ISSN 0554-6397
UDK: 004.032.26
*Preliminary communication*
*Received:* 3rd November 2021.

**Mirjana Kovačić**
E-mail: mirjana051@gmail.com;
**Matea Horvat**
E-mail: kapitanovic.matea@gmail.com
University of Rijeka, Faculty of Maritime Studies, Studentska 2, 51000 Rijeka, Croatia

# Environment Pollution in Croatia as a Consequence of Nautical Ports Development

## Abstract

The paper research the impact of nautical tourism on environmental pollution focusing on nautical ports. Based on data on the number of nautical ports in Croatia and previous research, various case studies and laws have been passed. Although the development of nautical tourism cannot be stopped despite a series of harmful effects, the reduction of environmental pollution can be influenced by emphasizing legal regulations, establishing a quality system as well as defining marine protected areas (MPA). The aim of this paper is to raise awareness of the importance of a clean and healthy ecosystem in the long run, not only in the seasonal parts of the year in order to preserve the environment and ultimately the future of humanity.

**Key words:** nautical tourism, nautical ports, pollution of the marine environment, marine protected areas

## 1. Introduction

The use of the sea as a waterway for economic purposes has been applied for centuries while man's need for movement and connection with nature arose as an escape from everyday life and frequent routines in the workplace. Croatian, whose coast contains 79 islands, 525 islets, and 642 cliffs and reefs [17], is classified as a maritime country and stands out as one of the most popular destinations that attracts yachtsmen around the world.

Nautical tourism, as one of the newer terms, has profiled itself as a term that is very often found in business circles as a recent activity. Given that the business and financial results of nautical tourism are increasingly noticeable and very interesting to

the national economy, this concept is also dealt with in official legislation and policy and it is especially recorded in official statistics. The development of nautical tourism, or water tourism as some authors call it, is accompanied by various definitions, while according to the Act on the provision of services in tourism (OG 130/17, 25/19, 98/19, 42/20), nautical tourism is defined as navigation and stay of yachtsmen or passengers on the vessel (yacht, boat, ship) for personal needs or economic activities, as well as stay in nautical tourism ports and nautical part of the port intended for public transport for recreation, leisure or cruising, while according to the Ordinance on classification and categorization of nautical tourism ports (OG 72/2008) nautical ports are divided into anchorages, marinas, dry marinas and boat storages.

Pursuant to the Act, the services prescribed in nautical tourism ports refer to the services of using berths, reception and accommodation of vessels (with or without sailors), charter services, organization of excursions or trips, and services of reception, storage, maintenance of vessels and their arrangement and preparations.

As a consequence of the services and activities that take place in the nautical tourism ports, the disruption of the ecosystem begins with small waste all the way to solid waste. The most common cause of pollution of the marine environment is human negligence, which is becoming increasingly pronounced despite warnings, while the greatest impact is reflected in changes in the original appearance of the marine environment [9]. Environmental pollution is also influenced by the reckless construction of nautical tourism ports without an environmental impact study, which is conditioned by the increased demand for nautical berths, as well as the inappropriate behaviour of yachtsmen staying in nautical tourism ports.

## 2. Past research on the environment pollution owing to the development of nautical tourism

Nautical tourism has been developing rapidly in the last twenty years, while research on the topic began ten years ago. In many areas, efforts were made to meet the needs of rapidly growing nautical tourism demand and areas of fragile ecological balance were often chosen for the construction of nautical tourism ports.

Previous research on marine pollution due to the development of nautical tourism cannot be found. Research is mainly based on sustainable development. The research "TOMAS NAUTIKA Yachting", published every year by the Institute of Tourism, studies the characteristics of nautical demand, monitors the trends that change in the market every day and points to the importance of a clean environment and prevention of pollution of the sea and marine environment, with floating debris, oily seas, lack of waste disposal areas being just some of the examples arising from the problem of pollution that affect the satisfaction of yachtsmen.

Various studies showed the impact of nautical tourism on the marine environment and measures to prevent pollution of the aquatorium by nautical tourism ports resulting

from yachts and boats, as shown by Dogan and Mršić in their paper "Preservation of natural resources of nautical tourism in the Republic of Croatia". Author Koljatić demonstrated that organic compounds and the lack of data on the number of pollutants in the sea contributes to ecosystem deterioration, while authors Luttenberger in their paper "Ecological aspects of nautical tourism" advocated for stricter regulations that would protect nationally sensitive areas because the existing regulations contain certain shortcomings.

In the study "The Impact of Tourism on the Environment", Camarda and Grassini wanted to draw attention to the fact that certain activities can have negative consequences for the environment, which affects increased environmental pollution and water quality, soil degradation and air pollution. A strategy that would contribute to the development of nautical tourism with the aim of environmental protection requires continuous monitoring and research of the nautical tourism port system, as shown in the paper "Marine pollution in nautical seaports by tourists" by authors Andres et al.

## 3. Theoretical aspects of environment pollution

The first and most commonly used definition of marine pollution was adopted by the UN Conference on the Human Environment in Stockholm in 1972, and reads: "*Marine pollution means man's direct or indirect introduction of substances or energy into the marine environment, including estuaries, that cause or can cause disastrous consequences such as damage to living resources and marine life, endanger human health, disrupt maritime activities, including fishing and other legal uses of the sea, degrade the required quality of seawater and reduce the attractiveness of the coastal and marine environment*." [8] Definition of pollution assists in understanding the extent of pollution and how any reckless and uncontrolled human activity can have a negative impact on the marine environment.

Since healthy and preserved environment serves for the benefit of all mankind, economic activities are related to environmental protection, so environmental protection instruments are divided into three groups [3]:

- ◊ regulatory control instruments – directly regulate prohibitions and permits in the production and consumption of goods and services and the location of human activities,
- ◊ economic instruments of direct and indirect regulation of environmental management – taxes, penalties, fees, subsidies and other forms of economic incentives and burdens of environmental management,
- ◊ voluntary instruments derived from the knowledge and willingness of producers, consumers and the state in promoting ecological balance, such as: integrated planning with emphasis on sustainable development, environmental responsibility of producers during the product lifetime, agreements and control measures and environmental assessment (pollution

levels), public information systems on the condition and problems of the environment (combined with public moral pressures).

Establishing a quality system (International Standard ISO: 14001) based on the ideology of plan-implement-verify-act[3] requires the organization to determine the roles, authority and responsibilities for any job, thus establishing and implementing environmental policy. The aim of the standard is to preserve the environment by applying legal regulations which oblige organizations to apply and establish an environmental management system by rational energy consumption, reducing negative environmental impacts and promoting a clean environment.

In the Republic of Croatia, the Environmental Protection Act (Official Gazette 80/13, 153/13, 78/15, 12/18, 118/18) prescribes assessment instruments that determine the necessary environmental protection measures in order to preserve the existing situation and reduce negative impacts on the environment.

The Strategic Environmental Assessment (SEA) is an environmental protection instrument that assesses the environmental impacts resulting from the implementation of the strategy, plan and programme. The study is conducted prior to the issuance of a site permit or any other permit required for the project and therefore contains guidelines at all stages of the plan, programme, strategy based on economic analytical methods and techniques [10].

Although the study is conducted before the implementation of the programme, plan or strategy to analyse the existing state of the environment and determine the ability to implement the programme, testing the same parameters during the implementation of the project and after a certain period could provide a more detailed insight into such a study because certain parameters can change significantly, while in the existing ecosystem new organisms can develop that can be to the detriment of the existing ones thus endangering the habitat and becoming the dominant species. The construction of various facilities in the sea and the environment, in addition to solid waste, generates wastewater, as well as dust which, in addition to entering the sea directly, can reach the surrounding streams that lead the same particles directly into the marine environment. Act on Sustainable Waste Management (OG 94/13, 73/17, 14/19, 98/19) determines measures that contribute to the prevention or reduction of saving activities caused by waste and affecting human health and the environment. The provisions of the law regulate activities that include the principles, objectives and management of waste, locations where waste disposal is envisaged, such as containers for sorting waste in nautical tourism ports, as well as obligations in waste management.

Since the ecosystem is viewed as a whole, because it consists of a coexistence of all living organisms with an antibiotic environment [22], or inanimate nature, it can be seen through the levels where each level is determined on a temporal and spatial scale [23]. The most widespread are marine systems that cover 75% of the earth's surface and are divided into shallow and deep oceans.

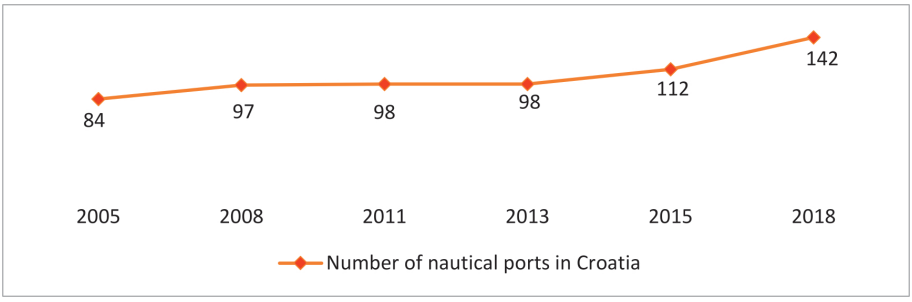
The Adriatic Sea, which belongs to the shallow marine system, is rich in various ecosystems [14], each of which has its own unique role in the development of the ecosystem, with the greatest emphasis on critical habitats; areas where the most important biological processes involved in food production take place. Although due to ecological and geomorphological characteristics, certain areas of the Adriatic are not exposed to such an impact, the northern Adriatic stands out as the most critical. The largest and most visible pollutants in shallow marine ecosystems are organic compounds such as steroids that enter the sea from vessels, most often recreational vessels due to the discharge of faecal water and waste disposal, whether solid or liquid. Although small amounts of organic compounds can contribute to the formation of fertilizers in the sea, larger amounts can be catastrophic. The enormous development of green planktonic algae due to increased oxygen consumption along the coast of Istria has caused the death of fish, while the multiplication of algae and bacteria, better known as algal bloom, it might cause the formation of toxic products.

## 4. Nautical tourism and sea pollution

The indentation on the eastern side of the Adriatic coast attracts a lot of attention by yachtsmen, so according to the report of the Ministry of Maritime Affairs, Transport and Infrastructure in 2018, 758 foreign yachts and 52,065 foreign boats, a total of 59,583 foreign sports and leisure vessels, were registered in Croatia. In 2018, 142 nautical ports were registered according to the Central Bureau of Statistics in Croatia. The largest share of nautical ports was located in the Zadar County and on 31 December 2018, a total of 13,617 vessels were registered at permanent berth, 11,742 of which used berths at sea [7].

The increased number of nautical tourism ports (Graph 1) has positive effects in economic terms, but in terms of environmental pollution, environmental impact studies should be considered. It is the uncontrolled use of natural resources and naturally shaped space that is the biggest threat to the long-term development of nautical tourism. Responsible environmental management for conservation purposes should be the main motive in planning the use of space for the construction of nautical tourism ports.

*Graph 1. Number of nautical ports in Croatia from 2005 to 2018.*




*Source: authors according to Croatian Bureau of Statistics, https://www.dzs.hr/ [Accessed on September 15th 2021]*

The accelerated development of nautical tourism is one of the serious sources of coastal pollution and in order to maintain the quality of life, it is necessary to systematically plan its development[16]. When tourists-yachtsmen choose a destination regardless of the type of nautical tourism port, the main factor of choice is the environment. Environment may be an indicator of the state of the sea – cleanliness, transparency, bays, beautiful beaches, marinas and all other attractions that are offered. The negative aspects of nautical tourism are manifested through environmental pollution, nautical tourism ports, beaches, bacterial pollution, destruction of flora and fauna by various illegal activities in prohibited areas, fishing during spawning and growth, and destruction of the coast. The Adriatic Sea with its coast and islands is a very valuable and vulnerable natural system. It is a unique and sensitive marine ecosystem with hydrographical, oceanographic, biological, bio-geographical and other properties that differ from others in the Mediterranean, while it is an integral part of it [12].

An important component of the ecological condition of the sea is the quality of the coastal sea. The amount of faecal bacteria that reach a certain area is determined by microbiological testing of water. In addition to sewage, faecal bacteria enter the marine environment through the uncontrolled discharge of faecal water from boats and yachts. According to the Barcelona Convention [6], in 1989 the Republic of Croatia began with systematic and controlled monitoring of the bathing sea. Intestinal enterococci (CFU/100ml) and Escherichia Coli (CFU/100ml) are microbiological indicators monitored in the sea (Table 1). Final, annual and individual assessments are determined on the basis of criteria defined by the Bathing Water Quality Regulation and the EU Bathing Water Quality Directive.

*Table 1. Criteria for sea quality assessment according to the Bathing Water Quality Regulation*

| STANDARDS FOR SEA QUALITY ASSESSMENT AFTER EVERY TEST | | | | |
|---|---|---|---|---|
| Indicator | Sea quality | | | |
| | excellent | good | satisfactory | |
| intestinal enterococci (CFU/100 ml) | < 60 | 61-100 | 101-200 | |
| Escherichia Coli (CFU/100 ml) | < 100 | 101-200 | 201-300 | |
| STANDARDS FOR SEA QUALITY ASSESSMENT AT THE END OF THE BATHING SEASON AND FOR THE PREVIOUS THREE BATHING SEASONS | | | | |
| | excllent | good | satisfactory | unsatisfactory |
| intestinal enterococci (CFU/100 ml) | ≤ 100* | ≤ 200* | ≤ 185** | > 185**(2) |
| Escherichia Coli (CFU/100 ml) | ≤ 150* | ≤ 300* | ≤ 300** | > 300**(2) |

*Source: authors according to Bathing Water Quality Regulation (OG 73/2008)*

CFU – colony forming unit
* - based on the value of 95th percentile (1)
** - based on the value of 90th percentile (1)
**(2) – instant action for individual samples, if the number of intestinal enterococci exceeds 300 CFU/100 mL, Escherichia Coli 500 CFU/100ml

Bathing water quality testing is conducted at more than 900 points every 15 days between 15 May and 30 September. At 98% of the test points, the quality of the bathing water was excellent and good for the period from 2011 to 2014, thus putting the Republic of Croatia, along with Cyprus and Malta, at the very top in Europe.

In the period from 2016 to 2019, out of a total of 920 survey points including seven counties, 885 points were rated with an excellent grade while only 11 points were unsatisfactory. The Dubrovnik-Neretva, Split-Dalmatia, Šibenik-Knin, Zadar and Lika-Senj, Primorje-Gorski Kotar and Istria counties participated in the research. Lika-Senj County had the largest share (100 %) of excellent grades, while Split-Dalmatia County (94.08 %) was last[19].

Given that the largest share of pollution in nautical tourism ports comes precisely from vessels, according to Dogan and Mršić, the sources of pollution [9] are coatings used during ship painting, wastewater generated during washing ships and engines during repairs, faecal, oily precipitation, and bilge and ballast waters that flow directly into the sea, while biocides contained in antifouling paints in contact with water release

toxins that, in addition to the organisms that have settled on the vessel, affect the organisms in the port waters.

Perhaps the biggest problem in nautical tourism is the reduced availability of equipment and the capacity of reception facilities for collecting pollutants in appropriate places [14], although efforts are made to pay attention to the protection of the environment in nautical tourism ports. Provisions on the protection of the marine environment can be found in the ordinances on internal order in marinas. According to the provisions, the master of the vessel shall keep garbage and waste oils until he arrives at the marina where he shall hand them over. Also, the master of the vessel shall hand over all waste before departure. In order to act preventively, it is necessary to install a sufficient number of reception facilities for oily water, oil, garbage and waste. It is also necessary to ensure that these devices are regular emptied and that the tank and the surrounding area are clean. The discharge of faecal water from boats and yachts into port waters can be prevented by prohibiting the use of ship toilets to those who have an open discharge system, i.e. who do not have a black water tank. Since the infrastructure on the coast has toilets tourists – yachtsmen should be instructed to use them. Smaller vessels, i.e. fishing boats, yachts and other tourist and recreational vessels, do not make sufficient use of the possibility of unloading liquid waste [21]. Since these vessels do not have large wastewater tanks, it is assumed that they discharge them at a certain distance from the mainland and islands.

In the Republic of Croatia, any discharge of faecal water by ships within 12 nautical miles is prohibited. Ports for international traffic are well organized, including a number of marinas, while small settlements, uninhabited places, areas where excursion boats pass are not under control. Ships cannot cause pollution of the narrow sea belt since they have black water tanks in which they store their wastewater and discharge it to designated places. The Maritime Code clearly stipulates that the master of the ship, members of the ship's crew, the person operating the boat or yacht and crew members of the boat or yacht and crew members or professional workers on fixed offshore or floating facilities shall when sailing or staying in inland waters, territorial sea, the epicontinental or the economic zone of the Republic of Croatia, comply with international, European and Croatian regulations and standards on protection against marine and air pollution from maritime facilities and pollution caused by immersion from maritime facilities.

## 5. Quality standards – recommendations and measures for further nautical tourism development

Although it is generally accepted that the lack of knowledge and action within the activities of nautical ports causes negative consequences for the quality and health of marine ecosystems, the impacts and pressures on the environment are still being investigated [11]. Impacts such as environmental pollution, deteriorating sea quality, injuries or deaths of marine animals resulting from collisions of nautical vessels or

consumption of plastic waste are visible, but awareness of their problem has not been raised, indicating insufficient awareness of irresponsible behaviour of yachtsmen in nautical ports, which has devastating consequences for the marine ecosystem and its organisms

While society expects the nautical port environment to look exactly as it does on various flyers, the reality is different. The nautical port ecosystem should be of similar quality as marine protected areas due to natural values [1]. Every pollution starts from the source itself, which in this case is the yachtsmen, i.e. their behaviour during stay in the port (Table 2, 3).

*Table 2. Assessment of tourist impact in nautical ports*

| | |
|---|---|
| Vessel up to 12 meters | Number of crew: 2-15 members |
| Time spent in port | 70-80% annually |
| Food remains | 0.5-3 kg day/person |
| Maintenance remains | 100 kg vessel/annually |

*Source: Andrés, M. A., Madariaga, E., Delgado, O., Martínez, J. E. (2017) Marine pollution in the nautical seaports in Croatia by the effluent of tourists, European Transport \ Trasporti Europei, 1(64):3, 1-11*

*Table 3. Assessment of tourist impact in nautical ports*

| Food | Wrappings | Plastics | Aluminium | Glass/metal |
|---|---|---|---|---|
| 38% | 17% | 16% | 16% | 13% |

*Source: Andrés, M. A., Madariaga, E., Delgado, O., Martínez, J. E. (2017) Marine pollution in the nautical seaports in Croatia by the effluent of tourists, European Transport \ Trasporti Europei, 1(64):3, 1-11*

When looking at the above data, it is not enough just to control/treat the pollution, but also to identify its causes and avoid them. Establishing an environmental monitoring system based on a system of indicators can contribute to pollution prevention. In this way, it contributes to standardization, reduced number of controls and easier data collection and processing[14]. Such a system could quickly detect the type of pollution, facilitate the management process in nautical ports and enable international collaboration between scientists, managers, and companies. Establishing an environmental monitoring system would influence activities such as[5]:

- ◊ preventing/limiting environment degradation,
- ◊ taking actions with optimal expenses of implementing measures for pollution prevention and maintenance,
- ◊ evaluation of actions that include reasonable investment and comparison of cost and benefit for the environment.

Marine pollution is a global problem that forms a concept suitable for researching all parameters of nautical tourism polluting the environment, not related only to the activities of yachtsmen and the problem of waste disposal. Such problems include the problem of invasive species, ballast water, sewage and air pollution by noise, vibration and discharge of black and gray waters in nautical ports, as well as uncontrolled industrial construction (Table 4) [1].

*Table 4. Ecological consequences and recommended preventive measures*

| Ecological consequences | Preventive measures |
|---|---|
| Boat disturbance and collisions with cetaceans and other marine animals | Define a clear navigation route and safe distance (determine the speed limit, set acoustic surveillance systems) |
| Anchor damage to Posidonia oceanica* | Monitor their distribution and state of health; seagrass-friendly mooring systems based on carrying capacities and vessel type; surveillance of illegal anchoring; issue entry and/or anchoring permits and setting time limits; establishment of an anchoring committee; environmental education |
| Discharge of pollutants | Partner with experts to tackle contamination |
| Discharge of black and grey and waters | Partner with experts to tackle contamination |
| Noise pollution | Set speed limits |
| Light pollution | Reduce the use of lights |
| Overcrowding | Determine carrying capacities; monitor boating activity; create a forecasting system to be used in the spatial planning of recreational boats |

*Source: González D. A.: Managing the environmental sustainability of nautical tourism in Mediterranean Marine Protected Areas, http://www.ecounion.eu/en/ [Accessed on September 15th 2021]*

Posidonia oceanica* or Posidonia plays a major ecological role as a supplier in the ecosystem and provides shelter and food for other organisms. Morphological and molecular research methods have shown that the microflora of individual fungi is associated with Posidonia, which allows the production of ligninolytic enzymes and teniases that contribute to the decomposition and detoxification of lignocellulose residues in the presence of high salt concentrations [20].

Also, the uncontrolled construction of nautical ports and ancillary facilities leads to environmental devastation, reducing the aesthetic value of the environment [9]. Given that soil degradation is affected by increased industrialization and rapid urbanization

and that the port infrastructure is stable, i.e. long-term, it is important that during its life there is no disturbance of the natural balance. During construction, it is important to determine the type of nautical port and use adequate equipment so that the entire process affects the environment as less as possible. The Ordinance on the classification and categorization of nautical tourism ports prescribes the minimum requirements and special minimum requirements that must be met in order to meet the status of a nautical tourism port.

In aquatic ecosystem, noise is intentionally produced for seismic exploration, harassment devices or sonar, or is an unintentional by-product such as industry, shipping, and recreational boating [13]. In recent years, human activities along the coast have increased significantly, affecting noise level. The increase in noise level negatively affects marine animals and reduces their ability to communicate, avoid predators, and find food.

Preserving the quality of the sea with the rational use of marine resources and reducing the impact of pollution from marine vessels, as well as nautical ports contributes to preserving the existing state of the environment and maintaining a clean environment.

## 6. Conclusion

Due to its natural indentation and long coastline, the Republic of Croatia is a real magnet for yachtsmen. Nautical tourism, as a newer branch of tourism, is developing rapidly, and accompanying actions on the protection of the marine environment do not follow its development.

In order to protect its national interests, the Republic of Croatia strives to act for the long-term protection of natural habitats and maritime and economic assets. The enactment of laws within the institute of maritime domain and the updating legal regulations control the economic use of coastal and maritime resources of parts of the Adriatic Sea under the territory of the Republic of Croatia. Due to the constant globalization and rapid development of technology, legal regulations are sometimes not feasible in practice, so the management of maritime territory is possible only through the definition of marine protected areas.

Despite a number of harmful effects of nautical tourism on the environment, it is not necessary to stop the development of nautical tourism, but it is necessary to determine the equipment and its standards and equip ports for receiving waste from vessels. If “no-discharge zones” were declared, waste and faecal water would be discharged into onshore reception facilities.

The importance of the sea in sustaining life on Earth is irreplaceable. We should all raise awareness about preserving the marine environment and pass it on to the next generations from whom we have only borrowed the environment.

## References


1. Andrés, M. A., Madariaga, E., Delgado, O., Martínez, J. E. (2017) Marine pollution in the nautical seaports in Croatia by the effluent of tourists. *European Transport \ Trasporti Europei*. 1(64):3, 1-11
2. Bathing Water Quality Regulation (OG 73/2008)
3. Boban, M. (2016) *Ekonomija okoliša i strategija održivog razvoja; realnost ili utopija?* Available from: http://terraconbusinessnews.com/ekonomija-okolisa-i-strategija-odrzivog-razvoja-realnost-ili-utopija/ / [Accessed on September 15th 2021]
4. Buntak K., Drožđek I., Kaniški J. (2014) Making the manual on environmental management system on the example of company machiper equipment. *Tehnički glasnik 8*. 4, 418-425
5. Carpenter, A., & Macgill, S. M. (2005) The EU Directive on port reception facilities for ship-generated waste and cargo residues: The results of a second survey on the provision and uptake of facilities in North Sea ports. *Marine pollution bulletin*. 50(12), pp. 1541-1547
6. Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean
7. Croatian Bureau of Statistics, Available from: https://www.dzs.hr/ [Accessed on September 15th 2021]
8. Čorić, D. (2009) *Onečišćenje mora s brodova: Međunarodna i nacionalna pravna regulative*, Rijeka, Pravni fakultet Sveučilišta u Rijeci
9. Dogan, K., Mršić, T. (2013) Očuvanje prirodnih resursa nautičkog turizma u Republici Hrvatskoj. *Pomorski zbornik.* 47-48, 73-85
10. Erdelez, A., Katavić, I. (2015) The Position and the Role of Strategic Environmental Assessment in Integrated Coastal Area Management of the Republic of Croatia. *Naše more.* 62(1)/2015 – Supplement, pp. 26-35
11. González D. A. (2021) *Managing the environmental sustainability of nautical tourism in Mediterranean Marine Protected Areas*, Available from: http://www.ecounion.eu/en/ [Accessed on September 15th 2021]
12. Gračan, D., Gregorić, M., Martinić, T. (2016) Nautical tourism in Croatia: Current situation and outlook, Tourism and Hospitality Industry, *Congress Proceedings*. pp.66-79
13. Hildebrand John, A. (2009): Antropogenic and natural sources of ambient noise in the ocean *Mar. Ecol.Prog.Ser*. 385, 520. (doi:10.3354/meps08353)
14. Koljatić, V. (2000) Ekološki aspekti nautičkog turizma. *Pomorski zbornik.* 38,1, 373-382
15. Komilis, D. P. (2008) Conceptual modeling to optimize the haul and transfer of municipal solid waste. *Waste management*. 28(11), pp. 2355-2365
16. Kovačić, M., Grižetić, Z., Dundović, Č. (2006) Planning and Selection of Location for the Nautical Tourism Port for Sustainable Development. *Naše more.* 53(3-4)/2006.
17. Leder, D. T. (2004) Coastline lengths and areas of islands in the Croatian part of the Adriatic Sea determined from the topographic maps at the scale of 1:25 000. *Geoadria.* 9/1, 5-32
18. Luković, T. (2007) Nautical Tourism – Definition and Dilemmas. *Naše more*. 54(1-2)/2007.
19. National report on the final annual sea quality assessment on the beaches of the Croatian Adriatic in 2019
20. Panno L., Bruno M., Voyron S., Anastasi A., Gnavi G., Miserere L., Varese G. C. (2013) Diversity, ecological role and potential biotechnological applications of marine fungi associated to the seagrass Posidonia oceanica. *New Biotechnology.* 30(6): 685-694
21. Prelec, Z., Šverko, M. (2002) Mogućnosti financiranja zbrinjavanja zauljenih voda iz brodova na području Kvarnerskog zaljeva. *Pomorski zbornik.* 40(2002)1, 541-552
22. Principles of Biology, Available from: https://courses.lumenlearning.com/ivytech-bio1-1/chapter/ecology-of-ecosystems/ [Accessed on September 15th 2021]
23. Radonja R., Koljatić V. (2010) The marine ecosystem as a functional whole. *Pomorstvo.* 24/1, pp. 3-18