

## Implementation of institutional and technical instruments for the protection of the Adriatic and the Baltic marine environment: a comparison

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*The paper studies the vulnerability and protection of marine environments of two semi-closed seas, the Baltic and the Adriatic, in terms of physical and socio-economic factors. Institutional and technical instruments and policies of protection, at global, pan-European, EU and regional levels, are reviewed. The pioneering role (for Baltic) of the Helsinki Convention, signed in 1974 by the Baltic coastal states, is highlighted, whereby all sources of pollution were made subject to one single instrument. There is no similar comprehensive agreement yet on the semi-closed Adriatic Sea, but protection of the Adriatic Sea is included in the Barcelona Convention signed in 1976 by 16 states and the European Union (presently there are 22 parties to the convention) which was a follow up of the pioneering (for Adriatic) Mediterranean Action Plan signed by contracting parties in 1975.*

*The Baltic region, with 90 million people in its catchment area, is economically well developed; out of nine of its coastal states, eight are EU members. The catchment area of the Adriatic, home to about 15 million people, is characterised by even larger socio-economic contrasts, with Italy as the dominating player as for population size and the economy.*

*The marine and coastal environmental burdens of both the Baltic and the Adriatic are mainly due to agriculture, industry, shipping, fisheries, and tourism, not to forget the legacies of unsustainable past. The Adriatic, a busy transportation route for oil vessels, is one of the most vulnerable areas in the Mediterranean.*

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**Key words:** Adriatic Sea, Baltic Sea, marine environment, multilateral protection instruments, technical protection instruments, HELCOM, regional protection policies

### INTRODUCTION

The Regional Seas' Programme, launched in 1974, is one of UNEP's most significant achievements of the past 35 years (UNEP, 2015). It addresses the accelerating degradation of

oceans and coastal areas by engaging neighbouring countries in actions to protect their shared marine environment. By now, more than 143 countries participate in 13 programmes. Of particular interest is the protection of marine and coastal environment in sensitive land-locked

water bodies like the Caspian, or semi-closed seas as the Baltic Sea. For the first time ever, all the sources of pollution around an entire sea were made subject to a single convention, signed in 1974 by the Baltic coastal states, entering into force in 1980. In the light of political changes, and developments in international, environmental and maritime law, a modified Convention was signed in 1992 by all the states bordering on the Baltic Sea, and the European Community, and entered into force in 2000. The Helsinki Convention (HELCOM, as it is called in shorthand, covers the whole of the Baltic Sea area, including inland waters as well as the water of the sea itself and the sea-bed.

HELCOM Parties do not include all tributaries (for example Belarus is not a Party) but they are included in the action programme (JCP); hot spots are also found inland. Measures are taken in the whole catchment area of the Baltic Sea to reduce land-based pollution – a unique and, for the Baltic, pioneering approach (HELCOM, 2015c). The present Contracting Parties are Denmark, Estonia, European Community, Finland, Germany, Latvia, Lithuania, Poland, Russia and Sweden.

In contrast to the Baltic Sea, no similarly comprehensive agreement has been concluded yet, specifically focused- on the protection of the semi-closed Adriatic Sea, the surface of which is about 1/3 of that of the Baltic Sea. The protection of the Adriatic is covered in a different, more fragmented way by a variety of instruments, in particular by the Barcelona Convention for Protection against Pollution in the Mediterranean.

The main motivation of the present paper is to study the differences and similarities in challenges to marine environments in the Baltic and the Adriatic regions, to compare the process of evolving institutional and technical instruments of protection, primarily multilateral, and to draw conclusions with respect to the measures undertaken and/or development of environmental policy.

Territorial disputes, including those under the law of the sea, are not addressed by the present authors. Neither is the challenge of

regional adaptation to the consequences of climate change, since it was the topic of a recent paper by the authors (BOŠNJAKOVIĆ & MRŠA HABER, 2015).

### **Socio-Economic, Hydrographic and Oceanographic Characteristics of the Adriatic and the Baltic Marine Area**

#### **Socio-economic characteristics of the two regions in geopolitical comparison**

The Baltic Sea is a region characterised by relatively high economic wealth, a high level of education and in most countries a high level of environmental awareness among its inhabitants. Eight out of the nine riparian countries are EU member states, with corresponding prospects for further growth.

The Adriatic Sea is characterised by larger socio-economic contrasts. Three out of the six coastal states are EU members: Croatia, Italy and Slovenia, whereas the three others are in different phases of approximation to the EU. Italy, as one of its six coastal countries, is the dominating player in terms of population size and the GDP.

The socio-economic differences are discussed here in terms of four indicators: Gross Domestic Product (GDP); Human Development Index (HDI); Environmental Performance Index (EPI); and Transparency rank. They are summarised in Table 1.

Column 2 describes the relative economic strength of a country in terms of the Gross Domestic Product (GDP) per inhabitant in 2014. In the Adriatic region, there is a sub-division between the three EU member states with GDP *per capita* above \$ 20.000 (Croatia, Italy, Slovenia), and the three other countries with GDP *per capita* of \$ 15.000 or less (Albania, Bosnia and Herzegovina, Montenegro). In the Baltic region, the GDP *per capita* of all riparian states is above \$ 20.000, but particularly high (above \$ 40.000) for Denmark, Finland, Germany and Sweden.

Column 3 gives the UNDP Human Development Index (HDI) of a country for the year 2013, based on: life expectancy at birth; mean and expected years of schooling; and gross national

Table 1. Socio-economic characteristics of riparian countries in the Adriatic and Baltic Sea regions

Country	GDP per capita (\$ x1000) in 2014 (WIKIPEDIA, 2015b.)	HDI rank in 2013 (UNDP,2014)	EPI rank in 2014 (EPI, 2014)	Transparency rank in 2014 (TRANSPARENCY INTERNATIONAL, 2015)
Albania	11	95	67	110
Bosnia&Herzegovina	10	86	107	80
Croatia	21	47	45	61
Italy	35	26	22	69
Montenegro	15	51	62	76
Slovenia	30	25	15	39
Denmark	44	10	13	1
Estonia	27	33	20	26
Finland	40	24	18	3
Germany	46	6	6	12
Latvia	24	48	40	43
Lithuania	27	35	49	39
Poland	25	35	30	35
Russian Federation	25	57	73	136
Sweden	46	12	9	4

income *per capita*. Column 4 gives the Environmental Performance Index (EPI), based on environmental health criteria, and on ecosystem vitality. The riparians of the Adriatic range from the very good rank 15 (Slovenia) to the rather disappointing rank 107 (Bosnia and Herzegovina). The eight EU riparians of the Baltic Sea range in EPI rank between place 6 (Germany) and place 49 (Lithuania), with new EU member states performing significantly less well than the older ones. However all EU member states perform by far better than the Russian Federation (rank 73). Column 5 gives the Corruption Perceptions Index, a measure of the perceived levels of public sector corruption, provided by the independent organisation Transparency International in 175 countries and territories. In this respect, the Adriatic riparians rank relatively low, with the best mark for Slovenia (rank 39), and by far the worst for Albania (rank 110). In the Baltic Sea region, all riparian EU states do quite well, with Denmark, Finland and Sweden placed at the world top (ranks 1, 3 and 4), while Russian Federation is placed at the very disappointing rank 136.

Taken together, the differences in the above mentioned and discussed socio-economic characteristics and indicators – GDP *per capita*, Human Development Index, Environmental Performance Index, Corruption Perceptions Index, may be partly responsible for the differing attitudes on, participation in and development and implementation of various instruments and mechanisms addressing environmental protection, both between individual countries, as well as between the two regions as a whole (as discussed in Chapters 2 and 3).

A main socio-economic difference is that at least four of the Riparians of the Baltic Sea (Sweden, Denmark, Finland and Germany) are wealthy and have very high environmental policy ambitions, based on broad popular endorsement. These four countries plus Estonia are among the 20 with the highest EPI worldwide. Conversely, in the Adriatic region only Slovenia ranks among the 20 best. It may be added that among the 22 Contracting Parties to the Barcelona Convention, only two – Slovenia and Spain – are among the 20 with the highest EPI worldwide.

## Hydrography and oceanography of the Adriatic and the Baltic Sea

Table 2. contains some basic hydrographic and oceanographic attributes of observed regions. The Baltic catchment area is almost 7 times larger than that of the Adriatic; Baltic Sea has twice the length of the Adriatic, but almost the same maximal width. The average depth of the Adriatic Sea is about 4 and half times bigger than that of the Baltic.

### Currents patterns in the Adriatic

The physical processes occurring along the two opposing coasts of the Adriatic Sea differ markedly in their characteristics. Water exchange between the semienclosed basins of the eastern coast and the open sea is mainly forced by the local wind. An incoming current is found along the eastern Adriatic coast, carrying the saline Levantine waters into the Adriatic, while less saline water flows out of the Adriatic along the western coast. The current gradients are the primarily cause for the general cyclonic (counterclockwise) circulation. The incoming current is more pronounced along the eastern coast in winter, while the outgoing current is more pronounced along the western coast in summer. This seasonal rhythm is primarily under the influence of gradient currents and the seasonal changes in the winds. In summer, the dominant northwestern wind (“maestral”, in Croatian) increases the outflow of marine waters in the surface layer, while the currents

in winter are under the influence of the southeasterly wind (sirocco, in Croatian “jugo”) that increases the inflow of marine water (CROATIAN HYDROCARBON AGENCY, 2015). The shelf area along the western coast is dominated by the Po River outflow, which in winter mostly remains confined to a coastal boundary layer, whereas in summer it spreads to the open sea as well (ORLIĆ *et al.*, 1992).

### Current patterns in the Baltic

The modeled circulation of the Baltic Sea consists of several bathymetry-controlled and mostly cyclonic gyres. The surface circulation pattern varies over the annual cycle. During the period from October to March, currents are relatively strong. A cyclonic circulation around the Proper Baltic exists with the mean current velocities along the coast up to  $6 \text{ cm s}^{-1}$ . The main flow in the upper 33 m continues to the north along the eastern side of the Proper Baltic towards the southwestern coast of Finland. Portions of this flow enter the Gulf of Finland to the east and the Gulf of Bothnia to the north but its major part recirculates to the south towards Gotland. During winter, the circulation there evolves into a 200 km diameter mesoscale cyclonic gyre occupying the northern part of the Proper Baltic. The southward current splits north of Gotland into a western branch following the coast of Sweden and into an eastern branch along the eastern side of Gotland. To the north, a semi-enclosed cyclonic gyre occupies the entire Bothnia Sea. In spring, the upper

Table 2. Basic hydrographic and oceanographic attributes of the Adriatic and the Baltic region

Region	Catch-ment area [km <sup>2</sup> ]	Max. length [km]	Max. Width [km]	Average depth [m]	Water volume [km <sup>3</sup> ]	Residence time [years]	Average river runoff [m <sup>3</sup> /s]	Mean annual precipitation [mm]
Adriatic	235 000	800	200	253	35 000	3.4±0.4	3 900 (SEKULIĆ & VERTAČNIK, 1996)	1 020 (CUSHMAN-ROISIN <i>et al.</i> , 2001)
Baltic	1641 650	1 600	193	55	21 700	25-35	12 968 (KRONSELL & ANDERSSON, 2014)	750 (HELCOM. 2007)

ocean circulation is less organized, it weakens and becomes less defined during summer. There are two regions where circulation reverses from cyclonic in November to anticyclonic in February: one in the northern Gulf of Bothnia and another one in the northernmost part of the Baltic Proper. The local circulation patterns modeled in the Slupsk Farrow suggest high temporal variability of the mass transport (MASLOWSKI & WALCZOWSKI, 2002).

### **Drainage basins**

A comparison of the Adriatic and the Baltic drainage basins can be made on the basis of a comprehensive report by UNECE (UN ECONOMIC COMMISSION FOR EUROPE, 2011). For the Adriatic, only eight water basins were included in the UNECE assessment: Po River Basin, Isonzo/Soča, Krka, Neretva, Bileća Lake, Drin, Lake Skadar/Shkoder and Buna/Bojana. The Po River basin, for 94% on the territory of Italy, dominates by far all other basins both in riverine runoff and in the amount of pollutants. The 33 drainage basins of the Baltic Sea include Narva, Lake Peipsi/Chudskoe, Daugava, Lieupe, Neman, Vistula and Oder/Odra, containing large-scale industrial and agricultural activities.

Due to above facts - smaller sea water volume, much smaller average depth, smaller annual precipitation, but also less favourable current patterns, and a much longer residence time – it seems likely that the pollutants in the Baltic Sea accumulate faster than in the Adriatic. Moreover, the waterborne input of pollutants has been determined largely by riverine runoff, which is three times higher in the Baltic than in the Adriatic.

### **Institutional instruments – policies and laws – relevant for the environmental protection of the Adriatic and Baltic Sea**

Several levels of policies and instruments are of relevance for the protection of marine environments. Since in the present paper the focus is not on the domestic but on the regional level, only policies with a substantive transboundary

and/or regional impact shall be considered. The policy and legal levels addressed are:

- International treaties and conventions with universal validity
- International conventions at the pan-European (UNECE) level, focusing on environment.
- EU policies and legislation relevant for marine environment.
- policies and agreements with regional character, such as the Helsinki Convention on the protection of the Marine Environment of the Baltic Sea Area, the Barcelona Convention, or the EU regional strategies.

For each of the four levels, a selection of the most relevant instruments will be briefly characterised by their scope, and acceptance, by the coastal states in the Adriatic and Baltic regions.

#### **International treaties and conventions with general validity**

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (1989, Basel, Switzerland) (UNEP, 2011). Its objective is to protect human health and the environment against the adverse effects of hazardous wastes, its principal aims are: (a) the reduction of hazardous waste generation and the promotion of environmentally sound management of hazardous wastes; (b) the restriction of transboundary movements of hazardous wastes except when in accordance with the principles of environmentally sound management; (c) a regulatory system applying to cases where transboundary movements are permissible. All coastal states of the Adriatic and the Baltic have ratified it and are Parties to it.

Convention on Fishing and Conservation of Living Resources of the High Seas (1958) was designed to solve through international cooperation the problems involved in the conservation of living resources of the high seas, considering that some of these resources are in danger of being overexploited (WIKIPEDIA, 2013). Entered into force in 1966, its impact has been limited. In the Baltic region, Denmark and Finland are the only two parties, in the Adriatic. Bosnia and Hercegovina.

### **Environmentally relevant conventions under the IMO (International Maritime Organisation)**

In 1948 an international conference in Geneva adopted a convention formally establishing IMO (IMO, 2015a). IMO introduced a series of measures designed to prevent tanker accidents and to minimize their consequences, the most important being the International Convention for the Prevention of Pollution from Ships, as modified in 1978, and in 1997 (MARPOL). The Convention includes regulations aimed at preventing and minimizing pollution from ships - both accidental and from routine operations - and currently includes six technical Annexes. Special Areas with strict controls on operational discharges are included in most Annexes.

- Annex I Regulations for the Prevention of Pollution by Oil
- Annex II Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk
- Annex III Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form
- Annex IV Prevention of Pollution by Sewage from Ships
- Annex V Prevention of Pollution by Garbage from Ships
- Annex VI Prevention of Air Pollution from Ships.

In addition, Revised guidelines for the identification and designation of Particularly Sensitive Sea Areas (PSSAs) (adopted by Resolution A.982(24) (IMO, 2015b) allow areas to be designated a PSSA if they fulfil a number of criteria, including: ecological criteria, diversity of the ecosystem or vulnerability to degradation by natural events or human activities; social, cultural and economic criteria, such as significance of the area for recreation or tourism; and scientific and educational criteria. Whereas the Baltic Sea area (Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland and Sweden), with the exception of Russian Federation national waters, was designated as PSSA in 2005, this is still not the case in the Adriatic. Another IMO

instrument is the Guide to good practice for port reception facility providers and users (MEPC.1/Circ.671) (IMO, 2009). The Marine Environment Protection Committee of the IMO adopted in 2006 the Action Plan on Tackling the Inadequacy of Port Reception Facilities.

If all of the conventions, protocols, and amendments are counted, there are at present 25 environmentally related instruments that have been developed under the auspices of IMO (IMO, 2015c). Looking at the contracting states to these instruments, one finds the following number of ratifications per country among the Baltic and Adriatic coastal states (as of 27 April, 2015): Albania (13), Bosnia-and Herzegovina (0), Croatia (15), Italy (18), Montenegro (13), Slovenia (17); Denmark (20), Estonia (16), Finland (17), Germany (20), Latvia (14), Lithuania (12), Poland (17), Russian Federation (17), Sweden (20). The average number of IMO instruments to which a country is contracted state amounts to 12.7 in the Adriatic region, and 17.0 in the Baltic region. The difference is significant, mainly (but not exclusively) due to the fact that Bosnia-Herzegovina so far has not decided to join any of the IMO instruments.

### **EU policies and legislation relevant for marine and coastal environment**

EU Integrated Coastal Zone Management (ICZM). In 2000, the Commission adopted a proposal concerning the implementation of Integrated Coastal Zone Management in Europe (adopted by the European Parliament and Council as 2002/413/EC) (EUROPEAN COMMISSION, 2015b). In 2010, the Council ratified the Protocol on Integrated Coastal Zone Management to the Barcelona Convention (Council Decision 2010/631/EU).

Marine Strategy Framework Directive (2008/56/EC) aims to achieve Good Environmental Status (GES) of the EU's marine waters by 2020 and to protect the resource base upon which marine-related economic and social activities depend. The Directive 2008/56/EC requires that, in developing their marine strategies, Member States use existing regional cooperation

structures, to co-ordinate among themselves and to make every effort to coordinate their actions with those of third countries in the same region or sub-region (EUROPEAN COMMISSION, 2015g). The Directive lists four European marine regions – the Baltic Sea, the North-East Atlantic Ocean, the Mediterranean Sea and the Black Sea (EUROPEAN COMMISSION, 2015e). In the context of regionalisation of the „European seas“, which is an underlying element of the Marine Strategy Directive, the relevance of an Adriatic Sea PSSA becomes even more apparent (SCHEIBER & PAIK, 2013). Ability to cooperate on a PSSA may prove a key test-case for the Adriatic countries towards meaningful implementation of the EU Marine Strategy.

Guidelines for the Establishment of the Natura 2000 Network in the Marine Environment (EUROPEAN COMMISSION, 2007) represent a key challenge for EU biodiversity policy in the coming years. The establishment of a marine network of conservation areas under Natura 2000 is supposed to contribute to both halting the loss of biodiversity in the EU, and to broader marine conservation and sustainable use.

EU legislative and policy drivers for river restoration, in particular in coastal areas (ECRR, 2014)

A range EU Directives can be grouped into two categories: those which drive the delivery or river and catchment restoration; and those which support the delivery of river restoration, through improvements, such as of water quality. The main legislative driver is the WATER FRAMEWORK DIRECTIVE, adopted in 2000, a key piece of European legislation supporting river restoration. It introduced an integrated approach to water management through the development of river basin management plans and aims to restore Europe's rivers, lakes, small water bodies and wetlands to good ecological health. River basin management plans are aimed at protecting and improving the water environment and are being drawn up in accordance with the Water Framework Directive. These plans contain the main issues for the water environment and the actions needed to deal with them. The Habitats Directive supports

river restoration as well. It aims to protect the wild plants, animals and habitats. The directive created a network of protected areas - Natura 2000 sites - of national and international importance.

The main supporting instruments include: the Common Agricultural Policy; the Industrial Emissions Directive; the Nitrates Directive; and the Groundwater Directive.

### **Policies and agreements focusing on regional seas**

The 1976 Barcelona Convention for Protection against Pollution in the Mediterranean Sea aims to prevent and abate pollution from ships, aircraft and land based sources in the Mediterranean Sea. This includes dumping, run-off and discharges. Signatories agreed to cooperate and assist in dealing with pollution emergencies, monitoring and scientific research. The Barcelona Convention and its protocols form part of the UNEP Regional Seas Programme (WIKIPEDIA, 2015a).

The Barcelona Convention has given rise to seven Protocols (UNEP-MAP, 2000-2007): Dumping Protocol Prevention and Emergency Protocol; LBS Protocol; SPA and Biodiversity Protocol; Offshore Protocol; Hazardous Wastes Protocol; ICZM Protocol.

With regard to the number of ratifications of the Barcelona Convention and its 7 Protocols in the Adriatic region, the lead position holds Albania (8), followed by Croatia and Slovenia (6), Italy and Montenegro (5), and Bosnia and Herzegovina (1).

The Barcelona Convention and its protocols, together with the Mediterranean Action Plan (MAP), involve 21 countries bordering the Mediterranean (plus the EU), and form part of the UNEP Regional Seas Programme. The MAP was the first-ever plan adopted as a Regional Seas Programme under UNEP's umbrella (1975). The Strategic Action Plan (SAP MED) to combat pollution from land-based sources, and the related National Action Plans (NAPs) and national policy frameworks have been adopted by meetings of Contracting Parties to the Barcelona Convention. The

NAPs prepared in 2003-2004 and endorsed by COP 14 in 2005, serve as policy tool at national level to identify and prioritize actions to protect the Mediterranean from land based pollution. Following the preparation of the NAPs, the task is still to confront the challenge of implementation, through which to achieve concrete and lasting results. A mid-term evaluation of SAP/NAP implementation in 2014 gives a detailed overview of the achievements in the 2003-2008 period of SAP-MED targets for the Mediterranean area as a whole, but not specifically for the Adriatic region (UNEP-MAP, 2014).

HELCOM Convention (Convention on the Protection of the Marine Environment of the Baltic Sea Area, 1992) (HELCOM, 2015a) covers the whole of the Baltic Sea area, including inland waters as well as the water of the sea itself and the seabed. Measures are also taken in the whole catchment area of the Baltic Sea to reduce land-based pollution. The governing body of the Convention is the Baltic Marine Environment Protection Commission, also known as Helsinki Commission, or short HELCOM. In 2007, the HELCOM Baltic Sea Action Plan (BSAP) was adopted, with four areas of priority: 1) Eutrophication - towards a Baltic Sea unaffected by eutrophication; 2) Hazardous substances – towards a Baltic Sea with life undisturbed by hazardous substances; 3) Biodiversity – towards a favourable conservation status of Baltic Sea biodiversity; 4) Towards a Baltic Sea with maritime activities carried out in an environmental friendly way.

#### **Environment-related cross-border cooperation structures in the Adriatic Sea region**

The Adriatic countries have been involved in a number of initiatives relevant for the protection of marine environment (EUROPEAN COMMISSION, 2011b).

- a) The Trilateral Commission for the protection of the Adriatic, (CROATIAN MINISTRY OF ENVIRONMENTAL PROTECTION, PHYSICAL PLANNING AND CONSTRUCTION, 2008) originally a bilateral commission between Italy and Yugoslavia (1974), was re-launched in 1992, including Italy, Croatia and Slovenia, with Montenegro recently becoming a member. Albania, and Bosnia and Herzegovina, also expressed their interest.
- b) The Adriatic-Ionian Initiative (AII) (ADRIATIC-IONIAN INITIATIVE, 2015), a political initiative by the Conference on Safety and Development of the Adriatic and Ionian Sea (Ancona, Italy, May 2000), includes representatives of Albania, Bosnia and Herzegovina, Croatia, Greece, Italy, Montenegro, Serbia and Slovenia. Its objectives are achieved by cooperation in: tourism, transport, maritime affairs, culture, education as well as environmental protection and sustainable development. Environmental protection and maritime safety are seen as central for the socio-economic development in the region.
- c) The Adriatic Euroregion (AE) (2006) (REGIONE EMILIA-ROMAGNA, 2009) aims at transnational and interregional cooperation between regions of the Adriatic coastline. It consists of 26 regional and local governments from Albania, Bosnia-Herzegovina, Croatia, Greece, Italy, Montenegro and Slovenia. The AE addresses environmental protection; and sustainable economic development (tourism, fisheries, agriculture). The Commission for Environment (led by the Emilia-Romagna Region) aims to identify common policies and joint projects to promote the sustainable development of the Adriatic area.
- d) IPA (Instrument for Pre-Accession Assistance) Adriatic Cross-border Cooperation Programme (IPA ADRIATIC CBC PROGRAMME, 2007-2013) seeks to provide targeted assistance to countries which are candidates or potential candidates for membership of the EU.

The EU Strategy for the Baltic Sea Region (2009) (EUR-LEX, 2009) covers a wide range of issues, but foremost is the recovery of the Baltic Sea environment. The environmental actions are directly supporting the work in HELCOM,



but also actions on sustainable agriculture and fishery, maritime safety and research are closely linked to HELCOM. The EU subsequently developed the EU Governance of Macro-regional Strategies (2014) (EUR-LEX, 2014b), and the EU Strategy for the Adriatic and Ionian Region (2014) (EUR-LEX, 2014a).

Adriatic Sea Environment Program: Rapid Assessment of Pollution Hotspots for the Adriatic Sea (ASEP) is a proposal by the World Bank to provide technical assistance and investment funding to the riparian countries in the Adriatic to reduce the level of pollution of the Adriatic Sea. One of the steps in the preparation of ASEP is to update the inventory of the pollution hotspots in the Adriatic and determine the sources of pollution (ANDRIČEVIĆ *et al.*, 2011).

The findings of the present chapter suggest that formal adherence (e.g. by ratification) to global and pan-European environmental protection agreements is on the average slightly better in the Baltic than in the Adriatic region. However, the main challenge is not in achieving a high ratification score, but the issue of implementation. One case in point is the establishment of PSSAs under the corresponding IMO resolution: whereas the Baltic Sea was designated as such (albeit with the exception of Russia's national waters), the designation of the Adriatic as PSSA has still not taken place. Another case in point is the importance of EU environmental legislation as political driver for its member states, especially the new ones, to integrate into the EU framework. This driver is more powerful in the Baltic region (with 8 out of 9 riparians being EU members) than in the Adriatic (with only 3 out of 6). A third case in point is the functioning of agreements focusing on regional seas. Whereas the implementation in the Baltic region progresses under the drive of wealthy, environmentally conscious majority of its riparians, the regional approach in the Adriatic depends still mainly on the cooperation structures established for the very heterogeneous Mediterranean area. Already in 1995, disparities existed not only in socio-economic terms (GDP, HDI, EPI...), but the area was also politically explosive. Lack of resources combined with many high

political conflicts has significantly hampered implementation of MAP (SKJAERSETH, 1996). During the last decade, the security situation in the Middle East and North Africa riparians has dramatically deteriorated. All these points taken together favour the establishment of an additional regional framework specifically focused on the Adriatic.

### **Challenges and Responses to Environmental Pressures**

When assessing the state of the environment, it is sometimes convenient to use the DPSIR (Driving force, Pressure, State, Impact, Response) framework, introduced by the European Environment Agency in its reportings and recommendations to policy-makers. In the context of this paper, a simplified approach is used whereby for selected economic sectors or driving forces, pressures/impacts are discussed on a number of end points related to (marine) environment, and policy responses are assessed and compared with regard to available institutional instruments, in the Baltic and the Adriatic regions. The selected sectors or driving forces include agriculture, industry, municipalities, tourism, fisheries, mariculture, maritime traffic, oil/gas industry, and hazardous substances. The considered end-points include marine biodiversity, quality of tourism destination, air and seawater quality.

### **Eutrophication**

Impact of agriculture, together with industry and municipal waste water treatment, on biodiversity is similarly important in both regions: it is the main input of nutrients (nitrogen and phosphorus) that cause eutrophication. Eutrophication, which alters food webs, causes death of fish and benthic organisms, affects commercial and recreational fishing stocks. With oxygen being depleted at sea bottom, increased primary production and progressive transfer of organic matter into deeper layers, excessive phytoplankton blooming are often occurring. Particularly in the Adriatic, consequential proliferation of toxic

phytoplankton species may result in a reduction of biodiversity (EADES & WARING, 2010).

There are large differences how eutrophication occurs in the two regions: as in the Adriatic sea by far the biggest contribution is due to the River Po (DEGOBBIS *et al.*, 2000), eutrophication is mainly located in the northern Adriatic. It was estimated that the Po carries about 100.000 tonnes/year of inorganic nitrogen and about 6.000 tonnes/year of inorganic phosphorous; total inputs from Italian sources into the Northern Adriatic amount to 270.000 and 24.000 tonnes/year, respectively (KACHEL, 2008). In the Baltic, marine eutrophication is a major problem in most areas. The Gulf of Bothnia and north-eastern parts of the Kattegat are the only open areas of the Baltic Sea, which are not affected by eutrophication. The only coastal areas that are not affected by eutrophication are limited to the the Gulf of Bothnia (HELCOM, 2015c).

Statistical analyses show that the total inputs (air- and waterborne) of nitrogen N and phosphorus P to the Baltic Sea have significantly decreased (HELCOM, 2015j) by 16% and 18%, respectively, from 1994 to 2010. The corresponding national reductions of N and P are in the range from 15-35% and 17-29%, respectively, but Latvia's input increased significantly (by 75%). The total atmospheric deposition of nitrogen to the Baltic Sea decreased by 24%, with reductions being in the range between 10% and 40% in all countries but Russia, where a significant increase in atmospheric deposition of nitrogen has been noted (44%); however this includes emissions from a bigger area of the country (HELCOM, 2015j). With regard to waterborne nitrogen inputs to the Baltic Sea (riverine + direct inputs from point sources), reductions in Denmark, Poland, Germany, and Sweden were 15-36%. The total waterborne input of phosphorus has been *reduced* by 19-38% in all countries except Russia and Latvia; in Latvia, it increased significantly by nearly 70%. Inputs of nitrogen and phosphorus from point sources discharging directly to the Baltic Sea have significantly decreased by 43% and 63%, respectively, from 1994 to 2010 (HELCOM, 2015j).

According to (HELCOM, 2015j) the average total normalized annual inputs during 2008-

2010 were approximately 829.000 tonnes of nitrogen and 33.100 tonnes of phosphorus, of which 197.000 tonnes of nitrogen (24%), and 2.100 tonnes phosphorus (6.3%) were due to atmospheric deposition (HELCOM, 2015i). The contributions of industry to total water load concentrations of nitrogen and phosphorus are about 12% and 20% respectively (HELCOM, 2015h). Industrial production of cattle, pigs and poultry in the Baltic has been partially addressed through the relevant EU legislation (e.g. the Industrial Emissions Directive), as for other industrial point sources. Moreover, special conditions on cattle, poultry and pig farms are included in the Helsinki Convention (see Part 2 of its Annex III).

The measures taken before and after 1994 - to reduce emissions to air from (industrial) combustion processes and losses from diffuse sources (agriculture and forestry) - reduced the input to the Baltic Sea by more than 200 000 tonnes of nitrogen and by about 7 000 tonnes of phosphorus.

HELCOM estimated in 2007 that for achieving good environmental status, the maximum allowable annual nutrient pollution inputs into the Baltic Sea would be 21 000 tonnes of phosphorus and about 600 000 tonnes of nitrogen. Annual reductions of some 15 000 tonnes of phosphorus and 135000 tonnes of nitrogen would be required to achieve the plan's crucial "clear water" objective (HELCOM, 2015f).

HELCOM Heads of Delegations (HOD) have agreed on the need to cooperate more closely with transboundary river basin commissions in order to engage them in the work to reduce inputs of nutrients to the Baltic Sea, i.e. efforts to reach country-wise reduction targets (CART) for nitrogen and phosphorus and to improve data on transboundary pollution inputs and retention within surface waters in the catchment area of the Baltic Sea. This implies the need to 1) improve data on input of nutrients to the Baltic sea via transboundary rivers through cooperation with transboundary river basin commissions, 2) to open a dialogue with transboundary river basin commissions, in order to improve cooperation, and to better follow

up national progress in fulfilment of the BSAP nutrient reduction scheme and 3) to discuss initiatives/activities to ensure better data on inland water retention for all catchments in the Baltic Sea watershed (HELCOM, 2015f). According to the European Commission (EUROPEAN COMMISSION, 2011a), actions to reduce nutrient inputs to the sea to acceptable levels have to focus on preparing a timetable for phasing out the use of phosphates in detergents. In order to achieve the overall objective regarding the eutrophication of the Baltic Sea, the BSAP has defined maximum allowable inputs of nitrogen and phosphorus in the sub-basins of the Baltic Sea.

Comparable data on the cumulative contributions of different sectors to total water load concentrations of nitrogen and phosphorus for the Adriatic are not available. With regard to nutrient inputs in the Mediterranean as a whole, the SAP/MED target was a reduction of 50% by 2010. In reality, the period 2003-2005 witnessed an increase by 11%. (UNEP-MAP, 2014). There are no specific region-wide policy actions with regard to land-based pollution of the Adriatic.

### **Air pollution**

The industry in the Baltic region is overall more developed and widespread, but also more polluting than in the Adriatic region. A report „Analysis of main pollution source of NO<sub>x</sub>, SO<sub>2</sub>, VOC/odour and waste water in the BSRegion“ compiled the data of the European Environment Agency (EEA) on 2009 emissions of the EU member states within the Baltic Sea Region. The analysis presents the main sectors responsible for the largest emission in 2009, separately for each pollutant group: NO<sub>x</sub>, SO<sub>2</sub> and VOC. The main sources for NO<sub>x</sub>, SO<sub>2</sub> and VOC emissions are located in Germany and Poland (DORS, 2010).

The main sectors contributing to total NO<sub>x</sub> emissions are public electricity and heat production (24.4%), road transport by heavy-duty vehicles (20.2%) and road transport by passenger cars (13.9%). The main sectors contributing to total SO<sub>2</sub> emissions are public electricity and heat production (59.5%), stationary combustion in manufacturing/ construction industries

(17.3%) and petroleum refining (6.0%). The main sectors contributing to total VOC emissions are industrial coating application (9.3%), other product use (8.6%), decorative coating application (6.3%) and printing (5.8%). Other sectors contribute in total VOC emissions to the Baltic with less than 5%. Comparable data for the Adriatic region are not available.

Driving forces for reducing industrial emissions to air – at least for the EU member states – are several EU directives. The implementation of Directive 2010/75/EU on industrial emissions (IED) from 7 January 2013 onward should result in tighter regulation of pollutant emissions to air (and water) from industrial installations operating in EU Member States (EUROPEAN COMMISSION, 2014). Directive 2001/80/EC on large combustion plants (LCP) sets emission limit values for SO<sub>2</sub>, NO<sub>x</sub> and dust from combustion plants with a rated thermal input of 50 MW or more. The LCP Directive will be repealed and replaced by the IED from 1 January 2016 (EUR-LEX, 1994). Directive 1994/63/EC and Directive 2009/126/EC on petrol storage & distribution are two related instruments aiming to prevent emissions to the atmosphere of volatile organic compounds (VOCs) by imposing measures on key steps in the storage and distribution of petrol from terminals, to service stations, and to individual vehicles.

The UNECE Convention on Long-range Transboundary Air Pollution (LRTAP Geneva, 1979), with protocols concerning the NO<sub>x</sub>, sulphur and volatile organic compounds, is applicable to essentially all coastal states, both in the Baltic and the Adriatic region. However, as previously discussed, not all coastal states have ratified all the protocols, whereby the deficits are somewhat larger in the Adriatic than in the Baltic region.

### **Hot spots in the Baltic**

For the reduction of nutrient and other inputs impairing marine and coastal environment, „hot spots“ programmes have proven to be of essential importance.

The Baltic Sea Joint Comprehensive Environmental Action Programme (JCP) specified

a series of actions to be undertaken at the polluting Hot Spots around the Baltic Sea drainage basin. The most notorious are point sources such as municipal facilities and industrial plants, but the programme also covers pollution from agricultural areas and rural settlements, and sensitive areas such as coastal lagoons and wetlands where special environmental measures are needed (HELCOM, 2015e).

Originally, 53 municipal or municipal/industrial Hot Spots were designated in 1992, including mainly sewerage networks and wastewater treatment plants. Subsequently the total number of listed municipal Hot Spots has risen to 75, of which now 53 have been deleted. Additionally, many industries are connected to municipal sewerage systems listed as municipal Hot Spots. At least three pulp and paper mills and two food-processing plants have been closed, or the production has been reduced. There were originally 65 industrial Hot Spots, but by 2011, 43 of these sites could be deleted (HELSINKI COMMISSION, 2013). Finland has the responsibility to co-ordinate and assess the implementation of measures at the industrial Hot Spots. According to the Finnish „Review on the progress at industrial hot spots“ (THE FINNISH ENVIRONMENT INSTITUTE, 2002) the originally selected hotspots represent various industrial sectors, and their discharges and emissions include various types of pollutants: organic and inorganic substances, chemicals, nutrients, heavy metals, pesticides, SO<sub>x</sub>, NO<sub>x</sub>, dust, suspended solids, etc. Overall load reductions achieved with deletion of hotspots, both total and per industrial branch clearly shows the importance of reduction of organic matter and nutrient loads from pulp & paper and municipal wastewater treatment sectors<sup>9</sup>. Although significant progress has been made at industrial Hot Spots, continued and substantial support should be required to reach the targets of the programme.

Large areas of the Baltic Sea catchment area have been identified as agricultural Hot Spots. The list of JCP Hot Spots established in 1992 contained 17 Agricultural Hot Spots, as well as 5 Coastal Lagoon/Wetlands Hot Spots that are impacted by agricultural activities and where

relevant management programmes were needed.

Over two-thirds (109) of the 162 hot spots originally identified in 1992 have been cleaned up by 2013 up, leaving more than 50 still to be deleted (HELCOM, 2013b). In fact, the earlier mentioned overall estimated total pollution load reductions are based on the deletion from the Hot Spot List. The largest remaining sector, in 2013, of active hot spots is still municipal wastewater treatment (23), followed by pulp & paper industry (7), and the most challenging agricultural (6) and coastal management (3) hot spots. The number of remaining hot spots in the whole catchment area per country in 2013 was as cited Poland (19), Russia (15), Latvia (7), Belarus (3), Estonia, Lithuania and Czech Republic (2), Sweden, Germany, Finland and Ukraine (1) (HELCOM, 2013b).

### Hot spots in the Adriatic

The assessment process under ASEP consists of the following steps: adopting a definition of a pollution hotspot site and endangered area, preparing a list of potential pollution hotspot sites, identifying pollution hotspot sites, ranking pollution hotspot sites in terms of their environmental and socio-economic impacts, preparing a list of top pollution hotspot sites. The definition of the pollution hotspot site closely followed similar previous initiatives HELCOM, and UNEP/Mediterranean Action Plan (MAP).

In 1999, UNEP/MAP/WHO prepared jointly a report “Identification of Priority Pollution Hotspots and Sensitive Areas in The Mediterranean” (ANDRIČEVIĆ *et al.*, 2011). Originally, 101 priority hotspots were identified as impacting public health, drinking water quality, recreation, marine biodiversity, as well as marine resources of economic value. In 2003-2005, under the same initiative, the Adriatic countries prepared a National Diagnostic Analysis and National Action Plans to reduce pollution from land-based sources and further reported the status of the Pollution hotspot sites. A report published by the European Environmental Agency in 2006 states that out of a total 131 pollution hotspot sites in the Mediterranean Sea, 20 were

identified at the Adriatic coast. Six hot spot sites have been eliminated: Ulcinj (Montenegro); Dubrovnik and Krk (Croatia); Izola, Piran (Slovenia) and Manfredonia (Italy).

### Tourism

The way tourism contributes to the GDP of the riparian countries differs significantly in the two regions. Practically all Adriatic countries have larger tourism contribution in total GDP than any of the Baltic countries (WORLD DATA ATLAS, 2015). In the Adriatic by far the biggest share is in Croatia (30.2%), followed by Slovenia (28.3%), Montenegro (24.5%), Albania (22.8%), Italy (10.5%) and finally Bosnia and Herzegovina (9.9%). Contributions in the Baltic area range from Estonia (13.0%), followed by Sweden (11.1%), Latvia (8.8%), Finland (7.0%), Denmark and Poland (both 6.6%), Russian Federation (6.2%), Germany (4.4%), Lithuania (3.7%). Tourism is thus of significantly larger economic interest in the Adriatic than in the Baltic countries. In both regions, tourism may disturb wildlife habitats and ecosystems, produce wastewater, contribute to phytoplankton blooming and the production of large quantities of mucilage whose decomposition has an adverse impact on marine organisms (CLARK, 2006). The impact of tourism may impair the quality of tourism destination by disturbing the purity of the sea, and the beauty of landscape. Tourism generates solid wastes and wastewater, which often exceed the carrying capacity of the local infrastructure (BORELLI & BROGNA, 2000). In the Baltic region, the yearly rise of cruise tourism is about 12% (CRUISE BALTIC, 2010), of recreational boating about 5-6% (EUROPEAN COMMISSION, 2006). There are no similar data about yearly cruise tourism growth in the Adriatic as a whole, but the yearly rise of it in the Croatian waters from 2006 to 2007 amounted to 16.3%. It seems that no region-wide policies exist related to environmental impacts of tourism in either of the two regions.

### Fisheries

In view of the ineffectiveness of the 1958 Convention on Fishing and Conservation of Living Resources of the High Sea, the Common Fisheries Policy (CFP) as far as the EU member states are concerned, regulates fisheries. It sets in a pragmatic way quotas up to which member states are allowed to catch each type of fish. Total allowable catches (TACs) are catch limits that are set for most commercial fish stocks. Some multi-annual plans contain rules for the setting of the TACs (EUROPEAN COMMISSION, 2015d). TACs are set annually for most stocks (every two years for deep-sea stocks) by the Council. For stocks that are shared and jointly managed with non-EU countries, the TACs are agreed with non-EU countries including Russia.

TACs are shared between EU countries in the form of national quotas. EU countries can exchange quotas with other EU countries; they have to use transparent and objective criteria when they distribute the national quota among their fishermen, and are responsible for ensuring that the quotas are not overfished. For the 2016 TAC proposals the Commission intends to continue using the concept of MSY (Maximum Sustainable Yield) (EUROPEAN COMMISSION, 2015a). The significant progress achieved in the setting TACs in line with MSY (from 5 in 2009 to 36 for 2015), has contributed to increasing the number of stocks that are fished at levels corresponding to MSY (26 stocks in 2015). A notable example is the Baltic Sea, where the Council recently has moved to setting TACs in line with MSY, resulting in a move from 0 to 3 (out of 6 MSY-assessed) stocks being fished at MSY in recent years. The Commission has tabled a proposal for a multiannual plan covering Baltic Sea fisheries, which includes target values, and deadlines for achieving MSY. The Commission continues to be concerned about the situation in the Mediterranean including the Adriatic, since there most fisheries are managed by input controls only. Concrete measures are needed to achieve MSY.

The EU fishery policies have been heavily criticised as unsustainable (FINLEY & ORESKES,

2012; LEGOVIĆ, 2008; LEGOVIĆ *et al.*, 2010; KHALILIAN *et al.*, 2010; VILLASANTE *et al.*, 2011). The criticism addresses the fact that adequate monitoring of TACs is not in place in any sea, and hence setting TACs is unsustainable. While MSY exists for one isolated population of fish, it does not exist for an ecosystem where species, including predators, depend on each other. Achieving MSY for any prey species, means extinction of predator species. There are 86% of EU waters that are overfished; and some species are on the edge of extinction (personal communication by Prof. LEGOVIĆ).

Regulation establishing a multiannual plan for the management of Northern Adriatic Sea small pelagic fisheries (EUROPEAN COMMISSION, 2015f) is undergoing at present a public consultation.

The present annual level of total catch in the Baltic region is approximately 700 000 tonnes (HELCOM, 2015b). The shares of fisheries to the GDP are: Latvia 1.15% (FAO, 2015d), Lithuania < 1%

(FARNET, 2015), Russia 0.3% (NFSO, 2015), Finland 0.2% (CNNFMS, 2015), Sweden 0.2% (FAO, 2015c), Denmark 0.15% (EUROPEAN PARLIAMENT, 2013), Germany «1% (FAO, 2015b), Poland 0.07% (REPUBLIC OF POLAND, 2007-2013). In the Adriatic region the corresponding numbers are: for Croatia it varies (0.2-0.7% ) (REPUBLIC OF CROATIA, 2013), for Italy (fisheries and aquaculture) it is less than 0.1% (FAO, 2015 a). In 2011 the catches of Italian fisheries exceeded 140 000 t followed by Croatia with 70 552 t (MED, 2015). The yearly catch in the Baltic is thus about three times larger than in the Adriatic.

### Mariculture

Mariculture impacts on biodiversity by narrowing fish genetics as farmed fish may spread diseases and parasites that harm wild fish populations. Mariculture in the Baltic region produces less than 50 000 t/year, mainly in Denmark, Finland, Sweden (WWF, 2010a).

The HELCOM Recommendation on aquaculture was the lead topic in a Fish group meeting held in April 2015. The aim of a draft

Recommendation on aquaculture is to give guidance for the best practices for minimizing and preventing negative environmental impact of aquaculture on marine ecosystems of the Baltic Sea. The core issues still to be agreed on by the HELCOM members relate to nutrients input to the Baltic Sea and establishment of aquaculture facilities in marine protected areas. Another vital part concerns the risk of non-indigenous species, as they are common in fish farming but if accidentally released, may have impact on wild populations of species (HELCOM, 2015d).

In the Adriatic Sea, the majority of cultured marine fish species are grown in cages (FRANKIĆ, 2003). Shellfish mariculture includes oysters (*Ostrea edulis*), and Mediterranean mussel (*Mytilus galloprovincialis*) (HERAL&PROU, 1994). Current production of shellfish is only about 4.500 t/year while for example Ireland's production of mussels and oysters (*Crasostrea gigas*) amounts to 23.210 t/year! Fish farming in floating cages includes mainly sea bass (*Dicentrarchus labrax*), and sea bream (*Sparus aurata*), producing only about 2.700 t/year based on fry stock (BENOVIĆ, 1997) (KATAVIĆ&VODOPIJA, 2001). In Italy, over 60% of the cage-based mariculture installations are concentrated in the south and account for only 35% of the total aquaculture. In Croatia, four hatcheries are producing about 30 percent of the total mariculture amount, and the remaining 70% is imported mainly from Italy and France. Farmed marine species in the Adriatic are: in Italy: sea bream, sea bass, meagre, in Croatia: seabass, seabream, bluefin tuna, in Albania and Montenegro: sea bream and sea bass, in Slovenia: sea bream, seabass, mussel ( U.N. ENVIRONMENT PROGRAMME, 2014).

The Commission intends to boost aquaculture through the Common Fisheries Policy reform (EUROPEAN COMMISSION, 2015c), and has published Strategic Guidelines for the sustainable development of EU aquaculture-COM/2013/229, presenting common priorities and general objectives at EU level. Other regulations address concerns about locally absent species in aquaculture, rules on organic aquaculture animal and seaweed production.

As there are no comprehensive data on yearly quantities of mariculture products in the Baltic and the Adriatic, and no implementation of policy instruments concerning mariculture on the regional level, an inter-regional comparison is not feasible.

By numbers about yearly quantities of mariculture products in the Baltic and the Adriatic, it seems that mariculture is less developed in the Adriatic than in Baltic. This does not mean that quality of fish produced in the Adriatic is inferior, due to better environmental conditions; fish produced in the Adriatic, especially eastern Adriatic is probably of a higher quality. Adriatic has great potential for expansion of mariculture.

## Maritime traffic

### Oil spills

Effects of oil spills on biodiversity are oiled birds and mammals suffering from hypothermia and poisoning. In the Baltic region yearly 100.000- 500.000 ducks and seabirds die from illegal oil spills (BIRD LIFE INTERNATIONAL, 2015). The vegetation is contaminated, and the oil seeps down into the ground where it can continue to leak back to the surface for years. Although the acute effects can be fatal, the long-term non-lethal effects are harder to ascertain. Most studies show that the environment will recover after a few years, but long-term impacts may be observed, such as reproductive and behavioural effects, shifts in population structure and habitat loss (ITOPF, 2010).

The largest oil spill in the Baltic Sea was the Globe Asimi outside Klaipėda in Lithuania 1981. In total, approximately 16 000 tonnes of oil were spilled as a result of that incident (MIDBØE & PERSSON, 2004). Subsequent spillages increased the awareness of the threats of oil spills (PÅLSSON, 2015). Still, in 2008, 6.5 tonnes of oil were spilled accidentally in the Baltic sea. The risk of major oil spills or hazardous substances is decreasing but still present. In the Baltic sea, many of the oil tankers are old, and single hull tankers are not yet phased out despite the MARPOL ban in 2010. The relatively low

present frequency oil spills may increase due to the large amount of oil transport, presently over 100 million tonnes per year (SCHERNEWSKI & SCHIEWER, 2002), which is expected to double by 2030 (WWF, 2010a).

The two major IMO instruments dealing with marine pollution are the international Convention on Oil Pollution Preparedness, Response and Cooperation (OPRC, 1990) (ratified by all Helcom countries), and the Protocol on Preparedness, Response and Cooperation to Pollution Incidents by Hazardous and Noxious Substances (OPRC-HNS Protocol, 2000), ratified by 5 states Parties to Helcom (HELCOM, 2010a) (Sweden, Denmark, Germany, Poland, Estonia, (EMSA, 2010). Some Baltic riparians have set goals for oil spill response, for example Finland is prepared to cope with an oil spill of 30 000 tonnes, Germany for 15 000 tonnes, Sweden 10 000 tonnes and the Russian Federation for 5 000 tonnes (PÅLSSON, 2015). Moreover, all ships entering the Baltic Sea must comply with regulations arising from the appointment of the Baltic Sea area as a Special Area for the Prevention of Pollution by Oil (Annex I of MARPOL) and garbage (Annex V). Although control over discharges from ships by the coastal states has been established, illegal spills and releases are still happening.

For the Adriatic sea, information on oil spills is provided by the Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea (REMPEC); among oil spills that occurred between 1977 and 2003, 85 happened in Italian waters, 7 in Croatian waters and 2 in Slovenian. Recent examples are oil spillages that happened in 2005 and in 2007 when some 10.000 L of polluted waters spilled into the sea, near the Port of Koper. On the average, there are some 10 minor spills per year in the Slovenian sea area (DEL BIANCO, 2007).

The amount of ongoing maritime transport in the Adriatic is illustrated by the following numbers: in 2006 over 11 millions of tons of oil products were handled in the port of Venice, and 37 millions in the port of Trieste; the port of Koper handled more than 12 millions tonnes of goods in 2006, especially from dry bulk cargoes, the port of Rijeka 2006 handled almost 11 mil-

lions of tonnes, mainly from liquid bulk cargoes (DEL BIANCO, 2007). The sum of all handled oil products in these ports in 2006 might have been up to 71 millions of tonnes (other ports were even not considered in the estimation). Comparing this number with the actual oil transport in the Baltic sea (over 100 million tonnes per year), one may conclude that the quantity of oil yearly passing through the Adriatic is not much smaller than in the Baltic.

### Ballast water

The amount of ballast water discharged from maritime traffic in the Baltic sea during 2011 was in the order of 250 millions of tonnes. The impact of ballast water on biodiversity can be assessed by monitoring the number of invasive species. The expansion of foreign, non-native species, is recognized as one of the greatest threats to biodiversity in the world. A number of established and newly perceived alien species have been increasing in the Baltic Sea from the 19<sup>th</sup> to the 21<sup>st</sup> century, and the number continues to rise due to exploding maritime traffic. Over 100 non-native and cryptogen species to date entered the Baltic marine environment, 80 of these species are known to be reproducing in some parts of the Baltic. With the aim of preventing, minimizing and eliminating the transfer of harmful aquatic organisms and pathogens through the control and management of ships' ballast water and sediments, the Convention for the Control and Management of Ships' Ballast Water and Sediments provides the international regulation framework to face this global marine pollution threat. IMO Guidelines reflect consensus at IMO level, and are thus highly authoritative, but sometimes lack all the details needed for harmonised implementation in a specific region like the Baltic Sea. Such detail can be provided i.a. through HELCOM regional cooperation (HELCOM, 2014a).

The total amount of ballast water that entered into the Adriatic sea in 2003 was around 8 million tonnes, of which around 80 % was discharged in the Italian Adriatic ports, while the remaining volume was shared between Slov-

enia's port of Koper and all the Croatian ports together (INSTITUTE OF PUBLIC FINANCE, 2006). Due to expected growth in import and export flows, far larger ballast water volumes are expected to be carried by vessels from ports outside the Mediterranean Sea. The number of invasive species could correspondingly increase in significant way (ANDRIČEVIĆ *et al.*, 2011). A total of 113 species (15 phytoplankton, 16 zooplankton, 16 macroalgae, 44 zoobenthic and 22 fish species) have been recorded in the Croatian waters, of which 61 species are alien (due to aquaculture activities and shipping) and 52 introduced (species from other Mediterranean subregions that are extending their geographic range) (PEĆAREVIĆ *et al.*, 2013). Data on total numbers of introduced alien species in the whole Baltic and the Adriatic Sea are missing.

### Sewage and garbage

IMO instruments dealing with pollution by sewage and garbage at sea are 3 Annexes to the Marpol Convention (III: Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form; IV: Prevention of Pollution by Sewage from Ships; V: Prevention of Pollution by Garbage from Ships), as well as the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (LC), 1972 (with the 1996 London Protocol). On regional basis, the 1976 Barcelona Convention gave rise to the Dumping Protocol. The MARPOL Convention prescribes the conditions under which the ship's wastewater could be discharged into the sea. Appendix IV provides protection of the sea from wastewater, but only in the range of 12 miles of territorial sea. Each country has the right to tighten the provisions of the Convention. The discharge of garbage is prohibited, food wastes may be discharged, but not within 12 nautical miles from the nearest land (HELCOM, 2012).

The UNEP has identified tourist ships as one of the principal pollution sources of marine ecosystems (JEFTIĆ *et al.*, 2005; ALLSOPP *et al.*, 2005). The Baltic Sea receives more than 350 cruise ships, with over 2.100 visits to ports each year. The wastewater produced in these vessels



is estimated to contain 113 tons of nitrogen and 38 tons of phosphorus (WWF, 2010b). More than half of the cruise ships in the Baltic Sea dump their toilet water into the sea (DEL BIANCO, 2007). That nutrient enrichment can contribute to eutrophication. Sewage and waste may contain also heavy metals, bacteria, viruses and other pathogens.

While land based sources contribute significantly to marine pollution in the Adriatic sea, ships are also a major source (DERRAIK, 2002). The number of passengers on cruise ships increases considerably. Although regulations of Croatian Shipping Register correspond to MARPOL Convention, Annex IV, cruisers process wastewater only to that minimum level at which it complies with the regulations, and the number of cruisers increase. Considering the limited control of Croatia's territorial sea, these unwelcome practices by cruise companies are likely to continue, without being noticed and pursued.

Waste from cruise ships is similar to communal waste in its composition, often a mix of organic and inorganic compounds (COPELAND, 2008) with a portion of hazardous substances such as cleaners, paints, and medicines (CARIĆ & MACKELWORTH, 2014). Yet, due to their mobility, the pollution they create is difficult to attribute to a source. The foundation for future waste disposal in Croatia will be the County Centres for Waste Management, which will separate and store waste for recycling. Currently waste is received in all ports, but it is often mixed together, which resulted in an increasing trend in floating waste, most of it plastic. Over the past nine years a survey of the Adriatic islands found that on an average beach of 200-400 m<sup>2</sup>, there are 100 to 2000 pieces of plastic bottles and polystyrene foam. An extreme example is the Mljet Island (Croatia) where in one month 6000 bottles and pieces of polystyrene foam were washed ashore (IRB, 2009). While there has been little investigation into cruise ships releasing hazardous wastes in the Adriatic many of the vessels do visit sensitive regions where the release of such toxins could have a catastrophic effect on local ecosystems. This is critical considering the low water exchange generally within the island

archipelagos of Croatia, many of which are on cruise itineraries (CARIĆ & MACKELWORTH, 2014).

In the two regions, considerable differences exist with respect to port reception facilities. HELCOM Baltic Sea Action Plan (BSAP), adopted by the Baltic Sea countries and the European Commission in 2007, included a commitment to address discharges of sewage from passenger ships. The IMO's 61st session of the Marine Environment Protection Committee (MEPC) approved the proposal of the Baltic Sea countries to designate the Baltic Sea as a special area under Annex IV of the MARPOL Convention where passenger ships will be required to follow more stringent regulations concerning discharges of sewage, for final adoption at MEPC 62. The sewage will have to be treated onboard to remove nutrients to the agreed standard or will have to be delivered to the port reception facilities (PRF). The new regulations will come into effect when the Baltic Sea countries notify IMO of having adequate port reception facilities for sewage. A recent overview was published in 2014 (HELCOM, 2014b).

On the other hand, reports by REMPEC on the country situations in Albania (REMPEC PROJECT, 2008a), Croatia (REMPEC PROJECT, 2008b), Montenegro (REMPEC PROJECT, 2008c) include as part of final recommendation that "to efficiently address illegal discharges from passing ships, [the country] should use the sub-regional co-operation as a way forward. To this end, REMPEC should be seen as a facilitator for the development of a sub-regional agreement".

### **Air pollution from ships**

Air pollution from ships is also a matter of concern in both regions. In the Baltic Sea emissions from ships in 2008 amounted to 393 kt NO<sub>x</sub>, 135 kt SO<sub>x</sub>, and 18.9 Mt CO<sub>2</sub> (HELCOM, 2009), with amounts decreasing yearly by a few percent. The impact of air pollution from ships on biodiversity may be eutrophication (from NO<sub>x</sub>) in the sea, whereas SO<sub>x</sub> acidifies seawater. In the absence of additional abatement measures, and assuming a two per cent annual growth in traffic, NO<sub>x</sub> emissions are projected to rise to

approximately 500,000 tonnes by 2040. In 2011, under the auspices of HELCOM, the Baltic Sea countries Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, the Russian Federation and Sweden discussed to propose to the International Maritime Organisation (IMO) that the Baltic Sea should be designated as a NO<sub>x</sub> Emission Control Area (NECA). If the Baltic Sea becomes a NECA, all new ships must comply with the stricter Tier III emission standards as from 2016, and ship emissions would then come down to about 160,000 tonnes by 2040. IMO Tier III obligations for NECA in the Baltic will enter into force as of 2016 (EUR LEX, 2013).

Emissions of sulphur dioxide (SO<sub>2</sub>) are already regulated through the designation of the Baltic Sea as a SO<sub>x</sub> Emission Control Area (SECA), which entered into force in May 2006 as the first SECA ever established under IMO's MARPOL Annex VI (AIR POLLUTION AND CLIMATE SECRETARIAT, 2011).

There are no consolidated data on air pollution from ships in the Adriatic, and no regional policy actions to reduce it.

### Oil/gas industry

Activities related to both exploration and production of hydrocarbons are capable of affecting a number of marine invertebrates. Significant impact is arising when drilling mud is discharged. Adult shellfish organisms feed by filtering seawater and thus can bio-accumulate harmful substances. For plankton there is no predictions for negative effect because they move freely in the pelagic area, but potentially negative effect on breeding populations of seabirds has been recognised (MINISTRY OF ECONOMY, REPUBLIC OF CROATIA, 2015). The oil and gas industry may impair the quality of tourism destinations, through leakages and because of the proximity of a platform can reduce the attractiveness of a tourist destination. Wastewater from deck can have impact on sea water quality by reducing dissolved oxygen and rising nutrient concentration, altering pH of water in the vicinity of the exploration and production platforms (HEDGECOCK *et al.*, 2012). Facilities on the platform, usually driven by diesel or gas emit NO<sub>x</sub>, SO<sub>x</sub>, volatile organic

compounds, and greenhouse gases such as CO<sub>2</sub> and CH<sub>4</sub>. Supply vessels and helicopters also pollute air. However, emissions have only localized impact on the air quality.

Most important oil platforms in the Baltic Sea are located in the south-eastern part of the region in the oil fields of Kravtsovskoye and B-3 (HELCOM, 2010b). Three of the platforms, Baltic Beta, Petro Baltic and PG-1, are Polish, and one, MLSP D-6, is Russian. The reserves in Kravtsovskoye and B-3 are estimated to last until 2030 or longer. The average number of oil spills on the first three platforms per platform/per year is 2.79 (DERVO & BLOM-JENSEN, 2004). The Russian D-6 platform has a yearly leakage of about 140 tonnes of oil (EUROREGION BALTIC OCH ÖSTERSJÖN, 2004). Oil leakages affect marine flora and fauna as well as the coastlines, as well as fishing, tourism and recreation (HELCOM, 2005). Offshore pipelines are on the increase in the Baltic Sea, many having been placed during the last decade. For example, the controversial 1,200 km long Nord Stream pipeline has been laid between Russia and Germany. Planning and putting Nord Stream pipeline into operation included the use of the international Convention on Environmental Impact Assessment in a Transboundary Context (Espoo, 1991). Platforms and supply vessels must comply with the provisions of the Annex VI of the MARPOL 73/78 Convention, which sets limits to emissions of sulfur dioxide, nitrogen oxide and ozone depleting chlorofluorocarbons and halons. MARPOL bans certain products as contaminated materials and polychlorinated biphenyls.

In the Adriatic, Italy has repeatedly drilled in its own waters. The exploration and production of hydrocarbons are currently being envisaged also in Croatian waters, causing a public controversy. On July 11, 2015, Croatian citizens organized in more than twenty cities and islands a campaign against the exploration and exploitation of oil in the Adriatic Sea. They appeal Government to desist from signing contracts that can harm the Adriatic, and negatively affect the citizens and the state. This action, initiated by a coalition of environmental NGO's, showed that opposition to oil drilling across the Adriatic is growing (S.O.S. ZA JADRAN,

2015). A „Strategic study of the likely significant environmental impact of the Framework Plan and the program of research and exploitation of hydrocarbons in the Adriatic“ by Croatian Ministry of Economy emphasises to include the provisions of the Espoo convention.

### **Dumped weapons in the Adriatic and Baltic Sea**

About 40,000 tonnes of chemical munitions were dumped into the Baltic Sea after the Second World War. It is estimated that these chemical munitions contained some 15 000 tonnes of chemical warfare agents (HELCOM, 2015k). According to Helcom (HELCOM, 2013a), chemical warfare materials are scattered within and in many cases outside the designated Baltic Sea dumping areas. Sulphur mustard mixtures represent about 63% of all materials dumped near Gotland and Bornholm. This chemical agent poses a risk to humans in contact with it, and to organisms within its immediate vicinity, through both short- and long-term effects. Arsenic-containing warfare agents have been shown to contaminate areas of the sea bottom and to spread both within and outside the dumpsites.

Overall, 16 areas at the German Baltic coast are marked as polluted by munition on maritime shipping charts (KOCH & NEHRING, 2007). Amounts of dumped ammunition in these areas are unknown. However, a total amount of more than 100 000 tons of munition can be assumed, comprising for the most part conventional ammunition (SHL, 2001). Conventional munition, especially the by far mostly used trinitrotoluene (TNT), is considered as toxic for micro-organisms and aquatic plants (SPYRA & KUKA, 1997), (EK, 2005) and, despite its rather low solubility in water of about 100 to 130 mg/l, it is toxic for fish at a concentration of 0.7 to 3.7 mg/l (HAAS, 1996). Self-detonations also present a potential environmental and human health risk: an initial analysis has shown that since the end of WW II at least six self-detonations were registered in German coastal waters of the Baltic Sea (NEHRING, 2007). However, an overview of chemical munitions in the Baltic Sea

concludes that „according to existing knowledge dissolved warfare agents do not pose a widespread risk...A phased programme of investigations is recommended...No attempts should be made to recover dumped munitions as the risks for salvage crews and the environment would be greater than any existing danger.“ Denmark accepted the role of the lead country (THEOBALD, 2002).

Adriatic Sea is considered as another area of substantial dumping of chemical weapons (ONG *et al.*, 2009). In Italy, more than 200 fishermen were hospitalized between 1946 and 1966 after catching chemical-weapons agents in their nets. The Italian government has since identified numerous chemical weapons sites in the Adriatic Sea. Many of these areas are routinely used for ocean research, despite the fact that sediments surrounding these sites contain mustard degradation products, and local fish have lesions and contain elevated arsenic levels (MONTEREY BAY AQUARIUM RESEARCH INSTITUTE, 2008). No comprehensive data exist on dumped chemical weapons in the Adriatic, and no policy actions exist in both regions.

With respect to land-based pollution, there exist several targets and corresponding reductions for the Baltic; the reduction targets for the Mediterranean do not allow to evaluate the regional achievements in the Adriatic region. Air pollution is a larger issue in the Baltic than in the Adriatic; main driving forces for improvement are EU directives and LRTAP. Hot spots programmes addressing land-based pollution were essential milestones in both regions. Tourism is of significantly larger interest in the Adriatic region, but no regional policies exist to limit its environmental impact: this should be a priority. Fishery policies are mainly determined by EU regulations, often criticised as unsustainable by scientists. On mariculture, no comprehensive data exist for either of the two region; development of corresponding regional policy instruments would be desirable. Oil spills due to sea traffic are of high interest in both regions, in view of similar amounts transported. REMPEC provides corresponding information in the Adriatic; the Baltic Sea region is a step further due to

its designation, under the IMO, as a Special Area for the Prevention of Pollution by Oil. Ballast water is seen as a challenge in both regions due to the expansion of non-native species, but comprehensive data are missing. Regarding sewage and garbage from ships, the two regions differ with respect to port reception facilities: the Baltic Sea has been designated as a special area under the MARPOL Convention where passenger ships must follow more stringent regulations. With regard to oil/gas industry, the Espoo Convention has been applied in the Baltic region e.g. in the case of Nordstream gas pipeline, and it should be also used for exploration in the Adriatic. The large number of nuclear reactors in the Baltic region is in contrast to none in the Adriatic catchment area; however the radioactive contamination in both seas is comparable, and mainly due to the Chernobyl accident 25 years ago. The issue of dumped chemical weapons exists in both regions; in the Baltic region Denmark accepted to be the lead country in addressing this issue at regional level, whereas in the Adriatic the issue has been largely ignored in terms of regional policy.

## CONCLUSIONS

Certain basic facts - smaller water volume, shallowness, less favourable current patterns, and a much longer residence time - make the Baltic Sea more vulnerable than the Adriatic with regard to pollutants. At the same time, the quantity and quality of industrialisation, municipal services and agriculture in the Baltic, as well as insufficiently developed environmental performance, particularly in the coastal countries formerly part of the Soviet bloc, led to a deterioration of the marine environment that could not be ignored even during the 1970's. The rise of Green movements and the ground-breaking Stockholm Conference 1972, led to the conclusion of the Helsinki Convention on the Protection of the Marine Environment of the Baltic Sea Area in 1974, in the middle of the Cold War. Together with the Barcelona Convention and MAP, launched at about the same time, it was a milestone in regionally coordinated coopera-

tion on transboundary environmental protection. Although all Adriatic coastal states are parties to the Barcelona Convention, the protection specifically focused on the Adriatic as a whole has remained fragmented, less coordinated, and probably less effective.

Protection of the marine environment cannot function properly without making use of a variety of instruments and policies, established at various levels. An analysis of the formal adherence of the Baltic and the Adriatic coastal states to the relevant conventions at the universal and the pan-European level is in general satisfactory; the adherence of the Baltic coastal states to the conventions and regulations under the IMO is slightly better than is the case with the Adriatic ones; a similar picture emerges for the adherence to the UNECE conventions. A regulatory advantage and driver for the Baltic region is the fact that 8 out of the 9 coastal states have been a full member of the EU for more than a decade, thus profiting from the EU regulatory and policy rules, whereas in the Adriatic region, only 3 out of 6 coastal states are full members of the EU, whereas the 3 others are in various stages of approximation.

One of the major challenges in both regions is the eutrophication, caused mainly by inputs from agriculture, but also from municipal waste and industries. Progress in reducing inputs of nutrients and other pollutants into Baltic Sea has been considerable, mainly based on national programmes designed to achieve the jointly allocated reduction targets. Specific measures include (a) improved treatment of wastewater, including increasing phosphorous removal; (b) substituting phosphorous in detergents; (c) changes in manure handling and fertilisation practices; (d) cleaning up by 2012 of more than 2/3 of 162 major pollution hot spots identified by JCP. However, further measures are necessary for reaching the BSAP goal of a Baltic Sea unaffected by eutrophication: one reason is still insufficient cooperation between HELCOM and the numerous river basin bodies. This is even more so the case for the Adriatic, where the water basin management, in particular of the Po river basin, by far the largest source of eutrophication

cation, is largely disconnected from the needs of regional marine protection. Here the provisions and experience established under the UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes should be made use of. Numerous relevant instruments and policies established by the EU should be strictly implemented by all coastal EU countries. In the Adriatic, out of about 20 identified hot spot sites, six have been eliminated.

Tourism, being both source and potential victim of environmental deterioration is a major issue, much more so due to its relative economic importance, especially in the Adriatic region. Region-wide policies related to environmental impacts of tourism should be established.

Maritime traffic as a whole is a serious challenge in both regions, both in terms of air pollution, oil spills, ballast water, and sewage and garbage. On top of the very extensive general regulations established under the International Maritime Organisation, a number of additional measures have been, or are being introduced for the Baltic Sea area, including: (a) designation as PSSA; (b) setting of national goals, by Finland, Germany, Russian Federation and Sweden, for the ability to cope with oil spills; (c) designation of port reception facilities for sewage; (d) designation of the Baltic Sea as a SO<sub>x</sub> Emission Control Area (SECA); (e) initiative to designate the Baltic Sea as a NO<sub>x</sub> Emission Control Area (NECA). None of these measures exist for the Adriatic as a whole.

Although it cannot be easily concluded which of the two regional seas is (more) overfished, it is significant that the European Commission has tabled a proposal for a multiannual plan covering the Baltic Sea fisheries, including values and deadlines for achieving Maximum Sustainable Yields (MSY) under the Common Fisheries Policy (CFP). The EU fishery policies have been heavily criticised by scientists as unsustainable. A regulation establishing a multi-

annual plan for the management of Northern Adriatic Sea small pelagic fisheries is undergoing at present a public consultation. Mariculture is a rapidly growing sector in both regions, not well quantified; development of corresponding regional policy instruments would be desirable.

Whereas there are several oil platforms and gas pipelines in the Baltic Sea, drillings in the Adriatic so far have been restricted to Italian waters. In both regions, corresponding public controversies and political connotations have erupted, which may be the reason that HELCOM has not been involved in these issues in a substantial and active way. But there is a generally shared agreement that exploration and production operations should be preceded by applying relevant instruments – Espoo Convention, and Annex VI to the MARPOL Convention.

HELCOM has carried out an integral thematic assessment of hazardous substances in the Baltic Sea. A zero-emission target has been set for all hazardous substances in the whole Baltic Sea catchment area by 2020. Dumped, in particular chemical, weapons, dating mainly from the aftermath of WWII, are another challenge for marine environments and human health in both regions. A phased programme of investigations has been recommended by scientists. Whereas for the Baltic some rough estimates exist on dumping sites and dumped quantities, the knowledge basis in the Adriatic is very limited.

To summarize, the cooperation in the Adriatic on collecting data, developing policies, and implementing them, is less developed and less focused than in the Baltic region. One, but not only reason for that may be seen in a relatively better state of the marine environment. The authors recommend to improve coordination among Adriatic coastal states through a more focused agreement. The approximation of the Adriatic region to the EU, will most likely improve also regional cooperation.

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## Provedba institucionalnih i tehničkih instrumenata zaštite morskog okoliša Jadrana i Baltika: usporedba

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### SAŽETAK

U radu je riječ o ranjivosti i zaštiti morskih okoliša dvaju poluzatvorenih mora, Jadrana i Baltika, u smislu fizičkih i socio-ekonomskih čimbenika. Opisani su institucionalni i tehnički instrumenti i politike zaštite i komentirani na globalnoj, paneuropskoj, EU i regionalnoj razini. Rad ističe (za Baltik) pionirsku ulogu Helsinške konvencije, koju 1974. godine potpisuju baltičke obalne države, prema kojoj su svi izvori onečišćenja podvrgnuti jednom instrumentu.

Ne postoji sličan toliko sveobuhvatan sporazum još na polu-zatvorenom Jadranskom moru, ali zaštita Jadrana je uključena u Barcelonskoj konvenciji, potpisanoj 1976. g. od 16 država i Europske unije (trenutno postoje 22 stranaka Konvencije), koja predstavlja nastavak pionirskog (za Jadran) Mediteranskog akcijskog plana, a potpisale su ga ugovorne stranke 1975. godine.

Baltik, s 90 milijuna ljudi u slivnom području, je ekonomski dobro razvijeno područje; od devet njegovih obalnih država, osam je članica EU. Slivno područje Jadrana, na kojem živi oko 15 milijuna ljudi, odlikuje se većim socijalno-ekonomskim suprotnostima, s Italijom kao dominantnom državom u veličini populacije i ekonomije.

Poljoprivreda, industrija, prijevoz, ribarstvo, turizam, i neodrživa nasljeđa ophođenja prema okolišu iz prošlosti predstavljaju najveća morska i obalna opterećenja Jadrana i Baltika.

Jadran, opterećen prijevoznim putevima naftnih plovila, jedno je od najosjetljivijih područja na Mediteranu.

**Ključne riječi:** Jadransko more, Baltičko more, morski okoliš, multilateralni instrumenti zaštite, tehnički instrumenti zaštite, HELCOM, politike regionalne zaštite