D6.6 Restoration Demo at Vistula Lagoon, Poland

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WP6

Lead beneficiary: IBW PAN

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REST-COAST

Large Scale RESToration of COASTal Ecosystems through Rivers to Sea Connectivity

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Preface

This document illustrates the demo materials and activities by IBW PAN to demonstrate the benefits of Nature restoration in the Polish context of the Vistula Lagoon. The materials were primarily designed to address a variety of target groups, such as local and provincial authorities, environmental protection agencies and NGOs, scientists of various disciplines, journalists, teachers, students, and the general public at large.

The materials range from posters and videos to presentations and educational activities, for active involvement, particularly of young generations and influential business circles. The aim is to raise awareness on the threats of climate change and on the associated potential of large-scale Nature-based Solutions (NbS) for coastal restoration to provide biodiversity (BDV) improvement and ecosystem services (ESS) to curb water pollution, coastal flooding and erosion. These activities are and will be implemented using a top-down strategy of distributing the knowledge from the core professional group (IBW PAN and the Maritime Office in Gdynia (MO) – coastal administration agency with vast competences and jurisdictions) to the target groups mentioned above. For example, the Vistula Lagoon Pilot was demonstrated at the Smart Development Forum (SDF) in October 2023, where we received the award in the Project of the Future category. Here we addressed the business and academic circles. Consequently, we published an article in the top daily journal in Poland (Rzeczpospolita), which holds very high reputation for their impartiality and is read by central, provincial and local politicians and broad professional circles, also those related to climate change and environment protection. The concept of NbS and additional benefits from the project to ESS were particularly underscored during those events.

Summary

This report provides an overview of the restoration activities within the Vistula Lagoon pilot site of the REST-COAST, including a presentation of demonstration activities intended to show how restoration actions contribute to enhancement of biodiversity and mitigation of the impacts of climate change on coastal and riverine ecosystems.
The document is structured to present a comprehensive view of the efforts done in the Vistula Lagoon pilot site, starting with an introductory section that explains the significance of the pilot site and the various benefits of restoration.
The report describes the specific aspects of demonstration activities done in Vistula Lagoon. It covers the production of a restoration demo video, the meetings within our CORE-PLAT, consisting of IBW PAN and MO professionals, the organization of field trip in order to collect sediment samples, participation in the SDF, and preparation of the article in Rzeczpospolita daily.
The core of the document focuses on the demonstration activities themselves, detailing the hands-on restoration actions undertaken, the modelling activities performed, and the pivotal role of the CORE-PLAT.
Finally, the report evaluates the demonstration value of these activities and explores their potential for replication in similar contexts.

List of acronyms

BDV	Biodiversity.
ECSA	Estuarine and Coastal Scientists Association
ESS	Ecosystem services.
IBW PAN	Institute of Hydro-Engineering of the Polish Academy of Sciences.
ICCE	International Conference on Coastal Engineering – the largest conference on coastal engineering organized by the American Society of Civil Engineers on biannual basis
MOs	Maritime Offices – Polish coastal authority agencies; MO in Gdynia is in charge of Vistula Lagoon.
NbS	Nature based solution.
PSU	Practical salinity unit
SDF	Smart Development Forum; a science-policy and science-business interface awarding outstanding scientific projects and businesses so that they gain due recognition in Polish academic and business circles as well as among local and regional politicians/decision makers.

1 Introduction to the Pilot Site

The Vistula Lagoon measures 838 km^2 and has a drainage basin of 23870 km^2, cf. Figure 1. It is a transboundary area with the single inlet (Baltiysk Strait) in the Russian part. The lagoon runs along the SW-NE axis and is ca. 91 km long and about 9 km wide, Różyński et al. 2019. The coastline is about 270 km long, and the volume of water is ca. 2.3 km^3. It is a shallow coastal ecosystem with the average depth of just 2.7 m and the maximum natural depth of 5.2 m at the Russian part the lagoon opposite the Baltiysk Strait. The lagoon is separated from the Gulf of Gdańsk of the Baltic Sea by the Vistula Spit (Figure 2), The Baltiysk Strait inlet is an entrance to Kaliningrad Sea Canal connecting the Kaliningrad harbour with the Baltic Sea. The Vistula Lagoon is a brackish water body with the average salinity 2.5-4.3 PSU in the eastern part, 3.9-5.0 PSU in central part and 1.0-3.4 PSU in the southern part respectively. At the Baltiysk Strait salinity may reach up to 7 PSU. Despite the fact that the lagoon hydrology is mostly controlled by marine water inflow, which is 4.5 times higher than riverine freshwater input, Chubarenko, Margoński 2008; eutrophication is one of the key issues directly related to the large drainage area with dominating agricultural land use. Also, nutrient-rich sediments accumulated due to large past discharges substantially contribute to persisting eutrophication, Różyński et al. (2015a).

Figure 1 Location of the Vistula Lagoon in the Baltic Sea

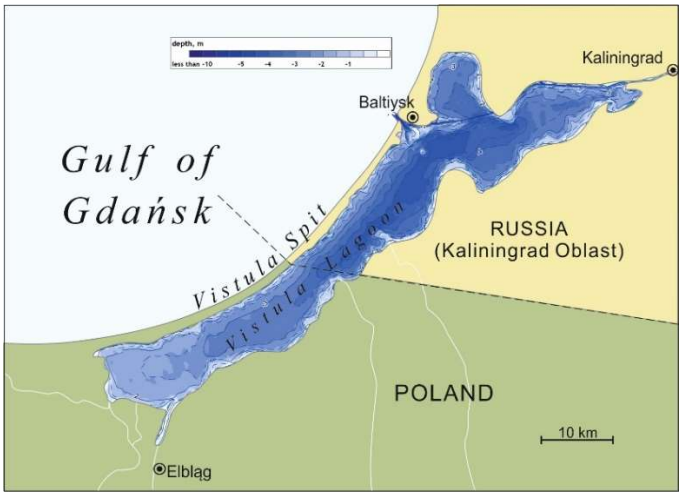


Figure 2 Bathymetry of the Vistula Lagoon

The lagoon faces typical trans-boundary problems, mainly related to divergent legal systems in the EU and Russian Federation. This makes the management of the lagoon difficult, especially during periods of political tensions. The main issue until recently was inequality regarding the access to the Baltic Sea, as the only lagoon inlet was located on the Russian part of the lagoon; currently an independent passage exists on the Polish part of the lagoon as well. The core pilot site is the artificial island that is being filled by the sediment dredged from the lagoon bottom during construction of the passage and the navigation channel to Elbląg city – the largest settlement on the Polish side of Vistula Lagoon. In general, the Vistula Lagoon region (excluding main cities – Kaliningrad and Elbląg) is not densely populated (less than 15 inhabitants per 1 km^2 in rural areas and 15 - 30 in the local municipalities). The economy is generally weak, so management of the lagoon primarily targets the reversal of economic and demographic decline, Różyński et al. (2015b). Hence, our pilot site is promoting an NbS solution vis-a vis this global target, cf. Figure 3.

Figure 3 Pilot site on Vistula Lagoon – artificial island aimed at creation of a bird sanctuary

Increasingly difficult relations with Russia in recent years triggered the construction of an independent passage from the Baltic Sea to the Polish part of Vistula Lagoon, completed in Sept. 2022. The Polish part of the lagoon is a NATURA2000 site, so potential environmental disturbances need to be eliminated and additional possible ecosystem benefits enhanced. This was the main underlying reason to launch the 1st Polish biodiversity restoration project, incorporating the building with nature paradigm. This paradigm was implemented as an artificial island providing habitats for targeted bird species. The new infrastructure required extensive earth works to cut the Spit and dredging operations during and after execution of the project. Therefore, 136 hectares is being filled during the construction phase of the island and the remaining 45 ha will serve as operational sediment storage facility. The main innovation is managed vegetation of the larger part by periodic mowing of planted grasses to foster its colonization by birds targeted for restoration

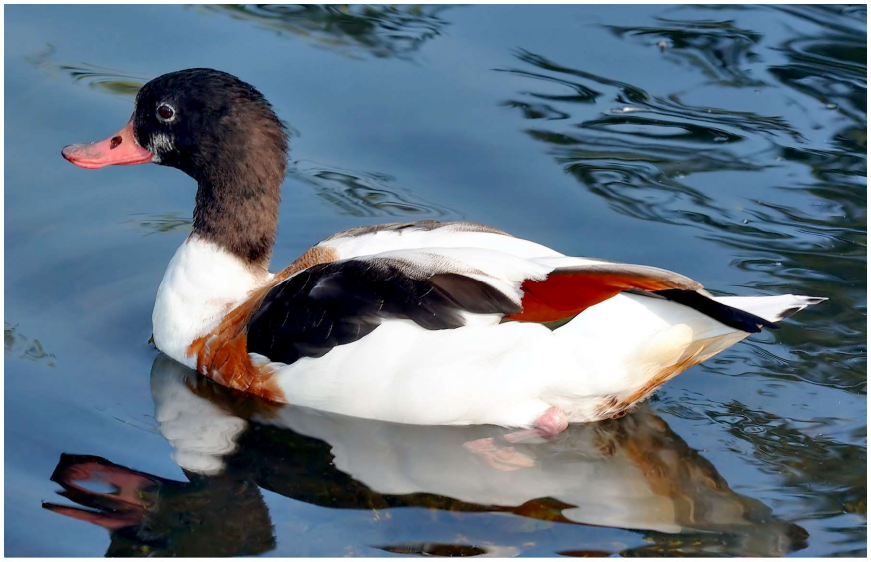
in order to enhance their wellbeing. Hence, shrubs will be eliminated to discourage cormorants – once an endangered species, but nowadays overabundant in the area.

1.1 Expected project impacts

The primary restoration function is the **provision of the resting grounds for ducks** (gadwall, shoveler, widgeon), grey, bean and white-fronted geese, and later the **nesting grounds** for snipe, northern lapwing and redshank, cf. Figure 4. These services will be protected by restricted access to the site, enforced by coastal authorities, and monitored with the assistance and advice of ornithologists. Later, shallow seabed rimming the island's banks will be naturally transformed into a spawning area of important, local fishes (bream, pike perch) by inducing natural appearance of reeds. In this way nature-based solutions are promoted. Development of this spawning ground will be consulted with ichthyologists.

Figure 4. Birds targeted for restoration: bean goose (top left), male northern shoveler (top centre), male and female widgeon (top right), northern lapwing (centre left), greylag goose (mid-centre), redshank (centre right) and snipe (bottom left)

The most ambitious goal that requires additional efforts, far beyond the current project, is the restoration of shelducks. The main obstacle here is creation of underground nesting chambers, See Figure 5, which will become possible after stabilization of sediments on the island – this topic is a subject of investigations in our pilot site as well.



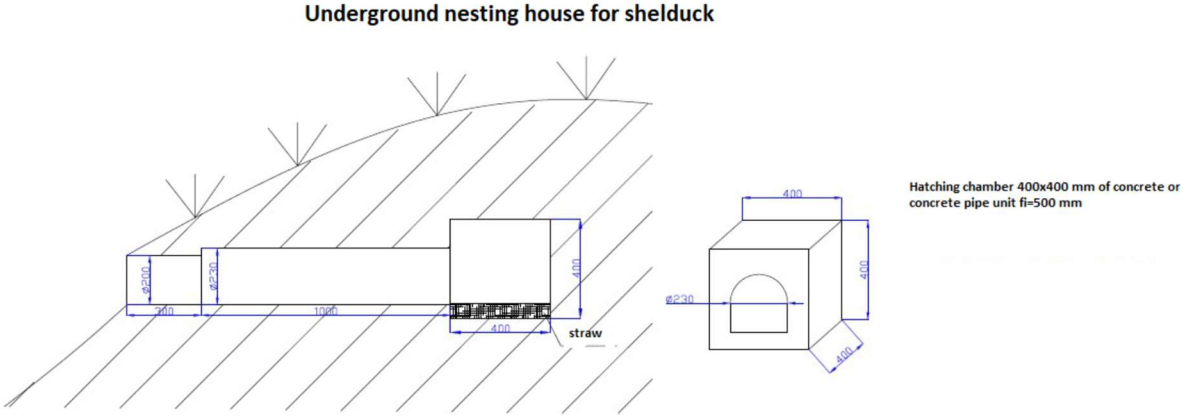


Figure 5 Shelduck – most ambitious and difficult restoration goal (top), nesting house for shelducks, (bottom)

2 Vistula Lagoon demonstrations

The overarching vision of the REST-COAST project in Vistula Lagoon is to gain experience in biodiversity restoration efforts among coastal professionals vis-à-vis the just adopted EU Nature Restoration Law (NRL). Next, we aim at transmission of biodiversity restoration concepts to well informed sectors of the society (business, academia, local and provincial authorities) to form a basis and support for such efforts in Poland in the near future. Finally, we aim at the general public to gain their understanding and support in the implementation of biodiversity policies.
The Vistula Lagoon case is somewhat peculiar with respect to other REST-COAST pilots from the point of view of coastal management. It is related to the very strong position of coastal authorities – the Maritime Office in Gdynia. It stems from early stages of transformation to market economy, when coastal authorities were created under Marine Areas of Poland Act of Parliament in 1991. MOs gained vast competences and jurisdiction in coastal zones, marine internal waters (e.g. lagoons), territorial sea and EEZ. Over years it resulted in accumulation of precious experience related to coastal zone management in local, regional and national scale. Therefore, the CORE-PLAT include the MO and IBW PAN, thus combining practical management and coastal science. The collaboration within CORE-PLAT defines the strategy implemented in Vistula in Lagoon the REST-COAST project, including the restoration video and supplementary activities, described below.

2.1 Restoration demo video

To further enhance the impact of their restoration efforts and to educate a wider audience about the importance of functional coastal ecosystems in climate change mitigation, IBW PAN, in cooperation with Pensoft company, produced a demonstrative video (https://youtu.be/eAFcpSCqxBc) for the Vistula Lagoon pilot site. The video serves as a vital tool for raising awareness among civil society, policymakers, stakeholders, and the educational community at all levels about the project and the general importance of coastal restoration.

Figure 6: Frame from Vistula Lagoon restoration videos, artificial island, still under construction, already supports thousands of birds.

The video features the artificial island under construction, filmed during the annual project meeting in Poland in September 2023. We can see that, despite being still under construction, the island is already serving as a sanctuary for many birds, who enjoy safety in the absence of predatory mammals, (Figure 6). By visually

showcasing these aspects, the video points to the benefits that humans who live in biodiversity-rich environment can enjoy. Thus, we demonstrate that one of the key aspects of high quality of life is the availability of healthy environment, where humans can harmoniously coexist with multiple species of flora and fauna.
The soundtrack of our video contains vital information about the pivotal role of the MO in Gdynia, who are in charge of constructing and operating the island. It illustrates the main approach of coastal management in Poland, where the coastal administration exercises firm jurisdiction thereby enforcing elementary order in the coastal strip and preventing the phenomenon of coastal squeeze, known to be a major obstacle to sustainable coastal management in many countries. Furthermore, their broad competences are used to ensure the goals of EU environmental policies, e.g. sound management of NATURA 2000 sites, Vistula Lagoon being one in terms of both birds and habitats. The soundtrack was consulted with and authorized by IBW PAN and MO in Gdynia.

2.2 Sediment samples

Sediment samples were collected on 19th Jul. 2023 from several locations on the island, known to accommodate sediments from different part of Vistula Lagoon seabed as well as from the Spit. The collection of samples is intended to determine consolidation times of sediments, that is the times required to press out the water from sediment pores. When the water is drained the island will become available for management operations - periodic mowing of grass after the hatching season. The operating procedures, prepared by the MO in Gdynia envisage execution of the mowing between mid-July and mid-August. The examination of consolidation times in soils with large initial moisture content and substantial fraction of fine and organic particles is a long process; it is expected that it will be completed in the first half of 2024. The results will be distributed among the scientists in the form of peer reviewed papers as well as among the practitioners – during future CORE-PLAT meetings, since they contain invaluable information for execution of similar projects in future, incl. up- and out-scaling ventures. This demonstrates clear synergy between scientific and managerial professionals. Figure 7 documents collection of sediment samples: unconsolidated condition of the sediment is clearly visible.

Figure 7 Preparation for (left) and collection of samples (right): very soft condition of soil is clearly visible

2.3 Dissemination activities/events

2.3.1 Smart Development Forum

The Forum is organized annually, it awards outstanding scientific projects and business initiatives so that they gain all-Polish recognition in the scientific and business sectors with outreach to local and regional politicians and policy/decision makers. The Polish pilot site was awarded in the Project of the Future category during the last edition of the Forum, which took place on 19th – 20th Oct. 2023. The Pilot leader gave a presentation about biodiversity restoration context in Vistula Lagoon and hosted a stand at the meeting venue to demonstrate the REST-COAST project to very well-informed public of scientists and business people. In this way biodiversity issues were promoted among very influential sectors of the Polish society.

Figure 8 IBW PAN stand at Smart Development Forum 19-20.10.2023

Figure 8 presents the Pilot leader in front of the stand of IBW PAN during the SDF event, Figure 9 presents the Pilot leader during his presentation on biodiversity restoration in Vistula Lagoon and Figure 10 documents the moment the award was handed to the Pilot leader.

Figure 9 Pilot leader during presentation on biodiversity restoration in Vistula Lagoon at SDF

Figure 10 Pilot leader receives the award in Project of the Future category.

2.3.2 Article in Rzeczpospolita daily

Parallel to SDF the most influential circles of Polish society were addressed by the article published in Rzeczpospolita daily newspaper – a medium having high reputation for their impartiality and commitment to the protection of environment. Importantly, this newspaper is the first source of information for most politicians on local, regional and central level, heads of governmental agencies, academia, people of art, etc. – in brief the groups that shape general views of the society at large. IBW PAN was approached by them to give an interview for their section dealing with innovations. Hence, we were able to transmit key pieces of information related to biodiversity restoration concept in the context of Vistula Lagoon. We underscored the need of biodiversity rich environment in a region, where economic decline is still acute and overcoming of that decline can be only successful taking due respect of the environment, sustained with NbS solutions. Figure 11 presents this article, which was circulated both in traditional (paper) and digital manner. The latter was found particularly interesting, since many recipients could read it just by opening their PCs or smartphones.

L4 | Rzeczpospolita

Rzeczpospolita cyfrowa

Wtorek 30 maja 2023 | cyfrowa.rp.pl

Rzecz O Innowacjach

„Partnerem jest Centrum Inteligentnego Rozwoju"

Wielka wyspa dla ptaków

Międzynarodowe konsorcjum naukowo-badawcze pracuje nad zwiększeniem bioróżnorodności terenów przybrzeżnych w wielu regionach Europy.

Polską częścią projektu „Large scale RESToration of COASTal ecosystems through rivers to sea connectivity", akronim REST-COAST, kieruje prof. Grzegorz Różyński z Instytutu Budownictwa Wodnego PAN, z którym rozmawia Jakub Maksymowicz.

Projekt REST-COAST angażuje wiele jednostek naukowych, skąd takie działanie?

REST-COAST powstał jako odpowiedź na politykę Unii Europejskiej, która zakłada przywrócenie bioróżnorodności na co najmniej 30 proc. stref brzegowych UE do roku 2030. Jest to bardzo ambitny cel, w którym chodzi o przywrócenie ciągłości ekosystemów, która została utracona w wyniku działalności człowieka. Studium przypadku polskiej części projektu jest sztuczna wyspa (Wyspa Estyjska) powstająca na Zalewie Wiślanym. Jej tworzenie ma związek z przekopem Mierzei Wiślanej, którego budowa ingeruje w obszar „Natura 2000". Przepisy unijne oraz krajowe wymagają kompensacji przyrodniczej takich przedsięwzięć. Urząd Morski w Gdyni, zarządzający obszarami przybrzeżnymi, zdecydował, aby wykorzystywać wyspę w celu odbudowy bioróżnorodności, dzięki czemu możemy realizować założenia w ramach projektu REST-COAST. W projekt zaangażowanych jest ponad 40 konsorcjantów, m.in. z Hiszpanii, Francji, Niemiec, Niderlandów, Bułgarii czy Włoch oraz Izraela. Koordynatorem projektu jest Universitat Politecnica De Catalunya w Barcelonie.

Co dokładnie staracie się państwo odtworzyć na powstającej wyspie?

Zalew Wiślany jest siedliskiem kormoranów, które były niegdyś gatunkiem zagrożonym, ale obecnie ich sytuacja się poprawiła.

Dlatego podczas wzbogacania bioróżnorodności sztucznej wyspy nie chcemy tworzyć warunków dla tych ptaków, a skupiamy się na utrzymaniu wegetacji w formie traw. Dzięki nim osiedlać będzie się inne ptactwo, które w rejonie zalewu zanika. Mowa o takich gatunkach, jak: bekas, krwawodziób oraz czajka, którym jest trudniej i utraciły swoje dotychczasowe żerowiska w wyniku zanikania pastwisk w rejonie Zalewu. Będziemy chcieli zapewnić im miejsce do życia, co więcej – wyspa ta będzie odizolowana od reszty brzegów i zamknięta dla osób postronnych decyzją Urzędu Morskiego.

Oczekujemy też stopniowego i spontanicznego porastania brzegów wyspy ławicą trzcin, która stwarzać będzie bardzo dobre warunki bytowania dla gęsi i kaczek. Jeżeli uda nam się osiągnąć założoną odbudowę bioróżnorodności na Zalewie, będzie to oznaczać, że podobne rozwiązanie jest realne do zaimplementowania w innych miejscach, np. na Zalewie Szczecińskim, gdzie ostatnio powstały dwie sztuczne wyspy.

A więc jest to sposób na uzupełnienie ekosystemów, które tracą w jakimś stopniu swoją bioróżnorodność w wyniku dużych inwestycji?

Tak, naszym celem jest pokazanie, że możliwe jest odbudowanie bioróżnorodności przy okazji dużego projektu hydrotechnicznego. Warto zauważyć, że jest to zbieżne z założeniami tzw. Blue Economy, która zakłada zrównoważony rozwój obszarów morskich.

Dzięki temu projektowi będzie można pokazać, że ochrona przyrody, a nawet jej odbudowa jest możliwa przy takich inwestycjach.

Jak doszło do tego, że został pan kierownikiem projektu i jakie są studia przypadku innych państw?

Byłem uczestnikiem szeregu projektów unijnych w ramach FP 5, 6 i 7. Brałem też udział w projektach w ramach mechanizmu Bonus EEIG, a także Horizon 2020. To wszystko doprowadziło mnie do obecnego przedsięwzięcia, w którym spora część naukowców z krajów partycypujących to osoby, z którymi współpracuję od wielu lat.

Sytuacja na Zalewie Wiślanym nie jest odosobnionym przypadkiem. Podobne wyzwania pojawiają się m.in. w Lagunie Weneckiej, Francji, na Sycylii, w Izraelu czy Bułgarii. Warto podkreślić, że jeżeli prace naszego projektu zakończą się sukcesem, będziemy mogli je aplikować na innych zbiornikach wodnych leżących w naszej szerokości geograficznej.

Jaki jest szerszy kontekst dotyczący całego projektu i wszystkich uczestniczących w nim przypadków?

Podmioty działające w ramach konsorcjum badają także, jak regeneracja bioróżnorodności w dużej skali może przyczynić się do redukcji emisji CO_2. Projekt REST-COAST zajmuje się również oceną funkcji ekosystemowych w regionie przybrzeżnych wydm, łąk na dnie morskim oraz przybrzeżnych mokradeł. Ich celem jest ograniczenie ryzyka erozji i powodzi, jak również zwiększenie różnorodności biologicznej i usprawnienie procesu magazynowania dwutlenku węgla w morskich roślinach. Działając na dużą skalę, badacze zajmą się rozwojem powiązań pomiędzy rzekami a wybrzeżem.

W ramach projektu zrealizowanych zostanie dziewięć programów pilotażowych w głównych morzach regionalnych UE (Bałtyk, Morze Czarne, Morze Północne, Atlantyk oraz Morze Śródziemne). Naukowcy chcą zwiększyć zaangażowanie obywateli, grup interesariuszy i decydentów w kwestie środowiskowe, co ma stymulować zrównoważony rozwój obszarów nadmorskich. /ee

Figure 11 Article in Rzeczpospolita daily newspaper on artificial island and bird sanctuary in Vistula Lagoon

2.3.3 ICCE conference in Sydney, Dec. 2022

IBW sent an abstract dealing with biodiversity restoration in Vistula Lagoon to 37th ICCE conference. The abstract was accepted and full presentation was given. Interestingly, the audience (consisting mostly of engineers) was particularly interested in sediment management details. The questions included not only placement of sediment on the island, or construction of its the rim, but also details related to chemical analyses that had to be done before the sediment could be deposited. In this way we were able to outline the global context, where biodiversity restoration must also resolve issues generated by past activities, where environmental protection was not a priority. By participating in this conference we again targeted influential circles, this time belonging to the realm of engineering; ICCE is now covering environmental issues to a much greater extent than before, so integration of technical and environmental approaches to coastal management is progressing – as coastal engineers we tried to provide and important contribution to that process. Figure 12 presents the 1st slide of the presentation at ICCE'2022 – the reference to REST-COAST is clearly visible. Apart from the presentation, an article was written and printed in the Proceedings of that conference, see References.

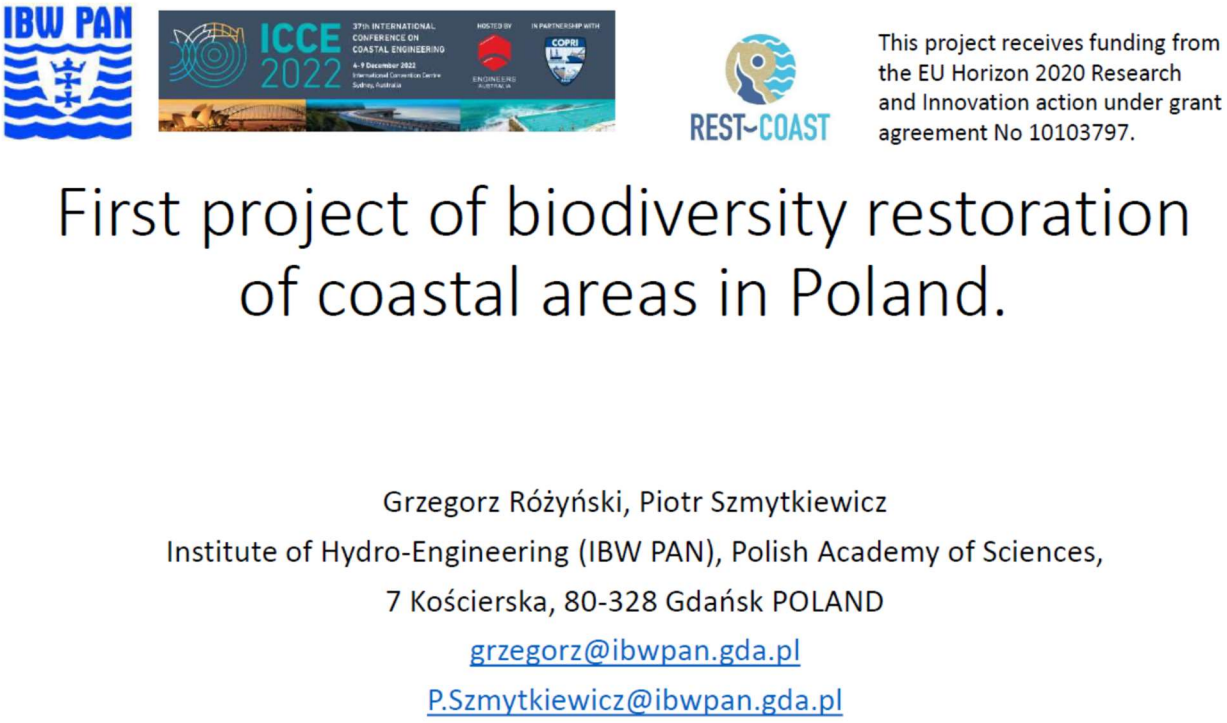


Figure 12 Title slide of ICCE'2022 presentation

2.2.4 ECSA conference in San Sebastian, Sep. 2022

IBW PAN participated in the 59th edition of that conference, organized by Estuarine and Coastal Scientists Association. An oral presentation titled 'How can geological past enhance coastal erosion and impair ecosystem services?' Here, the emphasis was put on the maintenance of ecosystem services of dunes after their artificial rehabilitation during beach fill operations (after heavy storms). In this way the 'working with nature' principle was promoted in situations where fully nature-based solutions are not possible. The ecosystem services can be maintained in dunes with artificial gabion cores provided that the cores are fully covered and that suitable vegetation is planted on the dunes. We highlighted a phenomenon of rapid erosion

of sandy dunes on the Polish coast, induced by clustered storms, whose attribution is debated, but who are likely to be driven by climate change. Once again, by participating in the conference we targeted influential circles of coastal engineers and managers, but also the emerging next generation of these professional groups – the conference was attended by many junior researchers and coastal managers. Figure 13 demonstrates the 1st slide of the presentation. Moreover, a scientific paper in the Continental Shelf Journal was published, see References.

Figure 13 Title slide of ECSA59 presentation

2.2.5 International School of Hydraulics, Kąty Rybackie, Poland, May 2023

IBW PAN participated in 50th edition of that School, organized by the Polish Academy of Sciences and aimed at young coastal, estuarine, riverine and marine professionals. A presentation titled 'Sustainable management of coastal lagoons. Cross-cut through Vistula Spit.' was given. Here, we focused on implementation of a large engineering project at a NATURA 2000 site, taking due account of environmental consequences and their remediation by environmentally neutral management of sediments, dredged during that project. In this context the concept of artificial island as a bird sanctuary was debated. For the 1st time the presentation was targeted at young professionals from ca. 20 countries, mostly the European ones. Importantly, many participants originate from extra-European territories, so the message we sent can be further transmitted to their countries of origin. Figure 14 contains the title slide of the presentation.

Figure 14 Title slide of presentation at 50th School of Hydraulics, May 2023, Poland

3 Demonstration value and replication

The above-mentioned demonstration activities served to transfer the knowledge on biodiversity restoration primarily to well informed circles of the Polish society, who shape the views of the general public. Vistula Lagoon has become a frequent topic in general media in recent decades in the context of independence of Poland's economy from Russia, bearing in mind past overwhelming dependence and the related adverse effects. Therefore, mentioning Vistula Lagoon in the biodiversity restoration context had an extra added value to familiarize this concept among wide sectors of the Polish public by making use of the highly respected circles. Consequently, the Vistula Lagoon pilot has another added value, consisting in demonstration of up- and out-scaling potential of biodiversity restoration in Poland and outside. Figure 15 shows the map of the Polish coast with two major lagoons marked by black circles. Apart from Vistula Lagoon in the east Poland has another transboundary lagoon – Szczecin Lagoon (Ger. Oderhaff), shared with Germany.

Figure 15 Two major transboundary lagoons in Poland

Recently, two large artificial islands were constructed there to accommodate sediments from expansion of the main local navigation channel, see Figure 16. They are also intended to serve as birds sanctuaries (for example, shelducks are also targeted for restoration). However, the local Maritime Office has not yet decided whether natural vegetation succession will be permitted, which may lead to colonization and later destruction the new islands by cormorants, or some kind of managed vegetation is envisaged. In case the number of cormorants in Szczecin Lagoon becomes too high, our experience, accumulated by the REST-COAST pilot at Vistula lagoon, can be readily exploited as a blueprint for similar activities in the Szczecin lagoon. The islands are referred to as W22 (123 ha) and W28 (250 ha), see Figure 16, we can therefore see that this project was much greater in terms of dredging works than that on Vistula Lagoon. Interestingly, Figure 16 also presents another artificial island named Chełminek. It covers only 14 hectares and was formed at the turn of 20th Century. Currently, it works as a bird sanctuary with natural vegetation succession.

As regards transboundary impacts, the Vistula Lagoon pilot can serve as a blueprint for may lagoons in mid-latitudes. In the Baltic sea context the obvious locations for similar projects (should a need arise) are the Curonian Lagoon – the largest lagoon in the Baltic Sea basin, shared by Lithuania and Russia, or Darss-Zingst Bodden chain of lagoons in Germany, near the city of Rostock. Interestingly, a similar policy of managed vegetation and elimination of trees is exercised on the artificial Kreupel island on Ijsselmeer lake in the Netherlands, cf. van Eerden & van Eerden 2021. Still, cormorant colonies were able to develop there, making use of residual debris; in the Ijsselmeer context such developments were deemed acceptable. Therefore, our project juxtaposed with the Dutch experience, offers yet another synergy aimed at elaboration of optimum

vegetation control measures to achieve desired population mix of species at bird sanctuaries located in mid-latitudes.

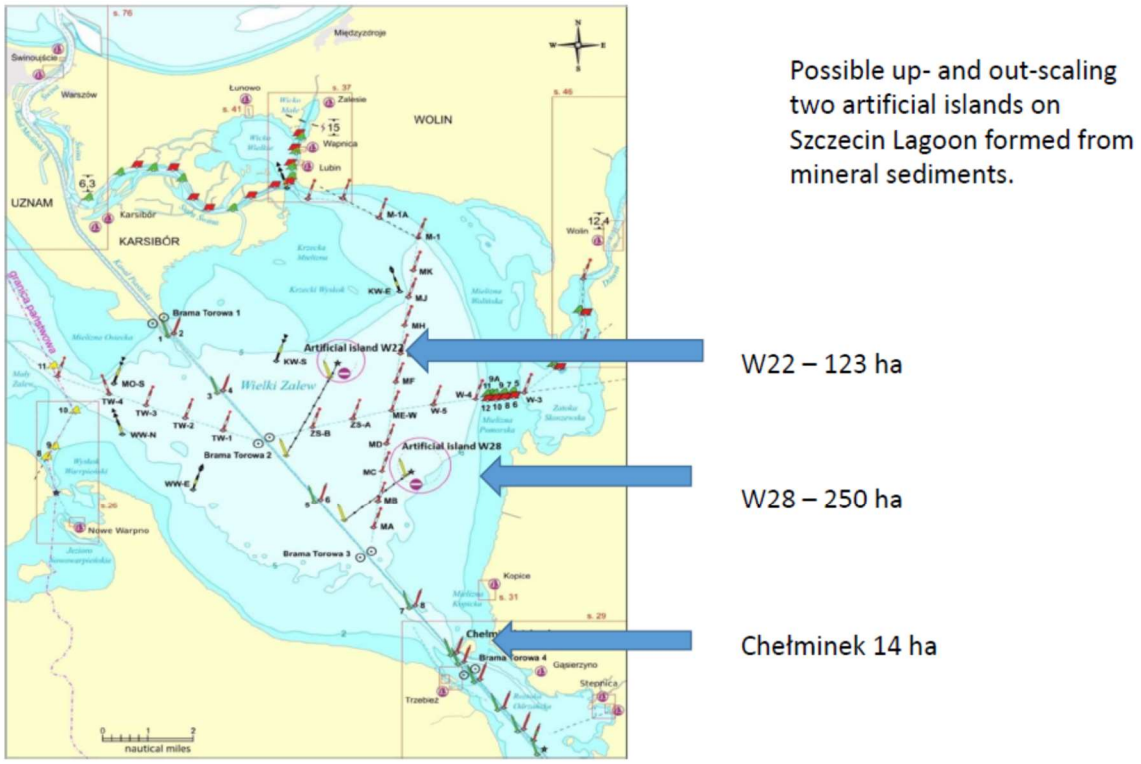


Figure 16 Szczecin Lagoon with artificial islands there

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