



POLAR MARINE RESEARCH

On the kind polar research that is less visible from land.

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Marine research does not account for a large segment of Polish science overall. If we counted up all the scholars professionally involved in marine research who hold a higher-doctorate degree (DSc, or *doktor habilitowany*) and publish at least one paper a year in journals listed with Journal Citation Reports (JCR), we would arrive at

no more than 300 individuals scattered across locations ranging from Szczecin through Słupsk and the Tri-City Area to Łódź, Poznań, Warsaw, and Kraków. Many of these Polish marine researchers are involved in studies of polar regions, however, and this is a field where we have achieved a truly outstanding success, especially if one considers how few individuals comprise this group.

The most distinctive aspect of marine research is its international dimension. Almost all projects are conducted in collaboration with the EU, Norway, the United States, or Canada. Another important characteristic of marine research is its interdisciplinary nature – a single sample from the sea will often be carefully inspected, analyzed, and discussed by geologists, chemists, physicists, and biologists of all spe-



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A crowded lab aboard the Oceania, abuzz with activity while out on voyage

cializations. This situation brings enormous added value to marine research, but it also means that it is hard to identify achievements attributable to a single individual.

Indeed, in marine research, success is always a result of teamwork. The scientific performance of Polish polar marine researchers, judged by such bibliometric indicators as the number of citations and the h-index, is on a good European level. A simple check of the Scopus website (using the query “European Arctic”) reveals that the international community has produced over 8,500 scientific publications on the Svalbard area. Out of this number, all of the Polish institutions taken together contributed to 1,200 (in disciplines ranging from geology and geophysics to botany). Of that number, in turn, marine research accounts for 710 publications, in other words for as much as 60% of the Polish contributions to Arctic research.

The Institute of Oceanology of the Polish Academy of Sciences (IO PAS) is proud to have a particularly high profile in Polish polar marine research. For instance, out of the 10 most cited Polish publications in the field of Arctic research, six had IO PAS affiliated authors. Out of the 10 most frequently cited international publications on Svalbard, in turn, only two were written by authors affiliated with a Polish research institution – and in both cases, this was the PAS Institute of Oceanology.

However, the purpose and essence of scientific research is not fame or recognition (though these can sometimes be important incentives) but rather the pursuit of knowledge and the discovery of new phenomena, patterns and regularities. The true value of scientific research lies in exploring the unknown and creating new knowledge. In keeping with the scientific method, the projects conducted by the Institute of Oceanology are chiefly based on the formulation of hypotheses and predictions about how nature works. Successful projects are a point of particular pride for us when members of the Institute’s own staff initiated the concept and also served as principal investigators or co-investigators. The success of an individual project represents the outcome of years of teamwork at sea, followed by efforts to properly formulate the results and have them published in international journals.

For years, the focus the Institute’s research has been on the study of the relations between ocean, climate, and the living ecosystem of the European part of the Arctic. The Institute’s research vessel, the “Oceania,” takes a voyage each year to study the geographic region of the North Atlantic between Spitsbergen and Greenland, which has special significance in processes of global climate change. This area, known as the Fram Strait, is where the main exchange of heat between the Atlantic and the Arctic takes place, determining the climate across a major part of the Earth.

Among the most prominent research accomplishments in this region, we can mention the discovery of the previously unknown yet significant branch of the West Spitsbergen Current, made by a team of IO PAS researchers (Waldemar Walczowski’s team, publications from 2000–2015). It has “always” been known that the northern end of the Gulf Stream, the North Atlantic Current, flows into the Arctic Ocean along the Spitsbergen coast and is the most important source of heat for this huge region. After more than a decade of measurements taken aboard the Oceania, however, researchers from the Institute of Oceanology demonstrated that this current is in fact a forking system of “branches” – separate rivers in the sea that change their course and vary in flow intensity as a result of hydrodynamic processes. Research by Maria Włodarska-Kowalczyk’s team in 1998–2005, in turn, showed that melting glaciers cause the same disturbances in benthic fauna as does water polluted with waste. The response of benthic animal communities to the stress caused by pollution was described back in the 1970s in the form of the Pearson–Rosenberg model; these studies showed that fauna responds in the same way to the inflow of freshwater from melting ice. Interestingly, the key publication on this issue was co-authored by Tom Pearson, the British researcher who was one of the authors of the original model. Another

significant achievement involved demonstrating that the observed warming of the Arctic fjords led to increased biodiversity and caused the dispersion of the energy flow in the ecosystem in line with the effect known from Odum's ecosystem maturation model. This was shown in a series of publications by Jan Marcin Węśławski's team in 2017–2020. Under this concept, which is new in terms of the assessment of the impact of climate change in the Arctic, the Arctic is not actually approaching a tipping point, nor is it undergoing a simple regime shift. Rather, the situation that is playing out before our eyes is the evolutionary stabilization of the young Arctic ecosystem.

As is often the case in science, some of the achievements that the IO PAS staff were certain would be a big success, with Institute being the first to announce the underlying discovery, proved to be belated – other foreign institutions were faster, and the Institute had to settle for the runner-up position. Such findings included the discovery of very large swarms of krill found not in the water column, which is their natural habitat, but near the bottom of the sea close to glaciers. The IO PAS's researchers publication on this finding was forestalled by a publication of German scholars, who had conducted their research in the same period yet managed to announce their findings earlier.

Some scientific research projects are also implemented in response to the need to address emergent problems. For example, marine science as a whole has for some time now had its attention turned firmly towards the problem of plastic in the environment. Such research is conducted aboard the research vessel Oceania – we collect data and the findings are published in research papers on plastic waste from various regions of the world. These studies have demonstrated that apart from the obvious aspect of environmental pollution, plastic plays a very important role in sea organisms being transported by currents. Previously, this role was played by tree trunks or parts of land-based plants. Today, fishing crates made of plastic or bits of rope are more commonly found than natural materials, and they often serve as rafts carrying bivalves and crustaceans.

Another important category of marine research resembles routine monitoring – it involves recording long-term time series of key parameters characterizing the status of the marine environment. Once underappreciated, such data became hugely important once rapid climate change related to global warming came to be observed. Thanks to many years of such studies, the IO PAS maintains regular observations at several dozen permanent stations in the North Atlantic, which translates into a unique sequence of data from an uninterrupted period of over 30 years! Such data provide us with invaluable information about the

changing environment and have been made available to and are used by the international community of marine researchers.

The infrastructure used in Polish polar marine research includes above all the Institute's aforementioned research vessel, the Oceania. The yearly cost of its maintenance is similar to the cost of maintaining the polar station of the PAS Institute of Geophysics on Spitsbergen, another important element of the Polish polar research infrastructure. The Oceania is currently the only Polish vessel used to conduct scientific research outside the Baltic Sea. Thanks to international collaboration and the resultant availability of the Longyearbyen harbor and infrastructure on Spitsbergen, the Oceania's annual research voyages are the largest-scale Polish polar research expeditions. Every year, there are over 60 scholars working aboard the Oceania, in four rotations. Apart from researchers from the IO PAS, the University of Gdańsk, and other Polish higher education institutions, regular participants in polar marine research voyages under the Polish flag include scholars from Norway, Germany, Italy, Spain, England, Lithuania, and a dozen other countries.

Poland's successful record in polar research invariably provokes surprised reactions from citizens of the Arctic countries: "How did you Poles end up here?" Plenty of explanations could be offered, but what is important is that today we can proudly boast of scientific accomplishments on par with those made by EU countries that invest a lot more in polar research than we do. Thanks to the Polish polar stations and the Polish research vessel, we have been able to join those who assume responsibility for the European sector of the Arctic, which is crucially important for our understanding climate change on Earth. ■



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Hard at work aboard
the Oceania