



Panorama of Lions Rump

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SCIENCE AND GLOBAL INTERESTS IN THE LAND OF ICE

For 40 years, Polish researchers have been observing krill-dependent species and actively participating in the activities of the Scientific Committee of the CCAMLR.

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The Antarctic is a distinctive biogeographical region that encompasses the continent of Antarctica, its adjacent archipelagos and islands, as well as the Southern Ocean, marked by its high productivity and diversity of species. As one of the coldest, driest, and windiest continents, Antarctica spans

13.66 million km², making up 9.2% of the Earth's land surface. Despite this vastness, most of the continent is perpetually encased in ice, with only a small fraction (about 46,000 km², or roughly 0.33% of the total area) directly accessible. The Antarctic ice sheet harbors 70% of the world's freshwater resources. Uninhabited by humans on a permanent basis, its wildlife primarily consists of marine mammals and birds that periodically spend time on land.

From the perspective of international law, Antarctica occupies a unique position. Under the protocol on environmental protection of the Antarctic Treaty, to which Poland is a signatory with voting rights, the entire territory is designated as a "natural reserve dedicated to peace and science." Despite its isolation



from the rest of the world by vast oceans, strong ocean currents, a harsh climate, and even its intricate legal status, Antarctica draws considerable global interest. It serves as a vital research site for scientists worldwide and attracts the attention of international corporations involved in deep-sea fishing.

Currently, territorial claims to parts of the continent and its adjacent islands are suspended, with the extraction of mineral resources in Antarctica prohibited. However, by 2048, any consultative party to the treaty will have the right to propose amendments. This raises the question of whether any party might want to revisit the suspended 1989 convention on regulating activities for the exploitation of Antarctic mineral resources, known as CRAMRA, which allowed for mineral extraction under stringent environmental standards. In any case, any proposed amendments would require unanimous approval by all consultative parties to the treaty.

Research Station

Polish scientists can boast of a long-standing tradition of research in the southern polar region. Henryk Arctowski and Antoni Dobrowolski were part of the Belgica expedition (1897–1899), conducting the first winter scientific observations of Antarctica. Arctowski, who led the research team, lends his name to the Polish Antarctic Station situated on King George Island in the South Shetland Islands of West Antarctica. Operating continuously throughout the year, without interruption since 1977, and currently managed by the Directorate of the Institute of Biochemistry and Biophysics of the Polish Academy of Sciences (IBB PAS), the station welcomes researchers from Poland and across the globe to engage in biological

and Earth science research. This facility promotes international collaboration and plays a pivotal role in scientific diplomacy.

The station acts as both a showcase for and an unofficial embassy of the Republic of Poland in this remote part of the world. It hosts international delegations, representatives from other countries' Antarctic programs, members of other Antarctic station teams, and thousands of tourists annually. In the period between 2006 and 2007, the station and its vicinity attracted a record 5,700 tourists. These visitors are educated about the ongoing research projects and the importance of preserving the natural environment. Poland is responsible for two specially protected areas, designated as Antarctic Specially Protected Areas No. 128 and 151, located along the coasts of two bays on King George Island and noted for their significant biodiversity. Access to these areas is restricted to those conducting scientific research who have obtained the necessary permits. Additionally, in collaboration with Brazil, the United States, Peru, and Ecuador, Poland alternates in overseeing and coordinating scientific endeavors in the Antarctic Specially Managed Area No. 1. The research undertaken on the island continually uncovers new insights about Earth's past, with studies in biology, geology, and glaciology having profound implications for scientific progress and practical applications.

Krill is paramount

Scientists involved in the station's operations support and represent Polish interests within the organizations governing Antarctica. As members of the Polish delegation, IBB PAS staff participate in the annual



Pygoscelis antarcticus



Pygoscelis adeliae



Pygoscelis papua

Dr. Korczak-Abshire's team, as part of international cooperation, studied the winter migrations of *Pygoscelis* penguins from colonies in the Antarctic Peninsula area. The data helps make decisions regarding fisheries management and the protection of the Southern Ocean

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Photo 1
Estimating the population numbers of *Pygoscelis* penguins on King George Island

Photo 2
Fieldwork by Polish researchers observing indicator species dependent on krill at Lions Rump, where currently only 13 areas are actively monitored as part of the CCAMLR Ecosystem Monitoring Program

Photo 3
Gentoo penguins (*Pygoscelis papua*) with chicks, significant consumers of Antarctic krill

Antarctic Treaty Consultative Meetings (ATCMs) and the Committee for Environmental Protection. Acting as scientific advisors to the Polish Ministry of Foreign Affairs on all matters concerning Poland’s presence in Antarctica, they are involved in preparing documentation related to fulfilling Poland’s international obligations, due to our active participation in these organizations. With representatives serving on the Scientific Committee on Antarctic Research and the Council of Managers of National Antarctic Programs, Polish researchers are able to help shape the global scientific agenda in the region.

Partnership with the Department of Fisheries of the Polish Ministry of Agriculture and Rural Development in enacting the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR) is particularly important. This convention aims to protect the natural environment and maintain the integrity of the ecosystems surrounding Antarctica, while not precluding the rational exploitation of its living resources. The CCAMLR commission is the sole authority managing fisheries in the Southern Ocean, with the Ministry benefitting from scientific guidance on matters related to deep-sea fishing. Scientists contribute to shaping Poland’s stance and formulating substantive arguments for its advocacy.

From 1977 to 2011, Poland engaged in fishing for Antarctic fish and krill (*Euphausia superba*), conducting pioneering research in the surrounding waters by means of the “Professor Siedlecki” research vessel and the “Tazar” industrial trawler. Throughout the years of regular fishing (1986–2011), annual catches were substantial, amounting to up to 20,610 tons (during the 1995/1996 season). Rich in protein, krill was pro-

cessed into protein concentrates, pastes, and sausage additives. The chitinous exoskeleton, containing the anti-inflammatory antioxidant astaxanthin, was utilized in producing wound-healing dressings, surgical sutures, and burn treatments. Krill-derived products also found applications as dye carriers in cosmetics, additives to radiation-blocking concrete, and in manufacturing plant protection products and artificial fertilizers. Strict modernization requirements for the fishing fleet’s infrastructure and the high associated potential investment costs led Poland to discontinue its participation in krill fishing in 2014. The absence of suitable vessels sidelined our experts from further oceanological and oceanographic pursuits for an extended period.

Nonetheless, worldwide interest in Antarctic krill fishing continues to grow. For example, in one of the CCAMLR statistical areas, the annual catch reached the historically record proportions of 450,800 tons in 2020. The main fishing countries are Norway, China, South Korea, and Chile. The stability of krill populations and their dependent predators should be ensured by setting a total catch limit of 620,000 tons annually. Although this catch quota is respected, the clear concentration of fishing in time and space raises concerns. Since 1991, krill has been fished exclusively in the waters of the western region of the Antarctic Peninsula, mainly around the South Shetland Islands and in the areas of the South Orkney Islands and South Georgia. In recent years, up to 57% of the catches occurred only in the Bransfield Strait, home to populations of numerous Antarctic fauna species. Additionally, due to climate change, changes in the distribution and age structure of krill populations have been observed.



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These changes adversely affect vertebrates that feed on krill, such as penguins and pinnipeds.

For four decades, Polish scientists have been closely monitoring species that rely on krill and playing an active role in the Scientific Committee for the Conservation of Antarctic Marine Living Resources (CCAMLR), fulfilling the aims of the international ecosystem monitoring program – the CCAMLR Ecosystem Monitoring Program – including work at the Lions Rump field station. The insights provided by these researchers are crucial for CCAMLR members when making policy-related decisions. The scientific community has long been in pursuit of tools that are both effective and minimally invasive to support

their research goals. Cutting-edge solutions include remote sensing and telemetry, which are particularly well suited for the study of polar ecosystems.

Spying on Penguins

A team of researchers from the Institute of Biochemistry and Biophysics of the Polish Academy of Sciences (IBB PAS), the Warsaw University of Technology, and the University of Warsaw have pioneered a groundbreaking approach to environmental monitoring. By employing unmanned aerial vehicles (UAVs) and conducting flights beyond the visual line of sight (BVLOS), they've introduced a new level of precision

Photo 4
The Arctowski Polish Antarctic Station and its surroundings on King George Island, South Shetland Islands. Aerial view captured by a long-range unmanned aerial vehicle

Photo 5
The PW-Zoom unmanned aerial vehicle during a photogrammetric mission over King George Island



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Photo 6

An important aspect of Antarctic tourism is education about polar regions and the research conducted there. Here: a tourist ship off the coast of King George Island

Photo 7

Chicks of Adélie penguins, consumers of Antarctic krill



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and reach in their studies. The PW-Zoom, a long-range UAV crafted at the Warsaw University of Technology, has successfully completed missions spanning 3,671 km across three research seasons. This UAV captured high-resolution photogrammetric data, enabling detailed mapping of the remote Penguin Island, 30 km away from its launch site. Flying at 550 meters above sea level, these UAVs can survey without disturbing wildlife, drastically improving population estimates, cutting down field data collection time by more than 90%, widening the area of observation, lowering costs, and enhancing worker safety. This project positions Polish scientists among the leading UAV operators in Antarctica.

In collaboration with partners from the US National Oceanic and Atmospheric Administration, the Argentine Antarctic Institute, and the National Antarctic Scientific Center of Ukraine, Polish sci-

tists have set up an extensive network of automated camera traps. These devices have been instrumental in tracking the reproductive timelines and breeding successes of the three *Pygoscelis* penguin species across various locations along the Antarctic Peninsula. Detailed research into the winter migrations and foraging sites of these penguins, previously not well understood, has unveiled their habitats beyond the breeding season. This study has also marked the first documentation of individual migration patterns among chinstrap penguins. Thanks to these comprehensive efforts, a detailed database and automated analysis methods have been developed, providing essential data for understanding changes in Antarctic ecosystems. Such long-term monitoring is invaluable, laying the groundwork for future environmental scenario planning and management strategies for the Antarctic area. ■

Further reading:

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Zmarz A., Rodzewicz M., Dąbski M., Karsznia I., Korczak-Abshire M., Chwedorzewska K.J., Application of UAV BVLOS Remote Sensing Data for Multi-Faceted Analysis of Antarctic Ecosystem, *Remote Sensing of Environment* 2018, vol. 217.



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Year-round observations are enabled by a network of automated camera traps established to record the breeding chronology and success of penguins in numerous locations along the Antarctic Peninsula. This project is partially funded by the CEMP Special Fund