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CONTROL OF WATER POLLUTION OF THE BALTIC SEA

Helsinki Convention on the Protection of the Marine Environment of the Baltic Sea Area, signed in 1974, is the first international agreement dealing comprehensively with all aspects coming from pollution.

A relatively small depth of the Baltic Sea, low rate of the water exchange (a complete renewal of the water takes 20-40 years), as well as the enormous economic potential of the seven states belonging to the catchment area of this sea have caused an almost expotential growth of concentrations of nutrients and accumulating toxic compounds, as well as distinct changes in marine ecosystem: disappearance of some species, increasing area of the so-called "benthic deserts" and progressing eutrophication.

The main task of the Convention, ratified in 1979, is to standardize the methods of pollution loads monitoring within the frames of international monitoring programme, and — at the first stage — to calibrate the methods of monitoring pollutants distribution, and to select the appropriate methods for the removal of pollutants particularly hazardous to marine environment. The paper discusses also the legislation, research and implementation activities, as well as the structure of the most important bodies of the Helsinki Convention.

1. INTRODUCTION

The Convention on the Protection of the Marine Environment of the Baltic Sea Area' the Helsinki Convention, was signed in Helsinki on 22 March 1974 by the seven Baltic Sea States: Denmark, Finland, the German Democratic Republic, the Federal Republic of Germany, Poland, Sweden and the Soviet Union [4]. The purpose of this paper, written on the basis of the authors experience in the work within the Interim Baltic Marine Environment Protection Commission (abbreviated as Interim Commission — IC), is to illustrate the magnitude of the problems facing the Baltic States, discuss some of the technical dilemmas, introduce the structure of the Interim Commission and the proposed future trends in the research and implementation.

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1.1. HISTORICAL BACKGROUND

The Helsinki Convention is not unique in the field of marine pollution control, although it is the first one to deal comprehensively with all aspects of pollution — coming from air, land and water. The United Nations, through its UNEP and UNDP agencies, has been active in this field as documented by recent activities in the called priority areas [11]. The Regional Seas Activities programme of UNEP has led to the drafting of several conventions, agreements and definitions in such environmentally fragile areas as: the Red Sea (in cooperation with the ALECSO); in the South-East and the South-West Pacific (document to be issued in 1980); Caribean Sea where Cuba-based UNDP project has just (1979) started; in the West African Region where 19 states from Senegal to Namibia have recently (Nov. 1979) formulated an Action Plan for the area; and the Kuwait UNDP project set in area that moves over 60% of the world oil and invests over 20 mln dollars per km of coastline.

Many of these activities are coordinated by IMCO — Intergovernmental Maritime Consultative Organization — through its special committees and expert groups.

2. ENVIRONMENTAL BACKGROUND

The Baltic Sea (fig. 1) is one of the major brackish water basins in the world. Its total area is about 370,000 km^2. The average depth is only 55 m (e.g. the Mediterranean Sea has 200 m), and the total volume approximately 20,000 km^3. The Baltic Sea is connected with the North Sea through narrow sounds which limit the water exchange. It is estimated that a complete renewal of the water of the Baltic Sea takes 20-40 years i.e. an annual outflow of min. 5% of the volume. The Baltic Sea consists, in fact, of a series of basins separated by sills. Therefore, conditions vary considerably between different parts of the Baltic Sea [9]. Furthermore, due to stratification phenomena caused by differences in salinity and temperature, the water in the main parts of the Baltic Sea is divided into horizontal layers of different density, thus preventing effective mixing in the water body (fig. 2).

Owing to stratification the water of the Baltic Proper and the Gulf of Finland can be roughly divided into surface water and deep water. The lighter, less saline surface water extends down to a depth of about 50-70 m, where a sharp change in salinity occurs in a boundary layer — the halocline. Below the halocline lies the heavier, more saline deep water. Nutrients concentrate in the deep water, where — owing to the lack of light — there are few organisms able to utilize them [9]. The great resistance to mixing, caused by the difference in density between the surface water and the more saline deep water, increases the risk of the pollution of the Baltic. In the surface layer, mixing occurs down to the halocline and oxygen is replenished from the air [9]. Thus notable oxygen deficits seldom occur in this water, except in limited areas where pollutants are discharged from the coast. In the deep water, below the halocline, the main source of oxygen is oxygen-rich water flowing in through the Danish Sounds. In the deepest parts of the Baltic two deep water layers may often be distinguished: the upper layer, flowing slowly northwards, and the

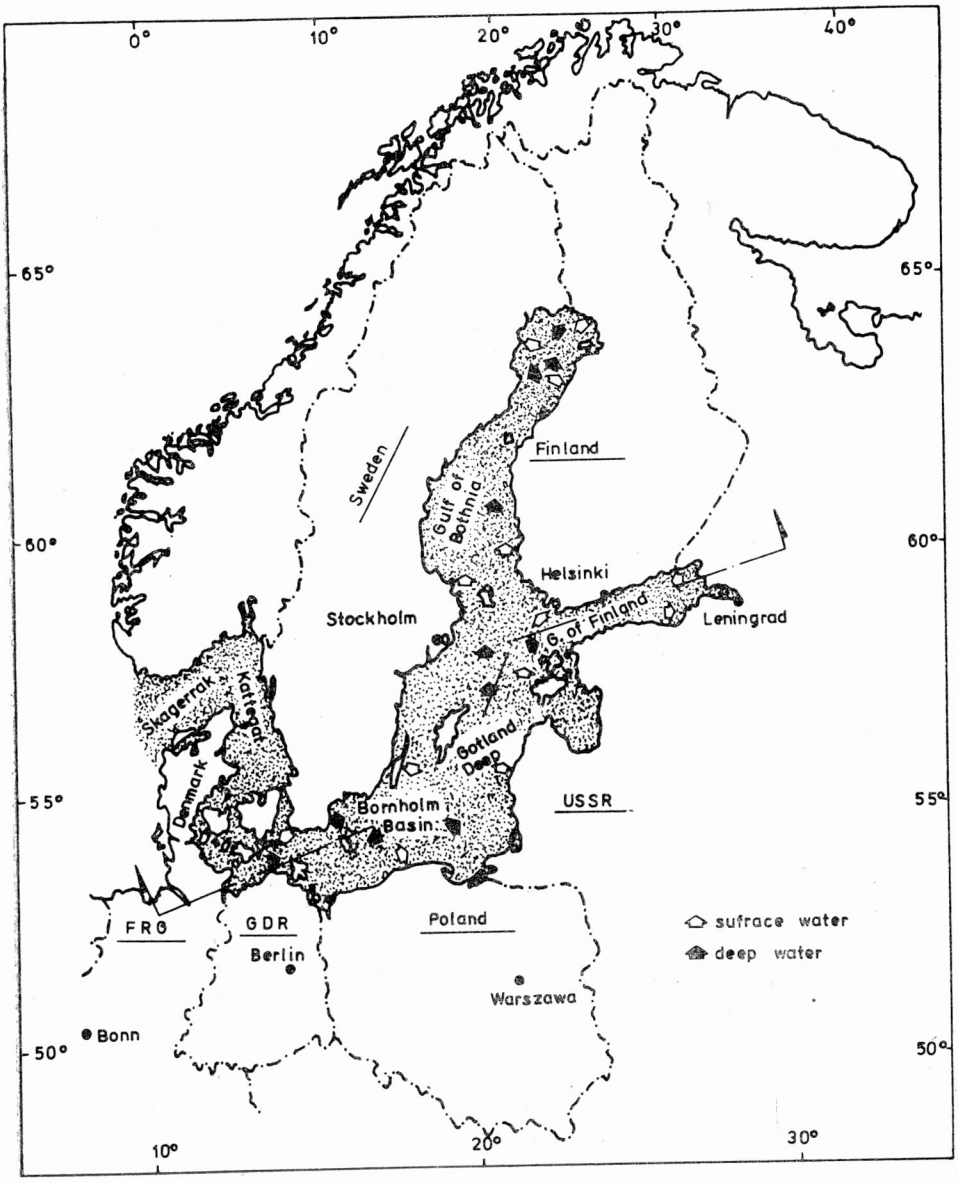

Fig. 1. Baltic Sea with indication of principal currents [9]
Rys. 1. Bałtyk z zaznaczeniem głównych prądów [9]

lower layer, or bottom water, which lies stagnating at the bottom of the deep basins. In the slowly moving upper layer, the oxygen content becomes depleted, but is seldom completely exhausted. In the bottom water, however, the water exchange is very irregular and the oxygen may not be replenished for some years. Here the constant consumption

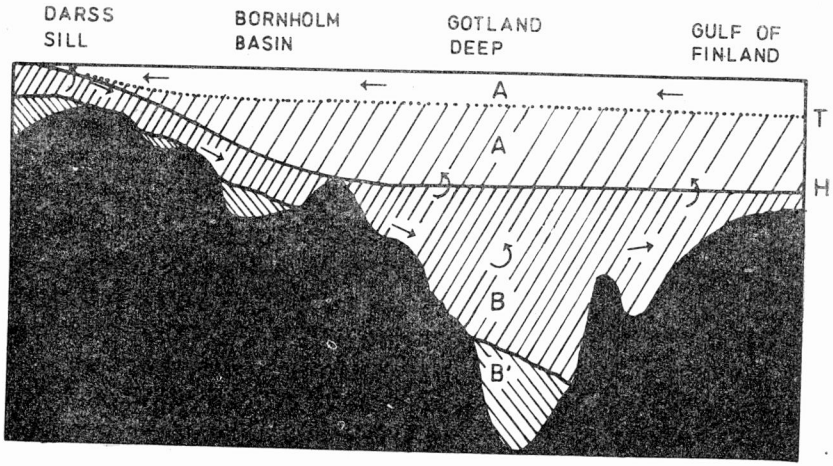

Fig. 2. The stratification of the Baltic Sea [9]:
A — surface water stratified in summer; B — deep water (B' — stagnant deep water); T — thermocline; H — the permanent halocline

Rys. 2. Stratyfikacja Bałtyku [9]:
A — wody powierzchniowe uwarstwione w lecie; B — wody głębokie (B' — stagnujące); T — termoklina; H — stała haloklina

of oxygen in the respiration of organisms and the decomposition of organic material may lead to complete deoxygenation [9]. Fig. 3 illustrates [1] the increase in the area of the so-called "benthic deserts" in the deep parts of the Baltic, which is a definite sign of man's

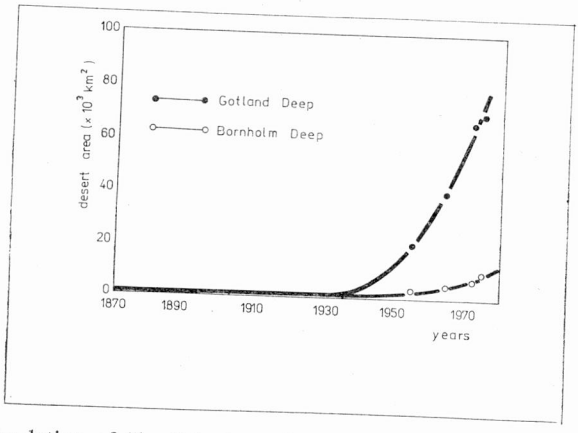

Fig. 3. Escalation of "benthic deserts" in the deep parts of the Baltic Sea
Rys. 3. Eskalacja obszarów ,,pustyni bentosowych" w głębokich partiach Bałtyku

impact and natural conditions depicted above. Exchange of the stagnant bottom water occurs only from time to time when, owing to stormy weather, the inflow from the North Sea is greater and more saline than usual. The heavy, saline water sinks to the bottom in the Baltic and travels along the sea bed, replacing the old bottom water [9].

The primary productivity is similar to that of the North Sea, due to high content of soluble organic carbon — some 3,5-4 mg C/dm^3 [7]. This leads to good primary productivity, amounting to 100 g C/m^2 for algae in the pelagic zone of Baltic Proper, while bottom annual productivity is 5 g C/m^2. These exceptional hydrographic, chemical and physical conditions, and the geological history of the Baltic Sea explain why it possesses quite unusual aquatic biota, consisting of both marine and fresh water organisms side by side, a number of relicts and a comparatively small number of species, some of which, however, often occur in abundance [2]. The biota is extremely sensitive to ecological changes, furthermore, persistent pollutants remain in this aquifer for a long time due to slow exchange of the sea water — which increases the bioaccumulation opportunity. Already visible effects are the extinction of the predator bird in the food chain: *diatom — edible mussel — rider — white tailed eagle.*

Concentrations of harmful substances such as DDT and PCB, have been noted to be considerably higher (estimates are 5-10 times) for instance in cod and herring caught in the Baltic Sea than in the North Sea fish [10, 13].

Some 70 million people live within the direct catchment area of the Baltic Sea. The Baltic Sea has always provided a natural bond as well as routes of navigation between the Baltic Sea countries. The Baltic Sea States are highly developed as regards industry and agriculture. In consequence, the pollution load in the Baltic Sea has been, and still is, rather high. There are many times more people living in the drainage basins of rivers emptying into Baltic Sea. Studies show that the pollutant load introduced by river inputs is overwhelmingly larger than the direct discharge to the sea.

Table

Estimation of phosphorus inputs into the Baltic Sea
Ocena zawartości fosforu wprowadzanego do Bałtyku

Source	Load/tons P/year
Municipal and industrial wastes	22000-33000
Atmosphere	3000-9000
Natural sources	500-3000
Danish Straits	0-6000
INPUT SUB-TOTAL	25500-51000
OUTPUT (Danish Straits)	7000
NET INPUT	44000

The state of Baltic Sea environment is not as yet uniformly defined, either the loads discharged are not accurately determined. The eutrophying potential of discharges may be illustrated in table where phosphorus inputs are estimated without adequate evaluation of the impact of rivers [7]. The net input of 41000 t/year due to man activity amounts to 10% of the total phosphorus content of the Baltic Proper.

A large number of oil spillages are reported annually in the Baltic Sea. Intense naviga-

tion, especially in certain parts of the area, is creating the risk of accidents which can cause pollution by oil and other harmful substances. It should be noted that in the 1954 Convention for Prevention of Pollution of the Sea by Oil executed by IMCO the Baltic Sea Area is classified closed to any oily discharges including the balast waters.

The Baltic Sea is recognized in the International Convention for the Prevention of Pollution from Ships, 1973 (the MARPOL Convention) as one of the "special areas" where more severe discharge restrictions concerning ships should be applied than to other sea areas [9].

The main reasons for which the Helsinki Convention was concluded is the endangered state of the Baltic Sea and its living resources and the growing awareness shared by the Baltic Sea States that national measures alone are not sufficient to protect and enhance the marine environment of the Baltic Sea Area.

3. STRUCTURE AND WORK WITHIN THE HELSINKI CONVENTION

Before the Helsinki Convention enters into force (spring 1980) the Interim Commission has conducted all preparatory work in the two main bodies: the Scientific-Technological Working Group (STWG) established in 1974, and the Maritime Working Group (MWG) in 1975.

The main tasks of the STWG are:

1. to elaborate criteria and standards for discharge of harmful substances, i.e. common criteria for issuing permits (Art. 6, § 5 of the Convention); to define methods for the assessment of the degree of pollution of the marine environment;

2. to develop further methods, models and programmes for the solution of scientific-technological problems resulting from the requirements of the Convention, e.g.: the development of the cooperative monitoring programmes on the basis of current national monitoring activities and the data submitted by the Signatory States; the definition of the amounts of pollutants entering the Baltic Sea Area from land-based sources including pollutants from the atmosphere; the consideration of the concentrations of harmful substances in bottom sediments and dredged spoils; etc.

The main task of the MWG is to assist the Interim Commission in its work on measures relating to prevention of marine pollution from ships and combatting marine pollution taking into Protection Committee (MEPC), Maritime Safety Committee (MSC), and other bodies of the Intergovernmental Maritime Consultative Organization (IMCO). MWG is also dealing with transfering many kinds regulations from Conventions which were deposited to the IMCO.

3.1. SCIENTIFIC-TECHNOLOGICAL WORKING GROUP (STWG)

In order to solve its major program encompassing three major areas:

1. criteria and standards for discharges of harmful substances,
2. monitoring, including methodology and intercalibration,

3. water pollution control technology,

he STWG has called several ad hoc working groups.

The ad hoc Working Group on criteria and standards (WGS) for discharge of harmful ubstances has worked [8, 6] towards finding possibilities of applying simultaneous immis- ion and emission requirements when issuing permits for discharges within the first major rea. Present and future activities of this group will concentrate on the following [7] prob- ems: the elimination of the introduction of DDT into the marine environment of the altic Sea Area; the regulation of the use of PCB and for the elimination of the discharges; valuation of the national information concerning disposal of PCB and PCT wastes; stablishing the preliminary environmental quality guidelines for Hg, Cd, Pb, Cu and Zn n water, organisms and sediment; drafting the preliminary emission or technical guidelines or the above substances and additionally for oil, resulting e.g. from chlor-alkali industry, il refining, metallurgical industry and municipal sewerage; drafting of a list of substances or which emission and immission standards are necessary and a list of substances for hich emission or immission standards and guidelines should be employed; promotion of he work on development and elaboration of combined emission and immission approaches or permits to discharge in accordance with the monitoring programme.

Future work will give high priority to the substances particularly harmful to the Baltic narine environment, i.e. halogenated hydrocarbons (PCB, DDT, PAH etc. as in Annex I o the Convention), elements such as Hg, Pb, As, Cd, Cu, Zn, Cr and their compounds nd the eutrophying elements — phosphorus and nitrogen.

It is interesting to note that even before the Convention entered into force the use of DDT has been practically abolished in the Baltic Sea States, while the work on elimination or substitution) of PCB is in progress.

The STWG/BMB ad hoc Working Group has been formed to develop the Baltic Marine iologists (BMB) action towards full-scope assessment of the Baltic environment. The roup, working together with the Baltic Monitoring Programme (BMP), works towards stablishment of the unified biological data collection, analysis and reporting system, ithin the second area of the STWG interests.

The third problem area, water protection technology, has been so far dealt with in hree seminars in Espoo (1976), Vaerlose (1978) and Stockholm (1979). The 1976 meeting n Finland has dealt with problems of novel wastewater treatment technology suited to he purposes of the Baltic Sea States, evaulation of the present status and outlined the uture development trends. The 1978 meeting in Denmark had been confined to the methods f elimination of heavy metals from solid and liquid industrial and municipal wastes, hile the Stockholm meeting dealt with the best practicable and available treatment technol- gy for wastes from refineries, communication, and metallurgical, pulp and paper, chemi- al and power industries.

3.2. MARITIME WORKING GROUP (MWG)

The work of the MWG was to draw upon the work carried out by IMCO which is irected on a global scale — in order to avoid the duplication of work.

Three ad hoc groups have performed special tasks pertaining to the prevention of marine pollution from ships and combating marine pollutions:

The Working Group on a possible joint field experiment within the Baltic Sea Area in tagging of oil residues in tankers (WGTO).

The Expert Group on oil combating (MWG EG). The meetings of this group have been hosted by the government of Poland.

The Group of Experts on a traffic information system (MWG WGTI).

The MWG has come up with the following proposals:

Standard discharge connections should be prescribed for ships flying the flag of the Baltic Sea State even before the entry into force of the MARPOL Convention, with respect to discharge pipelines for bunker ballast water [2].

A study should be made pertaining to the development of a standard test procedure for evaluating engine room cleaning agents with regard to their effect on the performance of bilge water purification equipment.

Statistic studies and analysis should be carried out continuously on the occurrance of ship casualties in the Baltic Sea Area so as to find the reasons and to assess the damage to the environment.

The MWG has invited all the Baltic Sea States to implement the IMCO scheme for reporting alleged inadequacy of reception facilities for oily waste, and to inform shipowners and shipmasters of the scheme at the earliest possible date [2].

The WGTO has established a scheme for the exchange of information on oil combating action, operations, equipment and drills. In addition, both the MWG and the MWG EG have provided for the continuous presentation of information pertaining to the work of the groups, by collecting information on reception facilities for wastes from ships, sea transports of noxious liquid substances carried in bulk, and the national capacity of the Baltic Sea States in respect of tug assistance for salvage operations in connection with pollution incidents etc. (MWG); collection of information on e.g. technical equipment and oil combating strike teams at the disposal of each Baltic Sea States (MWG EG). A working group on tagging oil residues (WGTO) has been called, with the aim to evaluate the applicability of the Swedish method for detecting the polluting vessel.

In greater detail, the MWG has recommended the consideration of the following issues [5]: amendments to the Annex IV of the Helsinki Convention concerning the discharge of clean or segregated ballast water; guidelines for type testing and approval of sewage treatment; application of the provisions on noxious liquid substances carried in bulk; use of dispersants, sinking agents and absorbents in oil combatting operations (with a recommendation to use mechanical means as far as possible); designation of harmful substances in packaged forms; facilitation of border passage in joint operations in territorial waters, in order to provide speedy assisstance; delimitation of regions in the Baltic Sea Area for surveillance and operational activities; analyses of ship casualties; establishment of the position reporting system for ships and the use of long distance pilots in the Baltic Sea Area; and other pertinent problems which should be taken into account in correspondence with the IMCO and MARPOL Conventions.

It should be noted that many major topics are finding solutions before the Convention enters into force. One such problem is the establishment by the Polish ports of the free-of-charge waste reception facilities. The 6-th Meeting of the IC has recommended that in the near future, but not later that the end of 1981, a system of no special fees being charged for reception of all wastes from ships in the Baltic Sea ports be adopted.

4. DISCUSSION AND SUMMARY

The Helsinki Convention will create for the Baltic Sea States a forum to exchange available information, to concentrate research efforts towards solving the most urgent problems in the area, to establish basis for common environmental policy making, planning, implementing and monitoring. So far, the problems have just been touched upon. They involve a host of unsolved issues that frustrated other hitherto existing international conventions and these dilemmas are well reflected by completed Barcelona Convention [8]. The problems involve, among other, differences in the legal and political approaches to water pollution control. Technical solutions to the problems of coastal discharges have shown to have a dividing potential for the Baltic Sea States. The problems of ship casualties, international insurance against environmental damage, rescue missions in case of spills, monitoring zones and monitoring in territorial waters, and similar problems await solution.

The Convention has started, however, a new chapter in the joint efforts towards protection of the vulnerable Baltic Sea environment. It is now up to the respective governments, and their experts united in this intergovernmental organization, how fast the work outlined here will be implemented in practice. So far, every country has given its best to facilitate the progress toward that — still distant — goal.

5. FUTURE WORK

Considerable effort is now launched on the global scale to assess, quantify and interpret environmental changes in marine ecosystems. Numerous international organizations are involved in this combined research, legislative and economic effort. It is of utmost importance to monitor these activities in order to avoid duplication of work and to draw upon the experience of other organizations. The role of global bodies such as Intergovernmental Oceanographic Commission — Working Committee of GIPME (Global Investigation of Pollution in the Marine Environment) should be more clearly defined, particularly in correspondence to such bodies as UNEP and the various marine conventions [12].

The technical problems to be resolved in the near future in the Baltic Sea Area include quantification of pollution loads i.e. inputs from land, air and water, assessment of their immediate and long range effects and, based on these findings, adoption of research pri-

orities and the action plan. Implementation of the various water pollution control measures is equivalent to a significant economic effort in unification of reception facilities, routine and emergency communication systems, built-up of the monitoring and control systems in parallel to settling the mounting problems of territorial waters and shelf, as well as under-sea-bed explorations.

The two principal areas here are ports and coastal waters that are subject to the more spectacular and concentrated pollutant discharges versus the open sea that suffers from long-life (persistent) forms of pollution and secondary pollution due to eutrophication. A lot of work is already at progress in the first area — with erection of ballast water treatment plants, redesigning tankers for carrying clean ballast, establishing of surface pollutants collection fleets and changing conventional cleaning practices. These achievements may, however, have a limited effect on the overall quality of the open sea ecosystems. The major portion of the pollutant load, affecting the Baltic Proper, comes from inland, in the form of global air pollutants emissions, and river inputs. In this context the protection of the marine environment of the Baltic Sea is directly related to the degree of overall control of pollutant emissions from the economic activities of the Baltic Sea States.

In view of these needs a major research effort is now launched in Poland to assess and quantify the degree of pollution of the Baltic. The programme, coordinated by the Research Institute for Environmental Development (RIED) unites in cooperation the Maritime Institute, Marine Fischeries Institute, Institute of Meteorology and Water Resources, Polish Academy of Sciences, various planning and design offices, state monitoring and control centers, various ship and port authorities and research centers. The work involves: elaboration of complete picture of pollutant inputs, delineation of the areas of the most severe pollution potential — in order to design investment programmes there and curtail the most dangerous discharges; optimization of the marine ecosystem monitoring network (i.e. unification of reporting formats) and connecting it with the inland systems; evaluation of the dynamics of the interface transport of heavy metals into phytoplankton, zooplankton and benthos, with determination of the bioaccumulation factors, definition of toxicity tresholds; definition of means to reduce pollution from ships, ports, sea and under the sea bed-explorations, dredgings etc.; elaboration of the technical system for complete pollution-control-oriented ship-service system, including emergency action plans for spills and accidents; perfecting collection and treatment methods for wastes from sea-related industry (sea foods etc.). Finally tourist industry and seashore development plans will be reviewed from the standpoint of both legal aspects and the economic efficiency of the means applied for protection of the marine environment.

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OCHRONA PRZED ZANIECZYSZCZENIEM WÓD BAŁTYKU

Podpisana w 1974 r. Konwencja Helsińska o Ochronie Środowiska Morskiego Bałtyku jest pierwszym międzynarodowym porozumieniem obejmującym w tak szerokim zakresie wszystkie elementy, które wpływają na stan czystości wód morskich.

Mała głębokość Bałtyku i niewielka prędkość wymiany wody (całkowita wymiana raz na 20–40 lat) oraz olbrzymi potencjał gospodarczy siedmiu państw należących do zlewni tego morza spowodowały, że w ostatnich latach stwierdzono niemal wykładniczy wzrost stężenia związków biogennych i akumulujących się związków toksycznych oraz wyraźne zmiany ekosystemu: zanikanie gatunków, powstawanie tzw. „pustyń bentosowych" oraz postępującą eutrofizację.

Ratyfikowana w 1979 r. Konwencja postawiła sobie za cel ujednolicenie metod kontroli zrzutów zanieczyszczeń w ramach międzynarodowego programu monitoringu oraz, w pierwszym etapie, ujednolicenie metod usuwania wybranych grup zanieczyszczeń szczególnie niebezpiecznych dla tego obszaru.

Artykuł omawia także działalność legislacyjną oraz badawczo-wdrożeniową, a także strukturę najważniejszych organów Konwencji Helsińskiej.

UMWELTSCHUTZ DER OSTSEE

Die Konvention über Umweltschutz der Ostsee, signierte in 1974, ist die erste internationale Verständigung, die im so weiteren Bereich alle beeinflussende die Reinheit des Meereswassers Anfangsgründe umfasst.

Kleine Tiefe der Ostsee, kleine Austauschgeschwindigkeit des Wassers (völliger Austausch jede 20–40 Jahre) und riesiges Wirtschaftspotential sieben Lander im Abflussgebiet zur Ostseee bewirkt, dass in letzten Jahre fast expotentialen Konzentrationsaustieg von Nahrungsstoffe und akkumunierenden sich Giftstoffe sowie merklichen Umgestaltungen des Ökosystems, wie das Speziesschwinden, die Entstehung von Bodenwüste und fortschreitende Eutrophisation festgestellt wurde.

Das Hauptzweck von der in 1979 ratifizierende Konvention ist die Vereinheitlichung von Kontrollweisen des Schmutzabwurf im Bereich von Internationalen Monitoringprogramm und in dem ersten Absch-

nitt die Vereinheitlichung der Reinigungsverfahren der ausgewählten Schmutzgruppen — besonders gefährlichen für dieses Gebiet.

Der Aufsatz bespricht auch Legislativ- und Forschungstätigkeit sowie die Struktur von wichtigsten Organe der Konvention.

ОХРАНА ОТ ЗАГРЯЗНЕНИЯ ВОД БАЛТИЙСКОГО МОРЯ

Подписанная в 1974 г. Хельсинская конвенция об охране морской среды Балтийского моря является первым международным соглашением, охватывающим в так широком объёме все элементы, которые влияют на состояние чистоты морских вод.

Малая глубина Балтийского моря и небольшая скорость водообмена (полный обмен раз на 20-40 лет), а также огромный экономический потенциал семи государства, принадлежащих к бассейну этого моря, вызвали то, что в последние годы отмечено почти показательное возрастание концентрации биогенных соединений, аккумулирующихся токсичных соединений, а также заметные изменения экологической системы: отмирание видов, образование так называемых „бентосных пустынь", а также прогрессирующая эвтрофизация.

Ратифицированная в 1979 г. Конвенция поставила своей целью унифицировать методы контроля выбросов загрязнений в рамках международной программы мониторинга, а также, на первом этапе, унифицировать методы удаления избранных групп загрязнений, особенно опасных для этой зоны.

В статье обсуждается также законодательная и исследовательская деятельность по внедрению, а также структура важнейших органов Хельсинской конвенции.