Chapter 16
Ocean Space and Sustainability

Jan H. Stel

Abstract The notion of ocean space stands for a holistic, system science approach combined with 4D thinking from the ocean, and the processes within it, towards the land. It is in fact a social-ecological concept that deals with sustainability challenges which are the consequence of the complex interactions between human activities and the marine environment at all scales. Ocean space is a critical player in the Earth System, it's central to climate regulation, the hydrological and carbon cycles and nutrient flows, it balances levels of atmospheric gases, it's a source of raw materials, and a sink for anthropogenic pollutants. On a human scale, it is impressively large. On a planetary scale, however, it's insignificant, although it's an ancient feature of the Earth.

Sustainability in ocean space is still an emerging issue. Since the early seventeenth century the Grotian notion of *Mare Liberum*, has dominated the unsustainable, use of ocean resources. Grotius, main challenge was to warrant freedom of navigation, trade, fisheries and whaling for the Dutch Republic. He was not at all interested in sustainability. In the 1960s Arvid Pardo introduced the principle of the 'Common Heritage of Mankind', which is incorporated in the present international Law of the Sea. It is an ethical and even today, controversial concept.

In this paper the global sustainability framework of the United Nations Convention on the Law of the Sea, and regional European developments with regard to its shared Exclusive Economic Zone, are discussed. It is concluded that for sustainability in ocean space, a more up-to-date and integrated or holistic, approach is urgently needed.

Keywords Earth system science • Anthropocene • Arctic climate change • UNCLOS • Apocalypse • Grotius • EU marine strategy • Ocean space

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1 Introduction

Perceptions colour our view towards ocean space. Indian Ocean societies and China have viewed the sea as a special place of trade, beyond society and social processes. It was considered an area to be crossed as quickly as possible; not as territory for control, influence or social power (Steinberg 2001). European societies, however, view ocean space in terms of ownership of (territorial zones) or access to resources and the freedom to trade. After World War II, this perception was more and more influenced by new technology that allowed a growing use of ocean resources. As a consequence, Grotius' notion of *Mare Liberum* was increasingly disregarded. This led to a new Law of the Sea treaty, which defines the rights and responsibilities of states with regard to the use of ocean space.

In contrast, the perception of the ancient Polynesian society was unique. Polynesians view the ocean as a multitude of islands connected by short journeys, in a field of crosscurrents, wave patterns, shifting breezes and flotsam, rich in bird and sea life, all laid out under a series of rotating constellations, whose intersection with the horizon easily marks one's place on the trail between islands (Lewis 1978). Their culture was fully adapted to ocean space. They knew how to live, and survive, within the ocean environment. Their sophisticated navigation system was based on observations of stars, ocean swells, flight patterns of birds and other natural signs. They used charts of sticks and shells to record the interference patterns of waves intersecting with islands (McKay and Walmsley 2003). And, as they moved further away from the continents, they developed a portable agricultural system, in which domesticated plants and animals were carried in their canoes for transplantation on the islands they encountered. They lived and survived in an immense, undefined ocean world where they could find their way over the open ocean – the surface of ocean space.

2 What Is Ocean Space?

Oceans are an ancient, 4.4 billion years old, characteristic of the Earth. The word as such is derived from the Ancient Greek 'okeanos', referring to a (3D) body of saline water. Time is the fourth dimension and leads to the notion of ocean space (Stel 2002, 2013). Humans have, just for convenience, divided the world ocean into the Pacific, Atlantic, Indian, Southern (Antarctic) and Arctic oceans. In reality, however, they are only temporary features of a single world ocean. At the dawn of the third millennium, outer space exploration has frequently reemphasised the Earth as a blue dot in the universe. Therefore, exploring and understanding the special colour of our planet, as determined by ocean space, is one of the big challenges of this century.

Ocean space – 1.37 billion km^3 of water covering some 70 % of the Earth's surface – is a different world, which, even today, we barely know. It is a dynamic world with complex currents, waterfalls and cataracts. Just 5 % has been explored. Life is everywhere, from microbes in watery cracks in the deep ocean floor to life in freshwater lakes and streams on the land filled with water temporarily on loan from the ocean. It's a weightless and mostly dark world, like outer space. It's a world alien to us, as a terrestrial species.

From an ocean perspective, phenomena like El Niño and La Niña, the thermohaline circulation, the onset and intensity of the Asian Monsoon, the carbon and water cycles and the release of methane from the (Arctic) ocean floor are shaping life on the land and framing human activities. In truth, processes within ocean space shape and mould our daily lives, our activities, our societies and our history (see Boxes 16.1 and 16.3). Ocean space is the last physical frontier on earth. The main drivers in ocean exploration are new technology (miniaturisation, biomarkers, etc.) and the fast increase in computer power for modelling.

From our human perspective, the oceans seem quite vast, but in regard to the planet as a whole, they are almost as insignificant as we ourselves. There is more water chemically trapped within the Earth's hot interior than there is in ocean space and the atmosphere. Ocean space is a critical player in the Earth system: it controls the climate, the hydrological and carbon cycles and nutrient flows and the gases in our atmosphere, it provides us with raw materials for use and it helps the planet attend to the anthropogenic pollutants, like CO_2, that result from that use. It's hard to understand why ecosystem services, as well as the value of ocean space, are not taken into account when we discuss human activities.

The notion *of ocean space* was coined in the 1960s, and *stands for a system science approach combined with thinking from the ocean, and the processes within it, towards the land*. It includes both human activities that are influenced by ocean space and human activities, like the exploitation of ocean resources and pollution, that affect ocean space itself. It's a concept that joins ideas of sociology and ecology to deal with sustainability challenges resulting from the complex interactions between human activities and the marine environment from the local to global levels. So far, the local to regional scale has been addressed in, for example, the concept of Integrated Coastal Zone Management (ICZM) which advocates a holistic approach for coastal zone management to reach sustainable development. Later, it was widened to the management of regional seas like the Baltic and EEZs (Stel 2006, 2012). [AU: A number of the ideas in these two paragraphs were expressed almost verbatim in the abstract. It is not uncommon for books of this type to use that format, but since that hasn't been the case in the other chapters so far, I felt that these should be re-written slightly so as to not be exact restatements of the same ideas.]

Box 16.1: Apocalypse: Climate Change in the Fourteenth Century

Fig. 16.1 Scene of the Four Horsemen of the Apocalypse Tapestry, Château d'Angers, France. The tapestry was ordered by Duke Louis I of Anjou in 1373, designed by the Flemish painter Hennequin de Bruges or Jan van Bondel and woven by Paris weavers between 1373 and 1389. The four horsemen represent pestilence, war, famine and death and herald the end of the world, according to Christian belief

Subtle changes in thermohaline circulation (THC) in the Northern Atlantic part of ocean space triggered a natural climate variation by bringing warmer seawater into the North Atlantic. The Medieval Warm Period (ca. 950–1300) allowed Vikings to travel far north, colonising Greenland and reaching Canada. It also spurred a cod fishing industry off western Greenland in waters some 4 °C warmer than before. In Western Europe, warm temperatures allowed for a rapidly increasing population, leading to urbanisation, prosperity and pollution on a local to regional level.

All this ended with the onset of the Little Ice Age (ca. 1300–1850), which, most likely, is related to a slowing of the THC. Weather in Europe was colder and wetter, due to a temperature drop of 1 °C. English vineyards disappeared, and fish stocks moved away from the then cold Atlantic waters. North Sea weather became stormier, leading to frequent flooding in the Low Countries. The worst climate-related event during the fourteenth century in NW Europe was the Great Famine between 1315 and 1322. In the spring of 1315, it rained continuously for up to a hundred days. This bad weather led to famine, with mortality rates up to 10 and 18 % in, respectively, Belgium and England.

(continued)

Box 16.1: (continued)

Late medieval societies not only had to cope with climate change but also with alien species causing the Black Death, killing more or less half of Europe's population, and man-made disasters, like the Hundred Years' War. Thus, it's not entirely surprising that some at the time did indeed conclude that the biblical apocalypse was near. But it was not.

3 Ocean Space and Sustainability

Since the early seventeenth century, ocean governance was dominated by the Grotian notion of *Mare Liberum*, the 'Freedom of the Seas'. De Groot, however, was not at all interested in sustainable use of ocean resources (Box 16.2). His main challenge was to warrant freedom of navigation, trade, fishery and whaling for the Dutch Republic (1581–1795). This type of thinking remained standard in use of ocean resources until the 1960s, when Arvid Pardo coined the notion of the Common Heritage of Mankind, a new type of ethical thinking (still controversial to this day) which has been incorporated into the present international Law of the Sea. But, for sustainability in ocean space, a more up-to-date and integrated approach is needed.

3.1 UNCLOS: A Global Framework

The notion of ocean space is derived from the Preamble of the United Nations Convention on the Law of the Sea (UNCLOS 1982). It is closely linked to Arvid Pardo (1914–1999), who became famous for his Draft Ocean Space Treaty, a working paper submitted by Malta to the UN Seabed Committee in 1971. Through the principle of the Common Heritage of Mankind (CHM), Pardo considered ocean space and its resources to be a global common that could not be owned by states. His principle forms a contrast with Grotius' *Mare Liberum*, which creates an open access regime and allows for its laissez-faire use.

Pardo, as well as Mann Borgese (1918–2002), advocated a sustainable use of ocean resources, its conservation and the transfer of knowledge and funds (capacity building; Stel 1990, 1994) to developing countries. The CHM concept comprises four building blocks: economic development, environmental protection, peace building and ethics for the sharing of the benefits. Basically, they are the three pil-

Box 16.2: Santa Catarina: A Tipping Point in Ocean Governance

Fig. 16.2 Jacob van Heemskerck, the Gentleman XVII of the VOC, and Hugo de Groot, players in a lawsuit that changed the world through the introduction of the notion of *Mare Liberum*

The capture of the 1.500 tonnes, Portuguese carrack *Santa Catarina* on 25 February 1603 by Admiral Jacob van Heemskerck off the coast of Malacca turned out to be a tipping point in international maritime law.

Although the 750 passengers, among whom a hundred women were allowed to leave peacefully, the ship and its cargo of Chinese silk, musk and Ming porcelain were kept as a prize: a valuable jackpot. When auctioned in Amsterdam in the fall of 1604, the profit was around 3.35 million Dutch guilders. In today's currency, this would be an estimated €54 million.

To the Dutch and certainly most of the shareholders of the United Dutch East India Company (VOC), van Heemskerck was a hero (Fig. 16.2). To the Portuguese, he was a pirate, and they reclaimed the ship and its valuable cargo. The Gentleman XVII hired Hugo de Groot or Grotius, a young brilliant lawyer. In his defence, de Groot wrote *De Jure Praedae*, which was largely based on van Heemskerck's own reasoning – revenge for the mistreatment of Dutch merchants in the East Indies by the Portuguese – to attack the carrack (Van Ittersum 2003, 2010). On 4 September 1604, the VOC formally confiscated the *Santa Catarina*. The decision of the Amsterdam Admiralty Court was widely publicised to gain national and international support.

Grotius also tipped the international scale in maritime law by introducing the notion of *Mare Liberum*, the principle of the 'Freedom of the Seas'. For this, he still is referred to as the 'father of international law' (Kröner 2011). However, Grotius' main aim was the right of free trade in Asia and the Americas for the Dutch Republic. By this, he was one of the founders of Dutch colonial rule (Boschberg 2006; Van Ittersum 2010). Even today, Grotius' notion is facilitating a whole range of unsustainable human activities in ocean space.

lars of sustainability. They were, however, strongly opposed by the USA. Nevertheless, the CHM concept is partly incorporated in the final text of part of UNCLOS. In retrospect, the visionary Pardo and Mann Borgese were frontrunners in a transition towards sustainability in ocean governance, a transition still to come.

UNCLOS led to the greatest 'land grab' in human history through the introduction of the concept of the exclusive economic zone (EEZ) (Fig. 16.3). This is a marine zone of 200 nautical miles in which states have the right to exploit marine resources in a sustainable way. Technically, it does not include the state's territorial waters. The EEZ's inner boundary follows the borders of the state's territorial waters (usually 12 nautical miles from the coast). The present enclosure through the EEZs covers approximately 142 million km^2, an area almost as large as the land surface, and covering 40 % of the world's oceans. They contain 90 % of marine resources.

Another new element of UNCLOS was the establishment of the International Seabed Authority for the exploitation of non-marine, ocean resources outside the EEZs. The open waters of the High Seas, however, are still a global common, where the 'tragedy of the commons' in deep sea fishery is part of daily life (Ostrom et al. 2000) The concept of *ocean states – a hierarchy of states based upon the size of the EEZ* – is also an effect of UNCLOS (Stel 2002, 2012). The European Union, with its 28 member states, has a shared EEZ of some 25 million km^2. As such, it's by far the largest in the world. The ocean-land ratio for the EU is about 5:1. Based on this ratio, one could consider the marine domain as the most important feature of the EU-28. As a terrestrial species, however, we tend to focus on the land instead of the sea (Steffen et al. 2011). Moreover, this ratio is also blurring the real situation, as most of the shared EEZ is situated outside Europe and relates to former colonies. From a national perspective, the USA has the world's largest EEZ, followed by France, Australia and Russia.

UNCLOS, ratified by 165 states and the European Union per 19 February 2013, governs all aspects of ocean space. This includes the delimitation of maritime boundaries, environmental regulations, scientific research, commerce and the settlement of international disputes involving marine issues. With Chapter 17 of Agenda 21, which

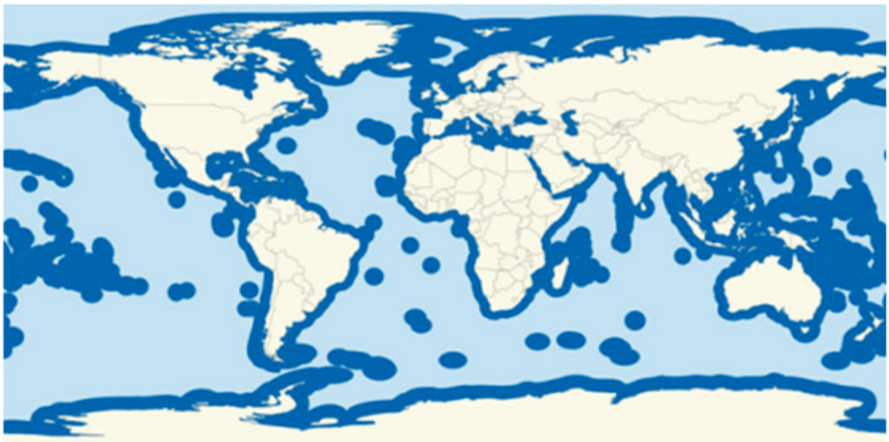

Fig. 16.3 The exclusive economic zones of the world

resulted from the United Nations Conference on Environment and Development (UNCED 1992), as well as the outcome of its successors, Johannesburg 2002 and Rio+20 in 2012, and the Convention on Biological Diversity (CBD 1993), it sketches the contours of a new and holistic vision of governance. In this perception, an ecosystem approach and stakeholder participation are key building elements. The 2012 UN initiative 'Oceans Compact' builds on the outcome of the Rio+20 conference. It aims at 'Healthy Oceans for Prosperity' or sustainability in ocean space.

3.2 Regional European Union

Europe, through the European Union (regional level), is, with the USA and Australia (national level), taking the lead in developing integrated approaches towards ocean space sustainability. In Europe, this transition has been dominated by the introduction of the Integrated Maritime Policy (IMP) in 2007 and the Marine Strategy Framework Directive (MFSD), which came into force in June 2008. The latter is the environmental pillar of the IMP, which was developed through extensive stakeholder consultation. The 23 EU member states with marine territories are obliged to protect the marine environment, to achieve a 'good marine environmental status' by 2020 and to protect the resource base for marine-related economic and social activities. A *good marine environmental status* is defined as *an ecologically diverse, dynamic, healthy and productive ocean space*.

Member states have to develop marine strategies that serve as action plans for applying an ecosystem-based approach to the management of their human activities. These strategies must be based on marine regions (Greater North Sea, Baltic) or subregions (Adriatic Sea) (Fig. 16.4) and should address the 11 Marine Strategy Framework Directive descriptors, like biological diversity, nonindigenous species, eutrophication, contaminants, marine litter, energy and noise (EU 2012).

The IMP covers a number of cross-cutting policy objectives in areas like marine data and knowledge, maritime spatial planning, Blue Growth, integrated maritime surveillance and coordination at the level of regional seas or marine basins such as the North Sea and the Baltic. Blue Growth refers to long-term economic growth based on different maritime sectors. Thus, it is about jobs and economic growth, and might just be the new magic word for continuing unsustainability in ocean space. At any rate, to foster the future exploitation of Europe's ocean space, considerable investments in science and technology will be needed (European Marine Board 2013). So far, Blue Growth has focused on five sectors with a high potential for economic growth. These sectors are short sea shipping, coastal tourism, offshore wind energy, desalination and the use of marine resources in the pharmaceutical and cosmetics industries.

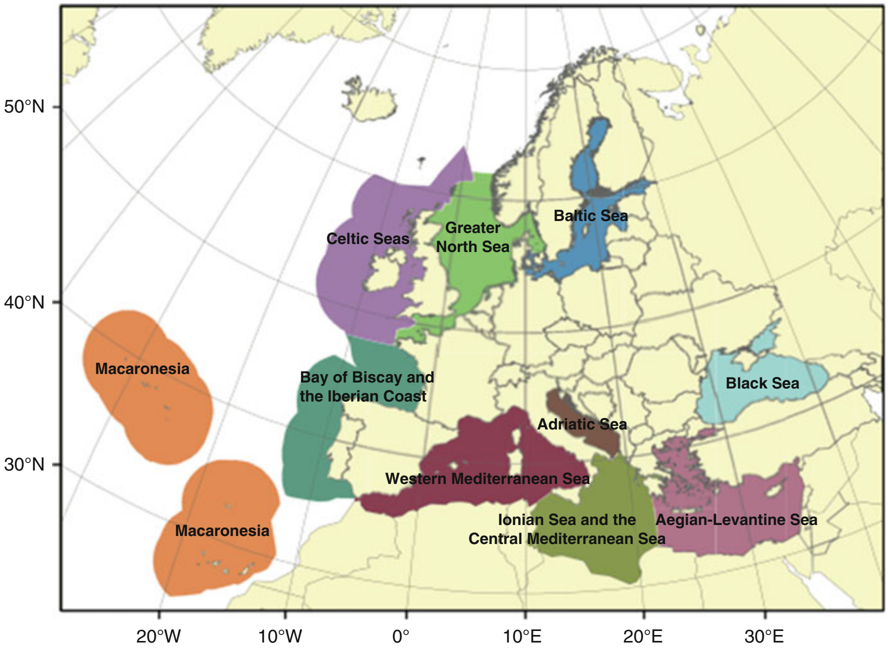

Fig. 16.4 Regions and subregions of the EU Marine Strategy Framework Directive

4 Conclusions

In 1967, when Arvid Pardo addressed the United Nations General Assembly about the new Law of the Sea, disciplinarity was the common research mode. Then, just as today, most oceanographers were trained in one of the traditional sciences, like physics, chemistry, biology and geology, or in a related field of engineering, meteorology, etc. (Pinet 2009). In dedicated research institutes or university departments, these disciplinary boundaries mostly blur though multi- and interdisciplinary research efforts. But even today, and despite the recognition of anthropogenic forcing in many modern environmental issues, social sciences are mostly not a part of or affiliated with these ocean research institutes. This is hampering the development of sustainability in ocean sciences.

Since Pardo, sustainability issues in ocean space have evolved in ways that never could have been imagined when UNCLOS was negotiated during the 1970s. Firstly, the world population grew from 3.4 to an estimated 7.2 billion by the end of 2013. Doubling the population also caused a tremendous growth in human activities, welfare and consumption. This leads to an ecological footprint that is increasingly overshooting the carrying or bio-capacity of the Earth (WWF 2012) with more than 50 % in 2012 and a biodiversity loss of 38 % between 1970 and 2008. Secondly, new technology allowed us to explore outer space, ocean space, the deep Earth, the micro- and nanoworld, etc. It dramatically changed society and lead to globalisation

Box 16.3: CO2 Pollution: Are We Ready for an Ice-Free Arctic

Fig. 16.5 Canadian research vessel in the Arctic in 2012

The Arctic is critical to our understanding of the global dimensions of anthropogenic climate change. It is the canary in a coal mine. In the old days, coal miners brought these small birds with them into the mines to detect odourless and colourless, but rather dangerous, pockets of methane or carbon monoxide. As long as the bird kept singing, the miners knew their air supply was safe. A dead canary, however, signalled an immediate evacuation. They were used in British coal mines until the late 1980s, when technology took over. Likewise, there are a selected number of signals in the Arctic that convey change and danger in the near future.

On 16 September 2012, Arctic summer ice cover reached its lowest level since instrumental records began. At just 3.4 million km^2, it follows an alarming decadal trend. Many scientists are now predicting an ice-free Arctic within a few years or decades at best. The environmental and societal implications are enormous, and as the ice is disappearing faster than predicted, we are largely unprepared. How will this, for instance, impact the European and North American weather system? We simply do not know. So, one could conclude that we are not at all ready for an ice-free Arctic.

and the post-industrial information society. It goes without saying that this new technology is also constantly reshaping ocean space research.

The management challenges of ocean space are changing rapidly, because of the increasing demand for resources, as well as the negative impact of human activities through CO_2 and other types of pollution, ocean acidification, dead zones and algal blooms. Since UNCLOS, fishing fleets have grown larger and more efficient, leading to overfishing that threatens 85 % of the world's fish stocks (FAO 2012). New technology will also allow deep sea oil and gas exploration and deep sea mining in the very near future. Finally, new scientific insights have paved the way for the development of pharmaceutical and cosmetic uses of marine genetic resources. So, ongoing unsustainable use of ocean resources might lurk just around the corner. This is one of the main challenges for sustainability science in the near future.

New standards of environmental planning and decision-making have been developed over recent decades and are, as a consequence, not (yet) dealt with in UNCLOS. These new standards are, for instance, the precautionary principle, the ecosystem approach and the ecosystem services. On the other hand, new tools like marine-protected areas, maritime spatial planning, strategic environmental assessments, environmental impact assessments and marine bioregional plans have been developed to protect ocean space, its resources and its biodiversity. Some of them are incorporated in new regional or national approaches, like the European IMP, and national management plans like those of Australia and the USA. But the need for sustainability in ocean space, based upon an internationally agreed-upon holistic view and vision, is urgent (Stel 2010). Ocean space is also a crucial element of the biosphere and delivers ecosystem services that dwarf traditional economic returns (Costanza et al. 1997, 2007).

Questions

1. How did climate change affect early fourteenth-century Europe?
2. How did technological advances affect everyday life?
3. What is ocean space?
4. Why did Grotius coin the notion of Mare Liberum? What was the effect for the Dutch Republic and other European countries and why has this notion become a leading principle in ocean law?
5. How did Arvid Pardo and Elisabeth Mann Borgese introduce sustainability in the present UN Law of the Sea?
6. Why should UNCLOS be actualised? What are the new elements and what are the threats?
7. Are we ready or not for an ice-free Arctic?
8. What are the main sustainability challenges in ocean space?

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