

國際海洋資訊

International
Ocean Information

20

October 2022

雙月刊 | Bimonthly

國艦國造最後一哩路——
國家船模實驗室興建與
船模試驗國家隊籌組

The Last Mile in National Shipbuilding -
Establishment of a National Model Test
Laboratory and Formation of a
National Team for Model Testing

立陶宛海洋資訊

Lithuania Ocean Information



海洋委員會
Ocean Affairs Council

發行



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Protecting Our Environment Legal Protections for Cultural Assets Upgrade Taiwan's Industries!

Translated by Linguitronics

Acting Minister of the Ocean Affairs Council: Mei-Wu Chou

Marine Spatial Planning (MSP) and protecting marine environments have been the key aspects of planning marine policies for many countries. This issue introduces how Lithuania, a country east of the Baltic Sea, plans marine demarcations in a closed ocean territory of 400 nautical miles with nearby countries such as Russia, Latvia, and Sweden; after some planning, legalization of Marine Spatial Planning was completed in 2014 and a MSP project was passed in 2015. Lithuania's marine environment affairs was headed by the country's Ministry of Environment, who's primary strategy was combining marine and terrestrial environments into one to prioritize the 4 major areas of "sustainable use of natural resources and waste management", "improvement of the quality of the environment", "maintenance of ecosystem stability", and "climate change mitigation and adaption" when dealing with issues involving the fishing industry, seawater quality, and biodiversity. Additionally, compliance to the EU Marine Policy, "International Convention for the Control and Management of Ships' Ballast Water and Sediments", and "Helsinki Convention on the Protection of the Marine Environment of the Baltic Sea Area" were implemented to effectively manage ballast water to prevent or mitigate the issue of invasion by alien species due to ballast water. The protection of marine environments cannot be the affairs of individual nations. During the 5th United Nations Environmental Assembly in 2022, the resolution "End Plastic Pollution: Towards a Legally Binding International Instrument" was passed. The international treaty to end plastic pollution is expected to complete in 2040 and become a massive step in the movement to reduce plastics as well as a new global milestone in the achievement of sustainability goals.

The path towards sustainability not only requires our focus on protecting natural resources, but cultural assets as well. The latest "International Issues" shares the archeology and preservation of underwater sites. Underwater cultural assets are a key resource for the cultural tourism industry. In the 1950's, France began to research underwater cultural artifacts or sunken ships; in 2007, Taiwan and France collaborated to nurture underwater archeologists and formed the first underwater archeology team. Additionally, "Special Report" introduces the final mile of Taiwan's "domestic shipbuilding"; since the period of Japanese rule, Taiwan has been involved in the construction, repair, and maintenance of various ships as well as providing the shipbuilding industry with experimental water tanks for the purposes of design, R&D, and education. These efforts have driven the technological improvements of the shipbuilding industry and integrated existing testing capabilities of ship model laboratories; currently, Taiwan has begun implementation of a ship model lab and the formation of a ship model testing national team to lead Taiwan's shipbuilding industry to new heights!



Figure/ Aerial view of rinsed land coastal cliff near Baltic Sea in Karkle, Klaipeda, Lithuania
Source/ Pride Advertising Agency Ltd.

The Last Mile in National Shipbuilding - Establishment of a National Model Test Laboratory and Formation of a National Team for Model Testing

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Translated by Linguitronics

Keywords: Seakeeping and maneuvering tank, rotating arm tank, model test

"Model testing" refers to the design, verification, and improvement of ships based on the results of tank tests. The required tests depend on the type or performance of the ship. In order to improve the performance of various vessels on the water surface and underwater, various performance verifications must be carried out through model testing at the design stage. While "model testing" is only a small part of the ship design process, it is an indispensable foundation stone of the whole process, from design and planning to construction. To be able to drive technological upgrading of Taiwan's shipbuilding industry and integrate the testing capabilities of existing domestic ship model laboratories, the pivotal issues at present are to provide consulting and verification services for engineering technologies applied to naval defense ships, marine disaster site reconstruction, and marine structural design, to establish a national model test laboratory, and domestically integrate and form a national team with capabilities in relevant areas.



Figure 1/ Conceptual design blueprint of the National Model Test Laboratory, which will be located in Xingda Port, Qiding District, Kaohsiung City [1]

Image by CECI Engineering Consultants, Inc., Taiwan

Overall Situation of Model Test Capability in Taiwan

The shipbuilding industry in Taiwan has a history of more than a century, from the construction and maintenance of ships and small motor boats during the Japanese occupation, to merchant ships, container ships, official vessels, research vessels, oil tankers, transport ships, reefer vessels, warships, and other types of ships (boats, ships) in the present. Taiwan also has model test tanks. There are currently 4 model test tanks in Taiwan: the National Taiwan University (NTU) towing tank, the National Cheng Kung University (NCKU) towing tank, the National Taiwan Ocean University (NTOU) cavitation tunnel, and the National Defense University (NDU) circulating tank. Descriptions as follows:

NTU's towing tank was built in 1992 with dimensions of 130 meters long $\times$ 8 meters wide $\times$ 4 meters deep. It has been renewed in 2010 with the "Tow Equipment Replacement Project". The tank can be used for resistance tests, flow field measurement, propeller open water test and underwater noise measurement (upper left of Figure 2).

The NCKU towing tank was built in 1982 with dimensions of 165 meters long $\times$ 8 meters wide $\times$ 4 meters deep; in 2022, it was expanded to 285 meters long $\times$ 8 meters wide $\times$ 5.5 meters deep. The tank can be used for resistance test, self-propulsion test, flow field measurement, stern wake measurement, propeller open water test (bottom left of Figure 2 [2]).

In 1996, a medium-sized cross section was built for the NTOU cavitation tunnel (2.2 meters long $\times$ 0.5 meters wide $\times$ 0.5 meters deep); in 2002, it was rebuilt as a large section sealed water tank with dimensions of 10 meters long $\times$ 2.6 meters wide $\times$ 1.5 meters deep. It can currently be used for propeller open water test, hull exciting force measurement, cavitation measurement, underwater noise measurement and anti-submarine speed test (upper right in Figure 2 [3]).

The NDU circulating tank was set up in 1981 with dimensions of 14 meters long $\times$ 5.3 meters wide $\times$ 2.2 meters deep. The tank can be used for resistance test, self-propulsion test, flow field measurement, stern wake measurement (bottom right of Figure 2).

It is obvious from the preceding that there is still a lack of model tests, such as seakeeping test, maneuverability test, and rotating arm test (middle of Figure 2). Therefore, when developing new ships in Taiwan, test tanks must be leased from abroad, which entails concerns about national security and data leaks.



Figure 2/ Design blueprints of the existing ship model laboratory and the National Model Test Laboratory
Image by the author

Planning of the National Model Test Laboratory

In order to build a seakeeping tank, reference is made to existing foreign designs of water tanks (Table 1). To determine the impact factors of length (X axis) and width (Y axis) of the seakeeping tank, several factors must be considered, for example, the ratio of the ship model to the actual ship length, the maximum speed of the ship model, the acceleration and deceleration of the towing carriage, the length of the required measurement time, etc. The National Academy of Marine Research (hereinafter referred to as the NAMR) surveyed and inventoried the shipbuilding plans of domestic shipbuilders, the Navy, the Coast Guard Administration, and the Shipbuilding Development Center for the next 5 to 10 years. After comprehensive analysis, the NAMR proposed the "National Model Test Laboratory Construction Project" to meet the needs of the shipbuilding industry, official ships, and naval defense ships. The preliminary plan includes a seakeeping tank and a rotating arm tank (see Figure 3 for the planning concept schematic). The dimensions of the seakeeping tank are 80 meters long x 40 meters wide x 6.5 meters deep (water depth 5.5 meters). Basic equipment in the water tank includes wave generators, wave absorbers, towing carriages and overhead cranes.

Table 1/ Specifications and Dimensions of Internationally Noteworthy Seakeeping Tanks

Nation	Unit	Dimensions		
		Length (m)	Width (m)	Depth (m)
Korea	KRISO	56	30	4.5
Japan	Japan Marine United Corporation	70	30	3
Japan	Mitsubishi Heavy Industries	160	30	3.3
Japan	National Maritime Research Institute	80	40	4.5
Japan	IHI	70	30	3
Japan	Kyushu University	38.8	24.4	2
China	Shanghai Jiao Tong University	50	30	6
China	China Ship Scientific Research Center	69	46	4
China	Shanghai Ship and Shipping Research Institute	90	30	3
India	Naval Science and Technology Lab	135	37	5
USA	DTMB	110	73	6.1
Canada	IOT-NRC	75	32	3.2
Netherlands	MARIN	170	40	5
Sweden	SSPA	88	39	3.5
England	QinetiQ	122	61	5.5
Norway	MARINTEK	80	50	10
Spain	CEHIPAR	152	30	5
Finland	VTT	40	40	2.8
Russia	Krylov State Research Centre	162	37	5
Bulgaria	Bulgarian Ship Hydrodynamics Centre	60	40	2.5

Source/ <https://itc.info/facilities/> [4]

The "seakeeping tanks" and "rotating arm tank" can perform below test items:

- I. **Seakeeping test:** To study the relationship between the force acting on the hull and the movement of the ship. This force mainly means the interference of external forces such as wind and waves. It can be divided into a regular wave test and irregular wave test, depending on the needs and the purpose of test. Meanwhile, the ship speed, heading, and the direction of the waves are the main factors to be considered for the test.
- II. **Maneuverability test:** The maneuverability test mainly analyzes the relationship between the force and the movement of the hull, for example, the influence of the rudder angle affects on the ship heading, and the time needed to change ship's heading. Depending on the purpose of test, it includes the rotating test, arm test, Zig-Zag test, and other tests.
- III. **Planar Motion Mechanism (PMM) Test:** The equation for the motion of a ship contains of a large number of hydrodynamic coefficients. In order to study the maneuverability of a ship, it is necessary to act on the relevant hydrodynamic coefficients of the ship. The PMM test mainly performs as particular ship motions to calculate the coefficients of equation.
- IV. **Underwater Vehicle Performance Test:** This test is to study the fluid dynamics of various underwater vehicles when the studied vehicle is underwater, surfacing or diving.

We have has no experience in building such a large and professional model test laboratory in Taiwan. Besides, the engineering, instrumentation, and equipment used with model test tanks are professional and require high precision. For these reasons, the NAMR, together with the Ship and Ocean Industries R&D Center (hereinafter referred to as the SOIC), which has extensive experience in model testing, are cooperating on the overall establishment, project management, personnel training, and maintenance management planning for model testing. In addition, CECI Engineering Consultants, Inc., Taiwan was invited to carry out planning, design, and subsequent supervision to successfully complete the construction of the National Model Test Laboratory.



Figure 3/ Planning Concept Schematic of the National Model Test Laboratory [1]
Image by CECI Engineering Consultants, Inc., Taiwan

Formation of the National Team for Model Testing

Comprehensive model testing must be carried out in different types of water tanks. In order to enhance the capability of model testing in Taiwan, the NAMR held the inaugural meeting of the national team for model testing on June 21, 2022. President Ing-Wen Tsai personally presided over and attended the meeting and voiced her full support for the project. A memorandum of cooperation was signed by universities in Taiwan that were in possession of model test tanks and underwater equipment and

technology (NTOU's cavitation tunnel, NTU's towing tank, NCKU's towing tank, and National Sun Yat-sen University [NSYSU]'s underwater equipment and technology). Through information sharing, resource sharing and technical exchange, the cooperation will gradually integrate the test capacity and human resources of various model test tanks in Taiwan to improve the overall level of national model testing technology in Taiwan and provide comprehensive, high-quality ship model test capacity, ship performance estimation, verification, and consulting services. In the future, domestic and foreign training programs will be jointly conducted for talent required for model testing, which will be used for operation and maintenance management after the completion of the construction of the National Model Test Laboratory, thus achieving our goal for national shipbuilding and autonomous applications.



Figure 4/ The launching ceremony of the inaugural meeting of the national team for model testing (From left, NTU Executive Vice President Shan-Chwen Chang, NTOU President Tai-Wen Hsu, NAMR former President Yong-Fang Qiu, Ocean Affairs Council former Minister Chung-Wei Lee, President Ing-wen Tsai, Executive Yuan Minister without Portfolio Jing-Sen Chang, National Policy Advisor to the President Wen-Wan Tang, NSYSU President Ying-Yao Cheng, NCKU Executive Vice President Fong-Chin Su)

Image by SOIC

Conclusions

After the construction of the National Model Test Laboratory (seakeeping tank and rotating arm tank) is completed, Taiwan will have complete model test capabilities. It will be used for not only design and R&D of shipbuilding-related industries, but also for research units conducting research and teaching. It can meet the testing needs of domestic ships, and fill technical gaps in the planning, design, and construction of "naval defense ships". The National Team for Model Testing will be the core of future development. Its goal is to be an "international model testing institution"; to integrate operation and management and link up the capacities of industry, government, academia, and research institutions; to benefit from effectively distributing capacity of domestic tank tests; to strengthen domestic model test research capabilities, cultivate talents in the shipbuilding industry, and establish a domestic model test database, gradually improve the international competitiveness of our shipbuilding industries in Taiwan, and lead the ship industry to a new peak.

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Preservation and Educational Promotion of Underwater Cultural Heritage in France

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Translated by Linguitronics

Keywords: Underwater Cultural Heritage, Underwater Archaeology

The ancient Greek philosopher Plato wrote about the sunken kingdom of Atlantis in his dialogue, *Timaeus-Critias*. Some people think it is a fable, while others believe it was a disaster event resulting from earthquakes and tsunamis. For over two thousand years, curiosity about ancient civilisations has extended from under the land to under the water. Then, in the summer of 1943, the French Naval lieutenant Jacques-Yves Cousteau and the engineer Émile Gagnan improved the underwater breathing apparatus, commonly known as the "aqualung". The new invention was lighter and cheaper. Since then, it has promoted scuba diving activities and established underwater archaeology development [1]. At the same time, it also launched a time-war between commercial salvage and the protection of the underwater cultural heritage.

The French National Department of Underwater Archaeological Research and Cultural Heritage Preservation

France's coastline is more than 10,000 kilometres, including mainland France and overseas. There are plentiful sources of underwater cultural heritage. In the 1950s, France began emphasising the archaeological methodology of studying underwater sites. In 1966, France became the first country to organise the protection of underwater cultural heritage. With long-term official support, the Marine Archaeology Research Department was established in 1991. Five years later, inland waters such as lakes, streams and rivers were also integrated into the Marine Archaeology Research Department. The name was changed to the Underwater Archaeology Research Department (Le Département des recherches archéologiques subaquatiques et sous-marines, DRASSM).

With DRASSM's headquarters in Marseille, the largest port city in France, the DRASSM's scope of work includes investigation, inventory, research, protection, and implementation of the *Les Biens Culturels Maritimes* (Maritime cultural property), authorisation to conduct preventive archaeology (L'archéologie préventive), and educational promotion [2] within the 11 million square kilometres of French economic waters. In the early period, divers would search only with their eyes while using marine scientific exploration technology; now, with the recent development of the underwater humanoid robot "Ocean One", archaeologists can operate the robot to work in high-pressure deep-sea areas to recover fragile artefacts. To this day, the DRASSM estimates that there are at least 20,000 to 30,000 shipwrecks in the French territorial waters [3].

In France, there are various levels of museums related to underwater cultural heritage, including the Musée National de la Marine in the northern city of Brest, which has displays on the theme of naval history and ships; the Musée de l'Ephèbe et d'archéologie sous-marine, in the southern town of Le Cap d'Agde, one of the few non-public underwater archaeological museums and one that was founded on the discovery of Alexandrian bronzes in nearby waters—when these were sent to the Louvre for restoration, due to their preciousness, the central government required a certain level of museum for the return of the cultural relics, and to preserve them locally, the residents actively contended for the

establishment of this exquisite community museum; the Musée de l'Arles et de la Provence antiques displays a wreck in the Rhone from ancient Roman times that has a complete hull and a length of 30 meters, with the goods and living utensils on board well preserved, reflecting river life at the time. In June 2022, the newly renovated Musée archéologique du Lac de Paladru reopens and presents surveys of alpine lake underwater sites from prehistoric to medieval times.



Figure 1/ Divers use the white lifting bag to lift artefacts out of water
Image by Photographer Lionel Roux (CNRS-CCJ)

Underwater cultural heritage and cultural tourism

Underwater cultural heritage is derived from underwater archaeology research, a branch of archaeology. Protecting these archaeological results could benefit cultural tourism. In Europe, the NEARCH survey project for "Awareness of Archaeology and Cultural Heritage" among EU citizens shows that more than half of the survey respondents believe that archaeology can touch people's hearts, allow the public to engage in a dialogue with history, ancient civilisation, and humankind's origins. Survey results show that although only 10% of EU citizens believe that archaeology is helpful for local and national economic development, 86% agree that having archaeological sites in the city where they live is a considerable advantage. In comparison, 83% believe that supporting the development of archaeology is very important to the country [4].

Such as the island of Délos, where the French School, École Française d'Athènes, initially excavated those archaeological sites. This island served as the official meeting place and treasury of the "Delian League" [5], an association of Greek city-states. Over the past two thousand years, due to the rising sea levels and earthquakes, Délos has rich archaeological sites on land and underwater, such as some submerged ports and houses. When the sea is not murky, one can even take clear pictures of the remnants of underwater buildings from the air. This island with significant archaeological sites is a World Heritage Site and is often on the "must-visit list" for many cultural travellers.

In France, The French National Institute for Preventive Archaeological Research (Institut national de recherches archéologiques préventives, INRAP) is responsible for archaeological assessments before land and underwater construction projects to take into account the preservation of cultural heritage and economic development; from prehistoric sites to World War II wrecks, these all belong to the collective historical memory of humankind.

Today, travel is not just about relaxing in exotic places, but more and more about learning about local cultures through an immersive experience. According to data, nearly 40% of European tourists' itineraries are based on local cultural heritage [6]. Protecting cultural heritage can become an essential benefit to cultural tourism.

From diving memorabilia to community-protected sites

While studying abroad, I used to participate in fieldwork of underwater excavation and reviewed the reports of different archaeological sites over the years. I also learned about the evolution of protecting the archaeological sites from construction damage to the present "preventive archaeology" development over the past 60 years in France.

Fieldwork in 2019 was under the research project "*Fossae Marianaë: The Ancient Port of Fos-sur-Mer and the Le Canal de Marius*"; the excavation sites in "Fos-sur-Mer" are next to the mouth of the Rhône river. At the end of the daily work, the evening sky was filled with colourful clouds from the garbage incinerator at the opposite end. According to the literature review, researchers believed that the industrial area was where *Le Canal de Marius* emptied into the sea during the reign of Caesar Augustus (27 BC-AD 14). As early as 1963, archaeologists recorded the location of some of the ruins. However, scholars speculated that the main archaeological site had already been demolished due to the construction of the industrial zones. The two thousand-year-old ruins disappeared silently in the torrent of economic development. In the 1970s, national research institutes launched a long-term investigation to find the remains of the remaining canal and surrounding port towns. They found 35 tombstones and altars dating back to the 1st and 2nd centuries AD at water depths of 3 to 4 meters and confirmed the dating in 1980 after collecting relevant artefacts [7].

In addition to the fact that construction may affect the site's preservation, Fos-sur-Mer has been a tourist destination for summer swimming since the 1970s. In its early days, many scuba divers would take away "diving souvenirs" at the end of their dives, ranging from small pieces of pottery and coins to large complete amphora, which was also detrimental to the current state of the site. The ancient canal brought crowds, items left behind by countless people and shipwrecks. During fieldwork, a citizen handed a bag of pottery shards he had picked up on the beach to the project investigator Souen Fontaine. These pottery shards were in poor condition because they had not undergone a complete desalination process.



Figure 2/ Archaeological survey on Fos-sur-Mer and the industrial area across the shore
Image by Photographer Lionel Roux (CNRS-CCJ)

Nevertheless, Fontaine still accepted the pottery pieces and made a simple record of their quantity and type. She said there used to be an old diver called the DRASSM, hoping to donate his "souvenirs" to the country to prevent them from being discarded by his children, who did not know their value. However, most of these artefacts weren't immediately protected and desalinated, and they have lost their context from the site, becoming a single, flat object. The artefacts without their context are not only losses to the researchers but also the collective memory of all people.

Awareness of protecting the underwater cultural heritage takes time to change. The enthusiasm of the archaeological sites in Fos-sur-Mer has gradually led to a consensus on the protection of the site. Half a century later, the public is still curious about local history and archaeological work. On the last Wednesday night of the excavation season in 2019, there was a public day to share the archaeological results. It relied solely on bulletin board posts and word of mouth in the community, but still, the activity centre was packed, and people raised various questions after the meeting. Similar activities are familiar to the locals, so as long as there is a team in the community to conduct archaeological excavations, there will be lectures to let the public know about the latest excavation progress of the year.

Conclusion: France and Taiwan

France has revised a set of practices earliest country to protect underwater cultural heritage. Over the past sixty years, the French government has adopted a way to continue the economic construction and preserve the cultural heritage and archaeological sites. At the same time, the French government integrates various domestic units, including government departments such as the DRASSM and INRAP, which conducts cooperative surveys on local archaeological companies, diving groups, and cultural and historical societies. Looking to the recent offshore wind farm developed in the waters off of Normandy as an example, the DRASSM has conducted a pre-assessment of its underwater cultural heritage and authorised the INRAP to be responsible for the detection and excavation work. It has also allowed the school to cooperate in systematic talent cultivation. The educational promotion of public archaeology has lowered the threshold for the public to access archaeological knowledge. By holding these events, the public will have a better understanding, and their curiosity will turn into the action of practising our past.

The DRASSM also provides international cooperation. For example, Taiwan once discovered suspect shipwrecks while dredging the Magong Harbor in Penghu. As a result, Taiwan signed an administrative agreement with France in 2007. Taiwan government invited domestic and foreign experts to investigate the port and conducted the first Training Workshop on Underwater Cultural Heritage Preservation. Then, the first underwater archaeology team was led by Academician Cheng-Hwa Tsang of the Institute of History and Philology, Academia Sinica. Over the years, entrusted by the Bureau of Cultural Heritage (BOCH) of the Ministry of Culture, Tseng has conducted general surveys of underwater cultural heritage in the waters near Taiwan. Taiwan's geographical location is important for shipping, especially on the Taiwan Strait. The seas near Penghu are dangerous and have a high potential for underwater cultural heritage [8]. So far, the underwater archaeology team has verified near hundred objects in the waters near Taiwan and identified 20 as underwater sites. The government listed six shipwrecks as significant shipwrecks, with nearly 1,600 artefacts extracted from water [9].

There is a variety of underwater cultural heritage around Taiwan seas, including Paleolithic sites in the Taiwan Strait, shipwrecks during the historical period, and the stone weir group still in use for traditional fishing. Anthropologist Chun-Sheng Ling once described the ancient maritime tradition among Southeast China, Southeast Asia, and the South Seas islands as "the Asian Mediterranean" and argued that it is as essential as the Mediterranean is to the birth of ancient Western civilisation [10].

Archaeological sites leave traces of the development of culture. From ancient times to the present, oceans have been bridges between islands and linked the past and future of humankind. To preserve the cultural heritage is to build up cultural tourism and enhance the capacity of cultural and creative industries.

Learning from foreign countries and adapting measures to the local conditions, Taiwan has continuously revised and improved a set of appropriate strategies over the past 15 years to promote the protection of underwater cultural heritage and has, as a result, achieved a balance between economic development and preservation of cultural heritage. In the *Underwater Cultural Heritage Preservation Act* passed in 2015, the principle of "in-situ preservation" was adopted; the revised *Regulations Relating to Underwater Cultural Heritage Surveying and Processing Prior to Water Area Exploitation and Utilisation* from 2020 is similar in spirit to "preventive archaeology" in that if a project can directly or indirectly affect the seabed, it is necessary to carry out a pre-development investigation. The BOCH also organises education and promotion activities such as talent training courses, museum exhibitions, workshops, publications, and school lectures. By holding these events, BOCH hopes to increase people's awareness of protecting underwater cultural heritage and also the sunken treasure of our maritime past.



Figure 3/ The BOCH of the Ministry of Culture held a workshop for diving instructors (2020). Captain Han-Zhang Huang of the underwater archaeology team demonstrated the operation method of in-situ preservation
Image by Photographer Xi-Yao Gao (Center for Ocean and Underwater Technology Research, Tamkang University)

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End Plastic Pollution: The Future of a Global Plastics Treaty?

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Keywords: Plastic Pollution, International Plastics Treaty, Circular Economy

On the 50th anniversary of the establishment of the United Nations Environment Programme, 175 Member States adopted a resolution "Ending Plastic Pollution: Towards a Legally Binding International Instrument" on March 2, 2022 at the resumed fifth session of the United Nations Environment Assembly. The resolution aims to complete an international treaty to end plastic pollution by 2040. This resolution marks a historic moment that the fight against plastic waste has taken a big step forward, and the protection of the natural environment has also reached a new milestone [1].

Ubiquitous plastic pollution is one of the Triple Planetary Crisis. Due to its flexibility, convenience and low price, plastic products have begun to appear in our daily lives in large quantities, and human dependence on plastic has also increased since the 1950s. According to a United Nations report, between 1950 and 2017, approximately 9.2 billion tonnes of plastic were produced globally. Among them, only one third remains in use, and the rest two third become plastic waste, which is discarded in landfills or the natural environment. Part of the plastic waste leaks into rivers or oceans, and further spreads through air or ocean currents all over the world. Plastic waste that cannot be decomposed in the natural environment has become the biggest crisis on the planet. Among them, the ocean is the most severely affected. A study pointed out that plastic waste account for nearly 95% of marine debris. If it is not actively treated, the amount of plastic waste in the aquatic ecological environment is expected to triple by 2040 [2].

The adoption of the United Nations Environment Assembly resolution means that countries around the world have recognized the catastrophic and seriousness of plastic pollution and are willing to work together to solve the current crisis. At the same time, it is also recognized that the solution of plastic pollution cannot rely on the policies of individual countries alone, but requires the cooperation and efforts of all members of the world, and can succeed through a legally binding international treaty.

Key Issues [3]

The resolution contains the following goals: reaffirming the sustainable development goals, acknowledging the seriousness and scope of plastic pollution, emphasizing the full life cycle of plastics and the circular economy, and establishing an intergovernmental negotiating committee to initiate negotiations on a global plastics treaty.

I. Reaffirming Sustainable Development Goals

The resolution reiterates the principles of the 2030 Agenda for Sustainable Development and the Rio Declaration. Protecting the natural environment is at the core of sustainable development. In order to implement the goals of sustainable development, countries must reduce plastic waste through recycling and reuse, and achieve sustainable production and consumption of plastics. The resolution also echoes the relevant resolutions of the United Nations Environment Assembly in the past, and believes that the practice of sustainable goals depends on a global perspective and long-term collective cooperation and governance, and recognizes the efforts of governments, relevant international organizations, non-international organizations and the private sector, as well as relevant international conventions.

II. Defining the Scope of Plastics

The resolution first affirms that plastic pollution should include microplastics, and pays particular attention to the impact of plastic pollution on the marine environment. At the same time, it is also recognized that the current large-scale and rapidly increasing plastic pollution has become ubiquitous, forming a global crisis, which not only harms the natural environment, but also impacts sustainable development, and its impact on the social and economic levels should not be underestimated.

Microplastics are defined by the National Oceanic and Atmospheric Administration (NOAA) as plastic particles that are small, irregular, and less than 5 mm in length or diameter. Microplastics not only severely impact the Earth's environment, but also threaten the ability of the oceans to act as carbon sinks, worsening the climate crisis. In addition, the spread of microplastics through the ocean, air and food chain, not only endangers the survival of organisms, endangers the ecological environment, but also accumulates in the human body, seriously threatening human health and well-being. Plastic pollution not only has adverse effects on human health, but also significantly increases the management and cleaning costs of plastic waste. Marine plastic pollution has also caused huge economic losses to tourism, fisheries, aquaculture and other industries.

Second, the resolution advocates that an effective solution to the problem of plastic pollution should focus on the entire life cycle and cross-border characteristics of plastics. According to the United Nations report, about 90% of plastic waste is post-consumer products, most of which are plastic packaging; the remaining 10% are pre-consumer products, such as refined or manufactured plastics product. From 1950 to 2017, the global plastic recycling rate was less than 10 percent. Throughout the entire life cycle of plastics, 1.8 billion tons of greenhouse gases will be produced every year, which not only aggravates the negative effects of climate change, but also threatens the global carbon emission goals. However, if the circular economy approach is adopted, the world is expected to reduce 55% of virgin plastic production and 80% of the amount of plastic discharged into the ocean by 2024 [4].

Finally, the resolution emphasizes the transboundary nature of plastic pollution in the oceans and other environments, which not only affects the global ecological environment, but also harms the health of all human beings. Therefore, it is emphasized that Member States should adopt all possible means to address the full life cycle of plastics through cooperation. In other words, in the future, from the production, manufacture, design, disposal of plastic raw materials to recycling and reuse will be expected to be included in international treaties and establish a complete regulatory mechanism.

III. A comprehensive approach

The third point of the resolution formulates the normative principles and connotations of the future international plastics treaty. To address the full life cycle of plastic, the instrument should adopt a comprehensive approach that allows for both mandatory and voluntary measures, taking into account the principles of the Rio Declaration and national circumstances and capacities. Therefore, the following key points should be addressed in the future international plastics treaty:

i. Strengthen circular economy to achieve sustainable consumption and production

The provision of the new instrument should emphasize resource efficiency and a circular economy approach, from product design to environmentally friendly waste management, to promote sustainable production and consumption of plastics. Countries should be urged to develop and implement national action plans aimed at preventing, reducing and eliminating plastic pollution in support of regional and international cooperation.



Figure 1/ The ubiquitous plastic debris has become a planetary crisis
Source/ Pride Advertising Agency Ltd.

ii. comprehensive measures

The treaty should promote national and international cooperation and coordinate with other relevant regional and international conventions to address existing plastic pollution and plastic pollution in the marine environment. Public participation is also encouraged, and all stakeholders, including the private sector, are encouraged to participate in action to facilitate cooperation at local, national, regional and global levels.

In addition, increase knowledge through awareness raising, information exchange and education, and encourage investment in research to further develop sustainable, innovative, affordable and cost-effective ways. Finally, the article should establish a scientific and socio-economic evaluation mechanism, and regularly evaluate the progress of the implementation of the agreement and the effectiveness of related measures.

IV. The establishment of an intergovernmental negotiating committee

In order to formulate a legally binding international treaty as soon as possible in 2024, the first point of the resolution calls for the establishment of an Intergovernmental Negotiation Committee (International Negotiation Committee) to negotiate the details of the treaty and start action in the second half of 2022. Furthermore, in order to enable developing countries and countries with economies in transition to effectively implement their international obligations imposed by future international treaties, the second point of the resolution affirms that the necessary capacity building, technical and financial support should be given priority to developing countries and countries with economies in transition, enabling it to participate effectively in the work of the Ad Hoc Working Group and the Intergovernmental Negotiating Committee.

In addition, according to the fourth point of the resolution, the negotiating committee should consider the following elements when negotiating. First, some provisions should be flexible, allowing countries to take into account their national circumstances and have discretion in how to implement their commitments. Second, past experience or best practice should be drawn from the best scientific, traditional, indigenous and local knowledge systems, including various informal or collaborative approaches. Finally, consider the possibility of establishing a mechanism to provide policy-based scientific information, socio-economic information and assessments related to plastic pollution.

Challenges and Prospects

The ubiquitous plastic and its waste are the most urgent issues to be solved in the world today. Although various countries have actively adopted various policies or measures to limit plastics, most of the measures are only aimed at specific projects and lack systematic policies and standards, which can

neither solve the problem of environmental pollution nor effectively reduce the economic and social costs of plastics. The adoption of this resolution brings hope for a cure to the global crisis and establishes a global scale and a systematic framework for plastic pollution control, but it also brings new challenges and impacts to the entire human society.

First of all, this resolution recognizes on behalf of the entire international community that plastic pollution should shift from a linear model that focused on end-of-pipe disposal to a circular model that addresses the entire life cycle of plastics. Reduce plastic from the source, extend the economic use value of plastic products through reuse and recycling, and establish a clear and complete plastic regulatory framework. The resolution requires that the future global plastic agreement will take comprehensive measures, including mandatory and non-coercive measures, to comprehensively address plastic pollution. Member States can also take measures that meet their national needs as appropriate. The design of this flexible and dynamic structure allows countries to adjust their response to changes in national economic, technological, political and social conditions, and is more willing to give or strengthen their promise.

In addition, the establishment of a circular plastic economy and the reduction of plastic pollution require the actions of different stakeholders, including the government, consumers, plastic industry-related manufacturers, waste management and other public and private sectors. The resolution emphasizes the importance of the participation of the public and multiple stakeholders, and recognizes the necessity of the participation of international organizations and non-governmental organizations to strengthen the legitimacy and decision-making basis of plastic pollution control, and contribute to the promotion and practice of the global plastic treaty in the future.

At the 12th WTO Ministerial Conference in June 2022, the informal dialogue on plastic pollution and environmentally sustainable plastic trade involving 73 WTO member states made a public statement in support of the adoption of the resolution and advocated that trade and trade policies should address plastic pollution, one of the means. WTO members should and will continue to work together to reduce plastics globally through trade-related means. In addition, in order to implement the Basel Convention on Plastics Amendment, the World Customs Organization has revised the definition of plastic waste. In the future, the international trade of plastic products is bound to be significantly affected, and how to reconcile trade and plastic reduction measures to avoid creating new types of trade barriers is also an upcoming challenge for countries [5].

Furthermore, although member states have committed in the resolution to formulate and adopt a global plastics agreement in 2024, the negotiation of the treaty is not only about the rights, obligations and capabilities of each country, but also involves domestic political consultation. Negotiations for general treaties take an average of five to ten years to complete [6]. The more countries involved in the negotiation, the longer it will take to complete the treaty negotiations. So it remains to be seen how Member States will complete negotiations on a global plastics agreement within two years. In addition, the resolution mainly elaborates on abstract value, purpose and normative direction. As for the specific goals, measures and monitoring mechanism, it still depends on further consultation among member states. Therefore, it remains to be seen whether the Global Plastics Agreement can be completed and implemented as scheduled.

Although the public's awareness of the crisis of plastic pollution is gradually rising, the global demand for plastics has continued to increase in recent years. After the outbreak of Covid-19, the global demand for virgin plastic has increased substantially, and the global petrochemical and plastic industries have continued to invest heavily. It is expected that plastic production will continue to grow. After the adoption of the international treaty in the future, it will also change the mode of plastic production and management, which will also have a major impact on the plastic-related industry. Therefore, how countries should strike a balance between the implementation of plastic reduction obligations and industrial transformation and development will also be a major test.



Figure 2/ A global plastics treaty will bring a cure for the planetary crisis of plastic pollution
Source/ Pride Advertising Agency Ltd.

Finally, in recent years, Taiwan has also shown its determination to gradually implement the plastic restriction policy. Since 2002, plastic bags for free shopping have been banned. In 2018, an action plan for marine waste cleanup was announced. Regarding to the four major categories of single-use plastic products, disposable food containers, utensils, and straws were banned at all restaurants for customers dining on the premises in 2020. Plastic bags, disposable containers, utensils, and straws will be charged and restricted in all commercial places by 2025. The government aims to achieve a plastic free Taiwan by 2030. Although the government's determination is laudable, the current policies and resources are mostly focused on the end-of-pipe treatment of plastic waste, which cannot effectively solve plastic pollution. In response to the new type of international plastics standard mechanism in the future, it is suggested that the government should review the current plastics governance policy as soon as possible, and plan the national blueprint for reducing plastics and related supporting measures as soon as possible, so as to make efforts for the sustainable development of the earth.

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The Ministry of Environment in Lithuania: Pursuing Environmental Protection and Leading Marine Spatial Planning

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Keywords: Lithuania, Ministry of Environment, National Environmental Protection Strategy, Marine spatial planning

Republic of Lithuania (briefly, Lithuania) is a member of the European Union as well as a contracting party of the United Nations Convention on the Law of the Sea. There is no institution dedicated to marine affairs and the things related to marine environments are under the auspice of the Ministry of Environment. The National Environmental Protection Strategy developed by the Ministry of Environment is a major policy document pertaining to the environmental governance. The principles of environmental protection policy laid out in this document, such as eco-efficiency, pollution prevention, polluter pays principle, Precaution, represent the core and values of environmental protection held by the Lithuanian government. They are of course applied in the marine environmental protection. Furthermore, the Ministry of Environment legalized the marine spatial planning (MSP) as early as in 2014, making the MSP as a component of the Comprehensive Plan of the Territory. The marine spatial plan was then adopted in 2015 by the Parliament, indicating Lithuania's strong political desire to engaging in marine spatial planning by seeing marine space as important territorial resources for the development of blue economic activities and protection of marine environments.

Overview of Lithuania

Lithuania lies on the eastern shore of the Baltic Sea, and shares land borders with Latvia to the north, Belarus to the east and south, Poland to the south, and Kaliningrad Oblast of Russia to the southwest. It lies between latitudes 53° and 57° N, and mostly between longitudes 21° and 27° E, and covers an area of 65,300 square kilometers, with a population of 2.8 million. The coastline is approximately 90.66 kilometer in length. The area of the territorial waters and the exclusive economic zone is about 1,810 square kilometers and 4,560 square kilometers, respectively [2]. The north section of the coastline faces the Baltic Sea, while the rest of the coast is close to the Curonian Lagoon. The sand dune on the sand spit of the Curonian Lagoon is the largest mobile sand dune in Europe and is designated as the national park as well as listed as a UNESCO world heritage site.



Figure 1/ Exclusive Economic Zone of each state bordering the Baltic Sea (red lines marking the EEZ boundary) and the maritime space of Lithuania (marked in orange oblique lines)

Source/ [1]



Figure 2/ Sand dune at the Curonian Lagoon, a UNESCO world heritage site (Note: The water area of the lagoon is on the side across the trees)

Image by Chung-Ling Chen

The Lithuanian government is a semi-presidential system. The head of state is the president, directly elected for a five-year term and serving a maximum of two terms. The president oversees foreign affairs and national security. The president appoints the prime minister, approved by the parliament. The prime minister appoints the ministers of the cabinet, approved by the President. Currently, there is a total of 14 ministries, including Ministry of Environment, Ministry of Energy, Ministry of Economy and Innovation, Ministry of Finance, Ministry of National Defence, Ministry of Culture, Ministry of Social Security and Labour, Ministry of Transportation and Communication, Ministry of Health, Ministry of Education, Science and Sport, Ministry of Justice, Ministry of Foreign Affairs, Ministry of the Interior, Ministry of Agriculture [3].

There is no institution dedicated to marine affairs. The things relate to marine environments is under the auspice of Ministry of Environment. The National Environmental Protection Strategy developed by the Ministry of Environment is a major policy document of environmental governance. In addition, the Ministry is also in charge of marine spatial planning (MSP). It is worth noting that Lithuania is a member of the EU and therefore the legal documents adopted by the EU have a binding effect for Lithuania, such as the EU Marine Strategy Framework, the EU Directive on Marine Spatial Planning (hereafter the EU MSP Directive), the Integrated Marine Policy of the EU. This essay is to introduce the Ministry of Environment and its two policy documents (i.e., National Environmental Protection Strategy and Marine Spatial Planning) in order to understand the things related to ocean governance.

Ministry of Environment and National Environmental Protection Strategy

The Ministry of Environment is in charge of the issues or activities related to climate change, ambient air, water, chemical substances, environmental impact assessment, waste management, pollution prevention, natural protection, forest, protected areas and landscape, territorial planning, sustainable development, etc. [4]. The National Environmental Protection Strategy, adopted by the Parliament on September 25, 2016, is a major policy document pertaining to environmental governance. The main content of this document includes principles of environmental protection policy, priorities areas of environmental protection and the key policy implementing directions [5].

The principles of environmental protection policy represent the core and values held by the Lithuania government in its pursuit of environmental protection. There are 11 principles, including eco-efficiency, pollution prevention, responsibility (polluter pays principle, rectification at source, integration of the environmental protection policy, use of the best available technologies, precaution, substitution,

subsidiarity, partnership and shared responsibility, and public participation and information. Among them, eco-efficiency refers to using fewer resources to generate more goods and services and decreasing the levels of waste and environmental pollution. Substitution means efforts are made to ensure that substances hazardous to humans and the environment are replaced with non-hazardous substances and non-sustainable resources with clean or less polluting renewable resources, while waste generated is returned for reuse, recycling or other uses (such as power generation). Subsidiarity means the strengthening of democracy and partnerships in decision making and implementation process. Efforts are made to assist local communities with taking care of their environment and increase opportunities for their participation in dealing with local environmental problems.

There are four priority areas of environmental protection, which are: sustainable use of natural resources and waste management, improvement of the quality of the environment, maintenance of ecosystem stability, and climate change mitigation and adaptation. These four priority areas represent the issues pertaining to the environment that Lithuania prioritize to deal with. It is worth noting that the issues pertaining to the marine environment are not dealt with in a standalone chapter or section in the Strategy. Instead, the marine environment is assimilated into the whole environment and the issues are dealt with in each priority area. For example, the issue of fish stocks is dealt in the priority area of sustainable use of natural resources and waste management. The issues of water quality of the Baltic Sea and the Curonian Lagoon is mentioned in the priority area of improvement of the quality of the environment. The issues relevant to biodiversity and ecosystem services are tackled in the priority area of maintenance of ecosystem stability.

As for the fish stocks, the issues were particularly mentioned that commercial fishing is intensive in the coastal zone of the Baltic Sea and in the Curonian Lagoon, and fish stocks suffer damage from illegal fishing, fishing gear without tools for deterring birds and marine mammals. Furthermore, key policy implementing directions for fish stocks are proposed, including assurance of the sustainable use of fish stocks, protection of fish (salmon and sea trout) migration routes and spawning grounds, and installation of fish migration routes from the coastal zone of the Baltic Sea to the upper reaches of rivers, proper regulations of fishing, etc.

Marine Spatial Planning

The European Council (EC) adopted the EU MSP Directive (Directive 2014/89/EU) in 2014. The Directive aims at promoting the sustainable growth of maritime economics, the sustainable development of marine areas and the sustainable use of marine resources [6]. In Europe, the 22 coastal Member States are obliged under the MSP Directive to develop a national maritime spatial plan at the latest by 31 March 2021, with a minimum review period of 10 years. To track the progress of MSP in each coastal member state, a European Maritime Spatial Planning Platform has been set up, containing the information of MSP pertaining to each member state [2]. In addition, HELCOM (Baltic Marine Environment Protection Commission) is a regional organization dedicated to establishing a healthy Baltic Sea environment. MSP is one of the tools used to fulfill this goal and a page in the website has been created to include the information of MSP of member states, including Lithuania [7]. The information regarding the MSP in Lithuania as seen below is thus mostly excerpted and compiled from these two websites.

Lithuania has one of the shortest shorelines among European countries. The country's marine area borders Latvia in the North, the Russian Federation in the South (Kaliningrad oblast) and the Kingdom of Sweden in the West. In response to the upcoming MSP Directive and to strengthen governance of sea space, Lithuania launched to revise Law on Territorial Planning as early as in 2013. The revised Law came into force on 1 January 2014. Since the legislation of marine spatial planning was completed, the

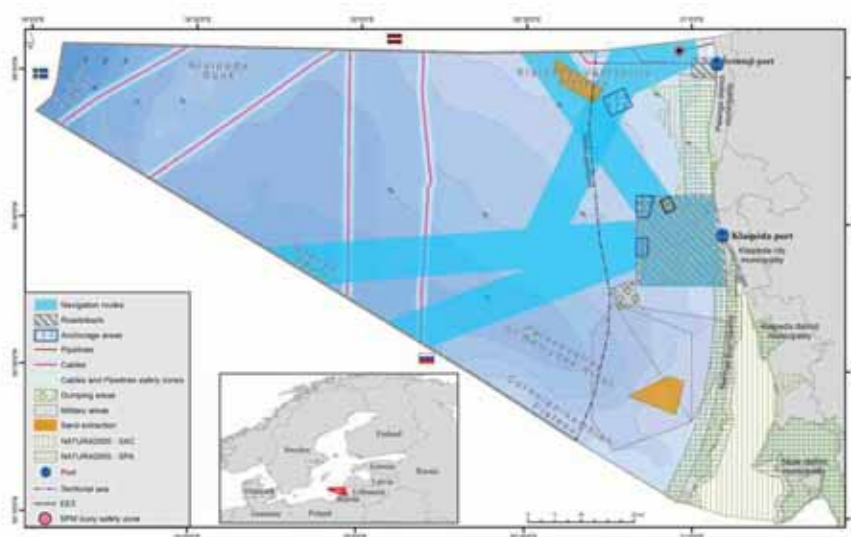


Figure 3/ Marine spatial planning of Lithuania, marking various uses pertaining to maritime spaces, including navigation routes, pipelines, cables, dumping areas, sand extraction, protection areas, etc

Source/ [8]

Ministry of Environment started to engage in marine spatial planning and the marine spatial plan was adopted by the Parliament on 11 June 2015, which becomes a part of the Comprehensive Plan of the Territory of the Republic of Lithuania. New Comprehensive Plan (2nd) that includes MSP was adopted by the Parliament on 29 September 2021.

The maritime space includes internal waters, territorial waters, the exclusive economic zone, the sea bottom and the soil underneath. The marine spatial plan (the official name is Comprehensive Marine Territory Plan) specifically lays out the regulations that need to be met, including the EU MSP Directive, the Law on Klaipeda State Seaport of the Republic of Lithuania, and the EU regulations for establishing a secure ferry and port infrastructure.

Main objectives of the plan were:

- to maintain equilibrium between economic and ecological development;
- to form a healthy and harmonious environment for creating better living conditions in the whole state;
- to form an integrated policy of development of different fields of activity;
- to protect, restore and rationally use resources of nature and recreation, values of natural and cultural heritage;
- to reserve territories for infrastructure and for other development needs of various kind activities in the maritime territories;
- to promote investments for economic development, preserving and restoration of values of natural, cultural heritage and recreational resources;
- to reconcile the interests of natural and legal entities, municipalities an state as well rights of subject of international law with regard to the use of the maritime territories.

Current uses, future uses, issues and identified spatial conflicts are taken into account during the elaboration of the MSP project. Zones with specific functions and their associated maps have been prepared, including the zones for spatial development concept and functional priorities of the territory, the zones for economic activity development, the zones for ensuring ecological balance and preserving the cultural heritage, the zones reserved for the national needs, etc. While these zones carry specific

functions, most of them are mixed uses as long as the use does not intervene with the prioritized activities and functions of a sea region. For example, in the non-specific and free marine region, the priorities are allocated for fishing, aquaculture, and sea-way passage. To facilitate renewable energy production, the part of sea area is allocated for renewable energy infrastructure such as windmills, wave energy generation and other innovative solutions. Another sea region is for high ferry mobility. The coastal areas are prioritized for ecosystem protection. Figure 3 shows the allocation of spaces for different uses, including navigation routes, pipelines and cables, ports, dumping areas, sand extraction, military areas, Natura 2000 Special Area Conservation (SAC), Natura 2000 Special Protection Area (SPA), etc.

Public participation is ensured during the spatial planning process. Measures include making the information public in all stages of planning process, making the materials of the Plan publicly available on the webpage of the Ministry of Environment, presenting the Plan during national and international conferences, organizing public hearings, etc. In addition, transboundary consultations were conducted during the planning process. The countries consulted are Latvia and Sweden, which are also EU member states and border with the maritime space of Lithuania.

Conclusion

No institution dedicated to marine affairs exist in Lithuania. The things relate to marine environments is under the auspice of Ministry of Environment. The National Environmental Protection Strategy and marine spatial planning, developed and implemented by the Ministry of Environment, are important policy documents on environmental governance. In particular, Lithuania legalized MSP as early as in 2014, making the maritime space being a part of the territory, and further adopted the marine spatial plan in 2015. Lithuania is one of the EU member states who take the initiative to complete the MSP project, demonstrating its emphasis on the development of economic activities and environmental protection in the maritime space.

The coastline of Lithuania is short, being merely 90.66 kilometers and the area of maritime space under its competence is only 6,370 square kilometers. While both are far smaller than Taiwan's coastline (about 1,900 kilometers) and the combined area of Taiwan's territorial sea and contiguous zone (approximately 83,700 square kilometers), Lithuania boldly sees its maritime space as an important national asset and actively engaged in marine spatial planning in order to meet the needs of development of national economic activities and ensure environmental protection. The way of Lithuania dealing with its maritime space serves a good model for our reference.

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Invasive Alien Species and Ballast Water Management in Lithuania

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Keywords: Baltic Sea, aquatic invasive species, HELCOM, ballast water exchange

The 2005 Millennium Ecosystem Assessment indicated that the impact of invasive alien species will grow over the coming decades. Invasive alien species are now recognized as one of the main causes of biodiversity loss and ecosystem change. The volume of goods transported by sea is growing due to the increase of trade globalization, which also indirectly leads to ships transporting a large amount of ballast water worldwide. The introduction of alien species into new marine environments through ballast water is recognized as a significant threat to the global ocean and biodiversity. In 2004, the International Convention for the Control and Management of Ships' Ballast Water and Sediments (Ballast Water Management Convention, BWMC) was formulated by the International Maritime Organization to ensure effective ballast water management. The BWMC aims to prevent or mitigate the introduction of alien species from ships' ballast water. Lithuania, located in the southeast of the Baltic Sea, is a contracting party to the Convention on the Protection of the Marine Environment of the Baltic Sea Area (Helsinki Convention). Based on the Helsinki Convention and BWMC, the countries of the Baltic Sea area cooperate in the measures of ballast water management to protect the marine environment and ecosystems of the Baltic Sea.



Figure 1/ Port of Klaipėda, Lithuania
Source/ <https://portofklaipeda.lt/en/naujienos/eu-funds-to-dredge-the-navigation-channel-up-to-15-meters-in-klaipeda-port/>

Invasive Alien Species and Ballast Water

Alien species are non-indigenous species introduced unintentionally or intentionally through human activities. Some biological species overcome geographic range limits and expand to areas beyond their natural distribution due to the frequent human activities around the world. Some alien species may dramatically change local ecosystems in the absence of natural controls such as predators, parasites or disease. Such species are called invasive alien species [1].

As international trade grows, shipping is crucial to the global economy. Shipping is the most cost-effective way to transport goods over long distances, with 80% of goods currently transported by ships. It is important for ship sailing to draw or discharge seawater as ballast water because it ensures the seaworthiness of ships. The main functions of ballast water are as follows [2]:

- Adjusting the ship's load and draft.
- Keeping the hull balanced when the weight of the load is unevenly distributed.
- Controlling the stability of ships under different weather conditions.
- Improving the usage efficiency of ship fuel.

Under natural conditions, most marine aquatic species will migrate or spread, but it is more difficult for species to spread to distant sea due to geographic barriers. However, when ships draw ballast water at source port, a large number of aquatic species enter ship's ballast tanks. Subsequently, at destination port, these species are transferred to another sea areas as the cargo is loaded into the ship and the ballast water is discharged. Ballast water is considered to be one of the main vectors for the invasive spread of potential alien species. As much as 14 billion tons per day of ballast water is transported around the world, and there may be approximately 7,000 to 10,000 different species of marine microorganisms, plants and animals in ballast water [3]. Table 1 lists the most invasive species transferred through ballast water. Currently, most countries are affected by ballast water discharge and realize that uncontrolled discharge of ships' ballast water may lead to the invasion of alien species and the transfer of pathogens, causing damage related to the ecological environment, economy and human health.

International Maritime Organization (IMO) Marine Environment Protection committee (MEPC) is also concerned about ballast water and the invasion of aquatic alien species. In 2004, the IMO Assembly in London, UK adopted the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM) to prevent or mitigate the introduction of invasive alien species from ships' ballast water. The BWM entered into force in September 2017. As of April 2022, 89 states ratified the BWM, accounting for approximately 91.20% of the gross tonnage of the world's merchant fleet [4].

Table 1/ The 10 most invasive species transferred through ships' ballast water

Common Name	Scientific Name
Cholera	<i>Vibrio cholera</i>
Cladoceran water flea	<i>Cercopagis pengoi</i>
Mitten crab	<i>Eriocheir sinensis</i>
Toxic algae	various species
Round goby	<i>Neogobius melanostomus</i>
Zebra mussel	<i>Dreissena polymorpha</i>
Comb jellyfish	<i>Mnemiopsis leidyi</i>
North Pacific seastar	<i>Asterias amurensis</i>
European green crab	<i>Carcinus maenas</i>
Asian kelp	<i>Undaria pinnatifida</i>

Source/ https://wwwcdn.imo.org/localresources/en/OurWork/PartnershipsProjects/Documents/Mono25_English.pdf

Aquatic Invasive Alien Species in the Baltic Sea and Lithuania

The Baltic Sea is a semi-closed water body, and the salinity of the upper and lower water layers is significantly different, which results in obvious stratification of the water body. Invasive alien species in the Baltic sea have increased over the past 50 years. Compared with previous data, relatively active maritime transportation have caused ships to transport a large amount of ballast water from more areas in shorter time, which made it easy for alien species in ballast water to be introduced into the Baltic Sea [5].

In order to protect the marine environment of the Baltic Sea, the coastal countries of the Baltic Sea (Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, Russia, Sweden) and the European Union jointly signed the Convention on the Protection of the Marine Environment of the Baltic Sea Area (Helsinki Convention). One of the aim of Helsinki Convention is to protect the Baltic Sea from land-based, air and marine pollution sources for the purpose of maintaining biodiversity and habitats. The Baltic Marine Environment Protection Commission (HELCOM), also known as the Helsinki Commission, is an intergovernmental organization. The purpose of HELCOM is to administer the Helsinki Convention, serving as a platform for regional marine environmental policy development. Since 2008, the HELCOM has compiled and updated the comprehensive list of invasive alien species in the Baltic Sea. Based on the historical data from the comprehensive list, the trend of introduction of alien species in the Baltic Sea has grown with the years [6]. It is estimated that approximately 120 aquatic invasive species have been recorded in the Baltic Sea, of which nearly 80 species have established breeding populations. Most of these invasive species have been introduced in the past 100 years, and shipping is the most important vector of introduction [7].

Lithuania is located in the southeast of the Baltic Sea with a coastline of 90.66 kilometers. Previous studies indicated that 17 species of bottom fauna introduced via ship's hull or ballast water were observed in the waters of the Lithuanian coastline. The species include one species of hydroids, one species of multi-bristle worms, 11 species of crustacean and four species of limpets [8]. The round goby, well-known invasive alien species, first appeared in the Gulf of Gdansk in Poland in 1990, and appeared off the coast of Lithuania in 2002. According to previous studies, it was indicated that the round goby found in Lithuanian coast may be from the ballast water of the Black Sea, the Azov Sea and the Caspian Sea [5]. Currently, the round goby is expanding further and up to a stable population in the Curonian Lagoon off the coast of Lithuania, which may affect the habitat and food resources of the ruffe (*Gymnocephalus cernua*), the native bottom fish [9].

Ballast Water Management in Lithuania

The Port of Klaipeda is the only commercial seaport in Lithuania with an annual cargo turnover of approximately 20 million tons. About 7,000 ships enter the Port of Klaipeda each year, discharging approximately 2 to 4 million tons of ballast water. Furthermore, the Port of Butinge Oil Terminal, operating since 1999, is another source of ballast water off the coast of Lithuania. Oil tankers are loaded at the Port of Butinger which is capable of accommodating tankers up to 150,000 tons [5]. The Klaipeda State Seaport Authority and the Butinge Port Authority are the competent authorities for ballast water management in the two ports respectively. The HELCOM and the Oslo-Paris Commission (OSPAR Commission) jointly adopt the measures of ballast water management to protect the Baltic Sea and the North-East Atlantic. Therefore, the competent authorities of ballast water management in Lithuania are subject to the regulations or guidelines established by these two regional organizations.

According to BWMC and "IMO 2017 Guidelines on designation of areas for ballast water exchange (G14)", ships should conduct ballast water exchange at least 200 nautical miles from the nearest land and at a water depth of at least 200 meters. If the aforementioned conditions cannot be met, ballast water exchange must be conducted at least 50 nautical miles from the nearest land and at a water depth of at least 200 meters. However, the water depth and distance from the land requirements for ballast water exchange cannot be met in the Baltic Sea area. Therefore, according to BWMC and G14, as well as most alien species in the Baltic Sea have a wide tolerance in salinity, the HELCOM considered that the Baltic Sea is unsuitable for ballast water exchange [10].

The HELCOM, OSPAR Commission and Barcelona Convention have co-operated on a set of three joint IMO voluntary interim guidelines. The guidelines specify the location of ballast water exchange based on the ship's route involving three sea areas. It should be noted that these interim guidelines do not apply when BWMC's D-2 standard (refer to Regulation D2 in Table 2) is applied to ships [6][10]. For ships sailing in the Baltic Sea, the Northeast Atlantic and the Mediterranean Sea, the relevant guidance for the exchange of ballast water are as follows:

- Since April 2008, ships transiting the Atlantic or entering the North-East Atlantic from routes passing the West African Coast are requested to discharge their ballast water at least 200 nautical miles from the nearest land and at a water depth of at least 200 meters before arriving at or passing through the OSPAR area. The volume of ballast water is exchanged in accordance with the D-1 standard (refer to Regulation D1 in Table 2).
- Since January 2010, ships leaving the Baltic sea and transiting the OSPAR area to other destinations are requested to discharge their ballast water at least 200 nautical miles off the coast of North West Europe and at a water depth of more than 200 meters. The volume of ballast water is exchanged in accordance with the D-1 standard.
- Since October 2012, ships sailing between the Mediterranean Sea and the North East Atlantic and/or the Baltic Sea are requested to exchange ballast water at least 200 nautical miles from the nearest land and at a water depth of at least 200 meters, as soon as they enter or leave the North-East Atlantic. The volume of ballast water is exchanged in accordance with the D-1 standard.

Additionally, the HELCOM and OSPAR Commission have adopted and amended the "Joint Harmonized Procedure for the Contracting Parties of OSPAR and HELCOM on the granting of exemptions under the BWM Convention, Regulation A-4 (JHP)" between 2013 and 2020. According to BWMC's regulation, JHP allows ships passing through the Baltic Sea and the Northeast Atlantic to apply for exemptions from ballast water management between specified ports. These specified ports are areas with low risk of harmful aquatic organisms and pathogens (HAOP). However, according to BWMC and IMO regulations, all ships must treat ballast water with an approved onboard Ballast Water Management System (BWMS) to meet D-2 standards by September 2024. Therefore, JHP is only an interim program for the transitional period (2017 to 2024). The transitional period will end by 2024 when the D-2 ballast water standard applies in full based on BWMC [11].

Conclusion

Invasive alien species introduced by improper discharge of ship's ballast water constitute a threat to the ecological environment, economic losses and human health of the sea area. The BWMC has been adopted by the IMO in 2004 to prevent or mitigate the issues of invasive alien species, and entered into force in September 2017. Lithuania, a Baltic country, is a contracting party to both the BWMC

Table 2/ Standards for ballast water discharge under the BWMC

Ballast Water Management Standards	Content
Regulation D1 Ballast water exchange standard	If the ship uses the sequential method, the exchange rate of 95% of the carried ballast water should be achieved. If the dilution method is used, the volume of water injected and discharged should be at least 3 times the volume of ballast water.
Regulation D2 Ballast water performance standard	Ballast water treated by the Ballast Water Management System (BWMS) must meet the standard of maximum allowable viable organism limits before it can be discharged into the sea. The standards are explained as follows: I. <10 living organisms per m ³ , sized ≥50µm; II. As well as <10 living organisms per ml of water, sized <50µm and ≥ 10µm, with a predetermined number of indicator microorganisms.

Source/ <https://www.imo.org/en/MediaCentre/HotTopics/Pages/Implementing-the-BWM-Convention.aspx>

and the Helsinki Convention. Therefore, Lithuania follows the norms of the HELCOM, and implement the BWMC based on the joint measures of ballast water management with other Baltic states. The HELCOM has collaborated with other regional organizations to develop voluntary interim guidelines. The guidelines specify the location of ballast water exchange based on the ship's route to comply with the D-1 standard. In addition, the HELCOM and OSPAR Commission have adopted and amended the joint harmonized procedure (JHP) for ballast water exemptions as an interim program until the full application to the D-2 standard in 2024.

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Maritime Delimitation Agreements and Relevant Practice of Lithuania

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Keywords: Latvia, Lithuania, Maritime Delimitation, Sweden, Russia

After the dissolution of the former Soviet Union, Lithuania has concluded maritime delimitation agreements with Russia, Latvia, and Sweden. Disagreements concerning economic activities at sea and exploitation of natural resources can be observed, and other factors, such as the changing state of the Baltic region and sovereignty disputes further complicate matters, leading to differing outcomes of such delimitation agreements. Through the introduction and analysis of the process and experience related to each of the agreements, this contribution seeks to aid in the understanding of how delimitation disputes can be resolved in order to promote regional peace.

Introduction: Delimitation Agreements in the Baltic Sea

All States surrounding the Baltic Sea are parties to the United Nations Convention on the Law of the Sea (UNCLOS) [1]. In addition to rules on the nature, scope, and rights and obligations of coastal and other States, the UNCLOS also contain provisions on delimitation between States of opposite and adjacent coasts. While different delimitation principles are provided for territorial sea (Article 15) vis-à-vis the exclusive economic zone (Article 74) and continental shelf (Article 83), agreements remain the common primary means of settling such disputes. For States with delimitation agreements, questions of delimitation are determined by the provisions of such agreements.

The Baltic Sea is relatively confined, and its average width is far shorter than 400 nautical miles. Considering that, pursuant to the UNCLOS, States may claim 200 nautical miles of exclusive economic zone, delimitation discussions with other States have become necessary for all States in the region, and the process and outcome of negotiations varies depending on the bilateral relations between the relevant States. Professor Erik Franckx, a prominent scholar with expertise concerning the region, often presents the analysis of relevant State practice in four time periods [2]:

- I. 1945-1972: This period covers the height of the Cold War. The first delimitation agreement was concluded in 1958 between Poland and the former Soviet Union concerning territorial sea, and the vast majority of subsequent agreements were concluded between States of the Eastern Bloc. Finland was the only non-Eastern Bloc State taking part in Baltic delimitation agreements during this period.
- II. 1973-1985: With the conclusion of the Basic Treaty between the two Germanies in 1972, partial normalization of relations between the two Blocs was under way, and cross-Bloc delimitation agreements were concluded during this period.
- III. 1985-1990: States worked on resolving more complicated issues (e.g., the effect of islands on delimitation) and new issues arising out of the conclusion of the UNCLOS (e.g., exclusive economic zones and their delimitation). This period marked the most productive one, with the higher number of agreements concluded compared to the forty years preceding this period.
- IV. 1990 to present: With the dissolution of the former Soviet Union, the legal effect of delimitation agreements concluded by it were questions, and the re-emergence of the Baltic States also prompted new delimitation needs.

At the end of the third period described above, most of the Baltic Sea had been delimited, with the exception of a small portion of the region. However, the dissolution of the former Soviet Union had a profound impact on the maritime delimitation of the region. While international law has developed theories concerning the effect of the unification and separation of international legal persons or the transfer of territory, and the Vienna Convention on Succession of States in respect of Treaties was concluded in 1978 [3], many theories and rules within the 1978 Vienna Convention remain disputed. Additionally, Baltic States are often of the opinion that they are not the successor States of the former Soviet Union [4]. Thus, new delimitation negotiations became pertinent, and the following section introduces the agreements concluded by Lithuania with other States.

Maritime Delimitation Agreements Concluded between Lithuania and Other States

The 1992 Constitution of the Republic of Lithuania declares that: "The Republic of Lithuania shall have the exclusive rights to the airspace over its territory, its continental shelf, and the economic zone in the Baltic Sea" [5], without stipulating further rules concerning maritime zones and their delimitation [6]. In June of the same year, Lithuania adopted the Law on the State Border of the Republic of Lithuania, confirming its 12-nautical mile claim of territorial sea. Subsequent legislation and resolutions have provided its claims of contiguous zone, exclusive economic zone, and continental shelf [7]. Among the official documents, an illustrative map of the maritime boundaries with other States was enclosed with a 2004 resolution by the Lithuania government (Figure 1).

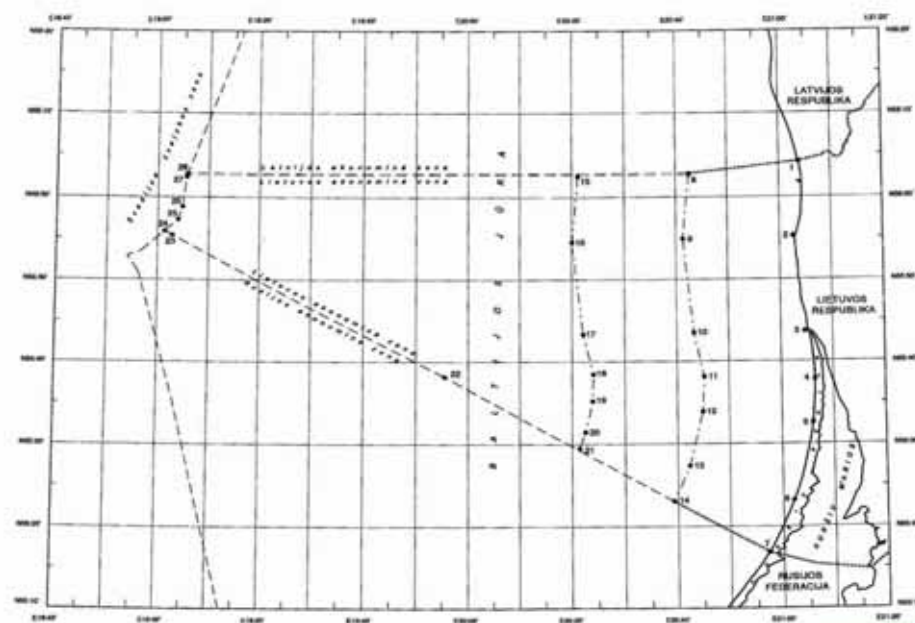


Figure 1/ Illustrative Map of Lithuania's Maritime Boundaries with Other States

Source/ Lithuanian Government (submitted to the United Nations Office of Legal Affairs, Division for Ocean Affairs and the Law of the Sea database) [8]

According to the information provided by Lithuania to the Division for Ocean Affairs and the Law of the Sea, United Nations Office of Legal Affairs, three delimitation agreements were concluded by Lithuania and other States and entered into force. These agreements all deal with the delimitation of both the exclusive economic zones and the continental shelf. Two are bilateral agreements with Russia and Sweden respectively, and one trilateral agreement with both Russia and Sweden. Practice of States in the region shows that if three States have overlapping maritime claims, States tend to initiate bilateral delimitation negotiations first. After the relevant States concluded bilateral agreements, the three States would then begin negotiations for a tri-point agreement [9]. Lithuania's practice, which is somewhat different, will be explained below.

Lithuania shares a border with Russia's Kaliningrad, and the two States concluded the Treaty between the Republic of Lithuania and the Russian Federation on the Delimitation of the Exclusive

Economic Zone and the Continental Shelf in the Baltic Sea in 1997. An equidistance line was used as a starting point for delimitation. As the two States proposed changes to the line, Russia placed more emphasis on the development of oil field off the coast, and Lithuania sought to keep a corridor to the center of the Baltic Sea. At the end, the first segment of the maritime boundary was close to the Russian approach, while the second segment took into account Lithuania's considerations for a corridor [10]. After the Treaty was signed, sensitive issues between the two States, including Russia's claim over Klaipeda and Lithuania's plan to join the North Atlantic Treaty Organization, brought uncertainties of how Russia's Duma would view the deal [11]. Despite these doubts, the Treaty eventually entered into force after Duma approved the ratification in 2003 [12].

Among the Lithuania's delimitation agreements that are in force, the second one is a tri-point agreement, namely the Agreement between the Government of the Republic of Lithuania, the Government of the Russian Federation and the Government of the Kingdom of Sweden on the Common Point of Boundaries of the Exclusive Economic Zones and Continental shelf in the Baltic Sea. This Agreement was concluded on November 30, 2005, and entered into force in 2011 [13]. Unlike the practice of States in the region described above, before the 2005 Agreement was concluded, there were only two bilateral delimitation agreements in force: the 1988 Soviet-Sweden Agreement and the 1997 Lithuania-Russia Agreement. In other words, Lithuania has not concluded a delimitation agreement with Sweden. From Lithuania's domestic legislation and the abovementioned 2004 resolution, it can be observed that, while these instruments do not make direct reference to the 1988 Soviet-Sweden Agreement, the boundary and points used in that Agreements have in fact been adopted by Lithuania [14]. In the tripoint agreement concluded in 2005, Article 1 explicitly refers to the 1988 Soviet-Sweden Agreement. This echoes the position of Russia and Sweden, who consider that the boundaries established in that Agreement continue in effect after the dissolution of the former Soviet Union. However, this explicit reference proved to be controversial at the domestic level in Lithuania, and the Seimas, Lithuania's parliament ratified the Agreement nearly six years later, allowing the Agreement to enter into force on June 17, 2011 [15].

The next delimitation agreement concluded is the 2014 Agreement between the Government of the Republic of Lithuania and the Government of the Kingdom of Sweden on the Delimitation of the Exclusive Economic Zones and the Continental Shelf in the Baltic Sea. This Agreement essentially builds on the consensus reached in the 1988 Soviet-Sweden Agreement and the 2005 tri-point Agreement. One major difference between this Agreement and the 1988 Agreement relates to fishery activities, which was a point of major contention between the former Soviet Union and Sweden. While the 1988 Agreement delimited the disputed areas, the two States concluded a separate fishery agreement, setting up quota and other rules for fishing activities in those areas. After the dissolution of the former Soviet Union, the fishing arrangements ceased to apply, and fishing activities were not a major concern in the discussions between Lithuania and Sweden.

In addition to the three agreements in force introduced above, Lithuania also concluded another delimitation agreement with Latvia in 1999, the Agreement between the Republic of Latvia and the Republic of Lithuania on the Delimitation of the Territorial Sea, Exclusive Economic Zone and the Continental Shelf in the Baltic Sea. This Agreement is directly related to the dissolution of the former Soviet Union and was sparked by the potential non-living resources in the disputed waters, including oil and natural gas. While Lithuania and Latvia decided on land and maritime boundaries in the 1920s [17], maritime claims at the time were significantly different from what States can now make under the UNCLOS. Delimitation negotiations were thus needed, and the two States concluded the Agreement on July 9, 1999, using an equidistance line as basis and taking into

consideration fishing and other economic activities. Lithuania ratified the Agreement in October of the same year. However, Latvia faced protests by the fishing industry [18], and it also sought to explore oil resources before committing to a delimitation agreement, thus failing to ratify the Agreement until now [19].

Conclusion

A few observations can be made from the Lithuania's delimitation agreements and relevant developments: Firstly, parties of a delimitation negotiation may have different priorities. It is important to have a firm grasp of the party's own goals and agree to compromise in a proper manner, in order to reach an agreement. Secondly, while the negotiation and conclusion of a maritime delimitation agreement involve discussions of delimitation methods, economic activities, resources exploitation, and other typical concerns, the eventual ratification and entry into force of an agreement can often be influenced by external factors. Successful resolution of delimitation disputes requires the meeting of minds on a broad range of issues. Finally, after the conclusion of a delimitation agreement, much effort needs to be made to ensure the ratification, entry into force, and implementation. It is incumbent upon the relevant State to maintain relations which are conducive to peaceful use of maritime spaces and to avoid the continuance or escalation of disputes.

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20
October 2022
雙月刊 | Bimonthly



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中華民國111年10月出版(每雙月出版)

中華民國108年8月創刊

ISSN 2706-638X (紙本)

ISSN 2706-6398 (電子)

中華郵政高雄雜字第236號執照登記為雜誌交寄

高雄郵局許可證 高雄字第2084號

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