NATURA MONTENEGRINA, Podgorica, 9(3):499-506

INTEGRATED COASTAL MANAGEMENT OF THE SHIPS' BALLAST WATER IN THE MONTENEGRIN SEA PORTS

Vera VUKANIĆ [1], Zvonko IVANOVIĆ [2], Vladimir UROŠEVIĆ [3] and Aleksandra LJUSTINA [2]

1 State University Novi Pazar, Department for bio-chemistry and medical sciences, Biology, 36600 Novi Pazar, Serbia; e-mail: v_vukanic@yahoo.com
2 Criminal - Police Academy, Belgrade.
3 MUP SBPOK, VTK, Belgrade, Serbia.

Key words:
Ballast water, convention, standardization, biodiversity.

SYNOPSIS

The standardization of the ships' ballast water management at the Montenegrin sea ports (Bar, Kotor, Bijela, Tivat and Zelenika) should mean, firstly, the complete implementation of IMO „Convention for the control and management of the ships' ballast water and sediments"(London, 2005), the standardization of methods and techniques for the control of the level (capacity) and content of the ships' ballast tanks, as well as, the standardization of the processes for discharging and/or treating this water. What should produce prerequisite for preserving biodiversity and preventing pollution of the Montenegrin territorial sea. It should come to the considerable development of the knowledge level in the fields of marine transport and environmental protection, what should have as a result contemporary development of scientific thought through the application of the new theoretical and experimental methods for managing ballast water in our country.

INTRODUCTION

Ship's ballast waters[2] are a huge global transport mechanism that could make a bad influence to the sustainable development, not only of the Montenegrin sea and coast, but to the whole Adriatic region. The ships that dock in the Montenegrin port routinely are discharging large quantities of ballast water containing numerous Allochthonous marine organisms and other organic and inorganic substances. In

supporting this statement there are data on quantities of discharged ballast water, or dismissed prior to entry into the Bay of Kotor, over the past 2007. year, which were obtained in a detailed analysis of the arriving frequency of ships in the Gulf. In this context it should be noted that the ballast water in Montenegrin ports and their hinterland could cause major degradation of ecosystems, and cause negative effects on human health, economic activity and overall sustainable development, therefore there should be more closely explored their monitoring and treatment and they deserve more special attention.

ANALYSIS OF DATA ON BALLAST WATER IN KOTOR BAY IN 2007

Although there was no reliable information on quantities, sources, models or seasonal trends of discharging ship ballast water at the entrance or in very own Bay of Kotor in the past, some information about discharged ballast water in the past, 2007. year, were obtained on the basis of ships traffic frequency through the Gulf and their capacity (Vukanić et al., 2008). The corresponding graph is shown in Figure 1.

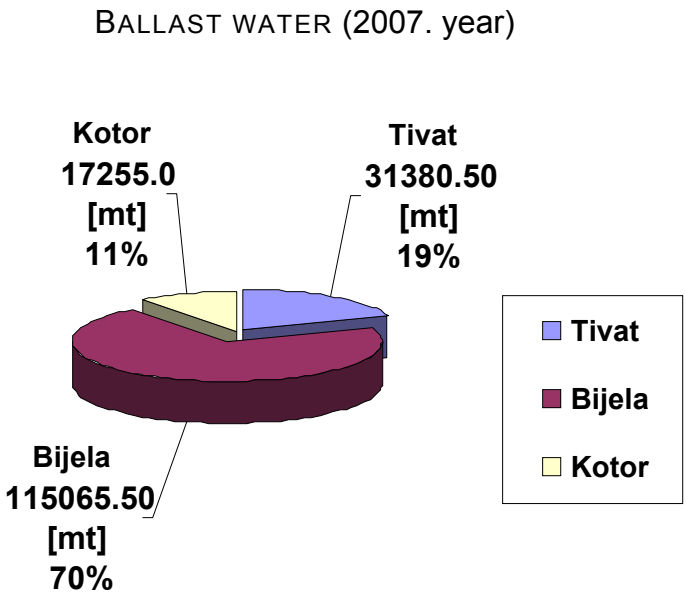

Figure 1: The estimated amount of ballast water, expressed in metric tons.

Over the past year, Port of Kotor, being the tourist port, mainly harbored Cruiser passenger ships, smaller or larger in size. In the research there were recorded frequencies of the docking of these ships in the port of Kotor, and on that basis, calculations of their estimations of ballast capacity that are needed to

regulate vessels trim and stability. In assessing the capacity of passenger ships ballast water, we have used the following rule (Shore, 2006): "A typical passenger ship - Cruiser, now has an average of 80 000 GRT. Such a ship, on average, should have 2000 metric tons of fuel and drinking water. Capacity of ballast water, in this case, is half to two thirds of the total capacity intended for fuel and drinking water. Ballast is distributed along the ship's tanks with a capacity to vary from ship to ship. The obtained numerical data, based on the density of passenger traffic and these heuristics are given in Table 1. The data in the table on the total amounts of ballast are given in the registration and metric tons.

Table 1: Review information on the ship ballast water to port of Kotor, in 2007. year.

IMO number	Ships name	GRT	Number of docking in The Bay of Kotor	Total GRT	Total ballast (min)	Total ballast (max)
6411964	Dalmacija	5619	3	16857	596.92	795.89
9210141	MSC Armonia	58625	1	58625	2075.96	2767.94
6806834	Logos II	4804	1	4804	170.11	226.82
9141807	Deuthschland	22496	1	22496	796.60	1062.13
9159830	Le Levant	3504	11	38544	1364.87	1819.83
6910544	Costa Marina	25558	2	51116	1810.06	2413.41
9156474	Regatta	30277	1	30277	1072.13	1429.51
6419057	Arion	588	21	12348	437.25	583.00
9156462	Insignia	30277	3	90831	3216.40	4288.53
9398008	Athena	1200	12	14400	509.92	679.89
7045803	Monet	1425	3	4275	151.38	201.84
7391422	Clipper Advent.	4376	1	4376	154.96	206.61
9320099	MSC Orchestra	92409	1	92409	3272.27	4363.03
7904889	Spirit of Advent.	9570	2	19140	677.76	903.68
9294197	Azzura	29407	12	352884	12495.89	16661.19
8802882	Corinthian II	4200	1	4200	148.73	198.30
9064126	Seven Seas Nav.	28550	1	28550	1010.98	1347.97
9210220	Royal Princess	30277	3	90831	3216.40	4288.53
8712178	Royal Clipper	4425	10	44250	1566.93	2089.24
8915433	Star Flyer	2298	4	9192	325.50	433.99
8802870	Hebridean Spirit	4200	1	4200	148.73	198.30
8807997	Seabourn Spirit	9975	2	19950	706.44	941.93
9192179	Silver Whisper	28258	2	56516	2001.27	2668.37
9200938	Nautica	30277	1	30277	1072.13	1429.51
9008598	Seabourn	9961	1	9961	352.73	470.30

	Legend					
6715372	The Calypso	11162	2	22324	790.51	1054.01
8954568	Elegant	131	1	131	4.64	6.19
7118404	Adriana	4490	1	4490	158.99	211.99
9408023	Phenix	643	1	643	22.77	30.36
6611863	Nat. Geogr. Edv.	3132	2	6264	221.81	295.75
8903923	Silver Cloud	16927	1	16927	599.40	799.20
7325629	Le Diamant	8282	1	8282	293.27	391.03
5018698	Salamis Glory	10392	1	10392	367.99	490.65
8897198	Ruby	2453	1	2453	86.86	115.82
Total:	[RT]			**1 183 215**	**41 898.55**	**55 864.73**
	[mT]			**417 675**	**14 790.19**	**19 720.25**

Unlike the previous case, in assessing the ballast capacity of ships, which sailed into the port of Tivat and White, we have used the following rule (Cohen, 1998): "Ballast water discharged from the ships are estimated at 26-54% of capacity of the ship, and for the ships that were loaded with the burden of 7-15% of capacity." Here, as the starting point, was used the presumption that the ships in the port of Tivat and White sailed in ballast, since, mostly, their visit purpose was repairing in shipyards. The corresponding numerical data on ballast water in these ports during the past year, are given in Table 2.

Measures that should be taken: What would certainly be carried out in the act when it comes to managing ship ballast water in our sea, in the shortest, would be included in the next (Bauk et al., 2008):

a) Full implementation of an internationally active "Convention on the supervision and management of ship ballast water and deposits", adopted by the IMO Conference in London, February 2005. year;

b) Analysis of flow and frequency of visits by foreign ships in territorial waters of Montenegro (forecasts, trends);

c) Standardization of methods to control the capacity (levels) of ballast water in ship`s ballast tanks;

d) Consultation and experts exchange of experiences;

e) Continuous biological monitoring: zooplankton, phytoplankton, and microbes (*Vibrio cholerae, Echerichia coli, Enterococci* sp.)

f) Regulation of control and management of ship`s ballast water and sediments.

Table 2: Review information on the ship ballast water to the port of Tivat and White, in 2007.

Port Tivat				
IMO number	Ships name	GRT	Ballast water	
			from 26% (min)	Up to 54% (max)
7623124	Clary	12165.00	3162.9	6569.1
8506517	Galassia	17599.00	4575.74	9503.46
8917417	Celtic Ambassador	3739.00	972.14	2019.06
8623975	Julianahaven	9489.00	2467.14	5124.06
9276743	Silvaplana	17951.00	4667.26	9693.54
9146118	Sir Jacob	6000.00	1560	3240
8614223	Cirene Star	5755.00	1496.3	3107.7
8703270	Sabrata Star	5755.00	1496.3	3107.7
Port of Bijela				
IMO number	Ships name	GRT	Ballast water	
			from 26% (min)	Up to 54% (max)
8419025	Shogun	25418.00	6608.68	13725.72
8852045	Bora Genc	794.00	206.44	428.76
9187136	Claudia	2999.00	779.74	1619.46
8626226	Cygnus	1283.00	333.58	692.82
9147435	Astro Altair	53074.00	13799.24	28659.96
9105009	Sea Gale	8633.00	2244.58	4661.82
7721598	Bothnia Carrier	5992.00	1557.92	3235.68
8010685	Dover Castle	26964.00	7010.64	14560.56
7602223	El Greco	16582.00	4311.32	8954.28
8318087	Vento di Levante	7335.00	1907.1	3960.9
9124380	Genda Senator	23897.00	6213.22	12904.38
9161314	Aral Sea	58129.00	15113.54	31389.66
8918722	Norheim	5658.00	1471.08	3055.32
8917572	Peruvian Reffer	7944.00	2065.44	4289.76
8917546	Chilean Reffer	7944.00	2065.44	4289.76
7819943	Humboldt Current	16992.00	4417.92	9175.68
7522239	Marina Star	4989.00	1297.14	2694.06
7910852	Algiers Star	7683.00	1997.58	4148.82
7320708	Vigo Stone	5355.00	1392.3	2891.7
Total:	[RT]	**366 118.00**	**95 190.68**	**197 703.72**
	[mT]	**129 239.65**	**33 602.31**	**69 789.41**

Something more explicit than these general goals and general strategy in improving the quality of ship ballast water management in Montenegrin ports should be in following:

- Implementation of the international "Convention on the control and management of ship ballast water and deposits. Providing recommendations to the competent authorities and institutions on the need for precise and mandatory data entry of ballast tanks capacity in all the relevant documentation that accompanies the ship. This also implicates the training of people working in the port and other relevant institutions involved in maritime transport, based on the implementation of the Convention;

- Analysis of the data showing ship`s flow and frequency of visits (that sail the world's seas) in the Montenegrin ports. The specification of the same according to: type, capacity, capacity of ballast tanks and the like. Identification of trends;

- Standardization of new methods to control the capacity (levels) of ballast water in ship ballast tanks, based on the recently developed theory of special transition function (Perović & Bauk, 2006). Analysis of the corrosion dynamics in ballast tanks, and comparison with the data entered in the appropriate documentation that accompanies the ship;

- Consultations and experiences exchange of experts on regional and international levels;

- Sampling of sea water, ie. Cloning sampling from the past year and a comparative analysis of results, in order to detect and confirm the presence of atypical species in the Montenegrin territorial sea (Vukanić, 2006a, 2006b, 2006c), all for the purpose of environmental monitoring and conservation of the marine biodiversity of the sea;

- Development of a preliminary study on the optimal locating and construction of reservoirs and/or stations for depositing and/or treatment (refining) of ship ballast water and sediment.

There are also some general recommendations concerning the control and management of ballast water in their board/unload:

- The port of ballast water uploading:

• Docking into the port with the maximum permissible burden. Board, if necessary, the minimum amount of ballast water. Board ballast water, again, just in case of need, from the proscribed depth, in order to reduce the possibility of taking up sediments and organisms from the bottom.

• Do not take ballast water, where it contains unwanted organisms, from trash deposites or docking areas, from areas that are marked as potentially dangerous (among other things for some diseases), from the waters of the "red tide" phenomenon or the shallow waters.

• At places where the incident occurred, the ships should avoid taking ballast.

• Ballast should not be taken at night when plankton organisms migrate to the surface.

• Do not take the burden in the shallow waters, which usually involves taking sediment and organisms from the sea bottom.

• Use a counter ballasting: ballast taken in drink water, if you will make deballast in salt and vice versa.

- The port of ballast water discharging:

• sail into the deballasting port with a minimum amount of ballast.

• Do not dicharge ballast near the zone with developed mariculture and marine protected area.

• The precautions delayed deployment of sediment from ballast tanks on the ground, and the like.

CONCLUSION

Loading and discharging of ballast water are essential components of ship management, because of:control trim and ships lay, the longitudinal stability of the boarding, and unloading of the cargo and the like. These water are contained in the tanks with different configurations and capacities, depending on the design and type of ship. Scientific studies conducted over the past twenty years show that different species of marine and freshwater organisms can not survive in the ballast water tanks, in terms of interoceanic and transoceanic transport. Some organisms may be able to resist in hibernation state and to "revive" after a certain period. These organisms can be loaded with ballast water, or they can develop mutations that will be later also unload with the burden. Several studies show a dramatic increase in the number of different organisms that can develop inside the ballast tanks during the trip (Johns et al., 2005), so that only one ship can unload thousands of individual invasive organisms. Although scientists are performing sampling and analysis of organisms in ballast water in many ports around the world constantly, and also in Montenegro, it is urgent to fully implement the standards of supervision and management of ballast water in order to further determine the nature and intensity of invasion and provide basic indicators the control of ballast water.

REFERENCES:

COHEN, A. 1998: Ships' Ballast Water and the Introduction of Exotic Organisms into the San Francisco Estuary Current Status of the Problem and Options for Management. - *San Francisco Estuary Institute*, Richmond, CA(USA), 81 pp.

JOHNS, D.G., EDWARDS, M. GREVE, W. & JOHN, A.W.G.S. 2005: Increasing prevalence of the marine cladoceran *Penilia avirostris* (Dana, 1852) in the North Sea. - *Helgoland Marine Research*, 59(3):214-218.

PEROVIĆ, S. & BAUK, S. 2006: An Approach on Special Trans Function Theory Base on the Conductive Fluid High Level Estimation. - *Modelling, Measurement and Control*, Series B, *Mechanics and Thermics*, 75(3): 75-85.

SHORE, T. 2006: Treating Ballast Water from Cruise Ships in the Port of San Francisco: Options and Feasibility. - *Project Marine*, LLC, CA.

VUKANIĆ, V. 2006a: Contribution to a knowledge distribution of *Sagitta friderici* Ritter-Zahony (Chaetognatha). - *Processing Rapport II International Symposium of Ecologists of Montenegro*, Kotor, Montenegro. pp**:** 49-56.

VUKANIĆ, V. 2006b: One-year observation on the population structure of Cladocera in Boka Kotorska Bay (Coastal waters of Southern Adriatic). - *Processing Rapport MWWD & IEMES 2006*, pp**:** 1-14.

VUKANIĆ, V. 2006c: Note on appearance of scyphomedusa *Chrysaora hysoscella* (Linne, 1766) at Bay of Kotor (Southern Adriatic). - *Natura Montenegrina*, Podgorica, 5:49-53.

VUKANIĆ, V., BAUK, S. & IVOŠEVIĆ, Š. 2008: Changes in the Zooplankton Biocenosis of Bay of Boka Kotorska due to Introduction of Alien Species in Ballast Waters. – *5th International Conference on Marine Waste Water Discharges (MWWD) and Coastal Environment Projects*, Cavtat-Dubrovnik, Croatia, October 27-31, 2008, (in press).

Original research article
Received 20 August 2010