

Summary of the Polish National Programme of Marine Research up to 2010

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1. The nature of this paper

The present paper has been drawn up by the Polish National Scientific Committee on Oceanic Research (SCOR), a group of leading Polish scientists fully competent in matters of oceanology and marine research. Its aim is to focus Polish research centres and scientists on objectives challenging oceanology and marine research in Poland and world-wide with a view to achieving a better understanding of the natural environment and its impact on the economy, culture and quality of human life.

It should be stressed that this paper is not a proposal for a directly financed research project. It is addressed to the State Committee for Scientific Research, in particular, to those among its teams, panels and management involved in marine science and economics, and in environment protection. It aims to assist decision-makers as regards the financing of research projects and the assignment of funds for statutory research, and to provide a guide to research problems that are significant to Polish and world science. Such a procedure will reduce the risk of unwise decisions and the consequent waste of valuable resources.

The present paper is based on the results of wide-ranging consultations among marine scientists and people directly involved with the sea regarding the justification for such a compilation and its content, and also on the recommendations contained in the following documents:

Polish

- State Policy on Science and Technology (government paper, approved by the Council of Ministers of the Republic of Poland, 20 July 1993);
- State Policy on Innovations (government paper, approved by the Council of Ministers of the Republic of Poland, 22 November 1994);

- Preferred lines of scientific research and development for the promotion of innovation in the economy (supplement to the government paper outlining state policy on science and technology, approved by the Council of Ministers of the Republic of Poland, 16 January 1996);
- Resolution No. 1/97 of the Council of Ministers of the Republic of Poland dated 7 January 1997 concerning the principles and procedures for setting up strategic governmental programmes;
- State Environmental Policy (paper produced by the Ministry for Environment Protection, Natural Resources and Forestry, which takes account of the Polish Parliamentary Resolution of 10 May 1991, Monitor Polski No. 18, § 18).

International

- World Climate Research Programme (WRCP),
- International Geosphere–Biosphere Programme (IGBP–Global Change),
- Resolutions of the UNO ‘Earth Summit’, (Rio de Janeiro, 1992),
- European marine biodiversity programme (BIODIVERSITY),
- Resolutions of the 19th General Assembly of the Intergovernmental Oceanographic Commission IOC–UNESCO (Paris 1997),
- The International programme of the European Union (Grand Challenges in Marine and Polar Sciences),
- Global Ocean Observing System (GOOS and EURO–GOOS),
- Joint Global Ocean Flux Study (JGOFS),
- Global Euphotic Ocean Zone Study (GEOZS),
- Global Ocean Surface Study (GLOSS),
- Harmful Algae Blooms (HAB),
- Land–Ocean Interaction in the Coastal Zone (LOICZ),
- Integrated Coastal Zone Management (ICZM),
- Baltic Experiment (BALTEX),
- Resolutions of the Helsinki Commission (HELCOM 1974),
- Baltic System Study (BASYS),
- Variability of Exchanges in the Nordic Seas (VEINS),
- Climate Variability and Predictability (CLIVAR),
- International ‘Baltic Sea 2008’ Programme (Baltic Sea 2008),
- United Nations Conference on the Law of the Sea (UNCLOS 1982).

2. The principal objective of the Programme and its justification

The protection of the natural environment and the rational utilisation of the useful resources of the Baltic Sea and selected regions of the world ocean, as well as the formulation of principles governing the sustainable development and integrated management of the Polish coastal region of the Baltic Sea.

Why the sea?

The need to undertake research that aims to achieve the above-mentioned objectives has arisen not only out of the cognitive, culture-forming aspirations of the Polish people, but also out of the practical needs of the maritime administration and economy. Both now and in the future the seas and oceans will continue to occupy an important place in the policies and economies of the countries of the world for the following reasons:

- they cover more than 70% of the Earth's surface and constitute a vast reservoir of water and utilisable open space;
- they store a considerable proportion of the world's reserves of utilisable food (protein from fish, plants and invertebrates), crude oil, natural gas and ferro-manganese concretions, not to mention vast quantities of building materials, dissolved salts, and unique raw materials for the food, cosmetics, pharmaceutical and other industries;
- they govern short-term changes in the global climate, since they are the principal source of oxygen for the atmosphere, absorb the majority of the carbon dioxide from it, and are primarily responsible for controlling heat-exchange processes with the atmosphere;
- they provide the cheapest form of intercontinental bulk cargo transport;
- continental shelf areas provide the states bordering them with innumerable practical benefits with regard to the economy, recreation, defence *etc.*;
- a number of marine phenomena on the one hand continue to threaten human life and property, *e.g.* the periodic inundation of low-lying coastal areas by seawater, extreme storm conditions on the high seas and in coastal areas, and submarine earthquakes and volcanic eruptions, but on the other are still little-used sources of energy.

Exploitation of the sea does affect the marine environment

Countries with access to the sea make use of it to the extent permitted by man's current knowledge of the marine environment and public awareness of such knowledge, as well as present-day technology and legal requirements. This means that:

- intensive methods are frequently employed in the utilisation of the living and non-living resources of the sea without regard for their adverse impact on the natural environment;
- ever more modern though environmentally unfriendly techniques are being applied in prospecting for and extracting crude oil, natural gas, building materials, ferro-manganese concretions and other non-renewable raw materials from the sea bed;
- ever larger vessels and other floating structures, ever more unfriendly to the marine environment, are coming into operation for the transportation of bulk cargoes, for fishing and for the extraction of mineral raw materials, *e.g.* large transoceanic tankers, fishery factory ships, drilling platforms;
- not infrequently, navigational and loading errors lead to emergencies and disasters involving large bulk carriers. Inaccurate forecasts of dynamic sea states in various parts of the world ocean are often responsible for such errors;
- high-capacity ports for the trans-shipment of bulk cargoes are built in open sea areas; these can exert a considerable impact on coastal zone stability;
- sewage as well as industrial and agricultural effluents of varying degrees of toxicity are discharged into the sea; moreover, the dumping of solid wastes is common practice. Even if the latter are regarded as harmless to living organisms, they can seriously disturb the ecological balance in the marine environment;
- methods and techniques of utilising and protecting the natural beauty of seashores, shipping lanes and port entrances are applied that are frequently based on an insufficient understanding of the processes occurring during the interactions between the lithosphere and the marine hydrosphere.

Hazards

As a result of insufficient knowledge and practical experience, as well as technical imperfections, man's injudicious activities are seriously endangering the existence of the marine environment, not to mention human life and property. In particular:

- they are diminishing the sea's capacity for self-cleaning and for the biodegradation of harmful substances originating from ports, ships and mining facilities, as well as those entering from the land via rivers and precipitation;
- they are retarding, and under certain conditions, are even precluding the processes by which the live resources of the sea renew themselves;
- they are giving rise to diseases in fish and invertebrates, and to blooms of harmful algae;
- they are contaminating inshore waters alongside built-up areas with harmful bacteria and chemicals, which are particularly hazardous in holiday resorts and health spas;
- they are reducing the sea's capacity to supply the atmosphere with oxygen and to absorb carbon dioxide from it; this will cause climatic changes and could lead to an ecological catastrophe of global proportions.

The need for research

Cognitive and utilitarian studies of the sea will enable optimal methods and organisational systems to be developed for the legal and technical control of human activities there and changes in the state of this environment to be predicted, both on a global and on a regional scale. In particular:

- our knowledge of the ocean's influence on the Earth's climate and biosphere will be enriched, and a reliable method of predicting short-term climatic changes and the level of the free sea surface, associated with these changes, can therefore be developed;
- practicable methods and systems for predicting changes in the marine environment and its coastal zone, caused by both natural and human agencies, can be developed;
- existing methods for forecasting extreme sea states and various hazards of marine origin can be improved and more accurate ones developed;
- they will provide an administrative foundation for organisational and legal regulations controlling the rational utilisation of the Polish economic zone of the Baltic Sea;

- international agreements and conventions regarding the economic exploitation of the Baltic's resources and the protection of its environment can be carried out properly.

Inaccurate, belated or incomplete information on the state of the marine environment and the processes occurring there often leads to enormous material and social losses, to natural disasters and environmental hazards. This is frequently the case when the adverse impact of high-risk human activities is compounded by unfavourable natural occurrences at sea. In view of the annually diminishing funds from national sources for financing research, the maintenance of the research infrastructure and the training of young scientists, it is deemed essential that State funding be directed to priority cognitive and utilitarian research objectives. If these are not achieved, no rational management of the sea and its coastal zone will be possible; indeed, both environment and people will in very many cases suffer the negative consequences ensuing therefrom.

3. Intermediate aims enabling the principal objective of the programme to be achieved

- 3.1 To investigate the processes of mass and energy transfer in the sea, their structures, mechanisms, interrelationships and their influence on exchange processes with the atmosphere. This is a priority objective of the World Climate Research Program (WCRP).
- 3.2 To investigate the effects of short-term climatic changes and of various aspects of human pressure on the marine environment and its coastal zone. An IGBP priority, this objective will enable an effective system of monitoring and protection of the Baltic Sea environment to be developed.
- 3.3 To investigate the chemical composition and properties of poorly understood components of the marine environment, thereby enabling the state of pollution of the Baltic Sea to be monitored and forecast. The objective is the scientific basis for improving Baltic monitoring within the framework of the Helsinki Convention.
- 3.4 To lay the foundations of rational exploration and exploitation of the living and non-living resources of the Baltic Sea, in particular those in the Polish economic zone.
- 3.5 To lay the foundations of rational management in the coastal zone and of the definition of principles for an integrated system of the Baltic coastal zone management. This is a priority objective of the Integrated Coastal Zone Management (ICZM).

- 3.6 To develop effective operational methods for counteracting threats to human life and property from the sea. These methods will enable rational organisational decisions to be taken in extreme situations at sea and on land.

4. Expected practical final effects

- The effective exploitation of living and non-living resources of seas and ocean, including fisheries, fish and invertebrate farming in the natural marine environment without harming this, and the extraction of crude oil, natural gas, building materials, heavy minerals, ferro-manganese concretions, *etc.* from the sea bed.
- The foundations of systematic action to conserve and shape the environment in marine areas of especial ecological, landscape and cultural value, such as submarine protected areas and coastal landscape parks.
- Effective monitoring of pollution of the water and the sea bed; the recommendation of methods and techniques for reducing discharges of excessive quantities of untreated sewage; modernisation of sewage treatment facilities in the Polish coastal region and elimination of health hazards.
- Recommendations for rational management in the Polish coastal region, to cover the construction, extension, and modernisation of harbour facilities, the construction of fish and invertebrate farms, the creation of recreational amenities, and the conservation of endangered sections of coastline.
- The development and implementation of an early-warning system against hazards at sea and in the coastal zone, such as the contamination of waters and beaches by spills of crude oil and other hazardous substances, and floods due to storm surges and inundation of floodplains around river mouths.
- The development and implementation of an integrated system of coastal zone management covering the environment, the coastal zone, ports and water transportation, tourism and recreation, and coastal landscape parks.

5. Outline of research tasks to be realised in the years 1999–2010

No.	Intermediate objective of research	Research tasks enabling the intermediate objective to be achieved	Current international research programme aiming to achieve the intermediate objective stated in column 2
1	2	3	4
1	3.1 To investigate the processes of mass and energy transfer in the sea, their structures, mechanisms, inter-relationships, and their influence on exchange process with the atmosphere	<p>3.1.1 To study the forms and structures of mass and heat transfer processes of different scales in energetically active areas of the ocean.</p> <p>3.1.2 To study the forms and structures of mass and heat transfer processes between the sea and atmosphere at the sea-air interface</p> <p>3.1.3 To improve the mathematical and phenomenological methods and models describing mass and heat transfer processes within the sea.</p> <p>3.1.4 To improve the mathematical and phenomenological models and methods describing mass and heat transfer processes between the sea and the atmosphere.</p> <p>3.1.5 To improve the methods of forecasting the impact of short-term climatic changes on the state of waters in the ocean and peripheral seas (particularly in the Baltic Sea).</p> <p>3.1.6 To improve the mathematical and phenomenological methods and models describing the transfer and conversion of solar energy in the sea and their effect on photosynthesis (particularly in the Baltic Sea).</p>	<p>VEINS ACSYS CLIVAR</p> <p>ACCYS BAEX JGOFS CLIVAR</p> <p>VEINS BALTEX CLIVAR</p> <p>JGOFS BAEX CLIVAR</p> <p>LOICZ BALTEX GLOSS</p> <p>GEOZS</p>

1	2	3	4
		<p>3.1.7 To improve the hydrological models of the mass and energy balance in the sea (particularly in the Baltic Sea).</p> <p>3.1.8 To improve remote, non-contact techniques to study the hydrophysical, hydrodynamic and geodynamic properties of the marine environment (satellite, acoustic, laser, radar, radiological).</p> <p>3.1.9 To develop and improve models enabling an understanding of palaeoclimates (geochronology) through the use of bio- and radioisotopic indicators.</p>	<p>LOICZ BALTEX</p> <p>BALTEX ESA</p> <p>EMDP LOICZ</p>
2	<p>3.2 To investigate the effects of short-term climatic changes and of various aspects of human pressure on the marine environment and its coastal zone</p>	<p>3.2.1 To develop on an international level an empirical marine data bank, which would be the basis of scientific analysis and modelling as well as rational rights and norms with respect to the protection of the marine environment (particularly the Baltic Sea).</p> <p>3.2.2. To monitor continuously the temporal and spatial changes in the physical, chemical and biological properties of the sea, human factors and weather conditions being taken into account (oceanographic monitoring).</p> <p>3.2.3 To study the effects of climatic factors and the dynamics of terrigenous material discharge into the sea on the life of organisms in the sea and its contact zones (water, land, atmosphere, estuaries).</p> <p>3.2.4 To study the biodiversity and ecological functions of unicellular organisms and viruses in the sea.</p>	<p>LOICZ BALTEX BIO-DIVERSITY CLIVAR GOOS</p> <p>BALTEX LOICZ BIO-DIVERSITY GOOS HELCOM</p> <p>IGBP BIO-DIVERSITY LOICZ</p> <p>BIO-DIVERSITY</p>

1	2	3	4
		<p>3.2.5 To determine indicators for estimating the self-cleaning capacity of environmentally degraded sea areas.</p> <p>3.2.6 To develop methods for assessing the impact of short-term climatic changes on the species diversity of marine biosphere.</p> <p>3.2.7 To develop biochemical techniques for assessing the influence of short-term changes in the properties of Baltic biotopes on the biodiversity of marine organisms.</p> <p>3.2.8 To study chemical compounds (including anthropogenic substances) as markers of the transfer and transformation of matter in the sea.</p>	<p>LOICZ</p> <p>BIO-DIVERSITY</p> <p>BIO-DIVERSITY</p> <p>BASYS</p>
3	<p>3.3 To investigate the chemical composition and properties of poorly understood components of the marine environment, thereby enabling the state of pollution of the Baltic Sea to be monitored and forecast.</p>	<p>3.3.1 To develop techniques for analysing new or poorly understood chemical compounds (heavy metals, radionuclides, organic compounds) in the sea, particularly in the southern Baltic.</p> <p>3.3.2 To study the physical and chemical forms (speciation) of simple and complex chemical compounds in the sea.</p> <p>3.3.3 To determine the temporal and spatial dynamics of new and poorly known chemical compounds in the southern Baltic.</p> <p>3.3.4 To understand the mechanisms by which chemical substances migrate across biogeochemical barriers in the sea.</p>	<p>HELCOM</p> <p>HELCOM</p> <p>BASYS LOICZ</p>
4	<p>3.4 To lay the foundations of rational exploration and exploitation of the living and</p>	<p>3.4.1 To create a representative bank of empirical data on the useful resources of fish and invertebrates as well as the useful mineral resources on the Baltic Sea bed. This is to form the</p>	<p>Cooperation within the framework of ICES agreements</p>

1	2	3	4
	<p>non-living resources of the Baltic Sea, in particular those in the Polish economic zone.</p>	<p>basis for drawing up norms for the rational exploitation of the Baltic's resources and for negotiations in this respect at international and intergovernmental level.</p> <p>3.4.2 Continuous monitoring and estimation of regional resources of fish and invertebrates (fisheries monitoring).</p> <p>3.4.3 To study the dynamics of changes in the chemical, physical and biological properties of spawning grounds in protected areas of the southern Baltic.</p> <p>3.4.4 To improve diagnostic and therapeutic techniques for combating poisoning and disease in marine organisms.</p> <p>3.4.5 To investigate and record the mineral resources in the Polish economic zone of the Baltic (geological and geophysical cartography of the sea bed and coastal zone).</p> <p>3.4.6 To improve methods for creating oceanographic protective zones around drilling platforms and the technology of the drainage of sedimentary deposits on the sea bed.</p> <p>3.4.7 To improve methods of forecasting the adverse environmental effects of the economic exploration and exploitation of the sea.</p>	<p>ICES (as above)</p> <p>ICES (as above)</p>
5	<p>3.5 To lay the foundations of rational management in the coastal zone of the sea and of the</p>	<p>3.5.1 To understand the laws governing the dynamic interaction of the marine hydrosphere and lithosphere in the coastal zone.</p>	<p>ICZM LOICZ PACE</p>

1	2	3	4
	development of principles for an integrated system of the Baltic coastal zone management.	3.5.2 To improve hydrotechnical methods and models describing the dynamics of geomorphological processes reshaping shorelines and the sea bed.	ICZM LOICZ BASYS PACE
		3.5.3 To assess the significance and potential of the coastal zone as a protective barrier for the marine environment.	ICZM
		3.5.4 To improve the hydrotechnical methods and models describing the action of the marine hydrosphere on diverse types of port and shore buildings, buffer systems, drilling platforms, desalination plants, water intakes, and other free-standing structures in the open sea.	ICZM
		3.5.5 To create premises for rational decision-taking by the state administration and local government with respect to the utilisation of areas of the coastal zone.	ICZM
		3.5.6 To create an integrated system of protection and utilisation of the coastal zone for economic and social purposes.	LOICZ ICZM
6	3.6 To develop effective operational methods for counter-acting threats to human life and property from the sea.	3.6.1 To develop methods for predicting the impact of rising sea levels on coastal areas along the southern Baltic (greenhouse effect).	LOICZ GLOSS GOOS
		3.6.2 To develop methods for predicting environmental hazards in the Baltic caused by disasters to bulk carriers, river- and air-borne loads of harmful substances, and other types of human pressure.	HAB BIO- DIVERSITY

1	2	3	4
		3.6.3 To improve methods and operational systems for predicting the time and place of extreme events, storm states of wind-generated wave-action, the piling up of water in the open sea and in the coastal zone.	GOOS GLOSS
		3.6.4 To study and monitor harmful algae blooms – a potential hazard to the living resources and recreational amenities of the Baltic Sea.	HAB HELCOM

Abbreviations and acronyms

ACSYS	– Arctic Climate System Study
BALTEX	– Baltic Experiment
BASYS	– Baltic System Study
BAEX	– Baltic Aerosol Experiment
BIODIVERSITY	– Biological Diversity
CLIVAR	– Climate Variability and Predictability
EMDP	– European Marine Drilling Programme
EURO-GOOS	– European Global Ocean Observing System
GEOZS	– Global Euphotic Zone Study
GOOS	– Global Ocean Observing System
GLOSS	– Global Ocean Surface Study
HAB	– Harmful Algae Blooms
HELCOM	– Helsinki Commission
ICES	– International Council for the Exploration of the Sea
IOC-UNESCO	– Intergovernmental Oceanographic Commission UNESCO
ICZM	– Integrated Coastal Zone Management
IGBP	– International Geosphere - Biosphere Programme
JGOFS	– Joint Global Ocean Flux Study
LOICZ	– Land-Ocean Interaction in the Coastal Zone
PACE	– Prediction of Aggregated-Scale Coastal Evolution
UNCLOS	– United Nations Conference on the Law of the Sea
VEINS	– Variability of Exchanges in the Nordic Seas
WRCP	– World Climate Research Programme

In order to reach a consensus among marine scientists and to draw up a written version of the programme, the Polish National SCOR appointed the following working group at a plenary meeting of the Scientific Committee:

Prof. Czesław Druet – group leader (chairman of the Polish SCOR),

Prof. Andrzej Zieliński (vice-chairman of the Polish SCOR),

Prof. Jerzy Dera (Polish representative to EMaPS),

Prof. Janusz Pempkowiak (chairman of the Marine Chemistry section of the Polish SCOR),

Asst. Prof. Jerzy Cyberski (chairman of the Marine Physics section of the Polish SCOR),

Asst. Prof. Maria Żmijewska (chairman of the Marine Biology section of the Polish SCOR),

Asst. Prof. Stanisław Musielak (chairman of the Marine Geology section of the Polish SCOR),

Asst. Prof. Jan Marcin Węslawski (scientific secretary of the Polish SCOR),

Prof. Tadeusz Jednorąg (member of the Polish SCOR).

The National Programme of Marine Research was approved by the Polish National Scientific Committee on Oceanic Research at a plenary meeting of the Committee on 14 December 1998.

Czesław Druet
Chairman of the Polish National
Scientific Committee on Oceanic Research

Gdańsk, December 1998