

VEDRAN JELAVIĆ, D.Sc.
E-mail: vedran.jelavic@unidu.hr
ŽELJKO KURTELA, M.Sc.
MILOŠ BRAJOVIĆ, B.Eng.
University of Dubrovnik
Ćira Carića 4, HR-20000 Dubrovnik, Republic of Croatia

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SOME NEW ELEMENTS IN POSITIONING ANCHORAGE AREA FOR PASSENGER CRUISERS NEAR PORT OF DUBROVNIK

ABSTRACT

There are several factors to be considered while creating anchorage area for cruising ships. Mandatory elements included in the analyses of the anchorage area are: security factor, aquatorium factor, ship factor, environmental pollution factor, anchorage occupancy factor and legal issues. Considering many specifics of the city of Dubrovnik and the surrounding area some new principles had to be included in order to find the most convenient solution for the new anchorage area. These principles are proportionality, traditionality and diversity applied to some aspects of cruisers and anchoring aquatorium. With such approach it was possible to position the optimal area for anchoring near very sensitive old city of Dubrovnik and satisfy all the subjects included in that problem.

KEY WORDS

Dubrovnik, anchorage, size of the cruiser, security, number of passengers

1. INTRODUCTION

The history of Dubrovnik port goes way back into the past. It has existed since the ancient times together with the neighbouring anchorage near the island of Lokrum. It is hard to estimate when passenger cruising traffic started but no doubt it was long time ago. Many pilgrimages to the Holly Land used to stop in Dubrovnik and also visit the Benedictines on the island of Lokrum.

New technologies in shipbuilding and maritime industry influenced the development of new, cruising industry, that will bring economic prosperity to the city of Dubrovnik. At the end of the 19th century anchorage beside the port was frequently visited by the big passenger cruisers. In September 1898 a huge French steam cruiser "Oriana" anchored near the island of Lokrum, bringing French tourists. Tradition of big steamers anchoring near Dubrovnik continued in 20th century with motor cruisers.

Over time the size of the ships has increased, the frequency of visits has changed and more ships used to anchor at the same time. Parallel with the change in ships, urban area and tourist area in the close vicinity of the anchorage have developed. Therefore, the initiative for changing position of the anchorage area was seriously taken into consideration by the local and state government. All the relevant factors for creation of the new anchorage area were grouped as follows: security factor, aquatorium factor, ship factor, environmental pollution factor and legal issues. Moreover, beside these factors, it was necessary to introduce principles of proportionality, traditionality and diversity in order to find optimal solution for anchoring.

2. AQUATORIUM FACTOR

Current anchorage (broken line in Figure 1) is located between the island of Lokrum and the mainland (Lokrum sea passage). The average length of the anchorage field is 1270 m; with average width of 470 m. Approximate anchorage area computed by planimetric methods occupies 617,000 m².

– Anchorage coordinates given from Bessel's ellipsoid:

P1 $\varphi = 42 38,23^\circ \text{ N}$ $\lambda = 18 07,60^\circ \text{ E}$

P2 $\varphi = 42 37,71^\circ \text{ N}$ $\lambda = 18 08,31^\circ \text{ E}$

P3 $\varphi = 42 37,50^\circ \text{ N}$ $\lambda = 18 08,00^\circ \text{ E}$

P4 $\varphi = 42 38,05^\circ \text{ N}$ $\lambda = 18 07,50^\circ \text{ E}$

– Significant spots around anchorage:

1. Old Port
2. Island Lokrum
3. Hotel "Excelsior"
4. Hotel "Argentina"
5. Hotel "Villa Dubrovnik"
6. Hotel "Belvedere"
7. Underwater cable Lokrum - Buža
8. Underwater cable and underwater pipeline Lokrum - Lazareti

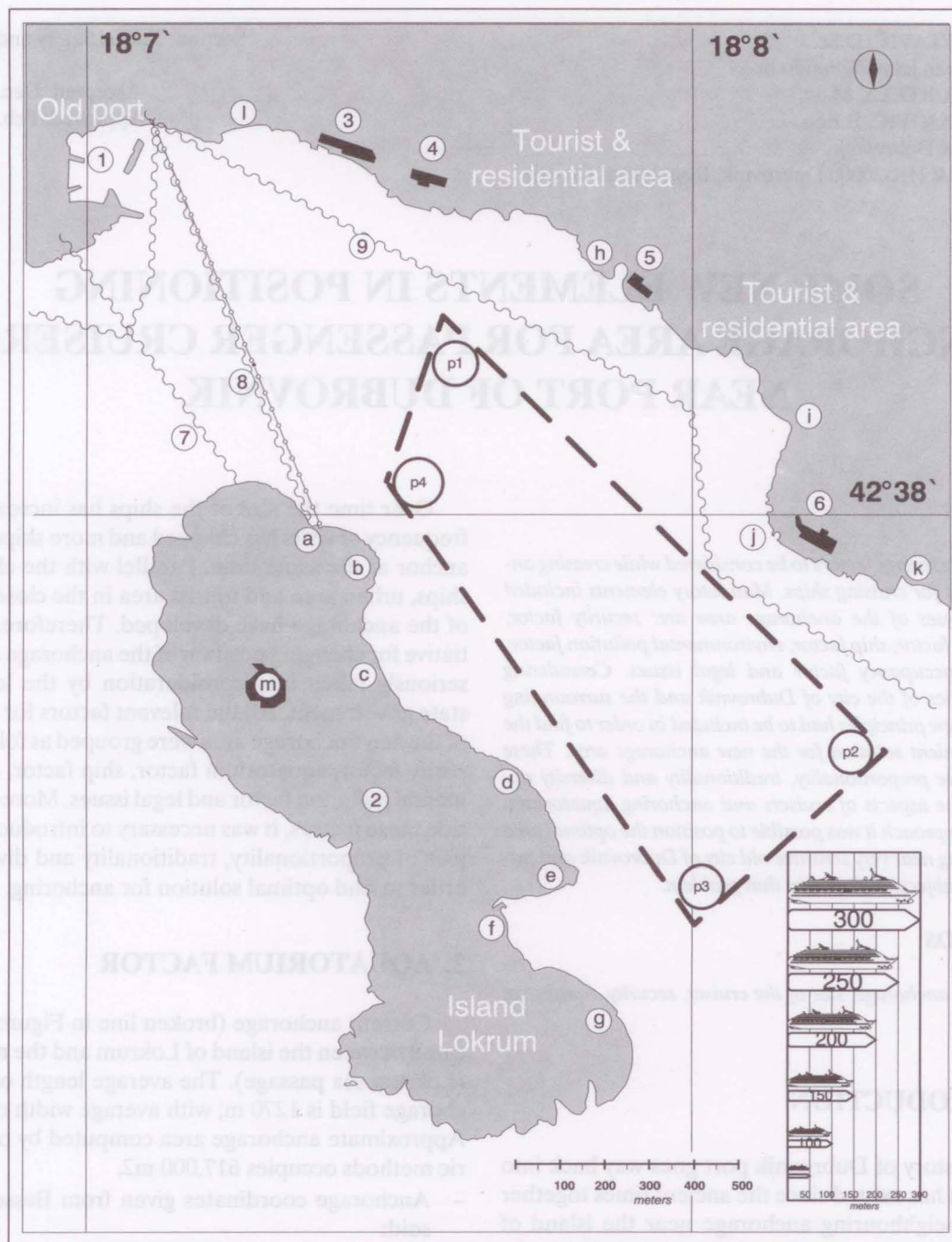


Figure 1 - Old anchorage position near the old port of Dubrovnik

- 9. Underwater cable from Cavtat
- a. Bay Skalica, bay D. Bočina
- b. Cape Križ
- c. Bay G. Bočina
- d. East coast of island Lokrum
- e. Cape Bijele seke
- f. Port Portoć
- g. Cape Škrinja
- h. Bay near H. Villa Dubrovnik
- i. Bay Sv. Jakob
- j. Cape Sv. Jakob

- k. Bay Mala Orsula
 - l. Beach Banje
 - m. Forth Royal
- Typical distances around anchorage:
- (P4-P1) 407 m
 - (P1-P2) 1407 m
 - (P2-P3) 593 m
 - (P3-P4) 1222 m
 - (P4-P2) 1287 m
 - (P1-P4) - Old port (1) - average distance 850 m
 - (P2-P3) - Old port (1) - average distance 2100 m

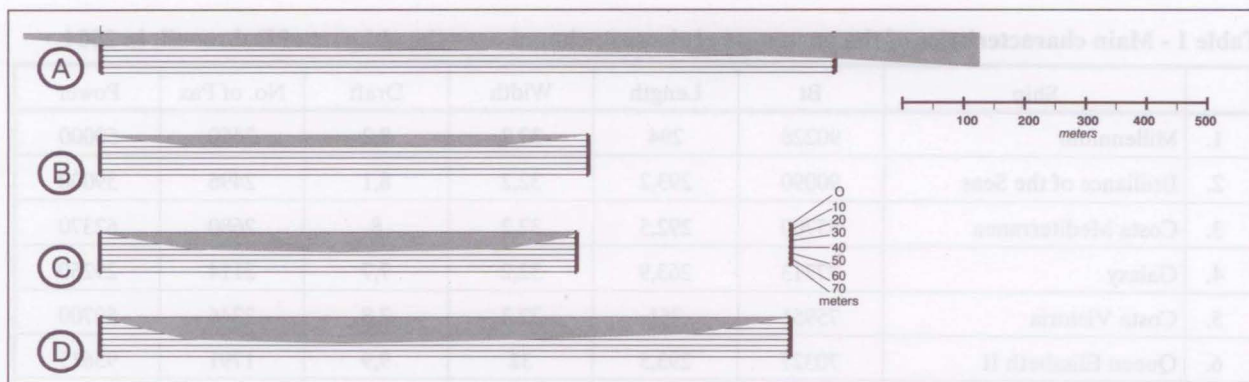


Figure 2 - Typical depths of the anchorage area

(P1) - Old port (1)	800 m
(P1) -Hotel "Excelsior" (3)	400 m
(P1) -Hotel "Argentina" (4)	300 m
(P1-P2) -Hotel "Villa Dubrovnik" (5) - the closest distance	350 m
(P1-P2) -Hotel "Belvedere" (6) - the closest distance	250 m
(P1-P2) - Cape Sveti Jakov (j) - the closest distance	175 m
(P3-P4) - Cape Križ (b) - the closest distance	120 m
(P3-P4) - Bay G. Bočina (c) - the closest distance	240 m
(P3-P4) - East coast of island Lokrum (d) - the closest distance	130 m
(P3-P4) - Cape Bijeje Seke (e) - the closest distance	140 m
(P3-P4) - Cape Skrinja (g) - the closest distance	260 m

Such position of the present anchorage fulfils all the safety requirements for the tourist excursion boats and other sea traffic around the old port of Dubrovnik.

Depths of the anchorage are presented in Figure 2 through 4, typical cross-sections: Longitudinal cross-section A. (northwest-southeast); transversal cross-section B. (Hotel "Villa Dubrovnik" - Cape Križ), C. (Sv. Jakov - pier at Bočina) and D. (Cape Mala Orsula - South cape Portoć). Longitudinally and transversally depth increases from 20 to 45 m without any sudden changes. The bottom consists mostly of sand and mud thus providing excellent anchor ground.

3. ANCHORAGE OCCUPANCY FACTOR

Figure 3 presents occupancy of the anchorage through the summer months of the season 2004. Free anchorage means no ships anchored, and occupied anchorage means one or more ships anchored. It is obvious that anchorage was completely free for about 1/3 of the busiest months. For the rest of the season more free days were available.

4. SHIP FACTOR

The total number of 38 ships anchored 149 times near the old port of Dubrovnik in 2004. Ships were dif-

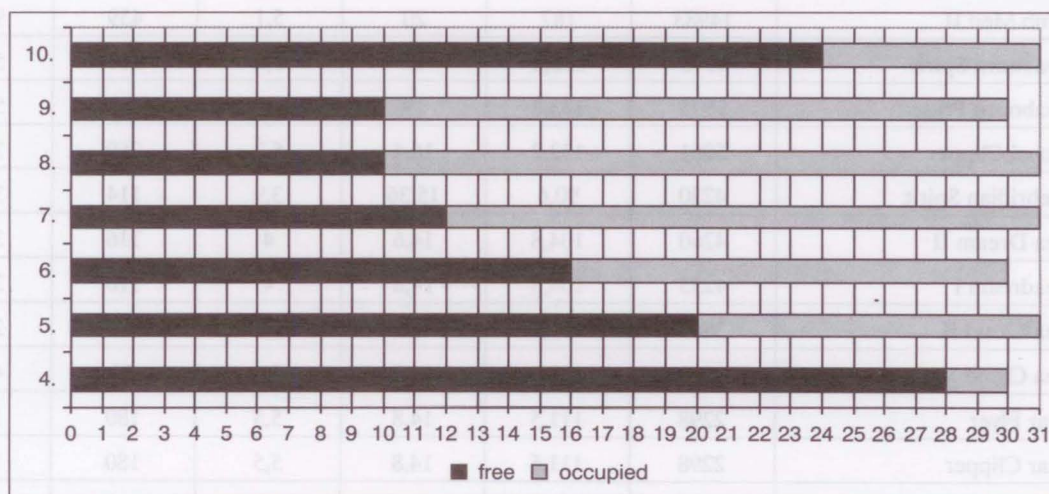


Figure 3 - Occupancy of the anchorage from April to October 2004

Table 1 - Main characteristics of the passenger cruisers anchored near the old port of Dubrovnik in 2004

	Ship	Bt	Length	Width	Draft	No. of Pax	Power
1.	Millennium	90228	294	32,2	8,2	2450	50000
2.	Brilliance of the Seas	90090	293,2	32,2	8,1	2496	39000
3.	Costa Mediterranea	85700	292,5	32,2	8	2680	62370
4.	Galaxy	77713	263,9	32,2	7,7	2114	29250
5.	Costa Victoria	75951	251	32,3	7,8	2246	50700
6.	Queen Elisabeth II	70327	293,5	32	9,9	1791	95615
7.	Crystal Serenity	68870	250	32,2	7,8	1140	52197
8.	Rotterdam	59652	234	30,8	7,5	1668	34560
9.	Msc Lirica	59058	251,2	28,8	6,6	2343	30600
10.	Costa Romantica	53049	220,6	28	7,3	1782	22800
11.	Msc Armonia	47275	216	28,8	6,9	1670	31680
12.	The World	43188	196,3	29,8	6,7	699	11040
13.	Aida Aura	42289	202,9	28,1	6,3	1687	27550
14.	Seven Seas Voyager	41500	206,5	28,8	7	768	16600
15.	Aida Cara	38531	193,3	27,6	6,2	1186	21720
16.	Minerva II	30277	181	25,5	5,8	702	13500
17.	Regatta	30277	181	25,5	5,8	702	13500
18.	Nautica	30277	181	25,46	5,95	850	18600
19.	Europa	28437	198,6	24	6	408	21606
20.	Costa Allegra	28430	187,7	25,8	8,2	1066	19200
21.	Silver Whisper	28258	186	24,8	6,1	396	15600
22.	Costa Marina	25558	174,2	25,8	8,2	1025	19152
23.	Marco Polo	22086	176,3	23,6	8,2	848	15447
24.	Radisson Diamond	20295	131,2	32	8,4	354	11400
25.	Silver Wind	16927	155,8	21,4	5,3	315	10600
26.	Seawing	16607	163,3	22,8	6,5	926	13240
27.	Club Med II	14983	187	20	5,1	439	9120
28.	Seabourn Spirit	9975	133,8	19	5,2	208	5355
29.	Seabourn Pride	9975	133,8	19	5,2	208	5355
30.	Royal Clipper	5061	133,2	16,4	5,7	260	3730
31.	Hebridian Spirit	4280	90,6	15,36	3,9	114	3514
32.	Sea Dream II	4260	104,8	14,6	4	116	3540
33.	Seadream I	4253	104,8	14,6	4	116	3540
34.	Sea Cloud II	3849	117,1	16	5,7	64	2480
35.	Sea Cloud	2532	109,5	14,9	5,1	64	4413
36.	Star Flyer	2298	111,5	14,8	5,5	180	1030
37.	Star Clipper	2298	111,5	14,8	5,5	180	1030
38.	Le Ponant	1189	88,5	11,9	4	64	1680

ferent in age, type, propulsion, power, size, number of passengers, cruising class, etc. Some ships visited Dubrovnik only once and some of them did it several times.

5. DIVERSITY OF SHIPS

Analysis of Table 1 shows significant differences in the main characteristics of the ships within the total population. Therefore, it makes sense to differentiate the ships in two groups, such as, big and small cruisers. Big cruisers are longer than 250 meters and small cruisers are shorter than 150 meters. On average the group of big cruisers is 2.42 times longer than the group of small cruisers.

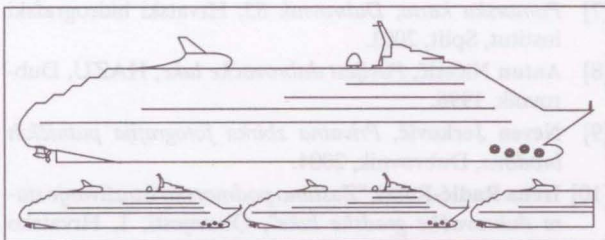


Figure 4 - Difference in length between big and small cruisers

The difference in length of 2.42 times makes big cruiser even 25.61 times more powerful and 19.84 times bigger. Moreover big cruiser accommodates 16.69 times more passengers than a small one. From the environmental point of view big cruisers are less convenient because the amount of every pollutant increases exponentially as power, size and number of passengers increase. From the economic point of view big cruisers are more convenient because of bringing more tourists and thus more money for the community.

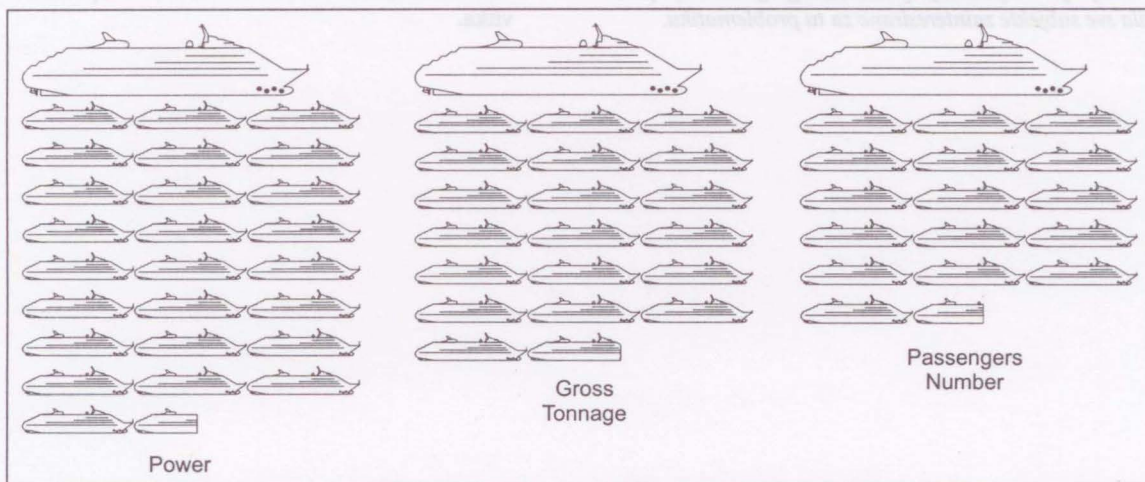


Figure 5 - Differences in power, gross tonnage and number of passengers between big and small cruisers

6. PROPORTIONALITY AND TRADITIONALISM CONSIDERING NEW ANCHORAGE POSITION

Obviously, the important elements in positioning the new anchorage area are diversity of the cruisers, relatively small anchorage area, constant increase in the number of ships and uniqueness of Dubrovnik. Considering all the relevant factors, it is very difficult to design a new anchorage area without dividing ships into two groups and dividing the area into two fields. Smaller area c is supposed to get small cruisers, while the bigger areas d and b get big cruisers. By using the principle of proportionality, the size of the ships and the size of areas are proportional in terms of area acreage, area depth, number of ships, frequency of anchoring, number of passengers and technical data of the cruisers. Most of the small cruisers are sailing cruisers thus contributing the strong and bright maritime tradition of Dubrovnik.

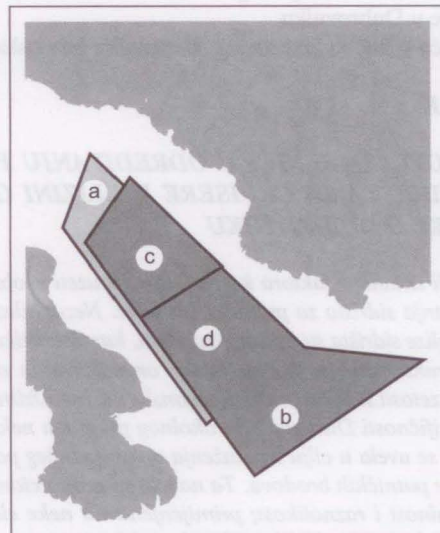


Figure 6 - Comparison between old and new anchorage position

7. CONCLUSION

It is not an easy task to design the anchorage area near the old port of Dubrovnik because of the delicate heritage from the past and the importance of the tourist facilities of today. After the implementation of the traditional factors, the solution for the anchorage area was not optimal. However, a convenient solution was found after the introduction of some new elements into the research. These elements are proportionality, traditionality and diversity applied to some aspects of ships and anchoring aquatorium. In order to meet all the requirements the anchorage area is extended and divided in two parts. The smaller part, closer to the city proposed for small cruisers and the bigger part, far from the city proposed for big cruisers.

Dr. sc. VEDRAN JELAVIĆ
E-mail: vedran.jelavic@unidu.hr
Mr. sc. ŽELJKO KURTELA
MILOŠ BRAJOVIĆ, dipl. ing.
Sveučilište u Dubrovniku
Ćira Carića 4, 20000 Dubrovnik, Republika Hrvatska

SAŽETAK

NEKI NOVI ČIMBENICI U ODREĐIVANJU POLOŽAJA SIDRIŠTA ZA CRUISERE U BLIZINI GRADSKOJ LUKE U DUBROVNIKU

Postoji nekoliko faktora koji se moraju uzeti u obzir kod osmišljavanja sidrišta za putničke brodove. Nezaobilazni elementi analize sidrišta su faktor sigurnosti, karakteristike akvatorija, karakteristike brodova, faktor onečišćavanja okoliša, faktor zauzetosti sidrišta i važeće zakonske norme. Uzimajući u obzir specifičnosti Dubrovnika i okolnog područja neka nova načela su se uvela u cilju iznalaženja najpogodnijeg područja za sidrenje putničkih brodova. Ta načela su proporcionalnost; tradicionalnost i raznolikost; primijenjena na neke elemente brodova i akvatorija u kojem ti brodovi sidre.

Takvim pristupom pronašla se optimalna zona sidrenja u posebno osjetljivom području pored staroga grada koja je zadovoljila sve subjekte zainteresirane za tu problematiku.

KLJUČNE RIJEČI

Dubrovnik, sidrište, veličina broda, sigurnost, broj putnika

LITERATURE

- [1] *ShipPax Guide 04*, Ferry, Cruise & Ro - Ro Register Yearbook, Simsonship, 2004.
- [2] "Podaci o dolasku i odlasku brodova u akvatorij sidrišta Gradske luke i Luke Gruž za period od 1. 4. 2004. godine do 16. 10. 2004. godine", Lučka kapetanija Dubrovnik, 2004.
- [3] *Peljar 1*, Jadransko more istočna obala, četvrto izdanje, Hrvatski hidrografski institut, Split, 1999.
- [4] "Pomorski zakonik", NN, 17/94., 74/94. i 43/96.
- [5] "Zakon o morskim lukama", NN, 108/95. i 6/96.
- [6] *Uredba o uvjetima koje moraju udovoljavati luke*, N. N. 22/95.
- [7] *Pomorska karta, Dubrovnik 83*, Hrvatski hidrografski institut, Split, 2001.
- [8] *Antun Ničetić, Povijest dubrovačke luke*, HAZU, Dubrovnik, 1996.
- [9] *Neven Jerković, Privatna zbirka fotografija putničkih brodova*, Dubrovnik, 2004.
- [10] *Irena Radić-Rossi, "Zaštitno podmorsko istraživanje stare dubrovačke gradske luke"*, Obavijesti, 1, Hrvatsko arheološko društvo, 2004, 109-117.
- [11] *Antun Ničetić, Nove spoznaje o postanku Dubrovnika, o njegovu brodarstvu i o plovidbi svetoga Pavla* (in print).
- [12] *A. Ničetić, V. B. Lupis, "Eksplozija austrijskog ratnog broda 'Triton' pred Lokrumom 1859. godine"*, Naše more, 5-6/1999.
- [13] *Ivo Perić, Razvitak turizma u Dubrovniku i okolici*, JAZU, Dubrovnik, 1983, 66.
- [14] *Ivan Penzar, "Sunčanost dubrovačkog područja"*, Otok Lokrum, Zbornik HED, Zagreb, 1989.
- [15] *B. Makljanić, B. Volarić, "Neke osobine klime Lokruma i šire okolice"*, Otok Lokrum, Zbornik HED, Zagreb, 1989.
- [16] *A. Ničetić, V. Jelavić, Ž. Kurtela, M. Brajović: Elaborat o izboru lokacije sidrišta za cruisere u akvatoriju grada Dubrovnika*, Ministarstvo mora, turizma, prometa i razvitka.