The Concept of Smart Marinas for the Implementation of Croatian Nautical Tourism

Andrea Gallo(✉)

University of Trieste, 34127 Trieste, Italy
andrea.gallo3@phd.units.com

Abstract. The present paper proposes to frame the analysis of the recreational boating tourism system for the coastal area of Croatia through an analysis of the system of ports and marinas, focusing on the implementation of sustainable development strategies from an environmental perspective by implementing the concept of "green ports" through the investigation of spatial components, energy management, water and waste management. Nautical tourism represents an extremely central component to the economy of coastal areas, which is why this contribution is structured through an initial overview of the marinas present in the area, the services offered, and tourist flows, focusing subsequently on the infrastructural aspects related to the energy and environmental efficiency of different port systems.

Keywords: Smart Ports · Green Ports · Smart Tourism · Croatia

1 Introduction

Tourist ports and marinas represent key infrastructure in the development of nautical tourism. However, the increasing attention paid to environmental issues is reflected in a growing focus on adopting technologies, systems, and solutions capable of reducing the negative externalities produced by different port systems [1]. In the process of optimizing performance, environmental issues related to energy supply [2], safety, waste management, and port operations will therefore have to be addressed [3].

In recent years, there has been a gradual and steady increase in demand for nautical tourism in the coastal and island areas of Croatia, abruptly interrupted by the pandemic but resumed from 2021. This represents an extremely important driving force for the local economy, generating an impact of over 125 million euros [4], subject inevitably to seasonal fluctuations. However, the increase in demand for nautical tourism has led, in the summer periods, to congestion of ports and marinas due to the greater number of boats present, leading to an increase in different factors of environmental pollution both in terms of emissions and in reference to waste disposal, atmospheric pollution, and groundwater pollution [5] and to a complex management of energy and water consumption, resulting in increased costs for both boat owners and marina managers [6].

© The Author(s), under exclusive license to Springer Nature Switzerland AG 2023
O. Gervasi et al. (Eds.): ICCSA 2023 Workshops, LNCS 14111, pp. 3–16, 2023.
https://doi.org/10.1007/978-3-031-37126-4_1

It should be emphasized that the economic and environmental components must go hand in hand in the optimal management of the Croatian marine infrastructure system, finding sustainable management models both from an economic and environmental perspective, pursuing environmental sustainability goals. To this end, the idea is that marinas adopt smart and low environmental impact solutions to improve processes in the transition to "green marinas" [7]. Such a transformation must be supported by the implementation of infrastructural and technological systems and by optimizing operational processes. In this context, marinas that are able to minimize time and optimize spatial and resource utilization will become more attractive [8], as well as an optimal waste management and accurate use of energy resources. These different factors represent the main challenges to be addressed in the market of recreational nautical tourism [9].

2 The Insular and Coastal Croatian Context

The Croatian geographical context has intrinsic characteristics that are ideal for the development of nautical tourism. The coastline is extremely rugged, constantly opening up to beaches and suggestive coves from a landscape point of view, where natural amenities combine with excellent hospitality services for recreational tourists. The infrastructure network of ports, marinas and other moorings for various boats is capillary distributed throughout the coastal and insular area [10]. In this context, nautical tourism represents an important driving force for the local economy, but to preserve the environment and try

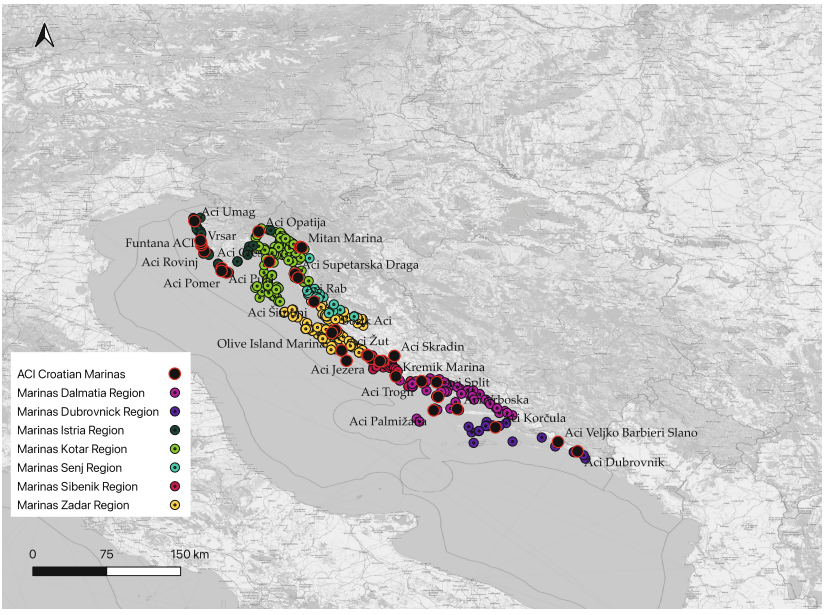


Fig. 1. Definition of the Study area and the Croatian Marinas. Source: Personal Elaboration on Framesport data. Author: Andrea Gallo

to mitigate the negative externalities generated by high volumes of tourist flows, it will be essential to act on different critical elements in order to improve the sustainability of these value creation processes [11].

This paper will consider the seven coastal administrative regions, highlighted in the map in Fig. 1, which will now be introduced briefly [12]:

Istrian Region (Istria) – located on the north-western tip of Croatia, bordering Slovenia and Italy. It has an area of about 2,820 km^2 and includes the city of Pula and the historic town of Rovinj.

Littoral-Mountainous Region (Primorje-Gorski Kotar) – northwest of Dalmatia and bordering Slovenia. It covers an area of about 3,590 km^2 and includes the city of Rijeka and the islands of Krk, Rab, and Cres.

Lika-Senj Region (Lika-Senj) – located northeast of Dalmatia, characterized by a mountainous topography, and includes a series of national parks, including the Plitvice Lakes National Park, covering an area of about 5,350 km^2.

Zadar Region (Zadarska županija) – located in the central part of the Croatian Adriatic coast and includes the city of Zadar, one of the oldest historic cities in Croatia, covering an area of about 3,640 km^2.

Šibenik-Knin Region (Šibensko-Kninska županija) – located on the central coast of Dalmatia, includes the city of Šibenik, as well as the Krka National Park and the Kornati Islands archipelago.

Split-Dalmatia Region (Splitsko-Dalmatinska županija) – located in the southern part of Dalmatia, with an area of 2,940 km^2, it is the most populous region of Croatia and includes the city of Split, as well as numerous islands such as Hvar, Brač, and Vis.

Dubrovnik-Neretva Region (Dubrovačko-Neretvanska županija) – located in the southernmost part of Croatia, bordering Montenegro, with a slightly smaller area than the other coastal regions at 1,780 km^2, it includes the city of Dubrovnik, one of the most famous and popular tourist destinations in Croatia, declared a UNESCO World Heritage Site, as well as the Mljet National Park.

Croatia is located on the eastern shore of the Adriatic Sea basin: due to its position within the Mediterranean Sea [13], it is becoming a primary tourist area for all of continental Europe [14].

All of these factors highlight how recreational tourism in Croatia has an extremely significant impact on the region in terms of its economic benefits, particularly with regards to the development of logistical infrastructure related to the various port systems, marinas, and moorings. It is estimated that the economic benefits of the industry in 2021 amounted to €125.5 million, with the regions of Zadar (19.5%), Sibenik (26.4%), and Split and Dalmatia (22.3%) contributing over 68% of the total. Data by the Croatian National Bureau of Statistics[1], suggests that in 2021 given, the total number of vessels in transit exceeded 210,000 units, with 67% being sailboats and 32% motor yachts. These figures highlight how environmental and panoramic factors, coupled with the existing infrastructure, have generated significant tourism flows for all coastal and island regions of Croatia. Furthermore, the Croatian statistical office estimates a total of 1,831 employees in the sector, with a total number of available moorings and docks amounting

[1] https://dzs.gov.hr/en accessed in data 21/03/2023.

to 18,942, capable of accommodating all types of vessels in terms of size, tonnage, and draft, as shown in the table below (Table 1).

Table. 1. Overview of Croatian touristic marinas infrastructure. Source: Croatian National Bureau of Statistics

Capacity of Nautical Port for Croatian Costal and Insular area	
Water Surface area (m^2)	4,643,877
Total number of moorings	18,942
Of that for ships:	
Under 6 m long	1,049
6–8 m	1,532
8–10 m	2,440
10–12 m	4,666
12–15 m	5,848
15–20 m	2,455
over 20 m	952
(m)	73,705
Number of employed persons	1,831
Of that with seasonal jobs	374

To fully understand the geographical context of Croatia's coastal area, we can compare Croatia with other European countries in the Mediterranean area such as Greece, Italy, Spain, and Turkey. From this analysis, it is evident that the tendency for recreational tourism in the Croatian area also arises from various intrinsic geomorphological characteristics of the analyzed area, such as the length of the coastline, the large number of islands, and the ruggedness of the coast. For the Mediterranean area, Greece has the longest coastline (approximately 13,670 km), followed by Italy (7,600 km), and in third place, we find the Croatian coast with 6,278 km, higher than that of Turkey (5,190 km) and Spain (2,580 km) [13]. With regard to the island context, Croatia is second only to Greece (3,053 islands) with 1,246 islands covering an area of 3,259 km^2 and an island coastline length of 4,398 km [13]. The land coastline thus represents about 29% of the Croatian coastal context. These data highlight how, compared to other Mediterranean countries, the geographical conditions are absolutely favorable for significant development of nautical tourism. These factors, combined with a multitude of bays, islands, and coves, are capable of making navigation interesting and represent a component to consider in choosing tourist itineraries [15, 16]. The combination of the maritime space and small and large urban settlements where different ports and marinas are located, represents a fertile ground for proactive development, due to the economic impact on the city fabric. Historic waterfront and cultural tourism: the case of Dubrovnik [17]. Inevitably, picturesque landscapes of fishing villages along the Croatian coast and on

numerous islands represent an important attraction for nautical tourism. These villages usually still retain their traditional charm and offer visitors an authentic experience of Croatian coastal life [18]. The analysis of the geographical context cannot overlook considerations of a geomorphological, biological, and climatic nature, where the mild climate, medium-intensity winds, and a large number of protected bays, deep seabeds and great marine biodiversity are certainly driving factors in the development of Croatian nautical tourism.

3 The Concept of Smart Marinas

The implementation of smart technologies in ports has led to the need for similar solutions in marinas, giving rise to the concept of the smart marina. To tackle the challenges faced by marinas, innovative technology-based solutions are being developed and implemented [7]. The concept of the smart marina has been derived from the smart port concept, which has been adapted to meet the specific needs of the nautical tourism market. Ports are also becoming increasingly conscious of their relationship with the local community in terms of environmental quality, living standards, and port development [19, 20]. The primary challenge faced by marinas is the effective handling and organization of vessels' arrival, departure, and maintenance. By adopting innovative management strategies and smart technologies, marinas can increase productivity, optimize capacity utilization, and reduce associated costs. Automated machinery can replace human workers, reducing human errors, safety issues, and congestion, resulting in increased service quality, safety, and security in the marina [21]. Additionally, the implementation of smart marina solutions can provide marina operators with valuable data insights that can help them make informed decisions regarding their operations. For instance, data on visitor patterns, vessel occupancy, and energy consumption can be used to optimize the use of resources and reduce waste [22].

Furthermore, smart marina solutions can also improve the overall customer experience by providing convenient and efficient services, such as automated check-ins and digital payment systems. The adoption of smart marina solutions is also in line with the growing trend towards sustainable and eco-friendly practices in the tourism industry [23]. By monitoring and reducing energy consumption and emissions, marinas can contribute to the overall reduction of the industry's environmental impact. In addition, the implementation of smart waste management systems can help address the issue of marine litter and protect the local ecosystem [22]. The emergence of smart technologies in ports has led to the need for similar solutions in marinas, giving rise to the concept of the smart marina.

By adopting innovative management strategies and smart technologies, marinas can increase productivity, optimize capacity utilization, and reduce associated costs while contributing to sustainable and eco-friendly practices in the tourism industry. Moreover, the smart marina concept can also enhance safety and security in the marina by providing real-time monitoring and alerts for potential hazards, such as bad weather conditions or intruders. This can help prevent accidents and ensure the safety of both vessels and visitors [24]. The implementation of smart marina solutions can also benefit the local economy by attracting more visitors and boosting tourism. By providing high-quality

and convenient services, marinas can enhance the overall tourist experience and increase the likelihood of repeat visits.

In addition, the use of smart technologies can also create new job opportunities in the fields of technology and data management. It is worth noting that the smart marina concept is not without its challenges [25]. The implementation of new technologies and management strategies can be costly and require significant investment [26]. The adoption of new practices may require changes to the existing regulatory framework, which can be a time-consuming process.

Overall, the smart marina concept offers many benefits for marina operators, visitors, and the environment [27]. As the tourism industry continues to evolve and embrace new technologies, it is likely that the adoption of smart marina solutions will become increasingly common.

4 Materials and Data Collection

The analysis of functionality parameters of Croatian tourist marinas are instrumental in assessing the attractiveness and environmental sustainability of these destinations through the elaboration of a matrix. The data presented in this section refer to the services and characteristics of five different marinas characterized by the road accessibility, despite the fact that Betina marina is located on the island of Murter and not on the mainland. However, road accessibility on the island is provided by the Tisno Bridge, effectively making this marina comparable to its predecessors.

The information presented derive from the analysis of the information provided by the online systems of the different marinas[2], as well as information presented as part of the European Project FrameSPort[3], which is available online and from the "Portolano[4]", an online database that gives a wide range of information related to ports and marinas.

Primarily, the focus of the analysis will be on the size of the marinas, in terms of operational capacity, number of berths available, and size of boats moored. Those informations are presented in Table 2.

Looking at the data provided for these marinas, we can draw some considerations about marinas this different marinas presented: as first, the size and facilities of a marina can greatly impact its capacity and ability to accommodate different types and sizes of boat, observing how the maximum boat length and vessel tonnage that those marinas can accommodate is an important consideration for boat owners when choosing a marina to moor their boats. Depending on the size and type of boat, some marinas may not be suitable due to restrictions in size and tonnage. And it is possible also to take in to consider that the width of a marina's entrance is also an important factor, especially for larger boats. A wider entrance allows for easier and safer navigation for larger boats, making it easier to access the marina and reducing the risk of accidents or damage to boats.

[2] https://aci-marinas.com/it/marina access on 26/03/2023.

[3] https://www.italy-croatia.eu/web/framesport/docs-and-tools last access on 26/03/2023.

[4] https://www.tuttobarche.it/ricerca-rade-e-porti last access on 26/03/2023.

Table 2. Infrastructural characteristics of the marinas under analysis. Source: Online web-page of marinas. Source: [28]

Marinas	Nr. of Berths (< 11 m)	Nr. of Berths (> 11 m)	Total number of moorings	Max boat lenght	Max vessel tonnage	Width of port's entrance
ACI Umag	340	20	360	60	500	60
Aci Veljko Barbieri Slano	40	130	170	15	150	70
ACI Betina	295	0	295	15	80	30
ACI Milna	327	13	340	20	40	600
Marina Veruda	380	250	630	40	NA	20

After the overview of the marinas analyzed in terms of mooring capacity based on the size of the boats and a screening of some characteristics, we will now analyze in detail the different services offered by these ports in the following table (Table 3).

Table 3. Servicies provided by different marinas: Source: FramesSport Project [28]

Marinas	ACI Umag	Marina Veruda	ACI Veljko Barbieri Slano	ACI Milna	ACI Betina
Fuel Station	Yes	Yes	Yes	Yes	Yes
Docking Service	No	No	Yes	Yes	Yes
Reception Office	Yes	Yes	Yes	Yes	No
Night security service	No	No	Yes	No	No
Presence of the custom	Yes	No	No	No	No
Car parking	Yes	Yes	Yes	No	No
Emergency defribillators	No	No	No	No	No
Grocery store	Yes	Yes	Yes	Yes	Yes
Services for straightening ropes	No	No	Yes	No	No
Engine maintenance service	No	No	Yes	No	No

(*continued*)

Table 3. (*continued*)

Marinas	ACI Umag	Marina Veruda	ACI Veljko Barbieri Slano	ACI Milna	ACI Betina
Toilets	Yes	Yes	Yes	Yes	Yes
Laundry	Yes	Yes	Yes	Yes	Yes
Water filtrartion sistem	Yes	Yes	Yes	Yes	Yes
Differentiated waste collection	Yes	Yes	Yes	Yes	Yes
Smart booking	Yes	Yes	Yes	Yes	Yes
Free Wifi	Yes	Yes	Yes	Yes	Yes
Boat rent service	Yes	Yes	Yes	Yes	Yes
Lowering and raising the vessel into the sea	No	Yes	Yes	No	Yes
Vessel Storage place	No	Yes	Yes	No	Yes
Crane Lift service	No	Yes	Yes	No	Yes
Final Marks	60%	70%	90%	55%	65%

In the previous table, some of the main services offered by the different marinas were presented, where it is essential to emphasize some key services that are fundamental in terms of attracting tourist flows. Marinas are in fact nodes of sea/land connection; therefore, it is evident that the presence of a parking area to leave vehicles parked during the period spent at sea, the presence of crane lift services to put boats into the water, and finally access ramps to the sea represent indispensable services for the attractiveness of a recreational marina.

Finally, data related to the accessibility of the marinas under analysis will be considered, considering both the distance to major strategic infrastructures such as hospitals and fire stations and the distance to major transportation services and logistical nodes: thus analyzing the distance in terms of minutes of car-driving distance to the airports, bus stops and distance to highways. These data are presented in the following table (Table 4).

The set of data presented will be useful to the development of a matrix of attractiveness of tourist marinas, presented in the next section, borrowing some considerations treated for the marinas of Sardinia, in the case of the Metropolitan City of Cagliari in the paper of Mundula et al. (2020) [29]. Here, will be take in consideration the intrinsic characteristics of the different marinas, the range of services offered and aspects of road accessibility and services of proximity as hospitals and fireworks stations, to the elaboration of an “Attractiveness Matrix”.

Table 4. Servicies provided by different marinas: Source: FramesSport Project [28]

	Distance from railway stop	Distance from Airport	Distance from the bus station	Distance to highway	Distance to the Firework station	Distance from the nearest hospital
ACI Umag	20	65	1	8	1	3
Aci Veljko Barbieri Slano	10	10	10	5	5	5
ACI Betina	50	40	15	15	15	15
ACI Milna	65	70	10	17	17	10
Marina Veruda	5	10	5	7	5	15

5 Methodology

This paper proposes to develop an attractiveness matrix of the different Croatian marine tourism destinations, based on two fundamental aspects: the first related to the services offered to tourists within the marinas, aimed at improving performance in terms of efficiency, safety, environmental sustainability [30], and smartness, while the second refers to the degree of accessibility for the different marinas [31], which therefore considers not only the availability of berths but also takes into consideration factors related to the geographical location of the different marinas in relation to the main logistical needs.

To be able to structure the accessibility matrix of the marine tourism destinations, 20 different key services proposed by the different marinas were taken as parameters, assigning a value of 5% to each service offered. For accessibility, an index was constructed, called "Marina-accessibility index" [33]. The elaboration of this Index derives from the application of the Simpson formula to the dataset presented [32] in Table 2 and Table 4. The aggregation of the information provided into this different tables we can obtain an extremely accurate overview of the accessibility level of different marinas. For this reason, it was decided to adopt the Simpson Index formula to construct the accessibility index. The Simpson Index has found wide application in statistics in the analysis of various characteristics of a finite population, finding its greatest application in the study of biodiversity in biology [32]. By analogy, we propose to adopt this index in port contexts, where it is assumed that, by combining the different characteristics of marinas, it is able to provide an accurate representation of the level of accessibility and centrality of tourist systems.

To calculate the "Marinas_accessibility Index", the Simpson formula was used, as shown below, in the following equation:

$$\text{Marina_Accessibility Index} = 1 - \frac{\sum n(1-n)}{N(1-N)} \quad (1)$$

where "n" is number of individuals of each species and "N" represent total number of individuals of all species [32].

6 Results and Discussion

It seems that the study is focusing on the evaluation of small tourist marinas in Croatia and their relationship with the different services provided. The study is attempting to identify a representative index that can measure the interrelationship between the marinas and the services, and then use this index to create a matrix of attractiveness for the various small tourist ports.

The study is also introducing the concept of the Marinas: Accessibility Index, which appears to be a metric used to evaluate the centrality level of the marinas based on their location and other features [33]. Overall, it seems that the study is trying to provide a comprehensive evaluation of small tourist marinas in Croatia and their relationship with the surrounding services and amenities. The resulting matrix of attractiveness may be useful for tourists and investors alike in determining which marinas are the most desirable and offer the best value. Below, the accessibility matrix elaborated through the use of the two different indicators is represented. On the two axes there will be the indicator of the services offered by the different marinas, based on the data presented before and on the other will be the marinas_accessibility index, based on the Simpson Index as presented previously [34] (Fig. 2).

The results obtained show that all the marinas under analysis occupy the suboptimal position of the proposed attractiveness matrix, except for the degree of acceptability of the. Marina Veruda as presented in the following table (Table 5):

These results are in line with expectations as only large marinas were considered in this elaboration and with an extremely aligned offer in terms of services, accessibility, and smartness. We can also note that the Marina ACI Milna is the most lacking in terms of services offered, but without missing the offer of basic services.

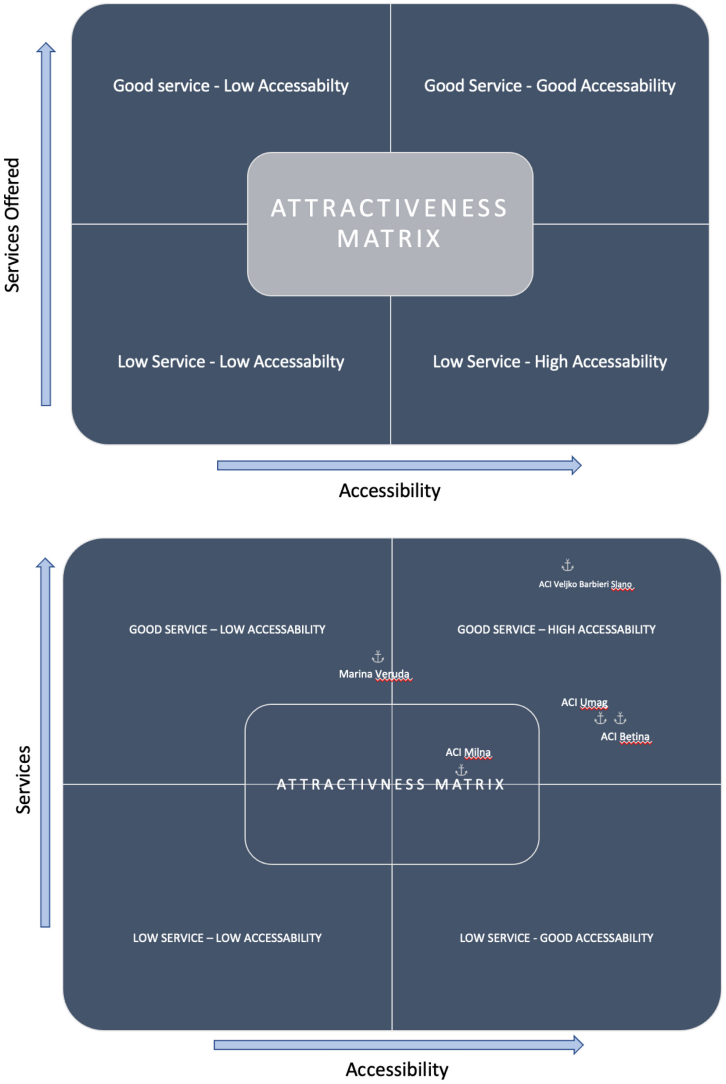


Fig. 2. The Attractiveness Matrix based on the different indicator of Services offered by marinas and the so-called Marinas_Accessibility Index (Fig. A), and the localization of the different marinas on the Matrix (Fig. B). Source: Personal Elaboration.

Table 5. Calculation of the marina:access*i*bility index and the services provided by different marinas. Source: Elaboration of the Author.

	ACI Betina	Marina Veruda	ACI Veljko Barbieri Slano	ACI Milna	ACI Umag
marina_accessibility index	0,6948	0,4947	0,7721	0,7100	0,6785
Services	60%	75%	90%	55%	60%

7 Conclusions

Marinas in Croatia are undoubtedly one of the key factors driving the growth and development of the national tourism sector. This is because Croatia has a privileged geographical location [13], with a vast coastline along the Adriatic Sea and numerous islands that attract tourists from all over the world. Thanks to the presence of numerous marinas, nautical tourism has become a major source of income for many coastal towns and islands in Croatia [15].

One of the distinguishing features of Croatian marinas is their widespread distribution throughout the coastal and island territory. There are marinas everywhere along the coast, from the largest (of which the marinas in ACI Milna, Betina, Veljko Barbieri Slano Umag, and Veruda have been analyzed in detail), to the small marinas on the most remote islands. This means that tourists wishing to explore the Croatian coast can easily rent a boat or yacht and sail along the coast, stopping at various ports and marinas along the way.

In addition to this, the presence of marinas throughout the country is also an important factor in the economic development of Croatian coastal towns and islands. Marinas attract tourists and consequently other tourist services, such as restaurants, souvenir stores, hotels, and private accommodation, thus creating new jobs and supporting the local economy. Marinas in Croatia thus represent key drivers for the growth and development of the national tourism sector, due to their widespread distribution throughout the coastal and island territory and the wide range of nautical tourism services offered.

These considerations thus intersect with the concepts of attractiveness and smartness for different marinas, where a wide range of services assisted by a wide range of special features implies that a given marina is more or less attractive and efficient. These considerations were highlighted through the development of a matrix of attractiveness for different marinas, taking a sample of five different large marinas for analysis: the choice fell on the marinas of Milna, Betina, Veljko Barbieri Slano Umag and Veruda because of the wide range of services offered and the availability of the different data used in particular in the marinas_accessibility index presented earlier.

Thus, the Croatian Tourism System sees tourist marinas as an important channel of development for the coastal economy, an asset to be preserved and implemented as much in terms of aspects related to accessibility, service offerings as in terms of environmental

sustainability, trying to adopt strategies to mitigate the negative externalities generated by these key nautical tourism infrastructures.

References

1. Molavi, A., Lim, G.J., Race, B.: A framework for building a smart port and smart port index. Int. J. Sustain. Transp. **14**(9), 686–700 (2020)
2. Lamberti, T., Sorce, A., Di Fresco, L., Barberis, S.: Smart port: exploiting renewable energy and storage potential of moored boats, pp. 1–3. In: OCEANS 2015-Genova. IEEE (2015)
3. Bucak, U., Kuleyin, B.: Evaluation of green performance indicators' priority perception in terms of sustainable port concept a comparative analysis for Turkish ports. In: Conference: 1st International Congress on Ship and Marine Technology: Green Technologies At İstanbul, pp. 249–260 (2016)
4. Croatian Bureau of Statistics: Natucal Tourism – Capacity and turnover of Ports, first release (2021)
5. Tselentis, V., Papadimitriou, S., Tzannatos, E.: Environmental management and monitoring for sustainable development in marinas. FME Trans. **44**(3), 305 (2016)
6. Shin, I.S., Kim, B.S.: Development smart yacht operational system and marina control system for navigational safety. Int. J. Infor. Electr. Eng. **4**(1), 16 (2014)
7. Karaś, A.:. Smart port as a key to the future development of modern ports. TransNav: Int. J. Marine Navig. Safety Sea Transp. **14**(1) (2020)
8. Battino, S., del Mar Muñoz Leonisio, M.: Smart ports from theory to practice: a review of sustainability indicators. In: Computational Science and Its Applications–ICCSA 2022 Workshops, Malaga, Spain, 4–7 Jul 2022, Proceedings, Part V, pp. 185–195. Springer International Publishing, Cham (2022)
9. Acciaro, M., et al.: Environmental sustainability in seaports: a framework for successful innovation. Marit. Policy Manage. **41**(5), 480–500 (2014)
10. Corluka, G., Mikinac, K., Milenkovska, A.: Classification of tourist season in costal tourism. UTMS J. Econ. **7**(1), 71–83 (2016)
11. Mikulić, J., Kožić, I.: An exploratory assessment of tourism sustainability in Croatian coastal destinations. EFZG Working Paper Series (4), 1–12 (2011)
12. Favro, S., Saganić, I.: Natural characteristics of Croatian littoral area as a comparative advantage for nautical tourism development. Geoadria **12**(1), 59–81 (2007)
13. Krstinić Nižić, M., Drpić, D.: Model for sustainable tourism development in Croatia. Tourism in Southern and Eastern Europe, pp. 159–173 (2013)
14. Luković, T., Favro, S.: Strategic and tactical plans as part of controlling in marina management. In: 6th Paneuropean shipping conference, Split (2005)
15. Horak, S., Marusic, Z., Favro, S.: Competitiveness of Croatian nautical tourism. Tour. Mar. Environ. **3**(2), 145–161 (2006)
16. Razović, M., Tomljenović, R.: Development model of tourism on Croatian open-sea islands. Tourism Int. Interdiscip. J. **63**(1), 19–36 (2015)
17. Bunja, D.: Modernizing the Croatian tourism industry. Int. J. Contemp. Hosp. Manag. **15**(2), 126–128 (2003)
18. Douaioui, K., Fri, M., Mabrouki, C.: Smart port: design and perspectives. In: 2018 4th International Conference on Logistics Operations Management (GOL) IEEE, pp. 1–6 (2018)
19. Dragović, B., Tzannatos, E., Tselentis, V., Meštrović, R., Škurić, M.: Ship emissions and their externalities in cruise ports. Transp. Res. Part D: Transp. Environ. **61**, 289–300 (2018)
20. Borruso, G., Balletto, G., Milesi, A., Ladu, M.: Cartography and security. Port security: trends and perspectives. In: Gervasi, O., et al. (eds.) ICCSA 2021. LNCS, vol. 12958, pp. 252–261. Springer, Cham (2021). https://doi.org/10.1007/978-3-030-87016-4_19

21. Balletto, G., Milesi, A., Ladu, M., Borruso, G.: A dashboard for supporting slow tourism in green infrastructures. A methodological proposal in Sardinia (Italy). Sustainability **12**(9), 3579 (2020)
22. Mundula, L., Ladu, M., Balletto, G., Milesi, A.: Urban and territorial accessibility. A new role for the marinas. In: Innovation in Urban and Regional Planning: Proceedings of the 11th INPUT Conference, vol. 1, pp. 665–663. Springer International Publishing, Cham (2021)
23. Min, H.: Developing a smart port architecture and essential elements in the era of Industry 4.0. Marit. Econ. Logist. **24**(2), 189207 (2022)
24. Maglić, L., Grbčić, A., Gundić, A.: Application of smart technologies in Croatian marinas. Trans. Marit. Sci. **10**(1), 178–188 (2021)
25. Karayel, G.K., Javani, N., Dincer, I.: Sustainable marina concept with green hydrogen utilization: a case study. Sustain. Energy Technol. Assess. **54**, 102900 (2022)
26. Martínez-Vázquez, R.M., de Pablo Valenciano, J., Milán-García, J.: Impact analysis of marinas on nautical tourism in Andalusia. J. Mar. Sci. Eng. **10**(6), 780 (2022)
27. Radulovic, A.:Smart Technology Applied in The Management of Yachting Marinas. *International Journal of Maritime Engineering*, *164*(A1) (2022),
28. FrameSPort Project Framework initiative fostering the sustainable development of Adriatic small ports, ICT platform 1st updating report – Marinas, W.P. 3, Deliverables: 3.2.2 (2022)
29. Mundula, L., Ladu, M., Balletto, G., Milesi, A.: Smart marinas. the case of metropolitan city of Cagliari. In: Gervasi, O., et al. (eds.) ICCSA 2020. LNCS, vol. 12255, pp. 51–66. Springer, Cham (2020). https://doi.org/10.1007/978-3-030-58820-5_5
30. Balletto, G., Ladu, M., Milesi, A., Borruso, G.: A methodological approach on disused public properties in the 15-minute city perspective. Sustainability **13**(2), 593 (2021)
31. Rodrigo González, A., González-Cancelas, N., Molina Serrano, B., Orive, A.C.: Preparation of a smart port indicator and calculation of a ranking for the Spanish port system. Logistics **4**(2), 9 (2020)
32. Comer, D., Greene, J.S.: The development and application of a land use diversity index for Oklahoma City OK. Appl. Geogr. **60**, 46–57 (2015)
33. Balletto, G., Borruso, G., Campisi, T., Meloni, I., Scappini, B.: City form, mobility and University students in post pandemic era. In: Gervasi, O., et al. (eds) Computational Science and Its Applications – ICCSA 2021. ICCSA 2021. Lecture Notes in Computer Science, vol. 12952, 267–281. Springer, Cham (2021)
34. Roh, S., Thai, V.V., Wong, Y.D.: Towards sustainable ASEAN port development: challenges and opportunities for Vietnamese ports. Asian J. Shipping Logistics **32**(2), 107–118 (2016)