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ECONOMIC ASSESSMENT OF THE IMPLEMENTATION OF THE BALLAST WATER MANAGEMENT CONVENTION IMPLEMENTATION IN THE REPUBLIC OF CROATIA

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SUMMARY

The indentation of the Adriatic Sea deeply into the European continent, rugged coastline, particularly the east coast, as well as the economic development of the Republic of Croatia favoured development of numerous ports, harbours and marinas. Croatia has six major ports serving international trade, in all larger coastal cities: Rijeka, Zadar, Šibenik, Split, Ploče and Dubrovnik and hundreds of secondary ports and marinas. In recent years, the continuous increase in investments and development as well as their growing importance for surrounding areas could be clearly noticed, particularly the investments in infrastructure and transport capacities. These developments clearly resulted with steady increase in shipping traffic and as a consequence there is a corresponding increase in the amount of discharged ballast waters.

It is quite clear that existence of indigenous marine organisms in one ecosystem may be endangered by transfer and introduction of invasive alien species (IAS), and maritime traffic is the most important means of such transfers. Transfer of different organisms by ships is possible via ballast waters, hull fouling and cargo. Ballast waters transfers, as an unavoidable activity of routine ships operations while underway or during loading and unloading of cargo, is by far the most important transfer vector of the largest number of organisms.

Introduction of invasive alien species and pathogens through ballast into coastal waters worldwide caused significant negative impacts to biodiversity, economy, tourism and man's health. Any introduced species in different environmental conditions can become invasive. Invasive species alter the composition of biological communities and habitats around the world including the Adriatic Sea. The devastation of the particular ecosystem could reach such proportion that its recovery to initial state is extremely costly and/or time consuming, and in some cases impossible. And changes of the ecosystem can take a variety of forms while their adverse effects could impact all activities related to the use and the exploitation of the sea.

The purpose of this Study is to assess the economic values of those (known) hazards that may threaten different resources along the east Adriatic Sea coast (coast of the Republic of Croatia) by invasion of marine alien species, as well as to estimate the cost of introduction of precaution measures i.e. the implementation of the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention).

According to the assessment conducted:

- The largest economic impact of introduction of invasive species via ballast waters is possible in the tourism where the outcomes of the worst case scenario are estimated at 2.7 billion USD.
- The losses in the fishing sector, if the worst case scenario takes place, are estimated at 110 million USD and additional 18 million USD if aquaculture sector is ravaged at the same time.
- Other costs to the community or the industry due to introduction of invasive species are mostly related to coastal infrastructure (ports, marine, power plants, municipal drains ...) and to human health, and are estimated at approximately 17.5 million USD.

- The BWM Convention implementation costs to be compensated by the Administration are estimated at 1.4 million USD.
- Certain activities related to of capacity building have already been implemented, and related costs are already remunerated.
- The costs of the BWM Convention implementation that are supposed to be paid by ship owners and related to ships flying Croatian flag, are estimated at 189 million USD.

1 INTRODUCTION

The Study is prepared following a consulting services agreement concluded between the Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea - REMPEC, as a client, and the Faculty of Maritime Studies in Rijeka, University of Rijeka, as a contractor, and for the Ministry of Maritime Affairs, Transport and Infrastructure, as a final beneficiary.

The aims of the Study are:

1. to assess economic impacts, resulting by introduction of alien invasive species in the Adriatic Sea by ballast waters transfer, on activities that are or may be exposed to such hazards, and
2. to assess costs and investments of implementing the provisions of the International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004, and measures provided by that international convention and related guidelines.

Assessments of values and costs are made according to the guidance given in the *Economic Assessment for Ballast Water Management: A Guideline, GloBallast Monograph Series No. 19,* and should *inter alia*:

- *"… demonstrate and quantify the economic values of an ecosystem and the potential impacts to these values by introduction of an invasive species;*
- *… integrate business and economic concerns into environmental management;*
- *… identify potential management plans or actions to minimize the probability of an invasive species incursion;*
- *… support national decisions with regards to international policy instruments, such as ratification of the BWM convention;*
- *… support preparation of a National Ballast Water Management Strategy (NBWMS)*
- *… specify funding needs to implement management policies, such as the construction of facilities to accept ballast water."*

The Study is prepared taking into account the following assumptions and principles:

- data used are those officially published and considered as the most accurate at the time; dedicated data collection was not conducted for the purpose of this study;
- numerical estimations are based on the data published for the year 2012; if those data were not deemed sufficiently representative or reliable the mean values for the period 2010-2012 were used;
- the *Total Economic Value*[1] concept was applied for the value assessment, as far as it was possible and appropriate in the given circumstances.

[1] TEV concept assumes estimation of the respective values as the sum of *Direct Use Value* and *Non-use Value*. In this Study *Direct Use Value* has been assessed based on the market value of certain activities while the *Non-Use Value* has been assessed as appropriate ratio of the market value. *Non-Use Value* was not

assessed if a particular activity does not have a proper and associated market value.

2 ECONOMIC IMPACT ASSESSMENT OF INVASIVE ALIEN SPECIES ON EASTERN ADRIATIC COAST

Economic impacts assessment of invasive species' possible consequences is based on available data and the following premises:

- all estimates refer to the annual value;
- fishery production data are taken from the Croatian Bureau of Statistics report "Marine Fisheries in the 2012" and reports the Ministry of Agriculture publishes on its website;
- assessment of damages that commercial species can suffer is based on the average market price of commercial species; it is estimated at 3.35 USD/kg;
- damage assessment for species being cultivated is based on the average market price; it is estimated at 6.70 USD/kg;
- estimation of worst-case scenario to commercial species is based on experiences with *Mnemiopsis Leidy* in the Black Sea, as it was published in international sources;
- damage assessment for less important commercial species takes into account the fact that their area distribution across the Adriatic Sea is much larger (if compared with most important commercial species) and that as a group they include several, significantly different species;
- assessment of the quantities caught by those involved in sport and recreational fishing is based on the assumed amount of 10 kg per vessel (boat or yacht) annually; economic value of the quantities assumed to be caught as a part of sport and recreational activities is not carried out due to a high variety of equipment used, and because the majority of the catch is used by those involved and are not offered at the market;
- assessment of the worst-case damages that coastal tourism could suffer is based on an hypothetical event with so severe harmful effects and adverse changes of the local ecosystem that tourism and related business activities are significantly minimized or completely cancelled for at least one year; the amount estimated is approximately equal to the annual production of the most significant tourist county in the Republic of Croatia (Istria);
- value of the worst-case damages to the local communities and industries is assumed to be approximately equal to annual production of the major industrial production that can be jeopardized (i.e. large city's drainage, major power plants).

Table 1 Assessment of the *Direct Use Value* exposed to harmful effects

Direct use values	Total yield/catch	Number employed or dependent	Total value of Sector	Total value of sector as % of GDP	Vulnerability to IAS (H,M,L)	% loss (worst case scenario)	$ loss (worst case scenario)[2]
Fisheries	Tons/year						
Commercial	**53.900**	3.500					
Sardina pilchardus	43.600		178 M USD	0,4%	M	60%	107 M USD
Engraulis encrasicolus	8.100				H		
Mullus surmuletus	1.300				M		
Merluccius merluccius	900				M		
Others	9.100		30 M USD	-	M	10%	2,7 M USD
Recreational	1.000	NA	NA	NA	L	-	-
TOTAL (fishing)	64.000	13.000					110 M USD
Aquaculture							
Thunnus thynnus	1.900				H		
Dicentrarchus labrax	2.400				H		
Sparus aurata	2.100				H		
TOTAL (aquaculture)	6.400	1.000				40%	18 M USD
Other living harvested resources							
Food production	330	200	1,2 M USD	-	H	50%	0,6 M USD
TOTAL (fishing, aquaculture, food production)	78.300	25.000	263 M USD	0,50%		-	-
Coastal tourism							
Tourist visits	9,8 M tourists				L		
Marinas	196.000 yachts	2-3.000	146 M USD		L		
Leisure and sport	103.000 boats				M		
TOTAL (Coastal tourism)			9 B USD	15,40%		30%	2,7 B USD

[2] All values are rounded to the higher value.

Table 2 Assessment of potential additional costs to local communities or industry due to intense introduction of IAS

Additional costs to society or industry	Number employed or dependent	Total value of Sector	Total value of sector as % of GDP	Vulnerability to IAS (H,M,L)	Type of costs possible incurred	$ loss (worst case scenario)
Shipping and port activities	27.000 seafarers 250.000 persons	320 M USD	0,6%	NA	NA	NA
Coastal infrastructure						
Ports	4-5.000	NA		M	Cleaning costs	2 M USD
Marinas[3]	2-3.000	146 M USD	-	M	Cleaning costs	2 M USD
Power plants[4]	500 (8)	-	-	H	Cleaning costs	2 M USD
Municipal drains and other discharges	-	-	-	H	Cleaning costs	4 M USD
Other				M	Cleaning costs	1 M USD

Table 3 Assessment of potential additional costs to public health due to intense appearance of IAS

Public health	IAS (with potential impact to human health)	Possible impact pathways	Possible impacts	Number affected	Treatment costs (per person)	$ cost (worst case scenario)
Vulnerable groups	Toxic algae, pathogens (cholera)	Food, touch	Poisoning	1% of coastal population	500 USD	6,5 M USD

[3] Values are related to the cost of maintaining the cleanliness of the sea as to ensure expected visual effect that is expected by average clients.

[4] Values are related primarily to the cooling systems using sea water and water discharges into the sea.

3 ESTIMATED COSTS OF THE BWM CONVENTION IMPLEMENTATION IN REPUBLIC OF CROATIA

Estimated costs of the BWM Convention implementation in Croatia are based on available data and the following premises:

- cost of a working hour is estimated at the amount of 20.000,00 HRK gross for 182 working hours; this amount corresponds approximately to the regular costs of employees with a university degree and several years of working experience; it is estimated that the majority of people involved in the process of implementing the provisions of the Convention need to have such level of education while only a small part of the operatives will have the secondary school education; based on the above premises the cost of a working hour is estimated at 20 USD;
- the administrative work required for the Convention implementation will be assigned to administrative officers and will take place mostly at the Ministry headquarters and will not require significant travelling costs ; contrary to that, those who will have to implement operating procedures are situated and work along the coast of the Adriatic Sea and are regularly required to travel either to the remote sites or to the headquarter in Zagreb; in both cases the majority of assignments will be carried out by civil servants, employees of port authorities and other persons involved in the convention implementation who are employed in accordance with customary employment policy; consequently, the total cost of travel and other expenses associated with these duties are estimated at 50% of a working hour or 10 USD per working hour;
- all travel and working costs include taxes;
- the costs of assignments entrusted to third parties are estimated without taxes;
- costs that are periodically incurred are estimated on an annual basis;
- costs to the shipping, bring about by the implementation of the Convention, are based on expenditures estimated for the steel ships, trading in international trade and able to carry ballast waters, with more than 400 gross tonnage; it is assumed that 150 such ships are registered in the Republic of Croatia.

It should be noted that the Republic of Croatia has already implemented certain measures defined or assumed by the BWM Convention provisions. The costs incurred during their development and implementation are included in the table below, regardless the fact that they have already been spent.

Table 4 Estimated costs of the BWM Convention implementation (1)

Issue	Obligation to whom flag/port/industry	Cost to whom flag/port/industry	Type of cost (cash/time in kind, etc.)	Efforts (working hours)	Estimated cost ($)
Preparatory Phase					
Capacity building, education and communication					
National task force meetings	Flag	Flag	time in kind	300 working hours	9.000 USD*[5]
Training (CME, PBBS, etc.)[6]	Flag	Flag, PA[7]	time in kind	1.000 working hours	30.000 USD
Regional task force meetings	Flag	Flag, PA	time in kind	120 working hours	3.600 USD*
Other	Flag	Flag, PA, PO[8]	time in kind	80 working hours	2.400 USD*
Legislative, policy and institutional reform					
National BW status assessment	Flag	Flag, PA	time in kind, cash	400 working hours	12.000 USD*
Economic assessment	Flag	Flag	cash	-	12.000 USD
National BWM strategy	Flag, industry	Flag, PA, PO	time in kind, cash	100 working hours	3.000 USD*
Legal review and drafting	Flag	Flag	time in kind	100 working hours	3.000 USD*
Other	Flag, PA	Flag, PA	time in kind	50 working hours	1.500 USD*
Port biological baseline studies (research and monitoring)	Flag	Flag, PA	cash	-	250.000 USD[9]*
Risk assessments	Flag	Flag	cash	-	25.000 USD

5 Costs highlighted with (*) are already completely or partially remunerated or foreseen in the budget of the Republic of Croatia for the next term.

6 Compliance, Monitoring and Enforcement – CME, Port Biological Baseline Survey – PBBS

7 Port Authorities

8 Port Operators

9 Baseline studies are planned for sea areas adjacent to five most important Croatian ports: Rijeka, Split, Ploče, Dubrovnik and Šibenik, covering approaching waterways and surrounding sea areas.

Issue	Obligation to whom flag/port/industry	Cost to whom flag/port/industry	Type of cost (cash/time in kind, etc.)	Efforts (working hours)	Estimated cost ($)
Flag state obligations					
Establishing procedures for issuing BWM Certificate	Flag	Flag	time in kind	50 working hours	1.500 USD*
Approval of ships' BWM Plans	RO[10]	Industry	cash	-	300.000 USD[11]
Type approval of BWM systems	RO	Industry	cash	-	20.000 USD
Surveys	RO	Industry	cash	-	150.000 USD[12]
Approval of exemptions	RO	Industry	cash	-	30.000 USD
Training	RO	RO	time in kind	500 working hours	15.000 USD[13]
Other	Flag, RO	Flag, RO	time in kind, cash	-	20.000 USD
Port state obligations					
Compliance monitoring and enforcement	Flag	Flag	time in kind	-	-
Inspection of ships	Flag	Flag	time in kind	400 working hours	12.000 USD[14]
Introduction of BW reporting form	Flag	Flag	time in kind	30 working hours	900 USD*
Sampling	Flag, PA	Flag	time in kind, cash	-	400.000 USD[15]

[10] Recognized Organizations

[11] Cost refers to two working days of an experienced expert for each ship engaged on ocean-going voyages. It is assumed that plans have to be drafted for 150 ships.

[12] Cost refers to one working day of an experienced expert to be spent on equipment inspection and associated procedures for each ship engaged on ocean-going voyages.

[13] The cost includes a training program for two groups of 8 persons and lasting 25 contact hours.

[14] Annual survey of 200 ships is estimated, assuming that two working hours is spent on average for each equipment inspection.

[15] Cost per one sampling is estimated at 10,000 USD with 40 tests conducted annually. It is assumed that the expected technology development in years to come and before Convention implementation will facilitate sampling with satisfactory reliability and matching up estimated cost.

Sediment reception facilities	Flag, PO	Industry	cash	-	100.000 USD[16]
Communication of requirements to IMO and other MS	Flag	Flag	time in kind	100 working hours	3.000 USD
Communication of BWM requirements to ships	Flag	Flag	time in kind	200 working hours	6.000 USD
Other	Flag	Flag	time in kind	1.000 working hours	30.000 USD[17]
Issue	**Obligation to whom flag/port/industry**	**Cost to whom flag/port/industry**	**Type of cost (cash/time in kind, etc.)**	**Efforts (working hours)**	**Estimated cost ($)**
Industry obligations					
Training of crew members and onshore personnel	Industry	Industry	cash	-	3.200.000 USD[18]
BWM Plans and Record books	Industry	Industry	cash	-	375.000 USD[19]
BW Exchange (D-1)	Industry	Industry	cash	-	125.000 USD[20]
BW Treatment (D-2) - Equipment	Industry	Industry	cash	-	60 M USD[21]
BW Treatment (D-2) - Operational cost	Industry	Industry	cash	-	75.000 USD[22]
Other	Industry	Industry	time in kind, cash	-	50.000 USD[23]
Other					

16 Costs of disposal of sediments and associated waste are based on the assumed price of 200 USD per ton and the total quantity of 500 tons per year (sediments and mixed waste material). Building of dedicated facilities is not foreseen for the time being; therefore, costs include transportation costs and costs for modernization of already present facilities used for industrial wastes disposal to accept sediments from ships.

17 The cost includes additional education and participation on seminars and conferences.

18 The estimated cost includes the preparation and implementation of training programs for 8,000 Croatian officers valued at 400 USD per person.

19 The estimated value refers to annual costs of all ships flying the Croatian flag.

20 The estimated cost is 0.05 USD per ton of ballast water. The expected volume of ballast waters discharged in Croatian ports of the Adriatic Sea is 2.5 M tons per year and includes also ballast waters transferred between Adriatic ports.

21 Taking into account the average size of ships under the Croatian flag, the average cost of equipment installation is estimated at 400,000 USD per ship.

22 The estimated cost is 0.03 USD per ton of ballast water. The expected volume of ballast waters discharged in Croatian ports of the Adriatic Sea is 2.5 M tons per year and includes also ballast waters transferred between Adriatic ports.

23 Cost relates to additional education and collaboration among relevant government departments.

Port biological monitoring programs	Flag, PA, PO	PA, PO	cash	-	150.000 USD[24]
Port BWM Plan development	PA, PO	PA, PO	cash	-	60.000 USD[25]
Other	PA, PO	PA, PO, Industry	cash	-	10.000 USD[26]

[24] Cost relates to the annual amount required to monitor the status of the marine ecosystem and its comparison with state determined in baseline studies, and provides for gradual increase of area of coverage from the main ports.

[25] Cost is estimated as the average annual cost for development of control and management of ballast water in ports of the Republic of Croatia.

[26] Cost is estimated as the average annual cost and mainly refers to promoting costs of the importance of control of invasive species and the maintenance of ecological balance of marine environment.

4 CONCLUSIONS

The most important conclusions of this study are:

1. The overall costs of the implementation of the BWM Convention in Croatia are significantly smaller than assumed negative economic impacts due to the potential introduction of invasive alien species transferred via ballast waters.
2. The overall costs of the implementation of the BWM Convention and economic impacts is estimated according to the guidance given in the *Economic Assessment for Ballast Water Management: A Guideline, GloBallast Monograph Series No. 19,* officially available statistical data for year 2012 (where exist and available), and assumptions adopted and used during assessment preparation.
3. The most significant economic impact of invasive species introduced in ballast waters is expected in the tourism and related sectors where the worst case scenario is estimated at 2.7 billion USD.
4. The total loss in the fishing sector in the worst case scenario is estimated at 110 million USD per year. An additional 18 million USD of losses could be expected in the aquaculture sector.
5. The most important costs to the local communities and industry due to invasive species introduced via ballast waters are related to coastal infrastructure (ports, marinas, power plants, municipal drains, etc.) as well as to human health and is estimated at approximately 17.5 million USD.
6. Costs of the BWM Convention implementation include the costs of institutional capacity building (including training and communication) as well as costs incurred when Administration acts as a Flag State or/and Port State, and are estimated to 1,4 million USD.
7. Certain costs, mostly those related to the building of administrative capacities required to implement the BWM Convention has already been remunerated; additional financial means are already foreseen in the state budget of the Republic of Croatia.
8. Costs of the BWM Convention implementation related to the industry, primarily to be borne by shipping and related to the ships flying the Croatian flag, are estimated at 189 million USD.

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