Cruise Ship Navigational Practices in the Central and Southern Part of the Adriatic East Coast – Biševo and Svetac Island Region

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The operational standards of the cruise industry differ from those of most shipping sectors. To meet passenger demand for appealing itineraries, cruise ships mainly sail in coastal areas with significant natural and cultural values. In addition, the emergence of new cruise destinations presents challenges for routing decisions in new cruise regions of notable natural and cultural importance, particularly as cruise ships predominantly operate in coastal navigation. This paper analyses data from a study on the navigational practices of cruise ships in the central and southern part of the Adriatic east coast in the periods: from August to October 2014; from June to July 2015 and from May to September 2022. The aim of the study is to determine the routes of cruise ships by documenting the daily movements of cruise ships of more than 50,000 GT and to determine areas of potentially elevated navigational risk by analyzing the navigation routes used, ship interactions, proximity to the coast and the characteristics of the area of the islands of Biševo and Svetac. The comparison of cruise ship navigational practices in the region over three time periods shows that the established coastal routes have become standard practice. The proximity of these routes to the coast as well as the interactions of vessels in the coastal areas indicate potential safety risks.

KEYWORDS
~ Cruise ships
~ Navigational safety
~ Routing
~ Adriatic East Coast
~ Biševo island
~ Svetac island

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1. INTRODUCTION

The operational standards of the cruise industry differ significantly from those of most other maritime sectors. As it is a predominantly seasonal industry, cruise operators strategically reposition their ships in different regions to optimize passenger occupancy and offer varied itineraries. Cruise ship operations tend to be typically regional in nature and are characterized by repetitive, circular itineraries of limited duration, designed to provide passengers with varied port experiences on a daily basis. To increase the attractiveness of cruises, cruisers mainly operate in coastal waters, often in areas of high ecological and cultural importance. Consequently, the sustainability of cruise routes in coastal navigation emerges as an important issue that requires a careful assessment of their long-term impact. The development of new cruise routes, the increasing number of cruisers and the increasing size of cruisers can jeopardize not only the safety of the ships but also the environment and the well-being of the local population, especially in places of special natural and cultural interest that have so far hardly been touched by the cruise tourism industry. Cruise lines often choose routes close to coastlines and unspoilt areas of great natural beauty to make the journey more interesting for passengers. Thus, cruise routes that pass very close to the coasts of the outer islands and in narrow passages between the islands are common for cruisers in the Croatian part of the Adriatic. Additionally, the intersection of longitudinal and transverse routes leads to risky situations (crossing, head-on and overtaking) that increase the possibility of collisions and groundings, particularly when this happens in confined areas.

Over the last decade, the cruise industry in the Adriatic region has experienced significant growth, reflected in an increase in passenger traffic, the frequency of cruise ship calls and the emergence of new cruise destinations in areas previously characterized by low maritime traffic density. This growth of the cruise industry is particularly evident in the central and southern part of the Adriatic east coast (Dorigatti, Perić, and Jelić Mrčelić, 2022a), which makes this region interesting for an in-depth analysis of cruise ship navigation practices and risk analyses. There are not many other studies examining cruise ship navigation practices in coastal navigation, especially in the newly developed cruise regions such as the Adriatic. The available studies focus on general sailing routes in the Adriatic and their navigational safety. Lušić and Kos (2006) analyzed the main navigational patterns in the Adriatic with particular emphasis on the general longitudinal traffic between the Strait of Otranto and the ports of the northern Adriatic and concluded that the longitudinal Adriatic corridor is of greater importance than the transversal routes. The Navigational Study for the Split-Dalmatia and Dubrovnik-Neretva Counties by Zec et al. (2016) defined the patterns of maritime passenger and cargo traffic, identified navigation routes and delineated high-risk zones. Part of the study focuses on the outer ridge of the island of Vis, which includes the island of Biševo, as a region that is still used in international maritime traffic to the ports of the northern Adriatic. Although it is expected that the traffic will be directed through the Central Adriatic Separation Scheme, a certain number of ships still pass the coast of the island of Biševo and cross Marine Protected Areas on their way to the ports of the northern Adriatic. The highest maritime traffic density occurs within the Central and Northern Adriatic Separation Scheme, while the traffic density outside this scheme is significantly lower. The sea corridor between the islands of Vis and Biševo, which was frequently used in the past, is hardly used today and maritime traffic does not require any additional safety measures (Zec at al., 2016). Lušić, Pušić, and Medić (2017) conducted an analysis of maritime traffic in the central Adriatic, focusing on the risks of collisions and groundings along the primary sailing routes that pass through this region. The research indicates that traffic density is greatest along the routes linking the north-western ports of the Adriatic to the Strait of Otranto. Within these routes, the greatest concentration is found along the primary sailing route, which is defined by the Northern Adriatic Separation Scheme, the separation zone near the island of Palagruža and the Strait of Otranto. Maritime traffic in the central Adriatic is well regulated, and the probability of collisions and groundings is low. There are no recorded cases of non-compliance with the routing regulations of the Central Adriatic Separation Scheme. However, deviations from the standard longitudinal sailing route are primarily observed in fishing vessels and pleasure boats. Overall, the volume of traffic on these routes can be estimated quite well based on the number of ships calling at the ports of the northern Adriatic (Lušić, Pušić and Medić, 2017).

Dorigatti, Perić, and Jelić Mrčelić, 2022b defined cruise ship navigation routes in the central and southern part of the Adriatic east coast and calculated the traffic density and retention period of cruise ships in selected high-risk areas in the time frame between August 2014 and July 2015 using the raw data from Perić, 2016. Using the same dataset, Dorigatti, Perić, and Jelić Mrčelić, 2022a also investigated navigation practises in the Vis, Biševo and Svetac islands region and pointed out that cruise ships often navigate high-risk routes in close proximity to island coasts and protected areas. An in-depth analysis of cruise ship routing practices in the area of the island of Lastovo and the island of Mljet was also presented by Dorigatti, Perić, and Jelić Mrčelić, 2022c and the study concluded that the established navigation practises have become standard operational procedures and pose a potential threat to the safety of ships, but also to the environment.

This paper analyses data from a study on the navigation practises of cruise ships in the central and southern part of the Adriatic east in the periods: from August to October 2014; from June to July 2015 and from May to September 2022. The objective of the study is to identify the cruisers routes by documenting the daily movements of cruise ships of more than 50,000 GT, and to determine zones of potentially elevated navigational risk by analysing the navigation routes used, vessel

interactions, proximity to the coast and the characteristics of these regions, with a focus on the area of the islands of Biševo and Svetac.

2. MATERIALS AND METHODS

The observation of cruise ship traffic and determination of cruise ship routes is conducted by daily recording of the movements of cruise ships (those above 50,000 GT). The study is carried out in three periods: from August to October 2014 and from June to July 2015 based on the data set of Perić, 2016 and Dorigatti, Perić, and Jelić Mrčelić, 2022a and the third period from May 2022 to September 2022 using the Marine Traffic application. The presentation and comparison of the researched data is carried out for the five busiest months of the two periods (from June to October). The interaction among cruise ship routes, navigation practices and traffic density in areas of high conservation value has identified regions of increased navigational risk, of which the region around the Biševo and Svetac Islands was selected for a detailed study of navigation practices.

3. RESULTS AND DISCUSSION

The North Adriatic Separation Scheme directs cruise traffic along assigned routes with no alternative options, while the Central Adriatic Separation Scheme offers several route alternatives, resulting in more widely distributed cruise routes compared to the northern Adriatic (Dorigatti, Perić, and Jelič Mrčelić, 2022a; IMO, 2017).

In the study by Dorigatti, Perić, and Jelić Mrčelić, 2022a the routes of cruise ships in the central part of the Adriatic east coast were defined and the conclusion was drawn that the area is regularly in use by cruise ships along both longitudinal and transversal routes. Longitudinal routes run south of the island of Svetac and the island of Biševo, between the islands of Svetac and Biševo, between the islands of Biševo and Vis and north of the island of Vis along the Vis Channel. Transversal routes run west of the island of Vis between the islands of Biševo and Svetac and east of the island of Vis between the islands of Hvar and Vis (Dorigatti, Perić, and Jelić Mrčelić, 2022a)

Figure 1 shows eight high-risk zones associated with cruise ship routes in the central and southern part of the Adriatic east coast, identified on the basis of cruise routes tracking information, proximity of cruise routes to island coasts and Marine Protected Areas, and interactions among cruise ship routes. The identified high-risk zones include the island of Svetac, the island of Biševo, the island of Sušac, the island of Lastovo, the Hvar Channel, the Svetac–Biševo Passage, the Sušac–Lastovo Passage and the Lastovo–Mljet Passage (Dorigatti, Perić, and Jelič Mrčelić, 2022a).

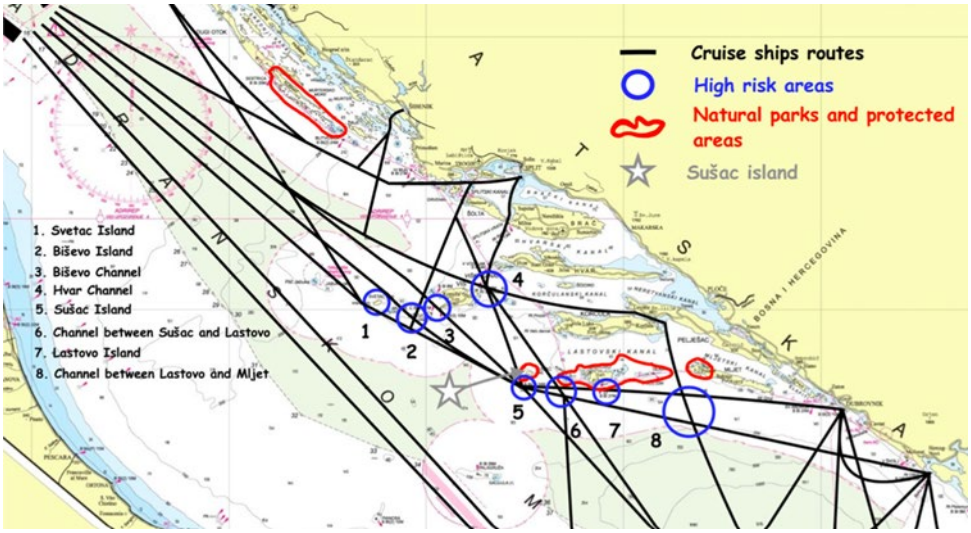

Figure 1. Cruise ship routes and potentially elevated risk zones in the central and southern parts of the eastern Adriatic. Black lines denote cruise ships navigational patterns, red curves indicate marine protected areas, blue circles highlight high navigational risk zones, and the grey star marks the island of Sušac. (Dorigatti, Perić, and Jelić Mrčelić, 2022a)

During the observation of cruise traffic between August and October 2014, as well as from June to July 2015, a navigation practice was identified whereby cruise ships departing from the ports of the northern Adriatic proceed on south-easterly courses along the North Adriatic Separation Scheme. After departing from the North Adriatic Separation Scheme, they continue coastal navigation along the outer island ridge and keep away from the Central Separation Scheme proceeding to the ports on the eastern coast of the southern Adriatic. The north-western routes from the ports of the southern Adriatic on the east coast to the destinations in the northern Adriatic follow the same pattern: the cruise ships continue coastal

navigation until they join North Adriatic Separation Scheme on the way to their final destinations (Dorigatti, Perić, and Jelić Mrčelić, 2022a; Dorigatti, Perić, and Jelić Mrčelić, 2022b). In the period between June and October 2022, cruise ships used the Central Adriatic Separation Scheme 172 times, while cruise ships stayed north of the Central Adriatic Separation Scheme and passed south of the island of Sušac 422 times. This information shows that a significant number of cruise ships exit the Central Adriatic Separation Scheme and continue along the coast until they reach their destinations on the eastern coast of the southern Adriatic.

The island of Vis and its archipelago, which includes Biševo, Svetac, Jabuka and Palagruža, are part of the outer island region in the central part of Adriatic east coast (United Kingdom Hydrographic Office, 2014). In this study cruise ship traffic was analyzed in region of Biševo Island and Svetac island. This region is of great value as part of the Vis archipelago. Due to its exceptional natural and cultural heritage, the Vis Archipelago region has the status of a Geopark and has been part of the UNESCO Global Geoparks Network since 17 April 2019. (Ministarstvo gospodarstva, 2022; Geopark Viški arhipelag, 2025). In addition to its great importance, the area of the island of Biševo and the island of Svetac was selected for detailed analysis as they are part of eight high-risk zones identified by (Dorigatti, Perić, and Jelić Mrčelić, 2022a) in a study on cruise ship routing procedures in the central and southern part of the Adriatic east coast. The high-risk zones were determined on the basis of increasing cruise ship traffic, cruise ships routes, their interaction and the proximity they pass from the island coasts.

The island of Biševo lies in both longitudinal and transversal corridors used by cruise ships. The longitudinal routes in a south-easterly direction led to destinations in the southern part of the Adriatic east coast, while the routes in a north-westerly direction head for ports in the northern and central part of the Adriatic. Transversal routes, which run both northwards and southwards, connect the port of Split with destinations in the southern part of the Adriatic east coast and on the Italian coast (Figure 1 and Figure 2).

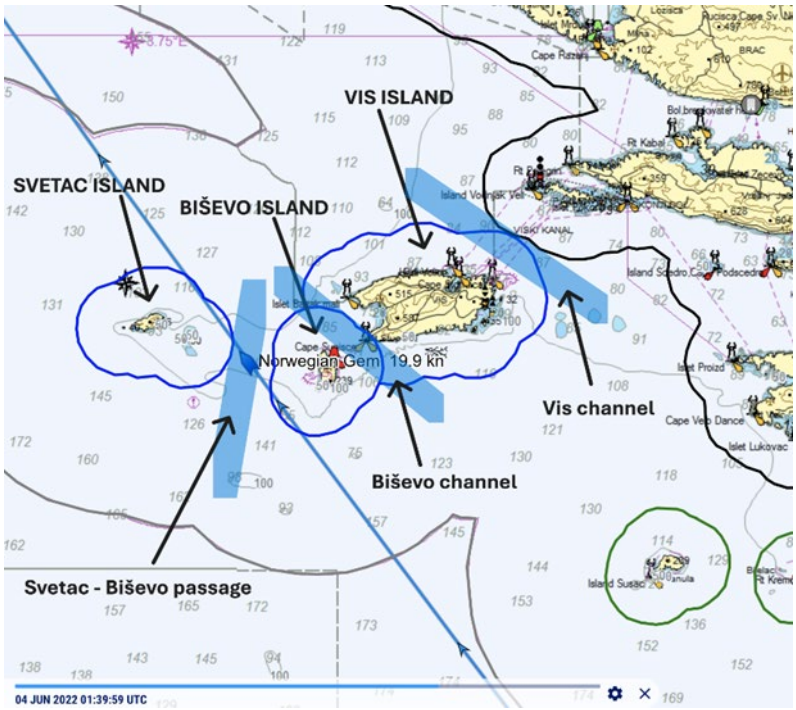

Figure 2. The example of a cruise ship route (cruise ship Norwegian Gem) in the study area on 04 June 2022 at 01:39:59 UTC: the dark blue lines indicate the 3M boundary; the grey lines indicate the 12M boundary, the blue ship symbol indicates the position of the cruise ship, and the light blue line indicates the route of the cruise ship (speed 19.9 knots)

Table 1. presents the number of passages of cruise ships within 3 M of the coast, cruise ships retention period within 3 M of the coast and the average retention period per ship in the island of Biševo region in the periods: from August to October 2014; from June to July 2015 (Dorigatti, Perić, and Jelić Mrčelić, 2022a) and from May to September 2022. The retention period is determined by calculating the time difference between arrival and departure from the 3 M zone. The average retention period is determined by dividing the total retention period for selected months by the number of arrivals and departures from the >3 M zone in that month.

Year	Month	Number of cruise ship passages > 3 M	Retention period of crusie ships > 3 M (min)	Average retention period per ship (min)
2014	August	10	156	15.60
2014	September	4	66	16.50
2014	October	3	61	20.30
2015	June	0	0	0.00
2015	July	4	98	24.50
2022	June	4	52	13
2022	July	7	99	14.14
2022	August	5	63	12.60
2022	September	6	131	21.83
2022	October	11	132	12.0

Table 1. Number of cruise ship passages within 3 M of the coast, cruise ships retention period within 3 M of the coast and average length of stay per ship in the Biševo Island region in periods: from August to October 2014; from June to July 2015 (Dorigatti, Perić, and Jelič Mrčelić, 2022a) and from May to September 2022

October 2022 was the busiest month with 11 passages 3 M from Biševo island and a total retention period of 132 minutes. The Biševo Channel runs between the south-western tips of the island of Vis and the island of Biševo. The channel is 2.2 M wide and is navigationally restricted for passage at less than 300 metres from the shore with recommended daily passage (United Kingdom Hydrographic Office, Admiralty Sailing Directions 2014). Cruise ships do not frequently pass through the Biševo Channel, but despite the restrictions, cruise ships were detected passing through the Biševo Canal during survey in 2014 and 2015 (Perić, 2016). Throughout the monitoring period in 2022, a cruise ship transited the Biševo Channel five times with average length of stay of 25.2 minutes at a distance of less than 3 M from the shore. The passage was performed by the same ship, this indicates that the route has become a standard routing practice for the monitored cruise ships. In the period from May 2022 to September 2022, no passages of large cruise ships (above 50,000 GT) were detected during traffic monitoring of the Biševo Channel, which indicates that the recorded ship passages were an isolated case and constant efforts should be made to prevent similar passages in the future, as the Biševo Channel area poses an increased safety risk due to its configuration and restrictions.

Table 2. shows the number of passages of cruise ships in the Svetac – Biševo Passage in the periods: from August to October 2014; from June to July 2015 (Dorigatti, Perić, and Jelić Mrčelić, 2022a) and from May to September 2022. October 2022 was the busiest month with 17 transits. These results show that the transversal corridor running through the Svetac – Biševo passage is a very frequent navigation option for cruise ships connecting the eastern and western Adriatic and the Strait of Otranto.

Year	Date	Number of cruise ship passages
2014	August	8
2014	September	14
2014	October	6
2015	June	6
2015	July	9
2022	June	8
2022	July	12
2022	August	10
2022	September	9
2022	October	17

Table 2. Number of cruise ship passages in the Svetac – Biševo Passage in the periods: from August to October 2014; from June to July 2015 (Dorigatti, Perić, and Jelić Mrčelić, 2022a) and from May to September 2022

The island of Svetac is part of the north-west and south-east longitudinal corridor. Cruise ships departing from the southern part of the Adriatic east coast destinations to the northern Adriatic ports on north-western routes do not use the Central Adriatic Separation Scheme. The Central Adriatic Separation Scheme is also not used on south-eastern routes from the northern Adriatic ports to destinations in the southern part of the Adriatic east coast. Cruise ships proceed along the route of the outer islands, passing the coasts of the island of Svetac to the south or north.

Table 3. shows the number of passages of cruise ships within 3 M of the coast, the total retention period of cruise ships within 3 M of the coast and the average retention period per ship in the Svetac Island region in the periods: from August to October 2014; from June to July 2015 July 2015 (Dorigatti, Perić, and Jelič Mrčelić, 2022a) and from May to September 2022.

Year	Month	Number of cruise ship passages > 3 M	Retention period of crusie ships > 3 M (min)	Average retention period per ship (min)
2014	August	13	225	17.30
2014	September	15	143	9.60
2014	October	17	233	13.70
2015	June	18	369	20.50
2015	July	13	256	19.70
2022	June	4	72	18
2022	July	5	114	22.80
2022	August	9	71	7.88
2022	September	8	224	28
2022	October	11	147	13.36

Table 3. Number of passages of cruise ships within 3 M of the coast, cruise ships retention period within 3 M of the coast and average length of stay per ship in the island of Svetac region in the periods: from August to October 2014; from June to July 2015 (Dorigatti, Perić, and Jelić Mrčelić, 2022a) and from May to September 2022.

June 2015 was the busiest month with 18 cruise ships passing within 3 M of the coast with a total retention period of 369 minutes. The month of September 2022, with eight cruise ships had a total retention period of 224 minutes (Table 3).

The Svetac–Biševo Channel, which is part of the transversal corridor connecting the ports of the eastern and western Adriatic and the Strait of Otranto, is very busy. The results of the study show that October had the highest number of cruise ship passages within 3 nautical miles of the shores in the region of Biševo Island, Svetac Island and the Biševo–Svetac Passage. However, in addition to the number of ships, average length of stay within this area is also an important indicator of the impact of cruise ships on the area, and this data fluctuates over time. The further development of the cruise industry and the increase in cruise traffic in the region will lead to even more cruise traffic in the area, which will require special attention from a navigational safety perspective.

4. CONCLUSION

The analysis of the data confirmed that cruise ship navigation practices in the Biševo and Svetac Island regions remained unchanged during monitoring period from June to October 2022 compared to the monitoring period from August to October 2014 and June and July 2015. The Svetac–Biševo Channel is an important part of the longitudinal and transversal corridor connecting the ports in the northern Adriatic with the destinations in the southern Adriatic and the Strait of Otranto, as well as the ports in the eastern and western Adriatic with the Strait of Otranto and is frequently used by cruise ships.

The frequent traffic of cruise ships in the Svetac–Biševo Passage leads to mutual ship interactions within the passage near the coasts of the islands. Throughout the observation of cruise traffic between June and October 2022, two encounters of two cruise ships at a distance of 3 M of the coast and one encounter of three cruise ships at a distance of 3 M of the coast were recorded within 60 minutes.

The increase in coastal routes, the increase in ship encounters close to shore and the lack of a well-developed routing system in the region (such as mandatory routing systems, traffic lanes, two-way routes, recommended routes, etc.) could lead to an increased safety risk due to collisions, grounding, etc. The results show that it is necessary to continue

monitoring, carry out risk assessment analyses and finally propose protective measures to elevate the navigational safety of cruise ships in the study region.

CONFLICT OF INTEREST

Authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

REFERENCES

Dorigatti, J., Perić, T. and Jelić Mrčelić, G. (2022a) 'Cruise industry trends and cruise ships' navigational practices in the central and south part of the Adriatic east coast affecting navigational safety and sustainable development', Applied Sciences, 12, 6884. Available at: https://doi.org/10.3390/app12146884.

Dorigatti, J., Perić, T. and Jelić Mrčelić, G. (2022b) 'Cruise ships routing in the central part of the Adriatic east coast', Transnav, 16(X), pp. XX–XX. Available at: https://doi.org/10.12716/1001.16.XX.XX.

Dorigatti, J., Perić, T. and Jelić Mrčelić, G. (2022c) 'Cruise ships routing in the south part of the Adriatic east coast – The island of Lastovo and the island of Mljet', Proceedings of the ICTS 2022, Portorož, Slovenia, 23–24 May 2022.

Geopark Viški arhipelag (no date) Geopark Viški arhipelag. Available at: https://www.geopark-vis.com/ (Accessed: 28 February 2025).

IMO (2017) Ship's routing. 13th edn. London: International Maritime Organization. Available at: https://www.imo.org/en/OurWork/Safety/Pages/ShipsRouteing.aspx (Accessed: 25 February 2025).

Lušić, Z. and Kos, S. (2006) 'Glavni plovidbeni putovi na Jadranu—The main sailing routes in the Adriatic', Naše More, 53, pp. 198–205. Available at: https://www.researchgate.net/publication/236667819_The_Main_Sailing_Routes_in_the_Adriatic.

Lušić, Z., Pušić, D. and Medić, D. (2017) 'Analysis of the maritime traffic in the central part of the Adriatic', in Dell'Acqua, G. and Wegman, F. (eds.) International Congress on Transport Infrastructure and Systems (TIS 2017). Rome, Italy: CRC Press/Balkema, pp. 1013–1020. Available at: https://www.researchgate.net/publication/321034646_Analysis_of_the_maritime_traffic_in_the_central_part_of_the_Adriatic.

Ministarstvo gospodarstva (2022) Geopark Viški arhipelag. Available at: https://mingo.gov.hr/djelokrug/uprava-za-zastitu-prirode-1180/zasticena-podrucja/medjunarodno-proglasena-zasticena-podrucja/geopark-viski-arhipelag/5471 (Accessed: 28 February 2025).

Perić, T. (2016) Evaluation model of sanitary wastewater pollution from cruise ships in the Adriatic Sea. PhD thesis. University of Rijeka, Rijeka, Croatia.

United Kingdom Hydrographic Office (2014) Admiralty sailing directions: Mediterranean Pilot Volume 3, NP47. 15th edn. United Kingdom Hydrographic Office.

Zec, D., Frančić, V., Rudan, I., Malgić, L., Lušić, Z., Đurđević-Tomaš, I., Brajović, M. and Vukuč, M. (2014) Prometno—plovidbena studija plovnog područja Split, Ploče i Dubrovnik. Pomorski Fakultet Rijeka. Available at: https://mmpi.gov.hr/UserDocsImages/arhiva/MPPI%20PRZ%20PROM-PLOV%20studija%2019-11_14.pdf.