Study of Conditions of Spatial Development of Polish Sea Areas

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of Spatial Development

# of Polish Sea Areas

GDYNIA, March 2016

NOTE TO ENGLISH VERSION

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INTRODUCTION

This *Study of Conditions of Spatial Development of Polish Sea Areas*[1] was ordered by the Directors of Maritime Offices in Szczecin, Słupsk and Gdynia, in the name of which acted the Director of the Maritime Office in Gdynia, and work on the first draft lasted from March until November 2014. The final version was finished in February 2015. In the document the physical-geographic, spatial, legal, economical, social and natural conditions are identified and analysed for the needs of preparing maritime spatial plan(s) for Polish sea areas. It is expected that such plans will be developed between 2015 and 2021. The Study is a compendium of best available knowledge needed to achieve this aim. Besides significant natural, oceanographic or geological features, also the present and planned ways of using the Polish sea areas are mapped. The Study is not binding for Polish planning authorities. It is not a legal document as e.g. the *studies of conditions and directions of spatial development* of municipalities are on land. It does not decide what solutions will be adopted in the Polish maritime spatial plans, or what plans for which sea areas will be developed. However, because of its content, it will be of significant practical importance for the work on these plans, e.g. in conflict and synergy analysis and during formulation of planning solutions.

The Study was discussed with interested parties. First, at the beginning of the process, a meeting was organised and discussion opened in June 2014, especially on the structure of the document and the scope of collected data. A second meeting was organised in November 2014, during the final phase of drafting, in order to present the collected material, verify its correctness (agreement with the real state) and verify methods of graphic presentation. Also, together with stakeholders, an introductory conflict and synergy analysis was carried out. The presented document is a resultant of the remarks collected from these debates (also of remarks sent in writing) and of the work of the expert team developing the Study. The team included experts from the Maritime Institute in Gdańsk, the Sea Fisheries Institute – National Research Institute, the Stanisław Leszczycki Institute of Geography and Spatial Organisation of the Polish Academy of Sciences, the Gdańsk University and the Regional Spatial Planning Offices of the West Pomeranian Voivodship in Szczecin and of the Pomeranian Voivodship in Słupsk.

Delimitation of the analysed area

The Study covers all Polish sea areas, as defined by the Act of 21st March 1991 *on sea areas of Poland and maritime administration* (unified text Official Gazette of 2013, it. 934 with later amendments), i.e. the Exclusive Economical Zone (EEZ), the territorial sea, the sea waters between the baseline of the territorial sea and the boundaries of land lots contacting with the sea, and the internal sea waters of the Gulf of Gdańsk mentioned in Article 4 point 2 of the above Act. The Study does not cover sea waters within the boundaries of ports and the Szczecin and Vistula Lagoons.

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[1] Translators' note: In proper English the term *marine areas* should be used. However, since the adoption of the EU Marine Strategy Framework Directive the word "marine" seems to have obtained a strongly environmental connotation. On the other hand "maritime" is basically related to human activities. It was therefore decided to use in the title the term *sea areas* to accentuate the neutrality of the document, and of managing the seas in general. It is also underlined that in this text the term "marine", whenever used, has no environmental or other sectoral connotation except that it generally relates to the sea.

The territorial sea of Poland is the 12 nautical mile (22 224 m) wide area of marine waters, measured from the baseline of the territorial sea (Article 5 paragraph 1 of the Act *on sea areas of Poland and maritime administration*). The baseline is defined as the line of the lowest measured sea level along the coast or the external border of internal sea waters. The territorial sea includes also roadsteads located fully or partly outside the 12 nm zone if loading, unloading or anchoring of vessels is carried out in them. Borders of such roadsteads are defined by the Ordinance of the Board of Ministers of 22nd February 1995 *on the determination of the border of the roadsteads of the seaports in Świnoujście and Szczecin* (Official Gazette of 1995 No. 20, it. 101). Like the territorial sea, internal sea waters belong to the territory of Poland (Article 2 paragraph 2 of the Act *on sea areas of Poland and maritime administration).* They are the waters between the land and the inner boundary (baseline) of the territorial sea. They are fully and exclusively subject to the governance of the coastal state, which includes also the air space above and the interior of bottom below them. The territorial sea and internal sea waters considered in this Study cover the area of 10 029 km^2 (territorial sea – 8813 km^2 and internal sea waters, i.e. the Gulf of Gdańsk – 1216 km^2).

The Polish EEZ was established on the basis of the Act *on sea areas of Poland and maritime administration*, and covers the area of about 22 570 km^2, in that an about 3500 km^2 zone, which is disputed with Denmark. The EEZ is located outside the territorial sea and includes the waters, bottom and interior of bottom below. The external boundaries of the EEZ are determined by international agreements. The EEZ is not a part of the territory of Poland, however Polish law is applicable to a number of issues (e.g. environmental, mining, location and construction of investments, planning, etc.).

Aims and scope of the Study

The aim of the Study is to collect and analyse information for the needs of preparing maritime spatial plan(s) for Polish sea areas. This includes information on the state of the marine ecosystem, i.e.:

- oceanographic (physical and chemical parameters, water depth, currents, waves, wind, magnitude of storms, water level, etc.),
- nature (boundaries of areas protected by law, presence of habitats and valuable species of fauna and flora, photic zones, spawning and feeding areas of commercially important fish, pressures),
- hydromorphological (coastal dynamics),
- geological, including types of sediments, mineral resources, etc.

The Study presents also existing ways of using the sea areas, such as:

- shipping routes, roadsteads, anchorages, fairways, traffic separation schemes,
- cables and pipelines,
- areas of exploration and of extraction (also potential) of mineral resources
- areas of cultural heritage – wrecks (including wrecks – war cemeteries), underwater remains of settlements, etc.,
- dumping sites (for dredged spoil)
- military areas,
- fishing activity areas and areas important for maintenance and conservation of fish species,
- areas used for sports, tourism and recreation,

- ports and havens.

In order to ensure cohesion between spatial development in the coastal land and in the marine areas, the Study contains analyses of land areas adjacent to the analysed sea areas:

- information connected with the dynamics of the coastline,
- physical and geographic information about the coastal zone,
- demographic , social and economic information about the coastal zone,
- information about the state of spatial development of the coastal belt and coastal hinterland[2],
- other information resulting from analysis of existing spatial plans, studies, programmes of development and plans of the coastal voivodships and municipalities.

Information on the planned and potential ways of using marine areas (among others renewable energy, mining, mariculture, etc.) was collected from:

- the record of applications for permits to construct and use artificial islands, structures and installations in the Polish sea areas submitted to the Minister competent for maritime economy,
- records of applications for permits for laying and maintaining underwater cables and pipelines submitted to the Directors of Maritime Offices,
- proposals to the maritime spatial development plan for the Polish sea areas,
- solutions of local statutory spatial development plans, studies, programmes and development plans of coastal voivodships and municipalities.

The Study contains also:

- a list and analysis of international and national legislation and strategic documents influencing the spatial aspects of sea use,
- a list and analysis of results of international projects most important for maritime spatial planning in the Baltic Sea area,
- a list of available literature forming the information source (the basis) for developing the Study.

Work on the Study was supported by spatial analyses using modelling of, among others, potential accessibility of Polish coast and selected ports, routes and intensity of sea traffic by vessel type, power production potential of Polish sea areas, applicability of sea areas for offshore wind farms, oil spill risk, preliminary assessment of losses incurred by fishery due to development of offshore wind farms.

Acknowledgements

Thanks are due to all the Authors for their engagement and input into this first stage of the process of spatial planning of Polish sea areas, and to all those, whose remarks and help allowed developing this Study.

[2] Delimitation of both areas is presented in Chapter 4. The coastal belt is defined in the Act *on sea areas of Poland and maritime administration*.

EXECUTIVE SUMMARY

The Study of Conditions of Spatial Development of Polish Sea Areas was ordered by the Directors of Maritime Offices in Szczecin, Słupsk and Gdynia, with the Director of the Maritime Office in Gdynia acting in their name, and was developed in the period March – February 2015. Territorial competences of the Directors and the boundaries of Polish sea areas are shown in Fig. S.1. The Study is a document which identifies and analyses spatial, legal, economical, social and natural conditions for the needs of developing maritime spatial development plan(s) for Polish sea areas. The Study is not a legally binding document, and it is not even required by law, as is the case with e.g. the *studies of conditions and directions of spatial development* of municipalities on land. It is a compendium of best available knowledge needed for the planning work. The Study is a resultant effect of remarks and information obtained during three debates with stakeholders (and also sent in writing to the drafting team) and the results of work of experts from the Maritime Institute in Gdańsk, the Sea Fisheries Institute – National Research Institute, the Stanisław Leszczycki Institute of Geography and Spatial Organisation of the Polish Academy of Sciences, the Gdańsk University and the Regional Spatial Planning Offices: of the West Pomeranian Voivodship in Szczecin and of the Pomeranian Voivodship in Słupsk.

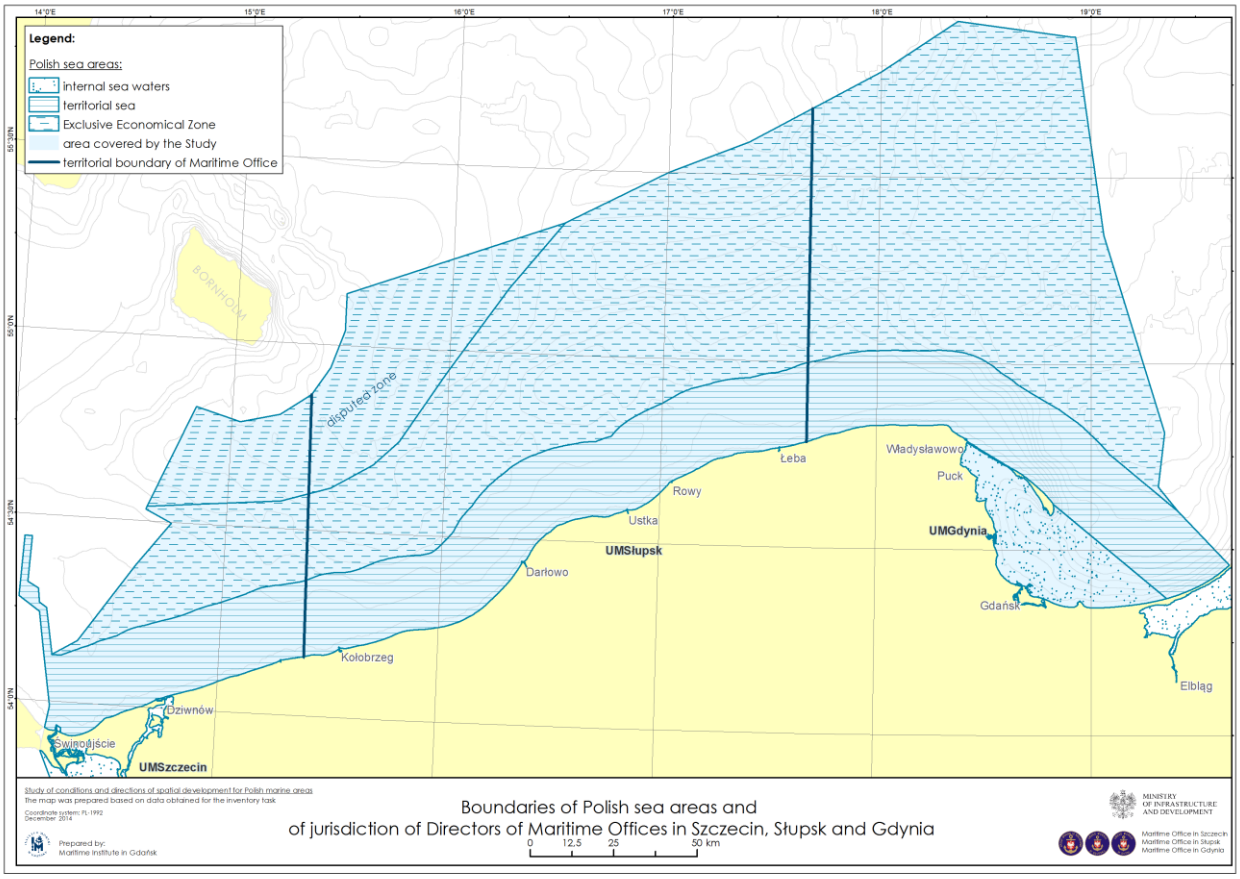


Fig. S.1 Boundaries of Polish sea areas and of jurisdiction of Directors of Maritime Offices in Szczecin, Słupsk and Gdynia.

Source: Maritime Institute in Gdańsk.

The Study covers Polish sea areas as defined by the Act of March 21st 1991 *on sea areas of Poland and maritime administration* (unified text JoL of 2013, it.934 with later amendments), i.e. the Exclusive Economical Zone, territorial sea, and sea waters between the baseline of the territorial sea and the boundary of terrestrial lots adjacent to sea waters. The Study covers also a part of the Polish internal sea waters, namely the Gulf of Gdańsk. The remaining parts of these waters, notably the Vistula Lagoon and Szczecin Lagoon are not included in the Study. This summary indicates main conclusions resulting from the Study, which should be taken into account in the spatial planning process.

1. Legal basis and experience from international cooperation

There is no legal obstacle to developing maritime spatial development plan(s) for Polish sea areas. The key legal act is the earlier mentioned Act *on sea areas of Poland and maritime administration*. The Directive 2014/89/EU of the European Parliament and Council establishing a framework for maritime spatial planning, adopted on July 23rd 2014, is an important reference document. However, there are some legal deficiencies concerning the sea borders of Poland, limitations caused by the fact that the baseline of the territorial sea is yet to be formally established and, with the exception of EIA, no formally established procedures for transborder consultation exist. These deficiencies will have to be dealt with within the planning process.

Important indications for maritime spatial plan development come from the national policies and strategies. Firstly, the determinations of the Maritime Policy of Poland until 2020 (with a 2030 perspective) have to be taken into account. This policy points to the primary importance of shipping, port development, and safety and protection of navigation. Other national strategic documents, i.e. the National Spatial Development Concept, the Long Term National Development Strategy, Medium Term National Development Strategy, and the nine integrated strategies, especially concerning transport, energy safety and national safety also must be taken into account. An important set of indications comes from the recommendations and good practices developed by international Baltic Sea Region projects and within the Baltic cooperation network, such as the Maritime Spatial Planning Principles developed by the HELCOM-VASAB Work Group on Maritime Spatial Planning in the Baltic Sea Region, the “Vision 2030” [*BaltSeaPlan Vision 2030*] developed by the BaltSeaPlan project, and the handbook on multilevel consultation in MSP developed by the PartiSEApate project. Use should also be made of guidelines which are presently being developed by the HELCOM-VASAB MSP WG (on implementation of the ecosystem approach and on transboundary consultations and co-operation and public participation in MSP).

2. Oceanographic conditions

The Baltic Sea is a very vulnerable ecosystem. Determinations of the maritime spatial plan(s) should not disturb and/or worsen the existing hydrological conditions, while at the same time making good use of them. The maritime spatial plan(s) of Polish sea areas should be based on reliable hydro-meteorological knowledge and should take proper account of potential climate change and its effects on the location and types of human activity in the sea space. But there are some limitations. Because of the lack of source data covering all the Polish sea areas, most analyses of oceanographic, physical-chemical, etc. conditions are based on modelling. Information available from the National Environmental

Monitoring is obtained at strictly defined monitoring stations, considered to represent summarily the whole area – however, they are still point data, especially since the stations are located far apart. There is a lack of information with required resolution. Procurement of spatially continuous oceanographic data is a costly process. The use (at national level) for planning of sea areas of information/data from preinvestment investigations carried out by the mining and energy sectors should be considered. It is also suggested that a modification of the distribution of monitoring stations should be discussed, with a view to the needs of maritime spatial planning in Polish sea areas.

Wind and waves are environmental factors, which in near or later future may represent significant resources of renewable energy. Polish sea areas are characterised by good wind resources with uniform spatial distribution of energy, tending to grow with distance from the coast. Wave and current energy resources are smaller, and their spatial distribution suggests a dependence on water depth. Of the two, wave energy shows higher potential, and its distribution shows relationship with wind field variability, water depth distribution and sea bottom relief. Energy resources from currents are much lower – at present they should not be seen as a prospective resource. It should be pointed out that installations producing power from waves and currents can be significant obstacles to other ways of using the sea, especially navigation and fishing in coastal waters. Additionally, capacity for power production from these two sources per sea surface unit is significantly lower than for wind. This could be a justification for not taking wave and current power production into account in the future maritime spatial plan, or for giving it only marginal attention.

There are documented resources of sand and gravel, hydrocarbons (still being documented) and probably (not yet documented) shale gas and oil. The maritime spatial plan(s) should protect the investigated and documented as well as prospective mineral and hydrocarbon resources. At the same time, because of the significant knowledge gaps, efforts should be made to obtain full knowledge about the geological resources of Polish sea areas.

The maritime spatial plan(s) should facilitate, and where possible ensure, the protection and cohesion of key habitats in the Polish sea areas. This is quite difficult because of the existing knowledge gaps. From the point of view of managing sea space, filling up the gaps in information about the quantitative and qualitative structure and distribution of sea bottom habitats is of key importance. The modified EUNIS system for classifying natural habitats in the Baltic Sea proved itself in the Polish sea areas for immobile hard substrata. This system should be used in other parts of the Baltic Sea, with more data being taken, aiming at development of accurate habitat distribution maps to facilitate rational habitat protection. This means also that continuous monitoring and special research would have to be carried out.

3. Natural conditions

In Polish sea areas there are basins of significant importance for the good state of sea mammals, ichthyofauna, avifauna, macrophytes and macrozoobenthos. Most valuable regions coincide with areas protected by the Act of April 16th 2004 *on nature protection* (unified text Official Gazette of 2013 it. 627, with later amendments), and these areas must be protected by the maritime spatial plan(s) of Polish sea areas. Additionally, the plan(s) should also take into due account the importance for nature conservation/protection of the Słupsk Trough (area valuable for macrozoobenthos) and eastern near-border waters (important bird wintering area). Activities which could result in deterioration of the ecological state of these waters should be prevented. It should also be beared in mind that in the territorial dimension of nature protection, the time factor is equally important as space.

The Polish maritime spatial plan(s) should also designate sea areas for nursing activities, as well as areas for aquaculture for aims of marine environment protection. Attention should be paid to the maintenance of regulation processes (e.g. denitrification) since they are important ecosystem services provided by the marine environment.

4. Conditions resulting from the development of coastal land areas

Geographical analyses showed that the land bordering the Polish sea areas has significant natural, recreational and touristic values, which should be taken into account in the Polish maritime spatial plan(s). The Pomeranian rivers are important ecological corridors, and these corridors should be kept open also from the sea side. Attention should be given to biocentres and buffer zones and other areas of highest natural value in order to minimise negative impacts from the sea. Landscape and climate conditions confirm the importance of tourism and recreation to the development of coastal communities. This means that appropriate sea areas should be provided for these activities in the Polish maritime spatial plan(s). Good soil for agriculture occurs only in some places along the coast. In the neighbourhood of areas where agriculture is developing, attention should be given to the need for space for aquaculture facilitating protection of marine environment (e.g. the outlets of Vistula and Odra). Where agriculture cannot become a leading function, the maritime spatial plan(s) should be used/seen as a chance to develop alternative ways of living.

Demographic analyses show an increasing demographic potential of coastal land areas, and concentration in the vicinity of Szczecin and the Tri-City (Gdańsk, Gdynia, Sopot). The maritime spatial plan(s) should take proper account of further development around these agglomerations of various functions related to making good use of benefits offered by the sea. Sea space in their vicinity should be managed sparingly and with special care, ensuring at the same time possibilities of development for regional drivers, i.e. ports and recreation. Due to the aging of Tri-City's population, demand for marine ecosystem sevices will grow, mainly related to recreation and rehabilitation. Ecologically valuable areas near the metropolis (1-2 hour driving distance) will come under increasing anthropogenic pressure (recreation and sub-urbanisation). It will be necessary to balance this pressure and the need to protect the environment. In the maritime spatial plan(s) attention should be given e.g. to the protection of reed fields and local river outlets.

The demographic potential along the central part of the Polish coastline is concentrated in the urban municipalities. This means that there is a chance of development of small ports located along that coastline, provided that proper use is made of the direct hinterland of these ports and that economical development of these municipalities and their neighbourhood is intensified.

Economical analyses show that the two earlier mentioned metropolitan areas are the drivers of economical development of the region. Quick development may be also expected in touristic municipalities (e.g. Krynica, Rewal, Ustronie Morskie, Mielno, Międzyzdroje, Dziwnów, Sopot and Sztutowo) driven by coastal tourism. For this aim a „bathing" marine space should be reserved, attention should also be given to the possibility of degradation of the marine environment (need to protect its most valuable elements). Maritime spatial plan(s) should locate human activities in the sea area in such a way that development of tourism in coastal municipalities is not excessively restricted, but at the same time that development of coastal tourism is harmonised with nature protection. In the remaining areas (with predominant touristic monoculture, suffering from the downfall of fishery, depopulation and low level of entrepreneurship) it is suggested to use the maritime plan(s) for generating conditions for locating in these areas new forms of benefiting from the sea, especially forms which would ensure year-round employment. However, spatial planning alone cannot fulfil this requirement, it can only develop initial spatial conditions.

Analyses of spatial development at regional and local level indicate that in the 2030 perspective the maritime spatial plan(s) of Polish sea areas should consider the possibility of providing sea space for:

- the development of potential of maritime economy based on functions of the port network,
- touristic use of natural and cultural resources of the coast,
- use of marine resources for industrial and power generation needs,
- sustainable development of coastal (bathing areas) and sea (eg. yachting, windsurfing, kitesurfing) tourism, and also
- allowing to maintain fishery as an important function of coastal settlements,
- providing conditions for safe migration of bi-environmental fish and maintenance of cohesion of the ecological system and of its links with the European system, as well as durability and resilience of regionally and supra-regionally valuable areas of protected nature,
- taking into account sources of significant accidents especially in the Tri-City region and the presence of national safety infrastructure in the coastal region.

These analyses have an important weakness related to the lack of knowledge about the reality (or rather the time horizon) of the planned developments (this gap is partly filled by analyses of operational programmes, territorial contracts and of programs connected with the realisation of various policies, port development programs, etc.).

Analyses of port accessibility show that, in the 2030 perspective, the maritime spatial plan(s) should:

- provide for sea space for a ferry terminal (maybe even two) in the central part of the Polish coast and space for improvement of its (their) national accessibility from land after building roads S10 and S11, and at least maintain the already high potential global accessibility,
- provide for further intensification and development of ports in Świnoujście and the Tri-City because their accessibility to the rest of Poland has been improved, and in case of Świnoujście additionally because the local labour market has grown,
- provide for a quick development of tourism (especially weekend tourism) in the central part of the Polish coast (except the northern part of the Pomeranian Voivodship) in function of distance from both metropolitan areas.

5. Conditions resulting from pressure on the coastal zone

Analyses of coastal erosion indicate that the predicted increase of length of eroded coastline and rate of erosion, and decrease of resistance to sea level change (even in the optimistic variant) should be duly taken into consideration in the maritime spatial plan(s). Consequences of coastal erosion along cliff coasts (gradual retreat of waterline, cliff top and foot) also require attention. The process will intensify with the predicted sea level rise. This in turn means that mainly these elements of the coastal system and of coastal and hinterland infrastructure should be preserved, which are given protection priority in the light of summary classification of the coastal zone and its hinterland. It is therefore important that the future maritime spatial plan(s) should realise tasks of the *Program of coastal protection* for the years 2004-2028. The spatial plan(s) should not impose limitations on works protecting against erosion, flooding and landslides along stretches of coast indicated in the *Program*. At the same time special attention should be given to pressures of spatial development of sea areas which act on the coast and its hinterland. The maritime spatial plan(s) should also protect documented and prospective resources of sand for artificial nourishment. In areas with such resources priority should be given to mining (for the needs of coastal protection), while dumping, laying cables and pipelines and locating any other permanent structures/objects, which make sand mining impossible, should be prohibited. Since the number of prospective sand mining areas is rather limited, use of spoil from maintenance dredging of port approaches for artificial nourishment should be considered (provided the spoil fulfils sand quality criterions).

6. Use of sea areas for fishery

Analyses of fishery indicate that four issues should be given special attention in the maritime spatial plan(s). Firstly, in the process of defining areas specially important for procreation of economically important species of fish with pelagic eggs, such as cod and sprat, the significant temporal and spatial variability of both their spawning and its effects should be taken into account. Secondly, in case of most of fish species with pelagic eggs, there is no method for precise delimitation of the area of their spawning (viz. the case of sprat). In this situation, effective procreation is possible only by ensuring that the areas, in which activities with negative influence on recruiting of the given species, constitute only an insignificant percentage of the procreation area. Thirdly, effective spawning of cod of the eastern stock occurs in the Bornholm Deep and in the Słupsk Trough, approximately in the water area limited by the 60 m depth contour. However, even in this case marked spatial and temporal variation of the distribution of roe and larvae is observed. Fourthly, migration routes to/from rivers should be protected. Analysis of spatial conditions of fishery is hindered by lack of long-term (multiannual) data and information series. This suggests that an in-depth analysis of location and conditions promoting effective spawning should be carried out in order to ensure the required space, and, if possible in the light of the variability of environmental conditions, to determine the conditions for correcting this delimitation. Long term BITS and BIAS data could be used for updating maps of occurrence of selected species. They contain important information about sea areas, which should be taken into account in planning measuring stations and exploratory fishing in Polish sea areas for the needs of monitoring and research. In recent years, fish migration through river mouths is subject to very dynamic changes. Assessment should be based on most recent and reliable data. Such data, if they at all exist for a given river, are available at the Institute of Inland Fishery. This information should be collected on a systematic basis.

The maritime spatial plan(s) of Polish sea areas should protect access routes of fishing vessels to hunting grounds and the hunting grounds themselves. Determination of the routes of fishing vessels is very important from the point of view of economics of the fishing industry. As a rule they are the shortest, i.e. most profitable ones. It is suggested to carry out an analysis of VMS data from at least 3 years preceding plan preparation. Similarly, the fishing effort and the catch amount should be analysed in a 0.05° grid, taking into account fish species and fishing tools. It should be remembered that VMS analysis concerns only vessels over 12m long; therefore it does not cover coastal fishing.

Coastal fishing operates mainly on traditional, confirmed by experience, and strictly defined in time and space fishing grounds. For example fishing with gill nets requires reserving areas within ca. 6 NM from the coast. It is important to determine the location of coastal fishermens' hunting grounds with higher accuracy than the scale of statistical fishing squares. This can be achieved by recording the fishing effort from independent research vessels and/or interviewing fishermen. In the opinion of fishermen the area with coordinates

- 55° 05,00' N 16° 10,00' E
- 54° 57,50' N 15° 58,00' E
- 54° 50,00' N 15° 30,00' E
- 55° 20,00' N 15° 30,00' E
- 55° 20,00' N 16° 10,00' E

is valuable for fishery, and within it priority should be given to fishery. In the end of January 2015 an amendment of the Act *on fishery* was passed, and this may require revising some of the above conclusions.

Very little information exists on recreational fishing, which is becoming an important factor, generating significant income in the coastal region. Because of its high dynamics and interest of the public in this form of recreation, it is recommended to carry out an analysis of recreational fishing, covering also the years 2013 and 2014.

Analyses dealing with small ports and havens show that in most of the local ports and havens fishery is the only economic activity carried out throughout the whole year. Concentration of fishing services in ports (fish handling centres) allows also for development of other functions, especially tourism-related, and at the same generates development of port infrastructure. In many cases the existence of a port is determined by services offered to fishery. Though there is a lack of information on the influence of fishery on local economical development, the need to ensure access of fishermen to relatively large sea areas to allow use of a variety of fishing techniques and tracking of the fish shoals, as well as free access to places of unloading the catch, seems indisputable. The area of operation of the fishing vessels does not have to be the same as the place of registration, especially in case of vessels longer than 15 m, which may use several ports during one year.

7. Conditions resulting from the development of navigation and ports

Most of the Polish sea areas are used for navigation. Only small parts of these areas remain free of intense navigation. There is a need to organise this better, in agreement with the principle of sparing use of sea space. The maritime spatial plan(s) of Polish sea areas should aim at fitting the system of navigation routes (obligatory, recommended and customary) to the future navigation situation, i.e. assume the appearance of new users of the sea space, and take care of the needs of safe navigation and the need to ensure free space for other traditional users of sea space, e.g. fishermen. It would be advisable to plan for future work aiming at extending and modification of traffic separation schemes and modification of acknowledged deep water routes.

Different vessels need different spatial configurations, and determining universal navigation routes is not possible. In the Polish maritime spatial plan(s) attention should be given to navigation routes connecting base points of the TEN-T system, as these connections should aspire to the status of “motorways of the sea”. Sea going yachts and other small touristic vessels will sail mostly in the coastal waters. Appearance of artificial islands will influence the spatial picture of navigation. Gdańsk and Władysławowo may become important places, starting points of voyages related to innovative uses of the sea (off-shore development), and this may result in appearance of new customary navigation routes. The maritime spatial plan should aim at minimising limitations put on navigation by locating permanent structures in sea areas.

Analysis of the spatial distribution of risk of contamination by oil spills shows that the most endangered stretches of coast are between Darłowo and Hel and between Gdynia and the border with Russia. This is caused by the direct nearness of navigation routes. Maximum risk of contamination is near the Hel Peninsula and in the Gulf of Gdańsk, forming a danger to touristic activities on the Hel Peninsula and along the coast between Gdynia and the Russian border, and endangering the Natura 2000 sites located in the Gulf. When preparing Polish maritime spatial plan(s), a careful analysis should be carried out to determine which elements of navigation routes generate highest risk of contamination by oil spills, and possibilities of reducing that risk in nature protection areas and in areas with intense coastal tourism activities should be considered. The plan could introduce additional solutions for navigation near the Hel Peninsula and Rozewie in order to reduce the above mentioned risk.

Analyses dealing with ports of basic importance to national economy indicate that development of this sector will be directed at development of existing ports. No new ports are planned. The number of connections and size of served ships will grow, while reducing the ships’ stay in port time. It results that the maritime spatial plan(s) should reserve space for seaward development of these ports. The plan(s) should also provide for anchorages, fairways and approach routes allowing servicing by the ports the largest vessels that can enter the Baltic Sea. Attention should also be given to safety of navigation in conditions of growing intensity of traffic on the approach routes and growth of vessel size.

Analyses dealing with local ports indicate that their importance will grow with the growth of wealth of population and with integration of the ports into the local economical system. Local ports intend to correct their boundaries. However, on the basis of their strategic documents, it is not clear whether these intentions concern the sea space. Nevertheless, a spatial reserve should be made to provide for the appearance of new functions, such as new marinas (especially on the coast between Łeba and Władysławowo) or increase of cargo throughput. Ports located nearest to wind farms could become base ports for a variety of services connected with the construction and operation of offshore wind farms. These functions could be realised first of all by the ports in Kołobrzeg, Darłowo, Ustka and Władysławowo. A high quality professional base for servicing sea tourism, yachting and other water sports will develop both through utilisation of the existing hydrotechnic structures in ports and by new developments which should be connected with an activation of accompanying services in the hinterland of the ports (technical services, repairs, wintering of yachts, renting of equipment, training). In accordance with the Act of December 20 1996 *on seaports and havens*, the maritime spatial plan(s) should ensure that each local port has a possibility of maintaining a safe approach to the port from the sea and of necessary elements (roadsteads, anchorages, turning basins). The plan(s) should also ensure good access from the sea to both the Szczecin and Vistula lagoons and to the local ports of these two water areas. Therefore the maritime spatial plan(s) should take into account the possibility of building a channel between the Gulf of Gdańsk and the Vistula Lagoon, if such a decision would be taken.

8. Conditions resulting from immobile forms of utilizing sea areas

Having in mind presently nonexistent or insufficiently diagnosed ways of using the sea space, e.g. biotechnology, the principles of coexistence and space-sparing planning should be used, so that sufficient space is left for such activities. In case of forms of sea area use which take up space permanently, the maritime spatial plan(s) should propose decision making procedures involving the sequencing (time factor) and principles of occupying these areas.

Optimum locations for development of marine wind power production can be indicated basing on analysis of natural conditions (spatial distribution of wind parameters and water depths). In spite of the common opinion that building offshore wind farms (OWFs) close to the coast is most profitable, this analysis allows to conclude that areas to the north of the boundary of the territorial sea are predestined for this form of sea use. This is reflected by the already issued permissions. The maritime spatial plan(s) should ensure space for connecting the OWFs to the national power grid and to the possible Baltic Grid. The plans should also take into account the need for a higher degree of coexistence of OWFs with other users of sea space (some types of fishery, mariculture, also sea tourism). The maritime spatial plan(s) should designate space for navigation routes between the wind farms allowing access to fishing grounds in the Słupsk Trough area. The needs of cultural heritage protection should also be taken into account in the areas designated for wind farms (and also in other areas). The plan(s) should consider issues of safety of navigation (e.g. by correcting and improved organisation of navigation routes in the vicinity of OWFs) and take into consideration the needs of OWF dismantling after decommissioning, taking also into account that they may become valuable habitats. The plan(s) should also take into account the requirement for sea space of potential heat power plants[3] (location of cooling water intake and discharge pipelines and of safety buffer zones) and potential permanent closing of these zones to some economical sectors, e.g. tourism, yachting, offshore mining and passive fishery. It should be also taken into consideration that location of a nuclear power plant in the coastal zone might result in building of a local port servicing that investment during the plant construction as well as operation stages. All this should be done while having in mind the high degree of uncertainty caused by the lack of key decisions on the location of a nuclear power plant in Poland and on offshore wind energy, lack of decisions on connecting offshore wind farms to the national power grid, lack of decisions on the layout of the Baltic Grid (the concept is in initial stages of development), lack of detailed information about the complex impact of OWFs on the ecosystem and ecosystem services of the Baltic Sea, and lack of knowledge of the cost of coexistence of OWFs and other forms of sea use.

Analyses of marine mining indicate that the maritime spatial plan(s) of Polish sea areas should take due account of issued licenses for extraction, prospecting and investigation of aggregates and hydrocarbons. The plan(s) should indicate in the graphic and textual parts the examined resources of hydrocarbons, metal ores and aggregates and protect them for future exploitation. The plan should also designate multifunctional (multimodal) infrastructural corridors to organise in an orderly way the routes of pipelines as well as potential cables from nearby wind farms. This organising should apply not only to national installations, but also installations which do not enter the Polish territorial sea. For these last the corridors would be only an option of development.

[3] mainly of the planned nuclear power plant

With view to potential extraction of minerals from areas on which prospecting is presently carried out, the plan(s) should allow in these areas laying and maintenance of pipelines. The plan(s) should also allow for the possibility of exploratory investigations.

The construction of the dispositions of the Polish maritime spatial plan(s) should take into account that as a rule a long time passes between obtaining a license for exploration of hydrocarbon resources and the moment of starting extraction, and consider the possibility of allowing in these areas non-conflicting functions until the time when extraction begins, and also after the extraction ends (before start of extraction these will be functions which will not conflict with the rights of the licensees, e.g. rights for exploration and investigation). The same concerns wind farms. The plan(s) should take into account the influence of mining operations on changes in intensity of sea traffic (new navigation routes).

Analyses of linear infrastructure suggest its quick development. There is a need to arrange them in a possibly orderly way in accordance with the principle of sparing use of sea space. The maritime spatial plan(s) should take into account the existing linear infrastructure and investments for which decisions have been already issued. However, there is a difficulty for the planners: lack of knowledge about planned cables and pipelines, especially linear infrastructure connected with exploration and extraction of hydrocarbons (information comes only from issued decisions). From the point of view of the expected development of an international power grid, it is important to determine in the plan(s) the points of entrance of this grid into Polish sea areas. The concepts of the Baltic power grid should be taken into account. Because of the need to ensure sea-land harmonisation, it is necessary to indicate the landing points of this infrastructure in accordance with the requirements of the power networks, environment protection, coastal protection and safety of coastal population. The width of buffer zones and the set of limitations on the use of these areas must be defined. In connection with the potential development of offshore mining and wind farms, it is advised to consider the establishment of multifunctional (multimodal) corridors for linear infrastructure.

Analyses dealing with national defence and safety indicate that in the maritime spatial plan(s) of Polish sea areas all unclassified information should be properly taken into account, among others about the existing military infrastructure and its elements (especially locations of marine military training areas, anchorages and fairways of the Navy) and about the defence needs connected with classified information (this will be ensured through consultation of the draft plan(s) by the Ministry of Defence).

Analyses dealing with underwater cultural heritage show that identification of its resources in Polish sea areas is incomplete. In the investigated areas, protective zones should be established around objects of underwater historical heritage. Among others, the location of submerged settlements and landscapes and wrecks (of archaeological value and war cemeteries) should be taken into account. In incompletely investigated areas general regulations protecting underwater historical heritage should be established. For example, in descriptions of the ways of use of areas designated for installations, structures and linear infrastructure, it should be required that all maritime investments disturbing the structure of the bottom should be preceded by an inventory of the bottom with view to the presence of objects of cultural heritage. Areas for archaeological repositories should be designated in the plan(s). In such areas objects of underwater historical heritage could be stored without risking their destroying by atmospheric influences or waves, while ensuring protection against penetration of third persons and allowing access (under proper control) to selected objects.

Analysis of tourism in sea areas indicates that in the maritime spatial plan(s) of Polish sea areas provisions should be made for further development of qualified sea tourism, and the plan(s) should indicate sea areas best predestined for these activities. The plan(s) could also designate space for archaeological park(s) in areas of more intense development of wreck tourism (diving). Provisions should be made for drawing up detailed spatial plans for areas with high intensity of conflicts caused by qualified sea tourism (analyses of the Study suggest that these could be, among others, the Vistula Lagoon, Szczecin Lagoon and the Gulf of Gdańsk).

Analyses dealing with chemical weapon dump sites prove that there is a lack of full knowledge about areas in which they occur. The maritime spatial plan(s) of Polish sea areas must take due account of the existing risks, and designate closed areas, or areas of limited use, even with a certain surplus. All investigations carried out for the needs of investments in Polish sea areas should also include searching of the site of future investment for potential elements of dumped ammunition.

Analyses dealing with mariculture indicate that climate conditions limit possibilities of this type of activity in Polish sea areas. They are decidedly unfavourable for most known techniques of farming used in the world (at least for commercial objectives). Better chances may be for the development of mariculture for needs of environment protection.

Analyses of closed sea areas indicate that the maritime spatial plan(s) should take into account information about such areas, show them in the drawing of the plan and explain the nature of the limitations in the textual part. In case of temporal limitations, possibilities of alternative use of these sea areas during the time when the limitations do not apply should be considered.

9. Conflicts and synergies

A synthetic assessment of the relationships between the various forms of spatial development of sea areas is very difficult. The main reason is the complexity of the social-economic-oceanologic category built up by the forms of use of sea space and the relationships between them. For example, offshore wind farms are connected with the natural environment both by synergic ties (artificial reef) and pressures (e.g. infrasound which can have a negative effect on sea mammals). Because of that in analyses of the natural component (the most complex form of use of sea space), rather than conflicts, risks and impacts are discussed. Secondly, the character of the relationships results also from the intensity of the various forms of sea space use, technical solutions and the degree to which interested parties are open to the needs of the other users of the sea area. Thirdly, relationships between the forms of sea space use are of a hypothetic and/or real character. Some of the conflicts and synergies are rather potential, and do not appear in practice. However, the lack of real conflicts is often the result of good administrative decisions. Paradoxically, lack of a real conflict may be due to the existence of a strong hypothetical conflict, which lead to a common sense, or forced by law, mutual exclusion (e.g. fishing is excluded in port areas or roadsteads). Fourthly, relations between synergies and conflict are often asymmetrical. For example, diving is in conflict with fishery, but it is no problem for the fishermen.

9.1. The stakeholders' view of conflicts

Debates with stakeholders indicated that offshore power production, fishery and linear infrastructure generate numerous conflicts. In the opinion of stakeholders strong conflicts are generated both by nuclear and wind power production. Installations for cooling water intake and discharge of power plants may result, in a certain sea area around the ends of pipelines, in potential limitations (or closure) to touristic uses, fishery and navigation. According to the stakeholders, conflicts with offshore wind farms may occur in relations with underwater historical heritage, aggregate mining, fishery, navigation and linear infrastructure. Representatives of fishermen expressed their fears connected with the development of offshore wind farms. They pointed to resulting difficulties of access to fishing grounds and to areas of trawling in the coastal waters divided by potential cables (especially in case of the 4 NM wide belt between Ustka and Władysławowo, which is a traditional trawling area). Less controversy was found between OWFs and recreational fishing. Areas used for sea angling tourism are located 12-16 NM from the coast, east of the Słupsk Bank. Here the conflict with OWFs could be solved assuming that navigation (manoeuvring) could be allowed between the pylons – buffer zones are required. Generally however, fishermen postulated that a better knowledge of the impact of OWFs on marine environment, fish, their life cycles, migration routes, behaviour of marine organisms should be obtained before starting preparation of maritime spatial plans, and only after that decisions on location of the wind farms should be taken. In the opinion of fishermen, new ways of using the sea may prevent them making full use of the granted to Poland fishing quotas.

The debate revealed conflicts of fishery with nature conservation (seals feeding on introduced smolts and preventing reproduction of salmon, protected birds damaging fishing nets and eating fish out of them, etc.). Also earlier known problems at contact with cultural heritage (nets damage wrecks), linear infrastructure (drag nets hooking onto cables and pipelines), dumping dredged spoil (areas inaccessible to fishermen) and dumped ammunition (damaging of fishing gear, risk to fish and fishermen), as well as at contact with water sports and bathing areas – in case of these last only passive fishing[4]. Different types of fishery compete also between each other for fishing grounds.

Besides fishery, power production and offshore mining, in the opinion of the participants in the debate strong conflict is generated by linear infrastructure, especially pipelines. However, the discussion was dominated by one case – the gas pipeline connecting Gdańsk with subterranean caverns in the Kosakowo municipality.

9.2. Spatial strengthening of conflicts – experts' approach

The picture of conflicts and synergies appearing from experts' assessment is far more complex. This means that stakeholders not always are aware of the complexity of various relationships. During preparation of this Study the approach of stakeholders representing navigation, environment protection, tourism and coastal protection was rather passive. This means that in the plan(s) preparation stage work with them will have to be intensified. When working with the stakeholders, sufficient time should be given to identification of their future plans on the use of sea space (it is advised to use a multi-variant and scenario approach) in order to arrive at a fair and dependable identification of real and potential conflicts and synergies.

[4] Passive fishing gear is the oldest type of fishing tools, and is used mainly in case of small scale, so called artisanal, fishery. These are various types of traps (made of nets or other materials) with or without bait, drift nets, anchored hooks etc. This type of tools is placed on the bottom or anchored to it, but there are also mobile tools (e.g. drift nets) which catch fish due to the difference between the slow motion of the tool in the water column and the movement of the fish.

The maritime spatial plan(s) of Polish sea areas should indicate areas with exceptional intensity of conflicts and synergies and require for them preparation of detailed spatial plans. Spatial analysis of the discussed above conflicts and synergies – the superposition of various forms of sea space use and the knowledge resulting from the conflict and synergy matrix – indicates that at least the following areas qualify for detailed spatial planning:

- The sea basin of the Gulf of Gdańsk – conflicts between protection of environment, coastal tourism (mainly water sports), ports, linear infrastructure (mainly gas pipelines), coastal protection, fishery, national defence,
- The sea basin of the Pomeranian Bay – conflicts between protection of environment, coastal tourism (mainly yachting), national defence, pipelines (planned gas pipeline), navigation, ports and, to some extent, fishery,
- The coastal sea basin between Władysławowo and Darłowo – conflicts between fishery and linear infrastructure (mainly between trawling and cables connecting OWFs with the national power grid on land), protection of environment (closed area of the Słowiński National Park), national defence, navigation, water sports, potential location of nuclear power plant(s),
- Sea basins designated for OWFs – internal cable networks within each wind farm, external connections to main offshore and land power grids, need to ensure navigation routes for fishermen, need to indicate temporary, final and alternative functions in case investors desist from building OWFs, potential development of extraction of hydrocarbons and resulting development of linear infrastructure.

1. LEGAL AND INSTITUTIONAL CONDITIONS

1.1. Legal status

Based on report "Analysis of Legal Acts (legal status as of 6.10.2014), Dr. Tomasz Bąkowski, prof. at Gdańsk University, legal adviser— Annex 1.

The basic act of law, regulating the use of the seas and oceans, is the *United Nations Convention on the Law of the Sea* – UNCLOS, signed in Montego Bay on 10th Dec 1982 (JoL 2002, no 59, pos 542), ratified by Poland in 1998. The Convention is often called the "Constitution of the seas" as only military activity on seas stays beyond its regulations. The Convention regulates the use of the seas and oceans in a comprehensive way, creating a legal framework to which activities of states in these areas must comply. The Convention codified common standards as well as rules of laws of the sea, new ideas and legal regimes, it also created regulations for further development of specific fields of this law. The most important provisions of the Convention apply *inter alia* to borders of the territorial sea, ways of assignation of borders of the exclusive economic zone, rights and obligations of the coastal state, freedoms and limitations of international shipping, freedoms and limitations of other uses of the sea and research. It is stated in the preamble of the Convention that problems of the sea space are all strictly connected with each other and as such should be considered as a whole, but the document itself does not include direct regulations on the ways of creation or requirements for maritime spatial plans. Nevertheless, it influences the scope of plans and solutions included in them (e.g. the requirement of respecting stated in the Convention freedoms and limitations). The provisions of the Convention were included in the Act *on sea areas of the Republic of Poland and maritime administration*.

European Union does not have the mandate for spatial planning of sea areas. Treaties on the EU and its functioning do not provide *expressis verbis a* legal basis for maritime spatial planning. Some indications, pointing to the need for involvement of EU in MSP may be found in some articles of the Treaty establishing the European Community (TEC), i.e. in articles: 32 TEC (fisheries and agriculture), 70 TEC (transport policy including maritime transport), 158 TEC (economic, social and territorial cohesion) and 174 TEC (environment and health protection and rational management of resources) [Krzywda, 2014]. They provided the justification and inducement for issuing the Directive of the European Parliament and of the Council 2014/89/EU of 23 July 2014 establishing a framework for Maritime Spatial Planning. This Directive contains the requirement for Member States to develop Maritime Spatial Planning for their sea areas until 31st March 2021 the latest. It also creates the obligation to carry out reviews of the plans at least once every 10 years. It points to the need for an integrated approach in the planning process as well as stakeholder involvement and consultations, using best available data and information, taking into account the land-sea interactions, ensuring trans-border cooperation between Member States and third countries. The Directive does not impose the scope of the plans (but it contains suggestions on that scope), nor specific planning solutions. Basically, the Directive has been already transposed into Polish law, except for trans-border cooperation and periodic reviews of the plans.

The most important act of national law concerning spatial planning of the Polish sea areas is the Act of 21 March 1991 on sea areas of the Republic of Poland and Maritime Administration (JoL 2013, pos. 934 as amended). The provisions of Chapter 9 of the Act introduce a separate regulation on creating and issuing spatial plans of sea areas. All plans and projects connected with the use of internal sea waters and territorial sea are approved by the maritime authorities in consultation with relevant coastal municipalities. In the maritime spatial plans, or their parts, account must be taken of all valid permits for building and using artificial islands, structures and installations in Polish sea areas as well as permits for laying and maintaining underwater cables and pipelines in internal sea waters, territorial sea, issued under this particular Act. The textual part of the maritime spatial plan should take under consideration the distribution and delimitation of zones closed for shipping and fisheries and of published periodically hazardous areas for shipping and fisheries, established according to the needs of national defence or security. The Act does not regulate the procedure for plan elaboration and paths of appealing from its provisions.

The scope of the plans is regulated by the Regulation of the Minister of Transport, Construction and Maritime Economy and Minister of Regional Development dated 5 August 2013 *on maritime spatial plans for Polish sea areas* (JoL 2013., pos. 1051) which is an executive act issued pursuant to Art. 37b paragraph 4 of the Act on sea areas of the Republic of Poland and Maritime Administration. The Regulation specifies the required scope of the plans for internal sea waters, territorial sea and exclusive economic zone in the textual and graphic parts. The regulation defines also the scope of justification of the draft of the plan. Provisions of the regulation apply also to changes of the plans or their parts. The plan should take into account, in particular, the objectives and directions identified in development strategies and programs listed in the Act of 6 December 2006 *on the principles of development policy* (JoL of 2009. No. 84, pos. 712 as amended), as well as objectives and directions of sustainable development of the country, set out in the National Spatial Development Concept (NSDC) and objectives, rules and spatial policies of voivodships, as defined in spatial development plans for voivodships, public purpose investments of national importance included in the programs of governmental tasks, if they relate to sea areas covered by the plan. The regulation is in force since 25 September 2013.

From the perspective of the preparation of maritime spatial plans for Polish maritime areas, Resolution No. 190 of the Council of Ministers of 29 October 2013 *Rules of procedure of the Council of Ministers* (Polish Monitor pos. 979) is also important. It provides for an obligation to assess the expected socio-economic impact (*S-EIA)of a* normative act, i.e. an Act of Parliament, normative act of the Council of Ministers, Regulation of the Prime Minister or Minister, Ordinance of the Prime Minister, assumptions for draft of legal act, other documents, in particular strategy, program, report, information, position of the government to the non-governmental draft of act of Parliament or other position as provided in existing legislation, ordered by the Council of Ministers or the Prime Minister or prepared with his consent in order to present the Council of Ministers.

S-EIA contains in particular:

- indication of subjects that are affected by the draft of the normative act;
- Information on the consultations conducted before developing the draft, the public consultations and evaluations of the draft, including the obligation to consult specific entities resulting from separate regulations;
- results of analysis of the impact of proposed normative act on the affected subjects and on important areas, in particular on:
    - the public finance sector, including the budget of the State and budgets of local government units,
    - the labour market,
    - competitiveness of economy, general entrepreneurship and functioning of entrepreneurs;

- indication of sources of financing, especially if the draft involves burdens to the national budget or local government budgets;
- indication of data sources and assumptions adopted for calculations.

Highly important for the preparation of maritime spatial plans is the Act of 16 April 2004 *on Nature Conservation* (consolidated text JoL 2013, pos. 627 as amended), which states that conservation objectives are implemented, among others, by taking into account the requirements of nature conservation in spatial planning of internal sea waters, territorial sea and exclusive economic zone. Parts of a maritime spatial plan which concern a nature reserve and its buffer zone, a landscape park and its buffer, and area of protected landscape require coordination with the Regional Director of Environmental Protection in scope of the solutions of the plan which could have a negative impact on the protected area.

Also other acts of law put specific requirements on maritime spatial plans of Polish sea areas. Among others according with:

- the Act of 28 July 2005. *on health resort medical treatment* (consolidated text JoL of 2012., pos. 651 as amended.) the textual part of the maritime spatial plans of Polish sea areas shall take into consideration the arrangement of waters protected according to that act, and the graphic part of the plan should include borders and designation of objects and areas protected under the provisions of that Act
- the Act of 9 June 2011 *Geological and Mining Law* (consolidated text: JoL 2014., pos. 613 as amended) – in the maritime spatial plan must be taken into account licences issued in the area of the plan for: 1) exploration for hydrocarbons, black coal, methane deposits occurring as accompanying resource, lignite (brown coal), metal ores with the exception of bog iron deposits, metals in natural state, ores of radioactive elements, native sulphur, rock salt, potassium salt, potassium-magnesium salts, gypsum and anhydrite, gemstones (regardless of where they occur, they are covered by the mining property); 2) search for or exploration of an underground carbon dioxide storage complex;3) extraction of minerals from deposits; 4) underground tankless storage of substances; 5) underground storage of waste; underground storage of carbon dioxide. Apart of that, the plan should include the distribution of areas where mineral deposits are documented or confirmed by initial information or investigations shown in geological maps and the distribution of mining areas covered by the mentioned above licences,
- the Act of 27 April 2001 *Environmental Protection Law* (consolidated text. JoL of 2013, pos. 1232 as amended) – the maritime spatial plan must take into account, among others, the arrangements of protection plans for Natura 2000 areas, the graphic part must include in particular the borders and designations of objects and areas protected under the provisions of this Act,
- the Act of 28 March 2003 *on the establishment of the multiannual program "Coastal Protection Program"* (JoL No. 67, pos. 621) – the maritime spatial plan or its parts must take into account the objectives and directions set out in this Program,
- the Act of 18 July 2001 *Water Law* (consolidated text JoL of 2012, pos. 145) – borders and designations of objects and areas protected under the Act must be taken into account in the maritime spatial plan or its parts,

- the Act of 23 July 2003 *on the conservation and the guardianship of monuments* (JoL No. 162, item. 1568, as amended) – the textual part of the maritime spatial plan should take into account the distribution of sea basins protected under this Act, and the graphic part of the plan should contains among others the borders and designations of objects and buffer zones protected by provisions of this Act,
- the Act of 16 April 2004 *on nature conservation* (consolidated text JoL of 2013, pos. 627 as amended) – the textual part of the maritime spatial plan should take into account the distribution of sea basins protected under this Act, and the graphic part of the plan should contain among others the borders and designations of objects and areas protected by provisions of this Act.
- the Act of 6 December 2006 o*n the principles of development policy making* (consolidated text JoL of 2009 No. 84, pos. 712 as amended) – objectives and directions defined in development strategies and programs (ie. in the long-term national development strategy, medium-term national development strategies and other development strategies) must be taken into account in the maritime spatial plan or its parts,
- the Act of 18 August 2011 *on maritime safety* (JoL No. 228, item. 1368, as amended) – maritime spatial plans should identify the purpose of specific sea basins, *inter alia* for the needs of ensuring maritime safety.

During the execution of the Strategic Environmental Assessment especially the following acts of law should be taken into account:

- International law:
    - UN ECE *Convention on Environmental Impact Assessment in the cross-border context*, signed in 1991 in Espoo and ratified by Poland in 1997, and Strategic Protocol to Espoo Convention.
    - The UN ECE *Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters*, signed in Aarhus in 1998 and ratified by Poland in 2001 r.
- EU law:
    - Council Directive 85/337/EEC of 27 June 1985 *on the assessment of the effects of certain public and private projects on the* environment,
    - Directive of the European Parliament and Council Directive 2001/42 / EC of 27 June 2001. *on the assessment of the effects of certain plans and programs on the environment*,
    - Council Directive 92/43 / EEC of 21 May 1992. *on the conservation of natural habitats and of wild fauna and flora*,
- National law:
    - the Act of 3 October 2008 *on the provision of information on the environment and its protection, public participation in environmental protection and environmental impact assessments* (JoL of 2013, pos. 1235 consolidated text) – Article 46.

The last mentioned act of law implements the obligations set out, *inter alia*, in the three above mentioned directives. According to this Act, the planning process associated with the preparation of a maritime spatial plan or its parts shall be documented in a durable manner, in the form of a structured set of documents that were produced during the preparation of the plan, including in particular documentation of procedures and public participation required by that Act.

Important elements of the legal order, which have to be taken into consideration in plans for the sea areas, are the standing orders of the Directors of Maritime Offices. As a rule they relate to the establishment of safety zones around structures and installations in the sea, delimitation of the technical and protective belt on land, borders of havens and typical general ordinance cases. A part of them is of a normative character, e.g. the standing order no 5 of 3rd April 2014 of the Director of Maritime Office in Gdynia (Pomeranian Voivodship Official Journal, pos. 1416, Warmia and Mazury Voivodship Official Journal, pos. 1492) *on the establishment of conditions for safe navigation in the sea area of the inner Puck Bay*. This law is a result of negotiations conducted with the stakeholders and cooperation with the self-government of the Pomeranian Voivodship. It organizes the issues of navigation and sports in the inner Puck Bay. Some of its regulations will influence the solutions of the maritime spatial plan, though on the other hand, one cannot exclude a modification of this standing order in result of solutions of the maritime spatial plan. This does not change the fact that standing orders of this type should be a subject for reflection at the initial stage of plan development because they codify important social processes and are a record of preferences of costal communities with respect to the ways of sea area utilization.

Analysis of legal conditions shows no gaps or limitations preventing creation and implementation of maritime spatial plans for Polish sea areas within the legal order existing in Poland. However, it has to be underlined that there are three important problems, which will hinder the construction of the plans:

- the Polish legislator did not specify the axiological layer of maritime spatial planning, we are lacking priorities for use of the Polish sea areas (the priorities are either very general or scattered among a number of legal acts and mutually uncoordinated), there is no definition of the concept of spatial order on sea, there is also a lack of international agreements defining the directions sea area utilization, such as use of the Baltic Sea for energy production, or coherent environmental protection,
- certain sections of the sea borders of Poland are still not determined
- along some sections of the coast the coastline is not formally designated, also the baseline of the territorial sea is not established.

With respect to the first issue, during development of the maritime spatial plans, it will be necessary to refer to soft law, i.e. existing strategic documents which do not posses the legal force (they are often of a recommendation/guideline character), but have been worked out during multilateral cooperation of many countries or many sectors within one country. This matter will be further discussed in section 1.3

The second issue concerns mainly the exclusive economic zones of Denmark and Poland in proximity of Bornholm. All external borders of the Polish exclusive economic zone are set by bilateral agreements with countries, whose marine waters contact with the Polish zone, except the border between Poland and Denmark south of Bornholm, where until this moment the situation remains legally unsettled. The disputed area on Polish marine maps is assigned to the Polish zone, on Danish maps – to the Danish zone. As a precaution both countries are refraining from any activity in this area which could cause a reaction of the other side of the dispute. The risk lies in the possibility that both countries may simultaneously develop their maritime spatial plans. On the other hand, this could give an impulse to attempt regulating the legal issues. Other risks include the inability of positive opinion on the Polish maritime spatial plan by Denmark, also the lack of administrative competence of public administration to issue decisions (e.g. location decisions, construction permits).

The third problem means that in consequence of the lack of the baseline and incomplete (not covering the entire Polish coast) legal designation of the coastline the administrative borders of the sea areas will be imprecisely determined in the maritime spatial plans – which can lead to spatial conflicts and even questioning of the decisions issued on the basis of these plans. The border of planning jurisdiction is defined by the legally designated coastline. Its designation is regulated by provisions of the *Water law* – it is the edge of the shore or line of permanent growth of grass, or a line which is determined on the basis of the average water level from a period of at least last 10 years (Art. 15 of the Act). On internal sea waters this line is determined by the Director of the appropriate Maritime Office. In a situation when the coastline is not determined, the legally valid border of planning jurisdiction is the northern boundary of municipal plots. In November 2014 the designated coastline existed on the whole length of the coast in territorial competence of the Maritime Office in Gdynia (at present, along some stretches the Office is carrying out surveys in order to update the coastline) and the Maritime Office in Szczecin. No legally designated coastline exists along the coast in competence of the Maritime Office in Słupsk, and therefore for the planning purposes the northern boundary of municipal plots should be applied. However, in this Study, for presenting the use of Polish sea and coastal areas (maps), for the area of the Maritime Office in Słupsk the physical coastline is used – determined on the basis of 10 years of coastal monitoring.

The boundaries of zones in the sea are determined on the basis of the baseline of the territorial sea. According to Art. 5 of UNCLOS this is the low-water line along the coast, as marked on large-scale charts officially recognized by the coastal State (Fig. 1.1).

Poland is the only country in the Baltic Sea Region which has not defined its baseline. According to the act *on sea areas of the Republic of Poland and Maritime Administration* (Art. 5, paragraph 2) the baseline of the territorial sea is the lowest-water line along the coast or the outer limit of internal sea waters. The course of the baseline is necessary for correct and clear identification of both the internal (the area between the coastline and the future baseline will have the status of internal sea waters), as well as the outer limit of the territorial sea. Thus, the baseline determines the correct determination of the inner boundary of the exclusive economic zone. Because the baseline in Poland is not appointed, the width of the territorial sea is at present referred to with respect to the coastline, which, as already mentioned, is missing in certain sections. The legally established coastline in many places runs at a significant distance landwards of the future baseline (as it will be placed in accordance with the specific provisions of UNCLOS). The result is that between the two lines appears an area which is not included in the property register of Poland (an internal sea waters' area). Only in the area of territorial competence the Director of Maritime Office in Gdynia this is an area of approx. 14 km^2. In result of establishing the baseline, the outer boundary of the territorial sea can be moved even 200 m seawards. Determination of the baseline is also necessary for determining the boundary of the so-called "contiguous zone" (24 Nm from the baseline). In this zone, Poland will have special rights with regard to anti-terrorist, customs, taxes, immigration, sanitary legislation and regarding objects of archaeological or historical interest.

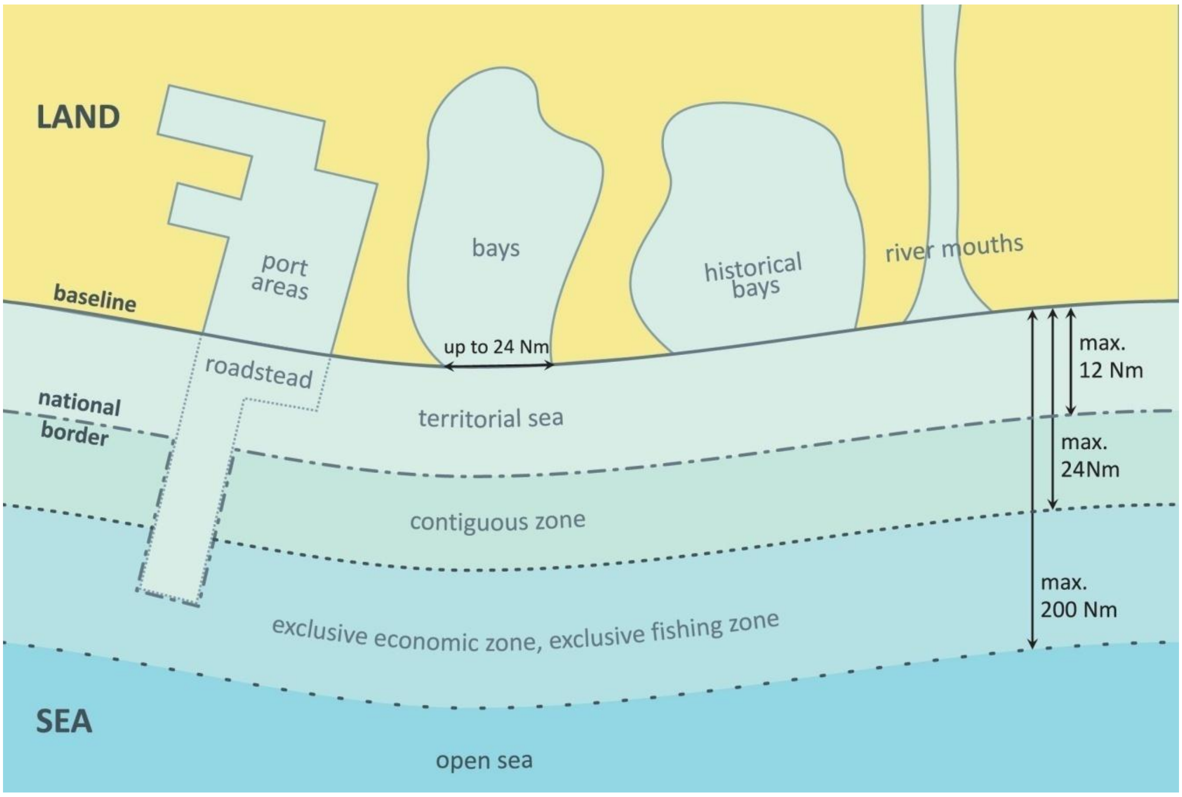


Fig. 1.1. Boundaries of sea areas according to UNCLOS
Source: Maritime Institute in Gdansk.

1.2. Maritime Policy of the Republic of Poland until 2020 and other fundamental national strategic documents

Maritime policy of the Republic of Poland until 2020 (with 2030 perspective) was adopted on 27th November 2014 by the Committee for European Matters. The document was prepared by the Interdepartmental Group for Maritime Policy of the Republic of Poland, according to §2.1. point 1 of the *Regulation no. 103 of the Prime Minister dated 17th September 2008 on setting up* the *Interdepartmental Group for Maritime Policy of the Republic of Poland* (M.P. no. 70, pos.63 and from 2009, no. 34, pos. 503 and from 2010 no. 87, pos. 1025). The basis for the development of this document were the previously prepared *Assumptions for the Maritime Policy of the Republic of Poland until 2020*, acknowledged by the Permanent Committee of the Council of Ministers on 14th September 2009. The *Maritime Policy 2020*, according to art. 4.3. of the Act *on the principles of development policy making* of 6th December 2006 (JoL from 2009, no. 84, pos. 712 and no. 157, pos. 1241), is a development policy document. Its preparation results from recommendations of the European Commission contained in the Communication *Integrated Maritime Policy of the European Union* COM (2007) 575 and *Guidelines for an integrated approach to maritime policy: towards best practice in integrated maritime governance and stakeholder consultation* COM (2008) 395.

In the *Maritime Policy*, maritime spatial planning (MSP) is included in the chapter on improvement of maritime management. In the chapter MSP is defined and its role is described (in accordance with Directive 2014/89/EU) as a tool for optimal utilisation of sea space and for achieving a balance between competing human uses of the sea and sectoral interests. The list of actions to improve maritime management includes the task of "developing maritime spatial plans of Polish sea areas taking into account the ecosystem approach". One of the indicators for monitoring the realisation of the maritime management improvement direction of maritime policy is "coverage of the Polish sea and coastal areas with maritime spatial plans(in hectares)".

In the chapter on sea ports it is stated that "investments in access infrastructure from land and sea require more extensive use of the instruments of spatial planning and integrated costal zone management". In the chapter on exploitation of natural resources of seas and oceans, while discussing the need to verify geological maps, it is also mentioned that this work will provide a good basis for spatial planning and proper management.

The described policy specifies the intentions of public authorities of the Republic of Poland concerning the use of MSP as a process of maritime management and coordination activities in this field. However, the document does not allow clear identification of priorities of sea area utilisation. On one hand, it is stated that the overarching directions of the policy are: strengthening of the position of Polish sea ports, improvement of the competitiveness of sea transport and ensuring maritime safety, but on the other hand the remaining directions are treated on an equal plane (no preference is indicated). In effect the policy will not be decisive when it comes to formulating solutions of a maritime spatial plan in case of a spatial conflict (e.g. between power industry and fisheries). Some activities do not appear in the document e.g. mariculture serving purposes of marine environment protection (except supporting research and indicating the possibility of its co-location in areas designated for wind-farms). Moreover, descriptions of the activities are general to such an extent, that it will be difficult to transfer them to spatial plan level.

Apart of the *Maritime policy*, there are other strategic documents with significance for the maritime spatial plans. A part of them is important, but stays at high level of generality because of their long time horizon. With respect to maritime spatial planning, indications of these strategies are rather of a directional character. They will not make decision making in spatial conflict situations easier. It may be only supposed that the issues mentioned in these documents are more important than the omitted ones.

The above concerns e.g. the National Long Term Development Strategy – *Poland 2030. Third wave of Modernity* (adopted by the Council of Ministers on February 5th 2013), which in general presents the importance of innovation, endogenous potentials (e.g. sea resources) and energy from renewable sources. The document contains the statement that it is necessary to "look again at the issue of using the Baltic Sea as a factor of development, possibly of energy safety". In this context the LNG terminal is mentioned. Similarly, the National Spatial Development Concept (adopted by Council of Ministers on 13th December 2011) indicates that spatial development of Polish sea areas cannot be considered without recognition of spatial development on land, and that sea areas and the coastal zone are important functional areas requiring planning.

The provisions of middle term strategy i.e. National Development Strategy until 2020 – *Active society, competitive economy, efficient State* should also be perceived in this context. The Strategy stipulates that mechanisms of Integrated Coastal Zone Management will be implemented, and maritime spatial plans drafted. Much attention is given to sea areas in the chapter dealing with climate change. Among others, it is stated that "one of the important tasks is to protect the coastal zone as the most exposed to climate change, in that, among others, to ensure effective and safe for the environment and nature values coastal protection, minimizing progressing coastal erosion and ensuring effective prevention of pollution of the sea and outlet sections of rivers discharging into the sea". Moreover, the document points out that "exploitation of the sea environment should be sustainable, and should guarantee the possibility of using the environment and carrying out activities by present and future generations. It means that the structure, functions and processes of the marine ecosystems must be fully taken into account, marine species and habitats protected, and loss of biological diversity caused by humans – stopped. Effective protection of the Baltic Sea and achieving a good state of marine environment require coordinated action aimed at limiting the pressures and negative impacts on the Baltic Sea environment. This will be realized also basing on functional planning of the coastal and sea areas".

The important provisions of the middle term strategy relate to economic exploitation of sea areas. It is outlined in this document that "the maritime policy aims at maximising the benefits for citizens and economy deriving from utilising the coastal location of the country and from living and mineral resources of the sea. The development of the national maritime sector will be supported, e.g. in the area of capacities of marine navigation or transoceanic connection services. The economic potential of Polish sea areas will be based in the future on development of sea ports, in particular of ports of basic importance for national economy (Gdańsk, Gdynia, Szczecin, Świnoujście). In the context of increasing ports' turnover and handling and storage capacity of ports, it is important to build modern terminals and intermodal logistics centres in the ports and their hinterland. Development and modernization of access to ports and havens from sea and land side, including building of deepwater berths and fairways as well as roads, rail and inland water connections will be crucial. Furthermore, marine tourism will also be an important factor of development of Polish sea areas. With sea space are also connected expectations for diversifying supplies for power production and resulting from exploration and exploitation of natural resources". Strengthening of sea transport links is recognized in the strategy as one of the key investment activities until 2020.

Other strategic documents (in particular integrated strategies) are presented in this Study within analyses of the specific sectors. Strategies which do not refer directly to sea areas are omitted. All the nine integrated strategies are listed below, and the ones analysed further in the Study are underlined:

- Strategy for Innovation and Effectiveness of Economy "Dynamic Poland 2020" (Ministry of Economy) – adopted by Council of Ministers on 15th January 2013,
- Strategy for Development of Human Resources (Ministry of Labour and Social Policy) – adopted by Council of Ministers on 18th June 2013,
- Strategy for Development of Transport until 2020 (with 2030 perspective) (Ministry of Transport, Construction and Maritime Economy) - adopted by Council of Ministers on 22th January 2013,
- Strategy "Energy Safety and Environment" – Perspective 2020 (Ministry of Economy) - adopted by Council of Ministers on 15th April 2014,
- Strategy "Efficient State" 2020 (Ministry of Administration and Digitalization) – adopted by Council of Ministers on 12th February 2013,
- Strategy for Development of Social Capital 2020 (Ministry of Culture and National Heritage) – adopted by Council of Ministers on 26th March 2013,

- National Strategy for Regional Development – Regions, cities, rural areas (Ministry of Regional Development) - adopted by Council of Ministers on 13th July 2010,
- Strategy for Development of Ruaral Areas, Agriculture and Fisheries for the period 2012-2020 (Ministry of Agriculture and Development of Rural Areas) – adopted by Council of Ministers on 25th of April 2012,
- Strategy for National Safety of the Republic of Poland (Ministry of National Defence) – adopted by Council of Ministers on 21st October 2014.

1.3. Conditions, knowledge and experience resulting from international cooperation

On the basis of the report "Analysis of International Project" J. Przedrzymirska, I. Rakowska, Project Service Centre of the Maritime Institute in Gdańsk, 2014 - Annex 2

International cooperation achievements, important from point of view of maritime spatial planning, include first of all the documents of the HELCOM-VASAB MSP Work Group. From axiological point of view, special attention should be given to the developed by this Group principles for MSP in the Baltic Sea area which concern the following issues:

1. Sustainable management,
2. Ecosystem approach,
3. Long term perspective and objectives,
4. Precautionary principle,
5. Participation and transparency,
6. High quality data and information basis,
7. Transnational coordination and consultation,
8. Coherent terrestrial and maritime spatial planning,
9. Planning adapted to characteristics and special conditions at different areas,
10. Continuous planning.

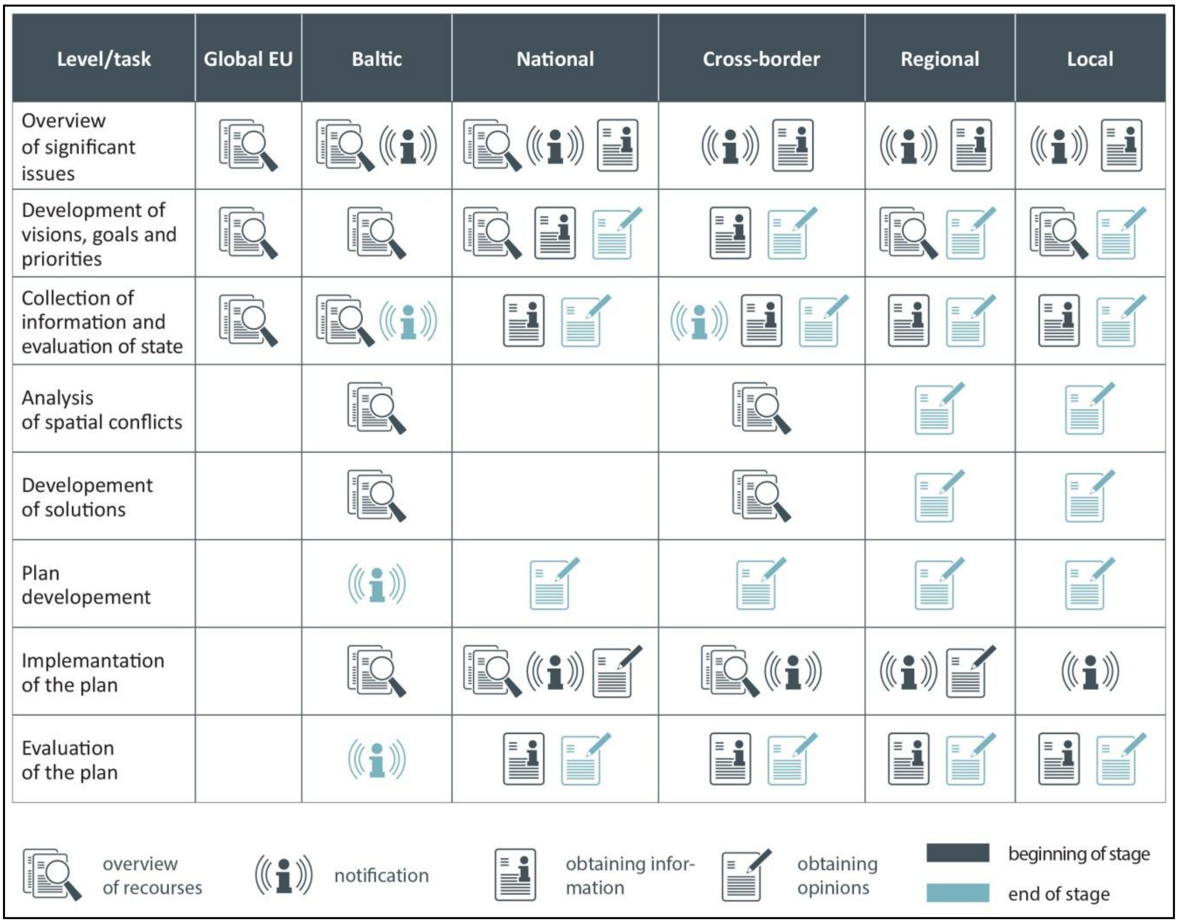
Principles proposed by the European Union should be treated in a similar way. The catalogue of common principles essential for MSP in the EU includes:

1. Using MSP according to area and type of activity,
2. Defining objectives to guide MSP,
3. Developing MSP in a transparent manner,
4. Stakeholder participation,
5. Coordination within Member States — Simplifying decision processes,
6. Ensuring the legal effect of national MSP,
7. Cross-border cooperation and consultation,
8. Incorporating monitoring and evaluation in the planning process,
9. Achieving coherence between terrestrial and maritime spatial planning — relation with ICZM,
10. A strong data and knowledge base.

The above principles indicate what requirements should be fulfilled by a maritime spatial plan, or rather the planning process, to fit into the Baltic and European MSP framework.

It seems that the handbook on multilevel consultation, developed in 2014 by the PartiSEApate project could help to design the planning process for Polish sea areas. The handbook shows what planning level and at what stage of the planning process should be consulted and what should be the scope of the consultation (informed, analyzed with respect to possessed publicly accessible information, asked for opinion, asking for more in-depth input). Details are shown in Table 1.1. The handbook contains also a check-list of issues, which need to be verified by the planning team at each stage of the planning process in order to guarantee a proper consultation process.

Table.1.1 Consultation with planning levels at various stages of the planning cycle



Source : Maritime Institute in Gdańsk, based on Matczak M. and others. [2014].

Proper attention should be given to documents, which are not ready yet, but soon will be finalised and adopted by the HELCOM- VASAB MSP Work Group:

- Guidelines for the implementation of ecosystem-based approach in Maritime Spatial Planning (MSP) in the Baltic Sea area,
- Guidelines on transboundary consultations, public participation and co-operation.

In the process of developing maritime spatial plans for Polish sea areas account should also taken of the methodological directions contained in the most important international projects dedicated to MSP. Of key importance is the *BaltSeaPlan Vision 2030 – Towards the sustainable planning of Baltic Sea Space: The Vision of planning of sea areas spatial management* [Gee and others, 2011], developed by the BaltSeaPlan project, which also gained support of the Committee for Spatial Planning and Development of VASAB. The document identifies the fields which require international cooperation in maritime spatial planning: ecology, power engineering, sea transport, fisheries and mariculture. It also stresses the need for pan-Baltic thinking, effectiveness of sea space utilisation (co-use), need for ensuring connectivity and coherence in the Baltic dimension of planned linear infrastructure – with respect to transport corridors, blue corridors (connecting marine habitats) and the marine habitats themselves. Other important sources of knowledge are handbooks on MSP and contained in them models of the planning cycle. Most important of them are the reports of the PlanCoast project [Schulz-Zehden and others, 2008] and UNESCO [Ehler and Douvere, 2009].

Use should also be made of meritoric information contained in many international projects. From the point of view of innovative forms of protection of sea environment (mariculture, algae collection), most important seems to be the roadmap developed by the SUBMARINER project [Zimna and others, 2013]. For environmental protection the concept of underwater landscapes developed by the BALANCE project [Al-Hamdani and Reker (eds.), 2007] is important.

During work on this Study a stocktake was carried out of over 300 Baltic Sea projects contained in the databases of HELCOM, 6th and 7th Framework Programme, BONUS, LIFE+, EWT and EOG Programs and domestic Polish programs, which were not directly known to the authors of the Study. 119 projects with significance to maritime spatial planning of Polish sea areas were identified, of which 73 were analysed in detail. The subject matter of the analysed projects was as follows:

- oil spills – 10 projects,
- biology, chemistry, ecology, hydrology – 35,
- geology – 1,
- sea transport, navigation, ports – 6,
- maritime spatial planning – 2,
- underwater noise – 2,
- other (sewage management, agriculture, genetics, etc.) – 17.

Source information was also derived from questionnaires sent to Polish participants of the above mentioned projects. The result of the carried out analyses, including information derived from questionnaires related to 27 projects, is given in the report: “Analysis of international projects” (Annex 2). The projects were divided into 3 groups: *i*) vital, *ii*) probably vital and *iii*) rather not vital for maritime spatial planning. Results of 16 projects were recognized as vital for Polish MSP. They will require careful analysis by the team(s) drafting the maritime spatial plans.

Among the projects dealing with nature and ecological issues the following should be mentioned:

- SAMBAH and BIAS – measurements of noise in water,
- ZOSTERA, “Structure…”, BALTIC-C, INFLOW, KNOWSEA, AQUILO – sea bottom habitats, benthic organisms and chemical parameters of waters,
- BALTIC GAS, AQUILO – geology, morphology, sediments.
- CHEMSEA – location of dumped chemical ammunition.

A separate group is formed by projects basing on historical data or data collected using non-standard methods (e.g. using devices installed on ships) and presenting results of analyses of natural phenomena, including also climate change:

- BALTEX/AMBER, ECOSU – anthropogenic influences in the coastal zone,
- Baltic-C – dynamics of change of chemical parameters in the Baltic Sea (POC),

- BALSAM – maps showing "Baltic Sea ecosystem health" (occurrence of species, eutrophication, toxic substances), assessment made using the HOLAS tool. Picture of the whole Baltic Sea area, and of its gulfs, among others the Gulf of Gdańsk.
- ELME – report on the state of sea organisms (ichthyofauna, phyto- and zoobenthos) – influence of eutrophication on the state of sea and organisms living in it,
- HELCOM FISH-PRO II – assessment of the state fish population in the Baltic Sea,
- Ferryscope – phytoplankton bloom monitoring.

It is also recommended that the planning team(s) would get to know the projects classsified as "possibly vital" and "rather not vital". The COCOA project may be an example. Within this project it is planned to draft management guidelines aiming at improving the ecological state of coastal ecosystems deteriorated by eutrophication. It cannot be excluded that results of projects in these categories may become important for the purposes of spatial planning of Polish sea areas – the final decision on using them should be in the hands of experts participating in the MSP work.

Conclusions for the maritime spatial plan of Polish sea areas

- Legal status is not an obstacle for developing maritime spatial plan(s) of Polish sea areas.
- However, when drafting a plan, consideration should be given to legal deficiencies regarding demarcation of the sea borders of the Republic of Poland or the lack of legally established cross-border consultation procedures (except environmental impact evaluations).
- Recommendations and good practices of international Baltic projects such as PartiSEAPate (e.g. multilevel consultation handbook) may be useful for overcoming the second of the above obstacles.
- Recommendations, knowledge and experience as well as good practices of cooperation worked out and accumulated as a result of projects and other forms of international cooperation, should be perceived as a vital determinant of work on drafting of Polish maritime spatial plan(s).
- In particular, attention should be given to such documents as: the Baltic Sea Braoad-Scale Maritime Spatial Planning Principles developed by the HELCOM-VASAB MSP Working Group and the Vision 2030 developed by the BaltSeaPlan project.
- Important are also guidelines which are currently being developed by the HELCOM-VASAB MSP Working Group.
- The Maritime policy of the Republic of Poland until 2020 (with 2030 perspective) is an important document for Polish MSP. It indicates navigation, port development and safety and protection of navigation as issues of priority significance in the use of Polish sea areas.

Knowledge gaps

Baseline and coastline (in consequence the borders of Polish sea areas).

2. OCEANOGRAPHIC CONDITIONS

2.1. General Characteristic

Bathymetry

The Baltic Sea is a nearly fully landlocked, shelf and shallow sea, with uneven bottom, with several deeper basins separated by sills and shoals. The following sub-regions are identified in the Polish sea areas [Szefler and Furmańczyk, 2008]:

- southern part of Bornholm Deep (max. depth 105 m),
- Słupsk Trough (65 m),
- eastern part of Gdańsk Deep (118 m),
- south-east part of Gotland Deep (120 m),
- western part of Pomeranian Bay.

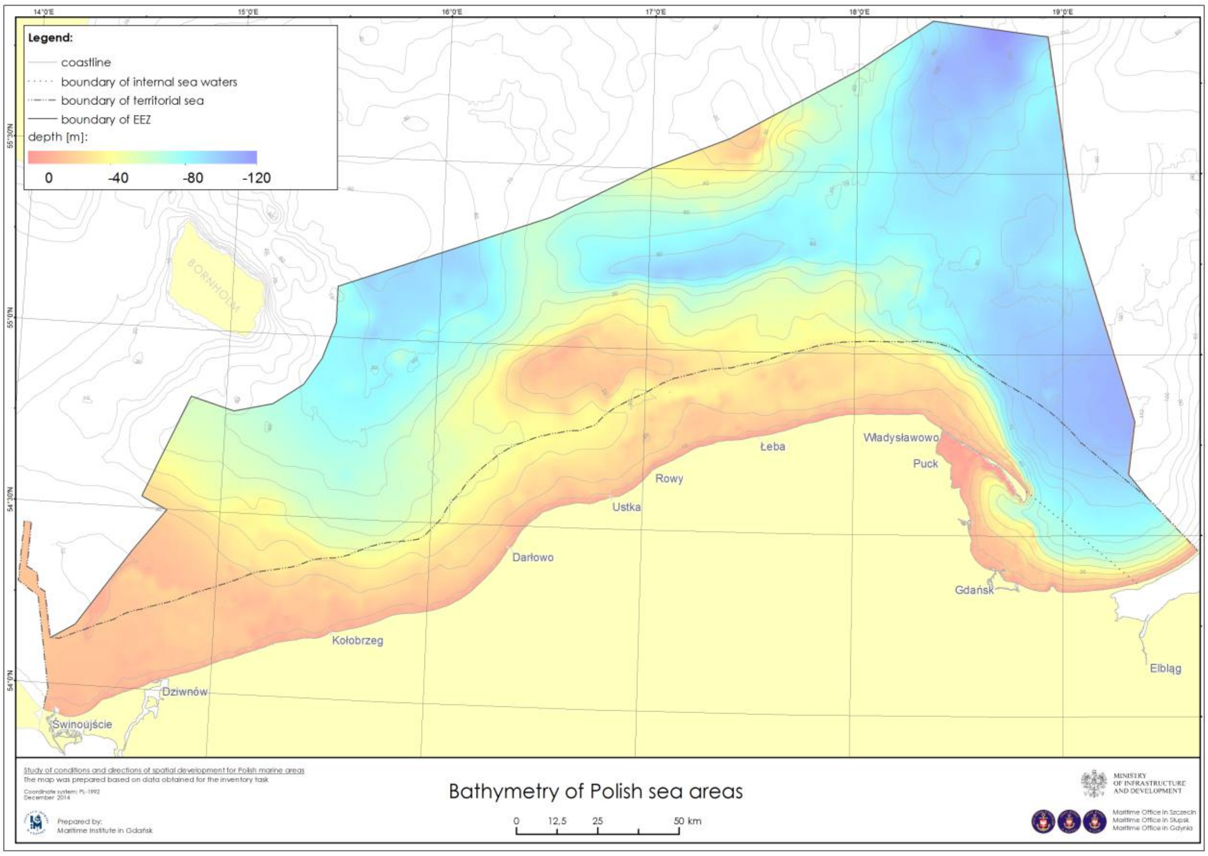


Fig. 2.1. Bathymetry of Polish sea areas.

Source: Maritime Institute in Gdańsk basing on data from HOPN.

Water depth in Polish sea areas, as in the whole Baltic Sea is rather small, exceeding 100 m only in the central part of the Gdańsk Deep and in the eastern part of Gotland Deep (Fig. 2.1). Along the coastline there is a wide belt of shallows (depth not exceeding 30 m), with the Odra and Słupsk Banks located even over 20 km from the coast. At the border of the Polish and Swedish EEZs is the Southern Middle Bank, separated from the Słupsk Bank by the Słupsk Trough. Over most of the Polish sea area the bottom slopes very slightly northwards, except the Gulf of Gdańsk, where the bottom slopes steeply towards the Gdańsk Deep (the steepest slopes are in the region of the Hel Peninsula and at the edge of the Puck Bay) (Fig.2.2).

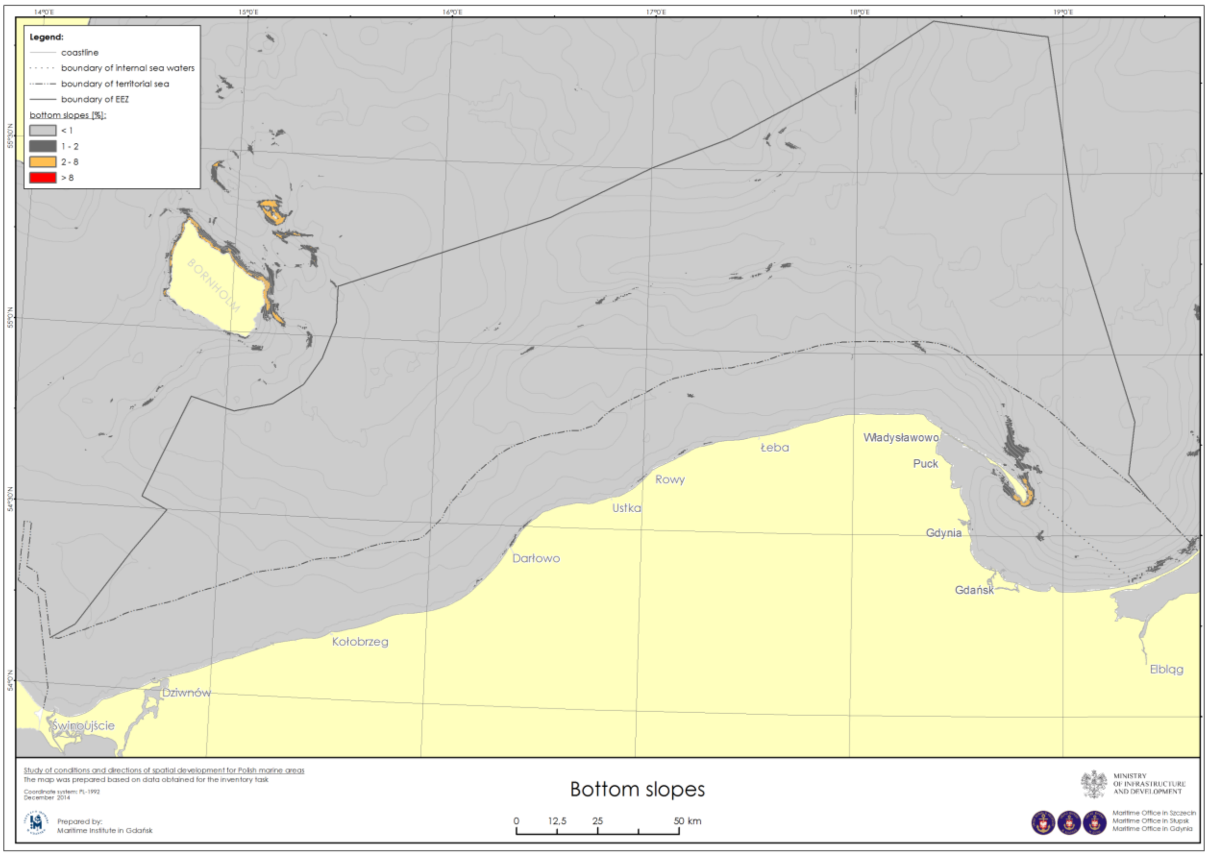


Fig. 2.2. Bottom slopes.

Source: Maritime Institute in Gdańsk on the basis of data from the HABITAT MAPPING project.

With respect to hydrological characteristics which influence biocenosis formation, the various parts of the Baltic Sea significantly differ between each other. The most important of these characteristics are:

- a high gradient of salinity and water temperature from east to west and from south to north,
- vertical stratification of water mass salinity, impeding mixing in the water column, which in consequence leads to a deficit of oxygen in the nearbottom water layers and in sediments over large areas, especially in the Baltic deeps,
- limited water exchange with the North Sea,
- large population living in the Baltic Sea's catchment area, large number of agglomerations and extensive use of the catchment area for agriculture.

The result is that, especially because of the last mentioned above characteristic, the Baltic Sea is very vulnerable to excessive supply of biogens, which quicken the process of eutrophication [Bubak (ed.), 2013].

Water salinity

Salinity is very important for the physiology of marine organisms [*Atlas siedlisk dna*… 2009]. Salinity at the surface of the Baltic Sea is the result of the relationship between the components of the water balance, while salinity and oxygenation of water in deep parts of the Baltic depend on the frequency and volume of salt water infusions from the North Sea.

Characteristic for the Baltic Sea is the two-layer vertical distribution of salinity, with an upper, less salty, and a lower higher salinity layer. These layers are separated by a halocline. The upper layer, which is not influenced by the salt water infusions, heats up during summer and then is subjected to mixing by convection currents. The intensity of these currents varies seasonally. The lower salty layer, dependent on infusions, remains cold, airing of the deeper waters comes from this layer, and its heavier waters do not participate in the convectional exchange [*Opracowanie dokumentacji*… 2007].

Average salinity above the bottom in the Polish sea areas is between 5.5 and 12 psu. The higher values are observed in the Bornholm Basin and Słupsk Trough. Variability of salinity in the shallow water zone is small and as a rule does not exceed 2 psu [*Atlas siedlisk dna…* 2009].

Oxygenation

As mentioned above, the halocline is a barrier hindering mixing of surface and abyssal waters, and for this reason these last are less oxygenated. In the deepest basins of the Baltic oxygen becomes completely used up, and toxic to animals hydrogen sulphide is generated. Oxygen content is improved exclusively by large infusions of well oxygenated oceanic waters from Kattegat. This happens only during heavy storms, and only once in a few years.

Normally seasonal hypoxia (oxygen deficit) appears in Polish sea areas in the summer season in the deep water part of the Gulf of Gdańsk (observed at stations P110 and P116). The oxygen situation in the Gdańsk Deep, Bornholm Deep and Gotland Basin is controlled by hydrodynamic conditions, and oxygen conditions improve after large infusions. Water near the bottom in the shallow waters along the central coast, in the Pomeranian Bay and Puck Bay is normally well oxygenated throughout the whole year ($4,5 > cm^3 *dm^{-3}$) [*Ocena stanu środowiska*… 2014].

pH

The pH is commonly used for describing water acidification caused by anthropogenic emission of CO_2 and its dissolution in water [ibid]. In the decade 2003-2012 the average value of pH in the surface water layer (0-20 m) was 8.24, and was higher by 5.9% than in the deeper layer below 20 m (7.75). Similar values were observed in 2013.

In the deeper parts of the sea the process of organic matter decomposition prevails over its production. This process intensifies in autumn, when dead organic matter from the euphotic layer settles in the deeper layers, and next decomposes using up oxygen. In effect water acidity increases – pH decreases. At low pH grows the content of CO_2 in water in the form of dissolved gas [ibid].

Currents

Water flow above the bottom is important for the shaping of habitats of marine organisms. On one hand, it causes the sediments to move, e.g. transport of sand grains, which limits the presence of organisms, but on the other hand it is necessary for the nutrition of filtering organisms [*Atlas siedlisk dna*… 2009].

Highest speeds of nearbottom currents occur in the area of western shallows and the coastal zone at the edge of the Pomeranian Bay, and also at the base of the Hel Peninsula (Fig. 2.3). The lowest speeds occur in the deep and flat bottom areas of the Gdańsk Deep. The relatively shallow area of the Słupsk Bank, located far from the coast, is characterised by rather high nearbottom current speeds, which favours the development of a rich epiphyte fauna [ibid]. In the coastal zone of the Gulf of Gdańsk long-shore currents prevail [*Ocena stanu środowiska*… 2014].

A characteristic feature of the bottom and habitats in areas with strong currents is the presence of well washed stones and hard till with gravel [*Atlas siedlisk dna*… 2009].

Surface currents in the Baltic Sea are generated mainly by wind. In effect their general distribution corresponds with the predominant wind directions. Observed current speeds are rather small, about 20 cm/s. Higher current speeds, over 200 cm/s, can occur in the coastal zone during strong storms [Uścinowicz (ed.), 2011].

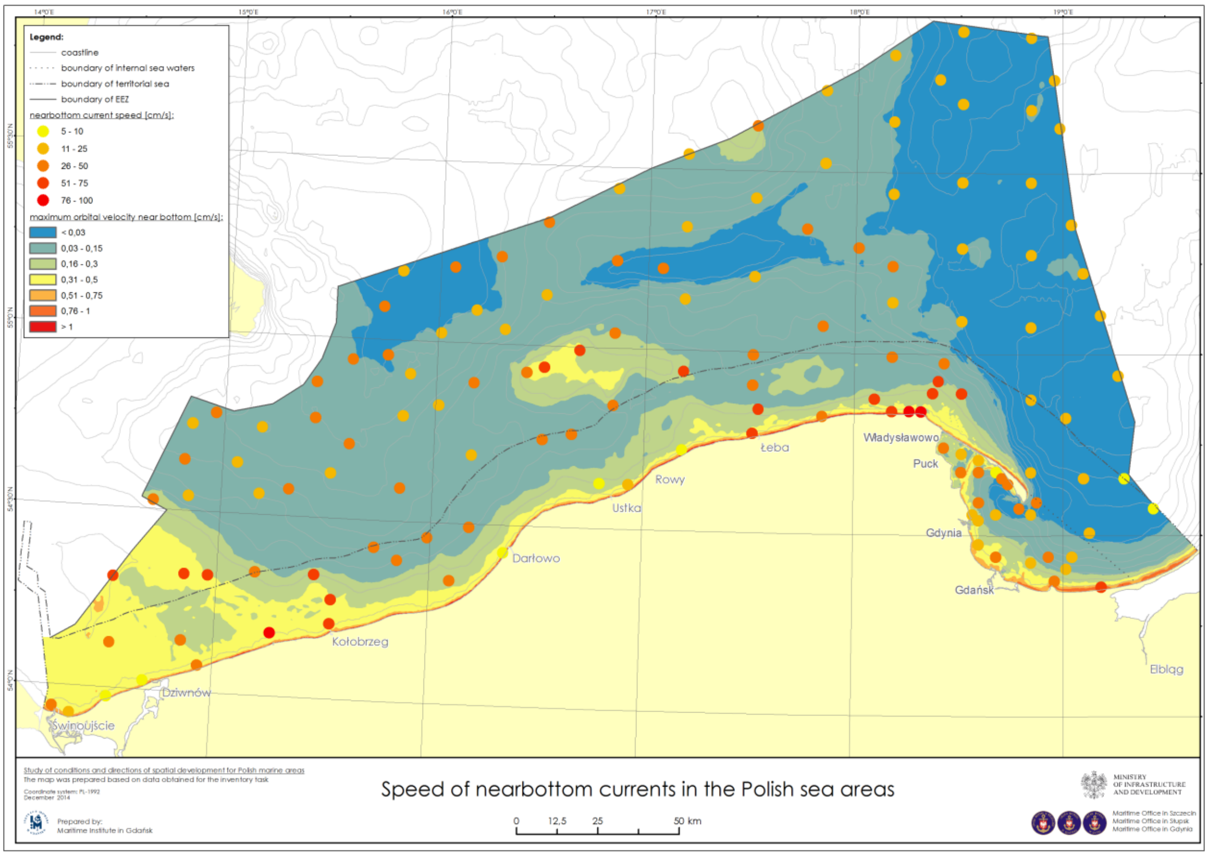


Fig. 2. 3. Speed of nearbottom currents in the Polish sea areas

Source: Maritime Institute in Gdańsk, on the basis of data from the project HABITAT MAPPING.

Waves

Wave generation on sea surface is connected mainly with changes of wind fields over the Baltic Sea and with the distribution of water depth, relief of sea bottom and distance from the coast. Highest waves should be expected in areas in which coexist relatively small water depths and strong nearbottom currents.

Waves have a significant influence on the range of organisms forming fragile bush-like structures easily destroyed by water movements. Wave motion facilitates intense filtration, causing pumping of water through permeable sediments (sand and gravel), and this is very important for self-purification of water [*Atlas siedlisk dna*… 2009].

In comparison with the reference period (1988-1993), wave characteristics in the southern part of the Baltic Sea will not change much in the years 2011-2030. Larger changes are expected in the second part of the 21st century. [Jakusik et al 2012].

Increase, above the present average, of the time during which occur high waves is certainly unfavourable from the point of view of navigation – it may increase difficulties for fishery (especially for small vessels), cargo and passenger traffic, in that seasonal touristic services. Apart of higher risks further offshore, increased wave heights have far reaching consequences in the coastal zone. Among others they result in increased risk of coastal erosion, higher cost of coastal protection and coastal cliff stabilisation, the need for additional protection of port infrastructure and increased maintenance costs [ibid] (more on this topic in Chapter 5).

Lighting

The main source of heat energy shaping the thermal conditions of Baltic Sea surface waters is solar radiation [Uścinowicz (ed.), 2011]. Light is also one of the factors shaping primary production and occurrence of plants (see p. 3.2.1 and Chapter 2 in Annex 4). The spectral range of photosynthesis active radiation (PAR) is 400–700 nm. Along the Polish coast the average value of PAR lighting at sea level at noon of a cloudless summer day is 300 MJ/h/m^2. About 85-95% of solar energy penetrates through the sea surface into the water column. Due to the difference in insolation, the sum of energy reaching the sea bottom during warm months is even 5 times larger than in cold seasons [*Atlas siedlisk dna*… 2009]. The range of the photic zone in Polish sea areas is shown in Fig. 2.4.

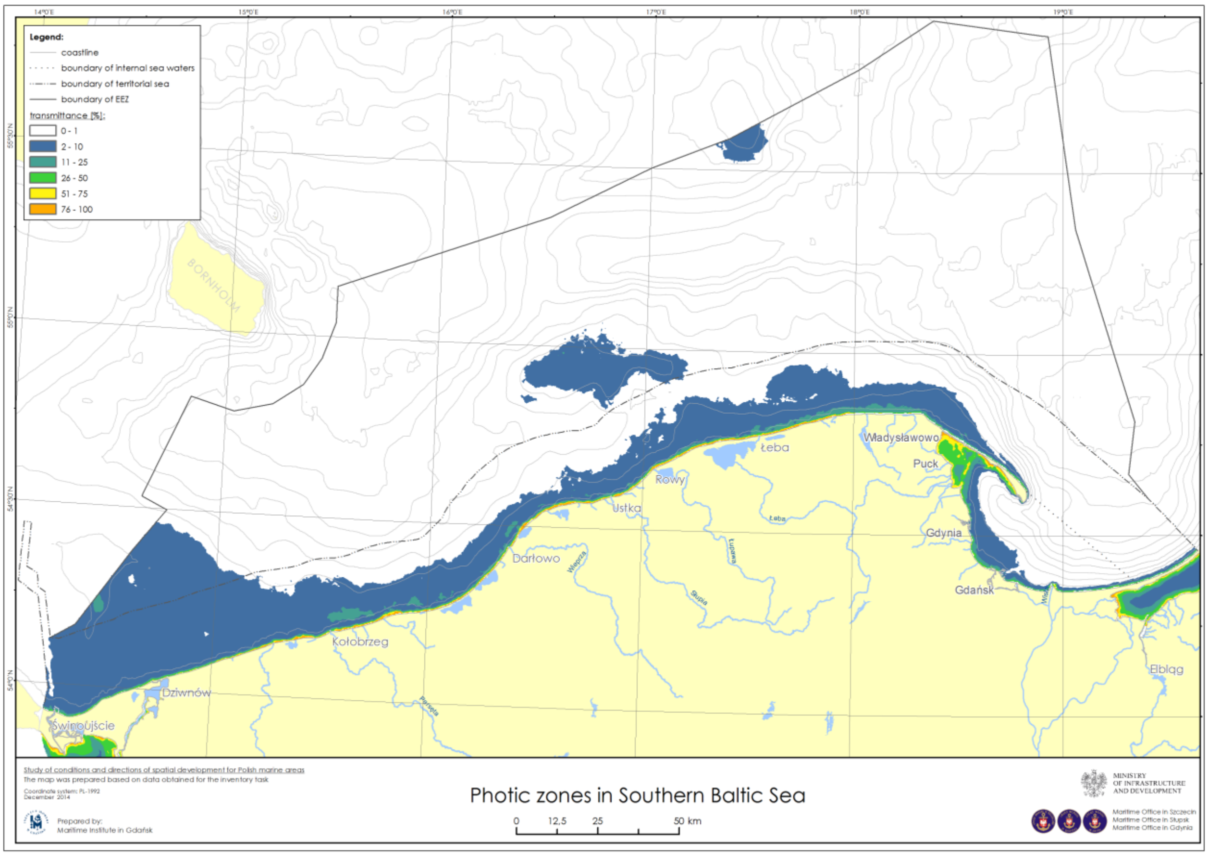


Fig. 2.4. Photic zones in Southern Baltic Sea

Source: Maritime Institute in Gdańsk, on the basis of data from the project HABITAT MAPPING

Water temperature

Water temperature is an important factor influencing the distribution of organisms and biodiversity. Temperature influences also important environmental conditions such as e.g. solubility of oxygen [ibid].

Cyclic seasonal variability temperature is a characteristic feature of Baltic Sea surface waters. Water temperature at sea surface varies in the annual cycle between 0 and 18^{o}C, and in the summer season it decreases from south-west towards north-east.

In the annual cycle, water temperature changes not only in the surface layer but also deep into the water column, causing a specific thermal stratification. Characteristic for Baltic Sea waters are three seasonal thermal systems: summer, equalised and inverted. In the summer system the warmest water is near the surface, in a 20-30 m thick layer. Below is the thermocline under which is cold water from the previous winter (Fig. 2.5).The equalised system appears in autumn and spring, and then water temperature is nearly the same (4–6°C) in the whole vertical profile, with a slight increase towards the bottom. The inverted thermal system occurs in winter, when temperature near the surface is lowest, over most of the Baltic Sea not higher than 1°C, and increases towards the bottom. The relatively high water temperature at larger depths is the effect of accumulation of water from the so-called warm infusions [Uścinowicz (ed.), 2011].

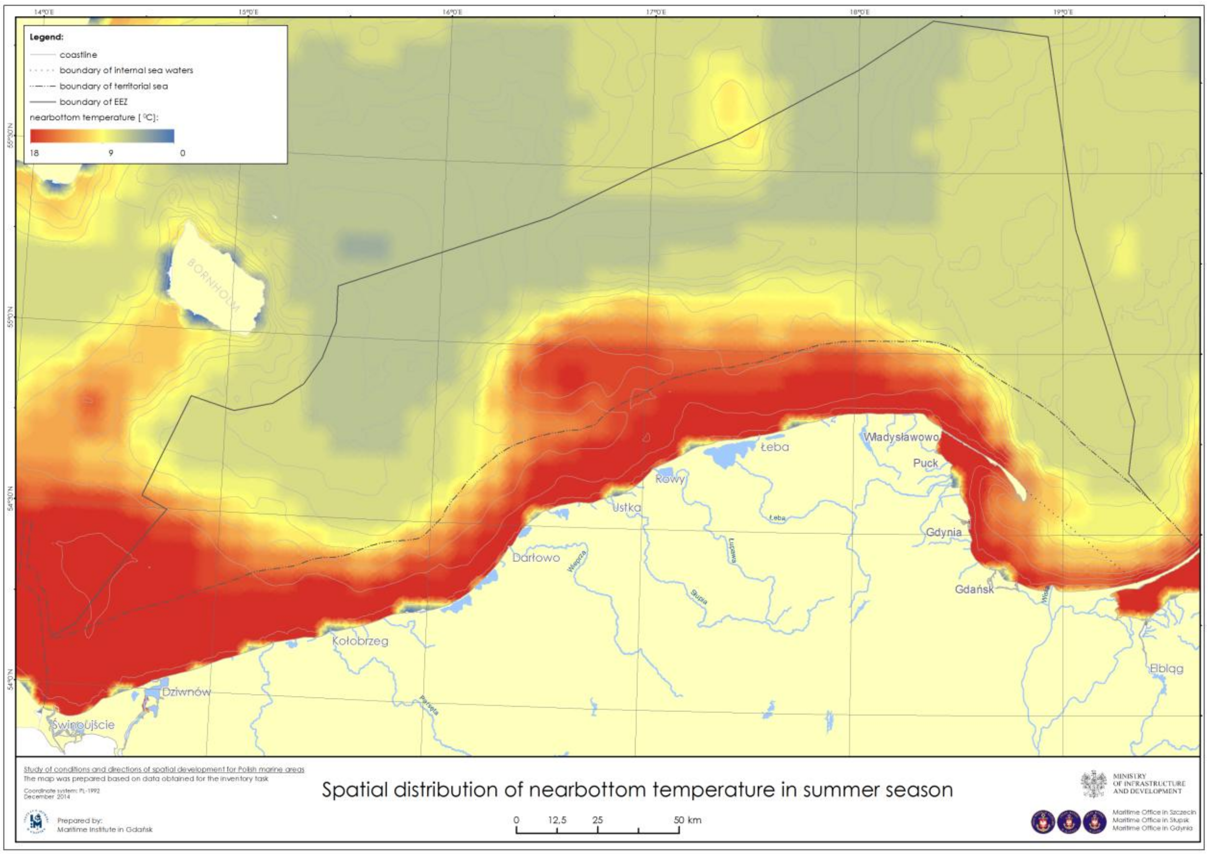


Fig. 2.5. Spatial distribution of nearbottom temperature in summer season

Source: Maritime Institute in Gdańsk, on the basis of data from the BALANCE project (HELCOM).

Mean air temperature in the period 1961-2008 in the scale of the whole country in its-geographic regions shows a statistically significant growth trend. The rate of change of mean area temperature in Poland is 0,24°C/10 years, and it is slightly higher in the west (0,25°C/10 years) than in the east (0,21°C/10 years) of the country. Quickest increase of temperature is observed along the coast (0,27°C/10 years) [Limanówka et al, 2012].

Ice cover

Icing is defined by the occurrence of sea ice, and the range and duration of the ice cover is one of the most sensitive to climate change elements of marine environment. Information about icing is also a very important determinant of conditions of winter navigation on the Baltic Sea. Every year ice sea ice impedes, or even makes impossible, navigation, transport of cargo and passengers and operation of sea ports, i.e. of key elements of maritime economy [Sztobryn et al, 2012].

The duration of ice phenomena differs significantly depending on geographic region. Icing is longest in the Gulf of Bothnia: between 130 and nearly 200 days, in the Bothnia Sea between 50 and 140 days, in the Gulf of Finland from 40 to 140 days, in the Gulf of Riga 70 to 110 days, and in the Baltic Proper 0 to 40 days [Uścinowicz (ed.), 2011].

Along the Polish coast, the maximum number of days with ice, in the years 1971-1990 was about 60 days (Świnoujście, Kołobrzeg i Ustka), the average number of days for these years was between 2 near Hel and 16 at Świnoujście [Sztobryn et al, 2012].

The phases of development of sea ice are dependent on thermal conditions. The basic effect of the present climate change is the increase of mean air temperature, especially evident during the last decades. The natural consequence of the observed and expected climate change would be a decrease of the range and duration of ice cover. Decrease of ice cover range on the Baltic Sea by the end of the 21st century is indicated by a number of investigations using a variety of models (downscaling statistical and dynamic) and emission scenarios [ibid].

Climate change – summary

Climate change seriously impacts the natural environment, economy and society. One of the most threatened areas is the coastal zone – the area of land-sea interaction. This zone is extremely important both for nature and for economy, and at the same time it is very sensitive to all natural and anthropogenic changes. Because of the contemporary climate change, probability of systematic sea level rise along the Polish coast is increasing, and this could result in flooding of coastal lowland areas within the next several decades [Jakusik 2012]. Also frequency of storm surges will increase. Ice cover, though as a rule it lasts only for a short time in Polish coastal waters, during heavy winters is a significant hindrance to the functioning of maritime economy, especially operation of ports and navigation. Ice-jams at river outlets can result in dangerous floods. The expected warming of climate may result in shorter periods of icing and in thinner ice, which would decrease the seasonal difficulties of navigation and the cost of icebreaking operations. On the other hand, significant changes of the natural environment are expected. Long term changes of the thermohaline structure of the sea only slightly depend on direct anthropogenic influences, but they are strongly dependent on climatic and hydrologic changes. Changes of atmospheric thermics and solar energy supply, as well as of supply of fresh water, determine the changes of sea water temperature and its density structure. Salt water infusions from the North Sea also are an important modifying factor, which changes both the density structure of the nearbottom water layers and concentration of oxygen necessary for the life and development of organisms in the water column. All the above factors facilitate change of the basic properties of the marine ecosystem. They are fundamental for the establishment of the ecosystem as oceanic or freshwater, which directly influences biodiversity, and in effect the productivity of the Baltic Sea ecosystem. Massive algae and cyanobacterial blooming in the sea (more in Annex 4) prove that water quality is decreasing. Processes and phenomena shaping the present image of the environment are generated by many connected factors, such as: geological structure, bottom relief, climate phenomena, hydrologic and hydrodynamic conditions, biotic elements, management of sea and coastal space and way of use of marine resources. It should be stressed that none of them should be considered, analysed and interpreted alone, without taking into account all the rest of them [ibid].

Conclusions for the maritime spatial plan of Polish sea areas

- determinations of the plan should not disturb or worsen hydrologic conditions of the area, and at the same time as far as possible make good use of them.
- planning should be based on reliable hydrometeorological knowledge and take into account potential climate change and its effect on location and type of human activities in the sea space.

Data and knowledge gaps

Most of the oceanographic, physical and chemical, etc. analyses is based on modelling because of the lack of source data covering the whole Polish sea areas. Data obtained by the National Environmental Monitoring are gathered at strictly defined measuring stations, considered to represent the whole area – but they are still only point data, especially since the stations are located far apart. The use (at national level) for planning of sea areas of information/data from preinvestment investigations carried out by the mining and energy sectors should be considered. It is also suggested that a modification of the distribution of monitoring stations should be discussed.

2.2. Assessment of energy resources of Polish sea areas

On the basis of report "Assessment of Energy Resources of Polish Sea Areas of the Baltic Sea", Maciej Kałas, Department of Operational Oceanography of the Maritime Institute in Gdańsk, 2014 – Annex 3

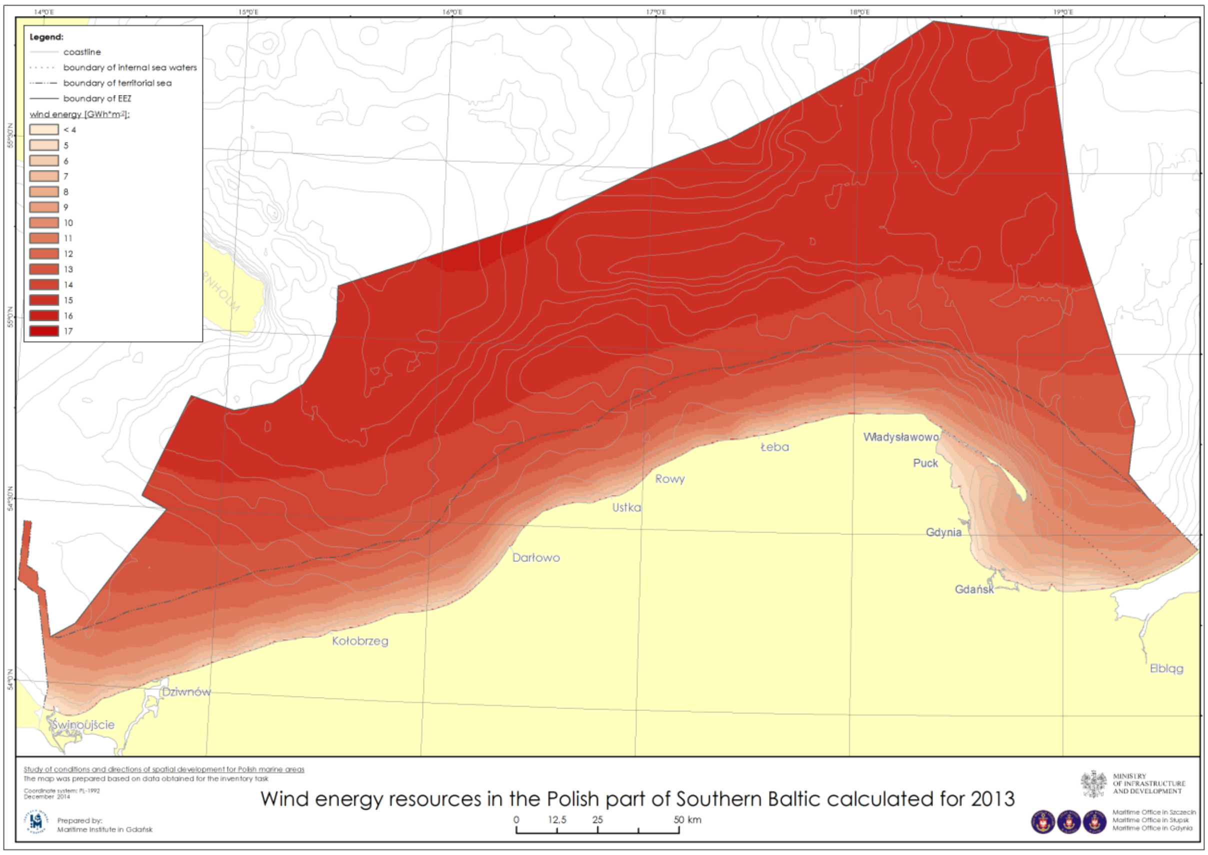
Atmospheric and hydrological processes in sea areas include significant amounts of energy, which can be used for economic objectives. Within this Study an attempt was made to assess these resources with respect to:

- wind energy,
- wave energy,
- sea current energy.

Precise determination of energy resources connected with the mentioned above phenomena is not possible not only because of their significant variability, both seasonal and between years, but mainly because there is a lack of reliable data (due to the lack of a permanent and sufficiently dense network of offshore measurement stations). Because of that, for the needs of the present analysis, information from numerical models of atmosphere and sea was used. All calculations were carried out for a period of one year, using forecast data for 2013.

Wind

The amount of energy, connected with wind phenomena over sea areas, depends mainly on the speed of air masses, which normally increases with height above sea surface. The spatial distribution of annual wind energy resources in the Polish part of Southern Baltic (GWh/m^2) is shown in Fig. 2.6.



Ryc. 2.6. Wind energy resources in the Polish part of Southern Baltic calculated for 2013[5]

Waves

Wave generation on sea surface is connected mainly with wind field changes over the whole Baltic Sea: wind duration, wind increase and decrease times, and also maximum wind speed and distance over which wind acts on the sea surface. Important factors are also the spatial distribution of water depths, sea bottom relief, distance from coastline and average water depth. Spatial distribution of annual wave energy resources in the Polish part of the Southern Baltic (MWh/m^2) in the SI system is shown in Fig.2.7.

[5] Figures in p. 2.2. come from Annex 3.

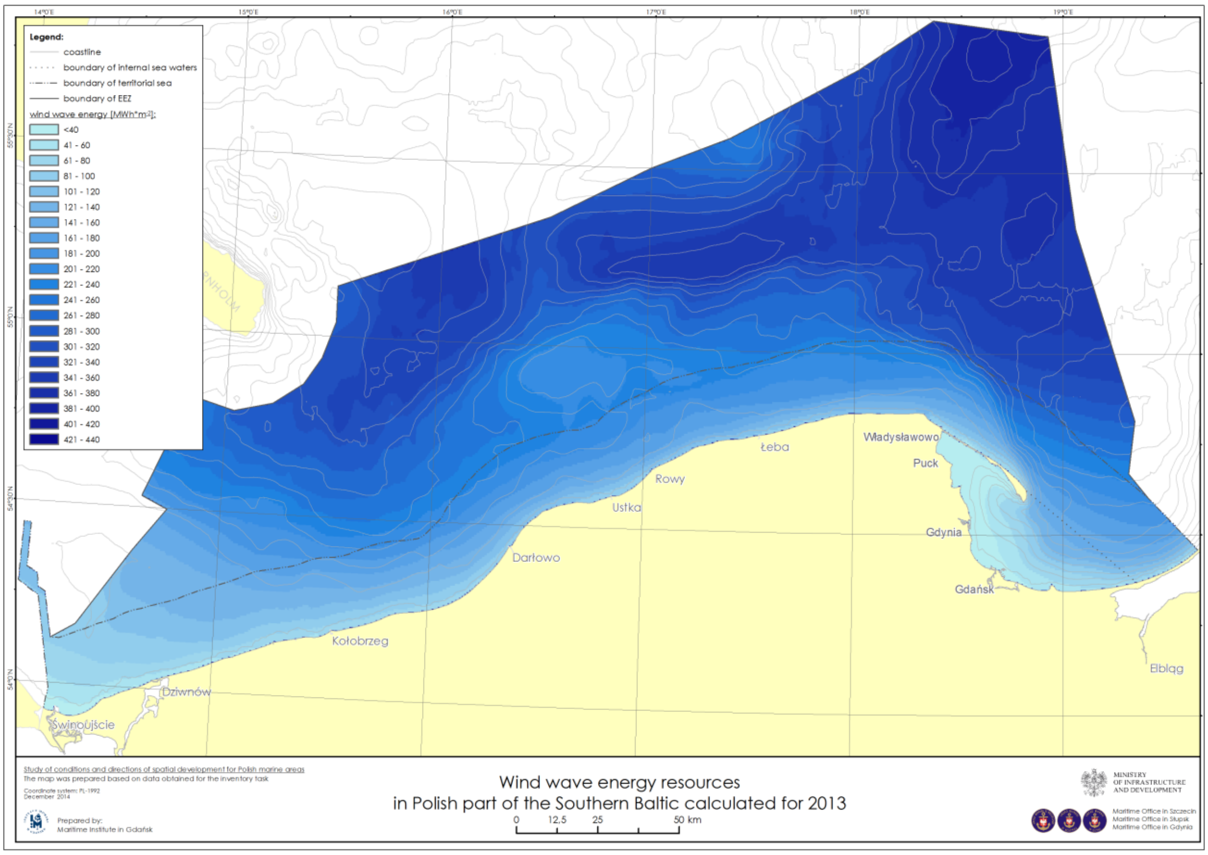


Fig. 2.7. Wind wave energy resources in Polish part of the Southern Baltic calculated for 2013

Currents

As in the case of wind waves, the intensity and direction of water flow in the whole water column is connected mainly with the distribution and size of wind fields over the whole area of the sea. However, there are some basins, where the system of currents seems to be more stabilised for longer periods.

Because highest water flows are recorded in the surface layer of the sea, and their speed significantly decreases with depth below surface, calculations for the determination of energy of currents were limited to the depth of 16 m. Fig. 2.8 presents the obtained spatial distribution of annual energy (MWh/m^2) of sea currents down to the depth of 16m.

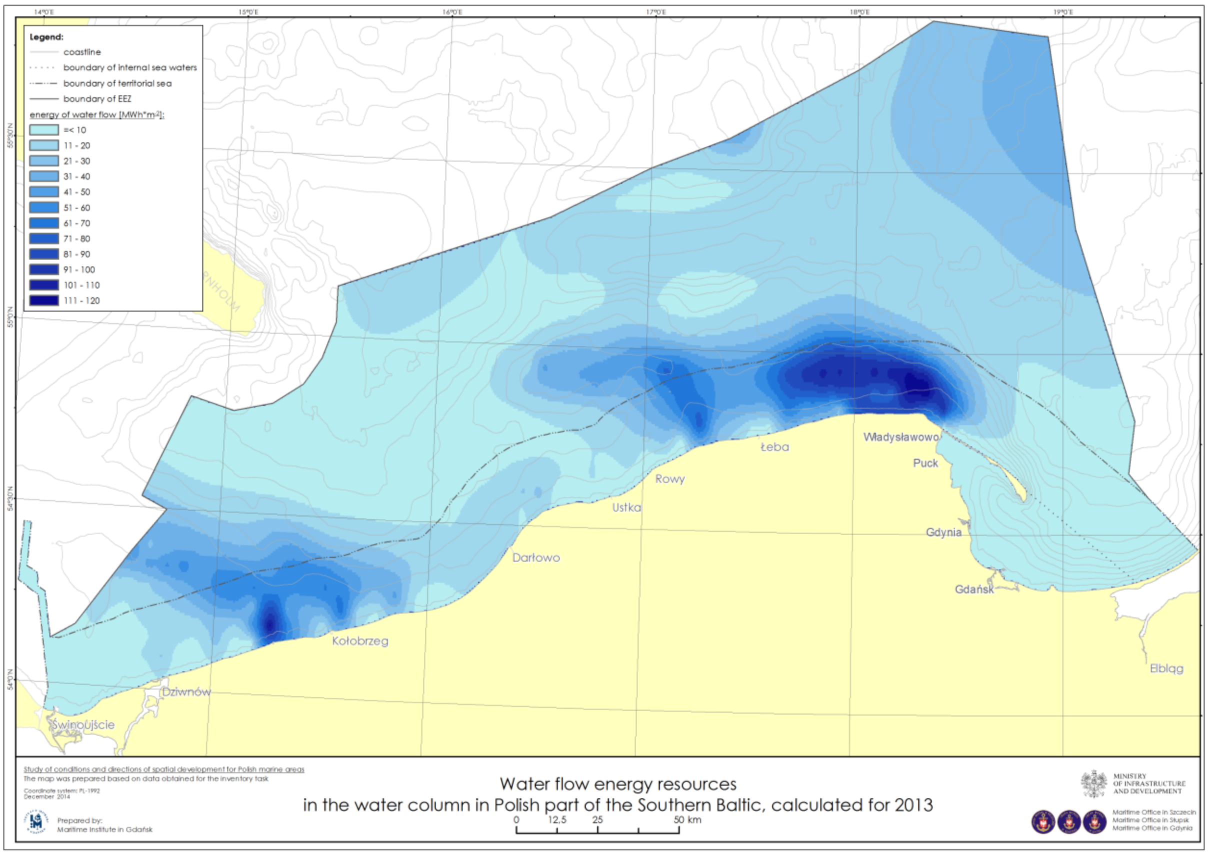


Fig. 2.8. Water flow energy resources in the water column in the Polish part of the Southern Baltic, calculated for 2013

Conclusions for the maritime spatial plan of Polish sea areas

- Wind and waves are the two environmental resources which in the near or further future could be used for renewable power production.
- Polish sea areas are characterised by good wind resources with a uniform spatial distribution of energy and an increasing trend with distance from the shore.
- At present, because of the lower energy per unit sea area parameter, energy resources of sea currents should not be considered as prospective resources and this may justify that the plan would rather not consider this resource.
- Installations producing power from waves (and also from currents) may be a significant obstacle to other ways of using the sea area, especially to navigation and fishery, and also to recreation in coastal areas.
- Location of these types of installations should be selected so that they have no negative effect on coastal stability.

2.3. Geological conditions

The Baltic is a young sea. Its basin was formed in Pleistocene during consecutive invasions of the Scandinavian ice sheet. The structure and relief of the Southern Baltic bottom is the result of long term sedimentation processes, operation of the Scandinavian ice sheets and of contemporary processes progressing on the sea bottom.

Silurian sediments are the oldest sedimentary rocks lying directly below the Quaternary cover. They are the predominant element in the sediment cover of the eastern part of Southern Baltic. They build the bottom of the Bornholm Basin, north of Słupsk Bank, north-west part of the Słupsk Trough as far as the Southern Middle Bank and further toward the Gotland Deep [Kramarska et al, 1999].

In the eastern part of Polish sea areas, Devonian sediments rest directly on top of the Silurian (the Rozewie block). In the eastern part of the Łeba block, northward of Władysławowo, the substrata of the Quaternary is formed by Permian and Triassic. Triassic sediments are also present along the Trzebiatowo fault and within the Kołobrzeg anticline where the surface below the Quaternary is built mainly of Jurassic sediments [ibid].

Jurassic forms the sub-Quaternary surface of the Gryfice block as far as the Odra Bank, and on small areas in front of Lake Żarnowiec, where also Triassic outcrops were found (Kramarska et al, 1999).

After the Sillurian, Cretaceous is the second largest in terms of area sediment rock complex forming the sub-Quaternary surface. Cretaceous sediments prevail in the west part of the Southern Baltic; they are present in the Wolin and Darłowo blocks, fill up the whole area of the Gdańsk block and Gulf of Gdańsk. They are present in the form of numerous small outcrops in Eocene and Miocene sediments along the central part of the coast (between Mielno and the Słupsk Trough and as far as regions of Władysławowo, Jastarnia and Gdańsk). Palaeocene sediments are present in the Darłowo block [ibid].

Pleistocene deposits are represented mainly by: boulder till which dominates the structure of the south-west part of Polish sea areas and of the Słupsk Bank and region east of it; subaqueous till filling the west and east part of the Słupsk Trough and further east, and also found on the bottom of the Gotland Basin together with clay and glacial-marine mud; clay and glacial-marine mud filling the deeper parts of the Southern Baltic from the Bornholm Basin to Słupsk Trough and further to the Gdańsk Basin; fluvioglacial sand occurring mainly in the eastern part of the Słupsk Bank and in the region of the South Middle Bank.

As a rule, the thickness of Pleistocene is between several and about 30 m. The largest, exceeding 100 m, thickness of Pleistocene sediments occurs close to the coast [Uścinowicz 1995c], where these sediments fill elongated depressions in the substrata of the Quaternary caused by river erosion and later glacial exaration.

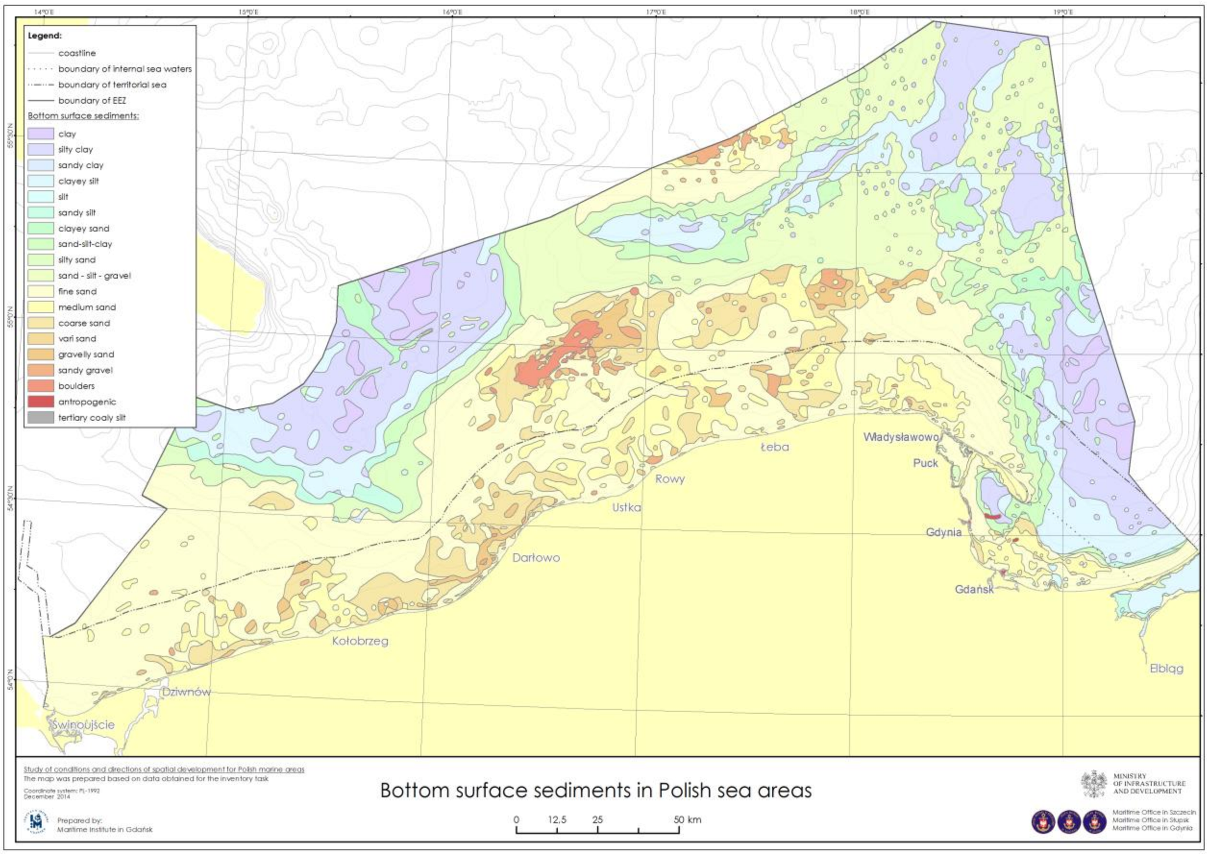
Holocene deposits form a rather thin, in some places non-continuous, layer of sand, mud and clay sediments of marine origin. The thickness of Holocene in the southern part of the Baltic Sea is only 1 m, in some places reaching 3 m. The most thick Holocene layers were found in the south-west part of Odra Bank (10 m), in some places of the Bornholm Basin (5 m), and in the Gdańsk Basin region (over 10 m) exceeding even 100 m in the region of the south-east part of Hel Peninsula [Uścinowicz 1995b].

Bottom surface sediments (Fig. 2.9)

The surface of the Southern Baltic bottom is built mainly of marine, fluvioglacial and glacial sediments. The bottom of the shallow-water area is covered mainly by marine sand, sometimes sand and gravel. Its thickness does not exceed 1-2 m, only rarely reaching several metres. Largest areas of bottom covered by sand are in the region of the Odra Bank, Czołpino Shallows, Stilo Bank, south part of Słupsk Bank and in the region of the South Middle Bank [Kramarska, 1995].

Larger accumulations of gravel and sand with gravel occur within the Słupsk Bank, South Middle Bank, and in small accumulations in the shallow belt along the coast.

In the deepwater area, especially the Bornholm Basin, most of the bottom of the Słupsk Trough and Gotland Basin, the predominant type of sediments are mud and clay. Mainly they are Yoldia Sea and Ancillus Lake clays and mud-clay Litorine and post-Litorine sediments. In some places appear outcrops of boulder till and subaqual till.



Ryc. 2.9. Bottom surface sediments in Polish sea areas

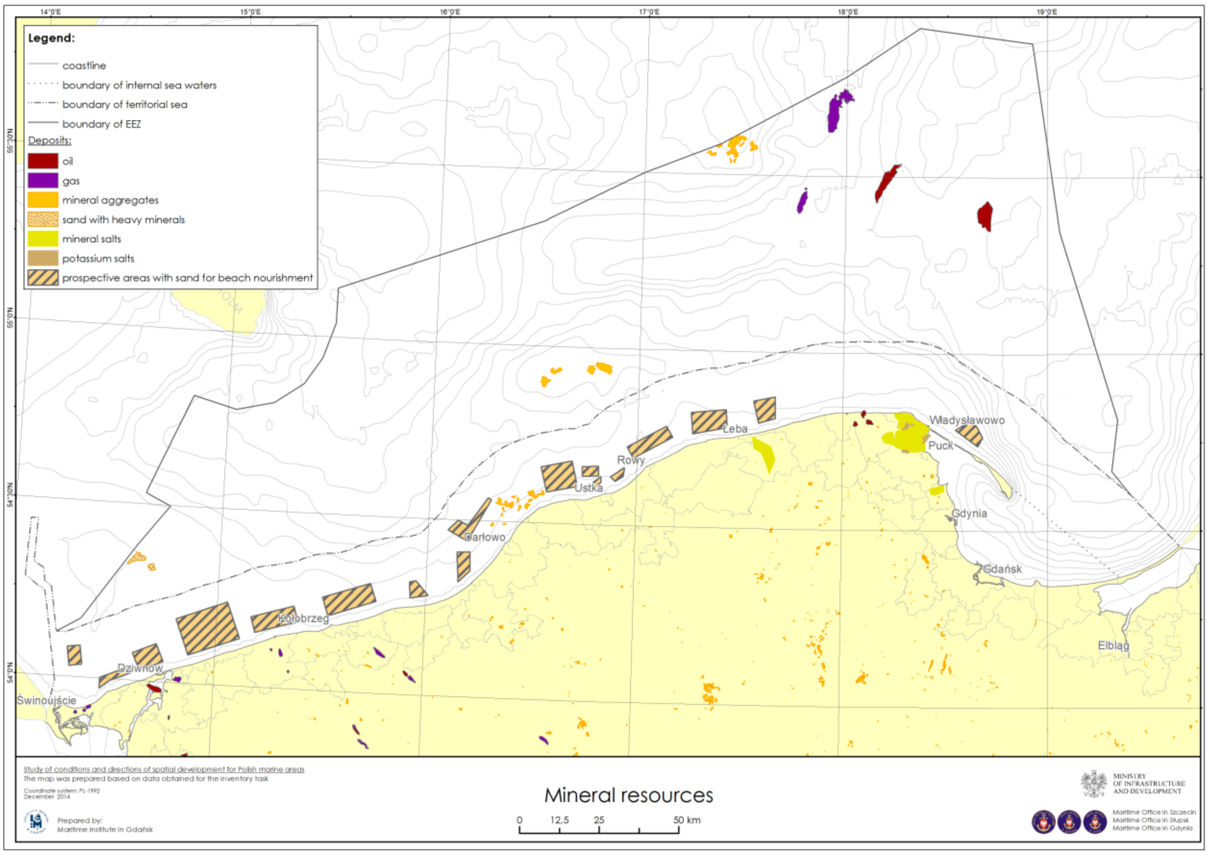
Source: Maritime Institute in Gdańsk developed on the basis of shape data of PGI-NRI.

Mineral resources

The recognition of the geological structure and mineral resources in the Polish part of the Baltic Sea is not uniform. Some of the deposits are documented and investigated, while some have the status of prospective or probable deposits (Fig. 2.10).

Cambrian deposits are an important horizon for gas and oil. In the region of the Middle South Bank they are present at about 1200 m below sea level (bsl). They slope down southward to 2700-3000 m bsl at the central part of Polish coastline and to over 4000 m bsl in the region of the west coastline. Oil and gas deposits were discovered in Middle Cambrian sandstones, in the northern part of the Peri-Baltic syneclise (Łeba upland) and in the Polish EEZ. In the area of east Baltic 4 gas concentrate and 2 oil deposits were discovered. The total volume of these deposits is assessed at about 10 billion m^3 of gas and about 30 mln tons of oil. Most of the discovered and documented deposits are connected with the system of regional dislocation zones.

Possible resources of the Cambrian formation were not assessed for the Polish EEZ. Possible resources contained in this formation in the land part were calculated in 1994 to be: 1.1 mln tons of oil and 1.3 billion m3 of gas. The size of these resources is undervalued and a new assessment should be carried out [on the basis of Bilans Zasobów Perspektywicznych 2011].



Ryc. 2. 10. Mineral resources

Source: Maritime Institute in Gdańsk on the basis of shape data of PGI-NRI and own data.

Among the most important mineral products of the surface of Southern Baltic bottom are: boulders, gravel, sand of fluvioglacial origin forming rather thin accumulations and marine sand and gravel forming thicker layers. Deposits of the Słupsk Bank, South Middle Bank and Koszalin Bay are well documented [Masłowska and Michałowska, 1995]. Heavy minerals are a potentially important resource, which are best investigated in the area of the Odra Bank and Słupsk Bank. There is also amber, but its areas of occurrence are still not sufficiently investigated and described. Good prospects seem to offer the shallow-water regions of the Gulf of Gdańsk, Ustka Bay, the region of

Jarosławiec and the region of Świnoujście [Mojski 1995]. The region of the Słupsk Bank is a prospective area for heavy minerals (mainly titanium minerals – ilmenite, rutile and zirconium) and for glass sand [*Atlas siedlisk dna*… 2009].

CO_2 storage complexes

Because of the progressing climate change it is necessary to reduce greenhouse gas emission – especially CO_2, which can be achieved among others by catching it and storing in geological formations (CCS technology). The process consists in capturing the gas emitted from industrial installations, transporting it to storage locations and pumping it into geological formations.

In order to select appropriate formations, the Ministry of Environment started in 2008 the national programme *„Investigations of formations and structures for safe storage of CO_2, and development of program of their monitoring”*. Results of carried out to date research allowed to identify formations and geological structures in which locating subterranean CO_2 storage can be allowed, taking into account safety issues. It is indicated that such storage should be possible in deep geological formations, such as exploited hydrocarbon beds and their neighbourhood.

In 2014 the Minister of Environment issued the Ordinance on *areas in which locating a subterranean carbon dioxide storage complex may be allowed* (Offcial Gazette of 23 September 2014). The area designated by this ordinance is located in the Cambrian structure in the Polish EEZ and its surface is 1390 km^2 (Fig. 2.11).

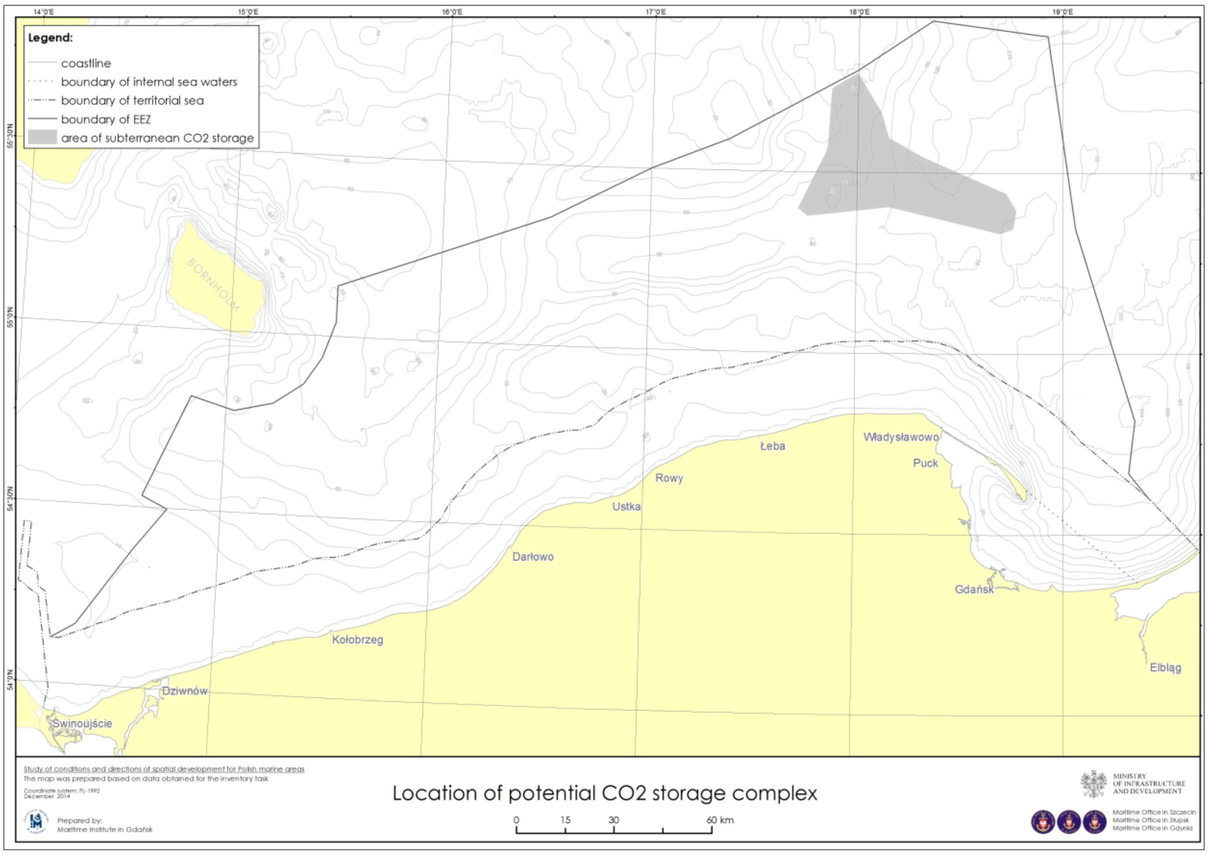


Fig. 2. 11. Location of potential CO_2 storage complex

Source: Maritime Institute in Gdańsk on the basis of the Ordinance of the Minister of environment on *areas in which locating a subterranean carbon dioxide storage complex may be allowed.*

At present, in accordance with regulations of the Act *Geological and Mining Law*, subterranean storage of CO_2 is possible only as a demonstration capture and storage project. It is planned to carry out, in the indicated area, investigations aiming at working out geological documentation.

Conclusions for the maritime spatial plan of Polish sea areas

- Examined and documented deposits of mineral resources should be protected.
- Prospective deposits should be protected against such forms of use, which will make it impossible to exploit them in the future. Since mining of prospective deposits may take place after a long time, decisions should be made about temporary forms of use of this space.
- The possibility of carrying out investigations in areas of prospective deposits in order to obtain full knowledge about the resources should be ensured.
- Areas designated by the Ordinance of the Minister of Environment for investigations to be carried out in the framework of the CO_2 capture and storage project should be taken into consideration.

Knowledge gaps:

Efforts should be made to gain full knowledge about the geological resources of Polish sea areas.

2.4. Habitats

The concept of habitat is defined in literature as a region of natural occurrence of plants and animals, characterised mainly by its physical characteristics and by species of plants and animals which occur in it [Davies et al, 2004; Brzeska et al, 2008].

These physical and chemical factors, such as salinity, oxygenation in the nearbottom water layer, bottom surface sediments and water column, type of bottom sediments and availability of light, shape the taxonomic composition, quantity and biomass of organisms. The distribution and quantity of given species are also influenced by biotic conditions, such as inter-species relationships and availability of food.

The first map of habitats of the Polish sea areas, based on physical parameters, was published in 2003 by Urbański and Szymelfenig, and was a supplement to the characteristic of benthic fauna communities proposed in 1995 by Warzocha [*Atlas siedlisk dna*… 2009] (see also p. 3.2.2 Macrozoobenthos).

Another important work on complex characteristics of habitats, which however concerns a relatively small area near Rowy, is the publication of Osowiecki and Kruk-Dowgiałło [2006]. A much larger area was covered by the coordinated by the Institute of Oceanography of Polish Academy of Sciences in Sopot project "Natural conditions for spatial planning in Polish sea areas taking into account the Natura 2000 network", within which the Maritime Institute in Gdańsk mapped bottom habitats of the Puck Bay, boulder fields of the Słupsk Bank and coastal waters between Ustka and Stilo.

In the European Union the most popular n the European Union method of distinguishing marine habitats is the EUNIS (*European Nature Information System*) classification. Determination of sea bottom habitats is carried out in a comprehensive way, basing both on their abiotic and biological (i.e. predominant species or communities of organisms) characteristics. Information about marine habitats in EUNIS classification is of hierarchical (multi-level) character, and the classification process consists in adding characteristic elements at each of the levels.

The used until now in Polish sea areas hierarchical structure of abiotic and biological elements (from highest to lowest level) was as follows [Brzeska et al, 2008; *Atlas siedlisk dna*… 2009; Kruk-Dowgiałło et al, 2011]:

susbstratum > salinity > depth > exposure to waves > type of organism community and/or organism community > predominant species.

Classification of habitats in Polish sea areas

At the third level of the EUNIS habitat classification system, based on sediment characteristics, 5 habitats are distinguished in the Polish sea areas [Kramarska et al, 2008; *Atlas siedlisk dna*… 2009] (Fif. 2.12):

- coarse grained deposits — gravel and coarse sand (A5.1), which occur over small surfaces in the widely understood coastal zone, on the Słupsk Bank and its extension eastward, and on the South Middle Bank,
- sand (A5.2) — occurs in a wide belt along the coast beginning from the Pomeranian Bay, through the slopes of Słupsk Bank, Czołpin Shallow and Stilo Bank, and in a narrower belt near the Hel Peninsula and in the Gulf of Gdańsk, also on the slopes of the South Middle Bank,
- mud – fine sediments (below 0.63 mm) (A5.3), which are present in the Baltic deeps, on the northern slopes of Słupsk Trough and in the southern part of the Gotland Basin,
- mixites (A5.4) — mixed sediments (sand, mud, gravel), present between the Bornholm Basin and South Middle Bank and the slopes of Słupsk Trough, and on the south east rim of the Gotland Basin,
- mosaic substratum (X32) — locally hard. In this category are areas with boulders and stones with sand and sometimes till between them. Sediments belonging to this habitat occur in the coastal zone in front of cliffs, in the Słupsk Bank area and to the east of Słupsk Bank.

Additionally, at the third classification level, the habitat hard immobile substratum (A3) has been distinguished – a unique in the Polish part of the Baltic Sea substratum in the form of elongated ridges formed by stones and boulders of even 3 m diameter. This habitat occurs in the north and central part of the Słupsk Bank [Kruk-Dowgiałło et al, 2011].

Using information from the project “Natural conditions...”, detailed valorization of habitats was carried out for three areas: Słupsk Bank [Kramarska et al, 2008; Kruk-Dowgiałło et al, 2011], Puck Bay and the belt of coastal waters between Stilo and Ustka [*Atlas siedlisk dna*… 2009].

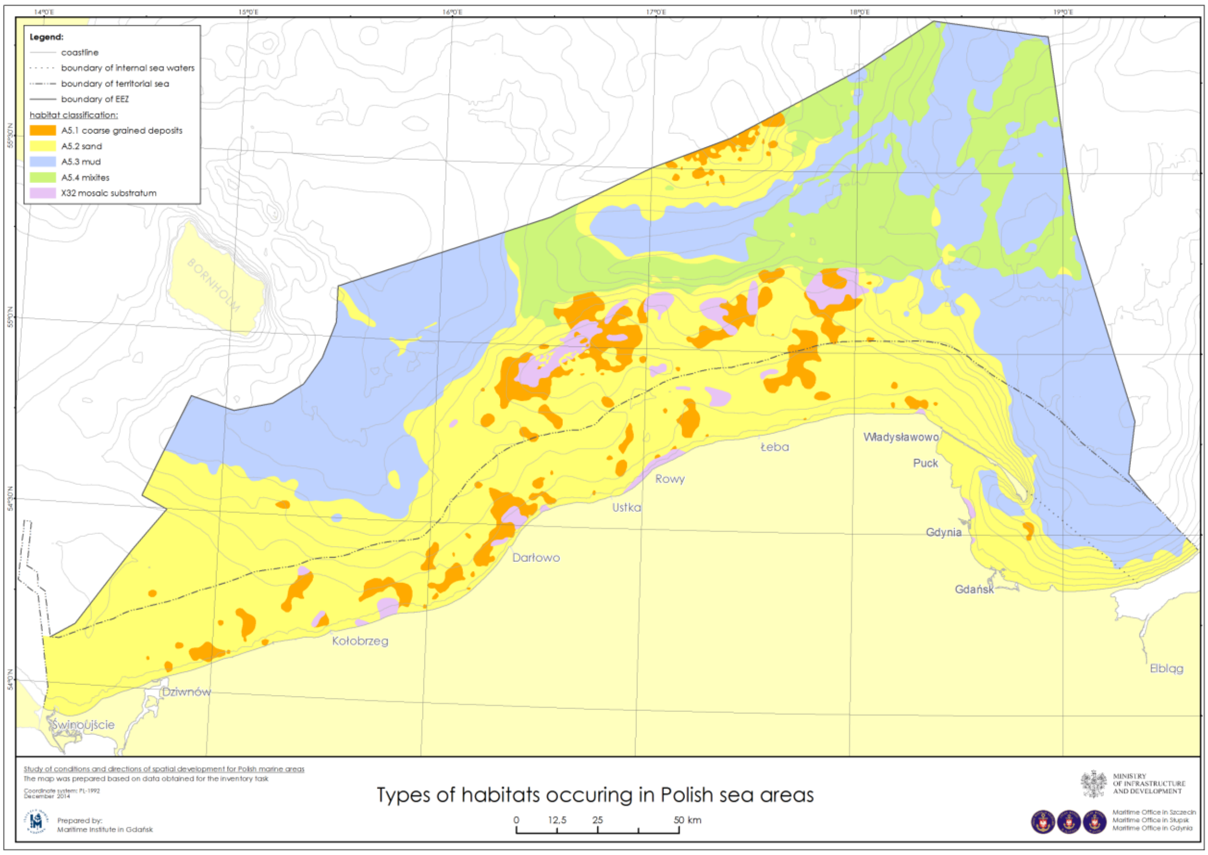


Fig. 2.12. Types of habitats occuring in Polish sea areas

Source: Maritime Institute in Gdańsk, on the basis of data of the HABITAT MAPPING project [Kramarska et al, 2008)].

Słupsk Bank

Four types of bottom habitats, described by types of substrate A5.1, A5.2, A3 and X32, were identified in the area of the Słupsk Bank's boulder field. The next stages of determination were carried out for the immobile hard substrate A3. At the lowest level of classification three types of habitats were identified:

- A3.111 hard habitat in the photic zone, highly exposed to waves, with predominant communities of *Furcellaria lumbricalis* and *Mytilus edulis trossulus*,
- A3.112 hard habitat in the photic zone, highly exposed to waves, with predominant communities of *Mytilus edulis trossulus*,
- A3.113 hard habitat in the photic zone, highly exposed to waves, with predominant communities of *Ceramium diaphanum* and *Mytilus edulis trossulus*.

The largest surface was taken up by habitat A3.111, the smallest – by A3.113 [Brzeska, 2008; Kruk-Dowgiałło et al, 2011].

Puck Bay

The Puck Bay is characterised by the presence of sandy deposits, and the most important factor is the occurrence in its area of multi-species underwater meadows. It is an exceptionally valuable nature region. Detailed characteristic is given in chapter 3.2 dealing with the valorisation of Polish sea areas from the point of view of elements of biocenosis (see also Annex 4).

Stilo – Ustka

In the belt of coastal waters between Stilo and Ustka occur two types of habitats. The largest area is taken up by a habitat connected with dynamic sands, with no vegetation and presence of valuable species of crustaceans. In the west part of the area, where the bottom is mainly of a mosaic character, on stones may occur algae [*Atlas siedlisk dna*… 2009].

Summary

Hydrological specifics: predominant influence of rivers, limited exchange of water with the ocean, decrease of salinity gradients eastward and their increase towards the deeps, strong stratification of water, and complementary to these phenomena occurrence of a limited number of species with differeing environmental requirements: freshwater, marine and euryhaline – practically without ecological functional doublers, cause that the Baltic Sea ecosystem is very vulnerable to degradation.

In the situation of a small sea, such as the Baltic, penetration by actively and passively migrating organisms (fish, mammals, birds, macroalgae) occurs over the whole area of the sea. This concerns not only freely moving (necton) organisms, but also sedentary species, e.g. macroalgae, which after becoming detached from their substratum are transported by currents far from their natural stands. Therefore many local habitats have a supra-regional importance for the durability of Baltic Sea populations, and moreover each of them in a certain sense is unique by itself. The special habitat conditions in the Polish sea areas and in other parts of the Baltic Sea are complementary. Change or loss of this diversity in sea basins administered by Poland may be difficult to compensate in other parts of the Baltic. Because of that the effect of local risks and degradation in one part of the sea may be transferred to another part, outside the administrative boundaries, e.g. outside the Polish EEZ [*Opracowanie dokumentacji…* 2007].

Conclusions for the maritime spatial plan of Polish sea areas

- Protection and cohesion of key habitats in Polish sea areas must be ensured.

Knowledge gaps

From the point of view of managing sea space, the key issue is to improve knowledge about the quantitative and qualitative structure and distribution of sea bottom habitats. The modified EUNIS system of classifying Baltic Sea natural habitats proved itself in the case of hard immobile substrata. It should be used in other regions of the Baltic Sea, increasing the quantity of data. Only in this way it will be possible to develop a system which will classify habitats of the sea bottom in a precise and correct way, in result allowing producing accurate maps of habitat distribution in order to protect their values.

This implies that continuous monitoring (which is ensured by the National Environmental Monitoring) and specialised investigations should be carried out.

3. NATURAL CONDITIONS

Based on „Analysis and description of natural conditions for the Study of Conditions of Spatial Development of Polish Sea Areas', M. Michałek et al, Department of Aquatic Ecology, Maritime Institute in Gdańsk, 2014 – Annex 4.

The guiding principle of spatial development of the sea areas (in acc. with HELCOM-VASAB, 2012) is the so called *ecosystem approach*, which demands intersectoral and sustainable management of human activities and whose aim is to achieve a good ecological status of the Baltic Sea environment. Sustainable management in this concept means reconciliation of economic, social and environmental interests. The environmental aspect is therefore an important component of maritime spatial planning, while natural conditions including both natural characteristics and legal status, especially with respect to areas protected under the Act of 16th April 2004 on nature protection (unified text JoL of 2013, it. 627 with later amendments), refer to almost every space.

Maritime spatial planning is promoted and recommended by the Marine Strategy Framework Directive (Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy, Official Journal of EU, L 164, 25.5.2008, hereinafter MSFD[6]). Furthermore, it is the basis for the planning with respect to regulations on environmental protection (point 3 of the Preamble to MSFD). It imposes an obligation on Member States to achieve a *good environmental status* (GES) in the marine region by 2020, to use the ecosystem approach and to ensure that pressure exerted by human activity does not prevent the achievement of GES. A good environmental status "means the environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive within their intrinsic conditions, and the use of the marine environment is at a level that is sustainable, thus safeguarding the potential for uses and activities by current and future generations".

From that point of view, maritime spatial planning is perceived as a useful tool for achieving good environmental status.

Preparation of a good spatial plan for the sea areas requires collecting and analysing information concerning natural values of a given sea basin in order to identify the most valuable areas as well as those which are susceptible to human interference. Within this work, the valorisation of sea space with respect to each of the elements of environment includes both quantitative and qualitative criteria [Derous et al, 2007; Natural conditions of spatial plans… 2008; Węsławski et al, 2009].

The quantitative criteria include:

- the number and biomass of species (e.g. high concentration of wintering water birds),
- the richness in species (biodiversity)

The qualitative criteria include:

- the rarity of a species/habitat (uniqueness)
- naturalness (degree to which a species complex/habitat is conserved in unchanged form)
- presence of protected species/habitats
- relevance of species/habitats for ecological process.

[6] Marine Strategy Framework Directive

Ecological coherence plays an important role in ensuring normal functioning of ecosystems, therefore the territorial dimension – significance of a particular sea area for the ecosystem, as well as time dimension of the demand of each of the ecosystem components for sea space of given quality, were considered. This mainly concerns maintaining the possibility of access of the various elements of biocenosis to important for their life cycle locations for breeding, resting and feeding purposes (Table 3.1).

Table 3. 1. Temporal dimension of demand for sea space[7]

Element of biocenosis	Temporal demand for specific sea space
Macrophytes	Whole year
Macrozoobenthos	Whole year
Ichthyofauna	Periods of breeding and migration
Avifauna	Periods of wintering, migration and breeding
Sea mammals	Periods of reproduction and moulting

The natural value of Polish sea areas is spatially quite diversified. For the purposes of maritime spatial plan(s) of Polish sea areas, it is important to identify which parts currently are, or may be endangered by economic activities. The goal is to minimize these effects of the activities, which significantly disrupt the structure of marine habitats in areas of exceptionally high natural value [*Natural conditions for spatial plans*… 2008].

3.1. Nature protection in Polish sea areas

Polish sea areas are characterized by diverse natural values, which is reflected in the quality, quantity and size of protected areas established in them. These protected areas include the highest spatial forms of nature protection, i.e. national parks, as well as Sites of Community Importance (SCI) which are in the Natura 2000 network of Special Areas of Conservation (SAC)) and landscape parks. Key bird protection areas were identified by BirdLife International as Important Bird Areas (IBA). These areas are protected as Special Protection Areas (SPA) within the Natura 2000 network (Table 3.2, Fig. 3.1). In Poland, no new protected areas were established undre the Helsinki Convention. Instead nine of Natura 2000 areas (all areas with largest sea space) were given the status of HELCOM *Baltic Sea Protected Area*. The total surface of the protected areas is 6494 km^2, which represents almost 20% of all Polish sea areas. Summary description of nature protection forms with a brief characteristic is presented in Table 3.2.

[7] Tables and illustrations in Chapter 3 come from Annex 4

Table 3. 2. Summary of nature conversation forms in Polish sea areas

Name	Legal status	Description/protection goals	Protection plan
National Parks			
Słowinski National Park	Ordinance of the Council of Ministes of 23.11.1996 on establishing the Słowiński National Park (JoL No 42, item 254).	Characteristic elements of the Słowinski National Park include a system of coastal lakes, bogs, peatbogs, meadows, coastal woods and forests, but first of all, dune belt on the spit with moving dunes. The general aims of conservation are to: 1. maintain ecological processes stability of ecosystems 2. maintain biological diversity 3. maintain geological heritage, 4. maintain or reconstruct the proper state of habitats and other natural resources of nature and its components, especially: wild plants and animals, natural habitats, habitats of protected vegetation and animals, migratory animals, plants or animals protected by special regulations, inanimate nature, landscape, 5. create proper attitude of people towards nature. Since 1977 the area of the Park is included into the UNESCO Global Network of Biosphere Reserves (within the framework of the Man and Biosphere Programme), and in 1995 it was included in the list of protected areas under Ramsar Convention on Wetlands of International Importance (No. 757). Included into the network of Baltic Sea Protected Areas (BSPA)[8] (85) and Natura 2000 Network.	Work in progress
Wolinski National Park	Ordinance of the Council of Ministers of 3.03.1960 on establishing the Wolinski National Park (JoL No 14, Item 79, as amended).	The landscape of Wolinski National Park includes high cliffs of particular value for Polish coastline, well preserved beech forests, 1 Nm wide belt of Baltic coastal waters, unique island-like delta of Swina and the "back delta" of Swina with its islands and surrounding waters of Szczecin Lagoon. Strictly protected areas cover a total area of 498.72 ha (4.56%).	Work In progress

[8] http://helcom.fi/action-areas/marine-protected-areas

Name	Legal status	Description/protection goals	Protection plan
		The general aims of conservation are to: 1. maintain ecological process and the stability of ecosystems 2. maintain biological diversity 3. maintain geological heritage[9], 4. maintain and restore proper state of habitats and other resources of nature and its componets, especially: wildly existing plants and animals, natural habitats, habitats of protected plant and animal species, migratory animals, plants and animals protected by special regulations, inanimate nature, landscape, 5. creating proper attitude of people towards nature.	
Landscape park			
Coastal Landscape Park (CLP)	Established in 1978 by the Resolution no. 142/VII/11 of Pomeranian Regional Assembly of 27.04.2011 on Coastal Landscape Park	Over half of its area is covered by the waters of the inner part of the Puck Bay, which are separated by a shoal, called Rybitwia Mielizna. The land part of the Park comprises the entire Hel Peninsula and a narrow strip of coast from Białogóra to Władysławowo including the area of Karwieńskie Błota. To the south from Władysławowo the borders of CLP cover the areas of Kępa Swarzewska, Puck, and ice-margin valley lowlands of Płutnica and Reda to the village of Mechelinki.This park features all types of sea coast characteristic for the South Baltic. The protection aims of the Park are to: 1. maintain the natural character of the coast and river outlets and the specifics of spit forms 2. maintain the characteristic zonal system and spatial continuity of the various types of coastal ecosystems, 3. protect floristic and phytocenotic values of the park, especially valuable phytocenosis inthe Puck Bay and on its coast, dune and cliff communities, forest peat bogs, swamps and water holes with rare plant communities, including plants of the Atlantic biogeographical range	None

[9] Geological heritage, including underwater landscapes, is very rarely protected. In the future more attention should be given to them For example, for the good state of ecosystem it is important to maintain regulatory processes (e.g. denitrification) as important ecosystem services provided by the marine environment.

Name	Legal status	Description/protection goals	Protection plan
		area, 4. protect of breeding, feeding and resting sites for individual groups of animals, especially fish and marine mammals as well as important bird nesting, resting and feeding areas during their migration and wintering. 5. maintain historical spatial diversity of various types of fishing and farming villages, settlements and areas with important strategic and navigation value, together with their architectural tradition 6. maintain non-material cultural values, in particular ethnic specificity, customs and cultural activities of Kashubian communities 7. protect characteristic landscapes of the open sea coast (dunes and cliffs) and bay (dunes, uplands and lowlands), including the characteristic organogenic-mineral plains of Hel Peninsula, exposed upland edges and extensive landscapes of coastal plains and ice-margin valleys. Included into the BSPA Network (84)	
Sites of Community Importance (SCI) which belong to the Natura 2000 network (Special Areas of Conversation – SAC)			
PLH220032 Puck Bay and Hel Peninsula	Submitted to the European Commission as a Site of Community Importance in August 2007. Approved by Commission's Decision in March 2009 (2009/93/EC). Updated by a Commission's Implementing Decision of 11.07.2013 adopting a seventh update of the list of sites of Community Importance for the Continental biogeographical region (notified under document number	The area is the only place in Poland where habitat type 1160 "large shallow bay" occurs with connected marine biotopes. 25 types of habitats listed in Annex I to the Council Directive 92/43/ EEC; (including 12 regarded as objects of protection),are identified in thisn area. Additionally,there are 3 plant species listed in Annex II of the Habitats Directive (SDF update 2013-10). Included in BSPA network (84)	Work on draft protection plan is in final stage. The draft will be submitted to the Minister of Environment by territorially competent Director of Maritime Office in 2015[10]

[10] Translators' note: Draft protection plans were developed and submitted to the Minister of Environment in April 2015.

Name	Legal status	Description/protection goals	Protection plan
	C (2013) 7358 (2013/741 / EU) Official Journal of the European Union L 350/287 of 21/12/2013).		
PLH220105 Cliffs and Stone Reefs of Orłowo/ Gdynia	Submitted to the European Commission as a Site of Community Importance in August 2012. Approved by Commission's Implementing Decision of 11.07.2013 adopting a seventh update of the list of sites of Community Importance for the Continental biogeographical region (notified under document number C (2013) 7358 (2013/741 / EU) Official Journal of the European Union L 350/287 of 21/12/2013).	The area includes the sea area of the Gulf of Gdańsk adjacent to the Kępa Redłowska Nature Reserve, from Polanka Redłowska to Kacza River, and also a narrow strip of land (separated by Redłowska Depression of Kacza River valley) along the edge of the Gdansk-Wejherowo hills, together with the mouths of the Swelini River and Kolibki Stream. Protection includes 7 habitats listed in Annex I of Council Directive 92/43 /EEC (SDF updated on 2013-10).	None
PLH220044 Vistula river mouth refuge	Submitted to the European Commission as a Site of Community Importance in August 2007 and approved in 2009 (2009/93/EC). Approved by Commission's Implementing Decision of 11.07.2013 adopting a seventh update of the list of sites of Community Importance for the Continental biogeographical region (notified under document number C (2013) 7358 (2013/741 / EU) Official Journal of the European	The area includes the estuaries of the largest Polish river – Vistula. They are one of the largest and most important estuaries in Poland. 9 types of habitats listed in Annex I of Directive 92/43 /EEC) have been identified in the refuge. They are a typical complex of plant communities growing on a sandy substratum, Despite strong anthropogenic pressure and significant transformation thereof are well-preserved dune vegetation communities. (SDF updated 2013-10) Included into BSPA network (302)	Work on draft protection plan is in final stage. The draft will be submitted to the Minister of Environment by territorially competent Director of Maritime Office in 2015

Name	Legal status	Description/protection goals	Protection plan
	Union L 350/287 of 21/12/2013).		
PLH220023 Slowinska Refuge	Submitted to the European Commission as a Site of Community Importance in August 2004 and approved in 2008 (2008/25/EC). Currently applicable by Commission's Implementing Decision of 11.07.2013 adopting a seventh update of the list of sites of Community Importance for the Continental biogeographical region (notified under document number C (2013) 7358 (2013/741 / EU) Official Journal of the European Union L 350/287 of 21/12/2013).	The area contains well-preserved, ranging over large large areas, habitats which arecharacteristic for coastal regions, including 26 types of habitat listed in Annex I of Directive 92/43 /EEC. The area rich in many rare and endangered species, listed in 23 of Annex II of Directive 92/43 / EEC (including 8 fish species, and one of the richest in Poland *Linaria odora* population – also a species listed in Annex II of the Directive) and many legally protected vascular plants (SDF updated 2014-02). The area is on the list of Ramsar Convention areas;it is also located within the Slowinski Biosphere Reserve. Included in BSPA network (85)	Under development
PLH990002 Refuge in Pomeranian Bay	Submitted to the European Commission as a Site of Community Importance in August 2006 and approved in 2009 (2008/25/EC). Currently applicable by Commission's Implementing Decision of 11.07.2013 adopting a seventh update of the list of sites of Community Importance for the Continental biogeographical region (notified under document number C (2013) 7358 (2013/741 / EU)	Key area for protecting habitat 1110 (sandy undersea shoals) and area of regular observations of harbour porpoises *(Phocoena phocoena)*. The area is also important for the Baltic population of twaite shad (*Alosa fallax*). Important bird refuge of international rank E82 (SDF updated 2013-10). Included into BSPA network (170)	Work on draft protection plan is in final stage. The draft will be submitted to the Minister of Environment by territorially competent Director of Maritime Office in 2015

Name	Legal status	Description/protection goals	Protection plan
	Official Journal of the European Union L 350/287 of 21/12/2013).		
Natura 2000 network Special Protection Areas (SPAs)			
PLB 220005 Puck Bay	Established by the Ordinance of the Minister of Environment of 21.07.2004 on areas of Special Protection for Birds Natura 2000 (JoL of 21.10.2004 no. 229 item 2313). Amended by Ordinance of the Minister of Environment of 12.01.2011 on Special protection areas for birds (JoL of 2012; no 25, item 133, as amended).	At least 28 species of birds listed in Annex I of the Birds Directive and 11 species listed in Polish Red Book are noted in the area. Nesting of over 1% of the Polish population (C3) of gray herons, herring gulls, common shelducks, common mergansers, citrine wagtails, oystercatchers and ringed plovers. Recently there were also nests of dunlins (schinzii). In the migratory period there is at least 1% of the flyway population (C2 and C3) of great crested grebes, horned grebes, tufteds, great cormorant; relatively high concentrations (C7) of: coots, whooper swans, oystercatchers and curlews. In winter there is at least 1% of flyway population (C2 and C3) of smews, tufted ducks, common goldeneyes, common mergansers, greater scaups, great crested grebes, mute swans. Waterfowl concentrations significantly exceed 20,000 individuals. (SDF updated 2013-10). Included into BSPA network (84)	Work on draft protection plan is in final stage. The draft will be submitted to the Minister of Environment by territorially competent Director of Maritime Office in 2015
PLB220004 Vistula River Delta	Established by the Ordinance of the Minister of Environment of 21.07.2004 on areas of Special Protection for Birds Natura 2000 (JoL of 21.10.2004 no. 229 item 2313). Amended by Ordinance of the Minister of Environment of 12.01.2011 on Special protection areas for birds (JoL of 2012; no 25, item 133, as amended).	At least 40 species of birds listed in Annex I of the Directive 79/409/EEC and 11 species listed in the Polish Red Book are noted. Important habitat for many waterfowl during whole year, especially the during migration period and in winter. At least 24 waterfowl species stay during breeding season and at least 120 outside the breeding season. (SDF updated 2013-10). Included into BSPA network (302)	Work on draft protection plan is in final stage. The draft will be submitted to the Minister of Environment by territorially competent Director of Maritime Office in 2015

Name	Legal status	Description/protection goals	Protection plan
PLB 990003 Pomeranian Bay	Established by the Ordinance of the Minister of Environment of 21.07.2004 on areas of Special Protection for Birds Natura 2000 (JoL of 21.10.2004 no. 229 item 2313). Amended by Ordinance of the Minister of Environment of 12.01.2011 on Special protection areas for birds (JoL of 2012; no 25, item 133, as amended).	Diversified sea bottom (from sandy shoals to extensive gravel and stone/boulder beds) with rich benthic communities. At least 3 bird species, listed in Annex I to the Birds Directive, are present in the area. During the migration season and in winter the area accommodates at least 1% of flyway population (C2 and C3)) of great crested grebes, red-necked grebes, horned grebes, smews, long-tailed ducks, common scoters, black guillemots, red-breasted mergansers, velvet scoters; relatively high numbers (C7) of black-throated and red-throated loons occur. Waterfowl concentrations exceed 20,000 individuals (C4), and iover 100,000 in winter. (SDF updated 2013-10). Included into BSPA network (170)	Work on draft protection plan is in final stage. The draft will be submitted to the Minister of Environment by territorially competent Director of Maritime Office in 2015
PLB990002 Baltic Coastal Waters	Established by the Ordinance of the Minister of Environment of 21.07.2004 on areas of Special Protection for Birds Natura 2000 (JoL of 21.10.2004 no. 229 item 2313). Amended by Ordinance of the Minister of Environment of 12.01.2011 on Special protection areas for birds (JoL of 2012; no 25, item 133, as amended).	The area of coastal sea waters with water depth between 0 and 20 m; extending along 200 km of coast from Hel Peninsula to the Pomeranian Bay. The sea bottom is uneven, with bottom relief amplitudes reaching 3m. Bird refuge of European significance E-80. Wintering area of 2 bird species listed in Annex I of the Directive 79/409/EEC: black-throated and red-throated loons (C7). In winter occurs at least 1% of flyway population (C3) of long-tailed duck, black guillemot and velvet scoter. (SDF updated 2013-10). Included into BSPA network (179)	Work in progress
Areas of special protection of habitats Natura 2000 network and Areas of Special Birds Protection Natura 2000			
PLC990001 Słupsk Bank	Submitted as an area of special protection of habitats in 2004, established by the Ordinance of the Minister of Environment of	Bird Area of European significance E-79. At least two birds species listed in Annex 1 to Birds Directive occur in the area. During winter at least 1% of flyway population of long-tailed ducks and black guillemots is observed. Waterfowl concentration exceed 20.000 individuals.	None

Name	Legal status	Description/protection goals	Protection plan
	21.07.2004 on Special Protection for Birds Natura 2000 (JoL of 21.10.2004 no. 229 item 2313). Submitted as an area of special birds protection in 2006. Approved in 2009 by 2009/93/ECC Directive.	Presence of red algae *Delesseria sanguinea* which were considered extinct in the Baltic Sea Proper. Shallows are colonised by numerous invertebrates, which provide a rich food base for waterfowl during the fall and winter months. (SDF updated 2013-10). Included into BSPA network (87)	

Detailed information on the aims of Natura 2000 Network and description of the Natura 2000 sites are submitted on Standard Data Forms (SDF) http://natura2000.gdos.gov.pl/datafile

Source: Department of Ecology of Waters, Maritime Institute in Gdańsk

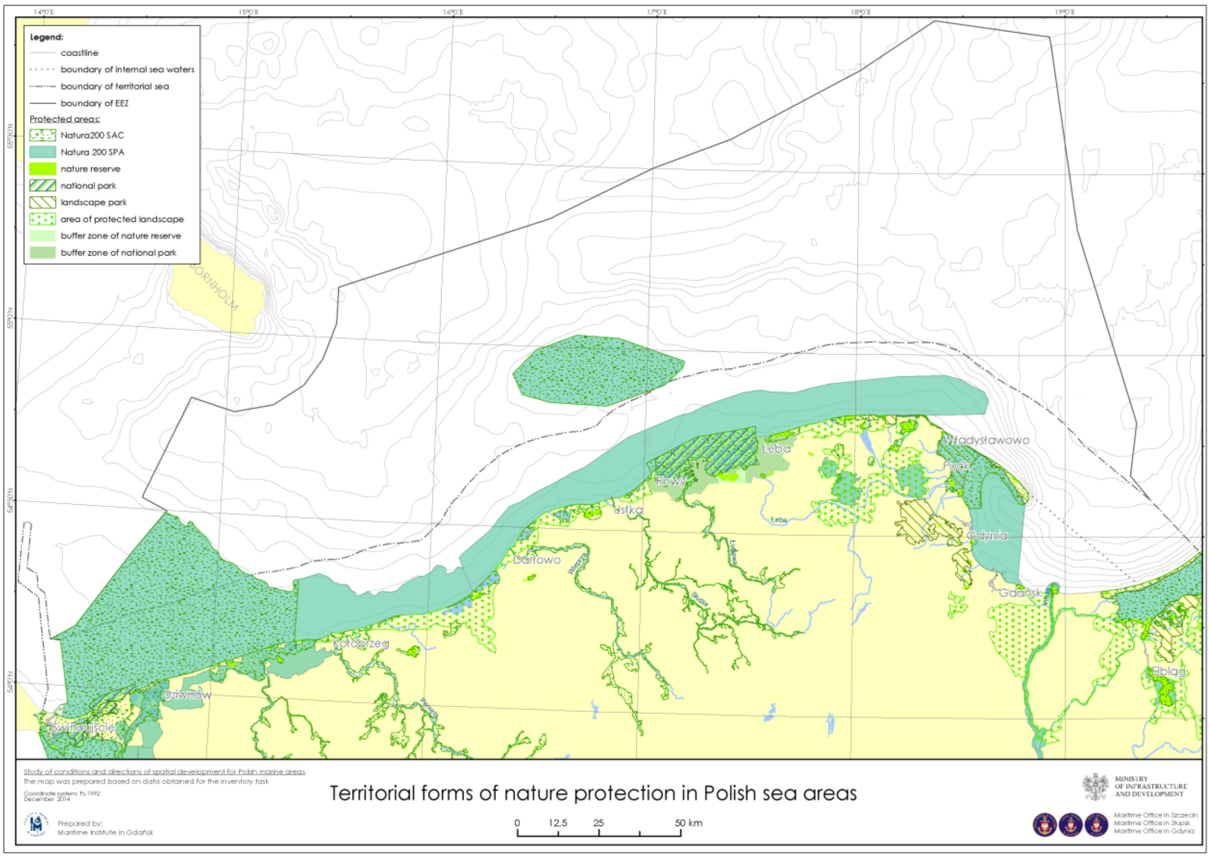


Fig. 3. 1. Territorial forms of nature protection in Polish sea areas

Species protection

Protection of species in Polish sea waters covers especially rare, endemic and close to extinction species of wild animals and plants [Głowaciński and others, 2001; Mirek and others, 2006]. Species protection in Poland is based on the Act of 16th April 2004 on nature protection (unified text, JoL of 2003, Item 627) and lower order implementing regulations. At international level, cooperation on issues concerning species protection is realised within the framework of the Birds and Habitat EU Directives[11].

3.2 Biological valorisation of Polish sea space in terms of individual elements of the biocenosis

3.2.1 Macrophytes

The assessment of value of macrophytes in the Polish sea area was based on methods adopted for valorisation of plants both for soft (sandy) and hard (rocky) bottoms [Kruk-Dowgiałło and Brzeska, 2009; Kruk-Dowgiałło and others, 2011], which take into account the analysis of qualitative and quantitative structure of macrophytes. Data used for the valorisation were obtained in the period of 2005-2013 within the framework of scientific and research programs, the Environmental Monitoring Programme and development of protection plans for Natura 2000 areas (Table 4.1.1 Annex 4). Based on these data, the qualitative and quantitative characteristics of macrophytes were identified in

[11] Protected species are presented in Tables 3.1-3.4 and Annex 4.

three Polish sea areas: stone and boulder field off Rowy, stone and boulder field on Słupsk Bank and the area of Puck Bay (Table 3.3.). The remaining areas could not be valorised because investigations directed at occurrence of macrophytes, especially macroalgae, were not carried out in them, or because results of investigations were not published and/or impossible to obtain. The best investigated sea area is the Puck Bay. The smallest number of investigations of macrophytes was carried out in the nearshore zone of the open sea coast.

Criterions of valorisation

The following valorisation criteria have been applied in the assessment[12]:

1. Occurrence of plant communities (which are the habitats for growing and living of fauna, as well as an important element of marine environment which increases the biodiversity and productivity of the sea basin);
2. Occurrence of rare and protected species (maintenance of habitats of these species is essential to preserving biodiversity and proper functioning of the marine ecosystem);
3. Dominance of eutrophication indicator species in the biomass (intensive development of these taxons indicates negative changes in marine environment which may threaten other components of biocenosis, thereby reducing the natural value of the area).

Characteristic of most valuable areas

Valorisation of nature, based on macrophytes, is presented in Table 3.3.

[12] Details in Annex 4

Table. 3. 3. Natural value of macrophytes in selected Polish sea areas

Criterions of valorisation	Puck Bay[13]	Stone and boulder field on Słupsk Bank	Stone and boulder fields off Rowy
Existence of communities	Communities of green algae (*Ulva* spp.), (*Polysiphonia fucoides*), and of vascular plants (*Zannichellia palustris*, *Stucenia pectinata (syn. Potamogeton pectinatus)*, *Zostera marina*)	Red algae communities (*Furcellaria lumbricalis, Coccotylus truncatus*, *Polysiphonia fucoides*, *Ceramium diaphanum*)	Red algae communities (*Furcellaria lumbricalis*, *Polysiphonia fucoides*)
Occurrence of protected species *	*Furcellaria lumbricalis*, *Ceramium diaphanum*, *Ceramium tenuicorne*, *Ceramium virgatum*, *Chara baltica*, *Tolypella nidifica*, *Nitella capillaris*, *Zostera marina*	*Furcellaria lumbricalis*, *Ceramium diaphanum*, *Ceramium virgatum*	*Furcellaria lumbricalis*, *Ceramium diaphanum*, *Ceramium tenuicorne*, *Ceramium virgatum*
Occurrence of rare species	*Potamogeton filiformis*, *Rhizoclonium implexum*, *Rhizoclonium riparium*, *Sphacelaria cirrosa*, *Protohalopteris radicans*, *Ruppia maritima*	*Coccotylus truncatus*, *Delesseria sanguinea*, *Rhodomela confervoides*, *Sphacelaria cirrosa*	*Coccotylus truncatus*, *Rhodomela confervoides*, *Sphacelaria cirrosa*
Dominance in biomass of eutrophication indicator species	*Cladophora glomerata*, *Pylaiella littoralis*, *Ectocarpus siliculosus*, *Chaetomorpha linum*, *Ulva* spp.	-	-

*In acc. with the Ordinance of the Minister of Environment of 9 of October 2014 on the protection of the species of plants; JoL form 2014 It. 1409.

The Puck Bay

The Puck Bay, especially its internal part and coastal zones of external part, is considered a unique area of valuable nature in the Polish part of the Baltic Sea, mainly because of the extensive underwater meadows and diversity of macrophytes [Kruk- Dowgiałło and Brzeska, 2009]. Apart of the largest number of protected species (8), there are also many rare species (6) belonging to the families of red, brown and green algae, as well as vascular plants (Table 3.3). The Puck Bay is the only place in Poland where protected green algae such as *Chara baltica, Tolypella nidifica* and *Nitella capillaris* occur, as well as vascular plants, which on sandy sea bottom form single-, double- or triple-species underwater meadows. The average biomass of species creating a meadow in the inner part of the Puck Bay is 15.5 g dry mass per m^2 [*Natural Conditions*… 2004-2009]. The most important and at the same time endangered component of underwater meadows is sea grass *Zostera marina*, which is strictly protected. Another exceptional location is the rocky bottom in front of the Orłowo Cliff which is the only stand of red algae *Furcellaria lumbricalis* identified in the Bay, and where are present rare in Polish sea waters brown algae, such as *Sphacelaria cirrosa*, *Protohalopteris radicans* and *Ceramium virgatum* [Osowiecki and Żmudziński, 2000; Kruk-Dowgiałło and Opioła, 2001; Saniewski, 2012].

[13] In the Puck Bay macrophytes occur in communities, and do not cover the entire surface of the Bay (description below).

In effect of uncontrolled discharging of urban waste waters and resulting eutrophication, in the mid 1970s, the structure of underwater meadows changed significantly. Eutrophication of the waters encouraged the development of *Pylaiella* and *Ectocarpus* brown algae [Kruk-Dowgiałło and Szaniawska, 2008]. Their excessive development caused a significant reduction of bottom areas with sea grass. Since 1996 some improvement of the state of water plants is observed [Kruk-Dowgiałło, 2000]. Despite the anthropogenic transformation of the qualitative and quantitative structure of macrophytes, the Puck Bay is considered as an area with high natural value, especially because of the role it fulfils for the other components of the ecosystem (Fig.3.2).

Risks

Actions which disturb the seabed (causing destruction of plants) such as dredging, building of hydrotechnical structures are identified as the most dangerous for macrophytes in the Puck Bay area. The qualitative and quantitative structure of macrophytes is also changed by discharges of biogenic compounds from point and non-point sources, causing increased growth of *Pylaiella* brown algae communities which in turn impact other plant species and fauna connected which are connected temporarily or permanently with bottom surface sediments.

The stone and boulder fields on Słupsk Bank

The Słupsk Bank stone and boulder field is an area rich in red algae communities, with dominance of protected species of *Furcellaria lumbricalis* and *Ceramium diaphanum* the average biomass of which is 25.8 and 24.8 g dw/m^2 respectively [Kruk-Dowgiałło and others, 2011]. They are accompanied by rare in sea areas macroalgae species (4) (Table 3.3) as well as unique in Polish scale red algae species *Delesseria sanguine.* The natural value of the area is enhanced by the sporadic only occurrence and insignificant number of species indicating high trophy of waters such as *Pylaiella littoralis* and *Ectocarpus siliculosus.* This is because the stone field is located far from the coast (about 25 km) and in effect anthropogenic influence is significantly smaller than in the littoral zone [ibid].

The stone and boulder fields of Słupsk Bank are the only place identified in the Polish sea areas, located at a distance from the coast, where numerous macroalgae species grow on a hard bottom– with patches of pebbles and boulders resting on gravel and sandy sediments. It is also the only area of hard bottom with such a large number of rare and protected species. Therefore the stone and boulder fields of Słupsk Bank should be regarded as a region of high natural value (Fig. 3.2).

Risks

Actions resulting in changes or destruction of natural habitats are a direct threat to macrophyte communities of the stone and boulder fields of Słupsk Bank. Such actions include inter alia: extraction of natural aggregates, exploitation and exploration of **gas and oil, as well as offshore wind farm construction. They result in fragmentation and removal of macrophyte communities and appearance of underwater flora (on constructions such as drilling platforms and offshore wind farm towers) different from the typical ecosystem of this region, and causing the disruption of the natural ecosystem.**

Stone and boulder fields off Rowy

The stone and boulder fields off Rowy are characterised by the presence of red algae communities, especially the common on rocky bottom *Polysiphonia fucoides,* with average biomass of 29.6 g dm per m^2

[Osowiecki and Kruk-Dowgiałło, 2006]. It is a refuge of the unique in Polish sea areas and strictly protected species *Furcellaria lumbricalis* and of other protected (Table 3.3.) and rare species [Kruk-Dowgiałło, 2006].

These stone and boulder fields, due to their location far from industrial centres, outlets of larger rivers or urban areas, are characterised by much better environmental state than other areas in Polish coastal waters. Vegetation was able to preserve its original and intact nature. This is confirmed by the relatively low percentage (10%) in total biomass of *filamentous brown algal species of Pylaiella littoralis*, *Ectocarpus siliculosus* and green algae *Cladophora glomerata* [therein].

Because of its unique character and localisation in the open sea coastal zone, this refuge is an important area for ecosystem biodiversity. The presence of macrophytes on stones provides additional habitats for *phytophillic* fauna and ichthyofauna. Therefore the stone fields should be seen as sites valuable for nature (Fig. 3.2.)

Risks

The main risks to the macrophyte communities in stone and boulder fields off Rowy come from actions which could result in destroying or changing of the natural habitats. Such actions include aggregate extraction and laying of linear infrastructure – cables. These activities can result **in fragmentation/destroying of macrophyte communities**.

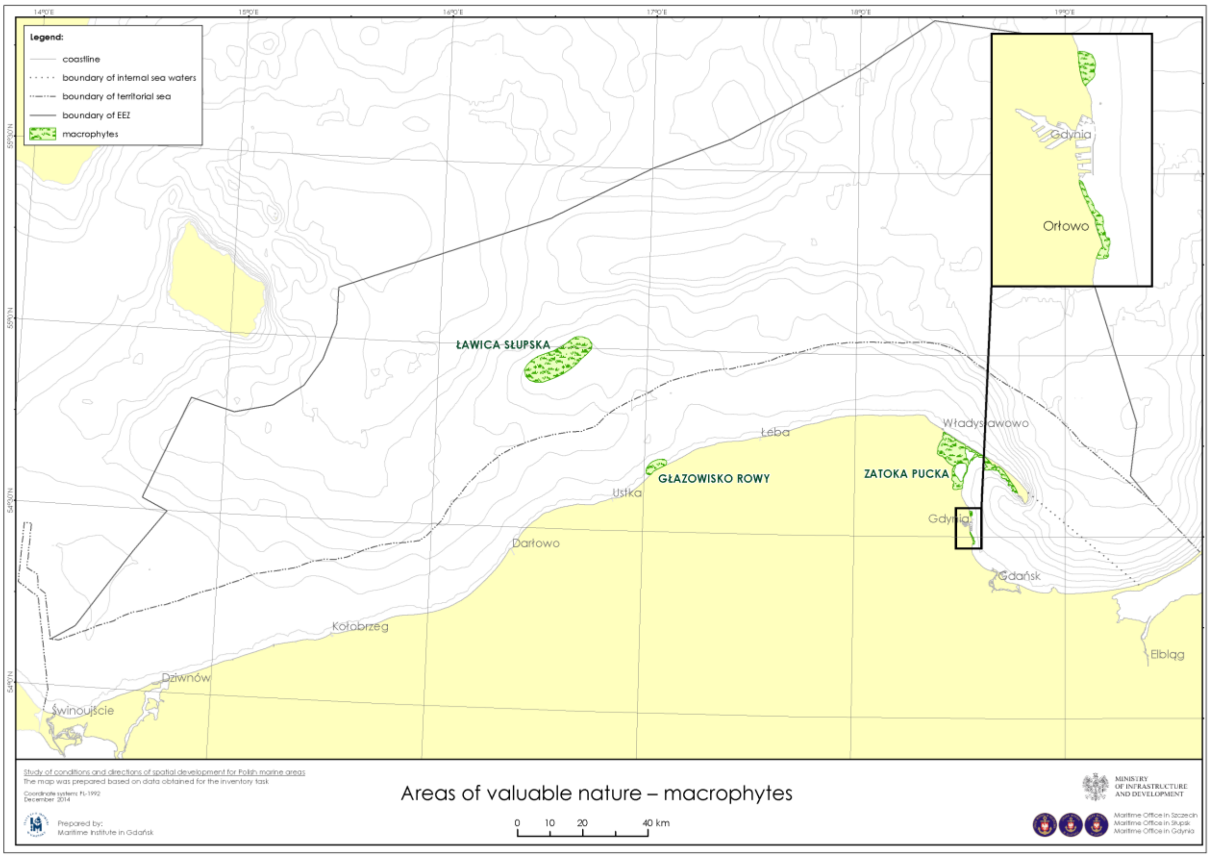


Fig. 3. 2. Areas of valuable nature – macrophytes

All identified tilll now regions of macrophyte occurrence, i.e. the Puck Bay, the stone and boulder fields on Słupsk Bank and off Rowy, despite the different environmental conditions which result in different value of nature, are very valuable, mainly because macrophytes occur in the Polish sea areas very rarely, and they are particularly sensitive to anthropogenic impacts [Bäck and others., 2002] (Fig. 3.2).

3.2.2. Macrozoobenthos

Macrozoobenthos oriented valorisation of Polish sea areas is based on information from literature, research projects and data of the State Environmental Monitoring (Table 4.2.1 in Annex 4). Research projects, in which large parts of Polish sea areas were investigated and characterised during nearly the same period, were considered the most useful source of information. Literature of the subject contains only a few works describing macrozoobenthos investigations covering the whole area of this Study. Most of the research projects were related to selected regions. The best investigated sea area is the southern and western part of the Gulf of Gdansk, in particular the Puck Bay [Wiktor, 1993; Osowiecki, 2000]. Least investigated are regions situated along the northern border of Polish sea areas, i.e. the Middle Bank and the Słupsk Trough.

Analysis of the map showing the spatial extent of benthic communities indicates that one of the elements of macrozoobenthos based valorisation may be the "commonness" of occurrence of a given community in the Polish sea areas. The smaller is the area of a habitat/community, the higher the risk of destruction or degradation caused by unfavourable factors even of local character. The size of bottom area occupied by the different macrozoobenthos communities differed largely. The smallest area was inhabited by *Mytilus edulis* (*trossulus*)–*Gammarus salinus* living on the stony bottom of the Słupsk Bank.

Criterions of valorisation

For determining the value of sea bottom habitats and of species living in them, a set of criterions, considered in literature of the subject as most significant in terms of chances to preserve the habitats and species, was adopted. Most important of them are:

1. Rareness of occurrence of a habitat/species (uniqueness);
2. Naturalness (degree to which a habitat/community is preserved in unchanged condition);
3. Significance of a habitat/community for ecological processes.

Rareness of occurrence concerns habitats with relatively small surface, e.g. underwater stony reefs, peat outcrops, etc. **Naturalness** characterises habitats in which there are no changes caused by anthropogenic pressure (e.g. over-fertilisation, pollution) or the changes are small. In this respect, low value characterises azoic zones of south-Baltic deeps, where the oxygen deficit in the near-bottom water layer is one of the effects of excessive eutrophication. The remaining areas, provided they are inhabited by typical for a given habitat benthic macrofauna, regardless of degree of richness of species, should be considered valuable. **Significance of habitat for ecological processes** concerns bottom areas performing additional functions in the ecosystem. These are spawning grounds, bird feeding grounds, channels through which flow saline water masses from salt water infusions from the North Sea, shallow shoals, reefs, etc.

Characteristics of most valuable regions within the Polish sea areas (based on macrozoobenthos)

Taking into account the above criteria, three regions are distinguished in the Polish sea areas, where macrozoobenthos communities are especially valuable (Fig. 3.3):

- boulder field in the Słupsk Bank;

- inner Puck Bay and a part of Puck Bay with depth smaller than 20m (within the area of Natura 2000 PLH 220032 Puck Bay and Hel Peninsula);
- area of Słupsk Trough.

Boulder field in the Słupsk Bank

The Słupsk Bank boulder field fulfils all three proposed criterions of valorisation. It is the only region in the Polish open sea having an area of just over 100 km^2, with bottom covered by boulders and cobbles (Criterion 1). The region is characterised by a high degree of naturalness since fishing is rather difficult due to bottom configuration, and other impacts – anthropogenic pressure – are low because the region is located far from industrial centres, large cities, river estuaries, etc. (Criterion 2). The underwater stony reefs, compared to the sandy deposits surrounding the boulder field, are characterised by a high degree of taxonomical diversification and abundance of macrozoobenthos. Therefore, the boulder field is a natural feeding area for sea birds and demersal fish (Criterion 3).

In 1999, macrophyte communities in the boulder field were found to have 28 taxons of macrozoobenthos [Andrulewicz et al., 2004]. Taxonomical diversification on sandy fragments of the Bank's bottom was slightly lower – 21 taxons, including 11 crustacean species. Within the Bank, three species of gammarus *Gammaridae* and a rare in the Polish waters of the Baltic Sea crustacean, *Callopius Iaeviusculus,* were found. The quantitative structure was dominated by *Turbellaria* flatworms, and biomass structure by the mussel, *Mytilus trossulus*. On shallower fragments of bottom, covered densely with mussel aggregations, traces of feeding birds and flatfish were noted. The study of the Słupsk Bank boulder field area was repeated in 2007 within the project "Sea Habitats Mapping". In total, at 106 stations of stony, gravel and sandy bottom of the Bank, 30 macrozoobenthos taxons were found. Most dominant in terms of quantity and biomass was the mussel, *Mytilus trossulus*. As in 1999, 11 crustacean species were found, among which the most populous group were *Gammaridae* flatworms.

Threats

Among direct threats to macrozoobenthos communities of the Słupsk Bank boulder field are economic activities as a result of which the natural bottom habitats are changed or damaged. Most important among them are, e.g.: extraction of natural aggregates and works related to exploration and extraction of gas and oil. Indirect threats arise from long term changes occurring in biocenoses of the seabed due to eutrophication or expansion of invasive species. In both cases, the expected effect is a transformation of the current qualitative and quantitative structure of macrozoobenthos.

Inner Puck Bay and a part of Puck Bay with depth smaller than 20m

The Inner Puck Bay is the only shallow water region with lagoon characteristics and salinity typical for the coastal zone of the southern Baltic Sea (Criterion 1). The diversity of seabed habitats causes that macrozoobenthos is characterised by high taxonomical diversification. Many species, e.g. four species of molluscs, are a food base for sea birds. Small crustaceans inhabiting macrophyte fields and nectobenthos are the main component of fish food (Criterion 3).

In the 1990s [Osowiecki, 2000], the benthic macrofauna of Puck Bay was composed in total of 50 taxons of benthic invertebrates. Investigations carried out in 2007 in the inner part of Puck Bay at 53 stations with vegetation covered sandy bottom and 48 stations with sandy bottom showed presence of 36 taxons of invertebrate benthic fauna. The belt of bottom adjacent to the Hel Peninsula, covered with underwater meadows, was characterised by especially high abundance of phytophilic species, among which can be distinguished *Idothea balthica*, *I. chelipes*, flatworms from family of *Gammaridae*, nektobenthic crustaceans *Neomysis integer* and *Crangon crangon* and numerously represented young individuals of molluscs and snails. The highest numbers of clean bottom indicative taxons were found on the border of Jama Rzucewska. In the southern end of the inner Puck Bay, close to the Ciesnina Glebinka (Głebinka Sound), the highest number and biomass of the *Mytilus trossulus* mussel was noted, which was accompanied by numerous and diversified fauna composed mainly of crustaceans. This region is a feeding ground for birds.

Threats

Threats to macrozoobenthos communities of the Puck Bay arise from possible changes of natural habitats of the seabed. Increased concentration of organic matter in the deposits resulting from progressing eutrophication, limitation or elimination of meadows of underwater macrophytes or expansion of invasive species could cause a change of the present qualitative and quantitative structure of macrozoobenthos.

Słupsk Trough acts as a main channel through which the saline and well oxidized water from the North Sea flows towards the Gdansk and Gotland Deeps (Criterion 1). Since it is situated far away from coastal sources of pollution, this region is characterised by high naturalness (Criterion 2). The infusions, moving to the east through the Słupsk Trough, are very important for macrozoobenthos inhabiting the bottom below the halocline, especially in the south-Baltic deeps (Criterion 3). After an infusion, until the time when oxygen becomes used up, the bottom of the deeps is inhabited by macrozoobenthos communities composed of several species. When the oxygen becomes exhausted, anaerobic process of organic matter decomposition produces toxic hydrogen sulphide, which eliminates all forms of macroscopic life.

The different than in other areas hydrological regime causes that on the bottom of the Słupsk Trough are found species of macrozoobenthos, which do not occur in other regions of Polish sea areas. The part of Słupsk Trough bottom inhabited by *Astarte borealis-Astarte eliptica* is defined by Demel and Mańkowski [1951] as “arctic”. The clay, sandy and gravel bottom of the Trough at 60-90m depth is inhabited by up to 20 taxons; dominated by *Astarte* spp., *Saduria entomon*, *Scoloplos armiger* and *Terebellides stroemi*. At the end of the 1940s, Demel and Mańkowski [1951] observed the presence of the rear-gilled snail *Lamellidoris muricata*, cited as “so far not observed in the Baltic Sea proper”. In 1981-1985 HELCOM COMBINE zoobenthos monitoring was carried out in the Słupsk Trough at two stations (P2 and P3). At station P2 (water depth 78m), two observations of a species from the group of sea spiders, Pycnogonida *Nymphon grossipes* (Fabricius, 1780) (own unpublished data) were made.

Threats

Because the Słupsk Trough is located far from large human concentrations, industrial centres and estuaries of large polluted rivers, threats to macrozoobenthos communities caused by anthropogenic pressure are rather small. The potential risks may arise from an expansion of invasive species which would disrupt the existing qualitative and quantitative structure of macrozoobenthos.

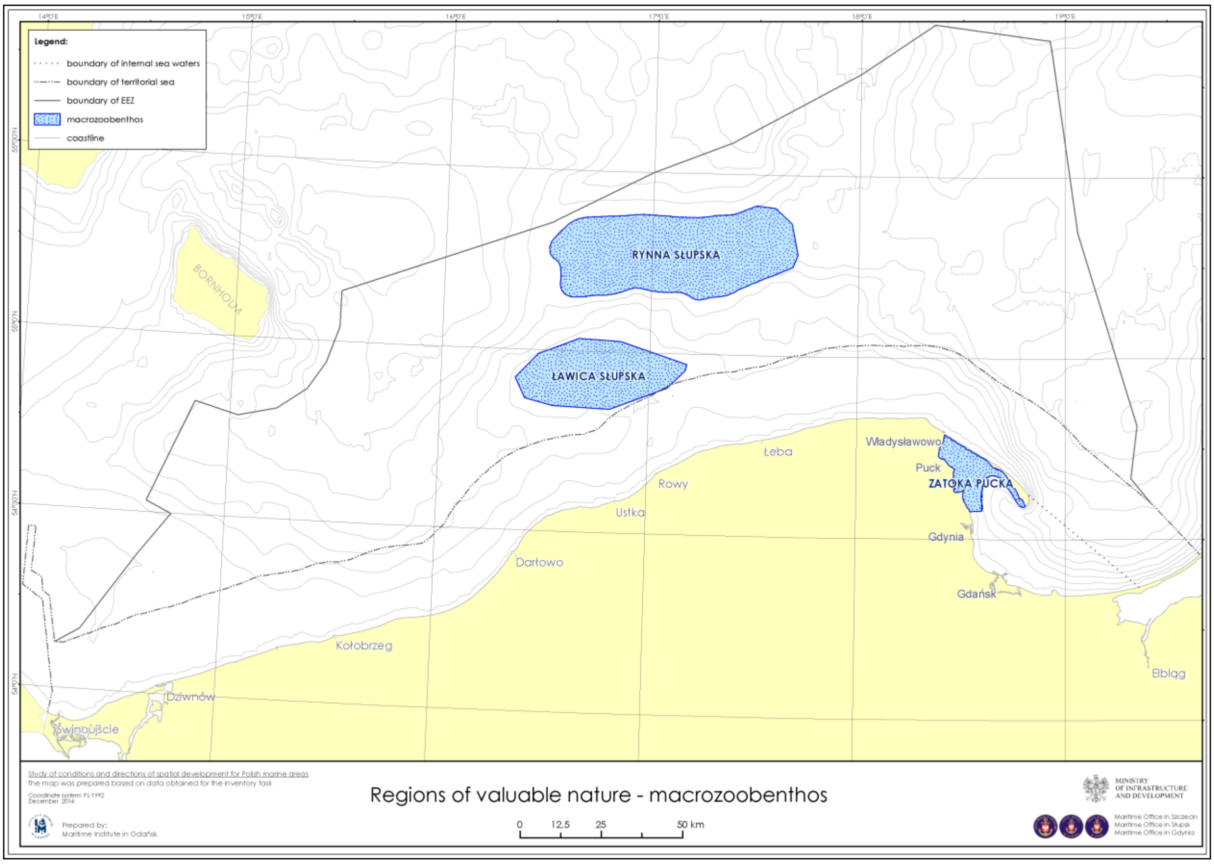


Fig. 3.3. Regions of valuable nature – macrozoobenthos

3.2.3 Ichthyofauna

The most recent environmental data on ichthyofauna in Polish sea areas come from 2011-2013 and were obtained in the framework of research projects, in the National Environmental Monitoring program [Chief Inspector for Environmental Protection – CEIP, 2011] and during drafting of protection plans for Natura 2000 areas (Table 4.3.1 in Annex 4). Valorisation of the Polish sea space from ichthyofauna point of view was based mainly on qualitative criterions. Quantitative criterions were not developed, because at present coherent temporal and spatial data are not available.

Criterions of valorisation

Valorisation of the area was based on qualitative criterions which take into account the role fulfilled by areas important for development of the ichthyofauna, with the assumption that not all the parts of Polish sea areas have the same influence on the character and functioning of ichthyofauna [BRISK, 2011].

As criterions were adopted the functions which are fulfilled for the ichthyofauna by a given sea area i.e.:

- feeding,
- breeding,
- migratory.

Characteristic of Polish sea areas important for ichthyofauna

The most important for ichthyofauna sea area is the **coastal zone** understood as the strip of sea waters along the whole Polish coast between the coastline and the 10 m depth contour (Fig. 3.4.). In this zone one the highest number of fish taxons is observed [Gibson and others, 1993; Harris and others, 2001; Repecka and others 2003; Sellesla and Amara 2007; Bilkovic and others, 2007] and it also fulfils an important role as: a feeding area [Demel, 1975; Zander, 1990; Skóra, 1993; Szymelfenig, 1998], breeding and nursery area [Demel, 1975; Nellbring and Sture, 1995; Szymelfenig, 1998; Sapota, 2001; Harris and others, 2001, Lappalainen and Urho, 2006; Sellesla and Amara 2007]. Moreover, the Polish coastal zone is noted for highest bio-diversity [HELCOM, 2009] and what follows, for the highest number of protected species.

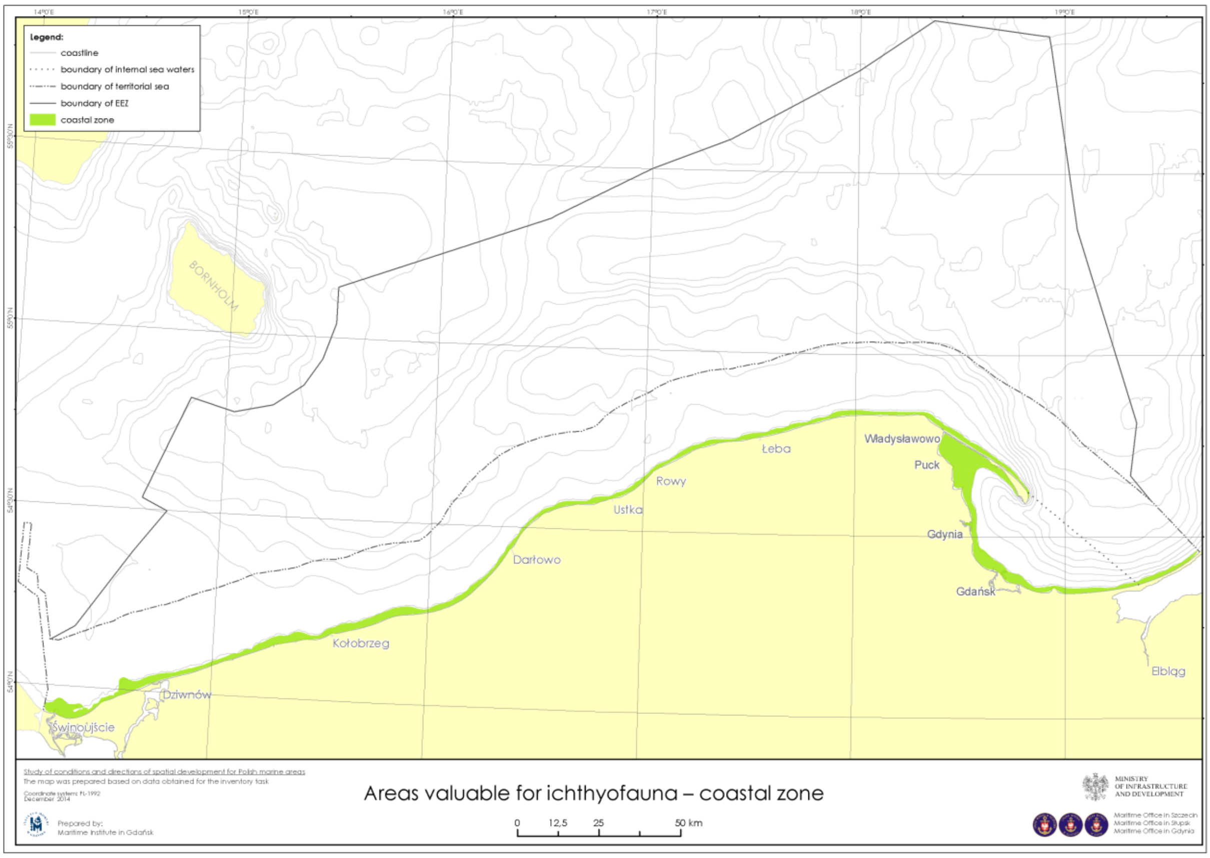


Fig. 3. 3. Costal zone of the Polish sea areas – areas valuable for ichthyofauna

Very important for ichthyofauna are also areas with **stony bottom** (Fig. 3.5) Most of the fish species prefer diversified sea bottom structures, such as stone and boulder fields, reefs, rubble at the foot of cliffs. These places are potentially richer in food; simultaneously they offer ideal shelter for juvenile forms and convenient conditions for spawning of litophilic fish. [Wei-Rung Chopu, 2002, Street and others, 2005,HELCOM, 2006, HELCOM 2009]. Besides, stony bottom is also a very rare habitat in Polish sea areas.

Locations of stony bottom areas were identified using the geological atlases of Baltic Sea bottom in which areas with stone and boulder accumulations resting on sand and gravel beds are shown [Jurowska and Kramarska, 1990; Kramarska, 1991; Michałowska and Pikies, 1990; Uścinowicz, 1989; Uścinowicz and Zachowicz, 1993; Pikies, 1992; Uścinowicz and Zachowicz, 1991; Uścinowicz and

Zachowicz, 1993]. Results of bottom surveys carried out by the Maritime Office in Gdynia indicate slightly different location of areas of stony bottom than the above mentioned sources. The information should be verified during work on the maritime spatial plan(s).

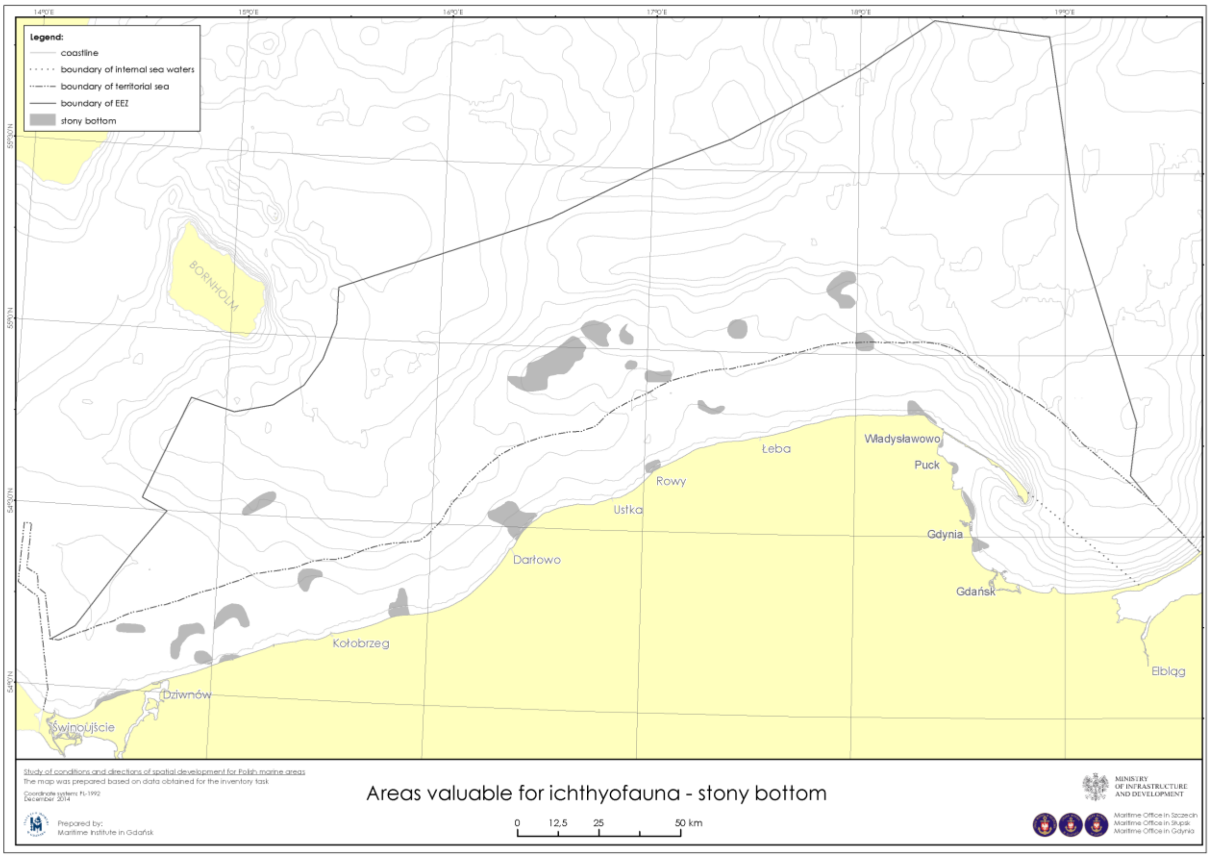


Fig. 3. 4. Stony bottom forming habitats for lithophilic and phytophilic fish

Taking into consideration the occurrence of bi-environmental species in Polish sea areas [Radke and others, 2010a], the next important for fish areas are **river mouths**, which are a migration route (Fig. 3.6.).

Such areas were identified around river mouths along the whole Polish coast on the basis of accessible literature indicating the occurrence in specified rivers of bi-environmental species or their juvenile forms [Radke and others, 2010; Dębowski, 1997;Dębowski and others, 2000; Dębowski and others, 2002a and b; Radke and others, 2007; Radke and others, 2010a and b; Radke and others, 2011]. As it is indicated in the chapter on fisheries (Chapter 6), there is a lack of sufficiently reliable information from investigations carried out in river outlets to allow determination of the actual state and size of ichthyofauna sheltering and/or feeding in these locations.

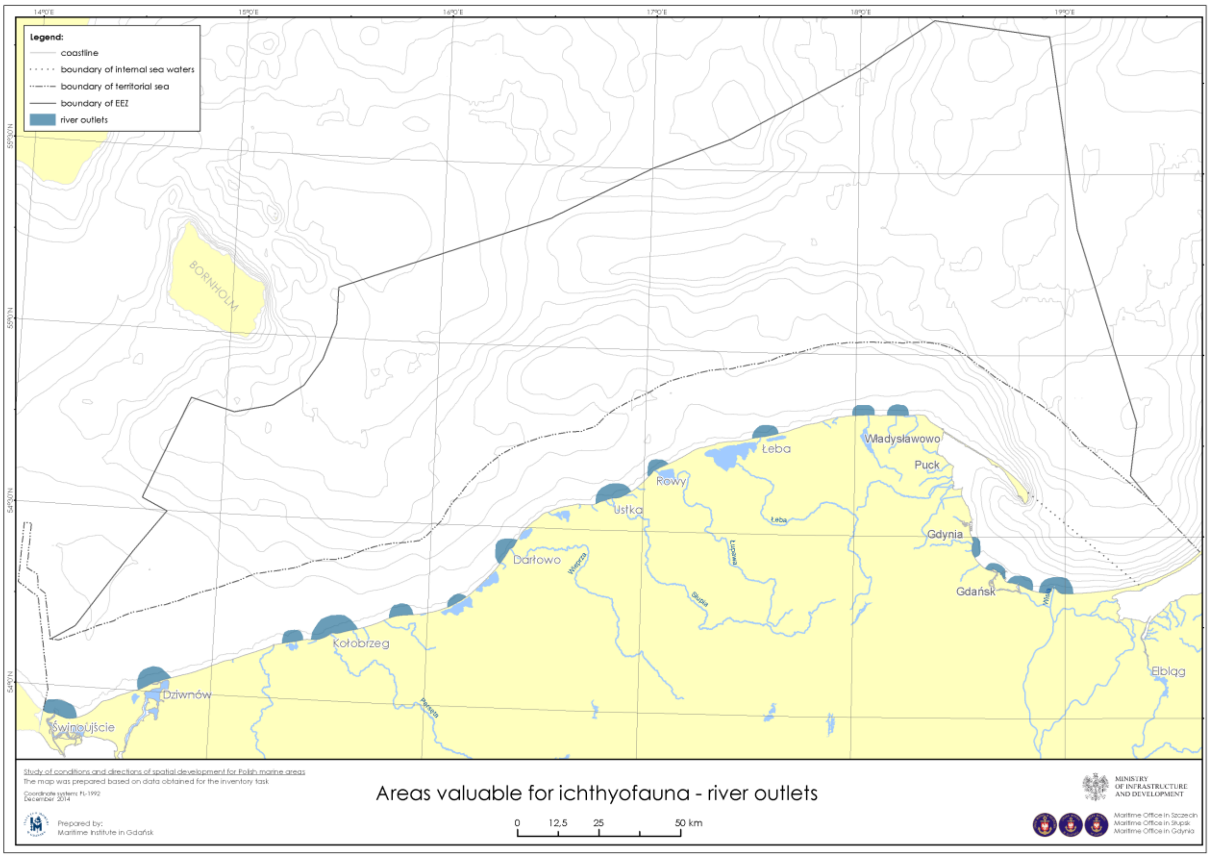


Fig. 3. 5. Outlets of rivers discharging into the sea along the Polish coast

The natural value of the identified areas i.e. the coastal zone, stony bottom areas and river mouths, changes seasonally depending on the number of criteria/functions fulfilled by the area.

For preparing a graphic presentation of the most valuable for ichthyofauna areas, taking into account their seasonal significance, weights were given to each of the areas depending on the season (spring, autumn, summer and winter), where the value of the area summarily increases. Four classes of value were adopted:

3 – very high: when all the criterions are fulfilled;

2 – high: when two out of three criterions are fulfilled;

1 – average: when one out of three criterions is fulfilled;

0 – low value: when none of the criterions is fulfilled.

To the earlier discussed areas: coastal zone, stony bottom and river mouths, yet another type of area was added – areas of occurrence of compact macrophyte communities during three seasons: spring, summer and autumn, which additionally increase the value of designated areas for the ichthyofauna. Most of fish species occurring in Polish sea areas are phytophilic, additionally plants, as in case of reefs, create favourable conditions for juvenile and mature forms of protected species such as: pipefish, straightnose pipefish, two-spotted goby. With improved knowledge about the location of plant communities in Polish sea areas, the map of sea area value with respect to habitats of phytophilic fish will be gradually improved.

The natural value of the identified areas is shown in seasonal maps (Fig. 3.7a, b, c, and d).

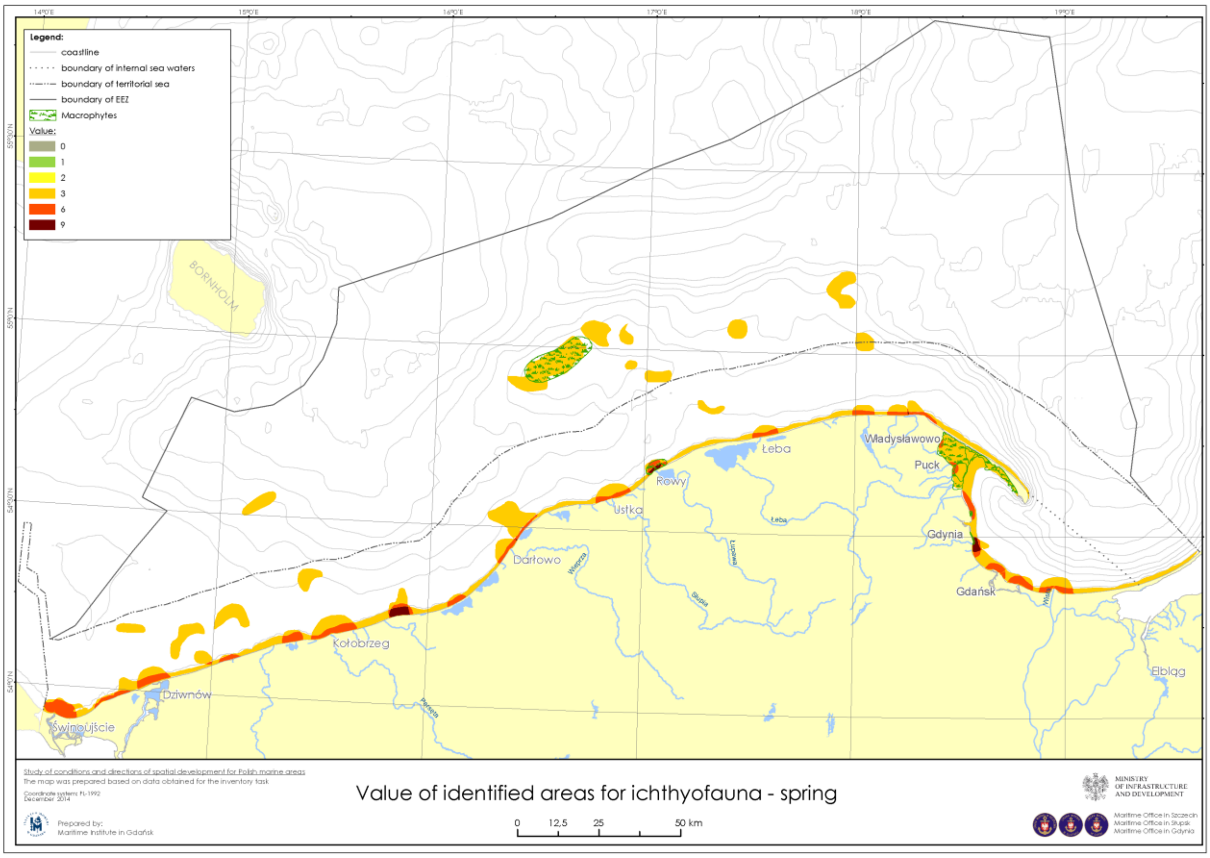


Fig. 3.7 a. Value of identified areas for ichthyofauna - spring

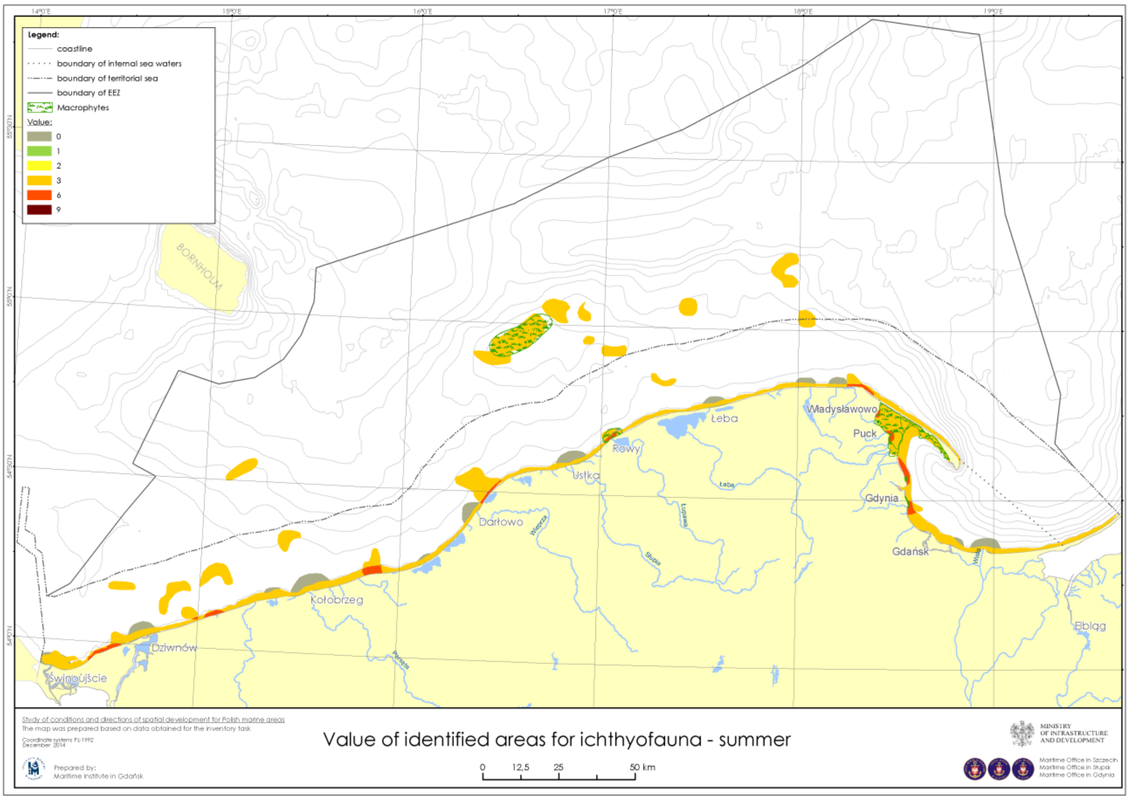


Fig. 3.7.b Value of identified areas for ichthyofauna - summer

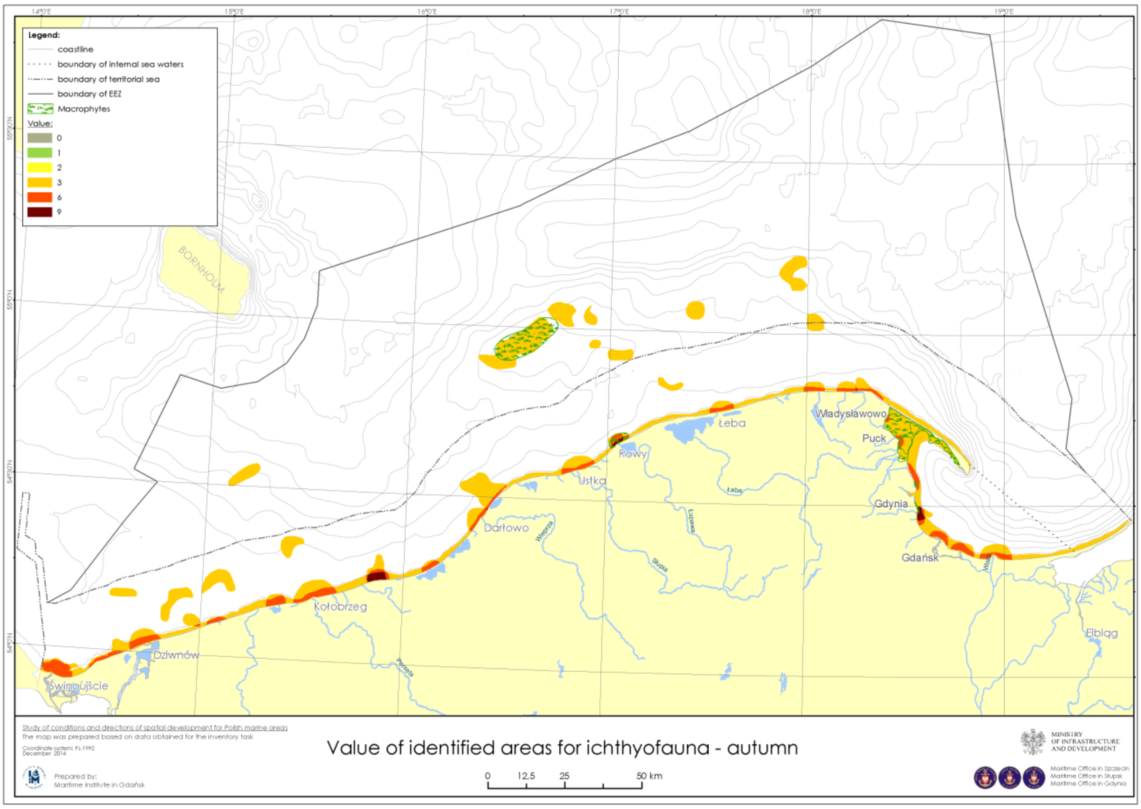


Fig. 3.7.c Value of identified areas for ichthyofauna - autumn

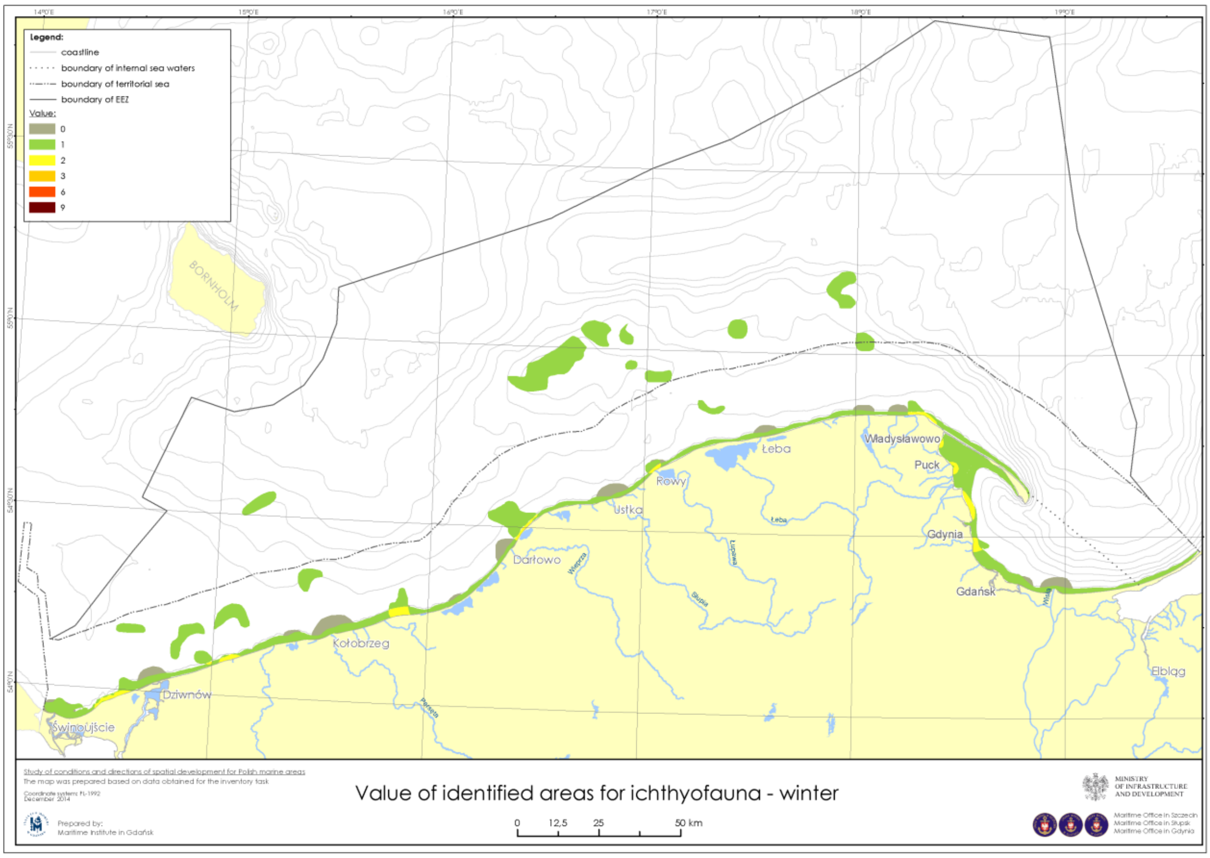


Fig. 3.7.d Value of identified areas for ichthyofauna - winter

The valorisation shows that, for all analysed seasons, the most valuable for ichthyofauna are shallow water areas with diversified substrate. Additionally, the significance of river mouths increases in autumn and spring, as can be seen in the seasonal maps. These maps show also that areas in front of the Orłowo Cliff and near to Rowy and Gąski are significant during the whole year.

In the Polish sea areas, the most valuable nature for ichthyofauna, fulfilling all the adopted criterions, is the area of the Puck Bay. The area offers exceptional conditions for development and existence of ichthyofauna. It is an area of special importance for the functioning of fish species which stay there permanently, such as e.g. protected under the Polish law: sand goby *(Pomatoschitus microps),* small goby *(Pomatoschitis minutus),* two-spotted goby (Gobiusculus flavescens), black goby *(Gobius niger),* pipefish *(Syngnathus typhle)* and straightnose pipefish *(Nerophis ophidian)* and for freshwater fish i.e. pike (*Esox lucius*), perch (*Perca fluviatilis*) and roach (*Rutilus rutilus),* as well as for fish which use it periodically, in particular for purposes of breeding, such as e.g. herring (*Clupea harengus),* garfish *(Belone belone).* The main important for ichthyofauna feature of the Puck Bay is the presence of underwater meadows and stone fields covered with macroalgae which are a habitat for procreation of phytophilic fish. Not far from the Puck Bay is the mouth of the Vistula river which, together with the Odra estuary, are the most important fish migration areas on the Polish coast. Breeding migrations of salmonid fish are observed there: salmon *(S. salar),* bull-trout *(S. trutta)* and protected: twaite shad *(A. fallax)* and river lamprey *(L. fluviatilis)* or zarte (*V. vimba).*

The area of Słupsk Bank, where macrophytes occur, is also noteworthy, but the values of this location for ichthyofauna remain to be investigated. A very important aspect for the results of valorisation is the research effort dedicated to different parts of Polish sea areas. The effort was high for the Puck Bay, and in effect its significance for ichthyofauna was described in detail. It is recommended that in the future valorisation should be carried out on a basis of comparable results of environmental surveys for the whole Polish sea area.

Description of the most important groups of commercial fish species – fishing and spawning areas

Clupeidae– in commercial fishing in south Baltic Sea waters the largest share among clupeidae have two species: herring *(C. Harengus)* and sprat *(S. Sprattus).* They live in the pelagic zone and feed on plankton. They spawn along the whole length of the Polish coast, with high intensity in the Pomeranian Bay and the Gulf of Gdańsk. Herring, represented by two breeds, spawns in autumn – autumn breed and in spring – spring breed. Sprat spawning starts at the end of winter and lasts until summer [BRISK, 2011].

Flatfish – in commercial fishing in south Baltic Sea waters the largest share among flat fish has flounder *(P. Flesus).* These fish live at the sea bottom and feed on benthic animals such as clams, shellfish and polychaetes. Flounders spawn in spring in deepwater areas such as the Gdańsk Deep, Bornholm Deep and Słupsk Trough [ibid].

Whitefish - in commercial fishing in south Baltic Sea waters the largest share among whitefish falls to cod *(G. morhua).* It is a predatory fish feeding on benthic animals and fish. Cod in the Baltic Sea spawns in spring, in water with temperature of ca. 4-6° C. Most often it finds favourable conditions in the deeper parts of the Gotland, Bornholm and Gdańsk Basins [ibid].

Migratory species - in commercial fishing in south Baltic Sea waters the largest share among migratory species falls to bull-trout *(S. trutta)* and salmon *(S. salar).* Mature forms of both species live in sea waters, where they feed on other fish and bigger shellfish. Salmonids spawn fresh water in rivers from end of summer through autumn [ibid].

Main dangers[14] for ichthyofauna connected with investments at sea, sea transport and exploitation of fish resources:

1. Pollution of sea waters with oil, chemicals, radioactive substances – long term negative direct influence, depending on the scale of the disaster
2. Mining of aggregates, oil, gas – short term negative indirect influence on the whole ichthyofauna, moderate negative direct influence on ichthyofauna using the given space as spawning location when spawn/fry is destroyed;
3. Construction of marine structures - short term negative indirect influence during construction stage, long term positive indirect influence (artificial reefs);
4. Exploitation and development of ports – long term negative direct influence due to emitted by ports pollution, long term positive indirect influence (artificial reefs);
5. Fisheries– long term negative direct influence in case of over fishing, long term negative indirect influence when the bottom is destroyed by bottom trawls, long term direct and indirect influence resulting from fodder fishing;
6. Blocking of migration routes of bi-environmental fish by build-up and/or silting in river outlets – long term negative influence.

3.2.4. Avifauna

For valorisation by avifauna results of the BRISK project [Meissner, 2010a] were used. Also use was made of the newest information on occurrence of birds in Polish sea areas: from investigations carried out for the needs of developing protection plans for NATURA 2000 areas in the Gulf of Gdańsk, Pomeranian Bay and Coastal Waters of the Baltic Sea, from National Environment Monitoring – Monitoring of Wintering Water Birds, Wintering Sea Birds and from lately published studies (Table 4.4.1. in Annex 4).

There is a lack of data on avifauna for the Polish part of Southern Middle Bank.

Seasonal variability of occurrence of avifauna

Depending on the stage in their life cycle, the places important for birds include: areas of nesting, feathering, areas where they stop during migrations and areas of wintering. Water birds connected with environment of the Baltic Sea, including its Polish part, gather mainly in winter and in periods of migration.

Wintering locations of birds

[14] Long term influence: lasts for several years after driving factor stops acting. Short term influence: lasts during action of driving factor. Negative influence: results in deterioration/disappearance of ichthyofauna. Positive influence: resultts in improved biodiversity/quantity of ichthyofauna. Direct influence: the factor reduces/destroys ichthyofauna immediately. Indirect influence: the factor reduces/destroys ichthyofauna by loss of habitats, feeding base, spawning areas and migration routes.

Of all the bird wintering locations of international significance in Polish sea areas, the most valuable is Puck Bay (Table 3.4.). Among open sea basins, largest concentrations of birds are observed in the eastern part of the Pomeranian Bay and western part of Słupsk Bank. Apart of these areas, big gatherings of birds are observed on single transects east of Władysławowo and off Krynica Morska (Fig.3.8.). The smallest number of sea birds stays along the central coast between Ustronie Morskie and Rowy [Meissner and others, 2010a; Meissner and others, 2012]. Probably, birds do not have a proper food base in this part of Polish sea areas. Apart of the density of benthos organisms, which are their food, the distribution of sea ducks is influenced by frequent scaring by passing ships [Meissner and others, 2012].

Table 3. 4. Wintering locations of international significance of birds (December-February) in Polish sea areas (on basis of Meissner 2010a)

Area	Number of regularly occurring species of aquatic birds	Total number of all water birds [in thousands of individuals.]
Puck Bay and Vistula River outlet	17	60-100
Estern border waters	13	50-100
Słupsk Bank	11	27-37
Pomeranian Bay	11	100-500
Coastal waters along the Central Coast	16	200-250

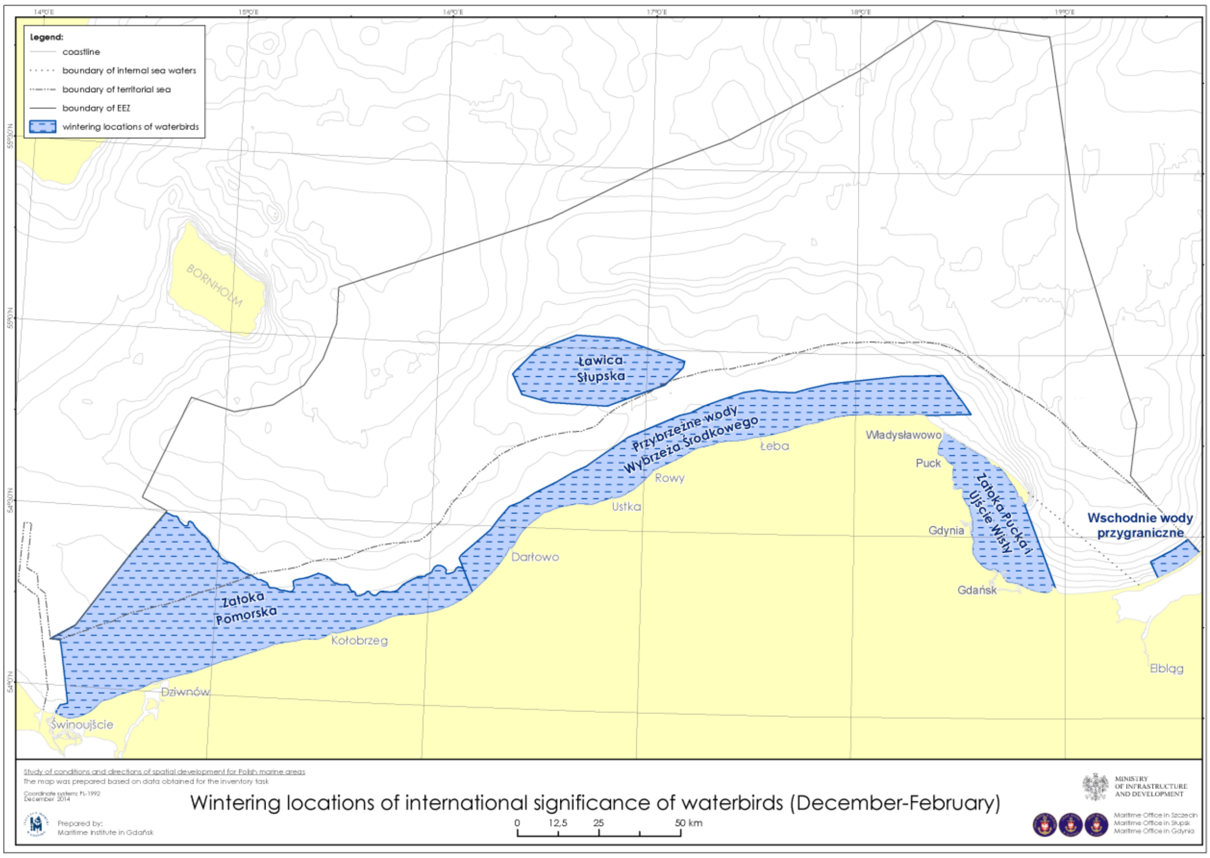


Fig. 3. 7. Wintering locations of international significance of waterbirds (December-February) in Polish sea areas (on basis of Meissner 2010a)

Resting areas of migratory birds

In accordance with the general classification of the system of migration of waterbirds in Eurasia, Poland is located in two large flight routes – the East Atlantic and the Mediterranean – Black Sea route, the range of which covers the whole Europe, large part of Africa, including the whole west coast of that continent, and a significant part of the North American Arctic. On large areas of Europe, Africa and Siberian Arctic these routes contact with the West Asia – Africa migration route, and through that route and nesting areas located far in the north – with the Central Asia – India and East Asia- Austral-Asian routes.[15]

A migration corridor of European importance, the so-called South Baltic corridor, is situated along the south coast of the Baltic Sea. It is a belt of 0.5 km width near Hel to approximately 12 km width north of the lakes Łebsko and Gardno [*Studium korytarzy*… 2014].

Knowledge about the tactics of seabird migrations in the area of the Baltic Sea is very poor. In summer (July and August), a quick flight of sea ducks (scoter males mainly) is observed, directed toward feathering places in the Danish Straits. These birds only exceptionally stop in Polish waters. The period of autumn migration of seabirds is much extended in time. Intensified migration of scoters to feathering places lasts from middle July to the end of August. The birds fly across the whole Baltic Sea from the Gulf of Finland to the Danish Straits. They are accompanied by eiders and uhls, but the number of both of these species is significantly lower than the scoters. In September and October along the Polish coast appear eiders, long tailed ducks, scoters, white-winged scoters, arctic loons, grebes, guillemots, auks and black guillemots. Probably a part of them stays here until winter; others after some time continue further flight to the west. In spring large flocks of sea ducks (long tailed ducks, white-winged scoters and scoters) are observed, which stop to rest in the Polish sea waters on the way to their nesting locations [Sikora and others, 2011].

In the Polish part of the Baltic Sea, seabirds stop during migrations generally at the same locations at which their wintering population stays in large numbers [Meissner, 2010a] (Table 3.5., Fig. 3.9).

Table 3. 5. Resting areas of migratory birds in Polish sea areas

Area	Number of regularly occurring species of waterbirds	The total number of all waterbirds [in thousands of individuals.]
Puck Bay and mouth of Vistula River	54	20-60
Słupsk Bank	12	30-50
Pomeranian Bay	12	200-400
Coastal waters along the central coast	12	100-200

[15] https://www.wetgiw.gov.pl/files/2354_opinia%20profGromadzkiego.pdf. Access: 02-12-2014

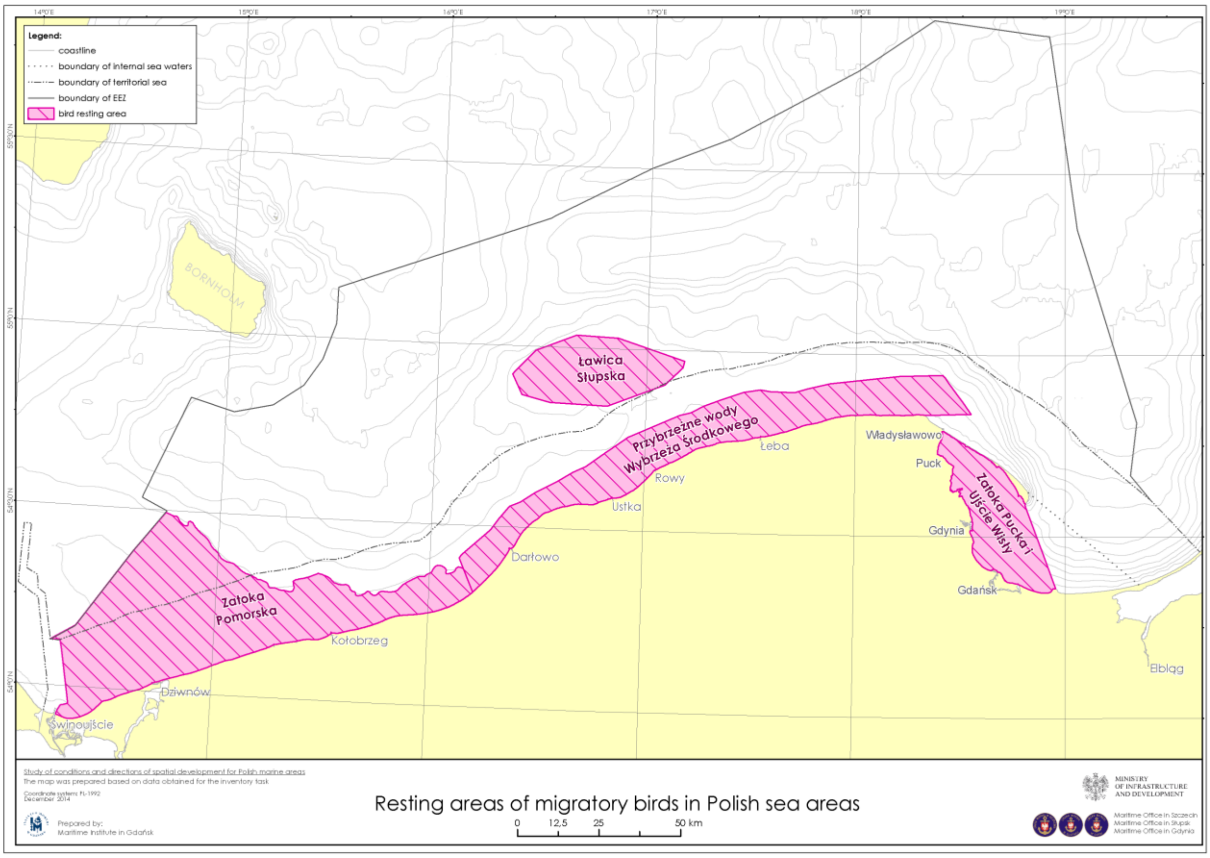


Fig. 3. 8. Resting areas of migratory birds in Polish sea areas

Nesting areas of birds

Of the nesting in Poland avifauna, species nesting in colonies on the coast include: cormorants, common terns, sandwich terns, little terns, herring gulls, common gulls and gulls. Nesting places of other species are rather dispersed; in areas with low anthropogenic pressure they may collect in larger gatherings, which still do not have the character of a breeding colony. The most valuable breeding location of seabirds on the Polish coast is the outlet of the crosscut of the Vistula. On its sandy islands and beaches nest 9 species of waterbirds. It is the only in Poland nesting place of sandwich terns [Meissner and others, 2014a], (Fig.3.10).

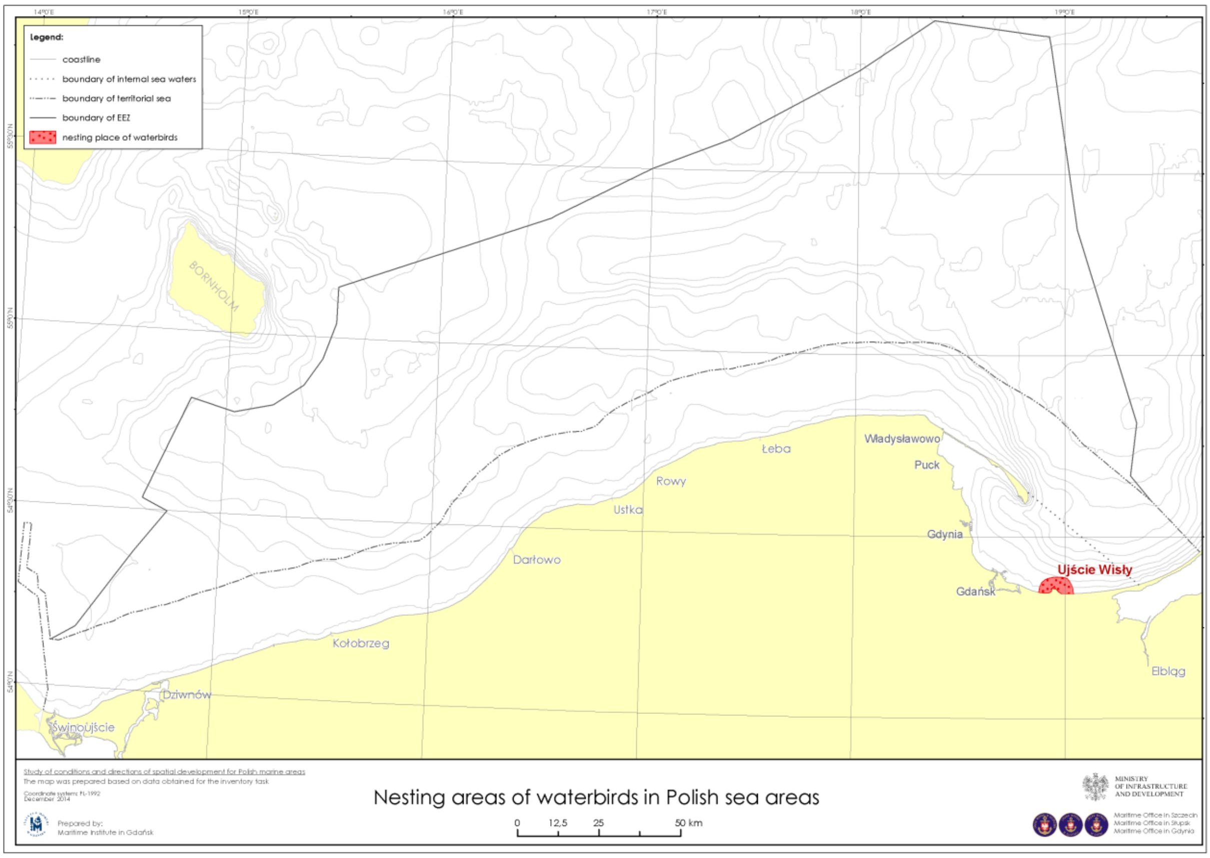


Fig. 3.10. Nesting areas of waterbirds in Polish sea areas

Criterions of valorisation

For designating areas important for avifauna, after Sidło and others [2004], the following criterions were taken into account:

1. occurrence of rare, in danger of extinction, species,
2. occurrence of protected species (including species listed in Appendix I of the Birds Directive),
3. high number of birds (places with high concentration of birds are essential - i.e. the ones in which at one time is gathered at least 1% of the passing through population of migratory species or where periodically stay at least 20 000 waterbirds or seabirds of one species or a few species together).

Detailed characteristics of most valuable for avifauna areas

All areas most valuable for avifauna are shown in Fig. 3.11

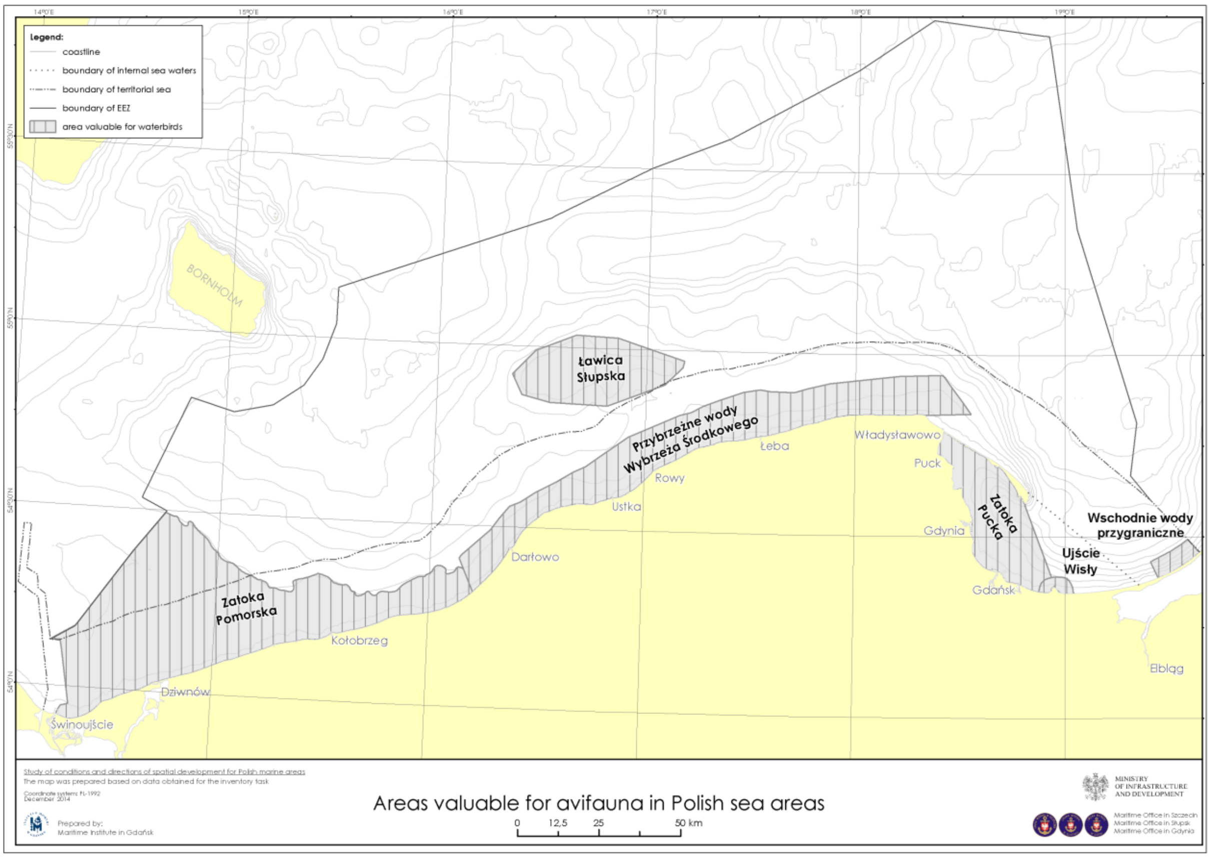


Fig. 3.11. Areas valuable for avifauna in Polish sea areas

West part of the Gulf of Gdańsk

Shallow and rich in food waters cause that the west part of the Gulf of Gdańsk (including in particular the Puck Bay) is one of the most important wintering and resting places for seabirds in the Polish coastal waters [Kośmicki and others, 2010a; Meissner and others, 2012]. In this sea basin appear at least 28 species of birds listed in Appendix I of the Birds Directive, 11 species from the Polish Red List (RL-Pl) (criterion 1, 2). In winter there is at least 1% of population of the migration route of species: smew *(Mergus albellus),* tufted duck *(Aythya fuligula),* common golden eye *(Bucephala clangula),* goosander (*Mergus merganser),* scaup (*Aythya marila*), great crested grebe (*Podiceps cristatus),* mute swan *(Cyganus olor*). Concentrations of waterbirds significantly exceed 20 000 individuals [Kośmicki and others, 2010a; Meissner and others, 2014 b; Meissner and others, 2012] (criteria 3).

Dangers

The most important dangers to avifauna in the area is by-catch in fishing nets (but its scale in Polish sea areas is not really known) and development of tourism which scares birds (growing number of fast moving vessels, development of infrastructure e.g. marinas, havens, etc.) Other significant dangers are the eutrophication of the Gulf's waters (indirect danger), oil pollution [Kośmicki and others, 2010a; Meissner and others 2014 b].

Mouth of the Vistula

This is a very important waterbird refuge throughout the whole year, but especially during the migration periods and in winter. The sandy shoals at the river mouth are the nesting place of the only in Poland colony of sandwich terns (up to 570 pairs). During the breeding season the area is inhabited by at least 1 % of domestic population of the following birds species listed in Polish Red List of Animals (RL-Pl): shelduck *(Tadorna tadorna),* oyster catcher *(Haematopus ostralegus),* little tern (*Sterna albifrons*), common tern (*Sterna hirundo),*common gull (*Larus canus*), ringed plover *(Charadrius hiaticula)* (criterion 1, 2). In some years occur relatively high densities of little ringed plover. In total, over 30 species of birds listed in Appendix I of the Birds Directive were observed in the area of the refuge (Kośmicki and others, 2010b; (criterion 2). During the migration period occurs at least 1% of the migration route's population of the following bird species: black tern (*Chlidonias niger*), tern (*Sterna caspia),* little gull (*Larus minutus*), common gull (*Larus canus*) and geese. In winter occurs at least 1 % of the migration route's population of: smew, common golden eye *(Bucephala clangula),* long-tailed duck (*Clangula hyemalis),* common gull (*Larus canus*), *scaup* (*Aythya marila*); relatively big numbers of: black-backed gull (*Larus marinus*), goosander (*Mergus merganser*), merganser (*Mergus serrator)* [Meissner and others, 2014a; Kośmicki and others 2010b]. Waterbirds occur in concentrations exceeding 20 000 birds (criterion 3).

Dangers

The key danger is water tourism and human penetration of the sandy shoals with breeding colonies of birds. Potential negative factors are the periodically conducted flood protection and icebreaking works in the river mouth [Kośmicki and others 2010b; Michałek and Kruk-Dowgiałło (ed.), 2014].

Eastern near-border waters

The area includes coastal waters up to 20 m depth and is situated along a stretch of ca. 6 km between Krynica Morska and Piaski. Large numbers of wintering white-winged scoter are observed (this is one of the three places of concentration of this species in Polish sea areas). This sea basin is also an important place for horned grebe (*Podiceps auritus)* and auk (*Alcidae)* [Meissner, 2010b] (criterion 2 and 3).

Dangers

The key danger in the area is the by-catch of birds (at present difficult to assess), occurring mostly in periods of their highest concentration, and potential oil pollution [Meissner, 2010b].

Pomeranian Bay and Odra Bank

The area is one of the three (the other two are the Puck Bay and Słupsk Bank) wintering locations of seabirds in Polish sea waters [Meissner, 2010c]. Inventory of non-breeding birds in 2008-2012 showed 80 species of waterbirds [Ławicki and others, 2012] including species from the Polish Red List such as black-throated diver (*Gavia arctica*) or merganser (*Mergus serrator)* (criterion 1). The most numerous group of birds are sea ducks: long tailed duck (*Clangula hyemalis)*, white-winged scoter (*Melanitta fusca)* and scoter *(Melanitta nigra),* which can be observed in the whole investigated sea area, both in shallow coastal waters and in areas situated even several dozen km from the coast. Large numbers of ducks of the *Anas* kind are observed mainly during migrations. The next group are coots *(Fulica),* plunges, common golden eyes, mergansers, great crested grebes (*Podiceps cristatus)* and cormorants (*Phalacrocroax carbo*). These birds are mainly seen in shallow coastal waters. During autumn migrations large numbers of waders *Charadrii* are observed*.* Numerous gulls and little gulls also are observed during migrations (criterions 2 and 3).

Dangers

The main danger in the area is by-catch of birds (currently difficult to assess) in periods of their biggest concentration. Other significant dangers are: water pollution, oil spills, wind farms, and, due to the proximity of the Szczecin and Świnoujście ports, vessel traffic which scares the birds [Meissner, 2010c; Ławicki and others, 2012].

Coastal waters of the Central Coast

The area covers a 200 km long strip of coastal waters to 15m depth between the beginning of the Hel Peninsula and the Pomeranian Bay. Numerous sea ducks winter in this area. About 12% of white-winged scoters (*Melanitta fusca*), 2% of scoters *(Melanitta nigra)* and 35% of long-tailed ducks (*Clangula hyemalis),* staying in Polish sea areas, gather there (criterions 2 and 3). Moreover, presence of the black-throated diver (*Gavia arctica)* was noted – a species listed in the Polish Red List of animals in danger of extinction[Meissner, 2010d] (criterion 1). It should be underlined that the distribution of birds in the Central Coast region is non-uniform and that not all of the area is characterised by equally high value.

Dangers

The key danger is by-catch of birds (currently difficult to assess) in periods of their biggest concentration. Other significant dangers are: water pollution (indirect danger), oil spills and vessel traffic which scares birds [Meissner, 2010d]

Słupsk Bank

This sea basin is situated in the open waters of Baltic Proper, within the 20 depth contour. In the shallowest places its depth is only 8m, creating favourable conditions for wintering and feeding of seabirds. Analysis of seabird distribution on Słupsk Bank showed that most important for the birds are its north and west parts [Durinck and others, 1994; Meissner and others, 2012]. Probably in these places the birds find richer food resources than in the east and south parts. In the Słupsk Bank area occur at least 2 species from Appendix I of the Birds Directive, and also 2 species – black-throated diver (*Gavia arctica)* and little gull (*Larus minutus*) – from the Polish Red List of animals in danger of extinction [Meissner, 2010e] (criterion 1 and 2).

In particular, the north part is the main place of non breeding concentrations of ram *(Cepphus grylle)* in the Southern Baltic. Moreover, in the area of the Bank stays over 10% of long-tailed ducks (*Clangula hyemalis)* wintering in Polish sea areas [Meissner 2010 e] (criterion 3) and relatively numerous auks (*Alca torda)* [Meissner and others, 2012]. Other species of seabirds are strongly dispersed over the area of the Bank. Gulls appear in large numbers only periodically, while accompanying fishing vessels at fishing sites. They are not connected with a specific depth zone. The most numerous are herring gulls (*Larus argentatus*), common gulls (*Larus canus*) and black-backed gulls (*Larus marinus*). The time of spring and autumn migrations are important periods. Sea ducks fly low above the water. Some relocation can be expected because of change of feeding places, including flights outside the migration period toward different feeding locations. However, it should be emphasized that there are no detailed data on bird migrations in the area of the Słupsk Bank.

Dangers

According to Meissner [2010e] construction of wind farms on bird migration routes may be a potential danger. Because of lack of data, at present formulating a detailed opinion on the potential influence of such investments on the avifauna of the Słupsk Bank area during migrations is not possible. However the danger may be significant for sea ducks wintering in that area. Meissner also points out other dangers such as setting nets in periods of biggest concentration of birds (by-catch) [Meissner, 2010d] and potential oil pollution [Chapman et al, 2012].

The above mentioned areas (except the area bordering with Russia) are included in the Natura 2000 (SPA) network. In 2011 in the area stayed 86% of all seabirds recorded during monitoring counting [Meissner and others, 2012]. Available data for the Polish part of the **Middle Bank** are insufficient for a detailed valorisation of avifauna. On the Swedish side, an IBA Bird Refuge was established in 2000, covering 29,700 hectares, because of the high concentrations of ordinary plunger [Zaucha and Matczak, 2011]. The Middle Bank is also indicated as a wintering and resting location during migrations of long-tailed ducks, arctic loons and eiders. The significance of the area for these species probably results from a good feeding base.

3.2.5. Marine mammals

Marine mammals are not covered by national environmental monitoring. From the end of the 1980ies data on their occurrence are collected by the Marine Station in Hel of the Institute of Oceanography of the Gdańsk University. The data come from random observations of live specimens, reports on remnants found on Polish shores, and reports on by-catch of these animals[16]. In 2010, in the framework of the project “Protection of habitats of marine mammals and birds” realised by WWF Poland, the “WWF Blue Patrol” was established, providing the only regularly conducted observations of sea mammals along the Polish coast.

Polish sea areas have been included in the international project “Static Acoustic Monitoring of Baltic Sea Harbour Porpoises” (SAMBAH), which aimed at obtaining data about the distribution and density of the harbour porpoise population in the Baltic Sea. Initial results indicate that porpoises do occur in Polish sea areas, but the number of recorded porpoise clicks was much smaller than in the EEZs of Denmark, Germany and Sweden, in its south part (Fig. 3.2). Basing on recordings obtained during two years, scientists have estimated the number of animals living in the whole Baltic Sea at only 447.

[16] A list of works used for the valorisation of Polish sea areas in aspect of sea mammals is given in Annex 4, Table 4.5.1.

Fig. 3.12. Visualization of information on detection of harbour porpoise *(Phocoena phocoena)* clicks

Results of the project were presented In December 2014. Using spatial modelling techniques, seasonal location maps of porpoises in the surveyed waters were developed. They show the areas in which periodically appear the two populations living in the area of the Baltic Sea – the Baltic Proper and the Western Baltic populations. It was found that they separate during the breeding period from May to December. Animals from the Baltic Proper population concentrate in an area south-east of Öland (mainly the Midsjö area within the Swedish EEZ).

Criterions of valorisation

The following assumptions were made for valorising the Polish sea space as a habitat of marine mammals:

- all the species of marine mammals occurring in Polish sea areas belong to the Baltic populations, which migrate over almost the whole Baltic Sea,
- during the last centuries populations of Baltic marine mammals have decreased and at present they are on the brink of extinction (harbour porpoise) or revival (grey seal, harbour seal, ringed seal),
- the valorisation should take into account the existence and state of secluded beaches and sandy shoals, which are not part of Polish sea areas but are a refuge for seals during the resting, moulting and breeding periods.

Selection of the criterions of valorisation was based on the knowledge collected in the studies "Grey seal (*Halichoerus grypus*)protection program – draft" and "Harbour porpoise (*Phocoena phocoena*) protection program – draft" prepared by WWF Poland together with specialists from the Marine Station in Hel of the Institute of Oceanography of the Gdańsk University.

Basing on the above assumptions it was assumed that the whole Polish sea areas should be recognized as a habitat of Baltic mammals and, irrespective of number of observations of particular specimen, as important for sustaining and development of their population. Particular value for sea mammals represents the mouth of the Vistula Crosscut, which is the place of most frequent observations of seals on the Polish coast.

Importance of Polish sea areas for marine mammals

For marine mammals (grey seal, harbour seal, ringed seal and harbour porpoise) Polish sea areas are without doubt waters in which they migrate and feed. It should be also assumed that they can be a location of breeding, procreation and nursing of cubs.

Sandy beaches and shoals located far from houses and intensive human activity are resting locations of seals. The sandy shoals at the mouth of the Vistula Crosscut are a special case, where herds of several dozen or more resting grey seals can be observed (Fig. 3.13). In that location, though less often and in much smaller numbers, occur also harbour and ringed seals. Though there are no supporting data, it cannot be excluded that some parts of the Polish coast are, or may become in the future, habitats of seals during the breeding and moulting periods.

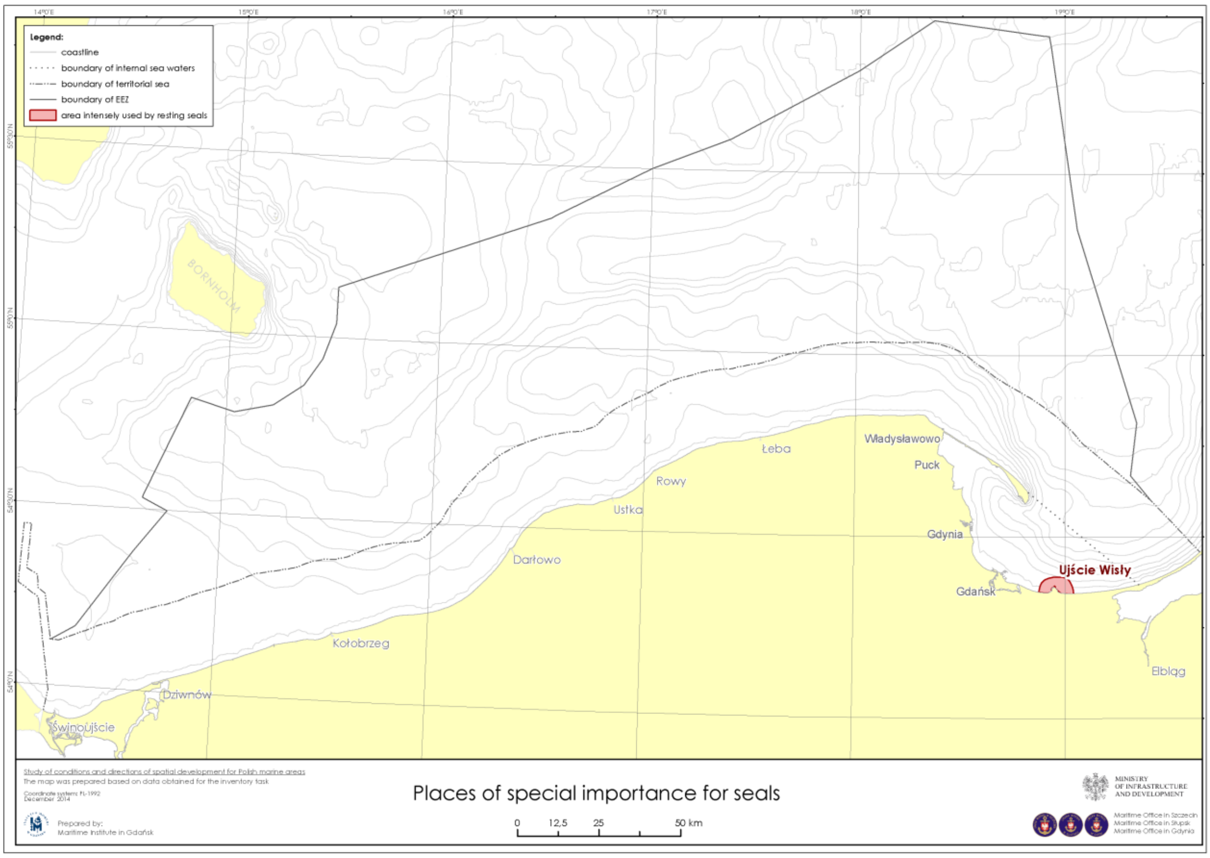


Fig. 3.13. Places of special importance for grey seal (*Halichoerus grypus*), harbour seal (*Phoca vitulina)* and ringed seal (*Pusa hispida*).

There is no substantiated knowledge to show which parts of Polish sea areas are particularly valuable for harbour porpoises. Experts from the Marine Station in Hel assess that the Puck Bay could be one of such places, since its environment creates good conditions for procreation and nursing of cubs.

Dangers

In the Polish part of the Baltic Sea seals are exposed to various dangers resulting from human activities. In the study "Grey seal (*Halichoerus grypus*) protection program – draft" [Gójska, 2012a] eight groups of dangers to grey seals were identified:

- disruption of peace and safety in land and sea habitats,
- changes (quantitative and qualitative) of food base,
- by-catch, i.e. accidental death in fishing tools,
- illegal killing,
- chemical pollutants introduced into the sea,
- eutrophication (changes in food base, potential influence of toxic cyanobacteria),
- epizootic and parasitic infections,
- ignorance and lack of effective protection.

These dangers are the same for harbour seals and ringed seals because all three species are characterized by similar biology and ecology.

Most significant dangers to harbour porpoises include [Gójska, 2012a]:

- chemical pollutants introduced into the sea,
- underwater noise,
- by-catch during fishing,
- disturbance and collisions.

There are also less significant dangers: change of food base and climate changes and fluctuations influencing the state of environment.

3.3. Monitoring of the state of marine environment

Good state of environment requires its monitoring, and this has a significant spatial aspect. The main concern is to guarantee proper space for (and access to) monitoring stations, which should be located at proper distances from each other.

Monitoring includes measurement of physical, chemical and biological conditions/parameters of the marine environment. Tasks of monitoring the state of marine environment in the Polish part of the Baltic Sea are of an obligatory character, because they are required among others by:

- provisions of the Helsinki Convention on protection of the marine environment of the Baltic Sea area,
- requirements of the Directive of the European Parliament and the Council of 23rd October 2000 establishing a framework for the Community action in the field of water policy.

These tasks are also the Polish contribution into the international COMBINE programme for monitoring of the Baltic Sea environment.

The main aim of the monitoring is to provide knowledge about the ecological (or ecological potential) and chemical state of Polish transitional, coastal and open sea waters, necessary for water management in river basins, in that for their protection against eutrophication and anthropogenic pollution.

The Baltic Sea monitoring system covers the deep water zone (stations in the Gotland, Bornholm and Gdańsk Deeps), the coastal zone, bays and lagoons (the Gulf of Gdańsk and Pomeranian Bay, Vistula Lagoon and Szczecin Lagoon at points not covered with monitoring within the task “Investigations and assessment of transitional and coastal waters”) (Fig. 3.14). The coastal and transitional zones are described by means of monitoring of surface waters. In the future an increase of spatial density of measuring stations should be expected.

On the basis of obtained data an annual assessment of the state of Baltic Sea environment is carried out.

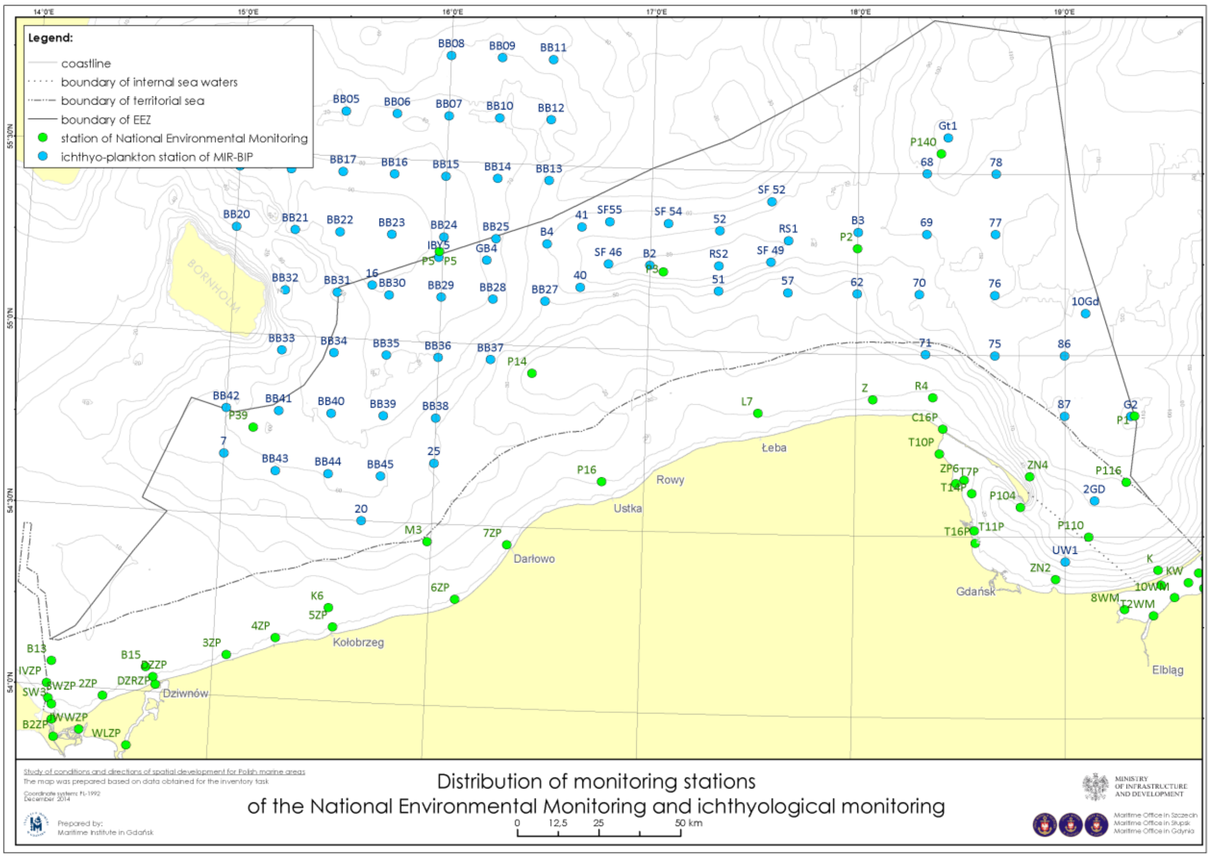


Fig. 3.14. Distribution of monitoring stations of the National Environmental Monitoring and ichthyological monitoring.

Source: the Maritime Institute in Gdańsk, on basis of MIR-BIP and CEIP

Conclusions for the maritime spatial plan of Polish sea areas

- Areas with most valuable nature should be taken into account; in many cases these areas are the same as areas protected under the Act on nature protection of 16th April 2004.
- The Słupsk Trough should be seen as a valuable area because of macrozoobenthos, and the eastern near-border waters as an important bird wintering area. Activities resulting in deterioration of ecological state of these areas should not be allowed.
- Provisions of protection plans for Natura 2000 areas should be supported. Work on detailed maritime spatial plans should take into account the extensive documentation created during the development of the protection plans.
- Maritime spatial plans should aim, among others, at facilitating connectivity between habitats to the

degree necessary to achieve a good state of environment.

- Results of the SAMBAH project should be given due consideration. They indicate that harbour porpoises gather during the breeding period (May to December) in an area to south-east of Oland (mainly Middle Bank – waters within the Swedish EEZ).
- Before starting work on the maritime spatial plan(s,) knowledge about areas of stone-covered bottom should be verified using survey data of Maritime Offices.
- Appropriate space should be secured for conducting environmental surveys of poorly investigated areas and for carrying out measurements within the National Environmental Monitoring programme.
- Provisions should be made for potential new Marine Monitoring stations (four stations were submitted as proposals to the plan), in particular in the area of the Słupsk Bank. Data from these stations will be shared, among others, with institutions responsible for the National Environmental Monitoring.

Knowledge gaps

It is essential, from sea space management point of view, to improve the knowledge about the quantitative and qualitative structure and location of sea bottom habitats. The modified classification system of environmental habitats of the Baltic Sea EUNIS in Polish sea areas was positively verified for an immobile hard substrate. It should be endeavoured to use it in other areas of the Baltic Sea, taking into account larger amounts of data [Brzeska and others, 2008]. This is the only way a system for proper and precise classification of sea bottom habitats can be created. In consequence accurate maps of location of habitats could be developed, which in turn would facilitate effective protection.

The information should be regularly updated, which means that a continuous monitoring system should be maintained (which is provided by the National Environmental Monitoring programme), and supplemented by investigations aimed at explaining specific problems/issues.

4. CONDITIONS RESULTING FROM THE DEVELOPMENT OF COASTAL LAND AREAS

4.1. Delimitation of analysed land area

Land and sea interact with each other, especially in the contact zone. However, there is no unequivocal delimitation of the coastal land area identified by the intensity of such interactions. The spatial range of "coastal land area" is far narrower in the tourism sector than for example in renewable energy, aquaculture or maritime transport. Therefore, delimitation of the analysed areas should be treated as a compromise between the various types of interactions and sea-land linkages.

Within the process of implementing Integrated Coastal Zone Management (ICZM) in Poland, a very pragmatic delimitation of the coastal zone was proposed, i.e. "for Poland, the best approach will be to assume that the land boundary of the coastal zone coincides with the borders of the coastal municipalities. However, in some cases a wider area should be included, e.g. in the neighbourhood of larger urban centres. Thanks to such delimitation – in accordance with administrative borders – ICZM easily fits into the existing subjective system of management, without the need of establishing new bodies or authorities" [Ministry of Construction, 2007]. Nevertheless, the Brzeg Morski [17] website shows many *overlapping and interpenetrating* delimitations, covering the area of the three coastal voivodships, coastal districts and municipalities belonging to the Association of Sea Cities and Municipalities (ASCM) . It should also be noted that such municipalities, as Pszczólki, Cedry, Pruszcz or Gniewino also belong to the ASCM, though they are not coastal in strict sense. On the other hand, not all coastal municipalities have entered the association. This shows that the criterion of self-identification operates somewhat differently than the location criterion.

For the purposes of this Study only coastal municipalities were analysed. The analysed coastal land area is shown in Fig 4.1. However, this rule is modified in case of geographical and socio-economic analyses (chapters 4.2-4.4 and 4.7). In these analyses it was taken into account that some economical, geographical and demographic impacts reach deeper inland than the coastal zone. This wider zone of influence is called the coastal area. Besides the coastal municipalities, the area includes municipalities of the Warminsko-Mazurskie Voivodship bordering with the Vistula Lagoon (which is not covered by this Study), Szczecin and the Szczecin Lagoon municipalities, because of the importance of Elbląg and Szczecin for Polish sea areas. The area covers also municipalities which are not in contact with the sea, but are located within 10 km from the coast. In cases, where the municipality area extended outside that zone, into account were taken only the units of which more than 50% was in the 10 km strip (Fig. 4.1). Such an extended delimitation (coastal area) still excludes from the analysis some municipalities located in the TriCity functional area (designated for the purposes of Integrated Territorial Investments[18]) such as Kolbudy, Pszczółki, Szemud, Przodkowo, Kartuzy, and the Szczecin functional area: Gryfino, Stare Czarnkowo and Kobylanka. A detailed list of the analysed municipalities is given in Annex 6 (Table1).

[17] http.//www.brzegmorski.pl/

[18] In acc. with the Rules on Integrated Territorial Investments in Poland issued by Ministry of Regional Development in July 2013 (the delimitation is narrower than mentioned in the ITI Agreement)

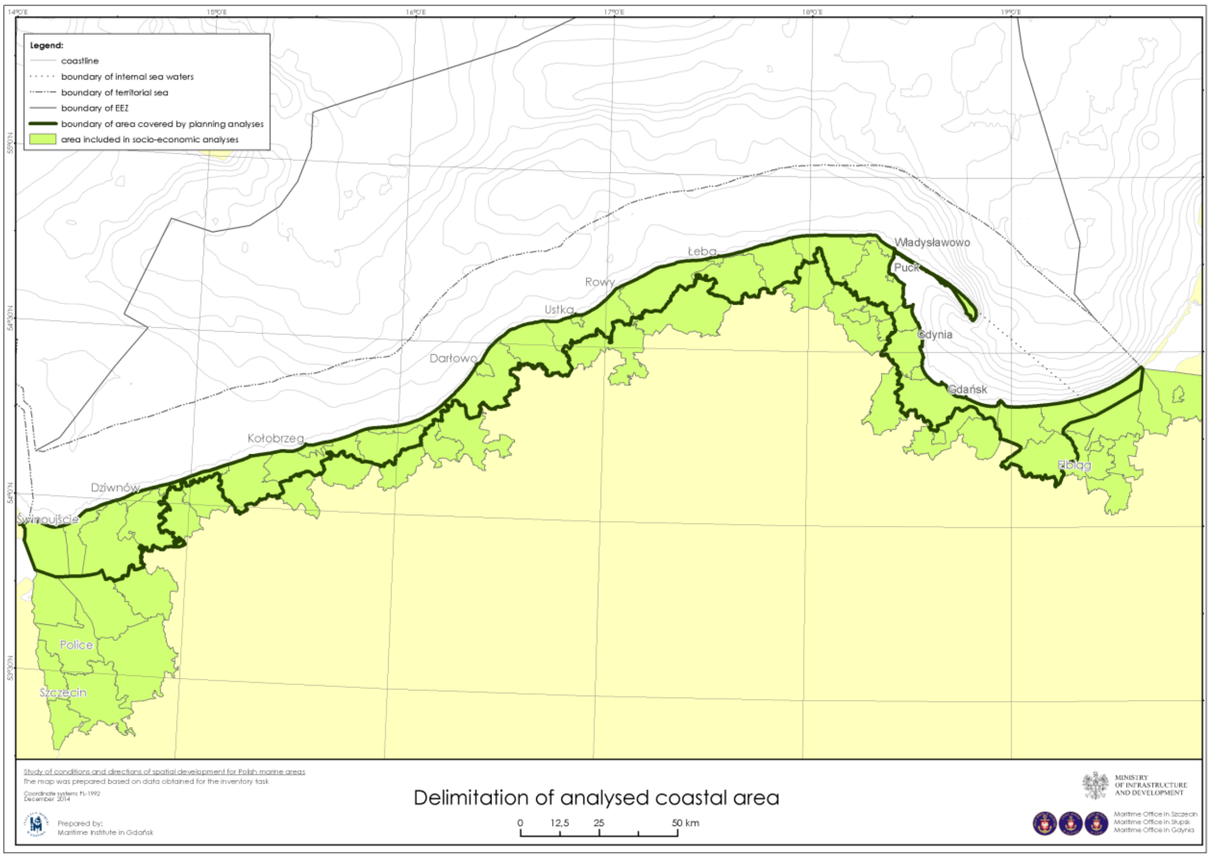


Fig. 4.1. Delimitation of analysed coastal area

Source: Maritime Institute in Gdańsk

The overall image of the coastal area is very heterogeneous. It includes small-sized municipalities such as City of Puck (5 km^2), or Jastarnia (8 km^2) but also municipalities of over 300 km^2 e.g. Szczecin, Wolin, Główczyce, or even 400 km^2 – Goleniów. Beside the cities with population over 100 thousand inhabitants, such as Gdańsk, Gdynia, Koszalin, Elbląg and Szczecin, medium cities (over 40-50 thous. inhabitants) such as Kołobrzeg, Rumia, Sopot and Wejherowo, there are also municipalities with less than 2000 inhabitants – e.g. Krynica Morska or Nowe Warpno.

Analysis of data obtained from the project Corine Land Cover (CLC)[19], enables assessment of coastal municipalities with respect to forms of space use. More than 50% of the area of municipalities is used for agricultural purposes, 30% is covered by forests and semi-natural ecosystems, about 6% is anthropogenised and a little more than 1% is wetland. The spatial diversification of land cover in the analysed area is shown in Fig. 4.2.

[19] The Chief Inspectorate for Environmental Protection is the entity responsible for realization of the Project CLC 2006 in Poland.

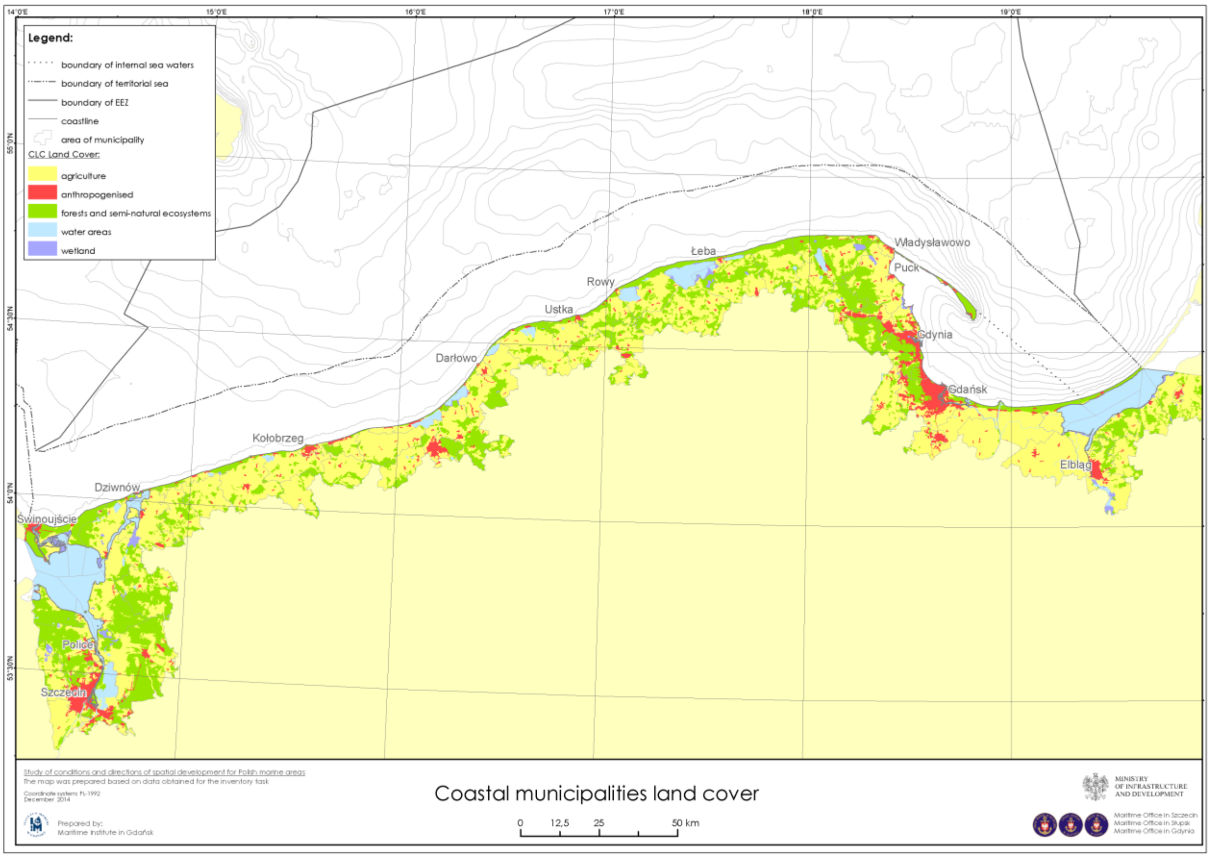


Fig. 4.2. Coastal municipalities land cover

Source: Maritime Institute in Gdańsk, on the basis of CLC 2006 data (GIOŚ).

4.2. Physio-geographical conditions of coastal area

On basis of report "Physio-Geographical Conditions in the Polish Coastal Area", Jan Faściszewski, Spatial Policy Laboratory of Maritime Institute in Gdańsk, 2014 — Annex 5

The analysed 68 coastal municipalities are located in The Southern Baltic Coastland (Figs. 4.3 and 4.4). The land part of the Study area contacts with the Baltic Sea on a length of about 500 km.

Besides coastal landscapes with rivers outlets, the coastal area is basically formed by moraine plains situated below 100 m above msl with a network of small ice margin valleys and some higher hills (Fig. 4.5). The following landscapes are distinguished in this area: dune landscape, deltaic landscape, lake-swamp landscape and upland landscape with sloping seawards cliffs. Natural conditions are strongly diversified in the coastal area.

Two big rivers cross the area of the coastal municipalities and discharge into the Baltic Sea: the Odra (total catchment 118,861 km^2, in Poland 106,056 km^2) and Vistula (catchment 198,313 km^2, in Poland 172,587 km^2) and several smaller rivers flowing directly into the sea with a total catchment area of 23,146 km^2. The largest of them are (Fig. 4.6): Pasłęka, Reda, Łeba, Łupawa, Słupia, Wieprza, Grabowa, Parsęta and Rega.

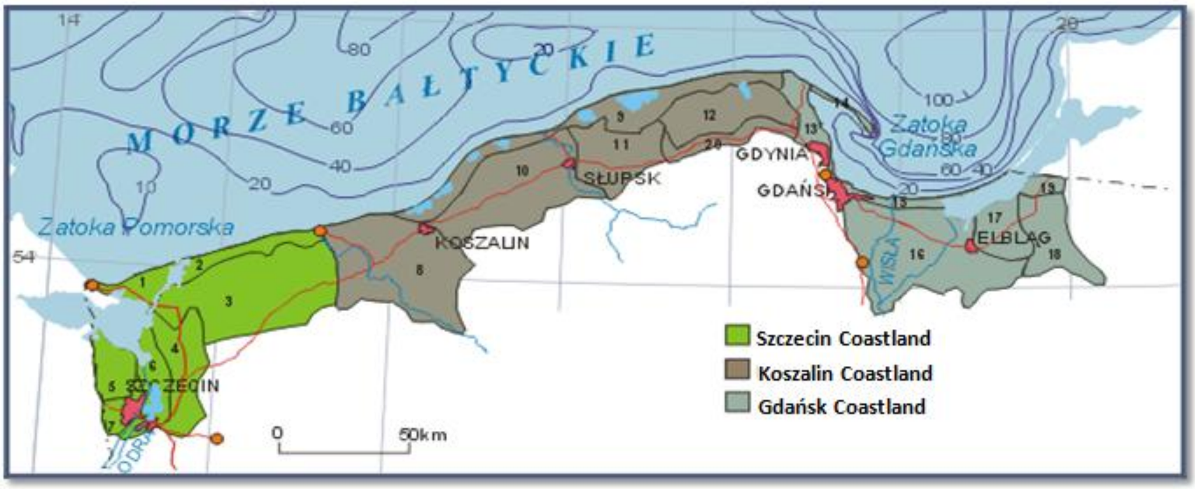


Fig. 4.3. Physio-geographical regions[20]

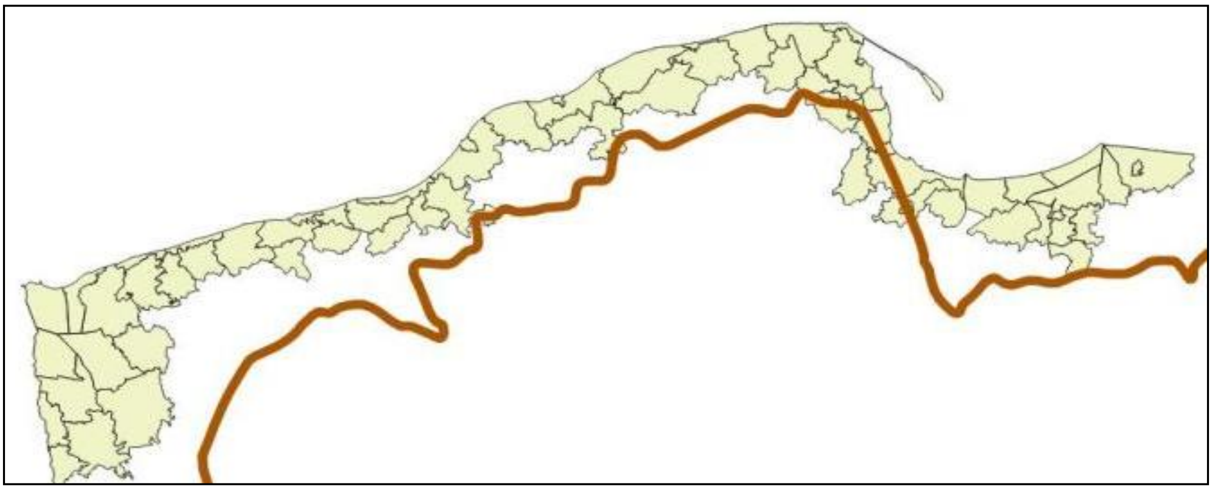


Fig. 4.4. Border of the Polish part of the Southern Baltic Coastland and municipalities of the analysed in the Study coastal area

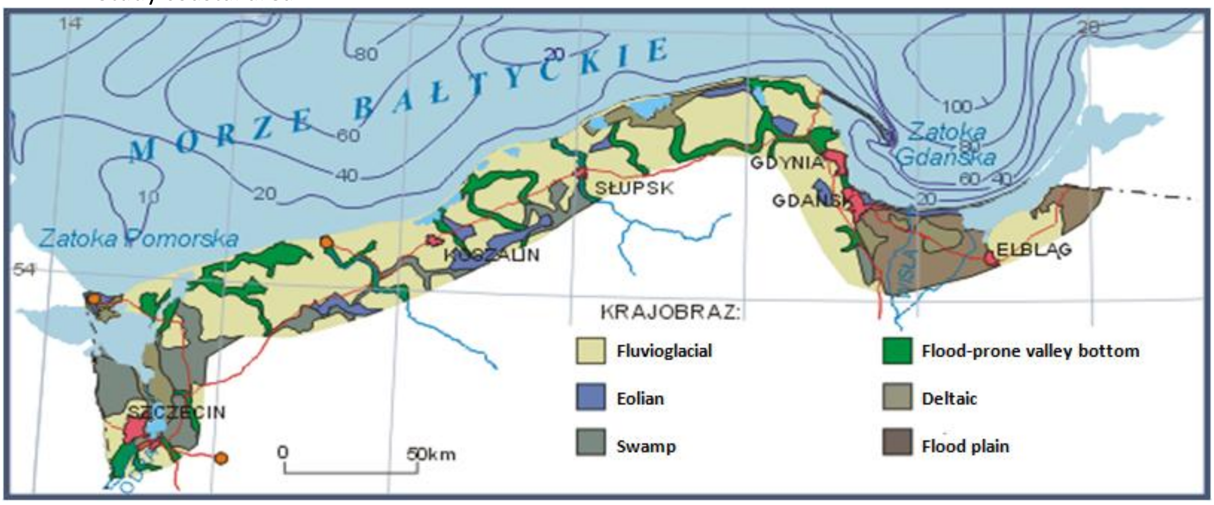


Fig. 4.5. Types of natural landscapes

[20] Illustrations in sub-chapter 4.2 are from Annex 4.

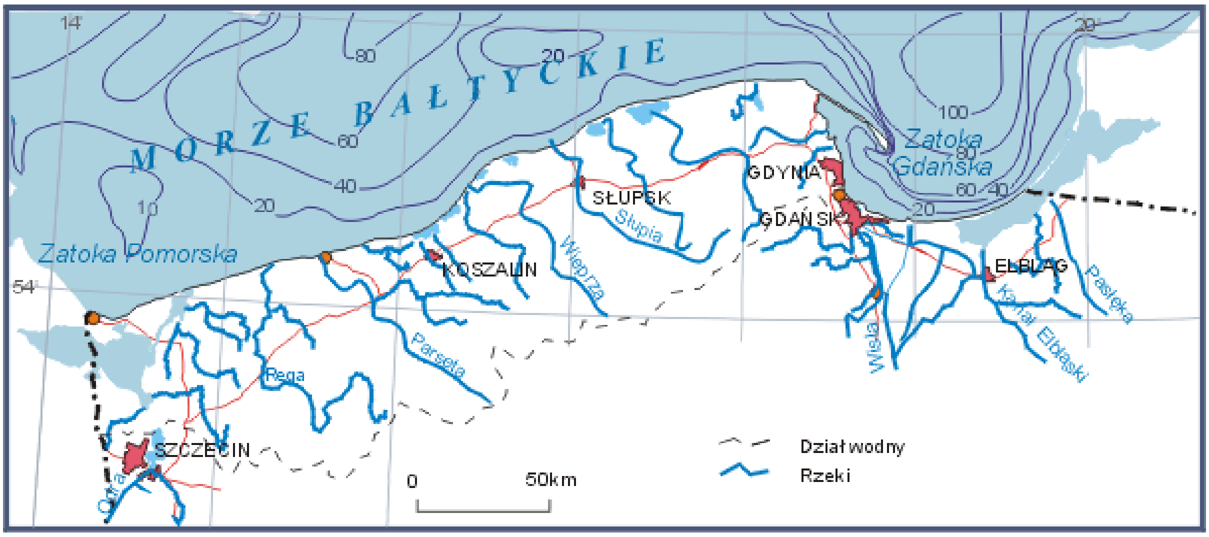


Fig. 4.6. River network

Most of the coastal areas are covered by soil formed from post-glacial (Pleistocene) deposits such as boulder till and sands of fluvioglacial accumulation. Mostly this is medium quality brown soil (most often acidic and *eutrophic)* and podsolic soils (Fig. 4.7). Soil complexes, with majority of agricultural lands of high and very high class of wheat and rye soils occur in the coastal areas between Dżwirzyno and Jarosławiec and also in the Pyrzyce and Stargard region. Best agricultural land – complexes of class 1, 2 and 4 value (very good and good for wheat production and good for wheat and rye production) is in the Żuławy Wiślane area, near lakes and in some places along the coast.

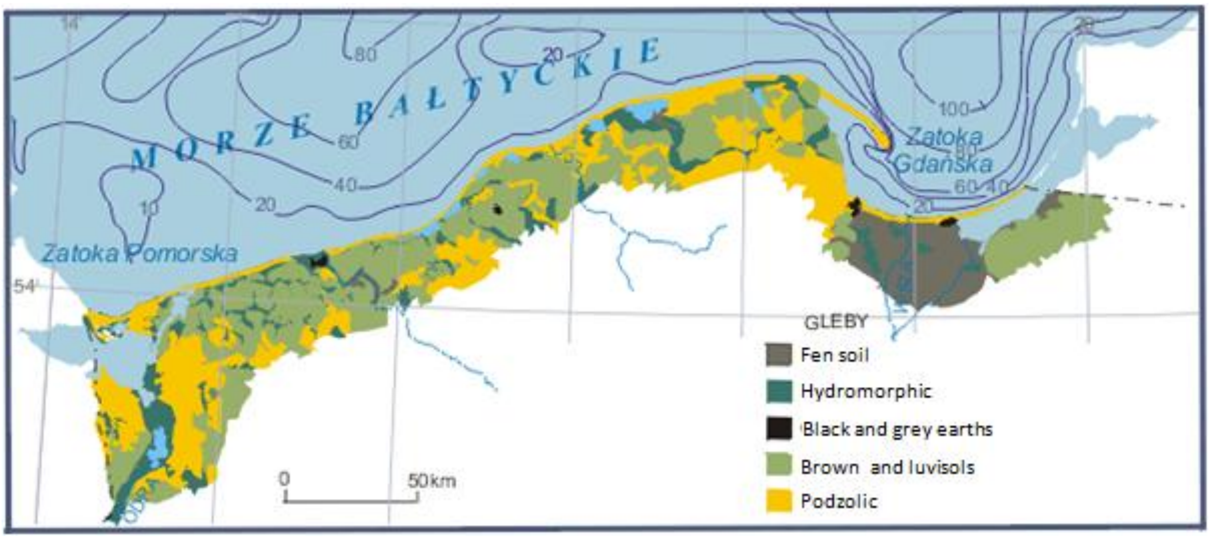


Fig. 4.7. Soils

The climate of the South Baltic Shoreland is influenced by the Baltic Sea and the Atlantic Ocean and by transient low-pressure systems (especially in late autumn and winter), and periodically occurring high-pressure systems (mostly in early spring and autumn). The highest total annual sunshine duration is noted along the Baltic coast, especially in the area of Świnoujście, Ustka and Łeba, with an average value of 1650 hours. The number of hours decreases with distance inland from the coast to about 1550 hours. The sunniest months are May, July and June. Rainfall is relatively small in the coastal area, with an average of 550 mm per year in the region of Świnoujście to over 700 mm in the Ustka and Łeba regions. A similar spatial picture occurs in summer (Fig. 4.8.).

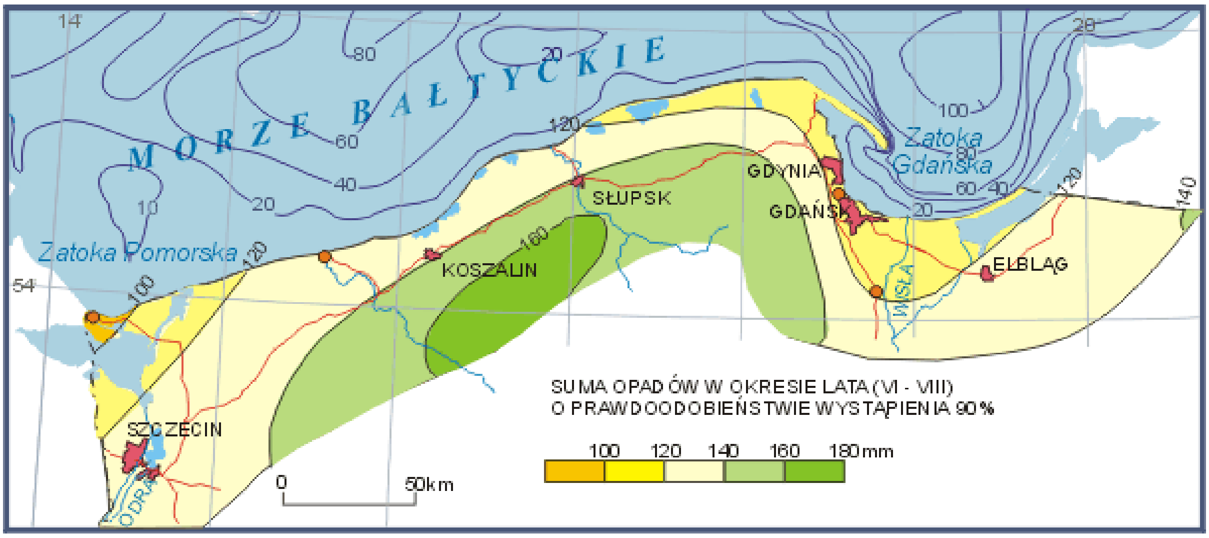


Fig. 4.8. Total 90% probability rainfall in summer

The system of nature protection in the coastal area includes:

- 2 National Parks: Woliński National Park and Słowiński National Park with buffer zone,
- 70 nature reserves,
- 4 Landscape Parks,
- 23 areas of protected landscape,
- 63 areas of the Natura 2000 network,
- 6 nature and landscape complexes.

The following areas with highest natural value were identified in the coastal zone in result of valorization of nature: the spit of the Świna Gate, parts of Wolinski National Park, area Pogorzelica-Mrzeżyno, area east of Kołobrzeg, Lake Bukowo Spit, area west of Ustka, Słowiński National Park, Lake Sarbsko Spit and the coast up to the Piaśnica River, Bielawskie Błota, nature reserve "Hel Peninsula Dunes", parts of the Tri-City Landscape Park, the Vistula mouth, the Vistula Spit Landscape Park, main ecological corridors: the Szczecin Lagoon and Lower Odra Valley, the Kamień Lagoon and the valley of Dźwina, valleys of main Pomeranian rivers: Rega, Parsęta, Wieprza with Grabowa, Słupia, Łupawa, Łeba and Reda, Żuławy and the Lower Vistula Valley and the directions of links with other areas of valuable nature of Northern Poland.

Similarly, the ECONET-PL network [Liro A., i in., 1995] identifies the Coastland's river valleys as ecological corridors of national importance, and the valleys of Odra and Vistula rivers as corridors of international importance. The whole Polish part of the Baltic Coastland is recognized as an international core area. It is divided into three connecting parts (all of international importance): the river Odra estuary, the Baltic coastal land area, and the mouth of Vistula. Within these areas biocentres and buffer zones were designated, which include: The Świna Gate spit and Lower Odra Valley with the Szczecin and Kamień Lagoons, parts of spits of lakes Jamno, Bukowo and Kopań, the Słowiński National Park, part of the Coastal Landscape Park, the Vistula mouth and part of the Vistula Spit Landscape Park.

Ornithological valorisation of the coastal zone was carried out by the Polish Society for the Protection of Birds (OTOP). It was the basis for designating IBAs in Poland. The European rank IBAs were designated in accordance with international criteria developed by BirdLife International. Below are presented IBAs of European (E) and national (N) importance:

- E-IBA (E) Poland 001 Delta Świny (Świna Delta),
- E-IBA (E) Poland 002 Zalew Szczeciński (Szczecin Lagoon),
- E-IBA (E) Poland 081 Zatoka Pomorska (Pomeranian Bay),
- K-IBA (N) Poland Zalew Kamieński (Kamień Lagoon),
- K-IBA (N) Poland Jezioro Liwia Łuża (Liwia-Łuża Lake),
- E-IBA (E) Poland 080 Wody Centralnego Wybrzeża (Waters of Central Coast),
- K-IBA (N) Poland Koszalińsko-Słupski Pas Nadmorski (Słupsk Coastal Belt),
- E-IBA (E) Poland 079 Ławica Słupska (Słupsk Bank),
- E-IBA (E) Poland 009 Słowiński Park Narodowy (Słowiński National Park),
- K-IBA (N) Poland Bielawskie Błota (Bielawskie Bogs),
- E-IBA (E) Poland 012 Zatoka Pucka wraz z łąkami Beki, Mechelinek i Jastarni (Puck Bay with Beka, Mechelinki and Jastarnia meadows),
- E-IBA (E) Poland 013 Ujście Wisły (Vistula Mouth),
- E-IBA (E) Poland 014 Zalew Wiślany (Vistula Lagoon).

Conclusions for the Maritime Spatial Plans of Polish sea areas

- Proper account should be taken of the role of Pomeranian rivers as important ecological corridors and their accessibility from the sea should be ensured in accordance with the concept of blue ecological corridors.
- Attention should be paid to located on land biocentres and buffer zones, as well as to other areas of highest natural value, in order to minimise negative impacts from the sea.
- Climatic and landscape conditions confirm the importance of recreation and tourism for the development of coastal municipalities. It is therefore important to designate appropriate sea areas for these activities.
- Soil conditions are good for agriculture only in some parts of the coastal area. In the areas where agriculture is developing, a space for development of aquaculture protecting the marine environment should be guaranteed (e.g. at the mouths of Vistula and Odra rivers). In the areas where agriculture cannot play a leading role, maritime spatial plans should be used to form conditions for locating new forms of sea use, especially such that can ensure year-round employment.

Knowledge gaps: Available information seems to be sufficient.

4.3. Population and demographic trends/potential[21]

The population of the analysed coastal area was in 2004 (i.e. ten years ago) 2 157 151 people, and 2 222 002 in 2013 (Fig. 4.9). This means a 3% increase. If the whole functional areas of Tri-City and Szczecin were included in the analysis the figures would increase to 2 264 718 and 2 344 574 respectively (giving a 3.5 % increase). Taking into account the general decrease of Poland's population, it may be concluded that the coastal area is exceptionally attractive for settlement.

In the period 2004-2013 population increased outside the metropolitan areas as well as in functional areas of Szczecin and TriCity – 1.4, 2.2 and 4.5 % respectively. In this last the growth was stronger beyond the area of 10 km from the coastline. If municipalities located further from the coast are taken into consideration, then the scale of demographic growth in the Szczecin and TriCity functional areas increases to 2.5 and 5.4 % respectively during the analysed period.

Over 70 % of people living in coastal areas are residents of the functional areas of TriCity and Szczecin (in the 10 km strip), and there is an increasing trend (69.31% in 2004, 69.78% in 2013).

There is an increasing trend in population growth during the analysed period in municipalities located close to big cities. The highest growth has been noted in Kołbaskowo and Dobra (located near Szczecin), 39.5 and 72.4 % respectively, as well as Kosakowo (near Gdynia) (54%), in the rural municipality of Pruszcz Gdański (52.1%), in Żukowo (near Gdańsk) (34.1%) and in rural municipality of Wejherowo (29.9%). However, this is an effect of the low number of inhabitants. In absolute terms this change meant a population growth of only several thousand – to approximately 8000 in Dobra, Żukowo or Pruszcz. It seems that similar trends of sub-urbanization are present in small towns such as Dziwnów, Kamień Pomorski and Darłowo. Dynamic growth is also noted in the rural municipality of Słupsk, the second in importance regional centre of the Pomeranian Voivodship. Among medium-sized towns the fastest-growing (by demographics) is Reda, which is the 'sleeping area' and trade and industrial hinterland of Gdynia and the whole TriCity. Sub-urbanization resulted in a decrease of population in the centres of big cities. The only big city, where the number of inhabitants remained at the same level, is Gdańsk. The number of permanent residents of smaller towns has also decreased. The record is held by Hel with a more than 11% decrease, caused by the relocation of the national defence function.

[21] Detailed tables are in Annex 6

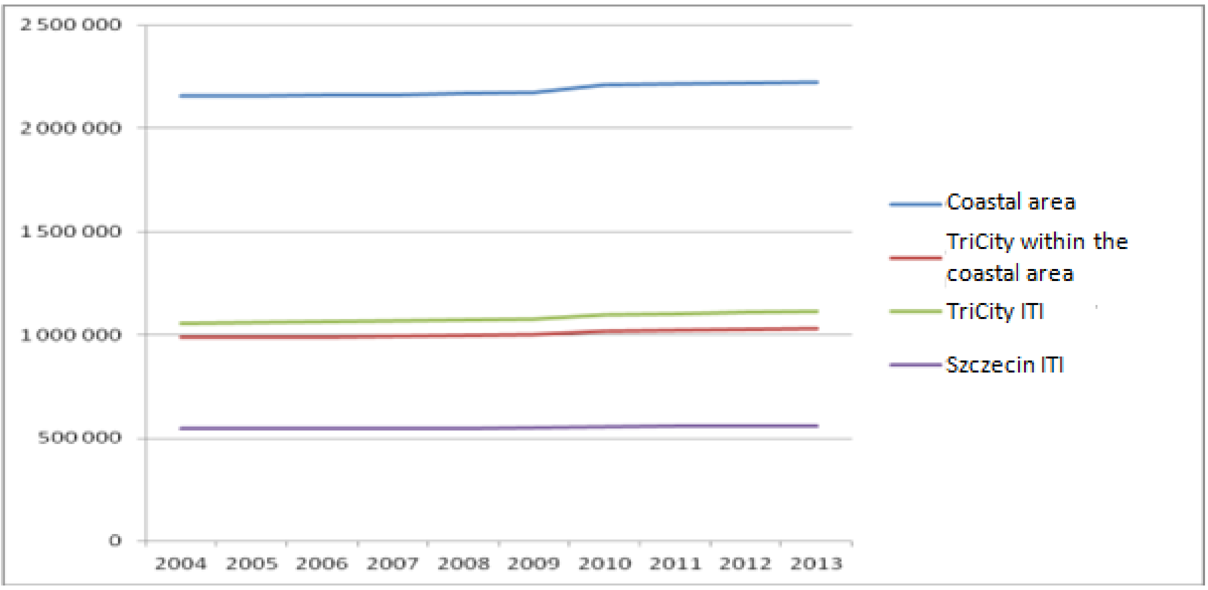


Fig. 4.9. Total population of the coastal area in the period of 2004-2013

Source: Maritime Institute in Gdańsk, based on BDL local bank data

Density of population in the coastal area increased from 215/km^2 in 2004 to 222/km^2 in 2013. It is higher than the national average (103/km^2 in 2013) and the highest densities exceeding more than 10 times the average is in the cities. However, Szczecin is a city with relatively low population density (only 11 times higher than the national average). The highest density is in Puck and Sopot (respectively 19. and 18 times the national average). But in general, density of population in coastal municipalities remains below 100/km^2 except for towns and municipalities situated in metropolitan areas. In some coastal municipalities population density has decreased to a level which even in Scandinavia is considered to be critical, e.g. Smołdzino (13.3/km^2), Stepnica (17/km^2) and Krynica Morska (11.7/km^2). In several municipalities, e.g. Krynica Morska, Sztutowo, Frombork, Tolkmicko, Braniewo, Świnoujście, Stepnica, Wolin, Nowe Warpno and partly Police this value is artificially low due to the inclusion of sea waters (lagoons) into the land area of these municipalities. Population density is illustrated in Fig. 4.10. It suggests that, to a large extent, anthropogenic pressure on marine ecosystems is of a local character.

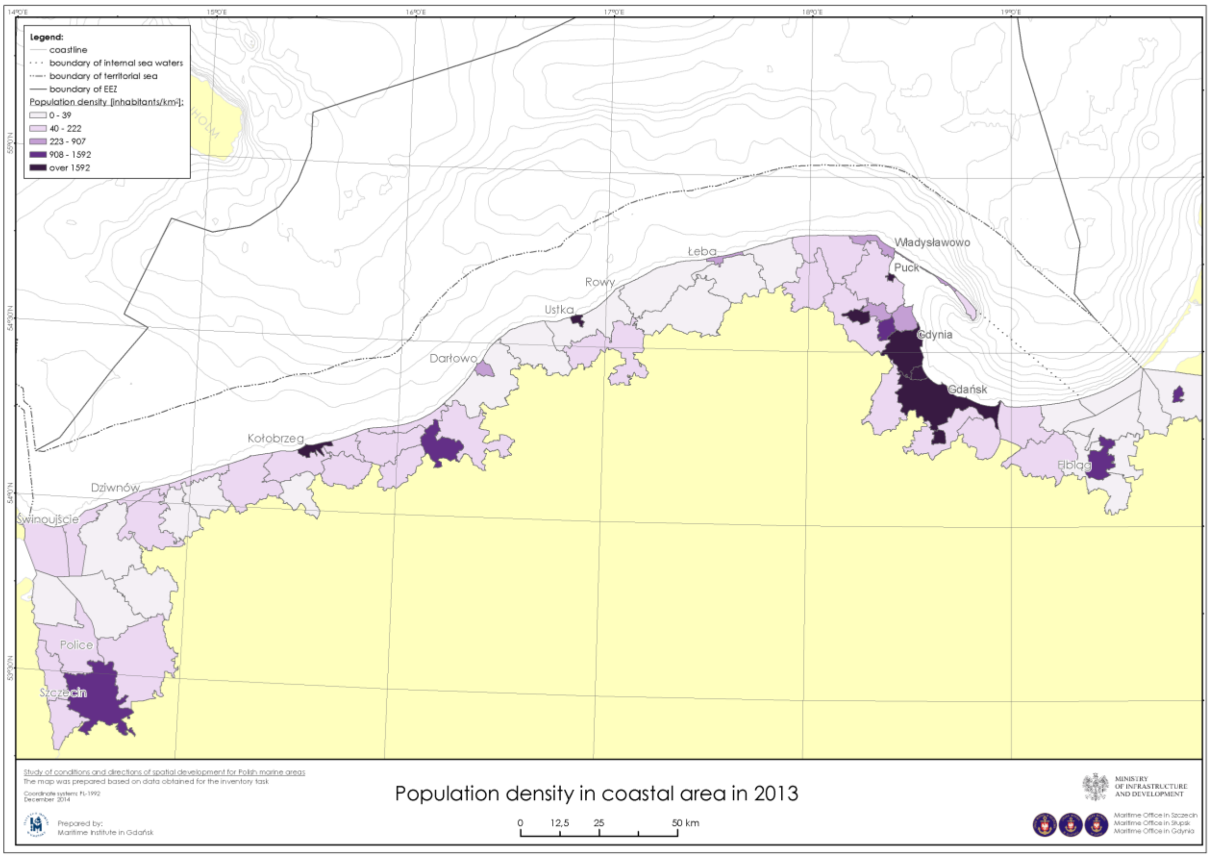


Fig. 4.10. Population density in coastal area in 2013

Source: Maritime Institute in Gdańsk, based on LDB data

Among the demographic phenomena, special attention should be given to the ageing issue. Nowadays more than 10% of population of big and medium cities is at the age of 70 or more. It creates a specific demand for marine ecosystem services, especially related to recreation and rehabilitation. The highest percentage of older people (in the population of the coastal arae) is observed in the TriCity. In Sopot, nearly one quarter of inhabitants (23%) is of retirement age.

Demographic analysis shows that big cities are the main development driver in the coastal area. They significantly influence the demographic and location processes in neighbouring municipalities. Over most of the area, there is a moderate increase of the number of inhabitants, causing no additional anthropogenic pressure on the environment. Analyses show that big cities should not be examined without taking into account their functional areas; without which the obtained picture would be untrue and misleading. Tourism industry located in coastal areas, seems to have quite a small impact on the number of permanent inhabitants (e.g. in Krynica Morska, which is a thriving summer vacations centre, the number of permanent inhabitants during last 10 years increased only by 30 people). No significant permanent increase of demographic pressure in the areas directly bordering with the sea, except for the functional areas of big cities is observed. This means that problems related to the human presence should be solved at river basin level and in functional areas of agglomerations. This is not to say, that seasonal growth of the number of people spending their time on the coast should not be taken into consideration while developing maritime spatial plan(s). During summer months, the demand for marine space will result from the needs of visitors, not the locals. This phenomenon will be of a strongly temporal character (see sub-chapter 4.6), and the involved stakeholders will have a specific approach, characterised by a concentration on short term benefits and a lack of strong emotional link with the area from which they are deriving their profit.

4.4. Economy

Available statistical information does not allow to identify the role of maritime economy in the development of the coastal area. There is also lack of information on municipalities disaggregation (NUTS 5) concerning employment in sectors of national economy or the generated added value. The scope of maritime economy is also unclear (i.e. which sectors of the national economy form this economy). In that regard, the approach of the DG Mare "Study on Blue Growth in the Baltic Sea Region"[22] can be applied. Calculations made for NUTS 2 level (voivodship) indicate that e.g. in the Pomeranian Voivodship the greatest number of jobs in maritime economy is created by fishing and fish processing (mostly fish processing) and by the shipbuilding industry. Tourism is also important. One may also mention yacht construction and short sea shipping. From the perspective of added value shipbuilding industry ranks first and fish processing is in second place. However, most of the processed fish come not from the Baltic Sea but are imported, mainly from Norwegian fish farms.

The DG Mare Study also identifies the largest and fastest-growing in the period 2008-2010 maritime economic sectors at the country level (NUTS 0). The result is an effect of averaging the level of employment and the added value. Similarly as in the Pomeranian Voivodship, the largest sectors of Polish maritime economy (on national level) include: fish processing and fishing, shipbuilding industry and coastal tourism. In next order one may mention maritime infrastructural projects, short sea shipping, yachting and yacht construction, safety of navigation and its monitoring. The quickest developing sectors are: passenger ferry shipping, gas and oil mining, cruise ships and related tourism, monitoring of the environment, aquaculture, yachting and yacht construction, fish processing and fishing. In many cases, this was an effect of a very low statistic base in 2008 (e.g. marine aquaculture around 0). Among the already well developed sectors the increase was seen mainly in ferry shipping. With regard to fishing and fish processing the increase was characterized by decrease of employment and at the same time, an increase of added value. Other important sectors, such as shipbuilding industry, short sea shipping or coastal tourism, showed, in the period 2008-2010, a drop both in employment and added value.

Information available from the LDB (at municipalities level i.e. NUTS 5) allows only a very rough estimation of the state of economy. On the basis of these data some conclusionions may be drawn concerning the spatial distributions of unemployment, entrepreneurship and general satisfaction with the socio-economic level of a municipality manifested by the net migration rate. For more detailed assessment of the state of economy expert knowledge was used on sectors of maritime economy of key importance for small coastal municipalities such as fishing, small ports and tourism.

In 2013, in the analysed area, 320,700 economic operators were registered in the National Official Business Register, REGON. Over 81% of them were based in Elbląg, Koszalin and in the considered in the present analysis functional areas of Szczecin and TriCity (city of Słupsk has not been considered). Among the remaining municipalities, Władysławowo (1.07%), Kołobrzeg (2.61%) and Świnoujście (2.04%) may be mentioned. Relative indicators, i.e. the number of economic operators per 10

[22] *Study on Blue Growth, Maritime Policy and the EU Strategy for the Baltic Sea Region* available at DG Mare website https://webgate.ec.europa.eu/maritimeforum/en/community/msexperts/articles/3550

thousand residents shows an above-average[23] level of entrepreneurship in municipalities such as: Rewal (3631), Łeba (3546), Krynica Morska (3471,5) and Jastarnia (2932) – more than two standard deviations from the mean value. A relatively high level of entrepreneurship (more than one standard deviation) characterizes also Władysławowo, Międzyzdroje, Sopot, Dziwnów, Mielno and Ustronie Morskie. For Gdynia, Gdańsk, Koszalin and Szczecin, this indicator is only slightly higher than average, because of their overwhelming impact on the value of the average. The relative entrepreneurship indicator was exceptionally low in Główczyce (617) and Gniewino (643), Cedry Wielkie (729), rural municipality of Braniewo (460) and Milejewo (694). Spatial distribution of entrepreneurship, i.e. the number of economic operates per 10 thousand inhabitants, is illustrated in Fig. 4.11. It shows that entrepreneurial attitudes appear mainly in municipalities having a well developed tourism-oriented profile. Just being on the coast is not a sufficient condition for intensive entrepreneurship.

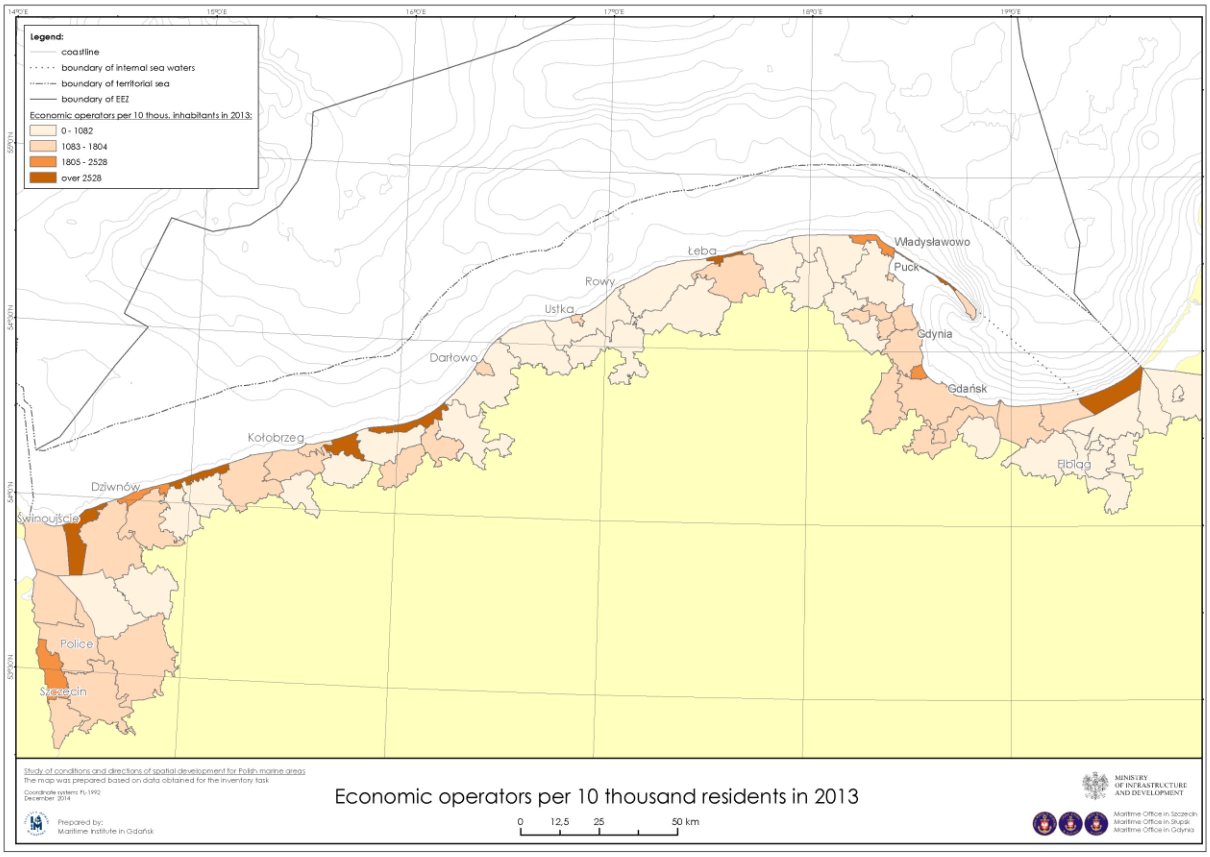


Fig. 4.11. Economic operators per 10 thousand residents in 2013

Source: Mritime Institute in Gdańsk, on the basis of BDL local bank data

Unemployment was concentrated spatially and coincided with demographic processes. In the analysed area there were 99 927 unemployed registered in Regional Labour Offices in 2013. Almost 56 % of them were inhabitants of the TriCity and Szczecin agglomerations. Available information does not allow calculating unemployment rate per municipality. An indicator of intensity of this phenomenon is the number of unemployed per 10 thousand inhabitants at the age of 20-64. Within the analysed area the average in this age group was 687 unemployed per 10 thousand inhabitants. Unemployment in several municipalities was relatively low i.e. in Gdynia (value of indicator: 412) and

[23] The average was 1443.3 of economic operators per 10 thousand residents in 2013.

in Sopot (318). At the other end of the spectrum were municipalities for which the indicator exceeded the average value by 2 standard deviations (rural municipality of Braniewo) or 1 standard deviation (city of Braniewo, rural municipality of Elbląg, Milejewo, Tolkmicko, Frombork, Stegna, Sztutowo, Krynica Morska, Nowy Dwór Gdański, Będzino, Wicko, Nowe Warpno, Wolin, Świerzno, Darłowo – urban and rural municipalities, Sianów, Karnice, Rewal). Żuławy and the adjacent coastal municipalities of the Vistula Lagoon are evidently areas of economic recession. It is also difficult to find the reasons of the high unemployment scale in Krynica Morska, Stegna and Sztutowo. It is probably linked with the seasonal employment in tourism, which dominates the economy of these municipalities, and the existence of "grey" economy. A similar phenomenon may be observed in other municipalities with developed coastal tourism such as Mielno, Postomino, Dziwnów and earlier mentioned Rewal. The spatial distribution of unemployed per 10 thousand inhabitants, is illustrated in Fig. 4.12. It clearly shows, that the closer to the centers of the large cities the area is located, the intensity of the problem decreases.

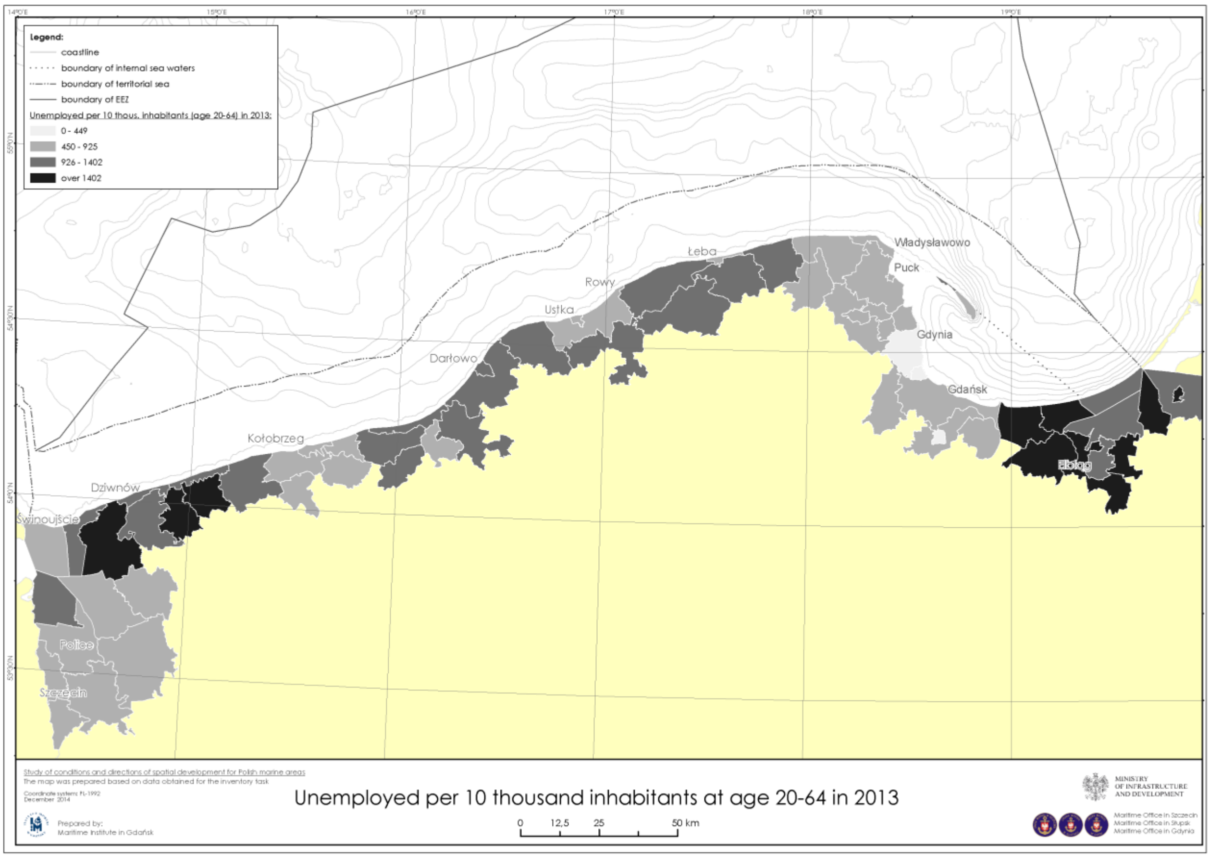


Fig. 4.12. Unemployed per 10 thousand inhabitants at age 20-64 in 2013

Source: Maritime Institute in Gdańsk, on the basis of BDL local bank data

Exodus of residents in long-term may be a sign that a municipality does not offer proper perspectives of development both in the social and economic dimension. In this context, it may be recognized as an indicator of the perception, or assessment, by the residents of a given territorial unit, of chances for future development in comparison with other Polish or even EU municipalities. Information provided in Table 3 of Annex 6 does not indicate such type of processes is taking place.

The only city with a high rate of loss of residents was Hel, due to the disappearance of one of the economical functions (national defence) of that city. Many large and medium cities have a negative migration balance, but it appears that people were moving from the cities to the suburban municipalities (e.g. the city of Kołobrzeg and rural municipality of Kołobrzeg, Szczecin versus its metropolitan area). This is why record population growth was observed in such municipalities as rural municipality of Pruszcz Gdański, Kosakowo, Kołbaskowo and Dobra. An interesting phenomenon, requiring analysis and explanation, is the outflow of people from coastal municipalities with well developed tourist functions e.g. from Jastania, Dziwnów, Łeba and Władysławowo. It may suggest the hypothesis that seasonal tourism is not able to provide by itself long-term development and requires support by other functions. The exodus from municipalities around the Vistula Lagoon (especially from Elbląg) confirms the hypothesis about the difficult social and economical condition of this area.

The spatial distribution of net migration in relation to the number of residents is illustrated in Fig. 4.13.

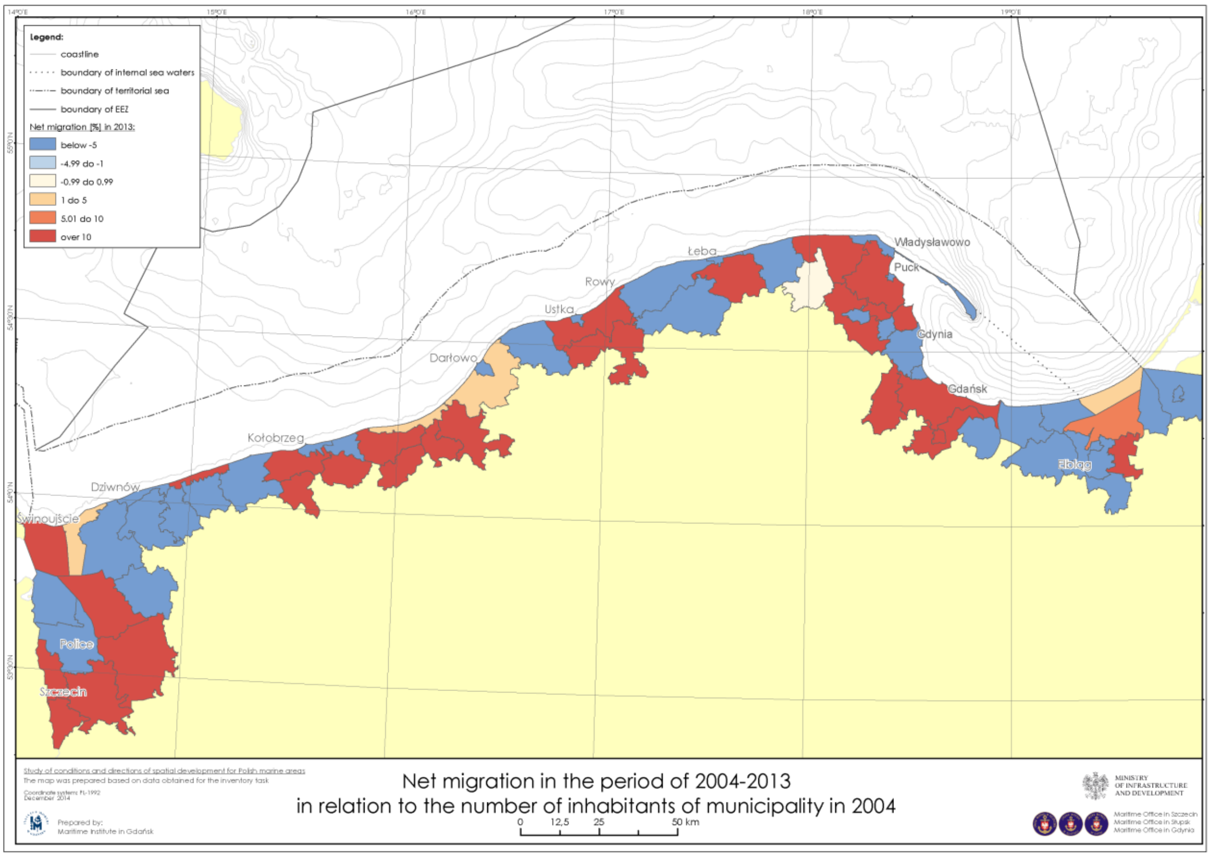


Fig. 4.13. Net migration in the period 2004-2013 in relation to the number of inhabitants of municipality in 2004.

Source: Maritime Institute in Gdańsk, on the basis of LDB information

The incomes of municipalities are often used as a measure of economic growth. Unfortunately, because of the policy of supporting weaker municipalities, they do not fully represent/indicate their development. But, without doubt, they show the growth potential of a municipality in the public sphere, i.e. in the area of ensuring the supply of local public goods. The total income in 2012 of all municipalities in the coastal area was 10,105,319,385 PLN, with an average per inhabitant of 4,548

PLN. As much as 72% of the total income was achieved by municipalities of the Szczecin and Tri-City metropolitan areas. This is slightly higher than the share of these cities (70%) in the total population of the analysed municipalities.

Analysis of income per inhabitant clearly shows two leaders: Krynica Morska with the sum of 20,529 PLN (four and a half times the regional average) and Nowe Warpno with 29,735 PLN (six and a half times the regional average). The smallest values were for Reda, Rumia and Braniewo: 2,458, 2,557 and 2,609 PLN respectively. After rejecting extreme values (Krynica, Rewal and Nowe Warpno), analysis of the distribution per inhabitant of municipality shows that values for many municipalities differ from the mean by more than one standard deviation value. In the group with high income per inhabitant are municipalities Krynica Morska, Rewal and Nowe Warpno, Ustronie Morskie, Mielno, Międzyzdroje, Dziwnów, Stepnica, Sopot, Gdańsk and Sztutowo – income over 5,965 PLN per inhabitant. In the low income group are Kamień Pomorski, Nowy Dwór Gdański, Puck (city), Reda, Rumia, Wejherowo (rural municipality), Smołdzino and Braniewo (city) – income below 3,042 PLN per inhabitant.

Conclusions for the maritime spatial plan of Polish sea areas

- Account should be taken of the c*ontinuing* development of various functions closely linked with availing of the benefits of the sea in areas of the Szczecin and Tri-City metropolies, where the highest demographic and economic pressure is observed. The sea space in these areas should be used economically, while at the same time its management should facilitate the regional drivers of development, i.e. ports and recreation.
- In the Tri-City area, due to ageing of population, the demand for marine ecosystem services, especially connected with recreation and rehabilitation, will grow.
- Special attention should be given to protection of ecologically valuable areas located relatively close to the metropolies (about 1-2 hour drive,) e.g. reed fields or local river mouths. These areas will be an arena of growing anthropogenic pressure (recreation, suburbanization). A balance between the pressure and the needs of environmental protection must be achived.
- In touristic and relatively rich municipalities (such as Krynica Morska, Rewal, Ustronie Morskie, Mielno, Miedzyzdroje, Dziwnów, Sopot and Sztutowo) rapid development of coastal tourism can be expected. For that purpose marine "bathing area" space should be reserved. Attention should also be given to the possibilities of marine environment degradation (need to protect especially valuable elements of environment).
- In the remaining areas (with dominating monoculture of tourism, faced by the collapse of fishery, depopulation, low level of entrepreneurship), the maritime spatial plan(s) should facilitate creation of conditions for locating new forms of sea use, especially such that ensure year-round employment. It is stressed that spatial planning alone is not able to meet this challenge.

Knowledge gaps

Municipal level statistical information freely available from the Polish Central Statistical Office (GUS) is sufficient for the Study in relation to the demographic issues. There is a lack of economic data on unemployment rate, the number of economically active and inactive persons, employment and the gross added value, according to NACE sectors, which would allow distinguishing employment and gross added value in maritime economy in accordance with the DG Mare methodology.

It is possible to obtain such information (for an additional payment) from the GUS; nevertheless at municipal level there is an information gap problem caused by statistical confidentiality (e.g. less than three companies or a dominating company).

Information on entrepreneurship is loaded by the inactive enterprise error, and therefore imprecise. Moreover, data from different databases are incomparable.

There is no assessment of rolling effect of maritime economy, i.e. how many work places are created in other sectors in result of increase of jobs in various branches of maritime economy.

4.5. Analysis of local and regional strategic and planning documents from the Pomeranian and West-Pomeranian Voivodships

On the basis of studies:

- *Analysis of conditions of spatial development of land part of coastal area located within the West-Pomeranian Voivodship for the purposes of the Study of conditions for the Maritime Spatial Plan of Polish sea areas, S. Dendewicz et al, Regional Office for Spatial Management of the West Pomeranian Voivodship, 2014 – Annex 7.*
- *Analysis of conditions of spatial development of land part of coastal area located within the Pomeranian Voivodship, J. Rekowska, 2014 – Annex 8, and*
- *Analysis of the Local Spatial Development Plans for areas connecting with the coastline of the Baltic Sea coastal zone, J. Faściszewski, J. Turski, Spatial Policy Laboratory, Maritime Institute in Gdańsk, 2014 – Annex 9*

Analysis of planning documents concerning the land part of the coastal area was carried out at two levels – regional and local. Analysis focused on the coastal areas and on statements/contents of significance for sea area planning, with special attention paid to the functions of the areas, status of protection, state of development, occurrence of hazards, infrastructural solutions, accessibility of the areas, and planned investments.

At regional level, both the voivodship spatial development plans and the current strategic and programming documents were taken into consideration. At the local level the analysis was based on the studies of conditions and directions of spatial development of municipalities[24], local spatial development plans[25] (in the coastal area), strategic studies and development plans of municipalities, as well as development plans of the ports, supplemented by available data and information. Some of the documents taken into consideration were produced over 10 years ago, and many of them were not updated since then, which limited their usefulness for the analysis.

In planning documents of municipalities of the West-Pomeranian Voivodship, the area of the coast is perceived in the perspective of touristic and maritime economy functions fulfilled by coastal cities and settlements and the natural and landscape values (in particular beaches and the sea). If a port exists in a municipality, then often development actions are focused on the port. If the dominant function is tourism and recreation, then development of these functions is supported by extending and/or modernizing infrastructure, widening the range of services and improving their quality.

Former military sites, which came under the ownership of the municipalities, are also perceived as a real challenge for the local governments. Very often these areas are "spatially separated" from the developed part of a municipality. Most often they are located in forests, and their objects are in poor technical condition. Generally, these areas are characterised by a low degree of transformation of environment. They often perform nature-related functions, while tourism-related functions are nearly nonexistent.

[24] For the City of Puck the analysis was based on the draft Study of directions and conditions, layed out for public scrutiny

[25] Many provisions of these plans are very general, e.g. without specifying the undertaking, they say: possibility of locating hydrotechnical structures and equipment facilitating navigation and related to coastal zone protection.

Among the most important issues, related to maritime transport infrastructure, is the Baltic Pipe project for a high-pressure gas pipeline Dn 700 between Poland and Denmark. The Baltic Pipe project has a valid permission for laying and maintenance of the pipeline in the territorial sea off Rewal, issued by the Director of Maritime Office in Szczecin.

The main conclusions pertaining to sea areas, resulting from the documents of the West-Pomeranian Voivodship, are that functioning and development of widely understood maritime economy (especially transport) and tourism should be ensured. There are also expectations connected with the national energy policy, but with no clear indications on the use of sea space.

Investment priorities and expectations of the voivodship and resulting expectations concerning sea areas are following:

- development of the intermodal transport chains
- finishing building of the external port and LNG terminal in Świnoujście,
- development of the ports in Kołobrzeg and Darłowo,
- maintaining and development of fishery, particularly in Kołobrzeg, Darłowo and Świnoujscie,
- development of tourism in the coastal area
- functioning and development of health resorts in Dąbki (near Darłowo), Kamień Pomorski, Kołobrzeg and Świnoujście,
- development of offshore wind farms,
- location of a nuclear power plant in the coastal area.

Actions related to these priorities are described in Tables 4.1 to 4.6.

Analysis of regional and local documents of the Pomeranian Voivodship indicates that maritime spatial plans should take into account:

- spatial development and intensification of the tourism and coastal recreation functions, which influence the state of the coastal belt and water space, and which will result in increased vessel traffic,
- development of housing in coastal settlements, and also of health services (in Sopot, Ustka and also other coastal resorts: Krynica Morska, Jastarnia, Jurata, Jantar, Mikoszewo, Stegna, Jastrzębia Góra, Kąty Rybackie, Lubiatowo and Łeba), for which it is important to keep proper standards, including noise level,
- development of port and next to port infrastructure and improvement of accessibility from land to the two most important ports in Gdynia and Gdańsk; with development of these ports an increase in both short-sea and long range shipping, including the largest container and bulk carriers and passenger ships able to enter the Baltic Sea, and also increased barge traffic on the sea, may be expected
- increased use of sea area for water sports, e.g. in the region around Łeba, which is aspiring to be a water sports centre, and in the area of Puck and Sopot,
- need to integrate sea and inland transports, as a result of planned development of the international inland waterways (E-40 and E-70) and investments in Pętla Żuławska (Żuławy Loop).
- development and functional transformations of small ports, especially for tourism purposes (marinas and passenger services), but also in order to increase the significance of cargo transport and handling operations (Ustka),

- development of fishery function (qualitative development of fishery), expected within the scope of the port functions , including Ustka and Władysławowo,
- investments in gas and liquid fuel transmission, especially if the decision to build the LNG Terminal in the Northern Harbour will be taken, and in relation with investments concerning the storage of oil and gas in Kosakowo municipality,
- possibility of building the channel linking the Gulf of Gdańsk with the Vistula Lagoon,
- construction and development of new yachting infrastructure, possible in the framework of networking products and as a consequence of revived and expanded coastal shipping,
- restrictions in the use and development of sea areas resulting from functioning of military objects,
- providing conditions for protecting from the sea side of areas with most valuable nature on coastal land and ensuring continuity of areas forming the ecological network, i.e. maintaining the coherence of the ecological system and its linkage with the European system, and assuring the durability of protected areas of special regional and supra-regional (including European) value, while not worsening the conditions of exposition of the coast and its scenic values,
- providing conditions for connecting offshore wind farms with the national power grid (in the Pomeranian Voivodship such connection is possible through two transformer/switching stations: at Żarnowiec and at Słupsk-Wierzbięcin; according to analysed concepts, these two stations can be connected in the future with the marine power network (the so-called Baltic Rail) enabling connection of many OWFs to the system; the spatial development plan of the Pomeranian Voivodship provides for expansion and modernization of both land stations.

According to local and regional documents, further exploitation of the coastal zone for tourism purposes is expected, in that the sea part, for: bathing (currently along approximately 70 sections of the open sea and Gulf of Gdańsk and Puck Bay shoreline), windsurfing and kitesurfing (especially in the areas of Puck Bay between Jurata and Puck and also Hel and Rewa, area of Sopot on the Gulf of Gdańsk, Dębki and Łeba on the open sea coast, and area of Krynica Morska on the Vistula Lagoon), diving (in the Gulf of Gdańsk and near Hel), yachting (in particular the area of Ustka, Rowy, Łeba, Władysławowo, Jastarnia, Jurata, Hel, Puck, Gdynia, Gdańsk, Sopot, Kąty Rybackie and Krynica Morska). On the land part the expected tourism/recreational uses include: sunbathing, recreational hiking, biking, horse riding, as well as hang gliding and paragliding (next to the coastal cliffs – Mechelinki, Rowy and Chłapowo) and health and wellbeing tourism.

Development of new functions will require the maritime spatial plan(s) to reconcile the needs of still dominating in the coastal zone recreation function with the economic needs, especially these which may threaten to pollute the environment or increase nuisance and burdens in their vicinity (e.g. offshore wind farms)).

At the same time, it is worth mentioning that municipalities, in their studies of conditions and directions of spatial development, determined directions, principles and plan investments aimed at protection of marine space and environment and including:

- expansion of the system of touristic routes, including cycling and walking routes, which, if well planned, will help to decrease the pressure of tourism on most vulnerable coastal areas,

- system solutions for discharge and processing sewage and rainwater, changing heating systems to more environmentally friendly;
- coastal protection[26].

The local and regional documents supplemented by national studies (concerning the migratory routes of bi-environmental fish) indicate that maritime spatial plans should take proper account of the need to ensure safe migration of bi-environmental fish, in particular in front of the river outlets of Vistula, Słupia, Łupawa, Łeba, Reda and Piaśnica.

Both, in plans of the Pomeranian and West Pomeranian Voivodships, as well as in municipal studies, flood risks were taken into account. All findings in this regard will be verified according to the provisions of amended in 2011 Water Law (spatial plans must take due account of areas shown in flood risk and flood hazard maps.).

Analysis of proposals to the maritime spatial of Polish sea areas indicated, that some of the coastal municipalities both in the Pomeranian and West-Pomeranian Voivodship are afraid (express objections) of investments linked with the development of offshore wind farms and offshore mining activities, as functions conflicting with tourism.

Analysis of documents of services responsible for the Polish airspace does not indicate any significant aspects concerning maritime spatial planning. All obstacles, which at present may be constructed near the coast, do not form a barrier to air traffic. Nevertheless, these issues should be taken into account in the future. Because of that, the set of maps produced for this Study includes a map showing approach zones to civil airports with minimum vertical boundaries for the Rębiechowo and Heringsdorf airports, and an activity map in the class G zone[27] (height from the ground to Flight Level 95 (FL95)(approx. 2500 AMSL[28]) outside the airport areas, which presents places on the Polish coast which are attractive for paragliders – these are manly cliff coasts.

The collected and analyzed material allows indicating the following three main thematic areas of activities:

- development of potential of maritime economy potential based on the functions of seaports (Tables 4.1. and 4.2.),
- touristic use of the natural and cultural resources of the coast (Tables 4.3 and 4.4),
- use of resources of the sea for industrial and power production purposes (Tables 4.5 and 4.6).

Furthermore, as it has been already mentioned, it is necessary to protect the most valuable natural coastal areas and ensure connectivity of the ecological network, and, where it is justified, to protect the coast against erosion and sea floods.

Investment plans and state of spatial development of the coastal area, as indicated by analysis of the planning and strategic documents of municipalities and voivodships, are illustrated in Fig. 4.14.

Development of potential of maritime economy based on functions of the seaport network

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[26] Coastal protection needs, among others in areas with strong recreational functions – e.g. the regions of Ustka, Łeba, Karwia and Hel Peninsula, are taken into account in the Program for Coastal Protection.
[27] The users of this zone are small touristic aircrafts, hang gliders, paragliders, parachutists, etc.
[28] Above Mean Sea Level

The potential of maritime economy is developed by improving the state of technical infrastructure inside the ports and ensuring better accessibility from land and sea. Improvement of accessibility from the sea (fairways and berths with proper parameters) is the main factor allowing further growth and extension of functions. Accessibility from land (road and rail infrastructure) also must be improved. Finishing construction of the LNG Terminal and the External Port in Świnoujście, and expansion of the North Harbour in Gdańsk are of key importance for the development of maritime economy. The ownership issue is an important condition of port development, especially in small ports. Communalisation of the ports can give good effects, but often, due to the difficult financial situation of municipalities and a lack of ideas for effective use of port potential, necessary investments are not undertaken. It is expected that for the network of small ports their scope of activity will be extended by touristic functions, including carriage of passengers and sea angling. The analyzed documents rather do not emphasise the need to use small ports for purposes of inland navigation by sea-river barges

Table 4.1. Development of potential of maritime economy based on functions of the seaport network, on the basis of analysis of regional and local documents[29]

Activity	Localization	Comments
Improvement of accessibility to ports from the sea – fairways	Świnoujście	Depth of fairway - 17 m Development of port infrastructure
	Szczecin	Depth of the Świnoujście-Szczecin fairway – 12.5 m Development of infrastructure of the port complex
	Dziwnów	Depth of fairway in Strait of Dzwina – 5 m
	Mrzeżyno	Reconstruction of port entrance
	Darłowo	Reconstruction of port entrance Port modernization Landfill and construction of berth servcing merchant ships
	Wolin	Dredging, modernization of navigational aids; improvement of road bridge
	Kamień Pomorski	Improvement of fairway parameters in Dziwna and Szczecin Lagoon Providing area for dredged spoil disposal
	Rewal	Construction fairway and breakwaters in the mouth of the Liwia Łuża Canal[30]
	City of Ustka	Improvement of port entrance and development of port basins

[29] Contents of the table result from analysed local and regional documents and development plans of ports, and were confronted with proposals submitted to the maritime spatial plan

[30] The project of constructing the fairway and breakwaters obtained negative opinions both of the Minister of Infrastructure and the Maritime Office, resulting in temporary suspension of the works. In spite of that the municipality aims to continue the works.

	City of Puck	The city submitted an application for two safe fairways to the fishing harbour and the marina with parameters enabling entrance of vessels up to 3.5 m draught
	Gdynia	Ensure entering of Baltimax vessels into the port
	Gdańsk	Modernization of fairway, improvement of navigation conditions in Nowy Port (including 12 m depth between the entrance to the port and Kaszubski Canal). Development of access infrastructure (from sea) to the North Harbour (extension of fairways, construction of new breakwaters, further development of deepwater terminals) The Study does not exclude the possibility of modernizing of the eastern (Wisła Śmiała) entrance to the port
	Sztutowo	Possible building of channel across the Vistula Spit
Development of port infra- and supra-structure (construction of berths, dredging of basins)	Świnoujście	Development of ferry terminal Building of modern container terminal Construction of new quay in external port
	Szczecin	Development of West-Pomeranian Logistics Centre Reconstruction of the Pólwysep Katowicki and Ewa quays Development of cargo handling capacity at Ostrowie Grabowskie
	Kołobrzeg	Building of ro-ro terminal Building of storage facilities for general cargo Container handling facility
	Darłowo	Repair of existing quays
	City of Ustka	Development of port to the west (on land); construction of external port with new breakwaters is under consideration, Planned construction of a marina and mooring place/places for cruise ships Construction of container handling facilities (for ships of 1500-1600 GRT, and 6 m draught)
	City of Łeba	Reconstruction of the Nabrzeże Wydmowe
	City of Jastarnia	Construction of marina and harbour office[31]
	City of Hel	Development of the marina (up to about 50 yachts); possible expansion of marina onto the inner basin

[31] Jastarnia's proposal to the maritime spatial plan includes a new yacht basin with a south-east breakwater and berths.

		Building of rescue coordination centre Modernization of social facilities for yachtsmen
	City of Puck	Continued modernization and development of port facilities for water sports and fishery; possible expansion of the marinas
	City of Gdynia	Polskie and Finskie Quays – the area of the ferry terminal (opening of ferry & passenger terminal in the area of Polskie Quay, as an element of Gdynia-Karlskrona Motorway of the Sea, is planned for 2016) Development of the BCT and GCT container terminals Location of the Distribution and Logistics Centre (West Port) Proposed haven "The Naval Shipyard" Operation of the Gdynia-Karlskrona Motorway of the Sea; Development of yachting infrastructure (possible new marinas in the Presidents Basin, Wenta Basin and at the torpedo house at Babie Doły
	City of Gdańsk	Development of storage and cargo handling potential in the North Harbour Construction of logistics and distribution potential including multimodal base/terminal Development of infrastructure for ferry and cruise ship services
Development of fishery infrastructure	Świnoujście	Development of new fishery base in Bosmański Basin and on the Karsibór Island Possibly largest area of fishing grounds should be taken into account
	Międzyzdroje	Support the functioning of fishing harbour in Międzyzdroje and fishery base in Lubin
	Rewal	Construction of a haven, also for fishing, at the mouth of Liwia-Łuża Canal [32]
	Mielno	Chłopy, Unieście (development of port functions – mainly qualitative)
	Darłowo (rural municipality)	Development of fishery based on Baltic waters and lakes
	Ustka Municipality	Rowy – modernization (replacement) of mooring dolphins in open sea

[32] Construction of the fishing haven in the mouth of the Liwia-Łuża Canal in Rewal probably will not take place for environmental reasons. The Regional Directorate for Environmental Protection refused agreement of draft local plans, and municipal authorities did not appeal from.

	City of Ustka	Development of fishery infrastructure (new fishing basin – under construction) According to strategy of port development – reactivation of fishing shipyard with slipway for fishing vessels Expansion and modernization of fish processing infrastructure
	City of Puck	Continuation of modernization and development of the port (including fishery infrastructure)
	City of Gdynia	New location of fishing haven in Gdynia Obuże is planned
Development of external port and LNG Terminal in Świnoujście	Świnoujście	Finishing construction of the LNG Terminal and taking advantage of opportunities for development resulting from access to the new deepwater berths in the external port
Defence-related activities linked with national security	Kołobrzeg	Ensure mooring places for naval vessels
	Gdynia	Infrastructure for NATO support forces – modernization of infrastructure in the Navy Harbour in Gdynia
Extension of port space	Trzebiatów	Extension of the land and sea areas of the port in Mrzeżyno
	Trzebiatów	Extension of port area in Dźwirzyno in the Trzebiatów municipality (Rogowo)
	Świnoujście	Changes in the surface area of internal sea waters, resulting from changes of the boundaries of the Port in Świnoujście, should be taken into account (after taking note of the external port area – in accordance with the Ordinance of the Minister of Infrastructure of 1 October 2010 on the establishment of the land boundary of the seaport in Świnoujście[33])
	City of Ustka	Development of the port to the west (on land); construction of external port with new breakwaters still under consideration
	Gdynia	Seeking and acquiring new areas for new terminals (also on water areas adjacent to present port boundaries)
	Gdańsk	Spatial development of the port is possible within lying in its administrative boundaries areas adjacent from the north-west to the existing deepwater port infrastructure

[33] This issue must be included into the work on the maritime spatial plan. The external port significantly extends beyond the coastline, and as a part of the internal sea waters will be the subject of a separate plan.

Improvement of passenger service infrastructure[34]	Kołobrzeg	Construction of passenger terminal
	City of Ustka	New mooring places for cruise ships Activation of existing railway line no. 405, road investments Construction of passenger terminal
	City of Łeba	Construction of infrastructure for servicing tourists(coming in by sea) Expansion of the transportation system
	City of Puck	Modernization of the port communications and spatial systems
	City of Gdynia	Plans for a new passenger ferry terminal at the Polskie Quay
	City of Gdynia and Kosakowo municipality	Planned Kosakowo airport
	Gdańsk	Expansion of infrastructure for servicing ferries and cruisers possible ferry terminal in the North Harbour, development of Westerplatte terminal, berths for white fleet vessels
Development of tourist functions linked with ports	Kołobrzeg	Marine museum in the port area
	City of Ustka	Quays dedicated for tourism purposes on east side of the port Tourist services, also in the planned marina in west part of the port
	City of Łeba	Development of a tourist and holiday area to west and south of the port, land facilities of the yacht basin
	City of Władysławowo	Construction of Coastal Promenade
	City of Hel	Reconstruction of Nadmorski Boulevard
	City of Gdynia	Culture, leisure and tourist services, among others close to the marina
	City of Gdańsk	Tourism development in the Westerplatte and Wisłoujście areas (e.g. military park)
Study for seaports, concerning the increase of their handling capacity and improvement of accessibility from sea and land (navigation aids and vessel tracking and control system)	All ports of West-Pomeranian Voivodship	Requirement resulting from the Spatial Development Plan of West Pomeranian Voivodship[35]

Source: Based on Annexes 7 and 8

[34] There is also a plan of adapting the port at Wolin to passenger shipping. The port is located in the Szczecin Lagoon, but its modernization may have an impact on intensity of traffic in the area covered by this Study.

[35] In order to coordinate future actions, it is recommended to develop a Study on improvement of cargo handling potential of seaports and on their land and sea accessibility

Table 4.2. Development of potential of maritime economy based on functions of the seaport network, on the basis of local spatial development plans

Municipality	Investment plans	Descriptions
Krynica Morska (Piaski)	Fishing haven	Development of land facilities of the fishing haven
Sopot	Marinas and quays	Construction of an island marina
Gdynia	Fishing haven	Plans for changing the boundaries of the "Gdynia -Obłuże" fishing haven
Gdynia	Fishing haven	Plans for changing the boundaries of the fishing haven at Osada Rybacka
Gdynia — city centre, area of Molo Rybackie (Fishing Pier)	Marinas and quays	Plans for a marina in part of the President's Basin (area adjacent to Nabrzeże Kutrowe and Pier no. 1).
Gdynia — Central District , the area of Hryniewickiego, Waszyngtona Streets and Alley of Jan Pawła II.	Marinas and quays	Plans for a marina in part of President's Basin (area adjacent to Nabrzeże Prezydenta).
Gdynia — Gdynia City Centre, the area of Węglowa and Waszyngtona Streets	Marinas and quays	Plans for a marina in area adjacent to Nabrzeże Przydokowe and Pirs Południowy.
Kosakowo	Fishing haven Piers	Construction of a pier and pier abutments in fishing haven in Mechelinki
Puck	Marinas and quays	Possible localization of a marina in the port in Puck.
Świnoujście — the area of Ku Morzu street	Seaports Other	Beach and dunes designated as reserve areas for port development Acceptable location of LNG terminal

Source: based on Annex 9

Touristic use of natural and cultural resources of coastal areas

Dynamic growth of coastal and marine tourism infrastructure is observed over the past few years. This is the right and desired direction, which should be continued both in the infrastructural and image-oriented ways. An example of the developments in marine tourism is the increasing popularity of internal coastal passenger fleet's (the so-called "White Fleet") cruises along the coast. The growing number of mooring places creates good conditions for short (few-days) coasting cruises linked with the opportunity of sightseeing in coastal towns.

A significant challenge for municipalities is wise investment, which would allow gaining profits and satisfaction from the contact with nature, and at the same time will not disturb the biological equilibrium and in effect destroy the unique characteristics and tourist value of the region. Many plans of the municipalities are aimed at regulating tourism in their area in a way which would reduce anthropogenic pressure by marking tourist trails, beach entrances, piers and localization of marinas.

Many settlements, where fishing havens are located, have a unique local colour. Fishing shaped the character of the settlements, their landscapes and the way they are perceived by the tourists. Fishing as well as all elements closely linked with this profession should be protected. The aim of the municipalities is to protect the character of these settlements as an element of local folklore, and this should be supported and strengthened also by the maritime spatial plans.

In many coastal areas, adaptation of former army exercise areas for purposes of tourism and housing is progressing. This process will lead to changes in the use of neighbouring sea areas, introducing tourist and recreational functions.

Table 4.3. Touristic use of natural and cultural resources of coastal areas on the basis of analysis of voivodship documents and municipality studies.

Activity	Location	Comments
Development of a coherent infrastructure for water tourism – construction and modernization of marinas	Świnoujście, in the fishing port at Karsibór	Mulnik Canal, in the former the dock for barges, Łunowo
	Rewal	At the mouth of Liwia-Łuża Canal(Niechorze/Pogorzelica)
	Dziwnów	Dziwnówek
	Ustronie Morskie	Bagicz
	Mielno	Mielno (Lake Jamno), Jamno Canal – building a connection with the sea, accessible for yachts, boats and canoeing (from the side of the lake)
	Postomino	Jarosławiec (fishing haven) and Lake Wicko
	Between Łeba and Władysławowo	Possible location of a new marina[36]
	City of Ustka	Possible location of a marina
	City of Władysławowo	Building of a yachting centre Modernization of yachting infrastructure at Chałupy (extension of existing floating pier)
	City of Jastarnia	(Kuźnica) water sports station (Jastarnia) extension of yachting centre (request to consider a new yacht basin with south-east breakwater and quays)
	City of Hel	Further development of marina Faility for scuba divers
	City of Puck	Possible further development of existing marinas
	Kosakowo Municipality	Proposed location of seasonal marinas at Mechelinki and Rewa

[36] In the study concerning small seaports and havens, as an example, two earlier considered sites are mentioned: Żarnowiec (a concept of a marina located on the lake with a lake-open sea connection) and Cetniewo (a concept of a marina built from floating elements)

	City of Gdynia	Possible construction of marinas in the President's and the Wenda Basins and at Babie Doły (site of previous torpedo house)
	City of Sopot	Plans for building an island marina
	City of Gdańsk	Marina – along the Motława River and Na Stępce Canal (Proposals submitted to the maritime plan include possible new marinas at Jelitkowo and Brzeźno).
Construction of piers designed for walking and mooring [37]	Świnoujście	Construction of pier along axis of Bolesława Chrobrego Street Construction of offshore artificial island "Water Palace"
	Kołobrzeg	Construction of piers along extentions of streets: Wschodnia, Plażowa, Brzeska and Fredry and modernization of existing pier
	Rewal	Rewal, Niechorze, Pobierowo
	Międzyzdroje	On extension of beach-entrances
	Dziwnów	Dziwnów on extension of Reymonta Street
	Mielno	Mielno, Mielenko and Sarbinowo
	Kołobrzeg (rural municipality)	Building of a hotel complex and pier at Grzybowo
	City of Władysławowo	Extension of the existing floating pier at Chałupy
	Kosakowo Municipality	Development of piers in Rewa and Mechelinki
Development of a new functions while maintaining the fishery-oriented character of the fishing ports and havens.	Międzyzdroje	Międzyzdroje
	Świnoujście	Świnoujście
	Kamień Pomorski	Kamień Pomorski
	Rewal	Rewal and Niechorze
	Trzebiatów	Mrzeżyno
	Kołobrzeg	Dźwirzyno
	Ustronie Morskie	Ustronie Morskie
	Mielno	Chłopy and Unieście
	Postomino	Jarosławiec
	Darłowo	Dąbki
	Ustka rural municipality	Rowy
	City of Ustka	Ustka
	City of Łeba	Łeba
	City of Władysławowo	Władysławowo

[37] Piers designated for walking and mooring and similar infrastructure is also submitted by municipalities in their proposals to the maritime spatial plans: City of Ustka (a pier and a viewing platform), City of Jastarnia (walking and mooring piers next to Rozgard) and Gdańsk (lengthening of pier at Zaspa and building new piers at Jelitkowo and Brzeźno).

	Jastarnia	Jastarnia and Kuźnica
	Hel	Hel
	City of Puck	Puck
	Stegna	Stegna and Jantar
Development of former military exercise areas for touristic purposes	Trzebiatów	Rogowo, west of Mrzeżyno
	Świnoujście	Development of the former army sites east of Ku Morzu Street
	Wolin	Świętouść
	Świnoujście	Application for releasing the Navy exercise area P-38 located east of Ku Morzu Street
	Rewal	Pobierowo
	Ustronie Morskie	Bagicz
	Postomino	Area between Rusinowo and Jarosławiec
	City of Łeba	The "Iskra" military rest complex
	City of Hel	in plans
	City of Gdańsk	Wyspa Sobieszewska – former military area near Sobieszewska street
Opening of the water route from Szczecin Lagoon to the Baltic through Dziwna	Wolin	Dziwna Strait
	Dziwnów	Dziwna Strait
Development of integrated inland and sea shipping	Coastal municipalities Krynica Morska, Sztutowo, Stegna and Gdańsk	Use of Pętla Żuławska infrastructure
Development of the Sea Station in Hel	Hel	Within the framework of the „Blue Village" project, among others construction of the Harbour Porpoise Centre on Puck Bay waters
Development of marine passenger transport – coasting navigation, water trams	Rewal	Rewal, Niechorze and Pobierowo
	Świnoujście	Świnoujście
	Wolin	Wolin
	Międzyzdroje	Międzyzdroje
	Kołobrzeg	Kołobrzeg
	Darłowo	Darłowo — Darłówko
	Kołobrzeg (rural municipality)	Dźwirzyno
	City of Ustka	Ustka
	City of Łeba	Łeba
	City of Jastarnia	Jastarnia
	City of Hel	Hel
	City of Puck	Puck
	Kosakowo Municipality	Rewa and Mechelinki (opening sea

		connection to Hel Peninsula)
	City of Gdynia	Gdynia
	Sopot	Sopot
	City of Gdańsk	Gdańsk
Functioning and development of health resorts	Świnoujście	Świnoujście
	Kamień Pomorski	Kamień Pomorski
	Kołobrzeg	Kołobrzeg
	Darłowo	Dąbki
	City of Ustka and Ustka Municipality	Health resort Ustka
	City of Sopot	Health resort Sopot
	Municipalities in Pomeranian Voivodship[38]	In accordance with Spatial Development Plan of the Pomeranian Voivodship, possibilities for development of health resort functions have following coastal towns/settlements: Krynica Morska, Jastarnia, Jurata, Jantar, Mikoszewo, Stegna, Jastrzębia Góra, Kąty Rybackie, Lubiatowo and Łeba
Protection of beaches against marine erosion	Whole coast[39]	Depending on the needs, coastal protection may include hard structures and / or maintenance of the beaches
Change of coastal waters' circulation in order to improve thermal conditions in the coastal zone	Kołobrzeg	Construction of artificial reef
Extending the use of sea area by selected forms of marine tourism[40]	Kołobrzeg	Yachting, windsurfing and angling
	Świnoujście	Yachting yacht racing
	Darłowo	Dąbki, Dąbkowice and Wicie — yachting and

[38] In accordance with documents of Pomeranian Voivodship municipalities, plans for potential development of health resorts and health care functions, include: Łeba – preparing application for granting health resort status; Sztutowo municipality (2004) – application for health resort status for municipality (development of health care functions at Katy Rybackie, Krynica Morska (2002) – desirable establishment of health resort protection areas and rules of their exploitation in accordance with the health resort status; Chcoczew municipality – development of health care functions at Lubiatowo, Kopalino and Zielonki; Krokowa municipality – development of health care functions at Białogóra and Dębki, and in the Karwieńskie Blota area; Jastarnia municipality – Jastarnia and Jurata; Władysławowo – development of basis for bioclimatic treatment, wellness therapy, rehabilitation; Stegna municipality – potential health care complex at Stegna Las; Gdynia – proposal for locating a rehabilitation, wellness and prphylactics complex.

[39] The Programme of Coastal Protection for 2004-2023 indicates specific stretches of coast and priorities. Tasks of the program are closely linked with the project "Coastal protection in the Łeba, Rowy and Ustka regions" to be realised in 2013-2015.

[40] Plans for extending the use of Puck Bay for water tourism purposes are indicated by proposals to the maritime spatial plan submitted by the Jastarnia municipality for designating several fairways, as well as anchorages on the roadsteads of Kuźnica and Jastarnia for ships with draught preventing their entry into port, and for taking into account tourist and sport functions, including bathing areas, wakeboarding, water skiing as well as wind- and kite-surfing schools.

	(rural municipality)	windsurfing
	Postomino	Jarosławiec, Lake Wicko – yachting
	City of Ustka	Development of yachting and water-sports
	Kosakowo municipality	Yachting and windsurfing
	City of Gdynia	Yachting, windsurfing, kitesurfing, scuba diving, swimming
	City of Sopot	Functions linked with water-based sports related to development of land facilities in the area between Lasek Karlikowski and city centre
	City of Gdańsk	Proposal for a service for transporting by small vessels passengers from cruise ships anchored in the roadsteads to touristic attractions in the city centre

Source: based on the Annex 7 and 8

Table 4.4. Touristic use of natural and cultural resources of coastal areas on the basis of local spatial development plans

Location	Planned investments	Description
Kosakowo – Mechelinki village	Pier	Construction of pier for pedestrians
Ustka — "Wczasowa street and neighbourhood"	Pier	Potential pier construction
Ustka — "Uroczysko"	Pier	Potential construction of new wooden pier
Darłowo — Darłówko Zachodnie — Area B1	Marinas and quays	Construction of a boulevard.
Darłowo — Darłówko Zachodnie — Area B2	Pier	Potential pier with pile foundations
Rewal, Pobierowo and Pustkowo – northern side	Pier	Potential realization of multifunctional pier Possible realization of slipways for yachts, footbridges, piers
Rewal - Pobierowo Services Centre	Pier	Potential construction of walking and mooring pier
Międzyzdroje — Promenada Wschodnia	Pier	Potential pier construction
Świnoujście —Nadmorska District	Pier	Potential pier construction

Source: on the basis of Annex 9

Industrial and power production use of sea area resources

Economic growth is closely linked with development of technical infrastructure in the sea area. It is expected that in the near future the greatest pressure will come from wind energy. However, none of the analysed documents contains reference to specific locations of the wind farms.

Another issue is the route of the Baltic Pipe gas pipeline between Poland and Denmark. It is also expected that exploitation of mineral resources will be started.

Table 4.5. Industrial and power production use of sea area resources on the basis of documents of voivodships and municipal studies on spatial development

Activity	Localization	Comments
Development of offshore wind farms	Polish EEZ	Potential offshore wind farms complexes at least 12 Nm from the shore. Issued decisions on connection of wind farms to the power grid allow a chance to build a marine power transmission system linking the Main Transformer Station Słupsk – Wierzbięcin with the Żarnowiec station (as a first phase of the so-called Baltic Rail)
Ensure the possibility of laying the high pressure gas pipeline 700 DN Baltic Pipe	Trzebiatów and Rewal	Two localizations are indicated in the documents: between Mrzeżyno and Rogowo (Trzebiatów) and in the Rewal municipality. The permission of the Director of Maritime Office issued in 2010 indicated the landing point of the pipeline near Niechorze (Rewal municiaplity). Nevertheless this still may be modified within the environmental decision process.
Development of exploitation of mineral resources	Polish EEZ	The following ports are indicated for locating support services: Gdańsk, Gdynia, Darłowo, Kołobrzeg, Szczecin and Świnoujście
Building of nuclear power plant in the coastal area.[41]	Mielno	Potential site – Gąski
	Choczewo municipality	Potential site – Lubiatowo
	Krokowa municipality (also Gniewino municipality)	Potential site – Żarnowiec
Other	Polish sea areas	The maritime spatial plan of Polish sea areas should take into account existing submarine 450 kV DC cable Sweden - Poland (between Stärnö Peninsula, next to Karlshamn in Sweden and Lędowo on the Polish coast)
	Gulf of Gdańsk	Possible construction of CNG or LNG terminals (with accompanying infrastructure)

Source: on the basis of Annex 7 and 8.

[41] Two potential locations for a nuclear power plant are considered In the Pomeranian region: Lubiatowo (Choczewo municipality) and Żarnowiec (the area of the former nuclear power plant construction in Krokowa and Gniewino municipalities). In analyzed documents of the Krokowa and Choczewo municipalities there were no references on possible nuclear power plant localization..

Table 4.6. Industrial and power production use of sea area resources on the basis local spatial development plans

Municipality	Investments plans	Description
Rewal, Trzęsacz — Northern part	other	Possible pipeline construction for discharging brine from geothermal installations
Rewal, Pogorzelica area — Balticpipe	other	Possible gas pipeline construction with the fibre-optic cable for servicing the gas pipeline to gas receiving terminal;

Source: on the basis of Annex 9

Conclusions for the maritime spatial plans of Polish sea areas

- the need to provide sea space should be taken into account:
  - for initiatives identified in this sub-chapter under the direction No. 1 „ Development of potential of maritime economy based on functions of the seaport network",
  - for initiatives identified in this sub-chapter under the direction No. 2 "Touristic use of natural and cultural resources of coastal areas"
  - for initiatives identified in this sub-chapter under the direction No. 3 "Industrial and power production use of sea area resources"
  - for sustainable development of coastal (bathing areas) and marine tourism (e.g. yachting, windsurfing and kite-surfing),
  - to allow supporting fishery as an important function of the coastal towns/cities,
  - to allow safe migration of bi-environmental fish and maintaining coherence of the ecosystem and its links with the European system, as well as resilience of areas of nature valuable in regional and supra-regional scale,
  - with consideration to the sources of major accidents concentrated in the TriCity region, and to the presence of national security infrastructure in the coastal area.

Knowledge gaps:

The main problem with the analysed pianistic documents, as well as local and regional strategies, is their general character and lack of real knowledge (especially time frame) of planned undertakings (partly this gap is compensated by analysis of operational programs, territorial contracts, programs related to the implementation of specific policies, port development programs etc.).

The variations in level of detail and validity of materials (some of them were issued 10 years ago) in conjunction with lack of territorial inventory result in difficulties with verifying the actions and undertakings included in the local documents, which have already been completed or are in the realization phase.

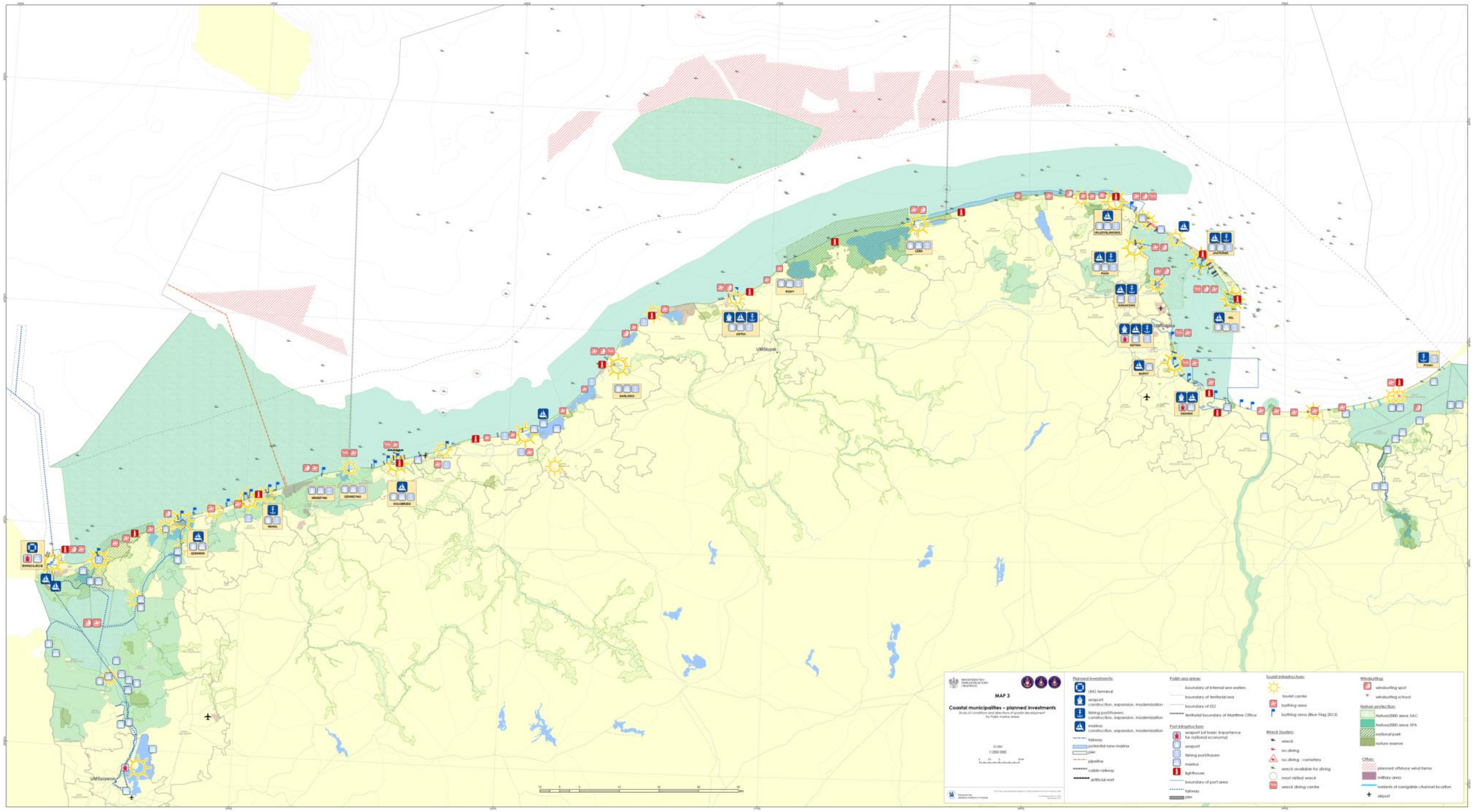


Fig. 4.14. Most important investments planned by coastal municipalities on the background of existing infrastructure and protected areas[42]

Source: Maritime Institute in Gdańsk, on the basis of annexes 7, 8 and 9

[42] Map printed in scale 1:200 000

4.6. Tourism and its development

The coastal area is one of the best recreational areas in Poland. The natural coastal landscape is one of the main values of coastal tourism – it is a basic product "offered" to tourists. Thus, it is the reason why tourist flow is directed particularly towards regions characterized by a natural and valuable landscape.

At present, every coastal settlement offers tourism-oriented functions. Some of them become active only during the summer season. Many of the former fishing settlements are developing touristwards (e.g. Niechorze, Rewal and Mielno) [Łabuz, 2004], retaining their rural character, which becomes more urban-like only during the tourist season (Annex 10).

About 1/3 of the accommodation facilities of Poland is concentrated in this area. Undoubtedly, the location of coastal municipalities determines their touristic profile.

Coastal municipalities have swiftly changed their fishery and/or agriculture oriented character and transformed into coastal housing estate or (more often) recreational amorphous areas, blurring the initial rural arrangement of space.

Development of touristic functions in the coastal areas is based also on the infrastructure of commercial ports (coasting passenger services), fishing ports and havens, marinas, ferry terminals and the presence of open to public objects of maritime culture, closely linked with Baltic Sea nature.

The network of touristic routes in the coastal area includes the planned international EURO-VELO routes: R-10 (around the Baltic Sea) and R-9 (from the Adriatic to Baltic – from Pula in Croatia to Gdańsk), water routes along rivers discharging into the sea and international inland waterways E-70, E-40, E-30 (unfortunately, not much used and requiring restoration and development) (more in Annex 8).

Over 80% of the touristic potential of the West-Pomeranian Viovodship is concentrated in the coastal area. This includes 85% of the voivodship's accommodation facilities visited by 61.9% of tourists (1.7 million tourists). The main tourist destinations are: Kołobrzeg, Świnoujście, Rewal, Mielno, Międzyzdroje, Kamień Pomorski. Investment in tourist infrastructure in the coastal area and its use are varied. In 2008 more than 1,079 thousand tourists visited that area. The most popular is the western part of the coast, from Świnoujście to Rewal and parts of coast in the areas of Kołobrzeg and Mielno.

Kołobrzeg has a dominant position, offering a wide range of leisure and health care possibilities, and visited annually by about 250 thousand tourists (including the rural municipality – about 300 thousand). Among the important tourist centres are also Świnoujście (128 thousand), Rewal (27 thousand), Mielno (109 thousand) and Międzyzdroje (108 thousand). In the coastal area of the West-Pomeranian Voivodship, excluding Kołobrzeg and Świnoujście where a significant part of the services is related to health care, seasonal accommodation of an average standard dominates. There are also poorly developed (in terms of tourism) coastal areas, with difficult access or inaccessible for nature protection or military reasons (municipalities of Trzebiatów, Kołobrzeg, Będzino and Postomino) (more in Annex 11).

Similar concentration of accommodation facilities is observed in the coastal area of the Pomeranian Voivodship (77% overall, 71% year-round places). Such a highly developed base represents both a potential and a risk, especially to the most attractive for investments dune belt areas. The main functions in the area are: vacationing and recreation, health care and marine tourism services. In the TriCity the dominant position have urban tourism, sightseeing and conferences. One of the most fundamental natural and tourist values of the coastal areas, besides the beaches and forests in the hinterland, are the good conditions for sailing, windsurfing and kite-surfing (Gulf of Gdańsk and Puck Bay) and the unique landscapes (biosphere and landscape resources, topography) – moving dunes in the Słowinski National Park, the Hel Peninsula and the Vistula Spit (Annex 11).

Currently, the most popular holiday destinations and recreational centres of the Pomeranian Voivodship are: Ustka, Łeba, Rowy, Gdańsk, Gdynia, Chałupy, Jastrzębia Góra, Chłapowo, Władysławowo, Sopot, Jastarnia, Jurata and Hel. The Pomeranian Voivodship has one of the biggest in Poland accommodation base. The offer is very diverse and includes 4- and 5-star hotels, lower class hotels and hostels, holiday centres, campings and campsites. In the coastal area dominate middle and lower class hotels, holiday centres, guesthouses, camping houses, campsites and private rooms, with a total of 797 objects, in that 342-year-round, which in 2007 placed the Pomeranian Voivodship in third position in Poland. [The development plan ... 2009] (Annex 11).

Conclusions for the maritime spatial plans of Polish sea areas

- Human activity at sea should be located in such a way that it does not impose significant limitations on the development of tourism in coastal municipalities.
- Development of coastal tourism should be harmonized with nature protection.

4.7. Road accessibility of the coast

On the basis of the report "Spatial accessibility of Polish seaports", T. Komornicki, Institute of Geography and Spatial Development of the Polish Academy of Sciences, 2014 – Annex 10.

Changes in accessibility of the coast will influence the development of widely understood maritime economy (including seaports), tourism and other forms of sea area use.

Overall assessment, carried out from the point of view of development of maritime economy, indicates that Polish ports have still insufficient road links with major national centres, which are their important economic hinterland (and places of concentration of trade on the Scandinavian direction). Insufficient are also connections/links with eastern markets. The best situation, in this context, is in the TriCity, and its further improvement depends on the construction of the S5 and S7 expressways and on investments within the agglomeration.

The spatial distribution of potential road accessibility in 2015 (weighted by national average) (Fig. 4.15) is characterized by a strong impact of the new investment (A1 motorway) on the value of the indicator in the eastern part of the analyzed area. Accessibility decreases gradually to the north-west from a line drawn between Gdańsk and Gorzów Wielkopolski. But nowhere in the Pomeranian and West-Pomeranian voivodships does the accessibility indicator exceed the national average; coming near to it only in the area adjacent to the A1 motorway between Grudziądz and Gdańsk. The strong impact of the new road ends in the TriCity, whereas the indicator decreases abruptly to the north of

Gdynia, in the area of strong touristic penetration. In the West-Pomeranian Voivodship, very low values of the accessibility indicator are observed in the whole northern part of the voivodship, in spite of improved accessibility to Szczecin.

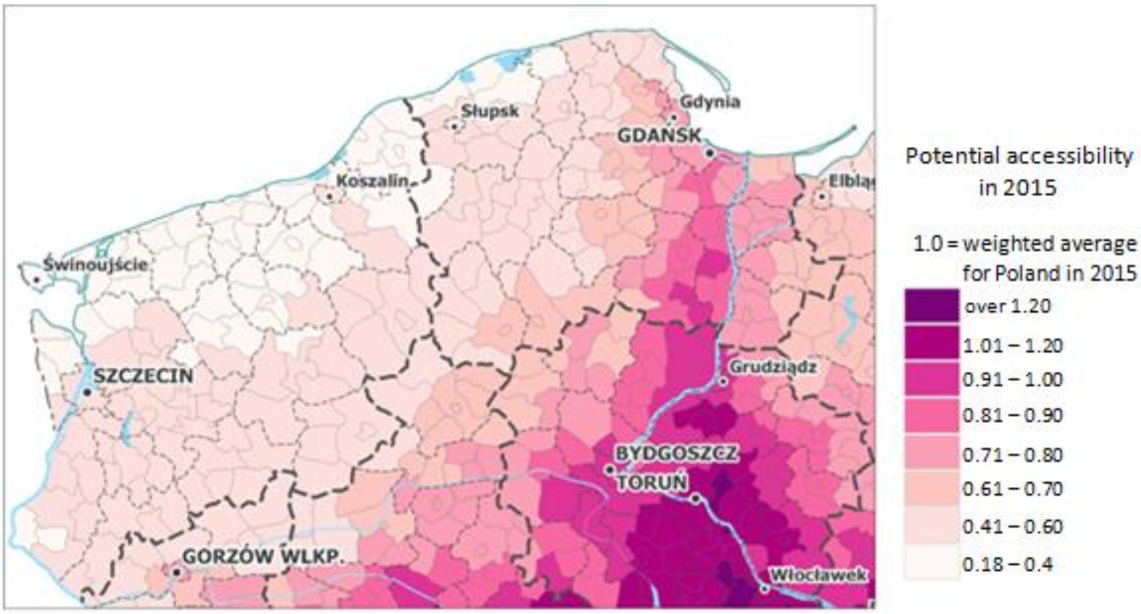


Fig. 4. 15. Level of potential accessibility in the coastal area in 2015[43]

Analysis of change of accessibility based on the Beta convergence coefficient (for the period 1995-2015, assuming that all road investments initiated in the 2007-2013 financial perspective will be completed), which allows to identify which voivodships are the losers, winners and which are catching-up with their internal accessibility, shows that among the coastal voivodships, the Pomeranian Voivodship is in the “catching up” group (high increases of the indicator at initial low value). The West-Pomeranian Voivodship is the only voivodship outside east Poland in the group of clear losers (low growth at low initial value). In the same group is the Warmia-Mazury Voivodship. This shows that the main investment, improving the accessibility of the entire coastal region, is the A1 motorway. Ending the analysis on the year of 2015, it may be assumed that the studied area has become internally polarised in terms of spatial accessibility. However, temporary increases of polarity indicators are a necessary effect of every wide-ranging investment process.

This situation is expected to improve in the new financial perspective[44]. Increasing the hinterland of the Szczecin Lagoon ports is more difficult, but still is possible if the S3 expressway would be built. Road accessibility of small ports of the central coast is bad, and is not likely to improve in the nearest years. Building of the S6 expressway will change this state only partly (because of its longitudinal

[43] The illustrations and table in sub-chapter 4.7 are from the Annex 11.

[44] The nearest financial perspective (in the road sector) for the analysed area and its vicinity includes:
- completion of the S7 expressway on the Warmia and Mazury sections (including the section Gdańsk-Elbląg);
- building of the S6 expressway from Gdańsk (in that the new metropolitan by-pass road) through Słupsk, Koszalin, Kołobrzeg to Szczecin;
- building of the S3 expressway between Szczecin and Świnoujście;
- building of the S5 expressway between Grudziądz, Bydgoszcz and Poznań.

route). Visible improvement could take place only after building the S10 and S11 roads proposed in the National Spatial Development Concept 2030 (NSDC 2030).

If all road investments specified in the NSDC 2030 would be realized, changes in potential accessibility would be significant. The effect of some planned investments, such as S6, S10 and S11 expressways, is shown in Fig. 4.16. The lowest value of the indicator remains still in the north-west part of the coastal region. The accessibility ranking of investigated ports does not change significantly. Kołobrzeg improves its position thanks to the S11 and S6 roads. In the southern part of the Pomeranian Voivodship appear municipalities for which the level of accessibility is higher than the national average. However, the general spatial distribution of accessibility remains stable. The dividing line marking areas with lowest values of the indicator moves further to north-west, with some disturbance caused by the corridors of better accessibility along some of the new expressways. Analysis of the two spatial distributions (for 2015 and 2030) confirms, that national (internal) accessibility of the coastal areas is decided by links with the main metropolitan centres of central and southern Poland, and also Warsaw and Poznań.

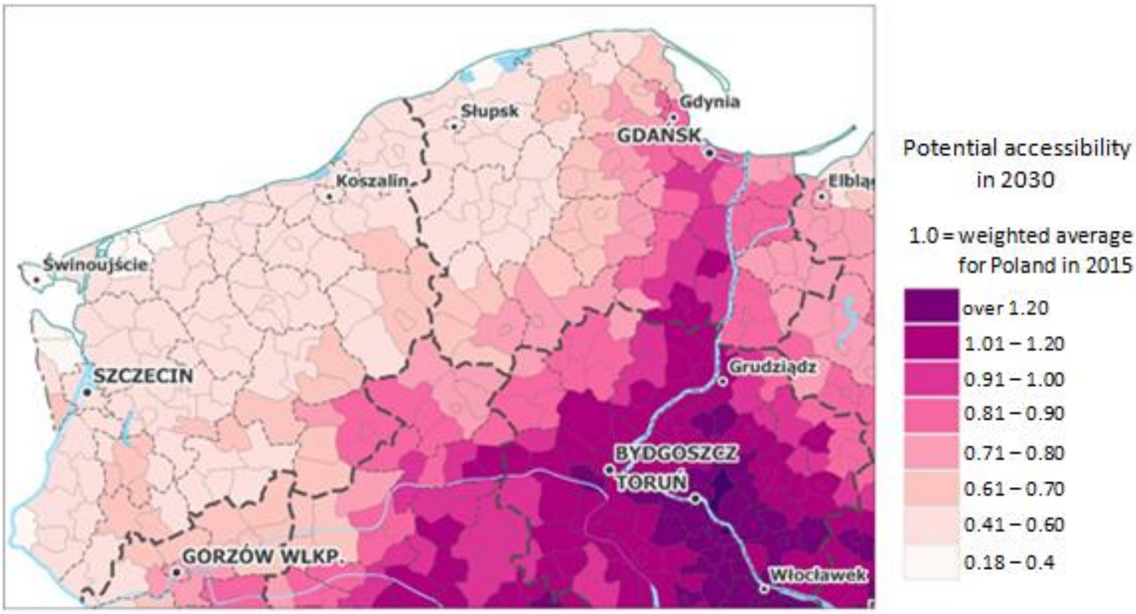


Fig. 4.16. Level of potential accessibility of the coastal areas in 2030 (simulation)

Highest increases of the indicator (Fig. 4.17) are observed in Central Pomerania and are connected with potential construction of the S10 and S11 routes, which link the area with Warsaw and with the region of Wielkopolska. The impact of the S6 expressway is also visible, especially in the Pomeranian Voivodship (as an extension of accessibility achieved by means of the A1 motorway), however it is limited mainly to units situated directly by the route. This is particularly noticeable in the north-east Pomeranian municipalities (including the entire tourist region of the Puck county), where accessibility remains nearly unchanged. One of the reasons is that the so-called Kashubian Route is located south of the urbanised zone Gdynia – Wejherowo, and therefore does not solve the congestion problem (appearing with special strength during the tourist season) in that zone.

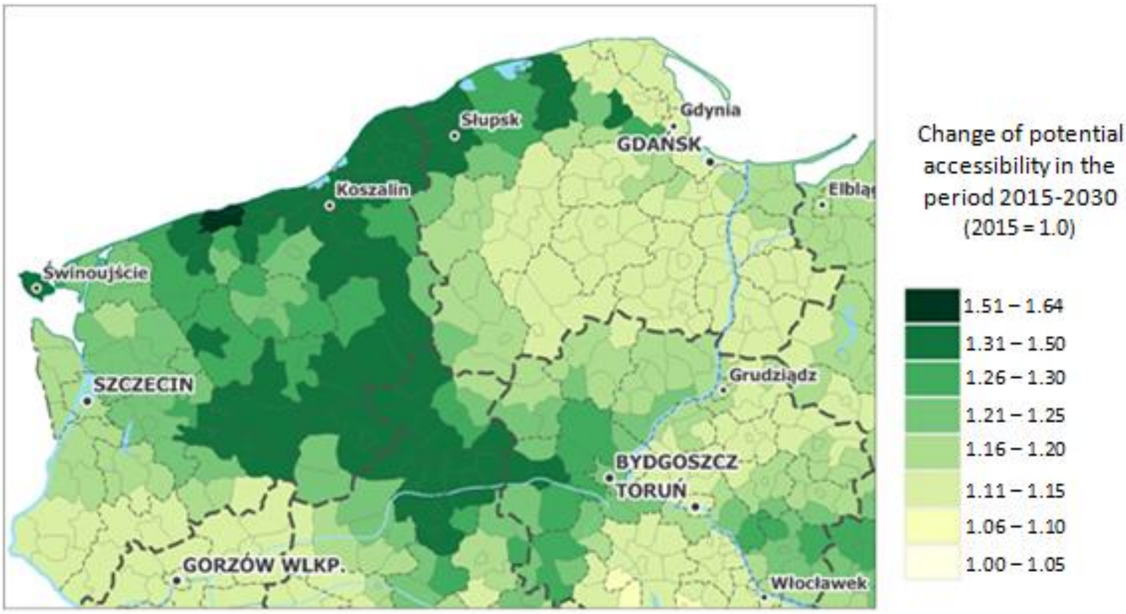


Fig. 4.17. Expected improvement of indicator of potential accessibility in the period 2015-2030

If all road investments listed in NSDC 2030 would be realised, then road accessibility in national scale would improve by 17%. The situation varies for different port-hubs (Table 4.7). Improvement for Gdynia and Gdańsk would be below the national average, whereas Szczecin, Elbląg and Police are close to that average. The situation becomes definitely better in Świnoujście and ports of the central coast. The greatest improvement, in scale of the whole coast, is predicted for Kołobrzeg (increase by over 52%). Significant beneficiaries would be also Świnoujscie and Ustka. The obtained result may be regarded as a localization premise for possible new port infrastructure, including e.g. a ferry terminal. One might even risk the conclusion, that starting investments in the S11 express road from Poznań through Piła and Koszalin to Kołobrzeg, should be considered only in parallel with development plans of the port in Kołobrzeg.

Table. 4. 7. Expected changes of potential accessibility y in selected ports in the period 2015-2030

Ports	Potential accessibility		
	2015	2030	change (2015=100%)
Elbląg	2 188 400	2 573 700	117.61
Gdańsk	2 583 900	2 920 400	113.02
Gdynia	2 465 000	2 796 600	113.45
Kołobrzeg	1 087 100	1 656 400	152.37
Police	1 051 900	1 221 700	116.14
Szczecin	1 563 700	1 833 200	117.23
Świnoujście	904 260	1 222 100	135.15
Ustka	1 118 300	1 456 500	130.24
POLAND	3 393 362	3 964 947	116.84

Assessing the development of maritime economy from point of view of the labour market (in conditions of demographic crisis and increasing role of commuting), it should be pointed out that at present a large integrated market exists only in the TriCity region. There is no such integration in the Szczecin-Świnoujscie complex and even more so along the central coast. Currently planned investments will increase the labour market zone of the TriCity metropolis and will allow integration of the labour market in the Szczecin Lagoon region. Influence of these investments on markets around small ports will be limited. Improvement of these markets requires local investment.

From the point of view of development of tourism, the level of accessibility of the coastal areas is not satisfactory, both with respect to long-term tourism (tourists from the interior of Poland and from other countries) and short-term tourism (from the nearby metropolies and medium-sized cities). The Central Coast is beyond the reach of the latter one, and, when the time needed for travelling from southern Poland is taken into account, begins to lose competition with Adriatic resorts. In contrast to the development of ports and maritime economy, for tourism the construction of the S6 expressway is a great positive impact. It will significantly increase the "weekend" access from the TriCity, Szczecin, and even Toruń and Bydgoszcz agglomerations; moreover it will improve the internal integration of the touristic area in its western part. On the other hand, this effect will be almost invisible along the eastern part of the coast (the northern part of the Pomeranian Voivodship).

Existing and planned road infrastructure may be viewed also in the context of other economic functions developed in the sea area, especially power production function (offshore wind farms). Construction of such objects requires modern road infrastructure (with proper profiles and capacity) leading to seaports, especially the small ports on the central coast. In this context, points of contact of expressways with ports are especially important. At present such contact occurs in theory in Gdansk, Gdynia and Elbląg. In reality, due to the various bottlenecks within these cities, such contact is achieved only in Gdansk. The planned investments of the present financial perspective will generate such points of contact in Kołobrzeg and Świnoujście. At the same time, the route of the S6 expressway allows for relatively easy links with other ports of the west and central coast. The worst situation occurs in the eastern part, between Łeba and Władysławowo. It is also important to ensure a good road service for possible onshore energy investments (Żarnowiec).

The effects of changes of road accessibility for selected ports are shown in Table 4.8.

Table. 4. 8. Conclusions regarding changes of accessibility level in selected cities/seaports

Port / City	Road accessibility level	Potential changes in long-term perspective until 2020	Potential changes in case of road investments indicated in NSDC 2030
Gdynia	Good accessibility in national scale, relatively weak from the west and north sides and in terms of intra-metropolitan area; integrated labour market of the Tricity agglomeration;	Relatively low effects of planned investments. Improved accessibility from interior of Poland (and from Eastern Europe), important for the economic hinterland of the port; no intra-agglomeration effects; improvement of integration of TriCity labour market (area from Lębork to Elbląg)	Lack of further significant effects of improvement of accessibility
Świnoujście	Low accessibility by road transportation, partly	Significant improvement of road accessibility provided the	Further improvement of accessibility in national

	conditioned by the peripheral localization; lack of road coherence with other ports of the Szczecin Lagoon; problems with internal accessibility (fixed water crossing); „detached" labour market	northern part of S3 expressway is built; possibility of integrating the labour market with Szczecin; chance to make effective use of all previous investments along the S3 route; integration of the western coast's touristic region	scale, thanks to the S10 expressway
Ustka	Low level of accessibility by road; limited hinterland for short-term tourism; limited and „detached" labour market	Noticeable effects of improved accessibility thanks to the S6 expressway (especially in relation to the TriCity), improved integration of tourist region, slight enlargement of labour market	Significant improvement of accessibility at national scale (basis for port development) due to S11 expressway; still only limited possibility of enlarging the labour market.

Conclusions for the maritime spatial plan(s) of Polish sea areas

- Sea space should be designated for a new ferry terminal (maybe even two terminals) on the Central Coast as a result of improved national accessibility after building the S10 and S11 expressways and the already high potential global accessibility.
- Further intensification and development of ports in Świnoujście and the TriCity should be expected due to improved links with the central parts of Poland, and in Świnoujście additionally because of the enlargement of the local labour market.
- Quick development of touristic functions should be expected (especially weekend tourism) along the central coast (with the exclusion of the northern part of the Pomeranian Voivodship) as a function of the distance from both metropolitan areas.

Knowledge gaps:

After adoption of operational programs for the period of 2014-2020, the analysis should be repeated taking into account investments in voivodship, county and even municipal road systems.

5. THE COAST – RISKS, TRANSFORMATION AND PROTECTION

On the basis of the report "Elements of the study of conditions for spatial development of Polish Sea Areas dealing with predicted climate change, anthropogenic changes, coastal protection and spatial conflicts, sites of dredged spoil dumping", H. Boniecka, A. Gajda, Department of Maritime Hydrotechnics of the Maritime Institute in Gdańsk, 2014 – Annex 11

The coast fulfils a variety of functions, from economical, housing, national defence to recreation and protection. The range of protection works realised along the Polish coast is determined by the observed since a century coastal erosion (caused by sea level rise) and progressing anthropogenic pressure.

5.1. Coastal risk and anthropogenic pressure

The length of coastline of the coastal municipalities, without the Szczecin Lagoon and Vistula Lagoon, is about 500 km, of which 72 km is the Hel Peninsula coastline. Together with both lagoons, the total length of Polish coastline is 843 km.

Analysis of land cover (in acc. with CLC 2006) of the 1 km wide strip of land along the coast indicates significant differences between this strip and the whole area of coastal municipalities (see page 101). Most of the strip is covered by woods and semi-natural ecosystems (nearly 60%). The percentage of anthropogenically transformed land is higher – exceeds 15%. Agricultural land covers 16% of the area, and the remaining 9% is water areas and wetlands. The spatial distribution of forms of land use is shown in Figs. 5.1 and 5.2.

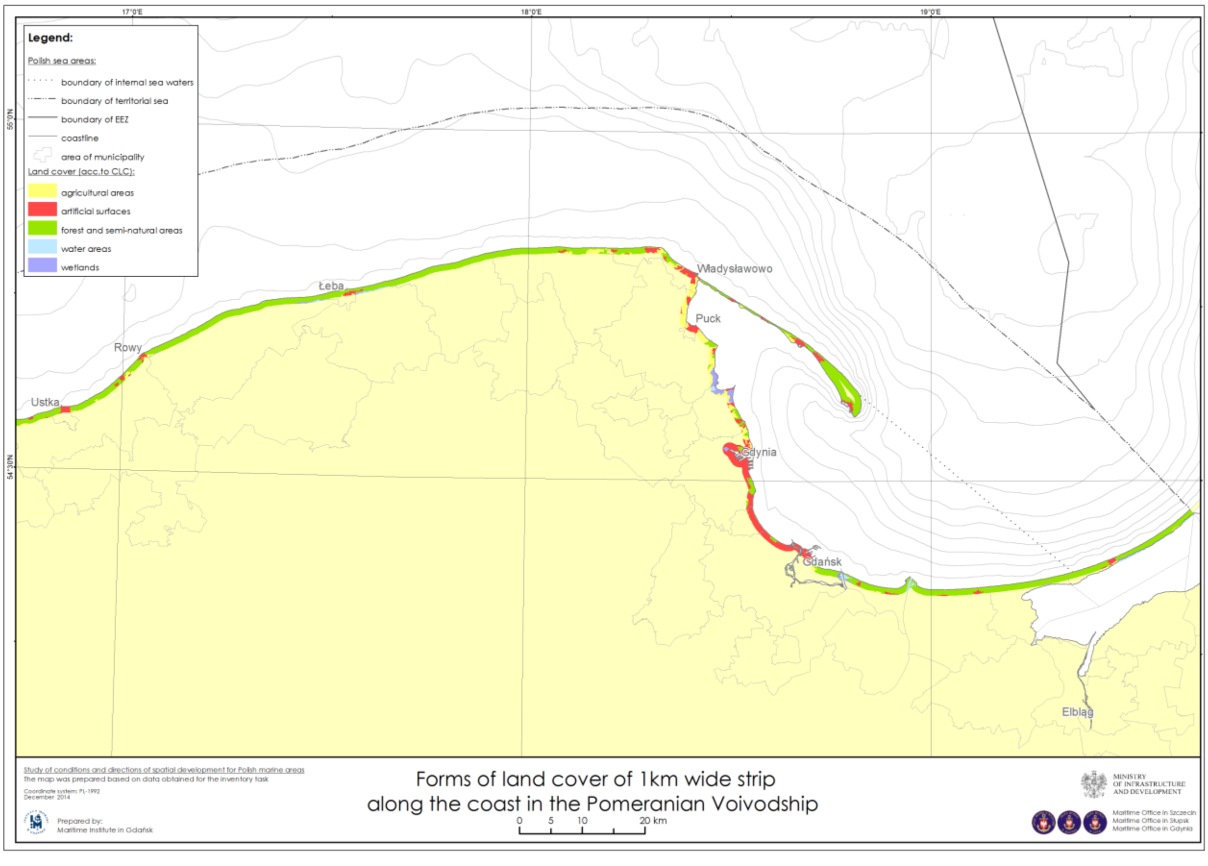


Fig. 5.1. Forms of land cover of 1km wide strip along the coast in the Pomeranian Voivodship

Source: Maritime Institute in Gdańsk basing on CLC 2006 data (CEIP).

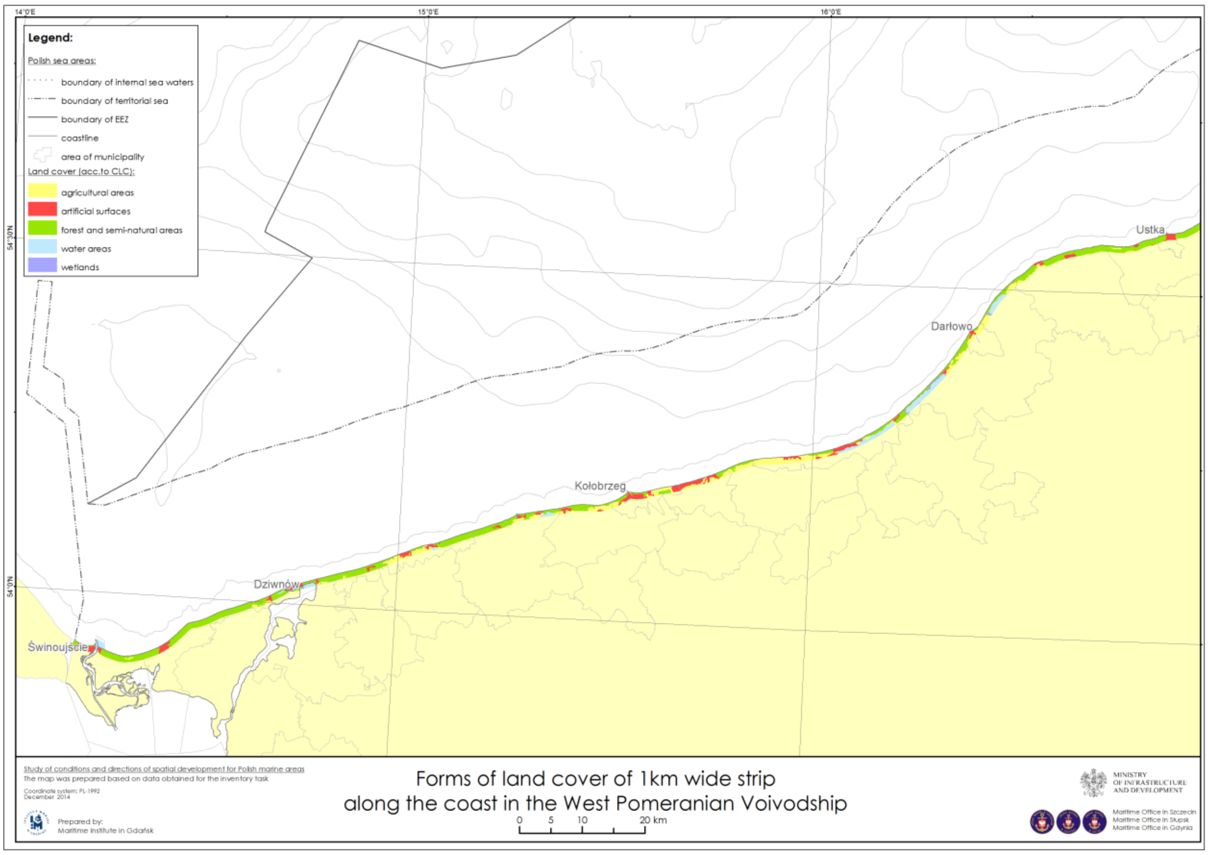


Fig. 5.2. Forms of land cover of 1km wide strip along the coast in the West Pomeranian Voivodship

Source: Maritime Institute in Gdańsk basing on CLC 2006 data (CEIP).

Urbanised areas take up about 170 km of the coastline, and they are composed of stretches with differing character of urbanisation, from the TriCity agglomeration with sea ports of basic importance for national economy to small coastal settlements with fishing and/or recreational havens (e.g. Chłopy, Dąbki i Unieście).

The predominant types of buildings in urbanised parts of the coastal strip are single-family houses, residential buildings, guesthouses, tourism and other services. There are also other forms of use, e.g. areas taken up at present or used in the past by the army (Pogorzelica, Rogowo). The coastal hinterland is presently in a phase of intense transformation and modernisation. This concerns especially building of new houses and touristic objects, modernisation of old buildings and potential urbanisation of areas released by the army.

a) b)

Ryc. Fig.5.3. Anthropogenically transformed coast at Ustronie Morskie km 321 (a) and Kołobrzeg km 333,50 (b)[45]

Source: Maritime Institute in Gdańsk.

From the point of view of anthropogenic pressure, one of the most characteristic parts of the Polish coast is the Hel Peninsula, where free of permanent build-up are only the dune areas on the open sea side of the Peninsula (except the Spa House in Jastarnia and the Bryza Hotel at Jurata). The Puck Bay side of the Peninsula is strongly urbanised. Because of its location, the whole Hel Peninsula region is one of the most attractive for tourism areas not only in regional but also in national scale. In 2012 there were 13 camping areas, in that 9 in the most narrow, close to mainland part, where the risk of inundation and flooding by storm surges is highest.

The highly developed touristic base is both a development potential and a risk, especially to the coastal dunes. Anthropogenic pressure takes a significant part in the process of coastline retreat. Human activity in every form (also coastal protection) modifies coastal processes and results in changes of coastline. Intense use of the coast results in degradation of coastal vegetation, woods, and initiation of dune sand movement and of landslide processes. Anthropogenic (e.g. breakwaters) and natural (river outlets) obstacles impede ‘longshore sediment transport, in effect resulting in coastal erosion. Depending on the prevailing direction and intensity of sediment transport they shape the range and development of erosional bays along the coast.

According to Gerstmann [2001], along the west and central parts of Polish coastline the most damaged by urbanisation are:

- steadily growing urbanised areas around settlements near the Słowiński National Park (Rowy and Łeba),
- east end of the Lake Kopań spit,
- area of Dąbki at the east end of Lake Bukowo spit,
- 25-kilometre long section of coast between Gąski and Łazy,
- 20-kilometre long nearly completely urbanised section of coast between Łukęcin and Pogorzelica.

At present, because of further development of recreation and holiday functions, urbanisation has extended by another 17 km, reaching as far as Międzywodzie.

[45] Illustrations and tables in Chapter 5 are taken from Annex 11

The most urbanised parts of the east coast are:

- the Tri-City agglomeration, and
- the coast of Hel Peninsula facing the Gulf of Gdańsk.

Between Sopot and Gdynia, and in the nearest to mainland part of the Hel Peninsula, build up has reached directly to the sea coast.

5.2. Threats resulting from predicted climate change

Besides anthropogenic influences, the coast is under increasing pressure of natural factors (waves, sea level rise). The predicted climate change will have significant consequences for the coastal zone and its hinterland.

Due to its relatively soft postglacial geological structure, the Polish coast is especially vulnerable to climate change related sea level rise and increased frequency of storms from dangerous for the coast directions. The rate and range of coastal erosion will grow.

Sea level changes are one of the subjects of extensive, globally coordinated climate analyses and investigations. Changes observed in the second half of the XXth Century along the Polish coast and published within the framework of the KLIMAT project[46] are significant — mean sea level grew in the analysed period by about 8 cm at Świnoujście and 14 cm at Gdańsk North Harbour. The average growth rate was 2 cm per 10 years [Jakusik et al, 2012].

According to experts of the Intergovernmental Panel on Climate Change (IPCC), by 2100 sea level will rise by 26 to 82 cm, depending on emission scenario[47]. This will happen also in the Baltic Sea. According to KLIMAT project calculations, depending on emission scenario, sea level will increase in the period 2011-2030 by about 4 to 5 cm. The biggest rise is expected for scenario A1B[48], and at all analysed stations will exceed 5 cm. Relatively smallest change may be expected in case of scenario A2[49] — only slightly more than 4 cm. Though during one year this sea level rise is hardly visible, in a scale of decades it becomes significant.

Changes of mean sea level rise will be practically the same at all calculation points in the Southern Baltic.

[46] The project identifies the most important threats resulting from climate change and defines adaptation actions, which should be realised in order to minimise negative impacts on economy, environment and society. Information is available on the portal of the Institute of Meteorology and Water Management http://klimat.imgw.pl/

[47] Developed by IPCC emission scenarios describe alternative global development paths, which include a number of demographic and technological indicators and resulting greenhouse gas emissions. They are widely used for assessment of future impacts of climate change.

[48] Scenario A1B – quick growth of global economy resulting from an increase of population, with a maximum in the middle of XXIst Century, and quick introduction of more efficient technology, variant – sustainable utilisation of energy sources.

[49] Scenario A2 – polarised world, with significant increase of population, slow economical development and slow technological changes.

5.3. Transformation of coastline

Last century

Coastal dynamics generate high risk of flooding of coastal areas, especially of the located in it buildings and infrastructure.

Analysis of coastline change, based on comparison of maps from different years [Zawadzka-Kahlau, 1999], shows that the process of retreat of beaches, dunes and cliffs proceeds along the whole Polish coast. The rate of change caused by both natural and anthropogenic factors varies along the coast. The average rate in the period 1875-1979 was -0.08 m/year, in the period 1960-1983 it was 0.5 m/year, and in the period 1971-1983 – 0.9 m/year. In the analysed 104 year period retreat occurred along 61% of the coastline, in the 24 years of the 1960-1983 period retreat extended to 72% of the coastline.

Spits, forming a barrier separating the coastal lakes from the open sea, are an element of the coastal zone of high importance for the safety of the hinterland. Analysis of changes of 9 spits of coastal lakes shows gradual loss of land. The highest increase of rate of coastal erosion was observed on the spits of lakes Łebsko, Gardno, Wicko and Kopań and locally of Lake Bukowo [op. cit]. This process is especially dangerous along stretches of coast with a single dune row and low hinterland, lying below +2.5 m m.s.l.

During the last 100 years the average rate of retreat of cliff coasts along the open sea coastline was 0.34 m/year. In the period 1960-1983 erosion processes increased along most open sea cliff coasts. The highest rates were recorded along the Ustka cliff. Erosion of cliff coasts along the Gulf of Gdańsk is less intense. In the period 1960-1983 highest increases of rate of erosion of Gulf of Gdańsk cliffs were observed along short stretches of cliffs at Mechelinki, Puck and Gnieżdżewo. All the cliffs remain active.

During the last decade coastal erosion occurs especially along stretches of coast east of the open sea ports, the coast of the Gulf of Gdańsk between the oulet of Martwa Wisła and Mechelinki, open sea coast of the Hel Peninsula and the morphodynamic region Jarosławiec – Sarbinowo. Significant erosion occurs also on the coast and in the foreshore of the eastern part of the Władysławowo-Jarosławiec region, where strengthening of erosion was observed already in the period 1960-1983 [*Elementy monitoringu…*, 2008].

At present, the main source of information about the state of the coastal zone is the realised since 2004 coastal monitoring. Calculations of parameters of the active part of the coastal zone, based on data from 2012 and 2013 (for the Gulf of Gdańsk – from 2004) allowed to show the Southern Baltic coastal system formed by alternately occurring stretches of erosion and accretion (Fig.5.4).

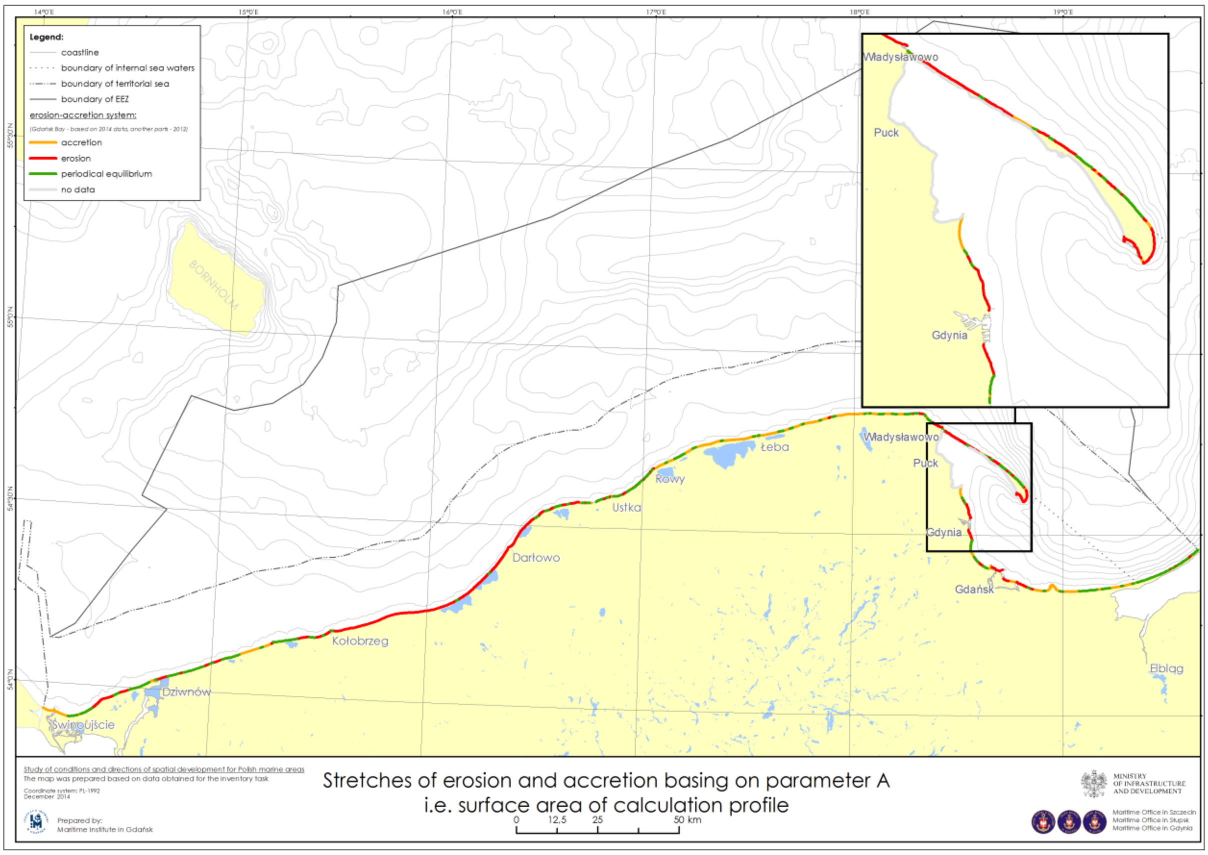


Fig. 5.4. Stretches of erosion and accretion basing on parameter A, i.e. surface area of calculation profile

Prediction of coastal change

The developed in 2001 Polish coastal protection strategy analysed three scenarios of sea level rise for the conditions of the Baltic Sea.:

- optimistic scenario – sea level rise of 0.3 m/100 years,
- most probable scenario – sea level rise of 0.6 m/100 years,
- pessimistic scenario – sea level rise of 1.0 m/100years.

Table. 5. 1. Predicted rate of coastline shift in morphodynamic regions for sea level rise scenarios, basing on observed changes during the last decade

Region	Optimistic scenario	Most probable scenario	Pessimistic scenario
	[m/year]		
Vistula Spit	-0.91	-1.31	-1.82
Gulf of Gdańsk	-0.053	-0.77	-1.07
Hel Peninsula – bay side	-	-	-
Hel Peninsula – open sea side	-0.85 -0.87	-1.22 -1.26	-1.70 -1.75
Władysławowo – Jarosławiec	-2.00	-2.88	-4.00
Jarosławiec – Sarbinowo	-0.55	-0.79	-1.10

Sarbinowo – Międzyzdroje	-0.58	-0.84	-1.17

Table 5.1. shows very clearly the differences in rates of coastline shift along the coast and for each of the sea level rise scenarios. Basing on the rate of coastline shift for the last decade, even for the optimistic sea level rise scenario, predicted changes will be large enough to endanger the coast along a significant part of the Polish coastline. In case of that sea level rise scenario maximum changes will occur along the Władysławowo – Jarosławiec stretch, and the rate of change could be about 2 m/year. Though highest rates of coastline retreat were observed in the past and are predicted for the future along this part of the coast, because of the relatively large reserves of sandy material in the foreshore and on land (beach and dune system), the predicted changes are actually not as alarming as they may seem.

Prediction of coastline shift based on averages for the last 20 years showed increased danger for the Hel Peninsula and strengthening of erosion along the central part of the coast (Władysławowo – Jarosławiec), and also increased danger along the coast of the Gulf of Gdańsk and Vistula Spit. The predicted rate of change will be relatively smallest along the Sarbinowo – Międzyzdroje stretch.

Calculations based on coastline change during the last 100 years differ significantly from results obtained from calculations based on the above mentioned periods. Because of the low reliability of these historical data results of these calculations are not presented.

Predicted loss of land

Predicted loss of land depends on sea level rise scenario and is a combined result of erosion and inundation. Using as a basis the rate of changes during the last 100 years, the average loss of land for the whole Polish coastline would be 6.4 ha/year for the optimistic scenario, for the most probable scenario – 10.5 ha/year, and for the pessimistic scenario – 15.5 ha/year. Looking at morphodynamic regions, the largest loss of land will occur in the Jarosławiec –Sarbinowo region (5.6 ha/year) and Sarbinowo – Międzyzdroje region (3.9 ha/year).

Basing on land loss for the period 1961-1983, average land loss for the whole coastline in the optimistic variant may be 25 ha/year. The largest losses are expected in the Władysławowo – Jarosławiec region. In case of pessimistic scenario the average loss is assessed at 52.4 ha/year. Over 50% of the loss will occur in the Władysławowo – Jarosławiec region.

Basing on land loss in the period 1971-1983, the assessed average land loss for the most probable scenario is 44.4 ha/year, and for the pessimistic scenario – 89 ha/year. Significant land loss will occur along the Vistula Spit (19 ha/year) and along the central part of the coast, Władysławowo – Jarosławiec (39 ha/year) [ibid].

Predicted changes of resilience

Predicted change of coastal resilience (in conditions of sea level rise and at present level of knowledge about coastal processes) indicates a gradual decrease of class of resilience understood as ensuring safety of hinterland from action of wind, waves and currents by the morphologic elements of the shore and foreshore.

Basing the assessment on changes in the last 100 years:

- the high resilience of the Vistula Spit coast gradually decreases from Class 4 to Class 3,
- Hel Peninsula will have the lowest class of resilience (among the regions with medium resilience),
- the central part of the coast (Władysławowo – Jarosławiec) will have medium class, and the Jarosławiec-Sarbinowo stretch will have a very low resilience class.

Basing on changes from the period 1961-1983:

- sea level rise of 0.6 m/100 years will result in further decrease of coastal resilience to Class 1, and along the stretch Władysławowo – Jarosławiec to Class -1 (state of danger),
- the pessimistic variant of sea level rise will result in passing of many stretches of the coastline to state of danger (-1), or even state of coastal breakdown (-2).

Assuming the average rate of changes resulting from coastal dynamics in the period 1971-1983:

- resilience of morphodynamic regions will be between low resilience (1) for the optimistic variant and state of coastal catastrophe (-3) for the pessimistic variant,
- one of the most endangered regions will be the Hel Peninsula, where coastal catastrophes may lead to breaking up its continuity.

The predicted decrease of resilience of the whole coastal system will require much higher funding of coastal protection works and, later on, adopting of a selective retreat policy along many stretches and protecting only priority regions (highly invested hinterland, high cultural and/or natural values). It is assessed that even in the case of sea level rise of 0.6 m/100 years it will be necessary to accept the necessity of retreat along some stretches and adopt polder protection of low-lying coastal areas.

5.4. Flood risk

Preliminary flood risk assessment

Increasing risk of sea floods is a natural consequence of sea level rise and the described above coastal changes. Preliminary Flood Risk Assessment (PFRA) is the first of four planning documents required by Directive 2007/60/EC of the European Parliament and the Council of 23 October 2007 on the assessment and management of flood risks (Floods Directive). The Polish PFRA was developed at the end of 2011.

The objective of the PRFA was to identify areas threatened by floods, i.e. areas for which the risk of flooding is significant and areas where flooding is probable. The preliminary assessment was carried out using available or easy to obtain information, and use of highly accurate data was not required.

The highest danger of flooding in the West-Pomeranian and Pomeranian Voivodships comes from the sea. Sea floods are connected with inundation of land by sea waters, as well as flooding of areas in the outlet parts of rivers and around coastal lakes (Figs. 5.5 and 5.6).

In the Pomeranian Voivodship, the most threatened by sea floods are the outlet part of the Vistula with Gdańsk, Żuławy Wiślane and the Old Prussians' Coast[50]. The port of Gdynia, parts of the

[50] Old Prussians' Coast – a region at the Polish-Russian border, most eastern part of the Pobrzeże Gdańskie (Gdańsk Coast) located along the Vistula Lagoon between the Elbląg Upland to south-west and the Pregola outlet to north-east. It is a narrow, low-lying alluvial plane of mainly the Bauda and Pasłęka rivers.

Puck, Hel and Ustka towns, outlet parts of the Reda River, Hel Peninsula between mainland and Jastarnia, low areas of the Nizina Karwieńska (Karwia Plain) and low areas in the watersheds of rivers Łeba and Łupawa, as well as the Łebsko and Gardno coastal lakes are also threatened by sea flooding.

Fig. 5.5. Areas threatened by floods, Pomeranian Voivodship

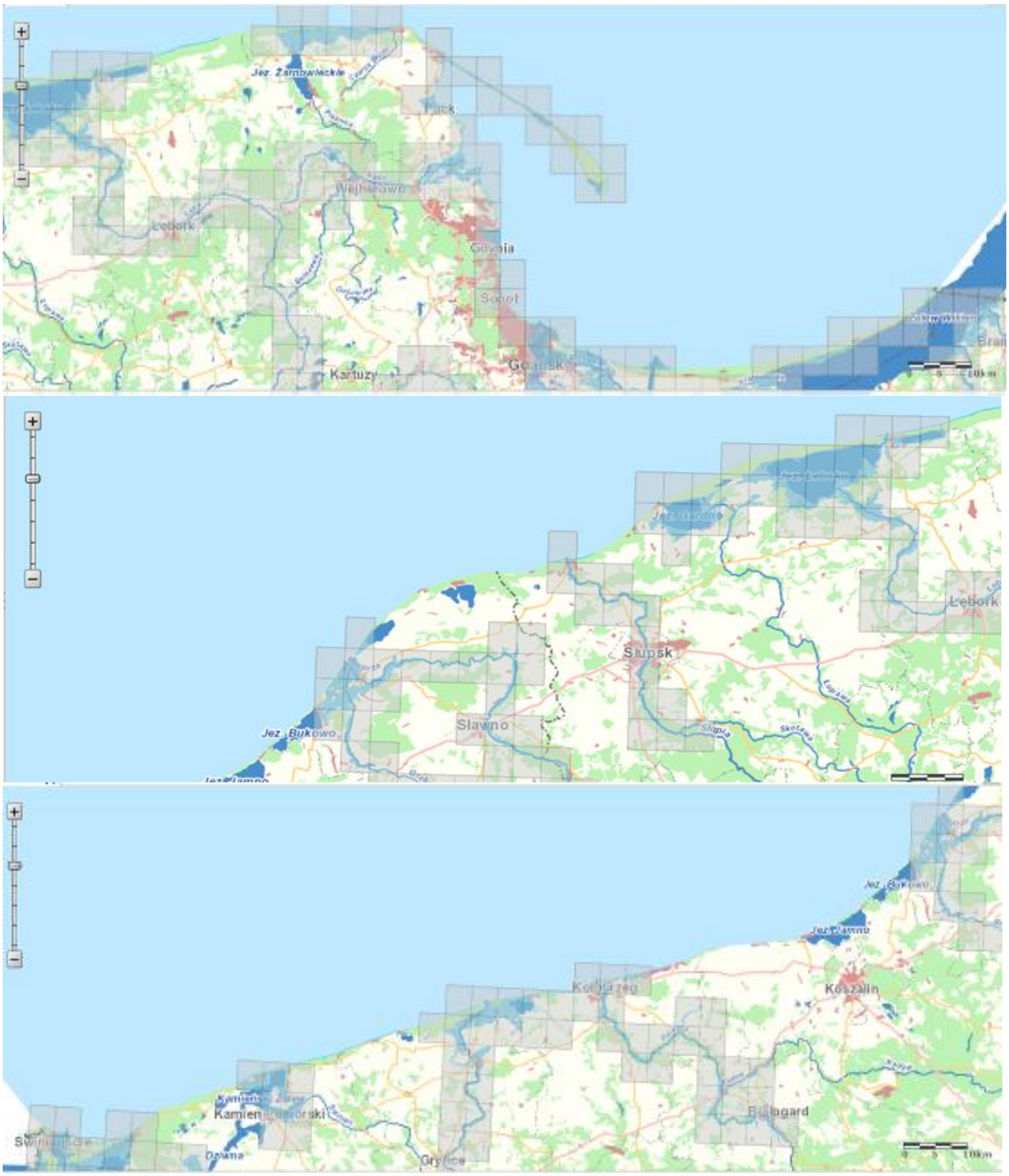
Source: Information obtained from the National Water Management Authority website http://www.kzgw.gov.pl/pl/Wstepna-ocena-ryzyka-powodziowego.html (access on 15.02.2015)

In the West-Pomeranian Voivodship most threatened by sea floods are areas in the outlet parts of the rivers Wieprza (towns Darłowo, Sławno), Parsęta (towns Kołobrzeg, Karlino, Białogard), Rega (Trzebiatów), Dziwna (Dziwnów) and parts of towns of Świnoujście and Kamień Pomorski. Apart of that, high flood risk comes from the Szczecin Lagoon and Odra river (Szczecin Plain, and Odra Valley) and from the Resko Przymorskie coastal lake together with the outlet part of river Błotnica.

Fig. 5.6. Areas threatened by floods, West-Pomeranian Voivodship

Source: Information obtained from the National Water Management Authority website http://www.kzgw.gov.pl/pl/Wstepna-ocena-ryzyka-powodziowego.html (access on 15.02.2015)

For areas which were found to be highly threatened by floods next planning documents were developed in 2013 – the flood hazard maps and the flood risk maps. The coverage of the Polish coast by flood hazard and flood risk maps in a 1:10,000 topographic map grid is shown in Fig. 5.7.a, b and c.



a)

b)

c)

Fig. 5.7. Coverage of Polish coast by flood hazard and flood risk maps

Source: Information obtained from the website of the IT System of theCountry's Protection Against Extreme Hazards (ISOK) (http://mapy.isok.gov.pl/imap) (date of access 15.02.2015)

Areas of flood hazard shown in the maps must be taken into account in:

- the National Spatial Development Concept,
- the spatial development plans of voivodships,
- the local (statutory) spatial development plans,
- decisions on location of public investments or decisions on conditions of development.

Flood hazard maps are supplemented by flood risk maps, which identify potential damages caused by floods, taking into account information on affected: inhabitants (number of people), structures and other development, protected areas, cultural heritage, potential sources of water contamination, important installations, also other significant additional information.

The flood hazard and flood risk maps are accessible on the website of the ISOK system.

The main objective of the flood hazard and flood risk maps was to form a basis for the development of flood risk management plans (the final document required by the Floods Directive). Flood risk management plans will include all aspects of flood risk management – prevention, protection and preparation for high water, in that flood prediction and early warning systems. The plans should also include actions to ensure: sustainable spatial management, more effective water retention and controlled inundation of some areas during floods. Results of cost and benefit analysis should be taken into account. In the management plans proper attention should be given to areas with potential retention capacity, environmental objectives of the Water Framework Directive, principles of water management, forms of land use, elements of spatial planning and development, nature protection, navigation and port infrastructure, flood prediction and early warning systems and critical infrastructure. In the development of the flood risk management plans, the long term issues and uncertainties connected with climate change predictions and with changes of the development of areas threatened by floods also will be taken into account[51]. The document should be ready by December 22 2015.

5.5. Coastal protection

The main objective of coastal protection is to ensure that the required level of safety of coastal hinterland is achieved and maintained, while maintaining a good state of environment in the technical belt. Because of the predicted sea level rise and strengthening of coastal erosion, protection of strongly eroded coasts with low resilience will have to be intensified, and existing coastal protection systems will have to be modernised and extended.

As described earlier, during the last century the coastal system of the Southern Baltic was transformed (with sea level rising 0.2 m) by natural and anthropogenic factors increasing the rate of coastal erosion. The distribution of stretches of coast protected by hydrotechnic structures is, to a large extent, connected with the building and development of ports and accompanying urbanisation. Extending into the sea breakwaters and port access infrastructure cause significant disturbance of natural sediment transport processes. "Downstream" of the ports they result in strengthening of erosion, sand deficit and reduction of the dynamic layer in the foreshore, beach and dunes. Morphodynamic processes are also significantly affected by hard coastal defence systems which often result in additional erosion in their neighbourhood.

Coastal protection works are carried out since at least 1873, especially east of the open sea ports and in front of coastal settlements. The length of stretches protected by technical means gradually increased, and by 1961 [Basiński, 1963] there were 20 protected regions. In 12 of these regions system protection was used, i.e. at least two types of coastal defences were built along the same

[51] information obtained from the website of the National Water Management Authority http://www.kzgw.gov.pl/pl/Wiadomosci/Informacja-o-rozpoczeciu-prac-nad-aPGW-i-PZRP.html (access: February 1st, 2015)

stretch of coast. In most cases it was seawalls and groynes. Coastal protection systems built until the end of the 1980s did not fulfil their role properly because of the side effects in their neighbourhood and increasing sand deficit. With progressing and extending erosion, the length of engineering intervention along the coast also increased.

At present the number of regions protected by various types of structures grew to 33, of which two are the coasts of the Vistula Lagoon and Szczecin Lagoon. In 19 of them there are groyne systems (formed by from only 3 groynes at Westerplatte up to 218 in the Unieście – Gąski region), operating independently or in a system with seawalls and/or artificial nourishment. Groynes are built along 82.1 km of coastline. Other hard protection structures are located along 62 km of the coast. Seawalls as an independent defence structure occur only in 5 regions of the eastern coast: on the Vistula Lagoon, at Wisła Śmiała outlet, Rozewie, Jastrzębia Góra and Karwia. In the remaining protected regions seawalls function together with groynes, artificial nourishment and coastal breakwaters. One of the most protected parts of the Polish coast is the Hel Peninsula, which is protected along about 50% of its coastline, and the stretch between Jarosławiec and Sarbinowo, where of the 60.5 km of coastline over 9 km is defended by various types of seawalls (Fig. 5.8).

During the last decades it is considered that the most rational, nature-friendly method of coastal protection is artificial nourishment with sand from dredging of fairways and from marine resources. The largest nourishment works were executed along the Hel Peninsula, where, along the stretch Władysławowo-Jurata (km H0.0-23.5), about 17 mln m^3 of sand were placed, rebuilding the dunes, beaches and morphological forms of the foreshore [Boniecka et al, 2012]. Along other parts of the open sea coast nourishment was carried in regions „downstream" of port breakwaters

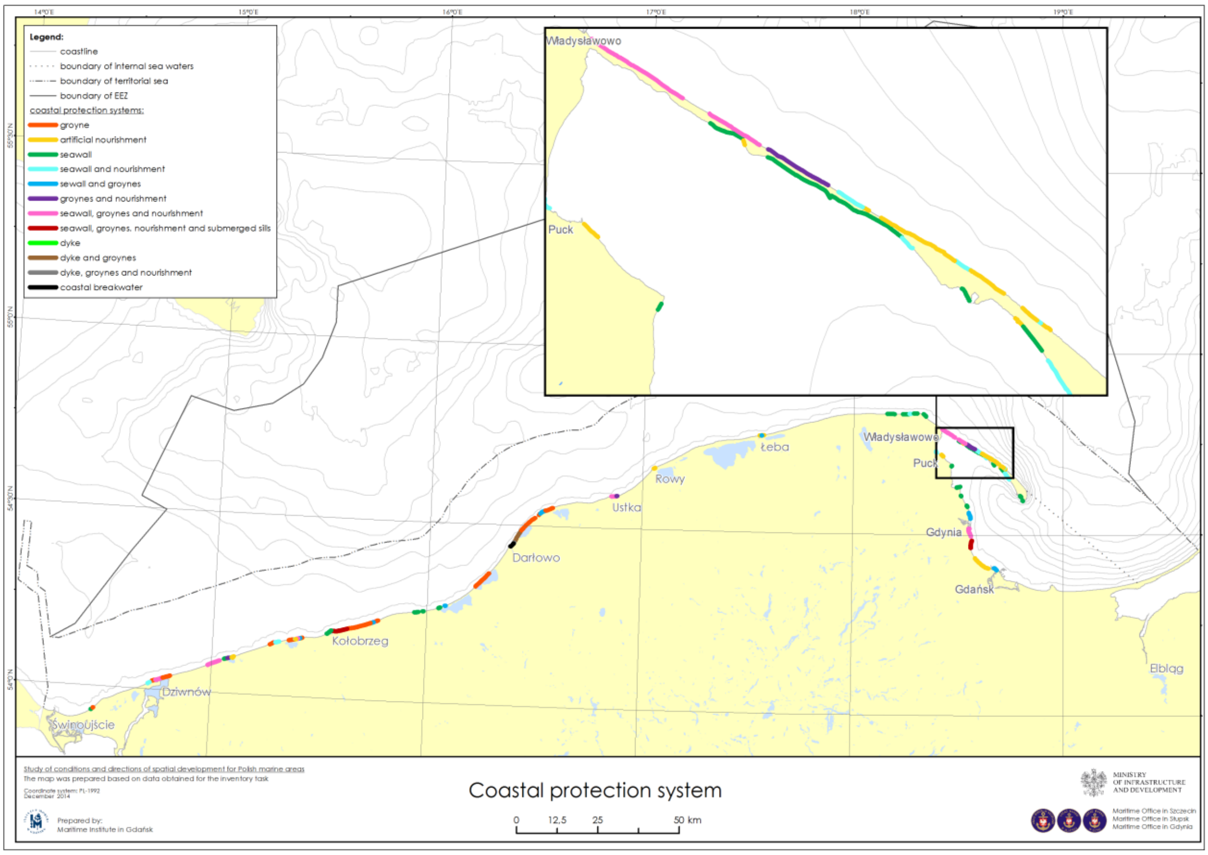


Fig. 5.8. Coastal protection system

When limitations imposed on investment in areas threatened by marine flooding and erosion prove to be ineffective or insufficient, then technical protection of increasingly long stretches of coast and further anthropogenic transformation of dune environment become necessary [Boniecka et al, 2013]. It is therefore extremely important that selfgovernmental (local) administration and national authorities, including spatial planning, environment protection and coastal protection agencies/authorities cooperate properly. The required by law processes of consultation of decisions pertaining to the coastal zone cause that the decision process is not simple and requires finding a consensus.

Long Term Program of Coastal Protection

The described above phenomena and transformation of the coastline triggered the development of a coastal protection strategy. Because of the very high, far exceeding the possibilities of the national budget, cost of maintaining the coastline along its whole length and because of the unacceptable impact on environment of such actions, it was decided to adopt the option of selective coastline maintenance for all sea level rise scenarios. It was assumed that the coast will be intensely protected along selected stretches with highly invested hinterland, qhile along the rest of the coast controlled retreat will be allowed. It was also decided that the preferred method of technical coastal protection will be artificial nourishment, if necessary supplemented by supporting structures. It is stressed in the strategy that a proper balance should be maintained between the development of coastal hinterland and level of safety provided by the coastal system.

Resulting from the strategy [*Synteza pracy…*, 2000] detailed program of coastal protection works took the form of the Act of Parliament of 28 March 2003 *on establishment of the multiannual programme "Program of coastal protection"* (Official Gazette No. 67, it. 621). Since 2004 technical coastal protection is realised in accordance with that Act, in which, for the period 2004-2023, are specified tasks concerning:

- construction, improvement and maintenance of marine flood and erosion protection system of coastal areas, including removal of damages in the coastal protection system.
- ensuring stabilisation of coastline of 2000 along selected stretches and preventing degradation of beaches,
- monitoring of the coastal zone, as well as actions, works and investigations aimed at assessing the actual state of the coast and indicating the necessary location and type of intervention.

The Program provides for six types of technical intervention: artificial nourishment, nourishment with supporting structures, building of coastal defences, modernisation of coastal defences, water management system for the Jastrzębia Góra cliff and sand by-pass system at the port in Władysławowo.

The total length of coastline to be protected (without the coasts of Vistula Lagoon and Szczecin Lagoon) is 203 km. Tasks within the Program cover about 57% of coastline between Górki Wschodnie and Międzyzdroje (Fig. 5.9).

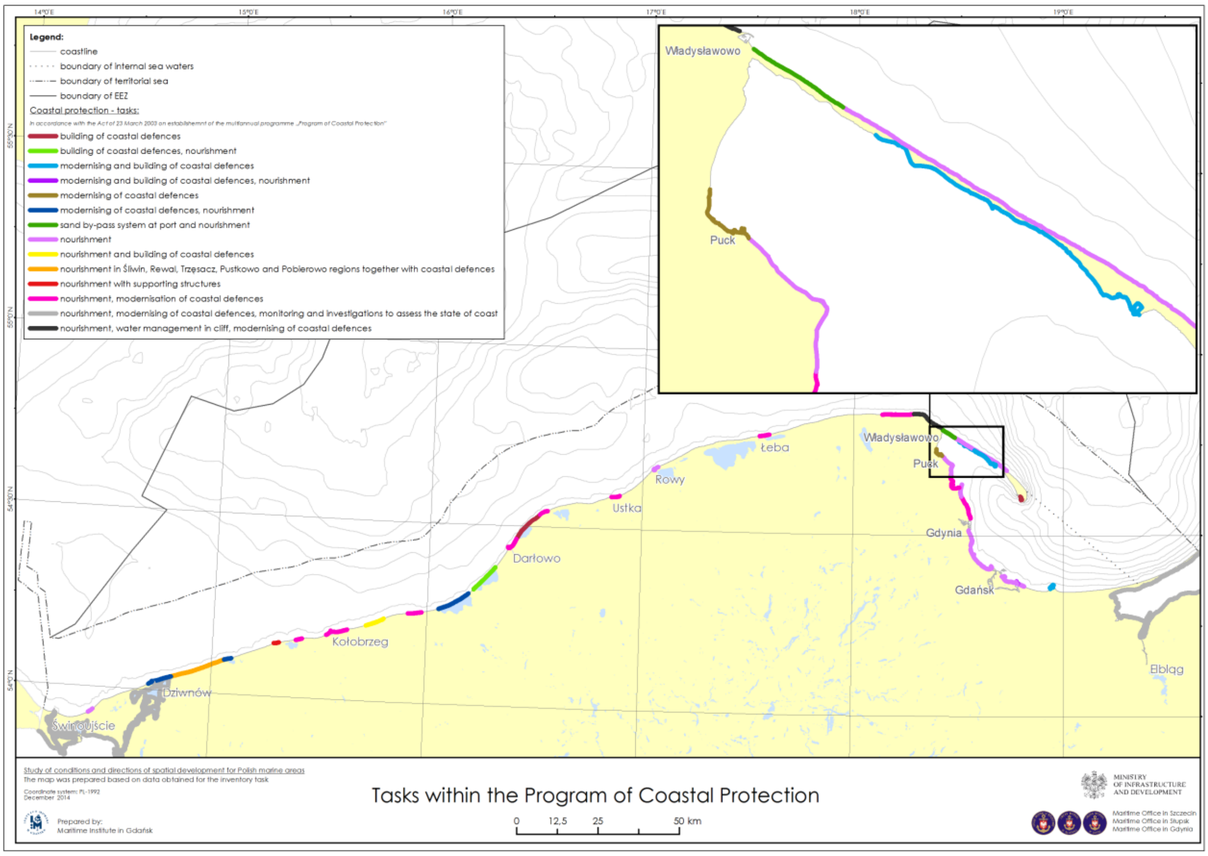


Fig. 5.9. Tasks within the Program of Coastal Protection

Realising the Program, along threatened by marine erosion stretches of coastline with especially valuable hinterland, artificial nourishment was supplemented by supporting structures (IInd line of protection) or existing defences were modernised. Various types of seawalls were used – from reinforced soil Green Terramesh structures (e.g. Mechelinki, Władysławowo, Ostrowo and Dziwnów) to typical rubble mound structures (Ustka, Ustronie Morskie, Kołobrzeg, Rewal and Trzęsacz). On the Lake Kopań spit a 4.74 km long dyke was built to protect low areas against sea flooding and to prevent uncontrolled overflowing of sea waters over the spit.

In the period 2004-2012 coastal defence structures were built or modernised along 26.3 km of coastline, of which over 70% is located between Jarosławiec and Dziwnów. In conditions of sand deficit, these structures may result in strengthening of erosion in the foreshore, reduction of beaches and development of erosional bays. In effect nourishment will be required along these stretches. Implementation of the Program in 2004-2012 was focused on stretches with most strongly eroded foreshore and coast along both cliff and dune coasts. Till present nourishments exceed 9.4 mln m^3. Sand for these nourishments comes from marine deposits and from dredging of fairways, roadsteads and port basins. It was used mainly for protection of the open sea coast of the Hel Peninsula, and also for strengthening the coast east of all the ports between Władysławowo and Dźwirzyno, for protecting the cliff foot at Ustronie Morskie and along the stretch Rewal – Trzęsacz, for nourishment of the strongly eroded Dziwnów Spit, and for nourishment of the Gulf of Gdańsk coast between Brzeźno and Sopot and at Orłowo.

It is evaluated that until 2023 coastal protection by artificial nourishment will require at least 60 mln m^3 of sand with mean grain size between 0.20 and 1 mm. This requires obtaining proper knowledge about available resources of marine sand fit for nourishment. Considering coastal dynamics, it is assumed that extraction of the sand may be carried out within the territorial sea at least 3 km from the shore, always outside of the underwater coastal slope. Investigation and exploitation of sand from Polish sea areas for artificial nourishment does not need obtaining a license normally required by the mining and geological law.

In the years 2003-2005, near the threatened by marine erosion sections of the coast, about 1260 km^2 of areas with potential sand resources were identified for further detailed geological investigation. Extraction of sand will be allowed only in areas where the thickness of appropriate sand deposits exceeds 1 m. Identified prospective areas for extraction of sand for artificial nourishment are shown in Fig. 5.10. In the identification, besides the coast protection zone (the 3 km strip), technical objects located on the sea bottom (pipelines, cables), other anthropogenic elements (anchorages, fairways, dredged spoil dumping areas) and state of biocenoses were taken into account.

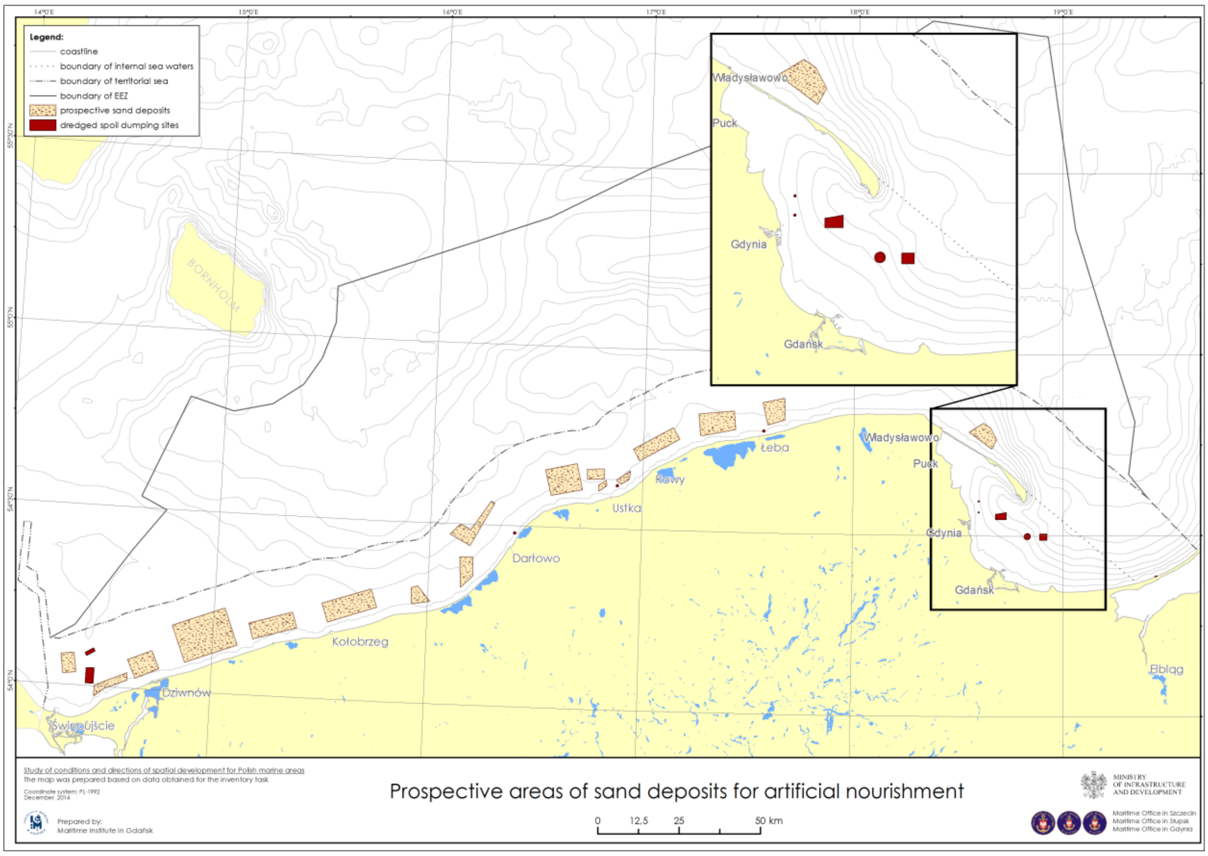


Fig. 5.10. Prospective areas of sand deposits for artificial nourishment

To date documentation works were carried out in the following prospective areas: „Rewal'' (area 204 km^2) – for nourishments at Niechorze, Rewal, Trzęsacz and Pobierowo; „Mrzeżyno" (area 70 km^2) and "Hel Peninsula" (area 33 km^2) – where 6 deposit fields were identified of 3,24 km^2 total surface, i.e. less than 10% of investigation area.

Investigations of seafloor deposits, in that of sand layer thickness, show that in some regions there is a deficit of suitable sand for artificial nourishment, and that exploitable sand fields containing varying amounts of sand are distributed irregularly in various zones of the investigated areas. For these reasons maritime spatial plans should distinguish these areas as a separate category of functional areas, similarly to dumping sites. In these areas priority should be given to extratction functions, and at dumping sites – to dredged spoil dumping and possibility of future using the spoil for coastal protection. Observations and assessments of the state of the coastal zone, carried out for the last decade, showed that along some stretches with developed hinterland, which are not taken into account the Program of Coastal Protection, sufficiently strong erosion began to appear to justify including these stretches into the Program. **There is no other alternative for stretches of coast with developed hinterland threatened by marine erosion and flooding.**

Basing on the observations and experience, the Polish maritime administration prepared an amendment of the "Program..." aiming at more effective and adequate to needs coastal protection. It is proposed to increase the total length of stretches to be protected by technical intervention by about 50 km, to increase the annual minimum value of protection works, to ensure monitoring along the whole length of the Polish coastline and to require consultation of implementation of the *Program's* tasks with relevant local self-governments.

The draft act amending the *multiannual programme „Program of coastal protection"* has passed through the SEA procedure in 2012. At present, after introducing significant corrections into the *Program*, the SEA is carried out once more. After adoption of the amendment, the drafting team of the maritime spatial plan should take into account the tasks listed in the *Program* for the years 2004-2028.

Conclusions for the maritime spatial plan of Polish sea areas

- No limitations should be put on works protecting against marine erosion, flooding and landslides along stretches of coast indicated in the Act *on establishment of multiannual programme „Program of coastal protection"* (Official Gazette 2003 No. 67, it. 621).
- After adoption of amendments of the above mentioned Act, tasks of the Program of Coastal Protection for the years 2004-2028 should be properly taken into account in the MSP. Similar attention should be given to requirements of Flood Risk Management Plans.
- Proper attention should be given to the expected growth of length of eroded stretches, increase of rates of erosion and decreasing resilience of the coast to sea level rise. It is possible that hard coastal defence may intensify through modernisation and elongation of existing systems along strongly eroded stretches, potentially forming a barrier to a number of economic activities, e.g. water sports or beach landing places for fishing boats.
- Consequences of coastal erosion on cliff coasts should be taken into account (gradual retreat of cliff top, foot and coastline).
- Special attention (e.g. by modelling and simulation) should be given to potential pressures of sea area uses on the coast and its hinterland.
- Account should be taken of conditions and requirements resulting from the existing and planned areas of nature protection.
- Marine sand deposits fit for artificial nourishment should be protected. The maritime spatial plan of Polish sea areas should, in these areas, assign priority to extraction functions for needs of coastal protection.

- Areas of sand accumulations fit for artificial nourishment exclude dredged spoil dumping (except when the dredged spoil can be used for later nourishment), laying of cables and pipelines and location of structures.

6. USE OF SEA AREAS BY FISHERIES

Based on the report "Use of sea areas by fisheries - input to the Study of Conditions Maritime Spatial Development of Polish Sea Areas, National Marine Fisheries Research Institute in Gdynia, 2014, Annex 12.

6.1 Ichthyofauna

6.1.1 Number and location of sprat and cod larvae, example from one cruise

During ichthyologic and plankton cruises, organized twice a year by the National Marine Fisheries Research Institute in Gdynia (MIR-PIB), the quantity of pelagic spawn and larvae of fish in the Southern Baltic is determined basing on results obtained from 60-70 stations located in the deeper parts of Gdańsk Basin, Słupsk Bank and Bornholm Basin (locations of survey stations in May 2013 are shown in Fig. 6.1).The area of the survey traditionally covers the EEZs of Poland, Denmark and Sweden. Areas of spawning of pelagic species are as a rule difficult to ascribe to a specific location. Below examples of analyses for cod and sprat caught during a cruise in May 2013 are presented.

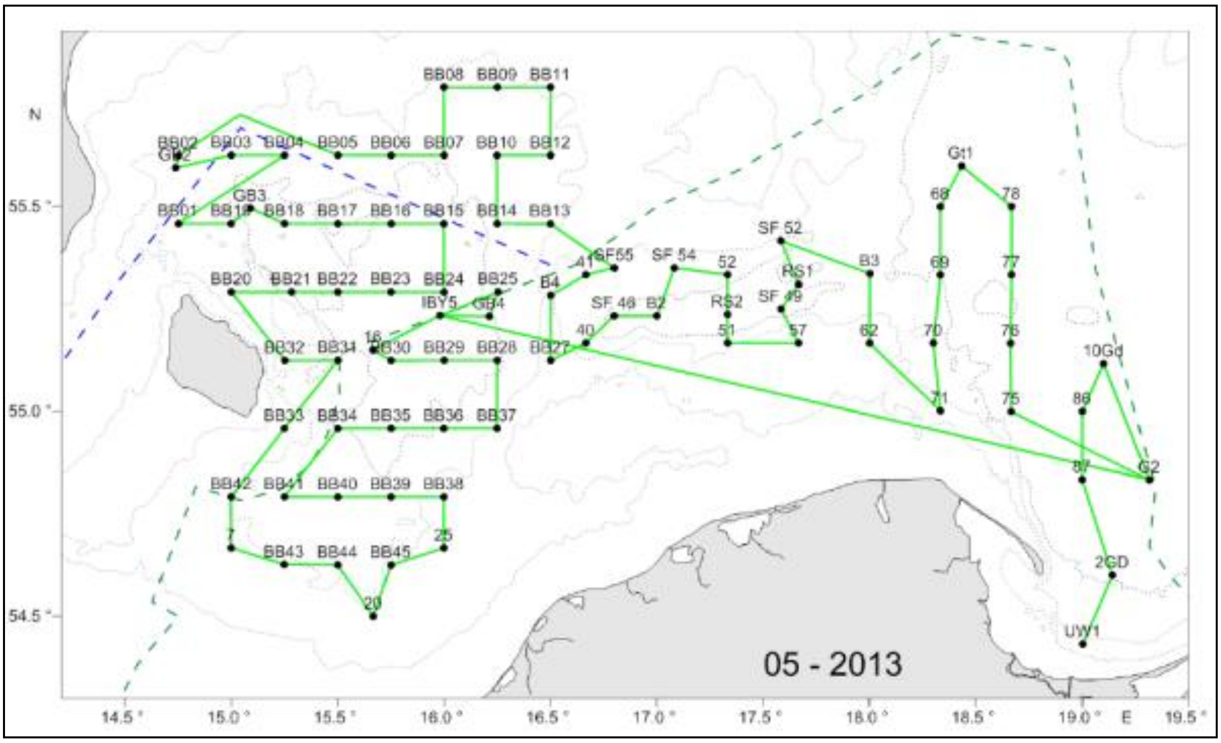


Fig. 6.1. Location of stations during cruise of r/v Baltica in May 2013 (green line shows the route of the cruise, dashed lines indicate EEZ borders[52].

Sprat procreates in open waters of the Baltic Proper mainly from May until August [Parmanne et al., 1994]. For this species it is not possible to determine exact spawning locations. Spawn as well as larvae of sprat were observed at all plankton stations, at which the samples were collected in May 2013 (Figs. 6.2. and 6.3.) For obvious reasons, the location of spawn and larvae is not uniform and it can be noticed that larger quantities were found at stations located in deeper areas.

[52] Illustrations and tables in subsection 6 come from Annex 12.

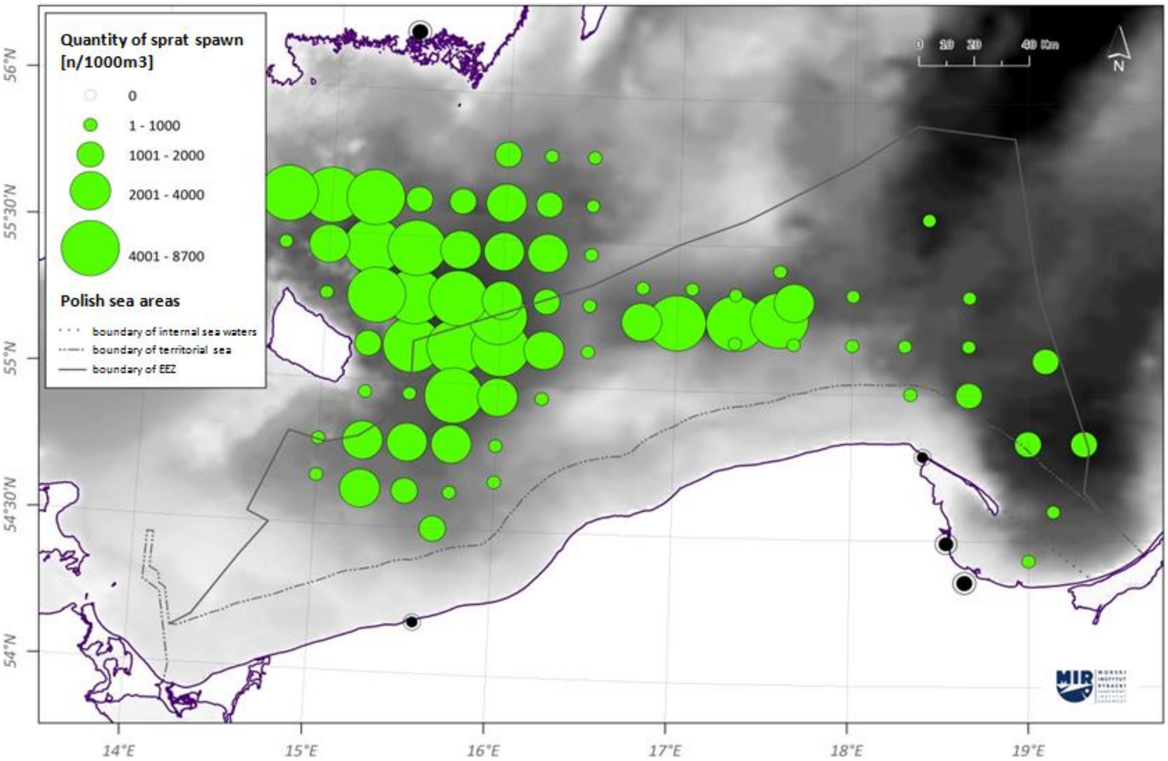


Fig. 6.2. Distribution and quantity of sprat spawn (n/1000m3) in May 2013 (Bongo 300 µm).

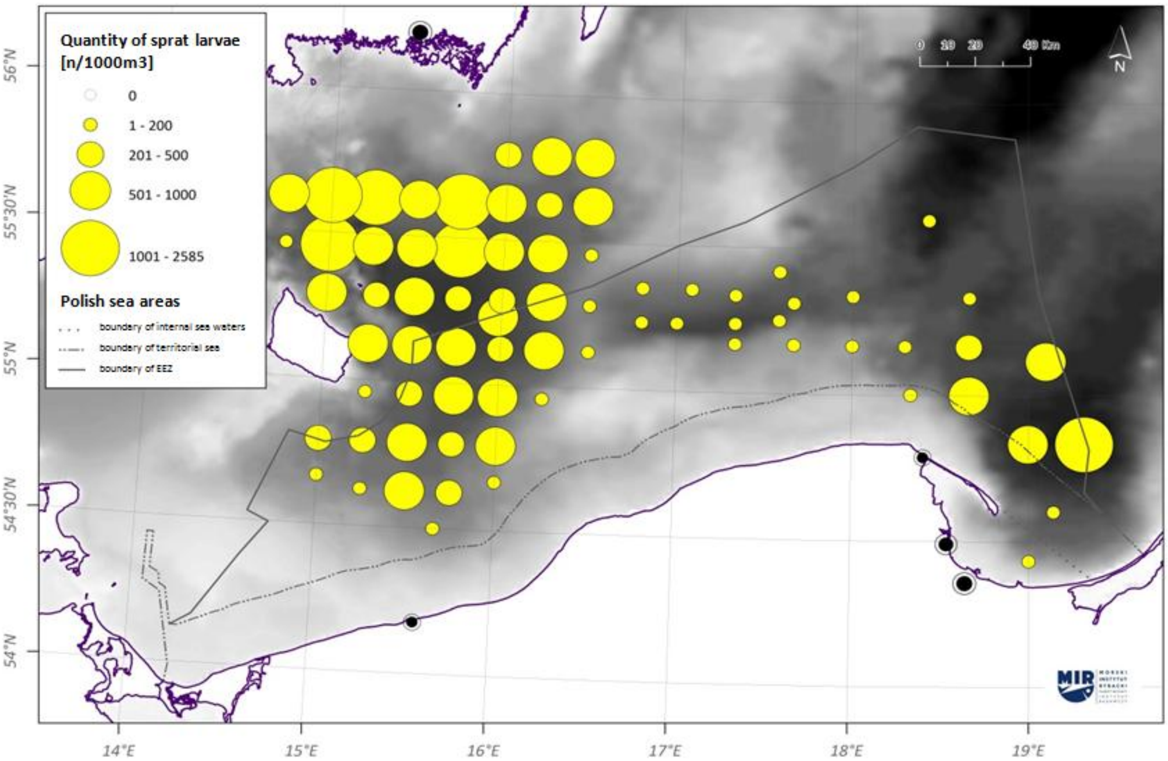


Fig.6.3. Distribution and quantity of sprat larvae (n/1000m3) in May 2013 (Bongo 300 µm).

With time the situation becomes increasingly complicated because the distribution of larvae largely depends on sea currents dominating in a given season. Baumann and others [2006] developed a “bottom depth anomaly” (BDA) index for sprat, which allowed to approximate the intensity of larvae transportation from open waters of the Baltic Sea, where spawning is taking place, towards the coastal areas (Fig. 6.4.). As can be seen, after 50 days of “drifting” the location of larvae may be very different.

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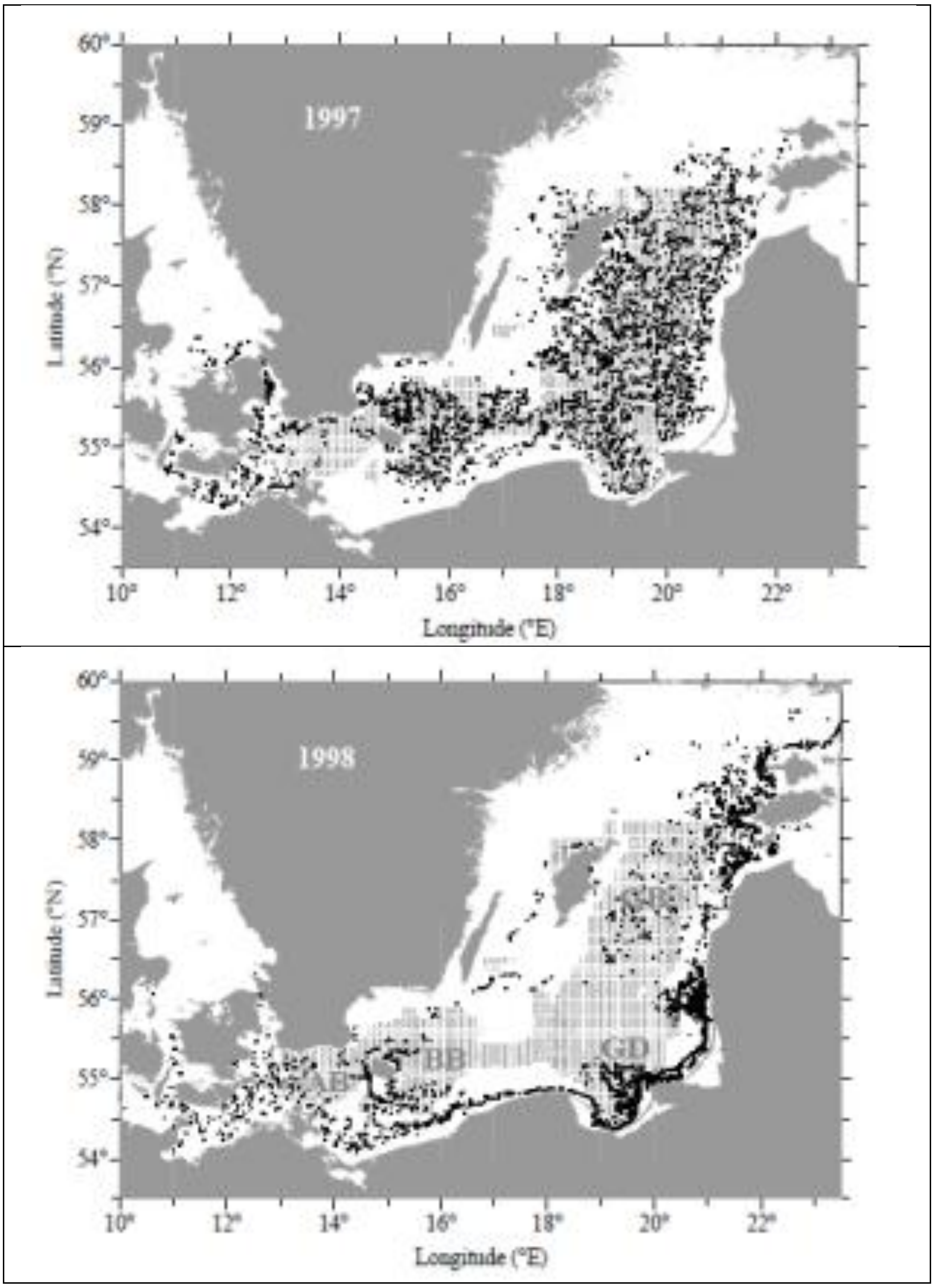

Fig. 6.4. Initial and final location of particles after 50 days of drifting driven by differing current systems in 1997 and 1998.

Spawning of cod is different. Because of the need to achieve neutral buoyancy of spawn, effective procreation of the east cod herd is possible in the deeper waters of Gotland, Bornholm and Gdańsk Basins and in much lesser extent in the Słupsk Trough (Fig. 6.5.) [Cardinale and Svedäng, 2011].

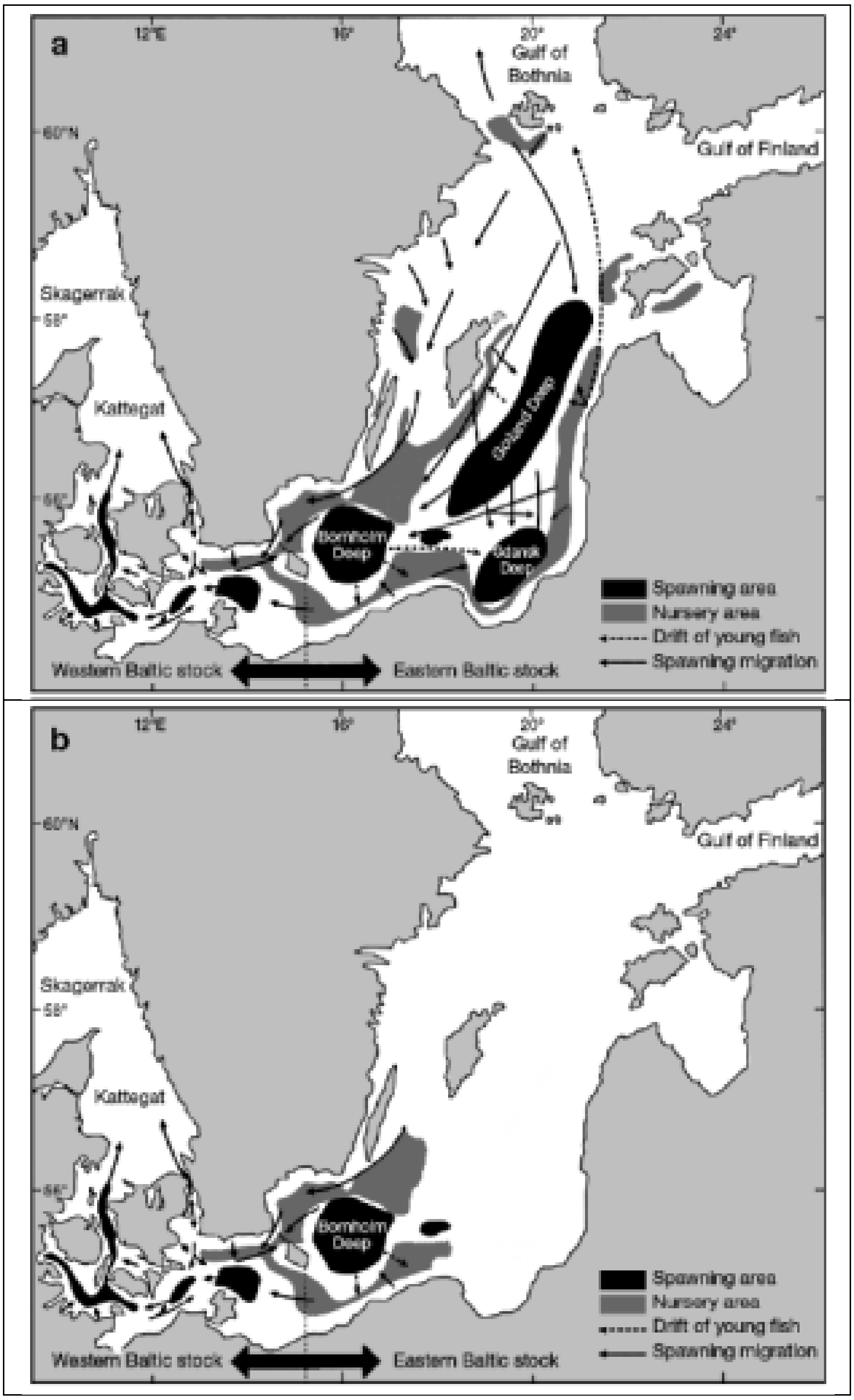

Fig. 6.5. Map of the Baltic Sea showing main historical (a), and present (b) procreation areas of the east herd of cod.

Critical values of hydrological parameters deciding about the effectiveness of procreation and survival capacity of spawn of east herd cod were determined basing on experimental investigations and are commonly called “cod water”: salinity >11 psu [Nissling and Weslin, 1997], temperature > 2 C [Wieland and others, 1994], content of dissolved oxygen >2 ml/l [ibidem]. The area of effective procreation of east herd is currently limited to Bornholm Deep and Słupsk Bank, because of significantly reduced frequency of inflows of salty waters from the North Sea in the last two decades (fig.6.5). These conclusions are confirmed by location of spawn and larvae of cod (fig. 6.6. and 6.7.) observed in May 2013 – spawning was taking place in an area approximately limited by the 60m depth contour. Single seeds of spawn were noted in the Gdańsk Deep.

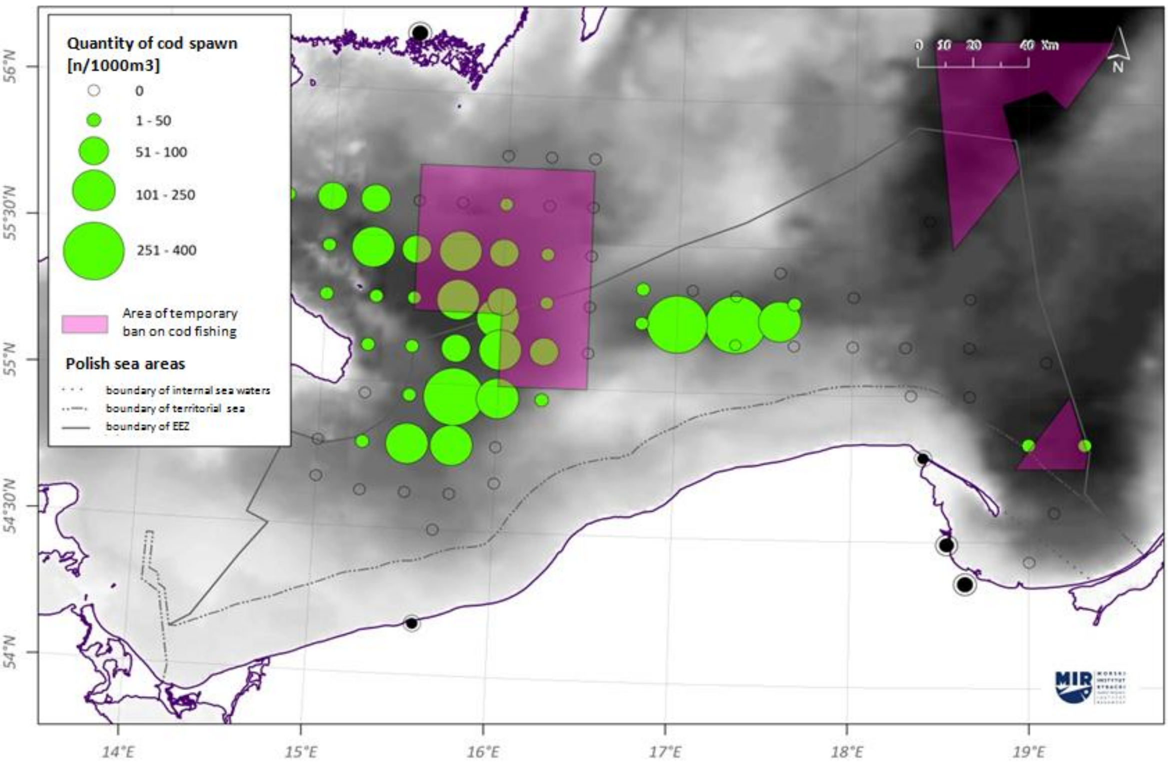

Fig. 6.6. Location and quantity of cod spawn (n/1000m3) in May 2013 (Bongo 300 µm). In purple are marked areas of temporary ban on cod fishing according to the Regulation of Council (EC) no. 1098/2007.

The period of peak spawning has changed in time: in the 70-ties and 80-ties of the last century, procreation was most intense between the end of April and middle of June, whereas from the beginning of the 90-ties it has extended until the end of July [Wieland and others, 2000]. Also in case of this species, the locations of spawn and larvae changes depending on the hydrological situation – in May 2013 the largest quantities of larvae were observed at the edges of the Bornholm Deep, outside the area of largest depths (Fig. 6.7.).

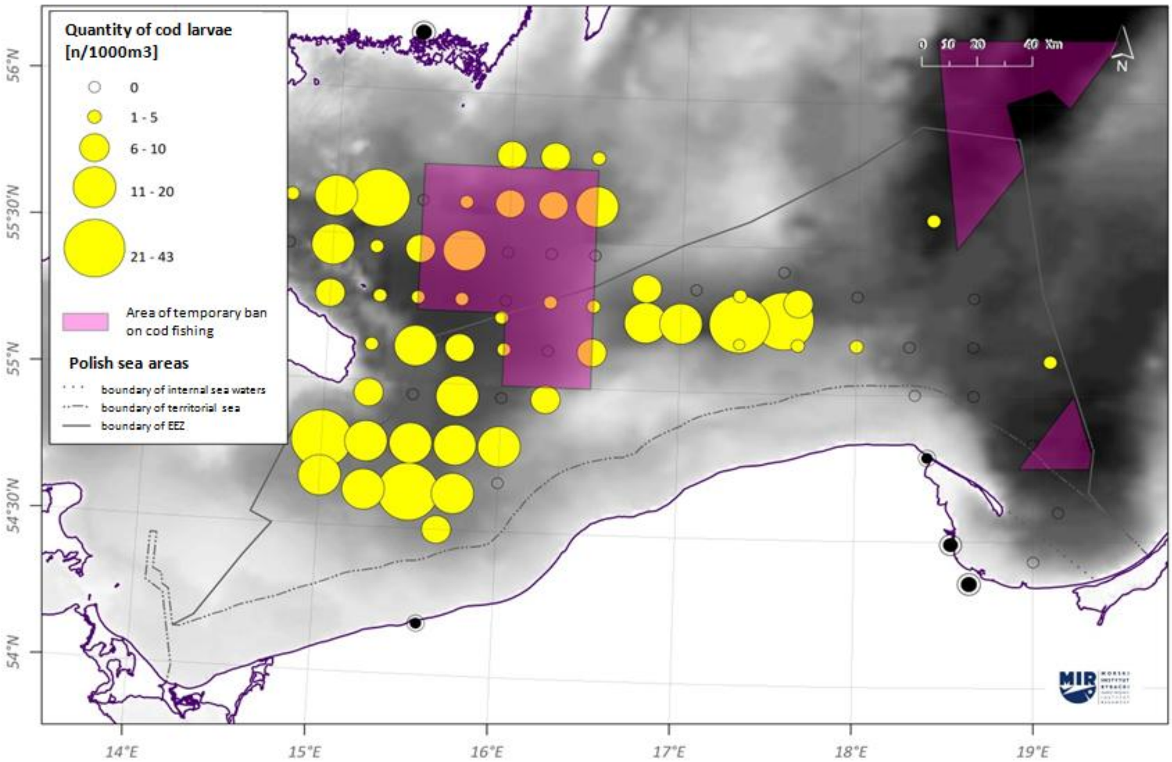

Fig. 6.7. Location and quantity of cod larvae (n/1000m3) in May 2013 (Bongo 300 µm). In purple are marked areas of temporary ban on cod fishing according to the Regulation of Council (EC) no. 1098/2007.

Hinrichsen and others [2007], have analyzed quarterly average values of thickness of "cod water" in the Bornholm Basin in 1989-2003. The analysis shows that the best conditions for effective procreation were in the central part, limited by the 80 m depth contour. The presented in Fig. 6.8 thickness of "cod water" and the quantities of cod spawn at earliest stage of development in August 1991 and 1999 indicates that the area closed for fisheries may, but not necessarily must, protect the majority of the fish during the spawning period from pressure of fisheries.

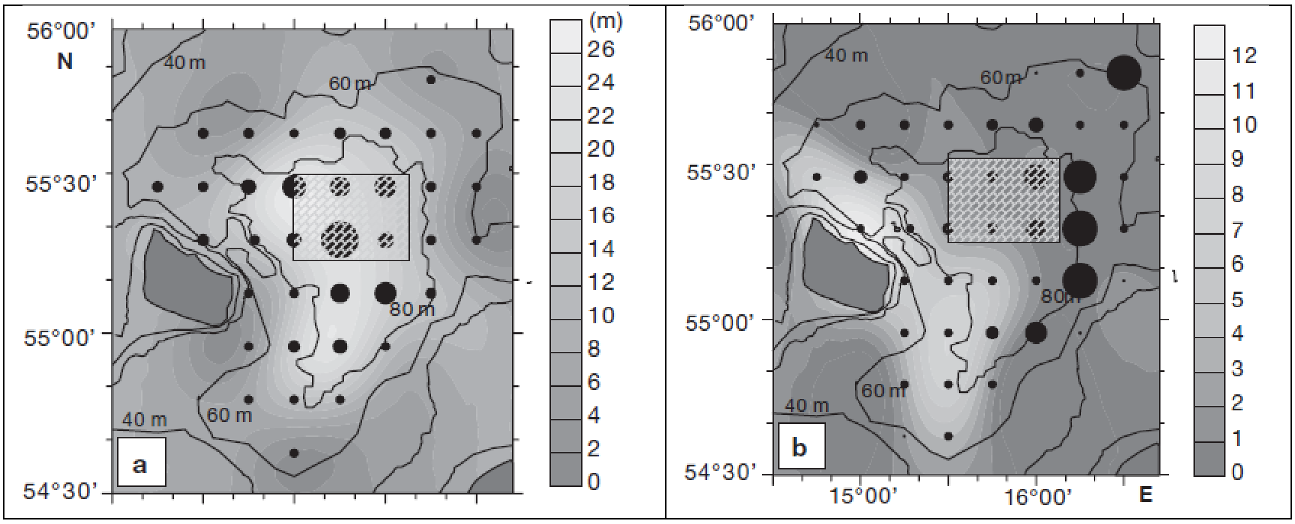

Fig. 6.8. "Cod water" thickness (m) and quantity of cod spawn in IA stage (n m-2) in Bornholm Basin: (a) in August 1991 and (b) in August 1999. The rectangle marks the area closed for fisheries in period of peak spawning in 1995-2003

6.1.2. Spawning grounds of flounder and plaice

Flounder – in the Baltic Sea there are two spawning populations – one which spawns in deep waters, and the other in areas of shoals [Plikšs and Aleksejevs, 1998]. In summer-autumn both populations migrate to coastal waters where they feed together [Nissling and Dahlman, 2010]. Flounders, which breed in the Bornholm Basin, head to Polish and German coasts, migrating westward along the coast to the neighbourhood of Rügen and eastward to the area of Cape Rozewie. From spawning grounds in the Gdańsk Deep flounders migrate along the coast to feeding grounds in the Gulf of Gdańsk or south of Bornholm [Aro, 1989]. There is a possibility that on the bottom of Słupsk Bank, bank flounders are spawning demersal spawn at the depths of 3-20 m [Bagge, 1981; Nissling and others, 2002]. In late autumn and early winter flounders start to migrate from the feeding to spawning grounds in the deepwater zone [Aro, 1989].

Plaice – in order to develop, the pelagic spawn of plaice requires water with relatively high salinity of 12.6-13.6 psu and temperature of 6-8°C [Gąsowska and others, 1962, Nissling and others 2002].

6.1.3. Outlet parts of rivers

One of the important achievements of evolution of water fauna (in particular ichthyofauna and cyclostomata) is the possibility of migrating. Migration enables an active choice of habitats with most favourable parameters, which allow realising basic functions needed for surviving – of individuals and of a whole species: procreating, feeding, resting etc.

Feeding migrations in the Polish part of the Baltic Sea basin to/from estuaries and/or lower parts of rivers are performed by most of the carp and perch fish and a part of marine species: herring, sea trout, salmon and flatfish.

Because of unfavourable anthropogenic changes of the inland water environment (pollution, hydrotechnic structures in watercourses, changed course of rivers. etc.) **the spatial range of both types of migrations and the quantitative participation of particular species in the migrations is undergoing very dynamic changes in recent years**. Because of that any attempt at even approximate assessment of the potential of estuarial parts of rivers to provide a living-space for bi-environmental fish and cyclostomata should be based on up-to-date and reliable scientific data.

In recent years such information was collected by the Department of Migratory Fish of the Inland Fisheries Institute to the order the Main Board of the Polish Angling Association, resulting in a detailed report on the ichthyofauna all rivers discharging directly into the Baltic Sea. However, the reports contain only highly aggregated data, which practically do not allow drawing conclusions on the significance of specific river mouths for bi-environmental fish. In order to obtain a complete picture of ichthyofauna living in these parts of rivers and full description the habitat (if such a description was at all made) application should be made to the holder of the data: Inland Fisheries Institute.

In case of the outlet part of the Vistula, practically there are no holistic data obtained by using scientific methods. Since the beginning of the XX century only a couple takes were made using rather incomparable methods. Some light on the significance of this part of the river as a communication corridor for ichthyofauna and bi-environmental lampreys may be shed by fisheries data, but their reliability is unsatisfactory. Summing up, the current state of knowledge does not allow proper defining of the significance of the Vistula mouth for each of the species of fish and lampreys.

6.1.4. Use of BIAS and BITS data

The aim of BIAS and BITS voyages is to acquire data for evaluation of resources of pelagic and bottom fish within the Baltic Sea. **On one hand, these data can be used for updating maps of feeding grounds of selected species, and on the other, they are an important information about areas that need to be taken into account when ensuring access to measuring stations and survey fishing in Polish sea areas for the purposes of monitoring and scientific research.**

BIAS

BIAS voyages (Baltic International Acoustic Survey) are aimed at acoustic evaluation of resources of pelagic fish. The acoustic survey is supplemented by pelagic control hauls (according to the methodology, at least two per ICES statistical square[53]) at fish concentration locations. On their basis species composition and biological characteristics are determined, which in turn are the basis for calculating the biomass of individual fish species.

Figs. 6.9 and 6.10 show the surface densities of biomass of herring and sprat calculated on the basis of data from a voyage in 2012.

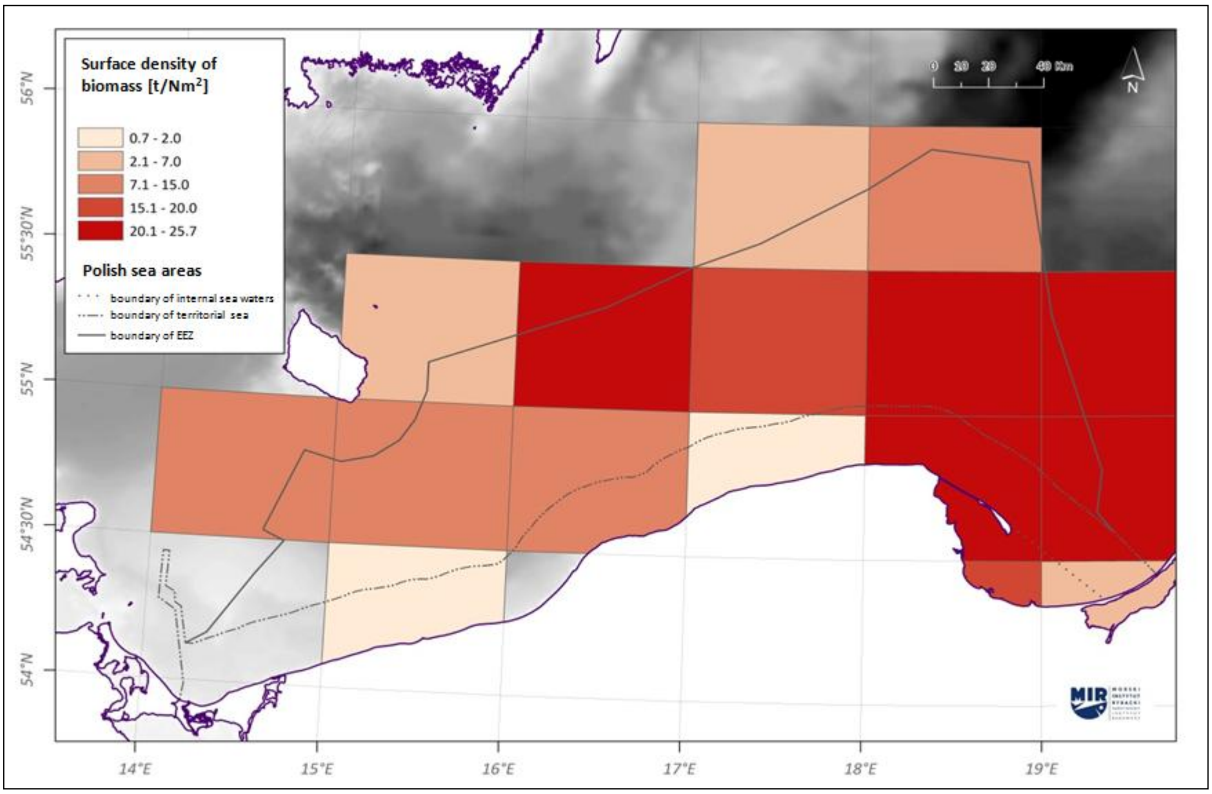

Fig. 6.9. Surface density of herring biomass in ICES statistical squares

[53] International Council for the Exploration of the Sea, http://www.ices.dk

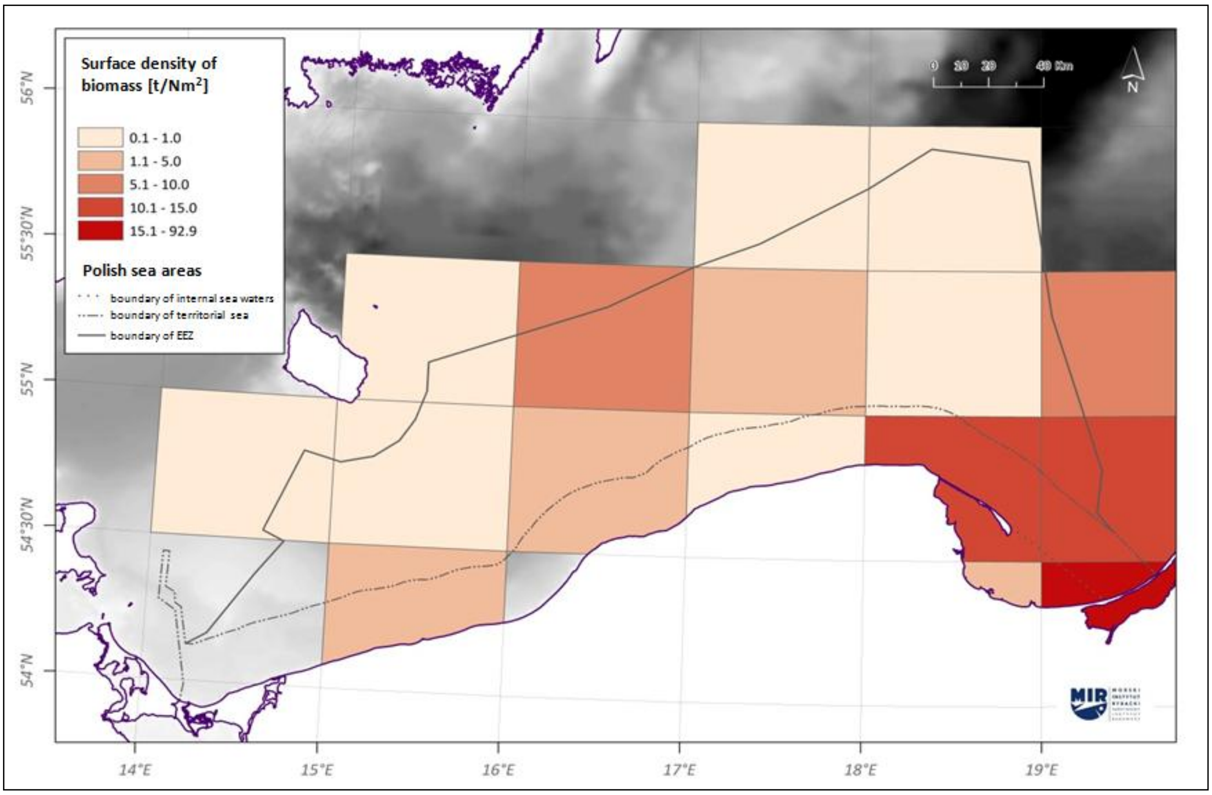

Fig. 6.10. Surface density of sprat biomass in ICES statistical squares

BITS

BITS voyages (Baltic International Trawl Survey) are aimed at evaluating the resources of bottom fish in the Baltic Sea and are conducted twice per year – in the first and fourth quarter.

The maps (Fig. 6.11-6.18) show CPUE – catch per unit effort in kg/0.5h in 2012 for four species: cod, herring, sprat and flounder, calculated basing on data obtained from all the States engaged in measurements in the Polish sea areas.

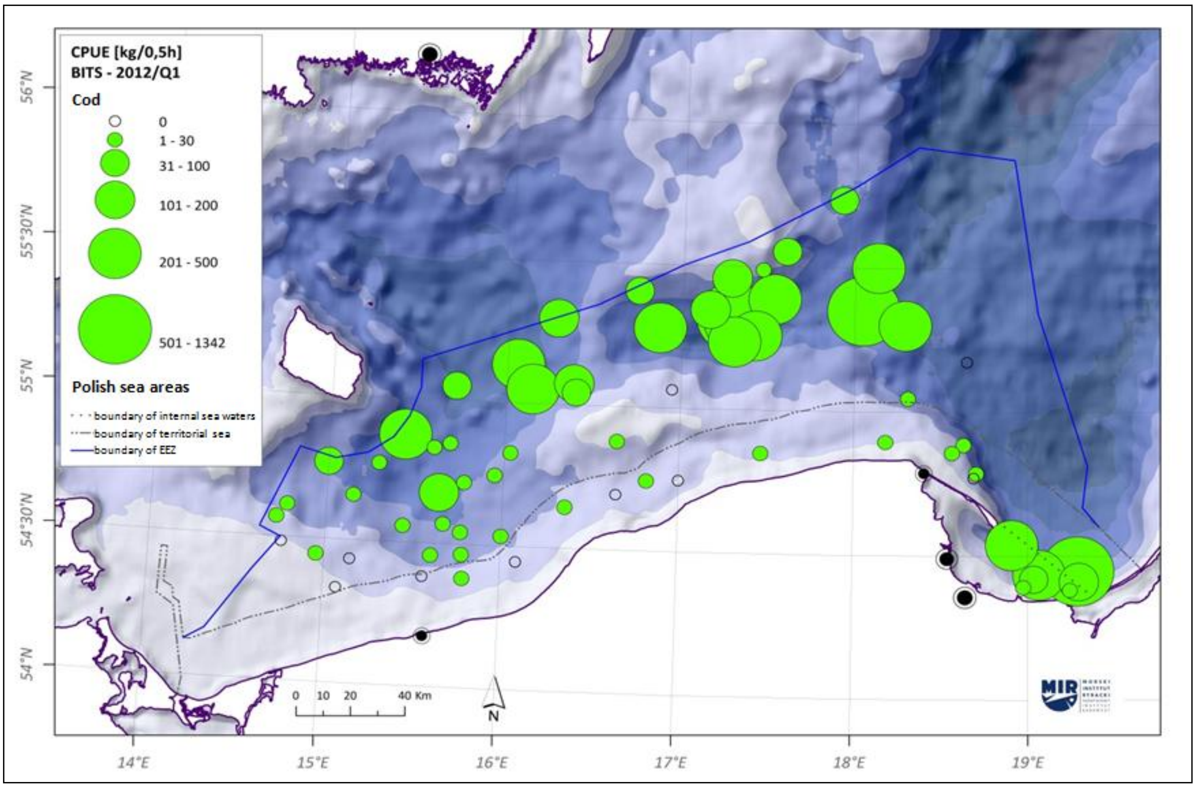

Fig. 6.11. CPUE [kg/0.5h] of cod during BITS voyage in the first quarter of 2012

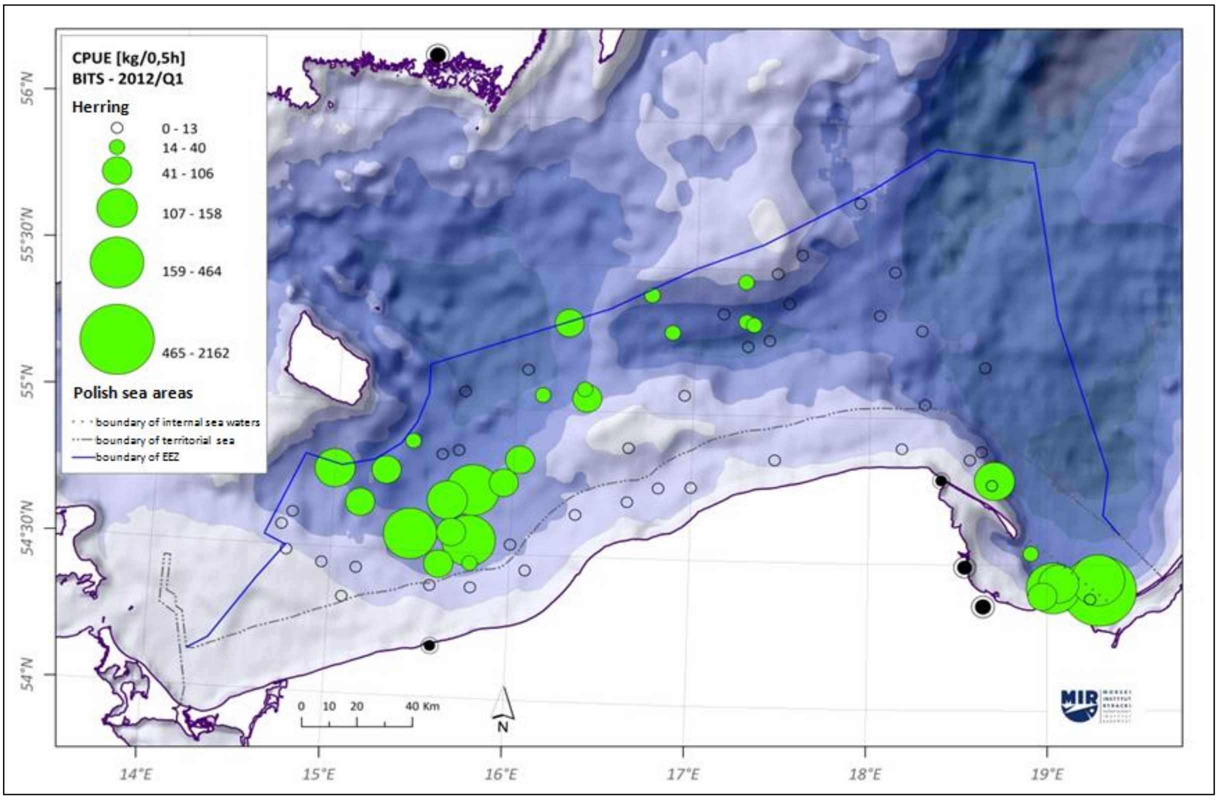

Fig. 6.12. CPUE [kg/0.5h] of herring during BITS voyage in the first quarter of 2012

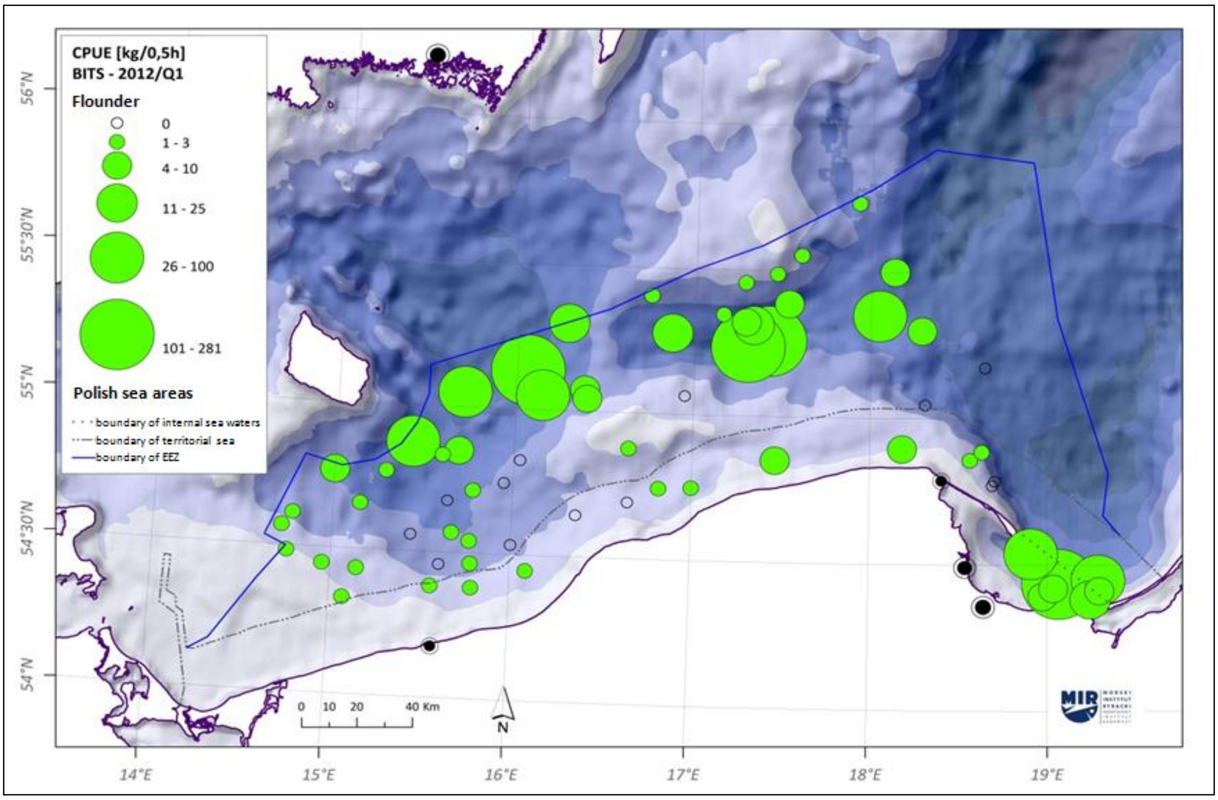

Fig. 6.13. CPUE [kg/0.5h] of flounder during BITS voyage in the first quarter of 2012

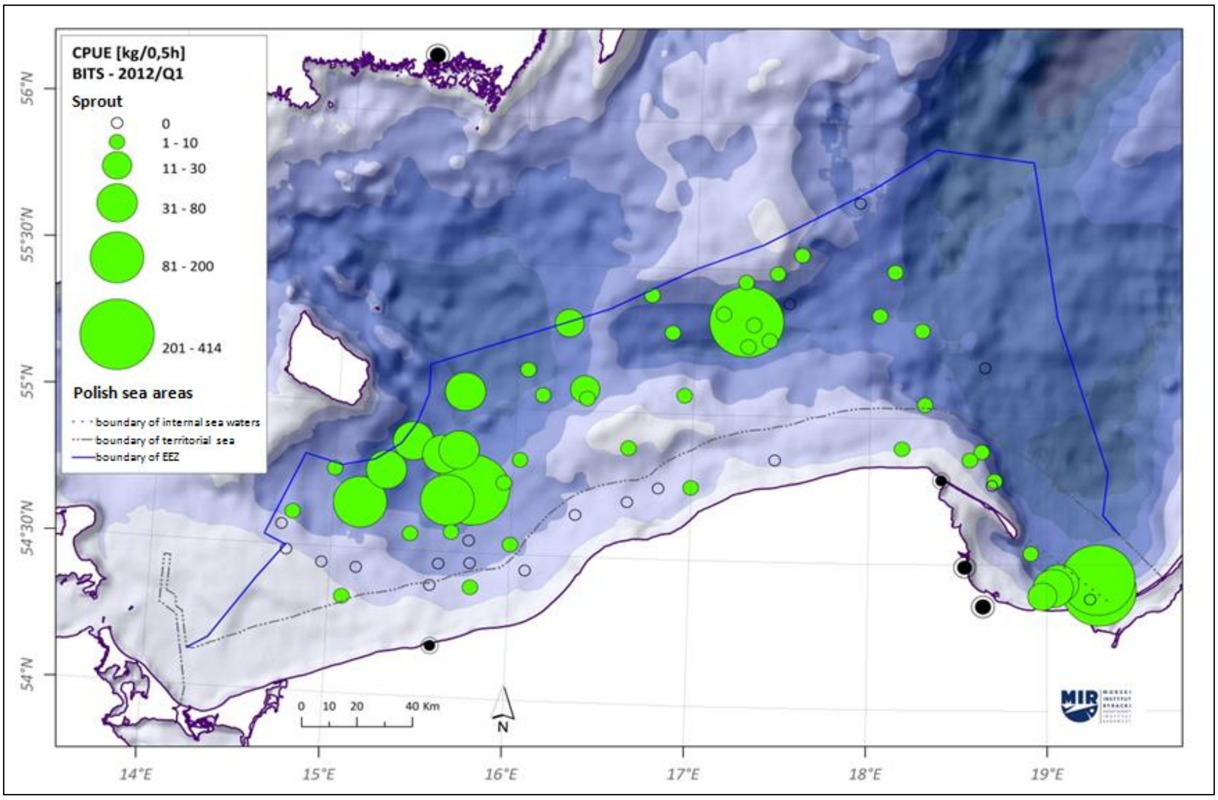

Fig. 6.14. CPUE [kg/0.5h] of sprat during BITS voyage in the first quarter of 2012

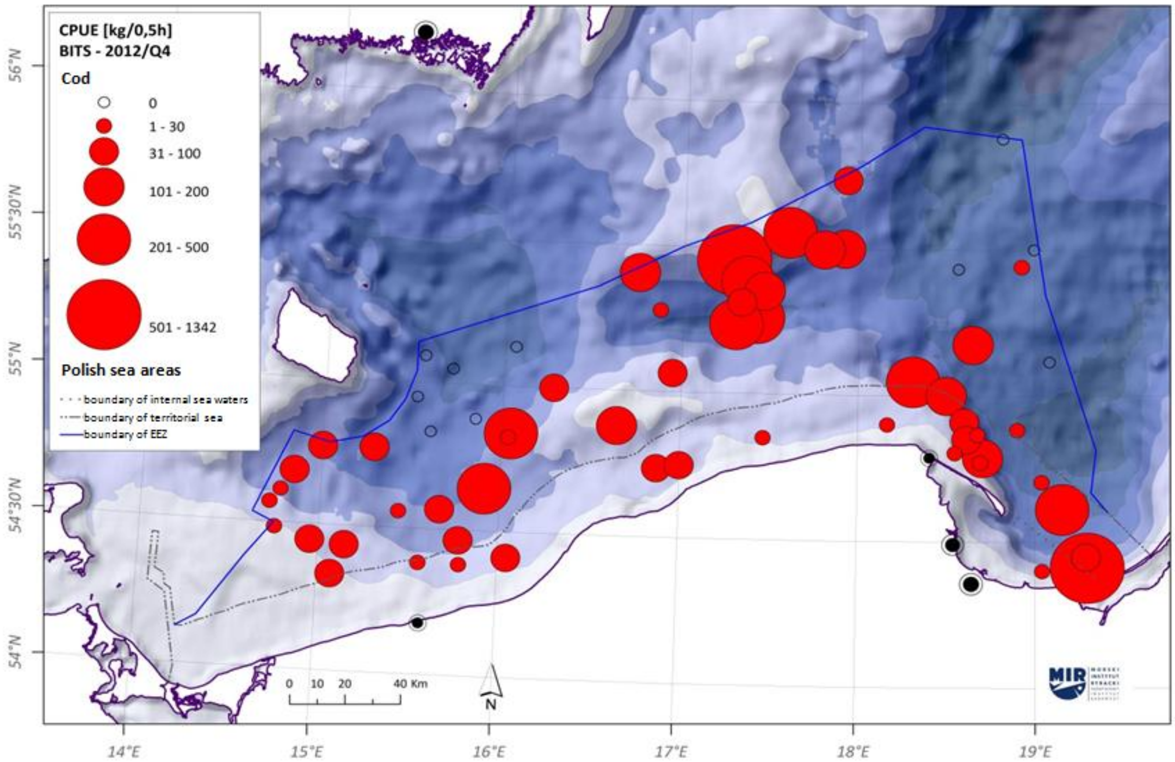

Fig. 6.15. CPUE [kg/0.5h] of cod during BITS voyage in the fourth quarter of 2012

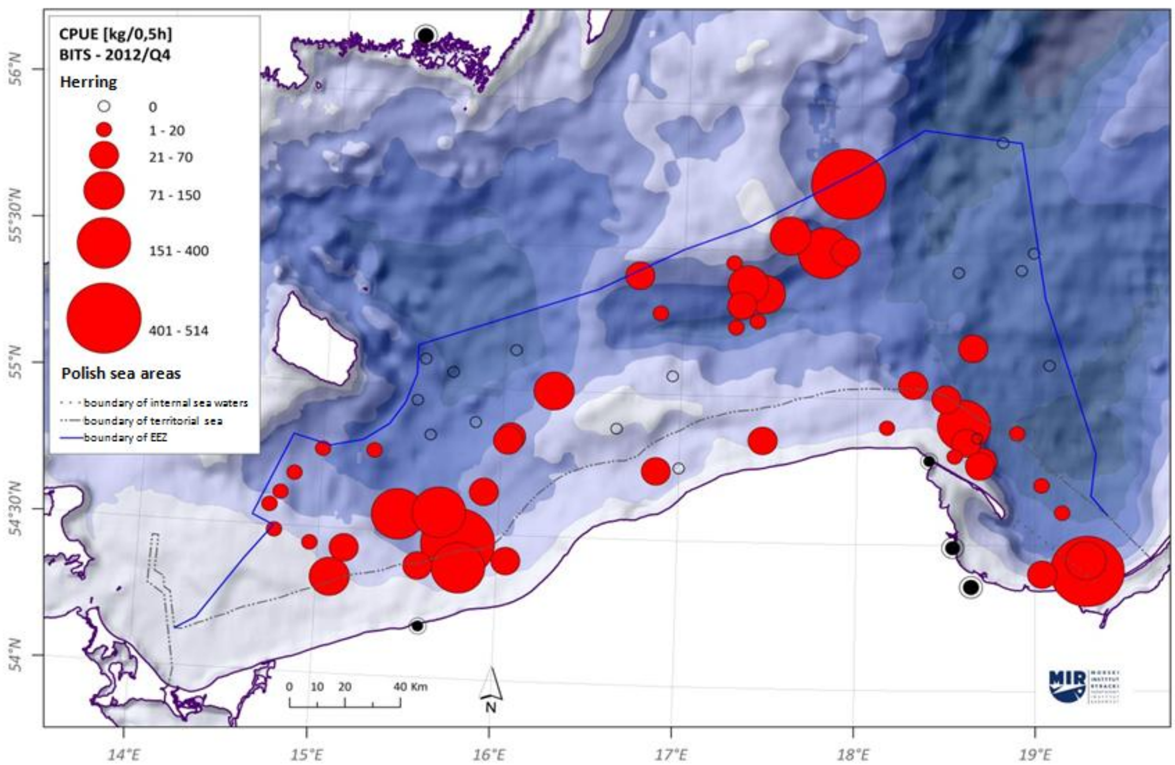

Fig. 6.16. CPUE [kg/0.5h] of herring during BITS voyage in the fourth quarter of 2012

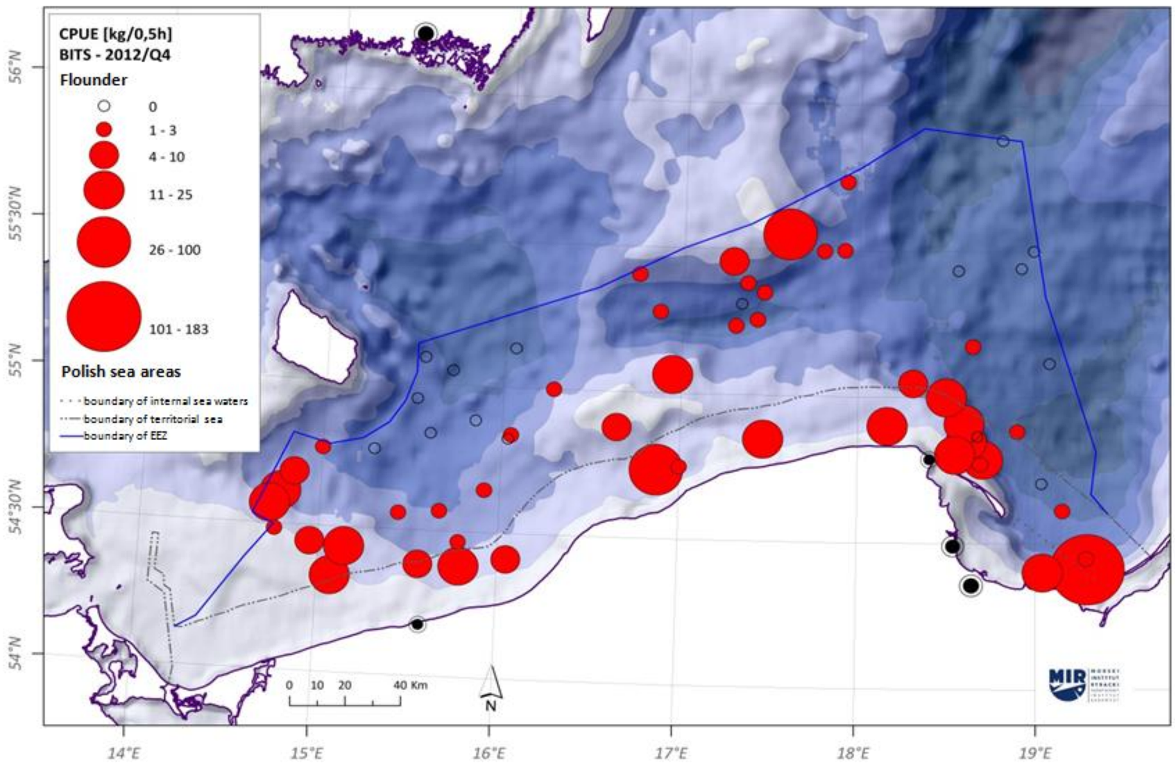

Fig. 6.17. CPUE [kg/0.5h] of flounder during BITS voyage in the fourth quarter of 2012

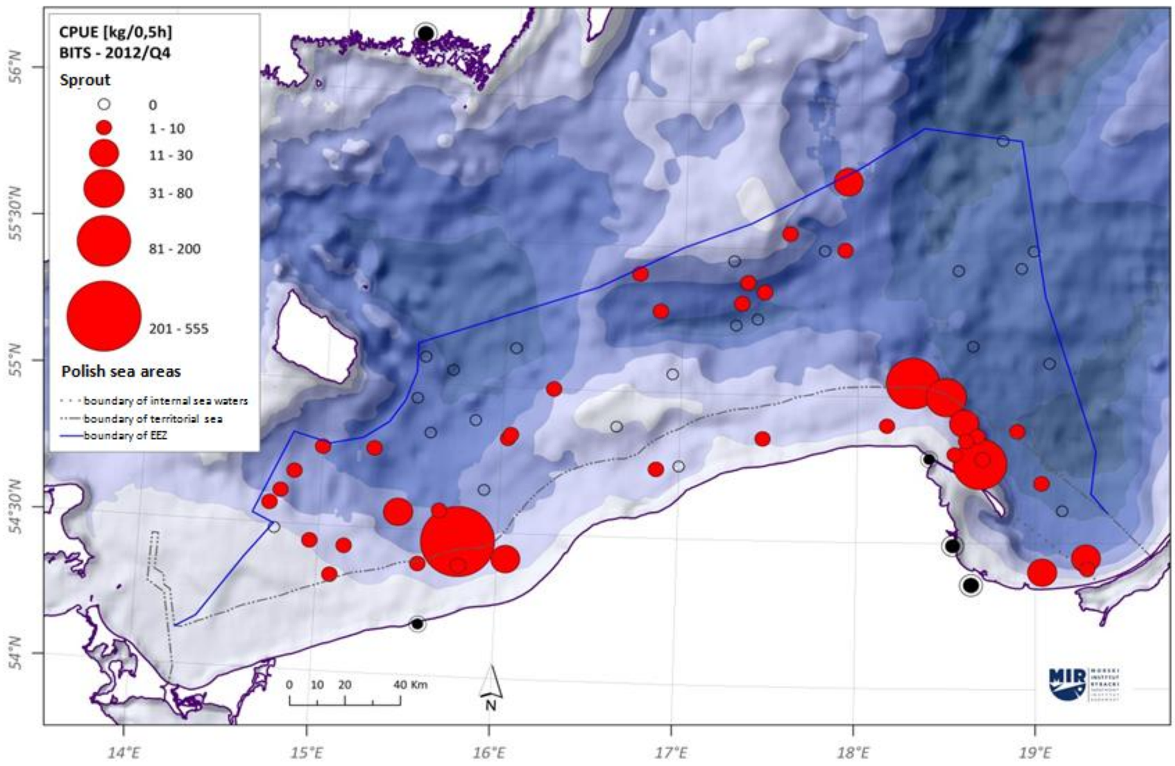

Fig. 6.18. CPUE [kg/0.5h] of sprat during BITS voyage in the fourth quarter of 2012

Protected species

Twait shad

During BITS voyages in the period 2009-2013 (until February), in 354 control hauls in the whole Polish EEZ, twait shad was recorded in 6 hauls (2% of the hauls), mainly (5 hauls) in the Gulf of Gdansk (in total 15 specimens) at a depth of 32-51m, and in one haul in the Słupsk Trough (one specimen 30cm long).

In 2009-2012, in the whole Polish EEZ, during BIAS voyages a total of 130 control hauls were made with a small-mesh, pelagic herring trawl and no presence of twait shad was found in the region of these investigations (Fig. 6.19).

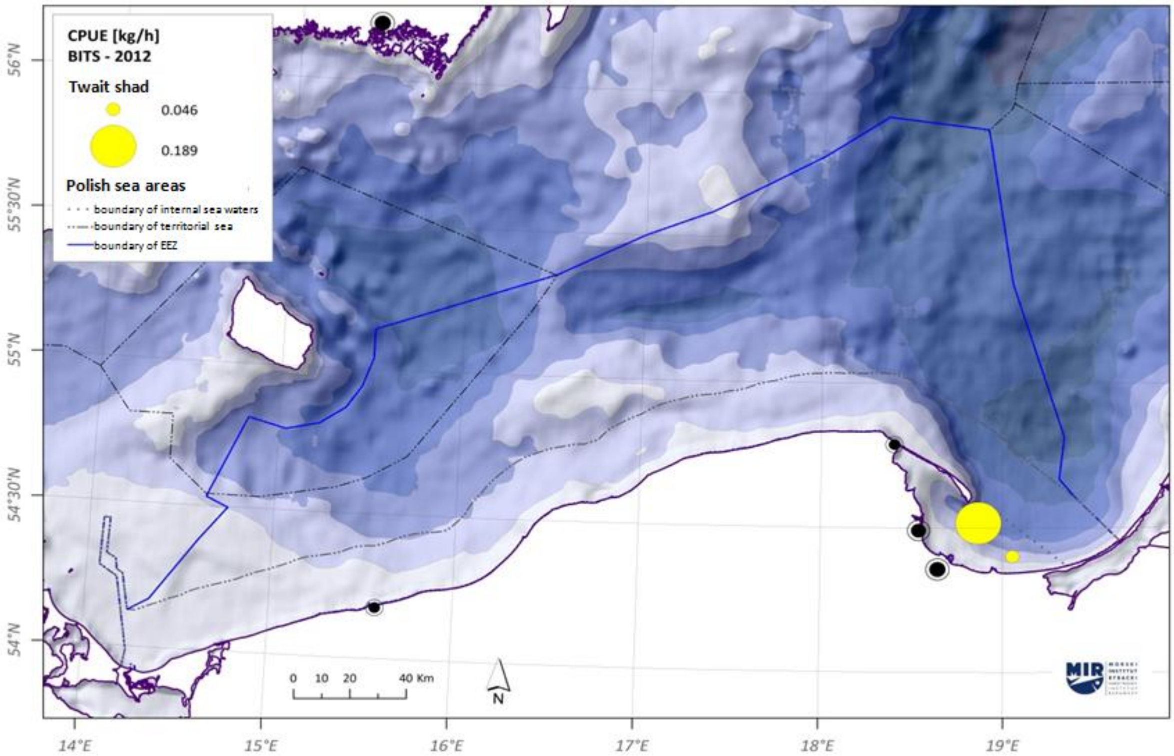

Fig. 6.19. CPUE [kg/h] of twait shad during BITS voyages in 2012

Conclusions for the maritime spatial plan of Polish sea areas

- In the process of determining areas with special importance for reproduction of fish species with pelagic spawn, having high economic importance, such as cod or sprat, the large temporal and spatial variability of both the spawning and its effects should be taken into account.
- In case of spawning of most fish species with pelagic spawn, there is no method to determine precisely the area of reproduction (sprat case). In such a situation, effective reproduction can only be achieved by ensuring that the size of the areas in which activities with negative impact on recruitment of a species is expected will constitute an insignificant portion of the spawning area.
- Effective spawning of cod of the eastern herd takes place in the waters of Bornholm Deep and Słupsk Trough, approximately within an area limited by the 60m depth contour. However, also in this case a significant spatial and temporal diversity in the distribution of spawn and larvae is observed.
- Migration routes to/from lower sections of rivers, in that outlets of water-courses and rivers, should be protected.

Knowledge gaps – recommendations

- An in-depth analysis of locations and conditions facilitating effective fish spawning should be carried out with the aim of ensuring the necessary space, and possibly, in face of the variable environmental conditions, determining the conditions for updating such delimitation.
- Migrations in the outlet sections of rivers have been subjected to very dynamic variation in the last few years. Assessment should be based on as recent and reliable data as possible. Such data, if they exist for a given water course, are in the possession of the Inland Fisheries Institute.
- Long-term data from BITS and BIAS voyages can be used for updating the maps of occurrence of selected species; they are also important information about the areas which need to be taken into account when ensuring access to measuring stations and survey fishing in the Polish sea areas for the purpose of monitoring and scientific research.

6.2. Fisheries

In Poland, rules of conducting fishing activities are contained in the Act on *fisheries* of 19th February 2004 (JoL no. 62, pos. 574) adopted by the Polish Parliament before accession to the EU. After accession, the Act was amended several times (JoL no. from 2005, no. 96, pos. 807; from 2006,no. 220, pos. 1600; from 2007, no. 21, pos. 125; from 2009, no. 18, pos. 97, no. 92, pos. 753, no. 168, pos. 753, no. 168, pos. 1323; from 2001, no. 34, pos. 168, no. 106, pos. 633, from 2014, pos. 822) in order to fulfil requirements of the Joint Fishery Policy.

The Act indicates the scope of tasks, the competence of authorities and mode of conduct in the following issues:

- granting rights for fishing,
- rational execution of fishing, including protection of live resources of the sea,
- control and supervision of fishing activities.

Currently work on a new Act on *fisheries* is progressing. Introduction of the new Act is planned for the beginning of 2015.

According to the provisions of the currently in force Act, conducting of fishing in the territory of Poland (internal sea waters and territorial sea) may be executed only by Polish fishing vessels which have a fishing license and a special fishing permission. The waters of Polish EEZ are from 1st of May 2004 open to foreign vessels.

Conducting of sea fisheries may be executed from a fishing vessel listed in the fishing vessels' register, having a fishing license and special fishing permission. Catch potential of the fleet, or its specific section, limits the registration of new vessels. Registration in the fishing vessels' register results in giving the vessel an identification number and fishing badge indicating its home port. The license is issued at the request of owner of the fishing vessel for an unlimited period of time. The Minister competent for fisheries may refuse issuing a license or cancel it in cases indicated in the Act.

In each calendar year, it is additionally required to obtain a special catch permission, in which the ship owner indicates species of fish he intends to catch, the area of conducting catches, the type of catch instruments and requested fishing limit in case of species, the catch of which is in that way limited.

The Act also provides, pursuant to the EC Regulation no. 1224/2009, the method of reporting of catch depending on total length of a fishing vessel:

- for fishing vessels of total length smaller than 10 m – monthly catch reports,
- for fishing vessels of total length equal to or longer than 10 m – catch diary in which, in a daily cycle, data required by EU regulations are registered - pursuant to the EC Regulation no. 1224/2009 (art. 14 point 1) as well as loading and unloading declarations (art. 21 point 1 and art. 23 point 1),
- for fishing vessels of total length equal or longer than 12 m – pursuant to the EC Regulation no. 1224/2009 (art. 15 point 1) electronic catch diary (ERS), which has been tested and adopted in Poland in 2012. Fishing vessels of total length equal to or longer than 12 m are also subject to satellite monitoring of fishing vessel position (VMS).

Catch diaries and monthly reports contain int. alia:

- number and species of marine organisms caught,
- area of catch to an accuracy of statistical catch square (Fig. 6.20),
- number of catch operations during each day,
- number of fishing tools used,
- time of catch

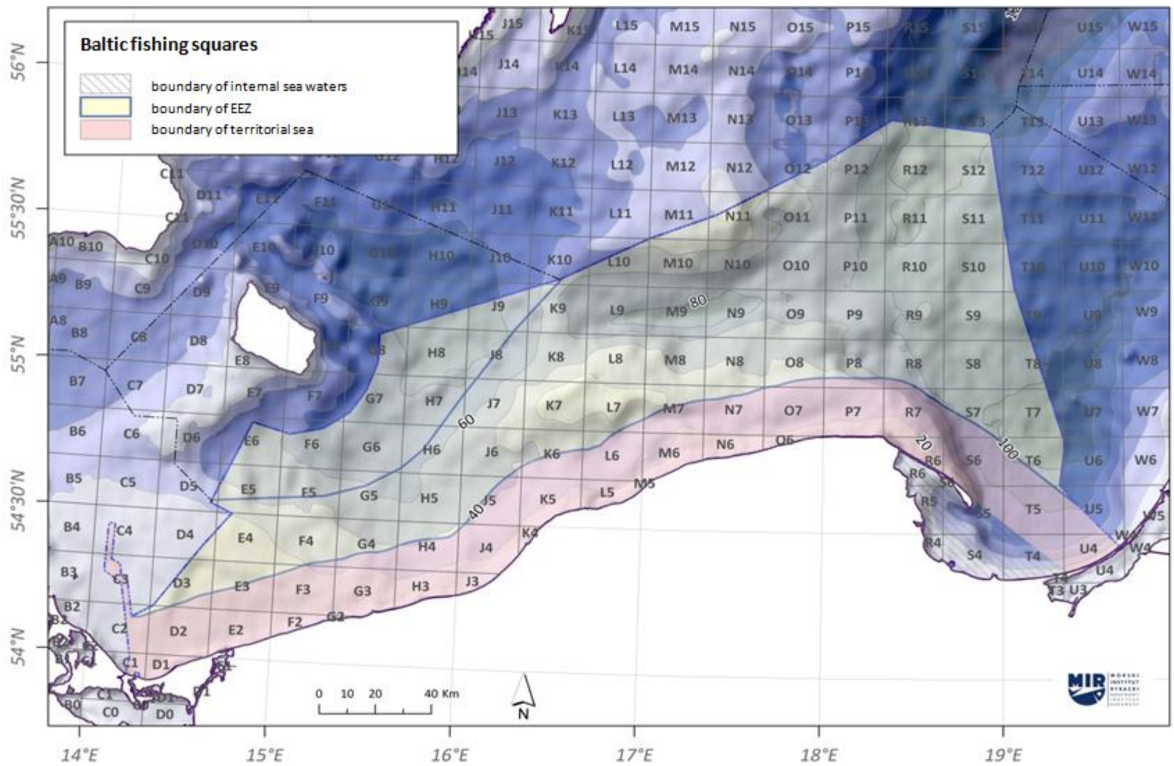

Fig. 6.20 Baltic fishing squares

The monthly catch report should be filled by the ship operator of a fishing vessel within 24 hours after returning from the fishing ground (art. 42 point 3). After the final fishing expedition during a given month, and not later than by the 5th of the next month, the report must be delivered to the Sea Fishery District Inspector competent for the mother port of the fishing vessel. Original pages of catch diaries also must be delivered to the Sea Fishery District Inspectors not later than 48 hours after end of fishing operation. These data are input into the Marine Fisheries Information System (MFIS) in the Fisheries Monitoring Centre (FMC) in Gdynia. FMC is a unit of the Fisheries Department of the Ministry of Agriculture and Rural Development. It has been created in 2003 and it performs its statutory functions since 1st January 2004. The obligation to create Fisheries Monitoring Centres was imposed by EU law.

In theory, data collected in the FMC should allow to assess the location of fishing effort per kind of fishing tool and species, with accuracy to a statistical fishing square. I**n many cases this is a too low resolution for the needs of maritime spatial planning of Polish sea areas**. There are also problems with recording of data by ship operators (in particular in case of monthly catch reports), of which one should be aware when analysing the data:

- area of catch – the division into statistical fishing squares is insufficient for distinguishing whether a given vessel was fishing in internal sea waters. This problem concerns the following statistical fishing squares:
  - T4, U4, W4, W5 – Vistula Lagoon/ Gulf of Gdańsk,

    Catch obtained from the Vistula Lagoon should be recorded with the additional mark "ZW" (eg. BW4ZW); however, detailed analysis of catch composition and verification of actual area of fishing carried out at the District Inspector's office showed that information in the database should be corrected.

- C1, D1, E2 – Szczecin Lagoon and neighbouring waters/Pomeranian Bay

  Catch obtained from the Szczecin Lagoon and neighbouring waters should be recorded with an additional mark (eg. BC1ZS or BC-1); however, verification showed that information in the database should be corrected.

- R6, S5, S6 – Puck Bay/coastal waters of open sea

  Catch obtained from the Puck Bay should be recorded with additional an mark (eg. BR6GD) but again verification showed that information in the database should be corrected.

• quantity of fishing gear – especially data on the number and kind of gill nets (GNS) which should be the basis for assessing the size and distribution of fishing effort may be incorrect. The biggest permissible number of GNS used at one time in the territorial sea is determined in the regulation of the Minister of Agriculture and Rural Development of 4th March 2008 on *dimensions and protection periods of sea organisms and detailed conditions of performing sea fishing* (JoL no. 43, pos. 260).According to par. 9, the number cannot exceed:
  - 100 pieces - for fishing vessels of total length smaller than 12 m,
  - 200 pieces – for fishing vessels of total length from 12 to 18 m,
  - 300 pieces – for fishing vessels of total length over 18 m.

In the FMC database for 2012 the minimum number of GNS type fishing tools used at one time is one piece, and maximum is 40,330. Setting one gill net is possible, especially in case of smaller vessels, but records showing more than 300 are most probably an error in recording of the data. In the FMC database for 2012, 670 entries were found with number of nets exceeding 300, including 27 with number of tools of over 1000. All should be verified and corrected, because analysis of distribution of fishing effort based on the FMC database will be incorrect.

6.2.1. Possibility of making FMC analysis more detailed – use of VMS data

VMS (Vessel monitoring system) collects since 2000 data on activity of a significant part of the European fishing fleet. The system provides at regular intervals information about location, speed and course of vessels. At present VMS system is an international standard for monitoring fisheries. EU law obliges all coastal States to implement compatible VMS systems. The range of vessel lengths required to be included in the system was extended over the years from at least 24m in 2000 to equal and over 12m since 1st January 2012.

Data for 2011-2013 show that nearly ¼ of fishing vessels is obliged to use VMS, but, what is most important, this part represents approximately 80% of fishing capacity assessed on the basis of tonnage (GT) and over 60% on basis of engine power (kW). Summing up, presently accurate monitoring covers **89% of the catch.**

These are vessels operating mainly in the EEZ, i.e. their activity remains in potential conflict with location of such investments as artificial islands/wind farms.

Fishing effort and size of catch

Apart of its basic function (monitoring and control), VMS provides also information about the distribution in space and time of the catch effort. Analysis of VMS data together with information from catch diaries allows preparing so-called activity profiles of fishing vessels, taking into account the type of fishing tool. Defining the kind of activity is an important element of work with data, since VMS signals do not contain information allowing connecting them directly with a given fishing operation. Analysis of data from several years has shown some regularities in the distribution of vessel speed for particular tools, and in consequence it is possible to analyse the data separately for each tool. The most distinct differences may be observed when comparing active tools (e.g. bottom or pelagic trawl) with passive tools (e.g. gillnets).

By connecting VMS data with data contained in fishing diaries it is possible to carry out analyses of catch size and value at high spatial resolution. Analyses using VMS data have a significant advantage over analyses based on raw administrative data, in which the smallest spatial unit is the statistical fishing square (dimension 0.333 x 0.167 degree) or the ICES square (dimension 1 x 0,5 degree).

In Figs. 6.23-6.39 are presented results of an analysis of VMS data for 2012. Because of the increasing need of standardisation of data, the calculations were made on a "C-squares" grid of 0.05 degree resolution used by FishFrame and recommended by the ICES Working Group on Spatial Fisheries Data. The drawback of such a solution, which should be taken into account when interpreting the data, is the non-uniformity of space of the squares. Of course, this problem appears always when divisions are based on a geographical grid, therefore, in some cases, the analysis should be carried out per space unit.

Adoption of the "C-squares" grid allows more detailed identification of the place of a fishing operation, narrowing the location of the fishing vessel to a 6 x 3 km rectangle (18 km^2). This is a 20 times higher accuracy than currently achievable for Baltic statistical fishing squares, the dimension of which is approximately 20 x 20 km (surface of ca. 400 km^2). Analysing the usefulness of such detailed information (about the place where the fish were caught) it should be remembered that fishing vessels during a fishing operation defined by the time and place of setting and hauling in nets can cover significant distances. In case of set gear the distance between the beginning and the end of the nets may be even 21 km[54], whereas the trawling distance by vessels using bottom trawls may be even 40-50 km. According to EU law the skipper is obliged to report the area (statistical square), in which the majority of catch was performed. Ipso facto, even in case of doing a haul, e.g. in area of two or three Baltic squares, all the caught fish will be assigned only to one of them. Using information available from VMS enables more precise location of activities of the fishing vessel, though it still will be an approximation because accurate position is measured once in ca. 2 hours.

Such information is undoubtedly useful for assessing the influence of investments which take up only a small part of a Baltic fishing square within which fishing activities are noticeably spatially diversified e.g. due to significant differences in type of bottom or depth. A good example, illustrating such a situation, is fishing square M9 in the Słupsk Trough area. As is shown in Figs 6.23 and 6.24 illustrating fishing activities, the fishing effort and catch in this square are concentrated in its deepest, central and south parts. A clear relationship between the depth and intensity of exploitation is visible for active tools, and is connected with intense activities of vessels conducting targeted fishing for cod

[54] According to Council Regulation (EC) no. 2187/2005 – concerns fishing vessels of total lenght over 12 m

by using bottom trawls in deepest waters. VMS information is also used for squares divided by spatial barriers such as e.g. the Hel Peninsula, where catch is reported jointly for the Puck Bay and the external part of the Gulf of Gdańsk, and additional marking by adding GD is unreliable (Fig. 6.21 versus Fig. 6.24).

It should also be remembered that because only a part of the fishing fleet is in the VMS system, not all fish species can be included in the analysis of catch location. On the basis of data from catch diaries and reports (e.g. for 2012 – Table 6.1.) it can be concluded that the analysis should not cover species, which are mainly fished by vessels shorter than 12 m, which are not covered by the VMS system. Maps of fishing effort distribution for vessels of length up to 12 m and over 12 m (Figs.6.21 and 6.22) clearly show that the fishing effort of vessels covered by the VMS system is not the most important in the coastal zone, even though the main part (in tons) of the total catch in the Polish sea areas is caught by vessels controlled by VMS. Fishing in the coastal zone is performed mainly by smaller vessels, and the importance of this segment of fisheries results not just from the size of catch, but also from other values, and in consequence this zone should be a subject of a separate analysis.

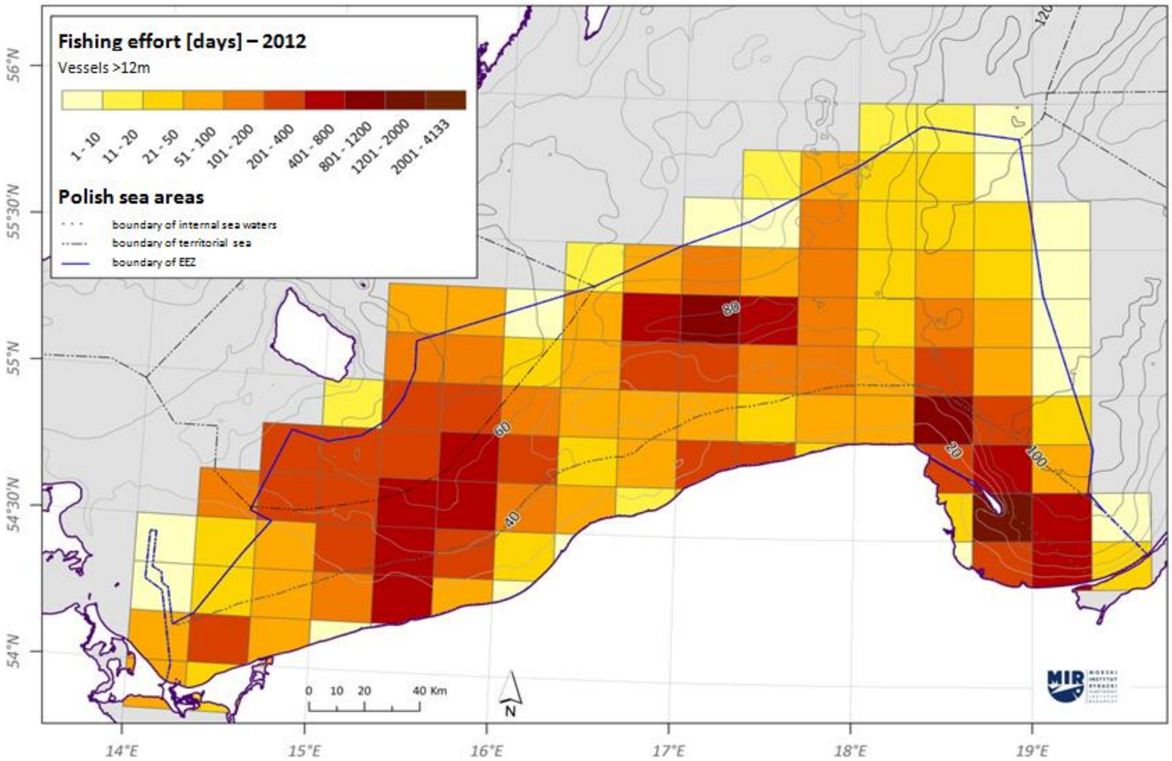

Fig. 6.21 Fishing effort in 2012 – vessels > 12 m

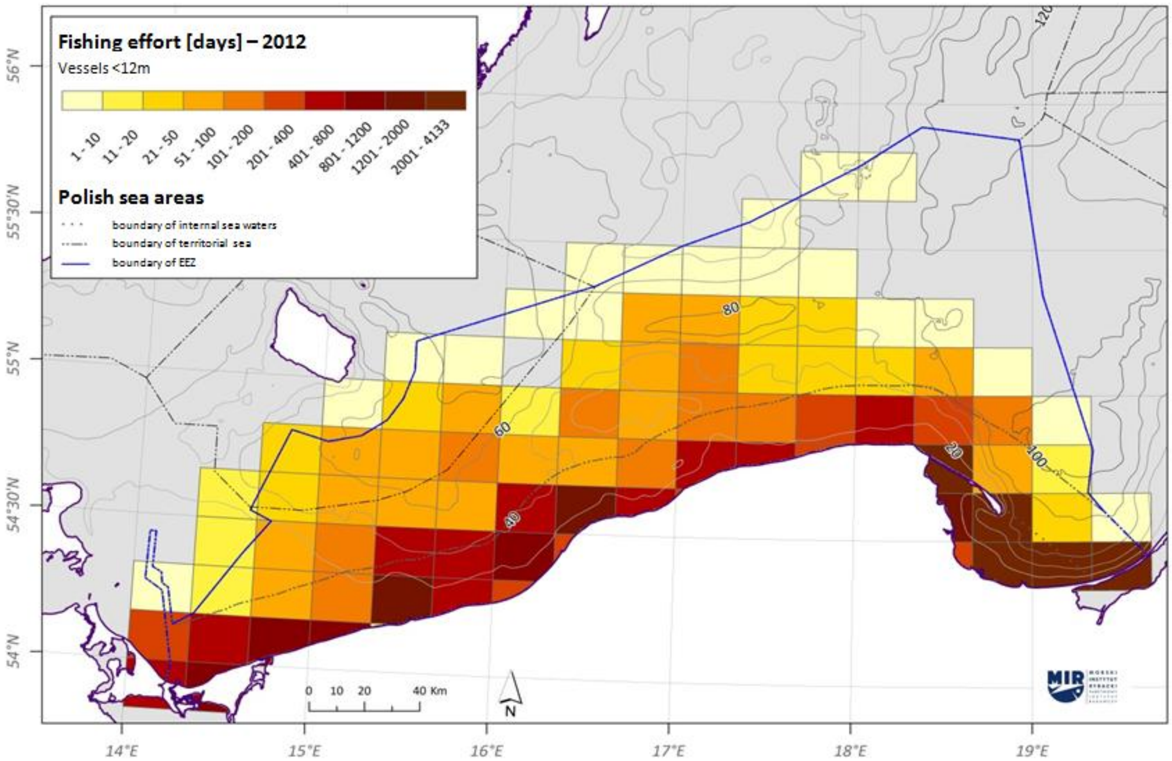

Fig. 6.22 Fishing effort in 2012 – vessels < 12 m

Table 6.1. Catch [t] in 2012

(green - analyse with VMS data, red – do not analyse, blue – according to expert assessment)

Species	Vessels not covered by VMS (less than 12 m)	Vessels covered by VMS (at least 12 m)	Total	% of catch by at least 12m vessels
Bream	544.9		544.9	0.0%
Silver bream	30.9		30.9	0.0%
Eel	30.8		30.8	0.0%
Ziege	28.7		28.7	0.0%
Garfish	26.3		26.3	0.0%
Crucian	16.2		16.2	0.0%
Burbot	13.1		13.1	0.0%
Pike	12.3		12.3	0.0%
Sea fish not elsewhere identified	8.4		8.4	0.0%
Smelt	6.9		6.9	0.0%
Tench	6.6		6.6	0.0%
Other	4.5		4.5	0.0%
Catfish	2.7		2.7	0.0%
Asp	2.2		2.2	0.0%
Ruff	1.2		1.2	0.0%
Gobies	0.7		0.7	0.0%
Eelpout	0.2		0.2	0.0%
Carp	0.2		0.2	0.0%
Cert	0.1		0.1	0.0%
Roach	641.5	**2.6**	644.1	0.4%
Pike perch	299.8	**8.1**	307.9	2.6%
Rainbow trout	3.4	**0.2**	3.5	4.6%
Perch	929.1	**67.4**	996.5	6.8%
Whitefish	21.7	**1.8**	23.5	7.5%
Turbot, brill	50.2	**16.0**	66.2	24.1%
Sea trout	46.1	**56.9**	103.0	55.2%
Flounder	4,106.1	**5,983.1**	10,089.3	59.3%
Plaice	18.5	**45.3**	63.8	71.0%
Cod	3,830.6	**11,013.2**	14,843.8	74.2%
Mackerel	0.0	**0.1**	0.2	76.1%
Atlantic Salmon	6.7	**23.3**	30.0	77.8%
Herring	3,558.0	**23,556.4**	27,114.4	86.9%
Whiting	0.1	**21.3**	21.4	99.6%
Sandeel	3.2	**2,335.5**	2,338.7	99.9%
Sprat	13.4	**63,105.7**	63,119.1	100.0%
Final total	**14,265.3**	**106,236.8**	**120,502.1**	**88.2%**

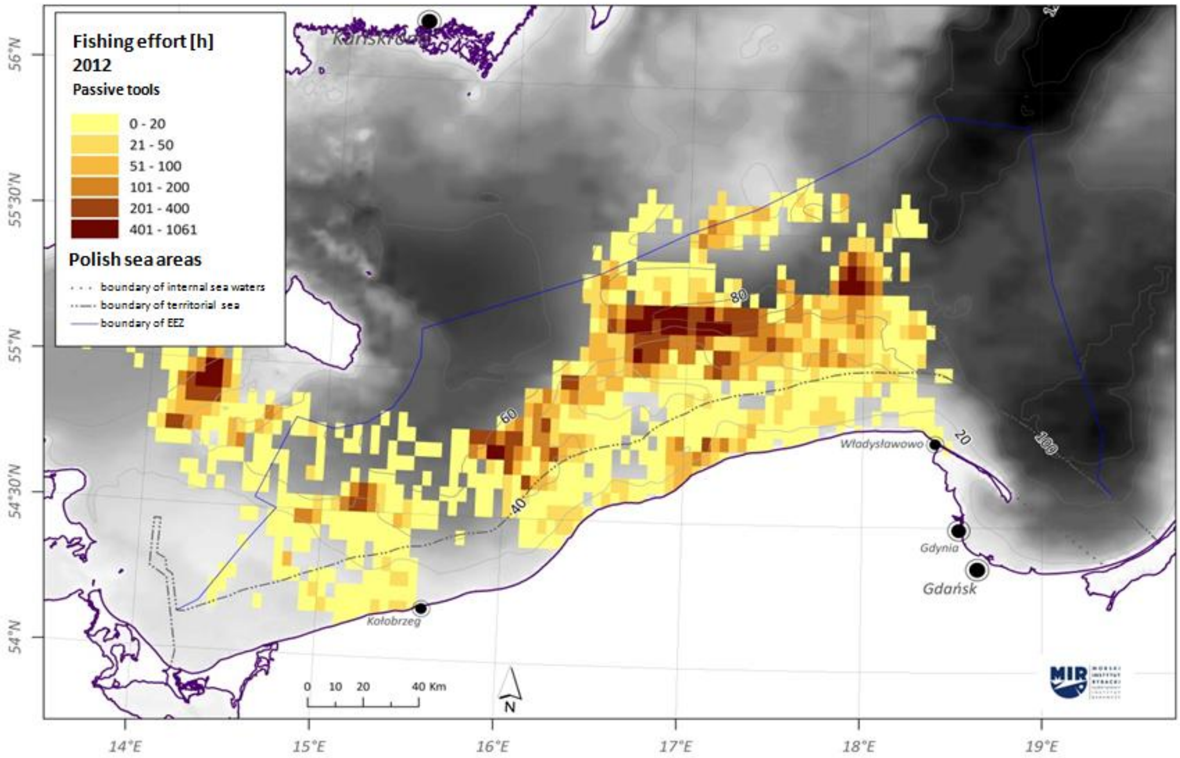

Fig. 6.23 Fishing effort by VMS in 2012 – passive tools

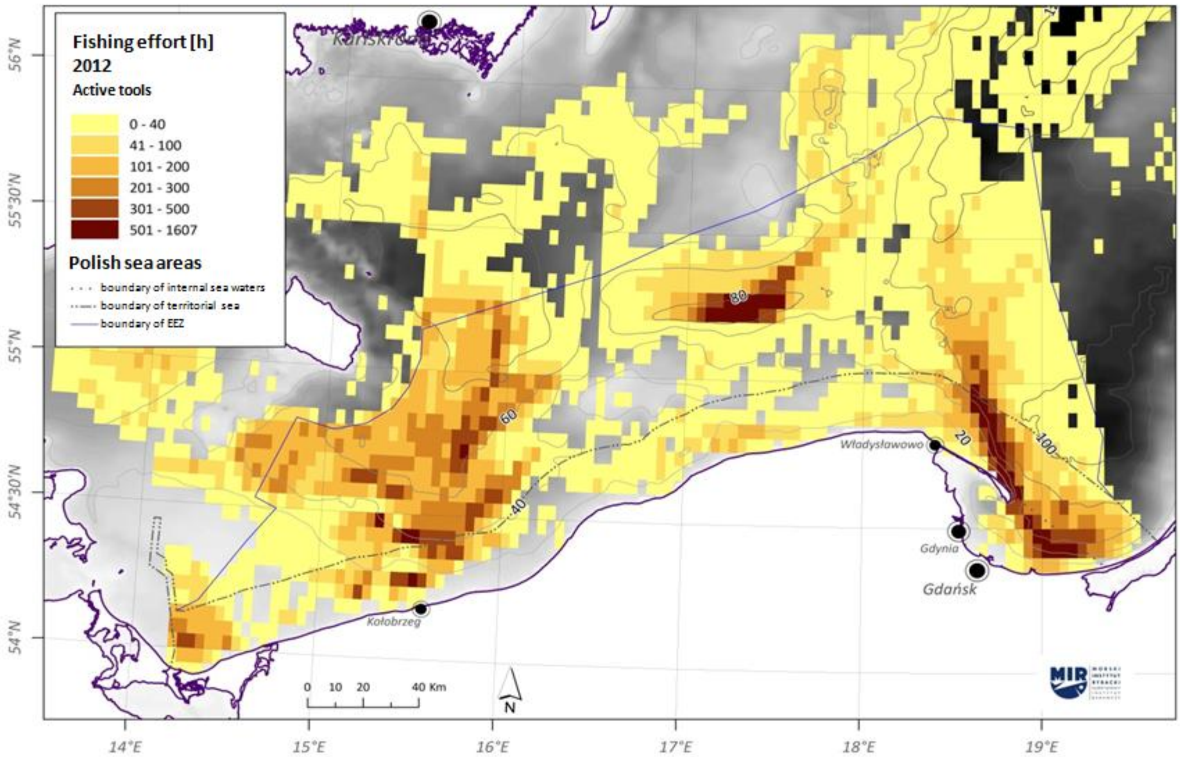

Fig. 6.24 Fishing effort by VMS in 2012 – active tools

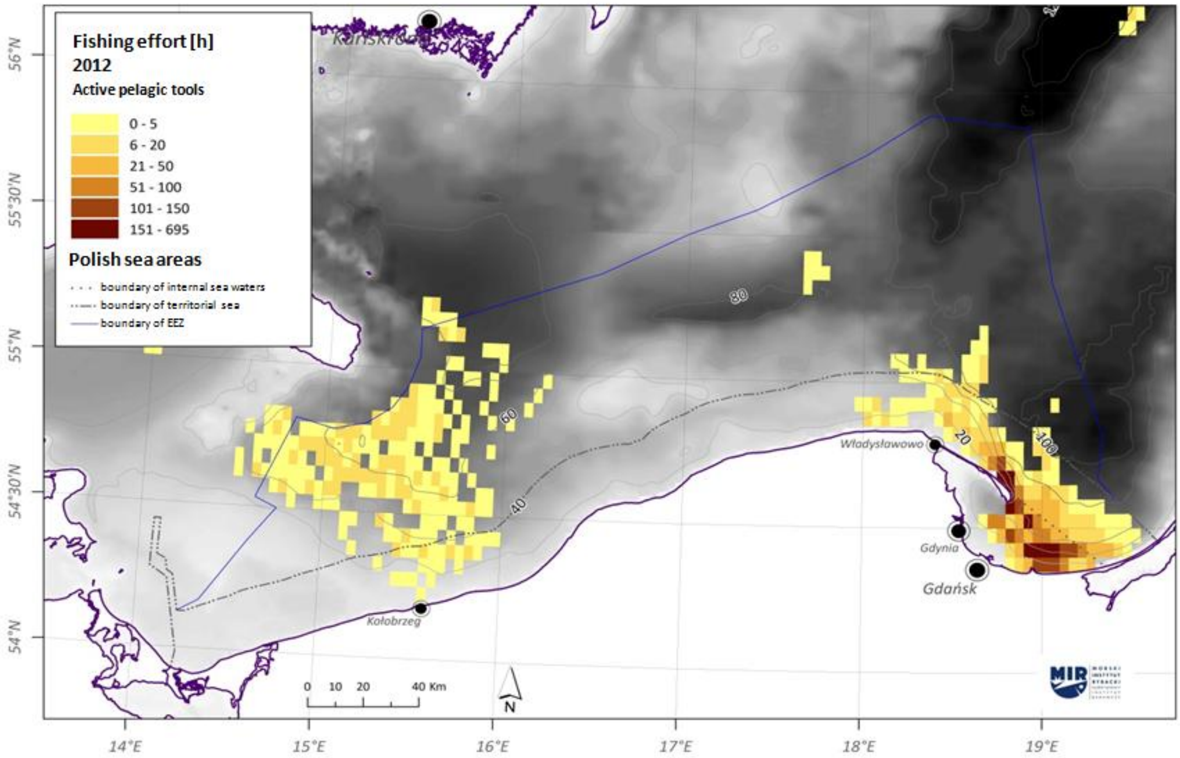

Fig. 6.25 Fishing effort by VMS in 2012 – active pelagic tools

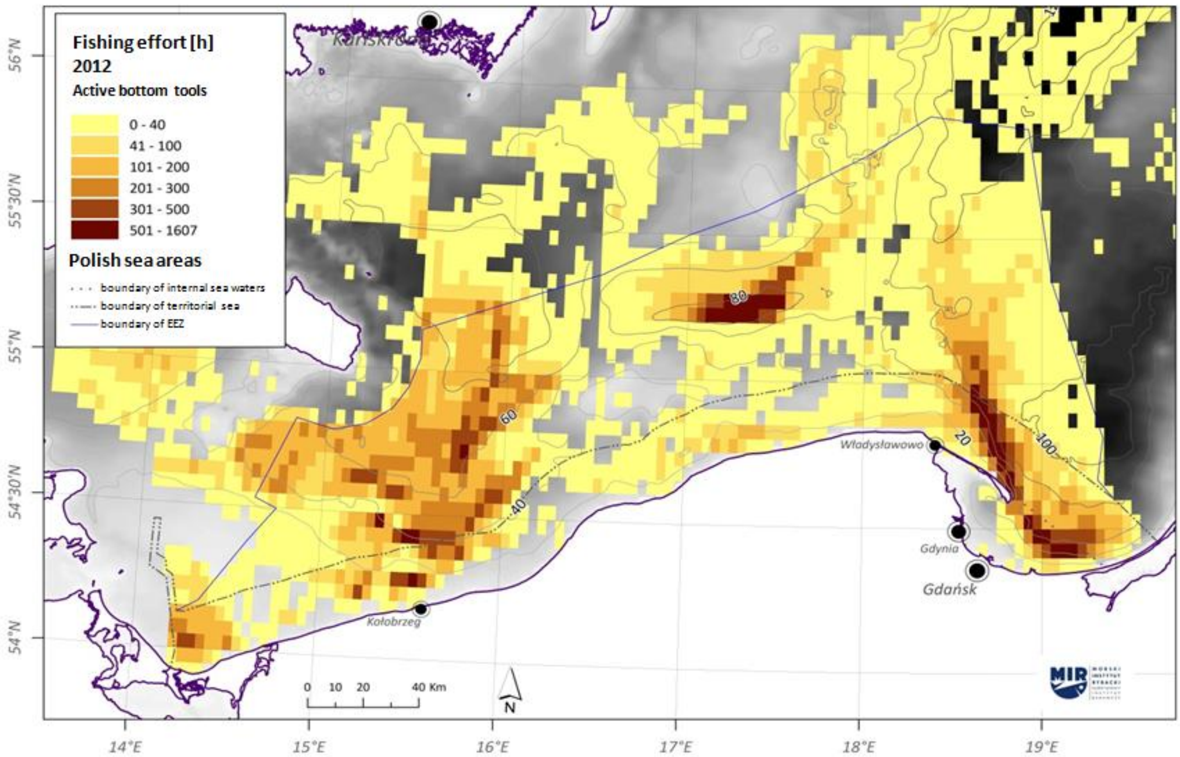

Fig. 6.26 Fishing effort by VMS in 2012 – active bottom tools

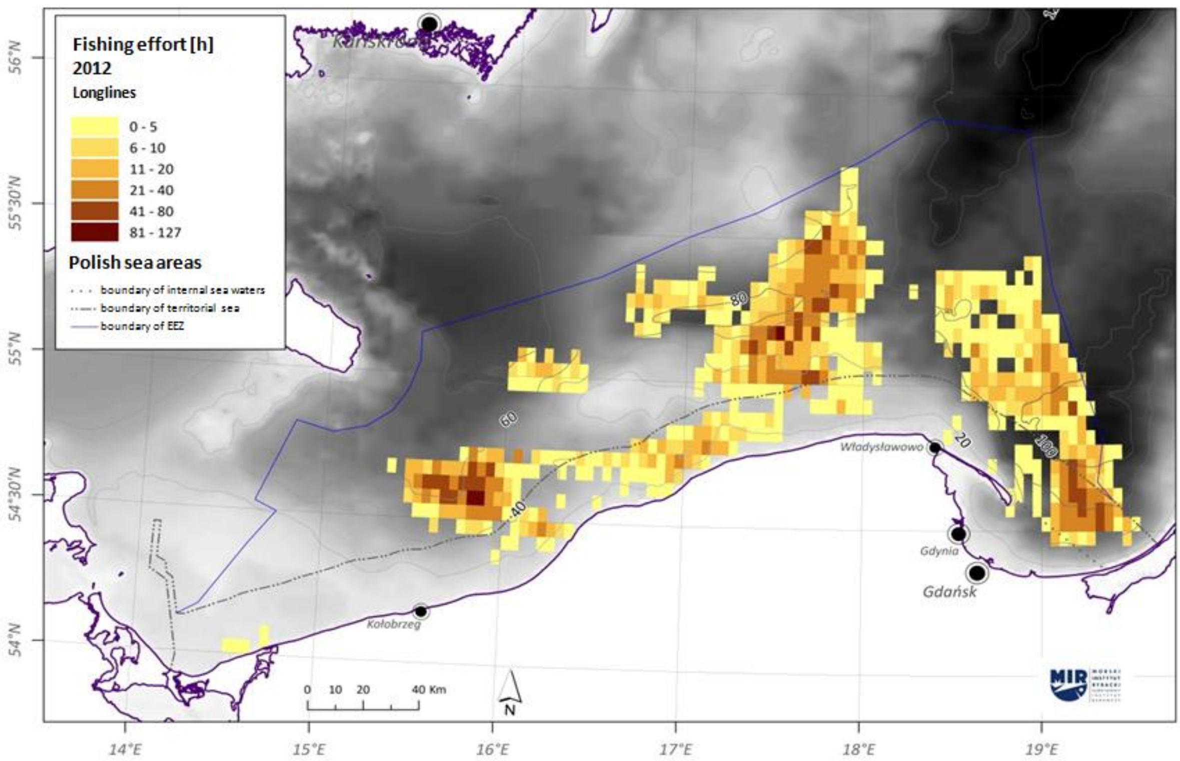

Fig. 6.27 fishing effort by VMS in 2012 – longlines

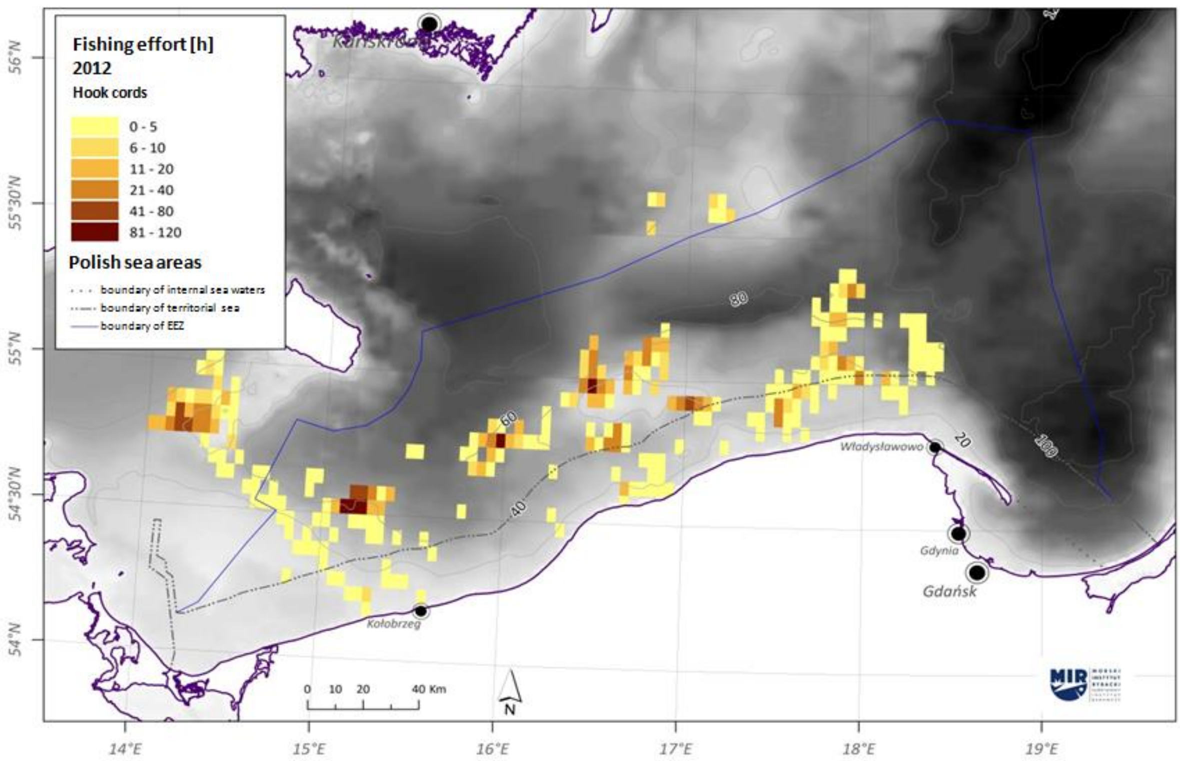

Fig. 6.28 Fishing effort by VMS in 2012 – hook cords

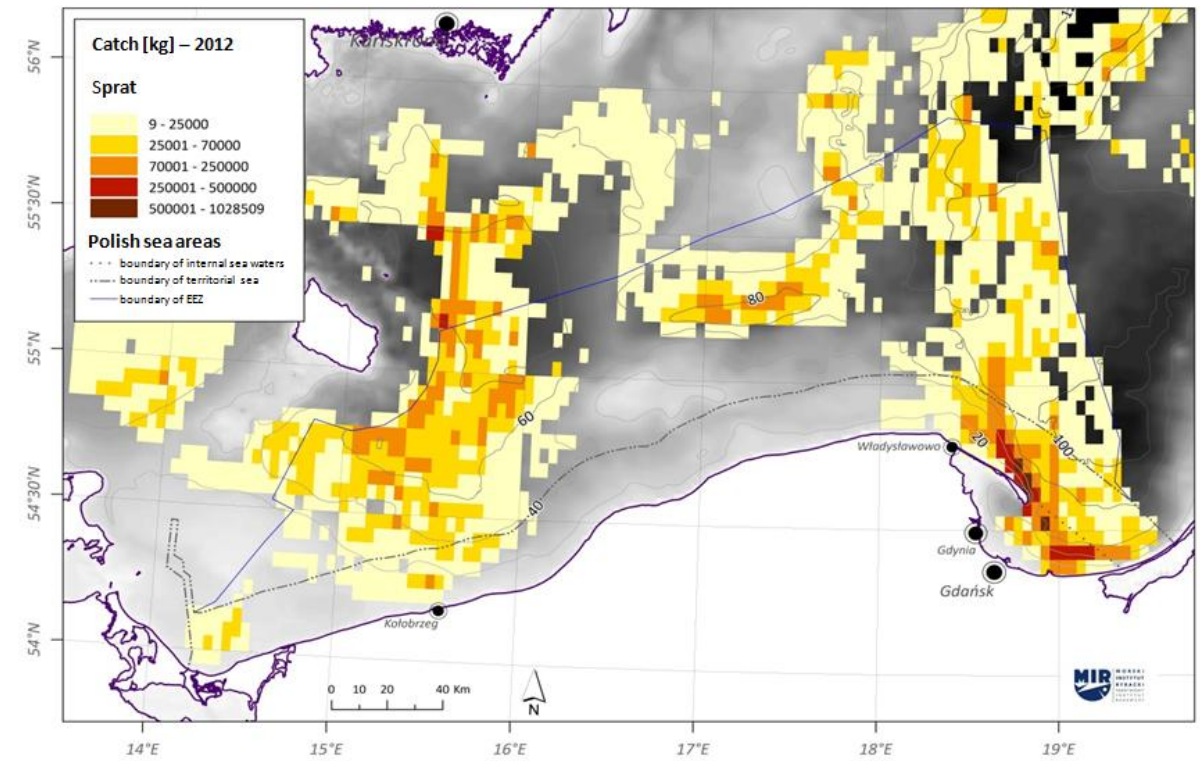

Fig. 6.29 Catch [kg] according to VMS in 2012 – sprat

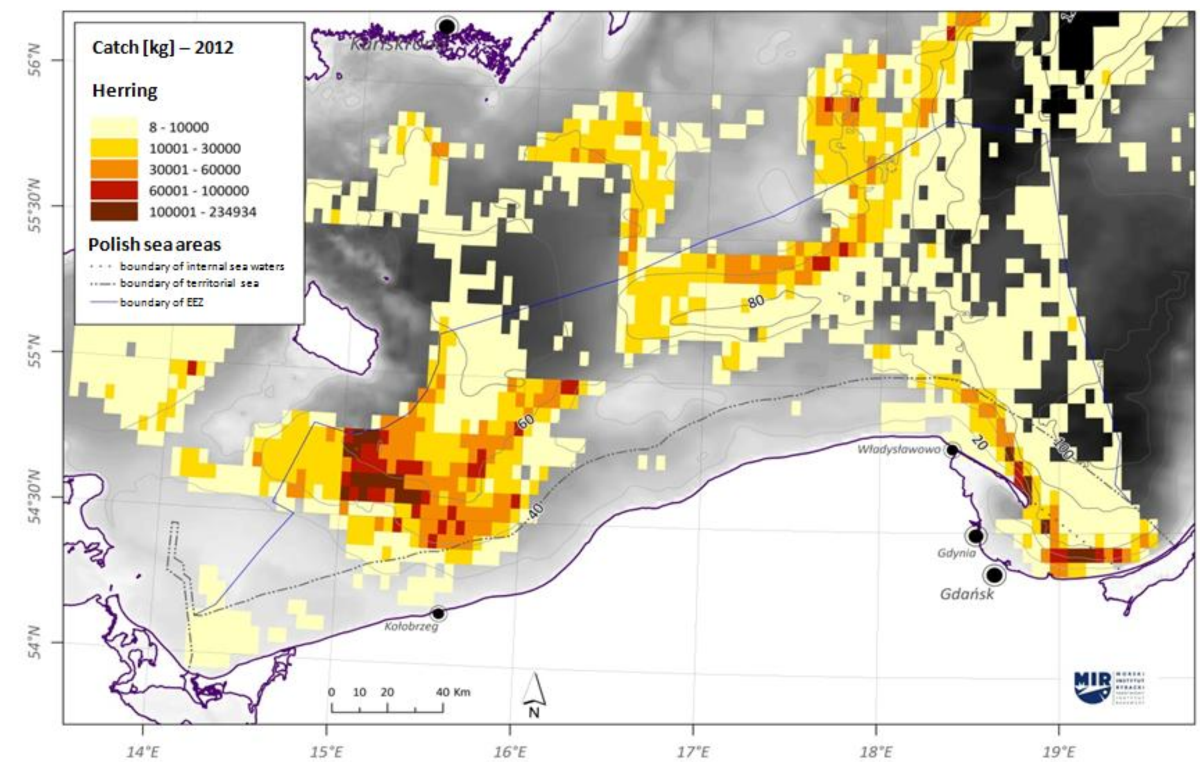

Fig. 6.30 Catch [kg] according to VMS in 2012 – herring

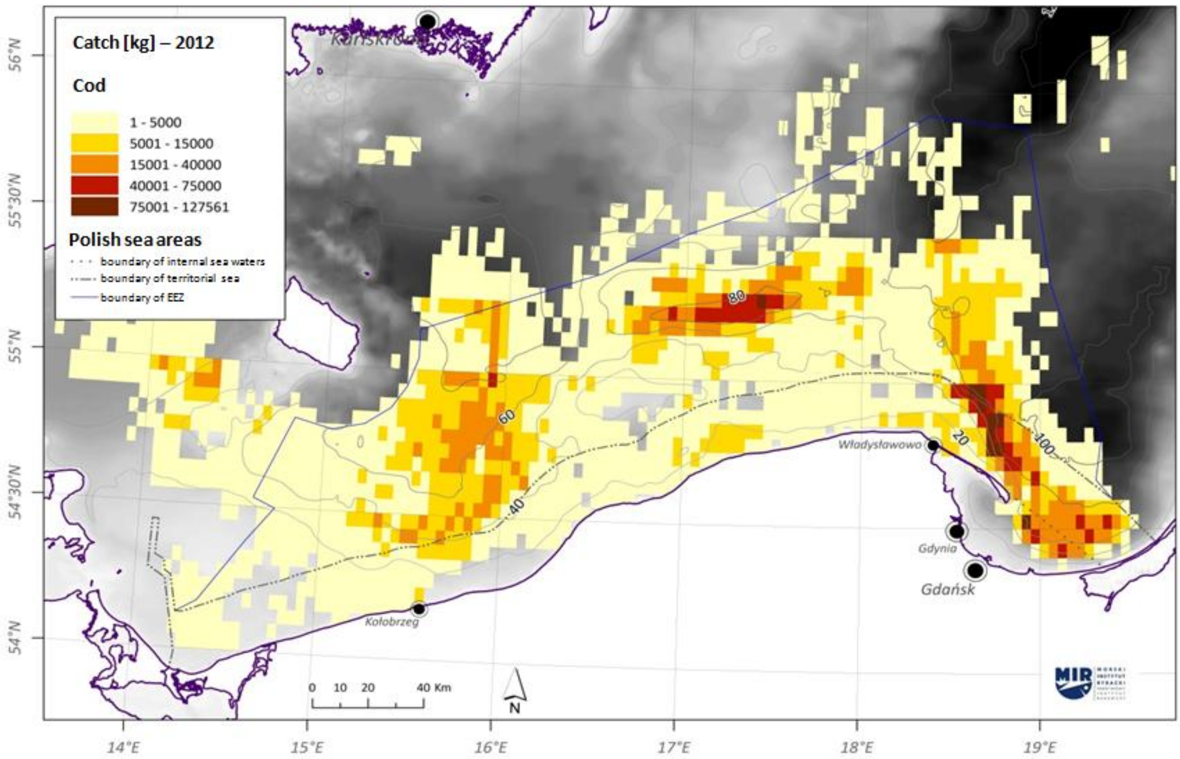

Fig. 6.31 Catch [kg] according to VMS in 2012 – cod

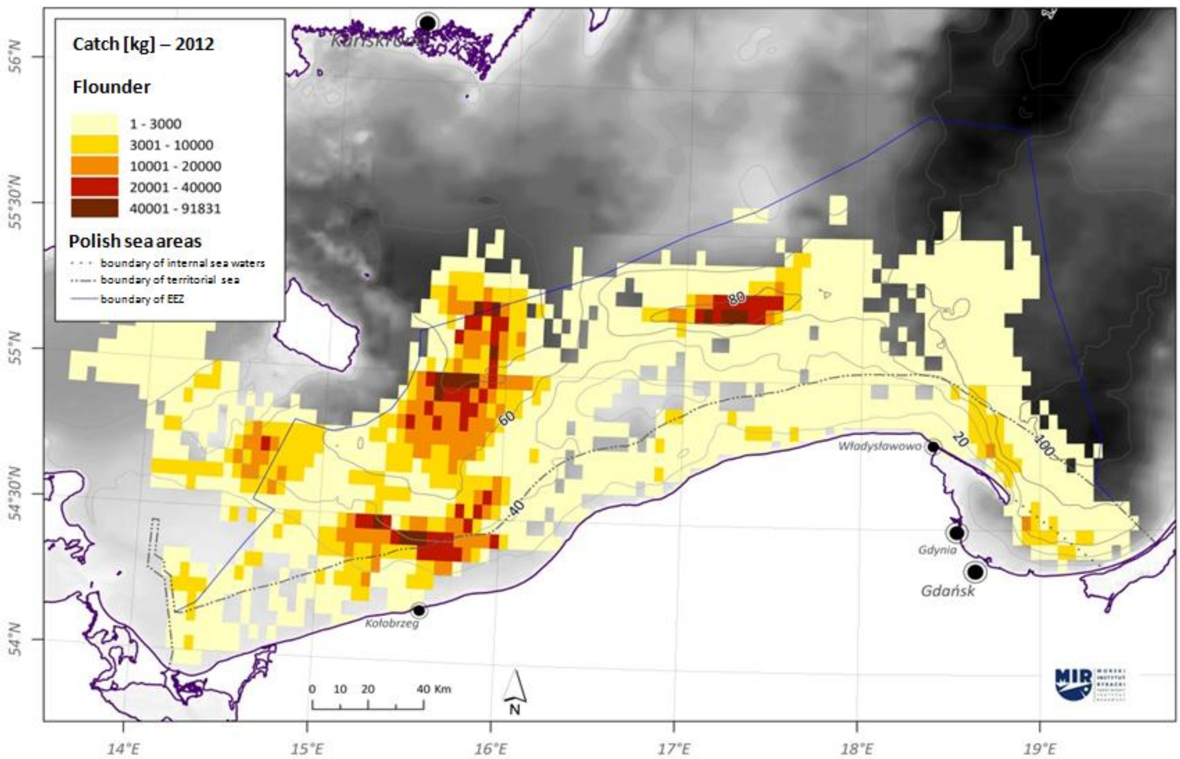

Fig. 6.32 Catch [kg] according to VMS in 2012 – flounder

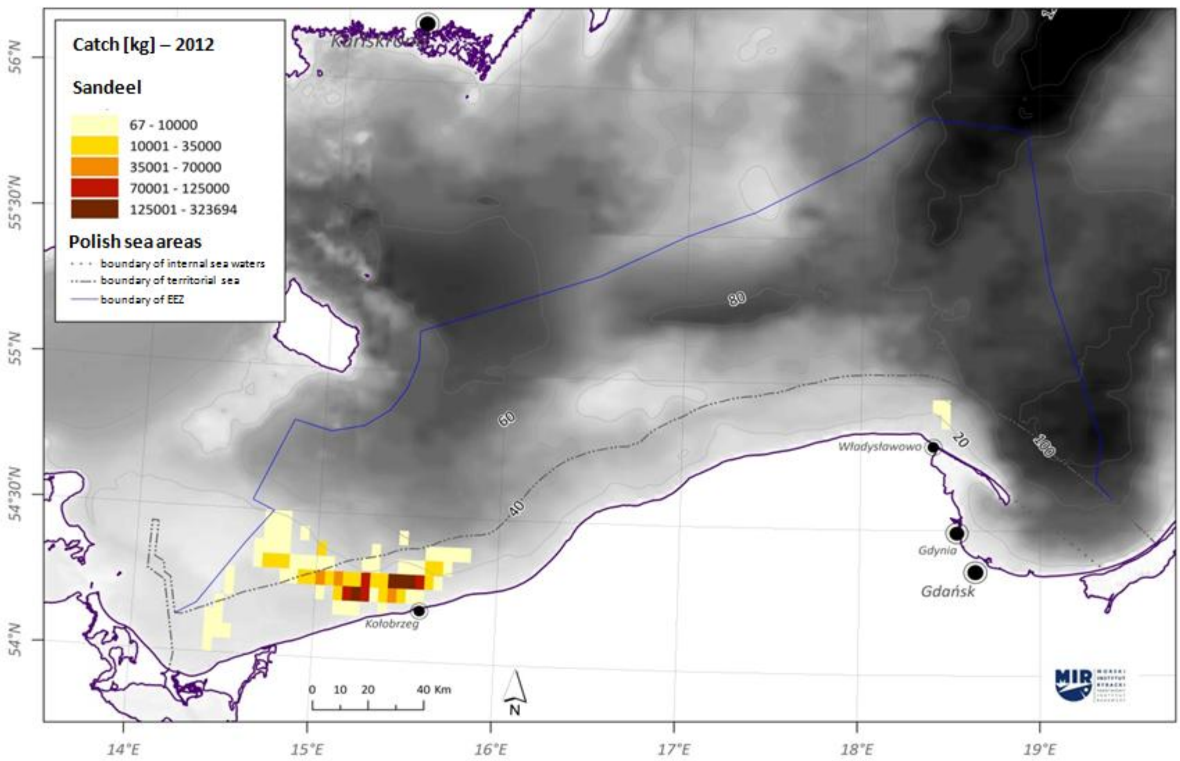

Fig. 6.33 Catch [kg] according to VMS in 2012 – sandeel

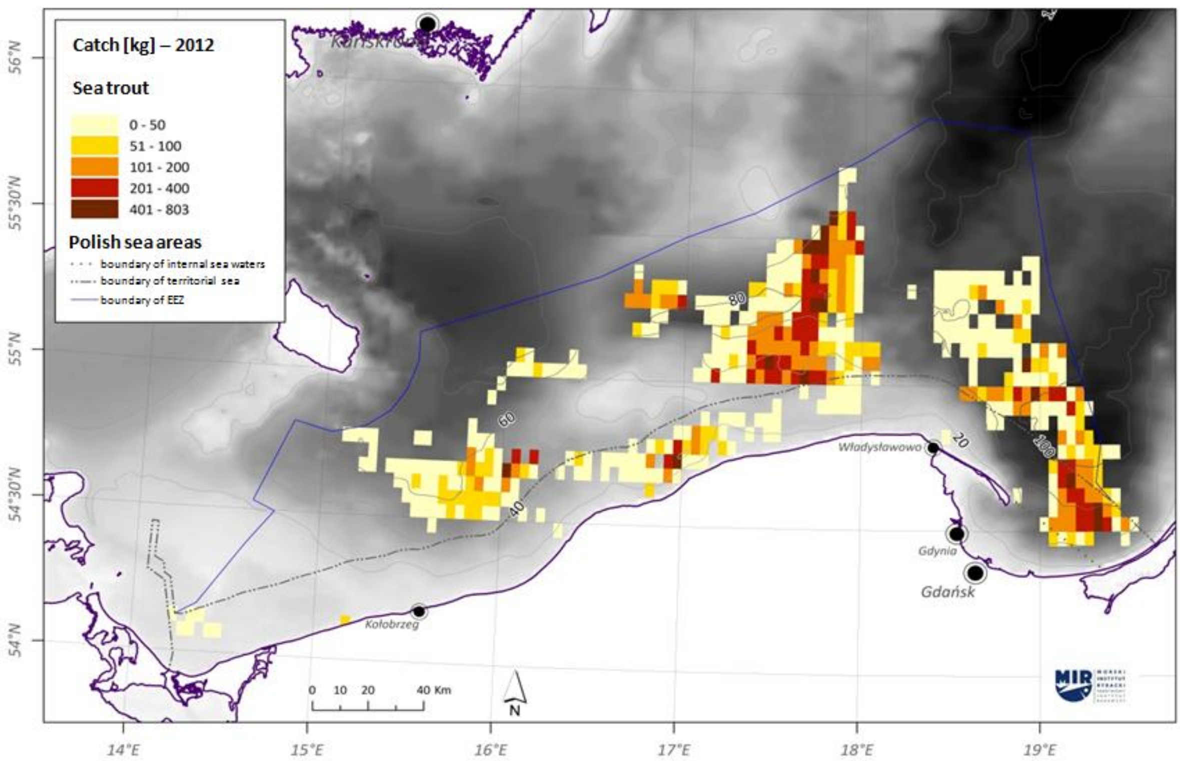

Fig. 6.34 Catch [kg] according to VMS in 2012 – sea trout

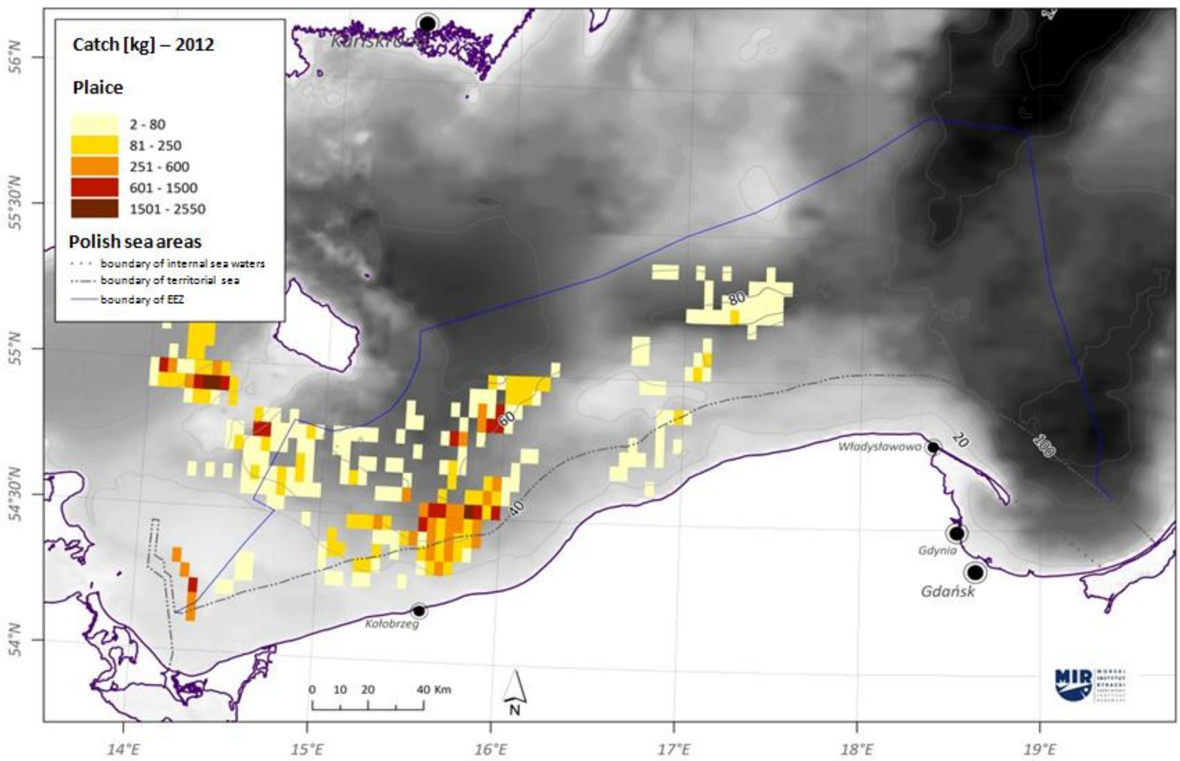

Fig. 6.35 Catch [kg] according to VMS in 2012 – plaice

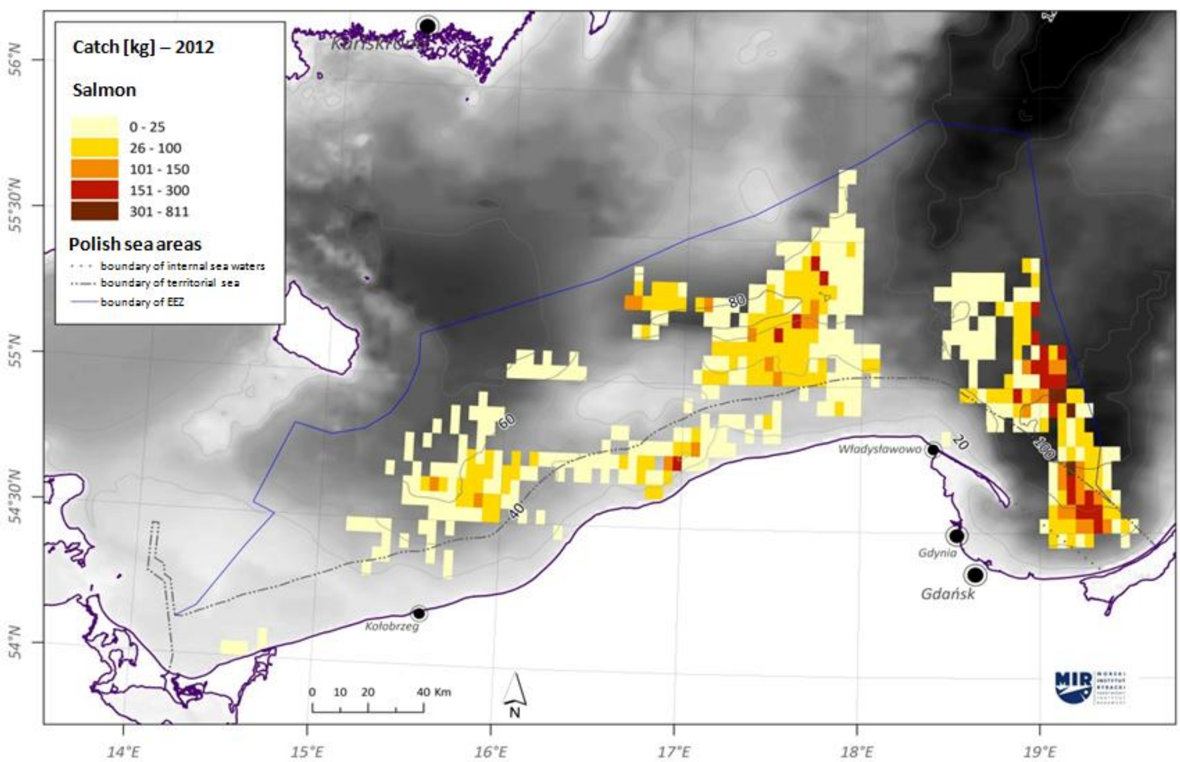

Fig. 6.36 Catch [kg] according to VMS in 2012 – salmon

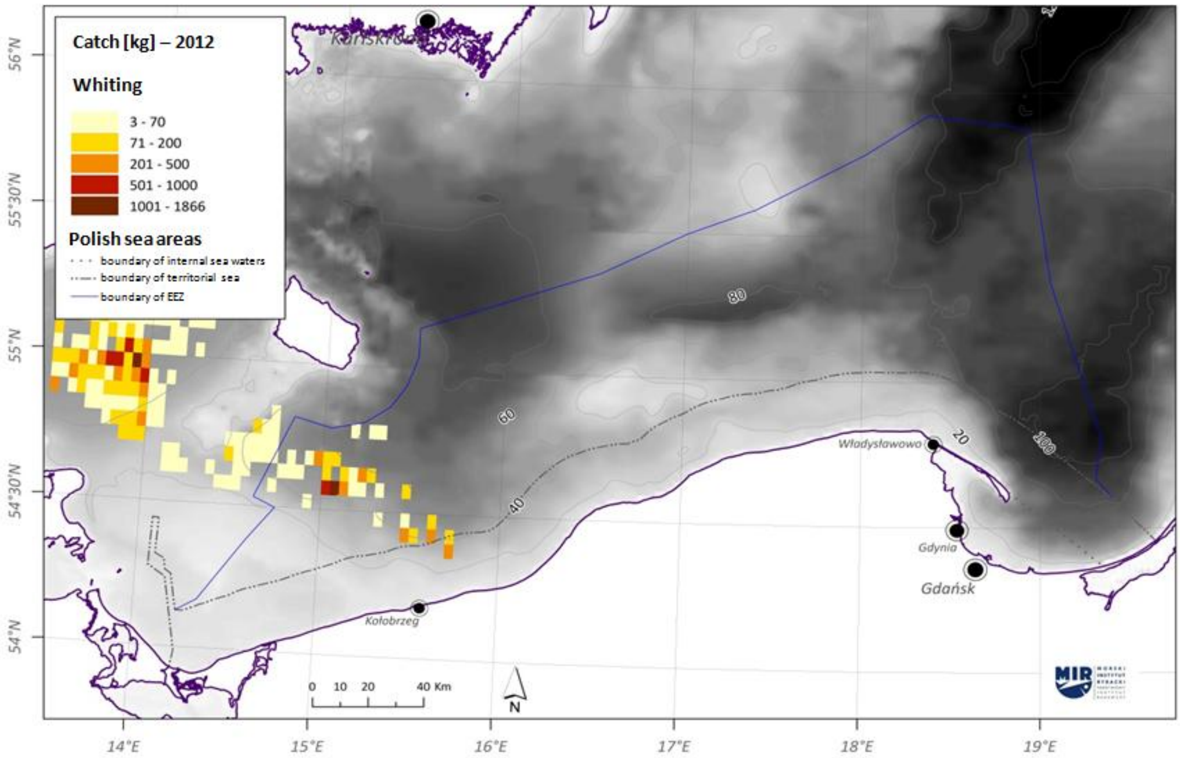

Fig. 6.37 Catch [kg] according to VMS in 2012 – whiting

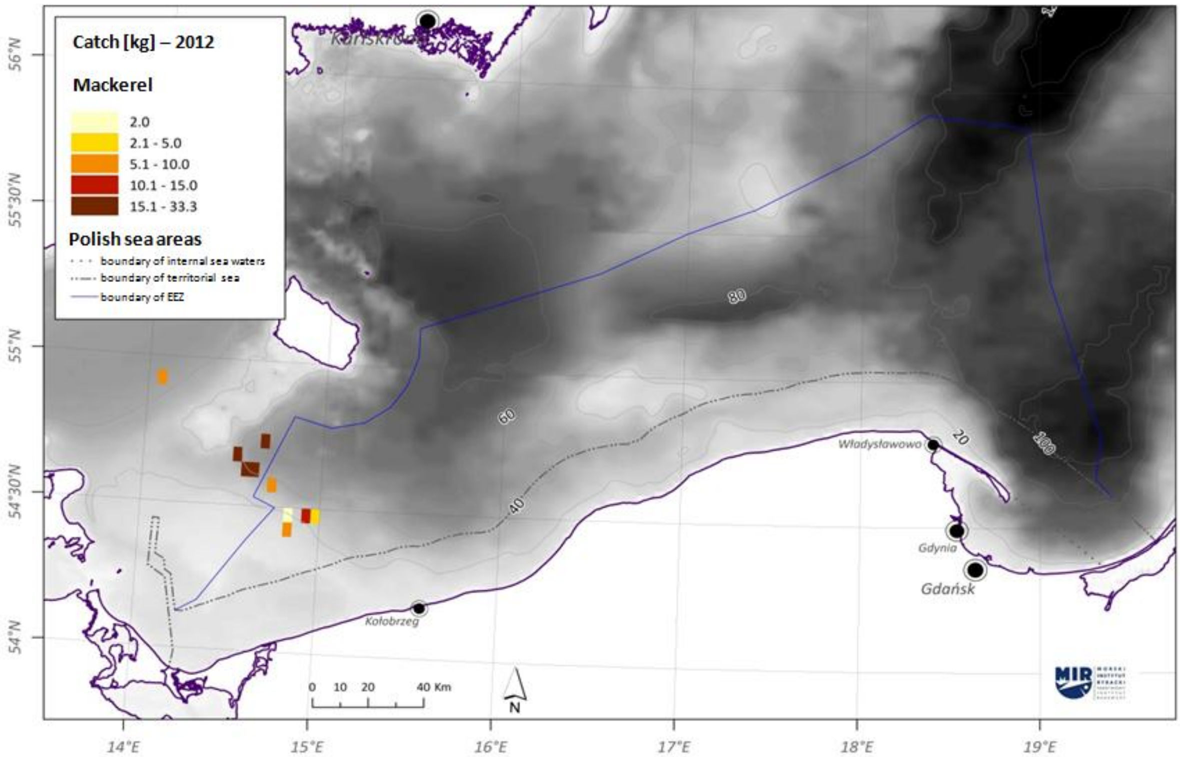

Fig. 6.38 Catch [kg] according to VMS in 2012 – mackerel

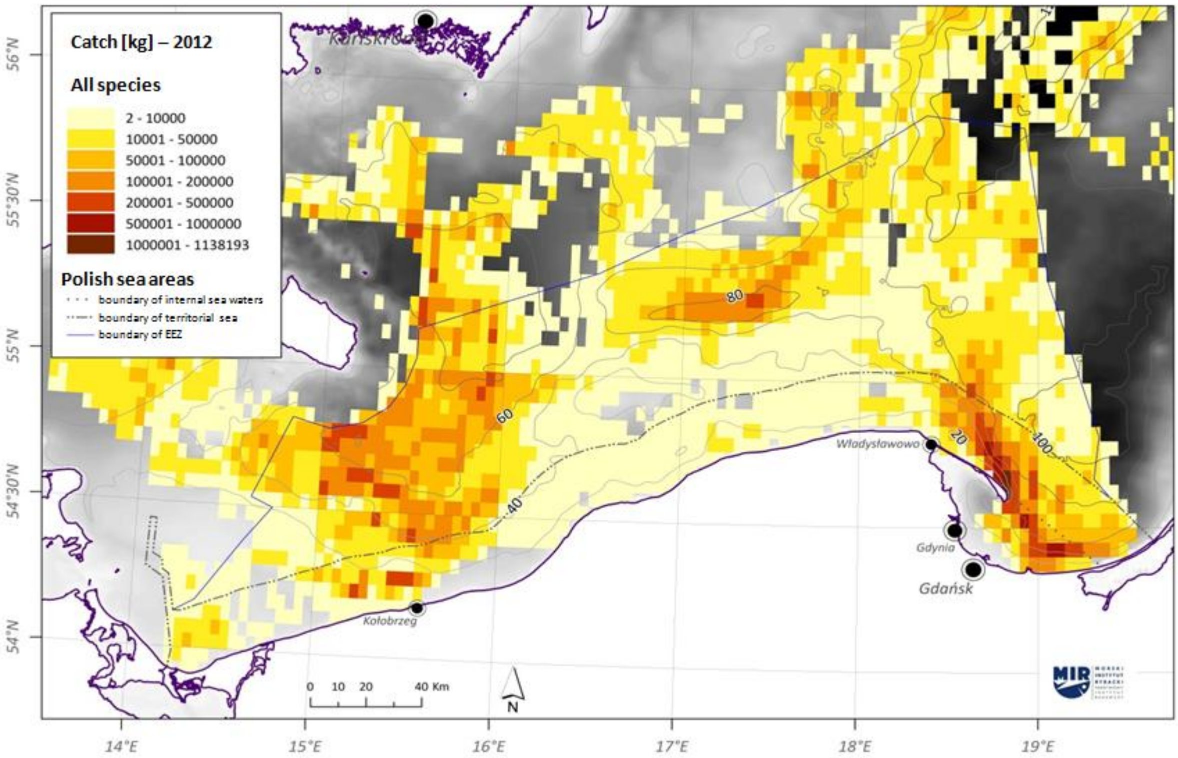

Fig. 6.39 Catch [kg] according to VMS in 2012 – all species

6.2.2. Routes of fishing vessels

Another type of VMS data analysis is the determination of fishing vessels' routes to fishing grounds using methods of interpolation and information on ports of departure and return from catch diaries. Visualisation of space used by fishing vessels in order to reach fishing grounds is important in view of economics of fisheries. They are mainly the shortest, i.e. the most profitable, routes.

The density of routes of fishing vessels in 2012 is shown in Fig. 6.40. Because of the changes, which take place in fisheries from one year to year, for purposes of maritime spatial planning of Polish sea areas, maps for at least 3 years preceding the development of the plan should be prepared and analysed. But even analysis carried out for one year clearly shows the spatial connection of the most important fishing grounds (among others Kołobrzeg-Darłowo, Bornholm S, Władysławowo, Słupsk Trough, Gdańsk Deep and Gulf of Gdańsk fishing grounds) with ports and havens (among others Świnoujście, Kołobrzeg, Darłowo, Ustka, Łeba, Władysawowo, Hel and Jastarnia). It should be remembered that the presented routes do not include fishing vessels < 12 m.

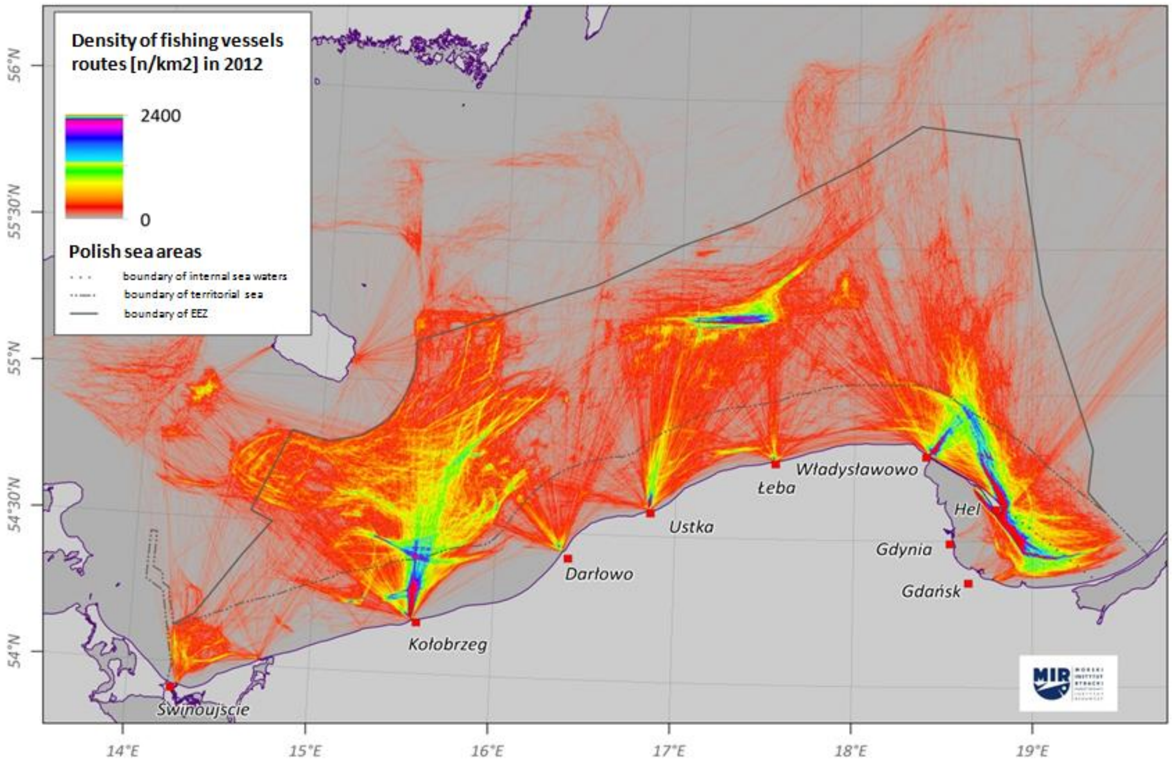

Fig. 6.40 Density of fishing vessels routes [n/km2] in 2012

The above elements can be used for more complex studies, such as calculation of trawling space taking into account the width of a fishing tool. VMS data can be also analysed in connection with other spatial data, e.g. temperature, salinity, depth or phytoplankton.

Processing and interpretation of data derived from VMS is possible thanks to informatics tools, but it is not a wholly automatic process. Many stages of analysis are conducted using expert knowledge. Persons working with VMS data should have IT skills, as well as knowledge of fishing techniques and characteristics of fisheries in the analysed area.

6.2.3 Small-scale coastal fishing

Small-scale coastal fishing is a customary term, not defined in the Act on fisheries. The resolution of the European Parliament of 22 November 2012 on small-scale coastal fishing, artisanal fishing and the reform of the Common Fisheries Policy contains a statement on the leading role of fishing vessels under 15 m length. The term was clarified by the first European Artisanal Fishermen's Congress, which defined that small-scale coastal fishing is the fishing executed from fishing vessels of up to 12 m length with the use of passive gear (bottom-set gillnets; pots and traps).

Defining small-scale coastal fishing in Poland is helped by the segmentation of the fishing fleet made for purposes of scientific reporting. The fish catch results are defined and compared for the distinguished segments, and on that basis the national fishing quotas for species with limitations are allocated.

Fleet segments were not defined in the old Act on fisheries. However the new Act on sea fisheries, which enters into force in March 2015[55], introduces the institution of legal segmentation of the Polish fishing fleet. This segmentation divides the fleet into three areas:

- Baltic segment (Baltic Sea open waters, EEZ, territorial sea and the Puck Bay and Gulf of Gdansk), in which 7 sub-segments are distinguished depending on the total length of a fishing vessel,
- Lagoon segment (Vistula Lagoon and Szczecin Lagoon with adjacent waters), where the fishing vessels above 12 m length are not allowed;
- Deep-sea segment.

Considering that fishing vessels over 12 m length are required by law to be equipped with vessel traffic monitoring system (VMS) installations, for the needs of this Study **small scale coastal fishing is defined as fishing carried out from vessels of up to 12m length**. Because the Vistula Lagoon and Szczecin Lagoon are outside the territorial scope of the Study, fishing on both lagoons should be excluded from the analysis, which means that into account should be taken only records without supplementary indications (ZS, ZW). In addition, due to errors in the recording of data, entries should be verified, taking into account the port of departure and return, the catch composition (typical for the area) and, in case of doubt, the local Sea Fisheries Inspectors should be consulted.

The fleet of up to 12 m vessels is highly diversified in terms of seaworthiness and equipment. The used fishing gear is typical for traditional artisanal fishing, such as trawls (active gear):

- pelagic trawls (3 recordings in 2012, including the 12 Nm zone)
- bottom trawls (816 recordings in 2012, including the 12 Nm zone)

(above mentioned active fishing gear is used by vessels of 8.4 to 11.99 m length)

- set longlines (520 recordings in 2012)
- pots and traps (574 recordings in 2012),
- set gillnets (28 746 recordings in 2012).

The set gillnets, which are most commonly used by the up to 12m vessels, vary in terms of net mesh size and place of setting (coastal, bottom, pelagic), which is the result of fish species oriented design of the gear.

Most commonly used are:

- cod gillnets (55 mm mesh size),
- flounder gillnets (52-80 mm mesh size), set gillnets.

Less commonly used are:

- perch gillnets (30-35 mm mesh size), nets used in the coastal sea,
- turbot nets (80-110 mm mesh size), bottom-set gillnets, used in Spring, on shallows, where turbot gathers before spawning;
- gillnets (or: set gillnets) – pelagic nets traditionally used in the Puck Bay (highest intensity of fishing during the Autumn-Winter-Spring season);
- herring gillnets (22-27 mm mesh size), used during the mass appearance of herrings in the coastal zone (Spring, to a limited scope in some years also Autumn).

[55] The Act was signed by the President on 29th January 2015 (JoL 2015, it. 222)

There are also other types of gillnets, used less often and only locally:

- garfish gillnets (26 mm mesh size), used during garfish spawning season in the Puck Bay
- whitefish gillnets (55 mm and larger mesh size), used in the Puck Bay

Small-scale coastal fishing using bottom-set gillnets, operates mainly on traditional fishing grounds, selected by each operator on the basis of his knowledge and experience. Because the up to 12 m vessels are not equipped with VMS, it is impossible to define, basing only on the Fisheries Monitoring Centre (FMC) database, the fishing grounds that are particularly important for coastal fishing. **Access to these traditional fishing grounds is critical for the profitability of fishing. At the same time, small vessels are not able to change these fishing grounds to other, comparable in terms of profitability areas in case of conflict with other types of sea area use. In effect, any limitation imposed on the use of traditional fishing grounds may result in economic elimination of this segment of the fishing fleet.**

In the past, assessment of distribution of coastal fishing effort was only fragmentary. For example, in case of the Puck Bay area, which is interesting for many users of sea space (NATURA 2000, sea transport, military areas, developed tourism and underwater technical installations), the last inventory of fishing grounds by separate fish species, based on knowledge of the fishermen, took place in the 60s of the last century (Fig. 6.41). Since that time both the environmental and technical conditions have changed significantly, and the information has become outdated.

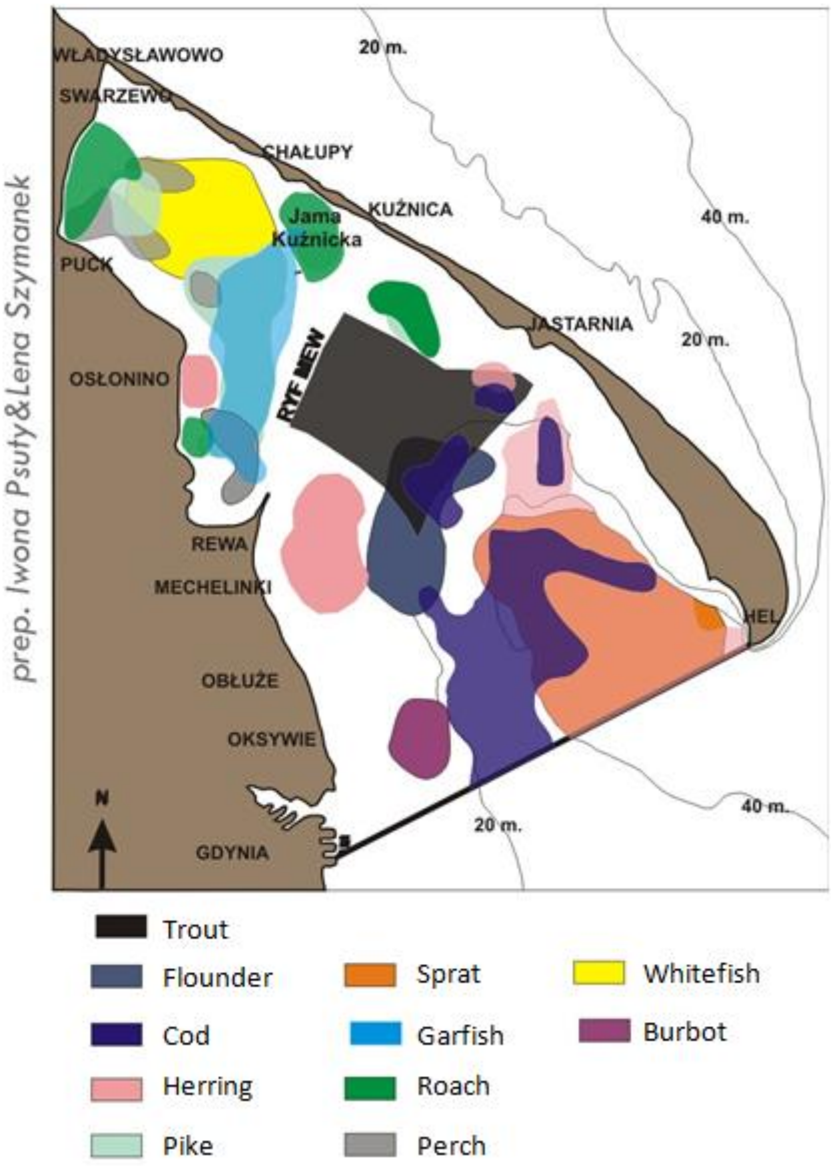

Fig. 6.41. Historical (60s of the last century) distribution of species important for coastal fishery in the Puck Bay

The spatial distribution of fishing effort and catches based only on FMC data does not reflect the distribution of coastal fishing at all (Fig. 6.42).

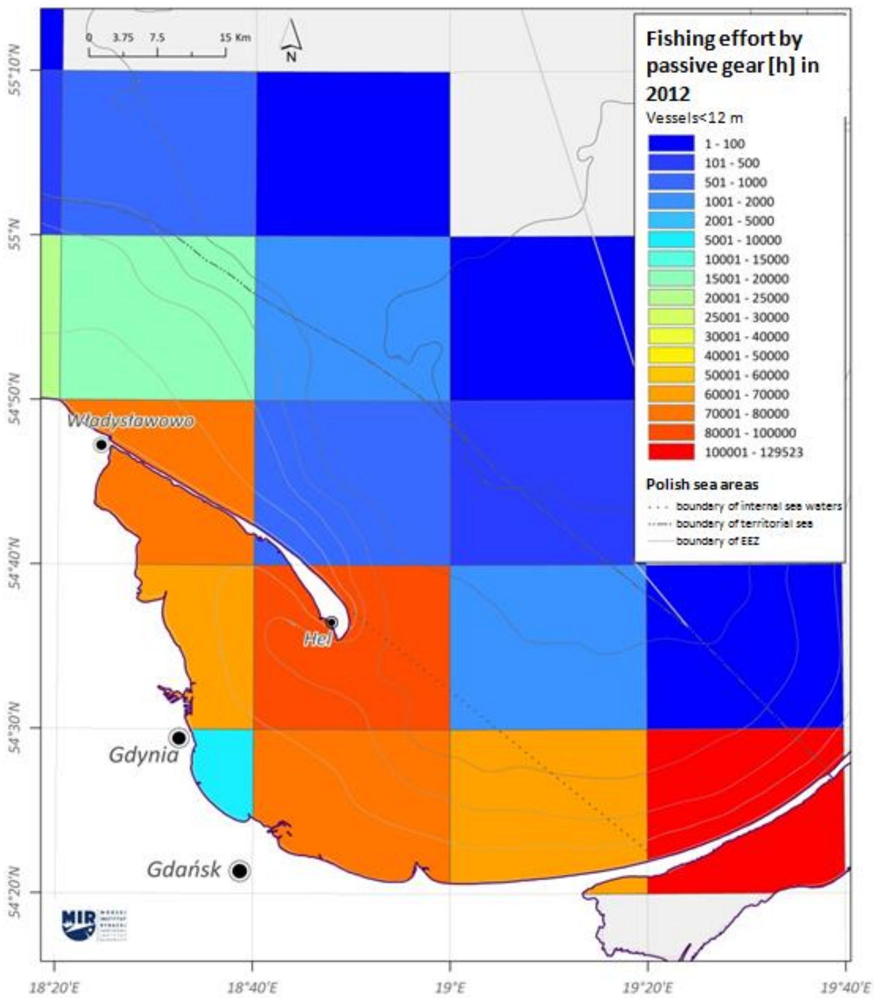

Fig. 6.42. Fishing effort [h] of coastal fishing (vessels up to 12 m length, passive gear) in 2012.

The process of coding data only into the statistical fishing squares provides only a very general picture of the importance of specific areas for coastal fishing. For example, in the Puck Bay there is a problem of coding catches, which occur in the same square but in the Puck Bay and in the open sea. The catches in Puck Bay should be additionally marked by the symbol GD, however investigations of the NMSFRI showed that not all fishing boat owners do this. CMR data should be verified taking into account the catch composition, information from the local fishery inspectorates and fishermen. Some of the fishermen periodically change their fishing area from the Puck Bay to the open sea. There are also exceptionally important for them fishing grounds, located at the interface of different fishing squares (Fig. 6.43), which cannot be located otherwise than by means of an on-site inventory of real fishing effort. These areas are especially important for coastal fishery, and their loss would be equivalent to economic elimination of coastal fishery since it is impossible to transfer the fishing effort of the local fishermen to some other sea area.

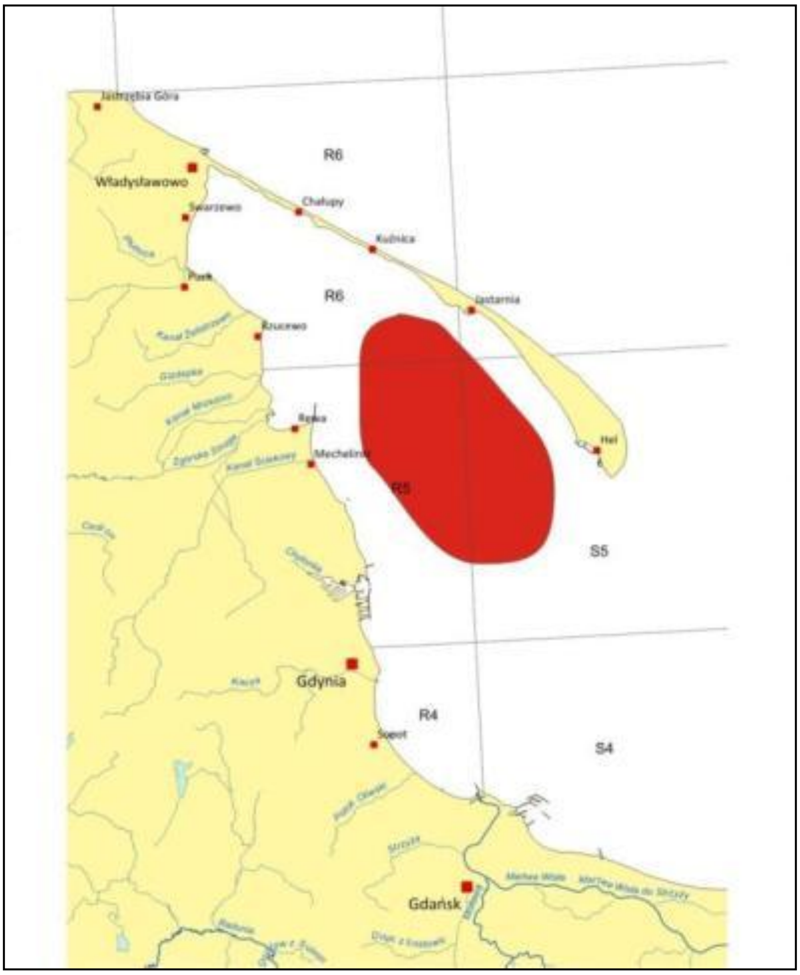

Fig. 6.43. Actual location of trout fishing grounds in the **Puck Bay**

Small-scale coastal fishing operates mainly in traditional, confirmed by experience, strictly defined in time and space fishing grounds. It is important to locate them in a more precise way than by means of statistical fishing squares. This will allow assessing the scale of potential conflicts with other types of sea space use.

Mapping of fishing grounds of key importance for the preservation of this segment of the fleet can be achieved by means of an **inventory**. Such an inventory could be based on direct recording of fishing effort distribution and/or questionnaires and interviews with fishermen from individual fishing bases.

6.2.4 Recreational fishery

Recreational fishery is an activity generating significant revenues in the coastal zone of the Baltic Sea, and also in other parts of the world. In the Baltic Sea, directions of the angling trips depend on the target species. Most often caught are: cod, trout, salmon, zander, perch, garfish, bream, eel, flounder, turbot, rarely roach, crucian carp, round goby and pike. Most of these species are targeted only during a specific time of the year, and require different methods of angling. Catches are carried out individually, often in the form of various competitions, but also as group fishing trips. Recreational fishery is not carried out all year-round, and is mostly dependent on seasonal availability of given species and weather conditions.

Due to the high dynamics and considerable interest in this form of recreation, an in-depth analysis of recreational fishing, taking into account data for the years 2013 and 2014, is strongly recommended.

Cod angling

Basic data describing development of cod angling, playing also a key role in estimating catch size, are obtained from Port Records and Navigational Logbooks made available by the Harbour Master Offices. Information on the number of angling trips and the number of participating anglers is recorded in electronic form by the NMSFRI. Six most important fishing ports were selected, which are also the main bases for angling boats. Apart of analysis of statistical data, the staff of the NMSFRI takes part in angling sea voyages during the period of greatest angling activity (June - September), collecting data on the quantity of catches and on biological characteristics of the caught fish. The number of trips and anglers in 2012 is shown in Table 6.2.

Table. 6. 2. Number of trips and anglers in 2012

Port	Number of angling trips	Number of anglers
Darłowo	3473	20 480
Kołobrzeg	2374	39 747
Łeba	1345	21 938
Ustka	554	8107
Władysławowo	3483	49 744
Hel	133	1387
Jastarnia	12	134

Statistics concerning the number of anglers participating in cod angling trips show a continuous upward trend. Moreover, from 2006 the dynamics of growth of the number of anglers are visibly higher than during the consecutive years in the period 1999-2005. The total number of anglers registered by the Harbour Masters Offices in 2012 was 141 thousand. The total number of departures in 2009 slightly exceeded 11.3 thousand. Many of the angling boats operating in Polish sea areas were imported and adapted for angling. Former pilot and patrol boats, tugboats, Naval and merchant fleet auxiliary vessels and other types are used. The area in which these vessels operate is unknown, but, considering the time and cost constraints, it seems that angling concentrates mainly within 10-15 Nm from the coast. Additionally, for cod angling often are used several metre long motor boats operating close to the shore, mainly in the Darłowo-Darłówek area. The average number of boat departures from Darłówek in the period May-September 2009 was 16 per day, with a recorded maximum of 54. It is worth noting that in the same time when sea angling showed most dynamic growth, the Polish fishing fleet was being reduced due to the *fishing vessel scrapping programme* co-funded by the European Union.

The statistics of cod angling are still not carried out. Therefore, assessment of catch size in angling can be only approximate. The new Act on sea fishery obliges ship operators to report the number of caught fish, but still such reports are not required from individual anglers.

Salmonid angling

In the last 6 years, salmonid angling becomes increasingly popular. Initially it was directed exclusively at brown trout caught by spinning from the beach, later also by trolling (the first successful catch using the trolling method took place in 2011). Among the three above mentioned angling activities, only salmon trolling is monitored.

Development of angling targeted at salmonides was quite “boom-like”, especially in the case of the cheapest method – spinning from the beach. At present anglers use all the beaches along the open sea coastline – from Świnouśjcie to Piaski on the Vistula Spit. The intensity of beach use is directly proportional to the density of population in a given region (number of anglers), hence the most often used beaches are near the TriCity – from Rozewie to Górki Zachodnie. Trolling is used for fishing trout both in the open sea and in the Gulf of Gdańsk and Puck Bay. The activity is carried out mostly from small boats in water depths not exceeding 15-20 m. Angling in larger depths requires expensive equipment, and there is no certainty that more fish will be caught. It is estimated that the number of such craft may reach 100-300 boats. Due to the lack of records of trout fishing, the presented above information is based on own observations and on analysis of posts on angler websites.

Salmon fishing by trolling is carried out in water depths from 20 m to over 108 m. The fishing grounds are located from a few to several dozen kilometres from the shore. Currently that method is used by 30 vessels. The most popular areas include: neighbourhood of fairways to north-east of Hel, Gdańsk Deep, the Gulf of Gdańsk and areas deeper than 20 m north of Kołobrzeg. Less frequently, the crafts depart from Mrzeżyno, Władysławowo or Ustka. In case of salmon trolling, one of the key factors for choosing the fishing ground, apart from the ones mentioned above, is the distance from port of departure to the place of residence (many crews are from outside of the coastal region).

In terms of effective fishing capacity, there are no significant differences between fishing grounds, which makes that method very expansive. Taking into account the rapid increase in the number of craft, it may be expected that in the future an increasingly large area of the Baltic Sea will be used for this type of activity.

Shore angling

Shore angling is carried out from the beaches, coastal protection structures, breakwaters and quays in ports. The number of anglers increases every year.

The growing scale of shore angling is proved by the number of permissions issued by the Regional Sea Fisheries Inspectorate (RSFI) in Gdynia at individual request:

- in 2005 – 2 636 permissions,
- in 2009 – 4 551 permissions,
- in 2013 – 8 360 permissions,
- until the end of June 2014 – 6 657 permissions.

Large numbers of shore anglers can be observed especially during herring migrations. From March to June thousands of people fish from port structures in Gdansk, Gdynia, Władysławowo, Łeba, Ustka, Darłowo, Kołobrzeg and Świnoujście. At one time even about 500-600 people were observed angling at the mouth of the Wisła Śmiała. Anglers fishing on the beach represent a smaller and more dispersed group. They fish mainly at the mouths of rivers and canals flowing into the Baltic Sea and in their vicinity.

Monitoring of marine recreational cod fishing will be carried out in the nearest years within the framework of the National Programme on Fisheries Data Collection (implemented by the NMSFRI). It is also planned to extend the monitoring to salmonid fishing. The monitoring will allow gathering more representative data on species, fishing effort and the number of people engaged in this kind of fishing activity along the Polish coast.

A more complete picture of recreational fishing, its scale generating economic and social values, may be obtained for planning purposes by:

- collecting statistical data from Harbour Master Offices and Bosun Offices on the number and size of boats registered and departing for recreational fishing trips as well as number of days at sea;
- sampling in fishing ports, where observations of the number of anglers fishing on the quays, of the number of vessels departing with anglers and the number of anglers on board, the type of gear they take with them, and after returning to port – the species, quantity and weight of the caught fish;
- sampling by participation of observers on board vessels – the observer collects data on fishing gear, species, number and weight of caught fish.

Conclusions for the maritime spatial plan of Polish sea areas

- it is recommended to carry out an analysis of routes of fishing vessels to fishing grounds on the basis of VMS data covering at least three years preceding the development of the maritime spatial plan. The analysis is important from the point of view of economics of fishery – the routes are usually the shortest and therefore the most profitable.
- The fishing effort and volume of catch should be analysed in a 0.05 degree grid taking into account species composition and fishing gear. Note: The analysis refers to vessels longer than 12 m, therefore in principle it does not include the coastal zone.
- As a rule coastal fishing is carried out on traditional and confirmed by the fishermens' experience, well defined in time and space fishing grounds. It is important to locate them more precisely than in the scale of statistical fishing squares. This can be achieved by recording the distribution of fishing effort from independent research vessels and/or by means of questionnaires/interviews with fishermen from each of the fishing bases.
- Recreational fishing is an important factor generating significant revenues in the coastal area. Due to its high dynamics and considerable public interest in this form of recreation in the analysed area, it is recommended to conduct an in-depth analysis of recreational fishing, taking into account the period 2013-2014.

6.3 Ports and havens with special emphasis on fishery

The importance of fishery and fishery oriented services in ports (Fig. 6.44) increases with decreasing size of the settlement in which the port is located, and the decreasing number of business operators in a given locality. Apart from the fishery base in Świnoujście, where a new municipality investment has been realised, and the fish cold store in Gdańsk built by the fish producer organization, it can be assumed that for ports of basic importance for national economy fishery does not play a significant role. According to information on plans for the functioning of the Gdańsk cold store, its operation will be linked with imports of processed and packaged fish, which means that deliveries to the store will be performed by transport units, not fishing vessels. Assuming that in the local ports and havens the shipyard infrastructure works for the needs of sectors using these ports and havens, it may be stated that besides fishery, the most important for maritime economy of the coastal municipalities are tourism and cargo handling. Analysis of local ports and marinas should be carried out in dependence of the functions they perform, especially taking into account the fishery service functions. Such a division may look as follows:

- multifunctional ports (Świnoujście, Kołobrzeg, Darłowo, Ustka, Władysławowo, Gdynia and Gdańsk),
- bi-functional ports and havens (Dziwnów, Mrzeżyno, Dźwirzyno, Rowy, Łeba, Jastarnia, Hel and haven Kuźnica II),
- monofunctional ports and havens (havens in Międzyzdroje, Rewal, Niechorze, Ustronie Morskie, Chłopy, Unieście, Dąbki, Jarosławiec, Dębki, Chłapowo, Chałupy, Rewa, Mechelinki, Obłuże, Oksywie, Orłowo, Sopot, Jantar, Stegna, Kąty Rybackie, Krynica Morska, Leśniczówka and Piaski II, fishery bases Pleniewo and Górki Zachodnie located in the Port of Gdańsk, and Świbno and Mikoszewo located in the mouth of the Vistula),
- Specialized ports (in Poland there is only one such port belonging to ZCH Police on the Szczecin Lagoon).

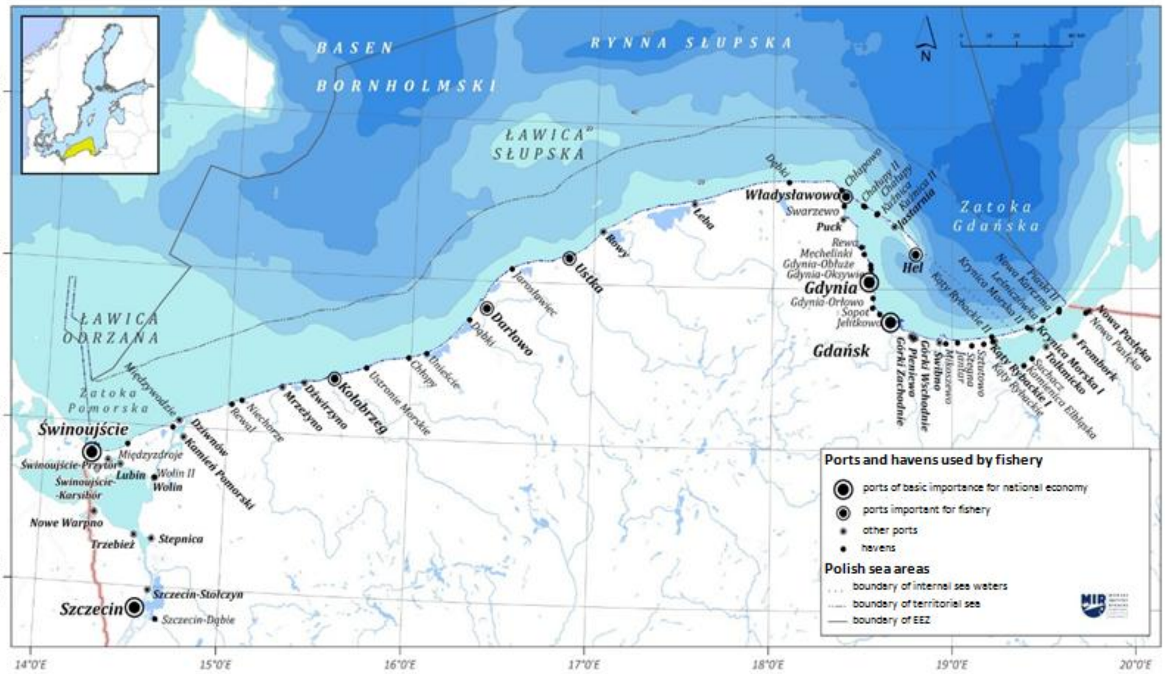

Fig. 6.44. Polish seaports and havens used by sea fishery

Some ports and havens on the Polish coast are used only by a few fishing boats, and in some no fishing activity is carried out (e.g. Chałupy I, Kuźnica I, Jastarnia I, Swarzewo, Osłonino, Jelitkowo). In the fishery statistics there are locations which do not even have the status of a haven, but fishing boats are registered in them. Such places include Sztutowo and Międzywodzie. Boats are also registered in a physically non-existent base in Gdańsk – Górki Wschodnie.

Development of transport and cargo handling functions depends mainly on available technical infrastructure and the possibilities of supply, storage and distribution of goods. Currently handling capacities are used only by the ports in Kołobrzeg and Darłowo, and to a lesser extent in Ustka and Władysławowo. The main function of ports and havens possessing fitting quays is tourist traffic services. In bigger ports, besides yachts, also white fleet vessels are serviced. In Darłowo, Dziwnow, Gdynia, Gdansk, Hel, Kolobrzeg, Łeba, Sztutowo, Świbno, Świnoujście, Ustka and Władysławowo station search and rescue craft.

The functions of ports and havens with regard to fishery are currently limited to berthing, loading and unloading, and minor repairs. Administratively, they are also the place of registration of the vessels.

An extensive investment programme aimed at modernization and development of technical infrastructure was carried out in the local ports and havens in the period 2004-2013. Most of the investments were supported by financial resources from operational programs for the fishery sector under the Sectoral Operational Programme "Fisheries and fish processing 2004-2006" and the Operational Programme "Sustainable development of fishery sector and coastal fishing areas 2007-2013" (OP "FISH 2007-2013"). The largest number of investments was completed in Władysławowo (31), Kołobrzeg (18) and Hel (14). In some cases, single investments resulted in full modernization of fishery service facilities (Sopot, Orłowo, Oksywie, Mechelinki and Świnoujście) or in significant improvement of conditions of operation (Chłopy, Kąty Rybackie, Krynica Morska, Kuźnica II, Dębki, or the first investment in Mrzeżyno). Data on all the investments are available at the Agency for Restructuring and Modernisation of Agriculture.

Research on accessibility of port infrastructure was carried out in 2012[56], and was focused on accessibility of berths and services for fishing vessels. The existing technical infrastructure and additional functions carried out by ports were also reviewed. It was found that accessibility and berthing conditions in most of the ports and havens are good[57]. Ports in Mrzeżyno, Władysławowo and Łeba were an exception due to sanding up of port entrances by waves, and Dźwirzyno and Rowy, because of the fast siltation of port basins. Bad technical condition of quays was found in the port of Ustka and river haven at Mikoszewo, while in Dziwnowo, Władysławowo and Świbno the state of quays was assessed as passable. Users of other ports and havens had no comments on the state of quays and berths. Technical equipment for lifting the boats/vessels from water was lacking. Gantry cranes and davits were in ports in Hel, Jastarnia, Kołobrzeg and Mrzeżyno; slipways in Kuźnica, Rewa and Ustronie Morskie. Repair shipyards were in Kołobrzeg, Dziwnów, Darłowo, Ustka and Władysławowo. Several minor ports and havens had repair workshops. In almost every port and haven good access to electricity and water supply was ensured, and waste and bilge water was collected in specially provided containers.

Fish processing businesses operated in ports of Darłowo, Dziwnów, Hel, Kołobrzeg, Świnoujście, Ustka and Władysławowo, using locally unloaded fish and imported material. In Kołobrzeg, Chłopy, Darłowo, Ustka, Łeba, Władysławowo, Hel, Gdansk and Krynica Morska fish producer organizations created the Local Fish First Sale Centres (LFFSC), which had the effect of cumulating the fish sale offer for fish caught in the Baltic Sea. Infrastructure for next LFFSC was built in Świnoujście and Mrzeżyno, and several new centres, e.g. in Piaski, are planned. In smaller ports and havens distribution of fresh fish is based on direct contracts with customers (when the amount exceeds 300 kg, an LFFSC

[56] Data collected by MIR-BIP for the report “Analysis of the state of infrastructure in fishing ports and havens from the point of view of further investment needs” ordered by the MA&RD

[57] Based on data on port accessibility and accidents obtained from Maritime Offices and interviews with port users

employee nust be present to record the unloading), direct sales on the waterfront (the so-called "waterfront sale") or in specially prepared points of sale. New, equipped with cooling infrastructure and fulfilling sanitary requirements facilities were built in Kąty Rybackie, Sopot, Orłowo, Oksywie, Mechelinki, Puck, Jastarnia, Mrzeżyno and Swinoujscie and in the LFFSCs.

Generally, the fishing service fuction remains the basis for functioning of monofunctional ports and havens and ensures year-round operation of bi-functional ports and havens. At the end of 2013, the number of vessels registered in all the ports and havens was 639 (191 over 12 m length, 448 less than 12 m) (Fig. 6.45).

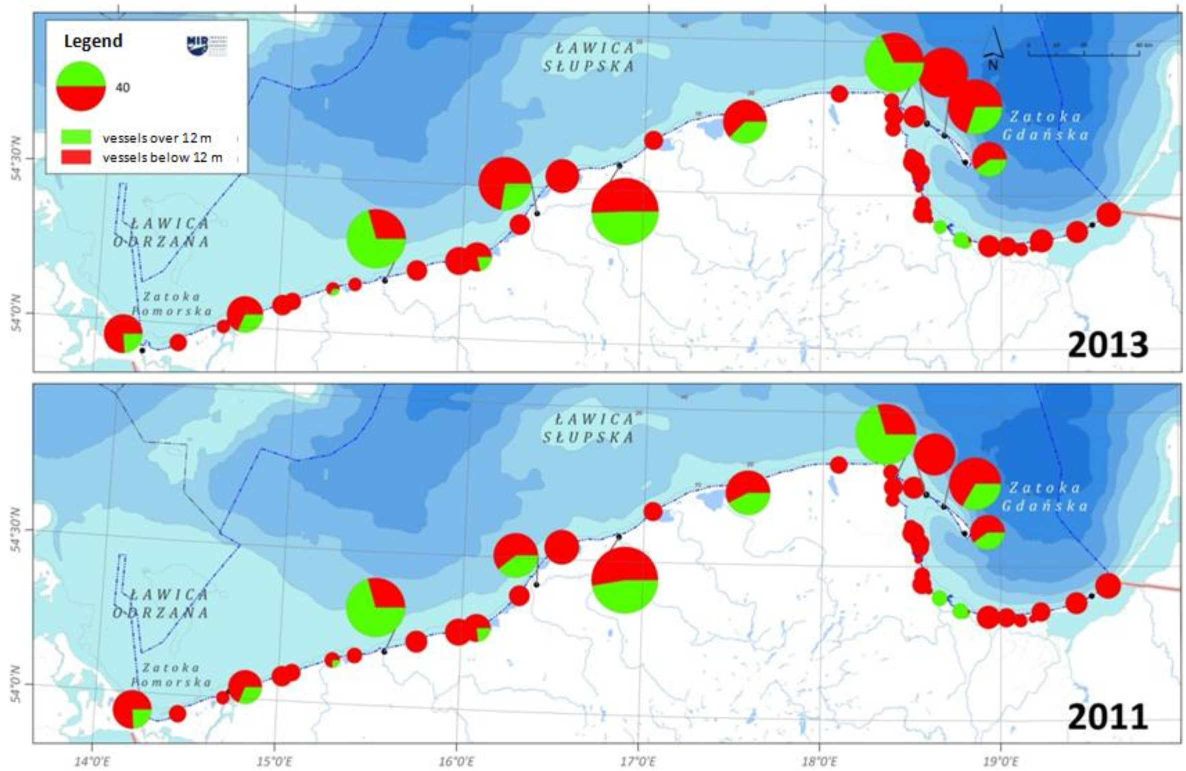

Fig. 6.45. Number of registered vessels

The place of registering does not necessarily reflect the operating area of the fishing vessels. Especially, in case of the over 12 m vessels the fishing area and the port of unloading can change during the year. The volume of unloaded fish is also influenced by foreign vessesls. In 2013 over 94 thousand tons of fish were landed in Polish seaports and havens. The dominant species in terms of quantity were sprat, herring, cod and flounder. In comparison with previous years, the scale of fish landing has not changed in spite of administrative restrictions on the number of fishing vessels and the possibilities of carrying out fishing operations. Detailed data on the number of fishing vessels, divided into craft of up to 12 m length and longer vessels, and also fish landing data for the period 2011-2013, with division between vessels below and over 12m length, between ports/havens and between fish species are given in tables in Annex 12 and shown in map form in Figs. 6.46 and 6.

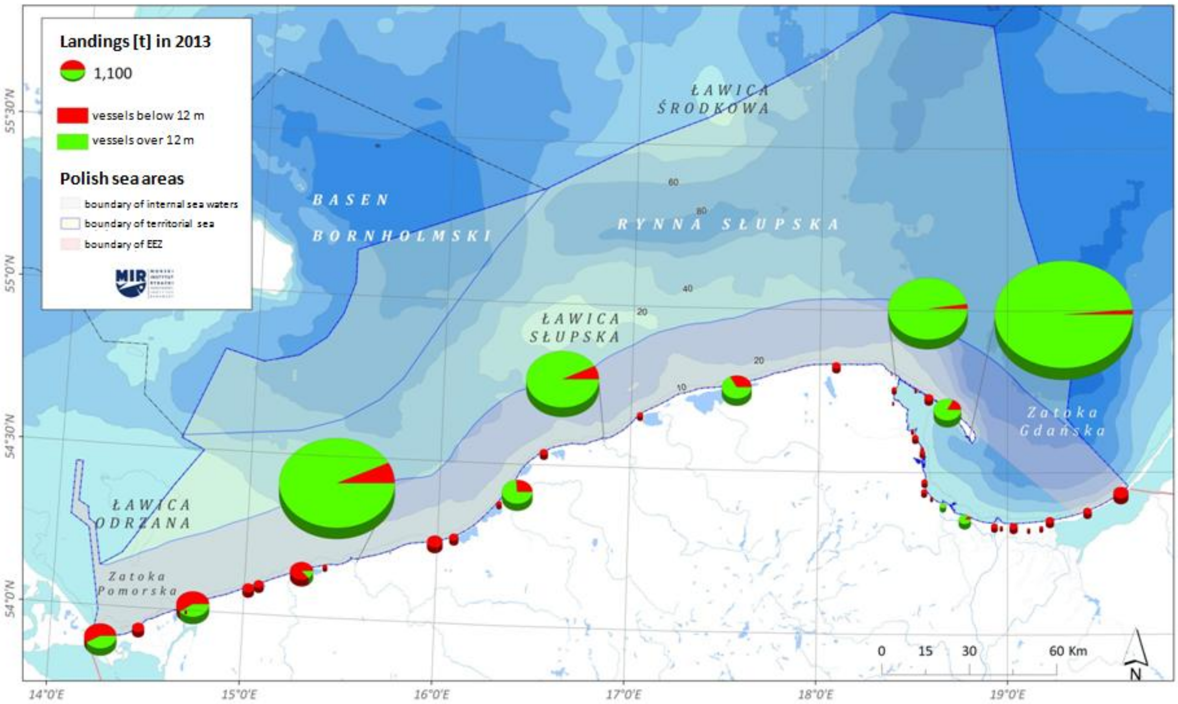

Fig. 6.46. Total landings [t] in 2013 divided into the vessel lengths (up to and exceeding 12 meters)

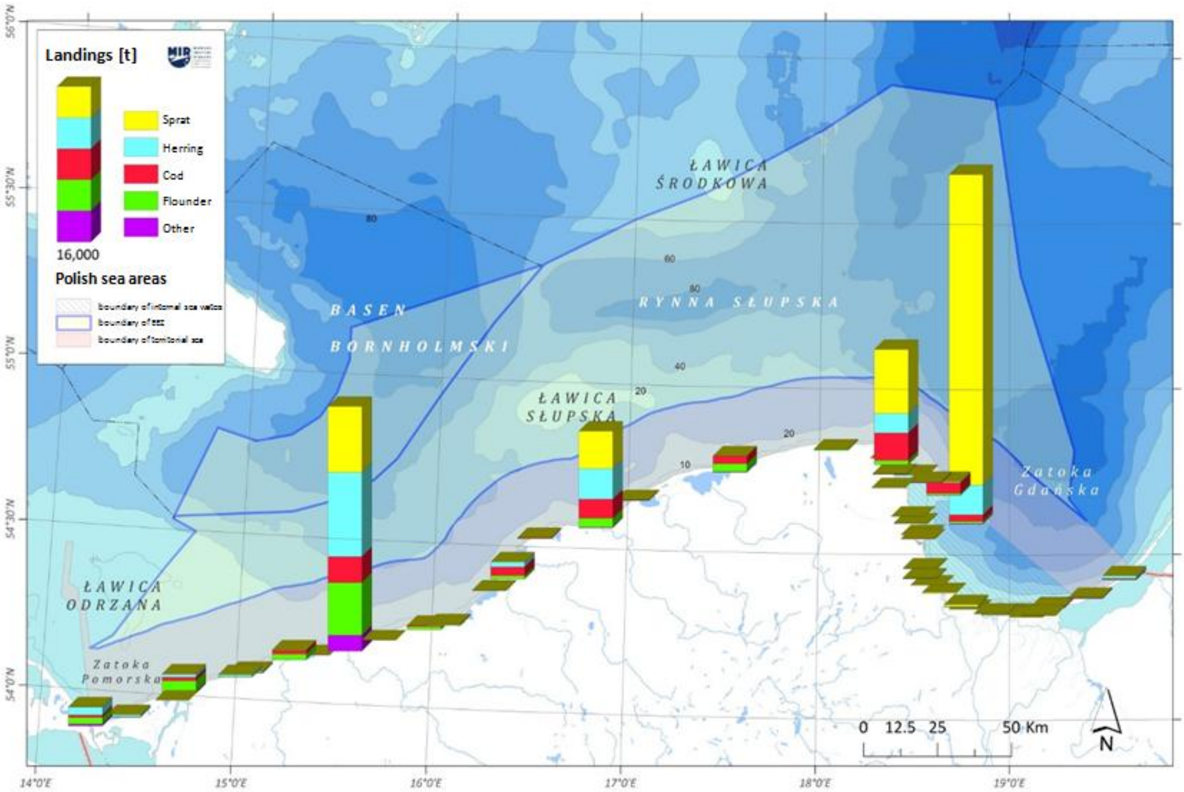

Fig. 6.47. The total landings [t] divided by fish species

When analysing the importance of fishery to the economy of coastal municipalities, attention should be paid to the complexity of this sector, which develops in an area of contact of processing industry, transport and hunting (fishing). Local authorities recognize the potential of fishery, however, limitations of the statistical system do not take into account the added value resulting from regional promotion, maintaining secondary industries such as production of equipment, repair services, commerce, local gastronomy, etc. During investigations, carried out in 2004 by the National Marine Fisheries Research Institute, authorities of selected coastal municipalities were asked to fill a questionnaire concerning the estimated share of fishery in the income of the municipality. Most of the respondents estimated the share at 5-10%, though hard data on revenue from taxes paid by shipowners and fish processing companies showed less than 1%. In case of Krynica Morska, the official data showed the shares at the level of 0.005%, though the Mayor of the city estimated that 3-5% of the income of the municipality is generated indirectly by other branches linked with the existence of fishery in the municipality. In order to determine the real influence of fishery on the economy of coastal municipalities, surveys or direct standardised interviews should be carried out. This is much needed, because the last survey was 10 years ago, and during that time not only fishery changed (reduction of the fishing fleet by about 40%; the fish processing sector became independent of catch by the Polish fishing fleet), but also the attitude of municipalities towards the use of ports and havens (municipalisation, increased investments using EU funds).

Taking into account the results of the 2004 survey, the reduction of the fishing fleet and the transfer of fish processing further inland outside the coastal area, it can be assumed that the fishery sector has a 1-5% share in the income of coastal municipalities. This would mean that the income of local selfgovernments generated by fishing and fish processing in the 32 municipalities is on the level of 57.5 to 287 million PLN per year[58].

The number of businesses listed in Section A Part 03 - "Fishery" of the Polish Classification of Activities in relation to the total number of businesses in coastal settlements can also be a measure of importance of fishery in the coastal area. Data of the Central Statistical Office in Warsaw show that this relation varies from 0.2% (3/1362) in Puck to 22% (9/41) in Mechelinki[59].

The number of registered business entities is helpful in assessing employment. In case of fishing boats 2 to 3 persons per boat are involved, the crew on cutters is 3 to 5 per vessel. Simple calculation would allow assuming that 1417-2195 people are dependent on direct fishing activities. More precise estimates made by Szostak [2013] indicate that on operating in the Baltic Sea Polish fishing vessels, worked 2.3 thousand people. However, these calculations did not take into account the onshore services, often realised by the families of the fishermen, which were not registered. On the basis of the Multiannual Fishery Data Collection Programme (MFDCP) the number of people employed in fishery was estimated by Kuzebski et al ,(2013). Including the Szczecin and Vistula Lagoons in 2012 directly in fishing activities were employed 2386 people, and in the onshore services approx. 545 people. Analysis of official data of the Central Statistical Office in Poland (GUS) and of the estimated employmentin the fishery sector in the coastal municipalities shows that officially employed people in fishing and fish processing represent 0.6% of the population and 2.3% of work places in coastal communities. In three coastal municipalities (Będzino, Choczewo and Wolin) there are no people officially employed in sea fishing or fish processing. Fig. 6.48 presents the level of employment in the fishery sector in each coastal municipality.

[58] On the basis the Local Data Bank of the Central Statistical Office of Poland (2012)
[59] Data from 2011

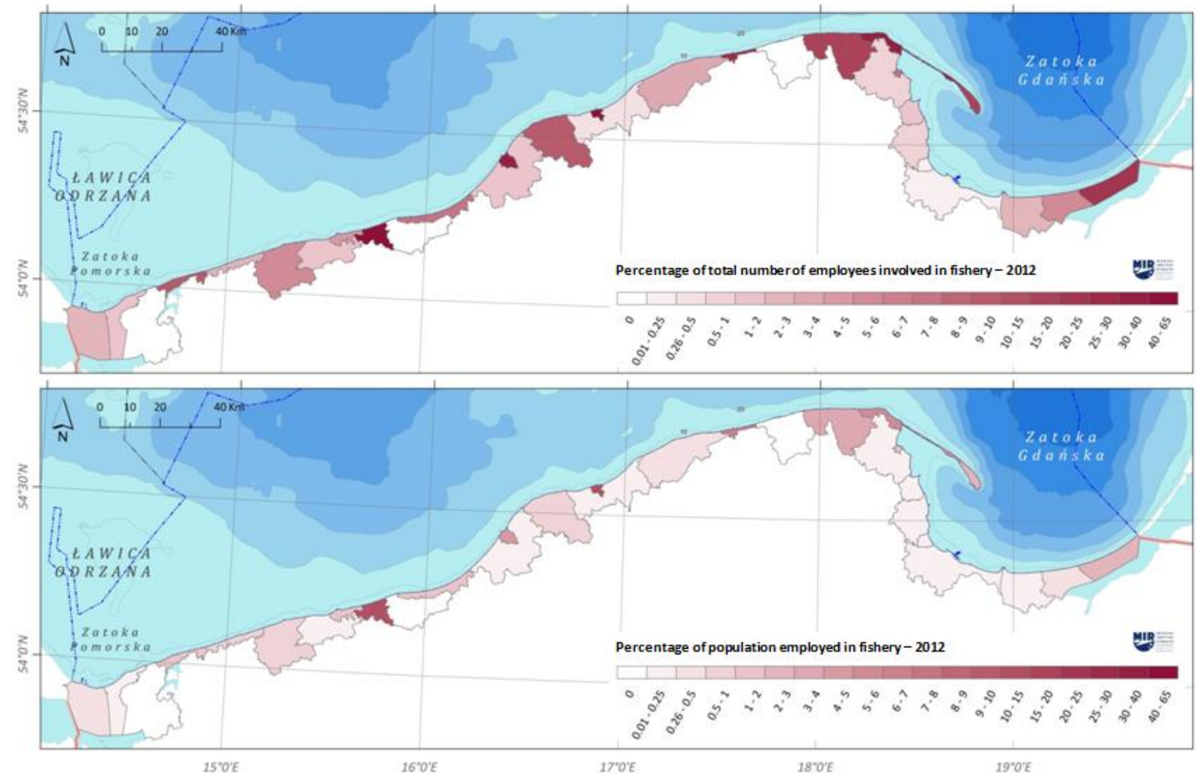

Fig. 6.48. Estimated employment in fishery in relation to the population and to total employment in coastal municipalities (data for2012)

Working out of scenarios for the influence of changes in the use of sea space on the development and fucntioning of ports/havens and local communities is limited by insufficient information about fishing activities and their links with the local communities. There is also a lack of up-to-date studies on the impact of fishery on the economy of coastal municipalities and of accurate data on employment in the local ports and havens. Monitoring of changes of port infrastructure and information on investment plans of subjects operating in the ports are also insufficient. Most of the data is obtainedthrough informal contacts of researchers,documented in accordance with individually established criteria, and are incomplete, which effectively prevents their objective comparison.

In order to create a base of comparable data on the impact of fishery on the functioning of ports/havens and municipalities, **personalised interviews with ship operators, fish producer organisations, port authorities, municipal authorities and specific departments of maritime offices should be carried out.**

Information on on-shore employment, income of municipalities generated by each activity of the maritime sector, development plans of ports and havens, development plans of operating in them subjects and on the priorities of the municipalities should be collected.

Conclusions for the maritime spatial plan of Polish sea areas:

- In most of the local ports and havens fishery is the only year-round economic activity. In many cases servicing fishery determines the existence of the port.
- As a hunter activity, fishing needs access to a relatively large sea area, which would allow the

use of various fishing techniques, the possibility of following fish schools and free access to selected places of landing.

- The areas in which fishing vessels operate are not necessarily the same as places where they are registered - especially in case of 15 m vessels, which may use several ports during a year.
- Fishing with passive tools requires ensuring space for such activity within approximately. 6Nm from the coast.
- Concentration of fishing services in ports (new landing/handling centres) gives a chance to develop new functions, especially linked with tourism, and at the same time generates further development of port infrastructure.

Knowledge gaps

There is a lack of information on employment in on-shore fishery services and on the influence of fishery on development of other, linked activities.

Information on investments in local ports and havens is outdated.

Information on employment on land, income of municipalities generated by the various activities of the marine sector, development plans of ports and of operating in them subject, and also on the priorities of municipalities are not gathered in a systematic way. Standardised interviews with ship operators, fishproducer organisations, port authorities, municipal authorities and adequate departments of maritime offices departments should be carried out in order to collect comparable data on the siginificance of fishery.

6.4 Fish protection areas, limitations on fishing

Within the framework of the EU Common Fisheries Policy (regulating fishing in the territorial sea and in the Polish EEZ) the minimum landing sizes, closed seasons as well as the detailed conditions for conducting fishery for certain species of fish (cod, herring, sprat, plaice, salmon) are defined. In cases unregulated under the CFP (including catches in the internal sea waters), the landing sizes and closed seasons, types and quantities of fishing gear and their design as well as the way fishing is executed, are regulated by the Minister responsible for fisheries, by means of Ministerial Orders, taking into account the protection and rational utilization of marine living resources.

The most important documents applicable to Polish sea areas are as follows[60]:

- Council Regulation (EC) No 2187/2005 of 21 December 2005 on Conservation of fishery resources in the Baltic Sea, the Belts and the Sound through technical measures and amending Regulation (EC) No 1434/98 and repealing Regulation (EC) No 88/98 (Official Journal. EU L 349, 31.12.2005)
- Council Regulation (EC) No 1098/2007 of 18 September 2007 on establishing a multiannual plan for the cod stocks in the Baltic Sea and the fisheries exploiting those stocks, amending Regulation (EEC) No 2847/93 and repealing Regulation (EC) No 779 / 97 (Official Journal. EU L 248, 22.9.2007)
- Regulation of the Minister of Agriculture and Rural Development on minimum landing sizes and closed seasons for marine organisms and detailed conditions for conducting marine fisheries of 4 March 2008, with later amendments (JoL of 2008 No. 43, item. 260, No. 66, pos. 407, No. 88, poz.538, No. 103, poz.663, No. 225, item. 1498; 2009, No. 65, item. 549; 2010, No. 71, pos. 460; the 2011 , No. 220, item. 1305; the 2013, poz.1545, from 2014, pos. 646)
- Standing orders of the District Sea Fisheries Inspectors[61].

[60] A full description of the documents is given in Annex 12

Protected Areas

- Regional Sea Fisheries Inspectorate Gdynia***:***

  Standing order No. 1/2010 of the Regional Sea Fisheries Inspector in Gdynia of 1 June 2010 on minimum landing sizes and closed seasons for marine organisms and detailed conditions for conducting marine fisheries in the internal sea waters of the Gulf of Gdańsk (*Official Journal* of Laws of *Pomeranian Voivodship No. 89, item. 1693),*

  with later amendments:

  Standing order No 2/2011 of the Regional Sea Fisheries Inspector in Gdynia of 17 October 2011 (*Official Journal* of Laws of *Pomeranian Voivodship No.* 141, item. 2898)

  Standing order No 1/2012 of the Regional Sea Fisheries Inspector in Gdynia of 28 May 2012 (*Official Journal* of Laws of *Pomeranian Voivodship,* item. 1889)

- Regional Sea Fisheries Inspectorate Słupsk:

  Standing Order No. 1/2004 of the Regional Sea Fisheries Inspector in Słupsk of 1 July 2004 on the establishment of protection zones and the detailed conditions for conducting marine fisheries (Official Journal of Laws of West-Pomeranian Voivodship No. 52, item. 954; *Official Journal* of Laws of *Pomeranian Voivodship No. 88, item. 1618),*

  with later amendments:

  Standing Order No. 1/2013 of the Regional Sea Fisheries Inspector in Słupsk of 5 April 2013 (Official Journal of Laws of West-Pomeranian Voivodship Item. 1454).

- Regional Sea Fisheries Inspectorate Szczecin:

  Standing Order No. 3/2004 of the Regional Sea Fisheries Inspector in Szczecin of 20 October 2004 on the establishment of protection zones and the detailed conditions for conducting marine fisheries (Official Journal of Laws of West-Pomeranian Voivodship No. 82, item. 1436),

  with later amendments:

  Standing Order No. 1/2005 of the Regional Sea Fisheries Inspector in Szczecin of 24 November 2005 (Official Journal of Laws of West-Pomeranian Voivodship No. 94, Item. 1920);

  Standing Order No. 1/2007 of the District Sea Fisheries Inspector in Szczecin of 20 November 2007 (Official Journal of Laws of West-Pomeranian Voivodship No.119, Item. 2161),

  Standing Order No. 2/2011 of the District Sea Fisheries Inspector in Szczecin of 27 June 2011 (Official Journal of Laws of West-Pomeranian Voivodship No. 77, Item. 1453).

Minimum sizes and closed seasons

- Regional Sea Fisheries Inspectorate Gdynia***:***

  Standing Order No. 1/2010 of the Regional Sea Fisheries Inspector in Gdynia of 1 June 2010 on minimum landing sizes and closed seasons for marine organisms and detailed conditions for conducting marine fisheries in the internal sea waters of the Gulf of Gdańsk (*Official Journal* of Laws of *Pomeranian Voivodship No. 89, item. 1693),*

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[61] The legal status may be subject to annual, minor modifications. Due to the biological and fishing situation variability in different places and periods, Inspectorates can change the place and duration of the established protection zones or establish new ones. The information is published in the official journals of the Voivodships.

with later amendments:
Standing Order No 2/2011 of the Regional Sea Fisheries Inspector in Gdynia of 17 October 2011 (*Official Journal* of Laws of *Pomeranian Voivodship No.* 141, item. 2898)

Standing Order No 1/2012 of the Regional Sea Fisheries Inspector in Gdynia of 28 May 2011 (*Official Journal* of Laws of *Pomeranian Voivodship Item. 1889).*

- Regional Sea Fisheries Inspectorate Słupsk:

  Standing Order No. 2/2004 of the Regional Sea Fisheries Inspector in Słupsk of 1 July 2004 on the minimum landing sizes and closed seasons for marine organisms in the internal sea waters (Official Journal of West-Pomeranian Viovodship No 52, Item. 955; Official Journal of Pomeranian Voivodship No. 88, Item. 1619)

  with later amendments:

  Standing Order No. 1/2014 of the Regional Sea Fisheries Inspector in Słupsk of 7 April 2014 (Official Journal of West-Pomeranian Viovodship Item. 1592; Official Journal of Pomeranian Voivodship Item. 1491).

- Regional Sea Fisheries Inspectorate Szczecin

  Standing Order No. 1/2011 of the Regional Sea Fisheries Inspectorate in Szczecin of 25 May 2011 on the minimum landing size and closed seasons for marine organisms (Official Journal of West-Pomeranian Viovodship No. 68, Item. 1210).

Recreational fishing

Recreational fishing is subject to the aforementioned Standing Orders of RSFI.

- Ordinance of the Minister of Agriculture and Rural Development on detailed conditions of sport and recreational fishing and formats of sport fishing permissions of 9 July 2004, with later amendments (JoL No. 164, Item. 1725; JoL of 2011, No. 87, Item. 490).;
- in accordance with art. 28 of the Act on Fisheries of 19 February 2004, as amended (JoL No. 62, item. 574, 2005. No. 96, pos. 807, 2006. No. 220, item. 1600; 2007. No. 21, pos. 125; 2009. No. 18, pos. 97, No. 92, pos. 753, No. 168, item. 753, No. 168, item. 1323; from 2011. No. 34, pos. 168, No. 106, item. 622, from 2014. item . 822), in cases not covered by this Act, if it is necessary for the protection of living marine resources and to preserve order in fishing, Regional Sea Fisheries Inspectors can issue standing orders, containing specific behaviour obligations or prohibitions.

On this basis, each year are issued temporary bans on sport and recreational angling in connection with artificial restocking activities.

During the last few years the Regional Fishing Inspector in Słupsk issued temporary angling bans in the ports of Ustka, Łeba, Rowy, Kołobrzeg and Darłowo, because of of spring stocking with trout smolts on the Słupia, Łupawa, Łeba, Parsęta and Wieprza rivers. This is just additional information since port areas are not included in the territorial scope of this Study.

The Regional Sea Fisheries Inspector in Szczecin, due to stocking activities, issued temporary bans covering, apart of the Mrzeżyno port waters, also the permanent protection area at the mouth of the Rega river.

In the last few years, the closed seasons were imposed, as follows:

- from April 29th 2011 to May 28th 2011,
- from April 28th 2012 to June 3rd 2012,
- from May 13th 2013 to June 14th 2013,
- from May 8th 2014 to June 15th 2014,

(in acc. with: - Standing Order No. 1/2011 of the Regional Sea Fisheries Inspector in Szczecin of 26 April 2011 (Official Journal of West-Pomeranian Voivodship No. 56, Item. 1015);
- Standing Order No. 1/2012 of the Regional Sea Fisheries Inspector in Szczecin of 26 April 2012 (Official Journal of West-Pomeranian Voivodship Item. 959);
- Standing Order No. 1/2013 of the Regional Sea Fisheries Inspector in Szczecin of 9 May 2013 (Official Journal of West-Pomeranian Voivodship Item. 1958);
- Standing Order No. 1/2014 of the Regional Sea Fisheries Inspector in Szczecin of 28 April 2013 (Official Journal of West-Pomeranian Voivodship Item. 1898);

Port regulations etc.

In accordance with Art. 48 of the *Act on sea areas of the Republic of Poland and maritime administration* of March 21, 1991, with later amendments (uniform text Journal of Laws of 2013, item. 934) in matters not solved by existing regulations, if it is necessary to protect life, health or property, for marine environment protection in the area of sea port or haven, in the technical belt, and also for the needs of safety of navigation and sea ports – the Director of a Maritime Office may establish, based on art. 42 par. 2, ordinances containing specific behaviour obligations or prohibitions.

Ordinance of the Minister of National Defence

- Ordinance of the Minister of National Defense Republic of Poland of 3 April 2014 on zones closed to navigation and fishing in Polish sea waters (JoL, Item, 482)

The spatial distribution of the above mentioned restrictions is presented in Fig. 6.49.

Fig. 6.49. Area restrictions on fishing

During the second consultation meeting, the representative of the Central Pomeranian Fishing Group proposed a change in the position of the 'Area 1' indicated in Council Regulation (EC) No 1098/2007 to an area with the following geographical coordinates:

a. 55° 05,00' N 16° 10,00' E
b. 54° 57,50' N 15° 58,00' E
c. 54° 50,00' N 15° 30,00' E
d. 55° 20,00' N 15° 30,00' E
e. 55° 20,00' N 16° 10,00' E

The experience of fishermen shows that the area indicated above better protects cod spawning in the Baltic Sea. Alternatively, it was proposed to designate that area along the 60 m depth contour.

Conclusions for the maritime spatial plan of Polish sea areas

- An area with the following coordinates

  a. 55° 05,00' N 16° 10,00' E **c.** 54° 50,00' N 15° 30,00' E **e.** 55° 20,00' N 16° 10,00' E
  b. 54° 57,50' N 15° 58,00' E **d.** 55° 20,00' N 15° 30,00' E

  in accordance with the fishermen assessment, is more valuable for fishing since it provides better protection for cod spawning than the currently indicated in Council Regulation (EC) No. 1098/2007 'Area 1', and this issue should be a priority for fisheries.

Guidelines:

In view of introduction of the new Act on fisheries at the beginning of 2015 (adopted on 12.19.2014, signed 01.29.2015 - JoL 2015., Item. 222); a revision of this Study will be necessary.

7. CONDITIONS ARISING FROM DEVELOPMENT OF SHIPPING AND PORTS

7.1. Strategy of development of transport until 2020

The strategy of development of transport until 2020 (with 2030 perspective) contains the following actions concerning maritime transport [MTBiGM, 2013a]:

- Development of infrastructure in sea ports and in their hinterland, on both the land and the sea side:
  - strengthening of maritime transport links of Poland with the world by developing the deep water infrastructure of seaports (fairways) and increasing cargo handling potential of the existing seaports;
  - development of road and rail land corridors and of some inland water routes ensuring better transport accessibility to seaports from land;
  - development and modernisation of port infrastructure aimed at, inter alia:
    - improving the energy safety of Poland and cooperation in implementation of priorities of EU energy policy (e.g. development of outer port in Świnoujście including building of the LNG Terminal by 2014);
    - adaptation of seaports to market needs (inter alia, construction of deep water berths for containerised general cargo and Ro-Ro);
    - limiting the negative impact of ports on environment (improved availability of port reception facilities);
- Strengthening of the economic function of seaports:
  - diversification of services offered by the ports and fitting them to market needs;
  - active participation of seaports in development of intermodal transport and cooperation of port managements with operators of intermodal terminals;
  - participation of ports in social and economic development of municipalities and port areas;
- Increasing importance of marine navigation in the cargo transport chain and in passenger transport:
  - creation of conditions for the return of Polish ship-operators under Polish flag and renewing of their tonnage, including preparation of a package of legal instruments;
  - promotion of development of short-sea shipping as a form of transport preferred by the European Union;
  - improvement of standards of safe navigation and fulfilment of international requirements related to protection of marine environment;
- Improvement of competitiveness of Polish ship-operators on the shipping market while maintaining a high level of maritime safety and marine environment protection:
  - creation of conditions favouring the development of ferry navigation, including its participation in intermodal transport;
  - development of an effective strategy of further development of Polish liner shipping businesses, adaptation of their offer to the needs of the European short-sea shipping market;
  - creation of platforms of cooperation of ship-operators and maritime academies, active promotion of seafarer's profession;
  - participation in EU initiatives aimed at transferring cargo transports from land to sea;
  - facing up to new challenges of European sea shipping such as evolution of market conditions (inter alia, extension of the EU internal market onto maritime transport), environmental protection and energy policy of the European Union.

Thus, the strategy assumes development of ports and shipping. This concerns large as well as small and medium ports. According to the provisions of the strategy “in the case of smaller Polish seaports, the priority for development until 2020, and in further perspective, will be to strengthen the economic functions of these ports and strengthen their role as important focal points of local and regional development. Opportunities for development of small sea ports and havens should be seen, apart of the traditional function of serving sea and lagoon fishery, in servicing passenger traffic, yachting and tourism. A key role in further development of these ports should be played by municipalities in the areas of which the ports are located. In the case of medium ports, in which transport functions are also being developed (cargo handling and storage), initiatives aimed at boosting their cargo traffic (development of port and access from land and sea infrastructure) will be undertaken while respecting the development of other economic functions of the ports".

For the purpose of implementing the strategy, a concept of developing approaches to Polish sea ports has been worked out, and its details are included in the programme: Development of Polish sea ports until 2020 (with 2030 perspective) [MTBiGM, 2013b]. This Programme includes, inter alia, the most important investment tasks necessary for the development of the ports. From the point of view of maritime spatial plans, the most important investments are listed under Priority 1 (Development of port infrastructure and of infrastructure providing access to ports from the sea) in Objective 1 (Adaptation of service offer of sea ports to changing market needs). When developing maritime plans also other investment goals need to be considered, e.g. concerning the improvement of connection of ports with their hinterland or development of infrastructure inside the ports, since they can result in a higher volume of import and export cargo handled by the ports. The Programme also indicates that two ports, i.e. Gdynia[62] and Gdańsk[63] will be enlarged using the marine space. In August 2014, the implementation document for the Transport Development Strategy until 2020 (with a view to 2030) was adopted [MIiR, 2014]. It contains a list of priority investments which will be realised until the available funds become exhausted. Implementation priorities will be indicated after determining precise allocation from the EU funds for transport for the period 2014-2020. Among these investments are 50 maritime projects for an amount of over 11 bln PLN. Besides modernisation of fairways and improvement of breakwaters of the North Harbour in Gdańsk, most of the investments listed in the implementation document are outside the sea area covered by this Study. The most important investment plans are discussed further in this chapter.

7.2. Navigation

Based on the report "Monitoring of ship traffic in the Polish EEZ, territorial sea and internal sea waters", B. Hac, Department of Operational Oceanography of Maritime Institute in Gdańsk, 2014 – Annex 13 (in Polish)

According to the United Nations Convention on the Law of the Sea (UNCLOS), navigation on the seas (excluding internal sea waters) is free. However, there are important departures from this rule. In confined regions, i.e. where customary navigation routes meet or cross and where intensity of traffic requires rigorous regulation, the traffic may be regulated by decisions of the International Maritime Organization (IMO). In agreement with IMO, local maritime administrations (in Poland, the

[62] Further extension of Gdynia Port will require new areas acquired either from other entities or in the form of landfil in sea area "outside the existing breakwater".

[63] "In case of the Port of Gdańsk, projects concerning modernisation of North Port fairway are necessary to allow for further development of cargo handling terminals, in particular the container terminal. Also, the concept of port development in the sea area outside the North Peninsular Breakwater, referred to on a working basis as the Central Port".

Maritime Offices in Gdynia, Słupsk and Szczecin) establish Traffic Separation Systems (TSS), zones covered by special technical supervision (Vessel Traffic Service – VTS), where vessels are required to report all their manoeuvres, entering and leaving the zone, passing of successive reporting points. In these regions rigorous vessel traffic supervision systems are operating (similar to the ones used in aviation) in which the traffic control centre continuously monitors the safety of vessel traffic and interferes into decisions taken on board a vessel by ordering changes of speed, direction or route.

In open sea areas, outside the TSS and VTS zones, shipmasters are not subordinate to decisions of traffic supervision centres and may take free decisions on the course and route they will sail on, unless there is a rescue operation in the area they are in and they are involved in it by the Rescue Coordination Centre, or any other operations are performed, e.g. military training or construction work at sea, etc. In such a situation, they should immediately obey the decisions issued by the supervision of these actions announced by the NAVTEX (Navigational Information Communication System). In other situations, they should follow good sea practice and indications of local sailing directions.

The Baltic Sea is a region with particularly high intensity of vessel traffic, with large number of vessels navigating on its waters at the same time. This region, and in particular, the region of Danish Straits and their approaches, is among the areas with the highest intensity of vessel traffic in the world. In order to reduce the number of collisions and marine accidents, and to make the traffic more fluent, a series of regulations was introduced, consisting in, inter alia, the creation of traffic separation schemes, mandatory fairways to sea ports, recommended routes and Traffic Control Systems distributed over the whole area of the Baltic Sea. In Poland, traffic separation systems are established in the Gulf of Gdańsk and south of the Słupsk Bank. At present the VTS Control System covers areas around the largest ports, i.e. ports of the Tri-City and Szczecin-Świnoujście (Gulf of Gdansk and Pomeranian Bay), but is planned to cover all the Polish sea areas.

Despite the high density of vessel traffic in the whole area of the Baltic Sea, the route by which a vessel may sail from port to port can still be chosen quite freely. This concerns the areas outside the mandatory shipping routes. In view of the current tendency of making vessel movement more orderly, it should be assumed that the traditional concept of "free navigation" is slowly becoming a thing of the past. However, for economic reasons, throughout the years, a part of the routes became customary shipping routes. They allow optimising the time of transfer between the departure and destination ports while maintaining the required level of safety. For these reasons, the customary routes also fulfil an important role similar to the recommended routes, traffic separation systems and fairways. They are subject to specific standards of protection. For example, UNCLOS states that "artificial islands, installations and structures and the safety zones around them may not be established where interference may be caused to the use of recognized sea lanes essential to international navigation" (Article 60). On the other hand, navigation is a relatively mobile (easy to move) use of sea space. However, changes of navigation routes usually are connected with changes of shipping costs, i.e. costs of the private sector.

Fig. 7.1 shows the distribution of navigation routes and directions in the southern Baltic Sea, in that within the Polish EEZ, territorial and internal sea waters.

Route A is the main navigation route for international traffic through the Baltic Sea from the western Baltic Sea (Arkona Basin) to Finland, Sweden, Estonia, Latvia and Russia. It is the commonly used route on the Baltic Sea – sailed by 53 thousand vessels every year. These are mainly cargo ships (60%), tankers (15%) and others (25%).

Route B is the main international navigation deep water route to Gotland, connecting two traffic separation systems in the north (Kopu Peninsula) and in the south (Bornholm Strait). This route is used mainly by tankers (67%), freight ships (15%) and others (18%). It is used by 5,100 vessels every year.

Route C is an often used route passing between Gotland and the mainland (Scandinavian Peninsula) and the Oland Island. It leads to Stockholm and further to the ports of the Gulf of Bothnia. It is sailed by 18,000 vessels every year. It is a branch of route A.

Route D connects the ports of the Gulf of Gdańsk with the Bornholm Strait. It is used mainly by medium-sized tankers and merchant vessels (bulk cariers). In 2013, it was used by 398 vessels (17.5% tankers, 53% merchant, other 22%).

Route E goes south of the South Middle Bank, connecting Klaipeda with the ports of the south Baltic Sea – mainly Świnoujście, Sassnitz and Mukram. It is used mainly by rail and cargo ferries (Mukram-Kłajpeda) and cargo ships. In 2013 it was used by 893 vessels (1.5% tankers, 38.5% merchant ships, 23% high speed ferries, 32% other).

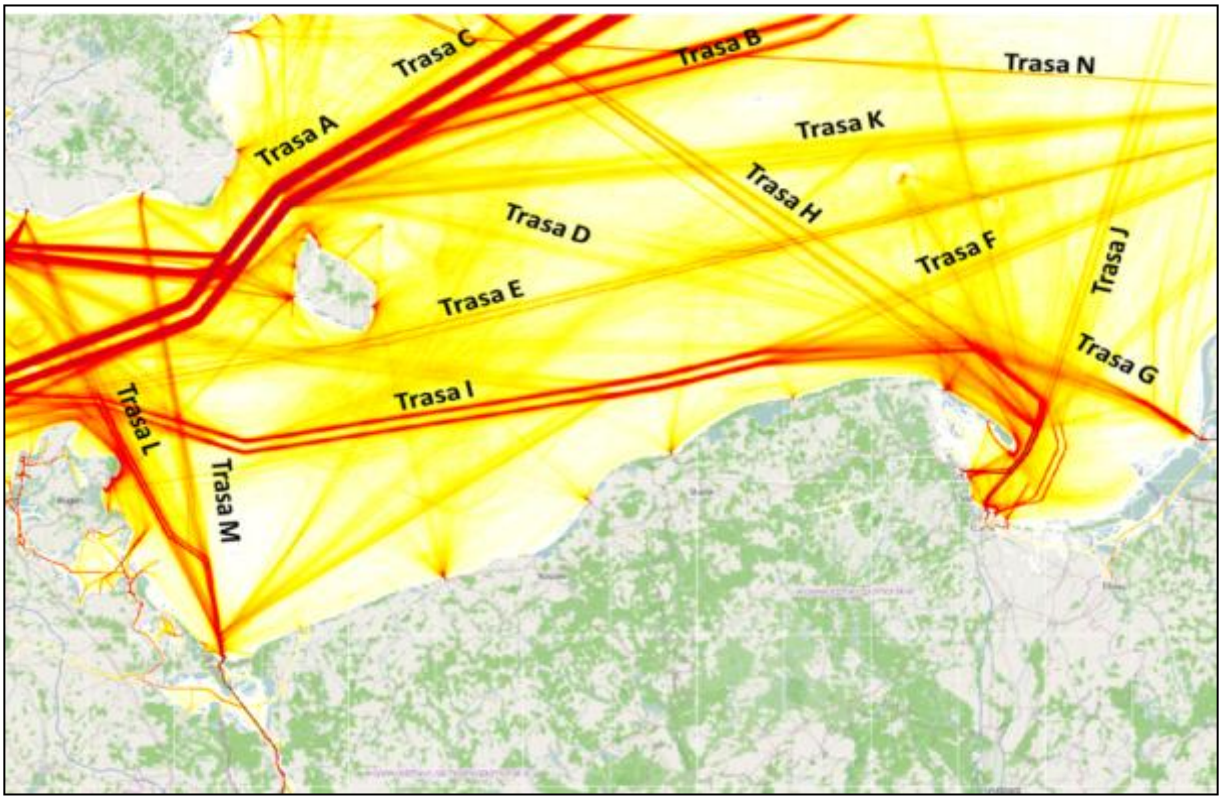


Fig. 7.1. Distribution of major and customary shipping routes in the southern Baltic Sea and the distribution of intensity of traffic of vessels equipped with AIS systems based on data collected during 1 year (from 01.01.2013 to 31.12.2013)[64]

[64] Illustrations in subchapter 7.2 are from Annex 13

Route F is a navigation route which is a northern branch of the route leading from the region of the Danish Straits into the area of Gulf of Gdańsk. After leaving the Słupsk Bank TSS, vessels sail to the ports of Lithuania and Latvia. In 2013, it was used by 755 vessels (6.5% tankers, 63.4% merchant ships, 4% Special Purpose Ships, 26% other).

Route G is a northern branch of the route leading from the region of the Danish Straits into the area of the Gulf of Gdańsk and further to Kaliningrad and Baltiysk. After leaving the Slupsk Bank TSS, vessels sail to the ports of the Kaliningrad Oblast. In 2013 it was used by 2,010 vessels (23.3% tankers, 54.4% merchant ships, 2.5% Special Purpose Ships, 19.4% other).

Route I is another often used route which passes south of Bornholm and leads to the Polish and Russian ports of the southern Baltic Sea. In 2013, it was used by 6,686 vessels (16.7% tankers, 44.4% merchant ships, 1% passenger ships, 6.7% Special Purpose Ships, 30.6% other).

Route J leads from the region of the Gulf of Gdansk Bay the Gulf of Finland. After leaving the traffic separation zone on the Gulf of Gdansk, vessels go north-east to the ports of Finland, Estonia, Russia. In 2013, it was used by 792 vessels (11% tankers, 19.3% merchant ships, 3% passenger ships, 2.5% Special Purpose Ships, 64.2% other).

Route K is an often used east-west route passing north of Bornholm. It goes out from Route A and leads to the Lithuanian and Latvian ports. It runs south of the Middle Central Bank. In 2013, it was used by 653 vessels, mainly cargo ships (60%), tankers (12%), 17.5% different vessels and other.

Route L leads from the region of Pomeranian Bay and Szczecin-Swinoujscie port complex towards the Danish Straits. After leaving the Świnoujście fairway, vessels sail to north-west to Ystad or towards the Danish Straits. In 2013, it was used by 5,175 vessels (6.3% tankers, 24.8% merchant ships, 13.5% passenger ships, 9.4% Special Purpose Ships, 39.2% different-type vessels and other).

Route M is an often used the south-north route passing west of Bornholm. It connects the ports of Swinoujscie in Poland and Karlshamn in Sweden. It is mainly used by passenger-cargo ferries, special purpose vessels and vessels of other purpose. In 2013, it was sailed by 3,819 vessels. These were mainly ro-pax – 35.7%, Special Purpose Ships – 17.6%, and other 46.5%.

Route N leads north of the South Middle Bank and connects the western Baltic Sea with Klaipeda, and is mainly used by large tankers.

Different types of vessels usually sail along different routes[65]. Ferries sail on fixed routes (Fig. 7.2), fishermen[66] (Fig. 7.3) sail to the fishing grounds from and to ports of refuge and discharge of fish (the distribution of routes of fishing vessels shows that the area of the Polish EEZ is the most attractive fishing area for the fishers). Figures 7.4 and 7.5 indicate that merchant ships and tankers use mainly the recommended routes, recreational vessels move freely (Fig. 7.6), while passenger ships, except large cruisers, sail along similar routes as ferries.

The coastal fleet operating in the Polish sea areas in 2012 consisted of 28 passenger vessels of total 5,400 gross tonnage. Coastal fleet ship-owners and ship-operators focus mainly on passenger transport, cargo carriage was not in the past, and still is not, the main object of interest. Passenger

[65] For detailed analysis see Annex 13

[66] Only large vessels were monitored with AIS

traffic in coastal shipping is dominated by domestic navigation. In 2012 coastal passenger transport amounted to 509,000 passengers. In accordance with the Regulation introducing the provisions of the Directive of the European Parliament and the Council 2009/45/EU of 6 May 2009 on safety rules and standards for passenger ships, the area of passenger ships operating the so-called “small passenger traffic” has been divided into four zones. The classification of vessels transporting passengers into four types of sea areas (A, B, C, D) allowing navigation with passengers on board brings order to the legal situation of these vessels. The result is concentration of the local tourist traffic in the regions of local ports. Hence, traffic of small vessels in tourist shipping concentrates in coastal waters. This is due to the fact that the marinas, or places where a vessel can moor safely, are located along the Polish coast, and also because a great majority of sail and motor vessels is small (less than 20m long) with significant limitations of sailing range. A large proportion of yachts may sail only within 20 Nm from the coast. This is because they have only basic radio equipment – GMDSS.

Fig. 7.7 shows routes and intensity of traffic of Special Purpose Ships, i.e. mainly research vessels, State services’ vessels (Border Guard, Fishery Inspection) and vessels servicing drilling platforms and installations of Lotos/Petrobaltic. It shows that the number of voyages with supplies, of equipment and personnel for the platforms from the port in Gdansk and particularly intensively from Władysławowo, completely changes the map of traffic in this area. This raises the status of the port in Władysławowo due to its importance in the chain of supplies and as a logistics base for offshore industry.

There are also attempts to create the so-called Motorways of the Sea. The main idea and purpose of their creation is to improve the use of the existing sea transport lanes or possibly to create new regular short sea shipping connections. Emphasis is placed on reducing the loading of the land transport routes currently used mainly by road transport. For a connection to achieve the status of a motorway of the sea it must connect two ports of A category in the TEN-T network.

A chance to create a motorway of the sea have connections between **Gdynia and Karlskrone** which form the sea section of the Base Network Corridor I of TEN-T (European Transport Network) Baltic – Adriatic, connecting Scandinavia with countries of the Central-Eastern and Southern Europe. According to the forecasts of the project SEB Trans-Link, until 2020 passenger sea traffic between Sweden and Poland will increase to 2 mln passengers. Also a further strengthening of Gdynia’s position on the sea cruise market is expected.

Other connections aspiring towards the status of motorway of the sea are:

- **Gdynia – Helsinki**, which is a part of the ferry service (only cargo) operated by Finlines;
- motorway created on the basis of ferry connection **Szczecin/Świnoujście – Ystad**, and
- motorway between **Gdansk and Rotterdam** (in planning stage).

The Maritime Office in Gdynia has attempted establishing a special deepwater navigation route (**Route D**) for large tankers and LNG carriers sailing from the North Sea to the ports of the Gulf of Gdansk. This route would come out from the Gulf of Gdansk in north-west direction towards the Bornholm Strait. However, it cannot be established without an approval from Swedish partners, who decidedly reject such a possibility. This route would pass from the east the location of planned wind farms.

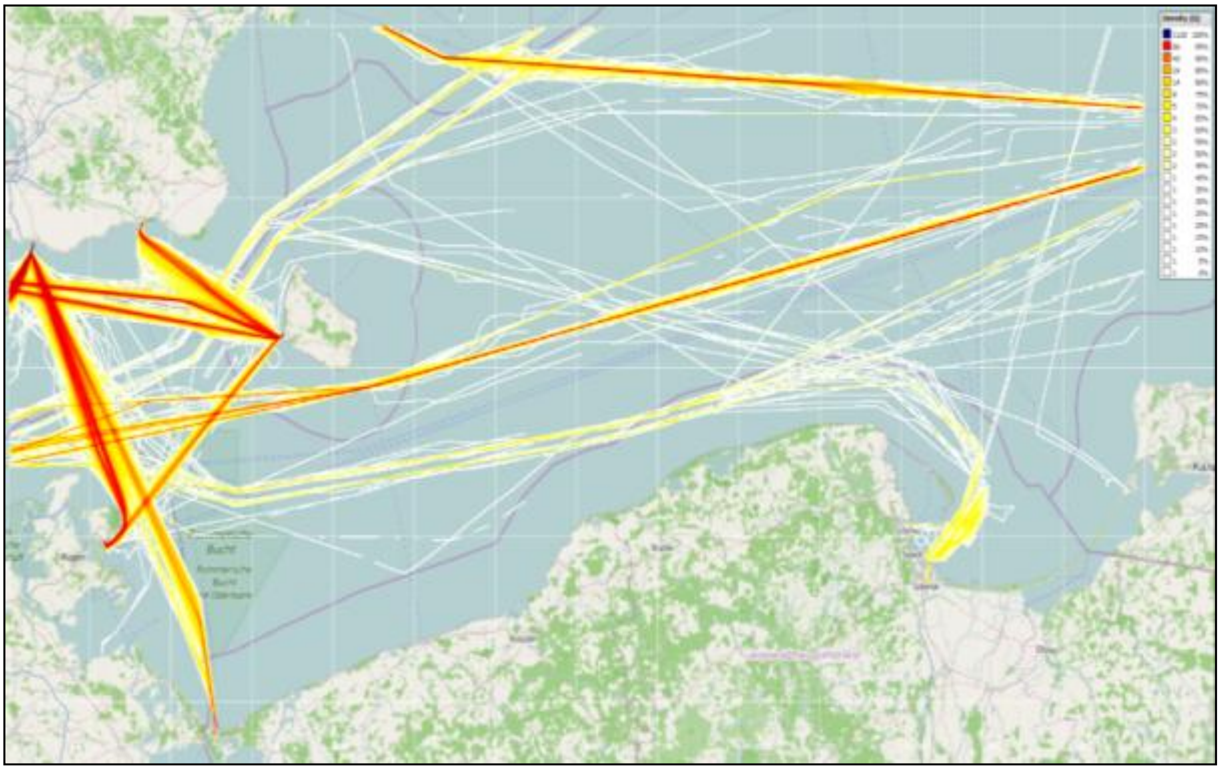


Fig. 7.2. Routes and intensity of traffic – fast ferries

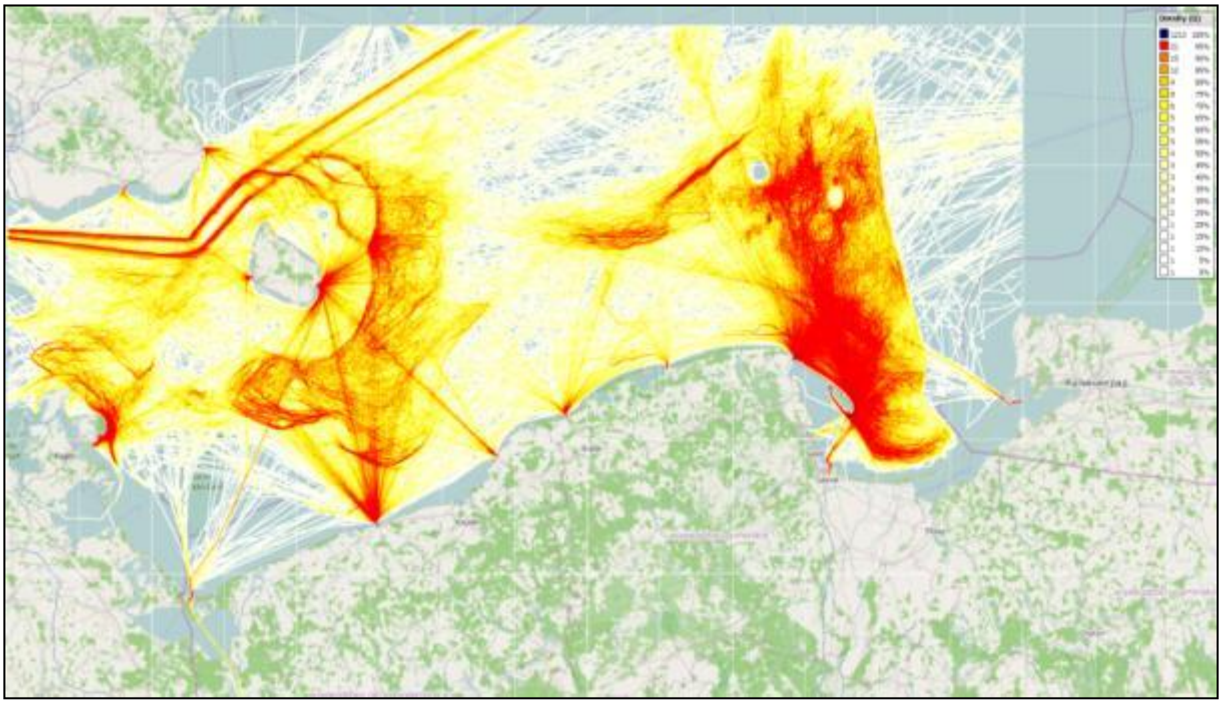


Fig.7.3. Routes and intensity of traffic - fishing vessels

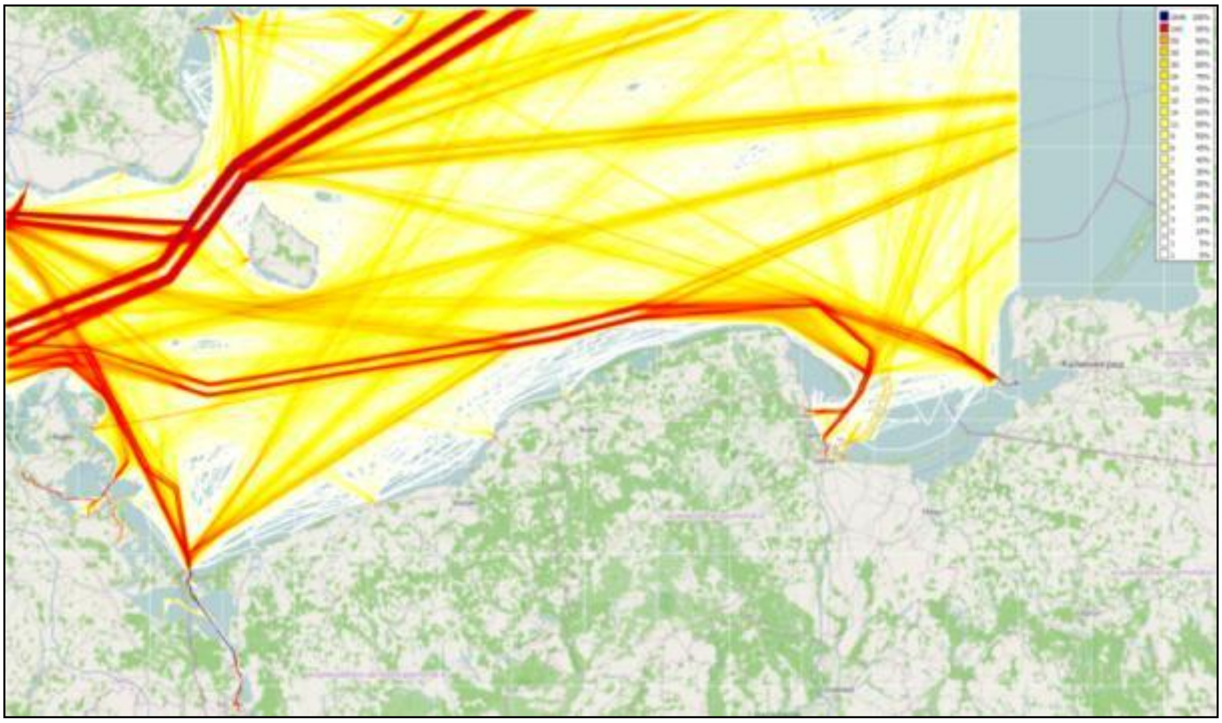


Fig. 7.4. Routes and intensity of traffic – merchant vessels

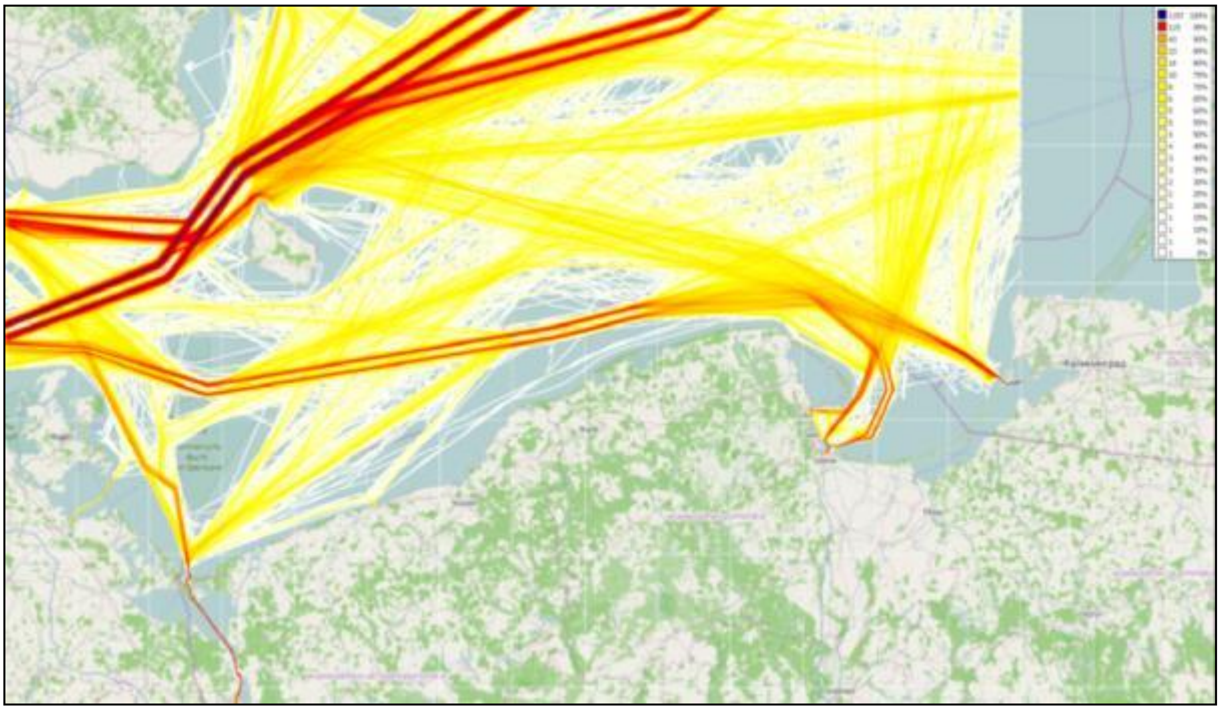


Fig. 7.5. Routes and intensity of traffic – tankers

Fig. 7.6. Routes and intensity of traffic –recreational vessels

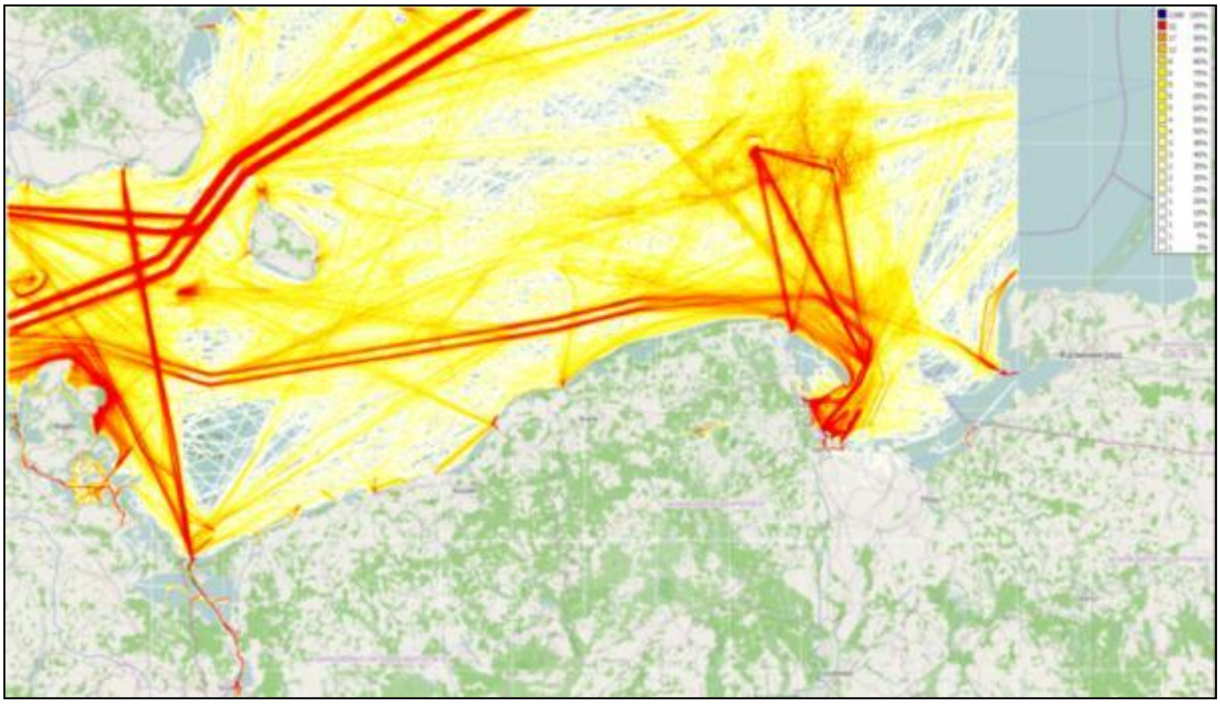


Fig. 7.7. Routes and intensity of traffic –Special Purpose Ships

During the last decade (2002 – 2011), there were 1,133 accidents and incidents on the Baltic Sea, which accounts for over 100 dangerous incidents/accidents per year (in 2011 – 121 accidents) [Helsinki Commission, 2012]. The most common cause of accidents on the Baltic Sea in 2011 was collision (32%) and grounding or sinking (29%). Data for 2001-2010 indicate that the highest risk areas are the regions of Danish Straits, Gulf of Finland and the southern part of the Bothnia Sea (Fig. 7.8).

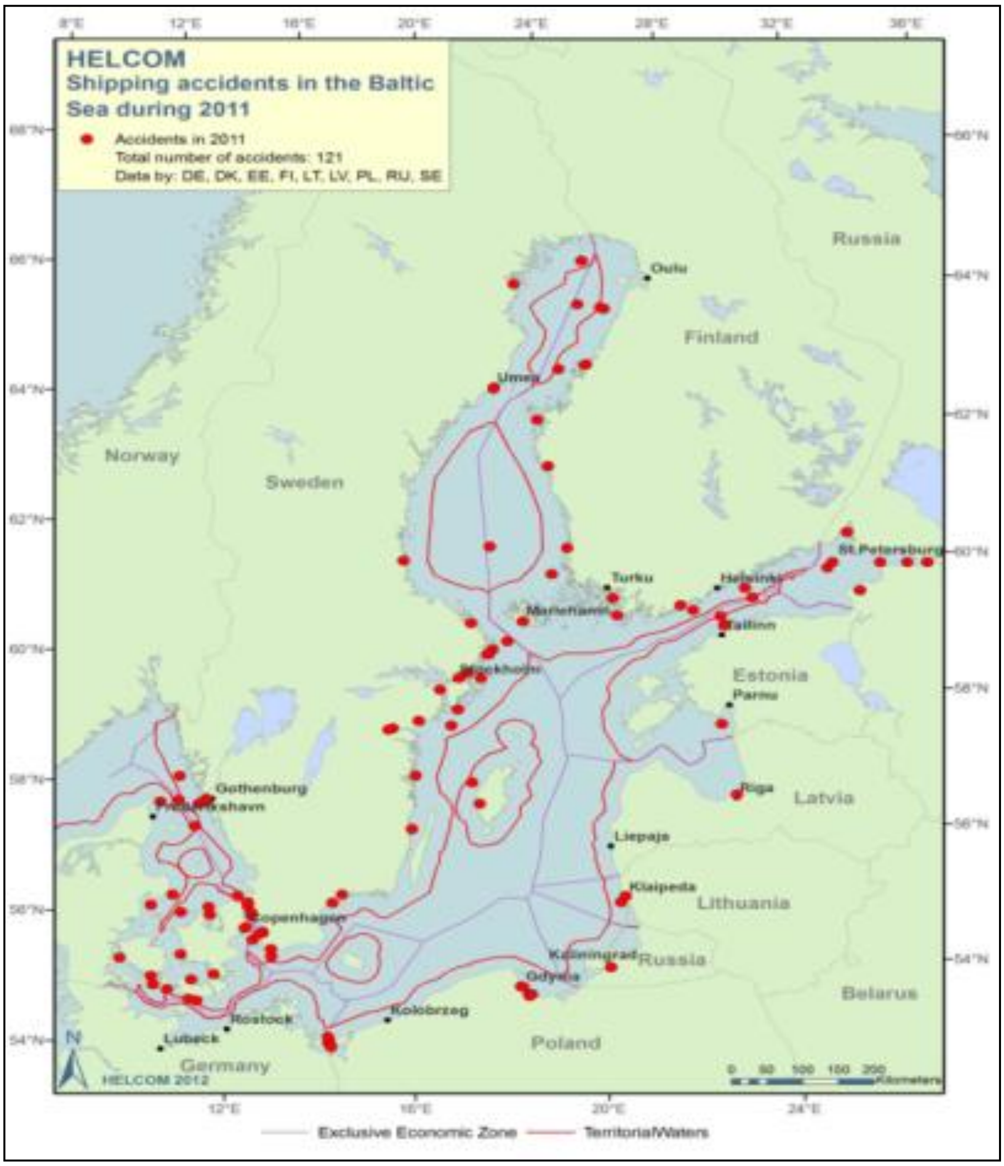


Fig. 7.8. Spatial distribution of accidents in the Baltic Sea in 2011

With the exception of local passenger and touristic vessels, the majority of investments in the coastal zone (because they do not reach far into the sea) will affect neither navigation nor the scale of incidents. Construction of offshore wind farms and offshore mining are carried out within the framework of licensing/permitting procedures. Therefore, it is possible to determine which of the areas currently used by fishing, merchant and other vessels will be closed to navigation. Knowing their effect on navigation, the maritime spatial plan of the Polish sea areas should aim at reducing the impact of these limitations.

The appearing picture shows clearly that there is a need for bringing more order and adapting navigation routes (obligatory, recommended and customary) to the future navigational situation. Orderly arrangement of vessel traffic will be of high importance for ensuring fluency of traffic, “capacity” of navigation routes, and, first of all, for safety of navigation. It cannot be done without correlating these actions with/between the present and future sea users, as well as between the States realising their actions in the southern Baltic Sea area. These actions could include cooperation in the development of new routes, optimal for all parties. Moving the routes away from the coast is not always effective. Simple actions at local scale can improve the level of safety only locally. More important is to achieve a system regulation of the navigation situation in the scale of the whole southern Baltic Sea.

In the case of this sea area it would be advisable to:

- extend further eastward the navigation route (TSS) south of Bornholm (TSS Adler Grund) since the development of wind farms in large areas located to south and south-east of the existing TSS between Odra Bank and Orla Bank will put limitations on free navigation in this area and result in higher risk of collision with the towers of wind farms;
- extend eastward up to Stilo or even Żarnowiec, the existing TSS to the south and south-east of the Słupsk Bank since the development in large areas located to north and south-east of this TSS will put limitations on free navigation in this area and result in higher risk of collision with the towers of wind farms. Due to the existing limitations of draught for the vessels using the existing TSS, the limitations would have to be in force already at the entry to this TSS;
- modify the planned deepwater route D planned for traffic of large vessels, connecting the ports of the Gulf of Gdansk with the Bornholm Strait and the existing TSS Borholmsgat;
- clarify the legal situation and increase the potential of the northern fairway to Świnoujście (Świnoujście-Szczecin port complex).

Risk of accidental oil pollution

Additionally, an analysis of risk of oil pollution from accidental spills related to vessel traffic in Polish sea areas was carried out. Oil spills were simulated for the period 2011-2013 assuming the traffic of vessels in 2013 (based on HELCOM AIS database). Figures 7.9 – 7.12 show the risk of oil pollution expressed as the time 1 gram of oil remains in the area during one year for every hectare of the area. For the calculations, the statistics of accidents from the HELCOM spatial database for 1988-2010 was used (simulations were carried out for all vessels, and separately for merchant ships, tankers and vessels denoted in the AIS system as "other ships"). In the area covered by the model in 1988-2010[67], for these groups of vessels, the reported volume of pollution was ca. 675m^3, 500m^3, 136m^3 and 36m^3 respectively. On a yearly basis, this corresponds to 31 m^3/year, 23 m^3/year, 6 m^3/year and 1.6 m^3/year. Simulations of spills were made according to the methodology used for Polish sea areas in the BRISK project [BRISK, 2011].

[67] Information from the HELCOM website http://maps.helcom.fi/website/mapservice/index.html). (access on 16.02.2015)

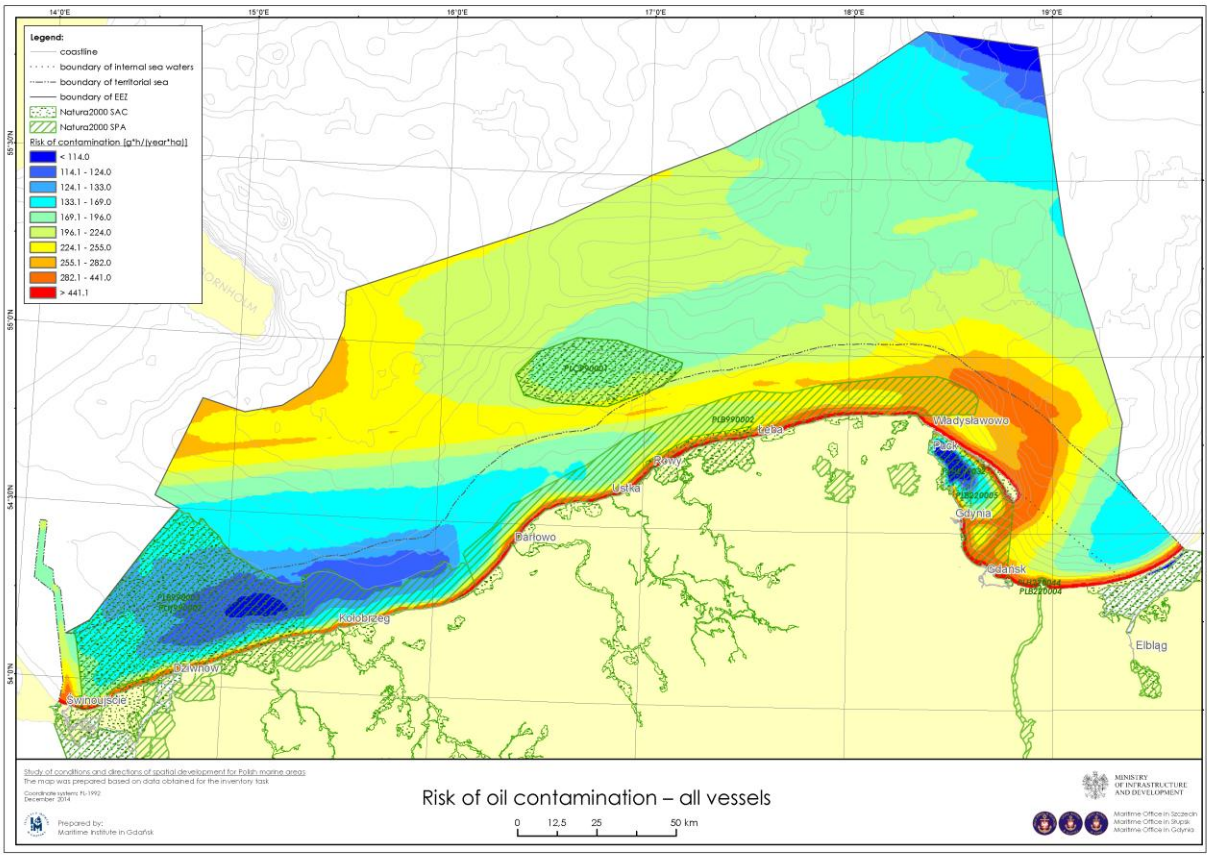


Fig. 7.9. Risk of oil contamination – all vessels

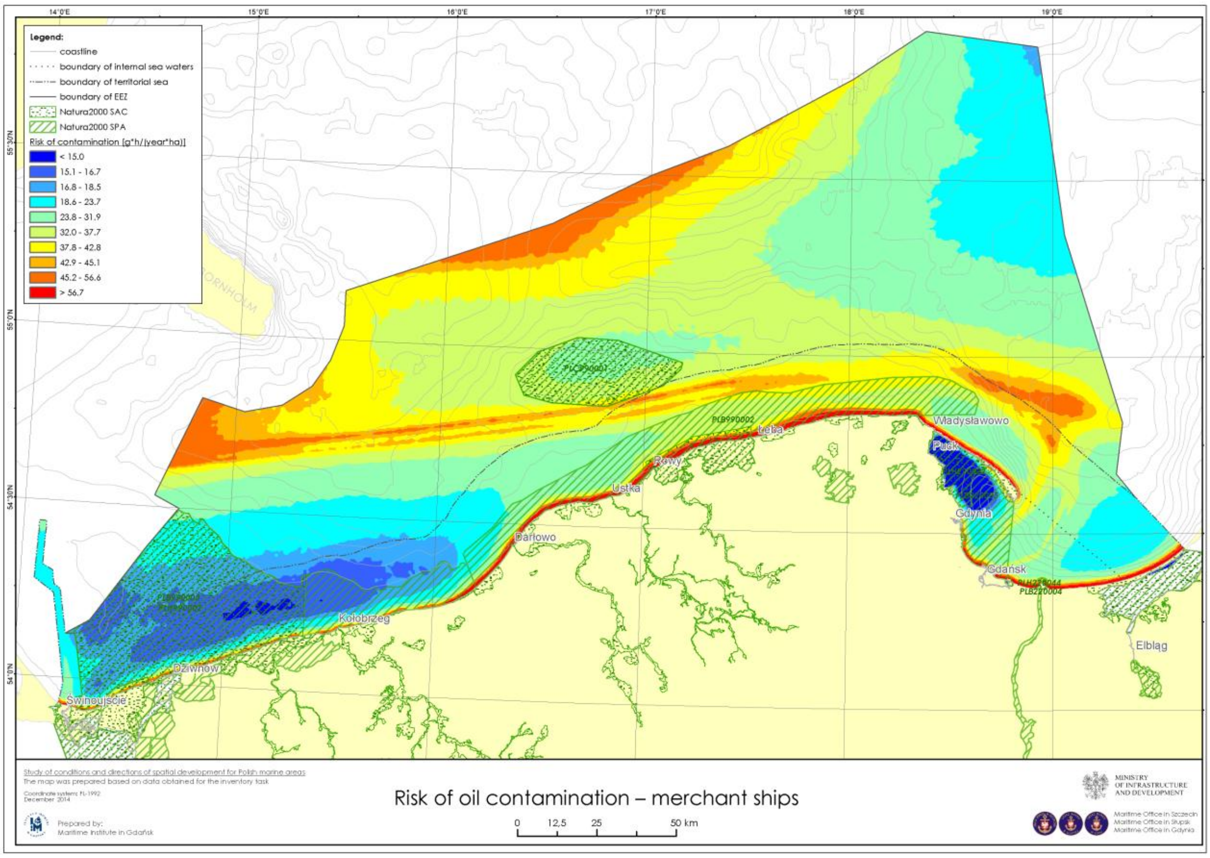


Fig. 7.10. Risk of oil contamination – merchant ships. (Source of 7.9 and 7.10: Maritime Institute in Gdansk).

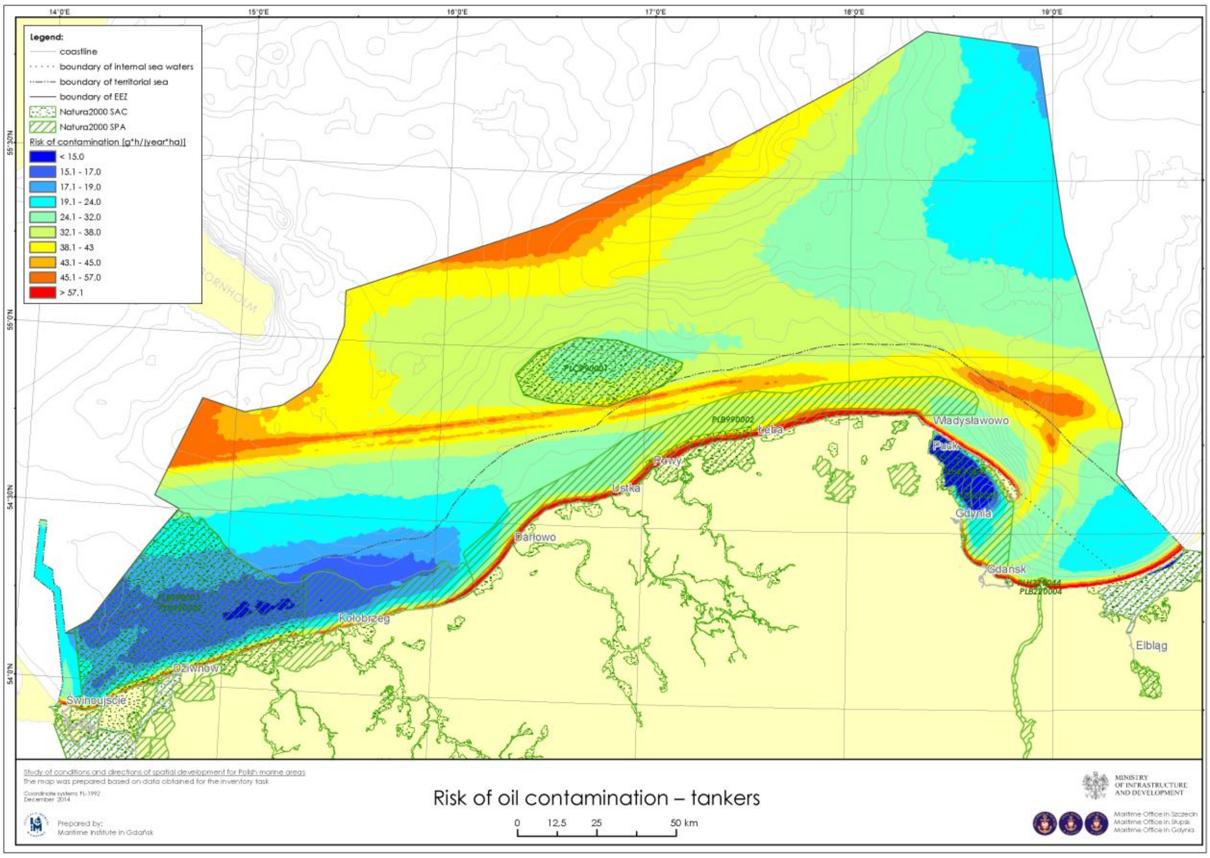


Fig. 7.11. Risk of oil contamination – tankers

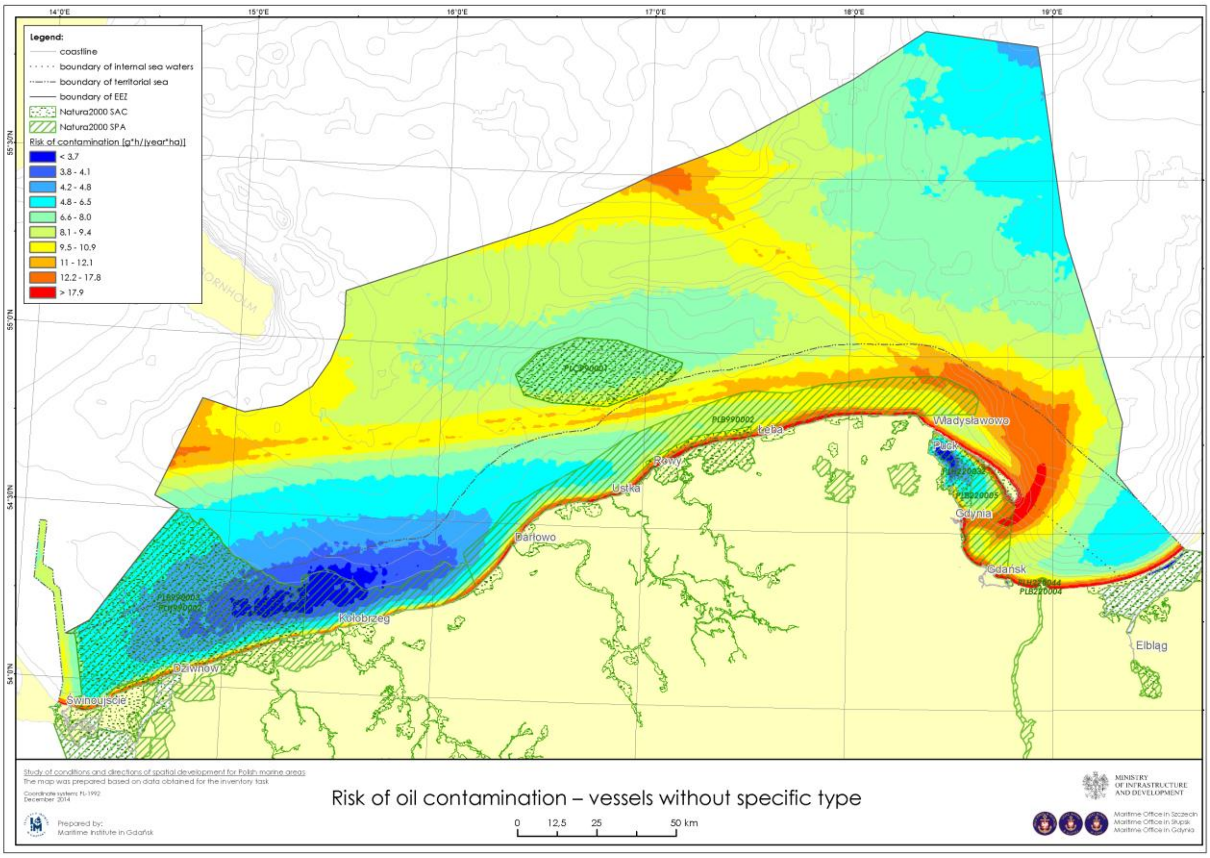


Fig. 7.1. Risk of oil contamination – vessels without specific type. (Source 7.11 and 7.12: Marit. Institute in Gdansk)

Analysis of spatial distributions of risk of accidental oil pollution shown in Figs. 7.9 – 7.12 points to the following:

- sections of coastline from Darłowo to Hel and from Gdynia to the border with Russia are most exposed to pollution. This is connected with the direct vicinity of navigation routes. This involves a risk to the areas of Natura 2000 network, in particular PLB990002, PLH220032, PLB220005, PLH220105 and PLB220004;
- for all performed simulations the maximum risk of pollution is near the Hel Peninsula and in the Gulf of Gdansk, forming a threat to tourism activities on the Hel Peninsula and coast from Gdynia to the border with Russia, and to Natura 2000 areas located in the region of the Gulf of Gdansk;
- potential pollution in the Swedish EEZ may have an impact on Polish sea areas – this is related to the relatively intense traffic of vessels sailing for the northern Baltic Sea via the Bornholm Strait;
- due to sea bottom relief preventing navigation of large draught vessels, and its position in relation to the navigation lanes, the area of Natura 2000 PLC99001 – Słupsk Bank is relatively slightly endangered for each of the considered traffic types;
- least endangered are Natura 2000 areas PLH990002 and PLB990003 except parts nearest to the approach to the Szczecin-Świnoujście port complex, where a local maximum of pollution risk is present.

Conclusions for the maritime spatial plan of Polish sea areas

- Navigation activities take place over most of the Polish sea areas with only small parts free from intensive traffic. There is a need to bring order to this phenomenon according to the principle of economic use of sea space.
- Different vessels need different spatial configurations and it is not possible to identify universal navigation corridors.
- Traffic of yachts and other small vessels in touristic navigation will concentrate along the coast, in the coastal belt of waters. The need to provide sea space for this purpose should be considered.
- It should be taken into account that Gdansk and Władysławowo became important locations for starting voyages related to deriving innovative benefits from the sea (offshore development).
- Action aimed at reducing limitations imposed on navigation by the appearance of artificial islands (which affects the spatial picture of navigation, see Fig. 7.7) should be taken.
- Navigation routes (obligatory, recommended and customary) should be adapted to the future navigational situation (i.e. anticipating the emergence of new users of the sea areas, having in mind the need of safe navigation and the need to maintain a free space for other traditional users of the sea space, e.g. fishery).
- Future work aimed at extending and modifying traffic separation schemes, and/or modifying recognized deep water routes should be anticipated.
- Navigation routes connecting base points of the TEN-T network should be considered as connections aspiring to the "motorway of the sea" status.
- As part of preparation of the maritime spatial plan for Polish sea areas, an analysis should be carried out to identify which elements of the navigation routes generate the highest risk of oil pollution and consider the possibilities for reducing such a risk in the areas of special environmental protection and coastal touristic activity.
- From the viewpoint of risk of oil pollution, additional solutions should be implemented to organize the navigation of vessels near the Hel Peninsula and Rozewie in a way which would significantly reduce such risks.
- It seems necessary to consider all the solutions aimed at reducing the risk of accidental oil pollution in a supra-national perspective, considering not only navigation in the Polish sea areas but also in the adjacent sea areas while respecting the relevant international legal regulations.
- The impact of development of offshore mining activities on the change of intensity of navigation should be considered.

Knowledge gaps

Navigation of vessels not fitted with AIS (it is however a small fraction of the whole traffic).

7.3. Ports of national and supra-national importance

Based on the report "Trends of development of largest Baltic Sea ports" R. Czermańska, U. Kowalczyk, Department of Economics and Law of the Maritime Institute in Gdańsk – Annex 14

By regulations of the Act on Ports and Havens, the owners of port areas in the ports of basic importance for national economy of Poland (Gdynia, Gdansk, Szczecin and Swinoujscie) are the Treasury (majority shareholder) and the municipalities. They are represented by the Port Authority, which administers the majority of port areas. This can be done also by other companies owned or a co-owned by the state – for example the Szczecin's Fishing Port "Gryf" (the Treasury is a shareholder). All the proceeds gained from the lease, rentals, tonnage charges, etc. by the Port

Authorities are allocated for development and investments. Additional sources of funding are loans and grants. Handling and storage services, in the understanding of the Act, are rendered by other, mainly private, businesses.

In the period 2005-2013, cargo turnover in Polish ports showed a growing trend. Average annual rate of increase of turnover was 2.6%. Especially high growth was in container handling, which increased by 15.9% per year (in tons). General cargo handling in ro-ro vessels increased on average by 2% per year. Ro-ro transports are realised mainly on Baltic relations with Scandinavian countries by ferries and, to a smaller extent, by ro-ro vessels, whereas the transport of containers is mostly in long distance shipping. About 10% of cargo of international marine turnover was transported by ferries in relations with Baltic Sea ports.

The development of port turnover was significantly influenced by transit of oil from Russia, directed through the Port of Gdansk, and a high increase, especially in the last years, of containerised general cargo, which is mainly a result of opening in 2007 the DCT container terminal in Gdansk.

Four largest ports of basic importance for national economy handle about 96% of Polish export/import and transit by sea. In principle, these ports determine the demand of Poland for marine cargo transports in the Baltic Sea area.

Assuming the current rate of increase of cargo turnover, it may be expected that in 2020 the total volume of cargo handled in Polish ports will be 75.8 mln tons, and in the individual ports of basic importance for national economy it will be:

- Gdansk 34.0 mln tons;
- Gdynia 19.9 mln tons;
- Szczecin 7.6 mln tons;
- Swinoujscie 15.4 mln tons;

If in the next years the average rate of increase of container and ro-ro turnover will be maintained at the current level, it can be expected that by 2020 the turnover will double reaching about 26 mln tons, whereas the general cargo handling in ro-ro vessels will increase by ab. 14%, i.e. to about 7.3. mln tons. In view of the global tendency in sea transports to develop carriage of cargo in containers and to increase vessel size, it can be expected that for containerised cargo transports, this rate of growth may increase in the next years. Growth of cargo turnover will require opening new shipping connections and will result in increased vessel traffic in the Baltic Sea.

At the basis of high dynamics of development of container handling is the construction of the DCT Terminal in Gdansk and the increased potential for container handling in Gdynia. The DCT Terminal created conditions for acquiring long range ocean-going shipping connections as well as new transit container cargoes. The Port of Gdansk became an important hub for other Baltic ports by operating new delivery/return connections. Therefore, there is a systematic increase of container services in transhipment relations, and the share of sea-sea transit in the total transit handling was, e.g. in 2013 as high as 51.7%.

Passenger transports in relations with the Polish ports are realised mainly by ferries, which in 2013 transported about 93% of passengers in relations with the Baltic ports. The major direction are ports in Sweden, mainly Ystad and Karlskrona, and to a lesser extent Trelleborg and Nynashamn. In relations with these ports, about 1.4 mln passengers depart or arrive every year, which, e.g. in 2013, accounted for 89.1% of the total number of passengers. In addition to the international passenger traffic, Polish ports service also internal passenger transports. In 2013, about 604.3 thous. passengers were transported in internal traffic. In the context of the current tendency, it may be predicted that in the nearest future no significant growth of passenger traffic in Polish ports should be expected due to the development of alternative branches of transport.

Polish seaports are also visited by cruise ships. The number of their arrivals in Polish ports, mainly Gdynia, shows no distinct rising tendency. On the other hand, the size of the vessels and the number of passengers on board a vessel per one visit are higher. In 2013, 97,200 passengers arrived at Polish ports by cruise ships. In the light of the observed higher interest in sea tourism, a small growth trend in the number of passengers in this segment of sea shipping in the Polish ports can be expected.

In the existing spatial conditions and in the context of a tendency to build larger vessels, the ports will develop **"seawards"** by, inter alia, landfills in port water areas, thus increasing the demand for marine space. The ports will need to adapt themselves to:

- servicing new cargoes and larger amount of cargoes and number of vessels (by conversion of the existing quays and/or construction of new terminals);
- servicing increasingly large vessels (investments in hydrotechnical structures and technical equipment).

No new ports of basic importance for national economy are planned. The existing ports will be developed. Investments in the largest Polish ports will contribute mainly to better servicing of oil and oil products (Gdansk), containers (Gdansk and Gdynia), grain (Szczecin), LNG (Swinoujscie) and also to a higher potential for ferry services (Swinoujscie).

The most favourable conditions for investment and development of deepwater terminals are in the Port of Gdansk. Strategic directions of development of this port include the development of potential for handling containerised and bulk cargo, especially cargoes related with national energy safety.

Important for the development of the deep water part of the port are investments planned by the Maritime Office in Gdynia, which include modernisation of the fairway to the external port and a new turning basin. Also, a new island breakwater, necessary for the east part of the port is to be built. The development of the port is also facilitated by the currently realised and planned infrastructural investments improving access from land.

The major investments of the Port of Gdansk to improve handling capacity are aimed at developing and modernizing the bulk cargo terminals and developing of the DCT container terminal, as well as building close to the DCT a logistics-distribution centre. Within the framework of development of potential of the DCT terminal[68] a new berth (DCT 2) is currently under construction. The investment will allow increasing annual handling capacity from 1.5 mln to 4 mln TEU.

The port plans also to develop its cargo handling potential aimed at ensuring national energy security. In the 1st quarter of 2014, the construction of the new Oil and Liquid Fuel Handling and

[68] Information obtained from the website of the Port of Gdansk http://www.portgdansk.pl/o-porcie/investments/8.jpg (access 07.12.2014)

Storage Base of PERN ("Przyjaźń SA") was started in the deepwater part of the port. Completion of the investment is expected in 2018. The storage tanks in the Base will have a capacity of 700,000m^3 for oil and fuels[69]. "Naftoport" is building a next new berth for tankers. Concepts of next bulk cargo terminals are being developed, including a terminal for plant-based products.

In Gdynia, the existing BCT and GCT terminals and the ferry terminal were further developed. Investments in the BCT terminal aim at allowing servicing of increasingly large vessels. The fairway and port basin are being deepened. Most important investments in **Gdynia** include the planned increasing of the turning basin and deepening of fairway and port basins from 13.5 to 15.5m. With these investments, the port will be able to service, similarly to Gdansk, the largest vessels entering the Baltic Sea.

Within the development program of Gdynia, in 2013-2015 three projects improving the handling potential and rail and road infrastructure are realised:

- development of the area of Nabrzeże Bułgarskie;
- reconstruction of the intermodal rail terminal;
- reconstruction of the Nabrzeże Szwedzkie.

In 2012, in Szczecin, a new grain terminal of 700,000 tons annual handling capacity, a new container terminal and a new sulphuric acid terminal started operation.

Road, rail and inland water infrastructure projects are being realised with the objective of improving access to ports in Szczecin and Swinoujscie. By 2020, 50 projects improving navigability of the Odra River will be finalized. Their total cost exceeds 10 bln PLN.

Currently, in the ports of Szczecin and Swinoujscie many large investment projects are realised, including:

- building of the LNG terminal in the external port in Świnoujście;
- development of existing ferry terminal in Świnoujście;
- development of the road and rail system connecting the ports with hinterland.

Additionally, in Szczecin the quay Nabrzeże Zbożowe on the Ewa Peninsula will be modernised (extended and deepened) and a new quay – Niemieckie Nabrzeże will be built.

The list of investments of the West-Pomeranian Voivodship, which will obtain funding from the central funds under the territorial contract for 2014 – 2020, contains nearly all infrastructural investments related to the improvement of access to sea ports, among others:

- modernisation of the Świnoujście – Szczecin fairway to the depth of 12.5m;
- development of infrastructure of the Szczecin – Świnoujście port complex;
- Improvement of access to the ports in Szczecin and Świnoujście;
- building of a tunnel under Świna in Świnoujście;
- improvement of infrastructure of the Odra inland water route;
- modernisation of the Odra Railway Line no 273 Szczecin – Wrocław.

The implementation document mentioned in Chapter 7.1 [MIiR, 2014] assumes further investment in port infrastructure for an amount of nearly one billion PLN for the Szczecin –

[69] Information obtained from the Port of Gdansk website http://www.portgdansk.pl/o-porcie/investments/4.jpg (access 07.12.2014)

Świnoujście port complex. The investments include, among others, further reconstruction of the ferry terminal in Swinoujscie, building of an LNG redistribution station. In Szczecin, on the other hand, modernisation of the grain and general cargo wharfs is to be continued, and also other investments improving the quality of Szczecin – Swinoujscie port are to be carried out.

The forecasts of economic development for Central Europe and the Baltic Region indicate a real opportunity of maintaining high dynamics in long term perspective. The carriers will have to hire larger vessels, in effect determining the need to develop infrastructure in some ports of the region. Until 2030, it is expected that, starting from 2010, most quickly in the Baltic Sea Region will develop Polish ports, St. Petersburg and Swedish ports.

However, earlier forecasts of development of transport turned out to be too optimistic, for example for the Polish ports a total turnover of 108.5 mln tons was expected in 2010, whereas the actual volume handled by ports of basic importance for national economy was only 62.7 mln tons.

Conclusions for the maritime spatial plan of Polish sea areas

- It should be taken into account that actions will be aimed at developing the existing ports of basic importance for national economy, not for building new ports. Both the number of connections and the size of vessels entering the ports will grow while ensuring their short time of stay in the port.
- Space for development of these ports "seawards" should be reserved.
- The existence of anchorages and fairways to the ports of basic importance for national economy, allowing acceptance of the largest vessels that can enter the Baltic Sea should be taken into account, and attention should be given to safety of navigation having in mind the increasing intensity of ship traffic on the approaches and the larger size of the vessels.

Knowledge gaps

The existing strategic documents of the ports not always allow proper identification of the demand for the marine space for their development goals.

7.4. Small ports of local importance

Based on the report: *Analysis of impact of ports on the development of coastal municipalities, B. Szwankowska, M. Szymańska, Department of Economy and Law of the Maritime Institute in Gdańsk – Annex 15*

In 2011, in the area of the three coastal voivodships (West-Pomeranian, Pomeranian and Warmia-Mazury) there were 78 ports and havens, including 33 ports [Pieńkowska et al., 2012]. Among the ports, 29 had a local only impact, and further in this text are referred to as local ports[70]. Further analysis was carried out for twelve of them, situated along the sea coast between the Odra and Vistula mouths. Because of the spatial limitations of this Study, this chapter focuses on the analysis of the mutual inter-relations between these 12 local ports, situated along the open sea coast and in the Gulf of Gdansk, and their neighbourhood – the municipalities and towns (Fig. 7.13 and Table 7.1).

[70] According to the terminology adopted in Luks K. (ed) (2010) "Porty lokalne w strategii aktywizacji peryferyjnych obszarów nadmorskich"

Tab. 7.1. Open sea and Gulf of Gdansk ports in the administrative structure of Poland[71]

Voivodship	County	Municipality/Town	Port
West-Pomeranian	Kamieński	Dziwnów municipality	Port Dziwnów
	Gryficki	Trzebiatów municipality	Port Mrzeżyno
	Kołobrzeski	Kołobrzeg urban municipality	Port Dźwirzyno
	Kołobrzeski	Kołobrzeg urban municipality	Port Kołobrzeg
	Sławieński	Darłowo urban municipality	Port Darłowo
Pomeranian	Słupski	Ustka City	Port Ustka
		Ustka rural municipality Commune	Port Rowy
	Lęborski	Łeba urban municipality	Port Łeba
	Pucki	Władysławowo City	Port Władysławowo
		Jastarnia City	Port Jastarnia (Jastarnia II)
		Hel City	Port Hel
		Puck City	Port Puck

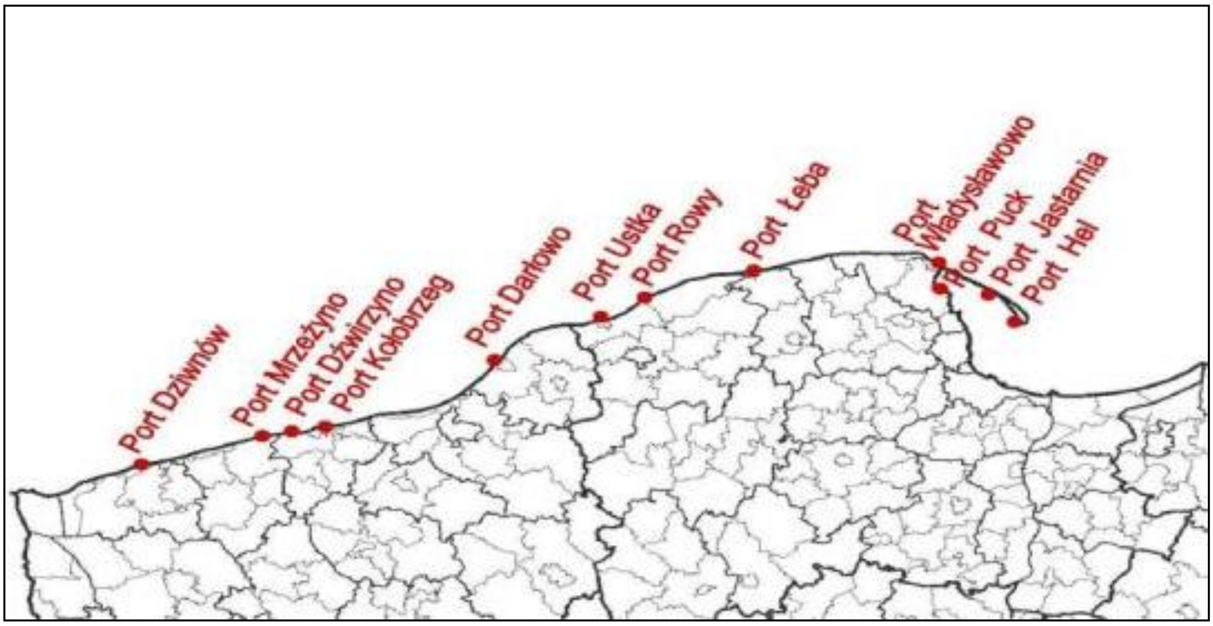


Fig. 7.13. Locations of analysed twelve open-sea and Gulf of Gdańsk local ports

The open sea local ports are mainly (8) situated in towns which are the seats of municipal authorities, i.e. in leading centres of the coastal region. The settlements in which the local ports are located are quite diverse, from medium-sized cities of sub-regional importance (Kołobrzeg – ca.

[71] Tables and illustration in subchapter 7.4 are from Annex 15

47,000 residents) through towns – seats of municipal authorities with 10,000 – 18,000 residents (Ustka, Darłowo, Władysławowo and Puck) to small towns or holiday villages with 2,000 – 5,000 residents (e.g. Mrzeżyno, Dźwirzyno and Rowy). Ports situated in these settlement centres are spatial bodies differing in terms of size of area, facilities and development. The size of the port in Darłowo is ca. 110 ha, port in Władysławowo – 76 ha, port in Ustka – 30 ha, port in Hel – 8 ha, port in Rowy – 2 ha.

Considering the potential of local ports, the economic and social condition of their local hinterland (towns and coastal municipalities) as well as activities of local governments aimed at stimulating the development of ports (removal of infrastructural barriers, attracting investors, acquiring funds for new investments), the local ports discussed in this study can be divided into 3 groups, i.e. ports with significant potential for development with possible supra-local (regional) impact, ports within the influence of the Tri-City metropolis, and ports with local profile activity (Table 7.2.).

Table. 7.2. Typology, functions and expected directions of activation of local ports

Importance of port	Name of port	Economic functions		Expected directions of activation
		strong	weak	
Ports with high development potential with possible supra-local (regional) impact	Kołobrzeg	Fishery Tourism	Transport	1. Base for offshore wind power 2. Base for offshore aggregate mining 3. Activation of transport function 4. Activation of international passenger shipping
	Darłowo	Fishery Tourism	Transport Industrial	
	Ustka	Fishery Tourism	Industrial Transport	
	Władysławowo	Fishery Tourism	Transport Industrial	
Ports influenced by the Tri-City metropolis	Jastarnia	Fishery Tourism		Stimulation coming from Tri-City to develop: 1. Sport-based tourism (windsurfing, sailing, kitesurfing, sea fishing, wreck tourism) 2. Carriage of tourists from/to Tri-City
	Hel	Fishery Tourism		
	Puck	Tourism		
Ports with local activity profile	Łeba	Fishery Tourism	Industrial	1. Development of tourism services 2. Development of fishery base
	Mrzeżyno	Fishery Tourism		
	Dziwnów	Fishery Tourism		
	Dźwirzyno	Fishery	Tourism	
	Rowy	Fishery	Tourism	

Development of local ports in the recent years was facilitated by EU structural funds. For example in Darłowo, the touristic services' infrastructure and base for fishery were developed, also quays were modernised and extended. A limitation of global character is their location. The Baltic Sea is characterised by a peripheral location in relation to the main shipping lanes, and the cold climate causes that passenger shipping and yachting are seasonal.

In case of the local ports, the situation is additionally made more difficult by the near-uniformity of the coastline, which does not encourage development of coastal shipping, as is the case in Sweden, Finland or Denmark. Additionally, in the case of some open sea local ports and havens, sanding up of port entrances is a significant problem, limiting the depth of fairways and generating additional maintenance costs.

The economic environment of the Polish open sea local ports does not favour their activation as transport centres, especially along the central coast, where the neighbouring land is mainly agricultural, and the small-scale local industrial activities do not generate significant demand for sea transports. This is topped by the limitations imposed by the common fishing policy of the EU, resulting in a decrease of the number of fishing vessels basing in small ports and havens. The standard of living in Poland is lower than in the "old" countries of the European Union. This affects the development of yachting and sea tourism, though in the last years a significant growth of the number of sailing and motor yachts under Polish flag has been observed.

An obstacle to the development of ports, also the local ones, is that on average only 22.5% of port areas is managed by port management authorities/agencies. The rest was transferred to private subjects (before the entry into force in 1996 of the Act on Sea Ports and Havens), in that natural persons, who often have nothing in common with port activities.

The current legal and organisational solutions in force have a negative effect on cargo and touristic traffic in the ports. An example are the laws regulating operation and development of border passes, which are more restrictive in case of marine border passes than in case of the land passes.

Difficulties with development of small ports are strengthened by their still unsatisfactory (despite the various investments) accessibility from land. In order to improve accessibility, the ports need to cooperate with the supra-municipal self-governments and national authorities, and this is not easy in the light of the limited human capital of these ports.

On the other hand, economic concerns of the local authorities have the result that after more than twenty years from the local government reform and nearly twenty years from adopting the Act on Ports and Havens, the process of municipalisation of local ports has not been completed. The process is finalised in case of the ports at: Dziwnów, Mrzeżyno, Kołobrzeg, Ustka and Darłowo. Władysławowo and Hel are managed by companies formed from the former fishing businesses, which are owned by municipalities or counties. The remaining local ports are managed by the maritime offices together with the municipalities which are minority shareholders (Puck and Jastarnia) or only by the maritime offices (Łeba, Dźwirzyno and Rowy). Such a state of affairs is not conducive to spatial integration of the ports and the towns/settlements in which they are located. Moreover, the managing authorities (maritime offices and municipalities) are not able to provide sufficient financial support for port development. As a rule, investments in ports are capitalconsuming and have a long return time, often do not increase or bring profits in the private sector despite significant external benefits.

Among the factors determining the development of local ports, possibly the most important is the stimulation of business activity in their closest environment (city, municipality, county). This also concerns the adjacent sea area where new types of activity may appear (offshore wind farms, offshore mining, mariculture), usually with innovative characteristics. The survey carried out for the purpose of this Study shows that such awareness begins to appear among the local policymakers. Gradually, the involvement of local governments in creation of favourable conditions for more intense use and improvement of the state of development of the ports is increasing. This mostly, though not exclusively, concerns these port organisms which already have been municipalised.

The number of businesses operating in the local ports is quite large and their type is quite diverse. Usually it is several dozen enterprises, including fishery services related to fishery (fishing, processing and distribution), tourism (passenger navigation, yachting and other water sports), repairs and cargo handling (operators). Often there are also businesses offering various culinary services. However, there is no reliable data on this subject.

The most often mentioned leading functions of the local ports are fishery (fishing, processing, distribution, trade and repair) and various segments of tourism and recreation (passenger transports, yachting and other water sports). In the ports with supra-local ambitions (Kołobrzeg, Ustka and Darłowo) also the transport function is indicated as a direction of development. This function has been also added to the plans of Władysławowo and Hel (Table 7.3.).

Tab. 7.3. Existing functions of ports

Port	Fishery		Industry		Transport - cargoes	Tourism		
	trade	fishing	Fish processing	Shipyard-repair		services	passengers	yachts
Dziwnów	1	1	0	1	0	1	1	1
Mrzeżyno	1	1	1	0	0	1	1	1
Dźwirzyno	1	1	0	0	0	1	0	1
Kołobrzeg	1	1	1	1	1	1	1	1
Darłowo	1	1	1	1	0	1	1	1
Ustka	1	1	1	0	1	1	1	1
Rowy	0	1	1	0	0	0	1	1
Łeba	0	1	1	0	0	1	1	1
Władysławowo	1	1	1	1	1	1	1	1
Jastarnia	0	1	0	0	0	1	1	1
Hel	1	1	1	1	0	1	1	1
Puck	0	1	0	0	0	1	1	1
Elbląg	0	0	0	1	1	1	1	1

Explanation: 1 – function exists, 0 – function does not exist

Some of the local ports have prepared long-term strategies of development, in which they plan to develop and strengthen their position in the local and even regional context.

However, spatial planning is not satisfactorily used as a tool for coordinating the development of local ports (Tab. 7.4.). General rules of spatial development of the local ports are usually included in the studies of conditions and directions of municipality development, but only very few ports have local statutory spatial plans adopted for their areas. In the rest of the ports investments are carried out basing on administrative decisions concerning terms of location of a given investment.

Tab. 7.4. Coverage with planning documents

Port	Strategic document of port management	Local spatial plans covering port area
Dziwnów	-	-
Mrzeżyno	yes	yes
Dźwirzyno	.	yes
Kołobrzeg	yes	-
Darłowo	yes	yes
Ustka	yes	-
Rowy	.	yes
Łeba	-	-
Władysławowo	yes	-
Jastarnia	.	-
Hel	yes	-
Puck	-	-
Elbląg	yes	yes

Explanation: (-) no planning document, (.) no information

In spite of the drawbacks, the local ports are gradually becoming an element of infrastructure of coastal municipalities, generating workplaces and income. Almost all local ports plan to correct their territorial boundaries (this is related to a change of the minister's regulation), in order to realise specific investments and/or to support processes of ownership transformation. All the plans propose extension of the port areas. The local ports are transforming from purely fishery ports into ports serving tourism and recreation functions – yachting, tourism and sports fishing/angling. For Ustka, Darłowo or Kołobrzeg, Bornholm has become an important destination for development of passenger services.

Kołobrzeg, Darłowo, Ustka and Mrzeżyno plan development of their handling potential and transport infrastructure. The most important investments are presented below.

In **Kołobrzeg**, a new road system is planned in order to improve access to the port. The plan includes necessary engineering structures, lighting, and reconstruction of colliding technical infrastructure. A port basin is to be built (3rd quarter of 2014 – 3rd quarter of 2015) in the Fishing Port on the Wyspa Solna Island including modernisation of the existing quay and accompanying investments (construction of sanitary facilities, and road and pedestrian tracts). Given the high interest in yachting, the Port Authority plans to enlarge the yacht basin as part of the port development.

In **Darłowo**, many development investments are planned. Three projects concerning the reconstruction of the existing quays, building a heavy quay and an access road to the port have been prepared. The existing Nabrzeże Słupskie will be extended (by 118.5m) including new technical infrastructure (electrical system, sewage reception and storage facility, container fuel station and a new approach road). Extension of the quay will provide new space for mooring fishing cutters. It is also planned to reconstruct the port entrance and build a passenger clearance terminal.

In **Ustka** Port, which is an important fishing port on the central coast, by May 2015, a fishing basin for small vessels (with a length of 10 to 17m and draught of up to 4m) will be built. There are 76 vessels of this type registered in the port, including 26 longer than 15m. The new basin will enable mooring of 30 vessels.

Conclusions for the maritime spatial plan of Polish sea areas

- It may be expected that the importance of the local ports will rise with the growth of wealth of Poland and its citizens and with integration of the ports into the local economy complex. Dynamic transformation begins to appear in Mrzeżyno.
- In accordance with the provisions of the Act on ports and havens, each port should be guaranteed safe approach from the sea and maintenance of necessary water areas (roadsteads, anchorages, turning basins).
- It should be taken into account that local ports plan for adjustments of their boundaries. However, basing on their strategic documents, it is difficult to say whether this concerns also sea space. Spatial reserves should be adapted to the possible emergence of new functions, including the construction of new marinas or activation of cargo handling.
- Ports located closest to offshore wind farms could become base ports for various types of services related to the construction and operation of the OWFs, and the energy obtained from them could be used in the closest environment of the ports. Due to the size of the ports, accessibility from the sea and land, technical characteristics, functions and reserves in the use of quays and port areas, such functions could be realised mainly by the ports in Kołobrzeg, Darłowo, Ustka and Władysławowo.
- High quality services for the needs of sea tourism, yachting and other water sports will develop using both the existing hydrotechnical objects in the ports and the extension of port facilities, which should be combined with activation of port hinterlands and accompanying services (technical base, repairs, wintering of yachts, hire of equipment, courses and training).
- The need to ensure a good access from the open sea to both the Szczecin Lagoon and the Vistula Lagoon and to their local ports should be taken into account.

Knowledge gaps

There is no information showing which businesses are connected to, or use, the individual ports.

Some ports have no strategy of development, thus it is difficult to determine the directions of their development.

The existing strategic documents of the ports not always allow determining accurately their strategic demand for sea space needed for further development.

7.5. Port in Elbląg

In addition to the previously analysed ports, another important sea port located within the Warmia-Mazury Voivodship, at a short distance from the Kaliningrad Oblast is the Port of Elbląg. It is the largest port on the Vistula Lagoon and the closest EU port able to operate transports to Kaliningrad and Baltiysk (Pilava). This is especially important in the context of entry of Poland in 2004 into the structures of the European Union. This port is located outside the area of analysis of this Study, but the planned construction of a channel connecting the Vistula Lagoon with the Gulf of Gdańsk is an element with a potential impact on the sea area covered by the Study. The decision to build the channel is not yet taken.

The Vistula Lagoon is separated from the Baltic Sea and from the Gulf of Gdansk by the relatively narrow Vistula Spit. The only connection between the Vistula Lagoon and the Baltic Sea is the Strait of Baltiysk which is in the Kaliningrad Oblast. Sailing through it is determined by the location of the Strait outside Poland as well as by the foreign policy of Russia. The area of the Vistula Lagoon on the Polish side has the status of internal sea waters. Since the end of World War II, the area of the Vistula Lagoon has been an object of conflict concerning the right to non-harmful and non-interrupted navigation[72].

The greatest chances for activation of the Port of Elbląg are seen in the building of a navigational channel across the Vistula Spit, not in navigation through the Strait of Baltiysk, which is under the jurisdiction of the Russian authorities. Four locations of the channel are considered: at Skowronki, "Nowy Świat" in the region of Siekierki, between Skowronki and Przebrno and between "Nowy Świat" and Siekierki.

The navigational channel across the Vistula Spit will open a sovereign access to the Baltic Sea for the towns and municipalities located in the Polish part of the Lagoon, especially to the seaport in Elbląg for vessels of up to 100m length, up to 20m width and draught of 4m.

Conclusions for the maritime spatial plan of Polish sea areas

- The plans of Polish sea areas should take into account the need to provide a possibility of building a channel connecting the Gulf of Gdansk with the Vistula Lagoon, if such a decision is taken.

Knowledge gaps

No decision on starting or cancelling the investment in question or on the time horizon of its realisation.

[72] "Evaluation of conditions for acceptance of the multi-annual programme „Construction of water route connecting the Vistula Lagoon with the Gulf of Gdansk" in the context of impact on environment, in that on areas of the Natura 2000 Network".

8. CONDITIONS ARISING FROM NON-MOBILE FORMS OF SEA AREA USE

This chapter presents conditions concerning non-mobile ways of using sea areas such as linear infrastructure, national defence, tourism, underwater cultural heritage, mining and power production. They are related with the sea space, usually the seabed, but also with the coast. They can be limited, but it is hardly possible to move them to a different place. In some cases (e.g. chemical weapons), it may be possible to remove them, while in other (e.g. military training area), their relocation can be imagined, provided that sea areas are found with similar characteristics as the already occupied regions (in practice this may be difficult to achieve). Permanent occupation of space, especially by structures and installations, as a rule results in spatial conflicts. Often, it is not enough in this situation to employ simple solutions consisting in the spatial reallocation of the mobile uses of sea areas. An example can be the dilemma reported by fishermen during consultation meetings, consisting in the negative impact of the structures and installations on drift fishery (e.g. salmon and sea trout fishing tackle), which requires a very large free space. Hence, within the planning process it is necessary to carry out a very careful analysis of the mobile methods of use of Polish sea areas. There is also a need to formulate the principles for the decision-making procedures (what to decide and in what order).

Conditions presented in this chapter, together with the conditions arising from navigation, ports and fishery should form a full picture of human use of the sea areas. Nevertheless, it still is not a complete list. The analysis did not cover, e.g. marine biotechnology or the spatial distribution of scientific research activities at sea (apart from the environmental monitoring which is described in Chapter 3.3 of this Study), even though, e.g. in the Puck Bay, an experimental mussel farm for the aims of environmental protection is tested. It seems that activities of this type have, for the time being, low significance within the Polish sea areas. There is also no reliable information allowing assessing its future demand for marine space and the scale of possible conflicts. In this case, the principle of economic management of sea areas, formulated in the BaltSeaPlan Vision 2030 [Gee et al., 2011] should be sufficient.

Conclusions for the maritime spatial plan of Polish sea areas

- In relation to the non-existing or poorly assessed methods of use of marine space the principles of co-use and "thrifty" planning of marine space should be used so that space is left for such activities.
- In relation to the methods of use of sea areas resulting in a permanent occupation of the space, it is recommended to propose decision-making procedures concerning the sequence (time factor) and principles of occupation of these areas.
- The need to prepare detailed plans of sea areas with special intensity of conflicts should be indicated.

Knowledge gaps:

Lack of spatial sense of the programme of sea research and investigations and lack of assessment of possible conflicts of scientific research with other ways of using the marine space.

No reliable knowledge on the development of biotechnology and the arising need for marine space, and lack of assessment of potential for conflict of this development with any other ways of using the marine space.

8.1. Offshore wind farms

According to the Strategy for Energy Safety and Environment – perspective until 2020 (adopted in April 2014), until 2020 the Polish power production will be based on coal, but its contribution in the production of energy until 2030 will decrease, while production of electricity will increase (from 143.8 TWh in 2010 to ca. 188 TWh in 2030, which is an increase by ca. 31%) due to an over 30% increase of demand (from 119.1 TWh in 2010 to 161.4 TWh in 2030). In the strategy it is indicated, among others, that:

- the importance of system power plants using fossil fuels will decrease considerably (their contribution in installed power until 2030 will drop from 69 to 37% in the analysed scenario);
- the contribution of renewable sources of energy, mainly wind, will increase (until 2030 installed power will be ca. 8,900 MW) and the contribution of natural gas fuelled plants will grow from 4.2 TWh in 2010 to ca. 14.2 TWh in 2030 – production of energy from renewable sources in 2030 will amount to 32 TWh;
- also a nuclear power plant will be built after 2030.

Offshore wind energy is one of the fastest growing forms of energy production in the world. Offshore wind farms can be a key element in the implementation of the climate and energy policy of the European Union. Development of this sector leads to the creation of new workplaces. Poland is required to fulfil the assumptions of the climate and energy package, inter alia, in the part concerning the contribution of renewable energy in the total consumed energy and reduction of CO_2 emissions until 2020.

The National Renewable Energy Action Plan (NREAP), adopted by the Council of Ministers on 7th December 2010 is so far the only governmental document, containing estimations of the development of this sector. According to NREAP the total planned installed power of offshore wind farms in 2020 can be 500 MW. NREAP estimates that utilisation of capacities installed in offshore wind farms (OWFs) located in the EEZ will be 3,000 MWh/MW/year, which means that total electric energy produced by this technology in 2020 will be 1.5 TWh[73].

Ernst & Young in cooperation with the Polish Wind Energy Association has prepared a report in which three scenarios of development of OWFs are analysed [Ernst & Young, 2013]. According to the experts, by 2025 – assuming the scenario of fast development – Poland could install 6 GW of generated power in the offshore wind farms[74] (which can account for more than 10% of demand for

[73] It should be noted that currently the total installed power resulting from valid permits significantly exceeds estimations of NREAP. However, the connection conditions limit these numbers. Currently it is known that the goals for 2020 will not be achieved.

[74] Key conditions of the fast development scenario:

- Preparation of a long-term strategy of development of OWF in Poland;
- Stable, long-term support system to ensure reduced investment risk;
- Ensuring connection of sources to the power network;
- Ensuring the necessary infrastructure (accompanying industry);
- Maximum utilisation of natural potential of OWFs in Poland;
- Stable economic situation and availability of funding;
- Support system ensuring income that covers the capital and operating expenditure and a satisfying return for a significant majority of investment projects;

electric energy in Poland) (Fig. 8.1.). In practice, assuming that ca. 5 MW of generated power are installed per 1 km^2, it means ca. 1,200 km^2 of the sea area would be occupied. Since the size of turbines is constantly growing, the amount of installed power could increase so much that Poland could become the biggest electric energy producer on the Baltic Sea.

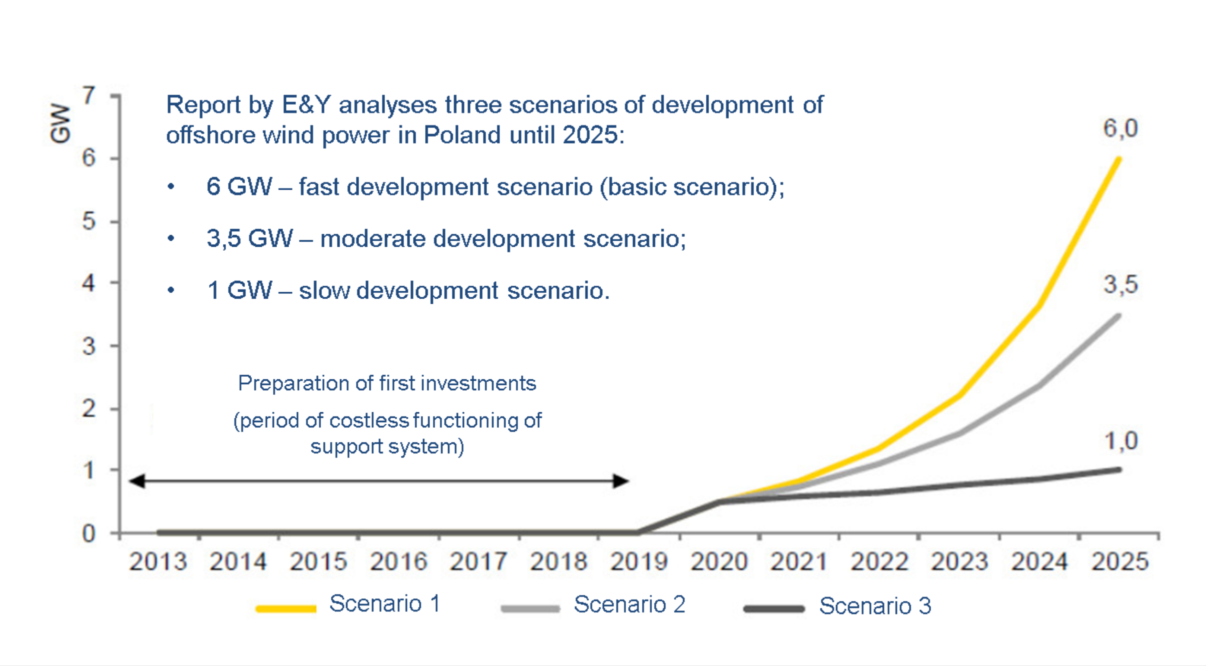


Fig. 8.1. Scenarios of development of offshore wind power

Source: Ernst & Young [2013]

Areas predisposed for development of offshore wind power production

In accordance with the existing law, Polish sea areas can be used for locating wind farms only outside the territorial sea[75]. The main criteria of usefulness of marine space for OWFs are shown in Table 8.1.

Table 8.1. Criteria of usefulness of marine space for OWFs

Criteria of Usefulness	Usefulness		
	Low	Medium	Highest
Windiness	< 9 m/s	9–10m/s	10 m/s
Depth	> 40 m	30–40m	20–30 m

- In longer perspective, a significant decrease of OWF as an effect of scale of development of the sector and of the accompanying industry.

[75] Under the Act on sea areas of Poland and maritime administration, offshore wind farms can be located only in the economic zone – which in practice means a distance of minimum 22 km from the coast (12 Nm).

Distance from land	Very low < 12 Nm Low 12 Nm–18 Nm	18 Nm–24 Nm	> 24 Nm
Conflicts	Strong conflicts (e.g.: protected areas, navigation routes, military exercise areas, fishing grounds, low-flight routes)	Medium conflicts (e.g. existing linear infrastructure, mining, cultural heritage)	Lack of conflicts (e.g. spawning grounds, mariculture, etc.)

Source: Maritime Institute in Gdansk, based on POWER [2009]; Stryjecki [2013]; Niecikowski and Kistowski [2008]; Szefler and Furmańczyk [2010].

Analyses of wind conditions show that conditions for locating OWFs in the Polish EEZ are good. The analyses made, e.g. for the development of the Southern Baltic Sea Windiness Atlas [SBWA, 2011] indicate that at the height of 80 m the average wind speed is ca. 9m/s, at a height of 100 m it is ca. 9.25 m/s, and at 125 m – 9.5 m/s (Fig. 8.2). This is confirmed by other analyses [Sokołowski and Stryjecki, 2012; calculations for the Study 2014] – at the height of 100m mean wind speed is often more than 9-9.5m/s, the number of windy hours in a year reaches 7,000 and the efficiency of energy production can exceed 40%.

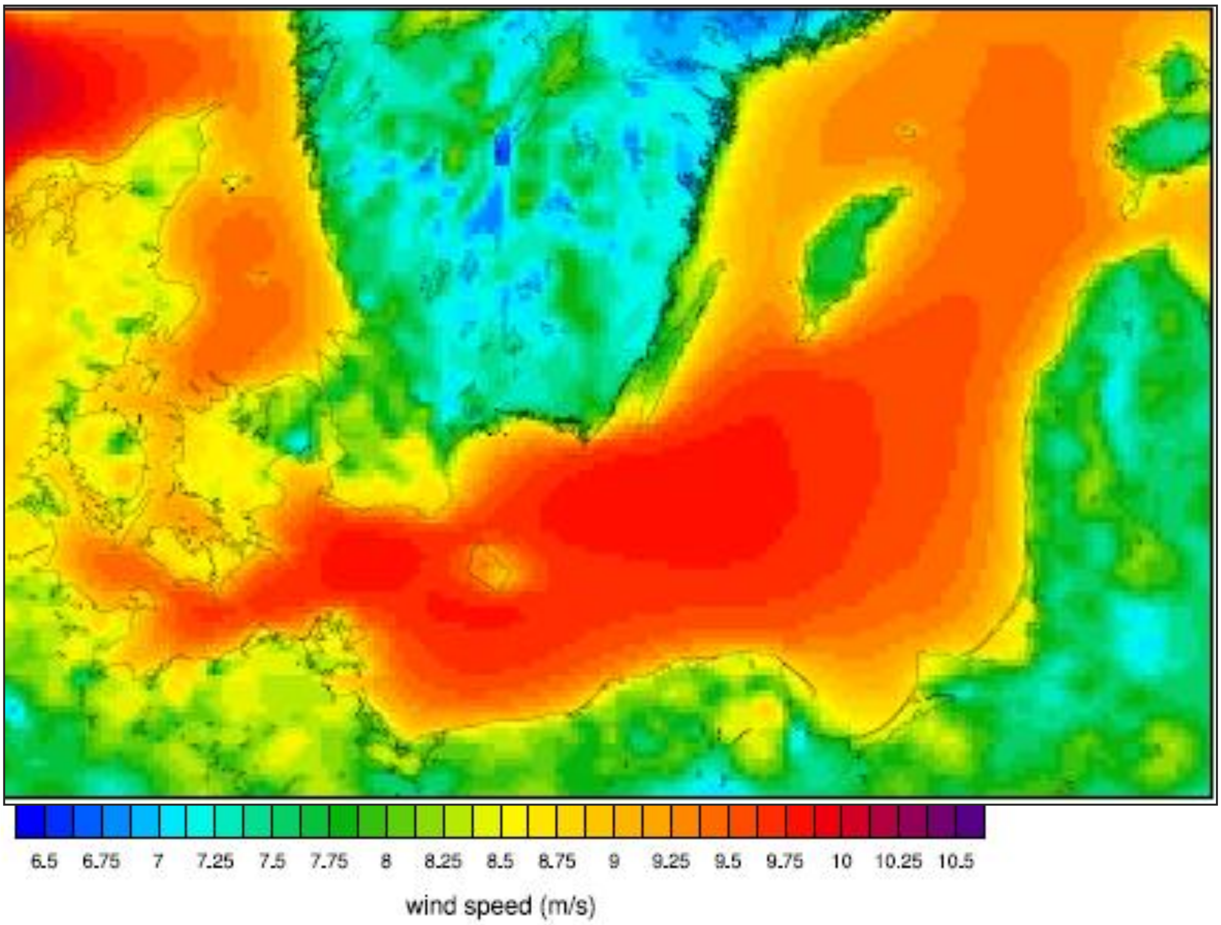


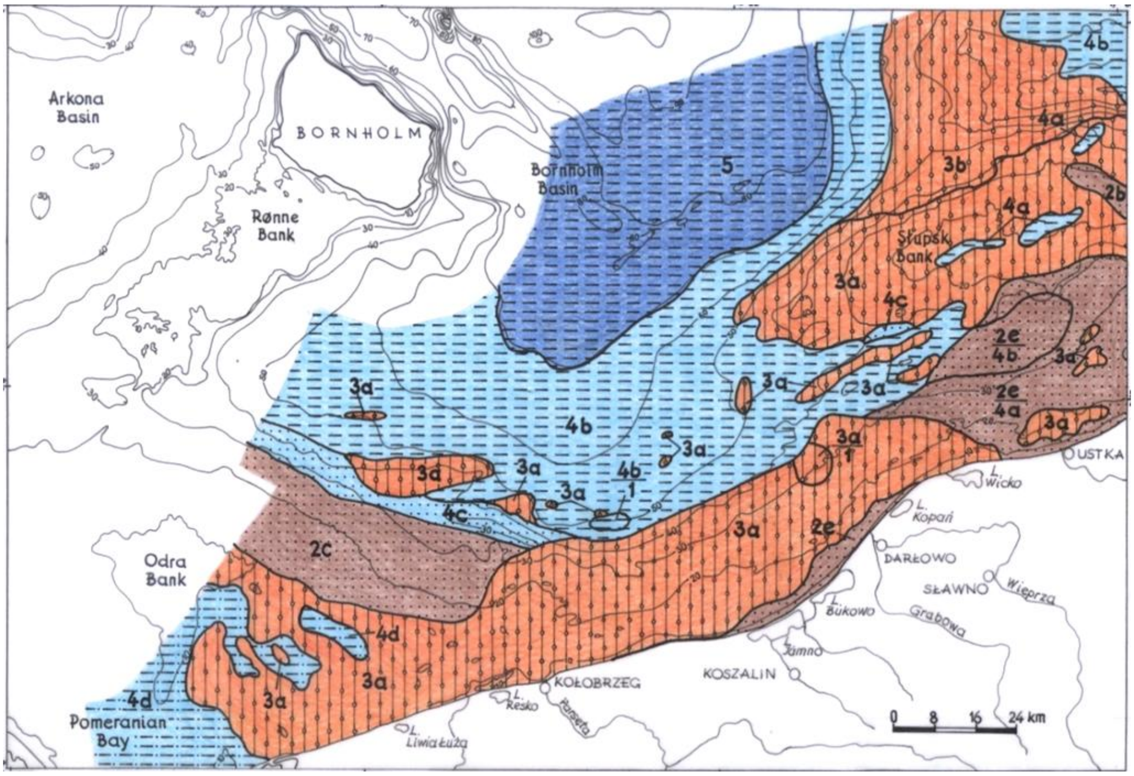
Fig. 8.2. Mean wind speed at a height of 125m, January 2007 – December 2009

Source: SBWA [2011]

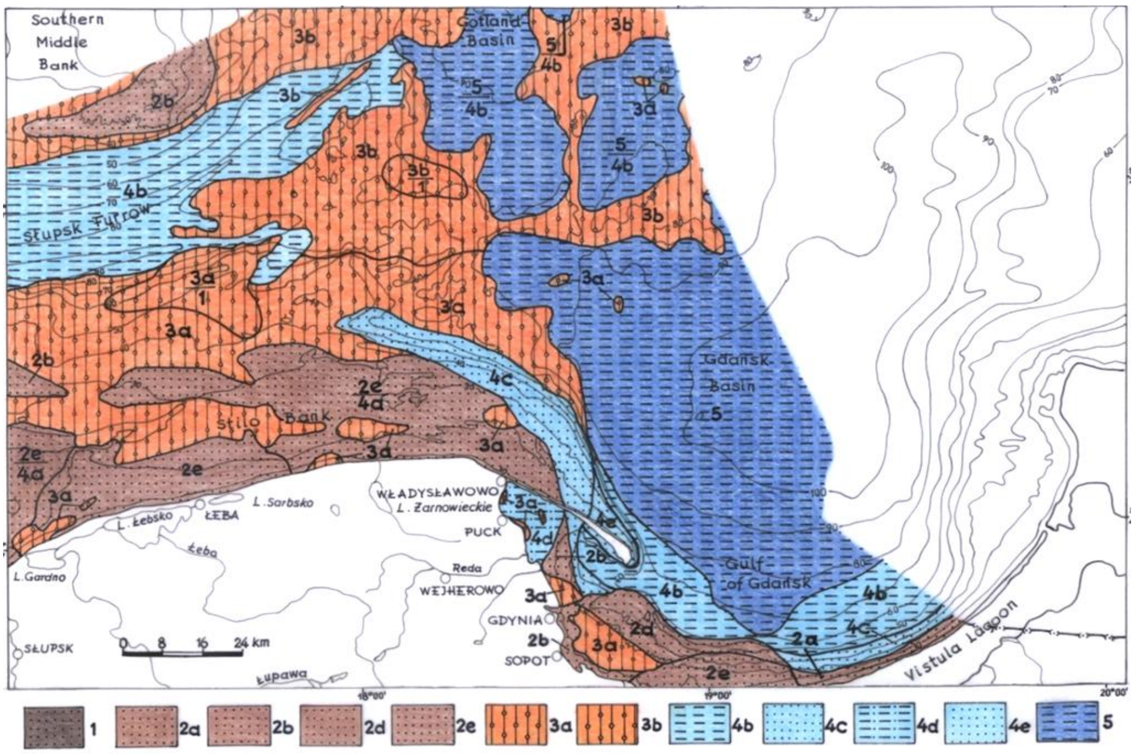
The limitation is the use of the fitting marine space for other purposes. The decisions on assigning a given sea area for the development of OWFs at cost of other users should be preceded by an extended analysis of the cost and benefit chain. A limitation can also be the long distance from coast and large depth which can increase the cost of servicing the farms and of investment in energy transmission, forcing the use of more expensive technical solutions (e.g. larger foundations). To some degree the location of new investments is also limited by the type of seabed – geological engineering analyses are usually made at the stage of preparing the construction design. Technical progress allows overcoming most of the problems caused by non-ideal soil conditions (but at higher cost). A limiting factor is still the sloping of the seabed and presence of some extremely unfavourable deposits. According to the geological-engineering study carried out in 2008 – 2013 [Kaszubowski and Coufal, 2008; 2014] soil conditions in the Polish EEZ are mainly good to satisfactory for maritime structures[76] (Fig. 8.3 a and b). Analysing the current procedures for location permissions for OWFs, it seems soil conditions will not be a limitation for foundations of the wind farm towers.

[76] The determination of seabed types was carried ou basing on a detailed analysis of geological maps of the Baltic Sea bottom in a scale of 1:200,000, geological interpretation of seismoacoustic investigations of selected fragments of the seabed, results of detailed geological-engineering studies of selected fragments of the seabed and geological-engineering studies of the coastal zone of the West Pomeranian Voivodship. The analysis took into account specific geological criteria such as type of deposits, origin and age, and the following geotechnical parameters were considered: compaction, plasticity, internal friction angle, cohesion, compression strength, shearing strength and consolidometer modulus of primary compressibility. Also the bottom relief was analysed and the following morphologic bed types were identified: flat seabed, slightly inclined seabed, inclined seabed, strongly inclined seabed, slightly steep seabed, steep seabed and very steep seabed.

a)



b)



Usefulness of seabed for maritime structures: 1 – very good, 2 – good, 3 – satisfactory, 4 – bad, 5 – very bad.

Fig. 8.3. Geological-engineering units of seabed in the Polish part of the Baltic Sea

Source: Kaszubowski, Coufal [2008]

Within the work on this Study, a spatial analysis of the usefulness of sea areas for the development of wind power was carried out basing on parameters of windiness and depth, also taking into account the distance from the coastline (as earlier mentioned this affects the costs of power connection infrastructure). The analysis considered the information acquired for development of the Study – such as depth data or wind speed distribution at the height of 100m a.s.l. (calculations for 2013). The depth data were interpolated and a raster with pixel size 400 x 400m was obtained, and then regions with parameters specified in Table 8.1 were identified. A similar procedure was used for data on wind speed distribution and distance from land. Each class of all the 3 resulting rasters (wind, distance from coast, depth) was assigned a weight and using map algebra, a resultant comprehensive raster was obtained with classes of value from 2 to 9, which show the degree of usefulness of the sea area.

Analysis of the earlier described criteria allows identifying areas predisposed for the development of offshore wind farms (Fig. 8.4).

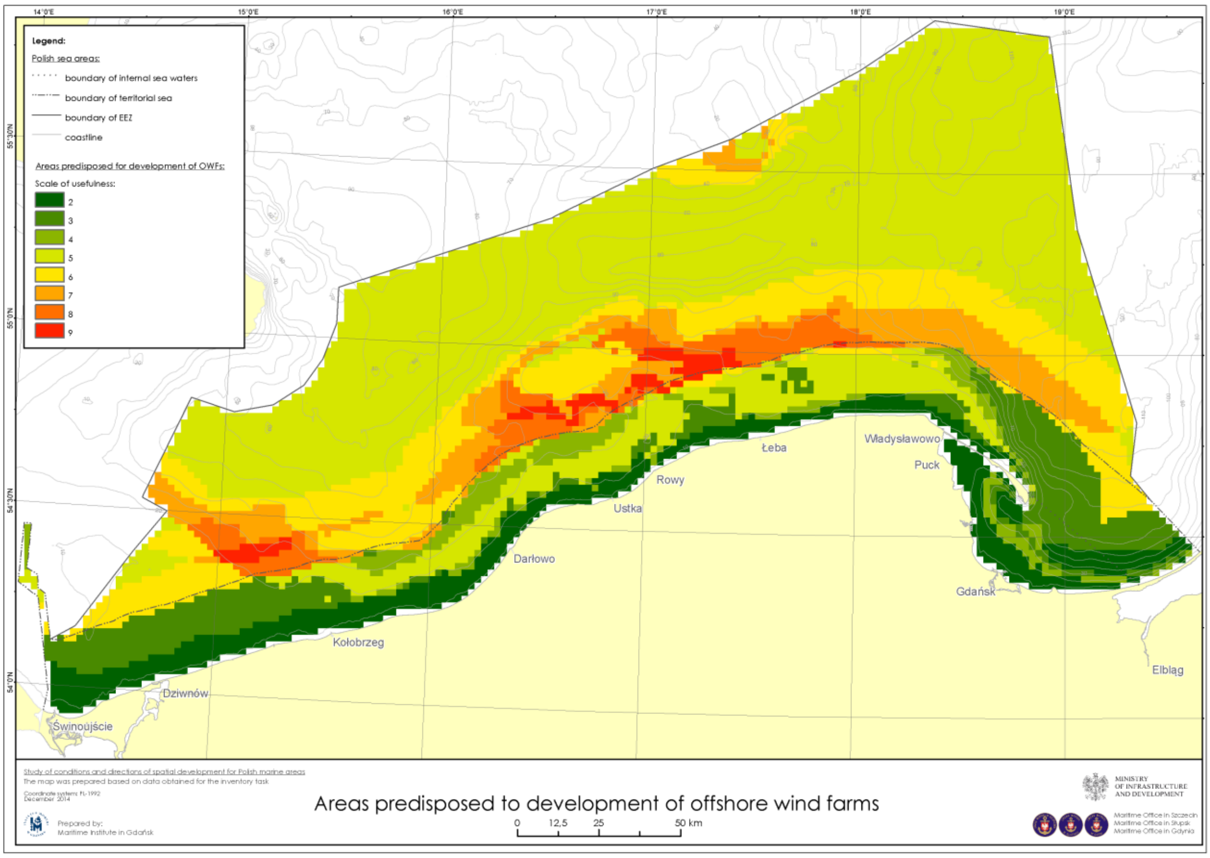


Fig. 8.4. Areas predisposed to development of offshore wind farms[77]

Source: Maritime Institute in Gdansk.

Basing on the carried out preliminary analysis it can be concluded that despite the common opinion that construction of offshore wind farms is most cost-effective for small distances from the

[77] Maps showing predisposed areas versus navigation routes and environmental protection areas are shown in catalogue POWER ENGINEERING.

coast, the natural conditions in the Polish sea areas, also areas located to the north from the boundary of the territorial sea, are predestined for this form of use of marine space. This is mainly because wind speed is lower near the land and also because locating wind farms inside the territorial sea is prohibited by law.

In addition to the described factors conditioning the usefulness of the areas for development of OWFs, there are also important economic and political conditions. The main are:

- a stable and effective system of support for renewable energy sources;
- possibility of connecting new installations to the National Electrical and Power System (currently, until 2025, available OWF connections are for less than 3 GW[78]);
- creation of a national shipyard and port base.

However, these factors are outside the influence of maritime spatial planning.

It can be estimated that the spatial demand of infrastructure of one farm is [Andrulewicz et al., 2013]:

- generators with foundations - < 1ha/tower;
- power cables inside the wind farm – 50–100 m wide corridors (usually located ca. 3 m below bottom surface);
- transmission/conversion stations – 1–5 ha;
- connection cables – buried or protected with concrete mattresses or stones, in areas of fishing with bottom trawls – corridor of up to 500 m width;
- free passage of construction and maintenance vessels/

The sea area with offshore wind farms will be closed to merchant and passenger shipping and access for fishery will be limited.

So far, no wind farms have been built in the Polish sea areas. Until November 2014, 75 applications for a permit to erect and use OWFs in Polish sea areas were submitted. 37 permits were issued, of this number, in November 2014, valid remained 23 (9 paid, 3 suspended at the request of investors, 10 decisions issued in 2014 are not final yet since the fee for the permit has not been paid). Payment of the fee is a condition for being granted the right to use the sea space for the future investment. 14 permits are no longer valid due to non-payment of 1st instalment (6 applications were re-submitted). The currently binding decisions (23) assign for development of wind power a total area of ca. 1,880km^2 (Table 8.2) and are concentrated in three regions:

- on north-east slopes of the Słupsk Bank (Region A) – ca. 1,081 km^2;
- around the Southern Middle Bank (Region B) – ca. 568 km^2;
- north of the Odra Bank (Region C) – ca. 227 km^2.

Fig. 8.5 shows in green the locations of offshore wind farms for which the scope of environmental reports is agreed, in maroon are shown the locations of future wind farms which received terms of connection to the National Power System.

It is expected that first projects may be implemented before 2030.

[78] Information obtained from http://www.reo.pl/przyszlosciowy-sektor-offshore (access: 01.12.2014),

Table 8.2. Localisation permits issued for offshore wind farms, as of November 2014

Element	Value
Localisation permit for offshore wind farms	23
Area (km^2)	1876
Max power installed (MV)	17 000
Payment made	9
Application for environmental conditions of realising the investment	9
Environmental investigations for the EIA report	7
Construction permit	-
Terms of connection to National Power System	3
Permit for laying and maintaining submarine cables	2

Source: Maritime Institute in Gdansk, based on data of the Ministry of Infrastructure and Development

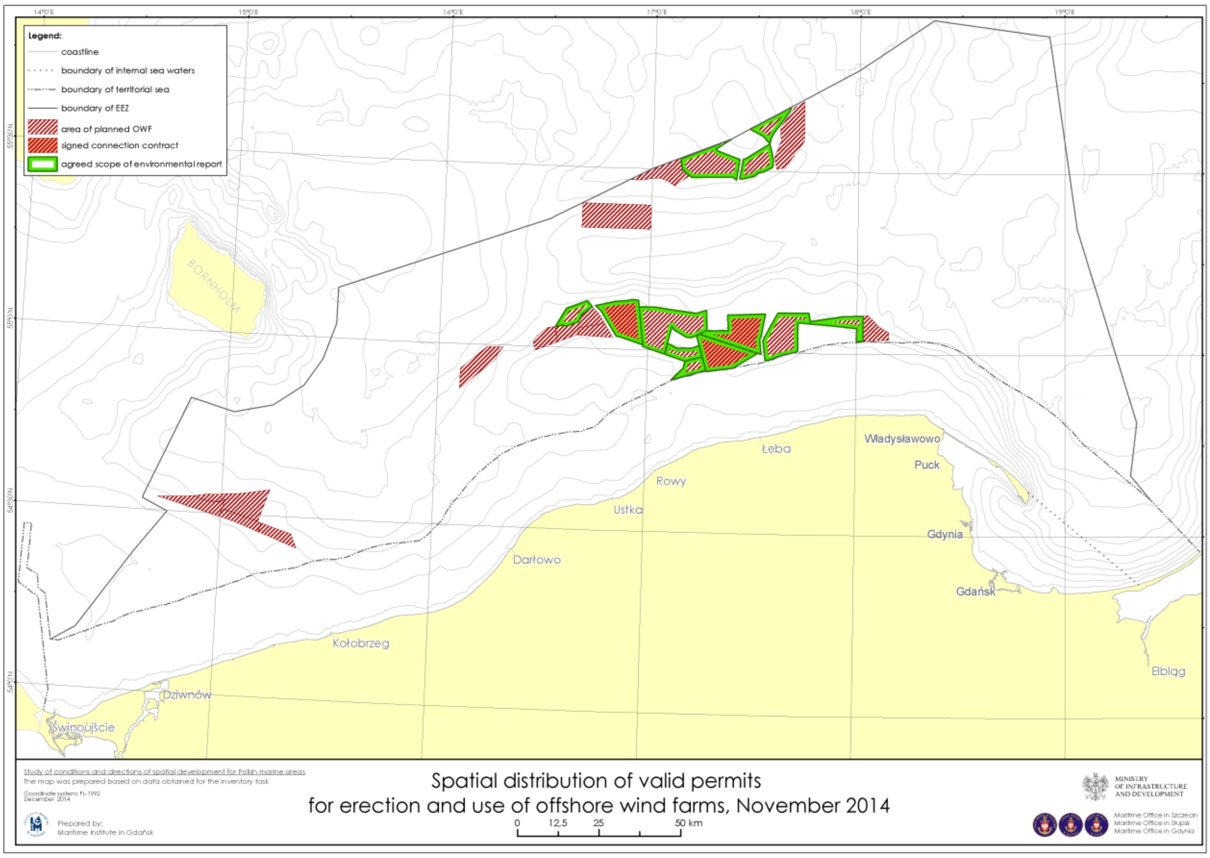


Fig. 8.5. Spatial distribution of valid permits for erection and use of offshore wind farms, November 2014

Source: Maritime Institute in Gdansk, based on data of the Ministry of Infrastructure and Development

Table 8.2, the calculations and Fig. 8.5 take into account only the issued legally valid decisions, records of which were made available for the needs of this Study by the Ministry of Infrastructure and Development. Among the proposals to the spatial plan, submitted in response to the announcement of the Directors of Maritime Offices on starting the process of maritime spatial planning of Polish sea areas, there are many proposals for locating OWFs which concern also locations for which decisions have become invalid or decisions were issued to a different subject. A full list of offshore wind farms (decisions and proposals to the plan) is given in Annex 15. However, because some of the proposals were covered by a non-disclosure clause, access to this list is limited.

So far, terms of connection to the National Power System (NPS) have been obtained by two projects with total power of ca. 2,250MW, to be connected in stages, partly in dependence of adaptive investments to be carried out by the Polskie Sieci Energetyczne (Polish Power Grid Co,). One of the investors (who also submitted a proposal to the maritime spatial plan) obtained terms of connection from the Energa Operator Co., however, the location permit for his wind farm has expired.

In August 2014 terms of connection for offshore wind farms Middle Baltic Sea III and II were signed. Connection of energy produced by these two OWFs to the national grid will be done in two stages in the period 2020-2025. They are to be connected to the Słupsk-Wierzbięcino transformer station. Currently, for both investments EIA reports are finalised. The investor plans to start construction of the Middle Baltic Sea III OWF in 2020 and of the Middle Baltic Sea II – in 2023. It is expected that these OWFs will start operation in 2022 and 2026, respectively[79]. It means that the earlier mentioned NREAP goals will not be achieved in the planned time.

On 24 October 2014, Polskie Sieci Elektroenergetyczne (Polish Power Grid Co.) also concluded an agreement for connection of the OWF Baltica to the national power grid (installed power ca. 1045.5MW). Connection of the Baltica OWF will be realised in five stages and is to be completed by the end of 2030. It will be connected to the 400kV switching station in the existing 400/110kV Żarnowiec power station in the Pomeranian Voivodship.

The issued terms of connection, though they are given to projects located relatively close to each other, indicate different points of connection to the national power grid. At present, it is possible to connect wind farms to the national power grid at one of the three stations: Żarnowiec, Słupsk and Dunowo.

Because of the limited possibilities of connection to the national power transmission system, development of offshore wind farms will probably require creating a comprehensive power transmission system, an international marine power grid which would include offshore wind farms of several countries, enabling energy exchange in case of excess of its production (good wind) in a given part of the sea, or deficit (lack of wind) in some other part. This concept is more widely discussed in subchapter 8.4.

At present, there are no technical possibilities for issuing further terms of connection. In accordance with currently in force regulations, OWF investors are treated in the same way as other investors applying for connection of power generating sources, and are required to fulfil formal requirements and to build at own cost the power infrastructure both on land and sea, including the connection infrastructure.

[79] Information obtained from http://www.pepsa.com.pl/pl/strona/farmy-morskie (access: 01.12.2014)

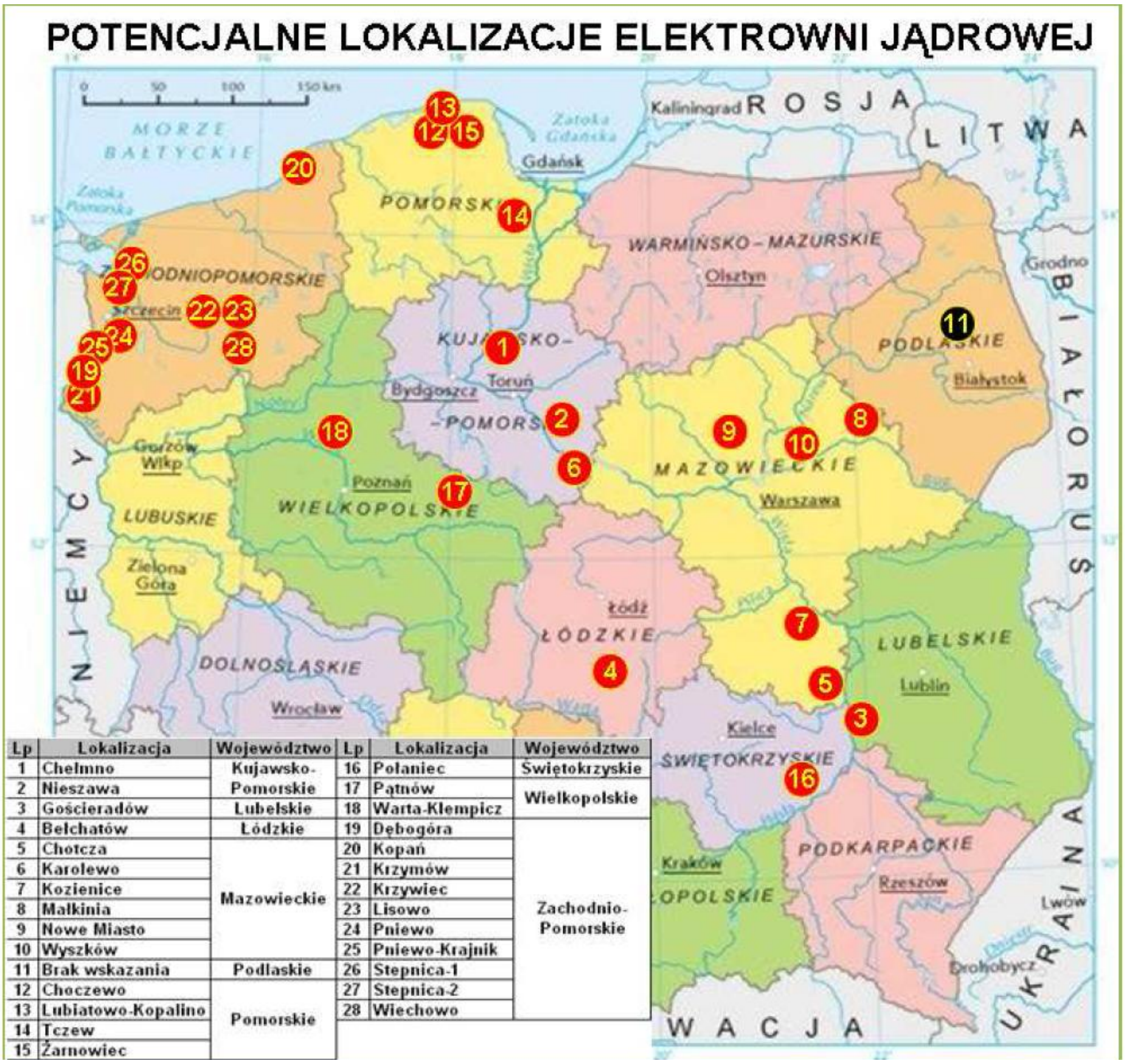
8.2. Nuclear power plants

The argument for nuclear power plants is the need to ensure a proper level of energy safety for Poland. The priorities of the Polish energy policy with respect to nuclear power are defined in the document Energy Policy of Poland until 2030, chapter 3 paragraph 4 – "Diversification of electric energy generation structure by introducing nuclear power engineering". The development of nuclear power engineering is also specified in the priorities of the Strategy for Energy Safety and Environment as expansion of Goal 2 – Ensuring safe and competitive energy supply for national economy – Modernisation of professional electrical power engineering, including preparation for introduction of nuclear power engineering (2.4.). Continuation of work on implementation of nuclear power engineering is Activity 28 of the Strategy.

In 2014, the Polish Nuclear Power Engineering Programme was adopted. It specifies the scope and organisational structure of activities necessary for implementing nuclear power engineering, ensuring safe and effective operation of nuclear power engineering objects, their removal after ending operation and ensuring safe handling of burnt nuclear fuel and radioactive waste.

Basic decisions on localisation of the plants are yet to be taken. However, work in this direction is progressing, and the strategic documents indicate the possibility of locating such type of power plants in the coastal region.

In 2009, the national Government, in agreement with local governments, updated the proposals for localisation of nuclear power plants. Also, new offers were collected. Based on this, a list of 28 potential locations of nuclear power plants was developed (Fig. 8.6) (PPEJ, 2014].



Lp	Lokalizacja	Województwo	Lp	Lokalizacja	Województwo
1	Chełmno	Kujawsko-Pomorskie	16	Połaniec	Świętokrzyskie
2	Nieszawa		17	Pątnów	Wielkopolskie
3	Gościeradów	Lubelskie	18	Warta-Klempicz	
4	Bełchatów	Łódzkie	19	Dębogóra	Zachodnio-Pomorskie
5	Chotcza	Mazowieckie	20	Kopań	
6	Karolewo		21	Krzymów	
7	Kozienice		22	Krzywiec	
8	Małkinia		23	Lisowo	
9	Nowe Miasto		24	Pniewo	
10	Wyszków		25	Pniewo-Krajnik	
11	Brak wskazania	Podlaskie	26	Stepnica-1	
12	Choczewo	Pomorskie	27	Stepnica-2	
13	Lubiatowo-Kopalino		28	Wiechowo	
14	Tczew				
15	Żarnowiec				

Fig.8.6. Map of potential locations of nuclear power plants in Poland

Source: PPEJ [2014]

In 2010 the document "Expert opinion on criteria of localisation of nuclear power plants and initial assessment of agreed locations" [MG, 2010]was prepared. As part of the work a ranking of locations, based on expert opinion on 17 evaluation criteria, was carried out. The result of the evaluation is shown in Fig. 8.7 (the last place in the ranking is a location for which no geographic coordinates were given, which for formal reasons did not allow considering it in the ranking).

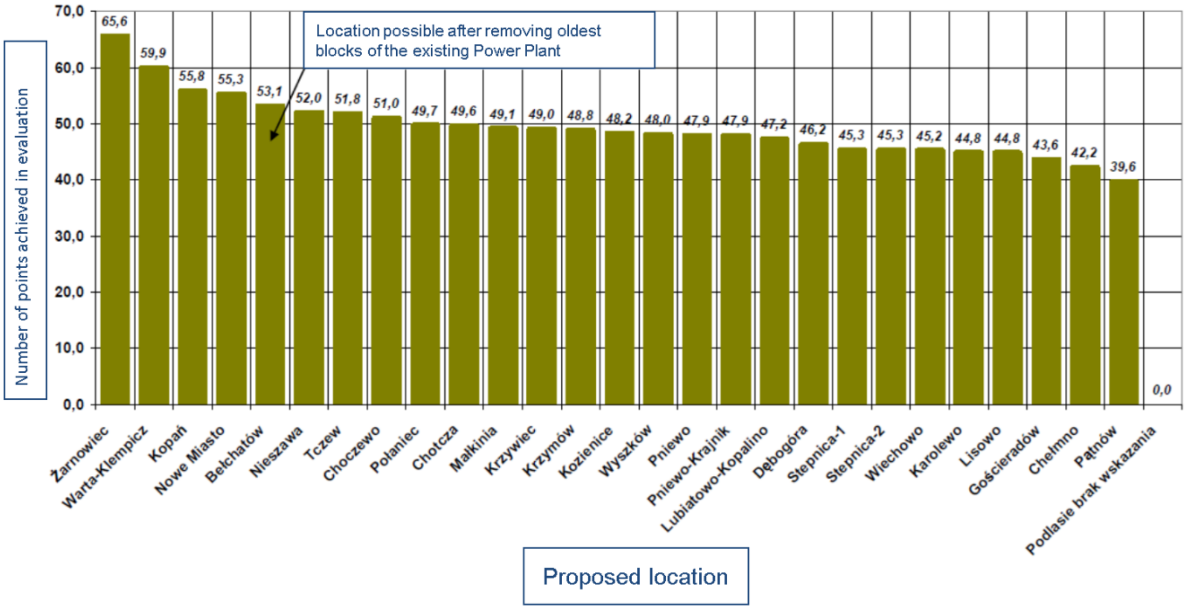


Fig. 8.7. Expert assessment of proposed location of first nuclear power plant in Poland Source: Ministry of Economy [2010].

Results of the work were passed to the potential investor of the first Polish nuclear power plant, the PGE Capital Group, for further study and analysis.

In accordance with the Act Nuclear Law (unified text JoL of 2014, item 1512), the investor is required to choose the location of the nuclear power plant and carry out a detailed localisation analysis. In November 2011, the investor – PGE SA published a list of 3 potential locations for the nuclear power plant:

- “Choczewo”, Pomeranian Voivodship, Choczewo municipality;
- “Żarnowiec”, Pomeranian Voivodship, Krokowa and Gniewino municipalities (site of discontinued construction of Nuclear Power Plant Żarnowiec);
- “Gąski”, Pomeranian Voivodship, Mielno municipality.

In accordance with the, developed in June 2011, Strategy for evaluation and selection of nuclear power plant location, the procedure of selection of the final location of a nuclear power plant consists of 3 main stages:

- searching for, and evaluation of location. Indication of location for site and environmental investigations;
- site and environmental investigations for 3 recommended locations;
- selection of target location.

In February 2013, preparations for the site and environmental investigations began paralelly at two locations: “Choczewo” and “Żarnowiec” (Fig. 8.8). The objective of the investigations is to confirm that a given potential location will be appropriate for the nuclear power plant from the environmental and nuclear safety point of view.

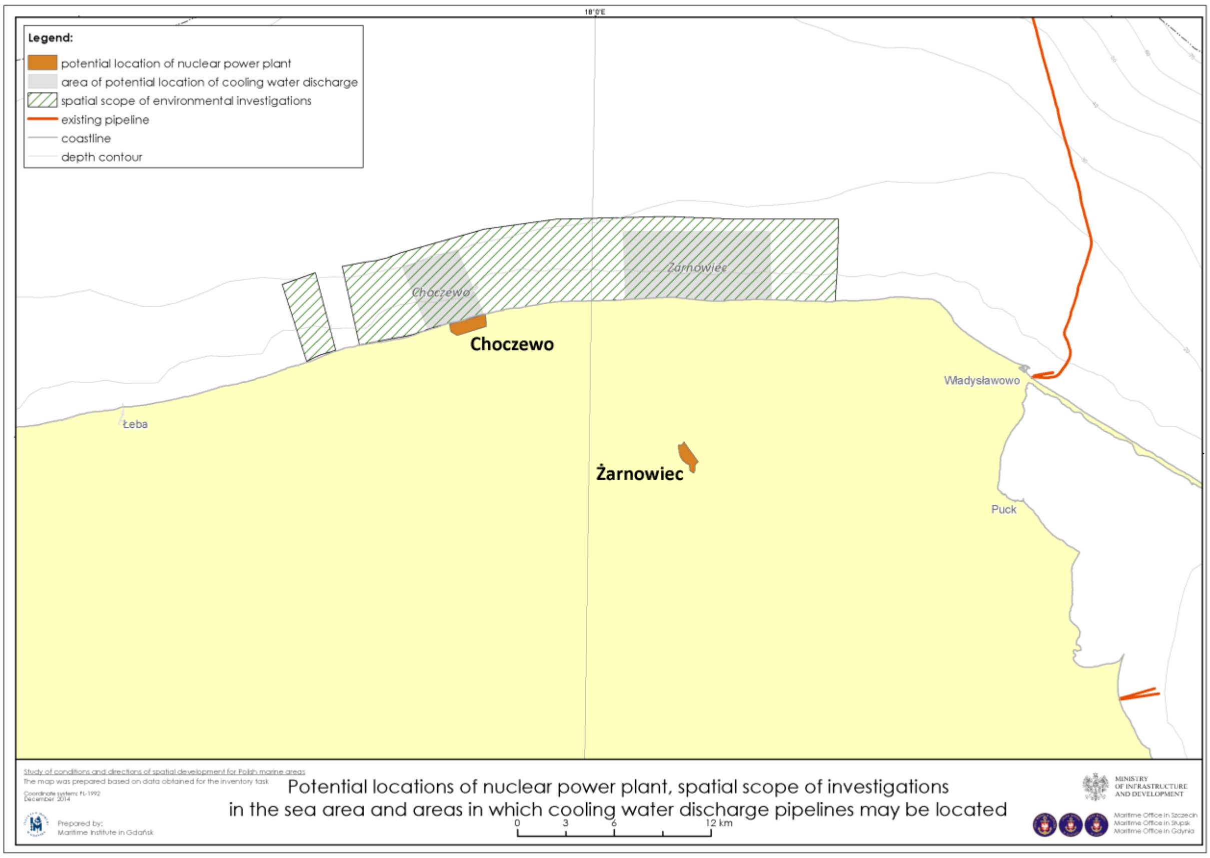


Fig. 8.8. Potential locations of nuclear power plant, spatial scope of investigations in the sea area and areas in which cooling water discharge pipelines may be located.

Source: Maritime Institute in Gdansk, based on information PGE EJ1.

Conclusions for the maritime spatial plan of Polish sea areas

Natural conditions in the Polish sea areas – windiness and depth – predestine areas northward from the border of the territorial sea for development of wind power engineering.

It is necessary to:

- identify optimum locations for development of offshore wind farms basing on existing information and in-depth analyses;
- take into account the already issued permits;
- ensure space for connecting the wind farms to the national power grid and to the possible Baltic rail;
- take into account the long time lag between obtaining the permit decision and start of construction of an offshore wind farm and consider the need to indicate, in the areas covered by such permits, non-colliding functions which could be realised until the start of construction of the farms (these will be temporary functions which cannot collide with the rights of the licensees);
- that authorities issuing permits give proper attention to the need to ensure a higher level of coexistence of offshore wind farms with other forms of sea space use (issue of limited fishery, mariculture or sea tourism);
- consider whether some fishing tools could be allowed inside the wind farms, as well as the possibility of locating fish farms or other types of mariculture in wind farm area;
- ensure access to fishing grounds in the Słupsk Trough area (along possibly short routes) by, e.g. designating appropriate navigational corridors;
- analyse the possibility of adjustments (organisation) of the course of navigation routes near the wind farms (in particular in relation to the recommended by HELCOM Route H);
- satisfy the needs of protection of underwater cultural heritage during localisation of the OWFs;
- address the need to dismantle the farms after their decommissioning (this is required by law, but foundations of the towers can become valuable habitats);
- take into account the demand for marine space related to the localisation of a potential nuclear power plant (cooling water discharge, possibly also a safety buffer) and exclusion of other uses in this space.
- take into account that locating a nuclear power plant in the coastal zone may also result in the appearance of a new local port at Choczewo or Dębki (base port for construction and operation of the plant) and reserve appropriate sea space for this purpose.

Knowledge gaps

Costs of co-existence of wind farms and other forms of use of marine space are not known.

Investigations of the usefulness of the seabed for foundation of wind farms should be continued.

There is a lack of detailed information on the overall impact of OWFs on the ecosystem and ecosystem services of the Baltic Sea.

There is a lack of a comprehensive analysis of losses of sectors affected by closing the sea space for their activities.

There are no decisions and final settlements on the connection OWFs to the national power grid.

The project of Baltic energy transfer networks is at a very preliminary stage of development of the concept.

There are no political decisions concerning launching of an OWF programme.

Key decisions regarding nuclear power plant localisation are lacking.

8.3. Mining and aggregate extraction for industrial needs

Geological and mining activities in seas and oceans can be divided into four groups [Kozioł et al., 2011]:

- submarine geological exploration drilling;
- submarine oil and gas mining – bore mining of oil and gas;
- submarine surface mining – surface mining of mineral products;
- submarine well and inclined drift mining – sub-bottom extraction of solid mineral products.

Geological investigations proved that Polish sea areas contain deposits of oil, natural gas, aggregate and amber. Potentially, there are resources of shale gas estimated only together for sea and land – there are no estimations exclusively for the sea area. On the other hand, it is known that the two documented deposits of oil in the Baltic shelf account for ca. 20% of national resources. In many deposits oil occurs together with natural gas.

Three deposits of gravel-sand aggregate were documented with balance resources of 147,983 tons, and the total area of deposit fields is 70.8 km^2. Aggregate deposits occur mainly in the coastal zone, within shoals and coastal berms.

Raw material deposits in the sea areas are still not fully investigated. Most of the Polish sea areas are covered by exploration licences. Investigations are continued with the aim of full balancing of these resources. The identified mineral deposits are shown in Fig. 2.10 in Chapter 2.

In the Polish sea areas extraction of mineral resources is done by drilling from platforms (oil and gas) or by collecting the material from bottom surface (sand and gravel) with dredgers. Despite the high amount of aggregate deposits on land, the aggregate in marine deposits is characterised by very high quality required for structural concrete, which determines the profitability of their extraction. Mining of amber was also considered. However, this would require making deep excavations in the sea bed or using the technique of flushing amber out under pressure, and would result in deep and relatively extensive cavities under the seabed. Both methods would result in a serious, probably irreversible, disruption of the sea bottom. In consequence no extraction of amber was undertaken.

A relatively large number of ferrous-manganese concretions is formed on the Baltic Sea bottom. It is estimated that their resources amount to ca. 100 mln tons. Currently, exploitation of land deposits of iron and manganese fully satisfies the needs of national economy, therefore there is no need to exploit the Baltic concretions. But in the future these deposits can be a valuable source of these metals [Szefler and Furmańczyk, 2008].

From the economic point of view extraction of hydrocarbons is the most important form of human activity in the sea area. Also important are resources of aggregate (sand) for coastal protection needs. Extraction of sand for beach nourishment is described in Chapter 5 (sub-paragraph Long-Term Programme of Coastal Protection).

Mining of hydrocarbons is important for macroeconomic reasons, inter alia such as economic growth which results in increasing demand for energy fuels, or international obligations, among others to reduce CO_2 emissions, which result in the need to diversify sources of energy production. As stated in the Strategy for Energy Safety and Environment, Polish economy is faced with the problem of maintaining stability of natural gas and oil supplies (variation of prices of the natural gas and oil and high dependence on supplies from the east). Ensuring their stable supply is a fundamental direction of the national energy policy. This means that it is necessary to make optimum use of own resources and to diversify the sources and directions of oil and of liquid and gaseous fuel imports.

The issue of improving energy safety is also an important topic in the new strategic document – the National Security Strategy of Poland signed by the President of Poland on November 5th 2014. When dealing with energy safety, the document puts particular stress on starting exploitation of Polish non-conventional deposits and on ensuring diversified access to sources and routes of energy materials' supply. It is also pointed out that the State should maintain control over the key infrastructure of the fuel and energy sector and extend supervision and control over all the geological resources of the State.

In accordance with Polish legislation, hydrocarbon deposits, regardless of where they occur, are the property of the State (art. 10 of the act Geological and Mining Law[80]). In accordance with the provisions of the Strategy for Energy Security and Environment and the National Spatial Development Concept 2030, not only currently exploited hydrocarbon deposits (also salt and ores of metals[81]) should be protected, but also deposits whose mining is currently uneconomical or involves a risk of high environmental costs, since it should be assumed that with the development of technology their mining will become cost-effective and non-harmful to the environment. The basic mechanism in this respect is to consider in the planning documents (among others in the local spatial plans) the information on documented deposits of minerals, especially those of strategic importance for national energy security. Documented deposits of strategic character are covered by special protection against development which would prevent the use of their resources in the future. In relation to sea areas this concerns shale gas, the extraction of which may contribute to a change of the national energy structure. An important strategic task is also the exploration and protection of potential subterranean CO_2 storage complexes.

Hydrocarbons

Until now, in the Polish exclusive economic zone 4 deposits of good quality natural gas have been identified (70-95% of methane), of which two are currently being exploited. Deposits B4 and B6 contain only natural gas, while in deposits B3 and B6 also oil is present. It is estimated that the resources of natural gas in the Polish part of the Baltic shelf account for 4% of Polish resources (Table 8.3). Currently, licences for exploration and extraction of natural gas from the Baltic Sea bottom are owned by LOTOS Petrobaltic SA and Baltic Gas Sp. z o.o. (Table 8.5, Fig. 8.8). The licence for extracting oil and coexistent natural gas from deposit B8 is valid until 2031. Licences for extracting natural gas from deposits B4 and B6 are valid until 2032.

[80] Operation of offshore mining is regulated by provisions of the Act of 9 June 2011 – Geological and Mining Law (JoL 2014 no 163 item 981 with later amendments) which was updated by the Act of 11 July 2014 on change of the Act – Geological and Mining Law and some other acts (JoL, item 1133). Changes became effective as of 1st January 2015. The Act does not apply to, inter alia, artificial nourishment of the coast with sand extracted from the sea bottom (art. 3, par. 5). The decisions issued basing on this Act which concern the internal sea waters and the territorial sea, and also the coastal belt, require agreement with the director of the relevant maritime office, whereas the decisions regarding the EEZ require agreement with the minister responsible for maritime economy (art. 8).

[81] Management of sand extracted from the sea bottom for needs of coastal protection is not subject to the Act Geological and Mining Law.

Table 8. 3. Comparison of geological balance resources and extraction of natural gas in sea areas (as of 31st December 2013)

Mineral	Number of deposits		Resources		Extraction (mln m^3)
	Total	in that managed	Extractable balance	Industrial	
total natural gas (mln m^3)	287	200	132,074.47	62,176.39	5,488.77
natural gas (Baltic Sea) (mln m^3)	4	2	561.75	1,289.88	15.99
B3	1	1	145.77	873.90	15.99
B4	1	-	2,686.60	1,972.40	-
B6	1	-	1,792.85	1,792.85	-
B8	1	1	415.98	415.98	-

An assessment of natural gas and oil resources in shale formations, the so-called Baltic-Podlasie-Lublin basin, was carried out for the Polish sea areas [PIG, 2012]. Considering the parameters of the estimation, the most probable exploitable resources of gas are within 346.1 – 767.9 bln m^3 (both for the marine and land parts of the basin) [Opioła and Tyszecki, 2012]. These estimates will be verified by further exploration works and investigations.

In 2013, a total of 85 deposits of crude oil were identified, including 2 on the Baltic shelf. Resources of the marine deposits account for ca. 19% of the total. Basic information on the documented deposits of crude oil in Polish sea areas is given in Table 8.4.

Table 8.4. Comparison of geological balance resources and extraction of crude oil in sea areas (as of 31st December 2013)

Mineral	Number of deposits		Resources		Extraction (thous. of tons)
	Total	In that managed	Extractable balance	Industrial	
Crude oil (thous. tons)	85	68	24,377.53	15,419.63	926.38
Baltic Sea (thous. tons)	2	2	4,840.96	4,770.30	145.59
B 3	1	1	1,388.31	1,317.65	145.59
B 8	1	1	3,452.65	3,452.65	-

Source: Maritime Institute in Gdansk, based on Mineral Deposit Resources Balance in Poland [2014].

At present the only licensee for extraction (until 2031) of oil and accompanying gas from the Polish part of Baltic Sea bottom is LOTOS Petrobaltic SA. In Poland, exploration and extraction works are carried out in nine areas of exploratory licences (Gaz Północ, Gaz Południe, Gotland, Leba, Rozewie, Sambia W, Sambia E, Słupsk W and Słupsk E) (Table 8.5; Fig. 8.9) and in four areas for which extraction licences were issued (Leba, Smołdzino, Lubiatowo and Kuźnica). The company is currently extracting oil from deposit B3 and preparing for exploitation of deposit B8.

The oil from deposit B3 is extracted by bore method (with twelve exploitation bores). Water is pumped into the deposit with directional bores. Oil and gas are separated in separation facilities on the platform. The gas is transported by submarine pipeline to Władysławowo, and the oil is transferred via submarine pipeline and mooring-transfer buoy to a tanker where it is stored.

Currently, deposit B8 is being prepared for exploitation – drilling in bore B8-5K was carried out. In October 2013, Polskie Inwestycje Rozwojowe and LOTOS Petrobaltic SA concluded an agreement on funding of an investment project with the objective of exploiting this deposit. In 2014, a drilling platform was purchased, which after necessary repairs will start operation at the deposit. The platform allows drilling in 105 m water depth, and after optional extension of its legs, even in 120 m depth. The repaired platform is expected to start operation in 2016[82].

Table 8.5. List of licences for extraction of hydrocarbons and for investigation and exploration of deposits

Name	No.	Type	Content	Date of issue	Date of expiration	In favour of
B3	108/94	Exploitation	Extraction of oil and accompanying natural gas from deposit B3 located 70 km to the north of Rozewie	29.07.1994	2016 - application for extension until 2026	LOTOS Petrobaltic S.A
B8	1/2006	Exploitation	Extraction of oil and accompanying natural gas from deposit B8 located within the Polish EEZ	05.09.2006	2031	LOTOS Petrobaltic S.A.
B4	6/2007	Exploitation	Extraction of gasoline natural gas from deposit B4 located within the Polish EEZ.	11.05.2007	2032	since 2013 BATLIC Gas Sp. z o.o
B6	2/2006	Exploitation	Extraction of natural gas (gas condensate) from deposit B6 located within the Polish EEZ.	7.11.2006	2032	since 2013 BATLIC Gas Sp. z o.o.
Gaz Północ	35/2001/p	Exploration and investigation	Exploration and investigation of deposits of crude oil and natural gas within "Gaz Północ" – eastern part of the Polish sea areas	14.12.2001	04. 2014	BALTIC Gas Sp. z o.o.
Łeba	37/2001/p	Exploration and investigation	Exploration and investigation of oil and natural gas deposits within the "Łeba" region – eastern part of Polish sea	14.12.2001	12.2014	LOTOS Petrobaltic S.A

[82] Beginning of extraction on deposit B8 is planned for 2015 using the Lotos Petrobaltic platform because repair of the Petrobaltic platform was delayed in view of the crisis on the fuel market (http://www.lotos.pl/322/p,341,n,4201/grupa_kapitalowa/nasze_spolki/lotos_petrobaltic/aktualnosci/lotos_konsekwentnie_realizuje_plan_zagospodarowania_zloza_b8_na_morzu_baltyckim access: 25.02.2015).

			areas			
Rozewie	38/2001/p	Exploration and investigation	Exploration and investigation of oil and natural gas deposits within the "Rozewie" region – eastern part of the Polish sea areas	14.12.2001	12.2015	LOTOS Petrobaltic S.A.
Got-landia	36/2001/p	Exploration and investigation	Exploration and investigation of oil and natural gas deposits within the "Gotland" region (licence blocks no. E9 and E10) – eastern part of the Polish sea areas	14.12.2001	12.2016	LOTOS Petrobaltic S.A.
Gaz Południe	34/2001/p	Exploration and investigation	Exploration and investigation of oil and natural gas deposits within the "Gaz Południe" region – eastern part of the Polish sea areas	14.12.2001	12.2014	LOTOS Petrobaltic S.A.
Sambia W	40/2001/p	Exploration and investigation	Exploration and investigation of oil and natural gas deposits within the "Sambia W" region (parts of licence blocks no. E69 and E9) – eastern part of the Polish sea areas	14.12.2001	12.2014	LOTOS Petrobaltic S.A.
Sambia E	39/2001/p	Exploration and investigation	Exploration and investigation of oil and natural gas deposits within the "Sambia E" region(parts of licence blocks no. 10 and 11) – eastern part of the Polish sea areas	14.12.2001	12.2014	LOTOS Petrobaltic S.A.
Słupsk E	11/2001/p	Exploration and investigation	Exploration and investigation of oil and natural gas deposits within the "Słupsk E" region (parts of licence blocks no. E66 and E67) located within the Polish EEZ	31.07.2013	07.2016	LOTOS Petrobaltic S.A.
Słupsk W	10/2001/p	Exploration and investigation	Exploration and investigation of oil and natural gas deposits within the "Słupsk W" region (parts of licence blocks no. E45, E46, E65, E66) located within the Polish EEZ	31.07.2013	07.2016	LOTOS Petrobaltic S.A.
Licen	10/2	Exploration	Exploration for oil and	26.07.2	2016	Baltic

ce Block C	001/p	and investigation	natural gas deposits within the Licence Block C (parts of licence blocks no. 30, 31, 50, 51) located in the Polish sea areas, i.e. within the internal sea waters, territorial sea and EEZ	013		Energy Resource s Sp. z o
B34		Potential licence for extraction of oil	Extraction of oil	After approval of geological documentation the Investor will apply for a licence for extraction		BALTI C Gas Sp. z o.o.

Source: Maritime Institute in Gdańsk based on information from the Ministry of Environment and proposals submitted to the plan.

A further increase of natural gas and oil extraction in the Polish sea areas should be expected. Prospective areas are shown in Fig. 8.9. The strategy adopted by LOTOS Petrobaltic assumes that 52% of funds of the Investment Programme will be spent on exploration for oil deposits, of which most (73%) will be allocated for exploration in the Baltic Sea[83]. In 2015, own extraction of the company (in the Baltic Sea and on the Norwegian shelf) is to be 1.2 mln tons of oil, and in 2020 it should reach the level of 5 mln tons. Further development of this type of offshore mining will result in permanent spatial changes distributed in time (new platforms and pipelines). In the mining regions B4 and B6 extraction is to start not later than December 31st 2017 (decision of the Minister of Environment of 28.11.2014 and of 5.12.2014), therefore next production centres with safety zones will appear, which will be closed for shipping and fishery by regulations of the territorially competent Director of Maritime Office. They will be connected with land by submarine installations which will put limitations on the use of the seabed. Work in areas covered by licences for exploration is at various stages of progress, which translates into a variety of times at which actual extracting may begin. Investigations for the Gaz Południe licence are far advanced, and most probably extraction works should begin within the next 10 years. The other licence areas are at preliminary stages of exploration and investigation (or even preparation for exploration) – in these cases the time horizon of potential extraction is 20 – 30 years. The total area of exploratory and investigation licences is more than 8,500 km^2. In view of potential extraction in areas where currently exploratory works are carried out, the maritime spatial plan should allow for these areas the function of laying and maintaining submarine pipelines. Table 8.6 shows the leading functions and limitations of use of areas designated for development of offshore mining.

Table 8.6. Diversification of use of mining areas in the Polish sea areas

Type of area	Name	Status	Designation
Mining areas	Kuźnica 1	Existing	Leading function: • extraction of oil and accompanying natural gas
	Łeba	Existing	

[83] Information obtained from the Annual Integrated Report 2013, http://raportroczny.lotos.pl/ access: 11.2014

	Lubiatowo	Planned	• erection and use of structures related to extraction • laying and maintaining sub-marine cables and pipelines
	Smołdzino	Planned	
Production centres (platforms on deposits B3 and B8, B4 and B6)	B3	Existing – safety zones defined by the Ordinance of the Director of the Maritime Office in Gdynia	Leading function: • construction – extraction, preparation for transport, loading oil on the tanker, preparation and transfer of gas by pipeline
	B8		
	B4	Planned	
	B6		
Industrial areas of mining plants	B8-BB, B6-BB, B6-Łeba	Planned	Leading function: • Laying and maintaining sub-marine cables and pipelines
Potential linear infrastructure - pipelines	-		
Licences for exploration	Gaz Północ	Existing	Leadingr function: • exploration, investigation of oil and natural gas deposits; • erection and use of structures related to exploration for deposits; Acceptable: • extraction of oil and accompanying natural gas; • erection and use of structures related to extraction; • laying and maintaining sub-marine cables and pipelines
	Łeba		
	Rozewie		
	Gotlandia		
	Gaz południe		
	Sambia W		
	Sambia E		
	Słupsk E	Planned	
	Słupsk W		
	Licence Block C		
Licences for extraction	B34	Planned	

Source: Maritime Institute in Gdansk, based on data submitted for the Study.

It is difficult, however, to estimate the temporal perspective for exploratory and mining activities aimed at identifying and extracting gas and oil from the shale formations [Opioła and Tyszecki, 2012]. This will require development and implementation of new techniques fitted to the specifics of the mining process itself and its location in the marine environment. It will be also necessary to develop formal and legal solutions, and to estimate the risks and long term effects/impacts of this mining activity in the sea areas.

Aggregates

The earlier mentioned three documented aggregate deposits (Table 8.7) can be characterised as follows [Kozioł, 2011]:

1. **South Middle Bank** – the deposit is divided into 9 fields with an area of 0.5 to 16.9 km^2 (a total of ca. 26 km^2) with average thickness of deposit layer of 0.9m (maximum > 5m). The documented balance resources in category C2 are 56.5 mln tons and industrial resources – 56 mln tons. The deposit is composed of three mining regions: "Południowa Ławica

Środkowa A", "Południowa Ławica Środkowa B", "Południowa Ławica Środkowa C" and one mining area "Południowa Ławica Środkowa".

2. **Słupsk Bank** – the deposit is made up of 8 isolated fields of sand and gravel deposits resting on a sandy substratum or, in the western part, on boulder till. The area of the fields is between 0.9 and 10.5 km^2 (in total ca. 21.45 km^2) and the average thickness of the deposit layer is ca. 0.91 m (maximum > 2 m). The documented balance resources in category C1 and C2 are 45.5 mln tons, in that industrial resources – 44.2 mln tons. The deposit is composed of four mining regions: "Ławica Słupska II", "Ławica Słupska III", "Ławica Słupska VII", "Ławica Słupska VIII" and two mining areas: "Ławica Słupska I" and "Ławica Słupska II".
3. **Koszalin Bay** – the deposit is located in the Koszalin Bay, off the stretch of coast between Dąbki and Jarosławiec, in water depths 10 to 25 m. The aggregate is located in 17 fields forming isolated patches of sand and gravel formations resting on a sandy substratum, and on boulder till in the south-west section. The deposit is composed of four regions and four mining areas: "Zatoka Koszalińska I", "Zatoka Koszalińska IIA", "Zatoka Koszalińska IIB" and "Zatoka Koszalińska IIC".

Table 8.7. Geological and mining parameters of aggregate deposits in Polish sea areas

Deposit parameters	South Middle Bank	Słupsk Bank	Koszalin Bay
Deposit area (km^2)	25.64	21.45	20.7
Balance resources (mln. tons)	56.5	45.5	37.7
Balance resources (mln. m^3)	30.9	22.0	19.5
Industrial resources (mln. tons)	56.0	44.2	-
Number of deposit fields	9	8	17
Area of fields (km^2)	0.53–16.9	0.87–10.4	0.45–1.38
Type of substratum	sand	sand, till, clay	sand, till, clay
Presence of boulders	no	present	large amounts
Mean sand point (%)	53.7	64	60.1
Distance from coast (km)	90	30	3–4
Depth below sea surface of ceiling of deposit (m)	17.2–30.00	15.2–23.2	14.4–25.2

Source: Kozioł [2011]

For reasons of protecting coastal morphodynamics, mining of gravel and sand can be allowed at a distance of at least 5 km from the coastline, preferably where the sea depth exceeds 20 m. Before 2009 there was some sand and gravel mining from the Słupsk Bank bottom (Table 8.8). Since 2009 industrial scale exploitation of construction minerals is carried out on the South Middle Bank.

Exploitation of solid materials from the sea bed does not require erecting fixed structures, vessels are used which collect the materials from bottom surface. Depending on the technology a single collection (until filling the hold) lasts 3 to 24 hours. Each of the technologies has different consequences for the condition of the bed and therefore, it is recommended to carry out the excavation using the methods alternately. Extraction of the materials is carried out along straight lines in the direction of prevailing wind in the sea area. After excavation the vessel sails to a port for discharging the material. Usually, only one vessel is used.

Table 8.8. Information on licence procedures related to aggregate mining in the Polish sea areas

Name	No	Type	Content	Date of issue	Date of expiry	In favour of
South Middle Bank	3/2006	Extratxion	For exploitation of aggregate from deposit „Południowa Ławica Środkowa – Bałtyk Południowy”	15.11.06	2031	Morskie Kruszywa Natu-ralne Sp. z o.o.
Koszalin Bay	Licensing process for extraction in progress					
Słupsk Bank	Licensing process for extraction in progress					
Swarzewo	14/2013/p (change of licence)	Exploration and investigation	Investigation the magnesium-potassium salt deposit „Swarzewo” in the area of municipalities: Puck and Władysławowo, Puck county, Pomeranian Voivodship	16.09.13	2015	Polski Potas Sp. z o.o.

Source: Maritime Institute in Gdansk, based on information from the Ministry of Environment

The prospects of developing exploitation of aggregates in the Polish sea areas are pictured in Fig. 8.9. As a proposal to the maritime spatial plan, a planned undertaking to mine aggregate by open-pit method from deposits: “Zatoka Koszalińska”, “Ławica Słupska” and “Południowa Ławica Środkowa – Bałtyk Południowy” was submitted. The investor possesses rights to geological information for deposits “Zatoka Koszalińska” and “Ławica Słupska”. According to information in the proposal, the aggregate would be mined (from three deposits) throughout the whole year, without seasonal breaks and for the whole duration of the licence, i.e. for 25 years (with possible extension of duration of licence, until the deposits are exhausted).

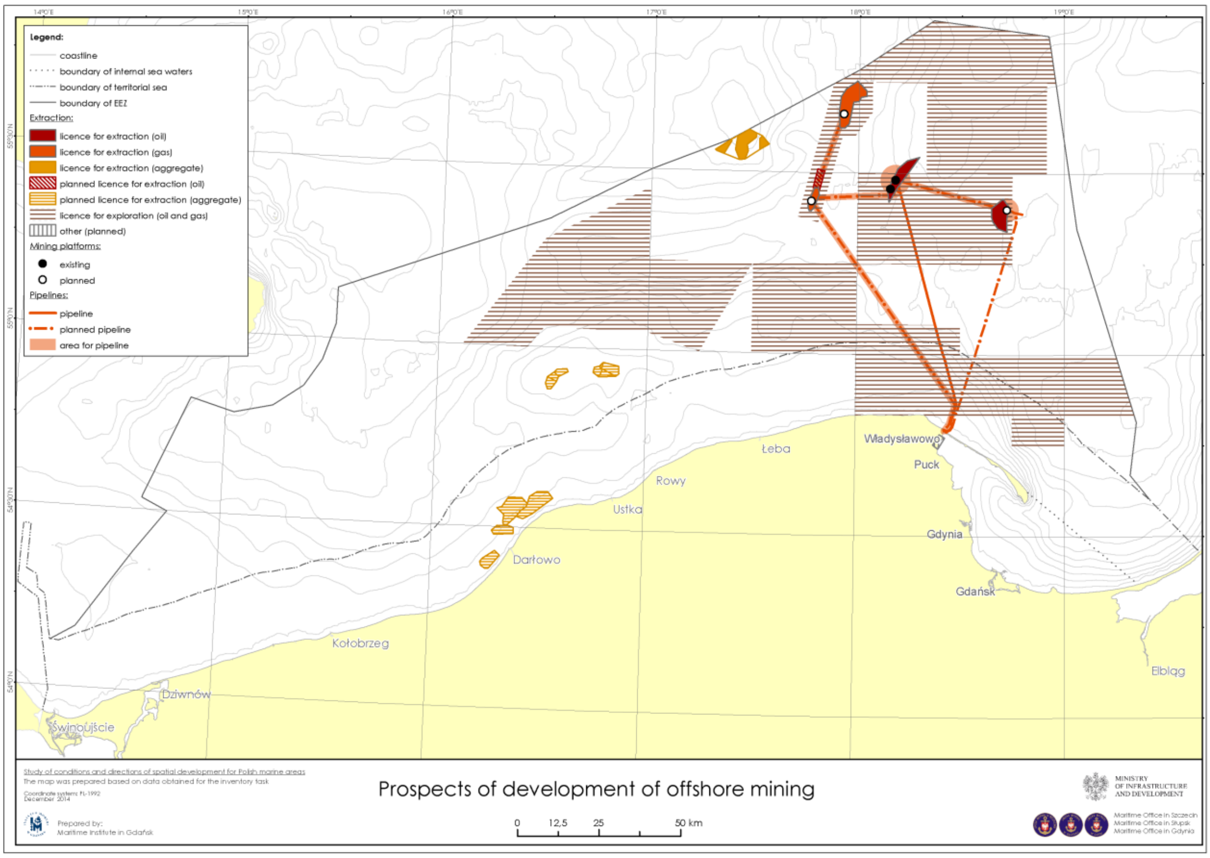


Fig. 8.9. Prospects of development of offshore mining

Source: Maritime Institute in Gdansk, based on information provided for the Study.

Conclusions for the maritime spatial plan of Polish sea areas

- Proper consideration should be given to issued licences for exploitation, exploration and investigation of aggregates and hydrocarbons.
- The identified deposits of hydrocarbons, ores of metals and natural aggregates should be indicated in the plan's graphical and textual parts and should be protected for future exploitation. It should also be ensured that extraction will begin only after a full investigation of environmental conditions, especially with respect to the presence of valuable species or habitat-creating elements.
- Considering the potential exploitation activities in areas where currently the exploration work is conducted, laying and maintaining submarine pipelines should be allowed in such areas.
- Decisions of the plan should allow for the possibility of carrying out exploration works and investigations.
- The formulations of the plan should take into account the long time lag between obtaining a licence for exploration and identification of hydrocarbon deposits and the time of starting exploitation, and consider the need to indicate possible non-conflicting functions, which could be realised in the exploration/investigation licence area until the time when exploitation begins (these will be temporary functions which should not collide with the rights of the licensees to carry out exploration and investigation works).

Lack of knowledge:

Incomplete identification of deposits in the Polish sea areas.

8.4. Linear infrastructure

The linear infrastructure in the Polish sea areas is mainly power cables, optical fibre cables and pipelines (wastewater or brine discharge pipelines and gas transfer pipelines). Existing linear infrastructure is shown in Table 8.9 and Fig. 8.10.

Table 8.9. Existing linear infrastructure in the Polish sea areas

Name of Investment	Location	Operator	Authority issuing the permit
PIPELINES			
Submarine gas pipeline within the territorial sea (Władysławowo – Baltic Beta platform)	Open sea	Energobaltic	Maritime Office in Gdynia and Minister of Infrastructure
Discharge of rainwater from the area of Eastern Ecopark in Kołobrzeg	Open sea	Municipality	Maritime Office in Słupsk
Discharge from the rainwater system at Podczele near Kołobrzeg	Open sea	Municipality	Maritime Office in Słupsk
Discharge of rainwater from the city of Kołobrzeg	Open sea	Municipality	Maritime Office in Słupsk
Discharge from sewage treatment plant at Grzybowo near Kołobrzeg	Open sea	Municipality	Maritime Office in Słupsk
Submarine discharge pipeline from sewage treatment plant at Swarzewo (Władysławowo)	Coastal zone of open sea	Spółka Wodno-Ściekowa „Swarzewo”	Maritime Office in Gdynia
Discharge of municipal wastewater from sewage treatment plant Gdansk – Wschód	Gulf of Gdansk	Municipality	Maritime Office in Gdynia
Pipeline for discharging waters of Sopot streams	Gulf of Gdansk	Municipality	Maritime Office in Gdynia
Submarine pipeline for discharging brine from Underground Gas Storage Facility Kosakowo	Puck Bay	PGNiG	Maritime Office in Gdynia
Submarine pipeline discharging sewage from “Dębogórze” sewage treatment plant into the Puck Bay	Puck Bay	Municipality	Maritime Office in Gdynia
Trunk pipelines discharging sewage and rainwater	Coastal waters	West Pomeranian Board for Melioration and Water Facilities in Szczecin, coastal municipalities	
CABLES			
450 kV DC cable in territorial sea - SWEPOL	Open sea	PSE	
Optotelecommunications cable between the ports of Gdynia and Gdansk	Gulf of Gdansk	Maritime Office in Gdynia	Maritime Office in Gdynia

BALTICA optotelecommunications cable between Kołobrzeg and Pedersker (Bornholm, Denmark)	Open sea	Orange Polska	
Optotelecommunications cable Denmark-Poland 2 between Mielno and Gedebak Odde (Bornholm, Denmark)	Open sea	Orange Polska	
Inactive military cables between Hel and Gdynia and in the EEZ			

Source: Maritime Institute in Gdansk based on data delivered for the Study.

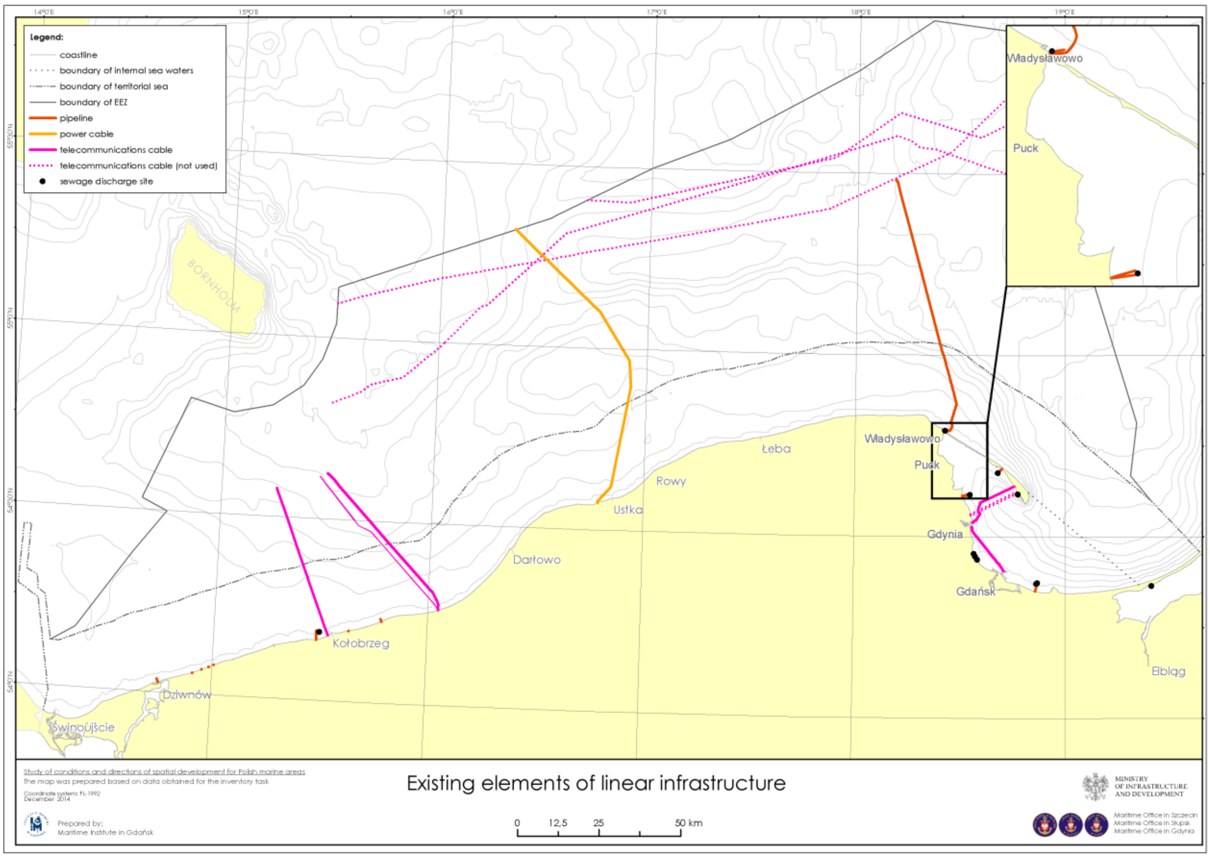


Fig. 8.10. Existing elements of linear infrastructure

Source: Maritime Institute in Gdansk, based on issued decisions and navigation map of HOPN

Some of the cables in the EEZ are inactive and have no owner. It is not known to whom they belong and whether they are used and if they are, then for what purpose. Identification seems impossible.

Planned linear infrastructure is mainly a consequence of the need to develop the energy and mining sector and to ensure energy safety of the State by diversifying sources of energy materials' supply (in accordance with the provisions of the Strategy for Energy Security and Environment and the Strategy for National Security[84]).

Development of offshore wind farms forces investments in infrastructure for transmitting the produced electric energy to the power system. As mentioned earlier, two investments planned on the eastern slope of Słupsk Bank have already obtained terms of connection (one to the Słupsk-Wierzbięcin station and the other to Żarnowiec)[85]. Both investments are in the process of investigations for selecting localisation (the investments were submitted as proposals to the plan). Such conditions force selecting routes and construction of separate power transmission systems, but on the other hand create an opportunity for constructing a marine network (marine power grid) enabling complex connection of all offshore wind farms [Stryjecki, 2013]. As mentioned earlier, the possibilities of connection to the National Power Grid are limited; therefore the concepts of the marine grid are being developed with the view of allowing connection of Polish offshore wind farms with power grids of other countries, as well as strengthening the northern segment of the National Power Grid. One of the concepts is the so-called Marine Power Grid (MPG) developed by the Foundation for Sustainable Energy, which is reflected in the already issued permits for laying and maintenance of submarine cables and in the submitted applications (Fig. 8.11). This concept was also submitted as a proposal to the maritime spatial plan of the Polish sea areas, for which this Study is a preparation stage. Some elements of the grid are created independently of the wind farm developers and without obtaining terms of connection to the National Power Grid.

[84] Starting exploitation of energy materials from the national non-conventional deposits, development of network and production infrastructure based on coal and gas fuels, and ensuring diversified access to sources and routes of delivery of energy materials are the particularly stressed goals of the Energy Security Strategy.

[85] There is also another connection contract (with Energa Operator) but the permit for localisation of the offshore wind farm obtained by the investor is no longer valid.

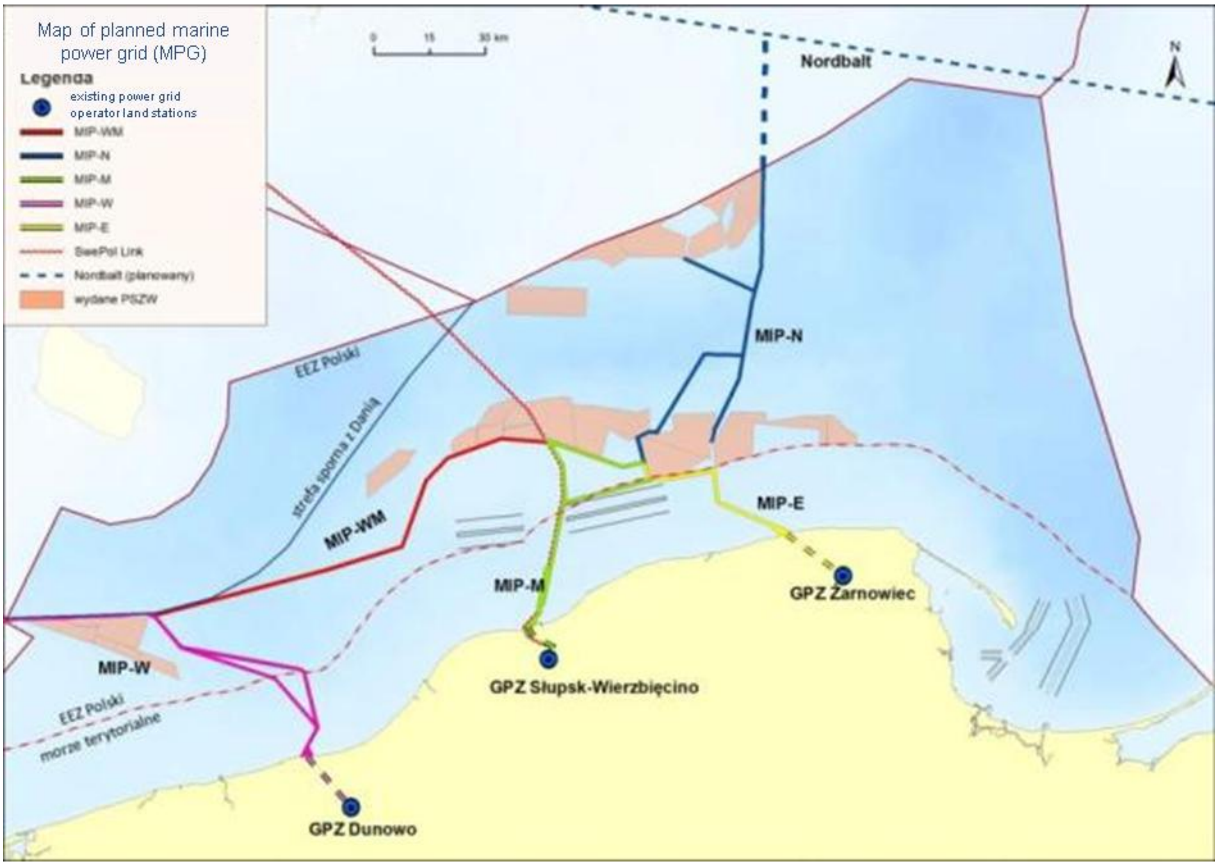


Fig. 8.11. Concept of Marine Power Grid (MPG)

Source: M. Stryjecki, presentation *Projekty systemowe z zakresu zagospodarowania energetycznych zasobów morza 2014/15* and consultation meeting 15.07.2014, Gdynia.

Another proposal is the concept of the Baltic Rail (Fig. 8.12), which is being developed since 2009 by the Polish Offshore Wind Energy Society (POWES). In October 2014, work on updating the concept has started and a preliminary concept, which assumes creating an integrated power infrastructure in the Polish sea areas to allow both reception of the electric energy and its transborder transmission, was submitted as a proposal to the maritime spatial plan of Polish sea areas. The submitted proposal assumes establishment of infrastructural corridors, localisation of potential power grid hubs and indicates potential directions of exporting power from the National Power Grid through transborder connections.

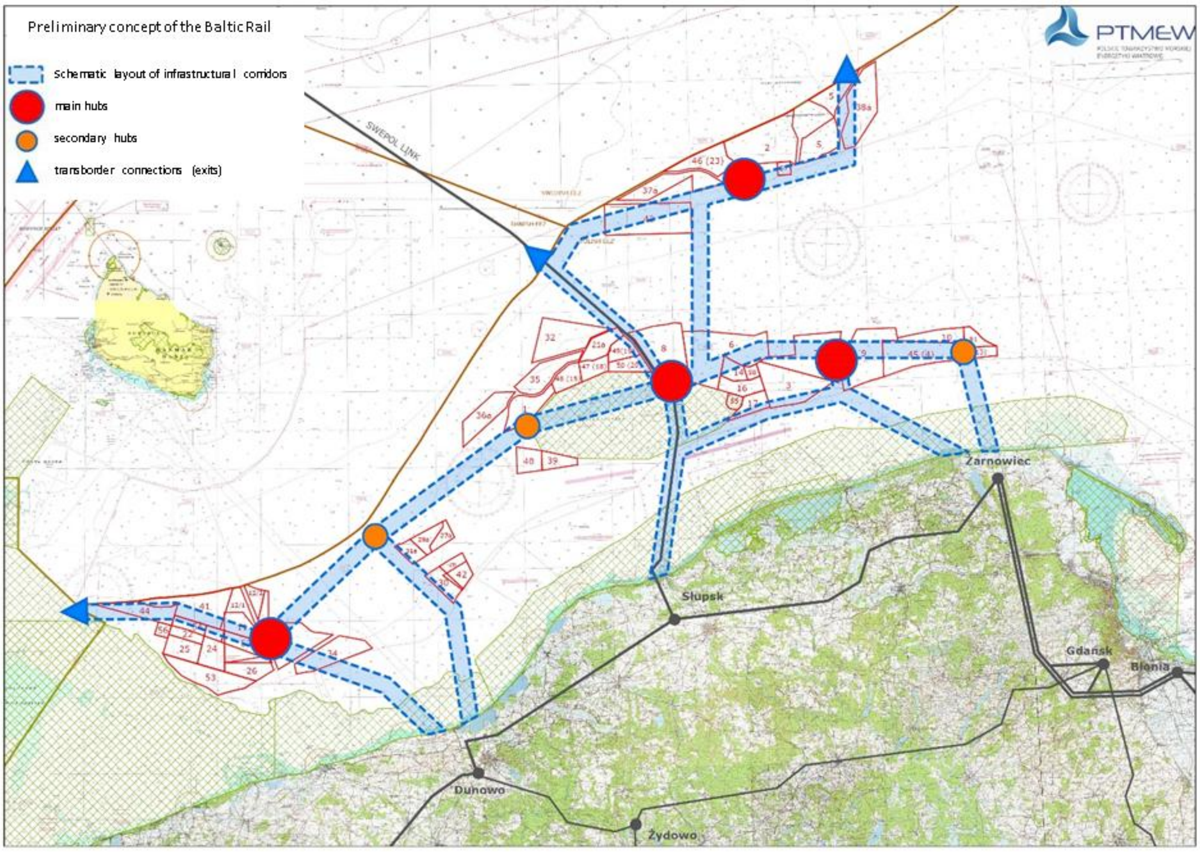


Fig. 8.12. Preliminary concept of the Baltic Rail

Source: Polish Offshore Wind Energy Society.

A fibre-optic cable will be layed between Hel and Gdynia as an element of the National Maritime Safety System.

The planned pipelines are for gas transmission and modernisation of sewage systems. In connection with the progressing exploration and investigation for hydrocarbon deposits, there is a possibility that transmission pipelines will be layed in the areas of exploration licences as well as pipelines connecting these areas with plants located on land (proposal to the spatial plan of the Polish sea areas).

Another proposal submitted to the spatial plan of Polish sea areas is the construction of the Baltic PIPE gas pipeline – a concept for connecting with Scandinavian deposits. It is a gas pipeline connecting the gas transfer systems of Poland and Denmark, fitting into the EU concept of the North-South corridor. The project is currently in pre-investment stage. In 2010, Gas-System obtained a permit for laying and maintaining a submarine pipeline in the Polish territorial sea and in 2013 analytic work was carried out in order to find the optimum option realising the investment. This gas pipeline was placed in the European list of common interest projects published in October 2013 as part of the Action Plan of the Baltic Energy Market Interconnection Plan (BEMIP) for gas[86].

The submarine high pressure gas pipeline DN 700 (submitted as a proposal to the spatial plan of the Polish sea areas and having a permit) is a land-sea gas pipeline of ca. 53.3 km length, connecting the unloading buoy on the Puck Bay with the underground gas storage facility "Kosakowo" in the Kosakowo municipality and further with the Wiczlino–Kosakowo gas pipeline, i.e. with the National Gas System and with the Kolnik – Gdańsk "Przejazdowo" gas pipeline in the Pruszcz Gdański municipality. The planned undertaking is a part of a concept for creating a gas transfer ring in the Gulf of Gdansk region.

A local example of linear infrastructure development is the connection infrastructure of the tested submarine hotel which is to be located by the Port of Gdynia.

The list of planned linear infrastructure (based on applications for permits submitted to the Ministry of Infrastructure and Development and to the Maritime Offices, on issued decisions and submitted proposals to the spatial plan of the Polish sea areas) is shown in Table 8.10 and Figs. 8.13 – 8.14.

Table 8.10. Planned linear infrastructure in Polish sea areas [87]

Name of investment	location	operator	authority issuing the location permit	proposal to plan	permit
pipelines					
Baltic Pipe gas pipeline	EEZ and territorial sea (Pomeranian Bay)	GAZ-SYSTEM	MTB&ME DMO Szczecin	+	+
Submarine gas pipeline DN 100	EEZ and territorial sea	LOTOS Petrobaltic Sp. z o.o.	MTB&MR DMO Gdynia	+	+
Submarine high pressure gas pipeline DN 700, p-8.4 MPa	Gulf of Gdansk	PGNiG	DMO Gdynia	+	+
Submarine pipeline for water intake from port basin and for discharge from treatment plant	Port of Gdansk	PERN Płock	DMO Gdynia	-	+
Sewage pipelines between Beniowski Quay in Port of Gdynia and designed submarine/above water object	Gulf of Gdansk	Deep Ocean technology Sp. z o.o. Gdynia	DMO Gdynia	-	+

[86] BEMIP - *The Baltic Energy Market Interconnection Plan.* Information obtained from the Ministry of Economy website http://www.mg.gov.pl/files/upload/8356/MG_DRO_sprawozdanie_2013.pdf (access: 01.12.2014).

[87] The table includes investments having permits and, by keywords only, proposals submitted to the plan. Because some of the proposals were submitted as confidential information, the publicly available list in Table 8.10 as well as maps in Figs. 8.13 and 8.14 contain incomplete information.

Reconstruction of rainwater discharge pipeline at km 350.75 of coastline	coastal zone	Kołobrzeg municipality	DMO Słupsk	-	+
Potential pipelines related to exploitation of hydrocarbons in areas of licences Słupsk E and W	EEZ and territorial sea	LOTOS PETROBALTIC	proposal to plan (confidentiality clause)	+	-
aPotential pipelines related to exploitation of gas from deposit B6	EEZ and territorial sea	BALTIC GAS Sp. z o.o.	proposal to plan	+	-
Potential high pressure gas pipeline Władysławowo – Kosakowo	Puck Bay	Polska Spółka Gazownictwa/ LOTOS	proposal to plan (cofidentiality clause	+	-
Potential rainwater discharges	coastal waters in front of Rewal municipality	Rewal municipality	provisions of local spatial plan (terrestrial)	-	-
Potential brine dicharge from geothermal installation	coastal waters in front of Rewal municipality	Rewal municipality	provisions of local spatial plan (terrestrial)	-	-
cables					
External connection infrastructure OWF Bałtyk Środkowy II and OWF Bałtyk Środkowy III to land station NPS Słupsk Wierzbięcino	EEZ and territorial sea	Bałtyk Środkowy III Sp.zo.o,	MTC&ME DMO Słupsk	+	+ +
External connection infrastructure of OWFs Baltica 1, 2 and 3	EEZ and territorial sea	EW Baltica 1, EW Baltica 2 and EW Baltica 3	Proposal to the plan	+	-
External connection infrastructure of OWF FEW Baltic II	EEZ and territorial sea	Baltic Trade and Invest Sp. z o.o.	MI&D DMO Słupsk	-	+ -
Marine power transmission infrastructure – western section (MIP-W)	EEZ and territorial sea	Inwestycje Infrastrukturalne Spółka z o.o.	refusal - MI&D DMO Słupsk	+	- -
Marine power transmission infrastructure – eastern section (MIP-E)	EEZ and territorial sea	Inwestycje Infrastrukturalne Spółka z o.o.	MI&D DMO Gdynia and DMO Słupsk	+	+ +
Marine power transmission infrastructure – eastern section (MIP-N)	EEZ	Inwestycje Infrastrukturalne Spółka z o.o.	refusal - MI&D	+	-

Marine electric energy transmission infrastructure – eastern section (MIP-WM)	EEZ	Inwestycje Infrastrukturalne Spółka zo.o.	MI&D.	+	+
Fibre-optic cable Hel – Port of Gdynia	Puck Bay	Director of Maritime Office in Gdynia	DMO Gdynia	-	+
Underwater power and telecommunications cables between Beniowskiego Quay in Port of Gdynia and designed submarine/above water object	Gulf of Gdansk	Deep Ocean Technology Sp. z o.o. Gdynia	DMO Gdynia	-	+

Source: Maritime Institute in Gdansk, based on issued permits for laying of submarine cables and proposals submitted to the spatial plan of the Polish sea areas

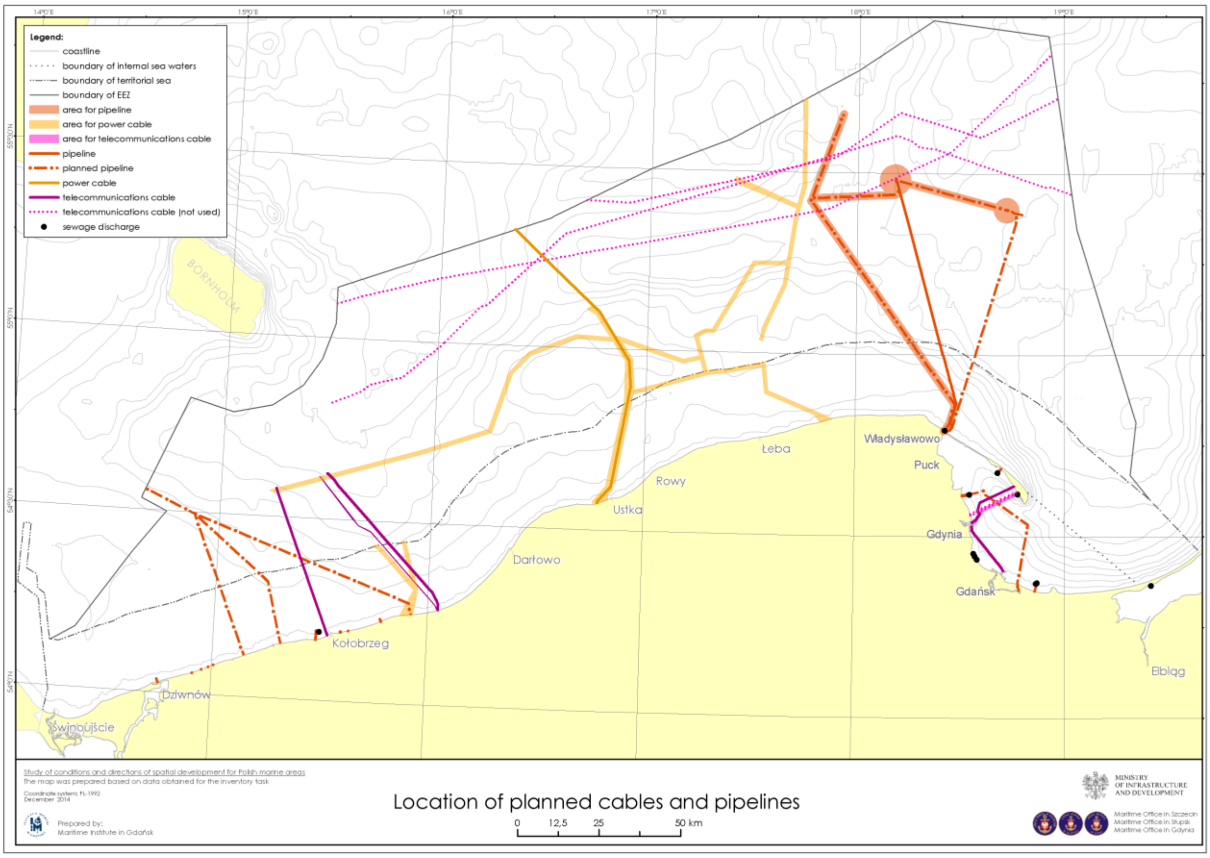


Fig. 8.13. Location of planned cables and pipelines

Source: Maritime Institute in Gdansk, based on issued permits for laying of submarine cables and some of the proposals submitted to the spatial plan of Polish sea areas

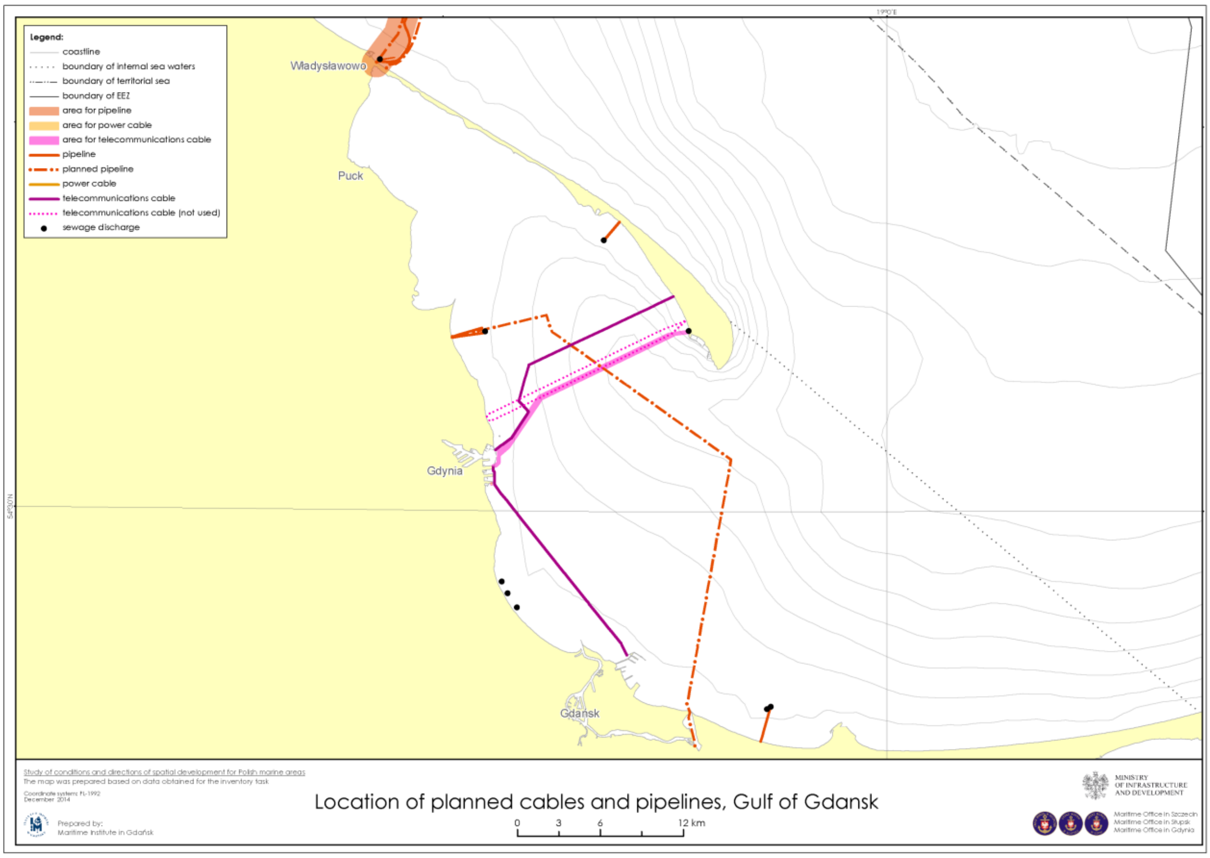


Fig. 8.14. Location of planned cables and pipelines, Gulf of Gdansk

Source: Maritime Institute in Gdansk, based on issued permits for laying of submarine cables and some of the proposals submitted to the spatial plan of Polish sea areas

Collected information on existing and planned investments, allows to identify main directions of development of the transmission infrastructure related to the potential operation of offshore wind farms, development of hydrocarbon exploitation and ensuring gas supply, and to indicate potential problem areas, for which the maritime spatial plan should determine principles of harmonisation of the routes of cables and pipelines (Fig. 8.15).

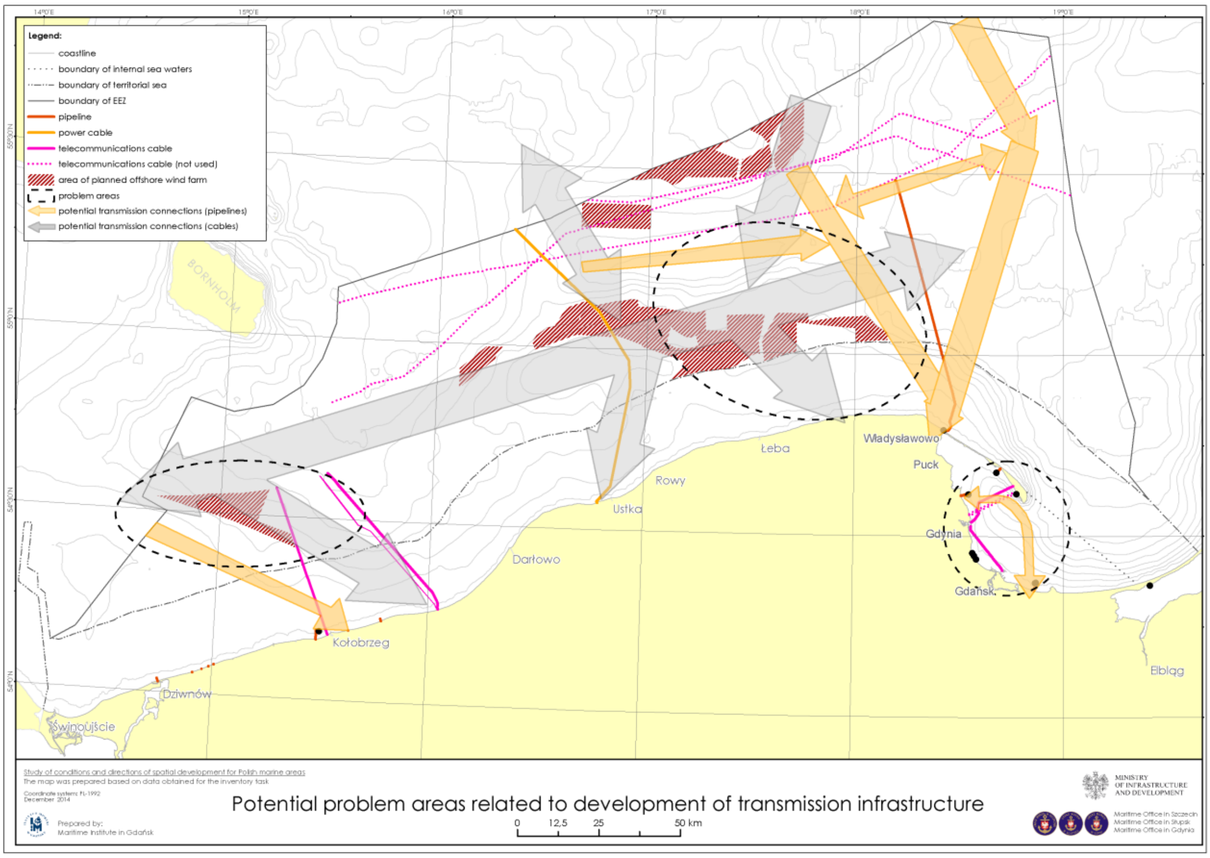


Fig. 8.15. Potential problem areas related to development of transmission infrastructure

Source: Maritime Institute in Gdansk, based on issued permits and submitted proposals to the spatial plan of Polish sea areas.

Conclusions for the maritime spatial plan of Polish sea areas

- Due consideration should be given to the existing linear infrastructure and the investments for which decisions have been issued.
- Fast development of linear infrastructure is expected. There is a need to organise it in accordance with the principle of economic use of marine space.
- Planned designation of sea areas should not interfere with the functions of coastal waters as the receptacle of rainwater and processed wastewater.
- Because of the potential development of extraction of hydrocarbons and of offshore wind farms, laying out multi-functional (multi-modal) corridors for linear infrastructure should be considered, especially in the problem areas (Fig. 8.15).
- From the point of view of the expected internationalisation of this infrastructure, it is important to determine the locations of its "entry" into the Polish sea areas. The submitted to the plan draft concepts of Baltic transmission connections should be taken into account.
- In order to harmonise the needs at the land-sea interface, it is necessary to indicate the landing points of this infrastructure, properly taking into account the needs of energy networks, environmental protection, coastal protection and safety of residents of the coastal municipalities.
- The width of buffer zones should be determined and limitations of sea area use in these zones should be worked out.

Knowledge gaps

There is no information about the ownership of inactive cables. The principles of proceeding with non-used elements of linear infrastructure should be developed.

There is no commonly recognised knowledge of the impact of power cables on marine organisms and marine nature and on the biological and fishing productivity.

There is no information on planned cables and pipelines, especially those related to exploration and exploitation of hydrocarbons (the information is implied only from issued decisions).

8.5. National defence and security

In the National Spatial Development Concept 2030 (NSDC) problems of national defence are covered by Goal 5 – Increasing the resilience of spatial structure of the country against natural risks and loss of energy safety and shaping of spatial structures supporting the defence capacity of the State.

One of the directions of actions in Goal 5 is to shape spatial structures supporting the defence capacity of the State (5.3). According to this action, the basic aim of strengthening the Polish space is to increase the effectiveness of preparations for defence and to create conditions ensuring high efficiency and continuity of functioning of the State when threats appear, during conflicts and in war. Among others, it is necessary to create conditions facilitating the tasks of the armed forces. The needs of the social and economic development and the needs of widely understood national defence should be treated on an equal plane. Location of military objects and changes of these locations must be taken into account in spatial plans. The NSDC stresses that in planning of spatial development of the country the issue of fulfilling the requirements of defence should be perceived in two basic areas:

- defining requirements which will be used for proper preparation of the infrastructure of the State;
- ensuring smooth, nonconflicting functioning of armed forces and institutions and services of the internal safety sector.

At strategic level, the issues of national security are defined by the Strategy of National Safety of Poland. This strategy indicates optimal methods of using all resources of the State in the defence, protection, social and economic spheres for safety purposes. The key issue is their proper integration in the national security system. A part of these resources are sea areas used for exercises of the Navy, aviation and rocket defence (Figs. 8.16 and 8.17). These military exercise areas and routes of access to them are necessary to ensure safety both within and outside the region of the Baltic Sea. Information about some of these areas is open to the public while others are confidential. Marine military exercise areas are located in the territorial sea, EEZ and in the internal sea waters.

The Ministry of National Defence recommends to consider, in the process of developing maritime spatial plans of the Polish sea areas, the needs of national defence arising from, inter alia, the established danger zones for shipping and fishery, and from military operations conducted in the sea areas.

It is necessary to achieve agreement with the Ministry of National Defence of planned undertakings which may affect:

- the safety of tasks realised by air forces and the Navy, and the designated zones of air space;
- radiolocation imaging of the surveillance system and marine radio-communication;
- functioning of military objects and complexes.

In accordance with the Ordinance of the Minister of National Defence of 3rd April 2014 on *areas closed to shipping and fishery in the sea areas of Poland* (JoL of 2014, item 482), most military exercise areas located in the internal sea waters and territorial sea have the status of temporarily or permanently closed zones for shipping and fishery.

Besides the Navy exercise areas, use of marine space is influenced also by the Central Exercise Area of the Air Forces in Ustka (established in 1974). Currently, this exercise area allows for a wide range of exercises, including combat shooting, for practically all forces. In the area exercises, shooting, and bombarding of air and water targets are carried out. Also, training and verification shooting is conducted, as well as exercises combined with shooting of units of tanks, infantry and coastal defence.

Also, routes of military flights at low height[88] (MRT) over sea areas should be considered. These are corridors, designated according to need, of 5 or 10 km width and height from sea level up to 2,700 m (Fig. 8.17).

[88] „Low height" is a height higher than the height of hedgehopping, but not higher than 900m

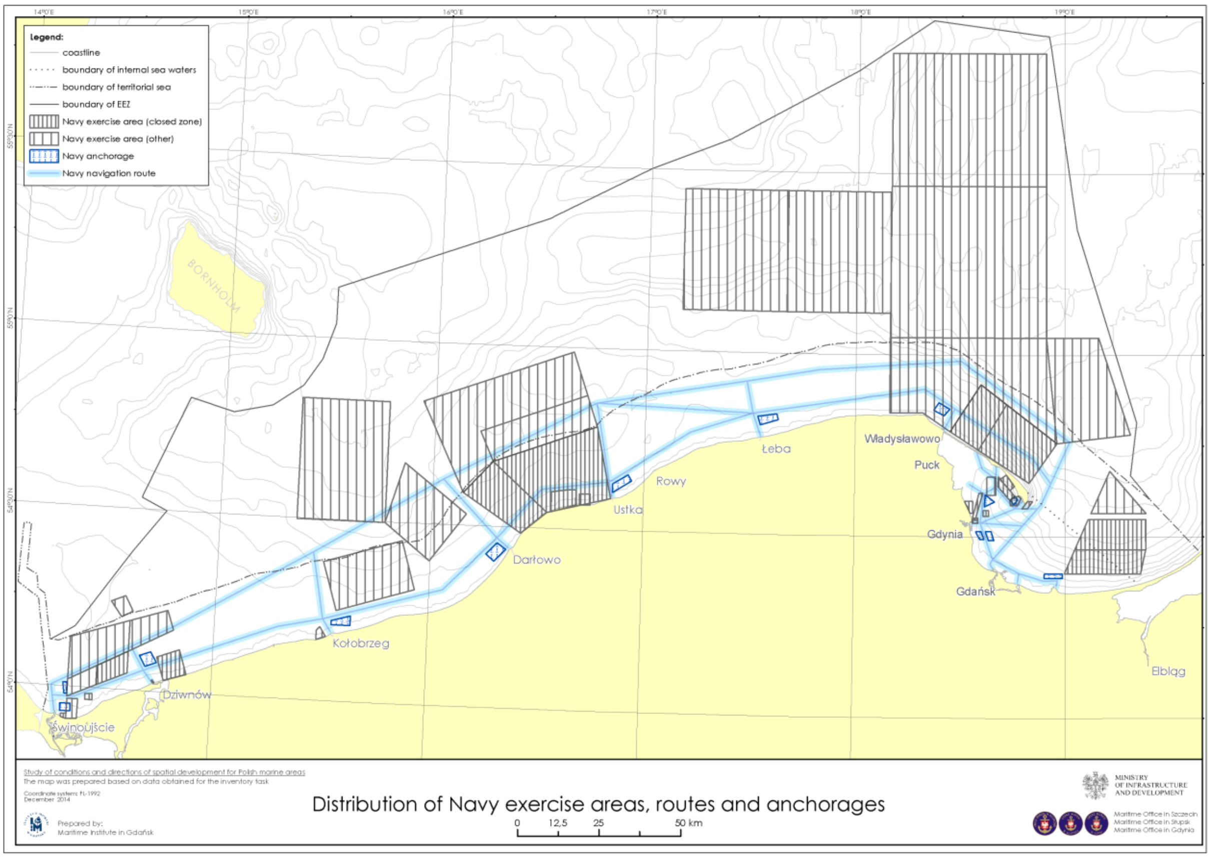


Fig. 8.16. Distribution of Navy exercise areas, routes and anchorages

Source: Maritime Institute in Gdansk, based on data provided by HOPN.

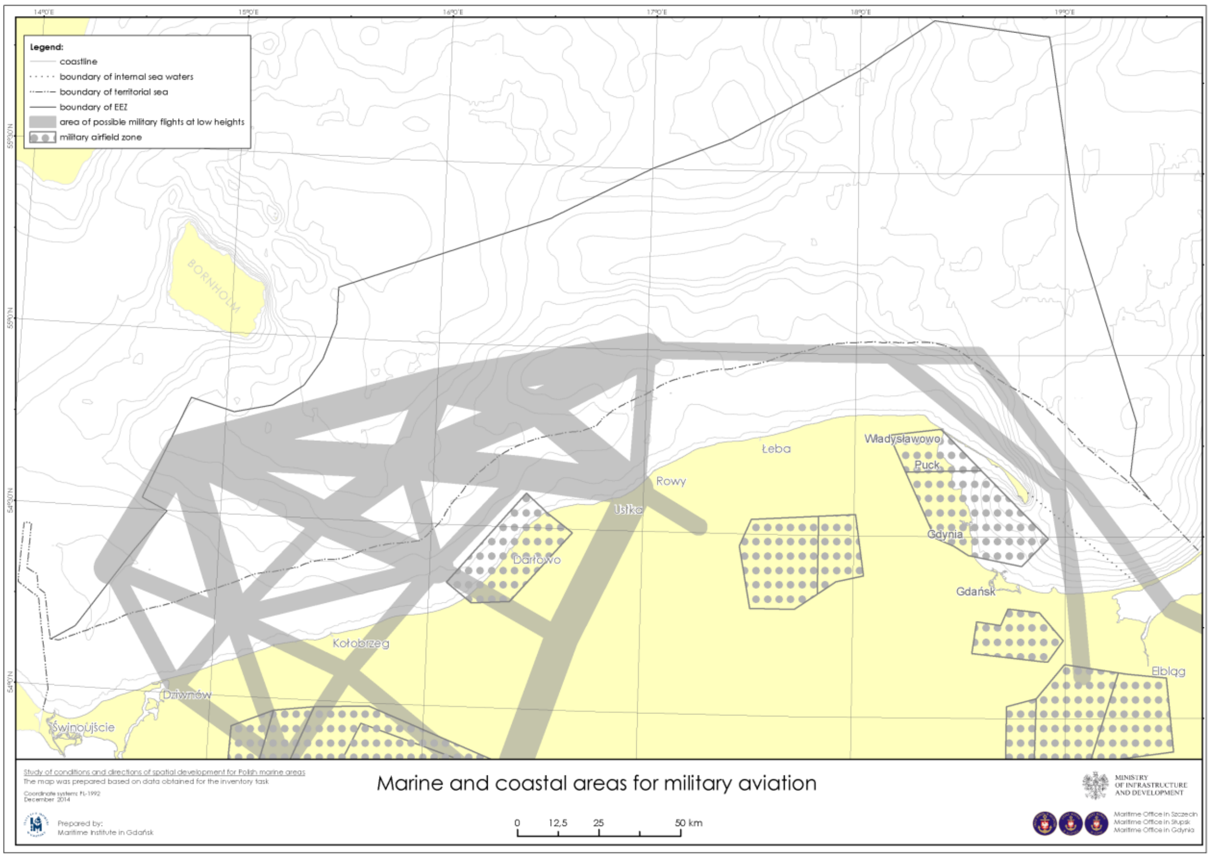


Fig. 8.17. Marine and coastal areas for military aviation.

Source: Maritime Institute in Gdansk, based on AIP.

Conclusions for the maritime spatial plan of Polish sea areas

- Unclassified information should be considered – concerning, inter alia, the existing military infrastructure and its components (especially the location of marine exercise areas, anchorages and fairways of the Navy).
- Fulfilment of the needs of national defence arising from classified information should be ensured by means of consulting the draft maritime spatial plan with the Ministry of National Defence.
- 500 m safety zones should be established around objects located in the sea areas, especially near military objects (proposal submitted to the plan).

Knowledge gaps

There is no knowledge about the real demand of the national defence sector for marine space and about the criteria of reserving given types of space. In effect starting rational discussion on these issues is difficult.

8.6. Underwater cultural heritage

The definition of "underwater cultural heritage" in *the Convention on the protection of underwater cultural heritage* of 2nd November 2011 (UNESCO Convention) covers any cultural, historic or archaeological traces of human existence that are partly or in whole under water, periodically or permanently, for at least 100 years, such as, inter alia, vessels, aircrafts, other vehicles or parts thereof, together with the cargo.

A cultural landscape is the result of historic transformation of natural environment by people inhabiting a given area throughout the centuries. The maritime cultural landscape is closely related with changes of the coastal land and marine bed[89].

Objects and structures related to maritime activities, such as harbours with mooring piles, wharfs and piers, lighthouses, warehouses and buildings and other remainders found on land are defined as "visible marine cultural landscape"[90].

Underwater cultural heritage comprise submerged settlements, landscapes and wrecks of vessels.

Underwater cultural heritage is protected in Poland basing on international conventions:

- the already mentioned Convention of UNESCO of 2 November 2001;
- The European Convention *on The Protection of the Archaeological Heritage*, prepared in La Valetta on 16 January 1992,

and on two national legal acts:

- Maritime Code and;
- Act of 23 July 2003 *on protection of historical monuments and their guardianship* (JoL of 2014, item 1446).

The provisions of these legal acts specify the requirements for conducting archaeological works, penetration of objects, regulate property issues of lifted objects, procedure in case of accidental finding of an object or the issue of ownership of submarine objects, and are a good basis for taking appropriate protective actions within the territorial sea. The methods of protecting objects of cultural heritage, in accordance with the provisions of *the Act on protection of historical monuments and their guardianship* include:

- entering into the register of monuments;
- recognition as a historic monument;
- creation of a cultural park;
- protection measures in local spatial plan or in the decision on location of public investment, decision on conditions of development, decision on permission for realising a road investment, decision on location of railway line or decision on permission for an investment for a public airport.

On the other hand, protection of underwater cultural heritage in the EEZ is much worse. According to Article 303 par. 3 of UNCLOS, in this zone the right of rescue and the right of "finder's fee" apply to the underwater cultural heritage. The discoverer of a wreck may dispose of it and its elements. Underwater cultural heritage protection outside territorial waters is the subject of the UNESCO Convention, but it is not ratified yet by Poland. Applicable here (to some extent) is also the Espoo Convention concerning the assessment of environmental impact in a trans-boundary context (1991), ratified or signed by all Baltic countries.

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[89] Information obtained from http://www.2wrecks.eu/czym-jest-morski-krajobraz-kulturowy (access: 03.12.14)

[90] Information obtained from http://www.2wrecks.eu/czym-jest-morski-krajobraz-kulturowy (access: 03.12.14)

Polish sea areas are rich in cultural heritage objects. The specific conditions of the Baltic Sea (low salinity, low diversity of species, relatively low temperature, low oxygen content, etc.) limit or even prevent the development of many marine organisms and bacteria, fungi and clams (e.g. shipworms) causing damage and decomposition of wood, which results in a very good condition of preserved underwater heritage objects.

The submerged settlements and landscapes are usually not only covered by water but also partly or completely covered by deposits on the seabed. Since the last glaciation the Baltic Sea coastline underwent significant changes, in effect of which large areas of southern Baltic coastal land became submerged under sea waters together with remains of settlements and surrounding them landscapes. The strip of southern Baltic waters up to 30 km from the present coastline is an area with high probability of occurrence of submerged settlements and landscapes. Within the MACHU project[91] were reconstructed palaeo-landscapes of selected regions in three southern Baltic test areas: Ustka, Puck and Gdansk. In the Ustka test area, at depth of 20-27 m were found lake deposits and enrooted trunks of trees which grew 9,500 years ago at a distance of 30 km from the present seacoast. In 1977, in the inner Puck Bay, at the outlet of Płutnica River, about 150 m from the present coastline an relicts of a Medieval port were discovered (hundreds of timber piles with horizontal timber structures and stone-earth banks, strengthened with fascine and also wrecks of Medieval boats). So far it is the only such well-preserved example of a port complex discovered in the Polish sea waters. The Gdansk test area includes the land and underwater part of the estuary fan of the Martwa Wisla and the roadsteads of the port in Gdansk. A younger type of settlements is represented by remains of Neolithic settlements. In the Polish sea areas, in the Puck Bay, there is a station of the so-called seal hunters dated to the Stone Age (5 – 2 thousand years BC). Locations of submerged landscapes and remains of settlements are shown in Fig. 8.18.

Wrecks can be classified by their cultural value as:

- wrecks which are an archaeological finding;
- younger wrecks, and among them:
  - wrecks whose owner can be identified;
  - wrecks whose owner cannot be identified;
  - military wrecks.

According to the UNESCO Convention, a historical object is a wreck which was under water for at least 100 years. Given its specificity and the need to ensure protection, some vessels sunken during World War II, though they not meet the time criterion have been classified as protected objects – so-called war cemeteries.

The knowledge base about archaeological resources in Polish sea areas is the Record of Underwater Archaeologist Sites (RUAS) developed and maintained by the National Maritime Museum since 2002. Its purpose is to collect and process information on the existing and potential underwater sites in the sea areas (territorial sea). The data are passed to the Hydrographic Office of the Polish Navy for including in the national database of seabed obstacles. The list of wrecks with archaeological value obtained from the National Maritime Museum for the needs of this Study

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[91] Information obtained from http://www.machuproject.eu (access: 5.12.14)

includes 67 objects (Fig. 8.18). Efforts are made to include them in the records of the "Archaeological Photograph of Poland" maintained by the National Heritage Institute.

Because of legal limitations, coastal countries collect information mainly on cultural heritage objects within their territorial sea and the contiguous zone (if established), while the information on objects outside the territorial waters is limited and rather accidental. Therefore, knowledge about wrecks or submerged landscapes and settlements remains fragmentary due to the inability to explore the whole seabed of Polish sea areas. For the purpose of spatial plans of Polish sea areas it should be assumed that objects with archaeological value can be found everywhere in the sea areas and that a high percentage of them has still not been found.

The discovered objects of underwater cultural heritage are often exposed to damage and complete loss. In most cases only archaeological documentation is made and the monument itself is disposed due to limited space and lack of funds. This is contrary to both the Act on protection and guardianship over monuments and the UNESCO Convention on the protection of underwater cultural heritage, which is to be ratified in the next few years. The main threat to underwater cultural heritage sites is the effect of the marine environment and human economic activity in offshore areas.

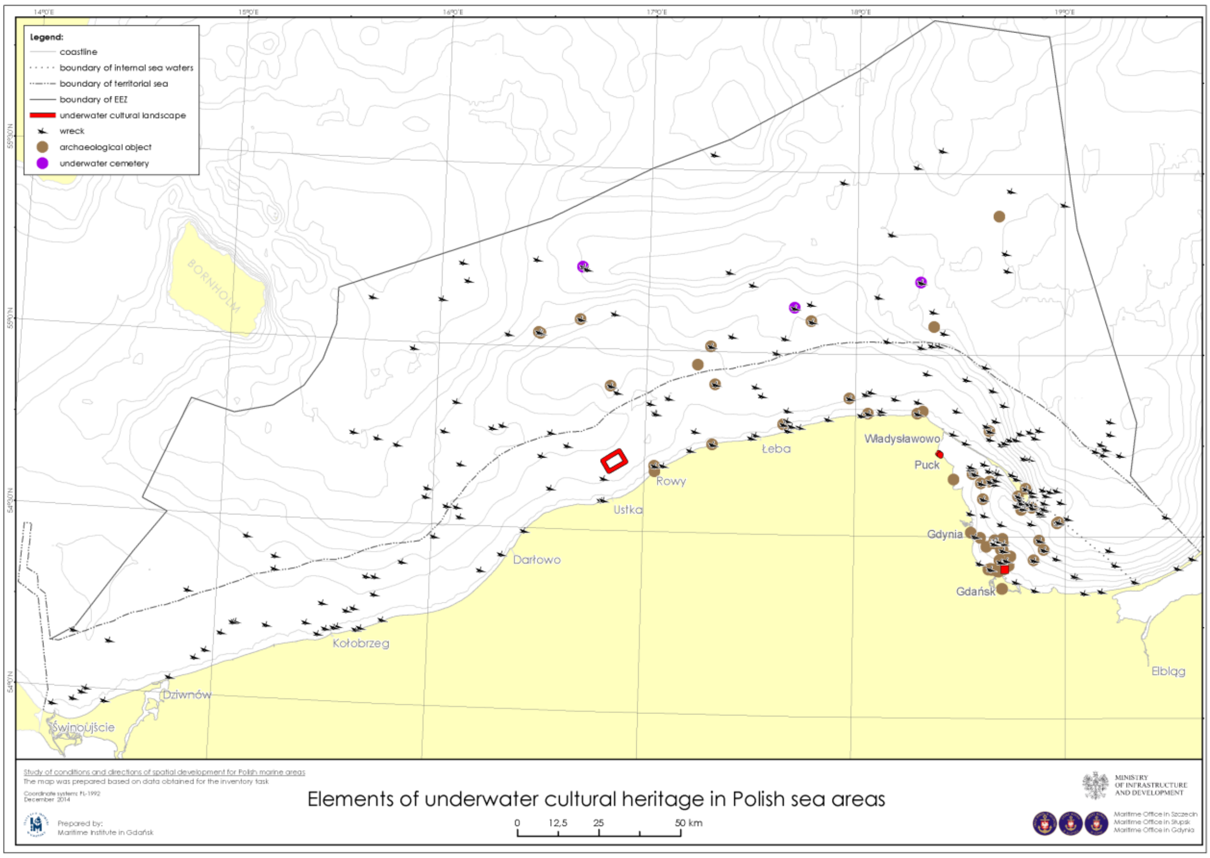

Fig. 8.18. Elements of underwater cultural heritage in Polish sea areas

Source: Maritime Institute in Gdansk, based on data of the National Maritime Museum.

In order to improve the current situation, the National Maritime Museum in Gdansk started attempts to ensure safekeeping of large sized monuments of wooden naval structures for the future generations in the natural marine environment by creating two types of underwater archaeological stores: short- and medium-term. The short-term store will be used for storing historical objects intended for conservation and museum exhibition, which cannot be subjected to conservation procedures due to limited space. The time of storage of the elements cannot exceed five years. The expected location is the Gulf of Gdansk, region of the Solen wreck. The Maritime Museum also plans to open at this location an underwater cultural park. The long-term store is intended for storing selected historical objects for a period of no less than 30 to 50 years. The planned localisation is the Gulf of Gdansk off the shore at Brzeźno, at a depth of at least 6 m.

Protection of objects of underwater cultural heritage in the spatial plans of the Polish sea areas can be facilitated by designating protection areas (with limited use). This can be done for well investigated areas where underwater historical heritage is well identified and its historical value properly assessed. In non-explored areas, on the other hand, designation of special protection zones is rather impossible. It seems more important to establish principles of cooperation between the users of marine space and develop methods which will contribute to a more comprehensive identification of this cultural resource. Principles of conduct, when during preinvestment investigations or other activity at sea a historically valuable object is discovered, should be developed.

Conclusions for the maritime spatial plan of the Polish sea areas

- The location of submerged settlements, landscapes and wrecks (with archaeological value and/or being war cemeteries) should be taken into account.
- Areas not explored for underwater cultural heritage should be distinguished and marked as areas requiring exploration.
- In the already explored areas protection zones should be designated around objects of underwater cultural heritage.
- The possibility of locating an underwater archaeological store in the Gulf of Gdansk should be considered.
- A provision should be introduced (in the description of ways of using areas primarily designated for installations, structures and linear infrastructure) that all investments in the sea area which disrupt the structure of the seabed should be preceded by an inventory of the bed for cultural heritage.
- The requirement of conducting an inventory of historical value resources in the process of preparing EIA documentation should be introduced. This will allow better protection of the historical objects and save from unplanned costs and breaks during realisation of investments.
- Attention should be given to the conflict between the planned archaeological park by the Solen wreck and the existing military exercise area.

Knowledge gaps

Localisation of objects of underwater cultural heritage in areas requiring exploration.

8.7. Tourism

Usually two main forms of tourism using the specific resources of the sea are distinguished:

- marine tourism (proper) – activity at open sea, which is performed on cruise ships, passenger liners, yachts (open sea sailing – touristic) or ferries,
- coastal tourism – all manifestations of activities in the coastal area, i.e. coastal passenger services (so-called “white fleet”), yachting, windsurfing, ice sailing, canoeing, diving, angling etc.

Another possible differentiating criterion could be the form of activity – qualified tourism (all water sports) and recreation tourism, which includes among others bathing, balneotherapy, cruising, etc.

Because in Poland cruisers enter only big ports, this subject was analyzed in the subsection on development of ports and shipping (7.3). In Poland coastal tourism is rapidly developing. The characteristic feature of this kind of tourism is its seasonal concentration. It lasts for about 60-90 days in a year due to weather and climate conditions. It is the most intensive form of sea tourism, but it concentrates at coast, in a narrow strip of bathing waters, as is shown in the analysis of strategic and planning documents of municipalities (subsection 4.5.). Demand for sea space is mainly reported by sailing (also windsurfing), wreck diving and recreational fishing/angling (see subsection 6.2.4). Other forms of tourism using the sea space include:

- underwater tourism – artificial reefs,
- paragliding (towed by a motorboat or from cliffs),
- canoeing (rather in the closed waters of lagoons),
- angling (from a fishing vessel and from the shore).

Development of the above forms of touristic activity largely depends on the wealth and level of education of the population, the existence of appropriate service facilities and on environmental and climatic conditions.

During the last decade the number of yachts and marinas has increased. Statistical investigations show that on Polish inland water routes and on the Baltic Sea dominate small yachts under 10 m length, which take on board 4 to 8 persons (Kaup, 2010). Currently almost every seaport offers berths for yachts. There are also separate, well equipped marinas able to accommodate over 100 yachts. Within work on this Study 62 marinas and yacht quays were identified along the Polish coast, allowing berthing of over 4000 vessels. The spatial distribution of marinas and havens (Fig. 8.19) reflects the irregularity of location of port structures.

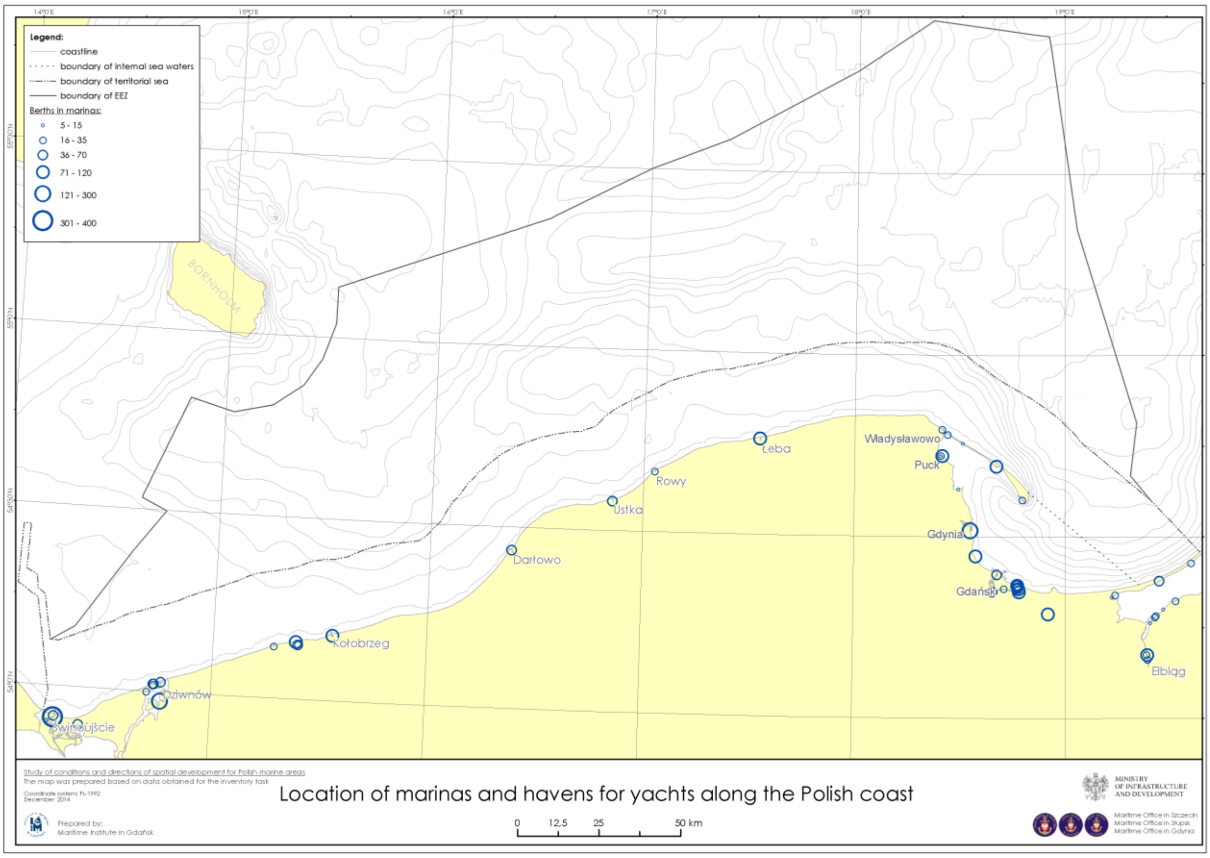

Fig. 8.19. Location of marinas and havens for yachts along the Polish coast
Source: Maritime Institute in Gdańsk, on basis of publicly accessible data.

The number of infrastructural projects for yachting, such as the "West Pomeranian Yachting Track – network of touristic ports of West Pomerania", the Puck Bay Ring or Żuławy Loop, is steadily growing. For example, in the framework of the MARRIAGE project the "South Coast Baltic" touristic product was developed, which promotes long term international cruises along the coast (Fig. 8.20).

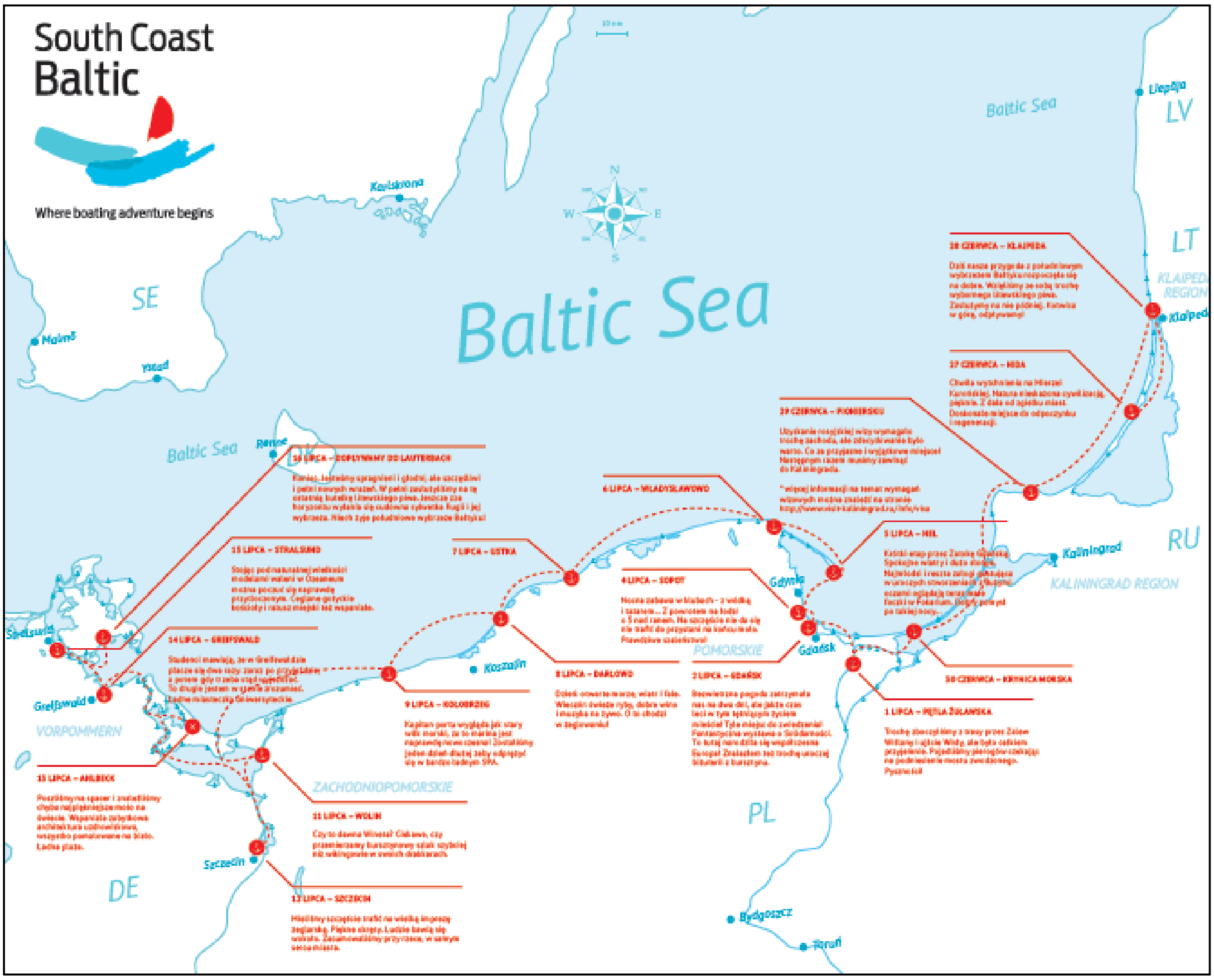

Fig. 8.20. Sailing track promoted within the South Coast Baltic product.
Source: information obtained from MARRIAGE project portal (www.project-marriage.net) (acces: on 6th December 2014).

Boardsailing, as a discipline of sport and a form of tourism, is quickly developing in Poland [Malinkiewicz and Ostrowski, 2010].

There are different kinds of boardsailing:

- wind surfing – a board driven by a sail,
- kitesurfing – a board driven by a paraglider,
- snowboard – surfing on ice,
- wakeboarding – combination of kitesurfing, snowboard and surfing, consisting in floating on a special board very similar to a kitesurfing board, towed by a motorboat, jet ski or a lift.

All the forms of boardsailing are quickly developing in Poland. Construction of a wakeboarding lift in the Puck Bay was submitted as a proposal to the maritime spatial plan of Polish sea areas.

Coastal waters offer the most convenient natural conditions for windsurfing tourism. Windsurfing is in general allowed within 2 Nm from coastline, in daytime from sunrise till sunset, on waters free of ice and when visibility is better than 2 Nm[92].

Mass windsurfing tourism in Poland develops mainly in the sheltered and shallow waters of Puck Bay – windsurfing schools are located in settlements along the Hel Peninsula (Fig. 8.21). This is one of the best places in Europe for learning and practising windsurfing. It is the place to which come the biggest numbers of persons practising this form of qualified tourism and where the biggest number of races of the Windsurfing Cup of Poland competition takes place [Parzych, 2010]. Similar conditions are on the Gulf of Gdańsk side of the Vistula Spit. Krynica Morska, Kąty Rybackie and Krynica Morska – Nowa Karczma are also quite popular among windsurfers[93].

Apart of the areas with numerous windsurfing schools, windsurfing can be practised along the whole Polish coast. Windsurfing spots indicated and described by windsurfers are shown in Fig. 8.21.

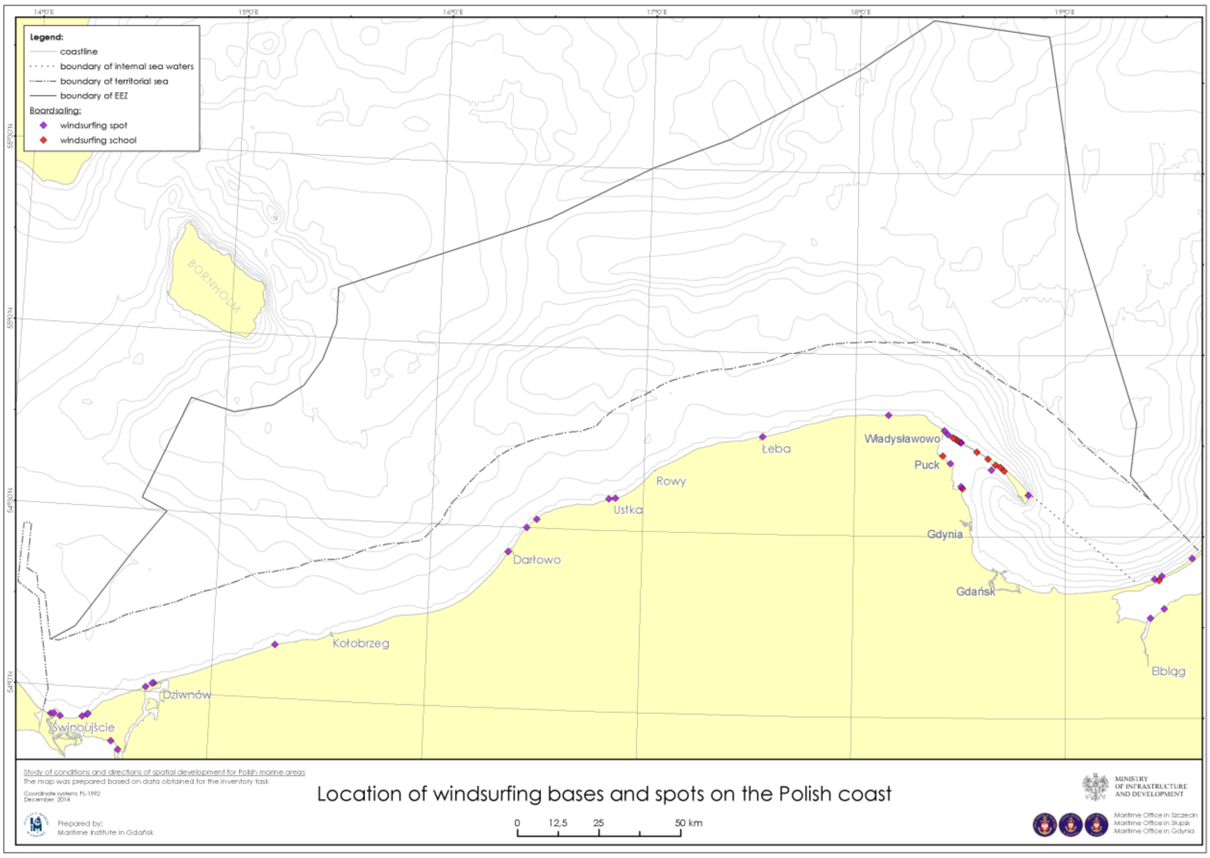

Fig. 8.21. Location of windsurfing bases and spots on the Polish coast.
Source: Maritime Institute in Gdańsk, on basis of internet information obtained from portal http://www.vistulasurf.pl/ and other internet resources (acces: 3.12.2014).

Especially during the last 15 years, scuba diving is becoming increasingly popular in Poland. In spite of unfavourable natural conditions (cold water with low transparency, low diversity of flora and fauna in comparison with other seas) wreck diving is becoming one of the biggest attractions of Polish sea areas. Because of formal obstacles existing until the end of the 1990ies, the wrecks are also less damaged by robbers.

[92] Information obtained from portal http://pomorskie.travel/Na_wodzie-Windsurfing_i_Kitesurfing-Windsurfing (access: on 3.12.2014)

[93] After the pomorskietravel portal

Issues concerning wreck exploration are regulated by the Act on *sea areas of the Republic of Poland and maritime* administration. Wreck diving requires obtaining a permission. Maritime Offices in Gdynia and in Słupsk approach the issue in different ways. The Maritime Office in Gdynia has developed and published a list of wrecks accessible for scuba divers. There are 40 objects on the list (including 29 at depths smaller than 50 m) (Fig. 8.22).

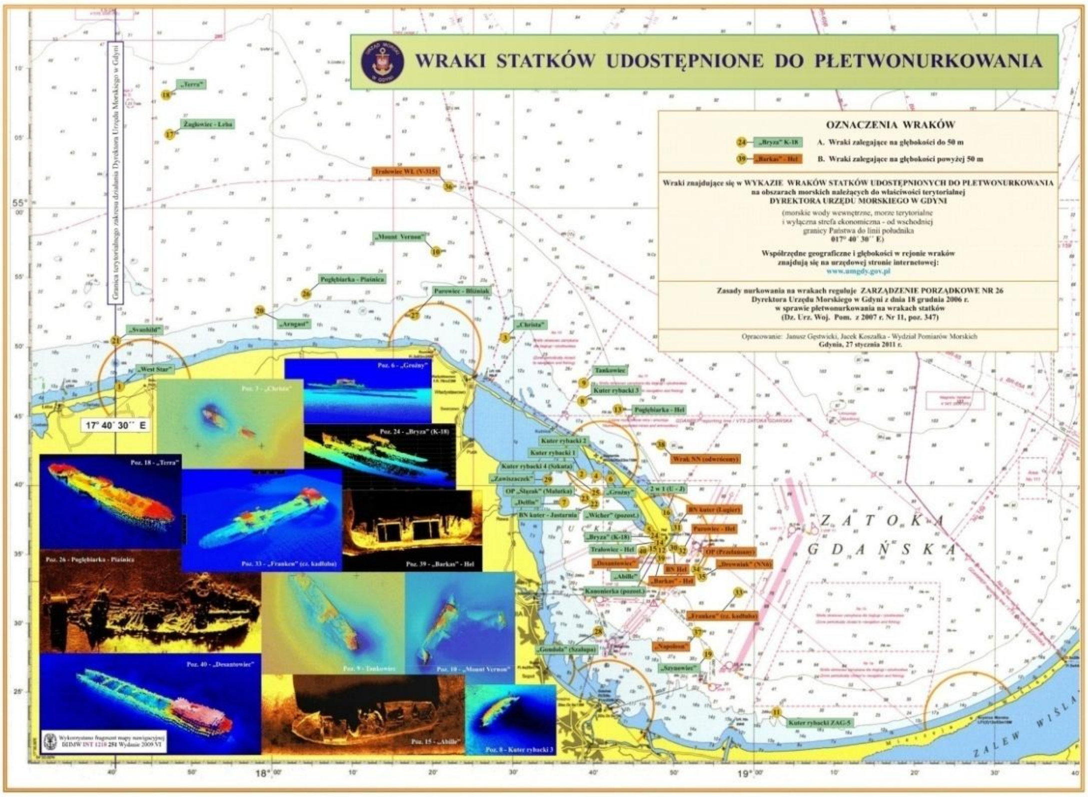

Fig. 8.22. Wrecks accessible for scuba divers. (marked blue – in less than 50 m water depth. marked brown – in over 50 m water depth)
Source: Maritime Office in Gdynia

The Maritime Office in Słupsk has issued a regulation indicating objects from the Registry of Underwater Aarchaeological Sites on which diving is forbidden.

Both Maritime Offices keep records of departures for wreck exploration. The records show that at least since 2006 the largest number of departures is from the ports of Hel and Jastarnia, next from Gdynia and Władysławowo (Fig. 8.23). Such spatial distribution of wreck tourism is conditioned mainly by accessibility (large number of wrecks close to the coast and at relatively small depths) and also by the above mentioned regulations, which summarily resulted in the observed development of the diving base in the Gulf of Gdańsk basin (Fig. 8.24). Bases servicing the West and Central Coast offer diving to wrecks situated on the Słupsk Bank and to objects located near Bornholm.

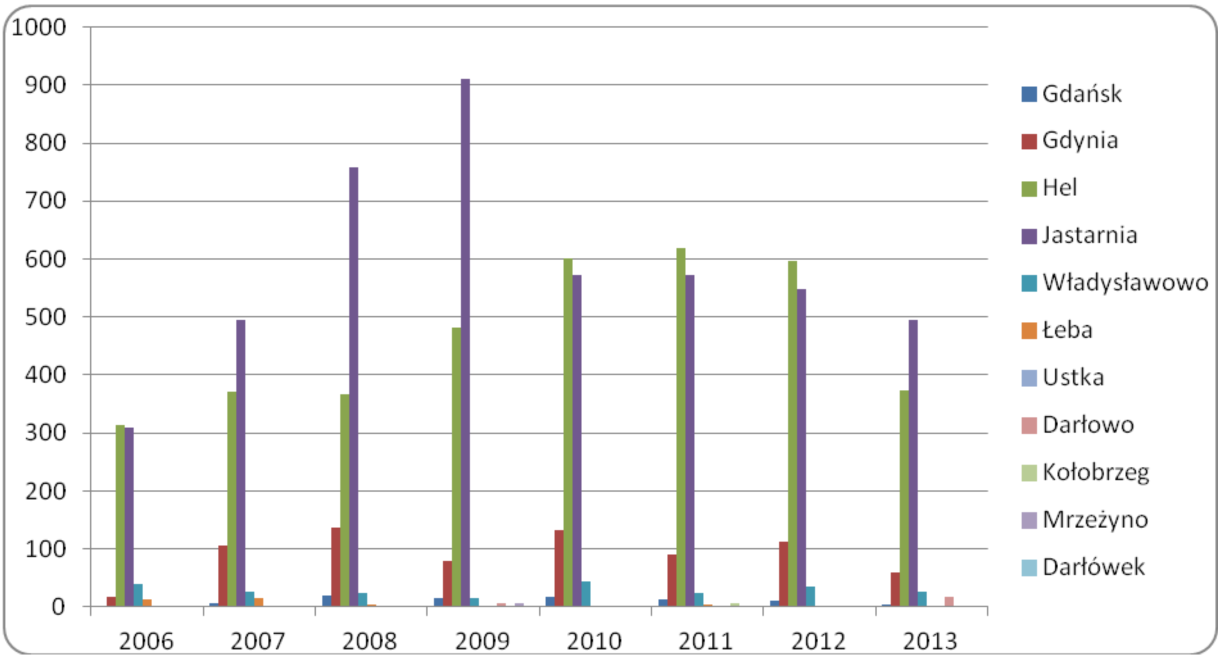

Fig. 8.23 Departures for wreck diving per port in 2006-2013

Source: Maritime Institute in Gdańsk, basing on records of the Maritime Offices in Gdańsk and Słupsk.

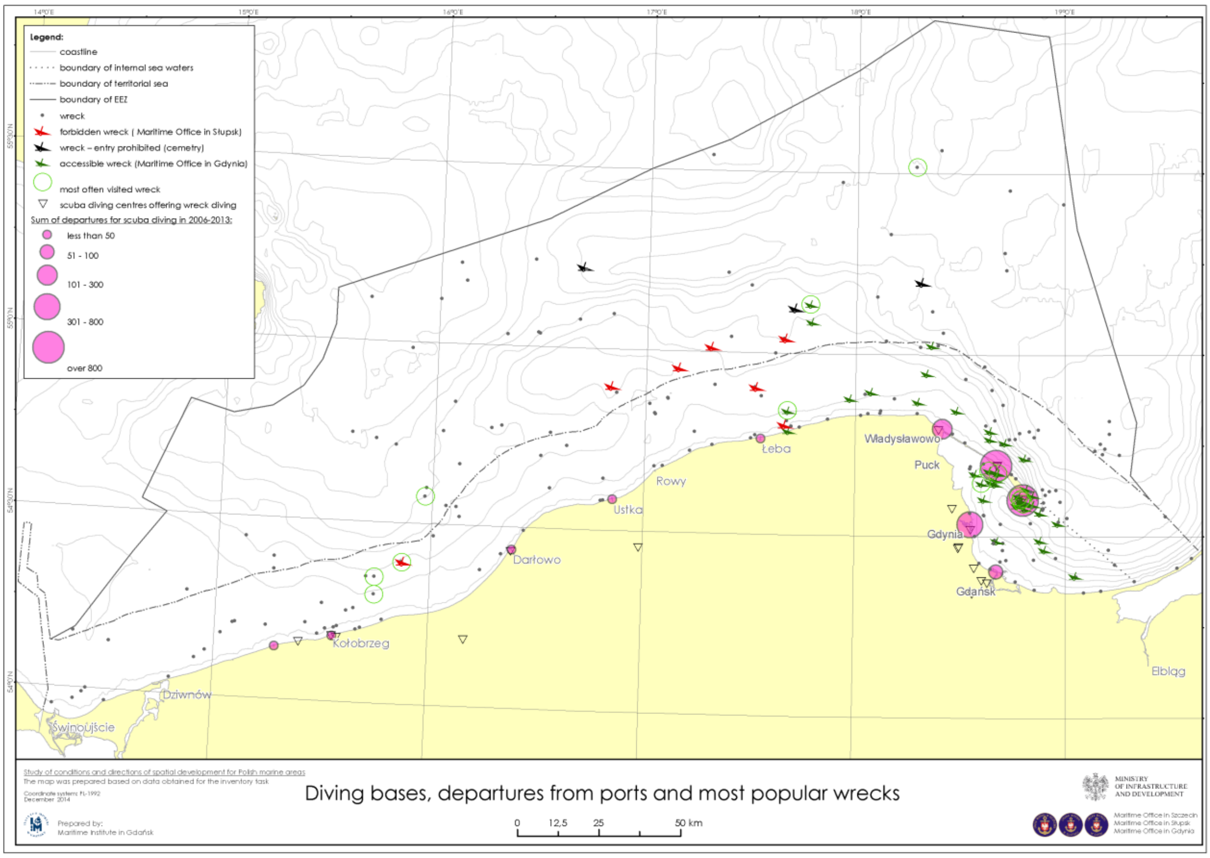

Fig. 8.24. Diving bases, departures from ports and most popular wrecks

Source: Maritime Institute in Gdańsk on basis of information obtained from http://www.balticseawrecks.com and other internet sources (access: 1.12.2014).

The present easy and uncontrolled access to wrecks may lead in a very short time to irreversible damages and significant deterioration of their value as a tourist attraction. Wreck tourism, as it functions now, does not make full use of the potential of Baltic Sea wrecks, and often does not fulfil basic requirements of safety and comfort of the activity. It also does not protect the wrecks against robbery diving [Pomian, 2009]. That is why this form of tourism should be controlled. An element of such a control is deliberate opening access to some wrecks or groups of wrecks (so called "archaeological park"[94]). A potential locvation for such an archaeological park is the area between the ports of Gdańsk and Gdynia, where at a depth of 14 m lie remains of two wrecks and iron guns casted in Sweden in 1771. Initially the artefacts were placed there only in order to protect them against damage. Considering the growing number of historic ship wrecks found during realisation of investments in the Port of Gdańsk, it is suggested that the problem of protecting these findings could be solved by storing them in the area of such a park [Pomian, 2009].

Analyses allowed identifying areas of particular intense coastal tourism (watersports) (Fig. 8.25).

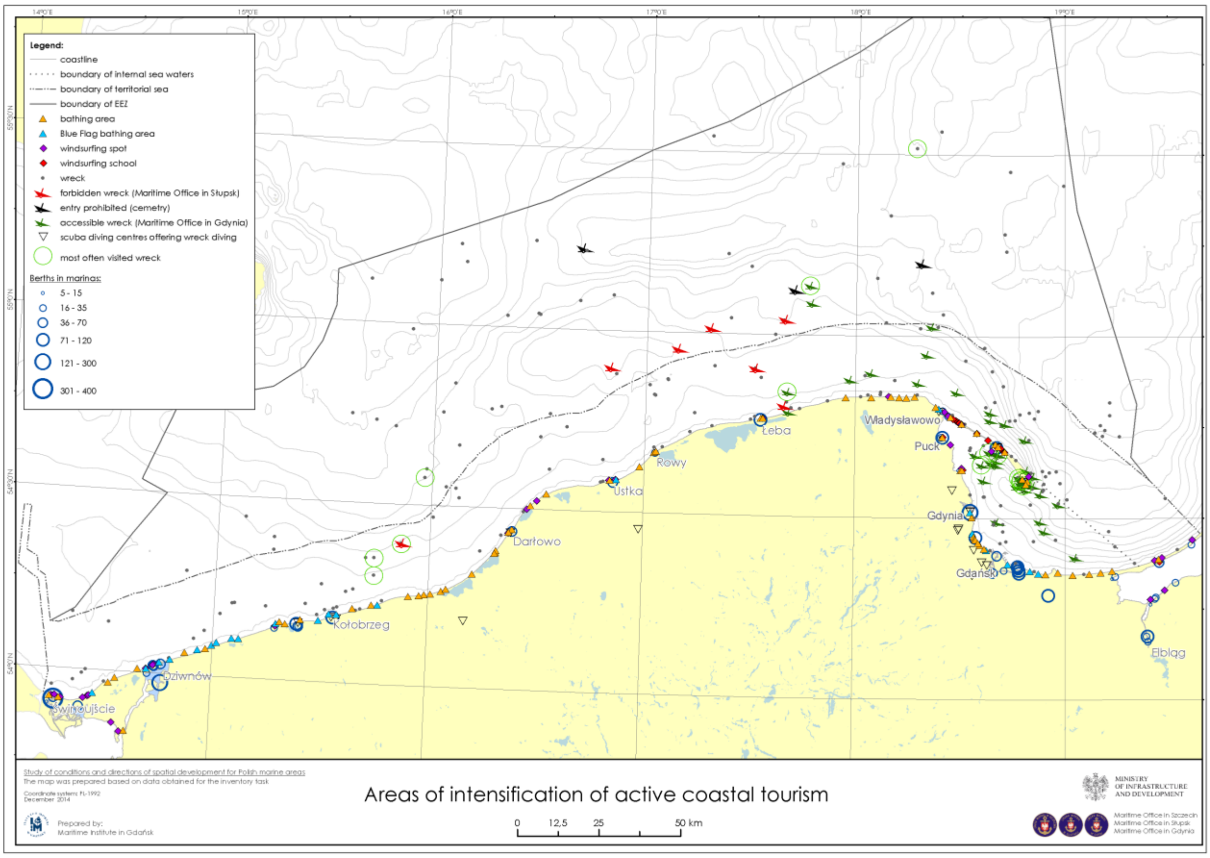

Fig. 8.25. Areas of intensification of active coastal tourism
Source: Maritime Institute in Gdańsk

The most intensely used areas for the above described active forms of coastal tourism are, and will be in the future, the waters of **Szczecin Lagoon** (also to some extent the Pomeranian Bay) and **Gulf of Gdańsk.** The Central Coast will remain a sea basin dominated rather by forms of recreation connected with vacationing and bathing (including jet-ski and fast boats).

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[94] For example Blue Parks – a network of archeological underwater parks in Denmark, Sweden and Germany open for scuba divers

Development of tourism in both mentioned basins is mainly limited by nature conservation – both are Natura 2000 areas, for which protection plans are currently being finalised. Provisions of these plans will be binding for maritime spatial plans. In order to balance development of tourism and nature protection in the internal part of the Puck Bay, provisions regulating tourist traffic, establishing zones closed for traffic, as well as safety zones where vessel traffic is subject to a set of limitations have been introduced (Ordinance No. 5 of the Director of the Maritime Office in Gdynia of 3rd April 2014) (Fig. 8.26).

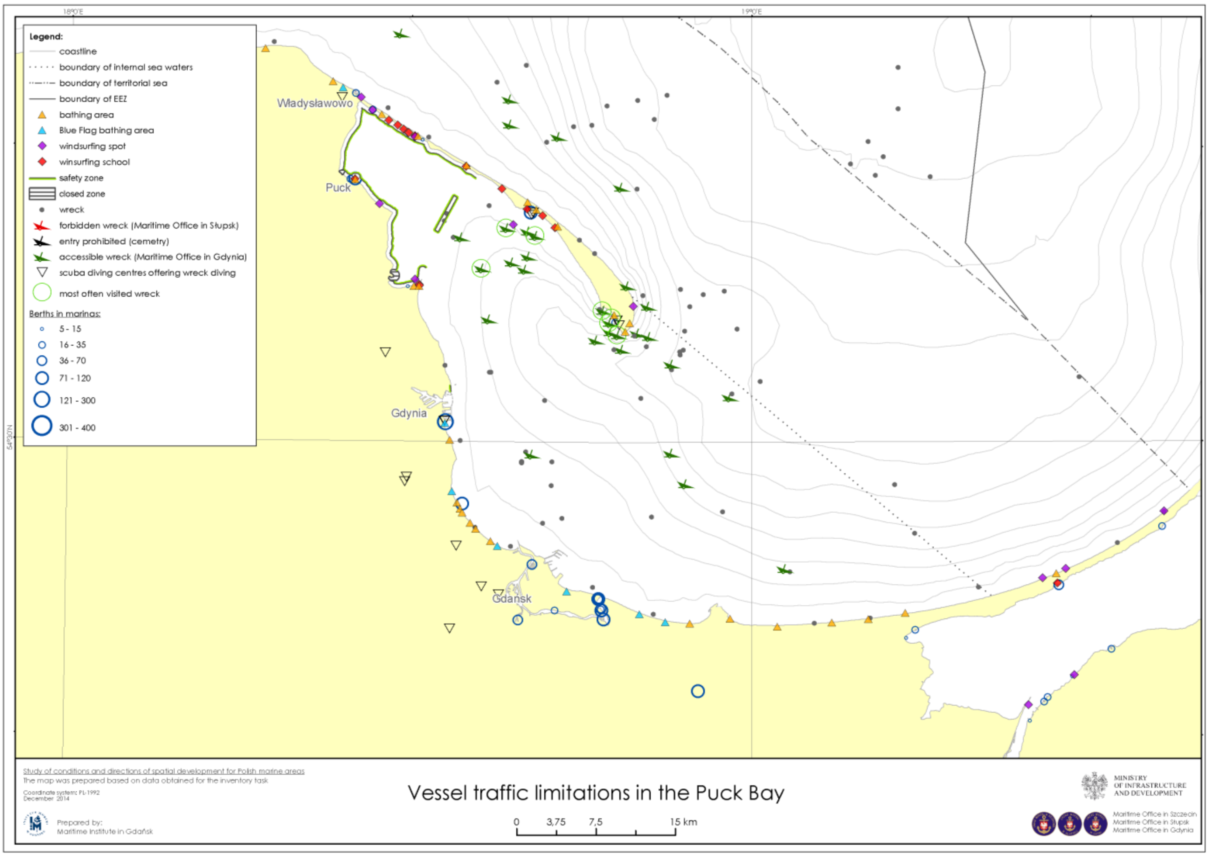

Fig. 8.26. Vessel traffic limitations in the Puck Bay.
Source: Maritime Institute in Gdańsk, on basis of ordinance no. 5 of the Director of the Maritime Office and own sources.

Conclusions for the maritime spatial plan of Polish sea areas:

- Space for an archaeological park should be reserved in areas of particular development of wreck tourism (diving).
- Further development of qualified marine tourism should be expected, especially in the most predestined areas (e.g. Puck Bay, Vistula Lagoon, Szczecin Lagoon and Pomeranian Bay).
- Detailed plans should be made for areas with highintensity of conflicts connected with development of qualified coastal tourism.

Knowledge gaps:

Touristic capacity of sea areas used for purposes of qualified marine tourism and water sports.

8.8. Dumping sites

8.8.1. Dredged spoil storage areas

On basis of the report "Elements of the study of conditions for spatial management of Polish sea areas with respect to predicted climate change, anthropogenic change, coastal protection and spatial conflicts, sites of dredged spoil storage, H. Boniecka, A Fajda, Department of Maritime Hydrotechnics of Maritime Institute in Gdańsk, 2014 – Annex 11.

In the environmental management sphere, one of the more important problems faced by seaports is the realisation of dredging works (investment and maintenance), and in particular the removal and management of dredged spoil.

Due to existing hydro- and lithodynamic conditions, dredging works are carried out in fairways, roadsteads and basins of all Polish seaports as well as in the lagoons. The works include not only extraction of material from the bottom, but also transportation and subsequent safe storage of the spoil in specially selected areas – the so called dumping sites (until the end of 1980ies the material dredged in port areas was dumped at various, as a rule dynamically inactive zones of sea bottom,) or using it for nourishing eroded parts of the coast (see Chapter 5).

In the period 1990-2008 the total volume of dredging in the roadsteads , fairways and basins of open sea ports, i.e. in Łeba, Ustka, Darłowo and Kołobrzeg was over 6.85 million m^3, of which a little over 40% was used for coastal protection (nourishment works). The rest was still dumped in offshore dumping sites [Boniecka and others, 2013a].

Depending on region of the coast, the dredged material was, and still is, used in various ways, depending on natural and anthropogenic conditions. Unused spoil is stored in designated places (dumping sites) on the sea bottom, which are not protected in any special way[95]. So far, their location was selected at such places where water depth allowed dumping on the bottom a thick layer of the spoil, taking into account hydrodynamic parameters (wave forces, currents) and possible impediments to navigation.

At present, the environmental aspect (influence on benthic organisms, fish, birds, mammals, humans and forms of nature protection) has gained in importance. Account has to be taken of collision situations with other users of the sea space.

Currently, there are 10 dumping sites for dredged in the Polish sea areas, of which 2 are located in the Pomeranian Bay for dumping spoil from construction of the external port and LNG Terminal in Świnoujście, and one is a reserve site at Mrzeżyno (Table 8.11 and Fig. 8.27).

[95] There are no forms of area protection existing which would make it impossible to store dredged spoil.

Table 8.11. Characteristics of dredged spoil dumping sitesl[96]

Name	Characteristics
GDAŃSK	Location: Gulf of Gdańsk Area: 2.69 km^2 Depth: 30 m
DCT	Location: Gulf of Gdańsk, at the slope Area: Depth: 55-60 m
GDYNIA	Location: Puck Bay Area: ok. 55 km^2
ŁEBA	Location: N-E of Łeba, 1.0 Nm from the port Area: circle of 2 cable radius (ca. 370 m) Depth: 10-15 m In 1990-2011 ca. 1.7 mln m^3 of spoil was dumped
USTKA	Location: 2 Nm from port entrance Area: circle of 2 cable radius (ca. 370 m) Depth: 14 m In 1990-2011 ca. 0.8 mln m^3 of spoil was dumped
DARŁOWO	Location: 2.5 Nm from port entrance Area: circle of 2 cable radius (ca. 370 m) Depth: ca. 10 m In 1990-2011 over 0.8 mln m^3 of spoil was dumped
KOŁOBRZEG	Location: 3.5 Nm to N-E from port entrance Area: circle of 2 cable radius (ca. 370 m) Depth: ca. 14 m In 1990-2011 ca. 0.6 mln m^3 of spoil was dumped
MRZEŻYNO	Reserved for the needs of the port at Mrzeżyno – curently not used Location: centre of dumping site 9.70 km from the coastline, height of spoil storing 1.0-1.5 m Area: 0.47 km^2 Depth: ca. 15.5 m
DUPMING SITE of Maritime Office in Szczecin	Location: coastal zone of Pomeranian Bay, distance of centre of dumping site from coastline ca. 10.5 km, height of spoil storing 1-1.5 m Area: ca. 12 km^2 Depth: ca. 12.2 m In 1990-2011 ca. 0.6 mln m^3 of spoil was dumped
DUPMING SITE of the Szczecin and Świnoujście Port Authority	Location: Pomeranian Bay, height of spoil storing 1.5 m, distance from dumping site centre to coastline ca. 19 km. The site is divided into subdivisions Area: 3 km^2 Depth: ca. 12.9 m

[96] The table and figure in subsection 8.8.1. are from Annex 10

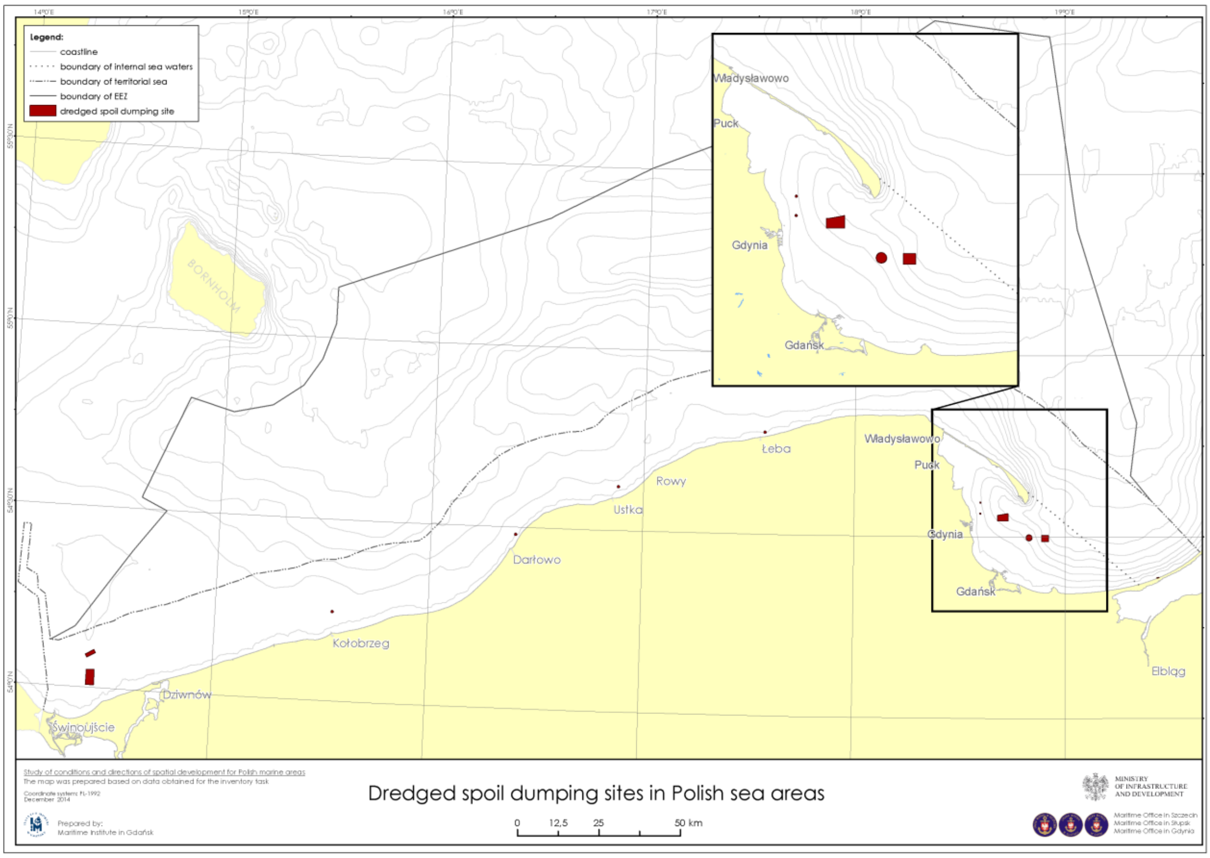

Fig. 8.27. Dredged spoil dumping sites in Polish sea areas, state as of 31st December 2013.

Besides the offshore dumping sites, in the Szczecin Lagoon there are special landfill areas for storing spoil from maintenance dredging of the Szczecin-Świnoujście fairway. They allow maintaining the fairway in good technical state, and because of that are very important elements of port access infrastructure. The biggest currently exploited landfill areas are: fields "D", "Chełminek", "Mańków", "Dębina" and "Ostrów Grabowski". Existing landfill areas are insufficient for purposes of planned modernisation of the fairway and connected increase of dredging works.

Improvement of accessibility of ports from the sea, which is connected with solving the problems of dredged spoil management, is one of the basic conditions for further development of the ports. Therefore, while planning for rational use of Polish sea areas, the needs connected with the existing and potential dumping sites in the territorial sea should be taken into account in order to minimise danger to valuable marine nature and to avoid conflicts with other users of sea space. A cost-effective and pro-environmental approach would be to use the dredged material for coastal protection and other needs instead of leaving it dumped in the sea.

Dumping should be an extreme exception, only when there is no other possibility of practical utilisation of the dredged material. Such approach will allow minimising conflicts with other users of sea space (among others shipping, the Navy, aggregate mining).

8.8.2. Dumped chemical ammunition

Ammunition dumped in the Baltic Sea after World War II is a significant problem for users of the sea and for the environment. Often together with chemical also conventional ammunition was dumped, which means that, besides contamination, there is an additional danger of explosion.

Baltic fishermen still get burned by chemical ammunition. Since 1952, in the Polish EEZ were noted 29 cases of contact with World War II ammunition/chemicals (Table 8.12). Chemical ammunition most often was found during fishing.

Tab. 8.12. Calendar of incidents connected with drawing/beaching / of chemical warfare agents /CWA/ in Polish sea areas

Year	Number of incidents at sea /on beach	Location of incident	Number of contaminated persons /equipment/	Comments
1952	½	E BORNHOLM KOŁOBRZEG – beach DZIWNÓW – beach		In 1952-1954 on the beach were found in total
1953	-/1	DZIWNÓW – beach		5 bombs
1954	1/1	GDAŃSKA BAY JURATA – beach		/unknown content/
1955	-/1	DARŁÓWEK – beach	102 children	Barrel with liquid CWA
1967 lipiec	1/-	H-9 E BORNHOLM	KOŁ 158 Crew	Contaminated fish net
1969 lipiec	1/-	HJ-8 E BORNHOLM	Part of UST 3 crew	Contaminated fish net
1971	1/-			
1974	2/-			
1976	2/-		6 fishermen from DARŁOWO	
1977	4/-	Middle Baltic	12 fishermen on KOŁ 158	A 20 kg lump
1979	3/-		- 3 fishermen from Kołobrzeg - 1 fisherman from Ustka - cutter WŁA 152	
1980	1/-		Cutter from Władysławowo	
1994	1/-	H-9 E BORNHOLM	Łeb 5	Drawn bomb passed over in Nexf
1997	1/-	ca. 30 Nm north of Władysławowo	8 fishermen WŁA 206	A 4-5 kg lump
TOTAL	**19/5**			

Source: Postwar chemical ammunition dumped in the Baltic Sea - Present state and the scope of further works - CHEMSEA portal http://www.chemsea.amw.gdynia.pl/index.php/bron-chemiczna/miejsca-zatopienia/9-incydenty/ (access 2.12.14).

In 2004 the international program “Modelling of Ecological Risks Related to Sea-Dumped Chemical Weapons” (MERCW) resulted in a detailed description of the dumping site near Bornholm. In 2010, in the framework of the EU Strategy for the Baltic Sea Region the flagship project "Assess the need to clean up chemical munitions", coordinated by Polish authorities (Chief Inspectorate of Environmental Protection) has been started, and in 2011 the ERDF subsidized project “Chemical Munitions – Search and Assessment”(CHEMSEA) began (mentioned earlier in Chapter 1). The Helsinki Commision established a new expert group on the topic (HELCOM MUNI), which published its report in 2013 [HELCOM MUNI, 2013]. Results of CHEMSEA were published in 2014 [Bełdowski, 2013].

Official Baltic dumping sites for chemical munitions are located in the Gotland Deep, Bornholm Deep and in Skagerrak – but a justified suspicion exists that there are also unofficial chemical munitions dumping sites (Fig. 8.28), where officially only conventional ammunition was dumped (Gdańsk Deep[97] and Słupsk Trough). Due to navigation errors, wrong marking of discharge areas or method of dumping (in drifting wooden boxes) zones where chemical munitions can occur are larger than previously expected. A part of the containers came ashore on Bornholm, Swedish and Polish beaches.

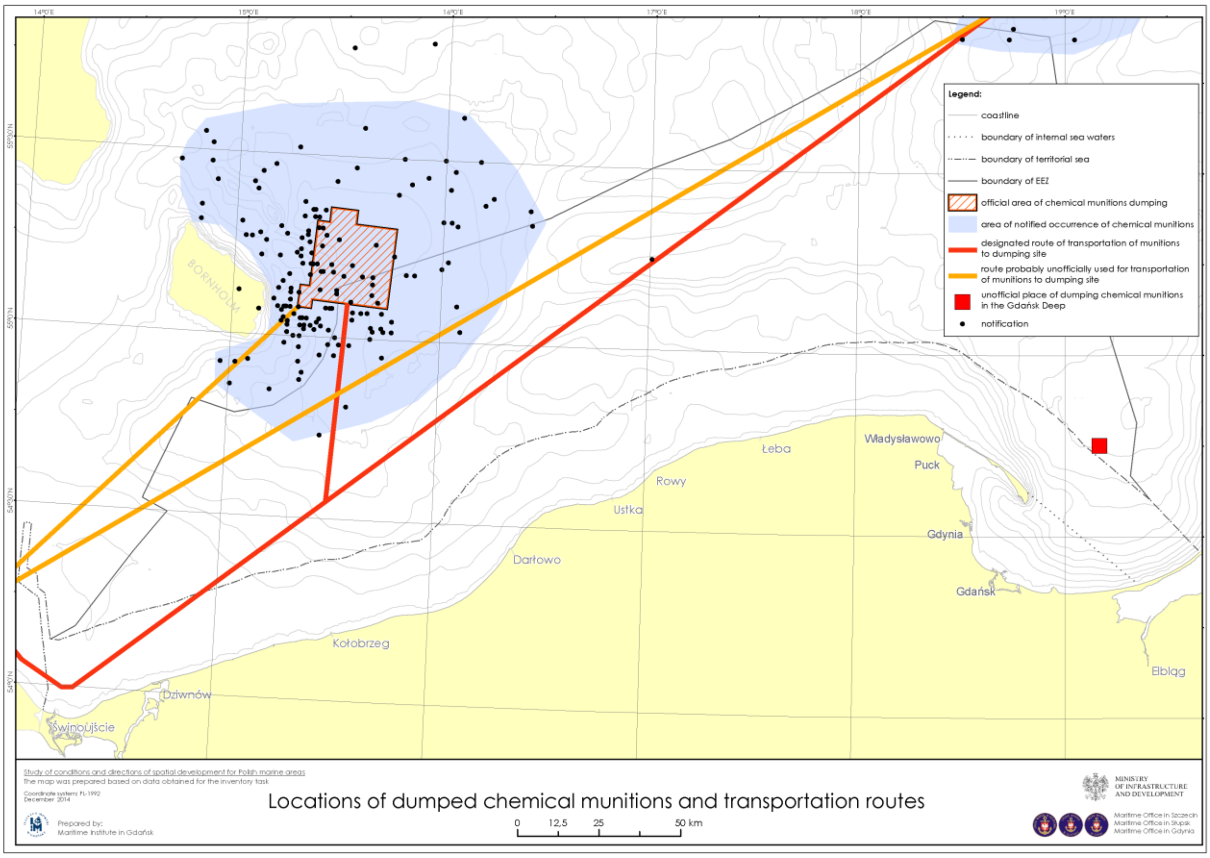

Fig.8.28. Locations of dumped chemical munitions and transportation routes.
Source: Maritime Institute in Gdańsk on basis of HELCOM MUNI data

The Bornholm dumping site has an area of approximately 150 km^2 and there are significant

[97] In an area with depths between 80 and 110 m. Small circular area of of 0.62 Nm diameter, shown in navigation maps at position 54°45´N, 19°10´E

amounts of dumped ammunition in large concentrations. The area has been identified as a severe ecological danger and is the best investigated of the three official sites.

In the Polish EEZ five regions are identified where human health is at risk or vessels may be contaminated by dumped chemical munitions. Unofficially 60 such risk places are talked about. They are located in the Bornholm area, at the border with the Danish EEZ (at depth of 70-105 m; bombs, artillery ammunition, mines and containers with mustard gas, arsenic compounds and chloroaceto-phenon), area of Dziwnów (at depth 10-2m; artillery shells containing mustard gas, lewisite, Clark I and Clark II), area of Kołobrzeg (depth 65m; bombs, artillery ammunition, mines and containers with mustard gas, lewisite, Clark I and Clark II, chloroaceto-phenone), area of Darłowo (depth 90m; bombs containing mustard gas) and Hel (depth 105 m; bombs, artillery ammunition, mines and containers with mustard gas, lewisite, Clark I and Clark II, chloroaceto-phenone). But the largest unofficial area in Polish waters is the Gdańsk Deep, where according to some sources about 60 tons of munitions containing mustard gas were dumped [Bełdowski, 2013]. In 1954 two incidents occurred in that area during fishing and presence of mustard gas was identified.

Conclusions for the maritime spatial plan of Polish sea areas:

- Existing areas of dredged spoil storage should be taken into account.
- Dumping of dredged spoil should not be allowed in prospective areas of sand extraction for coastal protection (nourishment).
- Risks existing in areas of dumped chemical munitions should be taken into account, and closed zones or zones of limited use should be designated in such areas.
- All preinvestment investigations in Polish sea areas should include a search for potential elements of dumped ammunition.

Knowledge gaps

Detailed spatial information allowing a delimitation of areas of occurrence of dumped chemical munitions.

8.9. Mariculture

On basis of the report "Possibilities of development of marticulture in Polish sea areas", M. Michałek and others, Department of Ecology of Waters of the Maritime Institute in Gdansk, 2014, Annex 4

Mariculture involves the cultivation of plants and animals in the sea for food and other economical purposes and for reproduction of other, rare or endangered, sea organisms [Sadowski, 2009].

Marine organisms, especially macroalgae, molluscs, reeds, microalgae and fish are farmed for food and in order to obtain substances valuable for many sectors of economy (mainly for pharmaceutical, cosmetics and food industry). Maricultures can be used for restitution of protected or endangered species and also for improving the state/quality of environment.

Especially in case of large scale marine farms, selection of an appropriate location is important. When choosing the location the following should be taken into account:

- insolation,
- temperature,
- rainfall/evaporation,
- weather anomalies,

- strength and time of ice cover,
- availability of water,
- availability of CO_2,
- availability of nutrients,
- availability of space,
- availability of qualified staff,
- labour and services' costs,
- transport infrastructure,
- market for the most important products,
- social and economic stability,
- legal issues.

Whereas proper insolation and temperature are rather difficult to find in Northern Europe, nutrients and CO_2 are easily available.

Macroalgae

The Baltic Sea is characterised by relatively low temperature, salinity and transparency of water, therefore it is not rich in macroalgae. In spite of that, at Swedish, Finnish, Danish and Estonian coasts, mainly near sewage collectors and diffusers, macroalgae cultures are maintained mainly in order to eliminate excessive quantities of biogens, and also with the objective of obtaining material for the pharmaceutical, cosmetic and fuel industries [Ek, 2001; Linne, 2001]. In Polish sea areas farming macroalgae for industrial purposes is difficult because of unfavourable weather and hydrological conditions (among others short vegetative season, high water dynamics along the open sea coast, poor availability of sheltered places, ice cover in the coastal zone).

Promising results were obtained during experiments carried out in the Gulf of Gdańsk, in which the use of *Enteromorpha* green algae for reducing eutrophication of the Gulf's waters was tested [Kruk-Dowgiałło and Kowalczuk, 1995].

Molluscs

These organisms are raised mainly for consumption. Demand for this kind of food is steadily growing, and their production in Europe is growing. In the Baltic Sea, due to environmental conditions (mainly low salinity), which have an impact on the size of molluscs, their farming for food is rather not considered. However, mollusc cultures in the Baltic Sea could have a pro-environmental character as a possible way of mitigating negative effects of eutrophication.

In Polish sea areas live two mollusc species with potential for farming: mussel *Mytilus edulis trossulus* and zebra mussel *Dreissena polymorpha*. According to current state of knowledge and experience, the location of a mollusc farm should fulfil the following criteria:

- weak or average water currents,
- lack or rare occurrence of ice cover in winter,
- salinity optimal for development of farmed species (in case of mussel>4 psu, in case of zebra mussel<4 psu),
- proper water exchange above the bottom in order to avoid anoxia,
- area of 1-10 hectare,
- sheltered water area,

- good access to the farm,
- lack of sources of pollution in closest neighbourhood,
- proper distance from fairways and recreation areas.

Considering the above requirements, Polish sea areas offer a limited number of places appropriate for mollusc farming. The main obstacle is the small number of sheltered waters with satisfactory hydrodynamic conditions (bays, lagoons) and in which recreation activities are only marginal.

Puck Bay, where the hydrological conditions are favourable for mussel farming, is periodically covered by ice. Moreover, it is intensively exploited in a variety of ways (fisheries, recreation, etc.). The situation is additionally complicated by the fact that the whole area is protected within the European Natura 2000 network[98]. Recently, in the external part of the Puck Bay, an experimental mussel farm was started. Results of the experiment are not yet available.

An additional possibility of mussel farming may be in the co-use of sea areas with offshore wind farms. The idea should be developed further, especially from technological point of view.

Optimal location of zebra mussel farms is limited to shallow freshwater bays and lagoons. In addition:

- water currents should not impede sedimentation of larvae (<2 m/s),
- there should be a stable level of salinity.

In Polish sea areas these conditions are fulfilled only in two basins: the Vistula Lagoon and the Szczecin Lagoon, which are not a subject of this Study.

Summing up, the possibility of locating in Polish sea areas mollusc farms cannot be excluded, but it seems that in the near future this type of activity will remain in the experimental phase. Mollusc farming at industrial scale will become possible only after solving the environmental and technological problems.

Common reed *(Phragmites australis)*

It is a long-term perennial growing in shallow fresh and saline waters. For industrial purposes it may be cut regularly, e.g. every two years, with no negative or positive effect on the plant's reproduction capabilities. High content of biogenic substances and fertility of soil result in increased density of reed clumps as well as the height and mass of shoots [Roosaluste, 2007].

Reeds are more often perceived as a useful means of mitigating environmental and climate changes. Reed clumps are an efficient tool for removing excess biogenic substances from the environment of shallow coastal waters. For a long time reed was used by humans in many ways (in construction for: covering roofs, walls, ceilings and floors, plaster underlay, etc.). It is a raw material in food and fodder industries and is used in cellulose production, for pre-treatment of sewage and for biofuel production.

Large areas of the Baltic Sea coast offer optimal conditions for reed growing, both from the point of view of depth (below 0.3m) and salinity (low salinity from 0 to 15 psu is preferable).

In Polish sea areas commercial common reed farming is possible, however an appropriate location

[98] Planned provisions of protection plans for Natura 2000 in Puck Bay prohibit introduction of mariculture.

would have to be found, which would not be a nature protection area and which would offer optimal conditions for growing the plant. Simultaneously, it is possible to use reeds in sewage treatment processes, creating artificial reed fields near sewage treatment plants, which would purify the discharge and would be used for biomass production or for construction purposes.

Fish

Stagnation in fisheries caused by overfishing of global fish resources and increased demand for fish products resulted in an exceptional increase of production in the aquaculture sector, which is currently the fastest developing branch of food industry, with annual increase of 8.8% since 1980 [FAO, 2010].

Currently in Poland mainly salmonid fish are bred, with domination of rainbow trout as main species. In recent years production of other species has developed, mainly in recirculation systems. Apart of the salmonids the main species are: sturgeon, European and African catfish, barramundi and tilapia. Carp aquacultures (approximately 300 farms) are located over all Poland. Trout farms (approximately 160) are located mainly in the northern part of the country, close to the coast and in areas of clean and cold waters in the south. Recently begin to appear fish farms introducing new species, especially species the supply of which has lately significantly come down because of their shrinking resources in natural waters (eel and zander) [SPRŁ, 2013].

In case of the Polish part of the Baltic Sea, apart of the area of Puck Bay and Gulf of Gdańsk and fragments of Odra estuary, locating pond farms in the coastal zone is not possible. However, these areas are not considered safe from ichthyopathologic point of view due to strong anthropogenic pressure. Because of pathogenic factors, social conditions, technical problems (storms) and negative impact on environment, currently there are no real possibilities of development of such fish farm technology in the Polish coastal zone.

Pond farming in the open sea consists in constructing systems of ponds (cages) of various size, designed to withstand even the strongest storms. In the case of closed seas, such as the Baltic Sea, the only problem is a proper surface of bottom at sufficient depth (50-60m). In the Polish sea areas such areas are located near the border and in the region of the Gulf of Gdańsk – and this does not provide big possibilities for the development of such form of mariculture. Limitations are manyfold e.g. impediment to navigation or protests of well organised groups of stakeholders (fishermen, ecologists, etc.). The only real chance of development of this technology may be in co-use of sea space with offshore wind farms [SPRŁ, 2013].

Pasture farming consists in pre-breeding of fry in artificial conditions and subsequent release of the fry into the natural environment, where mature organisms are fished using industrial methods. In the light of fishing limits in the Baltic Sea, legal and political regulations, and also economic calculus, such form of mariculture seems to offer the best prospects. It is already practised in case of salmon and bull-trout, and other fish species such as cod or whitefish are being tested [Sadowski, 2009].Moreover, such form of mariculture is politically attractive – the country which realises such a fishery policy may use it in negotiations regarding e.g. fishing limits.

Co-use of sea space

One of the factors limiting the development of mariculture in Polish sea areas is the scarcity of places appropriate for locating necessary infrastructure. One of the possible ways of solving this issue could be by placing mariculture farms in sea space already taken up by other uses, e.g. inside offshore wind farms. The easiest way is to collect organisms naturally growing on elements of wind farm structures (molluscs and macroalgae). Collected organisms may be used as biomass for biogas production. In addition, there is a possibility of connecting wind farms with fish farms. However, in spite of a growing interest, not many examples of implementing such solutions exist.

Conclusions for the maritime spatial plan of Polish sea areas:

- Possibilities of locating mariculture in Polish sea areas are rather limited, mainly because of climatic and hydrologic conditions and because of the existing utilisation of sea space, especially in the coastal zone.
- In Polish sea areas only two basins offer good conditions for macroalgae, reed and mollusc farming: Vistula Lagoon and Szczecin Lagoon (which are not the subject of this Study).
- Puck Bay, in spite of favourable hydrological conditions is used too intensively by recreation and fisheries. Protection regulations for Natura 2000 areas also do not allow using this basin for mariculture purposes.
- In the near future, mussel farming will still remain in the experimental phase. Mollusc farming at industrial scale will become possible only after solving environmental and technological problems.
- It is possible to use reeds in sewage treatment processes by creating artificial reed fields near sewage treatment plants, which would cleanse the discharged waters and could be used for production of biomass or for construction purposes.
- The only real chance to develop animal mariculture in Polish sea areas seems to be in the co-use of wind farm areas. Dialogue between OWF investors and potential farmers should be started. The possibility of placing in the maritime spatial plan(s) provisions indicating co-use of such areas should be considered

8.10. Spatial recapitulation

Existence of immobile ways of sea area use results in the appearance of closed areas and areas of limited use (Table 8.13, Fig. 8.29). In Polish sea areas in 2014 there were over 50 closed areas of such type.

Table 8.13. List of main areas of limited use in Polish sea areas (state in 2014)

Category of area	Name	Type of restriction	Time range
Oil rig	Baltic Beta	Prohibition of fishing and anchoring	Permanent
Oil rig		Prohibition of fishing and anchoring	Permanent
Training area of Polish Navy	S-1a	Prohibition of fishing and navigation	Periodical
Training area of Polish Navy		Restricted zone	Periodical
Training area of Polish Navy	S-5	Prohibition of fishing and navigation	Periodical
Training area of Polish Navy	S-3	Prohibition of fishing	Permanent
Training area of Polish Navy	Calibration ground	Prohibition of fishing, anchoring, dredging and diving	Temporary
Training area of Polish Navy	S-14	Prohibition of fishing	Permanent

Training area of Polish Navy	S-11	Prohibition of fishing and navigation	Periodical
Training area of Polish Navy	S-2	Prohibition of fishing and navigation	Periodical
Training area of Polish Navy	S-15	Prohibition of fishing and navigation	Permanent
Training area of Polish Navy	S-4	Prohibition of fishing and navigation	Periodical
Training area of Polish Navy	S-1a	Prohibition of fishing and navigation	Periodical
Training area of Polish Navy	S-1b	Prohibition of fishing and navigation	Periodical
Training area of Polish Navy	S-12	Prohibition of fishing and navigation	Periodical
Training area of Polish Navy	S-6a	Prohibition of fishing and navigation	Temporary
Training area of Polish Navy	S-10	Prohibition of fishing and navigation	Periodical
Training area of Polish Navy	S-6	Prohibition of fishing and navigation	Temporary
Training area of Polish Navy	S-6b	Prohibition of fishing and navigation	Temporary
Training area of Polish Navy	S-13	Prohibition of fishing and navigation	Periodical
Port area	Port of Gdańsk	Prohibition of fishing and limitation of navigation	Permanent
Pipeline	Gas pipeline BB – Władysławowo	Prohibition of fishing and anchoring	Permanent
Pipeline	Sewage discharge	Prohibition of fishing and anchoring, limitation of navigation	Permanent
Pipeline	Brine and Dębogórze sewage treatment plant discharge	Prohibition of fishing and anchoring, limitation of navigation	Permanent
Wreck	Cemetery	Prohibition of diving	Permanent
Wreck	Cemetery	Prohibition of diving	Permanent
Wreck	No name	Prohibition of fishing and navigation	Permanent
Wreck	No name	Prohibition of fishing, navigation, anchoring and diving	Permanent
Wreck	No name	Prohibition of fishing and anchoring	Permanent
Wreck	No name	Prohibition of fishing, navigation and diving	Permanent
Wreck	Cemetery	The prohibition of diving	Permanent
Dumped	No 125	Zone of limited anchoring, trawling and dredging	Permanent

ammunition			
Dumped ammunition	No name	Prohibition of navigation	Permanent
Dumped ammunition	No name	Prohibition of fishing and anchoring	Permanent
Dumped ammunition	No name	Prohibition of fishing and anchoring	Permanent
Dumped ammunition	No name	Prohibition of fishing and anchoring	Permanent
Other	Country retreat of the President of Poland	Prohibition of diving	Permanent
Other	Artificial underwater sill	Prohibition of fishing, anchoring navigation and diving	Permanent
Cable	Gdynia - Gdańsk Fibre-optic cable	Prohibition of fishing, anchoring and dredging	Permanent
Protected Area	Słowiński National Park	The prohibition of fishing	Permanent

Source: Navigation charts of the HOPN.

Conclusions for maritime spatial plan(s) of Polish sea areas:

- Information on limitations of sea area use should be taken into due regard, presented in the graphical part of the plan and the nature of the limitation should be made clear in the textual part.
- In case of non-permanent limitations, possibilities of alternative use of these areas during periods when the limitations are not in force should be considered.

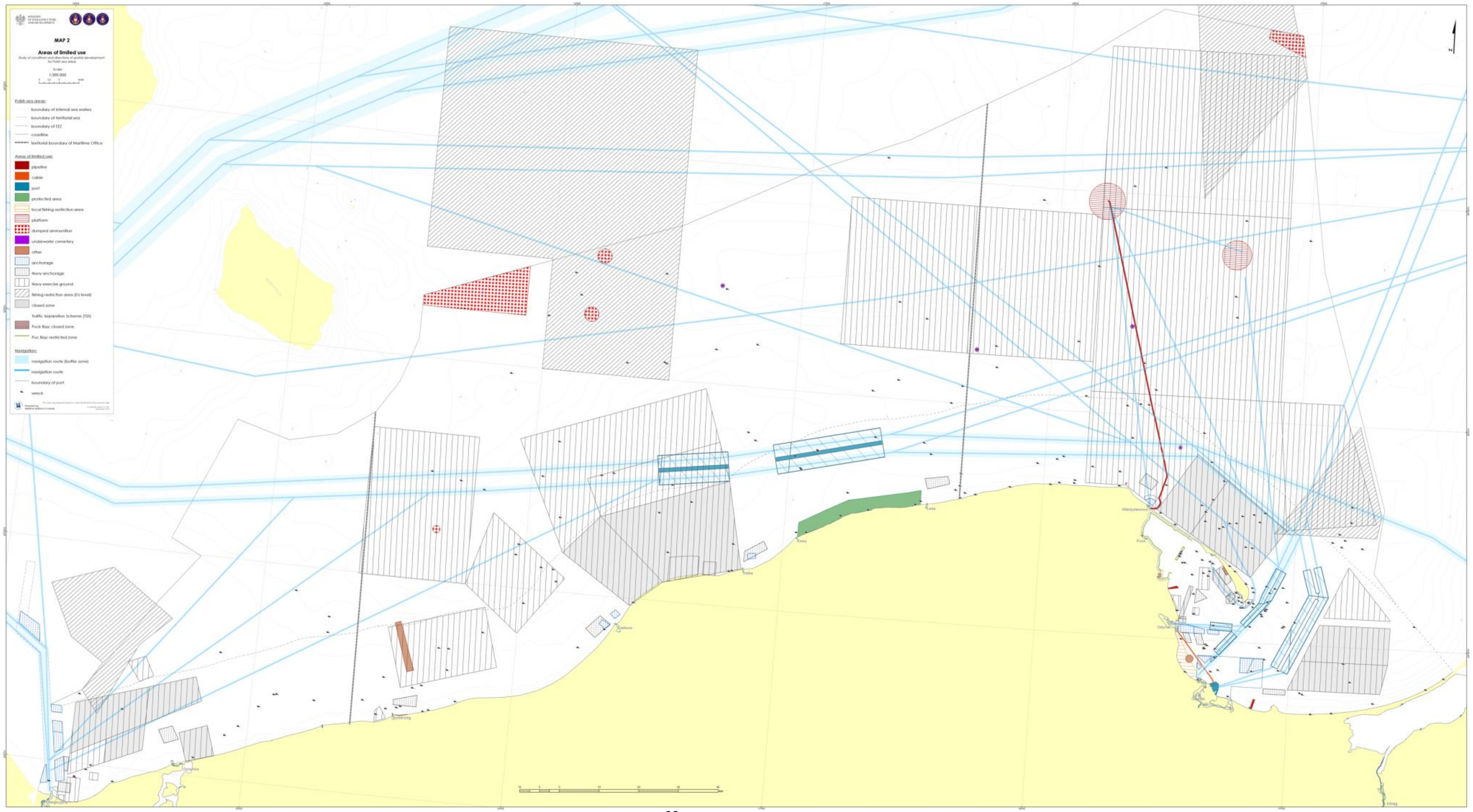

Fig. 8.29. Location of areas of limited use in Polish sea areas (state in 2013)[99]

Source: Maritime Institute in Gdańsk, on basis of navigation map of HOPN.

[99] This map is also attached in scale 1:200,000

9. INTRODUCTION TO CONFLICT AND SYNERGY ANALYSIS

This chapter presents relations between the various forms of spatial use of Polish sea areas. They were identified in result of expert work and through discussions with interested parties. In the assessment of these relationships attention was given to the identification of contradictions (conflicts) and possible synergies. The remaining relationships were considered neutral, i.e. that in their case there is no competition for sea space, and that no external profit can be found in taking up the same sea basins. Such approach results from the essence of spatial planning, which functions as a process of minimising spatial conflicts[100] and strengthening synergies.

A synthetic assessment of these relationships is very difficult. The reason is in the complexity of the social-economical-oceanographic category constituted by the different forms of spatial use of Polish sea areas and the relationships between them. For example, offshore wind farms are connected with natural environment by synergic links (artificial reef) but also pressures (e.g. infrasound having negative effect on marine mammals). Because of that in analyses concerning the natural component (the most complex form of sea space use) we rather write about risks and impacts than about conflicts.

In order to make the relationships better visible, it was also decided to separate some ways of sea use into more detailed classes. In effect e.g. bottom, pelagic and passive fisheries were distinguished, because only the first can be in conflict with linear infrastructure (cables and pipelines). Within tourism were distinguished water sports, bathing areas and diving, because e.g. port approaches and roadsteads have no real influence on sunbathing on the beaches or even yachting, but they are an obstacle to windsurfing and often exclude diving tourism. Such an approach allowed identifying conflicts within the same general types of sea use. Elements of linear infrastructure, e.g. cables, may be in conflct with pipelines, and moreover, pipelines may collide with each other. However, it should be beared in mind that the separating and typology performed for the needs of this Study are only initial and very general. We did not distinguish e.g. angling as a form of tourism; no separate slot was given to marine research. No separate forms of navigation are distinguished, though freedom of navigation of large vessels becomes limited by offshore wind farms, while small vessels might be able to pass through them. Mariculture has not been separated into industrial and serving purposes of environmental protection, though the impacts of each of these types of mariculture on marine environment are different. However, a balance between the degree of detail and required degree of generality had to be selected. It seems that more detailed typology would reduce the clearness of carried out analyses.

The character of relationships results also from the intensity of the various forms of sea area use. For example, fishery is in no conflict with relatively intense traffic, but fishing should not take place in

[100] Existence of spatial conflicts at sea results from the insufficient qualification of ownership rights with respect to marine resources. The Baltic Sea is owned by all of us. A conflict appears when different users want to have the right to use the same resources (the same space). On land, a farmer expropriated of his land receives compensation. At sea, a fisherman, though he loses his fishing grounds, has no right for compensation because he does not own them. This type of conflict has to be settled by public authorities in a public selection process. Spatial planning of sea areas is an example of such type of process.

a TSS. As was rightly pointed out by one of the stakeholders, the kind of relationship depends also on technology and on the openness of involved parties to the needs of the other users of sea space. The often mentioned fishery may be in conflict with e.g. protection of some marine organisms, but this may be minimised by using appropriate fishing techniques. Maritime spatial planning can and should actively support such solutions, but it cannot replace other public selection processes, such as common fishery policy, management plans for Natura 2000 areas, or technical and technological requirements introduced into permissions for erection and use of artificial islands, structures and installations.

The analysed relationships are of hypothetical and real character. This means that a part of the described below conflicts and synergic relations is only potential and does not occur in reality. It is rather difficult to speak about synergy between offshore wind farms and mariculture in other than potential categories, since the first of these forms of sea area use for the time being does not exist, and the second occurs very rarely. Potentially, there is a conflict between bathing areas, ports and thermal power stations (need to ensure safe cooling), but it is difficult to imagine that in real life discharge of cooling water would be permitted near bathing areas, anchorages or fairways. In theory, offshore wind farms are in conflict with bathing areas, roadsteads or port areas, but in reality this conflict cannot occur in Polish sea areas because Polish law does not allow locating wind farms in internal sea waters and territorial sea. Lack of real conflicts is the effect of preventive decisions. If they would be changed or removed, then these non-synergic relationships would become apparent. This explains why it was decided to analyse in this chapter all conflicts and synergies, existing and hypothetical (which could appear when e.g. regulations would change). Often the non-existence of a real conflict is the effect of the existence of a strong hypothetical conflict which resulted in a common sense or required by law exclusion, e.g. fishermen do not set their nets in ports.

Another conclusion resulting from the initial analysis of synergies and conflicts concerns their non-symmetrical relation. For example, diving does not conflict with fishery (assessment of fishery experts), while fishing can be dangerous to divers as has been pointed out by a tourism expert. This is why there are differences about existence of conflicts in the opinions of experts representing various forms of sea area use. It also should be pointed out that in some cases experts were unable to assess the character of the relationships. This explains the presence of so many question marks in the conflict and synergy matrixes. They should be seen as knowledge gaps.

9.1. The Stakeholders' view

The presented stakeholders' assessment is a result of the plenary discussions and work in small groups, using maps of sea area use, during the meeting which took place on 25.11.2014. It is not a complete picture, since the assessment was determined by the presence of intereested parties at the meeting, their preparedness and readiness to join the discussion. The most intense discussions were concentrated on the offshore power production issue. The identified conflicts and synergies regarding this sector and offshore mining are shown in Table 9.1.

Tab. 9. 1. Conflicts and synergies related to offshore mining and power production – stakeholders' opinion

SECTOR		Power Production			Offshore mining			Fishery			Linear Infrastr.		Navigation	Ports		Tourism			Underwater cultural heritage	National Defence			Civil aviation	Coastal protec.		Maricultures	Dumping sites		Protection of environment		
		waves	thermal *	Wwnd	Aggregates	oil & gas exploration	oil & gas exploitation	passive	near-bottom	pelagic	cables	pipelines		port area	roadstead, fairways	bathing areas	water sports	diving		exercise areas	Navy fairways	aviation		hard	soft		dredged spoil	dumped ammunition	habitats	birds	landscapes
Power prod.	waves	x	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.
	thermal*	n.o.	x	n.o.	n.o.	n.o.	n.o.	3	3	3	3	3	3	n.o.	n.o.	3	3	3	n.o.	n.o.	n.o.	n.o.	n.o.	3	3	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.
	wind	n.o.	n.o.	x	3	3/1	3/1	3	3	3/?	1	3/1	3/1	-1	0	0	1/0	0	1	n.o.	n.o.	n.o.	n.o.	0	0	-1	0	3/1	n.o.	n.o.	n.o.
Offshore mining	aggregate	n.o.	n.o.	n.o.	x	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.
	oil & gas exploration	n.o.		1	1	X	0	1	1	1	/1	/1	1	0	0	3	1	1	-1	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.
	oil & gas exploitation	n.o.		3/1	3/1		x	3	3	3	1	1	3	0	0	3	0	3	3	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.

Explanation:

n.o – no opinion 1– medium conflict 3– strong conflict (exclusion) 0 – no conflict

-1– synergy ? – experts were not able to assess the scale of conflict or synergy

* mainly cooling water systems

Source: Marine Institute in Gdansk.

With regard to the conflicts and synergies associated with aggregate mining and wave energy production (which does not exist in Poland, and probably will not appear in foreseable future) there has been no suggestion, even though representatives of the aggregate mining sector were present at the meetings. According to the stakeholder views, the development of both wind and thermal power production installations (including nuclear) will be a conflict-generating issue. In case of thermal power plants, the potential difficulties associated with the intake and discharge of cooling water were indicated. As a result of local, but potentially strong distubances caused by discharging and intake of water, difficulties for shipping, tourism and/or fisheries may occur. Without doubt, the location of pipelines will be designated as a closed area. Such assessment of conflict generation by these power plants is probably connected with discharges into the territorial waters. Offshore wind farms cannot be located in such highly sensitive areas, which explains the no conflict or small conflict assesment between the offshore wind farms and tourism and coastal protection.

It was also noted that there is synergy between offshore wind farms and port development (offshore wind farm construction and their maintenance will expand the range of functions of several local ports) and mariculture (existence of offshore wind farms can support breeding and cultivation of marine/aquatic organisms). In the stakeholders' opinion, conflicts with the offshore wind farms may occur in relation to underwater marine heritage, aggregate mining, fisheries, navigation and linear infrastructure. Exploration and exploitation of raw materials from the seabed was not considered as a high conflict-generating issue, it even appeared in synergy with underwater cultural heritage (support of exploration of/for wrecks and submerged settlements), while in relation to offshore wind such synergy was not identified (conflict exists). A wider range of conflicts appears when mining goes into the exploitation phase, and they are mostly related to fishing, navigation, underwater cultural heritage and marine tourism.

During the discussions several additional significant observations were made, such as:

- conflicts between OWFs and mining of aggregate, oil and gas are to a large extent solvable, except that location of platforms in an aggregate mining area is not possible;
- the standard 2.5 Nm buffer around a platform ensures collision-less access for service vessels and tankers to the mining area;
- multifunctional corridors for linear infrastructure would be very useful– this issue begins to appear in the discussions of experts from the energy and mining sectors – maritime spatial plans could facilitate solving associated problems and conflicts;
- aggregate, oil and gas mining, as well as offshore wind energy, can positively influence the development of ports, especially along the Central Coast;
- the offshore energy and mining sectors have a friendly attitude to each other, i.e they are oriented at coexistence rather than exclusion.

Therefore, some opinions on synergies and ways of minimising conflicts between mining and offshore wind farms were given:

- enabling aggregate mining on a site before the issuing construction permits for offshore wind farms at the same site will remove the conflict between these two sectors;

- common or paralelly executed studies and exploration at the stage of environmental investigations for offshore wind farms and oil and gas resource identification could remove opposing opinions of geologists during the process of issuing location permissions[101].

In the discussions, the fishermen expressed their concerns related to development of offshore wind energy. They pointed to difficulties with access to fishing grounds and trawling areas in the coastal zone which could become divided by potential cables (in particular the area from Ustka to Władysławowo; within 4 nautical miles from the shore – a traditional trawling area). Smaller controversy was aroused by conflicts between wind energy and recreational sea fishing. Areas used for angling tourism are located 12-16 Nm from the shore to the east of the Słupsk Bank. Here the conflict with the offshore wind farms could be solved, assuming that navigation in the buffer zones would be allowed. Generally, fishermen postulated that prior the development of spatial plans of the Polish sea areas, comprehensive knowledge on the impact of farms on the marine environment, fish, life cycles, migration routes and marine/aquatic organisms behaviour should be acquired, and only on the basis of such knowledge the decision where to place the farms should be made. According to the fishermens' opinions, new ways of the sea area use, may prevent the fisheries from taking advantage of fish quotas guaranteed to Poland.

During the plenary debate, a representative of the offshore wind energy sector pointed out the following issues:

- in the process of maritime spatial planning of Polish sea areas, offshore wind farms should not be stigmatised (e.g. presented as a wall closing access routes to fishing grounds);
- the final way of using the farms (how many units, how they are placed, where are the cables, location of buffer zone, etc.) will be determined after (within the scope of) the environmental decision (and in such a decision will take into account conflicts with fishery, fish, etc.);
- the area defined in the location permit is as a rule a maximum area, which never will be wholly "built-up";
- first offshore wind farms will be built in the period 2025-2030 – construction of next ones will depend on conditions of connection to the national power grid and on the economical and political situation – the maritime spatial plan of the Polish sea areas should indicate the offshore wind energy as a "target allocation", where until the time of building the wind farms other ways of using the space could be allowed (excluding those which will have a negative impact on the seabed – to be discussed with representatives of the sector);
- with regard to coexistence with the mariculture, opinions of the power production sector are divided - on one hand, investors should have nothing against – better image, collaboration with fishermen instead of conflicts; on the other hand, there may appear liability issues and possible compensations for damages to wind farms caused by the presence of the mariculture installations and servicing of the mariculture by ships;
- it is expected that passage of fishing vessels to fishing grounds through the area of a wind farm (the area strictly indicated in the construction project) will rather not be possible, but it

[101] This standard should also include cultural heritage (expert opinion)

will be possible through buffer zones between the wind farms (note – such a buffer zone not always exists);

- experts from the offshore wind energy sector are aware of the existence of conflicts with fishermen and will invite them to discussions.

It results from the above, and from Table 9.2, that fishery is also a sector with a large number of conflict relationships. In the earlier part of this Study were presented conflicts of this sector with the wind and thermal energy. But discussion was dominated by conflicts with nature conservation (seals feeding on introduced smolts released into the sea and preventing reproduction of salmon, protected birds damaging fishing nets and eating fish out of them, etc.). Identified were also problems with cultural heritage (wrecks damaged by nets), linear infrastructure (drag nets hooking onto cables and pipelines), dumping dredged spoil (areas inaccessible to fishermen) and dumped ammunition (damaging of fishing gear, risk to fish and fishermen), as well as related to water sport and bathing areas (in case of the last one, only the passive fishing). Different forms of fishing compete between each other for the fishing grounds.

Table. 9. 2. Conflicts and synergies with related to fishery – stakeholders' opinion

SECTOR		Power production			Offshore mining			Fishery			Linear Infrastr.		Navigation	Ports		Tourism			Underwater cultural heritage	National Defence			Civil aviation	Coastal protec.		Mariculture	Dumping sites		Protection of environment		
		waves	thermal*	wind	aggregates	oil and gas exploration	oil and gas exploitation	passive	near-bottom	pelagic	cables	pipelines		port areas	roadsteads, fairways	bathing areas	water sports	diving		exercise areas	Naval fairways	aviation		hard	soft		dredged spoil	dumped ammunition	Habitats	birds	landscapes
Fishery	passive	n.o.	n.o.	3	n.o.	1	n.o.	x	1	1	n.o.	n.o.	1	n.o.	n.o.	1	1	n.o.	n.o.	3/1	n.o.	n.o.	n.o.	0/-1	0/-1	n.o.	n.o.	n.o.	1	1	n.o.
	near-bottom	n.o.	n.o.	3	n.o.	1	n.o.	1	x	n.o.	3	3	1	n.o.	n.o.	n.o.	1	n.o.	3	3/1	n.o.	n.o.	n.o.	0/-1	0/-1	n.o.	3	3	1	1	n.o.
	pelagic	n.o.	3	3	n.o.	n.o.	n.o.	1	n.o.	x	n.o.	n.o.	1	n.o.	n.o.	n.o.	1	n.o.	n.o.	3/1	n.o.	n.o.	n.o.	0/-1	0/-1	n.o.	n.o.	n.o.	1	1	n.o.

Explanation:

n.o. – no opinion   1 – medium conflict   0 - no conflict

-1 – synergy   3 –high conflict (exclusion)   ? – experts were not able to assess the scale of conflicts or synergy

* mainly cooling water systems

Source: Maritime Institute in Gdańsk

The third, after fishery, power production and mining, most conflict-generating way of sea area use, according to the interested parties, appeared to be linear infrastructure, especially pipelines (Table 9.3). The discussion was dominated, however, by one case – the gas pipeline connecting Gdansk and the underground gas storage facility in the Kosakowo municipality. Residents in the municipality fear for their safety and also they cannot see any benefits for the municipality from this investment. Moreover it is a threat to local nature in the sea area, to the coastline (at landing point of the pipeline), fisheries and tourism in the Bay of Puck, and also it may cause difficulties in construction of the local havens, dredging of fairways to local ports. Generally, stakeholders from this municipality see no point in locating next industrial functions in an area already characterised by high intensity of conflicts between tourism, fishery and nature protection.

In the discussion, participants from Szczecin pointed out that the map in the Study and the future maritime spatial plans of Polish sea areas should show the route of the Nord Stream pipeline, particularly in the area of the fairway to Swinoujscie.

Table. 9. 3. Conflicts and synergies related to linear infrastructure – stakeholders' opinion

SECTOR		Power production			Offshore Mining			Fishery			Linear Infrastr.		Navigation	Ports		Tourism			Underwater cultural heritage	National defence			Civil Aviation	Coastal protec.		Mariculture	Dumping sites		Protection of environment		
		wave	thermal*	wind	aggregate	oil and gas exploration	oil and gas exploitation	passive	near-bottom	pelagic	cables	pipelines		port areas	roadsteads fairways	bathing areas	water sport	diving		exercise areas	Navy fairways	aviation		hard	soft		dredged spoil	dumped ammunition	habitats	birds	landscapes
Linear Infrastructure	cables	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	x	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.
	pipelines	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	3	3	n.o.	n.o.	x	n.o.	3	3	3	3	3	3	n.o.	n.o.	n.o.	n.o.	3	3	n.o.	n.o.	n.o.	3	3	n.o.

Explanation::

n.o. – no opinion
1 – medium conflict
-1 – synergy
3 – high conflict (exclusion)

* mainly cooling water systems

Source: Maritime Institute in Gdańsk

Except underwater cultural heritage (Table 9.4), other forms of the sea area use did not arouse discussion during the stakeholders' meeting. Wrecks and submerged settlements show synergy with marine tourism (diving) and exploration for hydrocarbons, as has already been mentioned. Potential synergy with fishery and environmental protection was not noted, even though many wrecks form artificial reefs. Underwater historical heritage is in conflict with dumping of dredging spoils, bathing areas (strong conflict with submerged settlements) and water sports, power production (especially thermal), fishery (though from the point of view of the heritage stakeholders the conflict is less intense than in the opinion of fishermen), national defence (except aviation) and linear infrastructure. The conflict and synergy assessment by stakeholders is different from the assessment of the National Maritime Museum, which is responsible for underwater cultural heritage issues in Polish territorial sea and internal sea waters (Table 9.5). In the Museum’s opinion there is much more synergy than conflict. Representatives of the Museum pointed to the need to develop procedures for noninventoried sea areas – to develop standards for preinvestment and other studies, which will include cultural heritage (observer on board research vessel, special methods of measurement, etc.).

During plenary discussion some other issues concerning relations resulting from the use of sea areas by other sectors. The following relationships, considered important, but not shown in the conflict and synergy matrixes, were identified:

- conflict of national defence with health resort/care function - placing of radars in health resort areas;
- potential conflict – cable landing vis coastal protection and environmental protection;
- conflict between coastal protection and environmental protection;
- ingerence in the landscape – transformations;
- hard coastal protection – disruption of natural morphodynamic processes (should be not allowed outside urbanized/built-up areas).

Stakeholders representing navigation, protection of environment, tourism and coastal protection, which seem to be linked by numerous relationships with other ways of sea area use, mentioned no conflict or synergy during the plenary debates and discussions in smaller groups. This points to the need for especially intensive work with representatives of these sectors during the process of developing the maritime spatial plan of Polish sea areas.

Table 9. 4. Conflicts and synergies related to underwater cultural heritage – stakeholders' opinion

SECTOR	Power Production			Offshore mining			Fishery			Linear Infrastr.		Navigation	Ports		Tourism			Underwater cultural heritage	National Defence			Civil aviation	Coastal Protec.		Mariculture	Dumping sites	
	waves	thermal*	wind	aggregates	oil and gas exploration	oil and gas extraction	passive	near-bottom	pelagic	cables	pipelines		port areas	roadsteads fairways	bathing areas	water sports	diving		exercise areas	Naval fairways	aviation		hard	soft		dredged spoil	dumped ammunition
Underwater cultural heritage	1	3	1	1	-1	3/1	1	1	1	1	1	0/1			3	1	-1	xx	1	1	0	0	0	0		3	

Explanation:

n.o. – no opinion
1 – medium conflict
0 - Lack of conflict
-1 – synergy
3 – high conflict (exclusion)
? – experts were not able to assess the scale of conflict or synergy

* mainly cooling water systems

Source: Maritime Institute in Gdańsk.

Table 9. 5. Conflicts and synergies related to underwater cultural heritage in the opinion of employees of National Maritime Museum

SECTOR	Power production			Offshore mining			Fishery			Linear Infrastr.		Navigation	Ports		Tourism			Underwater cultural heritage	National Defence			Civil aviation	Coastal Protec.		Mariculture	Dumping sites	
	wave	thermal*	wind	aggregates	oil and gas exploration	oil and gas extraction	passive	near-bottom	pelagic	cables	pipelines		port areas	roadsteads fairways	bathing areas	water sports	diving		exercise areas	Navy faiways	aviation		hard	soft		dredged spoil	dumped ammunition
Underwater cultural heritage																											

Explanation:
white –neutral relation
green – synergy
yellow – medium conflict
red – serious conflict (exclusion)

Source: Maritime Institute in Gdańsk, based on opinion of NMM representative

9.2. Assessment by the authors of the Study

Main spatial conflicts related to mining and offshore power production

Development of marine mining carries with itself a number of real spatial and ecological conflicts (Table 9.6). Location of mining activities is determined by the occurrence of resources, which are immovable and when found have to be protected.

The use of a sea area for mining oil and gas, and also for pipelines connecting the platforms with the coast or place of loading, excludes the use of that area for:

- extraction of sand and gravel: risk to the oil rig and to infrastructure, potential pollution of sediments near the platforms making sand and gravel useless;
- navigation routes (safety of navigation),
- nature protection (danger of pollution),
- dumping of dredged spoil (same reasons as in case of wind farms and cables)
- fishery and army exercises (for reasons of safety, and in case of fishery also because fish may be contaminated)
- ports and approach channels (a rather hypothetical conflict),
- marine tourism (safety zones).

Mining may result in destruction of underwater heritage, and it may permanently disrupt the coast by cable and pipeline connections with land. Appear also conflicts with power production. These are seen as stronger by experts from this last sector. The main issue is potential collision caused by damage or loss of steering qualities by special vessels servicing oil platforms or wind farms, or by tankers. Conflict with wind energy can be solved by appropriate location decisions; however, the obligation to protect mineral resources is a limiting factor when considering location and permissions for offshore wind farms. Due to the present areas of licences, the conflict between extraction of hydrocarbons and the discharge of cooling waters from a thermal power plant is somewhat hypothetical, but its appearance in the future is possible. This concerns not only the future nuclear power plant, but also other plants using sea water for cooling. For reasons of safety, the area of water intake and discharge will have to be in a safety zone (the extent of which will be larger than the area of cooling water influences). Similarly hypothetic is the conflict between bathing areas and port areas. Polish law does not allow extraction of hydrocarbons in such locations.

The scale and scope of conflicts related to aggregate mining are similar to mining of hydrocarbons. The difference is in that, that extraction does not require building structures, i.e. there is no need to establish safety zones. There is no risk of contaminating fish, but intense disturbance of sea bottom takes place. In effect there are some differences, with respect to hydrocarbon extraction, in the assessment of conflicts and synergies. The expert assessment of conflicts from the point of view of the aggregate mining sector indicates a strong potential conflict with thermal power production and wave power installations (which do not exist at present), and a smaller conflict with water sports, coastal protection and with roadsteads and anchorages, and no conflict with ports and bathing areas (common sense aproach, i.e. it is difficult to imagine that aggregates would be extracted in such locations because of coastal dynamics and dominance of already existing functions).

Exploratory works generate less conflict. Strong conflict (mutual exclusion) concerns clearly apparent situations. Exploration cannot be carried out in roadsteads, anchorages, dredged spoil dumping areas, fairways of the Navy, areas with dumped ammunition and mariculture areas. There is also some synergy: investigation of mineral resources will facilitate location of installations, structures and artificial islands permanently taking up the sea bottom. Intensification of exploration in Polish sea areas and investigations of sea bottom limit the use of sea space by other users – temporal closing of sea basins to allow investigations. This may cause difficulties, for a certain time, for navigation, marine tourism, fishery, aggregate mining or building of offshore wind farms. Exploration works include mainly sea bottom investigations, geophysical seismic investigations (generation of sound waves, which can have a negative impact on marine fauna, potentially harmful to spawn and fry, and also scaring animals out of the investigated area), and also geological works (exploratory and investigative drilling, the negative impact of which is connected with permanent ingerence into the sea bottom, and with the possibility of introducing various types of pollutants: liquids – drilling fluids, sanitary sewage, rainwater; solid contaminants – drillings etc.; atmospheric pollution – burning of waste gas from oil and gas from combustion engines; also potential oil spills in result of damage of equipment. Destruction of underwater cultural heritage or linear infrastructure is also possible (though this is rather improbable if proper standards are observed).

The scale of negative impact on environment depends on atmospheric and hydrological conditions, therefore each analysis of location of exploratory works and of exploitation should include appropriate analyses and modelling of effects (impacts). The involved risks are described in detail in the report *Zagrożenia wynikające z eksploatacji złóż ropy naftowej w szelfie Morza Bałtyckiego (Risks resulting from exploitation of oil resources in the shelf of the Baltic Sea)* ordered by CIEP and developed by OIKOS in 2010 and in a report of Opioła and Tyszecki [2012] dealing with exploitation of shale gas. Taking into account that mining in sea areas is subject to strict environmental requirements, that work on environment friendly techniques is far advanced, and that contingency actions are well organised, the probability of risk related with eruptions or spills is relatively low.

Table 9.6. Conflicts and synergies related to mining and power production – assessment by authors of the Study

SECTOR		Power production			Offshore mining			Fishery			Linear Infrastr.			Ports		Tourism				National defence				Coastal protec.			Dumping sites	
		waves	thermal*	wind	aggregates	oil and gas exploration	oil and gas exploitation	passive	near-bottom	pelagic	cables	pipelines	Navigation	port areas	roadsteads, fairways	bathing areas	water sports	diving	Underwater cultural heritage	exercise areas	Navy fairways	aviation	Civil aviation	hard	soft	Maricultures	dredged spoil	dumped ammunition
Power prod.	Waves	x	?	-1/0	3	1	?	?	?	?	3	3	3	-1/0	3	3	?	?	3	?	0	0	0	-1	?	3	3	3
	thermal*	?	x	?	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	0	3	3	3	3	3	3
	Wind	?	?	x	3	2	2	3?	3?	3?	2	2	3 /1?	3	3	3	2	0	2?	3	3	2	2?	0	0	-1	3?	3
Offshore mining	aggregate	3	3	2	x	1	3	3	3	3	3	3	3 /2?	0	1	0	2	3	3	3	1/2	0	0	1	0	3	?	3
	oil & gas exploration	?	?	2	1	x	0	2	2	2	2	2	1	1	3	1	1	1	2	2	3	0	0	0	0	3	3	3
	oil & gas exploit.	?	2	1	3	0	x	3	3	3	3	3	3	3	3	3	3	3	3	3	3	?	?	3	0	?	3	3

Explanations:

-1 – synergy 2 – high conflict 0- no conflict

1 – medium conflict 3 - exclusion ? – experts were not able to assess the scale of conflict or synergyii

* mainly cooling water systems

Source: Maritime Institute in Gdansk

Similarly to the view of stakeholders, in the opinion of the authors of the Study thermal power production and resulting disturbances of marine water circulation in the area of water intake and discharge is a potentially conflict generating form of power production. These conflicts haven't been investigated and there is no literature on the issue. Collected information indicates the possibility of strong conflict (exclusion) with all uses of sea space except aviation. But these conflicts will be limited in space. However, it is not known at present where they will occur (e.g. the location of planned nuclear power plant is not yet decided, lack of information from stakeholders about plans for other thermal power plants using sea water for cooling). In effect we do not know whether the intake and discharge of cooling water will take place in areas with low or high level and intensity of conflicts between sea space users.

Offshore wind farms (wind power production) are connected with potentially strong impacts on environment and space (limitation of other uses of sea space). The potential conflicts vary in dependence of the phase of the investment as well as individual characteristics of the project and selected locations (Table.9.7).

Table. 9.7. Potential impacts of offshore wind farms in dependence of phase of investment

Phase of investment	Impact	Subject	Type of impact
Preinvestment	Noise emissions (research vessels and airplanes)	Marine animals, birds	Short term, local
	Disturbance of sediments (sampling, etc.)	Marine organisms	Short term, local
	Spilling of pollutants from vessels	Marine organisms, water quality	Depends on size of spill and pollutant
Realisation (transport)	Disturbance of vessel traffic, noise and pollutant emissions, spills of harmful substances	Other users of sea space, Marine organisms	Short term, local
Realisation (construction)	Limitations of use of construction site	Other users	Short term, local
	Noise emissions	Marine animals, birds	Short term
	Disturbance of sediments (anchoring of vessels, foundations of towers)	Marine animals, sediments, underwater cultural heritage and linear installations	
Exploitation	Limitation of use	Other users, degree of limitation dependent on type of activity	Long term, area taken up by the wind farm
	Risk of collision	Other users, birds and bats	Long term, area taken up by the wind farm
	Change of geological processes (bottom surface dynamics)		Long term, dependent on character of the phenomenon
	Emission of noise and vibrations	Marine animals	Long term, area taken up by the wind farm

	Generation of new habitat	Marine organisms	Long term, area taken up by the wind farm
	Disturbance of transmission	Radio, TV and telecommunication signals	Long term, area taken up by the wind farm

Source: Maritime Institute in Gdańsk after: Stryjecki, Mielniczuk and Biegaj [2011].

Table 9.7 indicates that the largest number of impacts of offshore wind farms is on natural environment. But building of wind farms means also that many other forms of sea space use become excluded (maybe except mariculture). This is the source of conflict with fishery, navigation, mining of aggregates and hydrocarbons, and with national defence (exercise areas, Navy fairways). The farms should not be located in areas with dumped ammunition and dredged spoil dumping sites, though this statement is a kind of truism. Some conflict could appear with respect to water sports, linear infrastructure, underwater historical heritage, mineral resource exploration and aviation; but solutions minimising the conflicts and synergic connections (e.g. common programs of sea bottom investigations including cultural heritage, mineral resources and power production, common infrastructural corridors) are also possible. Conflict with ports, roadsteads and bathing areas is quite hypothetical in Polish sea areas because by law location of wind farms is allowed only in the EEZ. At present there are no wind farms in Polish sea areas, therefore assessing the effect of the above conflicts with other users is rather difficult. Only a few papers on the subject have been published in Polish literature, and they base on experience of other countries.

During the open debates, much attention was given to the conflict between wind farms and fishery. Analysis of the influence of offshore wind farms on catch volume [Andrulewicz et al, 2013], carried out on the assumption that all submitted applications for wind farms will be realised, and using the value of catch in 2011, indicated a potential loss to fishery of about 10 mln PLN per year (about 5% of value of total catch). The decrease of value of catch in the area taken up by wind farms should be treated as the highest hypothetical cost/loss of fishery resulting from closing the area to fishing. Taking into account that fishing activities will transfer to other areas, the actual loss may be indicated by the difference between the productivity of the excluded area and of the area onto which the fishing fleet will transfer its activities [ibid].

For the needs of this Study, calculations of losses to fishery were carried out again in more detail, taking into account concrete sea areas to be taken up by offshore wind farms. The value of catch in "fishing squares" was calculated on the basis of FMC data for 2013. The losses were calculated only for the squares in which potential investment is planned (assuming maximum extension of the investment, i.e. that 100% of areas for which permissions for wind farms have been issued will be covered by the farms) (Fig.9.1).

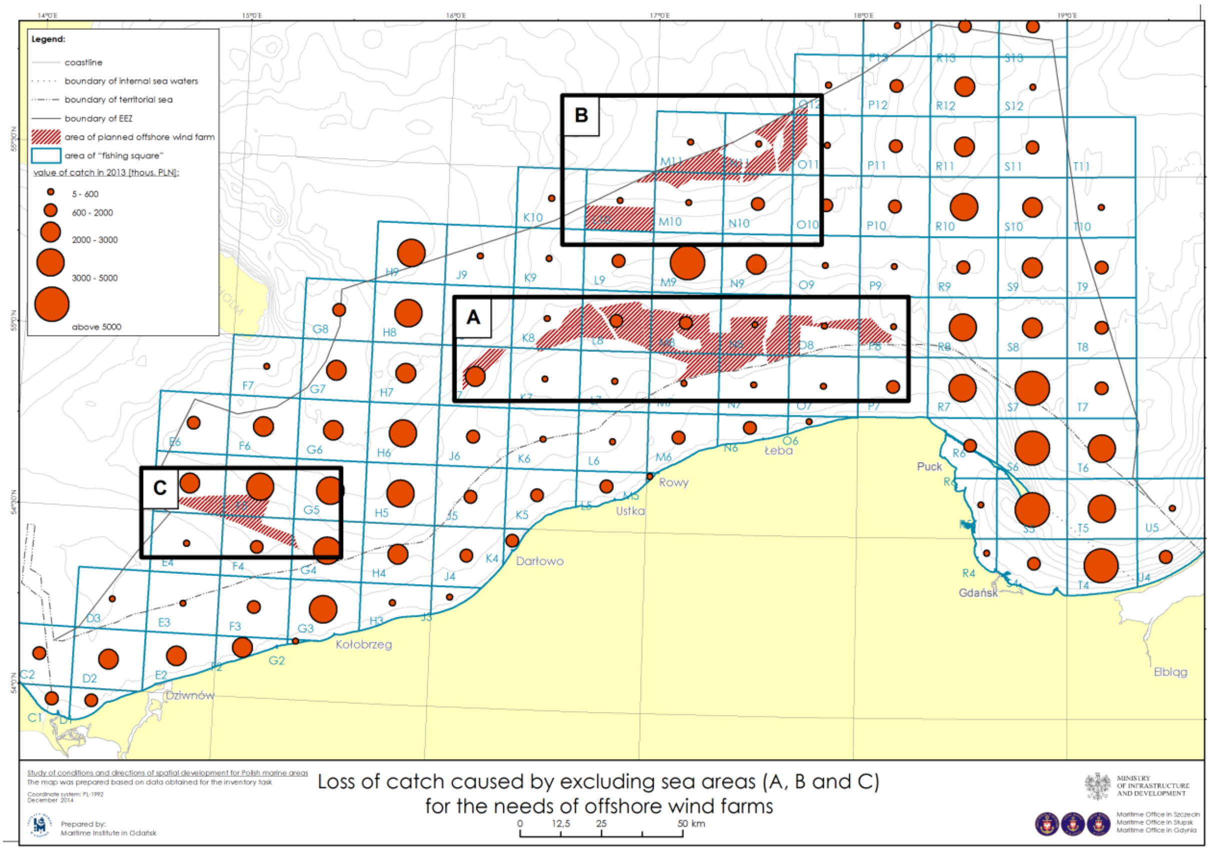

Fig. 9. 1. Loss of catch caused by excluding sea areas (A, B and C) for the needs of offshore wind farms
Source: Maritime Institute in Gdańsk.

Analysis was carried out using AIS data. The number of passages of fishing vessels through each fishing square was calculated (in a 250 m raster), and separately these parts of the squares which could be potentially taken up by wind farms and therefore excluded from fishing activities. For each of the squares percentage of participation of fishing vessels' activity in the area potentially excluded by wind farms activity with respect to activity in the whole fishing square, and in this way the potential loss of value catch was obtained. Separate calculations were made taking into account only the area loss factor (participation of the surface taken up by offshore wind farms in the whole surface of fishing square). Results of the analysis are shown in Table 9.8.

Table 9.8. Potential loss of catch value resulting from exclusion by OWFs

Area	Catch value (thous. PLN)	Loss (thous. PLN)	
		by surface	by activity
Area A	11 297.03	1518.82	971.88
Area B	6193.29	1567.94	1727.27
Area C	2485.15	331.65	266.86
Total (A+B+C)	19 975.47	3418.40	2966.01
Total (Polish sea areas)	165 653.18	x	x
Loss (%) re. A+B+C	x	**17.11 %**	**14.85 %**
Loss (%) re. Polish sea areas	x	**2.06 %**	**1.79 %**

Source: Maritime Institute in Gdańsk basing on FMC data.

The difference between the two variants of calculation is small. However, such analysis is burdened by errors which should be eliminated in more detailed analyses. The analysis does not take into account the time of stay of a vessel in the hunting ground and the type of activity (fishing tools used, etc.). It is based on the volume of catch, not on the fishing productivity of the squares. The improved calculations should also use VMS data, which are dedicated exclusively to fishing vessels.

Conflict with power production from waves is very hypothetical. It is difficult to expect that this form of power production will develop much in the near future because of the relatively low wave energy potential in Polish sea areas. New technical solutions could change this situation, and then a new conflict and synergy assessment will have to be carried out. It seems that in the present situation, devices/installations using wave energy for power production may be only a supplement of port infrastructure or coastal protection structures. This is why synergy is indicated in these relationships.

Main spatial conflicts related to fishery

In expert opinion, fishery is in conflict with wind farms, mining (a weaker conflict with exploration and investigation of mineral resources), dumping of waste and ammunition, mariculture and underwater cultural heritage (Table 9.9). The nature of these conflicts is competition for sea space. Additionally, in the case of wind farms, their effect on good state of fish is not known. The health of fish could be endangered by mariculture (fish farms). Some water sports (e.g. powerboating) could decrease fish welfare, but data on this are lacking. Yachting and windsurfing could, to a limited extent, be in conflict with passive fishing. The scale of conflict depends on the intensity with which both types of activities use a sea space. In case of underwater historical heritage, apart of conflict (loss or damage of nets) there is also synergy – wrecks form artificial reefs which facilitate biological diversity. Also ports show both conflict and synergy. Building of a port in the sea excludes that area from industrial fishing (at least with some tools). On the other hand, ports and havens are the main logistic base for fishermen and an attractive place for anglers. In this case synergy dominates over conflict. Some conflicts can be reduced. For example pelagic fishing does not collide with dumping of dredged spoil provided that the two activities take place at different times. Other conflicts are limited to one type of fishing (e.g. trawling and linear infrastructure, or competition for space between passive fishing and bathing areas), while collecting linear infrastructure into carefully routed corridors can reduce the scale of these conflicts. With respect to navigation, the conflict concerns fairways (fishing is prohibited in the fairways).

Coastal protection can result in temporal (during the time of construction) limitation of passive fishing, while active fishing close to the coast is forbidden (therefore a hypothetical conflict, or neutral situation).

Table 9.9. Conflicts and synergies related to fishery – assessment by authors of the Study

SECTOR		Power production			Offshore mining			Fishery			Linear infrastr.		Navigation	Ports		Tourism			Underwater cultural heritage	National defence			Civil aviation	Coastal prot.		Mariculture	Dumping sites	
		waves	thermal*	wind	aggregate	oil & gas exploration	oil & gas extraction	passive	near-bottom	pelagic	cables	pipelines		port area	roadsteads, fairways	bathing areas	water sports	diving		exercise areas	Navy fairways	aviation		hard	soft		dredged spoil	ammunition
Fishery	passive	?	?	3 ?	3	2	3	x	1	1	?	?	1	3/-1	3/-1	3	2	0	3/-1	1	?	0	0	2	1	3	3	3
	nearbottom	?	?	3 ?	3	2	3	1	x	0	3	3	1	3/-1	3/-1	0	1	0	3/-1	1	?	0	0	0	0	3	3	3
	pelagic	?	?	3 ?	3	2	3	1	0	x	0	0	1	3/-1	3/-1	0	1	0	1/-1	1	?	0	0	0	0	3	1	0

Explanations:

-1 – synergy
2 – high conflict
0 – no conflict
1 – medium conflict
3 - exclusion
? – experts were not able to assess the scale of conflict or synergy

* mainly cooling water systems

Source: Maritime Institute in Gdańsk on the basis of report of MIR-PIB.

Main spatial conflicts related to linear infrastructure

Cables and pipelines are in potential conflict with dumping areas, bathing areas, underwater cultural heritage and aggregate mining, and probably with power production from waves (hypothetical conflict, especially with respect to pipelines). They can be an obstacle (catching of anchors, nets) to nearbottom fishing, navigation, national defence, which last can in turn be a danger to the infrastructure during army exercises. Cables are a synergic element with respect to offshore power production (just as pipelines with respect to extraction of hydrocarbons), but lack of order in their arrangement decreases the area which can be designated for offshore wind farms. The main conflict is with coastal protection, since the most sensitive issue is the landing of linear infrastructure in such a way and location that natural coastal dynamics are not disturbed and at the same time that these processes do not endanger the infrastructure. To a large extent this conflict is mitigated by technical progress allowing installation of cables and pipelines deep in the soil, without disrupting the surface structures. The intensity of conflicts related to linear infrastructure is shown in Table 9.10.

Table 9.10. Conflicts and synergies related to linear infrastructure – assessment by authors of the Study

SECTOR		Power production			Offshore mining			Fishery			Linear infrastr.		Navigation	Ports		Tourism			Underwater cultural heritage	National defence			Civil aviation	Coastal prot.		Mariculture	Dumping areas	
		waves	thermal*	wind	aggregate	oil & gas exploration	oil & gas extraction	passive	near-bottom	pelagic	cables	pipelines		port area	roadsteads, fairways	bathing areas	water sports	diving		exercise areas	Navy fairways	aviation		hard	soft		dredged spoil	ammunition
Linear infrastructure	cables	1	2	2/-1	3	2	1	?	3	0	x	2	1	1	1	3	?	?	3	1	1	0	0	3	1	1	3	3
	pipelines	3	2	2	3	2	1/-1	?	3	0	2	x	1	1	1	3	?	?	3	2	1	0	0	3	1	1	3	3

Explanations:

-1 – synergy
2 – high conflict
0 – no conflict
1 – medium conflict
3 - exclusion
? – experts were not able to assess the scale of conflict or synergy

* mainly cooling water systems

Source: Maritime Institute in Gdańsk

Main spatial conflicts related to navigation and ports

There is an exclusion relationship between ports and navigation (though this could depend on the nature of the navigation) and areas of wind farms and offshore mining (closed areas), though both types of sea area use stimulate navigation and development of local ports. In the light of Polish law this conflict is hypothetical (potential) since offshore mining and offshore wind farms cannot be located in the areas of ports, roadsteads and fairways. The same applies to mariculture, it puts limitations on navigation, it is not possible in ports, but it can stimulate their development. Ports and navigation are also a certain difficulty to linear infrastructure (require bringing order to its routing). In ports and in areas of intense vessel traffic sport diving and bathing are impossible, also other water sports face some impediments. On the other hand, these sports and recreational diving have a positive influence on the development of many local ports (synergy) In areas of dumping of dredged spoil limitations on navigation of larger vessels may be required, while dumped ammunition is a general danger to navigation, especially anchoring. Storage (dumping) of dredged spoil is not possible in port areas (with the exception of planned land reclamation), roadsteads and fairways (this exclusion is a truism), but thanks to these dredged spoil dumping sites deepening and/or maintenance of the ports and approaches is at all possible (synergy). Military exercise areas are temporarily or permanently closed to navigation. It is self-evident that fishing (at least some types of it) cannot be carried out in the areas of ports, roadsteads and fairways, and a port cannot be a mining area or military exercise area. But the same ports are the base for fishermen, offshore miners and Navy (synergy). Synergies and conflicts related to navigation and ports are shown in Table 9.11.

Tab. 9.11. Conflicts and synergies related to navigation and ports – assessment by authors of the Study

SECTOR		Power production			Offshore mining			Fishery			Linear infrastr.		Navigation	Ports		Tourism			Underwater cultural heritage	National defence			Civil aviation	Coastal prot.		Mariculture	Dumping sites	
		waves	thermal *	wind	aggregates	oil & gas exploration	oil & gas extraction	passive	near-bottom	pelagic	cables	pipelines		port area	roadsteads, fairways	bathing areas	water sports	diving		exercise areas	Navy fairways	aviation		hard	soft		dredged spoil	ammunition
Navigation		?	3	3/1?	3/2?	3	3	1	1	1	1	1	x	0	-1	1	1	3	0	3	0	0	0	0	0	3	3	3
Ports	port area	?	3	3/-1	3/-1	3	3/-1	3/-1	3/-1	3/-1	1	1	-1	x	-1	2	1/-1	3/-1	?	3/-1	1	0	0/-1	2	2	3/-1	3/-1	0
Ports	roadsteads, fairways	?	3	3	3	3	3	1	1	1	1	1	-1	-1	x	0	2	3	3	3	1	0	0	0	0	3	3/-1	0

Eplanations:

-1 – synergy
2 – high conflict
0- no conflict
1 – medium conflict
3 - exclusion
? - experts were not able to assess the scale of conflict or synergy

* mainly cooling water systems

Source: Maritime Institute in Gdańsk.

Main spatial conflicts related to underwater cultural heritage and tourism

Synergies and intensity of conflicts related to underwater cultural heritage (UCH) are shown in Table 9.14. There is an exclusion relationship with thermal power production, bathing areas, aggregate mining, mariculture and dumping of dredged spoil. UCH is endangered especially by nearbottom fishing (but also to some degree by other forms of fishing), navigation (anchoring), water sports and any kind of works involving disturbance of the sea bottom, e.g. wind farms, hydrocarbon extraction, linear infrastructure, development of ports, or even coastal protection works. The nature of these conflicts is explained in Table 9.12. There is synergy with diving, which develops when exploration of wrecks is permitted. This in turn facilitates development of some local ports (synergy).

Table 9.12. Underwater cultural heritage – main conflicts (risks) resulting from human activities

Sector	Character of conflict
Navigation	Obstruction to navigation, especially in shallow-water areas
Fishery	Damaging of wrecks by trawling Remnants of nets entwining the wrecks
Water sports	Uncontrolled diving, stealing, damaging
Offshore mining	Risk of damage during exploration
Power production	Risk of damage during preinvestment investigations
Aggregate mining	Destroying artefacts of Stone Age settlements
Coastal protection	Destroying of remnants of submerged settlements and of underwater landscapes
Pipeline and cable laying	Destroying of wrecks, remnants of submerged settlements and of underwater landscapes
Development of port infrastructure	Destroying of wrecks and historic hydrotechnic structures

Source: Maritime Institute in Gdańsk.

Synergies and intensity of conflicts related to marine tourism are shown in Table 9.14. With the exception of beach nourishment, within bathing areas other forms of economical human activity are impossible. However, this is no problem because bathing areas take up only a very narrow strip of sea waters close to the coastline, and in practical terms locating mariculture, dumping of ammunition or extracting hydrocarbons in this strip is unimaginable. Therefore most of the conflicts are of hypothetical character. Significant conflicts, and also synergies (in case of beach nourishment), may appear in relation to coastal protection works. There is a conflict with offshore wind farms which can spoil the landscape, also with mining of aggregates too close to a bathing area. However, because of limitations imposed by law, these are hypothetical situations. Bathing areas may be endangered by large ports, because development of the ports may be at the expense of neighbouring bathing areas. Water sports (e.g. quick motorboats) can be dangerous to bathers; for this reason coexistence of these two forms of sea space use requires enforcing appropriate regulations. Coastal protection by hard structures can (but does not have to) result in a real conflict if it impedes access to the beach or results in decrease of beach width. Discharge and intake of cooling water for thermal power plants, when located too close to the coast, can be dangerous to the bathing areas. Bathing areas should not be located in areas of underwater historical heritage, or close to military exercise areas.

Similar conflicts pertain to water sports, which are practiced in a slightly wider belt along the coast. Conflict with fishery, mariculture and some military exercise areas and with bathing areas may appear. Diving is not possible in spaces taken up by mariculture, aggregate mining, discharge and intake of cooling water for thermal power plants, areas intensively used for water sports, in roadsteads and intense vessel traffic and in ammunition dumping areas. Diving is impeded in areas of dredged spoil dumping. There is also conflict with fishery (danger to divers). Explanation of most important conflicts is presented in Table 9.13.

Tab. 9.13. Marine tourism – nature of main spatial conflicts

Activity	Sector	Character of conflict
Yachting	Fishery	Abandoned nets, set nets
	Wind farms	Impediment to navigation Potential tourist attraction
	National defence	Areas closed to navigation
	Nature conservation	Frightening of animals,
	Navigation	Roadsteads, fairways
	Coastal protection	Collision with coastal defence
Surfing	Fishery	Entanglement in nets
	Nature conservation	Frightening of animals, destroying of coastal habitats
	Coastal protection	Collision with coastal defence
	Navigation	Roadsteads, fairways excluding surfing
Wreck tourism	Fishery	Danger to divers' life
	Navigation	Roadsteads, fairways excluding wreck diving
	Nature conservation	Frightening of animals, destroying of coastal habitats

Source: Maritime Institute in Gdańsk.

Table 9.14. Conflicts and synergies related to tourism and underwater cultural heritage – assessment of authors of the Study

SECTOR		Power production			Offshore mining			Fishery			Linear infrastr.		Navigation	Ports		Tourism			Underwatercultural heritage	National defence			Civil aviation	Coastal prot.		Mariculture	Dumping sites	
		fwaves	thermal*	wind	aggregates	oil & gas exploration	oil & gas extraction	passive	near-bottom	pelagic	cables	pipelines		port areas	roadsteads, fairways	bathing areas	water sports	diving		exercis areas	Navy fairways	aviation		hard	soft		dredged spoil	ammunition
Underwater cultural heritage		?	2	2	3	?	2	2	3	2	2	2	1	2	2	3	2	-1	x	?	0	0	0	1	0	3	3	?
Tourism	bathing areas	3	3	3	3	3	3	3	3	3	1	1	3	3	2	x	1	1	3	3	0	0	0	2	2/-1	?	0	3
	water sports	3	3	2	2	1	3	2	2	2	1	1	3	3	3	2	x	3	1	3	2	0	0	2	2	3	0	2
	diving	?	3	?	3	2	?	2	2	2	1	1	2	?	3	2	3	x	-1	?	2	0	0	0	0	3	2	3

Explanations:

-1 – synergy
2 – high conflict
0 – no conflict
1 – medium conflict
3 - exclusion
? - experts were not able to assess the scale of conflict or synergy

* mainly cooling water systems

Source: Maritime Institute in Gdańsk.

Main spatial conflicts related to national defence and civil aviation

In its present shape, civil aviation does not generate conflicts in the sea areas. But location of a new airport could result in conflict with bird protection. Military exercise areas and Navy fairways exclude, for the time of their closing, all other forms of sea space use, and permanently – forms of use for which structures and installations are necessary (extraction of hydrocarbons, power production, mariculture), with the exception of coastal protection. Military exercises can be dangerous to cables and pipelines, and even to underwater cultural heritage. On the other hand, since other forms of sea use are excluded from the exercise areas, underwater cultural heritage present in these areas comes under special protection (synergy). Temporal closing to fishery of sea areas for military needs may give rise to conflict, especially when use for fishing needs of other, previously accessible sea areas becomes impossible. Conflict with ports and bathing areas is rather hypothetical, and in the case of ports there is also synergy (ports as the base for the Navy). Military aviation is in conflict only with wind farms (flights at low altitudes) and with civil aviation. The synergies and intensity of conflicts related to national defence is shown in Table 9.15.

Table 9.15. Conflicts and synergies related to national defence and civil aviation – assessment of authors of the Study

SECTOR		Power production			Offshore mining			Fishery			Linear infrastr.		Navigation	Ports		Tourism			Underwater cultural heritage	National defence			Civel aviation	Coastal prot.		Mariculture	Dumping sites	
		fwaves	thermal*	wind	aggregates	oil & gas exploration	oil & gas extratction	passive	near-bottom	pelagic	cables	pipeline		port areas	roadsteads, fairways	bathing areas	water sports	diving		exercise areas	Navy fairways	aviation		hard	soft		dredged spoil	ammunition
National defence	exercise areas	1	?	2	1	1	2	2	2	2	1	1	2	3/-1	3	2	?	?	1 /-1	x	0	0	0	0	0	3	?	?
	Navy fairways	3	3	3	2	2	3	2	2	2	1	1	1	?	?	0	2	?	?	0	x	0	0	0	0	3	?	?
	aviation	0	?	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	x	1	0	0	0	0	0
Civil aviation		0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	x	0	0	0	0

Explanations:

-1 – synergy
2 – high conflict
0 – no conflict
1 – medium conflict
3 – exclusion
? – experts were not able to assess scale of conflict or synergy

* mainly cooling water systems

Source: Maritime Institute in Gdańsk

Main spatial conflicts related to dumping and mariculture

Dumped ammunition is in conflict with all ways of using sea areas except aviation. Dumping of dredged spoil excludes other forms of sea use (among others wind farms, cables, navigation routes, parts of sea used especially intensively by fishermen, areas of sand and gravel extraction). There are exceptions from this rule such as some forms of fishing or water sports. There may be synergy with coastal protection and, already earlier mentioned, with ports. In case of bathing areas interactions are not unequivocal. In some cases beaches may be rebuilt, in other beach reduction may occur.

Mariculture is not possible in direct vicinity of thermal plants' cooling water intakes and discharges, in port basins (hypothetical conflict), in areas of intense vessel traffic, underwater cultural heritage, dredged spoil dumping, bathing areas and in areas with high intensity of water sports. On the other hand, existence of a mariculture operation excludes diving and some forms of fishing. There may be competition for space between national defence and mariculture. Animal mariculture may be in conflict with fishery because it may involve biological risks. There is a potential possibility of a synergic relation with wind farms. The synergies and intensity of conflicts related to dumping and mariculture is shown in Table 9.16.

Table 9.16. Conflicts and synergies related to dumping and mariculture – assessment of authors of the Study

SECTOR		Power production			Offshore mining			Fishery			Linear infrastr.		Navigation	Ports		Tourism			Underwater cultural heritage	National defence			Civil aviation	Coastal prot.		Mariculture	Dumping	
		waves	thermal*	wind	aggregates	oil & gas exploration	oil & gas extraxtion	passive	near-bottom	pelagic	cables	pipelines		port areas	roadsteads, fairways	bathing areas	water sports	diving		exercies areas	Navy fairways	aviation		hard	soft		dredhed spoil	ammunition
Dumping	dredged spoil	1	?	2	1	1	2	2	2	2	1	1	2	3/-1	3	2	?	?	1	x	0	0	0	0	0	3	?	?
	chemical ammunit.	3	3	3	2	2	3	2	2	2	1	1	1	?	?	0	2	?	?	0	x	0	0	0	0	3	?	?
Mariculture		1	3/-1	-1	3	0	0	1	3	1	0	0	3	3	2	3	3	3	3	2	2	0	0	1	0	x	3	3

Explanations:

-1 – synergy

1 – medium conflict

2 – high conflict

3 – exclusion

0 – no conflict

* mainly cooling water systems

Source: Maritime Institute in Gdańsk.

Main spatial conflicts related to coastal protection

Improving safety of highly invested coastal land may require building hard coastal defences, which may generate conflict in the intensely used strip of coastal waters. The following negative effects may occur along a coast protected by hard coastal protection systems:

- deepening of coastal profiles and local bottom erosion, which, together with generated current systems, are dangerous to bathers,
- decrease of water and sand quality in stagnation areas between accumulation forms,
- impediments to water sports,
- transformation of natural landscapes.

Conflicts are with:

- aggregate mining – possible negative influence on the state of the coastal zone if mining is located too close to the coast,
- access infrastructure to ports – apparent conflict due to generation of disturbances in sediment transport and therefore sediment balance in the coastal zone,
- linear infrastructure crossing the coast (disturbance of coastal morphodynamics),
- tourism – water sports, bathing near hard structures located in the nearshore zone (especially island breakwaters and submerged sills).

There is no conflict between the recreation functions of the seashore and beach nourishment — rebuilding of the beach, dune and foreshore by artificial nourishment (preferred method of controlling erosion) does not conflict with recreation functions of the coast.

Submerged sills and artificial reefs, apart of their protection functions, are a danger to bathers and water sports, also to fishermen. They must be well marked, or the area has to be closed to other uses. The positives are that the quality of beaches and landscapes is maintained since the sills and reefs are not visible to people on the beach.

Seawalls are a hindrance to recreation and communication and can sometimes be dangerous to people on the beach (e.g. rubble or tetrapod mounds). They are an artificial barrier spoiling the natural coastal landscape. Seawalls can cause reduction of beach along the structure up to its complete disappearance (Jarosławiec and Niechorze) and development of erosion bays in their immediate neighbourhood. The result is reduction of recreational capacity of the beaches.

Additionally, requirements of safety are often in conflict with nature conservation, which requires that natural processes should remain undisturbed along possibly longest stretches of coastline. This conflict is strengthening with increasing risk of erosion and storm surge flooding of stretches of coast with high social, economical and natural value. The synergies and intensity of conflicts related to coastal protection are shown in Table 9.17.

Table 9.17. Conflicts and synergies related to coastal protection – assessment of authors of the Study

SECTOR		Power production			Offshore mining			Fishery			Linear infrastr.		Navigation	Ports		Tourism			Underwater cultural heritage	National defence			Civil aviation	Coastal prot.		Mariculture	Dumping sites	
		waves	thermal*	wind	aggregates	oil& gas exploration	oil & gas extraction	passive	near-bottom	pelagic	cables	pipelines		port area	roadsteads, fairways	bating areas	water sports	diving		exercise areas	Navy fairways	aviation		hard	soft		dredged spoil	ammunition
Coaastal prot.	hard	?	?	0	1	0	0	2	0	0	1	1	0	2	0	2	2	?	-1/0	0	0	0	0	x	0	0	1	0
	soft	?	?	0	1	0	0	1	0	0	1	1	0	2	0	0	0	0	0	0	0	0	0	0	x	0	1	0

Explanations:

-1 – synergy

1 – medium conflict

2 – high conflict

3 – exclusion

0 – no conflict

? – experts were notable to assess the scale of conflict or synergy

* mainly cooling water systems

Source: Maritime Institute in Gdańsk.

Assessment of impact of various forms of sea space use on nature and natural environment

For some enterprises/activities law requires that, before issuing an appropriate permission, an EIA procedure is carried out, which should be based on realistic premisses and detailed information on the state of environment at the site of the enterprise, proposed techniques and about the area in which the enterprise is to be realised, etc. At the present stage the assessment is demonstrative only. Potential risks to elements of biocenosis resulting from the various forms of sea space use are described in Chapter 3. Table 9.18 presents a summary of potential conflicts (defined as potential impact of threat character) between conservation of nature and marine ecosystem and the forms of sea space use. These conflicts may be spatially variable.

Such economical activities as aggregate mining, linear infrastructure, dredged spoil dumping, some methods of fishing, etc. are a direct threat to the benthic organism systems because they destroy or change the natural sea bottom habitats.

Main threats to ichthyofauna are connected with: investments at sea which may directly destroy fish habitats (e.g. wind farms, pipelines), sea transport, exploitation of ichthyofauna resources.

The most important threats to avifauna come from building wind farms in migration routes of birds, by-catch in fish-nets and scaring of birds by intensive tourism (including development of infrastructure, e.g. marinas, high speed vessels).

Threats to marine mammals in the Polish part of the Baltic Sea come from disturbance of peace and safety in habitats (terrestrial and marine); bycatch is an important threat to porpoises, i.e. accidental death in fishing tools.

Significant threats to all elements of biocenosis come from indirect impacts related to changes in the food base and to eutrophication, and also climate changes and fluctuations influencing the state of environment.

Table 9.18. Potential conflicts related to nature conservation caused by human use of sea space – assessment of authors of the Study

SECTOR/ elements of biocenosis		Power production	Offshore mining			Fishery	Linear infrastr.		Navigation	Ports		Tourism			Underwater cultural heritage	National defence		Civil aviation	Coastal protection	Mariculture	Dumping sites	
			aggregates	oil & gas exploration	oil & gas extratction		cables	pipelines		port areas	roadsteads, fairways	bathing areas	water sports	diving		exercise areas	Navy fairways				dredged spoil	ammunition
Benthos	phytoben.	x	x			x	x	x			x	x							x		x	x
	zoobenthos	x	x			x	x	x			x								x		x	x
Ichthyofauna		x	x			x		x			x					x			x	x	x	x
Avifauna		x	x	x	x	x			x	x	x	x	x			x			x	x	x	x
Marine mammals	seals	x	x	x	x	x			x	x	x	x	x			x	x		x	x	x	x
	porpoises	x	x	x	x	x			x	x	x		x			x	x			x	x	x

Explanations:

x – potential impact

Source: Department of Ecology of Wates of the Maritime Institute in Gdańsk

9.3. Areas with high conflict

Spatial analysis of discussed above conflicts – superpositioning of the various forms of sea space use (Fig. p.2) and the knowledge resulting from the synergy and conflict matrixes allows distinguishing areas in which the conflicts are especially strong. These are:

- Gulf of Gdańsk – conflicts between environment protection, coastal and marine tourism (mainly water sports), linear infrastructure (mainly gas pipeline), navigation, ports, coastal protection, fishery and military areas;
- Pomeranian Bay – conflicts between environment protection, coastal tourism (mainly yachting), national defence, pipelines (planned gas pipeline), navigation, ports, and, to some extent, fishery;
- Coastal waters between Władysławowo and Darłowo – conflicts between fishery and linear infrastructure (mainly trawling and location of cables of the external infrastructure connecting wind farms to national power grid), environment protection and nature conservation (closed area of the Słowinski National Park), national defence, navigation, offshore wind farms, water sports, potential site of thermal power plant;
- Sea basins designated for offshore wind farms – because of issues of connection, need to provide safe routes for fishing vessels, need to indicate temporary, final and alternative (in case it is finally decided not to build the OWF) functions, potential development of offshore mining (additional linear infrastructure, coexistence with OWFs).

In order to have a full picture of the conflicts, Fig. 9.2 should be viewed together with maps showing the value of sea space and indicating areas valuable for separate elements of biocenosis. Fig. 9.2 does not show fishing areas and important routes leading to them, as well as investment plans of coastal municipalities and ports, since the obtained picture would be unreadable. Also presently non-existent ways of sea use (e.g. mariculture) are not shown. These will have to be taken into consideration during the preparation of the maritime spatial plan for Polish sea areas. The present Study is only a photograph of the present state and of submitted by interested parties plans for future use of the sea space.

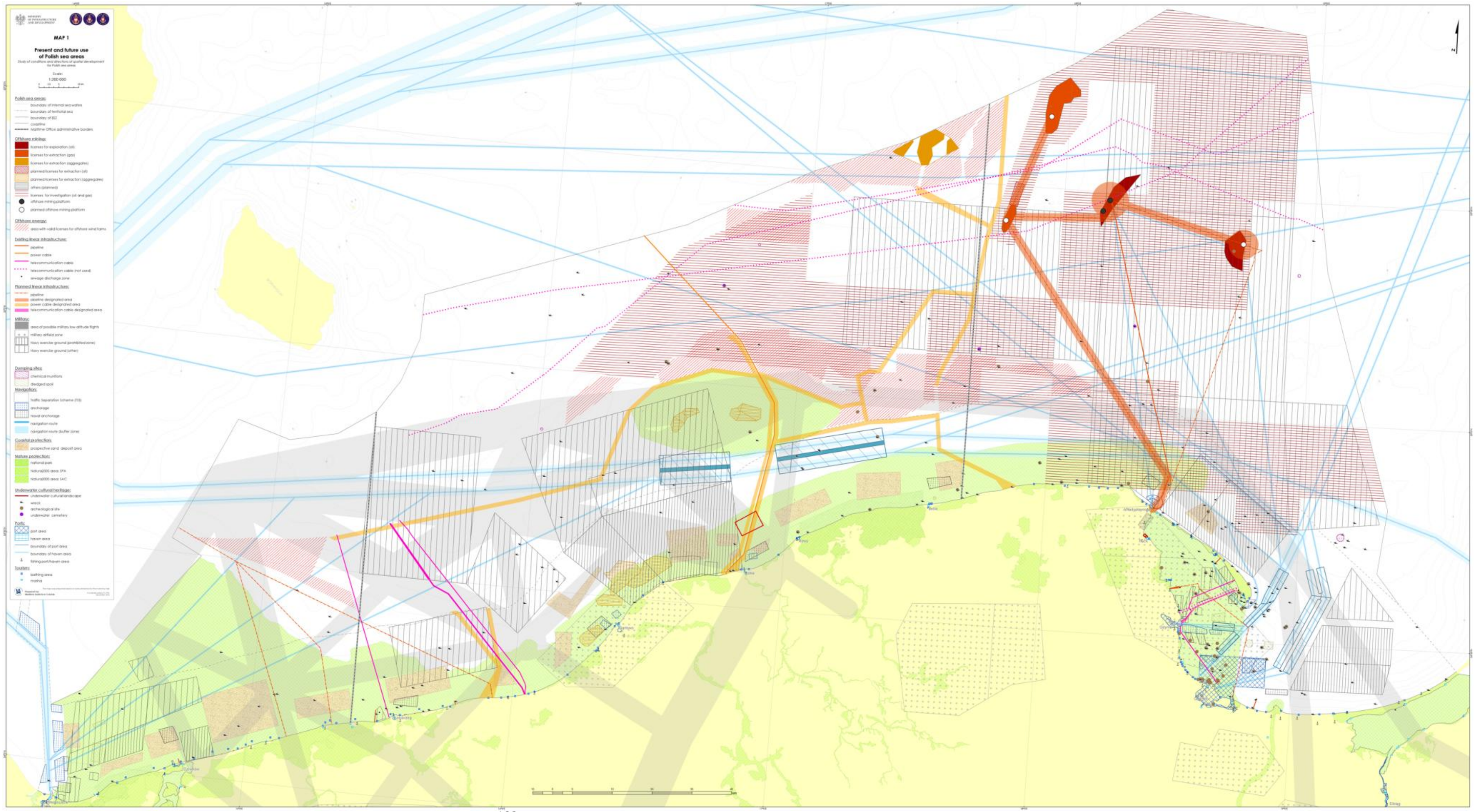

Fig. 9. 2. Superposition of various types of sea space use[102]
Source: Maritime Institute in Gdańsk

[102] Map printed in scale 1:200 000

Conclusions for the maritime spatial plan of Polish sea areas

- During plan preparation special attention should be given to work with stakeholders representing navigation, protection of environment, tourism and coastal protection because they were passive at the Study preparation phase.
- When working with the stakeholders, sufficient time and work should be given to identification of their plans for using the sea space (a multi-variant and scenario approach is suggested).
- For areas with especially high intensity of conflicts the need to prepare detailed spatial plans should be indicated.
- Sufficient time should be ensured for preparation of GIS based comprehensive maps.

Knowledge gaps:

Lack of knowledge about the influence of structures built in sea areas on fishing productivity;

Lack of reliable knowledge on mariculture (experience with open sea aquaculture near Bornholm should be studied);

Lack of comprehensive knowledge about the assessment of effects of conflicts between wind farms and other users of sea space;

Lack of comprehensive knowledge about the effects of conflicts between thermal power production and other user of sea space;

Lack of knowledge about the scale of danger to avifauna generated by offshore wind farms.

List of abbreviations

AIP — Aeronautical Information Package of the Polish Air Navigation Services Agency

AIS — Aeronautical Information Service of the Polish Air Navigation Services Agency

AMSL — Above Mean Sea Level —absolute height above mean sea level

ARMA — Agency for Restructuring and Modernisation of Agriculture

BCT —Baltic Container Terminal

BDA — bottom depth anomaly

BEMIP — The Baltic Energy Market Interconnection Plan — an action plan for interconnection of the Baltic Energy Market for Gas

BIAS — Baltic International Acoustic Survey

BITS —Baltic International Trawl Survey

BPI — Bulletin of Public Information

BSPA — Baltic Sea Protected Areas (HELCOM)

CCS —Carbon Capture and Storage

CEIP – Chief Inspectorate of Environmental Protection

CFP — The Common Fisheries Policy

CLC —Corine Land Cover

CLP – Coastal Landscape Park

CPUE — Catch Per Unit Effort

DCMP — Data Collection Multiannual Programme for Fisheries

DCT — Deepwater Container Terminal Gdańsk

EC — European Comunity

ECONET-PL — national ecological network

EEA —European Economic Area

EEC — European Economic Community

EEZ — Exclusive Economic Zone

EIA – Environmental Impact Assessment

EU —European Union

EUNIS — European Nature Information System

ETC — European Territorial Cooperation

FAO — Food and Agriculture Organisation of the United Nations

FMC — Polish Fisheries Monitoring Centre

GCT — Gdynia Container Terminal

GES — Good Environmental Status

GMDSS — Global Maritime Distress and Safety System

GNS - Set (anchored) gill nets

GT - Gross Tonnage

HELCOM – Baltic Marine Environment Protection Commission

HOPN — Hydrographic Office of the Polish Navy

H/V MSP WG – Joint Working Group of HELCOM and VASAB for Maritime Spatial Planning in the Baltic Sea

IBA — Important Bird Areas

ICES — International Council for the Exploration of the Sea

ICZM — Integrated Costal Zone Management

IMO — International Maritime Organization

IPCC — Intergovernmental Panel on Climate Change

ISOK - IT System of the Country's Protection against Extreme Hazards

ITI — Integrated Territorial Investment

JoL – Journal of Laws

LDB — Local Data Bank of the Main Statistical Office
LFSC – Local Fish Sales Centre
LNG – Liquefied Natural Gas
MA&RD – Ministry of Agriculture and Rural Development
ME — Ministry of Economy
MERCW - international project “Modelling of Environmental Risks related to sea-dumped Chemical Weapons”
MFIS — Marine Fisheries Information System
MI&D – Ministry of Infrastructure and Development
MIR- BIP - National Marine Fisheries Research Institute
MND-RP – Ministry of National Defense Republic of Poland
MPG – Marne Power Grid
MPSS – Main Power Supply Station
MRT – Low Flying Military Training Routes
MSFD — Marine Strategy Framework Directive
MSP – Maritime Spatial Planning
MTC&ME – Ministry of Transport, Construction and Maritime Economy
NACE – Statistical classification of economic activities in the European Community
NATO – North Atlantic Treaty Organization
NATURA 2000 – NATURA 2000 network – EU-wide network of nature protection areas
NEM – National Environmental Monitoring
NMM — National Maritime Museum
NPS – National Power System
NREAP – National Renewable Energy Action Plan
NSDC – National Spatial Development Concept
NTS – Nomenclature of Territorial Units for Statistics (NUTS)
OWF – Offshore Wind Farm
PAR - Photosynthetically active radiation
PAS – Polish Academy of Sciences
PERN - PERN "Przyjaźń" S.A. - Oil Pipeline Operation Company "Przyjaźń"
PGE - PGE Capital Group – Polish power generation and distribution capital group
PGI-NRI – Polish Geological Institute – National Research Institute
POWES — Polish Offshore Wind Energy Society
PSE — Polish Power Grid Company
PSU — Practical Salinity Unit
PTBA — Polish Trout Breeders Association
PZW — Polish Angling Association
RES – Renewable Energy Sources
RL Pl – Polish Red List
RSFI – Regional Sea Fisheries Inspectorate
RUAS — Record of underwater archaeological sites
SBWA — South Baltic Wind Atlas
SCI — Site of Community Importance
SDR — Special Drawing Rights defined and maintained by the International Monetary Fund
S-EIA – Socio-Economic Impact Assessment
SESE — Strategy for Energy Security and Environment
SOP — Sectoral Operational Programme
TEC — Treaty Establishing the European Comunity
TEU — twenty-foot equivalent unit — unit of cargo capacity describing capacity of container ships/terminals

TSS — Traffic Separation Scheme
TWH — therawatt hour
UG — University of Gdańsk
UN – United Nations
UNCLOS — United Nations Convention on the Law of the Sea
UNESCO — United Nations Educational, Scientific and Cultural Organization
VASAB — Visions and Strategies Around the Baltic Sea — intergovernmental cooperation in spatial planning and development in the Baltic Sea Region
VMS — Vessel Monitoring System/Service
VTS — Vessel Traffic Service —marine traffic monitoring system
WWF — World Wide Fund for Nature

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