International Ocean Information

國際海洋資訊

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海洋產業發展條例

Marine Industry Development Act

海洋產業資訊

Marine Industry Information

海洋委員會 Ocean Affairs Council 發行

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Blue Economy - Exploring Marine Industry Development and Safeguarding Marine Sustainability Goals

Minister of the Ocean Affairs Council: Bi-Ling Kuan
Translated by Chung Hua Translation Service

The "marine industry" stands as a pivotal sector in the promotion of the blue economy and holds irreplaceable importance. As the marine industry is also inseparable from human civilization and has been developed into a complex industry, every country has therefore adopted various protective measures to safeguard the marine environment in their pursuit of a robust marine industry, aiming to foster and establish an even more sustainable marine industry-driven economy.

For this issue of International Ocean Information, the "Special Report" shares details of the "Marine Industry Development Act" (hereinafter referred to as the Act) passed on June 21, 2023. The Act was drafted in 2019 and, with the collaborative efforts of the industrial, governmental, academic, and research sectors, as well as civil society organizations, it was finally successfully legislated this year. This specialized legislation with integrated regulatory effectiveness will, on the premise of environmental sustainability, offer a sound environment for the development of the marine industry. To facilitate promotion of the Act after its enactment, the Ocean Affairs Council (OAC) has initiated the integration of national marine information surveys to proactively build the National Ocean Database and Sharing System (NODASS). The system, which provides fundamental data and information for the marine industry, can not only assist the industrial, academic, and research sectors in meeting their development and planning needs, but also integrate the "marine conservation value" and "marine industry development" interfaces to coordinate and address challenges encountered in the marine industry's development, safeguarding marine sustainability goals. Moreover, the OAC collaborates with competent authorities in ocean-related industries to enhance various countermeasures, aiming to take significant steps towards the deployment and development of our marine industry with a focus on safeguarding marine sustainability.

"International Issues" examines the status of global ocean monitoring systems in 2022 and introduces the development of international operational ocean monitoring as a point of reference for the establishment of domestic operational ocean monitoring practices. This includes systematic ocean monitoring strategies, such as operational monitoring and research-oriented monitoring. "Industry Dynamics", on the other hand, holds a brief discussion on the European Union's (EU) 2022 Blue Economy Report. This section primarily presents the scope and scale of the blue economy analyzed in this report in order to provide a framework and data for policy decision-makers and stakeholders, aiding the EU in achieving the goal of sustainable development in the blue economy. "Organization Focus" introduces the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization (IOC/UNESCO) by providing a summary of its history, missions, objectives, organizational structure, expertise, as well as its ongoing ocean and marine activities. This aims to understand the capacity of the IOC/UNESCO in promoting the advancement and application of marine science knowledge.

Finally, the "Regulatory Systems" section of this issue is divided into two units to respectively introduce the background, development, and relevant regulations of "area-based management tools" (ABMTs), including "marine protected areas" (MPAs), within the "Agreement under the United Nations Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas Beyond National Jurisdiction" (BBNJ Agreement). It also covers the identification of the impact of relevant activities on the marine environment through environmental impact assessment.

Introduction to the "Marine Industry Development Act"

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Translated by Chung Hua Translation Service
Keywords: Marine Industry Development Act, marine industries, Ocean Affairs Council (OAC)

Vigorously developing marine industries hold indispensable significance in building an ecologically sound, safe, and prosperous high-quality oceanic nation. The marine industries possess complex characteristics and are closely related to the livelihoods of the nation's citizens. However, due to the dispersion of relevant regulations across various acts, it is deemed necessary to establish legislation that integrates all regulatory effectiveness to facilitate the consolidation of policies and coordination of related matters. This will ultimately contribute to creating a high-quality environment for the development of marine industries while ensuring environmental sustainability and responsible utilization.

Promote the legislation of "Marine Industry Development Act"

The "Marine Industry Development Act" encompasses two major scopes and ten major policy tools. The two scopes are "coordinating and managing marine affairs and tools across ministries" and "constructing an industrial support framework":

I. **Inter-ministerial marine affairs coordination and management tools:** These includes establishing an ocean database, allocating an adequate government budget, and allocating a portion of the fees and expenses collected by the ministries from marine enterprises as annual marine development funds.

II. **Industrial support policy tools:** These include concessional financing, assistance in establishing parks or special zones, guidance and incentives for businesses, talent cultivation programs, investment tax reduction and exemption, tariff exemption for machinery and equipment meeting specific conditions, and eligibility for the establishment of dedicated legal entities.

The purpose of establishing the Ocean Affairs Council (hereinafter referred to as OAC) is to facilitate horizontal coordination for marine affairs to enhance the planning, implementation and promotion of marine policies, with marine industries being an integral part of it. Promoting the legislation of the "Marine Industry Development Act" is also one of OAC's current major tasks.

History of promotion

The OAC initiated the drafting of the "Marine Industry Development Act" (hereinafter referred to as the Act) in June 2018. The OAC, which is the competent authority for this Act, is tasked with integrating, coordinating, and promoting marine industry policies across all organizations. To gather input from diverse perspectives, the OAC held a total of 16 seminars, coordination meetings, and consultation sessions, and invited representatives from the industrial, academic, governmental sectors, as well as ministries, to participate in these gatherings. On January 21, 2020, the OAC submitted the draft of the Act to the Executive Yuan for deliberation.

The Executive Yuan held three inter-ministerial review meetings on June 12, July 9, and October 22, 2020, respectively. On February 2, 2023, the Executive Yuan approved the proposal during the 3841st Executive Yuan meeting. Later on, May 26, the Legislative Yuan passed the third reading of the Act and the President announced the promulgation of the Act on June 21.

Content of the "Marine Industry Development Act"

The Act has 16 provisions, which are summarized as follows:

I. Definition of marine enterprises and industry. (Articles 3 and 4)

II. Integrate the ocean monitoring, surveying and mapping data from agencies (organizations) in order to establish an ocean database. (Article 5)

III. The government shall allocate a budget to promote the development of marine industries. (Article 6)

IV. Provide marine industries with concessional financing channels and credit guarantee mechanism necessary for industry development and investments. This will help marine enterprises to obtain the funds required for promoting marine industries. Additionally, aid in establishing parks of or special zones for the marine industries, and offer essential guidance and support. (Articles 7 and 8)

V. Foster and incentivize national participation in marine activities; offering suitable guidance, assistance, incentives or subsidies to marine enterprises; and promote collaboration between colleges/ universities and marine enterprises to nurture talent for marine industries. (Articles 9 to 11)

VI. Investments made by marine enterprises to enhance the soft power of marine industries are eligible for tariff exemptions. Additionally, machinery and equipment imported from overseas for the development of marine industries may also qualify for tariff exemptions within a specified timeframe. (Articles 12 and 13)

VII. Allocating a portion of fees and other expenses/revenue collected by the central competent authority from marine enterprises towards the development of marine industries as annual marine development funds. (Article 14)

VIII. The central competent authority is eligible to promote the development of marine industries as dedicated legal entities. (Article 15)

Conclusion

The "Marine Industry Development Act" can empower the OAC to play the role of integrating and coordinating marine industry policies. This not only helps to facilitate the development of marine industries, but also aids in achieving environmental sustainability goals, building an ecological, safe, and prosperous high-quality oceanic nation.

"Marine Industry Development Act"

Marine Industry Development Act

June 21, 2023
Hua-Zong-Yi-Yi-Zi No. 11200051181

Article 1

This Act are enacted to promote the sustainable development of the marine industry, enhance the competitiveness of the marine industry, and strengthen the functions of policy integration and coordination.

The marine industry development shall be in accordance with the provisions of this Act. Any other law that are more beneficial than this Act in facilitating the marine industry development shall prevail.

Article 2

In this Act the term "competent authority" refers to the Ocean Affairs Council at the central government level; or the municipal government in a municipality; or the county (city) government in a county (city).

Article 3

In this Act the term "ocean business" refers to a juridical persons, partnership, a sole proprietorship, or an individual engaged in the marine industry.

Article 4

In this Act the term "marine industry" refers to the following industries that use marine resources and space for various production and service activities:

I. Ocean energy.
II. Marine biotechnology.
III. Non-living marine resources.
IV. Marine mineral resources.
V. Ocean fishery.
VI. Ocean culture.
VII. Ocean sports.
VIII. Marine tourism and recreation.
IX. Ocean-sailing yachts, and other vessels and vehicles.
X. Marine transportation and support.
XI. Mariculture.
XII. Marine monitoring.
XIII. Marine surveying and mapping.
XIV. Marine information services.
XV. Marine engineering.
XVI. Marine environmental protection.
XVII. Other industries designated by the central competent authority.

The content and scope of the various industries mentioned in the preceding paragraphs shall be determined by the central competent authority in consultation with the central competent authorities of the respective industries.

Article 5

The central competent authority should coordinate with and integrate the marine monitoring, surveying and mapping information of various government departments (institutions) to establish a ocean database.

All government departments (institutions) should cooperate in providing the necessary marine monitoring, surveying and mapping information for the marine database mentioned in the preceding paragraph.

The central competent authority may coordinate with the relevant government departments (institutions) to set up necessary marine monitoring, surveying and mapping facilities, and then integrate and promote their maintenance and management affairs.

Article 6	The government should prepare a budget to promote the marine industry, and take necessary measures to ensure that the budget for the marine industry meets the needs of policy implementation.
Article 7	The central competent authority may consult with the relevant government departments, financial institutions and credit guarantee organizations to establish preferential financing channels and credit guarantee mechanisms for investments in marine industry development, and assist the ocean businesses in obtaining the funds needed to promote the marine industry.
Article 8	The central competent authority may assist the competent authorities of the various municipalities and counties (cities), government-owned and private enterprises, juridical persons or natural persons to set up marine industrial park or designate an area to establish a marine industrial zone according to the laws, and consult with the central competent authorities of the respective industries to provide necessary guidance and assistance.
Article 9	In order to encourage the citizens to engage in marine activities, the competent authorities and the central competent authorities of the respective industries shall jointly promote multi-use of the ocean, create friendly oceans, and establish guidance and management mechanisms for ocean sports, tourism and recreational activities. In order to train and educate highly skilled people in the marine industry and raise awareness about marine conservation, the central competent authorities of the respective industries may prepare a budget to subsidize the citizens' participation in marine activities. In order to encourage the citizens to participate in marine activities, governments at different levels should strengthen promoting marine activities to all citizens on National Oceans Day, and encourage various government departments, institutions, schools, juridical persons and organizations to hold different kinds of marine activities.
Article 10	The central competent authorities of the respective industries may provide appropriate guidance, assistance, incentives or subsidies to the ocean businesses in the following matters: I. Innovation of the marine industry. II. Mutual aid and cooperation between different industries. III. Establishment of self-owned brands, international cooperation and exchanges for expansion of international markets, as well as participation in domestic and foreign competitions or exhibitions. IV. Promotion of investment and invitation of investors. V. Cultivation of professional talents. VI. Industry-university cooperation, entrepreneurial incubation and counseling. VII. Facilitation of sustainable fisheries management. VIII. Marine industry clusters. IX. Collection of marine industry and market information. X. Promotion of research and development, production, marketing, extension, authorization and other industrial activities for the marine industry. XI. Other matters relating to facilitating the marine industry development. The central competent authority shall consult with the various central competent authorities of the respective industries to regularly review the aforesaid guidance, assistance, reward or subsidy receivable by the targets, their qualifications, review and approval criteria, application procedure, reward methods, as well as other related matters determined by the central competent authorities of the respective industries.

Article 11	In order to fully develop and utilize marine human resources, integrate the resources of teaching and research, and achieve the goal of cultivating talents in the marine industry, the competent authorities as well as central competent authorities of the respective industries may take the following measures: I. Encourage universities, colleges and junior colleges, as well as the ocean businesses to conduct industry-academia-government cooperative research and talent cultivation. II. Assist universities, colleges and junior colleges, as well as the ocean businesses in enriching the talent pool of the marine industry and establishing learning channels. III. Facilitate universities, colleges and junior colleges, as well as the ocean businesses to offer the relevant courses, or conduct research, observation and creation. IV. Request the vocational training centers to open training courses for the talents required in the marine industry, establish the related talent certification mechanism, and set up a talent pool and platform for matching the ocean businesses with the talents.
Article 12	In order to promote marine industry development, the ocean businesses may enjoy tax relief or tax exemption in accordance with the relevant tax laws or other laws, for the amount of expenses they have paid for investment in the research and development of marine products and services as well as related personnel training.
Article 13	The machinery and equipment imported by the ocean businesses from foreign countries for the marine industry development shall enjoy tariff exemption if the central competent authorities of the respective industries have certified the authentic purposes of the machinery and equipment, and that they have not been domestically manufactured or supplied yet. The implementation period of the tariff exemption mentioned in the preceding paragraph shall be three years as from the date of promulgation and implementation of the Act. The application procedure, as well as the identification methods and standards for certifying documents mentioned in Paragraph 1 shall be determined by the central competent authorities of the respective industries.
Article 14	The various central competent authorities of the respective industries shall collect from the ocean businesses the related additional compensation and other expenses or income required for the marine industry development. Every year part of the collected amount shall be appropriated to the Ocean Development Fund set up by the central competent authority for the matters of marine development and resource sustainability. The scope, appropriation procedure, calculation basis and other matters concerning the additional compensation and other expenses or income mentioned in the preceding paragraph, shall be determined by the central competent authority in consultation with the central competent authorities of the respective industries.
Article 15	In order to enhance and promote the marine industry development, the central competent authority may designate a juridical person to be responsible for handling operations pertaining to this Act.
Article 16	The effective date of this Act shall be determined by the Executive Yuan.

Insights into the Global Ocean Monitoring Systems of 2022

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Keywords: Operational oceanographical monitoring, global warming, ocean data center

The world's oceans cover 71% of the Earth's surface and form an indispensable foundation for human survival. They play a crucial role in our lives, serving as a central nexus that links Earth's systems of the atmosphere, hydrosphere, geosphere, and biosphere. From climate regulation to food supply and international trade, the oceans' significance is undeniable. Consequently, as global climate change and ecological threats continue to escalate, the importance of global ocean monitoring becomes even more pronounced.

As of 2022, many countries have already established systematic ocean monitoring approaches, which can roughly divide into operational monitoring and research-oriented monitoring. The former primarily aims to address the potential requirements of everyday human maritime activities or management, with the core objective of ensuring the safety and health of the marine environment. This monitoring method often necessitates the continuous and immediate collection of data, serving as the foundation for decision-making, early warning systems, or management strategies in marine-related sectors. Comparing with operational monitoring, research-oriented monitoring places even greater emphasis on scientific research requirements as its objectives are geared towards gaining a deeper understanding of ocean physics, marine geology and geochemistry, ecology, climate, and other relevant issues. This monitoring approach may be adjusted based on specific research questions.

Despite the differences between these two monitoring approaches in terms of their original intentions and methodologies, they frequently complement each other in practical applications. International experiences indicate that these two monitoring strategies tend to integrate and merge. This integration not only enhances the integrity and accuracy of monitoring data, but also enables a more effective response to the threats of climate change, all while ensuring the sustainable utilization of marine resources. This article will introduce the international development of operational ocean monitoring, providing a reference for the planning of domestic operational ocean monitoring.

Significance, Objectives, and Items of Operational Ocean Monitoring

"Operational" ocean monitoring emphasizes the transition of ocean-related monitoring techniques and methods from the research stage to practical operations and applications. In this regard, oceanography is the core concept of operational ocean monitoring because it is directly related to citizens' everyday maritime activities, such as shipping, fisheries, and safety of coastal activities. The oceanographical monitoring data primarily serves as the basis for weather forecast, seasonal and climate forecasts, maritime safety, marine pollution prevention and control, fisheries management, and coastal and continental shelf marine weather forecasts. Moreover, to facilitate users to make real-time decisions based on the up-to-date oceanographical information, "operational" oceanographical monitoring emphasizes the consistent, stable, and instantaneous output of data products.

Traditional oceanographical monitoring items primarily concentrate on gathering a range of environmental parameters. These include physical parameters like offshore wind fields, waves, tides, and currents; hydrological parameters such as sea surface temperature and salinity; and atmospheric parameters like pressure, temperature, and humidity. These parameters are crucial for predicting storms and other climate phenomena. With climate change and extreme weather events intensifying, future monitoring items will experience a growing demand for information on the fluxes of interactions between the atmosphere and the ocean. Therefore, observation must expand from

traditional items to advanced items in order to grasp the heat flux at the ocean-atmosphere interface and the exchange of greenhouse gases (GHG) between the ocean and the atmosphere. This requires techniques and instruments for the monitoring of atmospheric boundary layer above the sea level and the ocean surface boundary layer below the water surface [1].

Furthermore, given the escalating significance of the marine ecosystem, it is imperative to incorporate chemical and biological pollution monitoring into future operational ocean monitoring endeavors. This is particularly crucial for the monitoring of offshore chemical and biological pollution, such as heavy metals, plastic particles, and hazardous organisms, within offshore marine waters. Such monitoring plays a pivotal role in safeguarding the health of the marine environment.

Operational Ocean Monitoring Techniques

The techniques and platforms currently used in international operational ocean monitoring are classified as follows:

I. Satellite Remote Sensing

Satellite observation provides long-term, real-time, and continuous global ocean observational data with high spatial and temporal resolution. For example, the world's sea level, sea surface temperature, ocean color, sea ice, wave height, sea surface salinity (SSS), wind field, sea surface aerosols, and atmospheric water vapor content. These observational data can not only be accumulated as environmental background, but also be assimilated into numerical forecast models to improve the uncertainty of forecast products. They are thus regarded as integral components of the operational ocean observation system. These satellite data can exhibit varying temporal and spatial resolutions based on the payload of the observational instruments. The currently developed data fusion technology has the capability to integrate diverse satellite data into products featuring high temporal and spatial resolutions.

II. Coastal Radar System

The high-frequency ground wave radar operates based on the physical mechanism of emitting electromagnetic waves at frequencies ranging from 3 MHz to 30 MHz. During transmission, the moving rough sea surface generates Bragg backscattering, which is then received by the radar antenna. Due to the Doppler Spectrum produced by the relative motion between the radar antenna and the sea level, azimuth and distance information can be obtained through calculation, providing the average sea surface current and spectrum for several kilometers. This can also be used to estimate the sea surface wind field. As high-frequency radio signals can propagate over the sea surface to extend beyond the sea horizon, the monitoring range can reach up to 200 km to 300 km. It also allows continuous and intensive monitoring day and night, and is currently the only ocean monitoring technology that provides complete coverage for territorial waters, adjacent zone waters, and exclusive economic zones. The monitoring items include ocean currents, waves, and wind speed and direction, which contribute to facilitating coastal marine pollution prevention and control efforts. At the moment, there are over 440 coastal high-frequency radar stations established worldwide, with this number is still increasing rapidly [2].

III. Buoyage System

The buoyage system consists of drifting buoys and moored buoys. Drifting buoys are passively carried by ocean currents and are used to observe the characteristics of the surrounding water along their drifting paths in a Lagrangian measurement. Among them, the Argo Floats Global Array (ARGO) and the Global Drifter Program (GDP) are global buoy monitoring networks, which will be further explained later.

Another type is moored buoys. Moored buoys are primarily utilized to monitor oceanographic parameters, including wind speed, wind direction, temperature, and wave height. Currently recognized as the foremost ocean moored buoy observation system, the Global Tropical Moored Buoy Array

(GTMBA) is dedicated to long-term and continuous monitoring of global tropical ocean conditions and climate change [3]. GTMBA consists of a number of regional observation systems, including TAO/TRITON, PIRATA and Indian Ocean Observing System (IndOOS) Array, depending on their location and research purposes: The TAO/TRITON Array focuses on monitoring the Pacific Ocean through the collaboration between the United States and Japan; the PIRATA Array monitors the Atlantic Ocean through the combined efforts of France, the United States, and Brazil; and the IndOOs Array monitors the Indian Ocean with the collaborative contributions of India, the United States, and Japan. Since 1985, it has been continuously providing sea surface temperature information for the upper 300 meters of the ocean near the equatorial region for 25 years.

IV. Fixed Observation Platform

These observation stations are situated in shallow water areas, such as offshore regions or continental shelves, for the purpose of long-term monitoring of specific ocean parameters at distinct locations, with special attention to changes in sea level. Precisely determining sea level height is a complex task, and the Global Sea Level Observing System (GLOSS) is an international initiative specifically established in 1985 with the purpose of developing a sustainable global sea level observation network [4]. The tide gauge observation system supported and developed by the GLOSS can be utilized to detect changes in sea level and calibrate the stability of satellite altimeters. The underlying principle involves analyzing the observations obtained from this instrument to derive spectral energy. Currently, there are two main sea level data storage centers: The Permanent Service for Mean Sea Level (PSMSL) under the British Oceanographic Data Center (BODC) and the University of Hawaii Sea Level Center (UHSLC).

V. Ships and Shipborne Systems

Shipborne sensing instruments: By taking CTD instruments (which measure conductivity, temperature, and depth) as an example, CTS instruments can collect data while the ship is in motion. However, as the number of dedicated research vessels for specialized sensing is limited, effective monitoring data are in a scarcity.

The Voluntary Observing Ships (VOS) program: Supported by the United Nations (UN), this program encourages global commercial ships, container ships, and other vessels to voluntarily participate in the collection of weather and marine data. The VOS vessels are equipped with specialized instruments that enable the automatic or manual collection of various types of data. The data gathered by these vessels cover many regions that are only rarely traversed by research ships, making the VOS program a crucial component of operational ocean monitoring.

In conclusion, operational ocean monitoring relies on a range of advanced technologies and platforms, spanning from remote sensing techniques to on-site observation tools. Together, they work collaboratively to deliver continuous, reliable, and detailed marine data. This is especially true for the ARGO, GDP, and VOS programs, which play an indispensable role on the global stage, particularly in regions where most of the marine areas do not have fixed moored buoys or platforms. The ARGO, GDP, and VOS programs are summarized as follows:

The ARGO program is the world's largest operational ocean observation network [5], with its origins dating back to the mid-1990s. As scientists recognized the temporal and spatial limitations of conventional ocean observation approaches (such as collecting samples using vessels), particularly in deep-ocean and remote areas, the international community thus believed that there was an urgent need for an automated, continuous, and global observation network. In 1999, the ARGO program was launched with the support of the United States, Australia, Japan, France, the United Kingdom, and Canada. The ARGO buoy system consists of a series of drifting observational devices; and ARGO floats deployed by various countries and organizations undergo cycles of ascending and descending at specific time intervals. The buoys of the latest versions can descend to depths of up to 2,000 m underwater, recording temperature and salinity profiles throughout their journey. Moreover, these buoys are also equipped with a positioning system that enables them to transmit data to the ground via Argos or satellite when they resurface to the sea surface.

As of 2022, the ARGO program has successfully maintained simultaneous operations for over 3,850 buoys across the world's oceans. These buoys can be categorized into three main groups [5]: Core Argo, BGC Argo (focused on biogeochemistry), and Deep Argo, designed to reach depths of up to 6,000 meters. Additionally, every year, approximately 600 to 800 new buoys need to be deployed to replace aging or malfunctioning units, in order to sustain the required observation density. The net cost of each buoy's instruments, excluding operational expenses, is approximately US$35,000. The latest version of BGC buoys can measure more parameters, such as dissolved oxygen, pH levels, and chlorophyll concentration, which are significant for understanding marine ecosystems and carbon cycles. The most significant feature of ARGO is its remarkable data integration capability: Global monitoring data is transmitted through satellites directly to multiple regional data centers (RDCs) and two global data centers (GDCs) situated in France and the United States. These centers then engage in uniform formatting, quality control, and analysis of these data to ensure their consistency before providing them to researchers and decision-makers worldwide for their free usage.

Limitations of ARGO Buoys: Spatial resolution of the data products: The average distance between buoys is approximately 300 km, with a product spatial resolution of 3°x3° grid cells. This means that ARGO cannot capture ocean processes at smaller scales. Additionally, as ARGO buoys are primarily intended for profiling temperature and salinity, they are not equipped to measure waves. Thus, the measurement of ocean surface waves necessitates a dedicated buoy system.

Global Drifter Program (GDP): GDP is an important program [6] executed by the Data Buoy Cooperation Panel (DBCP), known as a collaborative organization of the World Meteorological Organization (WMO) and the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization (IOC/UNESCO). The objectives of the GDP are to deploy and maintain a large-scale network of ocean buoys to support meteorological, oceanographic, and climate research and forecasting. These drifting buoys are often equipped with a sensor to measure parameters like the ocean surface temperature and atmospheric pressure. Some buoys are also equipped with additional sensors, such as the salinometer, anemometer (wind speed and direction gauge), and wave gauge. The cost of a simple version of GDP instrument is around US$2,000 and any additional monitoring item costs around US$5,000 to US$6,000. The objectives of the GDP are to maintain a density of approximately 1,250 drifting buoys, with each buoy spaced at intervals of about 3°x3° grid cells.

The GDP and ARGO are both international collaborative ocean observation projects and play crucial roles in providing essential data about marine and atmospheric conditions. However, there are distinct differences between these two programs: GDP primarily measures ocean surface conditions, such as ocean surface temperature and atmospheric pressure. On the other hand, ARGO focuses on observing the upper ocean and can delve into the middle of the ocean to measure temperature, salinity, and so on. In terms of the design and functions of the buoys, GDP adopts surface drifting buoys, which primarily float on the ocean surface and are used to measure surface conditions. As for ARGO, it utilizes profiling floats that can dive and surface, allowing them to observe from the surface to the interior of the ocean. While there are notable differences between GDP and ARGO, both programs play essential roles in advancing modern oceanography and meteorology.

In regard to the Voluntary Observing Ship (VOS) program, WMO initiated this international program around 1860 to acquire ship weather reports over the vast ocean expanse. To obtain crucial maritime weather observation information, this program recruits vessels sailing across the world's oceans to install meteorological instruments in order to collect and transmit meteorological observation data. From 1960 till now, there have been 5,000 ships joined this program. As VOS provides one observation data every 3 to 6 hours, the lack of calibration of the observation instruments and relatively sparse sampling have resulted in a certain level of uncertainty in provided data. The information provided by VOS includes surface wind speed and direction, atmospheric pressure, humidity, sea surface temperature (SST), sea-level pressure, atmospheric pressure, wave conditions, cloud amount, cloud types, cloud altitude, visibility, sea ice, and precipitation [7].

In the past, these VOS data were recorded manually and then submitted to local port management units, which would then upload these records to the seven major Regional Specialized Meteorological Centre (RSMC) of the WMO for organization and issuance. In response to the decreasing number of

crew members and the advancement of automated instruments and telecommunications technology, ships began to be equipped with an automated observation system called AVOS (Automatic VOS) around 2000. Currently, some ships utilize the Automatic Identification System (AIS) on board to encode observation data and then automatically transmit this data to land-based stations.

As an automatic identification system designed for ships, AIS has been widely installed in commercial vessels and is primarily used for communication between ships and between ships and shore-based stations. In the beginning, AIS was primarily designed to enhance vessel safety in busy waters. By providing vessels with information about their position, heading, speed, and other navigation-related data, it can prevent collisions. Following the progress of technology, the communication function of the AIS can also be used to transmit meteorological and ocean observation data. This concept is called e-AIS. E-AIS is an important platform that supports AVOS observations.

Future challenges: Limited by the radio communication range of shore stations, the data range of e-AIS vessels is mostly within 20 nautical miles from the coast. Although this results in the lack of crucial observational data from the open ocean, the cost of real-time and dense satellite data transmission at sea is high. On the other hand, since participation is voluntary, large commercial vessels and ship owners tend to purchase commercial meteorological information services, which makes maintaining shipowners' participation willingness a continuous challenge. Therefore, a low-cost and reliable system that offers global coverage and the capability to integrate e-AIS data transmission becomes pivotal for expanding the scale of the VOS fleet. In the foreseeable future, an advanced AIS version, the VDES system, could offer a solution. With the advancement and reduced costs of low-earth CubeSat technology, higher maritime data transmission efficiency and quality can be assured. This is expected to further extend the applications of AVOS in the future.

Global oceanographical data integration platform

OceanOPS (formerly known as JCOMMOPS) is a platform specialized in supporting and coordinating global ocean observation programs. It is primarily funded and managed by member countries of the IOC/UNESCO and the WMO, and is also partially funded through voluntary contributions from ocean observation programs and groups such as Argo, DBCP, OceanSITES, GO-SHIP, SOT, GLOSS, and OceanGliders [8].

The objectives of the OceanOPS are as follows:

I. Coordination and support: OceanOPS provides operational support and coordination services to global ocean observation programs.

II. Data integration and sharing: The platform ensures the successful and timely integration of observation data, and provide these data to worldwide researchers and relevant organizations.

III. Technological development: OceanOPS promotes technological development and innovation to ensure the leading standards of ocean observation technology.

IV. Promotion and education: Enhance the public's awareness to global ocean observation programs and foster ocean scientists and researchers of the next generation.

OceanOPS provides support for multiple well-known ocean observation programs. At the moment, OceanOPS is engaged by 86 countries for ocean observation, encompassing approximately 10,000 ocean field observation platforms, 13 ocean observation networks, and 170 satellites. The platform delivers around 100,000 observations each day, offering essential services of monitoring, coordination, and data integration within the expanding global network of oceanographic and ocean meteorological observation communities. Additionally, it maintains continuous monitoring of global ocean and atmospheric conditions.

Besides OceanOPS, there are other organizations and platforms around the world dedicated to coordinating ocean observation and sharing related data. Examples are as follows:

I. Global Ocean Observing System (GOOS): Known as a part of IOC/UNESCO, GOOS aims to provide sustainable, regular, reliable, and standardized ocean data, information, and services.

II. Integrated Marine Observing System (IMOS): IMOS is an Australian ocean observation system that aims to monitor and understand changes in Australia's oceanic environment.

III. European Marine Observation and Data Network (EMODnet): EMODnet is a network funded by the Council of Europe and is dedicated to integrating and providing Europe's Ocean data, information, and knowledge.

IV. National Oceanographic Data Centers (NODC): Many countries have their own national oceanographic data centers, such as the U.S. NODC (now merged into NCEI), which collect, store, and distribute domestic ocean observation data.

Future Outlook

In the urgent context of global changes, the role of oceanographical monitoring has transformed from serving navigation, engineering, fisheries, and maritime activities to encompassing the monitoring of interactions between the marine system and other Earth subsystems. As basic oceanographical monitoring methods from the past are no longer sufficient to meet future demands, it is imperative to actively consider unifying new monitoring approaches, in order to facilitate the gradual integration of operational monitoring techniques with research-oriented methods, creating a mutually supportive framework. On the other hand, as communication costs are expected to decrease with the widespread adoption of low-earth CubeSat communication technology in the foreseeable future, conventional VOS monitoring and drifting buoys monitoring will also inevitably promote the integration of technologies to generate a new generation of ocean monitoring techniques. Among them, a trend of integrating satellite VDES system with sea-surface drifting buoys is also anticipated.

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A Brief Introduction of the EU Blue Economy Report 2022

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The term Blue Economy refers to all direct and cross-sectoral activities related to the sea and the coast. The objective of the EU Blue Economy Report 2022 is to analyze the scope and scale of the Blue Economy and to provide a framework and database for policymakers and stakeholders to achieve the EU's vision of a sustainable Blue Economy.

Concept and scope of the EU Blue Economy

The sectors defined by current the framework of the EU Blue Economy include both established sectors and emerging sectors and innovative sectors. These sectors serve as crucial foundations for EU economic growth and employment development. The established economic sectors comprise seven industries: I. marine living resources (primary production, processing of fish products), II. marine non-living resources (Oil and gas), III. marine renewable energy (offshore wind), IV. port activities, V. shipbuilding and repair, VI. maritime transport, and VII. coastal tourism. The emerging and innovative economic sectors include five industries: I. marine renewable energy (such as ocean energy, floating photovoltaic [FPV], and offshore hydrogen generation), II. blue bioeconomy and biotechnology, III. desalination, IV. maritime defense, security and surveillance, and V. research and infrastructure (e.g., submarine cables and robotics). Based on the EU Blue Economy framework, the subsequent sections of this article will stress on the "current status of established economic sectors," "future trends of emerging and innovative economic sectors," and "conclusions and recommendations."

Current Status of Established Economic Sectors

According to the latest statistical data in 2019, the established economic sectors of the EU Blue Economy employed approximately 4.45 million people, generated a turnover of 667.2 billion euros, a gross operating surplus of 72.9 billion euros, and a gross value added (GVA) of 183.9 billion euros. Over the past decade, these three key economic indicators have grown by 15%, 22%, and 20%, respectively.

From macroeconomic perspective based on GVA, the coastal tourism industry has the highest share (43.6%) among the seven established economic sectors, followed by maritime transport (18.7%) and port activities (15.2%). In terms of growth rates since 2009, the three sectors with the highest growth are marine renewable energy (+4,595.1%), marine living resources (+30.5%), and shipbuilding and repair (+38.9%). Regarding the total number of employees, the coastal tourism industry also has the highest share (63.0%) among the approximately 4.45 million employees, followed by marine living resources (12.1%) and maritime transport (9.1%). In terms of growth rates since 2009, the sectors with the highest growth in employment are marine renewable energy (+2,550.0%), maritime transport (12.7%), and marine living resources (1.9%). These data reveal that while the EU's established economic sectors are still based on traditional coastal tourism, maritime living resources, maritime transport, and shipbuilding and repair, their growth driving force comes from marine renewable energy (offshore wind energy). Notably, both the GVA and employment in marine non-living resources are in decline as shown in Tabie 1. The following is the development overview of each sector:

Table 1/ EU Blue Economy – Overview of Key Figures of Established Economic sectors

EU Blue Economy Established economic sectors	Gross Value Added (GVA)			Employed population		
	Billions of Euros (%)	Major countries	Secondary sectors	Thousand people (%)	Major countries	Secondary sectors
(1) Marine living resources	193 (10.5%)	Spain 19% Germany 16% France 15%	Distribution of Fish products 46% Processing of fish products 28% Primary production 26%	538.7 (12.1%)	Spain 22% Italy 14% France 11%	Distribution of Fish products 39% Primary production 37% Processing of fish products 24%
(2) Marine non-living resources	47 (2.5%)	Denmark 49% Netherlands 31% Italy 16%	Oil and gas 66% Support activities 31% Other minerals 3%	10.1 (0.2%)	Denmark 27% Italy 22% Netherlands 20%	Support activities 48% Oil and gas exploration 38% Other minerals 18%
(3) Marine renewable energy	19 (1.0%)	Germany 38% Denmark 29% Netherlands 12%	Offshore wind energy 100%	10.6 (0.2%)	Germany 80% Denmark 10% Netherlands 5%	Offshore wind energy 100%
(4) Port activities	279 (15.2%)	Germany 23% Netherlands 17% Spain 13%	Cargo and warehousing 54% Port and water projects 46%	382.6 (8.6%)	Germany 23% Spain 11% France 10%	Port and water projects 56% Cargo and warehousing 44%
(5) Shipbuilding and repair	156 (8.5%)	Germany 25% France 21% Italy 19%	Shipbuilding 83% Equipment and machinery 17%	299.1 (6.7%)	Germany 17% Italy 14% France 14%	Shipbuilding 85% Equipment and machinery 15%
(6) Maritime transport	343 (18.7%)	Germany 36% Denmark 18% Italy 14%	Freight transport 43% Services for transport 32% Passenger transport 25%	403.0 (9.1%)	Germany 34% Italy 18% France 8%	Services for transport 46% Passenger transport 30% Freight transport 24%
(7) Coastal tourism	801 (43.6%)	Spain 30% France 14% Italy 13%	Transport 23% Other expenditure 31% Accommodation 46%	804.6 (63.0%)	Spain 25% Greece 17% Italy 11%	Transport 15% Other expenditure 46% Accomodation 39%
Established economic sectors	1,839 (100%)	—	—	4,449 (100%)	—	—

Source/ The EU Blue Economy report 2022/ Summarized by MIRDC

- **Maritime living resources (GVA 19.3 billion euros):** This sector includes primary production (capture fishery), processing of fish products, and distribution of fish products. The EU's maritime living resources sector has shown improvement in its economic performance over the past decade, with employment relatively stable. However, it has been impacted by geopolitical factors such as the Ukraine-Russia conflict, the COVID-19 pandemic, and Brexit, affecting the overall performance of fishing fleets.

- **Marine non-living resources (GVA 4.7 billion euros):** This sector includes oil and gas, supporting mining activities, and other mining. In recent years, due to declining oil production, rising extraction cost, and increasing awareness of clean energy globally, the offshore oil and gas sector has been in decline and entering a decommissioning process. However, the EU aims to achieve independence from fossil fuel sources by 2030 to avoid threats from Russia and focuses on natural gas as a primary development area.

- **Marine Renewable Energy (GVA 1.9 billion euros):** The marine renewable energy sector in the EU mainly focuses on offshore wind energy, while other technologies such as wave energy and tidal energy are still in the research and development stage, and floating offshore wind energy has entered the commercial feasibility stage. Currently, 10 EU countries have installed a combined offshore wind capacity of 16.3 GW, and the renewable energy strategy aims to increase this capacity to 60 GW by 2030 and 300 GW by 2050 to achieve energy and climate goals.

- **Port Activities (GVA 27.9 billion euros):** The subsector includes cargo handling and warehousing and storage, as well as port and water projects. Ports are crucial to the European economy, and the

green initiatives (such as reducing the negative environmental impacts generated by port activities), technological innovations (such as logistics automation, artificial intelligence, and robotics) and changes in trade patterns their transformation will become an important key factor to drive port transformation.

- **Shipbuilding and repair (GVA 15.6 billion euros):** The subsector includes shipbuilding and equipment and machinery. The EU's shipbuilding industry has specialized expertise in cruise ships, fishing vessels, ferries, research vessels, and superyachts. In recent years, it has been affected by the COVID-19 pandemic, causing a continuous decline in shipbuilding output. On the other hand, the EU expects a continuous increase in demand for new ships, equipment, and technology in the Blue Economy sector in the next 10 years, focusing on lightweight materials, digitalization, automation, advanced design, and environmental friendliness.

- **Maritime Transport (GVA 34.3 billion euros):** The subsector includes passenger transport, freight transport, and services for transport. In recent years, it has been affected by the COVID-19 pandemic, causing a general decline in global trade flows and impacting maritime transport within the EU. Currently, the EU is encouraging the use of automated and environmentally sustainable ships and shipping to achieve the goal of 90% reduction in greenhouse gas emissions by 2050 as in the European Green Deal (EGD). Therefore, the EU is expected to promote the use of alternative and clean energy in maritime transportation tools in the future.

- **Coastal Tourism (GVA 80.1 billion euros):** The subsector includes transportation, accommodation, and other expenditures. Coastal tourism is the most crucial sector in the EU's Blue Economy, but it has been severely affected by the COVID-19 pandemic and the Ukraine-Russia conflict in recent years. However, the EU still expects the economic growth of coastal tourism to continue in the future by redesigning coastal infrastructure, port facilities, and embracing green transformation to improve overall tourism quality.

Future Trends of Emerging and Innovative Economic Sectors

In response to climate change, global order, and population changes, the Blue Economy is a vital key for the EU to strengthen its economic resilience, particularly under the goals set by the EGD. The Blue Economy not only needs to be economically viable but also aligned with environmental sustainability goals. Among the emerging and innovative sectors in the EU Blue Economy, they not only represent future development trends but also new industries of tremendous potential within the EU. Here are the future trends of the EU's emerging and innovative sectors:

- **Marine Renewable Energy:** The EU has identified emerging marine renewable energy as a critical component of the future. In line with the EGD, the EU's offshore hydrogen energy strategy, and the "Offshore Renewable Energy Strategy," the EU plans to increase offshore wind energy capacity from 12 GW to 300 GW by 2050 and invest in 40 GW of marine energy and other compatible emerging technologies, such as floating offshore wind energy, wave energy, tidal energy, FPV, and offshore hydrogen energy.

- **Blue Bioeconomy and Biotechnology:** Blue bioeconomy and biotechnology provide potential solutions for decarbonization activities. In this economy sector, the most noteworthy sub-sector is the algae sector. Currently, 23 EU member countries have seaweed and spirulina production facilities, with France, Spain, and Portugal being the most prominent, with an annual turnover exceeding 10 million euros. Additionally, the EU's development of algae-based food and feed products can effectively mitigate the environmental pressure imposed by agriculture, aquaculture, and fisheries and help reduce excessive carbon, nitrogen, and phosphorus elements in the oceans during their growth process.

- **Desalination:** The global demand for water resources continues to increase, and the EU estimates up to 30% of people facing water shortages by 2025. Therefore, developing seawater desalination technology can effectively increase freshwater supply. Currently, there are over 2,309 operating seawater desalination plants in the EU, mainly located in the Mediterranean region (Spain and Italy), producing about 9.2 million cubic meters per day. However, the EU has shown relatively less development in this area in the past decade compared to other regions such as the Middle East, North Africa, East Asia, and the Pacific, which have seen a doubling of installed capacity. Hence, the EU plans to continue investment in seawater desalination capacity in the future and contribute to sustainable development and energy transition.

- **Research and Innovation:** Research and innovation are considered as the core drivers to promote sustainable blue economic development. The EU has various projects to support the development of the Blue Economy. For example, the "Horizon 2020" program allocates most of its funding to marine observation (67.7 billion euros), blue economic growth (44.8 billion euros), and blue bioeconomy and biotechnology (34.5 billion euros). The new "Horizon 2021-2027" program has a budget of 95.5 billion euros, 35% of which is designated to support climate-neutral marine industry transformation.

- **Infrastructure:** The EU's blue economic-related infrastructure primarily focuses on submarine cables and underwater robotics technology. Submarine cables are critical infrastructure for data, telecommunications, and power transmission within the EU and other countries. Compared to satellites, cable transmission costs are more economical, and due to the impact of the COVID-19 pandemic, there is a growing demand for cable-provided information and data exchange. On the other hand, underwater robotics technology refers to remotely operated vehicles (ROVs) and autonomous underwater vehicles (AUVs), with commercial exploration being the most common area of use. Various countries are seeking alternatives to oil, which therefore promotes the demand for underwater robotics in the market.

Conclusion and Recommendations

While balancing economic development, the EU has environmental sustainable development as the core mission. Both established and emerging economic sectors move towards marine sustainability, clean energy, and green decarbonization. The EU's elaboration on the development of the Blue Economy reveals important foundations, including clear industry categorization, sound data management, government resource support, policy goals, and long-term monitoring of industry trends, to accurately address the state of industry development and future trends.

In May of this year, our country recently passed the Marine Industry Development Act, which will become the cornerstone of domestic marine industry development. However, the marine industry has always been characterized by its cross-disciplinary nature, leading to dispersed responsibilities and information among various government agencies. How to establish a systematic and structured framework for the marine industry in our country, and integrate data and information, and provide dynamic observation and strategic thinking are the pressing issues to be resolved in the future as well as aligning with international environmental sustainability actions during the industrial development.

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Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization (IOC/UNESCO)

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Keywords: United Nations Educational, Scientific and Cultural Organization (UNESCO), Intergovernmental Oceanographic Commission (IOC), Ocean Decade, Microplastics, Blue Carbon, Ocean Literacy, World Oceans Day

The main purpose of this Article is to introduce the origins, mission and objectives, organizational structure, areas of expertise, and current activities and projects of the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization (hereinafter referred to as "IOC/UNESCO") in the hope of providing readers with a basic understanding of this organization.

History of the IOC/UNESCO

The Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization (IOC/UNESCO) is the United Nations body responsible for supporting global ocean science and services. The IOC was established in 1960 as a body with functional autonomy within UNESCO. The IOC supports all its Member States in building their scientific and institutional capacity to achieve global goals outlined in the UN Agenda 2030 and its Sustainable Development Goals, the Paris Agreement on Climate Change and the Sendai Framework on Disaster Risk Reduction [1].

Missions and Objectives of the IOC/UNESCO

The purpose of the Commission is to promote international cooperation and to coordinate programmes in research, services and capacity-building, in order to learn more about the nature and resources of the ocean and coastal areas and to apply that knowledge for the improvement of management, sustainable development, the protection of the marine environment, and the decision-making processes of its Member States. (IOC Statutes, Article 2.1) [2].

On the General Assembly of IOC in Paris the strategy for the next intermediate period was confirmed (2014–2021, Resolution XXVII/2 and annexes 1-3) with the overall goals:

- conservation of ecosystem and ocean status;
- development of early warning systems and disaster readiness;
- mitigation of climate change and adaptation to climate variability;
- improvement of knowledge on oceans and emerging topics in ocean science;
- education and aid to the less developed in order to accomplish the predefined strategic goals [3].

The IOC is working to achieve its Vision through the following High-Level Objectives:

- Healthy ocean and sustained ocean ecosystem services;
- Effective warning systems and preparedness for tsunamis and other ocean-related hazards;
- Resilience to climate change and contribution to its mitigation;
- Scientifically-founded services for the sustainable ocean economy;
- Foresight on emerging ocean science issues [2].

Organizational Structure of the IOC/UNESCO

IOC/UNESCO is composed of 150 Member States from all over the world. Member States oversee the work of the IOC/UNESCO through the following two Governing Bodies [1]:

I. Assembly

The Assembly meets once per biennium. The purpose of the Assembly is to review the work of the Commission, including the work of the Member States and the Secretariat, and formulate a common work plan for the coming two years [1].

II. Executive Council

The Executive Council meets every year to review issues and items from ongoing work plans, and makes preparations for the Assembly. The Executive Council consists of up to 40 Member States, including the six Member States represented by the Chairperson and the five Vice-Chairpersons. Representation in the Executive Council Electoral Group I can consist of up to 10 seats; Group II of up to 3 seats; Group III of up to 9 seats; Group IV of up to 9 seats; and Group V of up to 9 seats [4].

The IOC/UNESCO Secretariat, which is led by an Executive Secretary, is located in Paris, France [4]. Both the Assembly and the Executive Council of the IOC/UNESCO are prepared, supported and run by the six IOC Officers, under the leadership of the IOC Chair, in close alignment with the IOC Secretariat, under the leadership of the Executive Secretary [4].

Fields of Expertise of the IOC/UNESCO

For 60 years, the IOC/UNESCO has worked behind the scenes to enable its Member States to work together to strengthen our knowledge and management of the ocean for the benefit of humanity [5]. Major enhancements and fields of expertise involved are briefly introduced as follows:

I. Understand

i. Microplastics

The IOC/UNESCO is leading global efforts to understand the sources, fate and effects of plastics and microplastics in the marine environment. The IOC/UNESCO is the lead agency, together with the United Nations Environment Programme (UNEP), of Working Group 40 on Plastics and Micro-plastics in the Ocean of the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) [6].

ii. Blue Carbon

Blue carbon ecosystems – mangroves, tidal and salt marshes, and seagrasses – are highly productive coastal ecosystems that are particularly important for their capacity to store carbon within the plants and in the sediments below, and are thereby considered a key component of nature-based solutions to climate change [6].

II. Measure

i. Data and Information

The International Oceanographic Data and Information Exchange (IODE) of the IOC/UNESCO was established in 1961. Its purpose is to enhance marine research, exploitation and development, by

facilitating the exchange of oceanographic data and information between participating Member States, and by meeting the needs of users for data and information products [7].

ii. Ocean Biodiversity Information System

The Ocean Biodiversity Information System (OBIS) is one of the flagship data systems of the IOC/UNESCO. OBIS is a global data platform that integrates, quality controls and provides access to over 100 million occurrence records of 160,000 different marine species and that number is growing by millions every year [7].

III. Alert

i. Harmful Algal Bloom Programme

Today, virtually every coastal country in the world is affected by harmful blooms of microscopic algae or phytoplankton. These blooms can kill marine life and even cause death in humans. The IOC's International Harmful Algal Bloom (HAB) Programme works to help Member States develop the research and management capacity needed to understand the causes of these blooms, predict their occurrences, and mitigate their effects [8].

ii. Global Tsunami Early Warning and Mitigation Programme

Coordinated by IOC/UNESCO, the Global Tsunami Warning System plays a critical role in protecting lives. The IOC/UNESCO Tsunami Programme supports Member States in assessing tsunami risk, implementing Tsunami Early Warning Systems (EWS) and in educating communities at risk about preparedness measures. With the support of Tsunami Service Providers and Tsunami Information Centers, IOC/UNESCO helps Member States in assessing tsunami risk, implementing Tsunami EWS and in educating communities at risk about preparedness measures [8].

IV. Manage

i. Marine Spatial Planning

Marine Spatial Planning (MSP) is a public process of analyzing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic and social objectives that have been specified through a political process. MSP is not an end in itself but a practical way to create and establish a more rational use of marine space and the interactions among its uses, to balance demands for development with the need to protect the environment, and to deliver social and economic outcomes in an open and planned way [9].

ii. Large marine ecosystems

Large marine ecosystems (LMEs) are regions of the world's oceans, encompassing coastal areas from river basins and estuaries to the seaward boundaries of continental shelves and the outer margins of the major ocean current systems. They are relatively large regions on the order of 200,000 km^2 or greater, characterized by distinct bathymetry, hydrography, productivity, and trophically dependent populations. Productivity in LMEs protected areas is generally higher than in the open ocean. Although the LMEs cover mostly the continental margins and not the deep oceans and oceanic islands, the 66 LMEs produce about 80% of global annual marine fishery biomass. In addition, LMEs contribute USD 12.6 trillion in goods and services each year to the global economy. Due to their close proximity to developed coastlines, LMEs are in danger of ocean pollution, overexploitation, and coastal habitat alteration [9].

V. Enable

i. OceanTeacher Global Academy

OceanTeacher Global Academy (OTGA) is a global network of Regional and Specialized Training Centers delivering training on ocean sciences, services and marine and information data management (including marine biodiversity data and ocean best practices) relevant to the IOC Programmes and contributing to the UN Ocean Decade, using the OceanTeacher e-Learning Platform. Courses cover a range of topics related to the IOC programs, contributing to the IOC Mandate and the implementation of the IOC Capacity Development Strategy, enabling equitable participation of all IOC Member States and IOC Programs [10].

ii. Ocean Literacy

Ocean literacy is defined as "an understanding of the ocean's influence on you and your influence on the ocean". The IOC is working to support ocean research institutions around the world to strengthen public engagement and build greater ocean literacy so we can all have a greater understanding of what we can do to protect the health of our ocean [10].

Recent Activities and Projects of the IOC/UNESCO

I. United Nations Decade of Ocean Science for Sustainable Development (2021-2030)

Proclaimed in 2017 by the United Nations General Assembly, the UN Decade of Ocean Science for Sustainable Development (2021-2030) 'the Ocean Decade' seeks to stimulate ocean science and knowledge generation to reverse the decline of the state of the ocean system and catalyze new opportunities for sustainable development of this massive marine ecosystem [11].

The vision of the Ocean Decade is "the science we need for the ocean we want." The Ocean Decade provides a convening framework for scientists and stakeholders from diverse sectors to develop the scientific knowledge and the partnerships needed to accelerate and harness advances in ocean science to achieve a better understanding of the ocean system, and deliver science-based solutions to achieve the 2030 Agenda. The UN General Assembly mandated IOC/UNESCO to coordinate the preparations and implementation of the Ocean Decade [11].

II. World Oceans Day 2023: Planet Ocean: Tides are changing

The ocean covers the majority of the earth, but only a small portion of its waters has been explored. Despite humanity's utter reliance on it, and compared to the breadth and depth of what it gives us, the ocean receives only a fragment of our attention and resources in return. But tides are changing. This year's United Nations World Oceans Day celebrates the theme Planet Ocean: Tides are Changing. In celebration of the 2023 event, the United Nations are joining forces with decision makers, scientists, private sector executives, civil society representatives, indigenous communities, celebrities and youth activists to underscore how earth is more than it may seem and finally put the ocean first [12].

III. World Tsunami Awareness Day

Though they may be rare, tsunamis are among the most devastating natural hazards. They know no coastal borders. Coastal communities, often concentrated in low-lying and highly populated areas, are the most potentially vulnerable to coastal hazards including tsunamis, with heavy human and economic losses. International cooperation is key for deeper political and public understanding; as well

as involvement in reducing our risks from these coastal natural hazards. In December 2015, the United Nations General Assembly designated 5 November as World Tsunami Awareness Day, to promote a global culture of awareness of and preparedness against tsunamis [13].

Conclusion

IOC/UNESCO promotes international cooperation in marine sciences to improve management of the ocean, coasts and marine resources. The IOC/UNESCO enables its 150 Member States to work together by coordinating programmes in capacity development, ocean observations and services, ocean science, tsunami warning and ocean literacy to meet the needs of its Member States from the oceans.

The work of the IOC/UNESCO contributes to the mission of UNESCO to promote the advancement of science and its applications to develop knowledge and capacity, key to economic and social progress, the basis of peace and sustainable development. Currently, the IOC/UNESCO is in charge of coordinating the work and cooperation among States for the "Ocean Decade," and promote the public awareness of people for the oceans through mechanisms such as the "World Oceans Day" and "World Tsunami Awareness Day."

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The Recent Development of Marine Protected Areas After the Adoption of the BBNJ Agreement

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The Agreement under the United Nations Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas Beyond National Jurisdiction (referred to as the BBNJ Agreement) is the latest agreement adopted under the United Nations Convention on the Law of the Sea (UNCLOS) aimed at addressing the conservation and sustainable use of marine biological diversity in areas beyond national jurisdiction. The United Nations has been conducting research on biodiversity in areas beyond national jurisdiction since 2000, along with the existing management regulations. Recognizing the need for a comprehensive and legally binding framework for managing biodiversity in these areas, in September 2018, the UN officially initiated intergovernmental negotiations for a legally binding instrument on the management of biodiversity in areas beyond national jurisdiction (referred to as BBNJ). After extensive discussions, representatives from the negotiating countries reached a consensus and officially adopted the BBNJ Agreement in New York on June 19, 2023 (Figure 1) [1]. Major provisions in the BBNJ Agreement are related to the management of marine genetic resources, area-based management tools (ABMTs) including marine protected areas (MPAs), environmental impacts assessment, capacity building, and technology transfer. These provisions are aimed at promoting the conservation and sustainable use of marine biological diversity in areas beyond national jurisdiction. This paper provides a brief overview of the background, development, and relevant regulations concerning MPAs as one of the ABMTs under the BBNJ Agreement. It aims to offer information to relevant organizations and the general public concerned about this issue. It serves as a reference for constructing marine protected areas strategies and developments.

Figure 1/ The dais applauds the adoption of the BBNJ Agreement
Source/ United Nations (2023) [1]

Management of Marine Biodiversity Beyond National Jurisdiction

The areas beyond national jurisdiction encompass nearly two-thirds of the global marine biological resources and ecosystems. Before the adoption of the BBNJ Agreement, the regulations for the sustainable use and conservation of biodiversity in these areas were primarily based on the general principles set forth in the UNCLOS, which established the obligation for countries to protect and preserve the marine environment. Additionally, certain regional organizations and entities concerned with specific issues, such as the Food and Agriculture Organization (FAO), Regional Fisheries Management Organizations (RFMOs), International Whaling Commission (IWC), OSPAR Commission for the Northeast Atlantic, and the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), may contribute positive management effect to marine biodiversity while managing fisheries or particular species.

With the rapid development of marine technology and the increasing global demand for maritime trade, coupled with the fact that the ocean is fluid and borderless, the impacts of human activities have extended across the entire marine ecosystem. The proliferation of global marine activities and fishing operations, along with long-term overfishing, habitat destruction, pollution, and excessive development, has led to the decline and depletion of marine biodiversity and habitats [3].

The core international laws related to biodiversity conservation and sustainable use, the Convention on Biological Diversity (CBD) adopted in 1992, aim to promote the conservation of biodiversity, sustainable use of its components, and the fair and equitable sharing of benefits arising from the utilization of genetic resources [4]. However, its scope is within national jurisdictions. Before the adoption of the BBNJ Agreement, there was a jurisdictional gap concerning measures for the conservation and sustainable use of biodiversity or habitats in marine areas beyond national jurisdiction.

The scope of the BBNJ Agreement is marine areas beyond national jurisdiction, and certain activities are excluded. The BBNJ Agreement aims to address the legal vacuum of existing regulations while maintaining the current systems and without compromising existing sovereignty, sovereign rights, or jurisdiction.

The Development of Marine Protected Areas (MPAs) Concept

MPAs are widely used to conserve marine resources and manage human interactions with the marine environment and its resources. The concept of MPAs originated from the broader concept of "protected areas," which initially focused on terrestrial parks. As the international society explored the connection between human activities in the oceans and their impact on the marine environment, the term "MPA" was first used during the 1982 International Union for Conservation of Nature (IUCN) World National Parks Congress. During this congress, there was a call for countries around the world to establish protected areas for marine, coastal, and freshwater environments [5].

The CBD promotes in-situ conservation and the concept of biodiversity. In-situ conservation, as defined by the CBD, refers to the conservation of species and their habitats in their natural environments to ensure that they can survive and reproduce within their natural habitats [4]. MPAs are a major form of in-situ conservation, as they provide designated areas for the protection of marine species and their habitats, contributing to the overall preservation of marine biodiversity.

As concepts of ecosystem, biodiversity, and habitat conservation gained prominence, particularly with the global goals set by the CBD for establishing protected areas, the importance of protected areas as a method for biodiversity conservation was established [6]. Although Taiwan is a non-party to the CBD,

the development of the marine protected areas concept in the country was not behind. Particularly, the concept of MPAs gained more attention in Taiwan starting with the 2001 IUCN World Conservation Congress for the East Asia held in Taipei. During this congress, there were discussions and recommendations for Taiwan to establish MPAs to conserve marine biodiversity and promote marine conservation [7][8].

In the same year, the Executive Yuan (Taiwan's cabinet) approved the "Biodiversity Promotion Program," which required that 5% of Taiwan's marine area should be designated as marine protected areas [9]. In April 2001, the Fisheries Agency, the coordinating agency at the time, convened relevant government departments to define the concept of marine protected areas. It was defined as "a designated area extending from the average high tide line into the ocean, containing special natural landscapes, important cultural heritage, and ecologically valuable resources that require protection and management through legal or other effective means." This is the first official definition of MPAs in Taiwan [10].

After the establishment of the Ocean Conservation Administration in 2018 under the Ocean Affairs Council, it is responsible for marine conservation-related matters. As of July 2023, Taiwan has 47 MPAs, designated under various laws including the Fisheries Act, National Parks Law, Wildlife Conservation Act, Cultural Heritage Preservation Act, and Act for the Development of Tourism, based on different purposes and needs. These areas cover approximately 8.17% of Taiwan's territorial waters beyond the outer boundary lines of the contiguous zone [10]. However, a specific legislation primarily to the conservation of marine biodiversity or marine ecosystems is lacking in Taiwan.

Terminologies of marine protected areas

After the wide application of ABMTs in oceans, various tools have emerged for spatial planning that have biodiversity conservation effects. These management tools have diverse objectives, such as focusing on species management or aiming for sustainable development. These areas may all be recognized as MPAs by their management authorities.

In 2010, the CBD adopted the Aichi Biodiversity Targets, which called for protecting oceans through MPAs and other effective area-based conservation measures by 2020. This highlighted the importance of using both MPAs and other spatial planning and management measures or so-called OECMs to achieve biodiversity conservation [11]. Although marine biodiversity conservation is commonly seen as the primary objectives of MPAs, other spatial planning and management measures may also contribute to marine biodiversity conservation efforts. In 2019, the IUCN reaffirmed that MPAs should have conservation as their long-term and primary objective, while defining OECMs as areas of significant conservation value where conservation is not the primary objective [6]. It is evident that ABMTs, regardless of their primary objectives, as long as they have a positive impact on marine biodiversity, are encouraged and considered useful measures. The BBNJ Agreement use "ABMTs" as a classification of area-based spatial management tools including MPAs which may contribute to marine biodiversity.

The BBNJ Agreement encompasses ABMTs as a category terminology of area-based or spatial management tools to improve marine biodiversity conservation including MPAs. ABMTs, including MPAs, are specifically addressed in Part III of the BBNJ Agreement. The BBNJ Agreement defines ABMTs as geographically defined areas established as tools to manage one or more activities for the conservation and sustainable use of biodiversity under the provisions of the agreement, including MPAs. Moreover, the BBNJ Agreement refers MPAs as marine areas with a specific geographically defined scope that are designated and managed to achieve specific long-term biodiversity conservation objectives [12].

It is important to note that the BBNJ Agreement's scope covers areas beyond national jurisdiction. To avoid potential conflicts with regulations within national jurisdictions, the BBNJ Agreement stipulates that the establishment of ABMTs, including MPAs, within its framework should not encompass areas under national jurisdiction or any areas subject to claims of sovereignty, sovereign rights, or jurisdiction or any disputes. Additionally, the Conference of the Parties to the BBNJ Agreement is not authorized to deliberate on proposals for the establishment of ABMTs, including MPAs, in such areas [12].

Conclusion

The development of MPA regulatory systems usually relies on international organization resolutions and national practices. With the adoption of the BBNJ Agreement, the term "marine protected area" is written in its provisions, marking a milestone from an international law perspective in promoting the sustainable utilization and conservation of marine biodiversity through ABMTs including MPAs.

With the expiration of the Aichi Biodiversity Targets in 2020, the latest conservation target was adopted at the 15th Conference of the Parties to the Convention on Biological Diversity in October 2022. The new target aims to protect at least 30% of the land and marine areas through protected areas or other effective area-based management measures by 2030. Hence it is referred to as "30x30 target." As of the end of June 2023, Protected Planet's statistics show that there are a total of 18,429 MPAs and 195 OECMs in the world, collectively covering approximately 8.26% of the global oceans. This positive trend reflects the growing commitment and collaborative actions toward achieving the global target of marine conservation. (Figure 2) [13].

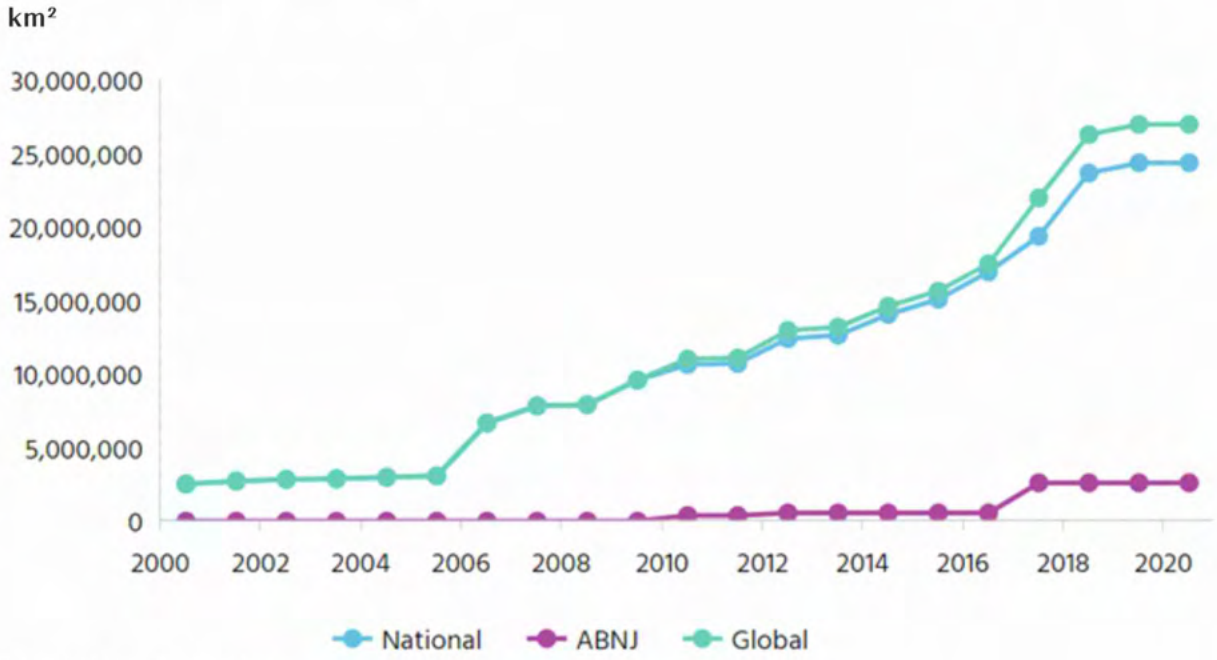

Figure 2/ Global Trend of Protected Area Coverage
Source/ Protected Planet (2023) [13]

The BBNJ Agreement will be open for signature on September 20, 2023, and will enter into force upon receiving the 60th instrument of ratification [14]. The BBNJ Agreement does not explicitly include any global target of MPAs in its text. Under the growing global awareness of marine conservation and promotion by other relevant conventions, after the BBNJ Agreement entry into force, it presents an opportunity to potentially increase the coverage of high-seas MPAs, contributing to the conservation of global marine biodiversity resources.

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Nip it in the bud: Framework of Environmental Impact Assessments for Activities in Areas beyond National Jurisdiction

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Intergovernmental Conference (IGC) of the United Nations (UN) adopted the Agreement under the United Nations Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas Beyond National Jurisdiction (referred to as the BBNJ Agreement) in June 9, 2023 [1]. The objective of this Agreement is to ensure the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction for the present and in the long term. To this end, this Agreement make regulations on marine genetic resources (including fair and equitable sharing of benefits, area-based management measures (including marine protected areas), environmental impact assessments (EIAs), and capacity-building and the transfer of marine technology to solve the long existing problems resulting from the unregulated use of marine resources in the areas beyond national jurisdiction. Part IV of this Agreement, EIAs, aims to build a coherent EIA framework for activities in areas beyond jurisdiction to avoid, mitigate and manage adverse activities and further protect marine environments. Under this framework, there are three major requirements for Parities who have activities in areas beyond national jurisdiction (i.e., the high seas and the Area). First, the Party, before authorizing the activity, shall evaluate its potential impacts to the marine environment and determine whether it should be subject to EIAs. Secondly, if yes, the Party starts to conduct assessments of its potential impacts, including cumulative impacts and the impacts within national jurisdiction. Thirdly, the Party, after authorizing the activity, shall monitor and periodically report its potential impacts.

Introduction

The fifth session of IGC, held in New York, 19 and 20 June 2023, reached consensus on the BBNJ Agreement. This Agreement is open for signature on 20 September 2023 [2] and shall enter into force 120 days after the date of deposit of the sixtieth instrument of ratification, approval, acceptance or accession (Article 68). It consists of 12 Parts, 76 articles and 2 annexes. The scope of application is areas beyond of national jurisdiction, which means the high seas and the Area (Article 1, Subparagraph 2). The provisions are mainly divided into four parts: Part II marine genetic resources, including fair and equitable sharing of benefits; Part III measures such as area-based management tools, including marine protected areas; Part IV EIAs, and Part V capacity-building and the transfer of marine technology. This essay is to introduce Part IV EIAs. It facilitates understanding of regulations on EIAs that need to be observed by Parties who intend to engage in activities in the high seas or the Area. (The content of this essay is mainly excerpted from [1])

Part IV of the BBNJ Agreement: Environmental Impact Assessment

"Environmental impact assessment" means a process to identify and evaluate the potential impacts of an activity to inform decision-making (Article 1, Subparagraph 7). A total of 13 provisions, from Article 27 to Article 39, are contained in Part IV. The content of major provisions is presented below:

- **Article 27 Objectives**

  Article 27 details the objectives of Part IV, which mainly include:

  I. Ensure that activities are assessed to prevent, mitigate and manage significant adverse impacts for the purpose of protecting and preserving the marine environment;

  II. Support the consideration of cumulative impacts and impacts in areas within jurisdiction;

  III. Achieve a coherent EIA framework for activities in areas beyond jurisdiction.

- **Article 28 Obligation to conduct EIAs**

  Article 28 details Party's obligation to conduct EIAs. Parties shall ensure that the potential impacts on the marine environment of planned activities under their jurisdiction or control that take place in areas beyond national jurisdiction are assessed before they are authorized. When the Party determines that the activity may cause substantial pollution of or significant and harmful changes to the marine environment in areas beyond national jurisdiction, it shall ensure that an EIA of such activity is conducted in accordance with the Part or that an EIA is conducted under its national process.

  The Party conducting such an assessment under its national process shall make relevant information available through the Clearing-House Mechanism, in a timely manner, ensure that the activity is monitored as well the EIA reports and monitoring reports are available.

- **Article 30 Thresholds and factors for conducting EIAs**

  Article 30 regulates the thresholds for the activity that needs to be evaluated for its environmental impacts and sets out the factors for consideration when determining whether the activity meet the threshold. When a planned activity may have more than a minor or transitory effect on marine environment, or the effects of the activity are unknown or poorly understood, the Party with jurisdiction of control of the activity shall conduct a screening of the activity. The factors for consideration in screening are such as: the type of and technology used for the activity and the manner in which it is to be conducted; the duration of the activity; the location of the activity; the characteristics and ecosystem of the location, including areas of particular ecological or biological significance or vulnerability; the potential impacts of the activity, including the cumulative impacts and the potential impacts in areas within national jurisdiction; the extent to which the effects of the activity are unknown or poorly understood.

- **Article 31 Process for EIAs**

  Article 31 deals with the process for EIAs, which includes the following main steps:

  Step 1: Screening

  Parties shall undertake screening to determine whether an EIA is required in respect of a planned activity under its jurisdiction or control and make its determination publicly available. It a Party

determines that an EIA is not required, it shall make relevant information publicly available through the Clearing-House Mechanism. Other Parties may register its views on the potential impacts of this planned activity with the Party and the Scientific and Technical Body (hereafter, STB), with 40 days of the publication of the determination. The Party that made the determination shall consider such concerns and may review its determination. Meanwhile, the STB shall consider and may evaluate the potential impacts of the activity based on the best available science and scientific information, and may make recommendations to the Party that made the determination.

Step 2: Scoping

Parties shall identify key environmental and any associated impacts, such as economic, social, cultural and human health impacts, including potential cumulative impacts and impacts in areas within national jurisdiction. The scope shall be defined by using the best available science and scientific information and relevant traditional knowledge of indigenous peoples and local communities.

Step 3: Impact assessment

Parties shall assess and evaluate the impacts of planned activities, including cumulative impacts and impacts within national jurisdiction.

Step 4: Prevent, mitigate and manage potential adverse effects

Parties shall identify and analyze measures to prevent, mitigate and manage potential adverse effects of the planned activities. Such measures may include the consideration of alternatives to the activity.

- **Article 32 Public notification and consultation**

Parties shall ensure timely public notification of a planned activity and offer opportunities by all States, in particular adjacent coastal States and any States adjacent that are potentially most affected. In addition, where a planned activity affects areas of the high seas that are entirely surrounded by the exclusive economic zones of States, Parties shall undertake consultations, including prior notification, with such surrounding Stats and consider their views on the activity and as appropriate, revise the activity accordingly.

- **Article 33 EIA reports**

The EIA reports shall include, at a minimum, the following information: a description of the planned activity, including its location; the results of the scoping exercise; a baseline assessment of the marine environment likely to be affected; a description of potential impacts, including potential cumulative impacts and any impacts in areas within national jurisdiction; a description of potential prevention, mitigation and management measure; a description of uncertainties and gas in knowledge, information on the public consultative process; alternatives to the planned activity; a description of follow-up actions, including an environmental management plan.

- **Article 34 Decision-making**

A party is responsible for determining if the planned activity may proceed. The decision shall only be made when it has made all efforts to ensure that the activity can be conducted in a manner consistent with the prevention of significant adverse impacts on the marine environment. Decision documents shall clearly outline conditions of approval such as mitigation measures as well as be made public, including through the Clearing-House Mechanism.

- **Article 35 Monitoring of impacts of authorized activities**

  Parties shall monitor the environmental and any associated impacts, such as economic, social, cultural and human health impacts of the authorized activity.

- **Article 36 Reporting on impacts of authorized activities**

  Parties shall periodically report on the impacts of the authorized activity. The reports are made publicly, including through the Clearing-House Mechanism, and the STB may consider and evaluate the monitoring reports.

- **Article 37 Review of authorized activities and their impacts**

  Should the Party identify significant adverse impacts that either were nor foreseen in the EIA, or that arise from a breach of any of the conditions set out in the approval of the activity, the Party shall review its decision authorizing the activity, notifying the Conference of the Parties (COPs), other Parties and the public, including through the Clearing-House Mechanism.

- **Article 38 Standards or guidelines to be developed the STB related to EIAs**

  The STB shall develop standards or guidelines for consideration and adoption by the COPs on:

  I. The determination of whether the thresholds for an EIA under article 30 have met or exceeded for planned activities;

  II. The assessment of cumulative impacts in areas beyond national jurisdiction and how those impacts should be taken into account in the EIA process;

  III. The assessment of impacts, in areas within national jurisdiction, of planned activities in areas beyond national jurisdiction and how these impacts should be taken into account in the EIA process.

Conclusion

Part IV of the BBNJ Agreement creates an EIA mechanism for activities in areas beyond national jurisdiction to prevent, mitigate and manage adverse impacts of activities. This mechanism consists of several key elements, including the thresholds for whether the planned activity is subject to an EIA; Parties are obligated to evaluate potential impacts of the activity to marine environments before authorizing it; an EIA process; EIA reports; authorization of the activity; monitoring impacts of the activity; periodically reporting impacts of the activity; review the authorization of the activity if significant adverse impacts identified; etc. Under this framework, Parties are obligated to evaluate environmental impacts of activities before they are conducted. This unprecedented 'nip it in the bud' approach, used in areas beyond national jurisdiction, is a pioneer undertaking in international marine environmental management and can prevent, mitigate and manage adverse impacts of activities in areas beyond as well as within national jurisdiction for further protection of marine environments.

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