ONE OCEAN FOUNDATION

Ocean Disclosure Initiative

PORTS AND WAREHOUSING INDUSTRY

SDA Bocconi SCHOOL OF MANAGEMENT
SUSTAINABILITY LAB

McKinsey & Company

CSIC
Consejo Superior de Investigaciones Científicas

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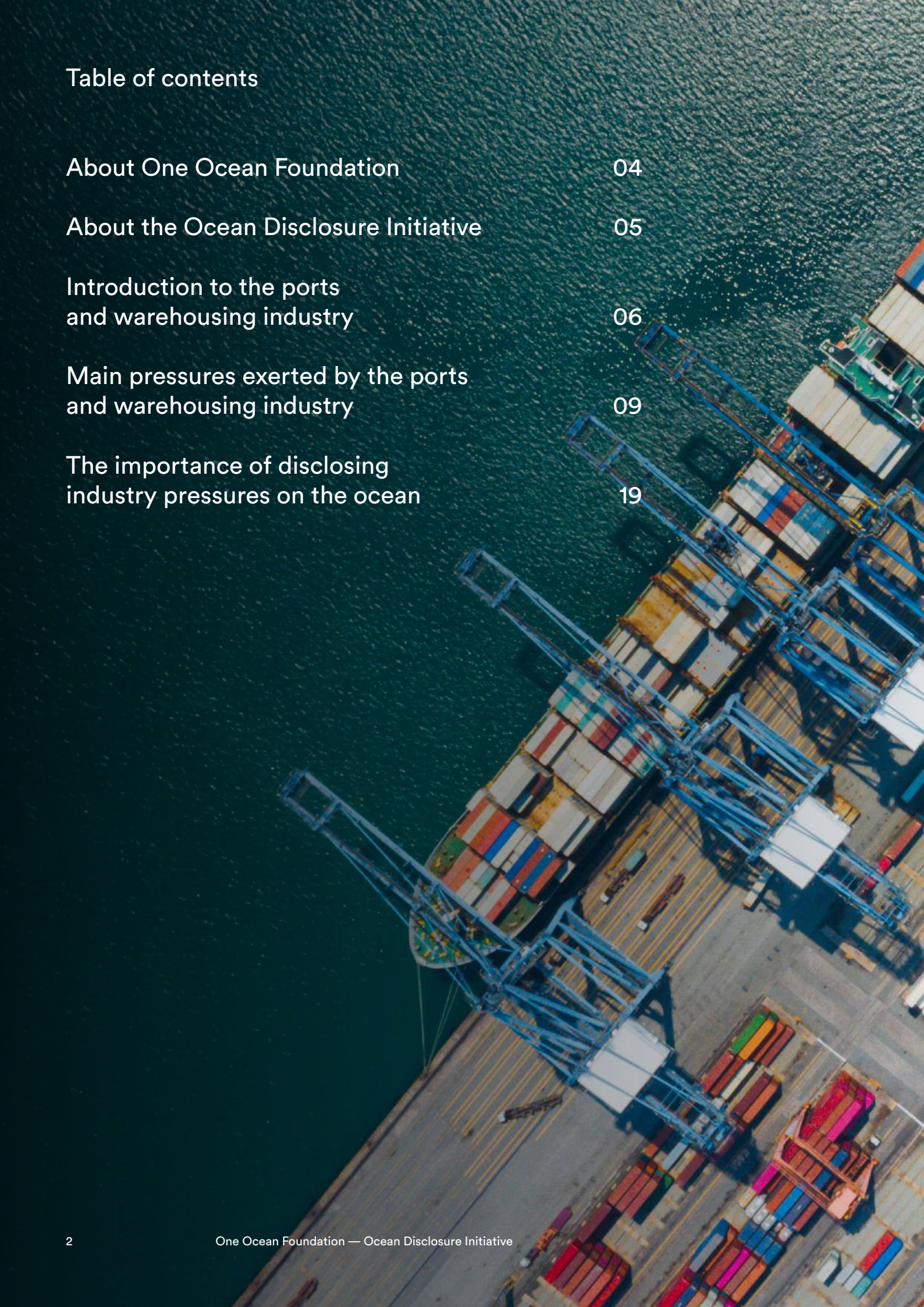

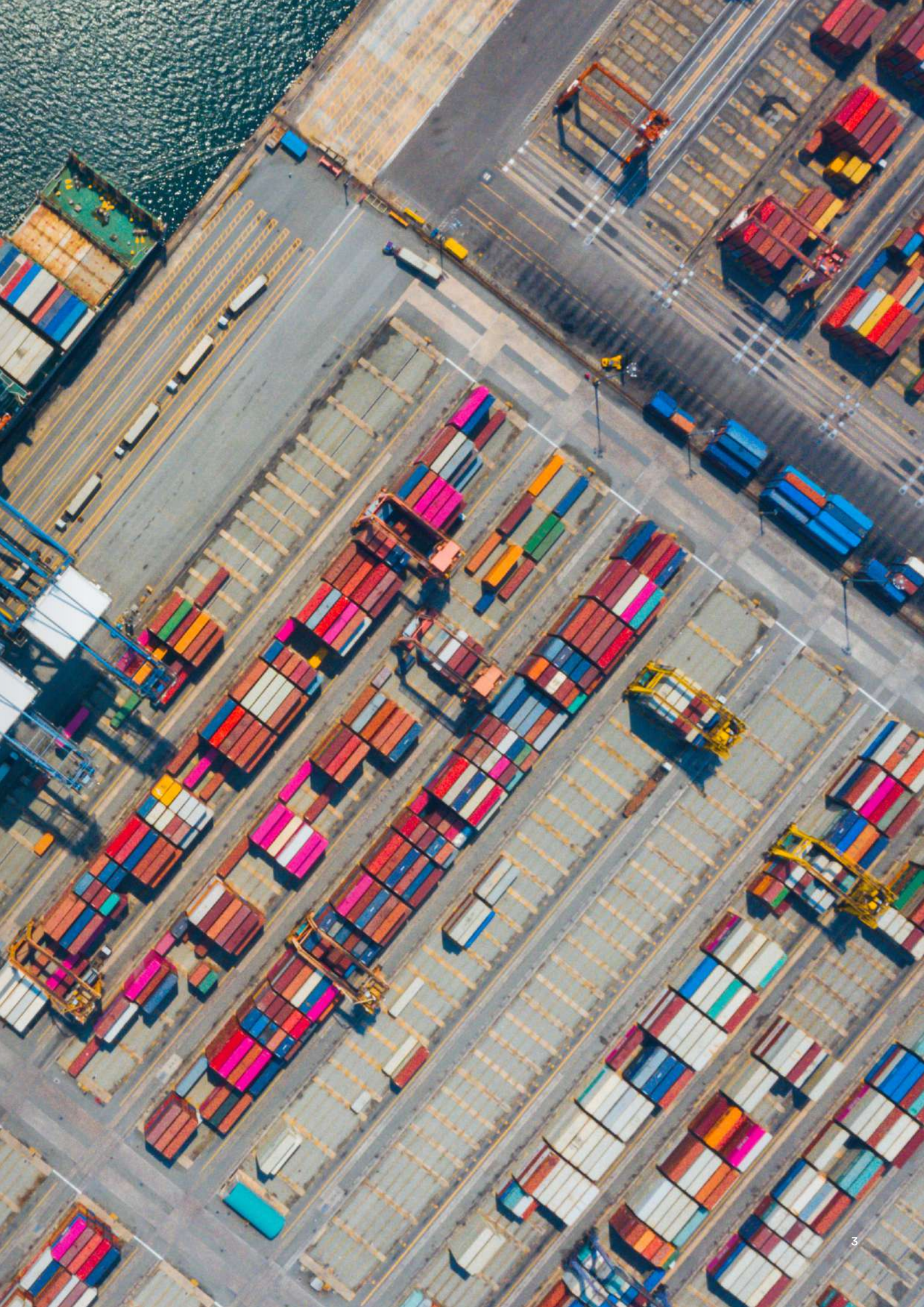

About One Ocean Foundation

This research is an initiative of the One Ocean Foundation as part of its Ocean Disclosure Initiative project.

The mission of the Foundation is to accelerate solutions to ocean issues by inspiring international leaders, institutions, companies and people, promoting a blue economy, and enhancing ocean knowledge through ocean literacy. The Foundation intends to develop a leading platform, bringing together and strengthening the voices speaking out on behalf of the ocean around the world.

The distinctive feature of the One Ocean Foundation is its scientific scope and, at the same time, its strong educational drive, with the aim of increasing awareness and establishing constructive relationships between all stakeholders engaged in marine preservation at different levels.

Thanks to its extensive network of partners, the One Ocean Foundation is engaged in numerous unique, innovative, and high added-value projects related to its mission of ocean protection in three main areas: education, environmental research, and the blue economy.

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About the Ocean Disclosure Initiative

The Ocean Disclosure Initiative project is part of the multi-year research “Business for Ocean Sustainability” conducted by the One Ocean Foundation (OOF) with the support of SDA Bocconi School of Management Sustainability Lab, McKinsey & Company and CSIC (Consejo Superior de Investigaciones Científicas) and aimed at building knowledge about the relationship between business activities and the ocean.

The project commenced in 2019 with the goal of investigating the role of companies in addressing ocean challenges, focusing on the pressures on marine ecosystems, levels of awareness within the business community and the main responses (technological and organisational) implemented.

The Ocean Disclosure Initiative aims to provide a science-based framework and methodology with the objective of supporting businesses from all industries in taking action on ocean-related issues, promoting prevention and/or mitigation responses and favouring disclosure and reporting.

Introduction to the ports and warehousing industry

Ports and warehouses serve as essential pillars of economic and political development for nations with access to the ocean. Additionally, they play pivotal roles in global trade and logistics, serving as key nodes in the supply chain. Port operations comprise important activities such as cargo handling, container operations, vessel loading and unloading, and provision of essential services including storage and repair facilities. Moreover, besides docking and transferring goods and people, ports serve as a base for the development of auxiliary activities, such as warehousing, infrastructure activities, pilotage[1]. In particular, warehouses are an integral part of port operations, as they facilitate the storage and transfer of goods destined for maritime transportation.

By acting as a means of integration into the global economic system, ports have the potential to facilitate the expansion of local investments and resources to a global scenario. Commercial databases list more than 11,000 commercial ports and terminals around the world, and port business increases in complexity every year[2].

According to the EU Blue Economy Observatory, the GVA generated by the port activities sector in 2020 in the EU blue economy amounted to €26.9 billion, corresponding to about 20.9% of GVA and 11.5% of blue economy jobs[3]. Additional data at the European level highlight that every 10% increase in port throughput could generate a 6–20% increase in the GDP of European regions[4]. Furthermore, the Geneva-based United Nations Conference on Trade and Development (UNCTAD) estimates that a consistent value of over 80% of total international trade is conducted using seaports.

PORTS SERVE AS ESSENTIAL PILLARS OF ECONOMIC AND POLITICAL DEVELOPMENT. ADDITIONALLY, THEY PLAY PIVOTAL ROLES IN GLOBAL TRADE AND LOGISTICS, SERVING AS KEY NODES IN THE SUPPLY CHAIN

1. Dwarakish, G.S., & Salim A.M. (2015) "Review on the Role of Ports in the Development of a Nation" Aquatic Procedia [online]. Available at: https://doi.org/10.1016/j.aqpro.2015.02.040 (Accessed: 19 June 2023)
2. Sorgenfrei, Jürgen (2018) "Port Business: Second Edition" [printed and online]. Available at: Port Business (degruyter.com) (accessed: 29 march 2024)
3. EU Blue Economy Observatory [online]. Available at https://blue-economy-observatory.ec.europa.eu/eu-blue-economy-sectors/port-activities_en (accessed: 29 march 2024)
4 Bottasso, A., et al. (2013) "The impact of port throughput on local employment: Evidence from a panel of European regions" Transport Policy [online]. Available at: https://doi.org/10.1016/j.tranpol.2012.12.001 (Accessed: 19 June 2023)

Therefore, by serving as a transit point for the majority of imports and exports, ports have a direct and positive link with the country's economic performance, and consequently with the nation's human development index.

While fundamental to the expansion of the global economy, port activities and the associated handling of goods and transportation potentially exert several pressures on the ocean. These pressures include GHG emissions, the introduction of non-indigenous species (NIS), discharge of contaminants and generation of marine litter, which port authorities, who are among the main responsible for monitoring the environmental impact of ports, and companies operating in the port areas should take into consideration.

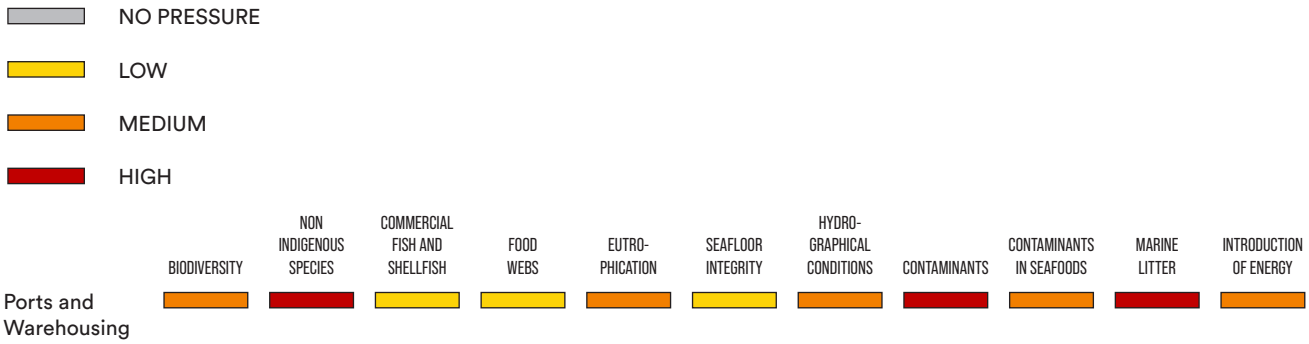
As awareness of the pressures exerted by port operations is increasing, the concept of green ports has begun to spread at the industry level. Indeed, the idea of green ports (or low-carbon ports), characterised by the development of a vibrant ecological environment, conscious use of resources, low energy consumption, and low pollution, was officially proposed at the United Nations Climate Change Conference in 2009[5]. In a similar vein, both the Paris Agreement and the Comprehensive Guide for Port Authorities[6] urge ports to operate based on a green growth strategy (economy-driven). Among other things, this implies adjusting terminal infrastructure, supporting multimodal transport, adding alternative fuel infrastructure, and providing alternative fuelling options[7], along with other green technologies[8].

5. Notteboom, T., et al. (2022) Port Economics, Management and Policy. Routledge. Available at: https://www.routledge.com/Port-Economics-Management-and-Policy/Notteboom-Pallis-Rodrigue/p/book/9780367331559
6. World Association for Waterborne Transport Infrastructure (2014) "A Guide for Port Authorities" PIANC [online]. Available at: https://sustainableworldports.org/project/pianc-sustainable-ports-guide/ (Accessed: 20 June 2023)
7. Such as green ammonia, hydrogen, batteries for electric vessels
8. Twrdy, E., & Zanne, M. (2020) "Improvement of the sustainability of ports logistics by the development of innovative green infrastructure solutions" Transportation Research Procedia [online]. Available at: https://doi.org/10.1016/j.trpro.2020.03.059 (Accessed: 19 June 2023)

To summarise, many port operations can potentially alter the integrity and stability of the marine environment and the associated biodiversity. As indicated in the table showing the pressures identified (figure 1 below), the scientific review conducted in the framework of the Ocean Disclosure Initiative project verified that the most significant potential pressures on the ocean exerted by this industry, marked in red, concern:

— Introduction of non-indigenous species (NIS)
— Introduction of contaminants
— Introduction of marine litter

FIGURE 1: Review of the pressures of the ports and warehousing*



Source: Ocean Disclosure Initiative, One Ocean Foundation, 2021

* Pressures exerted on the eleven Good Environmental Status descriptors (GES) of EU marine waters, listed in the figure as identified in the Marine Strategy Framework Directive of the European Union. https://ec.europa.eu/environment/marine/good-environmental-status/index_en.htm

In addition to these highest pressures, the emissions of GHGs and other air pollutants caused by the sector mainly impact the loss of marine biodiversity, marked in orange, contributing to acidification and eutrophication of seawaters, as further explained in the paragraphs below. Furthermore, the research conducted over the years has shed additional light on the impact of construction activities associated with port operations, such as dredging and sand extraction, which exert significant pressures on seabed integrity, causing harm to marine life.

The main pressures exerted by the ports and warehousing industry

The pressures mentioned above are caused by the core operations of the ports and warehousing industry, potentially affecting ocean health. Below, we expand on the main critical pressures and their potential consequences on ocean ecosystems.

1. Introduction of non-indigenous species (NIS)

PORTS ARE PRIMARY HOTSPOTS FOR INTRODUCING AND SETTLING NON-INDIGENOUS SPECIES INTO MARINE WATERS, MAINLY DUE TO THE MOVEMENTS OF CARGO SHIPS BETWEEN DIFFERENT PORTS

Ports, especially large commercial hubs, are primary hotspots for introducing and settling non-indigenous species into marine waters, often referred to as "bio-invasion hotspots"[9]. Indeed, the movement of transoceanic cargo ships between different ports could act as a pathway for the diffusion of these species, facilitating their dispersion across biogeographic barriers that would otherwise naturally prevent their spread[10]. Scientific literature reports that non-native species have been found even in the waters of the most pristine and isolated environments, such as the Antarctic, due to the globalised nature of the shipping network[11]. Although they exist as free-living organisms, these species can potentially establish new populations and become invasive, especially considering the more pronounced effects of climate change[12]. NIS are mainly introduced into port water environments through ballast waters and hull fouling, but also through sea chests, ballast sediments and ships' internal seawater piping systems[13]. Here, these species find suitable surfaces on which to settle and develop[14], displaying evidence of rapid adaptation and tolerance to new environmental conditions such as ports' polluted waters and eventually turning into invasive species.

9. Tempesti, J., et al. (2020) "Non-indigenous species in Mediterranean ports: A knowledge baseline" Marine Environmental Research [online]. Available at: 10.1016/j.marenvres.2020.105056 (Accessed: 19 June 2023)
10. Cabrini, M., et al. (2019) "Potential transfer of aquatic organisms via ballast water with a particular focus on harmful and non-indigenous species: A survey from Adriatic ports" Marine pollution bulletin [online]. Available at: https://doi.org/10.1016/j.marpolbul.2018.02.004 (Accessed: 19 June 2023)
11. McCarthy, A. H., et al (2022). "Ship traffic connects Antarctica's fragile coasts to worldwide ecosystems" Proceedings of the National Academy of Sciences. Available at: https://doi.org/10.1073/pnas.2110303118 (Accessed: 19 June 2023)
12. Ibidem
13 Miralles, L., et al. (2021) "If you know the enemy and know yourself: addressing the problem of biological invasions in ports through a new NIS invasion threat score, routine monitoring, and preventive action plans" Frontiers in Marine Science [online]. Available at: https://doi.org/10.3389/fmars.2021.633118 (Accessed: 19 June 2023)
14. Tamburini, M., et al (2021). "Monitoring non-indigenous species in port habitats: first application of a standardised North American protocol in the Mediterranean Sea." Frontiers in Marine Science [online]. Available at: https://doi.org/10.3389/fmars.2021.700730 (Accessed: 19 June 2023)

Best practices. The International Maritime Organization (IMO) has adopted the 2017 International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention) to assess and reduce the spread of non-indigenous species across ports. Ships and all commercial vessels that adhere to the convention must comply with procedures and standards related to the handling of ballast waters, specifically to the loading and unloading of water, for example, which must be discharged and replaced a minimum of 200 nautical miles from the shoreline before entering a new port[15]. Additional requirements also concern proper maintenance and cleaning of hulls and ship equipment directly in contact with water, to limit and prevent fouling composed of harmful aquatic organisms and their consequent introduction and diffusion in a different marine environment.

Moreover, recent research in this field comprises the development of antifouling coating for hulls. In most of the cases, marine vessels are covered by a biocidal coating that kills organisms that try to attach to the hull. Copper has gotten more attention recently as well and, in fact, by separating the steel vessel and the copper substratum with a polymer to avoid corrosion, modern ships are able to limit the spread of NIS in the marine ecosystems.

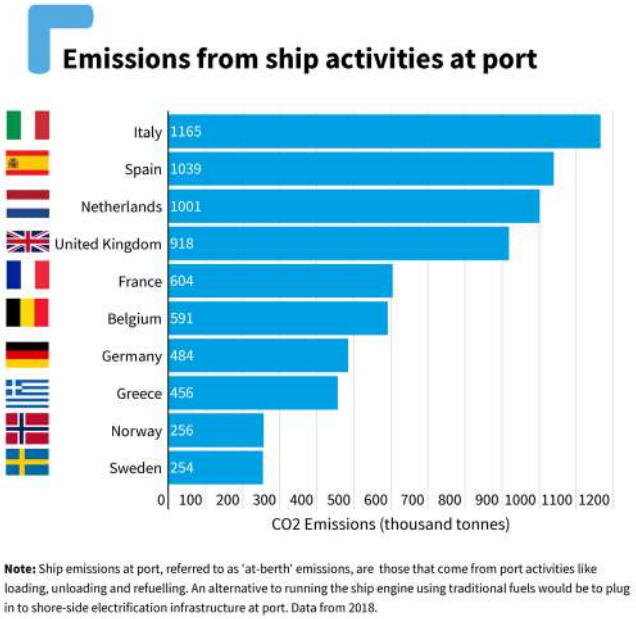
2. GHG emissions and air pollution linked to biodiversity loss

One of the main environmental pressures generated in port areas is the emissions of GHGs, which exacerbate global warming and have consequences for the marine ecosystems. In particular, diesel engines are a primary source of GHG emissions, such as carbon dioxide (CO2), which heavily contribute to global warming and climate change. In addition, the industry is responsible for the emission of other compounds that can have additional direct harmful effects on the environment, such as nitrogen and sulphur oxides (NOx, Sox), carbon monoxide (CO), particulate matter (PM) and volatile organic compounds (VOCs). Levels of pollution caused by these compounds are strongly related to port size: the larger the port, the higher the risk of pollution due to higher traffic intensity and the magnitude of the related operations. Ports rely on a wide range of vessels, vehicles, equipment, and facilities (including warehousing processes) that emit pollutants mainly through the burning of fuels[16].

ONE OF THE MAIN ENVIRONMENTAL PRESSURES GENERATED IN PORT AREAS IS THE EMISSIONS OF GHGS, WHICH EXACERBATE GLOBAL WARMING AND HAVE CONSEQUENCES FOR THE MARINE ECOSYSTEMS

15. IMO (2012). Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species.
16. EPA (2023) Ports Primer: 7.1 Environmental Impacts [online] Available at: //www.epa.gov/community-port-collaboration/ports-primer-71-environmental-impacts (Accessed: 19 June 2023)

FIGURE 2: Emissions from ship activities at port at the European level



Source: European Federation for Transport and Environment, Data for 2018.

The figure above represents the emissions of CO2 from ship activities at berth, such as loading, unloading and refuelling, from 10 European countries[17]. In general, oil tankers at berth activities constitute the majority of emissions for ports. Because of the high number of ports, Italy has the most emissions for port activities. However, none of its ports, perhaps because of their relatively smaller size, are ranked among the 10 most polluting in Europe. With regards to Asia, over half a million tonnes of CO2 are emitted every year solely in the port of Shenzhen in China, of which 40% correspond to port-related activities. The 2022 UN Conference on Trade and Development has estimated that reduced port emissions would benefit the health of 3.5 billion people worldwide while curbing climate change. This is because, in addition to substantial air and water pollution damaging marine and coastal ecosystems, emissions of greenhouse gases, such as carbon dioxide, and particulate matter are also dangerous to human health.

REDUCING PORT EMISSIONS WOULD NOT ONLY HELP ADDRESS CLIMATE CHANGE BUT ALSO IMPROVE THE HEALTH OF APPROXIMATELY 3.5 BILLION INDIVIDUALS GLOBALLY

17. European Federation for Transport and Environment (2022). "EU Ports' Climate Performance: an analysis of maritime supply chain and at berth emissions" [online]. Available at: https://www.transportenvironment.org/wp-content/uploads/2022/02/2202_Port_Rankings_briefing-1.pdf (Accessed: 19 June 2023)

Air pollution is related to some of the issues of major concern for the ocean, i.e. ocean acidification and the eutrophication of waters. While acidification refers to a reduction in the pH of the ocean caused mainly by the uptake of carbon dioxide from the atmosphere over an extended period of time, eutrophication occurs when a body of water becomes enriched in dissolved nutrients that stimulate the excessive growth of algae, eventually resulting in the depletion of oxygen and the creation of dead zones. Specifically, port construction, operations and maintenance contribute to nitrogen oxide emissions, formed during the combustion of fuel and organic material at high temperatures, representing the main cause of eutrophication.

Best practices. Given the impacts of fuel emissions on the marine environment, many ports have developed air quality programmes and implemented policies to comply with international regulations to limit pollution levels rate, reduce emissions and assess related environmental risks. Port action plans include mitigation activities that involve emission reduction targets and energy-saving measures from an operational and logistic-based perspective. Moreover, technological improvements could be implemented following the operational framework of green ports.

In this framework, one of the primary good practices is represented by ports' electrification, allowing ships at berth to shut down their auxiliary engines and connect to the onshore power source. Port electrification and reduction in emissions can be achieved through the replacement of diesel cargo handling equipment, such as cranes and forklifts, with electric equipment and the use of electric/hybrid on-road vehicles for transit at ports[18]. Additional good practices include using alternative fuels, more efficient and innovative engines, and devices to filter and trap exhaust emissions.

It is equally imperative to keep track of all pollutants released into the atmosphere over time. Databases would include important information about emissions from different sources (e.g. marine vessels, trucks, equipment, etc.) that could help measure the impact of port operations, thus aiding in the development of future emission reduction scenarios and sustainable strategies to limit air pollution.

18. Dhupia J., Adnanes A., et al. (2011) "Electrification of Port and Port Operations" [online]. Available at: Electrification-of-Port-and-Port-Operations.pdf (researchgate.net) (Accessed: 1 March 2024)

3. Introduction of contaminants

PORT ACTIVITIES, IF NOT WELL HANDLED, CAN WORSEN WATER QUALITY, AFFECTING THE HEALTH OF THE MARINE ENVIRONMENT. THE MAIN DETRIMENTAL CONSEQUENCES DERIVE FROM WASTEWATER DISCHARGES FROM SHIPS AND ACCIDENTAL SPILLS, AS WELL AS STORMWATER RUNOFF AT DOCKS

Port activities may worsen water quality, affecting the health of the marine environment. The main detrimental consequences derive from wastewater discharges from ships and accidental spills, as well as stormwater runoff at docks. Pollution from vessels includes sewage, bilge water and wastewater, often contaminated with oil. Cleaning of hulls and propellers is also of major concern since it can release toxic paints, including antifouling paints, used to coat surfaces to prevent fouling by organisms (biofouling). Stormwater runoff is a vector for pollutants since it carries all the deposits from the paved port surface directly into the waters surrounding the docks, often bypassing wastewater treatment plants. Accidental releases from oil spills include diesel and gasoline leakages from ships and residuals from the loading and unloading of oil tankers. Moreover, tanks and products used in washing operations in ports contain chemical compounds that, if not managed properly, can easily enter the marine environment, with potentially detrimental effects on water quality and marine biodiversity. Chemicals and hazardous substances are a common by-product of the dismantling process of end-of-life vessels which occurs in port areas, especially in countries where facilities for the proper management of waste are absent. These substances include heavy metals, synthetic chemicals such as PCBs and HFCs, asbestos and hydrocarbons, which are harmful to the health of the marine environment.

Best practices. Federal, state and local governments, including port authorities, regulate discharges in port areas. Best practices adopted by providers are linked to in-depth knowledge of the specific requirements for sediment and water quality, thanks to the availability of guidance documents. Annex IV of MARPOL provides a set of regulations regarding ship sewage discharge, including the requirements for provision of port reception facilities, specifications for surveys and certifications[19]. In addition, port authorities often mimic the approach used by local communities when dealing with estuarine or river basin discharges, with specific attention to the collection and absorption of floating oils through collection and absorption techniques.

19. IMO (2005) "International Convention for the Prevention of Pollution from Ships (MARPOL)" [online]. Available at: https://www.imo.org/en/OurWork/Environment/Pages/Sewage-Default.aspx (Accessed: 04 March 2024)

Technological advances also constitute a key element in water quality control. For instance, port authorities could set up an integrated monitoring system based on intervention and/or warning levels, which detects water and sediment quality in and around the port area. At the same time, the system could ensure adequate equipment is in place to intervene when certain levels have been reached or exceeded. To fulfil this purpose, the European Union founded SedNet[20], a network incorporating sediment knowledge into European strategies to achieve good environmental status descriptors.

Furthermore, the interception of water runoff and stormwater in port areas could enhance water quality. For example, the Port of Avilés in Spain has designed a stormwater system to treat all rainwater and utilise a portion of it. With separation devices and conductors to cisterns allowing the use of recycled water for irrigation, the stormwater system ensures compatibility with non-drinking water quality within the terminal's perimeter.

4. Introduction of marine litter

IMPROPER WASTE MANAGEMENT IN PORTS CAN HARM OCEAN HEALTH. NON-BIODEGRADABLE MATERIALS, LIKE PLASTICS, CAN ENTER MARINE FOOD WEBS, HARMING BOTH MARINE LIFE AND HUMANS

Waste can reach port areas from many sources, both onshore and offshore, and if not well managed, it can enter the marine environment with detrimental effects on the ocean's health. Offshore waste that is landed in ports includes, among other things, plastic, metal bottles, glass, other materials used for packaging such as Styrofoam, tape and wood, organic waste, paper products, and hazardous materials. Plastic, in particular, may be degraded into micro and nano-plastic and enter the marine food webs with cascading negative consequences on both the environment and humans. Waste can also be generated at port facilities onshore, such as warehouses, and is associated with maritime industry activities, including commercial operations and domestic use by harbour employees.

The garbage created on board during ships' operations is usually collected and disposed of at dock areas. Unfortunately, many ports possess inadequate waste treatment facilities. Indeed, port reception facilities often cannot easily be adapted in order to collect the different types of ship-generated waste. Ship demolition can also be considered a source of waste, since end-of-life vessels that have to be dismantled and/or recycled represent a potential source of water contamination due to several hazardous materials and substances contained within their structures.

20. More information can be found in the website: https://sednet.org/

Best practices. Ports play an important role in marine waste management. According to MARPOL Annex V, the effectiveness of ships' compliance with discharge requirements depends largely upon the availability of adequate port reception facilities for garbage[21]. In addition, port authorities could encourage shipowners to dispose of different types of landed garbage properly in order to promote safer and more environmentally friendly waste management. The International Maritime Organization has been working with the International Labour Organization to implement a "waste hierarchy" together with appropriate recycling methods as part of a Port Waste Management Plan, a useful instrument to avoid and minimise the potential impacts of ship-generated waste and move towards responsible management. For example, to ensure sustainable port-waste management, the Atlantic Smart Ports Blue Acceleration Network (AspBAN) was created in 2021 and currently involves more than 40 ports in different regions of the Atlantic. Overall, the project aims to transform ports into hubs for the development of new and sustainable businesses in the ocean economy.

Finally, installing innovative technologies at port docks to collect marine litter directly from waters could help reduce ocean pollution (e.g. collection devices for floating garbage, specific filters for microplastics, treatment of wastewater through different levels of treatments to remove large and suspended solids, blending with other water sources to achieve desired quality standards or dilute pollutants to acceptable levels and then discharge or reuse for non-potable purposes).

21. IMO (2005) "International Convention for the Prevention of Pollution from Ships (MARPOL)" [online]. Available at: https://www.imo.org/en/OurWork/Environment/Pages/Garbage-Default.aspx (Accessed: 04 March 2024)

Seafloor Integrity

Construction activities associated with port operations can exert significant pressures on seabed integrity. According to the EU, the main port activities causing pressures on seafloor integrity include dredging and the disposal of dredged materials, and sand extraction. For instance, dredging – the process of excavating material from a water environment – can cause sediments to resuspend, harming marine life, and changes in sedimentation can also be linked to coastal erosion[22]. Current issues with dredging processes include a lack of financial capital devoted to maintenance and a general misalignment between ports and local and national authorities on dredging regulations. For this reason, the World Bank has proposed to properly assess the characteristics and properties of dredged materials, in order to evaluate possible ways to reuse or dispose of them (such as wetland creation, habitat restoration and land reclamation) and to select excavation and dredging methods to minimise suspension of sediments and destruction of benthic habitat[23].

Physical damage to the seabed can originate from ship anchoring and anchor dragging, which is increasingly considered a threat to the health of benthic communities, due to destruction and changes in sediment type and ecosystem functioning[24]. Finally, additional pressure on seafloor integrity is caused by the excessive extraction of sand from ocean waters. This is because the construction industry considers the rounded grains found in ocean sand more suitable for concrete production than angular grains taken from the desert. However, both the dredging and extraction of sand can lead to the degradation of seabed morphology, ultimately affecting marine habitats and biodiversity, reducing the abundance of marine fauna and shifting species composition.

Additional considerations

Furthermore, the activities conducted in ports generate loud noises and illumination, creating underwater noise and light pollution that negatively impacts marine life. Exposure to underwater sounds could lead to changes in both the physical and acoustic behaviour of marine

22. UN Environment Program (2022). "Sand and Sustainability :10 strategic recommendations to avert a crisis". [online]. Available at: https://www.unep.org/resources/report/sand-and-sustainability-10-strategic-recommendations-avert-crisis (Accessed: 02 November 2023)
23. World Bank Group (2017). "Environmental, Health and Safety Guidelines for Ports, Harbors and Terminals". [online]. Available at: https://www.ifc.org/content/dam/ifc/doc/2010/2017-ports-harbors-terminals-ehs-guidelines-en.pdf (Accessed: 04 March 2024)
24. Watson, S.J., Ribó, M., Seabrook, S. et al. (2022). "The footprint of ship anchoring on the seafloor" [online]. Available at: https://doi.org/10.1038/s41598-022-11627-5 (Accessed: 04 March 2024)
25. Erbe, C., Marley, S. A., Schoeman, R. P., Smith, J. N., Trigg, L. E., & Embling, C. B. (2019). The effects of ship noise on marine mammals—a review. Frontiers in Marine Science, 606

animals, hearing loss, stress and the masking of communication and echolocation sounds in many marine species, especially marine mammals[25]. Indeed, ship noise may extend and overlap with frequencies used by cetaceans to communicate, navigate, reproduce, detect predators, and forage food, thus leading to behavioural disturbances that could also result in the animal's death.

Best practices. The limitation of dredging activities to keeping the port's nautical access open, clean, and safe, is key to mitigating possible damage to the seabed. Simultaneously, it is worth understanding the local environment and using natural processes such as hydraulics, hydrology, and vegetation to maximise the efficiency of dredging in both the short and long term. Current best practices include designing harbour basins based on hydraulic models that minimise the inflow of sediments and implementing overall sediment management reduction plans. Current deflector walls (CDW) have been successfully implemented in the Ports of Hamburg and Antwerp and constitute perfect examples. The approach consists of using the dredged material to extend existing sandbars, creating intertidal and shallow water areas and improving the biotic conditions in existing intertidal areas. The success of the project meant that the sediments disposed of remained stable and improved the ecology of the Western Scheldt estuary.

The following picture summarises the best practices that companies and organisations operating in the porta areas can implement to ensure the necessary sustainable transition in the sector.

FIGURE 3: Best practices in the port areas

Source: Elaboration of the authors from the EU-funded project "Sustainable Ports in the Adriatic-Ionian Region" project

In conclusion, addressing the degradation of the ocean with proactive measures is critically important for port authorities and associated companies, especially considering their vulnerability to future natural disasters.

The rising sea levels and more frequent extreme weather events resulting from climate change in fact pose substantial risks to port infrastructures and could cause costly downtime as well as further pressures on ocean ecosystems. It is estimated that climate-related disruptions contribute to a downtime risk of 1.4 days across ports globally and could have a significant impact on global shipping, trade, and supply chains[26]. From an environmental perspective, disruptions such as delays and physical damage to port infrastructure resulting from extreme weather events can escalate energy demands, consequently leading to heightened air emissions. Furthermore, storm surges and flooding can result in the discharge of pollutants, debris, and litter into marine waters, adversely affecting both ocean ecosystems and nearby communities, further exacerbating the issues discussed above in the sections related to the introduction and contaminants and marine litter.

Therefore, it is advisable that the managing entities lead the way in transforming their business practices in order to ensure the protection of both the entire port system and the marine environment concerned.

26. Verschuur, J., Koks, E.E. & Hall, J.W. (2023). "Systemic risks from climate-related disruptions at ports". [online]. Available at: https://www.nature.com/articles/s41558-023-01754-w (Accessed: 15 March 2024)

The importance of disclosing industry pressures on the ocean

The industry-specific edition of the Ocean Disclosure Initiative tool dedicated to the ports and warehouses sector, developed by One Ocean Foundation in collaboration with its partners, reflects the main pressures exerted by this sector with the aim of supporting companies in becoming aware of their potential impacts on marine ecosystems, assessing the related risks, and disclosing key information and strategic responses on the significant issues related to port activities.

As identified in our research and reflected in the industry-specific tool, these pressures include i) GHG emissions, mainly linked to port operations and warehouse management activities; ii) the release of hazardous substances or contaminants into water bodies; iii) operations that may alter sea-floor integrity, including construction of infrastructure for port activities; iv) the introduction of marine litter due to poor waste management at ports; and v) introduction of energy such as underwater light and noise emitted during port operations and construction of port infrastructure.

The importance of the Ocean Disclosure Initiative lies in the fact that, for the first time, companies, scientific and financial communities, and civil society can rely on a common language to measure, address, and mitigate the most relevant pressures that humanity exerts on the marine environment, sector by sector, with significant advantages for the health of the ocean.

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