, Kołakowski and Borys 1991; Kołakowska, Kołakowski and Szczygielski 1994; Kołakowski and Kołakowska 1992, 1993; Filho, Kołakowska and Cordoba 1984; Filho, Kołakowska and Vincente 1986) and supervised a number of M.Sc. theses.
 4. Leszek Gajowiecki dealt with processing krill for protein concentrates during Antarctic cruises of *r/v Profesor Siedlecki* (1981), *m/t Arcturus* (Deep-Sea Fisheries Company *Dalmor*, 1983), and *m/t Bonito* (Deep-Sea Fisheries Company *Gryf*; 1989, 1990). He published a number of research papers (Gajowiecki 1992, 1995; Kołakowski and Gajowiecki 1991, 1992; Kołakowski, Gajowiecki and Lachowicz 1979; Kołakowski *et al.* 1980a; Kołakowski *et al.* 1983; Kołakowski *et al.* 1984) to describe the fundamentals of onboard protein precipitate production from krill (Chojnacka 1983).
 5. Kazimierz Lachowicz participated, on board *m/s Żuławy*, in the 5th Polish Antarctic Expedition PAS to the *H. Arctowski* Station (December 1980 – April 1981) where he dealt with, *i.e.*, autoproteolysis and protein extraction from krill (Kołakowski and Lachowicz 1982, Kołakowski and Lachowicz 1984, Kołakowski, Gajowiecki and Lachowicz 1979, Kołakowski *et al.* 1979).
 6. Zofia Szybowicz took part in the 2nd Polish Antarctic Expedition organised by PAS and SFI on board *r/v Profesor Siedlecki* in 1978; she focused on Antarctic fish processing and production of krill semi-products manufactured on board (see Chojnacka 1983, Kołakowski *et al.* 1979, Kołakowski *et al.* 1980a).
 7. Wiesława Jachimiak studied technological properties of krill during the 10th Polish Antarctic Expedition PAS within 1985–1987.
 8. Studies on biology of Antarctic fish were pursued by Andrzej Kompowski, he took part in the research and fishing cruises during the 2nd Polish Marine Antarctic Expedition in 1976/1977 (*m/t Rekin* of the Deep-Sea Fisheries Company *Gryf* in Szczecin) and in the 1987/1988 fishing season on board *r/v Profesor Siedlecki* when he studied living resources of the Antarctic (Goal A-2, Subproject 2 of CPBR 10.11). He published his findings in numerous papers (Kompowski 1980a, b, c, 1983a, b, 1985a, b, 1988, 1989, 1990a, b, 1991, 1992a, b, 1993a, b, 1994a, b; Kompowski and Rojas 1989, 1991, 1993,

- 1994, 1995, 1996; Kulesz and Kompowski 1984; Mucha *et al.* 1984) and supervised Ph.D. thesis based on his materials (Rojas 1992).
9. Zbigniew Neja took part in the cruise of m/t *Manta* (Deep-Sea Fisheries Company *Odra* in Świnoujście commanded by captain of master mariner Kazimierz Augustyniak, the cruise was organised within the framework of the 3rd Polish Maritime Antarctic Expedition in summer season 1977/1978. His data were published (Neja 1978).
 10. Piotr Nowakowski participated in the 3rd Polish Maritime Antarctic Expedition in summer season 1977/1978 as a member of the SFI team on board m/t *Sirius* (Deep-Sea Fisheries Company *Dalmor*); he focused on research dealing with fisheries and fishing technologies (fishing gear, fishing ground exploration, catch per unit effort statistics) off South Georgia and South Orkneys. His data were utilised in publication (Świniarski *et al.* 1979).
 11. Henryk Sendłak sailed on board m/t *Manta* to the Antarctic fishing grounds in 1985 where he introduced a WP4-103/256 pelagic trawl for squid harvesting. Subsequently, on board m/t *Lyra* in 1986, he was involved in manufacture of krill protein precipitate and optimisation of the manufacture process parameters. His data were utilised in publications (Świniarski *et al.* 1979).
 12. Bernard Kłyszajko participated in a cruise of m/t *Likomur* (Deep-Sea Fisheries Company *Gryf* in Szczecin), commanded by Captain-master mariner Kazimierz Wilk, to fishing grounds off Falklands; his data were published in a paper on the Antarctic krill carotenoid content (Czeczuga and Kłyszajko 1986).

Then graduate students: Witold Drozgowski (1978), Marek Jarocki (1978), Piotr Palczewski (1980), and Marek Pietrucha (1980) Małgorzata Ruczkowska (1986) studied krill and Antarctic fishes while collecting, in 1977–1981, data for their M.Sc. theses on board fishing vessels of deep-sea fisheries companies based in Świnoujście and Szczecin; the theses were supervised by Juliusz C. Chojnacki.

Other M.Sc. theses based on data collected during Antarctic cruises were supervised by Anna Kołakowska (Czerniejewska-Surma 1979, Reksińska-Maksymowicz 1979, Pestka-Thomassen 1990, Behnke 1991), Józef Świniarski (Wierciński 1978, Czubaszek 1979), Włodzimierz Załachowski (Janeczek 1988, Macheta 1986) and Stanisław Krzykawski (Pawłowski 1982).

Contribution of scientists from the Szczecin Maritime Academy (SMA) to Antarctic research

Marek Szulc, a scientist from the Szczecin Maritime Academy, participated in the 1st Polish Marine Antarctic Expedition on board m/t *Tazar* (Deep-Sea Fisheries Company *Odra* in Świnoujście) and headed a team of fishing gear specialists. During that expedition, he tested Polish prototype krill trawls, stu-

died krill reactions to different gear types, and analysed echograms (Chojnacka 1983). As recorded by Czubasiewicz (1977), a *Głos Szczeciński* journalist and a chronicler of that expedition, the first 4 tonnes of krill were harvested by m/t *Tazar* on 28 January 1976 a few minutes past 4 a.m.

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