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International River Basin Management under the EU Water Framework Directive: An Assessment of Cooperation and Water Quality in the Baltic Sea Drainage Basin

We address issues connected with international river basin management and the EU Water Framework Directive (WFD). By creating a register of River Basin Districts established under the WFD, we show that the number and area of international River Basin Districts are significant. Further, we present an assessment of international cooperation and water quality in 14 international river basins in the Baltic Sea Drainage Basin. Our results indicate that the WFD is a push forward for international river basin management in the region. However the WFD in general, and the principle of river basin management in particular, may be hard to implement in river basins shared between EU Member States and countries outside the EU. According to the study, Vistula, Pregola, and Nemunas appear to be the international basins within the Baltic Sea Drainage Basin in greatest need of intensified cooperation with regard to the state of the water quality.

INTRODUCTION

According to the European Union Water Framework Directive (EU WFD) (1), adopted in 2000, River Basin Districts (RBDs) should serve as the new management units for water in Europe. A RBD may be made up of either one single river basin or of a combination of several small river basins, together with associated groundwater and coastal waters. For each district, a comprehensive River Basin Management Plan (RBMP) should be drawn up and published; the first one is to be ready in 2009. River basins that extend across international borders should be assigned to international RBDs. The WFD specifies that Member States should ensure cooperation on international RBDs lying within the territories of the EU, e.g., by producing joint RBMPs. However, somewhat confusingly, the directive simultaneously indicates that if these are not produced, plans must be set up for the part of the district falling within each country's own territory. If the basin extends beyond the territories of the EU, the WFD encourages Member States to establish cooperation with non–Member States and thus manage the water resource on a basin level.

Although the WFD is generally regarded as an innovative and ambitious piece of environmental legislation, more critical voices have expressed a fear that the vague formulations in the directive may result in weak and ambiguous interpretations by Member States in the implementation of the directive (2), and in fact, evidence of this has already been reported (3). Further, Macrory and Turner (4) point out that although the international dimensions are more explicit in the WFD than in other EU directives, potentially forcing Member States to move towards close cooperation in managing shared river basins, the strict legal requirements to actually achieve joint management are weak. Hence, there is an uncertainty regarding the implementation of the WFD in general, and the interpretations of its international aspects in particular. In view of this, an earlier study (5) tried to identify the number and area of international RBDs by assessing proposals of RBDs from Member States and Candidate Countries. The study showed that about a third of the districts are international and that international districts cover two-thirds of the total area of the districts. The study additionally showed that the plans and ambitions for cooperation on international districts vary considerably. Thus, these results further emphasize the need for focusing on international aspects of river basin management.

The Baltic Sea Drainage Basin (BSDB) is a large heterogeneous region. The drainage basin covers an area of 1 739 000 km^2, is shared by 14 countries (Belarus, Czech Republic, Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Norway, Poland, Russia, Slovakia, Sweden, and Ukraine), and is home to about 84 million people (6). During the last few decades, the countries in the BSDB have experienced vast political and socioeconomic changes. For instance, as late as 2004, the Czech Republic, Estonia, Latvia, Lithuania, Poland, and Slovakia joined the EU, and today as many as 10 of the 14 countries in the region are Member States of the EU. There are at least 14 larger international river basins in the region, covering more than half of the total area of the BSDB (5). Quite a large proportion of these basins are experiencing transboundary water quality problems, primarily caused by excess nutrients and pollution from hazardous substances (7–11). The Baltic Sea itself is a sensitive ecosystem, and from the late 1960s onward, there have been numerous reports about the very bad ecological status of the sea (12, 13). In order to improve the state of the Baltic Sea, politicians and scientists in the countries around Baltic Sea have taken action through, e.g., the establishment of the Helsinki Commission (HELCOM) and the initiation of various research projects (14, 15). However, despite the actions taken, serious problems, such as eutrophication, still remain (13, 16). The varying conditions—in terms of different political, socioeconomic, and environmental situations—of the countries and river basins in the BSDB, and the potential possible impact on the Baltic Sea itself, make it an interesting case for exploring international river basin management under the WFD more thoroughly.

Our objectives are to do the following: on the European level, to identify the number and geographical extent of international RBDs established under the WFD by creating a harmonized geographical data register of RBDs based on results reported by Nilsson et al. (5) and updated with more recent official information; and at the Baltic Sea region level, to characterize and empirically measure cooperation—primarily in relation to the WFD—in international river basins by assessing a number of selected indicators. We also aim to elucidate possible connections between cooperation and water quality (primarily with respect to eutrophication) in international river basins in the BSDB, first by making a water quality ranking

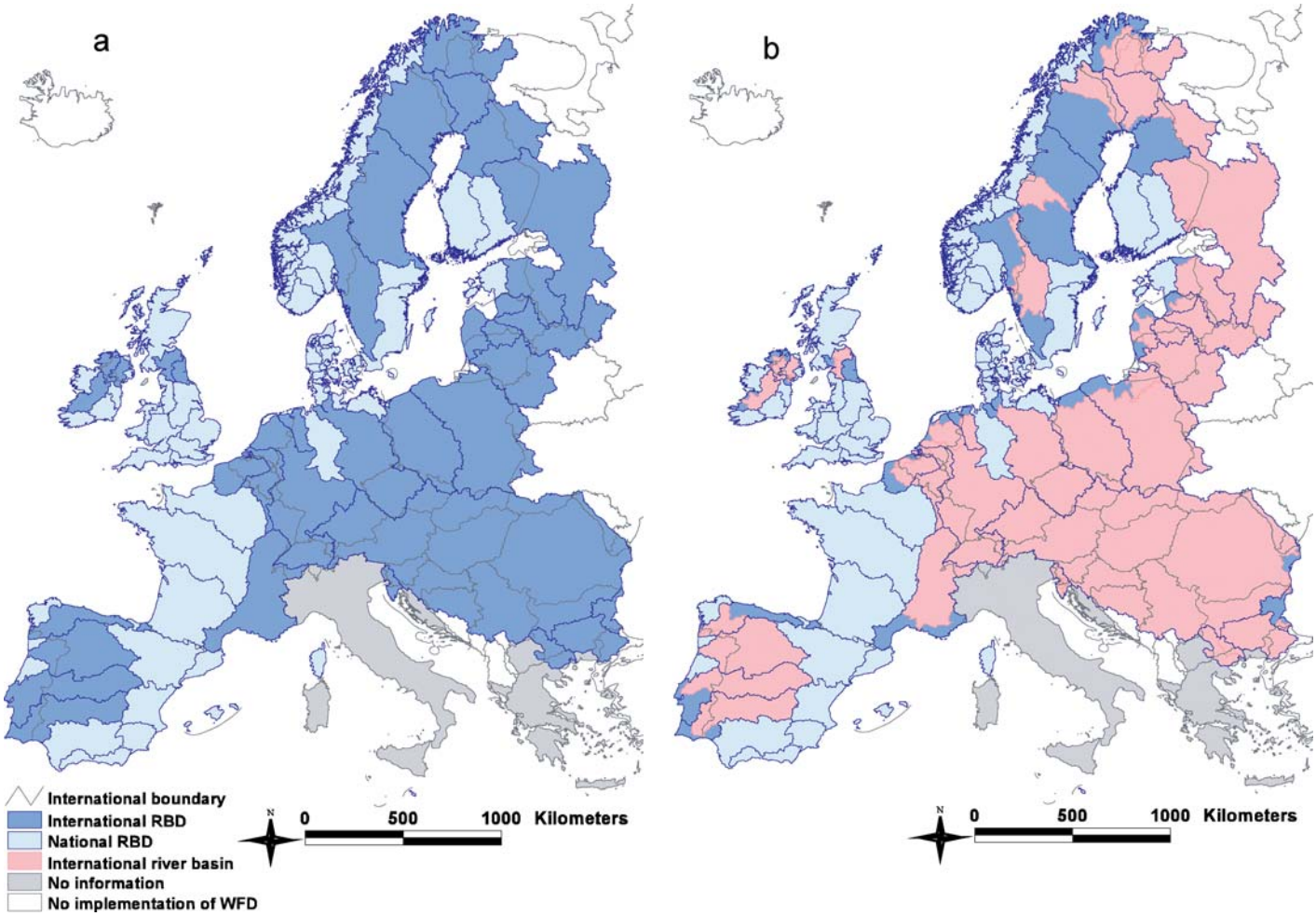

Figure 1. RBDs in Europe with (a) international RBDs (dark blue) and (b) international river basins within RBDs (pink).

based on selected indicators, and second by connecting the water quality ranking with the measured cooperation.

RBD Register

The creation of the geographical data register of RBDs was based on official maps of RBDs from countries implementing the WFD; that is, EU Member States, Candidate Countries except Turkey (17), and Norway. The maps were collected from Web pages or provided by informants well acquainted with the country's implementation of the WFD. Italy, Greece, and Croatia have, as of 30 June 2005, neither identified RBDs nor appointed competent authorities, and they were therefore excluded from the survey. In Norway and Spain, as of 30 June 2005, no decisions have yet been made concerning RBDs and competent authorities, but because proposals exist, they were included in the register. Although the WFD requires that groundwater and coastal waters also be identified and assigned to RBDs, this information was not incorporated in the register because we lacked the data.

As mentioned in the introduction, the WFD requires that international river basins are assigned to international RBDs. However, the WFD does not define an international district, but instead permits each Member State to decide. Rather than using Member States' own definitions of international RBDs, which may vary as a result of different interpretations of the WFD text, we have drawn up a definition of our own for the sake of this study. An "international River Basin District" was thus defined as a RBD where at least one river basin in the district covers the territory of more than one country. In practice, all districts with at least one river basin where more than 500 km^2 or 3% of the basin area covered the territory of more than one country were considered to be international districts.

The register, in the form of a Geographical Information Systems (GIS) data layer, was prepared following the same procedure as in Nilsson et al. (5). A GIS data set at the scale of 1 : 1 million for river basins draining into the sea, provided by EU's scientific and technical research laboratory the Joint Research Centre (18), combined with a GIS data set on international boundaries (19), were used as digital data input. By using the collected analog map material on RBDs as reference material, all river basins belonging to one district were selected, unified into one polygon, and given a unique identification number. Thus, the borders of the RBDs were defined on the basis of the borders of the river basins in the input data set.

The created GIS data register allowed us to extract summary statistics on the number and extent of international RBDs identified under the WFD. Figure 1a shows a map of national and international RBDs in Europe. According to the created register, the total number of districts is 105. Thirty-five, or 33%, of these are classified as international districts. In terms of area, the international districts constitute 70% of the total area of the districts. Most of the larger international river basins, such as the Danube and the Rhine, have been defined as stand-alone RBDs, and they are only joined with minor basins near the coasts (Fig. 1b). Smaller international districts, on the other hand, are not always stand-alone. Instead, they may have been joined with national river basins to form a combined RBD. An example of this is the RBD Bothnian Bay–Torniojoki, which is shared between Sweden and Finland, where Sweden has combined a number of national river basins and one international river

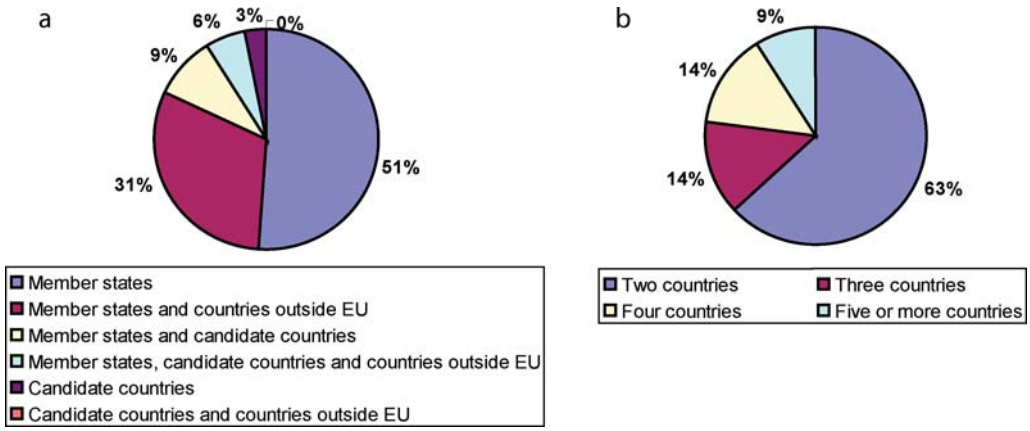

Figure 2. Characteristics of the 35 international RBDs. (a) Different types of countries sharing RBDs. (b) Number of countries sharing RBDs.

basin (Torne River) into one (international) district. Twenty-two, or 63%, of the international districts are shared between Member States and/or Candidate Countries, whereas 13, or 37%, of the districts are shared with countries outside the EU or outside Candidate Countries (Fig. 2a). A majority of the international districts is shared by two countries, but there are also districts shared by three, four, or five or more countries (Fig. 2b).

Case Study: The Baltic Sea Drainage Basin

The case study was restricted to international river basins in the BSDB (20) larger than 6000 km^2. By using the created RBD register, 13 international RBDs and 14 international river basins were identified (Fig. 3, Table 1). In view of the dynamics and the continuous developments in connection with the implementation of the WFD, 1 July 2005 was used as benchmark for the study.

For exploring international river basin management under the WFD in the BSDB, a framework of analysis was developed (Fig. 4). The framework tries to connect "degree of co-operation" with "water quality" in the international river basins included in the study. Water quality was in this study primarily restricted to relate to eutrophication. This may be considered unduly narrow; however, we justify our choice by

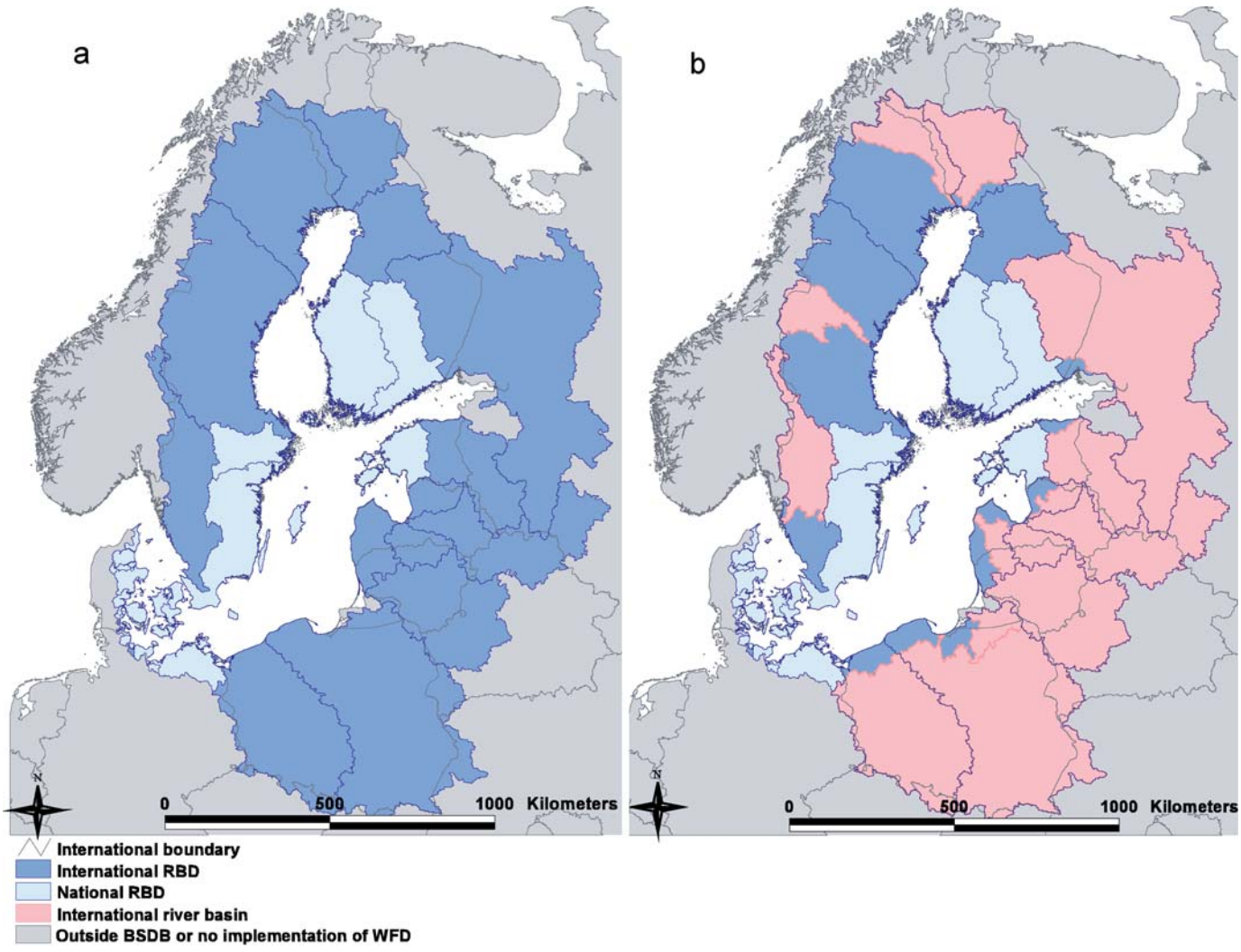

Figure 3. RBDs in the BSDB with (a) 13 international RBDs (dark blue) and (b) 14 main international river basins within the RBDs (pink).

Table 1. International RBDs and international river basins in the BSBD.

International RBD	Area RBD (km^2)	International river basin	Area river basin (km^2)	Countries sharing river basin and area of river basin in each country (km^2)
Västerhavet/Östfold, Akerhus, Hedmark, Oppland	120 559	Klarälven-Trysilelva/Göta Älv	48 326	NO, 7749; SE, 40 577
Bothnian Sea	181 841	Indalsälven	25 518	NO, 2021; SE, 23 497
Bothnian Bay/Torniojoki	128 190	Torne River	39 705	FI, 13 733; SE, 25 531; (NO, 441)
Kemijoki	55 545	Kemijoki	51 036	FI, 49 429; RU, 1578; (NO, 29)
Vuoksi/Lake Ladoga-Neva River	290 682	Vuoksi/Lake Ladoga-Neva River	286 553	FI, 56 217; RU, 229 871; (BY, 465)
East Estonia	60 013	Narva River/Lake Peipsi	56 797	EE, 17 345; LV, 3499; RU, 35 697; (BY, 256)
Koiva/Gauja	14 082	Gauja	8652	EE, 1113; LV, 7539
Daugava	86 052	Daugava	86 052	BY, 33 054; LV, 23 771; RU, 27 306; (LT, 1921)
Lielupe	17 876	Lielupe	17 876	LV, 8872; LT, 9004
Venta	26 517	Venta	11 624	LV, 6423; LT, 5201
Nemunas	92 318	Nemunas	92 318	BY, 44 654; LT, 43 285; PL, 2628; (LV, 93); (RU, 1658)
Vistula	226 201	Vistula	193 347	BY, 10 190; PL, 168 303; UA, 12 835; (CZ, 8); (SK, 2012)
Vistula	226 201	Pregola	14 783	PL, 7648; RU, 7052; (LT, 83)
Oder	127 422	Oder	117 862	CZ, 7418; DE, 4557; PL, 105 877; (SK, 10)

Notes: BY—Belarus, CZ—Czech Republic, DE—Germany, EE—Estonia, FI—Finland, LT—Lithuania, LV—Latvia, NO—Norway, PL—Poland, RU—Russia, SE—Sweden, SK—Slovak Republic, UA—Ukraine. Countries in parentheses have less than 500 km^2 or 3% of the basin area on their territory.

claiming that nutrient (phosphorus and nitrogen) overenrichment has been identified as the most pressing water quality issue for the Baltic Sea itself (11, 13, 21), and in a number of the so-called Article 5 reports, produced under the WFD and encompassing a first characterization of the RBDs, high levels of nutrient inputs into lakes and rivers are mentioned as one main cause for failing to meet the WFD's objective for "good" status by 2015 (22–24). The adopted approach can be regarded as a simpler follower to the empirical work of Wolf et al. (25) on identifying international river basins at risk, and the use of water quality indexes by, e.g., Canadian authorities (26), as a mean of effective communication of water quality information to policy makers and the public.

The analysis was performed in a two-step process. We focused first on indicators of relevance for international cooperation, and we focused second on indicators that influenced or described water quality. After selecting the indicators of cooperation, each indicator was assessed for each river basin according to a dichotomous scoring system, i.e., if a river basin fulfilled all conditions of the indicator at hand, the basin received a score of 1, and if the river basin did not fulfill the conditions of the indicator at hand, the basin received a score of 0. Last, the scores for each basin were summarized to receive an overall score for each basin, thus reflecting its degree of cooperation. For the selected indicators influencing or describing water quality, statistics for each indicator and basin were extracted by using a GIS. The actual, real values for each indicator were then normalized by the percentage of range approach (27). That is, a normalized value or score for each river basin was obtained by first calculating the range for an indicator and then dividing each indicator value less the minimum by its range. For facilitating further analysis, all scores were multiplied by 100.

With regard to the indicator at hand, a score of 0 represents the basin with the best water quality, and a score of 100 represents the basin with worst water quality. On the basis of the normalized scores for the selected indicators, two water quality ranking scales were constructed, one for pressure indicators and one for state indicators. These ranking scales were derived by taking the mean score for the pressure and state indicators, respectively. Thus, the ranking scores calculated for each basin reflects—relative to the other basins in the study—its pressure on or state of the water quality within the basin. After completing the first two steps of the analysis, the last step was to link the indicators of cooperation with the indicators influencing or describing water quality. This was done by plotting the scores of cooperation against the water quality ranking scores.

Indicators of Cooperation

Much of the theory behind the selection of indicators of cooperation is based on Savenije and van der Zaag (28). They suggest a classical temple as a model for sharing of international rivers. According to their model, Integrated Water Resources Management is the foundation of the temple, and the sharing of water resources is its roof. There are three pillars, one political, one technical, and one institutional, representing the necessary elements for sharing of international waters. By acknowledging this model, and by consulting literature on water conflict and cooperation, the text of the WFD, and guidance documents on the implementation of the directive, six indicators considered as giving a good measure of the degree of cooperation were selected. The selection and assessment of the chosen indicators is described further below.

Water Treaties. Today, it is widely accepted that institutions play a key role in promoting international cooperation and thus preventing and mitigating conflict (25, 29–31). For example, Savenije and van der Zaag (28) argue that international river basin organizations are essential for joint management, and Wolf et al. (25) found that the institutional capacity—defined as existence or absence of a water commission or treaty—within a basin appears to be a very good indicator of water conflict and cooperation. They saw that basins without treaties were significantly more prone to conflict than basins with treaties.

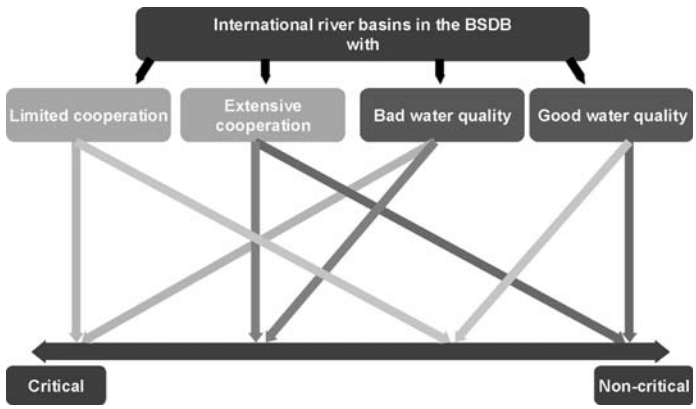

Figure 4. Framework of analysis used for exploring international river basin management in the BSDB. The framework tries to connect the "degree of cooperation" (limited to extensive cooperation) with the "water quality" (bad to good water quality). This may highlight the most critical basins—with regard to cooperation and water quality—of the 14 international river basins included in the case study.

For this case study, an initial screening showed that all river basins had treaties, meaning that all basins also fulfilled the conditions of the indicator, i.e., should receive a score of 1. However, because of the great variety in the extensiveness of the treaties, we decided to assess each treaty on the basis of three important aspects, as follows.

i) Water commission. If there is a water commission established and working, based on a treaty, then the river basin received the score 0.33.
ii) Bilateral/multilateral treaties. If all countries sharing the basin (except countries having less than 500 km^2 or 3% of the basin area on its territory; cf. Table 1) are signatories to the treaty, then the river basin received the score 0.33.
iii) Water quality/WFD issues. If the water treaty specifically deals with water quality or WFD issues, then the river basin received the score 0.33.

Information on treaties and treaty texts was collected from Ministries of Environment, Environmental Protection Agencies, and Oregon State University's International Freshwater Treaties Database (32).

Basins Shared by EU Member States. Savenije and van der Zaag (28) stress the importance of a joint legal framework for the sharing of international water resources. However, they also mention that it may also be important to harmonize national water laws and regulations between riparian countries, and this is in fact what the WFD seeks to do. It is therefore argued here to use basins shared by EU Member States as an indicator of cooperation because these countries also share the same legislative framework for water—the WFD. In other words, if a basin is shared only by EU Member States, then the basin received a score of 1.

International RBDs. Article 3 of the WFD states that river basins extending across international borders should be assigned to international RBDs. Thus, all RBDs with one or more international river basins should be designated as international districts. However, because the WFD text leaves room for interpretation, there may be variations in the definitions of international districts among Member States. In this study, RBDs officially appointed as international districts according to the WFD by all Member States sharing the district were used as an indicator for cooperation. Thus, if the basin belonged to an officially appointed international RBD, then the basin received a score of 1.

Ambitions for Joint RBMP. The WFD encourages countries to cooperate in producing joint RBMPs for international RBDs. The first plans are to be ready in 2009, and it is thus not yet possible to know whether there actually will be any joint plans produced. However, on the basis of a questionnaire sent to Member States, Candidate Countries, and Switzerland and Norway, Nilsson et al. (5) tried to map the ambitions of producing joint RBMPs according to the requirements of the WFD. These results were briefly updated (reflecting the situation as of 30 June 2005) and included as an indicator of cooperation. Thus, if there are officially stated plans of producing a joint RBMP for the river basin, then the basin received a score of 1.

Joint Characterization Efforts. According to Article 5 of the WFD, Member States should have carried out characterizations—with regard to water status, driving forces and pressures, and economic analyses—of all their RBDs. The results should have been summarized in one or more reports and sent to the European Commission in March 2005. Thus, by exploring the published reports, possible joint characterization efforts taken by countries may be identified and used as an indicator of cooperation. If joint characterization efforts—defined as production of a joint Article 5 report for the river basin—have been taken, then the basin received a score of 1.

Informal Cooperation Initiatives. The previous indicators reflect official opinions, decisions, and actions taken at the national level. However, in practice, cooperation on international river basins may take place at other levels of society, and such cooperation may be initiated and financed through other channels than official, national sources. Gooch (33), for instance, argues that transboundary water management involves actors at different levels of society; including state actors (both central and subcentral) and institutions, as well as nonstate actors such as the business sector, nongovernmental organizations, and civil society. For capturing this aspect of transboundary cooperation, the existence of more informal regional/basin cooperation through various projects between, e.g., local and regional authorities was therefore included as an indicator of cooperation. Thus, if there is any transboundary regional/basin cooperation on water management issues, or if there has been any project in the last 5 years, then the basin received a score of 1. Information on regional/basin cooperation was collected through extensive Internet searches and a questionnaire sent to people involved in the water management of each basin.

Indicators Influencing or Describing Water Quality

As explained earlier, the selection of indicators was restricted to primarily relate to eutrophication. In total, four indicators were used in the assessment. However, because this approach of giving only one single score to describe the relative water quality of a whole river basin might appear oversimplified and unreliable, and also because of the incompleteness of the data, we decided to produce two water quality ranking schemes, one based on two pressure indicators and the other based on two state indicators. The selection and assessment of indicators are described further below.

Pressure Indicators: Population and Cultivated Area. Population is an important driving force for pollution. The number of people, along with their activities and distribution, influences the water quality within a river basin and the water quality of the recipient into which the river discharges. Smith et al. (34) have, for instance, shown a close empirical relationship between human population and nitrogen and phosphorus loading. In this study, the population density in a river basin was used as a pressure indicator influencing water quality. The LandScan 2003 (35) population distribution database was used to calculate the population density (persons km^{-2}) in each river basin. The actual population density figures (number of people km^{-2}) was then normalized into values between 0 and 100, where value 0 represents the basin with the lowest population density and 100 represents the basin with the highest population density.

Pollution of water resources caused by agriculture is a big problem in Europe (22, 36). Approximately 65% of the total nitrogen load and 57% of the total phosphorus load to the Baltic Sea originate from diffuse sources, of which the main component is agriculture (21). The amount of cultivated (arable) land per river basin was therefore considered as a good pressure indicator for water quality. Thus, the Global Land Cover 2000 data (37), available at a resolution of 30×30 arc seconds, was used to calculate the percentage of cultivated land in each river basin. These actual percentage figures were then normalized into values between 0 and 100.

State Indicators: Nitrogen and Phosphorus Concentrations. The European Environment Agency georeferenced database, Waterbase, contains water quality monitoring information from all countries within the BSDB except for Belarus, Russia, and

Table 2. Overall assessment of cooperation in the 14 international river basins included in the case study of the BSDB based on six indicators.

International river basin	Water treaty indicator: Commission (0/0.33)	Water treaty indicator: All countries signatories (0/0.33)	Water treaty indicator: Water quality/WFD as specific task (0/0.33)	Shared by EU Member States	Int RBD	Ambitions for joint RBMP	Joint character-ization	Informal cooperation initiatives	Overall score[1] (0–6)
Klarälven-Trysilelva/ Göta River	0	0.33	0	0	1	0	0	0	1.33
Indalsälven	0	0.33	0	0	1	0	0	0	1.33
Torne River[2]	0.33	0.33	0.33	1	1	1	0	1	5
Kemijoki	0.33	0.33	0	0	0	0	0	0	0.66
Vuoksi/Lake Ladoga-Neva River[3]	0.33	0.33	0	0	0	0	0	1	1.66
Narva River/ Lake Peipsi	0.33	0	0.33	0	1	0	0	1	2.66
Gauja[4]	0.33	0.33	0.33	1	1	1	0	0	4
Daugava[5]	0	0	0	0	1	0	0	1	2
Lielupe[6]	0.33	0.33	0.33	1	1	1	0	1	5
Venta[6]	0.33	0.33	0.33	1	1	1	0	1	5
Nemunas	0	0	0.33	0	1	0	0	1	2.33
Vistula[7]	0.33	0	0.33	0	1	0	0	1	2.66
Pregola	0	0.33	0	0	1	0	0	1	2.33
Oder	0.33	0.33	0.33	1	1	1	1	0	5

[1] The sum of the scores, i.e., the overall score, represents the degree of cooperation in each basin.

[2] The agreement from 1971 is outdated in parts, and a new agreement is under development, which is planned to be signed in 2006. While waiting for the new agreement, the countries signed a note in 2003 to form a common international RBD for the Torne River. In this note, it is said that the partners should cooperate to fulfill the requirements of the EU WFD.

[3] It should be noted that the actual cooperation between Finland and Russia is restricted to the Vuoksi River Basin, i.e., the part of Neva River Basin flowing from Lake Saimaa into Lake Ladoga.

[4] A permanent working group has been set up to deal with water resources shared between Estonia and Latvia. In this assessment, the working group has been regarded as having the status of a commission.

[5] Actually, the technical protocol between Latvia and Lithuania, which deals with WFD issues and which establishes a permanent working group, also encompasses the part of the Daugava River Basin shared by these two countries. However, because the Lithuanian part of the Daugava Basin is less than 3% of the total basin area, in this assessment, the country has not been regarded as a country sharing the basin, and thus the treaty between Lithuania and Latvia has not been taken into consideration.

[6] A permanent working group has been set up to deal with water resources shared between Latvia and Lithuania. In this assessment, the working group has been regarded as having the status of a commission

[7] Three of the four existing treaties for Vistula apply only to the Bug River Basin. The Bug River is a tributary of the Vistula, and it is actually only this part of the Vistula Basin that is international (it is shared between Belarus, Poland, and Ukraine). The rest is in Polish territory.

Ukraine (38). By using the Waterbase database on rivers, the median of annual mean concentrations (for the years 2000–2004) of total nitrogen and total phosphorus (mg L^{-1}) from all water quality monitoring stations within one river basin were used as state indicators describing the water quality in a basin. Having calculated the median concentrations for nitrogen and phosphorus, respectively, the actual real values for each indicator were then normalized into values between 0 and 100.

RESULTS AND DISCUSSION

Table 2 shows the results of the assessment of the indicators of cooperation in the 14 international river basins in the BSDB. In this assessment, river basins could obtain a score between 0 and 6. As can be seen from Table 2, the actual overall scores obtained range from 0.66 to 5. Four river basins, Torne River, Lielupe, Venta, and Oder, obtained a score of 5. Five river basins obtained scores over 3, and nine had a score of 3 or below.

Kemijoki received the lowest score, 0.66. As mentioned earlier, all river basins have water treaties, and in a majority of these basins, a commission has been established. When this is compared with the global situation, where only 117 of the world's 263 international river basins have treaties (25), the BSDB can be regarded as a region with a solid base for international cooperation. Five of the river basins are shared by two or more countries; however, only in one case, the Oder, are all countries signatories to the treaty. In the rest of the cases, only bilateral agreements exist. A little more than half the treaties deal specifically with water quality or WFD issues. In the cases of Gauja, Lielupe, and Venta, the WFD was actually the main reason for setting up treaties (39). The treaties not specifically devoted to water quality issues are generally quite old and may focus on issues related to, e.g., hydropower or navigation. However, there are examples of treaties, such as the one for Torne River originally set up in 1971 to deal with issues connected with hydraulic engineering and fishing, that are now updated because of, among other things, the influence of the WFD (40).

Nine, or 64%, of the river basins are shared with countries outside the EU. This figure is substantially higher if compared with the figures reported in the RBD register for the whole of Europe, where 37% of the international RBDs are shared with countries outside the EU (cf. Fig. 2). It may be interesting to note that all river basins shared between EU Member States and countries outside the EU have an overall score of 2.66 or below, whereas the basins shared by only Member States have an overall score of 4 or more, or 3 or more if an adjustment is made for the fact that "shared by EU Member States" was included as one indicator. Quite a few of the basins, 12 in total, have been officially designated as international districts or basins according to the requirements of the WFD. Only Kemijoki and Vuoksi, which are shared between Finland and Russia, have not been officially appointed as international RBDs. In five river basins, all shared by EU Member States, there are officially stated plans to produce or coordinate joint RBMPs. However, from the results of the assessment of the indicator regarding joint characterization, it can be seen that in practice, very few joint actions have been taken so far. Only in one case, the Oder, has joint characterization according to Article 5 of the WFD been carried out. The International Commission for the Protection of the Odra River against Pollution has coordinated the work and has published the characterization reports in German, Polish, and Czech on their Web page (22, 41). As regards the indicator describing more informal transboundary cooperation initiatives, it can be seen that such initiatives are present in at least nine of the river basins. One may speculate if such initiatives play a more important role in river basins shared by EU Member States and countries outside the EU, where a formal, legal basis for cooperation, along with financial

Table 3. Water quality ranking scores for the 14 international river basins included in the case study of the BSDB.

	Pressure indicators			State indicators[1]		
International river basin	Population density (0–100)	Cultivated land (0–100)	Pressure water quality ranking score (mean of pressure scores)	N total concentration (0–100)	P total concentration (0–100)	State water quality ranking score (mean of state scores)
Klarälven-Trysilelva/ Göta River	14	12	13	14	5	9
Indalsälven	2	1	1	0	0	0
Torne River	0	0	0	1	5	3
Kemijoki	0	0	0	1	5	3
Vuoksi/Lake Ladoga-Neva River	14	2	8	6	7	6
Narva River/ Lake Peipsi	11	35	23	35	23	29
Gauja	12	42	27	31	28	29
Daugava	22	29	26	36	31	34
Lielupe	26	92	59	91	50	71
Venta	21	80	50	52	26	39
Nemunas	38	71	54	46	45	45
Vistula	89	79	84	68	87	78
Pregola	63	100	81	64	77	70
Oder	100	83	91	100	100	100

[1] Data from Belarus, Russia, and Ukraine are missing. Thus, for river basins shared with these countries, concentrations have been calculated on the basis of data only from EU Member States.

resources, may be lacking. For instance, in the Narva River–Lake Peipsi basin, there are a number of projects, funded by, e.g., EU LIFE, EU TACIS, and UNDP/GEF (42), that have been launched with the aim of supporting the development of water management plans or programs for Estonian and Russian authorities and the Estonian-Russian water commission.

The water quality ranking scores—with regard to pressure and state indicators—for the 14 international river basins in the BSDB are presented in Table 3. Although the two alternative rankings are not identical, they show a similar pattern: basins with high pressure scores generally have high state scores as well. For instance, Oder is ranked as "worst" for both pressure and state. It is impossible to compare our ranking results with results from other studies, because to our knowledge, no such studies exist; however, the results appear to be supported by more detailed studies addressing water quality problems in specific basins (7, 43, 44).

The results from the plotting of cooperation scores against water quality ranking scores are presented in Figure 5. For facilitating the interpretation of the figure, two lines have been drawn in each chart. The exact position of these lines may be determined according to different principles. For instance, they may be drawn on the basis of the median of the scores. In this study, however, we chose to draw the lines in the middle of each scale. The drawing of the lines resulted in four boxes. According to this suggested division, the lower left box is characterized by basins with moderate-low or very low water quality ranking scores (<50), and at the same time relatively low cooperation scores (<3). Thus, these basins may not have very well-developed cooperation. On the other hand, at least for the basins with very low water quality ranking scores, there may not have been a need for such cooperation to develop because the water-related problems, at least with regard to water quality, are relatively small. The lower right box encompasses river basins with moderate-low or very low water quality ranking scores (<50), yet high cooperation scores (<4). It may be interesting to note that the Torne River has a high cooperation score and a very low water quality score. One explanation for this may be that the triggers for cooperation in Torne River originally were related to other water issues, e.g., fishing, rather than water quality, but this may have actually facilitated cooperation around the implementation of the WFD.

The upper right box depicts river basins with both high water quality scores (>50) and high cooperation scores (5). The last box, in the upper left corner, encompass the international basins in strongest need of intensified cooperation (scores <3) with regard to water quality (scores >50). These basins are Vistula, Pregola, and—at least according to the pressure water quality ranking—Nemunas. Characteristics for these basins include the lack of established water commissions and lack of multilateral cooperation agreements. Further, the basins are shared by EU Member States and countries outside the EU, which may complicate WFD implementation. Although the European Commission, United Nations Economic Commission for

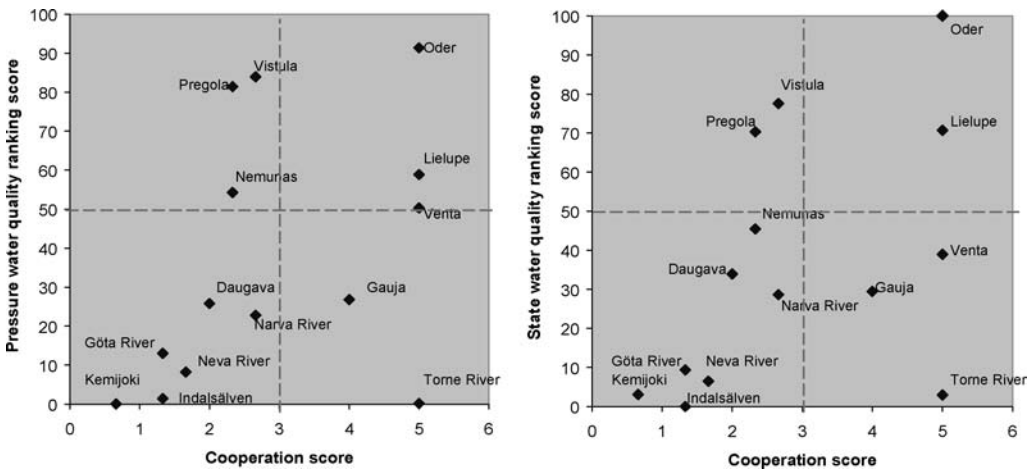

Figure 5. Plotting of cooperation scores with water quality ranking scores (both for pressure and state rankings) for the 14 international river basins in the case study of the BSDB.

Europe, and other institutions have directed attention toward these regions, e.g., through the Workshop on Transboundary Water Management at the North-eastern Border of the European Union (45), these results further emphasize the need for focusing on and strengthening these regions, at least if river basin management according to the WFD is to be a goal for all river basins in Europe. However, whether this goal is geopolitically feasible or desirable, or whether international funding mechanisms exist, is another story.

CONCLUSIONS

This article has explored international river basin management under the EU WFD. Extracted statistics from the created RBD register showed that 33% of the RBDs are international, and that international RBDs cover 70% of the total district area. The case study from the BSDB showed that river basins shared by countries within the EU appear to have moved toward joint management of international river basins by, e.g., signing water treaties and having ambitions of producing joint RBMPs. The same pattern cannot be distinguished for river basins shared between EU Member States and countries outside the EU.

The suggested approach of linking cooperation scores and water quality ranking scores is simple to explain and is based on robust and measurable indicators of cooperation and water quality issue of concern—here, eutrophication. It provides a benchmark for assessing the extent of cooperation in terms of the seriousness of the water quality issue of concern. If the applied approach can be periodically repeated, it could be used to investigate or monitor trends in cooperation and water quality. Additionally, if further developed, updated, and refined, the assessment could be extended to encompass more of the international river basins and RBDs in Europe. In addition to water quality (eutrophication), other urgent water related issues, such as water availability—an important issue in other parts of Europe—could be addressed (46).

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