



Marine pollution in the nautical seaports in Croatia by the effluent of tourists

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Abstract

The objective of this paper is to define the strategy to be followed to improve and develop nautical tourism in Croatia, taking into account all the factors involved in this activity, with the main importance of protecting the environment and establishing the lines to be followed to respond to the entire demand and for economic development. Nautical tourism seaports make an open, dynamic and complex system which has been rapidly evolving, this is the reason for the development of this system requires continual monitoring and research to preserve their environment and ecosystems to have a future tourism sector.

In order to have environmentally sustainable nautical tourism, investments must be made in infrastructures and in controls. The growth must respond to the demands, respecting in any case, the measures of management and prevention of fight against the pollution.

Keywords: Marine Pollution; Seaports; Marinas; Yachting; Nautical tourism.

1. Introduction

The Republic of Croatia was declared in 1991 its independence from Yugoslavia nation. In 1992 the Act on Territories of Counties, Cities, and Municipalities was passed, based on which the number of towns and municipalities increased more than five times. Currently, Croatia is 576 local and regional self-government units (20 counties, the city of Zagreb – NUTS III, 126 towns and 429 municipalities – LAU 1 and 2). Most local self-governments and all counties are new institutions. The population is 4.3 million and the density is 76 habitants/km². Approximately 790,000 people live in the capital city of Zagreb and another 318,000 in the surrounding Zagreb County accounting for a quarter of Croatia's total population (according to the census of the year 2011 by Central Bureau of Statistics and County Physical Plans of Croatia). Initially, three NUTS 2 level regions were introduced in 2006, which was changed in 2013 to only two regions: Continental Croatia encompassing 13 counties and the city of

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Zagreb, and Adriatic Croatia encompassing 7 coastal counties. Therefore, the Croatian population is widespread in its territory, with a high concentration in coastal cities (Rsa and Ambassador, 2013).

At the same time it is considered as a mass kind of tourism, due to a large number of people who participate in it, and since it is based on sailing, it is therefore mobile. The development of nautical seaports or marinas in Croatia is constantly pushing the demand and supply of nautical boats and crafts that satisfy the need for travel and pleasure (Kovačić et al., 2016). When planning the construction of new berths and seaports or expansion of existing ones, it is important to take into consideration the trend of the arrival of larger boats and crafts. The correct management of the development of nautical tourism is the key factor of a sustainable development, which presumes the necessity of finding a compromise between the need for economic development and the need for preserving the environment and natural areas (Favro and Saganić, 2007).

The natural basis for the development of nautical tourism is the Adriatic Sea with its indented, 6,176 km long coastline, 4,398 km of which belong to the island's coastlines, and with 1,244 islands, islets, and cliffs, 50 islands being inhabited (Ministry of the Sea, 2008) in the Table 1 shows the principals nautical seaports of Croatia and its characteristics.

Table 1: Principals nautical seaports of Croatia.

	<i>Nautical seaports</i>	<i>Locations ashore</i>	<i>Anchorage</i> s	<i>Total</i>
Istarska	14			14
Primorsko-goranska	15	7	8	30
Ličko-senjska				
Zadarska	16		7	23
Šibensko-kninska	11			11
Splitsko-dalmatinska	9	2		11
Dubrovačko-neretvanska	5			5
Total	70	9	15	94

Source: Authors with data of Central Bureau of Statistics and County Physical Plans of Croatia.

2. Nautical tourist in Croatia

The definition of nautical tourism as specified in the Act on the Provision of Tourism Services was taken as an acceptable starting point: “*Nautical tourism means navigation and accommodation of tourists – navigators on cruising vessels and in nautical seaports for the purpose of rest and recreation*” (Ministry of the Sea, 2008). It is important to define the concept of vessel and craft. Vessel is a boat with a length of 24 meters onwards, while the craft is a boat with a length between 6 meters to 24 meters of length. In the first concept "vessels" the range of navigation is global normally and this naval platform needs a qualification and normalization of the crew according to the legislation of the International Maritime Organization (IMO), while the craft need to operate (to navigation) only to personal with nautical sport titulation (sport licences) no professional of the merchant marine qualification. This appreciation is very important, since the professional crews of the merchant marine are well aware of the legislation on marine pollution, while nautical sports crews are based on the majority of the occasions in the education they received in their family and school formation.

Nautical tourism in promoting the economical development of the local coast areas of the country has a very high multiplier effect, allowing it to become one of the most

competitive tourist products of Croatia to the world. Nautical tourism is a selective form of tourism which ensures at least between from 180 to 210 days of business activities in the year, in relation to the hotel capacity, the turnover of the invested capital is much more dynamic, more intensive (Jugović et al., 2011). On the other hand, the nautical tourism is a type of special tourism which, in addition to navigation in own organization cruising in own or rented cruising crafts with accommodation and/or overnight stay of tourists on crafts, includes also circular tours organised by owners of cruising crafts and travel agencies with accommodation and/or overnight stay of tourists on crafts, as well as tourist navigation on crafts for the purpose of other forms of rest and recreation (fishing, diving). The negative influence of tourism on the area and the environment can be reduced to the minimum only by regulating its development, which presumes the planning of a rational and controlled, that is, limited and directed use of space for the building of accommodation, and the implementation of all environmental protection measures. Implementation regulations obligate nautical seaports to implement the system of reception facilities for the purpose of collection of waste products from crafts (foul sewage, oils, communal waste), which, along with the compliance with global environmental standards, effectively contributes to environmental protection. When choosing a particular port or marina there are a number of criteria and sub-criteria that users are going to take into account (see Table 2):

- There are some factors that we can consider fixed or own the country as they are: climatic conditions (sunny days, the frequency and intensity of the wind, air and water temperatures), beauty and purity of the sea, the beauty of the landscape which includes indented and diversified coast and islands with settlements;

- And there are other variable factors that will depend on the characteristics of each port: transport accessibility of the starting port in relation to the main markets, personal safety and the safety of navigation, number, spatial distribution and facilities in marinas, and the ability to link the ship in the marina and outside it, the kindness and education of staff, offer other facilities necessary for maintenance and equipment of the ship to sail, the attractiveness of the content on the land, the cost of services, legislation related to navigation and stationing ships, taxes (Gracan et al., 2016).

Table 2: Matrix of factors.

<i>Factors</i>	
1. Natural factors	1.1. Wind's influence 1.2. Waves' influence
2. Nautical factors	2.1. Port entrance and manoeuvring 2.2. Depth of the sea
3. Technical factors	3.1. Infrastructure's port 3.2. Reception capacities (number of berths) 3.3. Space for the development of other service activities in the port 3.4. Mobility of nautical tourists (required hours of travel) 3.5. Quality of berths and nautical services
4. Environmental factors	4.1. Ecological value 4.2. Supervision of the best quality of the sea and the port
5. Socio-economic factors	5.1. Impact on the economic development of local communities 5.2. Cultural impact on the local community 5.3. Impact on other services

Source: Authors.

Because of the income that Croatian nautical tourism and its recognition in the global

market, the increasing interest of foreign investors, the development of complementary activities, promotion and image of the outside borders of the Croatian and other economic indicators, Croatian nautical tourism has all the starting conditions for further investment momentum (Kovačić et al., 2011; Gracan et al., 2016).

2.1 Capacities and analysis.

Nautical tourism is a part of the overall Croatian tourist offer to the world. Considering global trends imposed by the marine market, changes in the structure of the nautical market, a growing number of large yachts, there are new segments and target markets, which offer many opportunities and open doors to numerous investors from all over the world for developing and building new marinas (Zambonino, 1998). Expand of capacity and its pervasive unstoppable increase in demand, imposes a faster construction of new berths (Uran and Gracan, 2005).

Taking into account the global trends imposed by the marine market as they are, the greater demand for berths or the increasing number of large berths, there are new segments and target markets, which offer many opportunities and open doors to numerous investors from all over the world to develop and build new marinas. The Croatian Adriatic is a unique (Badurina et al. 2016) and specific unit which can be divided into several regional entities, namely: the North Croatian coast, the North Adriatic and the South Croatian coast. According to their geographic characteristics, two sub-regions can be distinguished: Istria, which extends from the Bay of Piran to cape Kamenjak, and Kvarner, which extends across the East coast of Istria, Rijeka and the Opatija coastline, the Vinodol and Crikvenica coastline, the foothills of Velebit and the Kvarner islands (Cres, Lošinj, Krk, Rab and smaller islands, a wonderful country and unique).

According to the latest data (Central Bureau of Statistics and County Physical Plans of Croatia in 2016), Croatia has 53 marinas, 14 dry marinas, 13 berths and 22 moorings. Due to the constant growth in the demand for nautical capacities in Croatia, it is necessary to upgrade the infrastructure capacity and the capacity to complement the superstructure which would further enrich the offer (Kovačić, 2010). There have been 54,675 locations projected for construction by 2019, out of which 42,695 sea berths and 13,373 land berths (Ministry of the Sea, 2008). The largest planned growth in the total capacity refers to Istria which has been developing tourism in all its forms, with special emphasis on the sustainable and selective form of tourism, followed by the Split-Dalmatia, the Primorje-Gorski Kotar, and the Šibensko-kninska County. Particular growth projection refers to the Ličko-senjska County which doesn't even have any nautical capacities at the moment (Mikulić et al. 2015).

According to the data in Table 3, it is evident that the number of nautical tourism seaports and the number of marinas has increased. By comparison of the two presented tables, it can be said that the goals of the Strategy for the development of nautical tourism have been followed and they have been increasing, i.e. the construction of new nautical capacities increases the offer of the Croatian nautical tourism and thus provides greater demand and improved competitiveness of nautical services. Although it can be observed that the berths that have increased more are those of large lengths (greater than 15 meters).

To the question of why Croatian nautical tourism is less developed than nautical tourism in other Mediterranean countries, taking into account their capabilities? The

answer lies in the complexity of the management of the entire nautical tourism system. On the one hand, the lack of harmonization of legislation related to tourism, especially the regulation of nautical tourist seaports and the adaptation of the legislation of spatial planning for cities and counties (Uran and Gracan, 2005). It is essential to unify the law of concessions, which are the basis for the development of special purpose seaports and nautical tourism seaports gave their importance and role in the development of cities and organize port regulations and issues related to the construction of the maritime domain (Lukovic, 2013).

Table 3: Development of nautical seaports of Croatia.

	2013	2016
Number of marinas	67	72
Number of nautical tourism seaports	106	112
Number of berths	16,940	17,221
Water surface	3,278 064	3,322,650
Length of the coast for mooring (m)	63,110 m	65,178
Space for crafts and vessels on the mainland (capacity)	5,473	5,375
Total surface area (m ²)	799,822 m ²	799,032
Covered area	8,876	8,361
Craft length up to 6 meters	727	773
Craft length from 6 meters up to 8 meters	1,446	1,360
Craft length from 8 meters up to 10 meters	2,900	2,851
Craft length from 10 meters up to 15 meters	8,919	9,026
Craft length from 15 meters onwardsto length of vessel	2,948	3,211

Source: Authors.

It is important to know the demand, as far as the origin of the crafts and vessel ensign, as well as the more usual lengths, to respond to the demands of the nautical sector and directly to the tourist sector.

The capacity of mooring and anchorages is very important for the Croatian tourism sector. Environmental and waste management systems for nautical seaports have to be implemented to accomplish the objectives published in the “Nautical tourism development strategy of the Republic of Croatia 2009-2019” to enhance their natural resources as a paradisiac destination since the Adriatic sea stands out due to its shallow waters and higher number of plant and animal species including many endemic species (Ministry of the Sea, 2008).

3. Marine pollution in seaports

Society expects that the environment of nautical seaports is not necessarily different from what they demand in places where recreational facilities are located. The ecosystem of the nautical seaports should be of similar quality to that of legally protected areas for their natural values, as the axes of a plan as seen in Figure 1. Anyway the marine pollution is a global concept which is necessary to research about all parameters as invasives species (biofouling in the hulls), ballast water (stability tanks in a vessels and collectors engine cooling in the case of crafts and vessels), sewage (maintenance and generated by crews), atmospheric pollution (noises, vibrations, emissions of heat water in the seaports). It is not enough to keep pollution and other forms of environmental degradation under control, it is necessary to recognize the causes and avoid them (Carić et al., 2016).

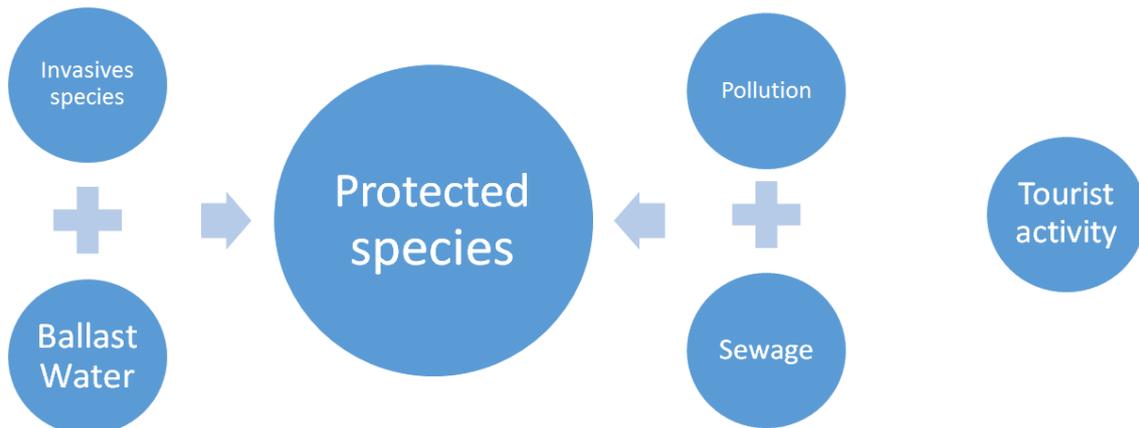


Figure 1: Axes of marine pollution.

Source: Authors.

The environmental management of nautical seaports cannot ignore environmental concerns (Zambonino, 1998), since they are crucial to maintaining or improving their quality and environment, it is, therefore, necessary to obtain a sufficient knowledge of the outstanding environmental characteristics of the environment, As well as the activities taking place in and around the port facilities (Puig et al., 2015). A useful procedure to address the environmental reality of a port is to establish an environmental monitoring system based on a system of indicators. These systems can quickly detect any major malfunctions and facilitate port management, both to be standardized for all, as it reduces the number of controls, data collection, and analysis needed (Komilis, 2008). In the same way, it is a procedure that can be achieved not only that communication between specialists, managers and the company is good and fast. This study gives the following guidelines as general perception to actuate in:

- Prevent or limit the forms that cause the most serious environmental degradation.
- Propose actions whose implementation entails reasonable costs for both installation and operation and maintenance.
- Evaluate actions that involve a reasonable investment. The comparison between the cost of the procedure and the environmental benefits must be contrasted between the managers of the nautical seaports and the marinas (Carpenter and Macgill, 2005).

Table 4: Evaluation of the tourist effluent of the nautical seaports and marinas.

<i>Berths for craft and vessel</i>	<i>No. motor craft/ vessel</i>	<i>No. of sail craft/ vessel</i>	<i>Crew number</i>
Length under 6 meters			
Length 6 meters to 8 meters.			
Length 8 meters to 10 meters			
Length 10 meters to 12 meters			
Length 15 meters to 24 meters			
Length over 24 meters (vessels)			

Source: Authors.

The general characteristics of nautical seaports and marinas should be summarized and documented. The characteristics of the nautical crafts and the type (motor or sail), quantification and number of users (crew numbers) will be described as shown in Table 4. The generation of waste can be defined if the number of crew is quantified. This amount will vary on the weekends over the weeks, just as the generation produced in the

summer is not the same as that produced in the winter (Gracan et al., 2016). For this reason, a location and capacity of the containers in the nautical seaports and marinas should be established so as to ensure the maximum capacity of a collection of waste that can be generated by both ships and their users (Donahue, 1996). The calculation of waste generated by crafts and vessels can be found in the IMO document MEPC 41/5/1. Generation of waste from leisure crafts and vessels is show in Table 5 and Table 6.

Table 5: Evaluation of the tourist effluent of the nautical seaports and marinas.

<i>Length from 12 meters</i>	<i>Generated load by crew number of 2-15 members</i>
Time in seaport	70% - 85% of the year
Food residues	0.5 – 3 Kg./person/day
Residues of maintenance	100 kg./craft-vesell/year

Source: Authors by recomendatios of OMI, MEPC 41/5/1.

Table 6: Evaluation of the tourist effluent of the nautical seaports and marinas.

<i>Food</i>	<i>Packaging</i>	<i>Plastics</i>	<i>Aluminium</i>	<i>Glass / Metal</i>
38%	17%	16%	16%	13%

Source: Authors by recomendatios of OMI, MEPC 41/5/1.

It is essential, in order to identify the waste and marine pollution generated, to define the activities performed in the nautical seaports regardless of the frequency of activity (Puig et al., 2015). These activities can be divided into three groups: tourist, facilities, and operations of navigation of the recreational crafts and vessels.

Tourist:

- Activities of restaurants and services.
- Logistics in passenger traffic (tourist movements).

Facilities:

- Cleaning of facilities and methods used.

Operations of navigation:

- Deck and boat hull cleaning.
- Fuel supply.
- Maintenance and painting of boats.
- Maintenance and repair of boats, engines, and gear (sails).
- Garbage, both liquid and solid, generated by crews.

3.1 Environmental characterization

The term "pollution" is necessary to specify the meaning that different expressions are used while specifying the concepts. Environmental change is understood as any change in the environment, due to causes of totally different origins as they can be: natural causes, human actions or a combination of one and another (Badran and El-Haggar, 2006).

Environmental effects only apply to changes due to human activities, whether desired or not. Environmental effects may or may not occur and can usually be measured (Donahue, 1996; Uran and Gracan, 2005). Liters of spilled fuel, the percentage of degraded land, the number of dead fish, economic losses. Since the environmental impact corresponds to an environmental effect or a set of environmental effects of an

action, consideration should be given (Donahue, 1996; Carpenter and Macgill, 2005; Uran and Gracan, 2005; Jugović et al., 2011; Grgić, 2016):

- Ecological and/or environmental impacts caused by changes in "natural" systems. These impacts presuppose a certain evaluation of the effects that have occurred and their result is important in the functioning of marine ecosystems.

- Social impacts that directly affect humans, either individually or collectively.

The society expects that the environment of the nautical seaports and the places where the recreational facilities are not necessarily different. The ecosystem of the nautical seaports must be of similar quality to the areas legally protected by their natural values. It is not enough to control pollution and other forms of environmental degradation, it is necessary to recognize the causes and avoid them. Croatian nautical seaports have high-quality standards, their aim should be to maintain that quality. The management responsible for seaports should be aware of this (Zambonino, 1998; M Puig et al., 2015). Therefore, as a guide for port managers and in general an action to attract, serve and give quality to users, that is, to improve the offer, based on a minimum knowledge of the environment surrounding each port, which in general terms can be summarized by stating the following:

- Unique, the differences in each environment must be taken into account, marine aquatic ecosystem and vegetation and wildlife, human settlements and local land use, etc., are different in each case.

- Complex, these are systems composed of many elements, minerals, plants, animals, humans, etc., strongly interrelated and subject to many processes.

- Dynamic, it is subject to permanent changes, not only due to natural causes but also to human action, generally severe in these areas.

- Open, even when it seems that the boundaries are better defined, there is a continuous transfer of matter and energy.

- Extra-dimensional, its magnitudes, in terms of space, time and energy, are clearly different from the human being.

Consideration should be given to potentially impacting activities arising from operations at nautical seaports and all actions taken in their environments. These activities are:

- Maintenance and repair of crafts and vessels; Cleaning with water or steam, detergents, degreasers, solvents, etc.

- Recycling of crafts and vessels and handicrafts. In some cases dismantling costs are not taken into account, leading to significant environmental problems. The sea walks, which for years are the fundamental areas of these crafts and vessels, become places of local marine and atmospheric pollution and visual impacts (Ćelić et al., 2014).

- Operational pollution, generated by the entry and exit of crafts and vessels in seaports, circulation of vehicles in the docks, exploitation of machinery, supplies or workload, etc.

- Poured liquid waste or liquid inmissions from crafts and vessels (Laurent and Castellanet, 2003). It is as such sewage as more or less aqueous fluid from the toilet of crafts and vessels, engine cleaning, washing of tanks, ballast water, and cooling water, etc. Ports must have facilities for receiving waste from ships (EU directive 2000/59/CE, of 27 November on waste reception facilities in seaports).

- Other wastes from crafts and vessels are made of solid wastes and containers of very different types (paper, metals, textiles, plastics, glass, wood), residues of cleaning products, ropes, tires, etc.).

- Wastewater and urban runoff is a source of contamination more common in the seaports, since not only from urban waste but also from crafts and vessels. In some cases, it may also be thermal pollution by the concentration of marine engines in the berthing areas of seaports (Favro and Kovačić, 2015).

- Industrial effluents in each port are determined by the type of industry that is in the area, studying processes such as capture and discharges to water.

- Dredging operations are aimed at maintaining the draught, conservation of the depth and extent of the access channel and works relating to the floating and suspended solids.

The improvement of environmental management systems for nautical seaports and seaports necessarily involves the study of their current situation, to identify needs and gaps. Each nautical port should detail the environmental control equipment currently available and the waste generated in each port facility (Georgakellos, 2007). The origin of the waste and marine pollution that is generated in the nautical seaports is linked to the activities carried out independently of the frequency of activity (Paker and Vural, 2016).

4. Environmentally sustainable model

For the design of waste reception facilities, the following aspects should be taken into account: Minimizing the visual impacts. This statement is very important, waste should not be visual in seaports. It is very important to know the types of waste that are generated (Kovačić, 2010). The nautical port will comply in at all times with all applicable legislation to manage dangerous and nondangerous waste. The seaports must be equipped with a number of containers that cover all the needs related to seaport users and the number of crafts and vessels. Once the activities are defined, the next step will be the identification of generated waste (Carpenter and Macgill, 2001). Each waste must be defined according to applicable law as hazardous or non-hazardous and identified according to European, national, regional and/or local legislation (Georgakellos, 2007). To be later labeled according to the international transport laws and corresponding legislation. Seaports will comply in at all times with all applicable legislation to manage hazardous and non-hazardous waste. The waste collection facility is called "clean point of the nautical port". An "ecological area" will be constituted in places where a set of four containers next to places of habitual passage of the users is installed. At these points will be stored as urban waste, glass, cardboard, and paper, plastic and metal. It turns out that the storage of bilge water (hydrocarbon-water) and sanitary water (WC) can be installed in fuel supply areas (port gas station).

The legislation which requires nautical seaports to implement the system of reception facilities for the collection of waste from ships, together with compliance with global environmental standards, effectively contribute to the protection of the environment. Considering nautical tourism is a relatively new socio-economic phenomenon that has grown exponentially in recent years, so the demand for new permanent moorings is greater than their offer. It is necessary to improve the available berths both through reconstruction and the rehabilitation of existing seaports, to apply new technologies and environmental standards, and finally to establish training and constant awareness of users in this branch of tourism, both professionals and of customers. To improve nautical tourism in Croatia it's necessary to build new marinas. For a good and sostenible ecological future, Croatia will need to build marinas for crafts and vessels. In the case of a marina for vessels with minimum length from 20 meters to 50 meters. Also, it is necessary to provide a modern range of facilities to the existing

marinas and seaports, equipped with clean points facilities and establish the monitoring system based on indicators for obtaining an adequate quality, the quality of Europe. Effective environmental management decisions will be necessary to avoid potential impacts. Since seaports and navigation zones can be located in natural areas of great value and vulnerability, some of them protected.

5. Conclusions

In order to improve the activity of nautical tourism in Croatia and to respond to the demand of the nautical tourism sector, an investment policy should be applied based on the increase of moorings, marinas and seaports for adapt to bigger length to vessels from 15 meters onward. In the evolution in the last years of nautical tourism in Croatia the greatest demand is for large vessels, therefore it will be necessary to create moorings that respond to this demand.

The implementation of environmental control of waste generated by crafts in nautical seaports has important economic multiplier effects on domestic production, directly and indirectly affecting many branches of activity. In the case of Croatia, it is an obligated investment for future tourists to maintain the beauty of its nautical seaports and preserve the high quality of Croatia's environment. In order to preserve the environment, it is important to train crews of recreational crafts in this aspect.

Each nautical seaport is different, the characteristics of their social and ecological environment are different. Therefore, the experience in a nautical seaport can serve as a guide for environmental management in others, but cannot be extrapolated without further evaluations and diagnostics.

Classification, identification, collection and management of waste must be similar in all seaports for standardized the costs and the services. With this common system of waste management, seaports are able to maintain a high quality and homogeneous standards among all nautical seaports.

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