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This handbook is intended for stakeholders from the nautical tourisms but also for all other stakeholders who are interested in a better understanding of how we impact our seas and what we can do to prevent it.

The more we know, the more we care!

The Editors
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1. INTRODUCTION - THE IMPORTANCE OF THE SEAS AND COASTAL ZONES

Seas and oceans cover 71% of the Earth's surface and contain around 97% of all water on Earth.[1] The marine ecosystems are essential for life on Earth. They produce oxygen, food, and energy, etc. and are very important for regulation of the Earth's temperature. The seas (and coasts) play a key role in supporting human welfare known as ecosystem services that are classified into three categories:

- *Provisioning services: benefits obtained directly from the ecosystem (e.g. food, water, etc.);*
- *Regulating services: benefits obtained from the regulation of ecosystem processes (e.g. climate regulation, etc.);*
- *Cultural services: Non-material benefits obtained directly from the ecosystem (e.g. aesthetic, spiritual, recreation, etc.).[2]*

Marine ecosystem services *provide more than 60% of the economic value[3, 4]* and about 260 million jobs.[5] Approximately 10 % of the world's population lives in coastal areas that are less than 10 meters above sea level and approximately 40% live within 100 km of the coast.[6] *According to EU Commision coastal zones are among the most productive areas in the world, offering a wide variety of valuable habitats and ecosystems services that have always attracted humans and human activities.[7]*

[1] Carleton, Ray G., McCormick-Ray, J. Marine Conservation: Science, Policy, and Management. Wiley-Blackwell, Oxford. 2013. 384 pp.

[2] https://op.europa.eu/en/publication-detail/-/publication/676bbd4a-7dd9-11e9-9f05-01aa75ed71a1/language-en/ (24/02/2020)

[3] http://www.fao.org/3/CA0268EN/ca0268en.pdf (06/02/2020)

[4] https://ec.europa.eu/assets/mare/infographics/ (05/02/2020)

[5] https://www.un.org/sustainabledevelopment/wp-content/uploads/2017/05/Ocean-fact-sheet-package.pdf (12/02/2020)

[6] https://www.un.org/sustainabledevelopment/wp-content/uploads/2017/05/Ocean-fact-sheet-package.pdf (12/02/2020)

[7] https://ec.europa.eu/environment/iczm/index_en.htm (05/02/2020)

34 % of the world's coasts are at high risk of degradation. The most threatened region is Europe with 86 % of its coastal ecosystems at risk.[8] The intensive concentration of population and excessive exploitation of natural resources puts enormous pressure on ***coastal ecosystems*** *leading to biodiversity loss, habitats destruction, pollution, as well as conflicts between potential uses, and space congestion problems.[9]*

The net gains in human well-being and economic development have been achieved at growing costs - the degradation of ecosystem services and the increasing of poverty (unemployment, social and political instability,...). These problems could considerably reduce the ecosystems benefits for future generations.[10]

[8] https://www.unenvironment.org/explore-topics/oceans-seas/what-we-do/working-regional-seas/coastal-zone-management (02/02/2020)

[9] https://ec.europa.eu/environment/iczm/index_en.htm (05/02/2020)

[10] https://www.millenniumassessment.org/en/About.html (05/02/2020)

2. THE CHARACTERISTICS OF THE MARINE ENVIRONMENT

Marine ecosystem *is a complex of living organisms in the marine environment.*[11] *The oceans, seas, and other major water bodies*[12]*, including their surface interface and interaction, with the atmosphere and with the land are referred as* ***marine environment (marine habitats)****.*[13] *The presence of seawater is common to all marine habitats. Marine habitats can be divided into pelagic and demersal (benthic) habitats.* ***Pelagic habitats*** *are found in the open water column, while* ***demersal habitats*** *are near or on the sea bottom. Pelagic habitats are shifting and are strongly dependent on ocean currents.*[14] *Pelagic habitats are divided into the* ***neritic province****, which includes the water above the continental shelf, and the* ***oceanic province****, which includes all the open waters beyond the continental shelf.*[15] *Many anthropogenic activities take place on the continental shelf (the sea bottom area up to 200m deep) and water above (neritic province).*[16]

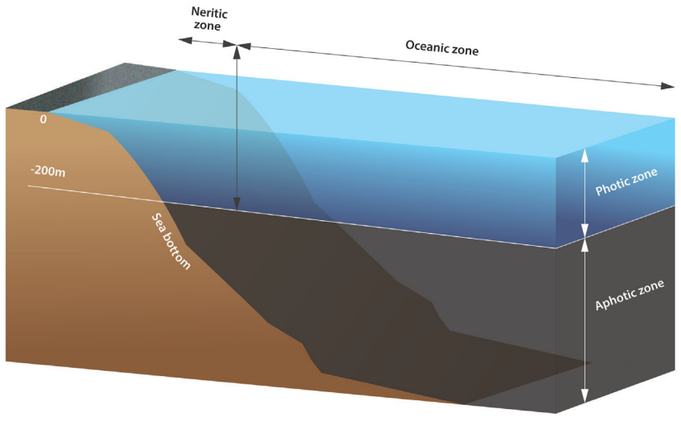

Figure 1. *The sea zones*

[11] https://www.un.org/sustainabledevelopment/wp-content/uploads/2017/05/Ocean-fact-sheet-package.pdf (12/02/2020)

[12] https://ec.europa.eu/environment/iczm/index_en.htm (05/02/2020)

[13] https://www.unenvironment.org/explore-topics/oceans-seas/what-we-do/working-regional-seas/coastal-zone-management (02/02/2020)

[14] https://ec.europa.eu/environment/iczm/index_en.htm (05/02/2020)

[15] https://www.millenniumassessment.org/en/About.html (05/02/2020)

[16] Speight, M., Handerson P. Marine Ecology, Concepts and Applications. Wiley-Blackwell, Oxford, 2010. 286pp.

Marine organisms *are not distributed evenly throughout the oceans. Variations in* ***characteristics of the marine environment (ecological factors)*** *create different habitats and influence what types of organisms will inhabit them. The availability of light, water depth, proximity to land, and topographic complexity all affect marine habitats.*[17] The stability of the marine environment is so complex and it depends on the interaction between living (biotic) and non-living (abiotic) ecological factors.

The **abiotic factors** are classified as physical factors (temperature, pressure, water movements…) and chemical factors (pH, salinity, nutrients, dissolved gasses …). The physical and chemical properties of seawater vary according to latitude, depth, nearness to land, and input of fresh water.[18]

Sea temperature is one of the most significant abiotic factors and is highly correlated with many physical properties of seawater (density, the solubility of gases,…). It influences the regulation of body temperature in the majority of marine organism and thus directly affects the distribution of organisms. The temperature does not decrease proportionally with depth. There is a thin layer in the sea in which temperature changes more rapidly with depth than in the layers above or below. It is called the thermocline.

The **composition of marine water** depends on: latitude, depth, erosion, atmospheric activity, and biological activity.[19, 20, 21]

Salinity is a total amount of salt (mainly sodium chloride) in grams dissolved in one kilogram of seawater. The salinity and water temperature are highly correlated with the density of the water.[22]

[17] https://www.britannica.com/science/marine-ecosystem (12/02/2020)

[18] https://www.britannica.com/science/marine-ecosystem (12/02/2020)

[19] Carleton, Ray G., McCormick-Ray, J. Marine Conservation: Science, Policy, and Management. Wiley-Blackwell, Oxford. 2013. 384 pp.

[20] Speight, M., Henderson, P. Marine Ecology, Concepts and Applications. Wiley-Blackwell, Oxford, 2010. 286pp.

[21] Tait, R.V., Dipper, F. Elements of Marine Ecology. Butterworth-Heinemann, Oxford, 1998. 448pp.

[22] Carleton, Ray G., McCormick-Ray, J. Marine Conservation: Science, Policy, and Management. Wiley-Blackwell, Oxford. 2013. 384 pp.

The density is an important factor because it influences the speed of particle sinking and it is very important for feeding of some organisms.

In seawater, we can find all atmospheric **gasses** dissolved, and oxygen and carbon dioxide are the most important ones. Oxygen is produced by photosynthesis. The high level of photosynthesis can increase oxygen concentration in seawater. **Oxygen** concentration depends reciprocally on the temperature and the salinity i.e. it decreases as the temperature and salinity rises.[23] The higher the pressure, the higher is oxygen solubility in the water.[24] The oxygen level can substantially decrease (hypoxia) due to the high input of nutrients, warming or high concentration of carbon dioxide in the atmosphere.[25] Anoxic area, i.e. area without oxygen, can result from oxygen consumption by microorganisms on sea bottom. It should be pointed out that hypoxic and anoxic areas are widespread, especially in some coastal areas.[26]

Carbon dioxide (CO2) is produced by the respiration of plants and animals. Carbon dioxide is consumed in photosynthesis. The higher the concentration of carbon dioxide in the atmosphere (near the sea surface), the higher is its concentration in seawater. Consequently, when more CO2 dissolves in seawater, sea water becomes more acidic. This phenomenon is called acidification. Ocean acidification drives community shifts towards simplified non-calcified habitats.[27, 28]

Sunlight and **nutrients** are factors important for the photosynthesis. The photosynthesis is a basic process in marine food web and all other food web levels depends on it. The photosynthesis is possible only in the upper levels of water column up to 200 m (euphotic zone) and manly depends on sunlight availability. **Nutrients** enter the marine environment from different sources but mainly it enters form land. They sink from upper levels to the bottom and they are usually reused in the food web. The most important nutrients are phosphorus and nitrogen.

[23] Tait, R.V., Dipper, F. Elements of Marine Ecology. Butterworth-Heinemann, Oxford, 1998. 448pp.

[24] http://www.fondriest.com/environmental-measurements/wp content/uploads/2013/10/dissolvedoxygen_fresh-salt.jpg (12/02/2020)

[25] Carleton, Ray G., McCormick-Ray, J. Marine Conservation: Science, Policy, and Management. Wiley-Blackwell, Oxford. 2013. 384 pp.

[26] Speight, M., Handerson P. Marine Ecology, Concepts and Applications. Wiley-Blackwell, Oxford, 2010. 286pp.

[27] Carleton, Ray G., McCormick-Ray, J. Marine Conservation: Science, Policy, and Management. Wiley-Blackwell, Oxford. 2013. 384 pp.

[28] https://www.nature.com/articles/s41598-018-29251-7 (12/02/2020)

*In marine systems, **ocean currents** transport the basic nutrients needed to support marine life. Atmospheric winds and pressure differences also produces **surface currents, waves** and **seiches**. Ocean currents are also generated by the gravitational pull of the sun and moon (**tides**), and seismic activity (**tsunami**). Plankton are marine life forms that are so small (less than 2 mm) that they cannot move, but must drift with the currents. Tiny drifting plants (the **phytoplankton**) are the primary producers in the oceans at the bottom of the food web, while the **zooplankton** (tiny drifting animals) are feed on the phytoplankton. If there is sufficient phytoplankton and zooplankton in the area, it attracts the forage fish that feed on them. If sufficient forage fish move to the area, it attracts the larger predatory fish and other marine animals that feed on the forage fish.*[29]

Biotic factors include all interactions between living organisms of the same species (interspecies interactions) or between different ones (interspecies interactions). in the marine environment. These interactions are mainly associated with habitation, feeding, and other requirements for resources and can be voluntary or obligatory. The effects of the relationships can be neutral (0) for both organisms, positive (+) or negative (-) for one of them, positive or negative for both.

Organisms can be related through the feeding process (predator-prey relationship), where these relationships are negative for pray and positive for predation. A parasitism is a relationship, where parasite lives on or inside the host, and benefits form this relationship. One of the most common relationships is a competition where two organisms compete for different restricted resources such as food, settlement area, etc. This relationship is usually negative for both organisms. Some relationships are positive for one organism but do not affect the other (commensalism). An example of commensalism is relationship between the shark and smaller fish that feeds on leftovers of his food and benefits from its protection.

[29] https://en.wikipedia.org/wiki/Marine_habitats (12/02/2020)

3. THE MAJOR THREATS TO THE MARINE (COASTAL) ENVIRONMENT

Though it covers the smallest part, less than 10%, of the marine environment, the continental shelf is affected by intensive anthropogenic influence.[30] Negative effects of anthropogenic activities include overfishing, habitat degradation/destruction, and reduction of water quality by pollutants, etc. These impacts can be considered as the short-term or the long-term impacts.[31]

3.1. MARINE/COASTAL HABITAT DEGRADATION AND DESTRUCTION

Degradation and destruction of marine/coastal habitats occur due to intensive competition for space in the limited marine/coastal area and high human pressure on these valuable areas. Some of human activities/operations that have the most severe impact on habitats are: dredging, bottom trawling, collecting of marine organisms…

Dredging is inevitable operation during the construction or the maintenance of the ports/waterways in order to get appropriate depth. **Dredging** directly destroys marine habitats and organisms, but also causes some short term effects such as the reduction in water transparency, the increase in turbidity, suspended sediments and nutrients and the increase of noise levels, or long term effects such as the changed currents or water circulation.[32]

Bottom trawling is intensive fishing method where trawl net scrapes the sea bottom, passes through seawater, collect and destroys everything on its way.

[30] Kaiser, M.J., et all. Marine Ecology Processes, Systems and Impacts. Oxford University Press, 2011. 528pp.

[31] Kaiser, M.J., et all. Marine Ecology Processes, Systems and Impacts. Oxford University Press, 2011. 528pp.

[32] Speight, M., Handerson P. Marine Ecology, Concepts and Applications.

Besides destroying effects of trawling on marine habitats, trawl net is very unselective fishing gear and catches large number of unwanted organisms (bycatch). In the process of collecting some shellfish such as **date shell** (*Lithophaga lithophaga*), it is necessary to break down the rocks on which they are found. This can lead to the complete destruction of habitats and it takes decades for these habitats to restore. Several governments have restricted the collection of these shells or even made it wholly illegal (*Croatia, Italy, Slovenia, France, Greece, Montenegro, etc. including participants in the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora*) in order to protect these habitats.[33]

3.2. GLOBAL WARMING

Global warming *is the mainly human-caused long-term rise in the average temperature of the Earth, mostly due to the use of fossil fuels. The burning process of fossil fuels (and other human activities) produces an increased concentration of greenhouse gases (carbon dioxide, nitrogen oxides, water vapours…) in the atmosphere. Greenhouse gases trap heat radiating from the Earth to space, thus warming the lower atmosphere and the surface.*[34] It should be stress out that without natural greenhouse gases effect, it would be impossible to live on the planet due to the freezing temperature. *The effects of global warming include regional changes in precipitation, expansion of deserts, but also* ***rising sea levels*** *and seawater temperature,* ***ocean acidification****, changes in water circulation.*[35] **Coral bleaching** can be connected to rise of sea temperature.[36]

[33] https://en.wikipedia.org/wiki/Lithophaga_lithophaga (12/02/2020)

[34] https://en.wikipedia.org/wiki/Global_warming (12/02/2020)

[35] https://en.wikipedia.org/wiki/Global_warming (12/02/2020)

[36] Kaiser, M.J., et all. Marine Ecology Processes, Systems and Impacts. Oxford University Press, 2011. 528pp.

3.3. THE REDUCTIONS IN WATER QUALITY

3.3.1. Nutrients

Nutrients are inorganic components of water and are used in the process of photosynthesis. Phosphorus and nitrogen are the nutrients that are the most important for the production in the oceans.[37] The marine environment can be classified by the concentrations of essential nutrients needed for primary production. The seas with low concentrations of nutrient are classified as oligotrophic seas while the seas with large concentrations are classified as eutrophic.[38] Anthropogenic activities such as **sewage discharge** (due to the urbanisation) and **agricultural runoff** are main sources of nutrients inputs into the marine environment. The excessive plant blooms can occur as a result of high nutrient levels in the seas. This phenomenon is known as **eutrophication**. Consequently, large quantities of dead organism end up at the sea bottom where these organisms are decomposed by bacteria. Due to large oxygen demand for decomposition process, the levels of oxygen can be significantly reduced (**hypoxia**) or totally depleted (**anoxia**) in the water (and in the sediment).[39] The eutrophication is a reversible process. If it is kept at low levels, it can have positive effects on primary production.[40] Sometimes eutrophication can lead to **toxic algal blooms** (ecotoxicity).[41] It should be pointed out that eutrophication can occur even naturally without any human impact.[42]

[37] Kaiser, M.J., et all. Marine Ecology Processes, Systems and Impacts. Oxford University Press, 2011. 528pp.

[38] Kaiser, M.J., et all. Marine Ecology Processes, Systems and Impacts. Oxford University Press, 2011. 528pp.

[39] Kaiser, M.J., et all. Marine Ecology Processes, Systems and Impacts. Oxford University Press, 2011. 528pp.

[40] Kaiser, M.J., et all. Marine Ecology Processes, Systems and Impacts. Oxford University Press, 2011. 528pp.

[41] https://en.wikipedia.org/wiki/Sewage (12/02/2020)

[42] Crowe, T.P., Frid, C.L.J. Marine Ecosystems: Human Impacts on Biodiversity, Functioning and Services (Ecology, Biodiversity and Conservation). Cambridge University Press, 2015. 406pp.

3.3.2. Sewage

Sewage is waste matter that originates from **domestic** and **industrial** premises[43] and it enters the marine environment through the sewage systems, agriculture runoff, and rivers.[44] Industrial sewage is used water from manufacturing or chemical processes.[45] Domestic wastes are composed of water form showers and sinks (grey water) and toilets (black water) usually contains nutrients, detergents, cleaning chemicals, and solids from toilets.

The discharge of untreated sewage can cause ecological damage but also it poses a threat to human health.[46, 47] Ecological damage is evident in covering seabed with suspended solids, eutrophication, reduced oxygen levels, etc.[48, 49] *All categories of sewage are likely to carry pathogenic organisms that can transmit disease to humans and animals.*[50]

The International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) prescribes strict rules regarding sewage discharge from ships. Sewage should be disinfected and commuted prior to discharging and the discharge should take place at minimum distance of 3 nautical miles from the nearest land. If the sewage is not treated on board the discharge is allowed but at minimum distance of 12 nautical miles from the nearest land.

Although measures and efforts to treat domestic sewage before discharge into the marine environment exist, direct discharge into the coastal area of untreated sewage is still widespread in Europe.[51]

[43] Speight, M., Handerson P. Marine Ecology, Concepts and Applications. Wiley-Blackwell, Oxford, 2010. 286pp.

[44] Tait, R.V., Dipper, F. Elements of Marine Ecology. Butterworth-Heinemann, Oxford, 1998. 448pp.

[45] https://www.britannica.com/topic/industrial-sewage (12/02/2020)

[46] Speight, M., Handerson P. Marine Ecology, Concepts and Applications. Wiley-Blackwell, Oxford, 2010. 286pp.

[47] Tait, R.V., Dipper, F. Elements of Marine Ecology. Butterworth-Heinemann, Oxford, 1998. 448pp

[48] Speight, M., Handerson P. Marine Ecology, Concepts and Applications. Wiley-Blackwell, Oxford, 2010. 286pp.

[49] Tait, R.V., Dipper, F. Elements of Marine Ecology. Butterworth-Heinemann, Oxford, 1998. 448pp

[50] https://en.wikipedia.org/wiki/Sewage (12/02/2020)

[51] Tait, R.V., Dipper, F. Elements of Marine Ecology. Butterworth-Heinemann, Oxford, 1998. 448pp.

During tourist season, large numbers of recreational boats significantly increase the inflow of untreated sewage into the marine environment.[52] In Europe, one of the major topics is pollution of beaches by sewage.[53] Constant water quality monitoring is of the great importance in order to preserve the high level of water quality for tourism and related activities.

3.3.3. Oils

Oil pollution includes any spill of crude oil or oil distilled products that can pollute the environment usually due to human activity.[54, 55]

Oceans are polluted by oil on a daily basis from oil spills (mainly from land sources: households and industry[56]), routine shipping, ships accidents, run-offs and dumping.[57]

Once the oil enters in marine environment, it goes through the various weathering processes, including evaporation, dispersion, emulsification, sedimentation, dissolution, biodegradation, etc. Weathering processes depend on type of oils spilled, weather condition and sea condition but also the site of the spill. Light fractions of oils evaporate quickly, while heavy fractions persist longer in the marine environment. Oil spills affect not only the ocean, but also shorelines and the seabed.[58]

Although the impact of the oil pollution makes a small part of a general pollution, the consequences of oil spills are extremely damaging for marine life.[59] The impact of oil spill to the marine organisms depends on the type of oil, quantity of oil, duration of exposure to the oils and life stage of organisms.[60]

[53] Tait, R.V., Dipper, F. Elements of Marine Ecology. Butterworth-Heinemann, Oxford, 1998. 448pp

[54] https://en.wikipedia.org/wiki/Oil_spill (12/02/2020)

[55] https://www.environmentalpollutioncenters.org/oil-spill/ (12/02/2020)

[56] Tait, R.V., Dipper, F. Elements of Marine Ecology. Butterworth-Heinemann, Oxford, 1998. 448pp

[57] https://www.water-pollution.org.uk/oil-pollution-in-water/ (12/02/2020)

[58] https://www.intechopen.com/books/sustainable-development-authoritative-and-leading-edge-content-for-environmental-management/oil-pollution-and-international-marine-environmental-law (12/02/2020)

[59] https://www.intechopen.com/books/sustainable-development-authoritative-and-leading-edge-content-for-environmental-management/oil-pollution-and-international-marine-environmental-law (12/02/2020)

[60] Tait, R.V., Dipper, F. Elements of Marine Ecology. Butterworth-Heinemann, Oxford, 1998. 448pp.

Oil is particularly dangerous for organisms which live on air-water boundary, such as birds or marine mammals. Organisms can inhale or ingest the oils what can cause lung or gut irritation. The most toxic oil compounds are light aromatic compounds that first evaporate.[61] *It can be lethal to adult animals in relatively low concentrations. It may also cause physiological or behavioral changes (prevention of normal feeding, respiration and movement).*[62]

In Annex I of MARPOL, different preventive measures are adopted in order to prevent the oil pollution form the ships. All MARPOL regulated ships are subject to port state inspection to determine proper operation of ships pollution prevention equipment.

3.3.4. Chemicals (including antifouling paints)

Of the 37 million chemicals used globally, 2000 are regularly transported by sea.[63] Various chemicals present in the marine environment are industry, agriculture and heat generation systems related.[64] The effects of chemical spills in the marine environment depend on the quantity and nature of the chemical spilled and location of the spill.[65] Long term deposition of chemicals in the marine environment should not be neglected.[66] Some chemicals persist for a long time in the marine environment and they can be very toxic to marine organisms.[67]

Many types of chemicals, such as polychloride biphenyls, heavy metals, etc., accumulate through the food web (bioaccumulation and biomagnification).[68]

[61] Tait, R.V., Dipper, F. Elements of Marine Ecology. Butterworth-Heinemann, Oxford, 1998. 448pp.

[62] https://www.intechopen.com/books/sustainable-development-authoritative-and-leading-edge-content-for-environmental-management/oil-pollution-and-international-marine-environmental-law (12/02/2020)

[63] https://www.researchgate.net/publication/322992301_Environmental_Effects_of_Marine_Transportation (12/02/2020)

[64] Kaiser, M.J., et all. Marine Ecology Processes, Systems and Impacts. Oxford University Press, 2011. 528pp.

[65] https://www.researchgate.net/publication/322992301_Environmental_Effects_of_Marine_Transportation (12/02/2020)

[66] Speight, M., Handerson P. Marine Ecology, Concepts and Applications. Wiley-Blackwell, Oxford, 2010. 286pp.

[67] Kaiser, M.J., et all. Marine Ecology Processes, Systems and Impacts. Oxford University Press, 2011. 528pp.

[68] Kaiser, M.J., et all. Marine Ecology Processes, Systems and Impacts. Oxford University Press, 2011. 528pp.

Heavy metals (mercury, copper, arsenic, cadmium etc.) are naturally present in the marine environment but in very low concentrations.[69] Mercury is contained in agricultural and industry effluents. In 1953, one of the major human mercury poisonings happen in Minamata Bay (known as Minamata disease), Japan due to consumption of mercury-contaminated marine organisms (related with industrial wastewater release from chemical factory).[70] *Minamata disease is a neurological disease caused by severe mercury poisoning. Signs and symptoms include ataxia, numbness in the hands and feet, general muscle weakness, loss of peripheral vision, and damage to hearing and speech. In extreme cases, insanity, paralysis, coma, and death follow within weeks of the onset of symptoms.*[71]

Copper can enter the seas from different sources such as sewage, pesticide runoffs form the land and **antifouling paints**.[72] The underwater parts of ships are coated with anti-fouling paints in order to prevent fouling. The coper is usually used as biocide in antifouling paints and elevated concentration of copper in surrounding water can be expected.[73] Particularly negative effects of antifouling paints that contain organic compounds of tin (tributyltin - TBT) were observed in marine organisms (deformations of oyster shells, the appearance of male genitalia on female snails, neurotoxic and genetic changes in other marine organisms…). Therefore, under the European Water Directive, TBT is on the list of priority pollutants.[74]

Based on the evidence of the negative impact of this coating on the marine environment, the International Maritime Organization (IMO) adopted *The Convection on the Control of Harmful Antifouling System on Ships* (the AFS Convention) in 2001.[75]

[69] Tait, R.V., Dipper, F. Elements of Marine Ecology. Butterworth-Heinemann, Oxford, 1998. 448pp.

[70] Tait, R.V., Dipper, F. Elements of Marine Ecology. Butterworth-Heinemann, Oxford, 1998. 448pp.

[71] https://en.wikipedia.org/wiki/Minamata_disease (12/02/2020)

[72] Speight, M., Handerson P. Marine Ecology, Concepts and Applications. Wiley-Blackwell, Oxford, 2010. 286pp.

[73] Speight, M., Handerson P. Marine Ecology, Concepts and Applications. Wiley-Blackwell, Oxford, 2010. 286pp.

[74] Directive 2000/60/EC of the European Parliament and the Council establishing a framework for the Community action in the field of water policy. Legislative Acts and other instruments, ENV221 CODEC 513. European Union. 2000.

[75] http://www.imo.org/en/OurWork/Environment/Anti-foulingSystems /Documents/ FOULING2003.pdf (12/02/2020)

The Convention prohibits the use of harmful organotins in anti-fouling paints used on ships and establishes a mechanism to prevent the potential future use of other harmful substances in anti-fouling systems.[76] Despite the ban, some recent investigations in the Adriatic Sea shown that the highest organotin concentrations were recorded in nautical ports and near the ports, and it was directly in correlation with the intensity of maritime traffic.[77] In order to prevent marine pollution with antifouling toxic compounds, preventive measures should be taken during cleaning, scraping and repainting process and all debris should be carefully collected and managed. Nowadays, new eco-friendly coatings are used.

3.3.5. Waste

UN Environment Program defines marine litter as any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment.[78] Almost 80% of offshore waste comes from land, and only a minority comes from various offshore sources such as ships, fish farms, and oil and gas platforms.

Plastic materials can persist for a long time in the marine environment, and it can present particular problem for marine organisms. Marine organisms may be entangled in the plastics or eat plastic by mistake and consequently suffocate.[79] Micro-plastic is form of plastic crushed by the physical action of waves and sunlight into tiny particles less than five millimetres in length.[80] Marine organisms usually mistake micro-plastic for food due to its small size and they do not enough energy for normal functioning. Micro-plastic is not biodegradable. Micro-plastic can be found in all parts of the food web - from zooplankton to top predators.[81]

[76] http://www.imo.org/en/About/Conventions/ListOfConventions/Pages/International-Convention-on-the-Control-of-Harmful-Anti-fouling-Systems-on-Ships-(AFS).aspx (12/02/2020)

[77] Furdek M. Vahčič M., Ščančar J., Milačič R., Kniewald G., Mikac N. Organotin compounds in seawater and Mytilus galloprovincialis mussels along the Croatia.com/science/plastic-pollution/Plastic-pollution-in-oceans-and-on-land (12/02/2020)

[81] https://www.britannica.com/technology/microplastic (12/02/2020)

The new EU regulation ban usage of single-use plastic objects (ear sticks, plates, straws, forks and knives) because it is hardly recyclable. Therefore, more sustainable production patterns should be used for production of these items.

In Annex V of MARPOL, waste defined as all types of food, domestic and operational waste, all plastics, cargo residues, incinerator ashes, cooking oil, fishing gear, and animal carcasses which have been generated by the regular operation of a ship. According to the revised Annex V of MARPOL, the discharge of all wastes into the sea is prohibited, with some exceptions. Large passenger ships should comminute **food waste** prior to discharge at the sea and discharge should take place at least 3 nautical miles from the nearest land.[82] The food waste can pose a problem at smaller ships that are not adequately equipped. All ports should be provided with facilities of adequate capacity (in size and location) for receiving various types of waste from ships, taking into account seasonal variations in waste quantity.

3.3.6. Light, noise and vibration

Light pollution affects the marine environment especially in shallow waters near the urban area.[83] The extent to which ecosystems are being affected is still unknown.

Noise and vibration pollution can originate from ships, oil and gas production platforms, coastal jet ski traffic...[84] The noise of marine engines is mainly caused by thermodynamic processes in the cylinders, exhaust, and air intake, as well as all moving parts of the diesel engine. The intensity and frequency of some sounds are irritating to marine organisms. Studies showed that noise pollution can be detrimental trough reducing the ability to hear environmental cues vital for their survival (feeding, breeding, and communicating).[85]

[82] http://www.imo.org/en/OurWork/Environment/PollutionPrevention/Garbage/Pages/Default.aspx (12/02/2020)

[83] https://www.nationalgeographic.com/environment/oceans/critical-issues-marine-pollution/ (12/02/2020)

[84] https://www.marineinsight.com/environment/effects-of-noise-pollution-from-ships-on-marine-life/ (12/02/2020)

[85] https://www.marineinsight.com/environment/effects-of-noise-pollution-from-ships-on-marine-life/ (12/02/2020)

3.4. BIODIVERSITY LOSS

Biodiversity loss is the decline in the number, genetic variability, and variety of species, and the biological communities in a given area. Primary drivers of biodiversity loss are: pollution, including global warming, habitat loss, overexploitation and invasive species.[86]

Invasive, alien or non-indigenous species (NIS) are non-native species that may outcompete native species for food and habitat significantly modify or disrupt the ecosystems they colonize. Invasive species may arrive in new areas through natural migration or through human introduction.[87] Although NIS can be introduced by unintentional aquaculture introduction or intentional commercial introduction and marine aquarium trade, maritime transport potentially is the largest source of introduction.

When it comes to ships, there are three sources of organism transmission: by **ballast water, hull fouling, anchor** and **cargo**. The majority of organisms being transmitted through ballast water, which is an integral part of the ship's regular operations and the navigation process itself. According to the *International Convention on the Control and Management of Ships' Ballast Water and Sediments*, which entered into force on September 8, 2017, all ships are required to manage the ballast water under IMO standards. Ports and terminals are required to provide adequate reception facilities for ballast water.

[86] https://www.britannica.com/science/biodiversity-loss (12/02/2020)

[87] https://www.britannica.com/science/biodiversity-loss (12/02/2020)

4. HUMAN ACTIVITIES AND MARINE/COASTAL ENVIRONMENT

4.1. BLUE ECONOMY AND BLUE GROWTH

European Commission defines **blue economy** as: *all economic activities related to oceans, seas and coasts. It covers a wide range of interlinked established and emerging sectors.*[88] *Blue economy activities include: seabed mining, offshore oil and gas extraction, offshore wind, ocean energy conversion, desalination, biotechnology,* ***fishing and aquaculture, maritime transport,*** *shipbuilding and ship repair,* ***maritime and coastal tourism.***[89]

Blue growth *is the long term strategy to support sustainable growth in the marine and maritime sectors as a whole. The strategy consists of three components:*

1. Develop sectors that have a high potential for sustainable jobs and growth, such as: aquaculture, ***maritime and coastal tourism****, marine biotechnology, ocean energy, seabed mining.*

2. Essential components to provide knowledge, legal certainty and security in the blue economy: ***marine knowledge*** *to improve access to information about the sea and* ***maritime spatial planning*** *to ensure an efficient and sustainable management of activities at sea, as well as* ***integrated maritime surveillance****.*

3. *Sea basin strategies to ensure tailor-made measures and to foster cooperation between countries.*[90]

[88] https://ec.europa.eu/maritimeaffairs/sites/maritimeaffairs/files/2018-annual-economic-report-on-blue-economy_en.pdf (05/02/2020)

[89] https://en.wikipedia.org/wiki/Blue_economy (05/02/2020)

[90] https://ec.europa.eu/maritimeaffairs/policy/blue_growth_en (05/02/2020)

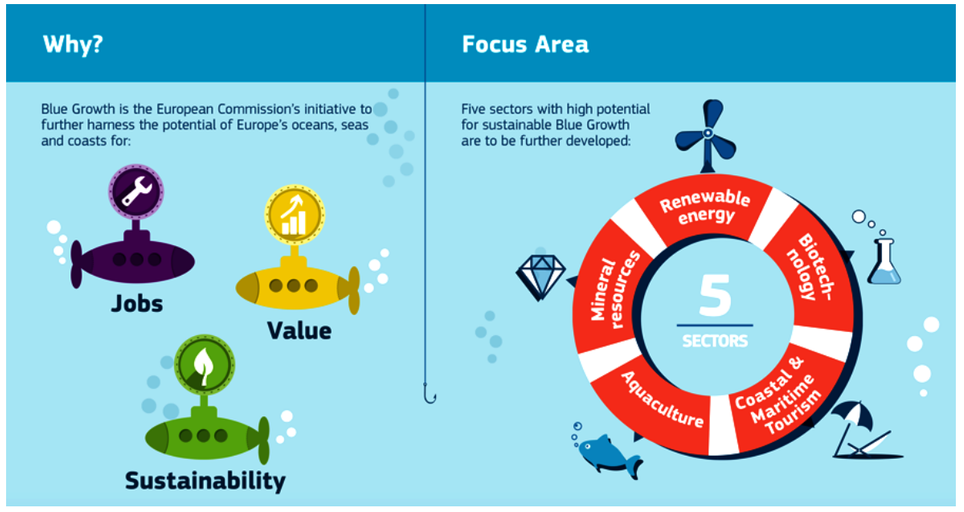

Figure 2. *Blue growth*[91]

4.1.1. Fishing and aquaculture

Increasing ***pollution, habitat destruction, over-exploitation*** *(overfishing and by catch),* ***illegal, unreported, and unregulated (IUU) fishing, decline of biodiversity*** *and* ***climate change*** *have become major threats to these aquatic eco-systems.*[92]

Overfishing *is the removal of a species of fish from a body of water at a rate that the species cannot replenish in time, resulting in those species either becoming depleted or very underpopulated in that given area.*[93] *In a Food and Agriculture Organization of the United Nations 2018 report, the FAO estimates that one-third of world fish stocks were overfished by 2015.*[94]

By catch *is the capture of unwanted sea life while fishing for a different species. It is a serious marine threat that causes the needless loss of fish, sea turtles and cetaceans.*[95]

[91] https://ec.europa.eu/assets/mare/infographics/ (05/02/2020)

[92] http://www.fao.org/policy-support/policy-themes/blue-growth/en/ (06/02/2020)

[93] https://en.wikipedia.org/wiki/Overfishing (06/02/2020)

[94] http://www.fao.org/3/I9540EN/i9540en.pdf (06/02/2020)

[95] http://www.fao.org/policy-support/policy-themes/sustainable-small-scale-fisheries/en/ (06/02/2020)

Illegal, unreported, and unregulated (IUU) *fishing is believed to represent 20 percent of total catches per year. Policies need to refocus on addressing the needs and challenges of small-scale fisheries, which are a critical source of employment, livelihoods, food and nutrition for millions of coastal families and communities.*[96]

Biodiversity *is essential to agriculture and food production.*[97] *Today* ***aquaculture*** *accounts for over 50% of the fish destined for human consumption and its importance will only increase in a future.*[98] *But aquaculture can pose a significant threat to coastal ecosystems. Fish farms can change water dynamics, while fecal waste and uneated food can cause nutrient enrichment of the waters (eutrophication). This can deplete oxygen in the water, creating algal blooms and dead zones. Local concerns with aquaculture may include the impact of fish farms on local wild fisheries with respect to disease and escaping, side-effects of antibiotics and pesticides and environmental degradation due to the site's location.*[99,100]

The sustainability and environmental impacts of farmed seafood products depends on many factors and varies with the methods used by the fish farms.[101] *Instruments such as the Ecosystem Approach to Aquaculture now help to ensure that aquaculture products have been produced in sustainable manner, but consumers can also contribute to sustainable Blue Growth through their purchasing choices and their efforts to reduce food waste.*[102]

[96] http://www.fao.org/policy-support/policy-themes/biodiversity-genetic-resources-and-ecosystem-services/en/ (06/02/2020)

[97] http://www.fao.org/policy-support/policy-themes/biodiversity-genetic-resources-and-ecosystem-services/en/ (06/02/2020)

[98] http://www.fao.org/3/CA0268EN/ca0268en.pdf (06/02/2020)

[99] https://en.wikipedia.org/wiki/Aquaculture (06/02/2020)

[100] https://www.aquaculturealliance.org/blog/what-is-the-environmental-impact-of-aquaculture/ (06/02/2020)

[101] https://www.talkingfish.org/2012/did-you-know/all-about-aquaculture-environmental-risks-and-benefits (06/02/2020)

[102] http://www.fao.org/3/CA0268EN/ca0268en.pdf (06/02/2020)

4.1.2. Maritime transport and related activities

Maritime transport *is essential to the world's economy. It transports about 90% of global trade – is, statistically, the least environmentally damaging mode of transport, when its productive value is taken into consideration.*[103] Multiple stressors from shipping act on the marine environment resulting in impact to marine **habitats** and **marine living resources**. The impact of shipping on marine ecosystemy include:

- **direct** physical destruction of the habitats caused by ship hull and equippment (anchoring, mooring, collision, grounding, sinking …) or by dredgers during port construction and operation;
- **indirect** environmental damage caused by changes of physical (temperature, currents,...) and/or chemicals (pH, oxygen content, pollutants...) paremeters of the water and acute or chronic poisoning of marine organisms.

Pollutants from ships can enter the sea during: ships operations or ships accidents. Although pollution caused by ships accidents draw more attention that pollution caused by every day operations, the operational dischargers contribute more to the marine pollution that accidental discharges. Operational discharge includes intended or unintended discharges of: oils, chemicals, sewage, garbage, air emissions, ballast waters, antifouling paints, light, noise and vibration emissions. *International Maritime Organisation (IMO) adopted a wide range of measures to prevent and control pollution caused by ships. Of the 51 treaty instruments for the regulation of international shipping IMO has adopted, 21 are directly environment-related.*[104]

Port activities *provide the basic infrastructure for many other sectors including fishing, transport, marine extraction of minerals, oil and gas, marine renewable energy or maritime tourism, but ports may also compete for space.*[105]

[103] http://www.imo.org/en/OurWork/Environment/Pages/Default.aspx (24/02/2020)

[104] http://www.imo.org/en/OurWork/Environment/Pages/Default.aspx (24/02/2020)

[105] https://op.europa.eu/en/publication-detail/-/publication/676bbd4a-7dd9-11e9-9f05-01aa75ed71a1/language-en/ (24/02/2020)

Port activities *can cause deterioration of air and marine water quality in the surrounding areas. During the construction and operation phase of port, regular monitoring and assessment are required.*[106] *Performance indicators or priorities for shipowners and ports often differ but include: air quality, water quality, energy consumption, greenhouse gas (GHG) emissions, noise (at sea and ports), impacts on local communities, ship and shore-based garbage, port development, dust, and dredging operations.*[107]

Shipbuilding and repair sector *includes: building of ships and floating structures, building of pleasure and sporting boats, repair and maintenance of ships and boats, marine and marine machinery.*[108]

4.1.3. Coastal and maritime tourism

In Europe, ***coastal and maritime tourism*** *employs over 3.2 million people and generates a total of € 183 billion in gross value added. It represents over 1/3 of the maritime economy.*[109] *Any maritime or landbased activity deteriorating the environmental can negatively affect tourism, but toursim also have negative impact on the environment. Co-existence with other Blue Economy sectors may depend on direct spatial conflicts, while synergies may also exist. Synergies may emerge through alternative activities, including eco-tourism and marine protected areas.*[110]

[106] Walker, T R. 2016. Green Marine: An environmental program to establish sustainability in marine transportation. Marine Pollution Bulletin 105 (1), 199–207.

[107] https://www.researchgate.net/publication/322992301_Environmental_Effects_of_Marine_Transportation (24/02/2020)

[108] https://op.europa.eu/en/publication-detail/-/publication/676bbd4a-7dd9-11e9-9f05-01aa75ed71a1/language-en/ (24/02/2020)

[109] https://ec.europa.eu/maritimeaffairs/policy/coastal_tourism_en (07/02/2020)

[110] https://op.europa.eu/en/publication-detail/-/publication/676bbd4a-7dd9-11e9-9f05-01aa75ed71a1/language-en/ (24/02/2020)

5. COASTAL AND MARITIME TOURISM

Coastal tourism *covers beach-based tourism and recreational activities, e.g.* ***swimming, sunbathing****, and other activities for which the proximity of the sea is an advantage, such as coastal walks and wildlife watching.* ***Maritime tourism*** *covers waterbased activities and nautical sports, such as* ***sailing, scuba diving and cruising****.*[111] ***Nautical tourism*** *special is a type of* ***tourism*** *which, in addition to* ***navigation in own organisation*** *– cruising in own or rented cruising vessels with accommodation and/or overnight stay of tourists on vessels, includes also* ***circular tours organised by owners of cruising vessels*** *and travel agencies with accommodation and/or overnight stay of tourists on vessels, as well as tourist navigation on vessels for the purpose of other forms of rest and recreation (fishing, diving). An important difference between nautical tourism and other forms of tourism is navigation, i.e. a considerable mobility of nautical tourists.*[112]

5.1. THE IMPACT OF COASTAL AND MARITIME (NAUTICAL) TOURISM ON THE MARINE ENVIRONMENT

Coastal and maritime tourism depend highly on good environmental conditions and in particular on good water quality.[113] *Protecting the marine environment is vital for developing and sustaining recreational marine activities in the long term.*[114]

The development od maritime and coastal toursim is connected with intensive **urbanisation** (hotels, appartments, marinas, artificial beaches) and landscape degradation (visual pollution).

[111] https://op.europa.eu/en/publication-detail/-/publication/676bbd4a-7dd9-11e9-9f05-01aa75ed71a1/language-en/ (24/02/2020)

[112] https://mmpi.gov.hr/UserDocsImages/arhiva/Strategija%20razvoja%20nautickog%20turizma%20ENGL%201.pdf (29/02/2020)

[113] https://op.europa.eu/en/publication-detail/-/publication/676bbd4a-7dd9-11e9-9f05-01aa75ed71a1/language-en/ (24/02/2020)

[114] https://www.europeanboatingindustry.eu/images/Documents/For_publications/Nautical-activities_what-impact-on-the-environment.pdf (27/02/2020)

The **port/marina construction and operation** (as well as beach and resort constructon) can directly destroy the **habitats** by dredging operations, or indirectly degrade the environment by changing the currents and quality of the water (transparency, pH, oxygen and nutrients content, pollutants,...) in the ports/marinas and adjacent sea. Unconscientious tourists can directly contribute to degradation of habitats by **intentional taking materials from beaches, leaving garbage, collection of marine organisms** (especially endangered species)...

5.2. RECREATIONAL BOATING

Boating is the leisurely activity of travelling by boat, or the recreational use of a boat whether powerboats, sailboats, or man-powered vessels (such as rowing and paddle boats), focused on the travel itself, as well as sports activities, such as fishing or waterskiing. It is a popular activity, and there are millions of boaters worldwide.[115]

5.2.1. The impact of recreational boating on marine environment

Recreational boating *acitvities can impact the environment due to regular boating operations (anchoring, mooring, sailing) or accidents (collision, grounding, sinking…). Operational pollution includes intended or unintended discharges of:* ***oils (fuels), sewage, garbage, antifouling paints, air emissions****, as well as* ***light*** *and* ***noise pollution****.*

The boats are intrusive, dangerous vehicles and have negative impacts on wildlife. Marine mammals sometimes cannot avoid the exceedingly speedy watercraft, and ***collisions*** *with hulls or scrapes by propellers often do fatal harm.*[116] *In sites frequently visited by pleasure boats, there is significant removal of seagrasses and/or corals by boat anchors.*

[115] https://en.wikipedia.org/wiki/Boating (27/02/2020)

[116] https://eponline.com/articles/2017/03/27/the-environmental-impacts-of-boating.aspx (27/02/2020)

Posidonia oceanica *meadows are identified as a priority habitat type for conservation in the Habitats Directive (Dir 92/43/CEE).*[117] Coastal development, nautical tourism development, eutrophication and other forms of pollution, mechanical damage due to anchoring and trawling, and numerous other influences have led to a decline in the population of Posidonia. Posidonia meadows are a large producer of oxygen, consolidate sediment, prevent erosion, mitigate the effects of waves and currents, and ultimately play a significant role in the circulation and binding of nutrients in the sea. Posidonia oceanica meadows are important marine habitats which provide shelter, nursery and feeding grounds to many marine organisms.[118]

In order to reduce the erosive pressure of free anchoring and mooring in shallow meadows, ecological moorings are increasingly being provided to boat users. In areas with high tourist pressure, seagrass-friendly mooring deployment does not suffice in itself, and has to be reinforced by a ban on free anchoring and free mooring.[119]

Cruise ships and boats are a serious threat to ***coral reefs*** *and its related organisms. In 2017, British cruise ship MS Caledonian had crashed onto the pristine coral reefs of Indonesia, destroying 17222 square feet of coral reefs and causing more than $19 million in irreparable damage.*[120]

Water quality *is often changed by the presence of boats. The presence of boats increase the growth of algae and kick up sediments, both of which obstruct sunlight. Chemicals used to clean, protect, and run watercraft often leach into the water, severely impacting the environment. Aquatic plants and animals have specific requirements for light, temperature, pH level, and more, and toxins from detergents, paints, petroleum products, batteries, and metals have disastrous effects on wildlife's ability to survive and thrive.*[121]

[117] https://ec.europa.eu/environment/nature/natura2000/management/habitats/pdf/1120_Posidonia_beds.pdf (27/02/2020)

[118] Boudouresque, C. F., Bernard, G., Bonhomme, P., Charbonnel, E., Diviacco, G., Meinesz, A., Pergent, G., Pergent-Martini, C., Ruitton, S., Tunesi, L. 2012. Protection and conservation of Posidonia oceanica meadows. RAMOGE and RAC/SPA publisher. Tunis: 1-202.

[119] https://ec.europa.eu/environment/nature/natura2000/management/habitats/pdf/1120_Posidonia_beds.pdf (27/02/2020)

[120] https://www.marineinsight.com/environment/8-ways-in-which-cruise-ships-can-cause-marine-pollution/ (29/02/2020)

[121] https://eponline.com/articles/2017/03/27/the-environmental-impacts-of-boating.aspx (27/02/2020)

Trace metals, especially copper from antifouling coatings, are commonly occurring contaminants in harbors and marinas.[122]

The use of ***oils*** *on boats causes serious marine pollution. Accidently spilling oil during filling up fuel tanks, faulty engine system and improper repair work are three areas through which oil could leak in the water.* ***Sewage (black water)*** *discharge from marine heads can cause nutrient enrichment of the waters.* ***Grey water*** *(washing waters) from recreational craft contains a wide range of chemicals and fats and is often released into the sea. The systematic use on board and in ports of 100% biodegradable cleaning products can solve the problem of chemical pollution.* ***Wastes/garbage*** *reduce the esthetic appeal of a club/marina and waterways, and is a hazard to wildlife and even humans. Garbage made of non-natural materials can break down and leach minute toxic elements into the environment or can persist for centuries.*[125]

Considering ***air pollution****, emissions from recreational marine engines represent 0.56% of total emissions caused by human activities. A carbon footprint is the total amount of greenhouse gases (including carbon dioxide) produced by our activities. The air pollution due to sulphur dioxide emissions is limited to commercial maritime transport, but air pollution due to nitrogen oxides emissions from boats pose a problem.*[126]

Noise pollution *due to boating activities results in modification of behaviour and use of habitat in some marine species. Studies in the Adriatic Sea show that the bottlenose dolphin (Tursiops truncatus) avoids areas with frequent nautical vessel traffic during the tourist season, spending less time on feeding and resting activities, and more time on avoiding contact.*[127]

[122] https://int.search.myway.com/search/GGmain.jhtml?p2=%5EBZD%5Exdm278%5ETTAB02%5Ehr&ptb=DFAC9DAE-9D9A-4C1E (27/02/2020)

[123] https://www.marineinsight.com/environment/8-ways-in-which-cruise-ships-can-cause-marine-pollution/ (29/02/2020)

[124] https://ec.europa.eu/environment/integration/research/newsalert/pdf/87na2_en.pdf (27/02/2020)

[125] https://ec.europa.eu/environment/integration/research/newsalert/pdf/87na2_en.pdf (27/02/2020)

[126] https://www.europeanboatingindustry.eu/images/Documents/For_publications/Nautical-activities_what-impact-on-the-environment.pdf (27/02/2020)

[127] https://www.sciencedirect.com/science/article/abs/pii/S0025326X12006030 (29/02/2020)

Light pollution *poses problems for organisms that need darkness for orientation in daily and seasonal migrations, feeding and breeding (birds, zooplankton, cephalopods, fish and potentially other marine species) putting them at risk of predation.*[128, 129]

For the last six decades, recreational boats are mainly built of reinforced plastic. The ***International Council of Marine Industry Associations (ICOMIA)*** *has estimated that there are more than 6 million recreational craft in Europe alone. Because composite vessels are highly durable,* ***end-of-life (EOL)*** *disposal has not so far been a major issue but the time will come when these craft will have to be disposed of.*[130]

5.2.2. How to prevent negative impact of recreational boating on marine environment

The nautical industry has a major role to play in encouraging respect for the environment and in producing clean products and technologies. ***The International Council of Marine Industry Associations (ICOMIA)*** *promotes a strategy for the* ***sustainable development of boating*** *aimed at encouraging its members to take a* ***product life-cycle approach****. It reviews the environmental impact of recreational marine products from their design and manufacture through ownership and operation, to eventual disposal.* ***The European Confederation of Nautical Industries (ECNI)*** *commissioned a team of European experts to study the environmental impact of nautical activities. The first study was released in September 2007.Several national associations representing the nautical industry have adopted voluntary programmes, developing practical measures to prevent pollution and protect the environment. These include the* ***Green Blue awareness campaign*** *for recreational boaters in United Kingdom and the* ***Programme Bateau Bleu*** *in France.*[131]

[128] https://esajournals.onlinelibrary.wiley.com/doi/full/10.1890/1540-9295%282004%29002%5B0191%3AELP%5D2.0.CO%3B2 (29/02/2020)

[129] https://www.researchgate.net/publication/335293367_SAFEGUARDING_MARINE_PROTECTED_AREAS_IN_THE_GROWING_MEDITERRANEAN_BLUE_ECONOMY_RECOMMENDATIONS_FOR_THE_CRUISE_SECTOR_Recommendations_for_the_cruise_sector_PHAROS4MPAs_project (27/02/2020)

[130] https://linset.it/it/news/scheda.php?id=71&st=1&k=End-of-life-Boat-Disposal-Looming-Issue (27/02/2020)

[131] https://www.europeanboatingindustry.eu/images/Documents/For_publications/Nautical-activities_what-impact-on-the-environment.pdf (27/02/2020)

*Nautical activities, because of their proximity to nature, are essential in **promoting environmental awareness**. They are a vehicle for teaching significant numbers of people to discover, appreciate, protect and preserve the flora and fauna of the natural marine habitat.*[132]

Here are some tips for how to be an environmentaly responsable boater (taken from Green Boating Guide):

- ***Fueling** - Filling up fuel tanks is one of the most common ways that waters are polluted. Take steps to mitigate the risk of accidently spilling oil or fuel.*
- ***Blackwater and Graywater** - Discover different ways to manage blackwater and greywater on vessel and what regulations may need to follow.*
- ***Waste** - Prevent waste from entering waterways by: refuse, reducing, reusing, recycling and dispose of properly.*
- ***Reduce Fuel Usage** - How boater maintain and drive vessels has a large of effect on how much fuel she use.*
- ***Biodiesel** - This renewable, non-toxic, clean-burning fuel can be a great alternative to conventional diesel and requires very few modifications for switching over.*
- ***Renewable Energy** (Sun, wind and water) can also be a source of energy to help power boats.*
- ***Non-Toxic Cleaning Products** – Choose non-toxic cleaning product that is ideal for both boat and the environment.*
- ***Antifouling Paint** - Choose eco-friendly alternatives over copper-based bottom paints, which can harm aquatic wildlife.*
- ***Anchoring** - Learn proper anchoring techniques to prevent damage to important ecosystems including coral reefs, seagrass and shellfish beds. Avoid anchoring in areas populated by invasive species like Caulerpa taxifolia and Caulerpa cylindracea in order to prevent invasive species spreading.*

[132] https://www.europeanboatingindustry.eu/images/Documents/For_publications/Nautical-activities_what-impact-on-the-environment.pdf (27/02/2020)

- ***Boating Near Marine Wildlife** – Avoid disturbing marine wildlife.*
- ***Invasive Species Prevention** - Take simple precautions to prevent non-native plants and animals from spreading and causing harm to new habitats and native species.*
- ***Green Fishing** – Observe responsible fishing practices to lessen the impact on fish populations and the environment.*
- ***General Maintenance** - Proactively managing your vessel reduces harmful environmental impacts, and also extends the life of your engine and boat. .*
- ***Batteries** - Choosing the right battery for boat and performing routine maintenance will ensure the optimal lifespan of the battery.*
- ***Bilge Maintenance** - Prevent oils and other toxic chemicals from sneaking into the ocean by inspecting and maintaining bilge.*
- ***Spring Preparation** - Get your boat ready to launch, while being green doing it.*[133]

Tips for how to be an environmentaly responsable diver/swimmer:

- ***Learn** as much as you can on marine ecosystems you visit.*
- *Take only **photos** and nothing else - leave other objects and organisms in their natural habitats.*
- *Leave no trace **(garbage)**.*
- *Choose **eco-friendly sunscreen** products, because sunscreen can wash off into the water, and some have chemicals that can harm marine wildlife.*
- *Do **not feed** animals. It can change their natural behaviour.*
- *Avoid **disturbing** marine organisms.*
- *Be **careful** when you dive/swim in order to avoid damaging marine habitats and organisms.*[134]

[133] https://www.sailorsforthesea.org/programs/green-boating-guide (27/02/2020)

[134] http://www.greenhome.co.me/fajlovi/greenhome/attach_fajlovi/lat/glavne-stranice/2017/06/pdf/Prirucnik_za_zastitu_mora.pdf (11/02/2020)

5.3. CRUISING

More routes, bigger ships and better facilities on board have opened up cruising to new markets. As the cruise industry is growing, so is its environmental impact.[135] *Based on Unated States Environmental Protection Agency estimates, in one week a 3000 passenger cruise ship generates about 210000 gallons of sewage, 1000000 gallons of gray water, 37000 gallons of oily bilge water, more than 8 tons of solid waste, millions of gallons of ballast water containing potential invasive species, and toxic wastes from dry cleaning and photo-processing laboratories.*[136]

5.3.1. The impact of cruising on marine environment

During their operational phase, cruise ships are either at berth, navigating, or anchored, impacting the natural environment through ***emissions/discharges*** *(gaseous, liquid or solid) and* ***physical disturbance*** *(noise, light and collision).* ***Oils (fuel)*** *enter the marine environment through routine activities such as the discharge of bilge water, ballast waters, and fuel intake.* ***Wastewaters*** *(black and grey waters) result in a decrease of available dissolved oxygen, algal blooming, entrance of enterobacteria and viruses in the marine environment.*

Ballast water *can contain wastewaters, oil, bacteria and invasive species. Ballast waters and hull fouling are among the main vectors for the introduction of non-indigenous species.* ***Antifouling coatings*** *contain high concentrations of antifouling biocides, which can have serious consequences for marine organisms.* ***Solid waste****, including marine litter, plastics and other inorganic and organic materials, is a growing problem.* ***Gaseous emissions*** *from ships increase greenhouse gases that contribute to climate change, acid rains and ocean acidification (due to the emissions of sulphur dioxides and nitrogen oxide).*

[135] https://www.ontheluce.com/cruise-environmental-impact/ (27/02/2020)

[136] https://www.pewtrusts.org/-/media/assets/2003/06/02/poc_summary.pdf (29/02/2020)

Noise pollution, light pollution *and* ***collisions*** *with marine mammals and sea turtles represent a big issues of concern.*[137]

5.3.2. How to prevent negative impact of cruising on marine environment

The EU Commission promotes a pan-European dialogue between cruise operators, ports and coastal tourism stakeholders to enhance synergies in the sector, targeting best practice sharing in innovation, competitiveness and sustainability strategies.[138]

In 2018 the Norwegian Maritime Authority (NMA) suggested several measures for cruises operating in the fjords:

- ***Determination of maximum speed*** *in defined zones in the fjords to keep consumption of fuel and emissions to a minimum.*
- *The* ***emission of NOx*** *shall not exceed the values set out in MARPOL.*
- *Only allow use of fuel with a* ***low sulphur content****.*
- ***Prohibition*** *against wastewater discharge (including scrubber water).*
- *Reducing the number of* ***port calls*** *(total number or per day/week).*
- ***Reporting*** *requirements for all ships entering world heritage fjords.*[139]

[137] https://www.researchgate.net/publication/335293367_SAFEGUARDING_MARINE_PROTECTED_AREAS_IN_THE_GROWING_MEDITERRANEAN_BLUE_ECONOMY_RECOMMENDATIONS_FOR_THE_CRUISE_SECTOR_Recommendations_for_the_cruise_sector_PHAROS4MPAs_project (27/02/2020)

[138] https://op.europa.eu/en/publication-detail/-/publication/676bbd4a-7dd9-11e9-9f05-01aa75ed71a1/language-en/ (24/02/2020)

[139] https://www.researchgate.net/publication/335293367_SAFEGUARDING_MARINE_PROTECTED_AREAS_IN_THE_GROWING_MEDITERRANEAN_BLUE_ECONOMY_RECOMMENDATIONS_FOR_THE_CRUISE_SECTOR_Recommendations_for_the_cruise_sector_PHAROS4MPAs_project (27/02/2020)

Cruise companies *have access to knowledge and technological solutions to reduce their impacts on the marine environment. Although, implementing environmentally friendly practices brings benefits for corporate image, the sector's current environmental performance is poor.*[140]

Here are some tips on what cruise companies should do to be environmentaly responsable:

- *reduce water usage (by usage of low-flow showers and efficient appliances) and use a purification system for wastewater;*
- *use environmentally friendly cleaning supplies;*
- *take care on how much waste they recycle and what happens to their recyclable waste;*
- *use shore power where they can so the engines can be turned off to reduce air pollution;*
- *reduce power usage (low-energy lighting, efficient air conditioning, key cards to turn power off passangers are not in the rooms);*
- *should use low sulphur fuel, not scrubbers because they pose environmental risks and must be carefully disposed of;*
- *improve their market image by taking their efforts to avoid strikes on whales seriously (applying night vision binoculars, infrared cameras, passive acoustic systems and real-time transmission of whale sightings) and including them in their marketing.*[141]

[140] https://www.researchgate.net/publication/335293367_SAFEGUARDING_MARINE_PROTECTED_AREAS_IN_THE_GROWING_MEDITERRANEAN_BLUE_ECONOMY_RECOMMENDATIONS_FOR_THE_CRUISE_SECTOR_Recommendations_for_the_cruise_sector_PHAROS4MPAs_project (27/02/2020)

[141] https://www.ontheluce.com/cruise-environmental-impact/ (27/02/2020)

6. MARINE ENVIRONMENT PROTECTION

International environmental law is one of the most rapidly evolving branches of international law. It encompasses intergovernmental organizations (IGOs), non-governmental organizations (NGOs), international financial organizations (IFOs), associations of private sector corporations and trade groups. The environmental law has been made uniform in international treaties. *In Europe, there are four cooperation structures which aim to protect the marine environment -* ***European Regional Sea Conventions****: OSPAR, 1992 - for protection of the North-East Atlantic; HELCOM, 1992 - for protection of the Baltic Sea Area; the Barcelona Convention, 1995 - for protection of the Mediterranean; the Bucharest Convention, 1992 - for protection of the Black Sea.*[142]

6.1. EU LEGISLATION

The EU Commission proposes policies and legislation that protect, preserve and improve Europe's environment.

6.1.1. Environmental Impact Assessment (EIA)

EIA Directive *defines the environmental impact assessment (EIA) process which ensures that projects likely to have significant effects on the environment are made subject to an assessment, prior to their authorisation. The EIA Directive is in force since 1985 and applies to a wide range of defined public and private projects, which are defined in Annexes I and II.*[143]

[142] https://ec.europa.eu/environment/marine/international-cooperation/regional-sea-conventions/index_en.htm(02/02/2020)

[143] https://ec.europa.eu/environment/eia/eia-legalcontext.htm (05/02/2020)

*The **Espoo (EIA) Convention** (The Convention on Environmental Impact Assessment in a Transboundary Context (Espoo, 1991) lays down the general obligation of States to notify and consult each other on all major projects under consideration that are likely to have a significant adverse environmental impact across boundaries.*[144]

6.1.2. Strategic Environmental Assessment (SEA)

*The **SEA Directive** is in force since 2001. The SEA Directive transposes the The **SEA Protocol** (The Protocol on Strategic Environmental Assessment to the Convention on Environmental Impact Assessment in a Transboundary Context, Kyiv, 2003) in the EU legislation. An SEA is mandatory for plans/programmes which are prepared for agriculture, forestry, fisheries, energy, industry, transport, waste/water management, telecommunications, tourism, town and country planning and other key plans.*[145]

6.1.3. Natura 2000

Upon **Birds Directive** in 1972 and the **Habitat Directive** in 1992, the EU established ecological network **Natura 2000** by connecting protected areas in 1992. The aim of the network is to ensure the long-term survival of Europe's most valuable and threatened species and habitats. *It stretches across all 28 EU countries, over 18% of the EU's land area and almost 6% of its marine territory, Natura 2000 is the largest coordinated network of protected areas in the world. The main advantage of Natura 2000 is that not a system of strict nature reserves from which all human activities would be excluded, but Member States must ensure that the sites are managed in a sustainable manner, both ecologically and economically.*[146]

[144] https://www.unece.org/fileadmin/DAM//env/eia/eia.htm (05/02/2020)

[145] https://ec.europa.eu/environment/eia/sea-legalcontext.htm (05/02/2020)

[146] https://ec.europa.eu/environment/nature/natura2000/index_en.htm (02/02/2020)

6.2. SOFT LAW (MANAGEMENT, QUALITY STANDARDS AND LABELS)

The new source of law comes from intergovernmental organizations (IGOs) and other entities that produce resolutions, declarations, guidelines, etc. that have recommendatory power. It is so-called soft law because it is non-binding but it can become binding over the time. Some of soft law sources are: **ISO14000 - Environmental Management System**[147] and **ISO 26000 – Guidance for Social Responsibility**[148], **Institute of Environmental Management and Assessment - IEMAs best practice standards**[149], etc. The European Commission developed **EU Eco-Management and Audit Scheme (EMAS)** – a management instrument for companies and other organisations to evaluate, report, and improve their environmental performance.[150] **Corporate Social Responsibility (CRS)**[151] is a concept that signifies the integration of environmental, social and human rights awareness into the corporate business model.[152]

6.3. INTEGRATED COASTAL ZONE MANAGEMENT (ICZM)

ICZM is a strategy for an integrated approach to planning and management, in which all policies, sectors and individual instests are properly taken into account, involving stakeholders in a participative way. It demands good communication among governing authorities (local, regional and national), and promises to address all three dimensions of sustainability: socio/cultural, economic and environmental.[153] In 2010, the European Commission ratified the ICZM Protocol to the Barcelona convention which allows Mediterranean countries to better manage their coastal zones.

[147] http://www.iso.org/iso/iso_14000_essentials (02/02/2020)

[148] http://www.iso.org/iso/social_responsibility (02/02/2020)

[149] http://www.iema.net (02/02/2020)

[150] https://ec.europa.eu/environment/emas/index_en.htm (02/02/2020)

[151] http://www.commercegov/ (02/02/2020)

[152] Nanda, VP, Pring, GW, 2013: International Environmental Law and Policy for the 21st Century, Martinus Nijhoff Publishers, Leiden/Boston, pp 665.

[153] http://www.coastalwiki.org/wiki/Some_definitions_of_Integrated_Coastal_Zone_Management_(ICZM) (02/02/2020)

6.4. MARITIME (MARINE) SPATIAL PLANNING (MSP)

The increasing demand for maritime space for different purposes, as well as the multiple pressures on coastal resources, require an integrated planning and management approach. Such an approach to ocean management and maritime governance has been developed in the ***Integrated Maritime Policy for the European Union (IMP)****, including the Directive 2008/56/EC* ***(The Marine Strategy Framework Directive)****. The IMP identifies* ***maritime spatial planning*** *as a cross-cutting policy tool enabling public authorities and stakeholders to apply a coordinated, integrated and trans-boundary approach.* In order to create a common framework for maritime spatial planning in Europe, the European Parliament and the Council adopted **Directive 2014/89/EU** in 2014.[155]

6.5. MARINE PROTECTED AREAS (MPA)

Only about 4% of the world's oceans are protected, and the vast majority of existing marine parks and reserves are either poorly managed, or not looked after at all. According to *World Wildlife Fund (WWF)* the *MPA include marine reserves, fully protected marine areas, no-take zones, marine sanctuaries, ocean sanctuaries, marine parks, locally managed marine areas,... with different levels of protection, as well as the range of activities allowed/prohibited within their boundaries.*[156] According to the *MARPOL Convention,* ***special areas*** *can be recognized at an international level for technical reasons, or due to their particular character and oceanographical/ ecological condition, for the purpose of adopting measures for the prevention of sea pollution by oil. The convention also provides for an* ***emission control area*** *designed to prevent, reduce, and control air pollution from NOx or SOx. Resolution A.982 (24) of IMO, provides the possibility for the designation of a* ***Particularly Sensitive Sea Areas (PSSA)****, especially in areas fulfilling a set of ecological, social, cultural, and economic criteria.*

[154] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0089&from=EN (05/02/2020)

[155] https://ec.europa.eu/maritimeaffairs/policy/maritime_spatial_planning_en (05/02/2020)

[156] https://wwf.panda.org/our_work/oceans/solutions/protection/protected_areas/ (02/02/2020)

Ecological Protection Zones (EPZ) *are established in the EU and in the Mediterranean with the approval of the IMO, in order to preserve ecological biodiversity.* ***Special Protected Areas (SPAs)*** *and* ***Sites of Community Importance (SCIs)****, established by the European Union in 1992, constitute the largest network of protected areas in the world, that includes terrestrial and marine sites, providing protection to valuable and threatened species, and habitats of natural importance. The SPA/BD Protocol of the Barcelona Convention provided the possibility for the designation of* ***Specially Protected Areas of Mediterranean Interest (SPAMIs)****. SPAMIs are also designated in marine areas of scientific, aesthetic, historical, archaeological, cultural, or educational interest.*[157]

6.6. POLICIES TO PROTECT AND PROMOTE UNDERWATER CULTURAL HERITAGE (UCH)

The UNESCO Convention on the Protection of the Underwater Cultural Heritage (2001) is drafted in order to harmonize the protection of submerged heritage, which includes ancient shipwrecks and sunken ruins, with the protection already accorded to cultural heritage on land. The Convention encourages the responsible access of the public to underwater heritage and examples of Best Practices. The first examples have been approved and been designated by a special Label that should aim at:

a. encouraging responsible and non-intrusive public access to underwater cultural heritage,

b. increasing public awareness, appreciation and protection of heritage,

c. promoting the Convention and the implementation of national juridical frameworks for protection,

d. supporting scientific research in accordance with the Convention and the Rules and capacity-building in that regard, and

e. the appropriate conservation of the heritage,

[157] https://www.mdpi.com/2571-9408/2/2/69/pdf (06/02/2020)

f. including appropriate stakeholders, at local, national and international levels in the process of identifying Best Practices, and cooperating in their promotion and application.[158]

6.7. SUSTAINABLE AND RESPONSIBLE TOURISM

Sustainable and responsible tourism are both alternative forms of tourism that aim mitigate the historically negative effects of tourism. ***Sustainable Tourism*** *aims to make a positive economic, social, and environmental impact on host destinations trough the actions of stakeholders and political leaders who work to improve the industry by fairly redistributing profit, alleviating poverty, introducing stable employment and implementing social protection measures.*[159] *Responsible Tourism aims to foster a positive economic, social, and environmental impact on host destinations; however, it depends on individual actors.* ***Responsible Tourism*** *refers to the way in which visitors, residents, and small businesses interact with a destination.*[160]

Figure 3. *The UN's Sustainable Development Goals (SDGs) - set in 2015 by the United Nations and intended to be achieved by the year 2030*[161]

[158] http://www.unesco.org/new/en/culture/themes/underwater-cultural-heritage/underwater-cultural-heritage/best-practices-of-underwater-cultural-heritage/ (06/02/2020)

[159] https://medium.com/sustaining-tourism/sustainable-v-responsible-tourism-the-nuanced-difference-5893d4e6706 (11/02/2020)

[160] https://medium.com/sustaining-tourism/sustainable-v-responsible-tourism-the-nuanced-difference-5893d4e6706 (11/02/2020)

[161] https://en.wikipedia.org/wiki/Sustainable_Development_Goals (11/02/2020)

Some of the strategies for sustainable coastal tourism include translocations of come activities in land (housing and eco-tourism) that can help to distribute pressure evenly and season expansion in order to distribute negative impacts of tourism throughout the year...

How to be an environmentaly responsable hotel/restorant:

- *try to reduce negative impact on the environment – natural, cultural and economic;*
- *implement measures for water saving;*
- *use renewable energy sources;*
- *use eco friendly materials;*
- *recycle waste;*
- *use local fresh products in the restorants...*

How to be an environmentaly responsable tourist:

- *do not replace the towels too often – it will save water, energy and detergents;*
- *switch off lights, air conditions.. when You do not need it (when leaving the room);*
- *do not use plastic cups, bags... it will probably end in the sea*[162]

6.7.1. The Green Key

The Green Key award is the leading voluntary eco-label standard for excellence in the field of environmental responsibility and sustainable operation within the tourism industry. The Foundation for Environmental Education (FEE) started the Green Kay programme in 1994. The high environmental standards expected of Green Key establishments are maintained through rigorous documentation and frequent audits. The criteria focus on environmental management, technical demands and initiatives for the involvement of guests, staff and suppliers.

[162] http://www.greenhome.co.me/fajlovi/greenhome/attach_fajlovi/lat/glavne-stranice/2017/06/pdf/Prirucnik_za_zastitu_mora.pdf (11/02/2020)

Some of the categories covered are: Water, Waste, Energy, Involvement and Awareness of Guests, Environmental Management, Staff Involvement, Use of Chemicals, Open Spaces, and Food and Beverages. Green Key is eligible for hotels, hostels, small accommodations, campsites, holiday parks, conference centres, restaurants and attractions.[163, 164]

6.7.2. The Blue Flag

The Blue Flag is one of the world's most recognised voluntary eco-labels awarded to beaches, marinas, and sustainable boating tourism operators on an annual basis. The Foundation for Environmental Education (FEE, Copenhagen, Denmark) started the Blue Flag programme in 1987. The mission of Blue Flag is to promote sustainability in the tourism sector, through environmental education, environmental protection and other sustainable development practices. In order to qualify for the Blue Flag, a series of stringent criteria (including standards for quality, safety, environmental education and information, the provision of services and general environmental management) must be met and maintained.[165]

Some of Blue Flag marina criteria:

- *Production of an environmental policy and plan at the marina that includes references to water, waste and energy consumption, health and safety issues, and the use of environmentally sound products when available.*
- *Bilge water pumping and toilet pumping facilities are present in the marina.*
- *Adequate and properly identified and segregated containers for the storage of hazardous wastes - the wastes should be handled/disposed of by a licensed contractor/at licensed facility for hazardous waste.*
- *Adequate and well managed litter bins and/or garbage containers - the wastes should be handled/disposed of by a licensed contractor/at licensed facility.*
- *The marina has facilities for receiving recyclable waste materials.*
- *All buildings/equipment must be properly maintained, comply with national legislation, and in a good integration with the environment.*
- *Adequate, clean and well sign-posted sanitary facilities, including washing facilities and drinking water. Controlled sewage disposal to a licensed sewage treatment.*
- *If the marina has boat repairing and washing areas, no pollution must enter the sewage system, marina land and water or the natural surroundings.*
- *Promotion of sustainable transportation.*
- *No parking/driving in the marina, unless in specific designated areas.*

Some of Blue Flag sustainable boating tourism operator criteria:

- *It is recommended to establish a management committee (for instituting environmental management systems and regular environmental audits).*
- *Each tour operator has to have an environmental policy and an environmental plan.*
- *All regulations pertaining to the location and the operation of the boats have to be complied with.*
- *Report of accidents that might cause environmental damages.*
- *Correct disposal of all wastes produced by the tourists and the tour operator.*
- *Correct treatment of bilge water.*
- *Use of adequate, properly identified and segregated containers for the storage of hazardous wastes.*
- *Use of adequate litter bins, including recycling bins.*
- *Use of recyclable products, biodegradable materials and environmentally friendly toiletries and cleaning products.*
- *Smoking should be prohibited on the boats.*
- *Provision of adequate sanitary facilities with correct sewage disposal.*

[163] https://www.greenkey.global/ (10/02/2020)

[164] https://en.wikipedia.org/wiki/Green_Key_International (10/02/2020)

[165] https://www.blueflag.global/ (10/02/2020)

- *Repair and paint works on the boats must be limited to specifically designated areas.*
- *Promotion of sustainable means of transportation from and to the boats.*
- *Speed and engine maintenance of the boats must be aimed at maximising energy efficiency and minimising pollution.*
- *Environmentally friendly anchoring.*
- *Correct disposal of boats that have reached the end of their life service.*
- *Vulnerable and protected areas must be respected.*
- *Any wildlife must be approached at a slow speed and in a manner that allows the animal(s) to evaluate the situation. They must not be encircled, trapped or chased.*
- *When in the direct vicinity of any wildlife, noise must be reduced to a minimum and the engine should be put into neutral whenever appropriate.*
- *Special precaution must be taken in the vicinity of breeding animals. Young animals must not be separated from their group.*
- *No animals or plants are to be touched or collected.*
- *Tourists and employees must not feed the animals.*
- *If there are any signs of disturbance, the boat must increase its distance from the animals.*
- *Injured, entangled, stranded or dead animals must be reported to the local authorities.*
- *The tour operator should be open to cooperation with research institutions.*[166]

[166] https://en.wikipedia.org/wiki/Blue_Flag_beach (10/02/2020)


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