

UN/ECE Working Group on Monitoring and Assessment

An Inventory of Transboundary Estuaries and their Current Monitoring Practises





UN/ECE Working Group on Monitoring and Assessment
under the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Helsinki, 1992)

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Summary

This report was drawn to provide an inventory of transboundary estuaries in the UNECE region and an overview of their current monitoring practices for the use of the Working Group on Monitoring and Assessment under the UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes (the Water Convention). The information presented here was obtained through a questionnaire and personal communication with appropriate authorities. Thirteen transboundary estuaries, covering a wide range of different sizes and types, were identified in the area covered by the Water Convention in the UNECE region. The inventory is, however, not complete due to the limited response to the questionnaire.

The uses of the estuaries that were most commonly reported as important or very important include conservation and wildlife, fishing, shipping and recreation. In some estuaries industrial use for cooling water and the extraction of water for drinking and irrigation purposes were also considered important uses. The main anthropogenic threat to the estuaries is the discharge of both municipal and industrial waste water, followed closely by diffuse pollution from agricultural runoff and other sources. Other threats that were mentioned include shipping and harbour activities, mariculture, heat pollution and atmospheric deposition.

Monitoring is mainly based on national water laws and EU Directives and to some extent also on various international agreements. Estuaries are generally included as a part of a wider monitoring programme, either one covering fresh waters or coastal waters, or one covering all surface waters in general. Monitoring is ordinarily overseen at a national level and carried out at local or regional levels. The data produced in monitoring programmes is stored at all levels of administration, with at least a summary of the data held nationally. Public reporting is usually done in the form of a national annual report.

Each country performs at least basic hydrological and physical monitoring and some level of chemical monitoring. Chemical factors are most often measured in the water phase; only three of the nine countries also monitor the concentrations of various contaminants in sediments and biota. Biological monitoring is carried out in six of the nine countries and is mainly concentrated on phytoplankton.

Most of the estuaries are covered by some international agreement advocating joint or co-ordinated monitoring, although no agreements have been specifically drafted for estuaries. Estuaries are most commonly included in agreements concerning rivers, and often also in agreements stipulating co-operation regarding shared coastal areas, as well as being encompassed in general bilateral agreements concerning all transboundary waters. However, in reality the implementation of the agreements is often lacking and the actual level of co-operation may be much lower than that aimed for in the agreement. Still, many of the countries that reported poor co-operation on the governmental level reported good co-operation and information exchange on the level of the scientific research community.

The ongoing implementation of the EU Water Framework Directive will have direct implications on many aspects of water quality monitoring in the EU Member States, and acceding countries, affecting both the variables that are included in monitoring programmes and the level of co-ordination and co-operation between countries sharing water bodies.

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List of Abbreviations

BOD	Biochemical Oxygen Demand
BSEP	Black Sea Environment Programme
CEP	Caspian Environment Programme
COD	Chemical Oxygen Demand
DDT	Dichloro-diphenyl-trichloroethane
EEA	European Environment Agency
EU	European Union
HCH	Hexachlorocyclohexane
HELCOM	Helsinki Commission
ICES	International Council for the Exploration of the Sea
IWAC	International Water Assessment Centre
MAP	Mediterranean Action Plan
OSPAR	Oslo and Paris Commission
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
P. E.	Population Equivalent
QA	Quality Assurance
RIZA	Rijksinstituut voor Integraal Zoetwaterbeheer en Afvalwaterbehandeling (Institute for Inland Water Management and Waste Water Treatment).
TBT	Tributyltin
TOC	Total Organic Carbon
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
WFD	Water Framework Directive

Introduction



In recent decades the transboundary nature of water pollution has become a commonly acknowledged problem and joint monitoring initiatives, increased information exchange and the co-ordinated management of water resources have been recognised as important tools in the assessment and reduction of the transboundary effects of pollution. Particularly in the last decade the United Nations Economic Commission for Europe (UNECE) and the United Nations Environment Programme (UNEP) with several other organisations have advocated a co-ordinated regional approach to resolving water related problems and prevention of conflicts over water through the reasonable and equitable use of transboundary waters (ECE/UNEP, 2000).

1.1 The UNECE Water Convention

The Convention on the Protection and Use of Transboundary Watercourses and International Lakes (from here on referred to as the Water Convention) was drawn up under the auspices of UNECE and adopted in Helsinki in March 1992. The Water Convention was intended to strengthen national measures for the protection and management of transboundary surface waters and groundwaters. The Convention Parties are required to prevent, control and reduce pollution of all waters likely to cause a transboundary impact, and to ensure that waters are used in an ecologically sound, reasonable and equitable way, taking into particular account their transboundary nature. Measures to control and reduce pollution should, where possible, be taken at the source of the pollution, taking into consideration both point and diffuse sources. The measures should include developing, adopting, and as far as possible, rendering compatible relevant legal, administrative, economic, financial and technical measures such as:

- Licensing, monitoring and control of waste water
- Environmental Impact Assessment (EIA)
- Precautionary Principle
- Polluter Pays Principle
- Best Environmental Practice (BEP)
- Best Available Technology (BAT).

All Convention Parties are also obliged to establish programmes for monitoring the condition of transboundary waters. Riparian Parties, i.e. the Parties bordering the same transboundary waters, should enter into bilateral or multilateral agreements, or adapt existing agreements, in order to increase their co-operation in the field of prevention, control and reduction of transboundary impact. They should also form joint bodies to collect and evaluate data, in order to identify pollution sources, as well as to elaborate emission limits and joint water quality objectives, and to develop concerted action programmes for the reduction of pollution loads. In the above framework, the Riparian Parties should also establish and implement joint programmes for monitoring the conditions of their transboundary waters and the

effectiveness of measures taken. Monitoring should be based on pollution parameters and factors that have been agreed upon, and be executed using harmonised measurement systems and devices. The analytical techniques, as well as the data processing and evaluation procedures used, should be compatible. The results of these assessments should be made available to the public in all of the countries.

The Water Convention came into force on 6 October 1996 and by 10 October 2003 it had been signed, ratified or accessed by 33 countries from the UNECE region, as well as the European Community. The work plan of the Convention is implemented through four Working Groups focusing on specific aspects of the convention,

- Working Group on Legal and Administrative Aspects
- Working Group on Water Management
- Working Group on Monitoring and Assessment
- Working Group on Water and Health.

The Working Groups review policies and draw up recommendations, codes of practice and other soft law instruments concerning their programme area, as well as provide guidance in the implementation of the work plan and promote the harmonisation of rules and regulations. The working groups also prepare draft decisions, proposals and recommendations for the consideration of the Meetings of Parties to the Convention held every three years.

1.2 The Working Group on Monitoring and Assessment

The Working Group on Monitoring and Assessment, which prior to 2000 was known as the Task Force on Monitoring and Assessment, is responsible for helping the Convention Parties bordering the same transboundary waters to initiate and implement joint monitoring programmes aiming both to determine the condition of the transboundary waters and to evaluate transboundary impacts and the effectiveness of measures taken to prevent, control and reduce them. The Working Group is also responsible for helping the countries reach agreement on pollution parameters to be included in routine monitoring, and promoting increased information exchange regarding environmental data, including monitoring data on the transboundary waters. To provide guidance the Working Group prepares guidelines, studies and reports on matters related to the monitoring and assessment of transboundary waters.

In 1996, the Working Group (under its previous name of the Task Force on Monitoring and Assessment) prepared an inventory of transboundary rivers and international lakes in the UNECE region, published by the Institute for Inland Water Management and Waste Water Treatment (RIZA). The report included a general description of the characteristics of these watercourses and an overview of their monitoring and assessment practises. The report identified a total of 158 transboundary rivers and 14 international lakes (Breukel and Timmerman, 1996).

An update on the monitoring practises and assessment of the environmental status of ten of the most significant transboundary rivers in different parts of Europe, namely the Rhine, Meuse, Tagus, Elbe, Oder, Danube, Morava, Tisza, Daugava and Bug, was produced in 2001 by the International Water Assessment Centre (IWAC), established under the Water Convention to support the implementation of the monitoring and assessment programme area of the work plan. The “Ten Rivers Report” updates the inventory of monitoring practices, which were considered most

likely to have changed in the five-year period between the two reports and also concentrates more on the interpretation and use of the monitoring results, which was outside the scope of the previous report (IWAC, 2001).

So far, the Working Group has produced guidelines on the monitoring and assessment of transboundary groundwaters and transboundary rivers. The guidelines on Monitoring and Assessment of Transboundary Rivers were first published in 1996, and have since been reviewed in 2000. Guidelines on Monitoring and Assessment of Transboundary Groundwaters were also published in 2000. During the 2000-2003 work plan, similar guidelines have been prepared for international lakes.

In addition to preparing the inventories and publishing guidelines the Working Group is running a number of pilot programmes on monitoring and assessment of transboundary rivers and groundwaters, as well as international lakes. The pilot programmes aim to assist countries in the implementation of the guidelines, whilst at the same time providing the opportunity to make adjustments and improvements to the guidelines based on the experiences gained from the pilot programmes.

1.3 Transboundary Estuaries and their Monitoring Practises

1.3.1 Aims and Objectives

The present report was compiled in order to produce relevant background information for the UNECE Working Group on Monitoring and Assessment to assess the need for separate guidelines on monitoring and assessment of transboundary estuaries. The report aims to provide an inventory of transboundary estuaries found within the remit of the UNECE Water Convention, together with an overview of their monitoring practices including the reporting of results, as well as the present extent of international co-operation in monitoring, at the time of the study.

1.3.2 Definitions

Article 1 part 1 of the Convention on the Protection and Use of Transboundary Watercourses and International Lakes states that the term 'Transboundary waters' means "any surface or ground waters which mark, cross or are located on boundaries between two or more States; wherever transboundary waters flow directly into the sea, these transboundary waters end at a straight line across their respective mouths between points on the low-water line of their banks".

In the context of this report an estuary has been defined as "a partially enclosed body of water open to saline water from the sea and receiving fresh water from rivers, land runoff or seepage" according to Day *et al.* (1989); and a *transboundary estuary* has been defined as "an estuary, which lies on the border of, and is thus shared by, two or more countries", hence only the estuaries that themselves are shared by two or more countries are included in the report, whilst the estuaries of other transboundary rivers, where the estuary itself lies entirely within the borders of one country are outside the scope of this report.

1.3.3 Method

Possible transboundary estuaries were initially identified by pinpointing rivers that seemed to debouch into the sea on a border between two countries, on World Atlas maps. This was to give a rough idea on the number of possible locations, however more detailed information and a confirmation of the transboundary nature of the estuaries was needed. The main part of the investigation was based on information gathered by the means of a questionnaire, which requested some basic information on the estuary followed by more detailed questions on monitoring practices, reporting of results and international co-operation. The questionnaire also enquired about any gaps that could be identified in any of the above categories and how the future implementation of the EU Water Framework Directive (Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy) was going to influence monitoring practices (see Appendix 2).

The questionnaire was sent to the Focal Points of each of the Parties to the UNECE Water Convention, that have a marine coastline, thus giving each of these countries the possibility of giving information on any estuary, that they determined to be transboundary. Each Focal Point was sent a paper copy of the questionnaire, and where possible, also an electronic copy through email, to be forwarded to the relevant person in the country. Where the focal point could not be contacted for any reason, such as the contact details being out of date, other possible contacts were identified and used. Some literature sources were used regarding the regional marine conventions and international agreements, which were of relevance to monitoring of transboundary estuaries.

Assessment of Method

Fifteen rivers, that on the map seemed to debouch into the sea along a border between two countries, thus possibly constituting a transboundary estuary, were identified from the initial search on general World Atlas maps. Without closer investigation it was, however, impossible to say whether the river actually formed an estuary or whether this estuary was truly transboundary instead of lying in its entirety inside the territory of one of the bordering countries. There may also be smaller rivers forming transboundary estuaries, which would not be depicted on the small scale atlas maps. Thus the final inventory of transboundary estuaries presented in this report is based solely on the estuaries for which questionnaire replies, or other confirmation of their transboundary status, were received.

Response to the questionnaires was varied and only 11 of the 30 countries the questionnaire had originally been sent to replied (Appendix 1.). The majority of replies came from countries in the European Union (EU) or countries preparing for accession into the EU. Many of the focal points did not respond at all, and it was assumed the questionnaire had not reached them, possibly due to the contact details being out of date. Where possible other contact persons were identified and approached but, regardless of this, 14 countries did not even acknowledge receipt of the questionnaire as requested. Two of the eleven countries that replied confirmed that they had no transboundary estuaries. Actual questionnaire replies were received from nine countries providing monitoring information on ten estuaries. Other information was received to confirm the transboundary status of three estuaries, for which, however, no monitoring information was received.

There were only two cases where both riparian countries replied. There were also differences in the completeness and thoroughness of the questionnaire replies, which forced the investigation to be made at the level of the more incomplete answers. There were also some discrepancies in the basic information, such as the size of the total catchment, reported by each of the riparian countries in the two cases where both replied. The room for interpretation allowed by the information received via the questionnaires was limited due to the small number of replies and their varying level of completeness, and thus any detailed analysis of the results was not possible. However, the questionnaire replies received gave an overall view of the state of monitoring and reporting in transboundary estuaries in the UNECE area, as well as the extent of international co-operation in monitoring, and information exchange among riparian countries, at the time of the study.

3

Inventory of Transboundary Estuaries

3.1 Estuaries

Thirteen transboundary estuaries were identified in the area covered by the UNECE Water Convention (Fig. 1.), ten of which were identified through replies to the questionnaire sent out to countries Party to the Water Convention. The other three, namely the Guadiana, Idefjorden and Volga estuaries were recognised as transboundary estuaries through personal communication (M. Varela, K. Petterson and H. Ghaffarzadeh, respectively) and have been included on the map of estuaries but they do not contribute to the overview of the current state of monitoring in the estuaries as no information on their monitoring practices was received. The ten transboundary estuaries, for which information was provided via the questionnaires, cover a wide range of different sizes and types of estuary with varying degrees of enclosure and different mixing regimes (Table 1.).



Figure 1. Transboundary estuaries in the UNECE Region. Estuaries identified based on the questionnaires include: 1. Virolahti, 2. Narva, 3. Curonian Lagoon, 4. Gdanski Basin, 5. Oder Estuary, 6. Ems-Dollard, 7. Scheldt, 8. Miño, 9. Neretva and 10. Meriç/Evros. Estuaries identified based on personal communication include: 11. Guadiana, 12. Volga and 13. Idefjorden.

Table 1. Basic information on the transboundary estuaries. All of the information presented here has been obtained through the questionnaires. Where the information given by the two riparian countries differed, the larger value given was used for the estuary and catchment sizes whereas both values are given for depths and mixing regime. Missing information is indicated by a line.

Estuary	Size (km ²)	Catchment (km ²) ¹⁾	Average depth (m)	Degree of enclosure	Mixing regime	Tidal regime (m)
Curonian lagoon	1584	100,500	3.8	semi-enclosed	mixed	n/a
Ems-Dollard	500	15,421	3-5	open	stratified/mixed	3
Gdanski Basin	25,600	323,200	57	-	-	n/a
<i>Vistula Lagoon</i>	838	23,871	2.7-3.1	enclosed	-	n/a
<i>Gdanska Bay</i>	4581	220.3	62	open	-	n/a
<i>Pucka Bay</i>	359.2	908.8	15.6	semi-enclosed	-	n/a
Meriç	200	53,000	1.5-5	semi-enclosed	partially mixed	n/a
Miño	-	-	-	-	-	-
Narva	-	56,225	15	open	mixed	n/a
Neretva	-	12,000	4.05	semi-enclosed	partially mixed	n/a
Oder Estuary	7425	130,621	3.5-10	-	stratified/mixed	n/a
<i>Lower Oder Valley</i>	738	-	-	-	mixed	n/a
<i>Sczeczinski Lagoon</i>	687	129,591	3.5-3.8	semi-enclosed	mixed/stratified	n/a
<i>Pomeranian Bay</i>	6000	-	10	-	mixed/stratified	n/a
Scheldt	390	-	10-20	open	mixed	4
Violahti	32.6	357	4.4	enclosed	mixed	n/a

¹⁾ The catchment figures are presented as given in the questionnaire replies; no information is available as to how the catchment area has been defined in each case.

The level of the basic information on the estuaries that the questionnaire replies provided was highly varied. Some presented very detailed information, whereas in other replies the basic information given was limited and, in the case of Miño, lacking entirely. The estuaries cover a wide range of sizes from the small enclosed Virolahti estuary, which encompasses a mere 32.6 square kilometres (km²) to the large estuarine complex of the Gdanski Basin, consisting of a lagoon and two bays, covering an estimated area of 25,600 km². These two are, however, extremes and the other estuaries fall into the size range between 200 and 2000 km². The Virolahti estuary also has the smallest catchment area at only 375 km², whereas the catchment of the Gdanski Basin spreads over 323,200 km². The catchments of the other estuaries fall within the range of 12,000 to 130,000 km².

The average depths of the estuaries also vary widely, ranging from around 1.5 to 62 metres, for the most part, however, remaining below 10 metres. In the larger estuaries mixing regimes vary in different parts of the estuary, so both stratified and mixed conditions can occur within the same estuary. The estuaries situated on the Atlantic coast have tidal ranges of approximately 3 to 4 metres, whereas the estuaries located on the Baltic and Mediterranean Seas do not experience actual tides, although they may undergo more irregular changes of water height due to changes in weather conditions (Table 1.).

3.2 Uses, Impacts and threats

The main uses of the estuaries vary depending on their size, type and location. Overall, fishing and shipping, as well as conservation and wildlife, were reported as the most important uses, closely followed by recreation. All questionnaire replies implied that the conservation of habitats and wildlife were thought of as being of a

relatively high importance. Shipping was reported as the most important use in the larger and more open estuaries, such as the Oder, Ems-Dollard and Scheldt estuaries. Fishing and recreation were the most important uses reported in many of the more enclosed estuaries, such as the Virolahti and Meriç estuaries as well as the Curonian Lagoon. The industrial use of water and the extraction of water for the purposes of drinking water and irrigation were reported as uses in several estuaries, however, in most cases they were considered to be of a lower importance. The use of estuarine water in industry was reported as important in the Vistula Lagoon of the Gdanski Basin, the Scheldt estuary and the Lower Oder part of the Oder estuary. The extraction of water for drinking and irrigation purposes was considered an important use in the more southern Miño and Neretva estuaries (Table 2.).

Table 2. Uses, impacts and threats in the estuaries. The table lists the uses of the estuaries, as well as the anthropogenic impacts and threats to the estuaries as reported in the questionnaires. Abbreviations used for Uses: CR = Conservation/Wildlife, F = Fishing, EoW = Extraction of Water, I = Industry, R = Recreation, S = Shipping. Abbreviations used for Impacts and Threats: WW = Wastewater, A = Agriculture, H/S = Harbours and Shipping, CW = Cooling Waters, M = Mariculture

Estuary	Uses	Impacts and threats
Curonian lagoon	F, CR, S, R	WW, H/S, A
Ems-Dollard	S, CR, I, F, EoW, R	WW, H/S, A
Gdanski Basin	I, R, F, S, CR	WW, A
Meriç	F, CR	WW, A
Miño	F, EoW	WW, A
Narva	S, R, F, CR, EoW, I	WW, CW
Neretva	CR, EoW, F, S, R	WW
Oder Estuary	S, F, R, CR, I, EoW	WW, H/S, A, CW, M
Scheldt	S, I, CR, EoW, F, R	WW, A
Virolahti	F, R	M, A

The main anthropogenic impact on the estuaries is caused by waste water, which was reported as a threat in all but one of the estuaries (Table 2., Fig. 2). All of the estuaries receive either direct discharges of waste water or the influx of waste water discharged into the rivers, or both. The waste water released into the estuaries and rivers consists mainly of municipal and industrial waste waters that receive at least a biological level of treatment, however, a small percentage only receives mechanical treatment and in some countries untreated municipal waste water is also released into watercourses. In the European Union Member States, the Directive of the European Parliament and of the Council 91/271/EEC Concerning Urban Waste Water Treatment (Waste Water Directive) sets the standard of treatment for municipal waste waters. The directive also applies to some industrial sectors, such as the food processing industry.

According to the Waste Water Directive, currently all waste water from municipalities with a population equivalent (p.e.) of 15,000 (10,000 if the receiving waters are considered sensitive) or more must be treated at least to secondary level of treatment, i.e. be biologically treated, before being discharged into a water body. By the year 2005 this will include all municipalities with a p.e. of 2000 or over. Although the directive may not be fully implemented in all countries due to restrictions on time and resources, it is an important move towards better treatment of waste waters and has also been included in the legislation of some of the European Union acceding countries. However, even with all of the required facilities to provide adequate treatment of waste water at least to the secondary level, and in some cases also to the tertiary level of treatment, the treatment facilities may in some cases be overwhelmed during strong rainfall, or the tourist season, when there is a

massive increase in the local population (OSPAR, 2000a; OSPAR, 2000b). In more rural areas the treatment of waste water is lacking due to the absence of the required infrastructure for the collection and treatment of waste water.

The other major environmental impact on the estuaries is caused by diffuse pollution originating from agriculture and the sparsely populated areas with no waste water treatment facilities, situated around the estuary and the river catchment. In those particular estuaries, where there are large harbours, the harbour industries surrounding the estuary and their related shipping traffic were considered an important source of both point and diffuse pollution. Other threats mentioned in the questionnaire replies included mariculture and the heat pollution caused by discharge of industrial cooling waters, which can cause more localised adverse effects on the ecosystem as well as the more widespread impact of atmospheric deposition of contaminants (Table 2. Fig. 2).

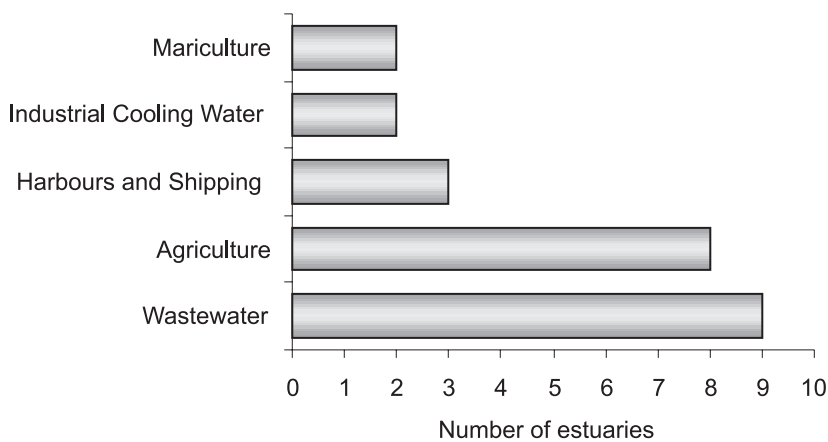


Figure 2. Threats to the estuaries. The figure shows the number of estuaries where a particular impact or threat was reported by one or both of the riparian countries.

4

Current Monitoring Practises

A water quality monitoring programme covers the whole process from the acquisition of quantitative information on the physical, chemical and biological characteristics of the water body using statistical sampling methods to the interpretation and reporting of the results. The type of information required depends on the aims and objectives of the monitoring programme, which can range from maintaining the quality of drinking water to assessing the current ecological state of the aquatic environment and detection of spatial and temporal trends in the physical, chemical and biological characteristics of water quality. (Kristensen & Bøgestrand, 1996).

The objectives of the monitoring programmes in the estuaries are largely based on the requirements of national water laws and regulations and, in the EU Member States and countries preparing for accession, EU directives. Monitoring programmes are also influenced by the requirements of international agreements, such as the regional seas conventions and in some cases the bilateral agreements between riparian countries. There are twelve EU directives, which have monitoring requirements that apply to estuaries (Nixon *et al.*, 1996). There are differences in the monitoring requirements stated in the directives, which range from preliminary investigations to routine monitoring, and the extent to which the requirements of the directives overlap each other depends on the national implementation of the directives. The monitoring undertaken as a result of the directives will therefore vary from country to country, with differences in sampling and analytical techniques as well as at the reporting stage (Nixon *et al.*, 1996). Most of these directives have now been integrated into the Water Framework Directive, which was drafted in an attempt to unify the requirements of the directives and create a more integrated water policy for Europe. The WFD will be looked at in more detail in Chapter 7.

Estuaries are rarely monitored separately, but are most often included as a part of a national water monitoring programme covering all types of surface waters or incorporated into particular national, or international, coastal or riverine monitoring programmes. In almost every case the aims of the monitoring programmes in the estuaries were reported to include investigations on temporal and spatial change in the natural environment and the detection of trends. The information gathered is used in the management of waters. Other important monitoring objectives are investigations of anthropogenic impact and the effectiveness of measures as well as checks on compliance with laws and criteria.

4.1 Organisations and guidelines

National guidelines and standards make national monitoring efforts more consistent and thus the results easier to interpret and compare. Adhering to shared international standards and guidelines in turn makes the comparison of monitoring results from different countries easier, and thus eases the exchange of monitoring information between riparian countries. All of the countries reported having some

kind of national guidelines on monitoring. In seven out of the ten estuaries monitoring is conducted according to international guidelines or standards set by a convention or an agreement.

In most cases the monitoring activities are overseen at national levels of environmental administration, however in Germany the top environmental administration stands at the State, or Länder, level. Collection and analysis of samples is mainly conducted at regional and local levels, although in four out of the nine countries at least some of the sampling is done at a national level. In the case of the Ems-Dollard and Oder estuaries some monitoring is also conducted by international organisations. In most of the countries information is stored both regionally and nationally. Three out of the nine countries hold some data locally although in all of these cases data is also forwarded either to a regional or national level, or both. Data is held exclusively at a national level in two countries. One country provided no information on the handling and storage of data.

4.2 Variables and media sampled

In most of the countries that replied to the questionnaire the variables to be included in monitoring of the estuary are chosen according to the requirements of national legislation, which is often based on EU directives. In many countries the choice of variables is also dependent on the requirements of their regional conventions, Helsinki Commission (HELCOM) and Oslo and Paris Commission (OSPAR), or other international agreements. Often variables are chosen to indicate signs of specific threats such as eutrophication or industrial impacts. The choice of variables as well as the number of sampling stations and frequency of sampling is often limited by the lack of available funds, equipment and human resources.

4.2.1 General Factors

All of the countries measure at least some of the basic hydrological factors such as river inflow, flow in estuary and water level, as well as common physical factors such as salinity, temperature, pH, O₂, conductivity, turbidity and alkalinity (Fig. 3). Basic indicators of organic pollution such as BOD, COD and TOC are also monitored in the water phase in different combinations by eight out of the nine countries and in sediments by two countries. Eight out of the nine countries also monitor effluents discharged into the water body. The influx of pollutants from the river is also monitored by most of the countries. Two countries monitor litter.

4.2.2 Nutrients and Chemical Pollutants

All of the countries also monitor the concentrations of various different combinations of chemical factors, including nutrients and chemical pollutants. Chemical factors are most commonly monitored in the water phase. Measuring the concentrations of contaminants in the water phase only can, however, give a distorted picture of the nutrient and pollutant load, as it ignores the stores of pollutants in the sediments, which have a direct effect on the bottom dwelling biota, and may also be released back into the water column at a later stage. Therefore, it would be preferable to also monitor the concentrations of nutrients and pollutants stored in the sediments in addition to the measurements made in the water phase. In order to observe the biologically relevant levels of contaminants, the pollutant burden of the biota should be investigated, as the contaminant concentration in biota reflects the actual

bioavailable concentration of pollutants in the environment. Only three of the nine countries also investigate the concentrations of chemical pollutants in sediments and two in biota (Fig. 3). The monitoring in the water phase is mainly conducted near the surface of the water column, only one country also takes measurements near the bottom, and another produces vertical profiles of total nitrogen (N) and phosphorus (P) concentrations.

All nine countries monitor nutrient load in the water phase (Fig. 4.). Eight of the countries conduct monitoring of nutrients on a monthly or seasonal basis. One country provided no information on the frequency of monitoring. All countries monitor total N and P concentrations and eight out of nine measure phosphates, nitrates and ammonia. Six countries also monitor silicate concentrations. Heavy metals including Cd, Hg, Pb, Cu and Zn, are monitored in the water phase in eight countries (Fig. 4.). Two countries monitor metals once a year, four on a monthly or a seasonal basis and in one country metals are sampled every other month; one country provided no information on monitoring frequency.

The monitoring of organic pollutants, such as TBT, PCBs, DDT, PAHs and HCH, in the water column is less extensive, although six countries monitor different combinations of at least one or two persistent organic chemicals (Fig. 4). The monitoring of organic pollutants is carried out annually by one country, whereas two countries monitor them seasonally, one every other month and one monthly; one country gave no information on the frequency of monitoring.

Only one of the nine countries also measures the concentrations of nutrients in estuarine sediments. Three countries measure the concentrations of heavy metals in sediments, two annually and one once in three years. The same three countries also monitor the concentrations of varying combinations of organic pollutants in sediments, one annually, one three times a year and one once in three years. Two countries also monitor the concentration of heavy metals found in biota on an annual basis. In one country a range of organic contaminants are monitored in biota and another country monitors the levels of DDT in biota (Fig. 3.).

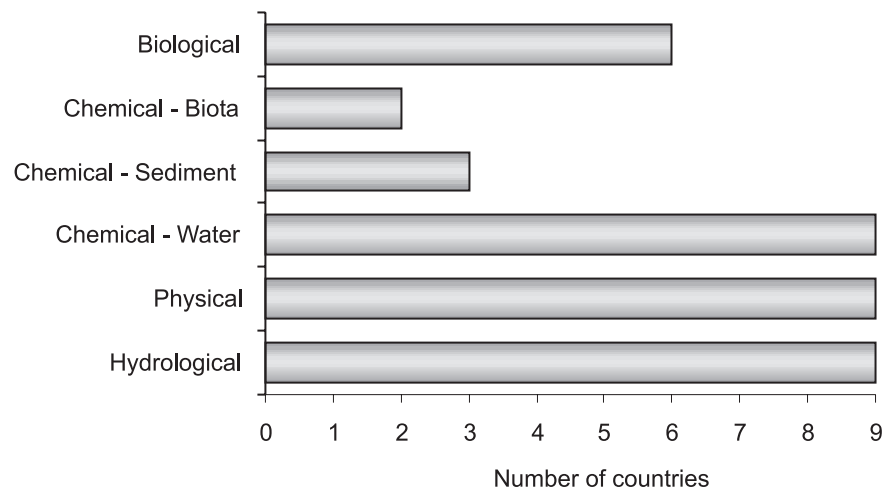


Figure 3. Types of monitoring in the estuaries. The figure shows the number of countries that monitor particular groups of factors. The number of countries monitoring chemical factors in each phase (water, sediments and biota) are shown separately.

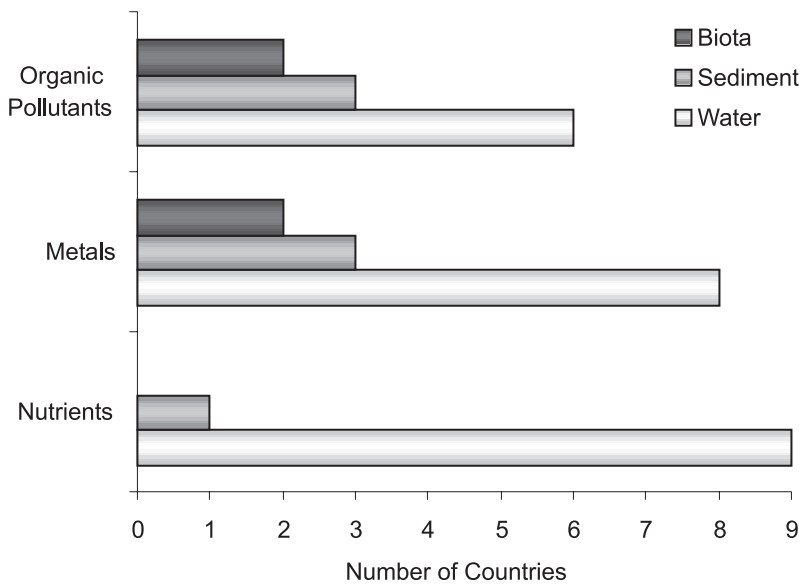


Figure 4. Monitoring of nutrients and chemical pollutants. The figure shows the number of countries that monitor nutrients, metals and organic pollutants in the water phase, sediment and biota.

4.2.3 Biological Monitoring

Six out of the nine countries carry out some type of biological monitoring (Fig. 3.). The two most commonly monitored biological factors are chlorophyll-*a* concentration and phytoplankton species composition, which are monitored by five of the countries on a monthly basis or during phytoplankton blooms. The monitoring of faecal pollution indicators is also relatively common. Four countries monitor total coliforms, three countries faecal coliforms and one country faecal streptococci. Three of the nine countries also monitor the species composition of the macrozoobenthos, and two of these also monitor the abundance of the macrozoobenthos. Zooplankton abundance and species composition are monitored in one country. Two countries monitor phytobenthic biomass and one of these also monitors the species composition of the phytobenthos. Vertebrates are monitored in one country (Fig. 5.).

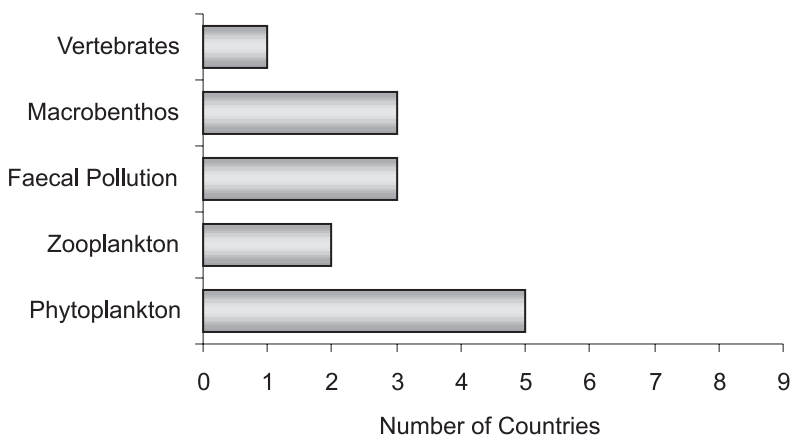


Figure 5. Biological factors monitored. The figure shows the number of countries that monitor some aspect of the following groups of biological factors: phytoplankton, zooplankton, faecal bacteria, macrobenthos (fauna and/or flora) and vertebrates.

Table 3. Groups of variables monitored ✓ in different countries. For the chemical variables a distinction has been made as to the sampling media used: ○ = Water ● = Sediment ▲ = Biota.

Variables	Country ⁽¹⁾								
	BA	EE	ES	FI	GE	LT	NL	PL	TU
Hydrological	✓	✓	✓	✓	✓	✓	✓	✓	✓
Physical	✓	✓	✓	✓	✓	✓	✓	✓	✓
Chemical	✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>Nutrients</i>	○	○	○	○	○●	○	○	○	○
<i>Heavy Metals</i>	○	○	○		○●	○●▲	○●▲	○	○
<i>Organic Pollutants</i>		○	○		●	○●▲	○●▲	○	○
Biological	✓			✓	✓	✓	✓	✓	
<i>Phytoplankton</i>				✓	✓	✓	✓	✓	
<i>Zooplankton</i>				✓		✓			
<i>Faecal Pollution</i>	✓					✓		✓	
<i>Macrobenthos</i>					✓	✓	✓		
<i>Vertebrates</i>							✓		

⁽¹⁾ Country codes: BA = Bosnia-Herzegovina FI = Finland EE = Estonia ES = Spain GE = Germany LT = Lithuania NL = The Netherlands PL = Poland TU = Turkey (ISO 3166 A2)

4.3 Quality Assurance

Quality Assurance (QA) procedures are important in assuring the reliability and usefulness of the data gathered in a monitoring programme. Using standardised procedures in analysis produces data of known quality and enables the comparison of results from different studies. Only one out of the nine countries who replied to the questionnaire stated there were no QA procedures in use in the monitoring of their estuary. Most others followed the quality assurance procedures of their regional conventions, or other internationally accredited procedures including inter-laboratory calibrations and international reference materials. Some followed QA procedures set by their national standards.

4.4 Reporting of Monitoring Results

One of the countries gave no information on the reporting of monitoring results. In the countries that did provide such information reporting of the results from water monitoring programmes is mainly performed at a national or regional level, although there are some locally prepared published reports. Most countries publish public reports at annual intervals. Five out of nine also publish some results on the Internet, but access to the databases is often limited. Most of the countries also forward monitoring information onto one or more international databases, such as EUROWATERNET, EUROSTAT, EEA and in most cases also to their regional convention databases, held by the International Council for the Exploration of the Sea (ICES), where the information will be available to other users. In all of the countries at least finished reports are available to the general public and in some cases some of the raw data is also available upon request.

International Co-operation in Monitoring

5

Achieving increased international co-operation in monitoring is a major objective of the Water Convention. The co-operation is to be accomplished through the development of bilateral agreements enabling the setting up of joint or co-ordinated monitoring programmes between Parties sharing a water body, as well as creating new initiatives on information sharing. Joint or co-ordinated monitoring initiatives ensure the compatibility of data produced by the riparian countries, thus easing the sharing of the information obtained from the common water body, therefore forming the basis for concerted water management. Only three of the nine countries reported a good, working system of information exchange between the authorities. No information exchange at governmental level was reported for the remaining six countries, although in some cases whilst governmental co-operation is lacking there appears to be extensive information exchange among research institutes, and within the framework of different conventions.

5.1 International agreements

In four of the ten estuaries at least part of the monitoring is based on an international agreement. There are no treaties or agreements that have been drafted solely for estuaries; however, nearly all of the estuaries investigated in this report are included in some kind of bilateral or multilateral agreement that advocates co-operation in monitoring and sustainable water management (Table 4.). Some are general bilateral agreements between countries regarding all of their shared water resources and thus including the transboundary estuaries in question. There are also agreements covering whole rivers, which also include the estuary of that particular river. Agreements on the joint monitoring and assessment of coastal marine areas, such as the Trilateral Wadden Sea Co-operation (Box 1.), often also include the estuaries in that particular coastal area.

In reality the state of implementation of the treaties and agreements has a significant effect on whether they are actually working or not. The actual level of co-operation may often be much lower than that aimed for through the signing of an agreement. Very little information was offered on the state of implementation of treaties and agreements, but some countries are still working on new legislation and regulations in order to implement various treaties and conventions. Some of the countries that reported agreements including provisions for joint or co-ordinated monitoring initiatives also stated that at the present time there are no joint or co-ordinated monitoring programmes in operation. In some countries the financing of the environmental field is lacking and thus the implementation of these agreements into actions is dragging behind (Gooch *et al.*, 2002). One country gave no information at all on co-operation in monitoring.

Box 1. The Trilateral Wadden Sea Co-operation.

Since the year 1978 the governments of The Netherlands, Denmark and Germany have been working together on the protection and conservation of the Wadden Sea through co-operation in management, monitoring and research. TMAP, The Trilateral Monitoring and Assessment Program of the Wadden Sea, aims to provide a scientific assessment of the status and development of the Wadden Sea ecosystem and to assess the status of implementation of the trilateral Targets of the Wadden Sea Plan. Assessment reports based on data from the existing national monitoring programmes of the member countries are produced every 3-4 years, related to the Trilateral Governmental Conferences. The reports describe and evaluate the current ecological status of the Wadden Sea, identifying issues of concern and indicating possible measures. All of the area's six estuaries, including the transboundary Ems-Dollard estuary, are included in the assessments. The assessments cover a relatively extensive range of factors, including measurements of chemical parameters such as nutrients, metals, and organic pollutants in water, sediment and biota as well as biological parameters, such as phytoplankton, zooplankton, macrobenthos and fish. TMAP also works in co-operation with OSPAR's monitoring programme JAMP, and information is shared between the two. An overview of the TMAP data is available via the Internet whilst access to the actual data is restricted to selected expert groups responsible for assessing and publishing the data (Bakker *et al.*, 1997; De Jong *et al.*, 1999).

5.2 Conventions and International Monitoring Initiatives

The European regional seas are all covered by conventions, each of which give guidelines on monitoring of the marine area they cover and obtain national results to be included in a large database to serve the whole convention area. Although none of the regional conventions directly assess the water quality of European estuaries, the data collected includes data from the larger estuaries (France *et al.*, 1996). The conventions are relatively complete and incorporate the necessary tools to achieve compatible monitoring information covering a large area, but they need to be enforced and co-ordinated in order to function properly and there are still fundamental economic and scientific constraints to achieving uniform coverage (Peronaci, 1999). Conventions also only perform large-scale assessments covering large areas over long time intervals, with several years between assessments. Due to analytical difficulties or the lack of Quality Assurance procedures some parameters are measured only on a voluntary and not on a mandatory basis, contributing to a lack in consistency and regularity in many existing datasets. There is generally a lack of data on the biological effect parameters, and estimates of contaminant fluxes are generally scarce or lacking (Bokn & Skjoldal, 1999).

The Helsinki Commission (HELCOM). The 1992 Convention on the Protection of the Marine Environment of the Baltic Sea Area stipulates that the Contracting Parties, individually or jointly, are to prevent and eliminate pollution in order to promote the ecological restoration of the Baltic Sea Area and the preservation of its ecological balance. HELCOM Recommendation 19/3, established in 1998, states that monitoring of the state of the marine environment in the member countries should

be performed in accordance with the manual for marine monitoring in the COMBINE programme. The COMBINE manual is a living document and is regularly updated with new developments and the latest updated version is always available on the HELCOM web site (Box 2.). Data on physical, chemical and biological variables collected under the COMBINE programme are used for wide ranging Periodic Assessments of the State of the Marine Environment of the Baltic Sea. Discharges and emissions within the Baltic Sea drainage basin are monitored under HELCOM's Pollution Load Compilation Programme (PLC). Both programmes include monitoring stations in the larger Baltic estuaries. The data is stored in the ICES databank and is easily accessible to the Helsinki Commission and the Contracting Parties, and after validation to members of the scientific community and the public (Manzella & Nair, 1998).

Oslo and Paris Commission (OSPAR). The 1992 Convention on the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention) requires that Contracting Parties take all possible steps to prevent and eliminate pollution to protect the marine environment. This includes undertaking and publishing joint assessments of the quality status of the marine environment, in the form of the Joint Assessment and Monitoring Programme (JAMP). The Ems-Dollard, Scheldt and Miño estuaries as well as the Guadiana estuary are all included in JAMP (Izzo *et al.*, 1998). The raw scientific data derived from JAMP is stored in the ICES databank, where all Contracting Parties have free access to the data. Other organisations can also have access on the basis of a formal request. In general all data are available to the public but the laboratory providing the data can limit data accessibility (Manzella & Nair, 1998). OSPAR has produced elaborate guidelines for its members on monitoring the marine environment for the purposes of JAMP, and these guidelines are available on the OSPAR web site (Box 2.)

Mediterranean Action Plan (MAP). The Mediterranean Action Plan was established to implement the Barcelona Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean. The Work Programme of MAP aims to protect and manage the Mediterranean marine resources. The Co-ordinated Mediterranean Pollution Monitoring and Research Programme (MED POL) was set up to produce information required for the implementation of the Barcelona Convention and its protocols. MED POL aims to formulate environmentally sound national and multilateral management decisions and to analyse the sources, levels, trends and effects of pollutants and the effectiveness of antipollution measures and to produce periodic assessments of the state of the Mediterranean (Izzo *et al.*, 1998). All Contracting Parties have access to the data. Raw data are not accessible to the general public however published assessment documents are available (Manzella & Nair, 1998). No information was available as to the estuaries included in the MED POL monitoring programme.

The Black Sea Environmental Programme (BSEP) and The Caspian Environment Programme (CEP). The Strategic Action Plan for the Rehabilitation and protection of the Black Sea (BS-SAP), 1996, which was created following the Odessa Declaration, 1993, and the Bucharest Convention, 1994, includes provisions for co-ordinated monitoring programmes in the Black Sea, including the measurement of the load carried by rivers, but does not specify monitoring of estuaries. The Caspian Environment Programme (CEP) is a regional programme aiming to protect the environment of the Caspian Sea and to promote sustainable development in the area. CEP addresses multiple environmental and bioresource issues, including effective regional intersectoral co-ordination and environmental management, public awareness and involvement in CEP, including the National Caspian Action Plans (NCAP) and the regional Strategic Action Programme (SAP). The aims of CEP include establishment of regional data and information management systems and a regional assessment of contaminant levels as well as integrated transboundary coastal area

planning and management and regional emergency response actions. CEP does not, however, have an estuarine monitoring programme. The monitoring of estuaries if ever attempted is the responsibility of the national governments (pers. comm. H. Ghaffarzadeh, CEP).

Box 2. The Internet addresses of Regional Marine Conventions and TMAP.

BSEP	http://www.blacksea-environment.org
CEP	http://www.caspianenvironment.org
HELCOM	http://www.helcom.fi
MAP	http://www.unepmap.org
OSPAR	http://www.ospar.org
TMAP	http://cwss.www.de/TMAP/Monitoring.html

Table 4. Bi- and multilateral agreements relevant to transboundary estuaries. The table shows the agreements and treaties between the riparian countries of different transboundary estuaries and the regional marine conventions that are relevant to the monitoring of European transboundary estuaries.

Estuary (Riparian Countries)	Bilateral and multilateral agreements/treaties	Regional Convention
Curonian Lagoon (Lithuania/Russian Federation)	Agreement between Governments of Russian Federation and Republic of Lithuania on Co-operation in the Field of Environmental Protection, 29th June 1999	HELCOM
Ems-Dollard (Germany/Netherlands)	Permanent Dutch-German Transboundary Waters Commission The Wadden Sea Trilateral Co-operation, 1997	OSPAR
Gdanski Basin (Poland/Russian Federation)	The Agreement between the Government of the Republic of Poland and the Government of the Russian Federation on Co-operation in the Field of Environmental Protection 25.08.1993 The Agreement between the Government of the Republic of Poland and the Government of the Russian Federation on Co-operation of North-Eastern Voivodeships of the Republic of Poland and the Kaliningradzki District of the Russian Federation 22.05.1992 The Agreement between the Government of the Republic of Poland and the Government of the Russian Federation on Co-operation of the Regions of the Republic of Poland with the Region of Sankt-Petersburg of the Russian Federation 2.10.1992 The Agreement between the Government of the Polish People's Republic and the Union of Soviet Socialist Republics on Co-operation on the Transboundary Water 17.07.1964	HELCOM
Meriç (Greece/Turkey)	None reported	MAP
Miño (Portugal/Spain)	Convention on Co-operation for Portugese-Spanish River Basins, 17th January 2000	OSPAR
Narva (Estonia/Russian Federation)	Agreement between the Government of the Estonian Republic and the Government of the Russian Federation in Co-operation in Protection and Sustainable Use of Transboundary Waters, 20th August 1997	HELCOM
Neretva (Bosnia-Herzegovina/Croatia)	(Agreement on water management under revision)	MAP
Oder Estuary (Germany/Poland)	Convention on the international Commission for the Protection of the Oder, 11th April 1996 Agreement between the Republic of Poland and Federal Republic of Germany on Co-operation in the Area of Transboundary Waters, 19 May 1992 Agreement on Co-operation in the Fields of Environmental and Nature Protection between the Mecklenburg-Vorpommern and Szczecin Voivodeship, 1991	HELCOM
Scheldt (Belgium/Netherlands)	Agreement on the Protection of the Scheldt (ICBS) (Verdrag inzake de bescherming van de Schelde) Charleville-Meziere, 26 April 1994	OSPAR
Violahti (Finland/Russian Federation)	None	HELCOM

6

The EU Water Framework Directive

The ongoing implementation of the Directive of the European Parliament and of the Council 2000/60/EC establishing a framework for community action in the field of water policy, commonly referred to as the Water Framework Directive (WFD), will change the focus of European water policy more towards a whole catchment based approach, and introduces a more biological view into water quality monitoring, and thus will have a great impact on routine water quality monitoring in the Member States. The directive is an attempt to co-ordinate and harmonise the practises of water management in all of the EU Member States. The management of water resources will be based on plans made for River Basin Districts, that are defined as the area of land and sea made up of one or more river basins, together with their associated groundwaters and coastal waters. Each Member State has to identify and designate the River Basin Districts found within its territory. International River Basin Districts are formed where a river basin covers the territory of more than one member country.

Co-ordinated surface water monitoring programmes are to be established for the whole River Basin District according to the guidelines and standards set out in the directive and further elaborated in the Common Implementation Strategy, in order to provide a coherent and comprehensive overview of the ecological and chemical status of the water bodies. The directive divides surface waters into four categories: rivers, lakes, transitional waters, and coastal waters. Estuaries fall under transitional waters, which are defined as “bodies of surface water in the vicinity of river mouths which are partly saline in character as a result of their proximity to coastal waters but which are substantially influenced by freshwater flows”. Specified biological, morphological, physical and chemical quality elements, that are to be included in monitoring, are given in the directive for each of the above surface water categories.

Monitoring activities are to be established in the form of surveillance and operational monitoring programmes. The surveillance monitoring programme is aimed at providing information on long term changes in natural conditions, and resulting from anthropogenic activity and is carried out at set intervals. The operational monitoring should be carried out to establish, and assess any changes in, the status of waters that have been identified as being at risk of failing to meet their environmental objectives. Additional investigative monitoring must be carried out when water quality standards have not been met and the reason for this is unknown, or to ascertain the magnitude and impacts of accidental pollution. Monitoring must also include an estimate of the pollution load which is transferred over Member State boundaries and which is transferred to the marine environment. The initial monitoring programmes are to be in force by the end of 2006 and River Basin Management Plans with their revised monitoring programmes are to be published by 2009. In the meantime work is done on the inter-calibration of monitoring systems among Member States and to create useful guidelines to ease implementation.

In the case of international River Basin Districts, the Member States concerned should work together to ensure co-ordination of management and monitoring efforts. Existing structures stemming from international agreements can be used to achieve the needed co-operation and help from the European Commission is available in organising co-ordination. The effects of the WFD are likely to reach further than the EU Member States, as where a River Basin District extends outside the EU, the Member States are to make an effort to establish appropriate co-ordination with the Non-Member States with the aim of achieving the objectives of the directive throughout the River Basin District. This will also include the EU countries sharing their expertise and technology to help the countries with less well-developed monitoring systems and equipment.

7

Conclusion

Due to the small number of replies to the questionnaire, the actual number of transboundary estuaries in the whole UNECE area was left somewhat unclear, and the inventory presented in this report is therefore incomplete. Difficulties were experienced especially in attempting to gain information from the countries bordering the Black Sea and the Caspian Sea. It was very difficult to get through to the focal points in these countries and none of them, with the exception of Bulgaria and Romania, replied to the questionnaire. In many cases it was assumed the request never reached the appropriate person. However there were also countries in Western Europe who failed to respond to the questionnaire. Eventually thirteen estuaries were identified either through the questionnaire replies or other communication. Monitoring information was received for ten out of these thirteen estuaries. The limited amount of information received, and the large variation in the standard of the obtained information made the analysis of results quite difficult, and the results can only be taken as indicative.

In most countries the monitoring of estuaries is executed as a part of the national surface water monitoring programmes, which aim to produce relevant information for the management of waters. The monitoring programmes and the variables measured are largely based on the requirements stated in national legislation, which in the EU Member States and acceding countries are often based on a multitude of EU directives. International conventions, such as HELCOM, OSPAR and MAP, also impose their own requirements on the information to be included in their databases and thus affect the monitoring programmes of their member countries.

In all cases but one the monitoring programmes are overseen, and the data stored, at the national level of environmental administration. Germany is an exception, as there the highest environmental authorities are at the level of the separate States, or Länder. The actual sampling and analysis of samples is most often carried out locally or regionally, which places great importance on ensuring the accuracy and compatibility of the data gathered and analysed by the different institutions and laboratories and calls for advanced Quality Assurance procedures.

The ability to compare results produced in different countries, and thus share the results of monitoring programmes requires the co-ordination of the methods used in sampling and analysis. Most countries that replied reported using international standards and accredited methods, as well as performing interlaboratory calibrations and using international reference materials. Most of the countries have use of an internationally accredited laboratory. In many cases the sampling and analytical techniques are chosen following the instructions given by the regional conventions. In some cases, such as the Oder estuary, monitoring is also jointly planned, although the actual sampling and analysis is conducted by the relevant institutions in each country. Joint planning and harmonisation of methods is necessary to ensure the compatibility of data gathered in the monitoring programmes and thus its usefulness for both Parties, forming the basis for co-operation in the management of waters.

The estuarine monitoring programmes are relatively comprehensive in the water phase, with good coverage of nutrients and chemical pollutants, but there are still gaps in the monitoring of contaminants in sediments and biota and in the

extent of the use of biological monitoring. The biological monitoring practices are currently often limited to the measurement of phytoplankton during the blooms of the growing season, as an indicator of eutrophication, or in order to detect the presence of any harmful phytoplankton species. The issue of biological monitoring and the use of bioindicators to study the contaminant load in the estuarine environment will be addressed, at least in the European Union Member States and in many of the acceding countries, with the implementation of the Water Framework Directive, which includes a water quality assessment system based on a more biological outlook. Water quality status will be derived from both the ecological quality and the chemical quality of the water body.

All of the estuaries are covered by some kind of agreement promoting co-operation in monitoring, and the sharing of monitoring results among riparian Parties. Some information is shared as a result of the regional seas conventions, through the data forwarded to their databases, which is freely available to all convention Parties. Bilateral agreements stating provisions for co-ordinated or joint monitoring initiatives are also in force in several estuaries, but the agreed co-operation in monitoring has actually been achieved only in a few cases. The lack of appropriate legislation, economic constraints and political differences often stand in the way of putting agreements into practice. However, information sharing at the level of research institutes was reported as being good also in the countries that reported poor governmental co-operation and information sharing.

The implementation of the EU Water Framework Directive will increase the co-ordination and co-operation in monitoring activities at least inside the European Union but also aims to include the countries sharing transboundary waters with EU Member States. The use of catchment-based management requires co-operation among the countries sharing a river catchment and a harmonised monitoring and management plan will be created for each International River Basin District. However, the implementation of the WFD, especially concerning the International River Basin Districts reaching outside the European Union, will face the same economic and political restraints as the other agreements and treaties.

After discussion on the results presented in this report, the Working Group on Monitoring and Assessment came to the conclusion that no guidelines were needed to cover monitoring specifically in transboundary estuaries. It is instead recommended that international monitoring and Quality Assurance guidelines, such as the guidelines produced by the various marine conventions, are followed to achieve the good standard of information and comparability of results between countries that is desirable in the context of transboundary water management. The ongoing process of WFD implementation is also producing guidelines in order to generate an integrated interpretation of the requirements of the directive, and achieve the required comparability in ecological and chemical information from different Member States.

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Appendix I. A List of Parties to which the Questionnaire was sent and Main Contact Persons

Country	Contact Person(s)	Reply
ALBANIA	Mrs. T. Hema	
AZERBAIJAN	Mrs. M. Adigezalova	
BELGIUM	Dr. J. Pauwels	X ¹⁾
BOSNIA AND HERZEGOVINA	Ms. E. Kupusovic	√ ²⁾
BULGARIA	Mr. Stetoslav Cheshmedjiev	√
CROATIA	Mr. Z. Ostojic	
DENMARK	Mr. Leo Bjørnskov	
ESTONIA	Mr. H. Liiv	√
FINLAND	Ms. P. Kauppila	√
FRANCE	Mr. Jean Paul Rivaud	
GEORGIA	Mrs. Mariam Makarova	
GERMANY	Mr. T. Stratenwerth, Mr. R. Gade, Mr. M. von Weber	√
GREECE	Mrs. Phani Daskalopoulou-Livada	
ITALY	Mrs. Viviana Bianco	
KAZAKHSTAN	Ms. Yelena Kochenova	
LATVIA	Mr. R. Bebris	
LITHUANIA	Mrs. V. Vinceviciene	√
NETHERLANDS	Ms. M. Dirkson	√
NORWAY	Mr. Ole.T. Nyvoll	X
POLAND	Mrs. M. Landsberg-Uczciwek, Ms. H. Sozska	√
PORTUGAL	Mr. L. Veiga de Cunha	X
ROMANIA	Ms. A. Drapa	√
RUSSIAN FEDERATION	Mr. Valery Kukosh	X
SLOVENIA	Mr. Marko Slokar	
SPAIN	Mr. M. Varela	√
SWEDEN	Ms. K. Pettersson	X
TURKEY	S. Erdogan, S. Bagci	√
TURKMENISTAN	Mr. Durdymurat Bayarammuradov	
UKRAINE	Mr. Yaroslav Movchan	
YUGOSLAVIA	Dr. Andjelka Mihajlov	

¹⁾ Country acknowledged the receipt of the questionnaire but did not send a reply

²⁾ Country replied to the questionnaire

3) Current Monitoring Practises

3.1 Organisation(s) in charge of monitoring (national and/or international):

3.2 Organisation responsible for:

Collection of samples: _____

Analysis of samples: _____

Interpretation of data: _____

Storage of information: _____

(Please indicate if local, national or international)

3.3. Is monitoring executed according to any

international agreements Yes No

international guidelines or standards Yes No

national guidelines or standards Yes No

If yes, please provide information on guidelines/standards used or indicate any possible documents, including web pages, available stating these standards:

3.4 Quality Assurance procedures applied regarding methods used in sampling and analysis (see notes):

3.5 The aims and objectives of monitoring

3.6 Sampling procedures and variables:

Provide all information available where appropriate. If a description of the monitoring programme can be found in a publication please indicate the name and source of the publication and proceed to the next question

f – Sampling frequency (*A* – annual, *S* – seasonal, *M* – monthly, *W* – weekly, *D* – daily, if other state exact frequency)

No – Number of stations sampled for the variable

D – Sampling depth (*S* – surface only, *B* – bottom only, *V* – vertical profile)

If variable monitored but no information on frequency, depth or number of stations available, tick next to the variable in question (✓)

Hydrological

Variable	✓	<i>f</i>	No	D
River inflow				
Flow in estuary				
Water level				

Physical

Variable	✓	<i>f</i>	No	D
Salinity				
Temperature				
PH				
O ₂				
Conductivity				
Turbidity				
Alkalinity				

Chemical

Variable	✓	Water phase			Suspended solids		Sediment		Biota	
		<i>f</i>	No	D	<i>f</i>	No	<i>f</i>	No	<i>f</i>	No
Total P										
Total N										
Phosphate										
Nitrate/ammonia										
Silicate										
BOD										
COD										
TOC										
Cd										
Hg										
Pb										
Cu										
Zn										
TBT										
PCBs										
DDT										
Dieldrin										
Dioxins										
Dibenzofurans										
hexachlorobenzene										
toxaphen										
PAHs										

Biological

Variable	√	f	No
<i>Phytoplankton</i>			
Chlorophyll			
Biomass			
Spp. composition			
<i>Zooplankton</i>			
Abundance/biomass			
Spp. composition			
<i>Phytobenthos</i>			
Biomass			
Spp. composition			
<i>Zoobenthos</i>			
Abundance/biomass			
Spp. composition			
<i>Vertebrates</i>			
Fish			
Mammals			
<i>Microorganisms</i>			
Faecal coliforms			
Total coliforms			
Faecal streptococci			
<i>Other</i>			

3.7 Is litter monitored?

Yes No

If yes, frequency of sampling: _____

3.8 Explain the basis for the selection of monitored variables

3.9 Is the input of pollutants from the river monitored? Yes No
If yes, frequency of monitoring: _____
monitoring body: _____
pollutants monitored: nutrients / metals / organic pollutants

3.10 Are there any early warning monitoring procedures? Yes No
If yes, frequency of sampling and description of methods used:

3.11 Are effluents monitored? Yes No
If yes, organisation/authority responsible for monitoring:

3.12 Describe any foreseeable changes to monitoring protocols due to the implementation of the EU Water Framework Directive and plans regarding these changes

4) Reporting

4.1 Organisation/authority in charge of reporting:

4.2 Formats used for reporting and names of reports:
Internal reports: _____
Published reports: _____
Databases: _____
Internet: _____
Other: _____

4.3 Timeframe for reporting of data:

4.4. International formats or standards used in reporting:

4.5 Who is the information available to?

4.6 What part of the information is available to the public?

4.7 International databases that monitoring information is forwarded to:

5) Current Situation in International Co-operation

5.1 Treaties or conventions country is a signatory to:

5.2 Status of implementation of signed treaties and conventions in national legislation:

5.3 Bilateral and multilateral agreements entered into in order to combat transboundary pollution that are relevant in the context of transboundary estuaries:

5.4 Description of joint or co-ordinated monitoring programmes concerning transboundary estuaries:

5.5 Initiatives relating to information exchange on monitoring:

6) Identifying any gaps in:

6.1 Monitoring practises:

6.2 Co-operation:

6.3 Reporting and public information:

Thank you for your co-operation