BALTIC SEA ENVIRONMENT PROCEEDINGS

No. 70

THE THIRD BALTIC SEA POLLUTION LOAD COMPILATION (PLC 3)

HELSINKI COMMISSION
Baltic Marine Environment Protection Commission
1998

For bibliographic purposes this document should be cited as:
HELCOM, 1998
The Third Baltic Sea Pollution Load Compilation
Balt. Sea Environ. Proc. No. 70

ISSN 0357-2994

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Preface

Within the framework of the Baltic Marine Environment Protection Commission - Helsinki Commission (HELCOM) - monitoring data on riverine and direct landbased waterborne pollution load have been collected and compiled three times since 1987. The aims are to evaluate the effectiveness of different measures taken to reduce pollution in the Baltic Sea and to determine the order of priority for different pollution sources. The first Baltic Sea Pollution Load Compilation (PLC-1) attempted to compile completely heterogeneous data submitted to the Commission on various occasions. Therefore, there were differences in the age and reliability of data, and also gaps in the data sets (Baltic Sea Environment Proceeding No 20, 1990). The Second Baltic Sea Pollution Load Compilation (PLC-2) consisted of generalised 1990 data quantifying the major pollution sources and the waterborne load with respect to BOD_7, total nitrogen and total phosphorus (Baltic Sea Environment Proceedings No 45, 1993), collected according to the PLC-2 Guidelines. However, several key data sets were missing.

This report, the **Third Baltic Sea Pollution Load Compilation (PLC-3)**, provides an overview of the riverine and direct landbased waterborne pollution load of BOD_7, nutrients and heavy metals to the Baltic Sea in 1995. National pollution load data were collected according to the Guidelines for the Third Baltic Sea Pollution Load Compilation (Baltic Sea Environment Proceeding No 57, 1994), but these Guidelines were not followed by all the Contracting Parties.

In this report a short description of the Baltic Sea catchment area, of the sampling, analysis and calculation methods and of the quality assurance work is given in Chapters 1 to 4. In the remaining chapters summarised information on the pollution load is presented and assessed for each Contracting Party and for nine Baltic Sea subregions showing that riverine load is the major source of pollution in the Baltic Sea. Further, a first attempt to determine how much nutrient riverine load derives from the natural background sources and how much from anthropogenic sources is presented in Chapter 6.

Some attention is drawn to the shortcomings of the data and information submitted by the Contracting Parties. The main problem was that the PLC-3 Guidelines were not fully followed by all the Contracting Parties in measuring the obligatory parameters for all sources. Consequently, it was impossible to present the total heavy metal load on the Baltic Sea.

This report concludes very clearly that the three Pollution Load Compilations can not be used for proving whether or not reduction targets (e.g. 50% reduction) have been met. The main reason is the lack of a point source and diffuse source inventory for the whole Baltic Sea catchment area permitting assessment of the anthropogenic part of the riverine input. Moreover, riverine load data are highly dependent on meteorological factors such as precipitation and runoff. It is also not possible to compare the results from PLC-3 with those of either PLC-2 or PLC-1 due to the incompleteness of the data submitted.

In accordance with the decisions of the Helsinki Commission, the Third Baltic Sea Pollution Load Compilation (PLC-3) has been carried out as a project within the "Working Group on Inputs to the Environment" (TC INPUT). **Ms Heike Herata**, Federal Environmental Agency, Germany, acted as Project Manager with the assistance of **Mr Ain Lääne**, Tallinn Technical University, Estonia.

We wish to extend sincere thanks to the representatives of all the Contracting Parties who have contributed as members of the Project Team to the success of the work not only during the expert meetings but also in the presentation of national data, the checking of results and the preparation of the report:

Mr Lars M. Svendsen, National Environmental Research Institute, Denmark, also the author of Chapter 6; **Mr Enn Loigu**, Tallinn Technical University, Estonia; **Mr Seppo Knuuttila**, Finnish Environment Institute, Finland; **Mr Horst Behrendt**, Institute of Freshwater Ecology and Inland Fisheries, Germany; **Ms Ilze Kirstuka and Ms Silga Strazdina**, Latvian Environment Data Centre, Latvia; **Ms. Judita Sukyte and Ms Aldona Margariene**, Ministry of Environmental Protection, Lithuania; **Ms Elzbieta Heybowicz,** Institute of Meteorology and Water Management, **Ms Krystyna Gazda,** National Inspection Board for Environmental Protection **and Mr Waldemar Jarosinski**, Meteorological Institute, Poland; **Mr Alexander Shekhovtsov**, Center of International Projects of the State Committee of the Russian Federation on Environmental Protection, Russia; **Mr Anders Widell**, Swedish Environmental Protection Agency, Sweden.

In the project invaluable support has been provided by our Consultant for Quality Assurance, the author of Chapter 4, **Ms Irma Mäkinen**, Finnish Environment Institute and by our Consultants for Data Management **Mr Antti Raike and Mr Vaino Malin**, Finnish Environment Institute.

The PLC-3 work was possible only with the close co-operation of all the Contracting Parties: Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, Russia and Sweden, who carried out the measurements both in the rivers and at the point sources and reported the information to the data consultants.

We also wish to express our appreciation to the Finnish Environment Institute for its financial support in hosting a series of expert meetings for the PLC-3 project and for taking responsibility for the language correction and final layout of the publication.

Finally, our special thanks go to the HELCOM Secretariat for its efficient technical and financial assistance throughout the project. In particular, we wish to thank **Mr. Vassili Rodionov** (former Technological Secretary).

Project Manager
Heike Herata

CONTENTS

LIST OF ABBEREVIATIONS

AAS	Atomic absorption spectroscopy (flame or graphite furnace technique)
AOX	Absorbable organic halogens
ARC	Archipelago Sea
b	Biological
BAP	The Baltic Proper
BOB	Bothnian Bay
BOD $_{(5,7)}$	Biological oxygen demand within 5, 7 days (BOD_5, BOD_7); measured for the amount of oxygen which is used by microorganisms in waste water within 5, 7 days at a temperature of 20 °C
BOS	Bothnian Sea
BSEP	Baltic Sea Environment Proceedings
BY	Belarus
c	Chemical
CEN	European Committee for Standardisation
Cd	Cadmium
COD_{Mn}	Chemical oxygen demand; oxidation with permanganate
COD_{Cr}	Chemical oxygen demand; oxidation with dichromate
CP	Contracting Party
Cr	Chromium
Cu	Copper
CZ	Chech Republic
d	Denitrification
DE	Federal Republic of Germany
DK	Denmark
DIN	Deutsche Industrie Norm (German Industrial Norm)
EC	Environment Committee of the Helsinki Commission
EE	Estonia
EN	European Norm
EU-PHARE	European Union - Poland and Hungary Assistance for Reconstruction of the Economy
EU-EQUATE	European Union - Copernicus Programme “Equal Quality of Water - related Analyses Throughout Europe”
f	Filtration
FEI	Finnish Environment Institute
FI	Finland
GUF	Gulf of Finland
GUR	Gulf of Riga
HELCOM	Helsinki Commission
Hg	Mercury
ICP/AES	Inductively Coupled Plasma/Atomic Emission Spectroscopy
ICP/MS	Inductively Coupled Plasma/Mass Spectroscopy
IEC	International Electrotechnical Commission
ISO	International Organisation for Standardisation
IR	Infrared spectroscopy
KAT	The Kattegat
L	Load
LT	Lithuania
LV	Latvia
m	mechanical
MWWTP(s)	Municipal wastewater treatment plant(s)
n	Nitrification
NCPs	Non-Contracting Parties
NERI	Danish National Environmental Research Institute
Ni	Nickel
N_{Kjel}	Total Nitrogen measured as Kjeldal nitrogen (the content of organic and ammonium nitrogen)
NO	Norway
N_{NH4}	Ammonium nitrogen
N_{NO2}	Nitrite nitrogen
N_{NO3}	Nitrate nitrogen
NRL(s)	National reference laboratory(s)

N_{total}	Total nitrogen
Pb	Lead
PE	Population Equivalent (amount of wastewater per capita)
PL	Poland
PLC(s)	Baltic Sea Pollution Load Compilation(s)
PLC-1 (2,3)	First (Second, Third) Baltic Sea Pollution Load Compilation
P_{PO4}	Orthophosphate phosphorus
P_{total}	Total phosphorus
Q	Flow, runoff
RU	Russia
SE	Sweden
SLO	Republic of Slovakia
SOU	The Sound
SS	Suspended Solids
STC	Scientific Technological Committee
TC	Technological Committee of the Helsinki Commission
TC INPUT	Technological Committee: Working Group on Inputs to the Environment
TC POLO	Technological Committee: ad hoc Expert Group on Pollution Load to the Baltic Sea
TOC	Total Organic Carbon
UA	Ukraine
WEB	Western Baltic
WMO	World Meteorological Organisation
Zn	Zinc

I

Introduction

1.1 Objectives of the Pollution Load Compilations (PLCs)

According to Paragraph 1 of Article 6 of the Convention on the Protection of the Marine Environment of the Baltic Sea Area, 1974 (the Helsinki Convention), the Contracting Parties undertake to take all appropriate measures to control and minimise land-based pollution of the marine environment of the Baltic Sea Area.

In implementing the objectives of the Convention, the Helsinki Commission needs reliable data on inputs to the Baltic Sea from land-based sources in order to develop its environmental policy and to assess the effectiveness of measures taken to abate the pollution. Such data are also required for evaluation of the state of the open sea and coastal waters.

The objectives of periodic pollution load compilations (PLCs) regarding pollution of the Baltic Sea from land-based sources are:

1. to compile information on the direct inputs of important pollutants entering the Baltic Sea from different sources on the basis of harmonised monitoring methods;
2. to follow changes in the pollution load from various sources;
3. to determine the priority order of different sources and pollutants for the pollution of the Baltic Sea;
4. to assess the effectiveness of measures taken to reduce the pollution load;
5. to provide information for assessment of the state of the marine environment in the open sea and the coastal zones.

The task of PLC has been carried out in stages.

1.2 The three stages of the Pollution Load Compilations (PLCs)

The First Pollution Load Compilation (PLC-1)

The results of PLC-1 were published in the Baltic Sea Environment Proceedings, BSEP No. 20, in 1987. It was the first attempt to compile heterogeneous data that had been submitted to the Commission on various occasions. Because the information came from various sources there were differences in the reliability and age of the data as well as gaps in the data sets. Assuming that the values were often preliminary or based on very rough background information, it was recommended that PLC-1 should be used with caution.

The Second Pollution Load Compilation (PLC-2)

PLC-2 was implemented as a pilot programme in the measuring year 1990, aiming at basic coverage of the major aspects concerned. In order to improve the quality of the compilation, during 1988-1989 the Scientific-Technological Committee (STC) developed the Guidelines for PLC-2 that were adopted by the Commission in HELCOM Recommendation 10/4 (1989). The PLC-2 Guidelines defined the aim of the PLC and provided a harmonised methodological basis for collection and evaluation of data on a national level (for example the measuring year 1990) for evaluation of pollution source categories and parameters to be controlled. It also provided a unified methodology for measurements, calculations and reporting.

The results of PLC-2 were published in the Baltic Sea Environment Proceedings, BSEP No. 45, in 1993. The report contained the general data characterising major pollution sources and loads for nine subregions of the Baltic Sea and the Baltic Sea as a whole. The initial national information and input data were written on floppy disks, thus enabling the use of data in different model calculations.

Though the results of PLC-2 were not perfect, the second stage of the Project was a definite step forward as it provided more reliable data, compared with the first compilation, on total loads in the Baltic Sea. Moreover, due to political changes in the Baltic Sea Region it became possible to improve reporting in the course of the project and to collect more detailed data than originally intended.

The Third Pollution Load Compilation (PLC-3)

PLC-3 was carried out within the ad hoc Expert Group on Pollution Load to the Baltic Sea (TC POLO). The Guidelines for PLC-3 were prepared by the lead countries - Estonia and Germany - with the assistance of experts from all Contracting Parties and are based on the recommendations of the Seminar on Monitoring of Pollution Load (14-16 April 1993, Gdansk) and the informal expert meeting on PLC-3 (15-16 June 1993, Tallinn). These Guidelines were adopted by the Commission in HELCOM Recommendation 15/2 in 1994, and published in the Baltic Sea Environment Proceedings, BSEP No. 57, in 1994.

The Guidelines incorporated the experience gained during PLC-2 and were aimed at preparing the next Pollution Load Compilation in a way that would serve to a wider extent the purposes of the HELCOM Programme Implementation Task Force, the Technological Committee and the Environment Committee.

During the third stage of PLC the major uncertainties and weaknesses of PLC-2 could be avoided by establishing a quality assurance system and creating a data-entry system closely connected to a database. The Finnish Environment Institute (FEI), hired by HELCOM, took the lead in both. The results of the inter-laboratory comparison test were discussed during a workshop in Helsinki in October 1994 with the aim of ensuring that national laboratories be able to maintain a continuously high level of quality in routine operations. After the first version of this data-entry system for personal computers was completed, a training workshop for national data experts took place in December 1994 in Helsinki. The final version of this programme was made available to all Contracting Parties in February 1995 and was used for submission of all data compiled on a national level after the measuring period 1995.

Due to the fact that much of the pollution load is introduced into the Baltic Sea via rivers, another important step forward was to distinguish between the natural and anthropogenic contributions to riverine fluxes. After comparison of three different methods in Finland, Denmark and Germany a guide was developed in an informal expert meeting on 30-31 May 1995 in Silkeborg, Denmark.

1.3 Classification of the inputs considered in PLC-3

PLC-3 deals with discharges to the marine environment of the Baltic Sea via rivers, coastal areas and direct point source loads, with the main pollution sources as follows:

1.Riverine inputs into the Baltic Sea
- Monitored rivers
- Partially monitored rivers
- Coastal areas

*2.Discharges from point sources into the Baltic Sea**
- Municipal effluents
  - -treated
  - -untreated
- Industrial effluents
  - -treated
  - -untreated
- Aquaculture inputs
  - -fish farming

Airborne pollution is not dealt with in PLC-3. Information about airborne pollution load is collected by the responsible working group, TC INPUT, and published simultaneously with this report.

1.4 Parameters reported in PLC-3

The parameters reported are classified as obligatory or voluntary according to their nature and by taking into account the detection limits of the substances in different water flows (see Table 1.1).

1.5 Division of the Baltic Sea catchment area

An overview of the entire catchment area and the nine subregions is presented in Figure 1.1. In order to make the outcome of this report comparable to the PLC-2 report, the same nine subregions of the Baltic Sea and their abbreviations were used. These are as follows:

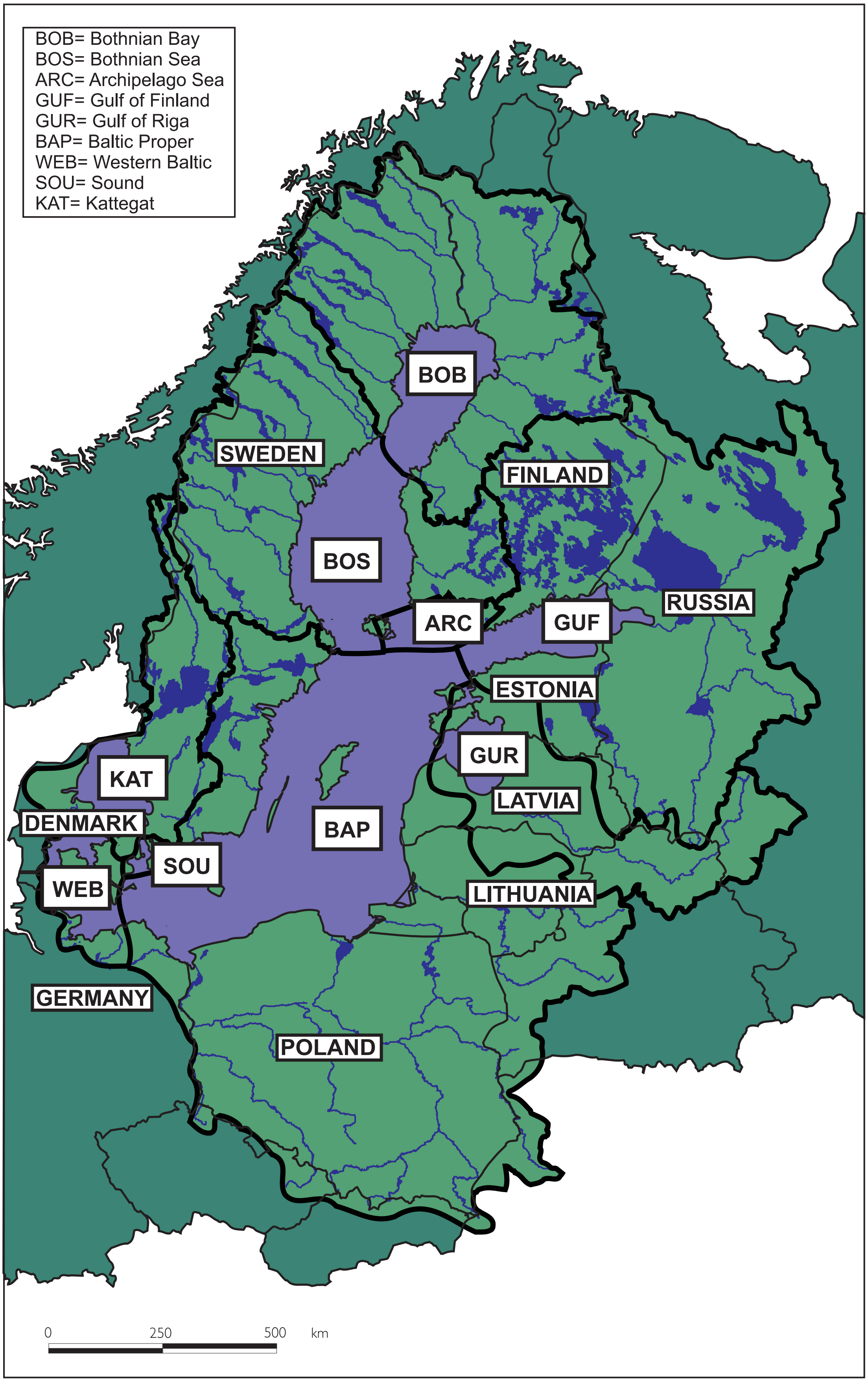
Bothnian Bay	- BOB
Bothnian Sea	- BOS
Archipelago Sea	- ARC
Gulf of Finland	- GUF
Gulf of Riga	- GUR
Baltic Proper	- BAP
Western Baltic	- WEB
The Sound	- SOU
The Kattegat	- KAT.

Table 1.1 Parameters reported in PLC-3

Parameters	Riverine inputs	Minicipal effluents*	Industrial effluents*	Aquaculture	Coastal areas
BOD_7	+[1]	+	+[3]		
COD_{Mn}	v				
COD_{cr}			+		
TOC	v	v	v		
SS	v	v[4]	+[4]		
AOX	v		+[3]		
P_{total}	+	+	+	+	+
P_{PO4}	+	v	v		
N_{total}	+	+	+	+	+
N_{NH4}	+	v	v		
N_{NO2}	v	v	v		
N_{NO3}	+	v	v		
Hg	+[1]	+[2]	+[3]		
Cd	+[1]	+[2]	+[3]		
Zn	+[1]	+[2]	+[3]		
Cu	+[1]	+[2]	+[3]		
Pb	+[1]	+[2]	+[3]		
Ni	v[1]	v[2]	+[3]		
Cr	v[1]	v[2]	+[3]		

Footnotes:
- \+ *obligarory*
- v *voluntary*
- [1] *except for rivers where BOD_7 and heavy metal concentrations are below the quantification limit*
- [2] *heavy metals are obligatory for urban areas larger than 10 000 PE*
- [3] *BOD_7, AOX and heavy metals are obligatory parameters for relevant industries if these parameters are regulated by sector-wise HELCOM Recommendations*
- [4] *only for untreated municipal or industrial effluents*
- * *In those cases where the recorded results are below the quantification limit, the load estimate should be supplied with the assumption that the real concentration is one-half of the quantification limit.*

**Municipalities and industries discharging to the rivers downstream of the lowest water quality monitoring station should be considered as direct discharge sources. Overflows and by-passes are to be included wherever information is available.*



Fugure 1. Baltic Sea catchment area and subregions

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Description of the Baltic Sea catchment area

The total Baltic Sea catchment area comprises 1 720 270 km^2, of which nearly 93% belongs to the Contracting Parties and 7% belongs to Non-Contracting Parties. The division of the catchment area between Contracting Parties and Non-Contracting Parties, for each of the nine Baltic Sea subregions is presented in Table 2.1. This table was compiled on the basis of information presented by the Contracting Parties (CPs) and compared with previously printed information (BSEP No. 45, Chapter 2).

The catchment areas of the Baltic Proper and the Gulf of Finland are the largest, namely 580 000 km^2 and 410 000 km^2, respectively. The Archipelago Sea and the Sound have the smallest catchment areas. Sweden possesses the largest portion of the Baltic Sea catchment area, 440 000 km^2. The next largest territories are those of Poland, Russia and Finland, all of which possess catchment areas a bit larger than 300 000 km^2. Germany has the smallest catchment area with 28 600 km^2. Total Baltic Sea catchment area not in the possession of Contracting Parties is 117 520 km^2.

The total long-term mean flow rate via all Baltic Sea rivers is 15 190 m^3/s (479 km^3/a), of which nearly one-half drains into the Baltic Sea via the seven largest rivers, namely the Neva, the Vistula, the Daugava, the Nemunas, the Kemijoki, the Oder and the Göta älv. The long-term mean flow rate of these rivers and the division of the river catchment area among the different countries is presented in Table 2.2.

Much of the pollution load is introduced into the Baltic Sea via rivers. Due to the fact that the catchment areas of the rivers often belong to different countries, the pollution load discharged by several Contracting Parties also includes the load originating in other countries (both Contracting and Non-Contracting Parties) located upstream or on the other side of border rivers. The pollution load carried from the Non-Contracting Parties via the rivers is comparatively small, with the exception of that of the Nemunas where only 48% originates in Lithuania. The question of distinguishing pollution load sources among the different countries is not addressed in this report. However, a first attempt was made to estimate natural and anthropogenic contributions to riverine fluxes (point source load and diffuse source load) for all large and many small rivers within the Contracting Parties.

For a better understanding of the load origin in different subregions, general information about population density (Map 2.1) and land use in the Baltic Sea catchment area is presented (Table 2.3 and Map 2.2). A remarkably large share (60-70%) of the territory is covered by agricultural land in Germany, Denmark and Poland (Table 2.3 and Map 2.3). The percentage of arable land in Estonia, Latvia and Lithuania is 30-50%, while the catchment area in Sweden, Finland and Russia each contain only about 10% arable land. Forests, swamps and waterbodies constitute from 65-90% of the catchment area in Finland, Russia, Sweden and Estonia. In Poland, Lithuania and Latvia they cover 30-50% of the catchment area, whereas in Denmark and Germany they cover only 19-25%. More detailed descriptions of the nine subregions of the Baltic Sea are given below in geographical order.

2.1 Bothnian Bay

The Bothnian Bay catchment area comprises 260 675 km^2 of which 56% (146 000 km^2) belongs to Finland, 44% (113 620 km^2) to Sweden and less than 1% (1 055 km^2) to Norway. The main rivers are the Swedish Lule älv and the Finnish Kemijoki, the latter being the seventh largest river in the Baltic Sea Area.

Sweden

About 26% of the total Swedish area belongs to the Bothnian Bay catchment area. It is situated in the northern part of Sweden and is rather sparsely inhabited, with a population density of 3 inhabitants per km^2 (390 000 inhabitants in a total of 0.2% urban area). It is also heavily forested and only small areas are agricultural areas (43% forested area; 0.8% agricultural area). Furthermore, it is rich in wetlands (17%) and lakes (lake surface area, 5.9%). Other areas, including mountains, cover 33%. The length of the coastline, excluding islands, is 370 km.

The catchment area contains a large number of rivers. The main river is the Lule älv with a long-term mean flow rate of 489 m^3/s (1961-1990). Moreover, there are four rivers in this region, with a long-term mean flow rate exceeding 100 m^3/s, for example the Torne and Kalix älven. 86% of this Swedish subregion catchment area is monitored hydrologically and hydrochemically.

Finland

About 47% of the total Finnish area is in the catchment area of the Bothnian Bay. This subregion is very sparsely populated with only 982 570 inhabitants; that means a population density of approximately 7 inhabitants per km^2. The land is dominated by forests (61%), wetlands (29%) and lakes (5.1%) with 4.6% agriculture taking place in the southern part of the Finnish Bothnian Bay catchment area. Urban areas cover 0.3% of the land. The length of the Finnish Bothnian Bay coastline, including islands, is 4 400 km.

The catchment area contains a large number of lakes and rivers. The total river flow from this catchment area into the Baltic Sea expressed as long-term mean flow rate is 1 794 m^3/s. The main river, the Kemijoki, has a long-term mean flow rate of 553 m^3/s (1960-1995). In addition, there are three rivers with flow rates exceeding 100 m^3/s and ten rivers have a long-term mean flow rate of between 5 and 100 m^3/s. 92% of this Finnish subregion catchment area is monitored hydrologically and hydrochemically.

2.2 Bothnian Sea

The Bothnian Sea catchment area comprises 220 765 km^2, of which 18% (39 300 km^2) belongs to Finland, 80% (176 610 km^2) to Sweden and 2% (4 855 km^2) to Norway. The main rivers in this Bothnian Sea catchment area are the Ångermanälven and Indalsälven in Sweden and the Oulujoki in Finland.

Table 2.1 Division of the Baltic Sea catchment area between Contracting Parties, Non-Contracting Parties for each of the nine Baltic Sea subregions in km

Subregion/ country	Bothnian Bay	Bothnian Sea	Archi-pelago Sea	Gulf of Finland	Gulf of Riga	Baltic Proper	Western Baltic	The Sound	The Kattegat	Total
Contracting Parties										
Finland	146 000	39 300	9000	107 000						301 300
Russia				276 100	23 700	15 000				314 800
Estonia				26 400	17 600	1 100				45 100
Latvia				3 400	50 100	11 100				64 600
Lithuania					11 140	54 160				65 300
Poland						311 900				311 900
Germany						18 200	10 400			28 600
Denmark						1 200	12 340	1 740	15 830	31 110
Sweden	113 620	176 610				83 225		2 885	63 700	440 040
Total	**259 620**	**215 910**	**9 000**	**412 900**	**102 540**	**495 885**	**22 740**	**4 625**	**79 530**	**1 602 750**
Non-Contracting Parties										
Belarus					25 800	58 050				83 850
Ukraine						11 170				11 170
Czech						7 190				7 190
Slovakia						1 950				1 950
Norway	1 055	4 855							7 450	13 360
Total catchment areas of the Baltic Sea including Contracting Parties and Non-Contracting Parties										
Total	**260 675**	**220 765**	**9 000**	**412 900**	**128 340**	**574 245**	**22 740**	**4 625**	**86 980**	**1 720 270**

Table 2.2 Division of river catchment area among Contracting and Non-Contracting Parties for the seven largest rivers flowing into the Baltic Sea

Rivers/ States	Neva	Vistula	Nemunas	Daugava	Oder	Göta älv	Kemijoki	Total
Long-term mean flow and long-term period of the seven largest rivers to the Baltic Sea								
in m^3/s	2 488	1081	664	633	574	572	553	6 565
period	1859-1988	1951-1990	1811-1995	1895-1995	1951-1990	1961-1990	1961-1990	-
Length of the seven largest rivers to the Baltic Sea								
in km	74[1]	1047	937	1020	854	90[2]	600	-
Catchment area of Contracting Parties in km^2								
Finland	56 200						49 470	105 670
Russia	215 600		3 170	27 000			1 660	247 430
Estonia				2 360				2360
Latvia			90	23 700				23 790
Lithuania			46 700	170				46 870
Poland		168 700	2 510		106 060			277 270
Germany					5 590			5 590
Denmark								
Sweden						42 780		42 780
Catchment area of Non-Contracting Parties in km^2								
Belarus		12 600	45 450	33 300				91350
Ukraine		11 170						11 170
Czech					7 190			7 190
Slovakia		1 950						1 950
Norway						7 450		7 450
Total catchment area of the rivers, including Contracting and Non-Contracting Parties								
Total	**271 800**	**194 420[3]**	**97 920**	**86 530**	**118 840**	**50 230**	**51130**	**870 870**

[1]length of the Neva to Lake Ladoga, [2]length of the Göta älv to Lake Vänern, [3]without delta

Table 2.3 Land cover in the Baltic Sea catchment area by country as %

Countries/ Land use	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Russia	Sweden
Urban areas	14	3	2	4	2	5	6	2	3
Forests(incl.mountains)	16	44	51	15	44	31	29	55	70
Arable land(incl.grass-land and green fields)	66	30	7	72	39	54	60	12	6
Water bodies (lake surface)	1	5	10	4	1	4	3	17	8
Marshes, swamps, wetlands	1	17	27	-	5	2	-	13	12
Other	2	1	3	5	9	4	2	1	1

Sweden

About 40% of the total Swedish area belongs to the catchment area of the Bothnian Sea. It is situated in the northern part of Sweden and is sparsely inhabited with a population density of 6 inhabitants per km^2. It is also heavily forested, with small agricultural areas (1.123 million inhabitants in a total of only 0.6% urban area; 53% forested area; 1.9% agricultural area). Furthermore, it is rich in wetlands (15%) and in lakes (lake surface area: 6.4%). Other types of land areas, including mountains, cover 23%. The length of the coastline, excluding islands, is 590 km.

The catchment area contains a large number of rivers. The main river is the Ångermanälven, with a long-term mean flow rate of 494 m^3/s (1961-1990). There are also two other rivers with long-term mean flow rates exceeding 400 m^3/s in this subregion, one of which is the Ulme älv. In addition, there are approximately 8 rivers in this catchment area with a long-term mean flow rate above 5 m^3/s. 87% of this Swedish subregion catchment area is monitored hydrologically and hydrochemically.

Finland

About 14% of the total Finnish area belongs to the catchment area of the Bothnian Sea. This area has a population of 929 260, with a population density of 24 inhabitants per km^2. The land is dominated by forests (66.4%), wetlands (9.1%) and lakes (8.1%). Agriculture (15.2%) is concentrated along the coast. Urban areas cover 1.2% of the land. The length of the Finnish Bothnian Sea coastline, including islands, is 6 600 km.

The catchment area contains a large number of lakes and rivers. The total river flow from this catchment area into the Baltic Sea expressed as a long-term mean flow rate is 377 m^3/s. The flow rate of one river exceeds 100 m^3/s, whereas three rivers have long-term mean flow rates between 5 and 100 m^3/s. 85% of this Finnish subregion catchment area is monitored hydrologically and hydrochemically.

2.3 Archipelago Sea

The catchment area of the Archipelago Sea comprises 9 000 km^2 which is completely part of Finnish territory. The main river in this subregion catchment area is the Aurajoki.

Finland

About 3% of the total Finnish area belongs to the catchment area of the Archipelago Sea. The population of this area is 458 710, with a population density of 51 inhabitants per km^2. The land is dominated by forests (61%), agricultural area (30%), wetlands (4.3%) and lakes (3.1%). Urban areas cover 1.7% of the land. The length of the Archipelago Sea coastline, including islands, is 20 100 km.

In all coastal rivers water flow is limited. These rivers also vary greatly in flow and water quality. The total river flow from this catchment area into the Baltic Sea expressed as long-term mean flow rate is 83 m^3/s. None of the rivers have a flow rate exceeding 10 m^3/s and four rivers have long-term mean flow rates of between 5 and 10 m^3/s. 40% of this Finnish subregion catchment area is monitored hydrologically and hydrochemically.

2.4 Gulf of Finland

The catchment area of the Gulf of Finland comprises 412 900 km^2 of which 107 000 km^2 (26%) belongs to Finland, 276 100 km^2 (67%) to Russia, 26 400 km^2 (7%) to Estonia and less than 0.1% (3 400 km^2) to Latvia. The largest river flowing into the Baltic Sea, the Neva, is part of the Gulf of Finland catchment area and drains from the Russian territory directly into the Gulf of Finland.

A large portion of the pollution load originating in this subregion is introduced into the Baltic Sea via two big rivers, the Neva and the Narva. Because the catchment areas of both rivers belong to more than one country, the measured load also includes the load originating from all countries located upstream or on the other side of border rivers. In the case of the Neva, only 51 300 km^2 is part of Finnish territory and flows through Lake Ladoga via the river into the Gulf of Finland. However, the main part of the catchment area (215 600 km), including the river outlet, is situated in Russia. On the other hand, 39 000 km^2 (69%) of the catchment area of the Narva is located in Russia but the remaining 17 200 km^2 (31%) belongs to Estonia from which the load enters the Baltic Sea directly.

Finland

About 36% of the total Finnish area belongs to the catchment area of the Gulf of Finland. This area has a population of 2 536 330, with a population density of 24 inhabitants per km^2. The land is dominated by forests (64%), wetlands (10%) and lakes (17%). Agriculture (8%) takes place along the coast. Urban areas cover 1% of the land. The length of the Finnish part of the Gulf of Finland´s coastline, including islands, is 8 000 km.

The catchment area is rich in lakes, which make up almost 20% of the total catchment area. The total long-term mean flow rate from this catchment area into the Baltic Sea is 460 m^3/s, including one river with a flow rate exceeding 100 m^3/s, five rivers with long-term mean flow rates of between 5 and 100 m^3/s and approximately ten rivers with flow rates of less than 5 m^3/s. 89% of this Finnish subregion catchment area is monitored hydrologically and hydrochemically.

Russia

About 1.6% of the total Russian area belongs to the catchment area of the Gulf of Finland. This area includes practically all the territory of the Saint Petersburg district, the eastern part of the Pskov district, almost all of the Novgorod district, the northwestern parts of the Tver and the Vologda districts, the western part of the Archangelsk district and the southern part of Karelia. 80% (215 600 km^2) of the area is drained by the Neva. The total population in the Russian catchment area is 8 million, meaning a population density of 30 inhabitants per km^2. 80% of the inhabitants live in the Saint Petersburg district. The catchment area is low and swampy. The length of the coastline, including islands, is 1 700 km.

The main rivers flow through the lakes Ladoga, Ilmen and Chudskoe (Lake Pepsi in Estonia). The retention time in Lake Ladoga is 4.5 years, in Lake Ilmen 1.5 years and in Lake Chudskoe 2.5 years. This means that a significant quantity of pollutants accumulates in these lakes. The Neva which enters the Baltic Sea directly from Russian territory has a long-term mean flow rate of 2 488 m^3/s (1859-1988). Its catchment area includes urban areas (2%), forests (55%), arable land (12%), swamps (13%), lake surface (17%) and other types of land (1%). About 70% of this Russian subregion catchment area is monitored hydrologically and hydrochemically. An additional 10% is monitored hydrologically only.

Estonia

About 60% of the Estonian territory belongs to the catchment area of the Gulf of Finland. This Estonian Baltic Sea catchment area has a population of 1.265 million, with a population density of 48 inhabitants per km^2. On average, 30% of the catchment area consists of arable land, 39% is covered by forests and 20% by swamps. The northern section of the Estonian portion of the Gulf of Finland catchment area belongs mainly to the carst region. South Estonia is mainly part of the catchment area of Lake Pepsi (Lake Chusdskoe in Russia), discharging via the Narva into the Gulf of Finland. The sub-soil of South Estonia consists of sandstone from the devon area. The landscape is covered with small hills, lakes and bogs.

The length of the Estonian part of the Gulf of Finland´s coastline, without islands, is 600 km. The Narva, with a long-term mean flow rate of 345 m^3/s (1956-1982) is the principal river. About 81% of the catchment area is monitored hydrologically and 85% hydrochemically.

Latvia

Less than 5.2% of the Latvian territory belongs to the catchment area of the Gulf of Finland. The Latvian catchment area of the Gulf of Finland has a population of 47 700, with a population density of 14 inhabitants per km^2. On average, 0.6% of the catchment area consists of urban areas, 37% is covered by forests, 45% is agricultural land and 2% lake surface. The territory is even and low-lying. In this part of the catchment area there are eight small rivers with a total long-term mean flow rate of 19.2 m^3/s over 20-50 years of observation. 994 km^2 (29%) of this catchment area is monitored hydrologically.

2.5 Gulf of Riga

The catchment area of the Gulf of Riga comprises 128 340 km^2, of which 18% (23 700 km^2) belongs to Russia, 14% (17 600 km^2) to Estonia, 39% (50 100 km^2) to Latvia, 9% (11 140 km^2) to Lithuania and 20% (25 800 km^2) to Belarus. The main river in the Gulf of Riga catchment area is the Daugava, the fourth largest river of the Baltic Sea Area. It empties into the Baltic Sea from Latvian territory.

In this subregion the same difficulties are encountered as in the case of the Gulf of Finland concerning distinguishing the sources of pollution load via rivers to the countries. More than half of the area drained by the Latvian rivers (77 000 km^2) is situated on the territories of Russia, Belarus, Lithuania and Estonia. Thus, the Latvian rivers serve as transit collectors for a remarkable amount of river water and, consequently, of pollution from other countries to the Baltic Sea. The most important example of this is the Daugava. Although the whole Russian subregion catchment area discharges into the Daugava, the river outlet is located in Latvia.

Estonia

About 37% of the Estonian territory belongs to the catchment area of the Gulf of Riga. The Estonian portion of the catchment area of the Gulf of Riga has a population of 295 000, with a population density of 17 inhabitants per km^2. About 20% of the catchment area is covered by arable land, 44% by forests and 26% by swamps. The land is low, with bogs and marshes.

The length of the Estonian part of the Gulf of Riga coastline, excluding islands, is 640 km. The main rivers are the Kasari and the Pärnu. The long-term mean flow rate of the Kasari is 25 m^3/s (1924 -1994) and of the Pärnu is 49.1 m^3/s (1921-1990). About 48% of the catchment area is monitored hydrologically and 56% hydrochemically. A small portion of South Estonia discharges its river waters via the Latvian river Gauja into the Gulf of Riga.

Latvia

About 77% of the Latvian territory belongs to the catchment area of the Gulf of Riga. The population of this territory is 2 263 500, meaning a population density of 45 inhabitants per km^2. This territory is used in the following way: urban areas 2%, forested areas 44%, agricultural areas 39% and lake surface 1.5%. The length of the Latvian segment of the Gulf of Riga coastline is 315 kilometres.

The Latvian territory in this subregion is even and low-lying. About 86% of the Latvian catchment area of the Gulf of Riga is monitored hydrologically and 93% hydrochemically. The total mean flow rate in this catchment area is 1 000 m^3/s over 20-100 years of observation. The rivers are not regulated, apart from the Daugava. The long-term mean flow rate of the Daugava is 633 m^3/s (1895-1995). About 96% of the river catchment area is monitored hydrologically and hydrochemically.

Russia

About 0.14% of the total Russian area belongs to the catchment area of the Gulf of Riga which is part of the catchment area of the River Daugava (the Sapadnaja Dvina in Russia) and has no direct outlet to the open sea. It has a population of 150 000, meaning a population density of 6 inhabitants per km^2. This area is situated west of the Valday Uplands. The main river is the Daugava which, along with seven of its tributaries originates here. The largest two tributaries are the Meza and the Lutshessa. The land is low and swampy without any large industrial centres or cities. Forests and agricultural areas dominate.

Lithuania

About 17% of the Lithuanian territory belongs to the catchment area of the Gulf of Riga (through the rivers Musa (the Meza in Russia), Birvyte and Laukesa (the Lutshessa in Russia)), which drains entirely via Latvian territory into the Gulf of Riga. Most of the area is monitored hydrologically and hydrochemically. The territory has a population of 313 600, with a population density of 26.5 inhab-itants per km^2. The Lithuanian sub-region catchment area is dominated by agriculture (53.6%) and forests (31.3%), with 4.8% urban areas, 4.1% water bodies, 2.4% wetlands and 3.8% de-voted to various other uses.

2.6 The Baltic Proper

The catchment area of the Baltic Proper comprises 574 245 km^2, to which all Contracting Parties except Finland belong, as well as Non-Contracting Parties Belarus, the Czech Republic, Ukraine and Slovakia with totally 78 360 km^2 (14%). The catchment areas of the Contracting Parties are divided as follows: 3% (15 000 km^2) belongs to Russia, 0.2% (1 100 km^2) to Estonia, 2% (11 100 km^2) to Latvia, 9% (54 160 km^2) to Lithuania, 54% (311 900 km^2) to Poland, 2.6% (18 200 km^2) to Germany, 0.2% (1 200 km^2) to Denmark and 15% (83 225 km^2) to Sweden.

Three of the seven largest rivers are situated in the Baltic Proper catchment area. Two of them, the Vistula and the Oder, enter the Baltic Sea from Polish territory. The third biggest river, the Nemunas, flows from the Lithuanian territory through the Curonian Lagoon into the Baltic Sea. In this subregion there are also many smaller rivers situated in the different countries. Therefore, the measured river pollution load also includes loads originating in all other countries located upstream or on the other side of the border rivers.

The total catchment area of the Vistula comprises 194 420 km^2, of which 87%, populated by 22.3 million inhabitants, belongs to Poland. 12 600 km^2 belongs to Belarus, 11 170 km^2 belongs to Ukraine and 1 950 km^2 belongs to Slovakia. The total catchment area of the Oder comprises 118 840 km^2. 89% of this catchment area, populated by about 13.1 million inhabitants, belongs to Poland. The catchment area of the Oder also includes 6% of the Czech Republic (1.4 million inhabitants) and 5% of Germany (0.4 million inhabitants). Another 10 406 km^2 of the Polish territory, populated by nearly 1 million inhabitants, is within the catchment areas of the Pregel and the Nemunas and of smaller rivers, flowing into the Baltic Sea via Russia and Lithuania.

The Nemunas, which discharges into the Baltic Proper from the Lithuanian territory (46 700 km^2), drains areas in Belarus (45 450 km^2), Poland (2 510 km^2), Russia (3 170 km^2) and Latvia (90 km^2). On the other hand, 7 459 km^2 of the Lithuanian territory belongs to the catchment areas of the River Venta and the River Bartuva, flowing into this Baltic Sea subregion through the Latvian territory. The River Sventoji drains directly to the Baltic Sea.

Estonia

About 3% of the Estonian territory, namely the western parts of the Islands Saaremaa and Hiiumaa, belongs to the catchment area of the Baltic Proper. That portion of the catchment area has a population of 10 000, with a population density of 9 inhabitants per km^2. The length of Estonia´s Baltic Proper coastline, excluding small islands, is 570 km. The territory consists of 14% arable land, 55% forests and 25% swamps. In it, there are neither rivers nor direct pollution sources related to the PLC-3 monitoring programme.

Latvia

Nearly 17% of the Latvian territory belongs to the catchment area of the Baltic Proper. The territory has a population of 311 500, with a population density of 28 inhabitants per km^2. It consists of 1.5% urban areas, 48% forests, 38% agricultural areas and 0.7% lake surface. The length of Latvia´s Baltic Proper coastline is 189 kilometres. The Latvian Baltic Proper catchment area is even and low-lying. About 63% of the catchment area is monitored hydrologically and 66% hydrochemically. Its total mean flow rate is 135 m^3/s over 20-60 years of observation. The main rivers are the Venta, the Barta (the Bartuva in Lithuania) and the Saka.

Lithuania

Nearly 83% of the Lithuanian territory belongs to the catchment area of the Baltic Proper, including the river catchment areas of the Nemunas, the Bartuva, the Venta and the Akmena-Dane. The population of this territory is 3 404 400, meaning a population density of 57 inhabitants per km^2. The Lithuanian subregion catchment area is dominated by agriculture (54%) and forest (31%), with 5% urban areas, 4% water bodies, 2% wetlands and 4% devoted to various other usages.

The main river, the Nemunas, discharges into the semiclosed Curonian Lagoon. The retention time for Nemunas discharges in the Curonian Lagoon in the case of full mixing is four months. The length of the Lithuanian part of the Baltic Proper coastline, including the Curonian Lagoon, is 99 kilometres. The long-term mean flow rate of the Nemunas is 664 m^3/s (1811-1995). About 96% of the catchment area of the Nemunas is monitored hydrologically and about 95% hydrochemically.

Russia

About 0.1% of the Russian territory belongs to the catchment area of the Baltic Proper, namely the Kaliningrad region. The main rivers are the Pregel and the Nemunas. The total population is 878 000, meaning a population density of 58 inhabitants per km^2. The total catchment area is monitored hydrologically and hydrochemically. The length of the Russian part of the Baltic Proper coastline, including islands, is 200 km. The largest part of the catchment areas of the rivers Pregel and Nemunas are situated in Belarus and Lithuania.

Poland

Almost all of the Polish territory (99.7%) belongs to the catchment area of the Baltic Proper. This area has a population of over 38 million, with a population density of 123 inhabitants per km^2. 62% of the population is concentrated in urban areas. The remainder lives in agricultural regions, constituting 60% of the territory, (46% of which is arable land, 1% of which is orchard and 13% of which is grassland). The entire catchment area consists of 29% forest, 3% waterbodies and 6% urban areas. The usage of the remaining 2% is not specified. The length of the Polish coastline, including that of the Hel Peninsula and the islands on the Baltic Sea side, is 528 km.

The main rivers in the Polish part of the Baltic Proper catchment area are the Vistula, which flows into the Gulf of Gdansk, and the Oder, which flows into the Pomeranian Bay through the Szczecin Lagoon. The Polish Vistula catchment area comprises 168 700 km^2 with a long-term mean flow rate of 1 081 m^3/s (1951-1990). The Polish Oder catchment area comprises 106 060 km^2 with a long-term mean flow rate of 574 m^3/s (1951-1990). About 99.7% of the Polish catchment area of the Baltic Proper are monitored hydrologically and hydrochemically.

About 35% of the monitored river water and 40% of waste water flows through lagoons and coastal lakes before entering the sea. These reservoirs, with retention times of several weeks, are affected by periodic inflows of sea water. Therefore, pollution load monitoring in the outflow into the sea is very difficult. The processes of degradation and of pollution accumulation that take place during the long retention time in the reservoirs also cause a significant decrease in pollution load in comparison with the monitored load.

Germany

Nearly 4% of the German territory belongs to the catchment area of the Baltic Proper. This comprises the main part of the area of Mecklenburg-Western Pomerania as well as the Oder catchment basin of the Federal States of Brandenburg and Sachsen. Approximately 1.56 million people live in the German Baltic Proper catchment area, meaning a population density of 86 inhabitants per km^2. Stralsund, Greifswald and Neubrandenburg are the population centres of this region. Land use is devided between agriculture, forestry and food production. About 70% of these combined areas are fields and grasslands, 17% is covered by forests and nearly 4% by water.

The length of the coastline along the open sea is 161 km, whereas the "bodden coastline is 1 135 km. Bodden is a specific term in Germany for shallow bays separated by spits of land or islands and peninsulas along the coast. Bodden coastline is typical of Mecklenburg-Western Pomerania. Because of changing water levels and currents and the effect of the surf, the coastline is always changing. The open sea coastline is particularly affected: 70% of it recedes 0.2-0.4 m per year.

The main rivers in the Baltic Proper area are the Peene and the Uecker. The catchment area of the Peene comprises 5 110 km^2, and the long-term mean flow rate is 23.6 m^3/s (1977-1994). The Uecker has a catchment area of 2 401 km^2 and a long-term mean flow rate of 7.8 m^3/s (1977-1994).

Denmark

Nearly 3% of the Danish territory, consisting of the islands of Zealand, Falster and Bornholm, belongs to the catchment area of the Baltic Proper. This area has a population of 82 400, meaning a population density of 68 inhabitants per km^2. 65% of the Danish Baltic Proper catchment area consists of arable land, 62% of which has been used for cereal cultivation. Forests cover about 22%, while meadows, moorlands and lakes cover about 2%. In total, natural and cultivated areas cover nearly 89% of the land. The length of the coastline in this subregion is nearly 443 km. Only 28% of the Danish Baltic Proper catchment area is monitored using the streams. The total long-term mean flow of Danish rivers into the Baltic Proper is 1.95 m^3/s (1971-1990). The main river is the Mern with a long-term mean flow rate of 0.41 m^3/ s (1971-1990).

Sweden

Nearly 19% of the Swedish territory belongs to the catchment area of the Baltic Proper, which is heavily forested (52%), but is also more densely populated than catchment areas further north. 4.1 million people live there in a total of 2.6% urban area; meaning a population density of 48 inhabitants per km^2. The agricultural area is larger than in the north, covering 16% of the catchment area. Wetlands and lake surface cover 3% and 10% of the land, respectively. Other types of terrain, including mountains, cover 16%. The length of the coastline, excluding islands, is 1 190 km. The major river is the Norrström, the outlet of Lake Mälaren through Stockholm, which has a long-term mean flow rate of 166 m^3/s (1961-1990). Moreover, there are approximately ten rivers in the catchment area with a long-term mean flow rate above 5 m^3/s. Approximately 68% of the Swedish catchment area is monitored.

2.7 Western Baltic

The catchment area of the Western Baltic comprises 22 740 km^2, of which 46% (10 400 km^2) belongs to Germany and 54% (12 340 km^2) to Denmark. There are no big rivers. Most of the pollution load comes into the marine environment via many small rivers each of which has a long-term mean flow rate of less than 20 m^3/s.

Germany

About 3% of the German territory belongs to the catchment area of the Western Baltic. The eastern third of the Federal State of Schleswig-Holstein and the western part of the Federal State of Mecklenburg-Western Pomerania are located in this subregion catchment area. The total population of the runoff area is approximately 1.74 million inhabitants (1.1 million in Schleswig-Holstein and 0.64 million in Mecklenburg-Western Pomerania), with a population density of 159 per km^2. The main centres of population in Mecklenburg-Western Pomerania are Rostock (230 000 inhabit-ants) and Wismar (51 000 inhabitants). In Schleswig-Holstein 50% of the total population lives in cities with more than 80 000 inhabitants. The largest populations and industrial centres are Kiel, Lübeck, Flensburg and Schleswig.

The catchment area in Schleswig-Holstein consists of 9% forests, 6% urban areas, 5% inland waters and nearly 80% agricultural land. The total length of the coastline is 521.5 km of which 193.5 km is open sea coastline belonging to Mecklenburg-Western Pomerania and 328 km is situated in Schleswig-Holstein.

The catchment area is a post-glacial moraine landscape. It drains into the southern part of the highly structured Western Baltic, which includes subbasins known as Bay of Mecklenburg, Bay of Wismar, Bay of Lübeck, the Kiel Bight and the Fehrman Belt. With sandy marl as the main soil material, the following other types of soil prevail in the catchment area: stagnic or other gleysoils, cambisoils and agrisoils. Humic gleysoils and fluvisoils are found in lowlands and along watercourses.

The main river in Mecklenburg-Western Pomerania is the Warnow with a catchment area of 2 982 km^2 and a long-term mean flow rate of 17.1 m^3/s (1974-1994). There are two big rivers in Schleswig-Holstein: the Trave with a catchment area of 1 807 km^2 and a long-term mean flow of 7.5 m^3/s (1971-1992), and the Schwentine with a catchment area of 714 km^2 and a long-term mean flow rate of 4.3 m^3/s (1971-1992).

Denmark

Nearly 29% of the Danish territory, with a population of 1.6 million, belongs to the catchment area of the Western Baltic. Population density in this area is approximately 128 inhabitants per km^2. The second and third largest Danish towns discharge into the Western Baltic. The Danish Western Baltic catchment area includes 68% arable land, of which 62% has been used for cereal cultivation. Forests cover about 14%, while meadows, moorlands and lakes, cover about 3%. Thus, natural and cultivated areas cover nearly 87% of the land. The remainder consists of consolidated areas: roads, villages and towns. The length of the coastline in this subregion is nearly 3 650 km. The area is covered mainly by Pleistocene fluvio-glacial sedimentary deposits with loam, sandy loams and loamy sand as dominant soil types. The elevation is low and slopes steeper than 6% only occur in about 2% of the total land mass.

More than 48% of the Danish Western Baltic catchment area is intensively monitored via numerous stations in the streams. The long-term mean flow rate from these Danish rivers into the marine areas is 50 m^3/s (1971-1990) for an area-specific runoff of about 267 mm. None of the seven largest Danish rivers flowing into the Western Baltic has a long-term mean flow rate exceeding 20 m^3/s; for example the Suså has a flow rate of only 6.8 m^3/s, the Vejle 6.6 m^3/s and the Odense 6.5 m^3/s.

2.8 The Sound

The catchment area of the Sound comprises 4 625 km^2, of which nearly 38% (1 740 km^2) belongs to Denmark and 62% (2 885 km^2) to Sweden. The main rivers in the Sound are the Tryggevalde in Denmark and the Kävlingeån in Sweden.

Denmark

Nearly 4% of the Danish territory with 1.5 million inhabitants belongs to the catchment area of the Sound. The population density of this region is 849 inhabitants per km^2. This catchment area of the Sound consists of about 43% arable land, 58% of which has been used for cereal cultivation. Forests cover about 18%, while meadows, moorlands and lakes, cover about 5%. All natural and cultivated areas cover nearly 66% of the land. The length of the coastline in this subregion is nearly 429 km.

Approximately 64% of the Danish Sound catchment area is monitored via the streams. The total mean flow rate from these Danish rivers to the marine areas is 6.1 m^3/s (1971-1990), equivalent to an area-specific runoff of about 175 mm. The main river is the Tryggevalde, with a long-term mean flow rate of 2.2 m^3/s (1971-1990).

Sweden

Approximately 0.6% of the Swedish territory belongs to the catchment area of the Sound. This catchment area is clearly different from all other Swedish catchment areas in that it contains a large share of agricultural land (64%). It also differs in population density, as there are no less than 625 000 inhabitants in this small area, meaning a population density of 240 inhabitants per km^2. Urban areas cover 6% of the land. Small areas are covered by forests (10%), wetlands (0.7%) and lakes (1.3%). Other types of terrain, including mountains, cover 18%. The length of the coastline, excluding islands, is 80 km. Five rivers have a mean flow rate of above 2 m^3/s, for example the Saxån and the Segeå. The major river is the Kävlingeån, with a long-term mean flow rate of 12 m^3/s (1961-1990). About 90% of the Swedish catchment area is monitored.

2.9 The Kattegat

The catchment area of the Kattegat comprises 86 980 km^2, of which 18% (15 830 km^2) belongs to Denmark, 73% (63 700 km^2) to Sweden and 9% (7 450 km^2) to Norway. The main river is the Göta älv in Sweden, which is the seventh largest river flowing into the Baltic Sea.

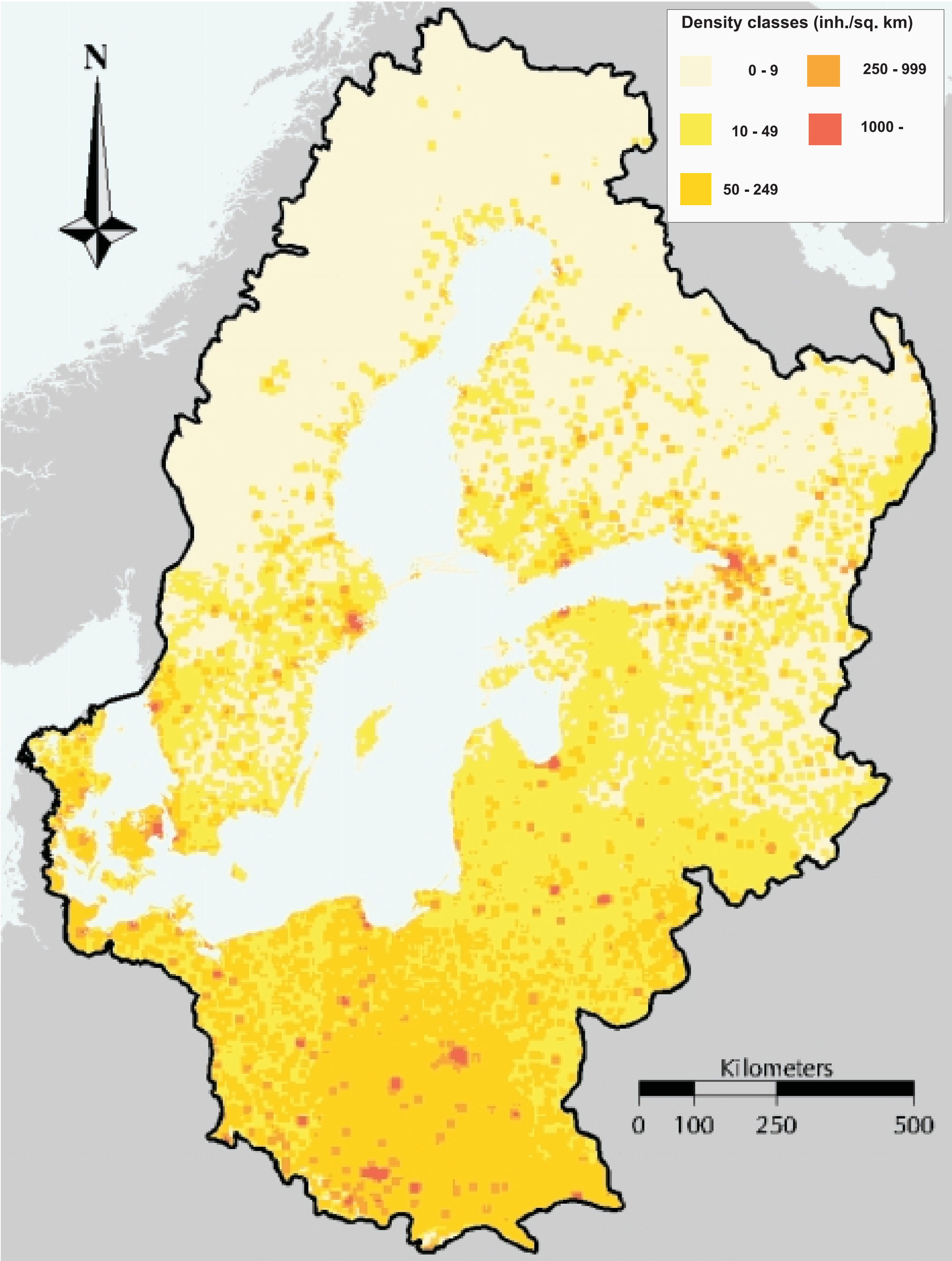
Denmark

About 37% of the Danish territory with 1.5 million inhabitants belongs to the catchment area of the Kattegat. Population density in this region is 92 inhabitants per km^2. The catchment area consists of 66% arable land, of which 54% has been used for cereal cultivation. Forests cover about 16%, while meadows, moorlands and lakes, cover about 5.5%. In all, natural and cultivated areas cover nearly 88% of the land. The remaining part consists of consolidated areas: roads, villages and towns. The length of the coastline in this subregion, including islands, is nearly 2 500 km. The area is covered mainly by Pleistocene fluvio-glacial sedimentary deposits. The elevation is low and slopes steeper than 6% occur in only about 2% of the total land mass. Sandy soils dominate in western and northern Jutland.

More than 61% of the Danish Kattegat catchment area is intensively monitored via numerous stations in the streams. The total long-term mean flow rate from these Danish rivers into the marine areas is 156 m^3/a (1971-1990), equivalent to an area-specific runoff of about 311 mm. There is one large river, the Gudenå, discharging into the Kattegat with long-term mean flow rate of 32.5 m^3/s (1971-1990). The second and third largest rivers draining into the Kattegat are the Karup, with a long-term mean flow rate of 9.5 m^3/s (1971-1990) and the Skals, with a long-term mean flow rate of 5.0 m^3/s (1971-1990).

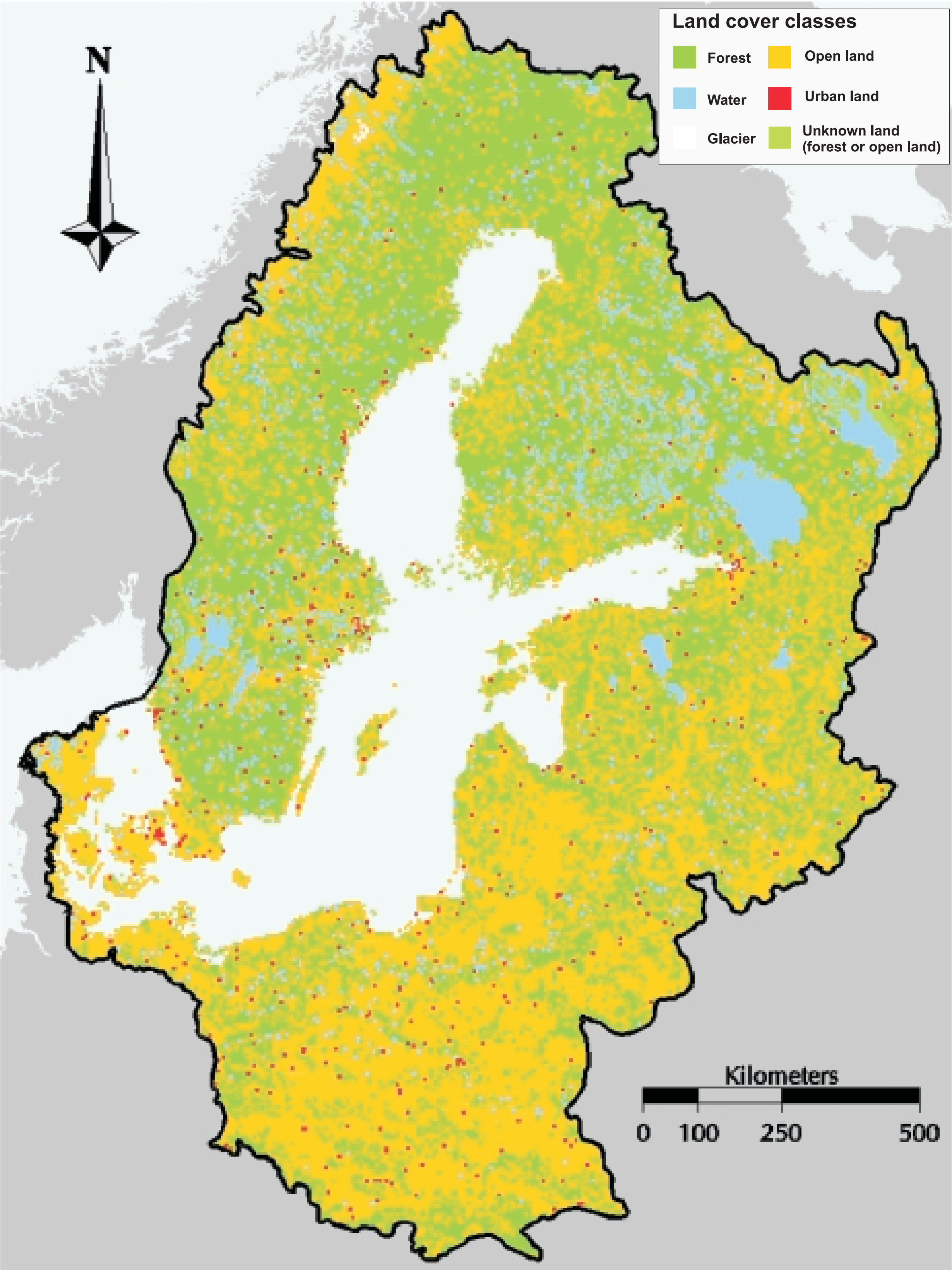
Sweden

About 14% of the Swedish territory belongs to the catchment area of the Kattegat. Except for its size this catchment area is basically similar to the Swedish portion of the Baltic Proper catchment area. Thus, it consists of 1.8% urban area and has 2.136 million inhabit-ants for a population density of 30 inhabitants per km^2. Forests cover 45% of the land and 12% is used for agricult-ure. Wetlands and lakes cover 7.3% and 14.2% of the land, respectively. Other terrains, includ-ing mountains, covers 20%. The length of the coastline, exclud-ing islands, is 250 km. The major river is the Göta älv with a long-term mean flow rate of 572 m^3/s (1961-1990). Approx-imately five other rivers have a long-term mean flow rate exceeding 20 m^3/s; for example the Lagan, the Nissam and the Åtran. About 90% of the Swedish catchment area is monitored.



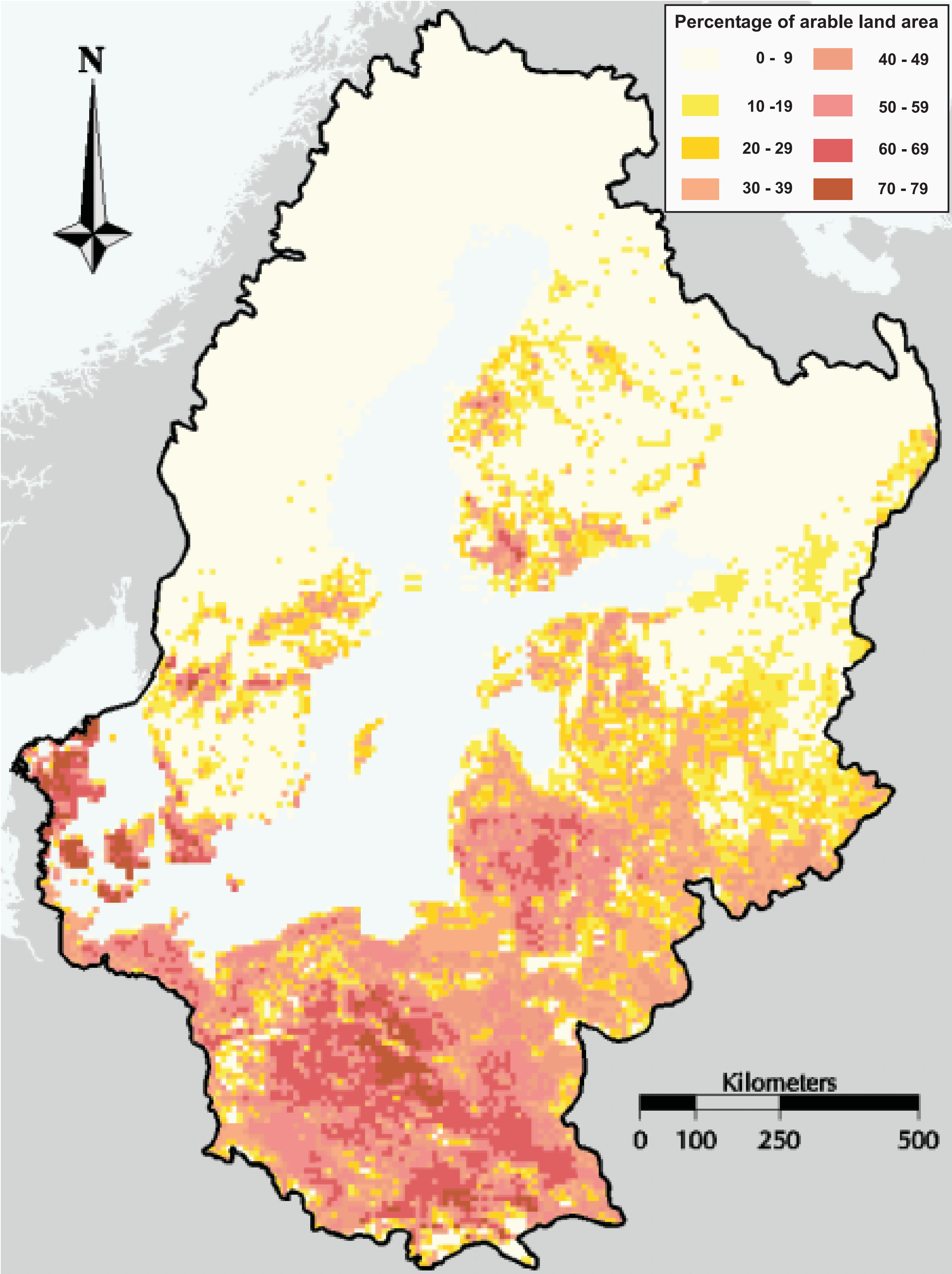
Map production by Beijer Institute of Ecological Economics, UNEP, GRID Arendal and Systems Ecology, Stockholm University.

Map 2.1. Population density classes of the Baltic Sea catchment area



Map production by Beijer Institute of Ecological Economics, UNEP, GRID Arendal and Systems Ecology, Stockholm University.

Map 2.2. Land cover classes of the Baltic Sea catchment area



Map production by Beijer Institute of Ecological Economics, UNEP, GRID Arendal and Systems Ecology, Stockholm University.

Map 2.3 Percentage of arable land area in the Baltic Sea catchment area

3

Methodology used for flow measurement, sampling and calculation

Obligatory measurement, sampling and calculation methods were described in the PLC-3 Guidelines. Taking into account that the harmonisation and follow-up of measurement, sampling and calculation is a complicated task, especially for the countries in transition, and that there are still certain unsolved problems, this chapter describes briefly the methods used by the Contracting Parties for better understanding and comparison of the load figures. Detailed information concerning the sampling sites, sampling frequency, parameters and catchment areas is presented in the Annexes to the report.

3.1 Flow measurement, sampling and calculation of pollution load via rivers

3.1.1 Flow measurement

According to the PLC-3 Guidelines the location of hydrological stations, measurement equipment, frequency of level and flow measurement as well as methods for calculation of annual runoff are regulated by the WMO Guide to Hydrological Practices.

All rivers included in the PLC-3 R of knowledge about the hydro-logical behaviour of the runoff of a comparable neighbouring known river basin.Flow measurements in the territory of each Contracting Party and its degree of conformity with the WMO-Guide are presented below (Table 3.1)

3.1.2 Sampling frequency

According to the PLC-3 Guidelines the sampling regime should be designed on the basis of historical records and should cover the whole flow cycle. The minimum sampling frequency is 12 times per year, appropriately reflecting the expected river flow pattern. The sampling points should correspond to ISO Standards 5667-6 and 5667-9.

Actually the sampling frequency in Denmark, Finland and Germany for large rivers especially concerning organic matter and nutrients, is higher than 12 times per year. The sampling frequency in Poland for all monitored rivers concerning BOD, COD, nutrients and heavy metals is 48-52 times per year (once per week). In the territory of the other Contracting Parties the sampling frequency, as a rule, is 12 times per year. For partially monitored rivers the frequency is smaller, between 4 and 8 times per year.

The sampling frequency for heavy metals is between 4 and 12 times per year, except for Denmark where water samples are not analysed for heavy metals, AOX etc. In Danish rivers a screening was performed in 1990 with the result that the concentrations for these parameters were below the detection limit. The same problem, i.e. that most of the concentration figures are below the detection limit, occurred in partially monitored rivers in the territories of some other Contracting Parties. Summarised results about sampling frequency are presented in Table 3.2.

Table 3.1 Flow measurements and calculation of flow

Country	Number of rivers included in the report	Number of rivers with permanent hydrological station	Flow calculation method	Conformity with the WMO Guide Y/N	Number of rivers or streams with estimated yearly runoff
Denmark	103	103	flow/level relationship	Y	0
Estonia	15	10	flow/level relationship	Y	5
Finland	27	27	flow/level relationship	Y	0
Germany	36	18	flow/level relationship	Y	18
Latvia	8	5	flow/level relationship	Y	3
Lithuania	3	2	flow/level relationship	Y	1
Poland	12	12	flow/level relationship	Y	0
Russia	20	13	flow/level relationship	Y	7
Sweden	41	41	flow/level relationship	Y	0

Table 3.2 Sampling frequency for different pollutants

Country	Sampling frequency for monitored rivers		Sampling frequency for partially monitored rivers	
	BOD, COD, nutrients	heavy metals	BOD, COD, nutrients	heavy metals
Denmark	12-26	-	12-26	-
Estonia	12	8-10	6	2-3
Finland	12	12	4-12	4-12
Germany	12-26	9-12	12-26	11-12
Latvia	12	6	6	6
Lithuania	12	4	*	*
Poland	48-52	48-52	-	-
Russia	12	6	6	2-3
Sweden	12	12	12	12

\- no measurements

* no partially monitored rivers

3.1.3 Methods for calculation of the riverine load

The methods to be used for calculating load in monitored, partially monitored and unmonitored rivers were described in the PLC-3 Guidelines. According to the Guidelines, selection of the calculation methods would depend on the Contracting Party. The following calculation methods compiled in Table 3.3 were used by the various Contracting Parties.

3.2 Flow measurement, sampling and calculation of pollution load from point sources

3.2.1 Flow measurement

According to the PLC-3 Guidelines, a relative error margin of less than 5% should be the target for open and closed measurement systems in each case. Flow measurement systems and methods should correspond to ISO and DIN standards. Continuous measurement and registration systems should preferably be used. A summary of information about flow measurement from point sources presented by the Contracting Parties has been compiled in Table 3.4.

Table 3.3 Methods used for calculation of the riverine load

Country	Monitored rivers		Partially monitored rivers	
	linear interpolation	daily flow and daily concentration regression	mean monthly concentration and mean monthly flow	estimation on the bases of similarity
Denmark		+		+
Estonia		+		+
Finland			+	+
Germany			+	+
Latvia			+	+
Lithuania	+			+
Poland		+		
Russia			+	+
Sweden		+		+

3.2.2 Sampling methods and sampling frequency

According to the PLC-3 Guidelines, samples from treated and untreated wastewater should always be taken as composite samples. Flow-weighted composite samples should be the target. Grab samples are acceptable only in exceptional cases. Sampling frequency depends very much on the polluters. For big polluters sampling frequency is 2-7 times per week. For smaller polluters it is 1-4 times per month, or only a few times per year for very small polluters.

The sampling methods and sampling frequencies presented by the Contracting Parties vary widely. Several Contracting Parties, for instance Germany, used only samples taken by the authorities for pollution load calculations and for this reason the sampling frequency is only 12 times per year. Other Contracting Parties, for instance Sweden, used all self-control samples as well as samples taken by the authorities for load calculation and for this reason the number of samples is significantly larger. An overview of sampling methods and frequencies is presented in Table 3.5.

3.2.3 Calculation methods

The main calculation methods were presented in the PLC-3 Guidelines. According to the Guidelines, calculated load figures must also include overflows and bypasses. For untreated and unmonit-ored discharge the load may be derived on the basis of per capita load figures. Based on the information provided by the Contracting Parties, an overview of calculation methods is presented in Table 3.6.

3.2.4 Aquaculture

Fish farming plants exist only in Estonia, Finland and Sweden. The load from these plants is calculated based on the amount of nutrients in fish and on the nutrient content of the feed, using for calculation the equations described in the PLC-3 Guidelines. Information about these inputs is included in the source category of industrial plants.

3.2.5 Diffuse inputs from coastal zones into the Baltic Sea

Diffuse inputs from coastal zones into the Baltic Sea include pollutants washed directly into the sea from agricultural areas, managed forests or non-managed natural areas including forests. Information about these inputs is included in the source category of unmonitored rivers.

Table 3.4 Flow measurement for point sources which are reported separately

Country	Number of point sources included in the report		Number of point sources using the continuous flow measurement with accuracy more than 5 %		Frequency of calibration of the equipment	Number of point sources using other methods	Number of point sources where volume assessed on the basis of consumption
	Municipalities	Industries	Municipalities	Industries			
Denmark	24		24		regularly	0	0
Estonia	8	4	4	0	once every two years	7	1
Finland	26	18	26	18	regularly	0	0
Germany	24	4	24	4	regularly	0	0
Latvia	22	29	2	1	3 times per year	0	48
Lithuania	5	2	2	1	once every two years	0	4
Poland	58	34	13	10	regularly	19	50
Russia	16	32	10	3	once per year	6	29
Sweden	43	36	43	36	once per year	0	0

Table 3.5 Sampling method and frequency for point sources

Country	Point sources ≥ 10 000 PE		Point sources < 10 000 PE	
	Type of sampling	Sampling frequency	Type of sampling	Sampling frequency
Denmark	flow proportional	12 times per year	random or flow proportional	2-12 times per year
Estonia	composite or grab	1-4 times per week	grab	2-12 times per year
Finland	composite, flow proportional	12-24 times per year	composite ,flow proportional	2-8 times per year
Germany	grab samples	11-13 times per year		
Latvia	composite	12-104 times per year	composite	12 times per year
Lithuania	composite	12 times per year	composite	12 times per year
Poland	composite, 24 hours, flow proportional	1-4 times per week; minimum: once per month	grab	1-2 times per week; minimum: two times per year
Russia	composite or grab	12 times per year	grab	2-12 times per year
Sweden	composite, daily or weekly, flow proportional	2 times daily/ weekly/ monthly	composite, flow proportional	2-12 times per year

Table 3.6 Pollution load calculation methods for point sources

Country	Load calculation methods for point sources				
	Continuous flow measurements and continuous sampling	Continuous flow measurements and non-continuous sampling	Periodic flow and sampling 1-12 times per year	Overflows and by-passes included Y/N	Estimation methods for untreated wastewater
Denmark	+	+	+	Y	*
Estonia		+	+	Y	capita load
Finland		+		Y	*
Germany	+			Y	*
Latvia	+	+	+		capita load
Lithuania	+	+	+		capita load
Poland		+	+	Y	capita load
Russia		+	+	N	capita load
Sweden	+			Y	*

* no untreated wastewater

4

Analytical methods and quality assurance

4.1 Analytical methods

4.1.1 Determinants and analytical methods

The Guidelines for PLC-3 presented descriptions for analytical methods to be used for different determinants in the monitoring programme. In many cases it was recommended that one method be used for the analysis of river water and another for the analysis of wastewater. On the basis of the information given by different countries the analytical methods appear to have corresponded rather well to the Guidelines. In general, the analytical methods used in Denmark, Finland, Sweden and Germany corresponded to Nordic or ISO standards and complied rather well with the requirements in the PLC-3 Guidelines. There was more variation in the methods used by the other countries. For some determinants methods also varied within countries (Annex 1).

The recommended obligatory and voluntary determinants are presented in Table 1.1 (Chapter 1).

In Denmark, Lithuania, Poland and Russia BOD_5 was measured whereas PLC-3 requires BOD_7 to be measured. The results of BOD_5 were converted to BOD_7 using a factor of 1.15 -1.2.

There was also some variation in methods used to determine nutrient content. In some countries the Nessler method was still used for determination of ammonia and a salicylate method for determination of nitrate (Annex 1). In the determination of total nitrogen and phosphorus the digestion procedure varied. In Poland and in some Danish laboratories the total nitrogen from wastewater was calculated as a sum of nitrogen fractions.

A variety of filters was used to analyse the suspended solids (Annex 1). For this reason, the results for wastewater particularly are not easily comparable with each other, because the amount of suspended solids filtered depends, in general, on the type of filter used as well as on its pore size.

Laboratories have mainly used amalgamation for analysis of mercury and the cold vapour technique for measuring. The enrichment method for mercury by amalgamation was used in Finland, Germany and Sweden, especially in those cases where low mercury values were detected in rivers.

Measurement of metals was generally carried out using atomic absorption spectrophotometry. Whether flame or flameless methods were used depended on the concentration of determinants. For determinations of low metal concentrations ICP/MS was used in Finland, Sweden and Denmark and volta-metry in Germany. The procedures used by the laboratories differed mainly in how well they measured low metal concentrations.

4.1.2 Detection limit

The detection limits depended both on the analytical method used and on the laboratory (e.g. on the quality of the deionized water and reagents and on the equipment used). In most cases it was only possible to approximate the detection limit, because it differed from laboratory to laboratory as well within most countries (Annex 2). Concentrations of determinants are, in general, lower in the rivers of the Nordic countries such as in Finland and Sweden. In these countries it is necessary to use the most sensitive analytical methods. Detection limits varied most in the determination of heavy metals and nutrients.

4.2 Quality assurance

4.2.1 Quality assurance activities

In order to obtain comparable results and to secure reliable data, a quality assurance programme was established before starting PLC-3. In total over 300 laboratories participated in the PLC-3 programme. Because the results from several laboratories were to be combined (Table 4.1), comparability of the results was essential for PLC-3.

The first step was to establish national reference laboratories (NRLs). These were set up in most countries (except Russia) before PLC-3 began. Each country has established two reference laboratories, one for analysis of river water and another for analysis of wastewater.

In the Guidelines it was recommended that the national reference laboratories in all countries take the following steps in order to obtain reliable data for PLC-3:

- set up and carry out internal quality control,
- test new methods when necessary,
- train the personnel of participating laboratories,
- conduct inter-laboratory comparisons.

Various activities of the reference laboratories have been underway both before and during the PLC-3 programme.

4.2.1.1 Internal quality control

The results of inter-laboratory comparisons have shown that the rigour of analytical quality control procedures within a laboratory can be related to its performance. Laboratories should conduct regular controls on the measurements in each batch in order to maintain an acceptable level of accuracy and precision in the analysis. On the basis of the information collected from the national reference laboratories internal quality control appears to have been implemented rather successfully. However it is evident that small laboratories in particular have not always had the resources to introduce quality assurance procedures in accordance with the requirements in the PLC-3 Guidelines.

Quality control procedures require some additional analytical work. Furthermore, unavailability of necessary standards or reference materials have caused problems in implementing quality control procedures. All Swedish laboratories that participated in PLC-3 were accredited.

Table 4.1 Laboratories participating in PLC-3 in various countries

Country	*Rivers*	*Wastewater*
Denmark	*Private and municipal accredited laboratories*	*NERI (trace metals), private and municipal accredited laboratories*
Estonia	*NRL, regional laboratories (common determinants), NRL for wastewater (heavy metals)*	*NRL (heavy metals, common determinants), industrial laboratories or treatment plants*
Finland	*NRL (heavy metals, AOX, TOC), regional laboratories (common determinants, TOC)*	*Industrial laboratories, treatment plants or authorised water laboratories (all determinants)*
Germany	*NRLs (all determinants)*	*NRLs (all determinants)*
Latvia	*NRL (heavy metals, common determinants), regional laboratories (common determinants)*	*NRL (heavy metals, common determinants), regional laboratories or treatment plants (common determinants)*
Lithuania	*NRL (heavy metals), regional laboratories (common determinants)*	*NRL (heavy metals), regional laboratories (common determinants)*
Poland	*NRL (all determinants), regional laboratories (all determinants, heavy metals)*	*NRL (heavy metals, common determinants), regional laboratories (common determinants, heavy metals), industrial laboratories or treatment plants (common determinants)*
Russia	*One research institute (all determinants)*	*Wastewater laboratories (common determinants, heavy metals)*
Sweden	*NRL (all determinants)*	*NRL, accredited industrial laboratories or treatment plants (all determinants)*

4.2.1.2 Training

In 1994-1995 the personnel of the national reference laboratories in Estonia, Latvia, Lithuania and Poland participated in international workshops on quality assurance and analytical procedures, e.g. the Quality Assurance Workshop/HELCOM in 1994, the Quality Assurance Workshop/EU-PHARE programme in 1995, the Quality Assurance Workshop/EU-EQUATE programme in 1995 or the workshop on Laboratory Accredition in Sweden in 1995.

When many laboratories in a country have participated in PLC-3, an essential function of the reference laboratory has also been to provide training in analytical procedures and quality assurance. The reference laboratories in Denmark, Estonia, Finland, Latvia, Lithuania and Sweden have provided training for their regional laboratories or for their environmental laboratories participating in PLC-3.

4.2.1.3 International inter-laboratory comparisons

The national reference laboratories took part in the international comparisons before or during the PLC-3 programme. The Finnish Environment Institute conducted the comparison test before PLC-3 in June 1994. The samples used were artificial and surface water, municipal wastewater or wastewater from the pulp and paper, and metal industries. The main obligatory determinants were compared. The results of the comparisons are summarized in Table 4.2.

The results showed that the relative standard deviation (between laboratories) was fairly high in some cases; e.g. up to 30-45% in the analysis of nitrogen compounds, several heavy metals (Cr, Cu, Pb, Ni, Zn) and mercury. Generally deviation was greater in determination of low concentrations. In this comparison the target value for criterion of bias was 10-40% and it also varied according to the concentration and on the determinant. The results were regarded as acceptable, if they differed less than 10-40% from the mean value or the assigned value (Table 4.2).

The following reasons seem to be the most significant sources of errors:

1. lack of appropriate resources (facilities, equipment, labware, pure ionized water, pure chemical reagents),
2. lack of systematic quality control procedures,
3. the use of methods which may not provide good quality data.

The comparisons were conducted only shortly before PLC-3 was started. In general reference labor-

Table 4.2 Summary on the international comparison test in 1994

Determinant	Surface water				Wastewater			
	Range	Reproducibility in %	Perform. Criterion in %	Accepted results in %	Range	Reproducibility in %	Perform. Criterion in %	Accepted results in %
BOD in mg/l					35	10	20	86
					300	14	20	62
COD_{Cr} in mg/l					< 100	17-24	20	64
					> 250	4-17	10	64
P_{total} in µg/l	< 100	23-24	20	56	< 500	13-16	10-20	67
	> 140	8-24	20	69	> 800	3-4	10	82
N_{NH4} in µg/l	< 100	23-33	30	73				
	> 100	11-30	20	87				
N_{total} in µg/l	< 1000	21-25	20-30	75	< 6000	15-41	20	80
	> 1500	12-13	20	86	> 6000	13-26	20	81
N_{NO3} in µg/l	< 500	7-25	10-20	72				
	> 1000	13-31	10	62				
Hg in µg/l	< 0.2	32-125	40	50	< 5	13-24	40	100
	> 1	12-44	40	100	> 9	2-6	10-20	70
Cd in µg/l	< 3	8-11	20	82	< 100	11	20	86
	> 30	6-12	20	88	> 150	14-15	10-20	82
Cr in µg/l	< 10	11-15	40	87	< 50	30	40	67
	> 200	12	20	90	> 600	5-14	20	90
Cu in µg/l	< 15	27-43	40	63	< 50	25	40	91
	>100	12-13	20	86	> 250	8-11	10-20	91
Ni in µg/l	< 20	9-25	40	85	< 50	21	20	45
	> 100	5-9	20	92	> 300	8-11	20	94
Pb in µg/l	< 10	12-22	40	81	< 50	42	40	70
	> 100	8-29	20-40	77	> 400	4-11	10-40	79
Zn in µg/l	< 50	12-35	20-40	78	< 200	10-17	20	80
	> 50	10-11	40	96	> 200	11-15	20	85

atories had neither the time nor the financial resources to effect many improvements. While PLC-3 was underway some improvements were made, particularly in the reference laboratories of Estonia, Latvia and Lithuania with the support of the EU-PHARE programme. How-ever, in 1995 the laboratories received mainly educational rather than technical support.

Some reference laboratories of Estonia, Latvia, Lithuania and Poland also participated in the comparisons conducted within the EU/EQUATE project in June 1995, in which most of the obligatory determinants in PLC-3 were compared. In general the results of this comparison were acceptable.

The Russian laboratories participating in PLC-3 did not take part in the international comparisons. Therefore it is impossible to compare Russian results with those from other countries.

4.2.1.4 National inter-laboratory comparisons

In the PLC-3 Guidelines the national reference laboratories were asked to conduct national inter-laboratory comparisons to monitor the performance of other laboratories in the country.

The countries conducted the inter-laboratory comparisons before or during PLC-3 (Table 4.3). There were some flaws in the way of the inter-laboratory comparisons. In some cases only a few determinants were compared. In other cases, only a few samples were distributed; the concentrations of the types of samples compared did not correspond to the real samples. In some countries these comparisons were also constrained by low financial resources.

National inter-laboratory comparisons were not necessary in Germany because only two national reference laboratories participated in PLC-3.

In terms of the results of BOD_7, the outcome in different countries seemed to be quite similar, whereas there were large differences between the countries when COD_{Cr} values were compared (Table 4.4). AOX and TOC, which were compared by Sweden, Finland and Denmark, seemed to be quite reliable determinants.

Concentrations of nitrogen compounds in the samples distributed by the different countries varied significantly. The variation in results generally depended on the concentration of the samples. In this data the results varied between 5-35% and the variation was the highest in the determination of ammonium nitrogen and total nitrogen. In general, the results of total phosphorus varied between 5-20%.

Determination of suspended solids was only compared by Denmark, Poland and Sweden. The Swedish laboratories used different kind of filters for determination of suspended solids in surface water. The observed variation in the Swedish comparison test, 35-45%, corresponded quite significantly with the variation in results reported by the countries in PLC-3. For higher values, variation was much lower.

Determination of mercury was compared only by Finland and Sweden. In this data the results varied up to 30% (Hg $< 0.2\ \mu g/l$). In determination of low concentrations of Hg from surface waters the variation can be much higher, up to 60%.

Heavy metal concentrations in the distributed samples varied considerably. The results varied up to 65%. The variation was the highest in determination of heavy metal concentrations at a level $\leq 1\ \mu g/l$ in surface waters.

The variation in results of the national comparisons did not differ very much from the variation observed in the international comparisons conducted for the national reference laboratories before the start of PLC-3 (Table 4.4). The variation between reference laboratories was 5-10% lower than the variation obtained in the national comparisons for determination of BOD_7, COD_{Cr} and heavy metals.

4.3 Conclusions

After the PLC-2 report has been published it became clear that a quality assurance system had to be established before PLC-3 got underway. Within the framework of such a system, laboratories could improve their ability to provide data of appropriate quality. The national reference laboratories have played an essential role in improving analytical performance in most countries. The laboratories have provided personnel training for their regional or industrial laboratories and wastewater treatment plants. In addition, most laboratories participating in PLC-3 carried out internal quality control during the programme, but some had difficulties in carrying out the national comparisons. Consequently some problems have arisen in drawing conclusions about the performance of the laboratories in some countries. Unfortunately some countries have had problems related to the use of insensitive and/or inappropriate methodology, lack of good quality labware and reagents and lack of adequate instrumentation.

In general the national reference laboratories took part in the international comparisons. However, there have been some problems in controlling the quality of the work that has been carried out by their national laboratories. Overall the laboratories have worked towards improvement of the quality of the data in PLC-3 and they have been aware of the importance of quality assurance procedures. Through better quality control the measurements are becoming more reliable. In addition, many laboratories participating in PLC-3 have implemented the quality system based on the EN 45001 and the ISO/IEC Guide 25. In any case, the quality assurance programme has to some degree supported the data produced for PLC-3, although it takes time to achieve improvements in quality assurance and analysis, especially in countries where financial resources are a problem. Nevertheless, the programme has provided essential information on methodology and quality assurance for many laboratories.

In order to obtain relevant and reliable data in the next stages of PLC, it is essential that the whole analytical process should proceed under a well-established quality assurance programme in PLC laboratories.

Table 4.3 National inter-laboratory comparisons

Country	Determinants	Type of water
Denmark	SS, COD_{Cr}, BOD_5/BOD_{2+5} (1994)	surface water
	N_{NH4}, $N_{NO3+NO2}$, N_{total}, P_{total}, P_{PO4} (1994)	wastewater
	Heavy metals (1994)	drinking water
	N_{NH4}, N_{NO3}, N_{total}, P_{total}, P_{PO4} (1995)	surface water
	SS, COD_{Cr}, BOD_5, TOC (1995)	wastewater
Estonia	BOD_7, N_{NH4}, N_{NO3}, N_{total}, P_{total} (1994)	surface water
	BOD_7, N_{NH4}, N_{NO3}, N_{NO2}, N_{total}, P_{PO4}, P_{total} (1995)	surface water
	BOD_7, N_{total}, P_{total} (1994)	wastewater
	Heavy metals (1995)	artificial samples
	BOD_7, N_{total}, P_{total} (1995)	wastewater
Finland	BOD_7, COD_{Cr}, N_{NH4}, N_{total}, P_{total} (1994)	wastewater (municipal)
	BOD_7, COD_{Cr}, N_{total}, P_{total}, AOX, TOC (1994, 1995)	wastewater (pulp and paper mills)
	Heavy metals, Hg (1994)	surface and wastewater
	N_{NH4}, N_{NO3}, N_{total}, P_{PO4}, P_{total} (1995)	surface water
Germany	Two laboratories participating.	
Latvia	BOD_7, COD_{Cr}, N_{total}, P_{total} (1994)	wastewater
	BOD_7, COD_{Cr}, N_{total}, P_{total} (1995, 3 times)	wastewater
	N_{NO3}, N_{NH4} (1994)	wastewater
	N_{NO3}, N_{NH4} (1994, 2 times)	artificial samples
	N_{NH4}, N_{NO3}, N_{total}, P_{total} (1994)	artificial samples (river water)
	Heavy metals (1994, 2 times)	artificial samples
	Heavy metals (1994)	wastewater
Lithuania	BOD_5, N_{NH4}, N_{total}, P_{total} (1994)	wastewater
	BOD_5, N_{NO2}, N_{total}, P_{PO4}, P_{total} (1995)	surface water
Poland	BOD_5, COD_{Cr}, N_{NH4}, N_{NO3}, N_{Kjel}, P_{PO4}, P_{total}, SS (1995)	artificial samples
	N_{NH4}, N_{NO3}, N_{Kjel}, P_{PO4}, P_{total}, SS (1995)	artificial samples
	Heavy metals, Hg (1994)	artificial samples
Sweden	BOD_7, COD_{Cr}, COD_{Mn}, AOX, TOC (1994)	wastewater
	Heavy metals, Hg	surface and wastewater
	BOD_7, COD_{Cr}, AOX, TOC (1995)	wastewater
	Heavy metals (1995)	wastewater
	N_{NH4}, N_{NO3}, N_{NO2}, N_{total}, N_{Kjel}, P_{PO4}, P_{total} (1995)	surface and wastewater
Russia	BOD, COD, N_{total}, P_{total}, heavy metals (1995)	surface and wastewater

Table 4.4 Coefficient of variation (CV %) in national comparisons in 1994-1995

Determinant	Denmark	Estonia	Finland	Latvia	Lithuania	Poland	Sweden
BOD							
< 10 mg/l		30-40%	30-40%	30-50%	30%*		30%
> 10 mg/l	10-15%	10-20%	< 10%	20-40%		14%	20-30%
COD_{Cr}							
< 100 mg/l	10-20%		5-20%	15-45%			25-30%
> 100 mg/l			> 10%	10-25%		6%	< 10%
AOX							
< 0.1 mg/l			< 5%				10-20%
> 0.1 mg/l	5-10%		5-10%				5-15%
TOC	5-10%		5-10%				10-15%
N_{NH4}							
< 200 µg/l	10%		5-15%	20-30%	5%**		10%
> 200 µg/l		10-40%	< 10%			< 2-7%	
N_{NO3}	5-10%	5-15%	< 5%	14-20%	4%**	< 5%	10%
N_{total}							
< 1000 µg/l	10%		5%	5%	20%		10%
> 1000 µg/l		5-15%	5-10%	10-35%		< 5%	10%
P_{total}							
< 100 µg/l	5%	20%	5%	1%	20%*		
> 100 µg/l		< 10%	< 5%	15-35%	5%*	< 20%	10-15%
SS							
2 µg/l	10-15%						35-45%
20-250 µg/l						6 - 19%	6-19%
Hg							
< 0.2 µg/l			30%				20%
> 5 µg/l						17%	
Heavy metals							
< ~ 5 µg/l	10-15%		15-30%			3-13%	15-30%
~ 5-50 µg/l			25-30%	10-65%		3-14%	
100-200 µg/l	10-50%					5%	

* Only one sample was distributed

** A high concentration of determinant

5

Pollution load entering the Baltic Sea in 1995

5.1 General information about rivers, municipalities and industrial plants

PLC-3 examined nutrient, organic matter and heavy metal loads entering the Baltic Sea marine environment from rivers, coastal areas and direct point sources such as municipalities and industrial plants. However, point source discharge was only taken into account when the source was discharging directly into the Baltic Sea or when it was located downstream of the hydrological/hydrochemical station in the river for which the load is given. Therefore, only a small portion of the total point sources located within a river basin were considered, which means that an inventory of all point sources in the whole Baltic Sea catchment area is lacking.

The runoff and direct point source discharge considered in PLC-3 is 466 320 million m^3/a, of which about 93% represents runoff into the Baltic Sea from monitored rivers. The runoff from coastal areas including unmonitored rivers is the second biggest share with nearly 6%. About 1% of the discharge came from municipalities and industrial plants, to which treated and untreated municipal discharge and treated industrial discharge each contributed about 0.3%. The amount of untreated direct industrial discharge was negligible in comparison with all other pollution sources (see Figure 5.1). In Figures 5.2 and 5.3 the distribution of runoff and amount of direct point source discharge from all pollution source categories considered in PLC-3 is shown by subregion and by Contracting Party, respectively.

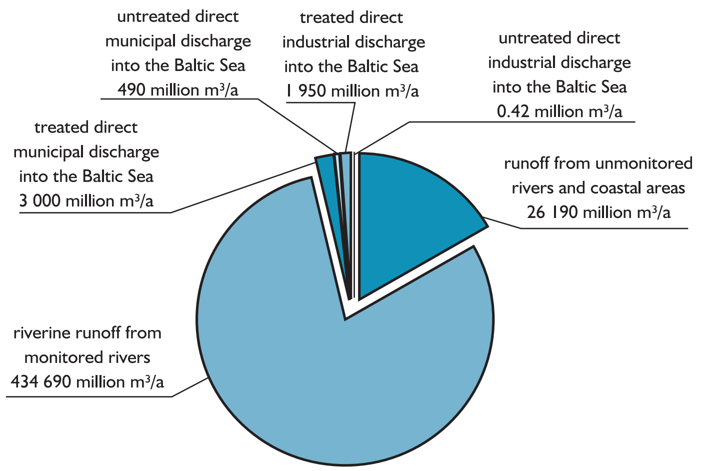


Figure 5.1 Distribution of runoff and direct point source discharge into the Baltic Sea in 1995. Total amount of riverine runoff and direct wastewater discharge: 466 320 million m^3/a

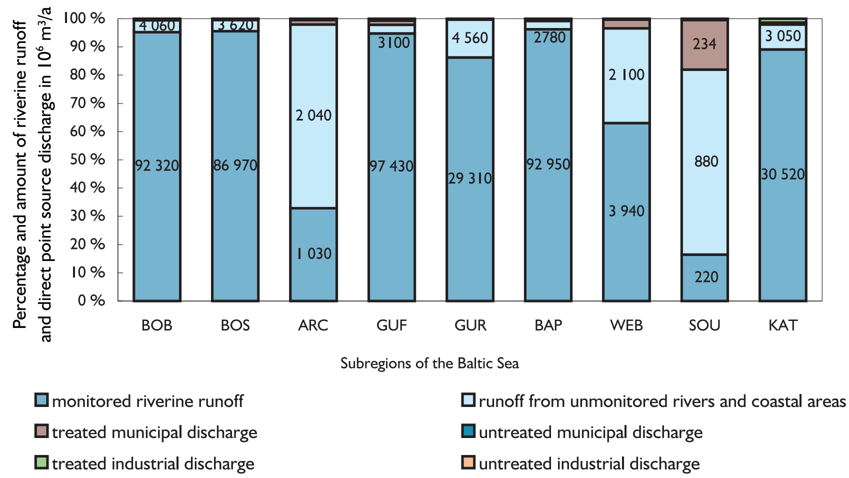


Figure 5.2 Riverine runoff and amount of direct point source discharge into the Baltic Sea in 1995 by subregion

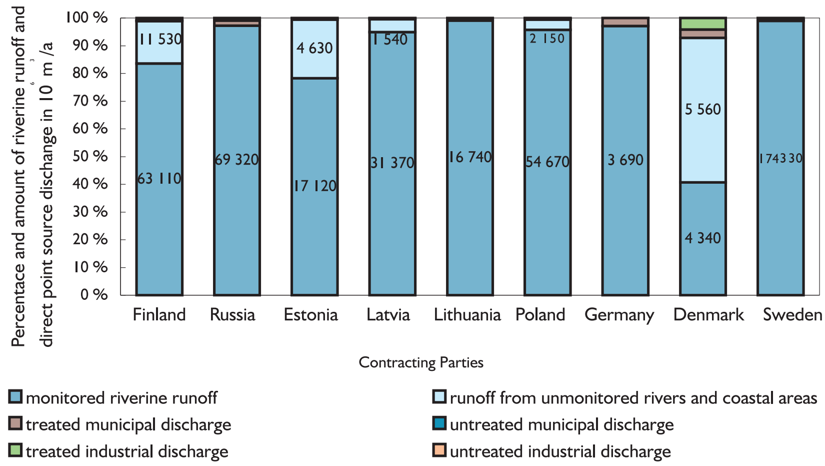


Figure 5.3 Riverine runoff and amount of direct point source discharge into the Baltic Sea in 1995 by Contracting Party

5.1.1 Information about rivers

Riverine load consists of load from different pollution sources within a river catchment area such as industrial plants, municipal wastewater treatment plants, diffuse load (e.g. agriculture, forestry, and scattered dwellings) and natural background load. It should also be noted that the load for transboundary rivers contains not only pollution load from the country in which the measurement site is located, but also load from point and diffuse sources situated in the territory of other Contracting Parties and/or Non-Contracting Parties.

In 1995 263 rivers were monitored or partially monitored. The total runoff of these rivers amounted to 434 690 million m^3/a with a total catchment area of 1.5 million km^2, of which 1.2 million km^2 are located within the territory of Contracting Parties in which the monitoring stations are situated. The runoff from coastal zones and unmonitored rivers amounted to 26 190 million m^3/a (6%) with a corresponding catchment area of nearly 125 000 km^2. According to Figure 5.4 and Table 5.1 riverine runoff into the Gulf of Finland was the greatest, with nearly 100 000 million m^3/a from a total catchment area of monitored rivers of nearly 400 000 km^2. The runoff into the Bothnian Bay, the Bothnian Sea and the Baltic Proper amounted in each case to about 90 000 million m^3/a. The total monitored river catchment area of the Baltic Proper subregion was the largest, nearly 500 000 km^2. The total monitored river catchment area of the Bothnian Bay and the Bothnian Sea subregions amounted to approximately 200 000 km^2. The number of monitored rivers varied: There were 16 in the Bothnian Sea catchment area, 21 in the Bothnian Bay catchment area, 39 in the Gulf of Finland catchment area and 49 in the Baltic Proper catchment area. The seven largest rivers flowing into the Baltic Sea, all but the Göta älv were situated in these four subregion catchment areas. Most of the monitored rivers were located in the Western Baltic catchment area, but the runoff from these 73 rivers was very limited. These rivers are streams compared with the large rivers in the catchment area of the other subregions. The Sound had the lowest runoff, about 220 million m^3/a, and the smallest catchment area, nearly 1 000 km^2.

According to Figure 5.5 and Table 5.2, the largest portion of the runoff - 174 330 million m^3/a, which is nearly three times higher than the runoff from Russia (69 320 million m^3/a), Finland (63 110 million m^3/a) and Poland (54 670 million m^3/a) - entered the Baltic Sea from the Swedish Baltic Sea catchment area. Sweden has monitored 42 rivers, Russia 19 rivers, Finland 26 rivers and Poland 12 rivers. Sweden is also the country with the largest Baltic Sea river catchment area, about 420 000 km^2. River catchment area in Poland, Russia and Finland amounts to slightly over 300 000 km^2 in each case. Denmark and Germany have the smallest river catchment area, about 15 000 km^2 and also the lowest amount of riverine runoff. In Denmark 103 rivers were monitored, with a runoff of 4 340 million m^3/a. Germany monitored 36 rivers with a runoff of 3 690 million m^3/a.

5.1.2 Information about municipalities

It should be stated, that the 177 million m^3/a wastewater originating in the Kaliningrad region of Russia with a population of 900 000 and flowing into the Baltic Proper, of which 151 million m^3/a were untreated, could not be taken into account in the report because no information about municipalities and loads was submitted by Russia. It is also important to stress, that due to the fact that Russia only submitted the total amount of direct municipal wastewater discharges into the Gulf of Finland, it was impossible to present the distribution of Russian municipalities in Figures 5.11 and 5.12.

In 1995 the total amount of direct municipal wastewater discharge was 3 490 million m^3/a, from 15 million inhabitants connected to a total of 430 municipalities. Approximately 13 million inhabitants were connected to 155 municipal wastewater treatment plants (MWWTPs) > 10 000 PE (Population Equivalents) which produced nearly 2 950 million m^3/a treated wastewater. The treated wastewater discharge from 264 small settlements (including non-systematically monitored settlements from Poland) with a total of 377 000 inhabitants was only 55 million m^3/a, which is less than 2% of total direct municipal discharge. Nearly 500 million m^3/a (14%) of the municipal wastewater discharges into the Baltic Sea were untreated. It was produced by 10 municipalities with a total of 1.6 million inhabitants (see Figure 5.6). According to Figures 5.7 and 5.8 the largest share of the untreated municipal wastewater, 430 million m^3/a, originated in Saint Petersburg and in the Leningrad region of Russia with a population of 1.2 million, flowing into the Gulf of Finland. The remaining 55 million m^3/a of direct untreated municipal wastewater discharges came from Poland (39 million m^3/a), Latvia (16 million m^3/a), Lithuania (0.4 million m^3/a) and Estonia (0.2 million m^3/a) and flowed into the Baltic Proper, the Gulf of Riga and the Gulf of Finland. None of the other Contracting Parties discharged untreated municipal wastewater into the Baltic Sea; thus no such discharge could enter the Baltic Sea from the catchment areas of the Bothnian Bay, the Bothnian Sea, the Archipelago Sea, the Western Baltic, the Sound or the Kattegat.

The distribution of direct municipal wastewater discharges, population and number of municipalities by subregion and by Contracting Party is shown in Figures 5.7, 5.9 and 5.11 and in Figures 5.8, 5.10 and 5.12, respectively. The largest share of treated municipal wastewater came from 14 MWWTPs > 10 000 PE discharging directly into the Gulf of Finland, treating 1 550 million m^3/a of wastewater and serving 5 million inhabitants. The treated discharge from 44 small settlements with a population of 23 100 discharging directly into the Gulf of Finland amounted to 5 million m^3/a. The second largest share of treated municipal wastewater, 500 million m^3/a, is produced by 48 MWWTPs > 10 000 PE discharging directly into the Baltic Proper and serving 3.8 million inhabitants. The treated direct discharge into the Baltic Proper from 85 small settlements amounted to 19 million m^3/a with a total population of 155 000. The direct treated municipal wastewater discharge from MWWTPs > 10 000 PE discharging directly into the Sound and the Kattegat amounted in each case to

Table 5.1 Runoff from rivers and coastal areas including corresponding catchment areas entering the Baltic Sea from the subregion's catchment area in 1995 (see Abbreviation List)

Sub-region	riverine runoff and corresponding catchment area							
	monitored/partially monitored rivers				unmonitored rivers/ coastal areas		runoff from rivers and coastal areas	
	runoff in 10^6 m^3/a	monitored catchment area within the CP in km^2	**total monitored catchment area in km^2**	number of rivers reported	runoff in 10^6 m^3/a	catchment area in km	runoff in 10^6 m^3/a	total catchment area with in the CP in km
BOB	92 320	226 610	**226 610**	21	4 060	25 270	96 380	251 880
BOS	86 970	186 380	**186 380**	16	3 620	23 000	90 590	209 390
ARC	1 030	3 010	**3 010**	3	2 040	5 940	3 070	8 950
GUF	97 430	298 970	**394 170**	39	3 100	10 530	100 530	309 500
GUR	29 310	48 690	**121 560**	7	4 560	13 400	33 870	62 080
BAP	92 950	402 510	**498 620**	49	2 780	23 700	95 730	426 220
WEB	3 940	12 290	**12 290**	73	2 100	7 410	6 040	19 700
SOU	220	990	**990**	14	880	3 160	1 100	4 150
KAT	30 520	63 920	**71 380**	41	3 050	11 890	33 570	75 810
TOTAL	434 690	1 243 370	**1 515 010**	263	26 190	124 300	460 880	1 367 680

Table 5.2 Runoff from rivers and coastal areas including corresponding catchment areas entering the Baltic Sea from the Contracting Party's catchment area in 1995

Contracting Party	runoff and corresponding monitored catchment area							
	monitored/partially monitored rivers				unmonitored rivers/ coastal areas		runoff from rivers and coastal areas	
	runoff in 10^6 m^3/a	monitored catchment area within the CP in km^2	**total monitored catchment area in km^2**	number of rivers reported	runoff in 10^6 m^3/a	catchment area in km	runoff in 10^6 m^3/a	total catchment area within the CP in km^2
Finland	63 110	197 550	**197 550**	26	11 530	33 570	74 640	231 120
Russia	69 320	231 440	**287 640**	19	N.I.	N.I.	69 320	231 440
Estonia	17 120	31 130	**70 130**	15	4 630	14 250	21 750	45 380
Latvia	31 370	46 690	**125 930**	8	1 540	5 610	32 910	52 300
Lithuania	16 740	47 280	**98 500**	2	120	390	16 860	47 670
Poland	54 670	281 810	**320 340**	12	2 150	10 850	56 820	292 670
Germany	3 690	16 590	**16 590**	36	-	440	3 690	17 030
Denmark	4 340	13 350	**13 350**	103	5 560	17 760	9 900	31 110
Sweden	174 330	377 530	**384 980**	42	660	41 430	174 990	418 960
TOTAL	434 690	1 243 370	**1 515 010**	263	26 190	124 300	460 880	1 367 680

N.I. = No information
\- = This source does not exist.

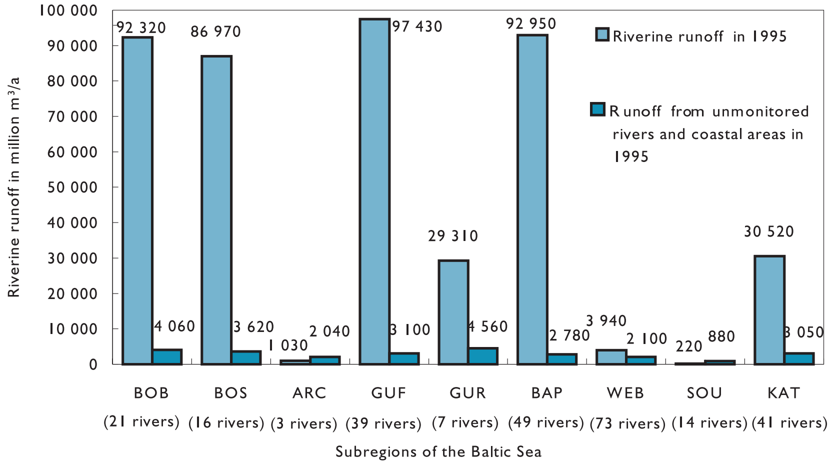
about 230 million m^3/a, serving a total of 1.4 million inhabitants. The lowest municipal discharges from MWWTPs > 10 000 PE originated in Latvia and Lithuania and were discharged into the Archipelago Sea, the Bothnian Bay and the Bothnian Sea.

In Denmark, Germany, Finland and Sweden all municipal effluents were treated in municipal wastewater treatment plants. Nearly all of these plants used mechanical, chemical and biological treatment methods with phosphorus removal rates of between 80% and 97%. In all the Danish plants except that of Copenhagen (LYN), nitrogen removal also took place, with elimination rates between 70% and 99%. In 10 of the 24 German plants additional nitrogen removal took place with elimination rates of about 80% to 98%. In the Finnish and Swedish plants the nitrogen removal rate was generally less than 50%, except in 4 of the 55 Swedish plants where the nitrogen removal rate was of the order of 70%. In one of the Polish plants and 2 of the Estonian plants the phosphorus removal rate was over 80%.

5.1.3 Information about industrial plants

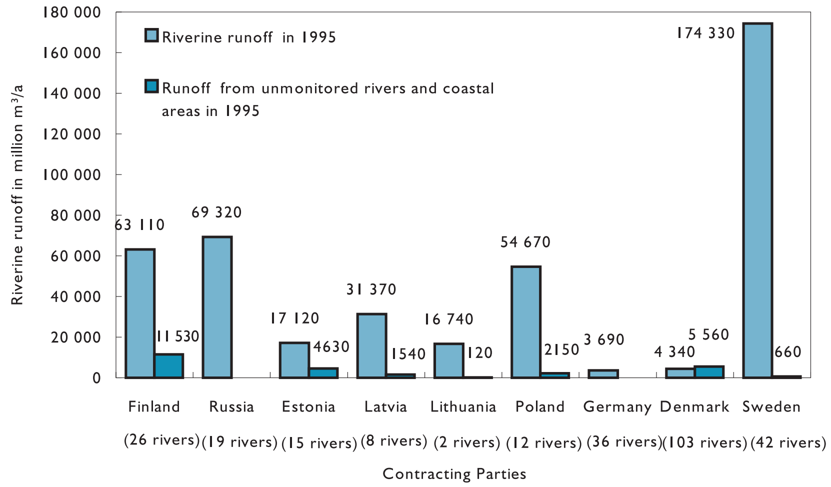
The 183 industrial plants considered in PLC-3 discharged 1 950 million m^3/a wastewater directly into the Baltic Sea in 1995, of which more than 1948 million m^3/a was treated wastewater discharged by 177 industrial plants. The untreated wastewater discharge from 6 industrial plants amounted to 0.42 million m^3/a, which is less than 0.1% of total direct industrial discharge. One of these industrial plants discharging untreated wastewater directly into the Baltic Sea is located in Estonia, two are located in Latvia and three in Poland.

The distribution of direct industrial wastewater discharges and number of industrial plants by subregion and by Contracting Party is shown in Figures 5.13 and 5.15, and Figures 5.14 and 5.16, respectively. According to these Figures the largest share of treated industrial wastewater was discharged by 60 industrial plants into the Bothnian Bay (540 million m^3/a), the Kattegat (460 million m^3/a) and the Bothnian Sea (350 million m^3/a). 13 industrial plants



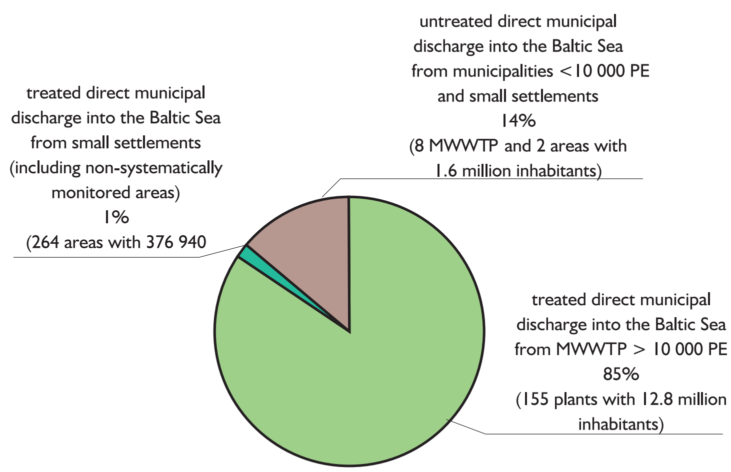
Total riverine runoff: 460 880 million m^3/a

Figure 5.4 Riverine runoff into the Baltic Sea in 1995 by subregion



Total riverine runoff: 460 880 million m^3/a

Figure 5.5 Riverine runoff into the Baltic Sea in 1995 by Contracting Party



Total amount of wastewater from urban areas: 3 487 130 · 10^3 m^3/a

Figure 5.6 Distribution of direct municipal discharge into the Baltic Sea in 1995

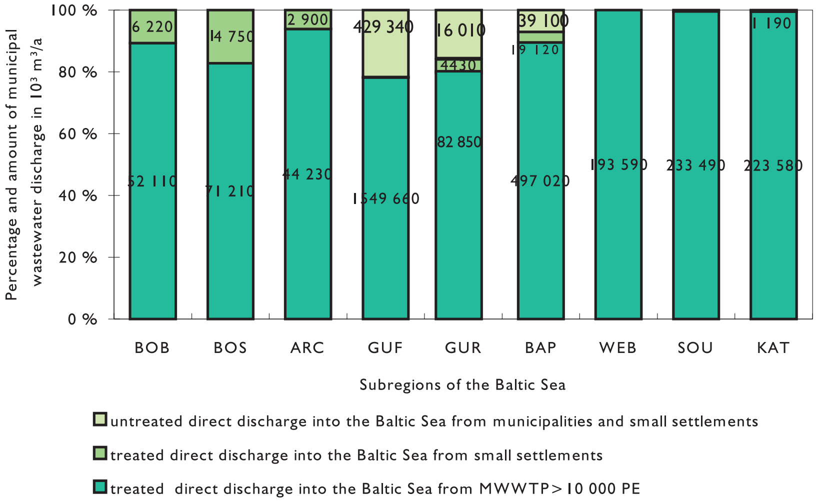


Figure 5.7 Distribution of direct municipal discharge by subregion into the Baltic Sea in 1995

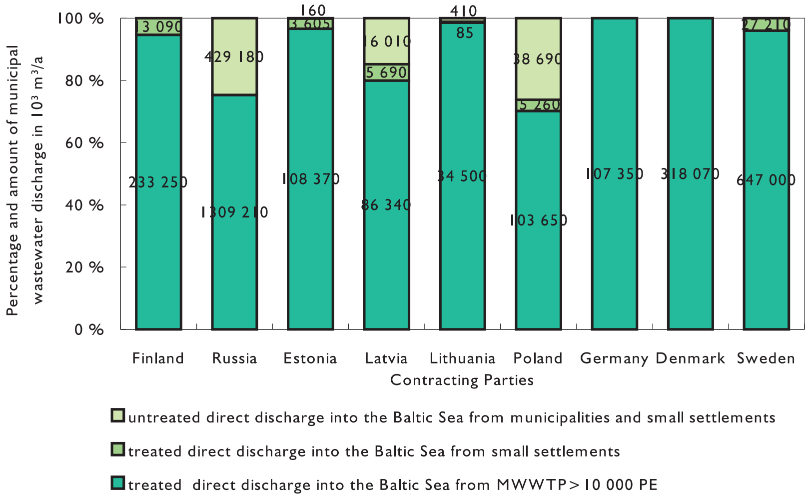


Figure 5.8 Distribution of direct municipal discharge by Contracting Party into the Baltic Sea in 1995

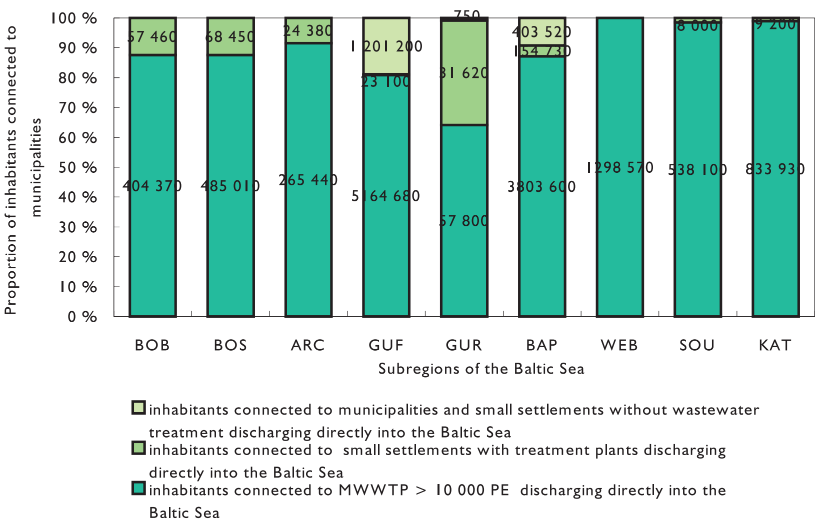


Figure 5.9 Distribution of population by subregion connected to municipalities discharging directly into the Baltic Sea in 1995

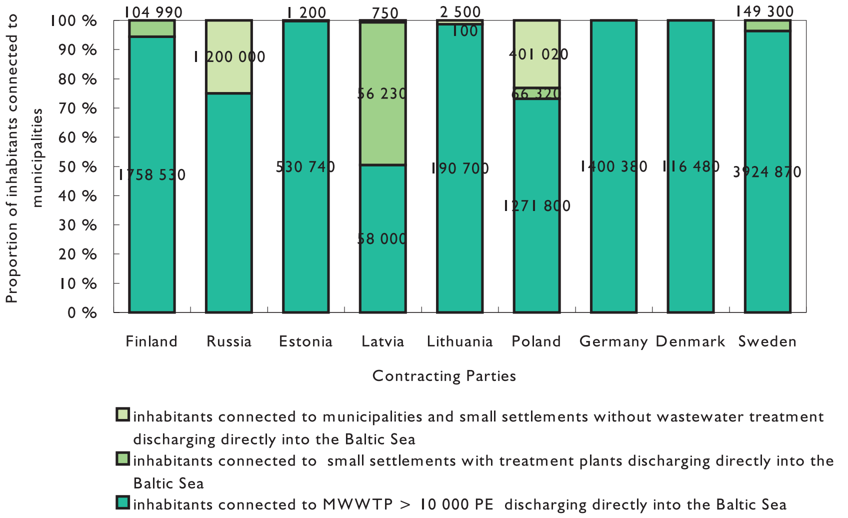


Figure 5.10 Distribution of population by Contracting Party connected to municipalities discharging directly into the Baltic Sea in 1995

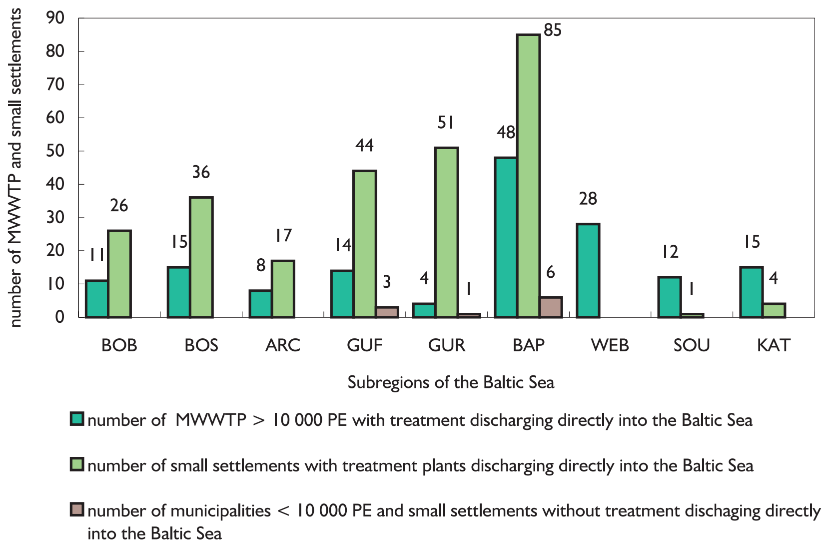


Figure 5.11 Distribution of MWWTP and small settlements by subregion in 1995 (except Russia)

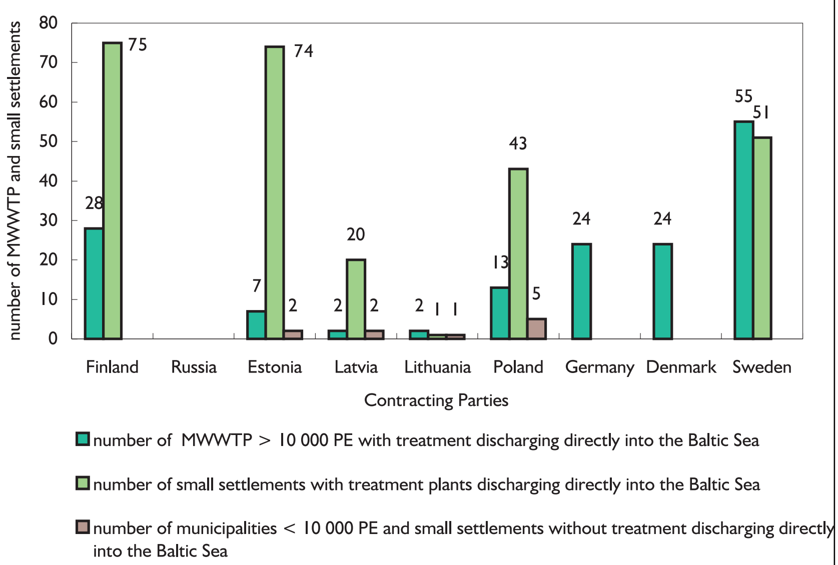
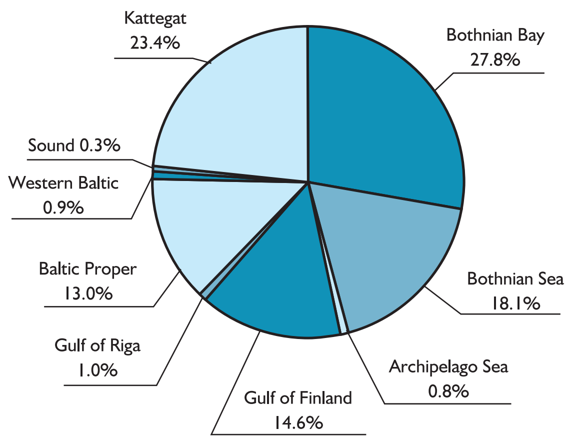


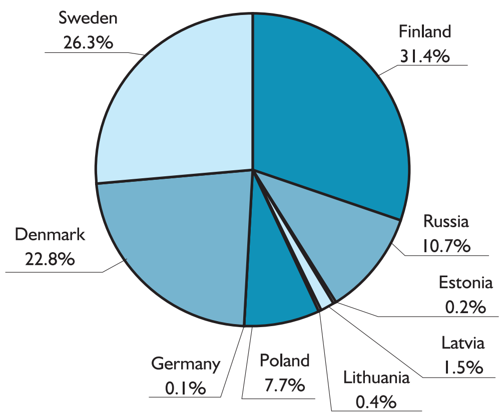
Figure 5.12 Distribution of MWWTP and small settlements by Contracting Party in 1995 (except Russia)

discharged 280 million m^3/a treated wastewater directly into the Gulf of Finland and 56 industrial plants discharged 250 million m^3/a treated wastewater directly into the Baltic Proper. Treated wastewater from 48 industrial plants discharging directly into the Sound, the Western Baltic and the Gulf of Riga were approximately 40 million m^3/a.

The distribution of the amount of treated industrial wastewater produced by the nine branches of industry considered in PLC-3 is given in Figure 5.17 by subregion and in Figure 5.18 by Contracting Party. The largest share of the direct industrial wastewater discharge, 890 million m^3/a, came from 40 **pulp and paper plants** located in Finland, Russia, Latvia, Poland and Sweden. The main wastewater discharge emitted by this branch of industry was introduced from the 24 Swedish (420 million m^3/a) and the 9 Finnish (320 million m^3/a) pulp and paper plants. The second largest amount of industrial wastewater, 530 million m^3/a, was discharged by **"other industry"**, of which 425 million m^3/a came from 25 Danish plants. The remaining 100 million m^3/a were emitted by industrial plants of this branch of industry in Latvia, Lithuania, Poland and Russia. Wastewater discharges from the chemical industry amounted to 230 million m^3/a with the largest share, 130 million m^3/a, from Poland and 90 million m^3/a from Finland. Wastewater from the **iron and steel industry** of 195 million m^3/a was discharged into the Bothnian Bay and into the Baltic Proper. One of these plants, discharging 140 million m^3/a, is situated in Finland, two of them, discharging 54 million m^3/a, are located in Sweden and the remaining 99 million m^3/a came from Poland. One Swedish **metal enrichment plant** discharged 27 million m^3/a wastewater into the Bothnian Bay and two Finnish **non-ferrous metal plants** discharged 21 million m^3/a wastewater into the Bothnian Bay. There are also 8 **petrochemical plants**, discharging 34 million m^3/a, of which 21 million m^3/a were discharged by the two Finnish plants. All Contracting Parties except Finland and Lithuania have **food industry** discharging directly into the Baltic Sea, consisted of a total of 39 plants producing 23 million m^3/a wastewater. The largest share of this wastewater



Total amount of treated wastewater from 177 industrial plants: 1 948 190 · 10^{3}m^3/a
Figure 5.13 Distribution of direct industrial discharge by subregion into the Baltic Sea in 1995



Total amount of treated wastewater from 177 industrial plants: 1 948 190 · 10^3 m^3/a
Figure 5.14 Distribution of direct industrial discharge by Contracting Party into the Baltic Sea in 1995

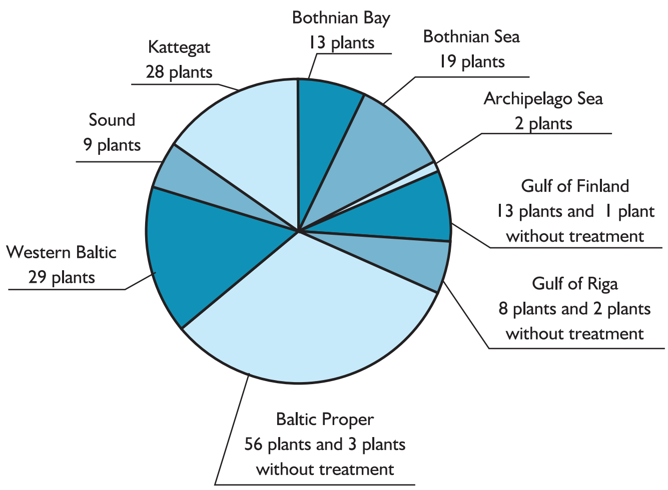


Figure 5.15 Distribution of industrial plants by subregion discharging directly into the Baltic Sea in 1995

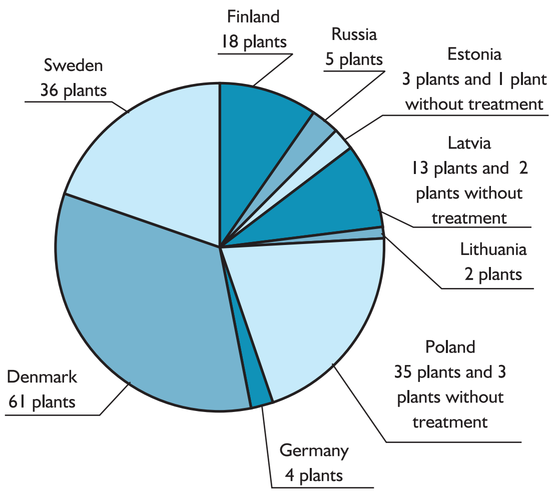


Figure 5.16 Distribution of industrial plants by Contracting Party discharging directly into the Baltic Sea in 1995

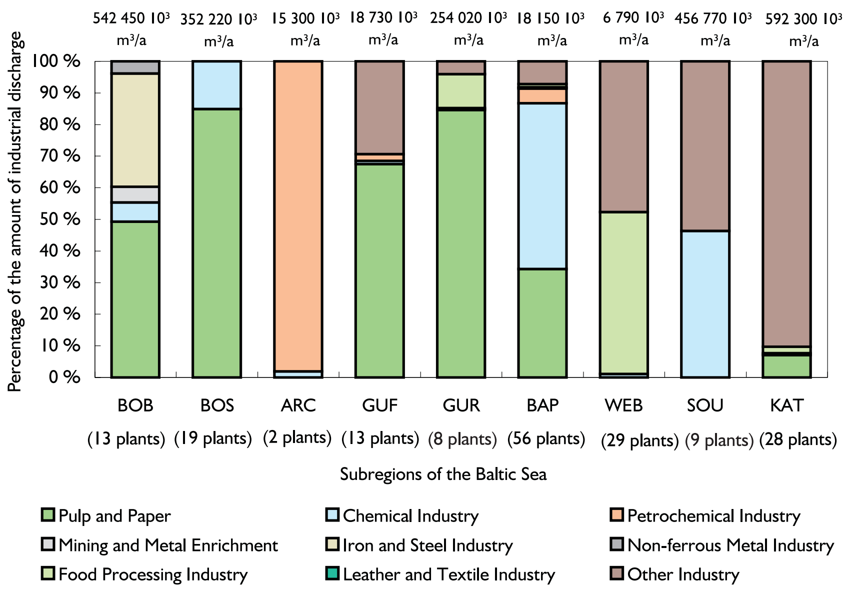


Figure 5.17: Distribution of treated direct industrial discharge by branch of industry and by subregion into the Baltic Sea in 1995

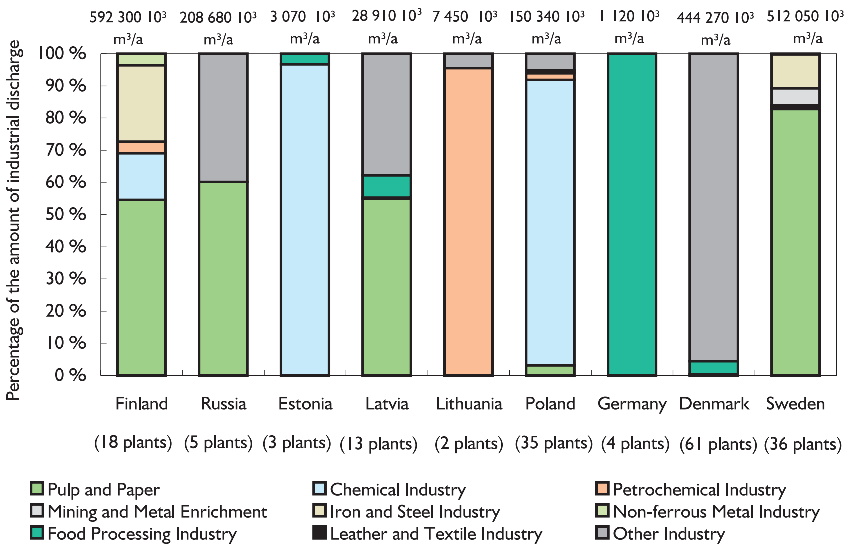


Figure 5.18: Distribution of treated direct industrial discharge by branch of industry and by Contracting Party into the Baltic Sea in 1995

from the food industry, 18 million m^3/a, were discharged from 27 Danish plants. The **leather and textile industry** is the branch producing the smallest amount of wastewater, 0.3 million m^3/a, which was discharged from one Russian plant into the Gulf of Finland.

5.2 Organic matter load going into the Baltic Sea

Organic matter is one of the concerns of the marine environment. Monitoring of oxygen depletion in waterbodies started already in the 1920s. Lack of oxygen is in some areas a problem for the open sea, especially in bottom layers in deep parts of the sea as well as in some coastal zones.

According to the PLC-3-Guidelines the organic matter load is measured as BOD_7, COD_{Mn}, COD_{Cr} or as TOC. In the following, however, only the results for BOD_7 are given, due to the fact that this parameter was measured in nearly all Contracting Parties for most pollution sources. In Finnish and Swedish rivers the BOD_7 load was calculated on the basis of TOC. In Denmark the BOD_7 load was calculated on the basis of the BOD_5. By that, it is possible to give an overview about the BOD_7 load by subregion and by Contracting Party.

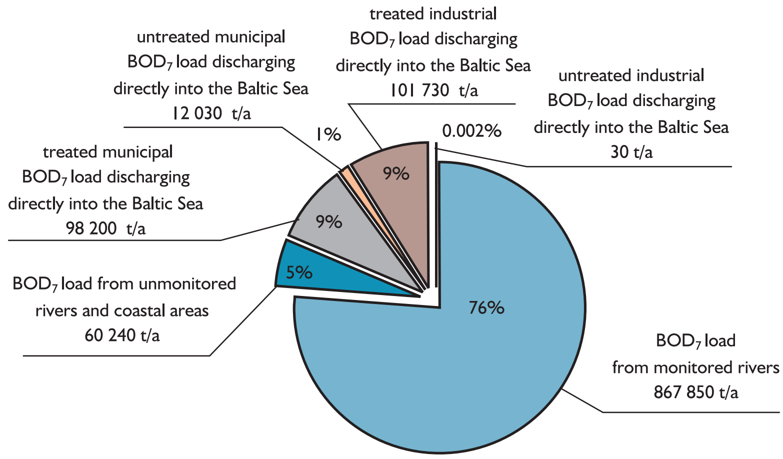
In 1995 the total BOD_7 load going into the Baltic Sea amounted to 1 140 080 t. The distribution of riverine and direct point source BOD_7 load is given in Figure 5.19. The major part of organic matter load, 80%, entered the Baltic Sea via rivers and coastal areas, of which 76% was via monitored rivers and 5% via unmonitored rivers and coastal areas. The BOD_7 load from municipalities and industrial plants discharging treated wastewater directly into the Baltic Sea is 9% in each case. The share of BOD_7 load from these pollution sources is considerably higher than the share of the amount of wastewater (approximately 0.3% in each case; see chapter 5.1 and Figure 5.1). The share of untreated municipal BOD_7 load was quite low, only 1%, but it should be noted that the untreated portion of the load from the Russian Kaliningrad region discharging directly into the Baltic Proper is missing. The share of untreated direct industrial BOD_7 load was also quite low, 0.002%. However, the actual industrial load should be higher due to the fact that in some countries (for instance Russia and Estonia) the main industries are connected to municipal wastewater treatment systems and were therefore not reported separately.

In Tables 5.3 and 5.4 the distribution of BOD_7 load for the 6 pollution source categories is given by subregion and by Contracting Party, respectively. Mostly the rivers are the dominant source of BOD_7 load. However, municipal and industrial BOD_7 load discharging directly into the Bothnian Sea, the Western Baltic and the Kattegat amounted to 30% in each case. In Denmark this share of BOD_7 load increased to 50%, but it should be noted that Danish figures for unmonitored rivers also included load from municipalities and industrial plants.

In 1995 up to 43% of the total BOD7 load was discharged into the Baltic Sea from the Baltic Proper catchment area. The main part of the BOD_7 load entered the Baltic Proper via the three largest rivers: the Vistula (164 620 t/a), the Oder (87 640 t/a) and the Nemunas (91 880 t/a). The BOD_7 load from these three rivers, running through the most densely populated parts of the Baltic Sea catchment area, comprised approximately 30% of the total BOD_7 load, but the corresponding runoff was only about 15% of the total riverine runoff. The second largest share of BOD_7 load, 237 350 t/a, entered the Baltic Sea from the Gulf of Finland catchment area, of which 125 900 t/a were discharged by the Neva and 45 000 t/a by direct municipal and industrial discharges from Saint Petersburg and the Leningrad region, which still contains some untreated wastewater.

The organic matter load from the rivers discharging into the northern part of the Baltic Sea (Bothnian Bay and Bothnian Sea) is mostly from natural areas with low impact from human activity caused by the high content of humic matter in these river waters (from forest, peat-soils etc.). In fact, the rivers discharging into the Bothnian Bay have BOD_7 concentrations below the detection limit, so that the BOD_7 load figures were calculated on the basis of measured TOC values.

The municipal BOD_7 load into the Bothnian Bay, the Bothnian Sea, the Archipelago Sea, the Western Baltic, the Sound and the Kattegat is low due to effective treatment of municipal wastewater in Finland, Sweden, Germany and Denmark, where the BOD_7 removal rate, as a rule, is higher than 90%. In



Total BOD_7 load: 1 140 080 t/a

Figure 5.19 Distribution of riverine and direct point source BOD_7 load into the Baltic Sea in 1995

Table 5.3 Riverine and direct point source BOD_7 load going into the Baltic Sea in 1995 by subregion

BOD_7		Load from monitored rivers	Load from unmonitored rivers and coastal areas	Treated municipal load discharging directly into the Baltic Sea	Untreated municipal load discharging directly into the Baltic Sea	Treated industrial load discharging directly into the Baltic Sea	Untreated indurstrial load discharging directly into the Baltic Sea	TOTAL BOD_7 LOAD	TOTAL DRAINAGE AREA	AREA SPECIFIC BOD LOAD
		in t/a	in t/a	in t/a	in t/a	in t/a	in t/a	in t/a	in km	in kg/km
	FI 1)	57 597	8 162	1 270	—	6 546	—	73 575	133 167	553
	SE 1)	32 052	4 664	1 245	—	8 060	—	46 021	118 710	388
BOB	**Sum**	**89 649**	**12 826**	**2 515**	**—**	**14 606**	**—**	**119 596**	**251 877**	**475**
	FI 1)	13 116	6 437	1 000	—	2 142	—	22 695	39 301	577
	SE 1)	57 470	6 262	603	—	41 060	—	105 395	170 088	620
BOS	**Sum**	**70 586**	**12 699**	**1 603**		**43 202**	**—**	**128 090**	**209 389**	**612**
	FI 1)	1 596	3 192	867	—	150	—	5 805	8 952	648
ARC	**Sum**	**1 596**	**3 192**	**867**	**—**	**150**	**—**	**5 805**	**8 952**	**648**
	FI 1)	15 422	2 723	1 577	—	3 685	—	23 407	49 703	471
	RU	125 896	*	44 876	*	257	*	171 029	287 641	595
	EE	39 298	2 530	1 022	6,5	54	—	42 910	67 357	637
GUF	**Sum**	**180 616**	**5 253**	**47 475**	**6,5**[2]	**3 996**		**237 346**	**404 701**	**586**
	EE	5 815	4 590	192	—	—	—	10 597	17 018	623
	LV	52 349	2 210	1 309	3 723	169	3,6	59 763	117 941	507
GUR	**Sum**	**58 164**	**6 800**	**1 501**	**3 723**	**169**	**3,6**	**70 360**	**134 959**	**521**
	EE	—	—	8	—	—	—	8	—	—
	LV	6 607	543	472	—	64	—	7 685	13 602	565
	LT	92 783	484	3 017	64	68	—	96 416	98 890	975
	RU	29 789	*	16 651	*	10 663	*	57 103	15 000	3 807
	PL	269 876	#	8 721	8 234	1 749	25	288 605	331 196	871
	DE	6 079	—	131	—	2,8	—	6 213	9 668	643
	DK 2)	87	453	1 282	—	144	—	1 966	1 206	1 631
	SE 1)	21 065	4 079	2 037	—	7 682	—	34 863	67 766	514
BAP	**Sum**	**426 286**	**5 559**	**32 319**	**8 298**	**20 372**	**25**	**492 860**	**537 328**	**917**
	DE	8 997	764	3 893	—	6	—	13 659	7 359	1 856
	DK 2)	3 292	5 102	1 072	—	6 838	—	16 304	12 342	1 321
WEB	**Sum**	**12 289**	**5 866**	**4 965**	**—**	**6 844**	**—**	**29 963**	**19 701**	**1 521**
	DK 2)	555	260	2 578	—	2 900	—	6 293	1 737	3 623
	SE 1)	36	662	714	—	—	—	1 412	2 409	586
SOU	**Sum**	**591**	**922**	**3 292**	**—**	**2 900**	**—**	**7 705**	**4 146**	**1 858**
	DK 2)	5 599	6 989	911	—	3 867	—	17 366	15 826	1 097
	SE 1)	22 474	139	2 749	—	5 625	—	30 987	67 435	460
KAT	**Sum**	**28 073**	**7 128**	**3 660**	**—**	**9 492**	**—**	**48 353**	**83 261**	**581**
Total Baltic Sea		**867 850**	**60 240**	**98 200**	**12 030**	**101 730**	**30**	**1 140 080**	**1 654 310**	**689**

– = nothing to report (this source does not exist)
* = data not available (should have been reported)
# = data not available, but not obligatory
data not complete

1) Riverine BOD_7 load in Finland and Sweden has been calculated from the TOC load using the coefficient 0.145.
2) Danish BOD_7 has been calculated from the BOD_5 using the coefficient 1.15.

Table 5.4 Riverine and direct point source BOD_7 load going into the Baltic Sea in 1995 by Contracting Party

BOD_7		Load from monitored rivers in t/a	Load from unmonitored rivers and coastal areas in t/a	Treated municipal load in t/a	Untreated municipal load in t/a	Treated industrial load in t/a	Untreated indurstrial load in t/a	TOTAL BOD_7 LOAD in t/a	TOTAL DRAINAGE AREA LOAD in km	AREA SPECIFIC BOD_7 in kg/km
				discharging directly into the Baltic Sea						
	BOB	57 597	8 162	1 270	—	6 546	—	73 575	133 167	553
	BOS	13 116	6 437	1 000	—	2 142	—	22 695	39 301	577
	ARC	1 596	3 192	867	—	150	—	5 805	8 952	648
	GUF	15 422	2 723	1 577	—	3 685	—	23 407	49 703	471
FINLAND 1)	**Sum**	**87 731**	**20 514**	**4 714**	**—**	**12 523**	**—**	**125 482**	**231 123**	**543**
	GUF	125 896	*	44 876	*	257	*	171 029	287 641	595
	BAP	29 789	*	16 651	*	10 663	*	57 103	15 000	3 807
RUSSIA	**Sum**	**155 685**		**61 527**		**10 920**		**228 132**	**302 641**	**754**
	GUF	39 298	2 530	1 022	6,5	54	—	42 910	67 357	637
	GUR	5 815	4 590	192	—	—	—	10 597	17 018	623
	BAP	—	—	7, 8	—	—	—	8	—	—
ESTONIA	**Sum**	**45 113**	**7 120**	**1 222**	**6,5**	**54**	**—**	**53 515**	**84 375**	**634**
	GUR	52 349	2 210	1 309	3 723	169	3,6	59 763	117 941	507
	BAP	6 607	543	472	—	64	—	7 685	13 602	565
LATVIA	**Sum**	**58 956**	**2 753**	**1 781**	**3 723**	**233**	**4**	**67 449**	**131 543**	**513**
	BAP	92 783	484	3 017	64	68	—	96 416	98 890	975
LITHUANIA	**Sum**	**92 783**	**484**	**3 017**	**64**	**68**		**96 416**	**98 890**	**975**
	BAP	269 876	#	8 721	8 234	1 749	25	288 605	331 196	871
POLAND	**Sum**	**269 876**		**8 721**	**8 234**	**1 749**	**25**	**288 605**	**331 196**	**871**
	BAP	6 079	—	131	—	2,8	—	6 213	9 668	643
	WEB	8 997	764	3 893	—	5,5	—	13 659	7 359	1 856
GERMANY	**Sum**	**15 076**	**764**	**4 024**	**—**	**8**	**—**	**19 872**	**17 027**	**1 167**
	BAP	87	453	1 282	—	144	—	1 966	1 206	1 631
	WEB	3 292	5 102	1 072	—	6 838	—	16 304	12 342	1 321
	SOU	555	260	2 578	—	2 900	—	6 293	1 737	3 623
	KAT	5 599	6 989	911	—	3 867	—	17 366	15 826	1 097
DENMARK)	**Sum**	**9 533**	**12 804**	**5 843**	**—**	**13 749**	**—**	**41 929**	**31 110**	**1 348**
	BOB	32 052	4 664	1 245	—	8 060	—	46 021	118 710	388
	BOS	57 470	6 262	603	—	41 060	—	105 395	170 088	620
	BAP	21 065	4 079	2 037	—	7 682	—	34 863	67 766	514
	SOU	36	662	714	—	—	—	1 412	2 409	586
	KAT	22 474	139	2 749	—	5 625	—	30 987	67 435	460
SWEDEN 1)	**Sum**	**133 097**	**15 806**	**7 348**	**—**	**62 427**	**—**	**218 679**	**426 408**	**513**
Total Baltic Sea		**867 850**	**60 240**	**98 200**	**12 030**	**101 730**	**30**	**1 140 080**	**1 641 810**	**694**

– = nothing to report (this source does not exist)
* = data not available (should have been reported)
# = data not available, but not obligatory
data not complete

1) Riverine BOD_7 load in Finland and Sweden has been calculated from the TOC load using the coefficient 0.145.
2) Danish BOD_7 is has been calculated from the BOD_5 using the coefficient 1.15.

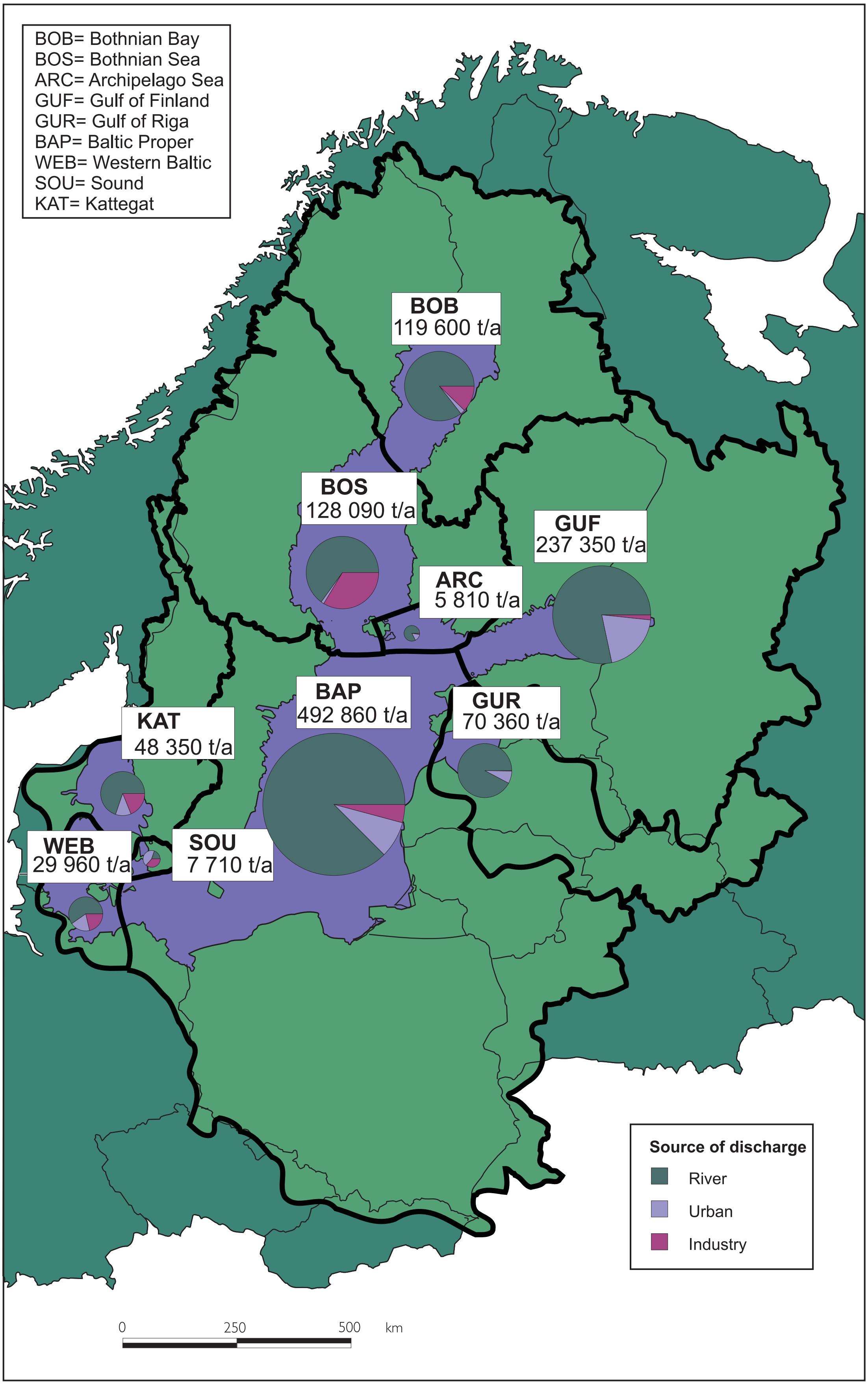


Figure 5.20 BOD_7 load going into the Baltic Sea in 1995 by subregion

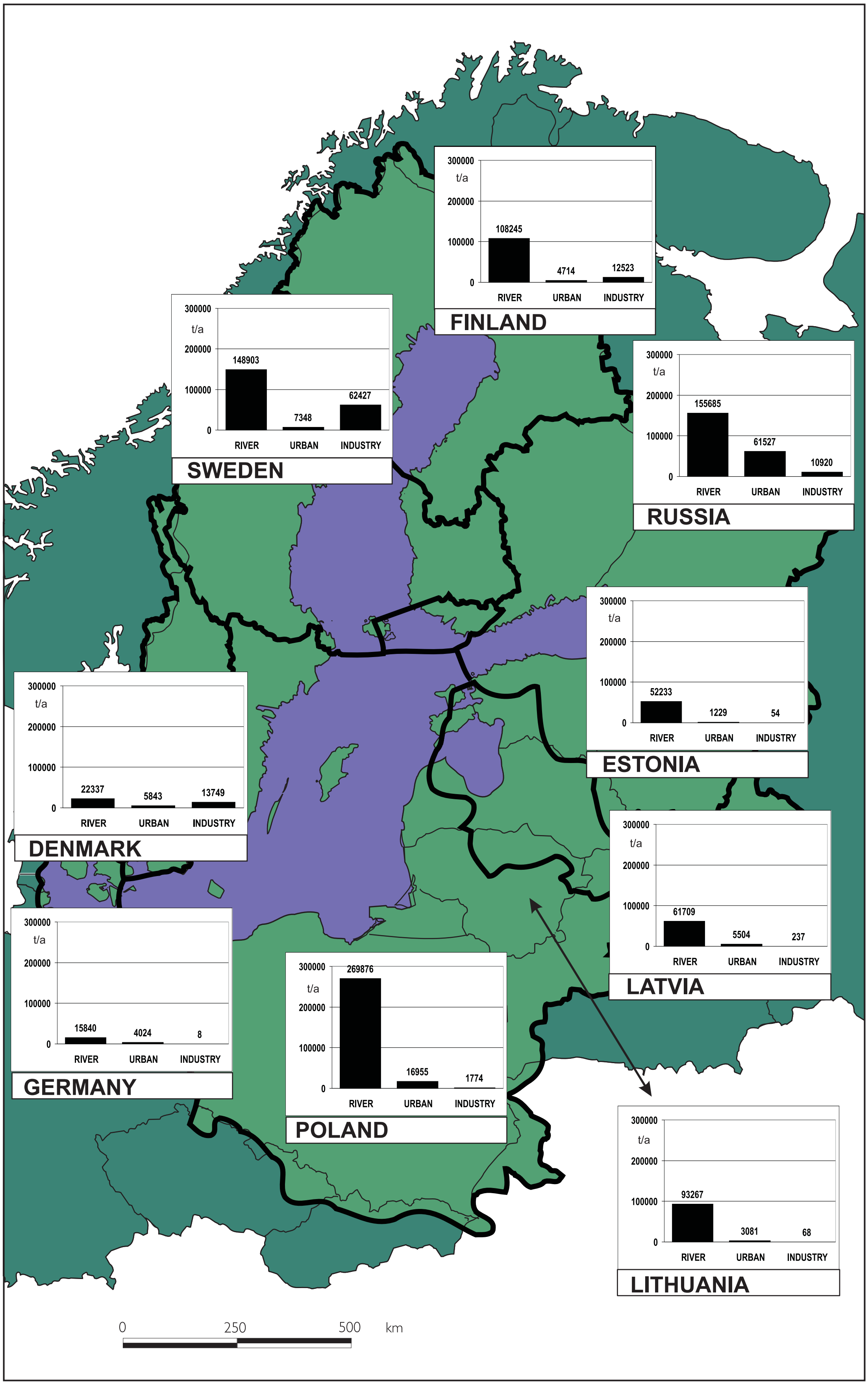


Figure 5.21 BOD_7 load going into the Baltic Sea in 1995 by Contracting Party

addition to Saint Petersburg and the Leningrad region high amounts of municipal BOD_7 load entered the Baltic Sea from the large cities in countries in transition on the coast of the Baltic Proper subregion, where the efficiency of wastewater treatment is not optimal.

Only in the case of the Bothnian Sea the industrial organic matter load is higher than the municipal organic matter load. The main industries discharging into that area are pulp and paper mills. The highest amount of organic matter load (BOD and COD) into the Bothnian Bay, the Bothnian Sea and the Gulf of Finland by industry also originated from the pulp and paper branch, mainly from Sweden and Finland. In Finland all the plants have biologically activated sludge removal treatment systems, but in Sweden some plants still rely on mechanical wastewater treatment methods.

5.3 Nutrient load going into the Baltic Sea

The main problem of the Baltic Sea Area is the nutrient load. Since the turn of the century, the Baltic Sea has changed from an oligotrophic clear-water sea into a highly eutrophic one (LARSON, 1985). The state of the Baltic Sea is alarming in many of its subregions: these regions have become overloaded with nutrients. Nitrogen and phosphorus as such do not pose any direct hazards to marine organisms or people. Excessive nutrient inputs may disturb the balance of the ecosystem. Excessive primary production, caused by high concentrations of phosphorus and nitrogen, has caused algae blooms, especially of the blue-green variety, to proliferate in the Baltic Sea. The abundance of toxic algae populations has even increased.

5.3.1 Nitrogen load going into the Baltic Sea

In 1995 the total waterborne N_{total} input into the Baltic Sea amounted to 760 750 t. The distribution of this load among the different pollution source-categories is given in Figure 5.22. The major part of N_{total} load, 90%, entered the Baltic Sea via rivers, 76% coming via monitored rivers and 14% via unmonitored rivers and coastal areas. The treated municipal and industrial share of N_{total} load discharging directly into the Baltic Sea comprised 8% and 2%, respectively. The portion of untreated municipal and industrial N_{total} load discharging directly into the Baltic Sea is quite low, only 0.3% and 0.2%, respectively. The calculations in PLC-3 can be considered more reliable and precise than calculations in PLC-1 and PLC-2, but still many uncertainties remain due to incomplete data sets especially from the Russian Baltic Sea catchment area, e.g. from the Kaliningrad region (see Tables 5.5 and 5.6).

In Tables 5.5 and 5.6 the N_{total} load distribution among the 6 pollution source categories is given by subregion and by Contracting Party. The part of direct municipal and industrial nitrogen inputs into all the Baltic Sea subregions is quite low: less than 20%. Into most of the subregions' direct municipal nitrogen inputs are of much greater importance than the corresponding industrial inputs. The only subregion, to which industrial nitrogen inputs exceeded the municipal nitrogen inputs is the Bothnian Bay, where the industrial nitrogen load originated primarily from the pulp and paper industry in the coastal areas of Finland and Sweden.

In 1995 up to 42% of the N_{total} load was discharged into the Baltic Sea from the Baltic Proper catchment area. The major part of this load entered the Baltic Proper via the three largest rivers: the Vistula (112 800 t/a), the Oder (76 970 t/a) and the Nemunas (34 190 t/a). The nitrogen load from these three rivers comprised approximately 30% of the total N_{total} load, but the corresponding runoff was only about 15% of the total riverine runoff. The second largest share of Ntotal load, 132 900 t/a (17%), entered the Baltic Sea from the Gulf of Finland catchment area, of which 54 170 t/a and 24 950 t/a being discharged by the Neva and the Narva, respectively. The riverine nitrogen inputs into all other subregions are lower. The Gulf of Finland (25 390 t/a) and the Baltic Proper subregions (15 600 t/a) also received the highest amounts of N_{total} load from urban areas. Especially the municipal discharges from Saint Petersburg and the Leningrad region into the Gulf of Finland constituted the main part of the N_{total} load, 19 680 t/a. 1 784 t/a of the untreated municipal effluents were discharged directly into the Baltic Sea from Poland. The main treated industrial nitrogen discharges are going into the Gulf of Finland (26%), the Baltic Proper (18%) and the Bothnian Sea subregions (17%). Nearly all the untreated industrial effluents, 1 570 t/a, were discharged from Estonian industry directly into the Gulf of Finland.

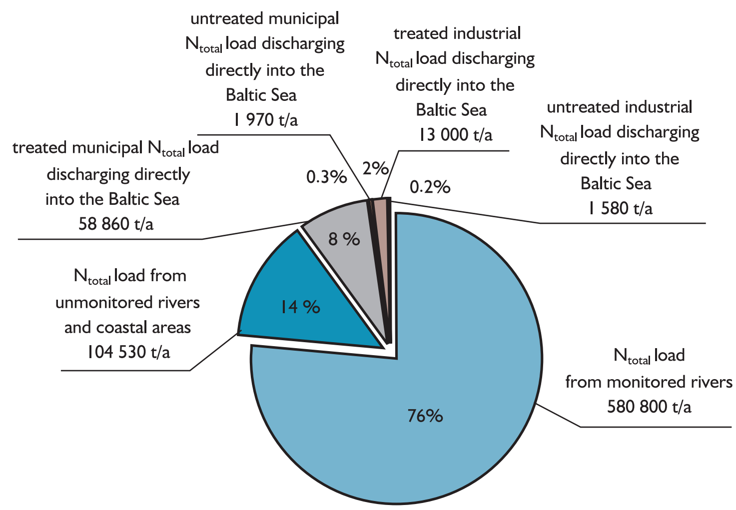


Figure 5.22 Distribution of riverine and direct point source N_{total} load going into the Baltic Sea in 1995

Table 5.5 Riverine and direct point source N_{total} load going into the Baltic Sea in 1995 by subregion

N_{total}		Load from monitored rivers in t/a	Load from unmonitored rivers and coastal areas in t/a	Treated municipal load (discharging directly into the Baltic Sea) in t/a	Untreated municipal load (discharging directly into the Baltic Sea) in t/a	Treated industrial load (discharging directly into the Baltic Sea) in t/a	Untreated indurstrial load (discharging directly into the Baltic Sea) in t/a	TOTAL N_{total} LOAD in t/a	TOTAL DRAINAGE AREA in km	AREA SPECIFIC N_{total} LOAD in kg/km
	FI	21 268	3 975	1 165	—	1 193	—	27 601	133 167	207
	SE	14 088	2 202	742	—	315	—	17 347	118 710	146
BOB	**Sum**	**35 356**	**6 177**	**1 907**	**—**	**1 508**	**—**	**44 948**	**251 877**	**178**
	FI	9 914	4 266	638	—	497	—	15 315	39 301	390
	SE	24 851	3 608	1 303	—	1 764	—	31 526	170 088	185
BOS	**Sum**	**34 765**	**7 874**	**1 941**	**—**	**2 261**	**—**	**46 841**	**209 389**	**224**
	FI	1 699	3 398	1 157	—	763	—	7 017	8 952	784
ARC	**Sum**	**1 699**	**3 398**	**1 157**	**—**	**763**	**—**	**7 017**	**8 952**	**784**
	FI	10 395	1 174	4 136	—	435	—	16 140	49 703	325
	RU	54 172	2 916	19 676	*	2 916	*	79 680	287 641	277
	EE	30 534	3 400	1 575	2,3	*	1 568	37 079	67 357	550
GUF	**Sum**	**95 101**	**7 490**	**25 387**	**2,3**	**3 351**	**1 568**	**132 899**	**404 701**	**328**
	EE	5 180	4 090	106	—	—	—	9 376	17 018	551
	LV	69 673	6 247	733	410	153	2,0	77 218	117 941	655
GUR	**Sum**	**74 853**	**10 337**	**839**	**410**	**153**	**2**	**86 594**	**134 959**	642
	EE	—	—	4,2	—	—	8,6	13	—	—
	LV	11 138	2 360	237	—	112	—	13 847	13 602	1 018
	LT	35 140	491	891	4,8	296	—	36 824	98 890	372
	RU	3 100	*	1 376	*	491	*	4 967	15 000	331
	PL	204 676	3 448	4296	1556	769	1,6	214 747	331 196	648
	DE	6 530	—	370	—	4,7	—	6 905	9 668	714
	DK	378	1 872	234	—	18	—	2 502	1 206	2 075
	SE	15 838	13 317	6 583	—	683	—	36 421	67 766	537
BAP	**Sum**	**276 799**	**21 488**	**13 991**	**1 561**	**2 374**	**10**	**316 223**	**537 328**	**589**
	DE	9 504	730	4 189	—	43	—	14 466	7 359	1 966
	DK	11 065	14 285	988	—	760	—	27 098	12 342	2 196
WEB	**Sum**	**20 569**	**15 015**	**5 177**	**—**	**803**	**—**	**41 565**	**19 701**	**2 110**
	DK	734	1 116	3 371	—	754	—	5 975	1 737	3 439
	SE	554	4 982	1 362	—	200	—	7 098	2 409	2 946
SOU	**Sum**	**1 288**	**6 098**	**4 733**	**—**	**954**	**—**	**13 072**	**4 146**	3 153
	DK	11 575	20 125	747	—	658	—	33 105	15 826	2 092
	SE	28 799	6 531	2 981	—	171	—	38 482	67 435	571
KAT	**Sum**	**40 374**	**26 656**	**3 728**	**—**	**829**	**—**	**71 587**	**83 261**	**860**
Total Baltic Sea		**580 800**	**104 530**	**58 860**	**1 970**	**13 000**	**1 580**	**760 740**	**1 654 340**	**460**

– = nothing to report (this source does not exist)
* = data not available (should have been reported)
# = data not available, but not obligatory
data not complete

Table 5.6 Riverine and direct point source Nitrogen load going into the Baltic Sea in 1995 by Contracting Party

Nitrogen		Load from monitored rivers	Load from unmonitored rivers and coastal areas	Treated municipal load	Untreated municipal load	Treated industrial load	Untreated indurstrial load	TOTAL LOAD	T OTAL DRAINAGE AREA	AREA SPECIFIC N_{total} LOAD
				discharging directly into the Baltic Sea						
		in t/a	in t/a	in t/a	in t/a	in t/a	in t/a	in t/a	in km	in kg/km
	N_{NH4}	2 907	1 234	#	—	#	—	4 141		
	N_{NO2}	#	#	#	—	#	—			
	N_{NO3}	16 313	8 225	#	—	#	—	24 538		
FINLAND	$\mathbf{N_{total}}$	**43 276**	**12 813**	**7 096**	**—**	**2 888**	**—**	**66 073**	**231 123**	**286**
	N_{NH4}	6 451	1 226	8 669	9 982	723	#	27 050		
	N_{NO2}	#	35	#	12	11	#	58		
	N_{NO3}	#	957	#	682	650	#	2 289		
RUSSIA	$\mathbf{N_{total}}$	**57 272**	**2 916**	**21 052**	*	**3 407**	*	**84 647**	**302 641**	**280**
	N_{NH4}	601	178	#	#	#	#	779		
	N_{NO2}	193	29	#	#	#	#	222		
	N_{NO3}	8 810	4 310	#	#	#	#	13 120		
ESTONIA	$\mathbf{N_{total}}$	**35 714**	**7 490**	**1 685**	**2,3**	*	**1 577**	**46 468**	**84 375**	**551**
	N_{NH4}	3 833	185	247	0,3	61	#	4 326		
	N_{NO2}	332	15	1	#	5	#	353		
	N_{NO3}	42 590	2 105	31	0,1	234	#	44 960		
LATVIA	$\mathbf{N_{total}}$	**80 811**	**8 607**	**970**	**410**	**265**	**2,0**	**91 064**	**131 543**	**692**
	N_{NH4}	3 984	38	640	#	105	#	4 767		
	N_{NO2}	128	1,6	2,1	#	3,9	#	136		
	N_{NO3}	19 961	207	32	#	38	#	20 237		
LITHUANIA	$\mathbf{N_{total}}$	**35 140**	**491**	**891**	**4,8**	**296**	**—**	**36 824**	**98 890**	**372**
	N_{NH4}	12 368	#	2 533	0,1	#	#	14 901		
	N_{NO2}	987	#	17	#	#	#	1 004		
	N_{NO3}	119 474	#	47	#	#	#	119 521		
POLAND	$\mathbf{N_{total}}$	**204 676**	**3 448**	**4 296**	**1 556**	**769**	**1,6**	**214 747**	**331 196**	**648**
	N_{NH4}	1 161	45	3 442	—	1,7	—	4 650		
	N_{NO2}	181	7,9	41	—	0,6	—	231		
	N_{NO3}	12 737	642	506	—	38	—	13 924		
GERMANY	$\mathbf{N_{total}}$	**16 034**	**730**	**4 559**	**—**	**48**	**—**	**21 371**	**17 027**	**1 255**
	N_{NH4}	397	832	#	—	#	—	1 229		
	N_{NO2}	#	#	#	—	#	—			
	N_{NO3}	18 620	29 767	#	—	#	—	48 387		
DENMARK	$\mathbf{N_{total}}$	**23 752**	**37 398**	**5 340**	**—**	**2 190**	**—**	**68 680**	**31 110**	**2 208**
	N_{NH4}	3 288	423	#	—	201	—	3 912		
	N_{NO2}	892	156	#	—	1,3	—	1 049		
	N_{NO3}	31 974	9 153	#	—	1,7	—	41 128		
SWEDEN	$\mathbf{N_{total}}$	**84 129**	**30 640**	**12 970**	**—**	**3 133**	**—**	**130 872**	**426 408**	**307**
Total Baltic Sea $\mathbf{N_{total}}$		**580 800**	**104 530**	**58 860**	**1 970**	**13 000**	**1 580**	**760 740**	**1 654 310**	**460**

– = nothing to report (this source does not exist)
* = data not available (should have been reported)
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data not complete

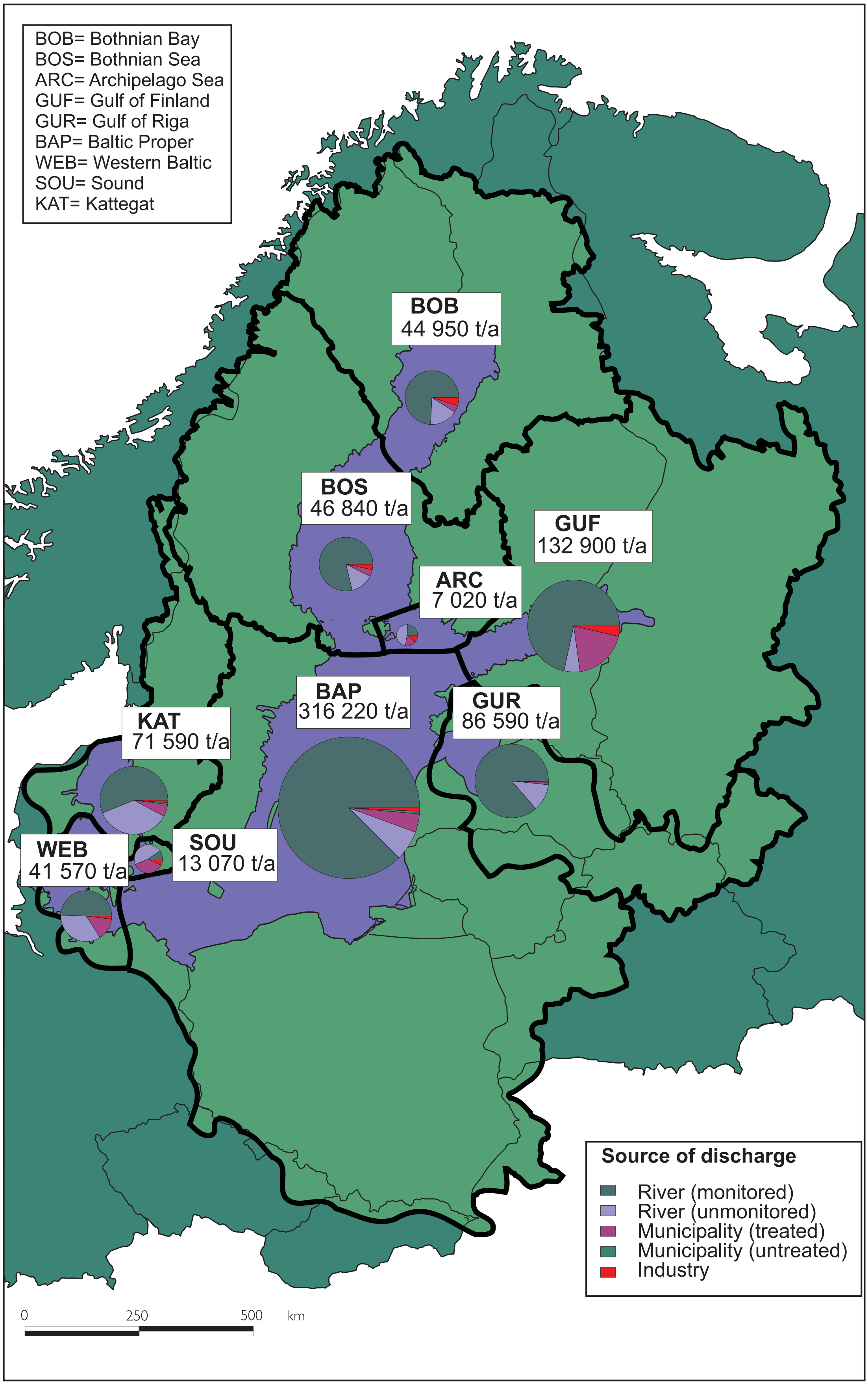

Figure 5.23 N_{total} load going into the Baltic Sea in 1995 by subregion

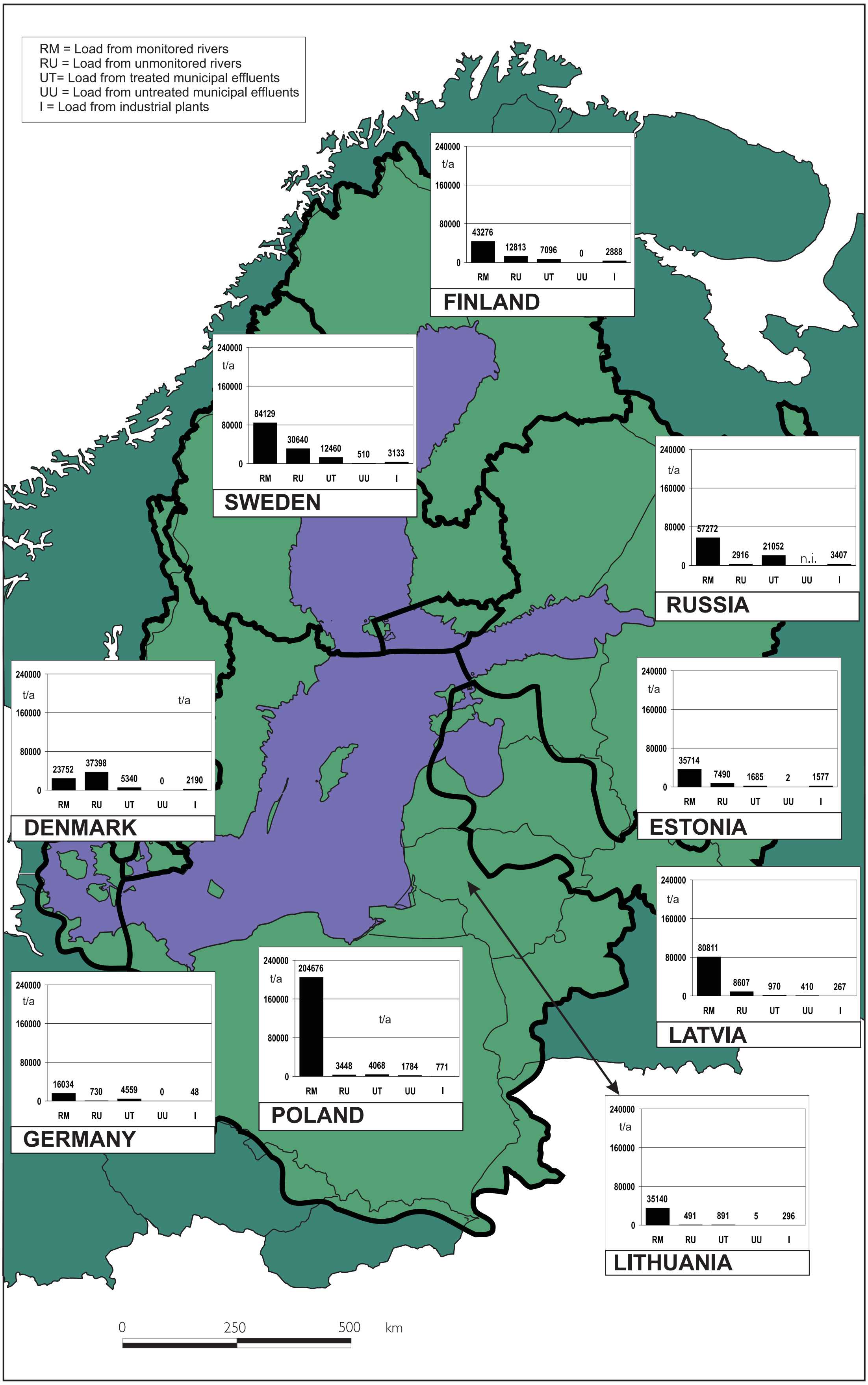

Figure 5.24 N_{total} load going into the Baltic Sea in 1995 by Contracting Party

5.3.2 Phosphorus load going into the Baltic Sea

In 1995 the total waterborne P_{total} load going into the Baltic Sea amounted to 37 650 t. The distribution of this load among the different pollution source categories is given in Figure 5.25. The major part of P_{total} load, 81%, entered the Baltic Sea via rivers, 72% via monitored rivers and 9% via unmonitored rivers and coastal areas. The treated municipal and industrial share of P_{total} load discharging directly into the Baltic Sea comprised 13% and 5%, respectively. The portion of the untreated municipal and industrial P^{total} load discharging directly into the Baltic Sea is quite low, only 0.1% and 0.02%, respectively. The calculations in PLC-3 can be considered more reliable and precise than calculations in the two previous load compilations, but still many uncertainties remain due to incomplete data sets especially from the Russian Baltic Sea catchment area, e.g. from the Kaliningrad region (see Tables 5.7 and 5.8).

In Tables 5.7 and 5.8 the P_{total} load is distributed among the 6 pollution source categories and given by subregion and by Contracting Party, respectively. The portion of direct municipal and industrial phosphorus inputs from all the subregions going directly into the Baltic Sea is quite low: less than 20%. Only in Denmark the treated municipal and industrial discharges going directly into the Baltic Sea were equal in quantity to the riverine inputs. In the Sound, however, direct municipal and industrial phosphorus load constituted 72% of the total phosphorus load. In most of the subregions, municipal phosphorus inputs discharging directly into the Baltic Sea are of much greater importance than the corresponding industrial inputs. However, into the Bothnian Bay, the Bothnian Sea and the Archipelago Sea the direct industrial phosphorus inputs were more than triple the direct municipal phosphorus inputs. These industrial phosphorus inputs came primarily from the pulp and paper industry in the coastal areas of Finland and Sweden. In addition, in the Archipelago Sea, the intensive fish farming contributed 18% of the total industrial phosphorus load into that subregion.

In 1995 up to 47% of the total P_{total} load entered the Baltic Sea from the Baltic Proper catchment area. The main part of this load was discharged into the Baltic Sea via the three largest rivers, the Vistula (7 320 t/a), the Oder (4 920 t/a) and the Nemunas (1 230 t/a). These three rivers together contributed approximately 36% of the P_{total} load, while total runoff from these three rivers constituted about 15% of the total riverine runoff. The second largest share of P_{total} load entered the Baltic Sea from the Gulf of Finland catchment area, 22% or 8 160 t/a, of which 2 800 t/a and 670 t/a were discharged by the Neva and the Narva, respectively. The riverine phosphorus load into the Archipelago Sea, the Western Baltic, the Sound and the Kattegat was considerably lower. The Gulf of Finland (2 610 t/a) also received the highest amount of P_{total} load from urban areas, of which direct municipal discharge from Saint Petersburg and the Leningrad region made up the largest share, 2 440 t/a. 74% of all untreated municipal effluents (290 t/a) was discharged directly into the Baltic Sea by Polish municipalities. Most of the treated industrial phosphorus load was discharged into the Gulf of Finland (41%), the Baltic Proper (21%) and the Bothnian Sea subregions (13%), and originated from Russia (45%), Sweden (17%) and Finland (14%). Only Estonia, Latvia and Poland discharged un-treated industrial phosphorus load directly into the Baltic Sea but it was negligible compared to the inputs from all other pollution source categories.

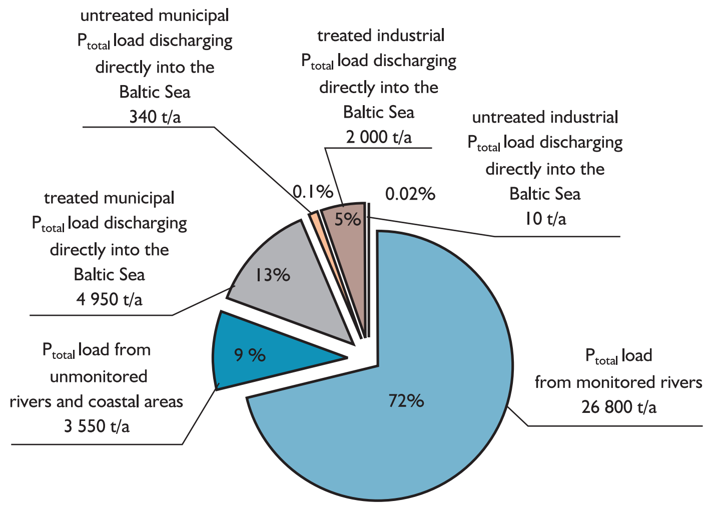

Figure 5.25 Distribution of riverine and direct point source P_{total} load going into the Baltic Sea in 1995

Table 5.7 Riverine and direct point source P_{total} load going into the Baltic Sea in 1995 by subregion

P_{total}		Load from monitored rivers in t/a	Load from unmonitored rivers and coastal areas in t/a	Treated municipal load (discharging directly into the Baltic Sea) in t/a	Untreated municipal load (discharging directly into the Baltic Sea) in t/a	Treated industrial load (discharging directly into the Baltic Sea) in t/a	Untreated indurstrial load (discharging directly into the Baltic Sea) in t/a	TOTAL P_{total} LOAD in t/a	TOTAL DRAINAGE AREA in km	AREA SPECI FIC P_{total} LOAD in kg/km
	FI	1 316	270	13	—	91	—	1 690	133 167	13
	SE	1 012	118	18	—	34	—	1 182	118 710	10
BOB	**Sum**	**2 328**	**388**	**32**	**—**	**125**	**—**	**2 872**	**251 877**	**11**
	FI	475	206	18	—	54	—	753	39 301	19
	SE	1 114	150	22	—	217	—	1 503	170 088	9
BOS	**Sum**	**1 589**	**356**	**40**	**—**	**271**	**—**	**2 256**	**209 389**	**11**
	FI	123	246	26	—	91	—	486	8 952	54
ARC	**Sum**	**123**	**246**	**26**	**—**	**91**	**—**	**486**	**8 952**	**54**
	FI	410	113	55	—	54	—	632	49 703	13
	RU	2 803	507	2 442	*	747	*	6 499	287 641	23
	EE	808	85	115	0,8	20	1,7	1 030	67 357	15
GUF	**Sum**	**4 021**	**705**	**2 612**	**0,8**	**821**	**1,7**	**8 161**	**404 701**	**20**
	EE	134	106	18	—	—	—	258	17 018	15
	LV	1 390	182	219	89	26	0,3	1 906	117 941	16
GUR	**Sum**	**1 524**	**288**	**237**	**89**	**26**	**0,3**	**2 165**	**134 959**	**16**
	EE	—	—	1,2	—	—	1,1	2	—	—
	LV	165	67	26	—	20	—	277	13 602	20
	LT	1 253	17	107	12	16	—	1 405	98 890	14
	RU	260	*	193	*	156	*	609	15 000	41
	PL	13 206	67	523	244	162	6,2	14 208	331 196	43
	DE	179	—	17	—	0,4	—	197	9 668	20
	DK	10	29	47	—	3,0	—	89	1 206	74
	SE	560	293	89	—	69	—	1 011	67 766	15
BAP	**Sum**	**15 633**	**473**	**1 004**	**256**	**427**	**7,3**	**17 799**	**537 328**	**33**
	DE	273	27	79	—	3,4	—	382	7 359	52
	DK	272	348	136	—	72	—	828	12 342	67
WEB	**Sum**	**545**	**375**	**215**	**—**	**75**	**—**	**1 210**	**19 701**	**61**
	DK	33	117	547	—	68	—	765	1 737	441
	SE	6,5	103	31	—	5,2	—	145	2 409	60
SOU	**Sum**	**40**	**220**	**578**	**—**	**73**	**—**	**911**	**4 146**	**220**
	DK	345	405	85	—	80	—	915	15 826	58
	SE	650	94	119	—	13	—	876	67 435	13
KAT	**Sum**	**995**	**499**	**204**	**—**	**93**	**—**	**1 791**	**83 261**	**22**
Total Baltic Sea: P_{total}		**26 800**	**3 550**	**4 950**	**340**	**2 000**	**10**	**37 650**	**1 654 310**	**23**

– = nothing to report (this source does not exist)
* = data not available (should have been reported)
# = data not available, but not obligatorY
data not complete

Table 5.8 Riverine and direct point source phosphorus load going into the Baltic Sea in 1995 by Contracting Party

Phosphorus		Load from monitored rivers in t/a	Load from unmonitored rivers and coastal areas in t/a	Treated municipal load in t/a	Untreated municipal load in t/a	Treated industrial load in t/a	Untreated indurstrial load in t/a	TOTAL LOAD in t/a	TOTAL DRAINAGE AREA in km	AREA SPECIFIC P_{total} LOAD in kg/km
				discharging directly into the Balrtic Sea						
FINLAND	P_{PO4}	1 068	463	#	—	#	—	1 531		
	P_{total}	2 324	835	112	—	290	—	3 561	231 123	15
RUSSIA	P_{PO4}	905	#	#	#	#	#	905		
	P_{total}	3 063	507	2 635	*	903	*	7 108	302 641	23
ESTONIA	P_{PO4}	547	109	#	#	#	—	656		
	P_{total}	942	191	134	0,8	20	2,8	1 291	84 375	15
LATVIA	P_{PO4}	1 188	55	#	#	20	#	1 263		
	P_{total}	1 555	249	244	89	46	0,3	2 184	131 543	17
LITHUANIA	P_{PO4}	1 070	16	63	#	13	—	1 162		
	P_{total}	1 253	17	107	12	16	—	1 405	98 890	14
POLAND	P_{PO4}	6 330	#	64	#	#	#	6 394		
	P_{total}	13 206	67	523	244	162	6,2	14 208	331 196	43
GERMANY	P_{PO4}	204	14	45	—	3,3	—	265		
	P_{total}	452	27	96	—	3,8	—	579	17 027	34
DENMARK	P_{PO4}	271	312	#	—	#	—	583		
	P_{total}	661	899	815	—	223	—	2 598	31 110	83
SWEDEN	P_{PO4}	813	137	#	—	#	—	950		
	P_{total}	3 343	758	279	—	338	—	4 718	426 408	11
Total BalticSea: P_{total}		**26 800**	**3 550**	**4 950**	**340**	**2 000**	**10**	**37 650**	**1 654 310**	**23**

– = nothing to report (this source does not exist)
* = data not available (should have been reported)
# = data not available, but not obligatory
data not complete

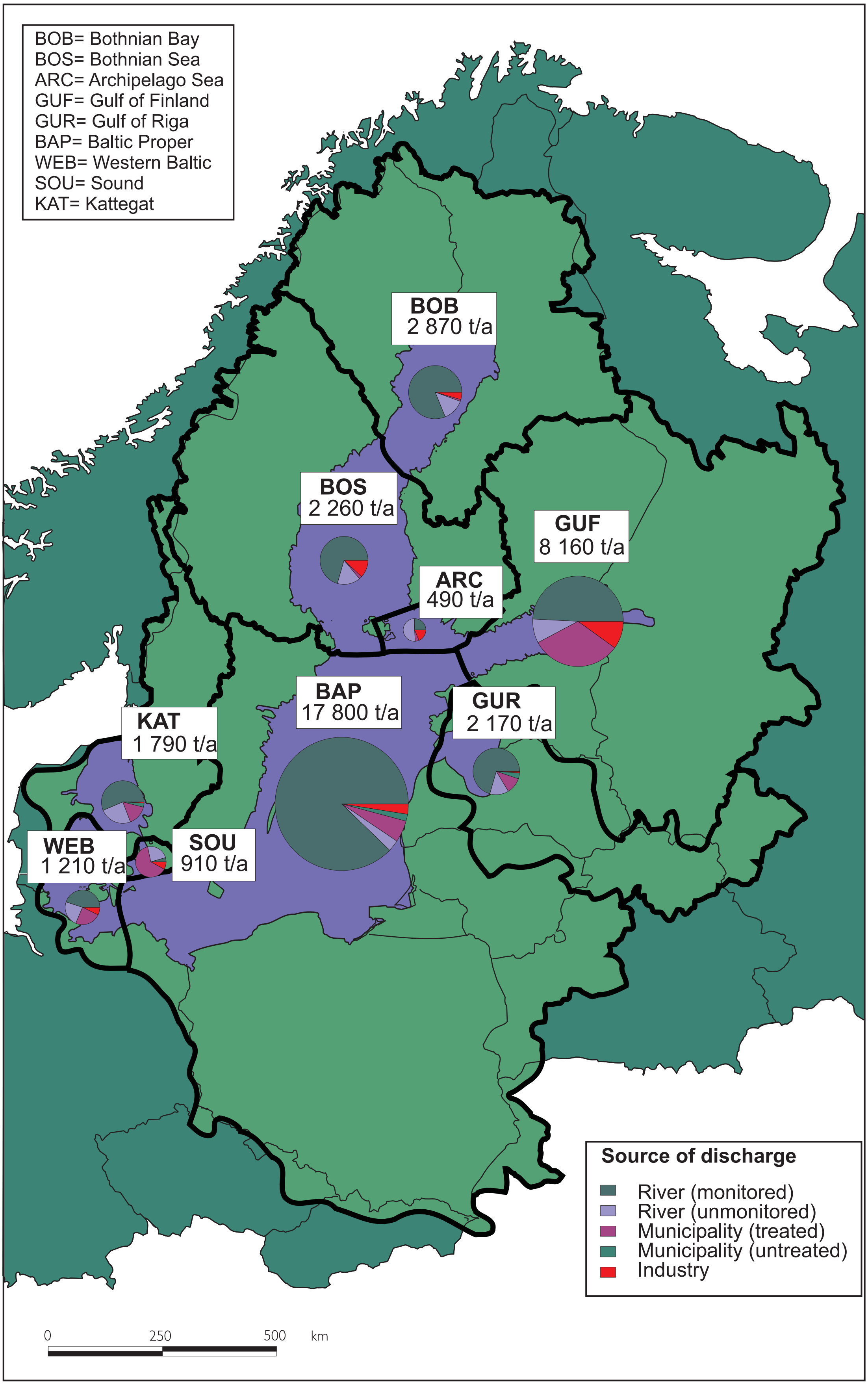

Figure 5.26 P_{total} load going into the Baltic Sea in 1995 by subregion

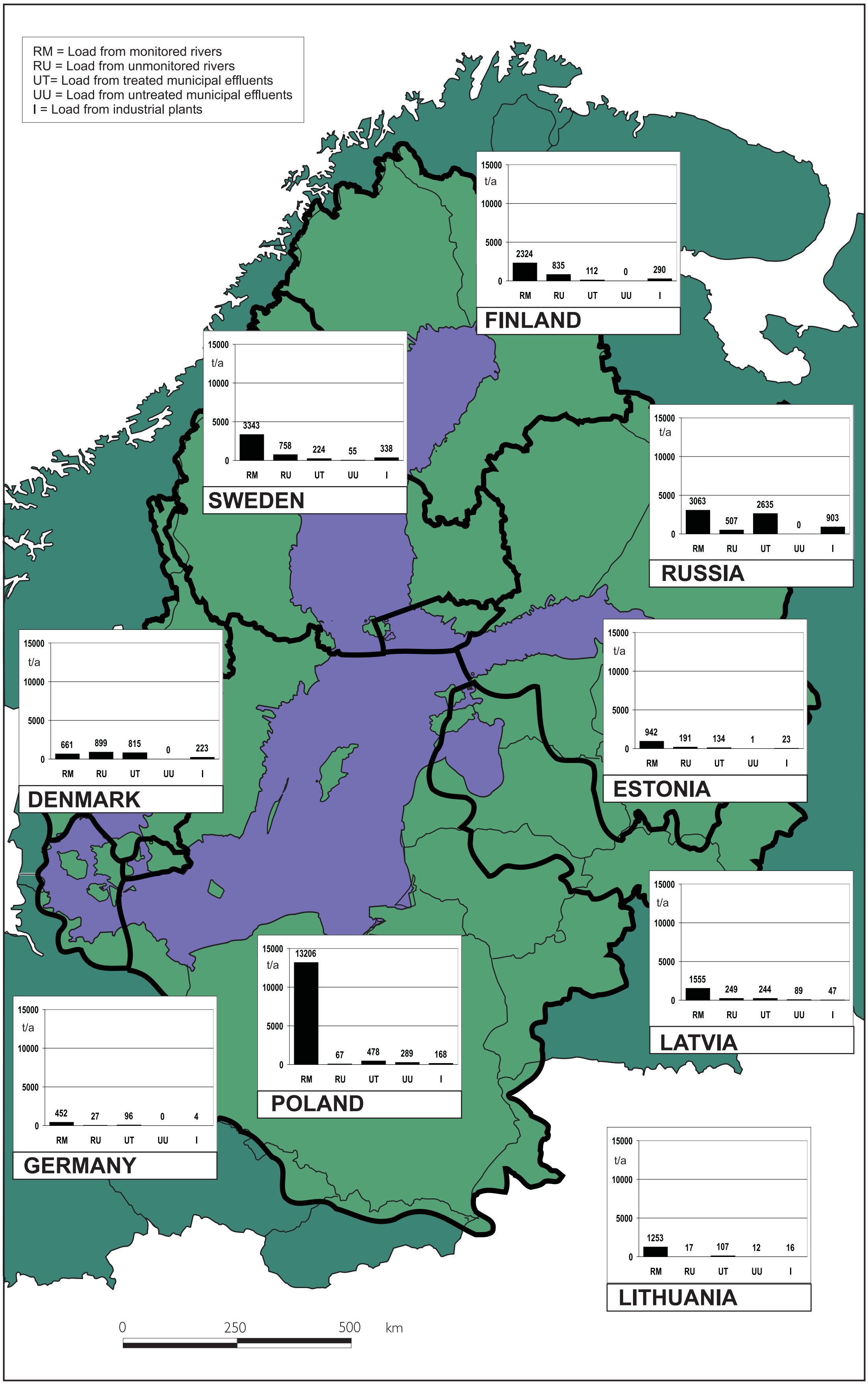

Figure 5.27 P_{total} load going into the Baltic Sea in 1995 by Contracting Party

5.3.3 Nutrient concentrations in monitored rivers

To present and compare concentrations in the monitored PLC-3 rivers they were divided into three groups according to their flow rate (Q) in 1995. The number of rivers in the Baltic Sea catchment area of each Contracting Party, in each of the three flow rate groups, is shown in Table 5.9:

a) small rivers: streams with flow rate ≤ 1 m^3/s
b) medium size rivers: rivers with flow rate between 5 and 50 m^3/s
c) large rivers: rivers with flow rate > 50 m^3/s.

Rivers belonging to the following 4 subregion groupings of the Baltic Sea were analysed:

A: BAP	(49 rivers)
B: BOB + BOS + ARC	(40 rivers)
C: GUF + GUR	(23 rivers)
D: WEB + KAT + SOU	(126 rivers)

Within each flow rate category in each of the four subregion groupings the monitored rivers were further grouped according to their flow-weighted nitrogen and phosphorus concentration, which was calculated by dividing the nitrogen or phosphorus load by the corresponding flow rate, respectively. Three categories of nitrogen concentrations and phosphorus concentrations were defined:

Nitrogen:
concentration lower than 1 mg/l N
concentration from 1 to 3 mg/l N
concentration higher than 3 mg/l N

Phosphorus:
concentration lower than 0.050 mg/l P
concentration from 0.050 to 0.150 mg/l P
concentration higher than 0.150 mg/l P

The result of grouping the flow-weighted nitrogen and phosphorus concentrations is shown in Figure 5.28. Nearly 95% of the rivers with a mean flow ≤ 5 m/s (e.g. small rivers) discharging into BAP (A) and more than 90% of rivers discharging to WEB+KAT+SOU (D) have flow-weighted nitrogen concentrations higher than 3 mg/l N (and up to 25 mg/l N). On the other hand, all small streams discharging into BOB+BOS+ARC (B) and 50% of the small rivers discharging into GUF+GUR (C) have flow-weighted nitrogen concentrations lower than 3 mg/l N. The large rivers (defined as rivers with mean flow > 50 m/s) have on average lower flow-weighted nitrogen concentrations than the small rivers in each of the four defined subregion groupings of the Baltic Sea. Only in subregion A (BAP) more than 50% of the large rivers have flow-weighted nitrogen concentrations higher than 3 mg/l N. For medium-sized rivers (those with mean flow ranging between 5 and 50 m/s) the distribution of flow-weighted nitrogen concentration is quite similar to that of the large rivers in the four subregion groupings of the Baltic Sea, except for subregion grouping D (WEB+KAT+SOU) where the distribution is comparable to that of the small rivers. Further, in the group of medium-sized rivers the widest range of flow-weighted nitrogen concentrations appears.

The distribution described for flow-weighted nitrogen concentrations in the three groups of rivers is also valid for the corresponding phosphorus concentrations (Figure 5.29). The group "small rivers" contains the greatest number of rivers with high flow-weighted phosphorus concentrations and the group "large rivers" has the greatest number of rivers with low flow-weighted phosphorus concentrations. Subregion groupings A (BAP) and D (WEB+KAT+SOU) have the highest number of rivers with high flow-weighted phosphorus concentrations, whereas more than 95% of the rivers have flow-weighted phosphorus concentrations higher than 0.050 mg/l P with maximum values of 0.600 mg/l P. In subregion groupin B(BOB+BOS+ARC) only 25% of the small rivers have flow-weighted phosphorus concentrations higher than 0.050 mg/l P. Only in subregion grouping A (BAP) there are large rivers with flow-weighted concentrations higher than 0.150 mg/l P (30%). In the other subregion groupings more than 60% of the large rivers have flow-weighted phosphorus concentrations lower than 0.050 mg/l P. The highest range of flow-weighted phosphorus concentrations occurs in the group of medium-sized rivers.

Large rivers generally contain a higher amount of groundwater leakage than small rivers, leading to lower concentrations in the former group. Nutrient concentration in many large rivers is also reduced by nutrient retention and turnover in lakes and in the rivers, in wet meadows and on periodically flooded riparian areas. Furthermore, these self-purification processes will reduce nutrient fluxes to the Baltic Sea significantly. These self-purification processes are markedly reduced where the rivers have been regulated by straightening or surrounded by dikes and where the riparian areas have been drained. Natural processes of retention and turnover of nutrients have a minor impact on nutrient load in small rivers. In addition, most of the small rivers and streams are located in Germany, Denmark and southern Sweden in catchment areas where farming is very intensive. Therefore the highest percentage of rivers with high flow-weighted nitrogen and phosphorus concentrations is found among the small rivers draining subregion groupings D (WEB+KAT+SOU) and A (BAP) and the lowest percentage draining subregion grouping B (BOB+BOS+ARC), where the amount of arable land is low in general. Many of the large rivers draining catchment areas situated in the central and northern parts of Sweden and Finland flow through areas with low percentages of arable land.

Table 5.9: Number of rivers in the Baltic Sea catchment area of each Contracting Party in each of the three flow rate groups

Flow rate in m/s	FI	RU	EE	LV	LT	PL	DE	DK	SE	TOTAL
≤ 5 m/s	1	-	4	0	0	1	33	97	7	143
5 to 50 m/s	20	-	5	4	1	9	3	4	17	63
> 50 m/s	6	-	2	4	1	2	0	0	17	32

- no information available

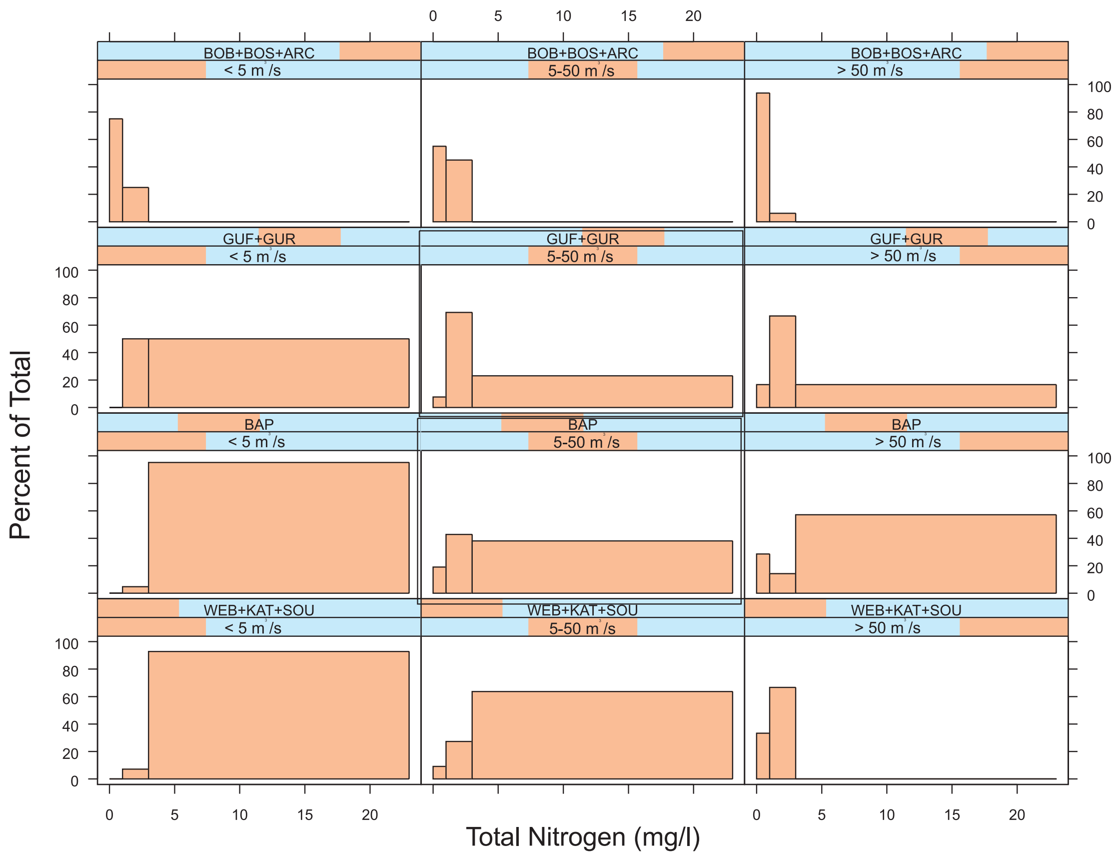

Figure 5. 28 Percentage of rivers in each of the three flow-weighted nitrogen concentration groups in 1995 by four subregion groupings

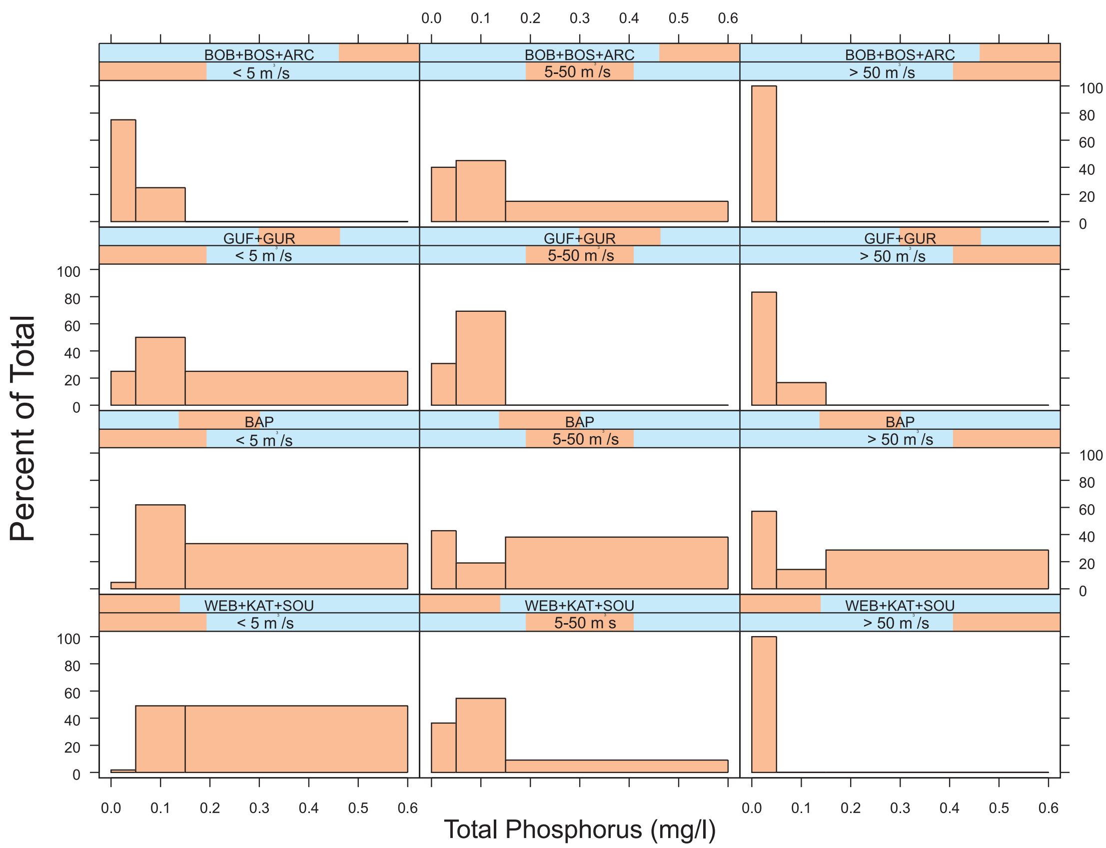

Figure 5. 29 Percentage of rivers in each of the three flow-weighted phosphorus concentration groups in 1995 by four subregion groupings

5.3.4 Area-specific nutrient load in 1995

Area-specific nutrient load is calculated as the total nutrient load from all pollution sources divided by the corresponding catchment area. The highest area-specific nutrient load of nitrogen occurs in the catchment area of the Sound (3 153 kg N/km^2), the Western Baltic (2168 kg N/km^2) and the Kattegat (860 kg N/km^2) (Table 5.5). The highest corresponding figures by Contracting Party are for Denmark (2 208 kg N/km^2), Germany (1 288 kg N/km^2) and Latvia (592 kg N/km^2) (Table 5.6). The highest area-specific nutrient load of phosphorus occurs in the catchment area of the Sound (220 kg P/km^2), the Western Baltic (63 kg P/km^2) and the Archipelago Sea (54 kg P/km^2) (Table 5.7). The highest corresponding figures by Contracting Party are for Denmark (83 kg P/km^2), Poland (43 kg P/km^2) and Germany (35 kg P/km^2) (Table 5.8). High area-specific nitrogen load is related to the high rate of agricultural activity, such as large amounts of live-stock per unit area and the use of large quantities of manure and fertiliser as in Denmark, Germany and the southern part of Sweden. A high rate of industrial activity coupled with a low degree of wastewater purification can also contribute to high area-specific nitrogen load. High area-specific phosphorus load is related to high population density (as e.g. in the Western Baltic and in the Sound), a high rate of industrial activity and to some extent to the intensity of agricultural activity. A low degree of wastewater purification also leads to higher area-specific nutrient load.

The area-specific load is lowered by processes such as retention, nutrient turnover as a denitrification processes and high groundwater influx to the rivers (see 5.3.3). These processes will generally affect large rivers, leading to lower area-specific nutrient load and lower flow-weighted concentrations compared with smaller rivers.

5.4 Heavy metals load going into the Baltic Sea

Riverine and direct load of heavy metals into the Baltic Sea is an environmental problem. The long-term effects of accumulation of some of the metals, e.g. mercury and cadmium in biota, are well known. The eventual fate of the metals when they finally come into contact with the bottom sediments is another cause for concern. Other processes such as eutrophication and anoxicity, may greatly influence the distribution of the metals.

The total pollution load of metals in marine waters varies among the different subregions depending on the population density, location of industries and the exploitation of natural resources. The anthropogenic load derives, for instance, from industrial wastewater, leakage from products in use and those removed from service, "natural" degradation of products and pollution from various types of land-use (for example fertilising: excess of cadmium in fertilisers) and mining (mine waste deposits).

Due to very incomplete data, a full picture of the heavy metals load, going into the Baltic Sea could not be given. The difficulties in obtaining comparable heavy metals load data in 1995 were caused by a lack of laboratory equipment for analysis, inability to ensure adequate sampling or difficulty in analysing very small concentrations of certain metals. Both countries in transition and other Contracting Parties encountered one or all of these problems. There are also very apparent differences in the size of the water courses in the various countries. For example, southern Sweden's relatively few large rivers could be sampled effectively, while the hundreds of small streams and brooks in Denmark were very difficult to sample in practice.

Therefore, many figures are missing from this heavy metals summary, but reported results indicate that riverine heavy metals load is the largest source of total pollution load with approximately 90% except perhaps for cadmium. The municipal and industrial wastewater discharges together with diffuse discharges within the river catchment areas are probably the main sources within the riverine load. The cadmium load data from Russia concerning municipalities and industrial plants discharging directly into the Gulf of Finland are very high. Although the figures for heavy metals load are very uncertain, Table 5.10 provides a summarised overview of the heavy metals pollution load on the whole Baltic Sea. In Tables 5.11 to 5.15 a more detailed overview of the heavy metals load by subregion is given, whereby no total load figures are presented due to the lack of many data.

Table 5.10: Heavy metals load going into the Baltic Sea from rivers, municipalities and industrial plants in 1995 (Data is incomplete.[1,2,3])

	Heavy metal load in kg/a			
METAL	Rivers[1,2,3]	Municipalities[1,3]	Industries[1,3]	TOTAL[1,2,3]
Mercury	11 580	1 140	610	13 330
Cadmium	16 410	6 590	610	23 610
Zinc	3 584 180	360 660	87 930	4 032 770
Copper	1 469 200	75 880	49 630	1 594 710
Lead	300 500	32 940	3 960	337 400

[1] All figures are missing for Denmark.
[2] Figures for rivers in Latvia (Hg only, because of lack of proper equipment for Hg) and for rivers in Russia (Hg and Cd only) are missing.
[3] All Estonian figures are from 1994.

Table 5.11 Riverine and direct point source Mercury load going into the Baltic Sea in 1995 by subregion

Hg		Load from monitored rivers in kg/a	Load from unmonitored rivers and coastal areas in kg/a	Treated municipal load discharging directly into the Baltic Sea in kg/a	Untreated municipal load discharging directly into the Baltic Sea in kg/a	Treated industrial load discharging directly into the Baltic Sea in kg/a	Untreated indurstrial load discharging directly into the Baltic Sea in kg/a	TOTAL Hg LOAD in kg/a	TOTAL DRAINAGE AREA in km	AREA SPECIFIC Hg LOAD in kg/km
	FI	575	10	2,4	—	22	—	609	133 167	0,0046
	SE	118	#	10	—	20	—	148	118 710	0,0012
BOB	**Sum**	**693**	**10**	**12**	**—**	**42**	**—**	**757**	**251 877**	**0,0030**
	FI	94	#	1,6	—	4,0	—	100	39 301	0,0025
	SE	144	#	4,0	—	#	—	148	170 088	0,0009
BOS	**Sum**	**238**		**5,6**	**—**	**4,0**	**—**	**248**	**209 389**	**0,0012**
	FI	4,0	#	6,6	—	#	—	11	8 952	0,0012
ARC	**Sum**	**4,0**		**6,6**	**—**		**—**	**11**	**8 952**	**0,0012**
	FI	78	#	9,7	—	#	—	88	49 703	0,0018
	EE [1]	886	#	*	#	*	#	886	287 641	0,0031
	RU	*		548	#	223	#	771	67 357	0,0114
GUF	**Sum**	**964**		**558**		**223**		**1 745**	**404 701**	**0,0043**
	EE [1]	117	#	#	#	#	#	117	17 018	0,0069
	LV	*	#	*	#	*	*		117 941	
GUR	**Sum**	**117**						**117**	**134 959**	**0,0009**
	EE [1]	—	—	#	#	—	—		—	—
	LV	*	#	*	—	*	—		13 602	
	LT	#	#	*	#	#	#		98 890	
	RU	*	#	*	#	*	#		15 000	
	PL	9 270	#	77	76	342	0,25	9 765	331 196	0,0295
	DE	46	—	1,0	—	0,034	—	47	9 668	0,0049
	DK	*	#	*	—	*	—		1 206	0,0000
	SE	62	#	35	—	#	—	97	67 766	0,0014
BAP	**Sum**	**9 378**		**113**	**76**	**342**	**0,3**	**9 909**	**537 328**	**0,0184**
	DE	57	0,5	2,0	—	0,0024	—	60	7 359	0,0081
	DK	*	#	102	—	*	—	102	12 342	0,0083
WEB	**Sum**	**57**	**0,5**	**104**	**—**	**0,002**	**—**	**162**	**19 701**	**0,0082**
	DK	*	#	155	—	*	—	155	1 737	0,0892
	SE	0,1	#	6,0	—	0,1	—	6	2 409	0,0026
SOU	**Sum**	**0,1**		**161**	**—**	**0,1**	**—**	**161**	**4 146**	**0,0389**
	DK	*	#	67	—	*	—	67	15 826	0,0042
	SE	117	#	41	—	1	—	159	67 435	0,0024
KAT	**Sum**	**117**		**108**	**—**	**1**	**—**	**226**	**83 261**	**0,0027**

– = nothing to report (this source does not exist)
* = data not available (should have been reported)
# = data not available, but not obligatory
data not complete

1) Estonian riverine Hg load is from 1994

Table 5.12 Riverine and direct point source Cadmium load going into the Baltic Sea in 1995 by subregion

Cd		Load from monitored rivers in kg/a	Load from unmonitored rivers areas and coastal in kg/a	Treated municipal load discharging directly into the Baltic Sea in kg/a	Untreated municipal load discharging directly into the Baltic Sea in kg/a	Treated industrial load discharging directly into the Baltic Sea in kg/a	Untreated indurstrial load discharging directly into the Baltic Sea in kg/a	TOTAL Cd LOAD in kg/a	TOTAL DRAINAGE AREA in km	AREA SPECIFIC D_d LOAD in kg/km
	FI	731	100	1,6	—	95	—	928	133 167	0,007
	SE	226	#	4,0	—	22	—	252	118 710	0,002
BOB	**Sum**	**957**	**100**	**5,6**	**—**	**117**	**—**	**1 180**	**251 877**	**0,005**
	FI	564	210	1,0	—	5,0	—	780	39 301	0,020
	SE	373	#	4,0	—	15	—	392	170 088	0,002
BOS	**Sum**	**937**	**210**	**5,0**	**—**	**20**	**—**	**1 172**	**209 389**	**0,006**
	FI	52	100	4,1	—	0,5	—	157	8 952	0,017
ARC	**Sum**	**52**	**100**	**4,1**	**—**	**0,5**	**—**	**157**	**8 952**	**0,017**
	FI	77	53	6,4	—	0,5	—	137	49 703	0,003
	EE 1)	1 520	#	*	#	*	#	1520	287 641	0,005
	RU	*	120	5 468	#	327	#	5 915	67 357	0,088
GUF	**Sum**	**1 597**	**173**	**5 474**		**328**		**7 572**	**404 701**	**0,019**
	EE 1)	377	#	#	#	#	#	377	17 018	0,022
	LV	1 233	52	99	48	64	0,5	1 497	117 941	0,013
GUR	**Sum**	**1610**	**52**	**99**	**48**	**64**	**1,0**	**1 874**	**134 959**	**0,014**
	EE 1)	—	—	#	#	—	—		—	—
	LV	82	7	*	—	8,0	—	97	13 602	0,007
	LT	824	#	*	#	#	#	824	98 890	0,008
	RU	*	#	*	#	*	#		15 000	
	PL	8 990	#	374	31	64	0,5	9 460	331 196	0,029
	DE	65	—	15	—	1	—	81	9 668	0,008
	DK	*	#	*	—	*	—		1 206	
	SE	351	#	63	—	5,0	—	419	67 766	0,006
BAP	**Sum**	**10 312**	**7,0**	**452**	**31**	**78**	**1,0**	**10 881**	**537 328**	**0,020**
	DE	75	3,5	22	—	0,053	—	101	7 359	0,014
	DK	*	#	132	—	*	—	132	12 342	0,011
WEB	**Sum**	**75**	**4**	**154**	**—**	**0,1**	**—**	**233**	**19 701**	**0,012**
	DK	*	#	192	—	*	—	192	1 737	0,111
	SE	1,0	#	5,0	—	1,0	—	7	2 409	0,003
SOU	**Sum**	**1,0**		**197**	**—**	**1,0**	**—**	**199**	**4 146**	**0,048**
	DK	*	#	85	—	*	—	85	15 826	0,005
	SE	220	#	34	—	1,0	—	255	67 435	0,004
KAT	**Sum**	**220**		**119**	**—**	**1,0**	**—**	**340**	**83 261**	**0,004**

– = nothing to report (this source does not exist)
*=data not available (should have been reported)
= data not available, but not obligatory
data not complete

1) Estonian riverine Cd load is from 1994

Table 5.13 Riverine and direct point source Zinc load going into the Baltic Sea in 1995 by subregion

Zn		Load from monitored rivers in kg/a	Load from unmonitored rivers and coastal areas in kg/a	Treated municipal load in kg/a	Untreated municipal load in kg/a	Treated industrial load in kg/a	Untreated indurstrial load in kg/a	TOTAL Zn LOAD in kg/a	TOTAL DRAINAGE AREA in km	AREA SPECIFIC Zn load in kg/km
				discharging directly into the Baltic Sea						
	FI	169 740	30 500	1 640	—	7 670	—	209 550	133 167	1,57
	SE	267 040	17 100	1 090	—	2 800	—	288 030	118 710	2,43
BOB	**Sum**	**436 780**	**47 600**	**2 730**	**—**	**10 470**	**—**	**497 580**	**251 877**	**1,98**
	FI	133 380	58 400	1 070	—	37 911	—	230 761	39 301	5,87
	SE	553 250	43 000	1 756	—	1 030	—	599 036	170 088	3,52
BOS	**Sum**	**686 630**	**101 400**	**2 826**	**—**	**38 941**	**—**	**829 797**	**209 389**	**3,96**
	FI	25 120	50 200	2 070	—	108	—	77 498	8 952	8,66
ARC	**Sum**	**25 120**	**50 200**	**2 070**		**108**		**77 498**	**8 952**	**8,66**
	FI	69 140	23 200	6 380	—	63	—	98 783	49 703	1,99
	EE 1)	140 660	#	*	#	*	#	140 660	287 641	0,49
	RU	581 147	4 190	260 745	#	33 845	#	879 927	67 357	13,06
GUF	**Sum**	**790 947**	**27 390**	**267 125**		**33 908**		**1 119 370**	**404 701**	**2,77**
	EE 1)	19 020	#	#	#	#	#	19 020	17 018	1,12
	LV	96 230	4 080	2 753	4 012	354	6,0	107 435	117 941	0,91
GUR	**Sum**	**115 250**	**4 080**	**2 753**	**4 012**	**354**	**6,0**	**126 455**	**134 959**	**0,94**
	EE 1)	—	—	#	#	—	—		—	—
	LV	11 920	980	54	—	78	—	13 032	13 602	0,96
	LT	89 751	#	3 400	#	#	#	93 151	98 890	0,94
	RU	190	#	*	#	*	#	190	15 000	0,01
	PL	801 330	#	11 076	19 923	3 572	72	835 973	331 196	2,52
	DE	8 018	—	896	—	13	—	8 927	9 668	0,92
	DK	*	#	*	—	*	—		1 206	
	SE	119 692	114 000	13 670	—	247	—	247 609	67 766	3,65
BAP	**Sum**	**1 030 901**	**114 980**	**29 096**	**19 923**	**3 910**	**72**	**1 198 882**	**537 328**	**2,23**
	DE	6 457	506	3 381	—	28	—	10 372	7 359	1,41
	DK	*	#	5 908	—	*	—	5 908	12 342	0,48
WEB	**Sum**	**6 457**	**506**	**9 289**	**—**	**28**	**—**	**16 280**	**19 701**	**0,83**
	DK	*	#	8 722	—	*	—	8 722	1 737	5,02
	SE	601	7 000	1 485	—	#	—	9 086	2 409	3,77
SOU	**Sum**	**601**	**7 000**	**10 207**	**—**		**—**	**17 808**	**4 146**	**4,30**
	DK	*	#	3 787	—	*	—	3 787	15 826	0,24
	SE	136 040	2 300	6 838	—	129	—	145 307	67 435	2,15
KAT	**Sum**	**136 040**	**2 300**	**10 625**	**—**	**129**		**149 094**	**83 261**	**1,79**

– = nothing to report (this source does not exist)
* = data not available (should have been reported)
# = data not available, but not obligatory
2 data not complete

1) Estonian riverina Zn load is from 1994

Table 5.14 Riverine and direct point source Copper load going into the Baltic Sea in 1995 by subregion

Cu		Load from monitored rivers in kg/a	Load from unmonitored rivers and coastal areas in kg/a	Treated municipal load (discharging directly into the Balrtic Sea) in kg/a	Untreated municipal load (discharging directly into the Balrtic Sea) in kg/a	Treated industrial load (discharging directly into the Balrtic Sea) in kg/a	Untreated indurstrial load (discharging directly into the Balrtic Sea) in kg/a	TOTAL Cu LOAD in kg/a	TOTAL DRAINAGE AREA in km	AREA SPECIFIC Cu LOAD in kg/km
	FI	35 650	6 600	380	—	167	—	42 797	133 167	0,32
	SE	64 714	5 000	271	—	750	—	70 735	118 710	0,60
BOB	**Sum**	**100 364**	**11 600**	**651**	**—**	**917**	**—**	**113 532**	**251 877**	**0,45**
	FI	2 640	#	260	—	948	—	3 848	39 301	0,10
	SE	105 422	6 900	679	—	168	—	113 169	170 088	0,67
BOS	**Sum**	**108 062**	**6 900**	**939**	**—**	**1 116**	**—**	**117 017**	**209 389**	**0,56**
	FI	4 690	9 400	360	—	99	—	14 549	8 952	1,63
ARC	**Sum**	**4 690**	**9 400**	**360**	**—**	**99**	**—**	**14 549**	**8 952**	**1,63**
	FI	19 662	6 900	1 530	—	39	—	28 131	49 703	0,57
	EE[1)]	350 200	#	*	#	*	#	350 200	287 641	1,22
	RU	478 843	5 670	55 624	#	46 071	#	586 208	67 357	8,70
GUF	**Sum**	**848 705**	**12 570**	**57 154**		**46 110**		**964 539**	**404 701**	**2,38**
	EE[1)]	76 800	#	#	#	#	#	76 800	17 018	4,51
	LV	28 350	1 200	605	553	203	0,5	30 912	117 941	0,26
GUR	**Sum**	**105 150**	**1 200**	**605**	**553**	**203**	**0,5**	**107 712**	**134 959**	**0,80**
	EE[1)]	—	—	#	#	—	—		—	—
	LV	3 356	270	48	—	48	—	3 722	13 602	0,27
	LT	29 017	#	700	#	#	#	29 717	98 890	0,30
	RU	200	#	*	#	*	#	200	15 000	0,01
	PL	127 700	#	1 193	1 216	1 051	2,0	131 162	331 196	0,40
	DE	6 596	—	86	—	3,0	–	6 685	9 668	0,69
	DK	*	#	*	—	*	—		1 206	
	SE	42 182	11 000	4 865	—	10	—	58 057	67 766	0,86
BAP	**Sum**	**209 051**	**11 270**	**6 892**	**1 216**	**1 112**	**2,0**	**229 543**	**537 328**	**0,43**
	DE	2 781	231	1 686	—	8,0	—	4 706	7 359	0,64
	DK	*	#	507	—	*	—	507	12 342	0,04
WEB	**Sum**	**2 781**	**231**	**2 193**	**—**	**8,0**	**—**	**5 213**	**19 701**	**0,26**
	DK	*	#	761	—	*	—	761	1 737	0,44
	SE	111	1 000	1 564	—	#	—	2 675	2 409	1,11
SOU	**Sum**	**111**	**1 000**	**2 325**	**—**		**—**	**3 436**	**4 146**	**0,83**
	DK	*	#	329	—	*	—	329	15 826	0,02
	SE	35 720	400	2 660	—	58	—	38 838	67 435	0,58
KAT	**Sum**	**35 720**	**400**	**2 989**	**—**	**58**	**—**	**39 167**	**83 261**	**0,47**

– = nothing to report (this source does not exist)
* = data not available (should have been reported)
# = data not available, but obligatory
data not complete

1) Estonian riverine Cu load is from 1994

Table 5.15 Riverine and direct point source Lead load going into the Baltic Sea in 1995 by subregion

Pb		Load from monitored rivers in kg/a	Load from unmonitored rivers and coastal areas in kg/a	Treated municipal load in kg/a	Untreated municipal load in kg/a	Treated indurstrial load in kg/a	Untreated industrial load in kg/a	TOTAL Pb LOAD in kg/a	TOTAL DRAINAGE AREA in km	AREA SPECIFIC Pb LOAD in kg/km
				discharging directly into the Balrtic Sea						
	FI	8 870	1 600	74	—	9,0	—	10 553	133 167	0,079
	SE	5 074	#	28	—	1 440	—	6 542	118 710	0,055
BOB	**Sum**	**13 944**	**1 600**	**102**	**—**	**1 449**	**—**	**17 095**	**251 877**	**0,068**
	FI	8 980	1 500	50	—	1 231	—	11 761	39 301	0,299
	SE	10 754	#	56	—	50	—	10 860	170 088	0,064
BOS	**Sum**	**19 734**	**1 500**	**106**	**—**	**1 281**	**—**	**22 621**	**209 389**	**0,108**
	FI	1 430	2 900	110	—	75	—	4 515	8 952	0,504
ARC	**Sum**	**1 430**	**2 900**	**110**	**—**	**75**	**—**	**4 515**	**8 952**	**0,504**
	FI	4 330	1 650	290	—	34	—	6 304	49 703	0,127
	EE 1)	21 680	#	*	#	*	#	21 680	287 641	0,075
	RU	63 090	190	25 825	#	37	#	89 142	67 357	1,323
GUF	**Sum**	**89 100**	**1 840**	**26 115**		**71**		**117 126**	**404 701**	**0,289**
	EE 1)	4 640	#	#	#	#	#	4 640	17 018	0,273
	LV	6 220	260	409	477	147	*	7 513	117 941	0,064
GUR	**Sum**	**10 860**	**260**	**409**	**477**	**147**		**12 153**	**134 959**	**0,090**
	EE 1)	—	—	#	#	—	—		—	—
	LV	896	72	*	—	34	—	1 002	13 602	0,074
	LT	17 976	#	*	#	#	#	17 976	98 890	0,182
	RU	*	#	*	#	*	#		15 000	
	PL	124 630	#	2 899	835	708	2,0	129 074	331 196	0,390
	DE	415	—	211	—	16	—	642	9 668	0,066
	DK	*	#	*	—	*	—		1 206	
	SE	4 212	#	396	—	114	—	4 722	67 766	0,070
BAP	**Sum**	**148 129**	**72**	**3 506**	**835**	**872**	**2,0**	**153 416**	**537 328**	**0,286**
	DE	969	84	351	—	1,0	—	1 405	7 359	0,191
	DK	*	#	163	—	*	—	163	12 342	0,013
WEB	**Sum**	**969**	**84**	**514**	**—**	**1 ,0**	**—**	**1 568**	**19 701**	**0,080**
	DK	*	#	198	—	*	—	198	1 737	0,114
	SE	25	#	40	—	—	—	65	2 409	0,027
SOU	**Sum**	**25**		**238**	**—**		**—**	**263**	**4 146**	**0,063**
	DK	*	#	103	—	*	—	103	15 826	0,007
	SE	8 052	#	423	—	66	—	8 541	67 435	0,127
KAT	**Sum**	**8 052**		**526**	**—**	**66**	**—**	**8 644**	**83 261**	**0,104**

– = nothing to report (this source does not exist)
* = data not available (should have been reported)
# = data not available, but not obligatory
data not complete

1) Estonian riverine Pb load is from 1994

6

Source apportionment

6.1 Introduction

Source apportionment is a tool for evaluating the importance of different sources to riverine nutrient fluxes. The objective of separating riverine fluxes is to assess the importance of anthropogenic sources. The political and administrative systems, therefore, could have a tool for evaluating what measures are the most cost effective for the environment in combating nutrient pollution. According to the PLC-3 Guidelines, the Contracting Parties should therefore estimate the proportion of natural (background) load and anthropogenic (point source and diffuse source) load.

Special Guidelines for the source apportionment were prepared at a workshop held in Denmark in June 1995, which are described in TC POLO 3/9, Annex 5 "Guidelines to estimate natural and anthropogenic contributions to riverine fluxes (source apportionment)". Three different methodologies for source apportionment were compared: the Danish, the German and the Finnish methodology. It was recommended that the Contracting Parties should use one of these three methodologies (TC POLO 3/9, Annex 5). In this chapter, the principles of source apportionment methodologies are described briefly, and the methodology used by each of the Contracting Parties is summarized.

6.1.1 Definitions

Anthropogenic nutrient sources are defined as load from human activities and can be divided into:

a) Point sources (wastewater from municipal treatment plants, industrial plants, fish farms, stormwater reservoirs and other stormwater sewage constructions)
b) Diffuse sources:
   i) agriculture
   ii) scattered dwellings

In some of the Contracting Parties loads from fish farming, stormwater reservoirs and other stormwater sewage constructions are not measured. In these countries, the diffuse sources consist of loads from agriculture, scattered dwellings, fish farming and stormwater constructions.

Separating loads from agriculture and scattered dwellings is very difficult, because:

1) Assessment of the potential load from scattered dwellings is difficult as it depends on the potential production of wastewater and the equipment used to collect and treat the wastewater if any treatment is applied;

2) An estimation of the part of the potential load reaching from scattered dwellings is very uncertain as the wastewater can infiltrate the soil, can be connected to tiles, collected in different kinds of containers. Further, the distance from the scattered dwelling to the recipient is an important factor.

Therefore, it was recommended that diffuse sources should include load from agriculture, from scattered dwellings and also the natural load (background load).

Natural sources (background load) of riverine nutrient fluxes are assumed to characterize the conditions in a watershed that is unaffected by human activity. Finding such watersheds is almost impossible as the amount of atmospheric deposition caused by human activity has been increasing in recent decades. Thus, the best estimate for background load is found in small, sparsely populated catchment areas with low human activity, such as areas of natural forest areas and/or uncultivated areas.

Assessing the importance of atmospheric deposition on riverine fluxes is not possible. From a scientific point of view, giving figures on the proportion of atmospheric deposition reaching the freshwater environment and the sea via riverine loads would be irresponsible. Only atmospheric deposition on larger bodies of freshwater can be evaluated in a source apportionment calculation.

In general terms source apportionment is assessed by subtracting the natural (background) load (NL) and the point source load (PL) from the riverine load (RL) and thus obtaining an estimate of the diffuse load (DL):

$$DL = RL - NL - PL, \qquad (1)$$

The importance of the different source is then expressed as:

Proportion of NL = (NL/RL) . 100% (2)
Proportion of PL = (PL/RL) . 100% (3)
Proportion of DL = (DL/RL) . 100% (4)

The anthropogenic load (AL) is:

$$AL = PL + (DL - NL) \qquad (5)$$

Nutrients from anthropogenic and natural sources are affected by temporary and more permanent sinks and by cyclical and removal processes (e.g. denitrification, retention in lakes and flooded riparian areas) which can be expressed as the retention of nutrients (RET). To assess the importance of different sources these processes must be taken into account as the measured riverine load only expresses the net riverine export. If retention is omitted from the source apportionment calculation, the diffuse load from agriculture and other sources will be underestimated. The source apportionment should therefore be based on the gross riverine load (GRL), i.e.:

$$GRL = RL + RET \qquad (6)$$

and equations 1, 2, 3 and 4 are amended thus:

DL = RL + RET - NL - PL (7)
Proportion of NL (NL/GRL).100% (8)
Proportion of P =(PL/GRL) .100% (9)
Proportion of DL= (DL/GRL).100% (10)

There are several methods for obtaining values for the background load, the point source load, the diffuse load and the transport of nutrients. These methods range from measurements, empirical relations, emission coefficients or values based on experience.

6.1.2 Background load and load from unmonitored rivers and coastal zones

The background load is a figure for the natural load from a catchment area that is not affected by human activity. Finding any catchment area in the Convention area which fulfils this condition is not possible, as the atmospheric deposition today is higher than, for example, 100 years ago. The best obtainable background load figures are obtained by measuring the load from small catchment areas with natural unmanaged forests and/or catchment areas with very low agricultural and other human activities. The catchment areas used should therefore be sparsely populated.

Often a part of the catchment area is unmonitored and load estimations from these areas are necessary to perform a proper source apportionment. Load from unmonitored parts of rivers (e.g. coastal zones) or unmonitored rivers themselves can be estimated by more or less sophisticated methods. The most frequently used methods are:

a) use of area coefficients for the diffuse load;
b) use of discharge-weighted concentrations;
c) use of models based on land use, climate, soil types etc.

a) Area coefficients:
Area runoff coefficients (kg N/ha and kg P/ha) may be determined from monitoring stations situated further upstream within the catchment area or from monitored catchment areas in which the soil type and land use corresponds to those of the unmonitored catchment areas. Before calculating the area coefficient the point source load must be deducted. The point source load for the unmeasured catchment areas are then added to the estimated diffuse load.

In some of the Contracting Parties no figures are available for the point source load in monitored or unmonitored areas. Therefore, a rough calculation is applied by extrapolating the figures from the monitored part of watersheds to correspond to the whole catchment area.

b) Discharge-weighted concentrations:
Use of discharge-weighted concentrations (the annual transport of a species of nutrient divided by the annual runoff of water) is recommended as the best estimate for the diffuse load from unmonitored areas. The optimum solution is to use measurements from agricultural catchment areas without point sources where soil type and land use correspond to those of the unmonitored catchment area. The discharge-weighted concentrations are then multiplied by measured or estimated runoff values. If there are no measured catchment areas without point sources with similar conditions to the unmonitored watershed, point source loads are deducted from the nutrient transport measured in a monitored watershed before the discharge-weighted concentration is calculated. Often an average of discharge-weighted concentrations from several measured catchment areas can be used for the unmonitored areas.

c) Models:
Empirical models can also be applied to estimate the diffuse load from unmonitored areas. The models can be based on relations between land use (proportion of cultivated areas, fertiliser and manure consumption, soil types, livestock etc.) in the watershed and the nutrient runoff to yield emission coefficients. These empirical models can be based on measurements combined with GIS information on land use, agricultural practices, soil types, livestock, use of manure and fertiliser etc.

6.1.3 Point source load and other methodological problems

Different approaches have been used to estimate the point source load:

a) direct measurements or empirical load figures
b) calculated load figures
c) indirect estimations

In some of the Contracting Parties the point source loads are generally based on measurements, and estimations are only done for small point sources.

In some of the Contracting Parties measurements of the point source loads in the monitored part of their watershed are lacking. The point source loads are estimated from the number of inhabitants and volume of industry connected to municipal wastewater treatment plants multiplied by the values of nitrogen and phosphorous content in the potential load from one person equivalent. The load from point sources is sometimes determined from load estimations during low flow conditions. Under low flow conditions it is assumed that the increase in nutrient transport from a river monitoring station situated upstream of a town to a corresponding monitoring station situated downstream is tightly correlated to the point source load from the city. Although these estimated figures for point source loads are very uncertain, they are used in this chapter for some of the Contracting Parties to give an impression of the importance of different load sources.

Source apportionment is performed for one or more of the following categories:

a) monitored rivers
b) total riverine load to the sea excluding load from direct point sources
c) total riverine load to the sea including load from direct point sources

The total riverine load is compiled on either a regional or on a nationwide scale. Performing a source apportionment for the total riverine load entering the Baltic Sea is not possible as information is incomplete or missing. Doing a source apportionment for all the Contracting Parties and all of the nine major regions of the Baltic Sea is also impossible. In chapter 6.3 the best obtainable results based on calculations and information of the Contracting Parties supplied with calculations made by the drafting group are shown. These results can only be compared with great caution and may be seen as a first attempt to give a rough estimate of load sources in the Contracting Parties.

6.2 Methodology used in the Contracting Parties

The applied source apportionment methodology in the Contracting Parties is briefly discussed in this chapter. The three recommended source apportionment methods can be divided into two groups.

a) the Danish and the Finish methods;
b) the German immission method.

Methods in group a) are based on measurements of the nutrient transport in rivers and measurements or estimations of point source load and background load. It involves data from one year.

The German immission methodology is based on an analysis of relationships between measured concentrations and water flow in rivers, on flow-load relationships and some information on larger point sources. It involves data from at least three or four years.

The Contracting Parties have applied one of the three methods with smaller or larger modifications as described below.

The Contracting Parties have estimated the background load from measurements in typical small unmanaged forested and/or non-cultivated catchment areas. The figures for background load therefore include not only natural background load and load from atmospheric deposition and from scattered dwellings, but also to some extent contributions from forestry and agricultural activity (if present).

6.2.1 Finland

The Finnish source apportionment methodology is described in detail in TC POLO 3/9, Annex 5). Finland performed the source apportionment for the total riverine load including direct point source load and load from unmonitored areas to the Bothnian Bay, the Bothnian Sea, the Archipelago Sea, the Gulf of Finland and totally for Finland in 1995. Source apportionment is not available for monitored rivers. Source apportionment is determined according to equations (1) to (5).

Altogether 28 rivers were included in the Finnish monitoring programme in 1995 covering approximately 95% of the Finnish Baltic Sea catchment area. Riverine load from the remaining 5% of the catchment area was estimated for each subregion by extrapolation from the monitored part of the catchment area (area coefficients).

Point source load was compiled on the basis of the obligatory monitoring programmes run by municipal wastewater treatment plants and industrial plants. It is assumed that the point source loads entering rivers remain quantitatively unchanged in the rivers, i.e. no retention is accounted for, as only the lower catchment areas below larger lake basins were taken into account. In catchment areas with many lakes the retention of nutrients of anthropo-genic origin was assumed to be near 100%. Point source loads only include load from municipal wastewater treatment plants and industrial plants, which are given separately. Loads from scattered dwellings, stormwater reservoirs and other stormwater constructions and from fish farming are included in the diffuse load.

Background load was estimated from studies in forested catchment areas and is:

a) 10 kg P/(km^2 · a) and 250 kg N/(km^2·a), in the catchment areas of the Gulf of Finland, the Archipelago Sea and the Bothnian Sea;
b) 10 kg P/(km^2 · a) and 170 kg N/(km^2·a), in the catchment area of the Bothnian Bay.

Due to retention in the catchment area the background load of phosphorus was estimated to decrease by 20 % in the three southern catchment areas (Gulf of Finland, Archipelago Sea, and Bothnian Sea) and by 25 % in the catchment area of the Bothnian Bay. For nitrogen, the retention percentages were estimated to be 15 % and 20 %, respectively. The background load figures included, to some extent, contributions from scattered dwellings etc.

The diffuse load is estimated by subtracting background load and point source load from the measured riverine transport (equation 1).

With the Finnish methodology, retention is only partly included and the anthropogenic load is therefore underestimated.

6.2.2 Russia

Russia has, in principle, used the Finnish methodology for source apportionment (equations 1 to 5). Russia have given information for 18 rivers, but as information on either point source load, background load or diffuse load (or total measured riverine load) is missing, the source apportionment has only been done for 8 or 9 rivers. Source apportionment is missing for the total Russian load entering the Gulf of Finland and Baltic Proper and for the total Russian riverine load. The source apportionment has not been done for the River Narva as information from Russia is missing.

Point sources as a rule include load from municipal wastewater treatment plants and industrial plants, and dividing the load from these sources is not possible. It seems that the phosphorus load from point sources is calculated on the basis of emission factors for urban areas (90 kg P/(km^2·a)). No figures are given for nitrogen. Background load was estimated from measurements in small non-agricultural catchment areas and forested areas yielding:

a) 7 kg P/(km^2 · a) for the northern coast of the Gulf of Finland;
b) 6 kg P/(km^2 · a) for the southern coast of the Gulf of Finland.

No figures are given for nitrogen. Determining whether the background load of phosphorus is deducted from the diffuse load in agricultural catchment areas is not possible.

The agricultural load that also includes load from scattered dwellings, smaller settlements and stormwater constructions is calculated by deducting the point source load and background load from the measured riverine load (equation 1). For unmonitored rivers in the coastal zone of the Gulf of Finland an area coefficient of 15 kg P/km^2 is used. Retention is not included in the Russian methodology.

The method gives only a very rough estimate of the importance of anthropogenic sources.

6.2.3 Estonia

Estonia has in principle used the Finnish methodology for source apportionment (equations 1 to 5). Source apportionment has been done for 14 monitored rivers, but not for the total Estonian load entering the Gulf of Finland, the Gulf of Riga or the Baltic Proper or for the total Estonian riverine load. Source apportionment has not been done for the River Narva as information from Russia is missing.

Point sources include load from municipal wastewater treatment plants and industrial plants, and dividing the load from these sources is not possible. No information is given concerning the way in which the point source load is obtained (i.e. whether measured or calculated /estimated).

The background load was estimated from measurements in small non-agricultural catchment areas yielding:

a) 430 kg N/(km^2 · a);
b) 12 kg P/(km^2 · a).

The load from forested areas is included as background load, since Estonian forests as a rule are managed without fertiliser consumption. It appears that background load is not deducted from the diffuse load in agricultural areas.

Agricultural load that also includes load from scattered dwellings, smaller settlements and stormwater constructions is calculated by deducting the point source load and background load from the measured riverine load (equation 1). Retention is not included in the Estonian methodology.

The method gives only a very rough estimate of the importance of anthropogenic sources.

6.2.4 Latvia

Latvia has in principle used the Danish methodology for source apportionment but without retention. Source apportionment has been done for 8 monitored rivers. Further, the author of this chapter used the Latvian methodology and submitted data to perform source apportionment for the total riverine load including the load from unmonitored areas and the load from direct point sources entering the Gulf of Riga and the Baltic Proper and for the total Latvian riverine load entering the Baltic Sea. Latvia has deducted the riverine load from neighbouring countries from the total riverine load to estimate the source apportionment from Latvian sources. The diffuse load from unmonitored areas is calculated on the basis of area coefficients from corresponding managed and non-managed areas.

The anthropogenic load is calculated by deducting the background load from the total riverine load. The diffuse load was calculated by deducting the load from point sources from the anthropogenic load.

The load from point sources in the diffuse coastal zone is known, but the way the load from point sources for monitored river catchment areas is obtained is not explained in detail. The number of inhabitants living in rural scattered settlements was estimated by deducting the number of inhabitants living in rural settlements from the number of inhabitants in administrative subregions. The point source load is assumed to include load from municipal wastewater treatment plants and from industrial plants.

The background load was estimated from measurements in small non-managed natural watersheds included forested areas yielding:

a) 750 (50-1 000) kg N/(km^2 · a);
b) 35 (10-60) kg P/(km^2 · a)

These are quite high background values, which assume the inclusion of loads from scattered dwellings, small towns and some industrial plants. Non-managed and managed areas and areas with rural scattered settlements were estimated from land use data. The load from forested areas is not deducted from the background load. Further, the background load is not deducted from the diffuse load in managed areas.

6.2.5 Lithuania

Lithuania has used a combination of the Danish and the German source apportionment methodology.

Source apportionment has been done for two rivers (the Nemunas and the sum of the rivers Akmena-Dané and Sventoji). Further, the author of this chapter used the Lithuanian methodology and submitted data to perform source apportionment for the total Lithuanian riverine load including the load from unmonitored areas and the load from direct point sources entering the Baltic Sea (Baltic Proper). Lithuania has deducted the riverine load from neighbouring countries from the total riverine load to estimate the source apportionment for Lithuanian sources only.

The background load was estimated from measurements in three watersheds with low agricultural activity (percentage of arable land less than 20%) yielding:

a) 0.32 to 0.80 mg N/l ;
b) 0.05 to 0.09 mg P/l.

The extension of arable land and forested land was calculated from land use maps and cadastral registers. No information is given on whether the background load has been deducted for the total river catchment area.

Measurements in 5 rivers draining watersheds with more than 50% arable land were used to estimate area coefficients for unmonitored agricultural watersheds and to estimate the diffuse transport from agricultural land.

The load from point sources is not measured. The load from point sources is estimated by deducting natural background load from the anthropogenic diffuse transport i.e. the background load and the load from agricultural land were deducted from the gross riverine transport. Distinguishing between the load from municipal wastewater treatment plants and from industrial plants is not possible. In the agricultural load the point source load is included to some unknown extent.

Retention was calculated using Bhrendt's formula (TC POLO 3/9, Annex 5):

$$RET_N = 41.456 * q^{-1.297} * C_N^{-0.542} \quad (11)$$
$$RET_P = 28.13\ q^{-1.708}, \quad (12)$$

where q is the specific runoff in $l/(s\ .\ km^2)$ and C_N is the average concentration of dissolved inorganic nitrogen in the river concerned.

The gross riverine load of nitrogen and phosphorus is also calculated using Behrendt's formula as:

Net load nitrogen/gross load nitrogen $= 1 / (1 + RET_N)$ 13)
Net load phosphorus/gross load phosphorus $= 1 / (1 + RET_P)$ (14)

Behrendt's retention formulas (11 and 12) are set up for some German rivers and the Danish River Gudenaa, but have not been set up for, e.g. Lithuanian rivers. Retention is not included in the background and agricultural load area coefficients used for unmonitored areas as the retention is assumed unimportant in the small watershed from which these area coefficients are determined.

6.2.6 Poland

The Polish source apportionment methodology is based on calculated emission coefficients for background load and load from agriculture. Source apportionment is done for 12 rivers. Further, the author of this chapter based on submitted data performed source apportionment for the total riverine load including load from unmonitored areas (coastal zones) from Poland to the Baltic Sea (Baltic Proper).

25 rivers were monitored within a 2 to 6-year cycle. These comprise 41 small agricultural watersheds and 5 forested watersheds both without any major point sources (municipal wastewater treatment plants and industrial plants). The resulting data were representative of 4 major physical-geographical regions of Poland. The following parameters were included in the modelling: morphology, soil permeability, fertiliser consumption and hydrology. The unit emission of nitrogen and phosphorus from the 5 experimental forested watersheds were used as background values and deducted from the unit values measured in the experimental agricultural watershed to obtain emission values from agriculture. Unit loads from agriculture were corrected only in relation to the amount of arable land in the watersheds. From this information the unit load was divided into background emission and agricultural emission. On the basis of data from 2 to 6 years, unit loads were recalculated to consider hydrological condition. In the calculations it is assumed that the amount of emitted nutrients is proportional to riverine runoff. The unit loads for nitrogen were calculated as:

$$Lr = (0.31536 * Cw_r * Q * Z_{1993}) / Z_{exp} \quad (15),$$

where:

L_r is a nitrogen (phosphorus) unit outflow from agriculture in $kg/(ha \cdot a)$;
Cw_r is the discharge-weighted nitrogen (phosphorus) concentration from agriculture in the runoff in mg/l;
Q is the mean runoff during the study period in $l/(s \cdot km2)$;
Z_{1993} is the fertiliser consumption (divided into mineral and natural) for the given area in 1993 in $kg/(ha \cdot a)$;
Z_{exp} is mean fertiliser consumption (mineral and natural) in the catchment areas in $kg/(ha\ .\ a)$;

$$L_t = 0.31536 * Cw_t * Q \quad (16),$$

where:

L_t is the background nitrogen (phosphorus) unit outflow in $kg/(ha \cdot a)$;
Cw_t is the discharge-weighted nitrogen phosphorus) concentration in mg/l
Q is the mean runoff during the study period for the area concerned in $l/(s \cdot km^2)$.

These corrected unit loads were average for the physical-geographical regions for four soil types, as discharge-weighted concentrations of nitrogen and phosphorus were calculated for each soil type in relation to runoff from fields and mean nutrient input from mineral and natural fertilisation during the study period. This procedure provides input data for a spatial model of the nitrogen outflow for the entire territory of Poland that has been set up for administrative units and for catchment areas. Data on soil types, morphology, hydrology and proportion of arable land is available on GIS.

Further, nitrate emissions from point sources were estimated, but no information is given about the methodology, nor about the methodology for phosphorus emissions from point sources. The emission coefficients from background, agriculture and point source loads then made it possible to calculate the importance of each source to the measured riverine load.

The ratio between the measured riverine load and the sum of the calculated emissions is an estimate of the retention within the watershed, the lakes and riparian areas.

6.2.7 Germany

Germany has applied two methods of source apportionment: the immission and the emission method. Germany performed the source apportionment for the total riverine load including direct point source load and load from unmonitored areas. Further, the source apportionment was done for 12 rivers (see chapter 6.3). For 9 of the 12 rivers investigated the emission method was applied and for the remaining 3 rivers the immission method was applied.

Both applied methods are quite different from the Finnish and Danish methodology. The emission method is fully independent of the observed load and uses a point source inventory and estimations on the different diffuse pathways via groundwater, interflow and surface runoff. Further atmospheric deposition, emissions from urban areas, erosion and agricultural direct emissions were considered. The diffuse emissions were estimated using GIS-data on landcover, soil types, elevation and statistical data on drainage areas, livestock and fertilizer consumption.

For three of the 12 investigated river basins the immission method was applied, where the separation of point and diffuse sources was derived from the discharge dependency of the observed concentrations and loads. The total emissions of these three rivers were estimated by the application of the Behrendt retention formula (1996).

Because both German methods do not implicitly include background emissions, the proportion of the background load of the total load was estimated based on the following assumptions:

- Emissions from the diffuse sources are zero with exception of the emission by groundwater (base flow);
- Flow is only caused by base flow;
- The nutrient background concentrations are estimated as the mean nutrient concentrations in groundwater measured in a distant groundwater table.

The background load was estimated using concentrations of 2 mg N/l and 0.025 mg P/l, and multiplying these values with the corresponding flow in the rivers.

Point sources are municipalities and industry. The method assumes that point source loads are relatively constant and only slightly related to meteorological factors. Further, it is assumed that point sources are evenly distributed within the catchment.

Retention is not directly incorporated in the German methods, but the retention can be estimated from the comparison of the results of the emission method with the observed load (for the emission method) and of the point emissions and the portion of point load at the observed load derived by the immission method. The results of these comparisons support the empirical formula of Behrendt (1996), which shows that the normalized retention is increasing with decreasing area-specific runoff. It is assumed that processes such as denitrification and sedimentation equally affect the load from different sources.

These formulas give the ratio between nutrient load and nutrient emission, where the load is measured in the rivers. From these empirical equations it is also possible to estimate retention.

Anthropogenic sources are calculated by deducting the calculated background load and the load from point-sources from the total riverine load.

6.2.8 Denmark

The Danish source apportionment methodology is also described in detail in TC POLO 3/9, Annex 5. Denmark performed the source apportionment for the total riverine load including direct point source load and load from unmonitored areas for the Danish part of the Baltic Proper, the Western Baltic, the Sound, the Kattegat and for the whole of the Danish Baltic Sea catchment area. Further, the source apportionment was done for 103 streams and rivers, but these results are only given as pooled information in chapter 6.3 (Tables 6.3 and 6.4). Source apportionment is determined according to equations 5 to 10.

The 103 rivers and streams included in the Danish river monitoring programme for the compilation of riverine Baltic Sea pollution load correspond to a 50% to 60% coverage of the corresponding Danish Baltic Sea catchment area. Riverine loads from the remaining 40% to 50% unmonitored areas (including coastal areas) are estimated using either area coefficients or discharge-weighted concentrations multiplied by representative flow.

Point source loads from industrial plants and municipal wastewater treatment plants are measured for all plants bigger than 30 PE in monitored and unmonitored areas. Loads from small municipal wastewater treatment plants (a potential load less than 30 PE) are calculated in monitored and unmonitored areas. Loads from stormwater reservoirs and other stormwater constructions in monitored and unmonitored areas are calculated by means of precipitation and empirical equations. Further, loads from freshwater fish farms are calculated from food consumption and production, and from water flow and concentration measurements upstream and downstream of the fish farm. In Denmark point sources include loads from municipal wastewater treatment plants, industrial plants, stormwater constructions and fish farms so that making a real point source inventory is possible.

The potential load from scattered dwellings is calculated for monitored and unmonitored areas based on inhabitants living in scattered dwellings and the content of phosphorus (1 kg/a) and nitrogen (4.4 kg/a) per person equivalent (1 PE). On average, it is assumed that approximately 50% of the potential load reaches streams and rivers, but this figure is uncertain. Load from scattered dwellings is a part of the diffuse load.

Background load is determined from measurements in 9 small (1-10 km2) scarcely populated catchment areas with low agricultural and forestry activity. The loads from these catchment areas in 1995 were:

a) 7.3 kg P/(km^2 · a) or a discharge-weighted concentration of 0.055 mg P/l (median value)
b) 290 kg N/(km^2 · a) or a discharge-weighted concentration of 1.4 mg N/l (median value).

These background load figures are used for 94% of the Danish catchment area draining to the Baltic Sea assuming that the remaining 6% is fortified area without any background load.

Retention is included in the Danish source apportionment figures. Retention is calculated on the basis of intensive mass balance studies for 37 lakes. Results from these lakes and from calculation of the median retention coefficient in other lakes, combined with the percentage of lakes in the catchment area are used to calculate retention in monitored and unmonitored catchment areas. On average, nitrogen retention in Danish lakes was 25% of the input to the lakes in 1995. The corresponding figure for phosphorus was 3%.

Diffuse load was estimated by equation 7, where the gross riverine load is calculated as retention added to the measured riverine load. Agricultural load is calculated by deducting the load reaching streams and rivers from the diffuse load. Anthropogenic load is estimated by equation 5.

6.2.9 Sweden

Sweden performed the source apportionment for the total riverine load of nitrogen including direct point source load and load from unmonitored areas entering the Baltic Proper, the Sound and the Kattegat. No figures were given for phosphorus sources. Source apportionment is not available for the total Swedish nitrogen load entering the Baltic Sea. Further, source apportionment for nitrogen has been done for 115 sub-catchment areas including unmonitored areas. The Swedish methodology is an emission method, based on measurements and/or calculations of the loading sources (point sources and diffuse sources), and the total riverine load is the sum of these sources. The calculated riverine load is not comparable with the measured riverine load. The methodology is described in detail in Arheimer et.al. (1997).

Load from coastal point sources (i.e. municipal wastewater treatment plants and industrial plants) is calculated from measurements of nutrient concentration and flow in the effluents. The remaining load from point sources is measured or estimated.

Load (emission) from small settlements and scattered dwellings is calculated from statistics on population and wastewater production per capita. These emissions are included in the calculated diffuse emission. The diffuse emission also includes inputs from agricultural land and background load.

The total emission, or the gross riverine transport, is calculated with a nitrogen model. In this model some biological and chemical processes within the catchment area, the lakes and watercourses is also incorporated to estimate nitrogen turnover and retention. Nitrogen concentrations leaving the root zone from cultivated areas with various land use and three different soil types are calculated with the SOIL-N model. Information on land use and load from point sources is presented by using GIS tools for 3 725 sub-catchment areas in the Baltic Proper, the Sound and the Kattegat. Emissions from forested areas and non-cultivated areas (natural areas) are estimated from measurements in some minor experimental catchment areas. Atmospheric deposition on lakes is calculated with the MATCH model.

Background emission is measured to amount to 200 - 700 kg N/(km^2 a). The model is calibrated against concentration and flow measurements in streams and against measurements in experimental small watersheds. Retention within the catchment areas, in lakes and watercourses constitutes from less than 25% of the emission of nitrogen in coastal zones to more than 75% in sub-catchment areas with high percentages of lakes.

The importance of different sources is calculated as the measured/calculated emission divided by the calculated riverine load. The resulting source apportionment is to some extent an average for several years and not only based on figures from 1995.

6.3 Results of source apportionment

The performed source apportionments are given inTables 6.1 to 6.4. When comparing the figures it is important to take into account the different source apportionment methodologies and assumptions. Further, there is much missing data and few countries have done a point source inventory. Therefore, only very rough conclusion can be drawn.

Tables 6.1 and 6.2 suggests that anthropogenic sources are the most important sources of riverine nitrogen and phosphorus loads including direct point source loads in the Contracting Parties except Finland, where the background load has the same importance as anthropogenic sources. Further, in Lithuania the background load of phosphorus makes up approximately 50% of the total load, which compared with the corresponding nitrogen figure of 5% of the total nitrogen load is very high quota. In Finland and probably Sweden, the background load is most important in the catchment area within the northern part of the country (catchment areas of the Bothnian Bay and the Bothnian Sea). In fact in the catchment areas of the Archipelago Sea and the Baltic Proper, the anthropogenic sources are also the most important in Finland. This reflects the fact that with higher human activity, such as agriculture, industry and the number of inhabitants per km^2 the anthropogenic load will rise in absolute figures and in relative importance.

Tables 6.1 and 6.2 also suggest the importance of point sources. In Latvia, Poland, Germany and Denmark, point sources make up a higher percentage of total riverine phosphorus load than the corresponding figures for nitrogen. In Poland, the load from point sources appears to have the highest importance of all the Contracting Parties. In Finland and Lithuania the opposite might be true, but it is important to remember that the load from point sources in many countries is very uncertain and that point sources do not include the same elements. In regions with high population density and high industrial activ-ity, such as in the catchment area of the Sound, point sources are a very important phosphorus source.

The major element in the load from diffuse sources is often agricultural load. The diffuse load might be the most important source of total riverine nitrogen load, including load from coastal areas, in the catchment area of the Archipelago Sea in Finland, in Latvia, in Lithuania, in Germany, in Denmark and in the southern part of Sweden (Table 6.1). In areas with very intensive agriculture such as in Germany, Denmark and the southern part of Sweden the diffuse nitrogen sources make up approximately 80% of the total waterborne land-based load entering the Baltic Sea.

The diffuse phosphorus load might be the most important source of the total waterborne land-based load in Finland entering the Archipelago Sea, in Latvia the Gulf of Riga, in Germany the Baltic Proper and the Western Baltic and in Denmark the Kattegat (Table 6.2).

The source apportionment of nitrogen and phosphorus for the monitored rivers and streams (Tables 6.3 and 6.4) shows overall the same picture as the information in tables 6.1 and 6.2. There are of course greater differences as some monitored rivers are draining small, essentially natural areas, and therefore the background load is very important. Only the mean source apportionment is given for the Danish rivers and streams draining to the Baltic Proper, the Western Baltic, the Sound and the Kattegat, although source apportionment was done for the 103 monitored rivers and streams. The importance of the different nitrogen load sources on these Danish rivers and streams show only minor variations between the rivers and streams running into the Baltic Proper, the Western Baltic and the Kattegat, but high variation between those running into the Sound, as some streams drain very intensive populated areas with a high point source load. The variation of the importance of phosphorus load sources is higher for the Danish rivers and streams draining into the Baltic Proper, the Western Baltic, the Sound and the Kattegat, than for the corresponding nitrogen figures.

Table 6.1 Source apportionment for the total riverine nitrogen load including load from coastal areas given for the 9 Contracting Parties and their subregion catchment areas in 1995. Other point sources are the load from stormwater construction and from freshwater fish farms.

CP/ Subregion	Background load	Anthropogenic load					
		Total	Diffuse load	Point source load			
				Total	MWWTP	Industries	Other points sources
	in %	in %	in %	in %	in %	in %	in %
FINLAND	**56**	**44**	**24**	**20**	**15**	**5**	**n.i.**
BOB	69	31	18	13	8	5	n.i.
BOS	56	44	32	12	8	4	n.i.
ARC	27	73	44	29	18	11	n.i.
GUF	47	53	16	37	32	5	n.i.
RUSSIA	**n.i.**	**n.i.**	**n.i.**	**n.i.**	**n.i.**	**n.i.**	**n.i.**
GUF	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.
BAP	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.
ESTONIA	**n.i.**	**n.i.**	**n.i.**	**n.i.**	**n.i.**	**n.i.**	**n.i.**
GUF	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.
GUR	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.
BAP	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.
LATVIA	**5**	**95**	**91**	**4**	**n.i.**	**n.i.**	**n.i.**
GUR	5	95	91	4	n.i.	n.i.	n.i.
BAP	5	95	91	4	n.i.	n.i.	n.i.
LITHUANIA	**8**	**92**	**49**	**43**	**n.i.**	**n.i.**	**n.i.**
BAP	8	92	49	43	n.i.	n.i.	n.i.
POLAND	**19**	**81**	**35**	**46**	**n.i.**	**n.i.**	**n.i.**
BAP	19	81	35	46	n.i.	n.i.	n.i.
GERMANY	**21**	**79**	**71**	**8**	**n.i.**	**n.i.**	**n.i.**
BAP	21	79	71	8	n.i.	n.i.	n.i.
WEB	22	78	70	8	n.i.	n.i.	n.i.
DENMARK	**12**	**88**	**74**	**14**	**11**	**2**	**1**
BAP	14	86	74	12	11	1	0
WEB	12	88	78	10	8	1	1
SOU	8	92	27	66	54	10	2
KAT	13	87	79	9	5	2	2
SWEDEN	**n.i.**	**n.i.**	**n.i.**	**n.i.**	**n.i.**	**n.i.**	**n.i.**
BOB	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.
BOS	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.
BAP	18	82	40	42	36	5	2
SOU	20	80	59	21	16	4	1
KAT	24	76	40	36	28	5	2

n.i. = no information

Table 6.2 Source apportionment for the total riverine phosphorus load including load from coastal areas given for the 9 Contracting Parties and their subregion catchment areas in 1995. Other point sources are load from stormwater construction and from freshwater fish farm.

CP/ Subregion	Background load	Anthropogenic load					
		Total	Diffuse load	Point source load			
				Total	MWWTP	Industries	Other point sources
	in %	in %	in %	in %	in %	in %	in %
FINLAND	45	55	40	15	5	10	n.i.
BOB	60	40	32	8	2	6	n.i.
BOS	40	60	48	12	4	8	n.i.
ARC	15	85	60	25	6	19	n.i.
GUF	37	63	37	26	11	15	n.i.
RUSSIA	**n.i.**	**n.i.**	**n.i.**	**n.i.**	**n.i.**	**n.i.**	**n.i.**
GUF	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.
BAP	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.
ESTONIA	**n.i.**	**n.i.**	**n.i.**	**n.i.**	**n.i.**	**n.i.**	**n.i.**
GUF	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.
GUR	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.
BAP	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.
LATVIA	**12**	**88**	**39**	**49**	**n.i.**	**n.i.**	**n.i.**
GUR	11	89	52	37	n.i.	n.i.	n.i.
BAP	14	86	36	50	n.i.	n.i.	n.i.
LITHUANIA	**52**	**48**	**20**	**28**	**n.i.**	**n.i.**	**n.i.**
BAP	52	48	20	28	n.i.	n.i.	n.i.
POLAND	**14**	**86**	**23**	**63**	**n.i.**	**n.i.**	**n.i.**
BAP	14	86	23	63	n.i.	n.i.	n.i.
GERMANY	**5**	**95**	**76**	**19**	**n.i.**	**n.i.**	**n.i.**
BAP	4	96	74	22	n.i.	n.i.	n.i.
WEB	6	94	79	15	n.i.	n.i.	n.i.
DENMARK	**12**	**88**	**35**	**54**	**43**	**5**	**6**
BAP	13	88	25	62	58	3	1
WEB	15	85	41	44	34	3	7
SOU	2	98	14	84	74	6	4
KAT	16	84	46	38	24	6	8
SWEDEN	**n.i.**	**n.i.**	**n.i.**	**n.i.**	**n.i.**	**n.i.**	**n.i.**
BOB	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.
BOS	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.
BAP	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.
SOU	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.
KAT	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.

n.i. = no information

Table 6.3 Source apportionment for the nitrogen load in monitored rivers in the 9 Contracting Parties in 1995. Other point sources are load from stormwater construction and from freshwater fish farms.

CP / Rivers	Background load	Anthropogenic load					
		Total	Diffuse load	Point source load			
				Total	MWWTP	Industries	Other point sources
	in %	in %	in %	in %	in %	in %	in %
FINLAND							
n.i.	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.
RUSSIA							
Neva	n.i.	n.i.	n.i.	100	n.i.	n.i.	n.i.
Balttietz	n.i.	n.i.	12	n.i.	n.i.	n.i.	n.i.
Gorokhovka	45	55	55	0	n.i.	n.i.	n.i.
Karasta	43	57	52	4	n.i.	n.i.	n.i.
Kovashi	n.i.	n.i.	n.i.	1	n.i.	n.i.	n.i.
Krasnenskaya	n.i.	n.i.	54	46	n.i.	n.i.	n.i.
Lebiacshye	54	46	43	4	n.i.	n.i.	n.i.
Luga	n.i.	n.i.	45	n.i.	n.i.	n.i.	n.i.
Malinovka	14	87	63	23	n.i.	n.i.	n.i.
Peschanaya	n.i.	n.i.	33	n.i.	n.i.	n.i.	n.i.
Polevaya	n.i.	n.i.	51	n.i.	n.i.	n.i.	n.i.
Seleznevka	23	77	77	1	n.i.	n.i.	n.i.
Sestra	n.i.	n.i.	n.i.	96	n.i.	n.i.	n.i.
Shingarka	30	70	55	15	n.i.	n.i.	n.i.
Sista	n.i.	n.i.	53	n.i.	n.i.	n.i.	n.i.
Strelka	2	98	58	40	n.i.	n.i.	n.i.
Tchernaya	40	60	49	11	n.i.	n.i.	n.i.
Tchulkovka	n.i.	n.i.	9	n.i.	n.i.	n.i.	n.i.
Voronka	n.i.	n.i.	n.i.	2	n.i.	n.i.	n.i.
ESTONIA							
Narva	n.i.	n.i.	n.i	n.i	n.i.	n.i.	n.i.
Pühajõgi	22	78	16	62	n.i.	n.i.	n.i.
Purtse	25	75	49	26	n.i.	n.i.	n.i.
Kunda	24	76	74	2	n.i.	n.i.	n.i.
Seljajõgi	16	84	77	7	n.i.	n.i.	n.i.
Loobu	43	57	55	2	n.i.	n.i.	n.i.
Valgejõgi	65	35	30	5	n.i.	n.i.	n.i.
Pudisoo	90	10	10	0	n.i.	n.i.	n.i.
Jägala	58	42	39	3	n.i.	n.i.	n.i.
Vääna	20	80	79	1	n.i.	n.i.	n.i.
Keila	19	81	79	2	n.i.	n.i.	n.i.
Vihterpalu	58	42	42	0	n.i.	n.i.	n.i.
Vasalemma	50	50	47	3	n.i.	n.i.	n.i.
Kasari	33	67	66	1	n.i.	n.i.	n.i.
Pärnu	40	60	55	5	n.i.	n.i.	n.i.

n.i. = no information

CP / Rivers	Background load	Anthropogenic load					
		Total	Diffuse load	Point source load			
				Total	MWWTP	Industries	Other poin sources
	in %	in %	in %	in %	in %	in %	in %
LATVIA							
Saka	7	93	91	2	n.i.	n.i.	n.i.
Irbe	11	89	86	3	n.i.	n.i.	n.i.
Bārta	6	94	89	5	n.i.	n.i.	n.i.
Venta	5	95	94	1	n.i.	n.i.	n.i.
Lielupe	2	98	95	3	n.i.	n.i.	n.i.
Daugava	6	94	91	3	n.i.	n.i.	n.i.
Gauja	7	93	90	3	n.i.	n.i.	n.i.
Salaca	12	88	87	1	n.i.	n.i.	n.i.
LITHUANIA							
Nemunas	8	92	50	42	n.i.	n.i.	n.i.
Aknema-Dané + Sventoji	6	94	34	60	n.i.	n.i.	n.i.
POLAND							
Lupawa	11	89	17	72	n.i.	n.i.	n.i.
Oder	16	84	33	51	n.i.	n.i.	n.i.
Parsêta	21	79	28	51	n.i.	n.i.	n.i.
Paslêka	23	77	59	18	n.i.	n.i.	n.i.
Reda	13	87	22	65	n.i.	n.i.	n.i.
Rega	14	86	25	61	n.i.	n.i.	n.i.
Slupia	20	80	22	58	n.i.	n.i.	n.i.
Vistula	21	79	38	41	n.i.	n.i.	n.i.
Ina	18	82	39	43	n.i.	n.i.	n.i.
Grabowa + Wieprza	16	84	66	18	n.i.	n.i.	n.i.
Leba	17	83	25	58	n.i.	n.i.	n.i.
GERMANY							
Trave	19	81	74	7	n.i.	n.i.	n.i.
Schwentine	54	46	35	11	n.i.	n.i.	n.i.
Füsinger Au	19	81	78	3	n.i.	n.i.	n.i.
Stepenitz	18	82	78	4	n.i.	n.i.	n.i.
Wallensteingraben	11	89	51	38	n.i.	n.i.	n.i.
Warnow	25	75	68	7	n.i.	n.i.	n.i.
Recknitz	29	71	60	11	n.i.	n.i.	n.i.
Barthe	24	76	69	7	n.i.	n.i.	n.i.
Ryck	25	75	74	1	n.i.	n.i.	n.i.
Peene	23	77	67	10	n.i.	n.i.	n.i.
Zarow	33	67	58	9	n.i.	n.i.	n.i.
Uecker	29	71	54	17	n.i.	n.i.	n.i.
DENMARK							
BAP: 8 rivers	12	88	87	1	1	0	0
WEB: 50 rivers	14	86	79	7	5	0	2
SOU: 13 rivers	18	82	63	19	12	0	7
KAT: 32 rivers	19	81	72	8	5	0	3
SWEDEN							
n.i.	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.

n.i. = no information

Table 6.4 Source apportionment for the phosphorus load in monitored rivers in the 9 Contracting Parties in 1995. Other point sources are load from stormwater construction and from freshwater fish farms.

CP / Rivers	Background load	Anthropogenic load					
		Total	Diffuse load	Point source load			
				Total	MWWTP	Industries	Other point sources
	in %	in %	in %	in %	in %	in %	in %
FINLAND							
n.i.	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.
RUSSIA							
Neva	n.i.	n.i.	n.i.	100	n.i.	n.i.	n.i.
Balttietz	n.i.	n.i.	10	n.i.	n.i.	n.i.	n.i.
Gorokhovka	64	36	16	20	n.i.	n.i.	n.i.
Karasta	15	85	5	79	n.i.	n.i.	n.i.
Kovashi	57	43	4	40	n.i.	n.i.	n.i.
Krasnenskaya	n.i.	n.i.	6	94	n.i.	n.i.	n.i.
Lebiacshye	21	79	5	74	n.i.	n.i.	n.i.
Luga	n.i.	n.i.	18	n.i.	n.i.	n.i.	n.i.
Malinovka	6	94	5	90	n.i.	n.i.	n.i.
Peschanaya	n.i.	n.i.	13	n.i.	n.i.	n.i.	n.i.
Polevaya	n.i.	n.i.	18	n.i.	n.i.	n.i.	n.i.
Seleznevka	37	63	20	43	n.i.	n.i.	n.i.
Sestra	n.i.	n.i.	n.i.	100	n.i.	n.i.	n.i.
Shingarka	10	90	6	84	n.i.	n.i.	n.i.
Sista	n.i.	n.i.	21	n.i.	n.i.	n.i.	n.i.
Strelka	1	99	6	93	n.i.	n.i.	n.i.
Tchernaya	24	76	6	70	n.i.	n.i.	n.i.
Tchulkovka	n.i.	n.i.	10	n.i.	n.i.	n.i.	n.i.
Voronka	n.i.	n.i.	n.i.	55	n.i.	n.i.	n.i.
ESTONIA							
Narva	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.
Pühajõgi	7	93	0	93	n.i.	n.i.	n.i.
Purtse	37	63	40	23	n.i.	n.i.	n.i.
Kunda	50	50	42	8	n.i.	n.i.	n.i.
Seljajõgi	9	91	52	39	n.i.	n.i.	n.i.
Loobu	40	60	43	17	n.i.	n.i.	n.i.
Valgejõgi	45	55	10	45	n.i.	n.i.	n.i.
Pudisoo	70	30	30	0	n.i.	n.i.	n.i.
Jägala	17	83	76	7	n.i.	n.i.	n.i.
Vääna	20	80	76	4	n.i.	n.i.	n.i.
Keila	19	81	63	18	n.i.	n.i.	n.i.
Vihterpalu	41	59	59	0	n.i.	n.i.	n.i.
Vasalemma	43	57	33	24	n.i.	n.i.	n.i.
Kasari	38	62	55	7	n.i.	n.i.	n.i.
Pärnu	47	53	32	21	n.i.	n.i.	n.i.

n.i. = no information

CP / Rivers	Background load	Anthropogenic load					
		Total	Diffuse load	Point source load			
				Total	MWWTP	Industries	Other point sources
	in %	in %	in %	in %	in %	in %	in %
LATVIA							
Saka	23	77	22	55	n.i.	n.i.	n.i.
Irbe	44	56	28	28	n.i.	n.i.	n.i.
Bārta	21	79	44	35	n.i.	n.i.	n.i.
Venta	20	80	57	23	n.i.	n.i.	n.i.
Lielupe	8	92	70	22	n.i.	n.i.	n.i.
Daugava	14	86	68	18	n.i.	n.i.	n.i.
Gauja	34	66	31	35	n.i.	n.i.	n.i.
Salaca	31	69	58	11	n.i.	n.i.	n.i.
LITHUANIA							
Nemunas	57	43	22	21	n.i.	n.i.	n.i.
Aknema-Dané + Sventoji	27	73	10	63	n.i.	n.i.	n.i.
POLAND							
Lupawa	16	86	8	78	n.i.	n.i.	n.i.
Oder	12	88	20	68	n.i.	n.i.	n.i.
Parsêta	32	68	18	50	n.i.	n.i.	n.i.
Paslêka	16	84	15	69	n.i.	n.i.	n.i.
Reda	18	82	16	66	n.i.	n.i.	n.i.
Rega	17	83	12	71	n.i.	n.i.	n.i.
Slupia	14	86	8	78	n.i.	n.i.	n.i.
Vistula	16	84	28	56	n.i.	n.i.	n.i.
Ina	10	90	42	48	n.i.	n.i.	n.i.
Grabowa + Wieprza	19	81	8	73	n.i.	n.i.	n.i.
Leba	18	82	12	70	n.i.	n.i.	n.i.
GERMANY							
Trave	10	90	85	5	n.i.	n.i.	n.i.
Schwentine	13	87	67	20	n.i.	n.i.	n.i.
Füsinger Au	12	88	88	0	n.i.	n.i.	n.i.
Stepenitz	7	93	77	16	n.i.	n.i.	n.i.
Wallensteingraben	4	96	42	54	n.i.	n.i.	n.i.
Warnow	6	94	77	17	n.i.	n.i.	n.i.
Recknitz	8	92	66	26	n.i.	n.i.	n.i.
Barthe	9	91	71	19	n.i.	n.i.	n.i.
Ryck	7	93	87	6	n.i.	n.i.	n.i.
Peene (total)	8	92	67	25	n.i.	n.i.	n.i.
Zarow	5	95	77	18	n.i.	n.i.	n.i.
Uecker (total)	3	97	69	28	n.i.	n.i.	n.i.
DENMARK							
BAP: 8 rivers	6	94	91	3	2	0	1
WEB: 50 rivers	24	76	48	28	19	0	9
SOU: 13 rivers	7	93	65	28	13	0	15
KAT: 32 rivers	29	71	44	27	18	0	9
SWEDEN							
n.i.	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.	n.i.

n.i. = no information

7

Results, Conclusions and Recommendations

7.1 Results

The Third Baltic Sea Pollution Load Compilation (PLC-3) carried out in 1995 examined nutrient, organic matter and heavy metal loads entering the Baltic Sea marine environment from rivers, coastal areas and direct point sources such as municipalities and industrial plants. However, point source discharge was only taken into account when the source was discharging directly into the Baltic Sea or when it was located downstream of the hydrological/hydrochemical station in the river for which the load is given. Therefore, only a small proportion of the total point sources located within a river basin were considered, which means that an inventory of all point sources in the whole Baltic Sea catchment area is missing. The calculations in PLC-3 can be considered more reliable and precise than calculations in PLC-1 and PLC-2, but still many uncertainties remain due to incomplete data sets, especially from the Russian Baltic Sea catchment area and from nearly all the Contracting Parties where heavy metals are concerned.

The **runoff and direct point source discharge** considered in PLC-3 is 466 000 million m^3/a, of which about 99% represents runoff into the Baltic Sea from rivers and coastal areas. Only 1% of the discharge came from municipalities and industrial plants located at the coast, to which treated and untreated municipal discharge and treated industrial discharge each contributed about 0.3%. The amount of untreated direct industrial discharge was negligible in comparison with all other pollution sources.

In 1995 the total **BOD_7 load** going into the Baltic Sea amounted to 1 140 000 t. The major part of organic matter load, 80%, entered the Baltic Sea via rivers and coastal areas. The BOD_7 load from municipalities and industrial plants discharging treated wastewater directly into the Baltic Sea is 9% in each case. The share of untreated municipal BOD_7 load was quite low, only 1%, but it should be noted that the untreated portion of the load from the Russian Kaliningrad region discharging directly into the Baltic Proper is missing. The share of untreated direct industrial BOD_7 load was also quite low, 0.002%.

In 1995 the **total waterborne N_{total} input and P_{total} input** (natural background and anthropogenic) into the Baltic Sea amounted to 761 000 t/a and 38 000 t/a, respectively. The major part of N_{total} load, 90%, and P_{total} load, 80%, entered the Baltic Sea via rivers. The treated municipal and industrial share of N_{total} load discharging directly into the Baltic Sea comprised 8% and 2% respectively, whereas these shares of P_{total} load were 13% and 5%, respectively. The proportion of untreated municipal and industrial N_{total} load and P_{total} load discharging directly into the Baltic Sea was quite low, less than 0.3% in each case.

Due to very incomplete data, a full picture of the **heavy metals load** going into the Baltic Sea could not be given. Many figures are missing from the heavy metals summary, but reported results indicate that riverine heavy metals load is the largest source of total pollution load with approximately 90%. The municipal and industrial wastewater discharges, together with diffuse discharges within the river catchment areas, are probably the main anthropogenic sources within the riverine load.

Because much of the pollution load is introduced into the Baltic Sea via rivers, another important step forward was to distinguish the nutrient load between the natural (background) and anthropogenic contributions (point source and diffuse source load) to riverine fluxes. The so called **source apportionment** is a tool for evaluating the importance of different sources to riverine nutrient fluxes. The objective of separating riverine fluxes is to assess the importance of anthropogenic sources. The political and administrative systems, therefore could have a tool for evaluating what measures for combating nutrient pollution yield the best cost benefit for the environment. According to PLC-3 Guidelines, the Contracting Parties should therefore estimate the proportion of natural load and the anthropogenic load, separately.

According to the results of the source apportionment the natural background load of nitrogen contributed 10-20% of the total load in Denmark, Germany and southern parts of Sweden, but more than 50% of the corresponding load in Finland. Diffuse load, mainly from agriculture, was the main nitrogen source in many Contracting Parties, between 70% and 90% of the total nitrogen load, but in Finland and Poland it was only one-quarter and one-third, respectively. The point source load is usually the minor source of nitrogen load constituting 15-20% of the total nitrogen load in Denmark, Germany and southern Sweden and up to approximately 40% in Lithuania and Poland. On the other hand, point sources were the largest source of phosphorus load in Denmark, southern Sweden, Germany, Poland and Latvia (50-65%), but the smallest in Finland (15%). Background load of phosphorus made up 10-15% in Denmark, Germany, Poland, Lithuania and southern Sweden and up to approximately 50% in Finland and Latvia. Diffuse sources constituted 20-40% of total phosphorus load. It is very important to mention that figures provided by the Contracting Parties were in some cases very uncertain. Moreover, no information was received from Russia or Estonia, so that the results given above should be used with caution. Within the Contracting Parties there is great variation in the importance of the load from different sources, depending on land use, soil types, percentage of agricultural land and population density.

7.2 Discussion of results and proposals for the next stage of PLC

During the third stage of PLC the major uncertainties and weaknesses of PLC-2 could be avoided by establishing a quality assurance system, creating a data-entry system closely connected to a database and by doing the first steps for a source apportionment. Compared with the former two Pollution Load Compilations PLC-3 is a significant step forward as it gives much more reliable and complete data on the total loads entering the Baltic Sea including the description of the methodologies used in the various countries. Compared with PLC-2, the coverage of the pollution sources in PLC-3 increased significantly as load from small rivers (Q < 5 m³/s) and small settlements (< 10 000 PE) were included. Nevertheless, during PLC-3 many uncertainties remain due to incomplete data sets from Russia and from nearly all Contracting Parties concerning heavy metals. Because the quality of the reported load data during these three stages was very variable, it was still impossible to compare PLC-3 with former pollution load compilations, to evaluate trends in loads and to evaluate the importance of various pollution sources.

The aim of the discussion is to reveal some issues that have arisen in the course of the work and to draw attention to some problems that need to be solved before the work starts on the next Pollution Load Compilation (PLC-4). In the following the main shortcomings are discussed.

Information about the Baltic Sea catchment area

There is an essential need to check and review the information by subregion and by Contracting Party with regard to the Baltic Sea river catchment areas and coastal areas including information on how the population is settled. Especially for transboundary rivers there were many difficulties in dividing the catchment area and the population between the countries concerned. When a part of a transboundary river catchment area is in the territory of a Non-Contracting Party, it was very difficult to obtain any information about these shares, including population. Therefore, separation of riverine load into Contracting Parties and Non-Contracting Parties could not be done. **For the next Pollution Load Compilation, it is very important that information (area, population, point sources and agriculture) should be given for each transboundary river catchment area as a whole and separately for each country's share (Contracting Parties as well as Non-Contracting Parties). Moreover, each Contracting Party should present information (area, population, point sources and agriculture) about the monitored and unmonitored parts of the river basins as well as coastal zones.**

Rivers

Flow measurement is a key element when calculating riverine load. The river flow in large rivers varies in most cases more than the concentration. Thus, it is of great importance that the flow is registered continuously. The main rivers in the Baltic Sea catchment area have permanent hydrological stations corresponding to the WMO Guide to Hydrological Practice. The partially monitored rivers have no permanent hydrological stations. **Partially monitored rivers should be avoided by making contemporary runoff measurements at the hydrochemical monitoring measurement site in order to obtain proper runoff information.**

In most of the Baltic Sea rivers the permanent hydrological/hydrochemical stations are not located at the river mouth, as far as the eastern and southern coasts are concerned these stations are very often situated far from the coast, sometimes at a distance of 50-60 km. Since the way of submitting the **riverine load for the unmonitored portion of monitored rivers** was not clearly defined in the PLC-3 Guidelines, different approaches were used: in some countries, e.g. Finland, the load for the unmonitored portion of monitored rivers was calculated on the basis of similarity and added to the measured portion of monitored rivers, so that a total riverine load figure could be given. In other countries, e.g. Denmark, the load for the unmonitored portion of monitored rivers was also calculated on the basis of similarity, but presented under the source category, unmonitored rivers. A third approach used in all other Contracting Parties was that the unmonitored portion of the monitored rivers was measured and reported under the source category "point sources". **In the next Pollution Load Compilation, a harmonised reporting procedure of the load for the unmonitored portion of monitored rivers should be precisely defined.**

In comparison with PLC-2, the **sampling frequency** in the monitored rivers has been increased to at least 12 times per year for organic matter and nutrients. Only in Polish rivers the sampling frequency for all parameters measured was once per week. For heavy metals a sampling frequency of less than 12 times per year was mostly insufficient. In a lot of rivers no heavy metal measurements were carried out. **For those rivers carrying the heaviest pollution load into the Baltic Sea such as the Neva, the Daugava, the Vistula, the Nemunas etc., the sampling frequency should be increased to once a week; the sampling procedure should take into account flow proportional sampling within the cross section.**

Point sources (municipalities and industrial plants)

With reference to PLC-2 the number of industrial plants and municipal wastewater treatment plants with continuously measured and registered flow measurements has increased considerably. Although the portion of the untreated wastewater is lower in PLC-3 than in PLC-2 the main difficulties are connected with the measurement of untreated wastewater from smaller settlements, scattered dwellings, overflows, by-passes and other stormwater constructions. Measurements of untreated wastewater is a problem for countries in transition, especially for large cities such as Saint Petersburg and Riga, which have a large number of outlets. **For the next PLC the measurement of untreated wastewater from all sources discharging directly into the Baltic Sea should be improved, so that all Contracting Parties provide the required information about loads, inhabitants, population equivalents and reduction coefficients for scattered dwellings.**

As indicated in chapter 3, only in Denmark, Finland, Germany and Sweden the treated wastewater amount is measured continuously with an accuracy of more than 5%. In all the other Contracting Parties there is sometimes a high percentage of point sources for which the wastewater amount has not been measured. This was determined on the basis of water consumption and is therefore only an estimate. **For the next PLC, the target should be to measure the amount of treated wastewater continuously in at least all large point sources (e.g. municipal wastewater treatment plants > 10 000 PE).**

Reliability of the results of PLC-3

The Contracting Parties are responsible for the quality and reliability of data. The main problem in PLC-3 was that not all obligatory parameters were measured by each Contracting Party. There was a big problem connected with Russian data because a lot of the figures were only estimated as totals by subregion, and figures from the Kaliningrad region were missing completely. Compared with PLC-2, heavy metal load data has improved a little, but there are still a lot of load figures missing, so that it is not possible to present total heavy metal load figures for the whole of the Baltic Sea.

The difficulties in obtaining comparable load data in 1995 were caused by a lack of laboratory equipment for analysis, inability to ensure adequate sampling or difficulty in analysing very small concentrations of certain substances. There are also very clear differences in the size of the water courses in the various countries. For example, southern Sweden's relatively few large rivers could be sampled effectively, while the hundreds of small streams and brooks in Denmark were very difficult to sample in practice.

In addition, the natural differences between the Contracting Parties and the consequences of different legislation should also be recognised. Due to the fact that Polish legislation does not allow load figures for industrial plants to be supplied plant by plant, Poland only submitted summarised load figures by branch of industry. Furthermore, some of the Contracting Parties monitored load from small plants with only 30 PE in monitored and unmonitored catchments, while others did even not monitor large municipalities.

The main task for the next PLC is that each of the Contracting Parties should report reliable and complete data sets of the pollution load. It will then be possible to estimate the total pollution load going into the Baltic Sea. Therefore, the parameters for which total loads of all source categories should be given must be obligatory in each source category, without footnotes and exceptions. It is useless to declare a parameter as being voluntary. All parameters must be mandatory.

Chemical Analyses and Quality Assurance

A quality assurance programme was established before starting PLC-3 to obtain reliable and comparable data. The first step was to establish national reference laboratories, which have played an essential role in improving analytical performance in most countries. The national reference laboratories have provided personnel training and carried out interlaboratory comparisons. Most laboratories that participated in PLC-3 carried out internal EN 45001 and ISO/IEC Guide 25. While PLC-3 was underway, some improvements were made, particularly in the reference laboratories of Estonia, Latvia, Lithuania and Poland with the support of the EU-PHARE programme. Unfortunately some countries had problems with, for instance, inappropriate methodology or inadequate instruments. However, the quality assurance programme has to some degree supported the data produced for PLC-3 and provided information on methodology and quality assurance for many laboratories.

In order to obtain relevant and reliable data in future stages of PLC, it is essential that the laboratories continue the implementation of the quality assurance programme to obtain international accredition. Establishing of working practices for quality assurance needs time. It is clear that the laboratories in the eastern Baltic countries still need support in terms of training and funding for improvement of analysis equipment.

Source Apportionment

In PLC-3 only the first steps were taken to distinguish between natural and anthropogenic contribution to riverine nutrient fluxes. Some of the Contracting Parties had not followed the Guidelines or had not provided the necessary information to carry out a proper source apportionment. Further, source apportionment has not been done at a comparable scale. Some of the Contracting Parties have carried out source apportionment on individual rivers, some on the sum of all monitored rivers, and some on the total load including load from unmonitored areas on a regional or national scale. The division between point sources and diffuse sources was problematic since load from freshwater fish farms and from stormwater constructions in some countries were included in the diffuse load, but in other countries in the point source load. Another problem was that some of the Contracting Parties could not deliver measured point source load figures, and that background load was not estimated by the same methodology. Apart from this, on some occasions source apportionment was carried out on gross riverine loads including retention and on other occasion only on net riverine loads. The former method gives a better estimate of the actual delivery from different load sources.

For PLC-4 it will be important to have a common definition of which sources constitute point sources and which constitute diffuse sources. A common methodology for estimating background (natural) load and retention is also required. Source apportionment should be carried out for all monitored rivers and for the Baltic Sea catchment areas of the Contracting Parties and for the nine Baltic Sea subregions. This means it will be necessary to develop a harmonised and comparable source apportionment approach. One of the most important prerequisites for that will be a point source inventory for the entire Baltic Sea catchment area. It should to some extent be possible to improve the source apportionment performed in PLC-3 to allow a comparison with a new source apportionment which will be carried out in PLC-4.

Data handling / data-entry system

Shortcomings in implementation of the PLC-3 Guidelines and in the reporting system with respect to time-tables and the data-entry system have caused many problems in data handling. The time-tables agreed by all Contracting Parties were not followed and were changed several times. Most of the data sets were incomplete and had very often to be corrected and amended by the countries concerned. Accordingly the agreed data outputs had to be changed several times during the PLC-3 process, too. In addition to that, many problems occurred with the data-entry system, developed as a Paradox application and built for storing of the

PLC-3 data. Due to the rapid development of computer technique this Paradox application did not fulfil the requirements of the Contracting Parties including the countries in transition. In the Paradox application the need to retrieve data stored in national databases into this programme was not foreseen, so that work was repeated in typing all data and information once more into the Paradox application. Furthermore, it was not possible to printout from the Paradox database to allow typing mistakes to be checked easily.

Although a data-entry system was implemented during PLC-3, there is a need to revise the existing database for future stages of PLC, to comply with the requirements of the Contracting Parties. **It is necessary to minimise the work of the information providers and to minimise the risk of errors caused by modification and refeeding of the data. This will be only possible with a new data system for data transfer from the Contracting Parties to the data consultant, which will allow the Contracting Parties to copy data from their own databases into transfer files in the most convenient way. Such a new system of data transfer including an improved HELCOM waterborne pollution load database, should be taken into use in PLC-4.**

The Contracting Parties only provided calculated annual load figures, so that checking of these figures by the data consultant was not possible. **In future, whether or not primary data such as concentration and flow should be reported in addition to or instead of calculated loads must be taken into account, so that the data consultant has the opportunity to check and calculate load data on the basis of the agreed harmonised calculation procedures like in the database for the air deposition data.**

7.3 Main conclusions and recommendations

The Third Baltic Sea Pollution Load Compilation (PLC-3) is a result of co-operation between all the Contracting Parties to the Helsinki Commission. So far, three Baltic Sea Pollution Load Compilations have been carried out in 1987 (PLC-1), 1990 (PLC-2) and 1995 (PLC-3) with the aim of compiling the direct inputs of major pollutants entering the Baltic Sea from various sources (rivers, municipalities and industrial plants) on the basis of harmonised monitoring methods. Compared with the two former Pollution Load Compilations, PLC-3 is a significant step forward as it gives somewhat more reliable and complete data on the total loads on the Baltic Sea including the description of the methodologies used in the different countries. However, the quality of the reported load data during the three Pollution Load Compilations was very mixed, so that it is still impossible to make a realistic assessment of changes in the pollution load. There are many reasons for this, by which the most important ones being the following:

- PLC-1 was the first attempt to compile heterogeneous data that had been submitted to the Helsinki Commission on various occasions. Because the information came from various sources there were differences in the reliability and age of the data aswell as gaps in the data sets. Assuming that the values were often preliminary or based on very rough background information, it was recommended to use PLC-1 with caution.

- PLC-2 contained the generalised data characterising major pollution sources and loads with respect to BOD_7, N_{total} and P_{total}. Information about untreated wastewater, overflows and by-passes from point sources discharging directly into the Baltic Sea, about the load coming from small rivers (< 5 m^3/s) and small settlements (< 10 000 PE) around the coast and coastal zones was missing. A quality assurance system was also missing.

- PLC-3 avoided the shortcomings in the coverage of the Baltic Sea catchment area, but the PLC-3 Guidelines were not fully implemented in all of the Contracting Party with respect to measuring all the obligatory parameters in all pollution source categories. So, many uncertainties remain due to incomplete load data sets, especially from Russia, and from nearly all Contracting Parties with regard to heavy metals.

The assessment of the three Pollution Load Compilations has clearly shown that these could not be used for proving whether reduction targets (e.g. 50% reduction) have been met or not. Based on the data collected within the Pollution Load Compilations, proving that riverine pollution load represents the main pollution source, it is not possible to assess whether the goal of 50% reduction between 1987 and 1995 which was set as a target by the Ministerial Declaration in 1988 has been fulfilled. This is mainly due to the fact that riverine load data are highly dependent on meteorological factors such as precipitation and runoff and that the anthropogenic part could not be separated.

By ratifying the 1992 Convention, the Contracting Parties will implement relevant measures in the whole Baltic Sea catchment area in order to prevent pollution of the Baltic Sea. It is well known that the major part of the pollution load is transported by rivers to the Baltic Sea. The load of these rivers is caused by discharges from point and diffuse sources within the catchment areas of these rivers, and it is therefore an important task for the next PLCs to start investigations on collecting load data for point and diffuse sources situated within the whole Baltic Sea catchment area. This requires e.g. that data on point sources must be reported on a plant by plant basis in order to obtain information about the anthropogenic part of the river input and as a tool to determine whether the reduction goals have been met or not. Furthermore, data must be reported on diffuse sources, especially from agriculture. With these point and diffuse source inventories, together with a proper source apportionment, such goals as the 50% reduction of pollution load between 1987 and 1995 could be realistically evaluated.

Annexes

List of References

Analytical Quality Assurance to Support the HELCOM PLC-3 Programme in the three Baltic States and Poland. Report to the EU PHARE Operational Services and HELCOM (Contract No 94-0891). Prepared by Dr. U. Lund, VKI and Dr. G. Topping, SOAEFD. Water Quality Institute (VKI), November 1996.

Arheimer, B., Brandt, M., Grahn, G., Roos E. and Sjöö, A. (1997): Modellerad kvävetransport, retention och källfördelning for södra Sverige. SMHI RH no. 13. Underlagsrapport till Naturvardsverkets uppdrag om Kväve fr n land till hav, 85 pp.

Behrendt, H. (1996): Inventories of point and diffuse sources and estimated nutrient loads - A comparison for different river basins in Central Europe. Water, Science & Technology, 33, 4-5, 99-107, 1996

HELCOM. Baltic Sea Environment Proceedings No. 45. Second Baltic Sea Pollution Load Compilation; 1993.

HELCOM. Baltic Sea Environment Proceedings No. 57. Guidelines for the Third Baltic Sea Pollution Load Compilation (PLC 3); 1994.

ISO/TR 13530, 1997. Water quality - Guide to analytical quality control for water samples.

ISO/IEC Guide 43-1, 1997. Proficiency Testing by Interlaboratory Comparisons - Development and Operation of Proficiency Testing Scheme.

Larson, U., Elmgren, R. and Wulff, F. Eutrophication and the Baltic Sea: Causes and consequences. AMBIO 14, 1985. pp. 9-14.

TC POLO 3/9 (Summary Record), Annex 5 "Guidelines for estimating natural and anthropogenic contributions to riverine fluxes (source apportionment)".

Annex 1. Analytical Methods

ORGANIC MATTER AND SUSPENDED SOLIDS

Analytical parameter	Principle	Country
BOD_7	Dilution with oxygenated water; incubation for 7 days in the dark at 20°C; determination by titration or by electrometry	DE, EE, FI, LV, SE
BOD_5 or BOD_{5+2}	Dilution with oxygenated water; incubation for 5 days in the dark at 20°C; determination by titration or by electrometry	DK, LT, PL, RU
COD_{Cr}	Digestion with potassium dichromate for 2 hours; addition of silver sulphate catalyst; open reflux; determination by titration	DK, LT, LV, PL, RU, SE
	Digestion with potassium dichromate for 2 hours; addition of silver sulphate catalyst; tube method; determination by titration or by photometry	EE, FI
COD_{Mn}	Digestion with potassium permanganate; determination by titration	DK, EE, FI, LT, PL, SE
TOC	Combustion at 600-1000°C or UV-radiation; determination by IR-spectroscopy	DE, DK, FI, SE
SS	Rivers: Filtration by membrane filter (~0.4- 0.5 mm)	DE, FI, RU
SS	Rivers: Filtration by membrane filter (~0.6-1.0 mm)	EE, LT, LV
SS	Rivers and wastewater: Filtration by paper filter (medium pore size)	PL
SS	Rivers and wastewater: Filtration by glass filter (1-2 mm)	DK
SS	Wastewater: Glassfibre filter (~10 mm)	FI, SE
SS	Wastewater: Membrane filter (~ 3 µm)	EE
SS	Wastewater: Membrane filter (~ 0.45 µm)	DE, LV

HEAVY METALS (Cd, Cr, Cu, Ni, Pb, Zn) AND MERCURY (Hg)

Analytical parameter	Principle	Country
Heavy LV, metals	AAS, acetylene-air flame or graphite furnace (depending mainly on concentration)	EE, DE and FI (wastewater), PL, SE, RU, LT
Heavy metals	AAS, graphite furnace	DE (rivers)
Heavy metals	Voltametry	DE (rivers)
Heavy metal	ICP-AES	DE (wastewater)
Heavy metals	ICP-MS	DK (wastewater), FI (rivers), SE
Hg	Digestion; reduction; determination by cold vapour technique	DK, EE, FI (wastewater), PL, SE (wastewater)
Hg	Digestion; reduction; enrichment on gold; determination by FLMS-analyser or CVAFS-analyser	FI (rivers), SE (rivers)
Hg	UV-radiation; enrichment on gold; reduction; determination by cold vapour technique	DE

Annex 1/2

NUTRIENTS

Analytical parameter	Principle	Country
P_{PO4}	Molybdenum blue method	DE, DK, EE, FI, LT, LV, PL, RU, SE
P_{total}	Digestion with peroxodisulphate; determination of orthophosphate by the molybdenum blue method	DE, DK, EE, FI, LT, LV, PL, RU, SE
P_{total}	Digestion with peroxodisulphate + sulphuric acid; determination of ortophosphate by the molybdenum blue method	FI (mainly wastewater)
P_{total}	Determination of orthophosphate by the molybdenum blue method; estimation of P_{total} by correction factor	RU (some wastewater laboratories)
N_{NH4}	Indophenol blue method	DE, DK, EE, FI, LV, PL, SE
N_{NH4}	Distillation and titration	DK (a minority of laboratories, wastewater)
N_{NH4}	Distillation + Nessler method or titration	PL (wastewater)
N_{NH4}	Gas diffusion indicator method	DK, FI (a minority of laboratories)
N_{NH4}	Nessler method	LT, PL, RU
N_{NO3}	Cadmium reduction method and determination of azo dye	DE, DK, EE, FI, LT, LV, PL, RU (rivers), SE
N_{NO3}	Devardas reduction	DK (a minority of laboratories, wastewater)
N_{NO3}	Salicylate method	EE (some wastewater laboratories), LV (wastewater), PL , RU (wastewater)
N_{total}	Peroxodisulphate digestion; reduction on cadmium column and determination of azo dye	DK, EE, FI, DE, LT, SE, RU
N_{total}	Peroxodisulphate digestion; determination of nitrate by salicylate method	LT (wastewater), LV
N_{total}	Kjeldahl plus determination of nitrate/nitrite	PL
N_{total}	Reduction with Devarda's alloy; determination of ammonia by titration or indophenol blue	DK (a minority of laboratories), FI (mainly for wastewater)

ANNEX 2. Detection Limits

	AOX in mg/l	BOD in mg/l	COD_{cr} in mg/l	COD_{Mn} in mg/l	TOC in mg/l	N_{NH4} in mg/l	N_{NO3} in mg/l	N_{total} in mg/l	P_{PO4} in mg/l	P_{total} in mg/l	Cd in µg/l	Cr in µg/l	Cu in µg/l	Ni in µg/l	Pb in µg/l	Zn in µg/l	Hg in µg/l
RIVERS																	
DE	10; 5	0.2; 1	3		0.1; 1	0.01; 0.01	0.01; 0.05	0.1; 0.05	3; 5	10; 5	0.07; 0.02	0.5; 0.2	0.2; 0.5	0.5	0.1; 0.2	0.2; 1	0.04; 0.001
DK		0.5			0.5	0.01	0.01	0.03	10	10							
EE		1				~0.002	0.01-0.02	~0.01	~ 2	~ 2	0.02	0.5	0.2	0.4	0.2	4.0	0.05
FI	10				0.2	~0.002	~0.005	~0.01		~ 2	~ 0.03	~ 1	~ 0.4	~ 1	~ 1	~ 10	~ 0.02
LT		0.5	5	2.5		0.02	0.01	~0.01	~10	~ 10	0.1	0.5	0.5	4	2	2.5	
LV		3				~ 0.020	~0.01	~0.01	~7	~ 10	~ 10		100		30	500	
PL		1; 5		0.5 - 2		0.01 - 0.09	~ 0.1	0.03 - 0.2	20 - 75	10 - 80	~ 0.1	~ 1	~ 1	~ 1	~ 1	~ 1	6 1
RU		3				~ 0.05	0.01	0.1	10	20	~ 1	~ 2	~ 1	~ 10	~ 2	~1	
SE	10	3			1	~0.001	~0.005	~0.01	1	1	0.02	0.4	0.4	0.6	0.2	0.6	0.02
EFFLUENTS																	
DE	10; 5	5; 1	15		0.1; 1	0.1; 0.01	0.1; 0.05	0.1; 0.05	10; 5	40	0.07; 0.02	0.5;.0.2	0.2; 0.5	0.5	0.1; 0.2	0.2;2	0.04;
DK		3	30	1	0.5						0.01	0.04	0.1	0.1	0.1	1	0.1
EE		3	30			0.1; 1	0.2	0.1; 5	100	100	0.02	0.5	0.2	0.4	0.2	4.0	0.05
FI	10	2	30		0.2	~0.01	~0.005	0.01 - 1	~ 2	~ 10	~ 1	~ 5	~ 5	~ 5	~ 5	~ 10	~ 1
LT		3	30	2.5		0.1	0.01	1	~ 10	~ 10	0.1	0.5	0.5	4	2	2.5	
LV		3	20			0.02	0.1	~ 0.1	10	40	50	250	200	250	500	70	
PL		5	10			0.04 - 0.1	~ 0.1	0.1	~ 50	~ 50	1	1	2	2	2	5	0.5
RU		3				~ 0.1	~ 0.01	~ 0.1		~ 50	~ 1	~ 20	~ 1	~ 10	~ 2	~ 1	
SE	10	2	4					0.01		2	0.1	1	1	1	1	5	0.2

Annex 3. Main information on monitored and partly monitored rivers in 1995

SUBREGION	NAME	TOTAL DRAINAGE AREA OF THE RIVER in km	TOTAL DRAINAGE AREA OF THE RIVER IN THE CP in km	UNMONITORED PART OF THE RIVER IN THE CP in km	DRAINAGE AREA CONTROLLED BY HYDROLOG. STATION in km	DRAINAGE AREA CONTROLLED BY HYDROCHEM. STATION in km	MEAN FLOW RATE 1995 in m/s	MIN. FLOW RATE 1995 in m/s	MAX. FLOW RATE 1995 in m/s	LONG-TERM MEAN FLOW in m/s	LONG-TERM MEAN FLOW PERIOD
FINLAND											
BOB MONITORED	IIJOKI	14191	14191	0			163	33	843	163	1970–1990
	KALAJOKI	4247	4247	0			35	4,9	407	41	1970–1990
	KEMIJOKI	51127	51127	0			565	119	4107	543	1970–1990
	KIIMINGINJOKI	3814	3814	0			44	6,1	296	43	1970–1990
	KYRÖNJOKI	4923	4923	0			38	3,4	273	45	1970–1990
	LAPUANJOKI	4122	4122	0			27	2,8	179	37	1970–1990
	LESTIJOKI	1373	1373	0			11	1,8	133	13	1970–1990
	OULUJOKI	22841	22841	0			257	64	478	257	1970–1990
	PERHONJOKI	2524	2524	0			21	2,7	178	23	1970–1990
	PYHÄJOKI	3712	3712	0			29	4,2	348	32	1970–1990
	SIIKAJOKI	4318	4318	0			37	2,3	326	44	1970–1990
	SIMOJOKI	3160	3160	0			44	6,3	426	37	1970–1990
	TORNIONJOKI	40131	40131	0			448	71	3287	390	1970–1990
SUM BOB MONITORED without Tornionjoki		**120352**	**120352**	**0**			**1271**			**1668**	
BOB UNMONITORED		**12815**	**12815**				**129**				
BOS MONITORED	EURAJOKI	1336	1336	0			12	2,0	37	11	1970–1990
	ISOJOKI	1098	1098	0			15	1,9	109	16	1970–1990
	KOKEMÄENJOKI	27046	27046	0			262	47	750	247	1970–1990
	LAIHIANJOKI	506	506	0			3,5	0,1	43	4,3	1970–1990
SUM BOS MONITORED		**29986**	**29986**	**0**			**293**		**278**		
BOS UNMONITORED		**9315**	**9315**				**115**				
ARC MONITORED	AURAJOKI	874	874	0			8,6	0	66	8,5	1970–1990
	KISKONJOKI	1050	1050	0			12	0,4	33	9,8	1970–1990
	PAIMIONJOKI	1088	1088	0			12	0	78	9,4	1970–1990
SUM ARC MONITORED		**3012**	**3012**	**0**			**33**		**28**		
ARC UNMONITORED		**5940**	**5940**				**65**				
GUF MONITORED	KARJAANJOKI	2046	2046	0			23	7,4	69	19	1970–1990
	KOSKENKYLÄNJOKI	895	895	0			9,9	0,8	72	8,4	1970–1990
	KYMIJOKI	37159	37159	0			327	174	511	334	1970–1990
	MÄNTSÄLÄNJOKI	783	783	0			8,4	1,1	73	7,5	1970–1990
	PORVOONJOKI	1273	1273	0			13	1,5	91	14	1970–1990
	VANTAANJOKI	1686	1686	0			17	1,8	110	17	1970–1990
	VIROJOKI	357	357	0			5,3	0,09	37	4,4	1970–1990
SUM GUF MONITORED		**44199**	**44199**	**0**				**404**		**404**	
GUF UNMONITORED		**5504**	**5504**					**57**			
SUM FINLAND (monitored)		**197549**	**197549**	**0**				**2001**		**2377**	
SUM FINLAND (unmonitored)		**20759**	**20759**					**366**		**0**	

SUBREGION	NAME	TOTAL DRAINAGE AREA OF THE RIVER in km	TOTAL DRAINAGE AREA OF THE RIVER IN THE CP in km	UNMONITORED PART OF THE RIVER IN THE CP in km	DRAINAGE AREA CONTROLLED BY HYDROLOG. STATION in km	DRAINAGE AREA CONTROLLED BY HYDROCHEM. STATION in km	MEAN FLOW RATE 1995 in m/s	MIN. FLOW RATE 1995 in m/s	MAX. FLOW RATE 1995 in m/s	LONG-TERM MEAN FLOW in m/s	LONG-TERM MEAN FLOW PERIOD
RUSSIA											
GUF	NEVA	271800	215600	0		271800	2198			2488	1859-1988
	BALTIETZ										
	GOROKHOVKA	731	731	31	700	700		1,5	37	7,3	1950-1995
	KARASTA										
	KOVASHI	612	612	107	505	505		0,1	87	3,7	1950-1995
	KRASNENSKAYA										
	LEBIACSHYE										
	LUGA	13200	13200	400	12800	12800		3,0	1190	87	1944-1995
	MALINOVKA										
	PESCHANAYA										
	POLEVAYA										
	SELEZNEVKA	623	623	137	486	486		0,06	69	4,1	1947-1995
	SESTRA	395	395	5,0	390	390		0,6	72	4,1	1947-1995
	SHINGARKA										
	SISTA	673	673	100	573	573		0,5	88	10	1946-1995
	STRELKA	155	155	61	94	94		0,2	16	1,4	1971-1995
	TCHERNAYA	668	668	375	293	293		0,3	21	3,2	1954-1995
	TCHULKOVKA										
	VORONKA										
SUM GUF; RUSSIA		**288857**	**232657**	**1216**	**15841**	**287641**	**2198**			**2609**	
ESTONIA											
GUF MONITORED	JÄGALA	1570	1570	0	903	1570	6,9	0,6	28	7,41	1942–1992
	KEILA	682	682	0	635	682	9,5	0,8	43	5,99	1925–1990
	KUNDA	530	530	2	406	528	3,7	1,2	11	4,35	1942–1990
	NARVA	56200	17200	140	56000	56060	447	2,3	957	378	1956–1991
	PUDISOO	144	144	21	123	123	1,3	0,1	7,4	1,07	1961–1990
	PURTSE	810	810	0	784	810	6,9	1,3	38	6,57	1925–1990
	VALGEJÕGI	453	453	0	404	453	3,9	0,9	12	3,45	1946–1990
	VIHTERPALU	479	479	5	474	474	6,2	0,2	29	4,23	1930–1990
PARTLY MONITORED	LOOBU	308	308	0	0	308					
	PÜHAJÕGI	196	196	0	0	196					
	SELJAJÕGI	410	410	0		410					
	VASALEMMA	403	403	0	0	403					
	VÄÄNA	316	316	0	209	316	2,2	0,3	14	2,1	1952–1990
SUM GUF MONITORED		**62501**	**23501**	**168**	**59938**	**62333**	**488**			**413**	
GUR MONITORED	KASARI	3210	3210	570	2640	2640	33,9	1,5	250	25	1925–1990
	PÄRNU	6920	6920	1766	5154	5154	55,3	5,5	349	48	1925–1990
SUM GUR (monitored)		**10130**	**10130**	**2336**	**7794**	**7794**	**89,2**			**73**	
SUM ESTONIA (monitored)		**72631**	**33631**	**2504**	**67732**	**70127**	**577**			**486**	

SUBREGION		NAME	TOTAL DRAINAGE AREA OF THE RIVER in km	TOTAL DRAINAGE AREA OF THE RIVER IN THE CP in km	UNMONITORED PART OF THE RIVER IN THE CP in km	DRAINAGE AREA CONTROLLED BY HYDROLOG. STATION in km	DRAINAGE AREA CONTROLLED BY HYDROCHEM. STATION in km	MEAN FLOW RATE 1995 in m/s	MIN. FLOW RATE 1995 in m/s	MAX. FLOW RATE 1995 in m/s	LONG-TERM MEAN FLOW in m/s	LONG-TERM MEAN FLOW PERIOD
LATVIA												
BAP	MONITORED	BARTA	2520	1968	780	1750	1740	24	1,2	146	20	1950–1990
		VENTA	11800	5990	2480	8320	9320	86	12	655	66	1922–1990
	PARTLY MONITORED	SAKA	1100	1100	0	0	1100	11				
SUM BAP MONITORED			**15420**	**9058**	**3260**		**12160**	**121**			**85**	
BAP UNMONITORED			**1442**	**1442**				**9,9**				
GUR	MONITORED	DAUGAVA	87900	23741	3900	84000	84000	668	8,0	2400	633	1929–1993
		GAUJA	7953	7953	0	7953	7953	88	19	350	70	1939–1993
		IRBE	2000	2000	80	1920	1920	17	2,3	75	16	1955–1990
		LIELUPE	17600	8880	1100	9390	16500	63	13	428	57	1920–1990
		SALACA	3396	3396	0	3220	3396	37	4,6	178	30	1926–1993
SUM GUR MONITORED			**118849**	**45970**	**5080**	**106483**	**113769**	**874**			**806**	
GUR UNMONITORED			**4172**	**4172**				**39**				
SUM LATVIA *(monitored)*			**134269**	**55028**	**8340**		**125929**	**995**			**891**	
SUM LATVIA *(unmonitored)*			**5614**	**5614**				**49**				
LITHUANIA												
BAP	MONITORED	AKMENA-DANE	580	580	0	580	580	7,5	0,8	58	7,1	1992–1995
		NEMUNAS	97920	46700	0	97920	97920	523	173	3084	664	1811–1995
BAP	UNMONITORED		390	390				3,7				
SUM LITHUANIA *(monitored)*			**98500**	**47280**	**0**	**98500**	**98500**	**531**			**671**	
SUM LITHUANIA *(unmonitored)*			**390**	**390**				**3,7**				
POLAND												
BAP	MONITORED	GRABOWA	535	535	96	439	439	7,4	5,1	13	6,8	1976–1990
		INA	2189	2189	26	2163	2163	13	6	24	12	1951–1990
		LEBA	1801	1801	681	1120	1120	14	7,9	35	12	1956–1990
		LUPAWA	924	924	119	805	805	10	8,1	16	8,2	1951–1990
		ODER	118861	106057	8787	110074	110074	540	246	908	574	1951–1990
		PARSETA	3151	3151	196	2955	2955	29	13	81	28	1956–1990
		PASLEKA	2294	2294	62	2232	2232	17	3,3	88	15	1961–1970
		REDA	485	485	90	395	395	4,8	2,1	13	4,4	1956–1990
		REGA	2724	2724	96	2628	2628	20	8,5	42	21	1951–1990
		SLUPIA	1623	1623	24	1599	1599	17	11	30	18	1967–1990
		VISTULA	194424	168699	10	194414	194414	1044	397	2170	1081	1951–1990
		WIEPRZA	1634	1634	115	1519	1519	18	8,1	37	16	1951–1990
SUM POLAND *(monitored)*			**330645**	**292116**	**10302**	**320343**	**320343**	**1734**			**1795**	

SUBREGION	NAME	TOTAL DRAINAGE AREA OF THE RIVER in km	TOTAL DRAINAGE AREA OF THE RIVER IN THE CP in km	UNMONI-TORED PART OF THE RIVER IN THE CP in km	DRAINAGE AREA CON-TROLLED BY HYDROLOG. STATION in km	DRAINAGE AREA CON-TROLLED BY HYDROCHEM. STATION in km	MEAN FLOW RATE 1995 in m/s	MIN. FLOW RATE 1995 in m/s	MAX. FLOW RATE 1995 in m/s	LONG-TERM MEAN FLOW in m/s	LONG-TERM MEAN FLOW PERIOD
GERMANY											
BAP MONITORED	BARTHE	292	292	78	214	214	1,7	0,03	11	1,6	1967–1995
	DUVENBAEK	67	67	6	61	61	0,3	0,006	2,0	0,3	1963–1995
	KAROWER BACH	23	23	0	14	23	0,1	0,03	0,7	0,2	1981–1995
	KÖRCKWITZER BACH	100	100	0	44	100	0,7	0,005	7,8	0,6	1990–1995
	PEENE	5110	5110	0	1403	5110	24	2,4	62	24	1955–1995
	RECKNITZ	669	669	122	445	547	3,8	1,1	14	3,8	1967–1995
	SEHROWER BACH	83	83	0	35	83	0,5	0,01	3,7	0,7	1976–1995
	UECKER	2401	2401	0	1435	2401	8,3	2,9	34	8,2	1964–1995
	ZAROW	748	748	0	100	748	2,9	0,1	16	2,8	1974–1995
	ZIESE	115	115	0	38	115	0,7	0,08	2,8	0,5	1974–1995
PARTLY MONITORED	PROHNER BACH	72	72	0		72	0,4			1,0	1983–1995
	RYCK	231	231	100		131	0,9			1,0	1979–1995
	SAALER BACH	63	63	0		63	0,3			0,3	1980–1995
SUM BAP MONITORED		**9974**	**9974**	**306**		**9668**	**44**			**45**	
WEB MONITORED	HELLBACH	210	210	0	107	210	1,9	0,06	8,9	1,5	1955–1995
	MAURINE	170	170	47	123	123	0,9	0,2	5,1	1,0	1965–1995
	STEPENITZ	701	701	215	441	486	3,9	1,0	21	3,7	1955–1995
	WALLENSTEINGRABEN	156	156	0	66	156	1,1	0,1	2,4	0,8	1974–1995
	WARNOW	2982	2982	0	2982	2982	16	0	104	15	1974–1995
	FÜSINGER AU	243	243	1	206	242	4,5	0,1	24	14	1971–1995
	SCHWENTINE	714	714	0	457	714	20	2,5	51	15	1971–1995
	TRAVE	2665	2665	1939	726	726	9,5	1,9	35	11	1971–1995
PARTLY MONITORED	AALBEK	42	42	0		42	0,5	0,1	4,2	0,4	1971–1995
	GODDERSTORFER AU	58	58	0		58	0,4	0,02	6,9	0,4	1978–1992
	GRIMSAU	34	34	0		34	0,5	0,07	2,1	0,5	1982–1992
	HAGENER AU	108	108	0		108	1,3	0,08	13	1,3	1971–1992
	HÜTTENER AU	63	63	0		63	0,9	0,11	6,2	0,9	1976–1992
	KOSELER AU	55	55	0		55	0,8	0,1	5,5	0,8	1976–1992
	KOSSAU	146	146	17		129	1,5	0,09	15	1,5	1971–1992
	LANGBALLIGAU	49	49	5		44	0,6	0,09	2,8	0,6	1982–1992
	LIPPINGAU	50	50	0		50	0,7	0,1	3,2	0,7	1982–1992
	MÜHLENSTROM	40	40	3		37	0,5	0,07	2,3	0,5	1982–1992
	OLDENBURGER GRABEN	109	109	0		109	0,7	0,03	13	0,8	1978–1992
	PEEZER BACH	52	52	0		52	0,4			0,4	1994–1995
	SCHWARTAU	223	223	14		209	2,5	0,6	21	2,2	1971–1995
	SCHWENNAU	34	34	1		33	0,5	0,07	2,1	0,5	1982–1992
	WAKENITZ	270	270	13		257	3,1	0,7	26	2,7	1971–1995
SUM WEB MONITORED		**9174**	**9174**	**2255**		**6919**	**73**		**76**		
WEB UNMONITORED		**440**	**440**	**440**							
SUM GERMANY (monitored)		**19148**	**19148**	**2561**		**16587**	**117**			**121**	
SUM GERMANY (unmonitored)		**440**	**440**								

SUBREGION	NAME	TOTAL DRAINAGE AREA OF THE RIVER in km	TOTAL DRAINAGE AREA OF THE RIVER IN THE CP in km	UNMONITORED PART OF THE RIVER IN THE CP in km	DRAINAGE AREA CONTROLLED BY HYDROLOG. STATION in km	DRAINAGE AREA CONTROLLED BY HYDROCHEM. STATION in km	MEAN FLOW RATE 1995 in m/s	MIN. FLOW RATE 1995 in m/s	MAX. FLOW RATE 1995 in m/s	LONG-TERM MEAN FLOW in m/s	LONG-TERM MEAN FLOW
DENMARK											
BAP MONITORED	BAGGE Å	43	43	1,5	41	41	0,2	0,007	2,7	0,3	1922–1995
	FAKSE Å	29	29	7,5	21	21	0,3	0,03	3,1	0,3	1994–1995
	HERREDSBÆK	5	5	0	5,2	5,2	0,05	0	0,5	0,05	1989–1995
	HULEBÆK	21	21	13	8,2	8,2	0,08	0	1,0	0,09	1989–1995
	KOBBE Å	24	24	0	24	24	0,2	0,002	2,4	0,3	1980–1995
	ØLE Å	49,3	49,3	0	49	49	0,3	0,001	4,4	0,4	1986–1995
	MERN Å	49,7	49,7	6,8	43	43	0,3	0,003	3,0	0,4	1979–1995
	TRANEGÅRD LILLE Å	21	21	2,5	19	19	0,2	0	2,1	0,2	1989–1995
SUM BAP MONITORED		**241**	**241**	**31**	**211**	**211**	**1,6**			**2,0**	
BAP UNMONITORED		**995**	**995**				**6,4**				
WEB MONITORED	BJERGE Å	146	146	90	56	56	0,4	0,007	5,4	0,4	1978-1995
	BRENDE Å	108	108	6	102	102	1,1	0,09	5,1	0,9	1976–1995
	BYGHOLM Å	186	186	31	154	154	1,6	0,3	10	1,6	1974–1995
	ELSTED BÆK	25	25	4,5	20	20	0,2	0,03	0,8	0,1	1988–1995
	FISKBÆK	24	24	3,7	20	20	0,2	0,004	2,6	0,2	1988–1995
	FLADMOSE Å	17	17	2,5	14	14	0,1	0	0,7	0,07	1990–1995
	FRIBRØDRE Å	69	69	13	57	57	0,3	0,004	2,3	0,3	1979–1995
	FRUERSKOV BÆK	2,0	2,02	0	2,0	2,0	0,03	0,006	0,3	0,03	1988–1995
	GIBER Å	51	51	4	47	47	0,4	0,02	4,9	0,4	1960–1995
	GREJS Å	88	88	25	63	63	1,2	0,5	6,1	1,2	1984–1995
	HØJEN Å	30	30	0,5	29	29	0,5	0,1	3,5	0,4	1989–1995
	HADERSLEV MØLLE	106	106	0	106	106	2,0	1,0	7,9		
	HANSTED Å	154	154	18	136	136	1,6	0,5	10	1,6	1995–1995
	HOVEDKANAL	204	204	0,1	204	204	1,1	0	18	1,2	1967–1995
	HÅRBY Å	92	92	13	79	79	0,8	0,1	4,0	0,7	1978–1995
	JERNHYT BÆK	7,4	7,4	0	7,4	7,4	0,2	0,1	0,7	0,2	1989–1995
	KÆR MØLLE Å	30	30	25	4,9	4,9	0,09	0,02	0,9	0,07	1988–1995
	KOLDING Å	273	273	5	268	268					
	KONGSHØJ Å	64	64	10	54	54	0,7	0,1	7,4	0,5	1981–1995
	LINDVED Å	65	65	0	65	65	0,6	0,08	4,3	0,5	1984–1995
	LUNDE Å	82	82	40	42	42	0,8	0,1	2,8	0,3	1978–1995
	MARREBÆKSRENDE	50	50	25	25	25	0,1	0	2,3	0,1	1979–1995
	NDR. HALLEBY Å	526	526	108	418	418	3,6	0,05	12	2,8	1989–1995
	NÆLDEVADS Å	70	70	30	40	40	0,2	0,001	3,2	0,3	1989–1995
	ODENSE Å	535	535	0	535	535	5,6	0,6	32	4,7	1931–1995

SUBREGION	NAME	TOTAL DRAINAGE AREA OF THE RIVER in km	TOTAL DRAINAGE AREA OF THE RIVER IN THE CP in km	UNMONITORED PART OF THE RIVER IN THE CP in km	DRAINAGE AREA CONTROLLED BY HYDROLOG. STATION in km	DRAINAGE AREA CONTROLLED BY HYDROCHEM. STATION in km	MEAN FLOW RATE 1995 in m/s	MIN. FLOW RATE 1995 in m/s	MAX. FLOW RATE 1995 in m/s	LONG-TERM MEAN FLOW in m/s	LONG-TERM MEAN FLOW
	PUGE MØLLEÅ	82	82	20	62	62	0,6	0,06	4,1	0,5	1976–1995
	PULVERBÆK	47	47	33	14	14	0,1	0,001	1,1	0,09	1988–1995
	RINGE Å	46	46	18	28	28	0,2	0,09	1,0	0,2	1976–1995
	ROHDEN Å	98	98	0	98	98	1,3	0,38	7,3	1,0	1989–1995
	RYDE Å	85	85	0	85	85	0,5	0	7,6	0,6	1974–1995
	RYDS Å	52	52	10	42	42	0,4	0,01	4,5	0,4	1977–1995
	SALTØ Å	155	155	10	145	145	1,1	0,005	9,1	1,1	1984–1995
	SEERDRUP Å	69	69	0	69	69	0,5	0,01	3,8	0,5	1978–1995
	SKALLEBÆK	28	28	5	23	23	0,3	0,08	1,6	0,3	1995–1995
	SOLKÆR Å	42	42	13	30	30	0,3	0,04	3,9	0,3	1979–1995
	SPANG Å	153	153	88	65	65	0,7	0,1	4,2	0,7	1954–1995
	STAVIS Å	88	88	10	78	78	0,7	0,05	4,1	0,6	1977–1995
	STOKKEBÆKKEN	54	54	1,1	53	53	0,6	0,08	5,7	0,5	1976–1995
	STORÅ	157	157	20	137	137	1,4	0,1	7,2	1,1	1976–1995
	SUSÅ	820	820	64	756	756	7,3	0,5	34	5,7	1934–1995
	SYLTEMAE Å	43	43	10	33	33	0,3	0,02	1,5	0,3	1976–1995
	TAPS Å	84	84	19	65	65	0,8	0,07	9,6	0,7	1974–1995
	TRANEMOSE Å	20	20	0	20	20	0,1	0	0,9	0,1	1989–1995
	TUDE Å	286	286	25	261	261	2,1	0,2	15	2,1	1979–1995
	VEJLE Å	229	229	30	199	199	4,1	3,0	12	3,7	1917–1995
	VEJRUP Å	44	44	2,5	42	42	0,4	0,08	2,0	0,3	1978–1995
	VEJSTRUP Å	48	48	7,5	40	40	0,4	0,006	3,3	0,4	1978–1995
	VIBY Å	31	31	2,2	29	29	0,3	0,02	1,6	0,2	1976–1995
	VINDINGE Å	176	176	48	128	128	1,2	0,08	9,3	1,0	1976–1995
	ÅRHUS Å	325	325	1,7	324	324	3,1	0,87	17	3,0	1984–1995
SUM WEB MONITORED		**6261**	**6261**	**892**	**5370**	**5370**	**52**			**44**	
WEB UNMONITORED		**6972**	**6972**				**67**				
SOU MONITORED	DAMHUSÅEN	79	79	15	64	64	0,3	0,02	2,3	0,3	1990–1995
	ESRUM Å	130	130	2	128	128	1,0	0,3	2,7	0,8	1990–1995
	KIGHANERENDEN	5,7	5,7	0,5	5,2	5,2	0,05	0,01	0,2	0,03	1989–1995
	KØGE Å	189	189	55	134	134	1,0	0,01	9,0	1,2	1994–1995
	LADEGÅRDSÅEN	24	24	0,5	24	24	0,02	0,003	0,1	0,01	1991–1995
	LL.VEJLE Å	46	46	21	26	26	0,1	0,003	1,7	0,09	1978–1995
	MØLLE Å	131	131	10	121	121	0,5	0	3,1	0,5	1989–1995
	NIVE Å	70	70	8	62	62	0,5	0,03	1,9	0,4	1978–1995
	SØBORG KANAL	63	63	5	58	58	0,5	0,1	2,6	0,5	1995–1995
	SKENSVED Å	38	38	13	26	26	0,0	0,002	0,6	0,04	1995–1995
	ST. VEJLE Å	57	57	5	52	52	0,4	0,1	3,5	0,4	1989–1995
	USSERØD Å	82	82	8	74	74	0,7	0,2	3,0	0,6	1978–1995
	ØSTERBÆK	16	16	7,5	8,9	8,9	0,03	0,001	0,2	0,02	1989–1995
SUM SOU MONITORED		**932**	**932**	**150**	**782**	**782**	**5,15**			**4,8**	
SOU UNMONITORED		**955**	**955**				**6,75**				

SUBREGION	NAME	TOTAL DRAINAGE AREA OF THE RIVER in km	TOTAL DRAINAGE AREA OF THE RIVER IN THE CP in km	UNMONITORED PART OF THE RIVER IN THE CP in km	DRAINAGE AREA CONTROLLED BY HYDROLOG. STATION in km	DRAINAGE AREA CONTROLLED BY HYDROCHEM. STATION in km	MEAN FLOW RATE 1995 in m/s	MIN. FLOW RATE 1995 in m/s	MAX. FLOW RATE 1995 in m/s	LONG-TERM MEAN FLOW in m/s	LONG-TERM MEAN FLOW
KAT MONITORED	ARRESØ KANAL	277	277	21	257	257	1,8	0,3	5,7	1,5	1978–1995
	BREDKÆR BÆK	18	18	0,5	17	17,1	0,2	0,1	0,8	0,2	1984–1995
	ELLING Å	138	138	15	123	123	1,4	0,5	5,5	1,2	1989–1995
	GERÅ	163	163	9,4	154	154	1,6	0,3	7,2	1,6	1985–1995
	GRENÅEN	473	473	0	473	473	3,4	2,1	8,3	3,5	1976–1995
	GRÆSE Å	38	38	13	25	25	0,2	0,06	0,7	0,1	1946–1995
	GUDEN Å	2638	2638	35	2603	2603	37	15	97	32	1974–1995
	HØJBRO Å	41	41	4,6	36	36	0,3	0,02	1,9	0,2	1978–1995
	HASLEVGÅRDS Å	86	86	5,0	81	81	0,7	0,1	4,1	0,6	1989–1995
	HAVELSE Å	131	131	28	103	103	0,6	0,08	3,6	0,5	1947–1995
	HEVRING Å	84	84	5,5	79	79	0,5	0,2	2,2	0,4	1989–1995
	HOVE Å	73	73	5,0	68	68	0,4	0,003	1,9	0,3	1980–1995
	JORDBRO Å	145	145	34	111	111	1,4	0,9	3,3	1,3	1980–1995
	KARUP Å	763	763	136	627	627	8,1	4,8	19	7,4	1986–1995
	KÆRS MØLLEÅ	139	139	10	128	128	0,9	0,4	2,8	0,9	1994–1995
	LAMMEFJORD SØKANAL	62	62	0	62	62	0,5	0	3,7	0,6	1981–1995
	LANGVAD Å	193	193	18	175	175	1,1	0,05	7,5	1,0	1989–1995
	LERKENFELD Å	191	191	75	115	115	1,4	0,8	6,7	1,3	1983–1995
	LINDHOLM Å	158	158	152	6,5	6,5	0,08	0,01	0,6	0,08	1989–1995
	MADEMOSE Å	5,4	5,4	0	5,4	5,4	0,02	0,002	0,1	0,01	1989–1995
	MAGLEMOSE Å	43	43	18	26	26	0,1	0,007	0,8	0,08	1989–1995
	ROMDRUP Å	35	35	7,0	28	28	0,2	0,03	1,4	0,2	1968–1995
	RY Å	545	545	260	285	285	3,2	1,2	13,7	2,9	1972–1995
	SØRENDE	10	10	0,5	9,8	9,8	0,04	0	0,04	0,04	1995–1995
	SIMESTED Å	240	240	26	215	215	2,6	1,8	7,8	2,5	1992–1995
	SKALS Å	617	617	60	556	556	5,0	2,5	10	4,5	1973–1995
	TUSE Å	158	158	51	107	107	0,9	0,06	6,2	0,8	1979–1995
	UDESUNDBY Å	36	36	7,5	29	29	0,2	0,03	0,8	0,2	1978–1995
	VÆREBRO Å	159	159	48	111	111	0,7	0,1	2,8	0,6	1978–1995
	VALSGÅRD BÆK	14	14	0	14	14	0,1	0,09	0,3	0,1	1989–1995
	VILLESTRUP Å	126	126	0,5	125	125	1,6	1,1	5,7	1,4	1989–1995
	VOER Å	245	245	6,1	239	239	2,8	0,7	16,9	2,5	1989–1995
SUM KAT MONITRED		**8041**	**8041**	**1049**	**6992**	**6992**	**79**			**70**	
KAT UNMONITORED		**8834**	**8834**				**97**				
SUM DENMARK (monitored)		**15476**	**15476**	**2122**	**13354**	**13354**	**138**			**121**	
SUM DENMARK (unmonitored)		**17756**	**17756**				**176**				

SUBREGION	NAME	TOTAL DRAINAGE AREA OF THE RIVER in km	TOTAL DRAINAGE AREA OF THE RIVER IN THE CP in km	UNMONITORED PART OF THE RIVER IN THE CP in km	DRAINAGE AREA CONTROLLED BY HYDROLOG. STATION in km	DRAINAGE AREA CONTROLLED BY HYDROCHEM. STATION in km	MEAN FLOW RATE 1995 in m/s	MIN. FLOW RATE 1995 in m/s	MAX. FLOW RATE 1995 in m/s	LONG-TERM MEAN FLOW in m/s	LONG-TERM MEAN FLOW
SWEDEN											
BOB MONITORED	ALTERÄLVEN	517	517	0	517	517	4,3			5	1931–1960
	LULE ÄLV	25237	25237	9	24488	25228	515			489	1961–1990
	PITE ÄLV	11285	11285	81	10797	11204	176			162	1961–1990
	RICKLEÅN	1678	1678	5	1673	1673	15			18	1931–1960
	RÅNE ÄLV	4160	4160	392	3768	3768	42			44	1931–1960
	SKELLEFTE ÄLV	11730	11730	494	11236	11236	156			156	1961–1990
	TORNE ÄLV	40157	40157	6094	34063	34063	433			391	1961–1990
	TÖRE Å	454	454	17	437	437	3,9			4	1931–1960
	KALIX ÄLV	18128	18128	0		18128	311			292	1961–1990
SUM BOB MONITORED		**113346**	**113346**	**7092**	**86979**	**106254**	**1656**			**1561**	
BOB UNMONITORED		**12456**	**12456**								
BOS MONITORED	DALÄLVEN	28953	28953	81	28634	28872	409			347	1961–1990
	DELÅNGERSÅN	2010	2010	18	1825	1992	22			17	1931–1960
	FORSMARKSÅN	387	387	2,0	387	385	2,9			3,0	1931–1960
	GAVLEÅN	2460	2460	10	2301	2450	26			20	1931–1960
	GIDE ÄLV	3430	3430	5	3017	3425	32			35	1931–1960
	INDALSÄLVEN	26725	26725	965	25760	25760	483			449	1961–1990
	LJUNGAN	12853	12853	777	12076	12076	140			133	1961–1990
	LJUSNAN	19826	19826	15	19805	19811	263			227	1961–1990
	UME ÄLV	26815	26815	316	26499	26499	463			439	1961–1990
	ÅNGERMANÄLVEN	31864	31864	1224	30640	30640	575			494	1961–1990
	ÖRE ÄLV	3030	3030	150	2880	2880	31			33	1931–1960
PARTLY MONITORED	LÖGDE ÄLV	1608	1608	0		1608	18			18	1931–1960
SUM BOS MONITORED		**159961**	**159961**	**3563**	**153824**	**156398**	**2465**			**2215**	
BOS UNMONITORED		**13690**	**136**								

SUBREGION	NAME	TOTAL DRAINAGE AREA OF THE RIVER in km	TOTAL DRAINAGE AREA OF THE RIVER IN THE CP in km	UNMONITORED PART OF THE RIVER IN THE CP in km	DRAINAGE AREA CONTROLLED BY HYDROLOG. STATION in km	DRAINAGE AREA CONTROLLED BY HYDROCHEM. STATION in km	MEAN FLOW RATE 1995 in m/s	MIN. FLOW RATE 1995 in m/s	MAX. FLOW RATE 1995 in m/s	LONG-TERM MEAN FLOW in m/s	LONG-TERM MEAN FLOW
BAP MONITORED	ALSTERÅN	1537	1537	192	1345	1345	12			11	1931–1960
	BOTORPSSTRÖMMEN	1004	1004	21	945	983	7,0			6,0	1931–1960
	EMÅN	4460	4460	14	4446	4446	36			28	1931–1960
	GOTHEMSÅN	476	476	126	350	350	3,6				
	HELGE Å	4780	4780	626	4025	4154	52			48	1931–1960
	LJUNGBYÅN	750	750	30	344	720	5,1			3,0	1931–1960
	LYCKEBYÅN	847	847	1,0	842	846	7,6			6,0	1931–1960
	MOTALA STRÖM	15480	15480	134	15389	15346	125			92	1961–1990
	MÖRRUMSÅN	3380	3380	6,0	3374	3374	38			26	1931–1960
	NORRSTRÖM	22650	22650	50	22600	22600	201			166	1961–1990
	NYKÖPINGSÅN	3620	3620	42	3578	3578	29			21	1931–1960
SUM BAP MONITORED		**58984**	**58984**	**1242**	**57238**	**57742**	**516**			**407**	
BAP UNMONITORED		**10024**	**10024**								
SOU MONITORED	RÅÅN	202	202	0	151	202	1,9			2,0	1931–1960
SUM SOU MONITORED		**202**	**202**	**0**	**151**	**202**	**1,9**			**2,0**	
SOU UNMONITORED		**2207**	**2207**				**21**				
KAT MONITORED	ÄTRAN	3343	3343	1,0	2442	3342	56			46	1931–1960
	FYLLEÅN	401	401	42	262	359	7,6			7,0	1931–1960
	GENEVADSÅN	225	225	6	225	219	3,9			4,0	1931–1960
	GÖTA ÄLV	50233	42780	1970	47546	48263	635			572	1961–1990
	LAGAN	6440	6440	317	5481	6123	87			71	1931–1960
	NISSAN	2682	2682	0	2417	2682	40			40	1931–1960
	RÖNNE Å	1890	1890	938	943	952	13,5			21	1931–1960
	STENSÅN	284	284	0	284	284	5,0			4,0	1931–1960
	VISKAN	2201	2201	41	2157	2160	41			31	1931–1960
SUM KAT MONITORED		**67699**	**60246**	**3315**	**61757**	**64384**	**889**			**796**	
KAT UNMONITORED		**3051**	**3051**								
SUM SWEDEN *(monitored)*		**400192**	**392739**	**15212**	**359949**	**384980**	**5528**			**4981**	
SUMSWEDEN *(unmonitored)*		**41428**	**41428**								

Annex 4: Main information on municipal wastewater treatment plants in 1995

	SUBREGION	NAME	NUMBER OF INHABITANTS CONNEC-TED	NUMBER OF PE CONNEC-TED	AMOUNT OF WASTE-WATER in 1000 m³/a	TREATMENT METHOD MEC.	CHEM.	BIOL.	PHOSPO-RUS REMOVAL in %	NITROGEN REMOVAL in %
FINLAND	BOB	KEMI	24799		3719		C	B	87	19
		KEMPELE	20712		1882		C		97	17
		KOKKOLA	30500		2850		C		96	20
		OULU	110905		16100		C		96	19
		PIETARSAARI	26784		2794		C	B	94	34
		RAAHE	18800		1753		C	B	97	18
		TORNIO	15370		109		C		79	12
		Small settlements: monitored (19)	39360		3532					
SUM BOB MONITORED			**287230**		**32739**					
	BOS	PORI	63000		9283		C	B	92	33
		RAUMA	34560		3719		C	B	87	51
		VAASA	55921		6563		C	B	90	28
		Small settlements: monitored (17)	18154		3724					
SUM BOS MONITORED			**171635**		**23289**					
	ARC	KAARINA	34538		3946		C	B	96	46
		MAARIANHAMINA	11429		1779		C	B	90	30
		NAANTALI	11550		1565		C		95	23
		PARAINEN	9600		2100		C		97	55
		RAISIO	19672		2908		C	B	88	35
		SALO	25630		3527		C	B	94	39
		TURKU	139234		26380		C	B	92	28
		UUSIKAUPUNKI	13788		2029		C		94	22
		Small settlements: monitored (17)	24376		2903					
SUM ARC MONITORED			**289817**		**47137**					
	GUF	ESPOO	252496		29730		C	B	94	18
		HAMINA	17885		3391		C	B	94	22
		HANKO	9900		2232		C	B	93	37
		HELSINKI	693399		88600		C	B	94	23
		KIRKKONUMMI	15900		1873		C	B	95	32
		KOTKA (MUS)	28700		3954		C	B	89	31
		KOTKA (SUN)	27500		4686		C	B	91	49
		PORVOO (KOK)	20909		3038		C	B	95	15
		PORVOO (HER)	14800		1414		C	B	94	15
		TAMMISAARI	10250		1323		C	B	96	52
		Small settlements: monitored (22)	23104		2933					
SUM GUF MONITORED			**1114843**		**143174**					
SUM FINLAND MONITORED			**1863525**		**246339**					
RUSSIA										
	GUF	St. PETERSBURG & LENINGRAD REGION: treated	3600000		1309210					
	GUF	St. PETERSBURG & LENINGRAD REGION: untreated	1200000		429180					
SUM GUF MONITORED			**3600000**		**1309210**					
SUM GUF UNMONITORED AND UNTREATED			**1200000**		**429180**					
SUM RUSSIA UNMONITORED AND UNTREATED			**4800000**		**1738390**					

Annex 4/2

	SUBREGION	NAME	NUMBER OF INHABITANTS CONNECTED	NUMBER OF PE CONNECTED	AMOUNT OF WASTE-WATER in 1000 m³/a	TREATMENT METHOD MEC.	CHEM.	BIOL.	PHOSPORUS REMOVAL in %	NITROGEN REMOVAL in %
ESTONIA	GUF	KOHTLA-JÄRVE	42940	61000	11650	M		B	10	15
		PALDISKI	4000	4000	358	M		B	2	3
		SILLAMÄE	13000	13000	3800	M		B	20	60
		TALLINN	413000	550000	84400	M	C	B	85	23
		Small settlements: monitored (22)	22500	2460		M		B	10	20
SUM GUF MONITORED			**472940**	**650500**	**102668**					
		TALLINN: Untreated and overflows	1200	133						
		Small settlements: untreated		26						
SUM GUF UNMONITORED AND UNTREATED			**1200**	**1200**	**159**					
	GUR	HAAPSALU	4800	4800	674	M			12	14
		KURESSAARE	12000	14500	1645	M		B	10	20
		PÄRNU	41000	58000	5840	M	C	B	86	81
		Small settlements: monitored (45)		5800	984	M	B	10	20	
SUM GUR MONITORED			**57800**	**83100**	**9143**					
BAP		Small settlements: monitored (7)		2200	161	M		B	10	20
SUM BAP MONITORED				**2200**	**161**					
SUM ESTONIA MONITORED			**530740**	**735800**	**111972**					
SUM ESTONIA UNMONITORED AND UNTREATED				**1200**	**159**					
LATVIA	GUR	RIGA		464164	74696	M		B		
		Small settlements: monitored (6)	31620	11394	3446					
SUM GUR MONITORED			**31620**	**475558**	**78142**					
		Small settlements: untreated	750	68	12					
		RIGA: untreated		128889	16000					
SUM GUR UNMONITORED AND UNTREATED			**750**	**128957**	**16012**					
	BAP	LIEPAJA	58000	53110	11640	M		B		
		Small settlements: monitored (14)	24609	10533	2241					
SUM BAP MONITORED			**82609**	**63643**	**13881**					
SUM LATVIA MONITORED			**114229**	**539201**	**92023**					
SUM LATVIA UNMONITORED AND UNTREATED			**750**	**128957**	**16012**					
LITHUANIA	BAP	KLAIPEDA	172700	200000	30093	M				
		PALANGA	18000	21000	4412	M				
		Small settlements: monitored (1)	100	150	85					
SUM BAP MONITORED			**190800**	**221150**	**34590**					
		Small settlements: untreated	2500	2550	415					
SUM BAP UNMONITORED AND UNTREATED			**2500**	**2550**	**415**					
SUM LITHUANIA MONITORED			**190800**	**221150**	**34590**					
SUM LITHUANIA UNMONITORED AND UNTREATED			**2500**	**2550**	**415**					

	SUBREGION	NAME	NUMBER OF INHABITANTS CONNEC-TED	NUMBER OF PE CONNEC-TED	AMOUNT OF WASTE-WATER in 1000 m^3/a	TREATMENT METHOD MEC.	CHEM.	BIOL.	PHOSPO-RUS REMOVAL in %	NITROGEN REMOVAL in %
POLAND	BAP	GDANSK (W)	463000	432137	41198	M	C		81	14
		GDANSK (Z)	110000	102190	11419	M		B		
		GDYNIA	354000	305300	27296	M	C	B		
		GRYFINO	19500	16900	1451	M	C	B		
		JASTRZEBIA GORA	21000	20228	395	M	C	B		
		KOLOBRZEG	50000	50000	8056	M		B		
		LEBA	68000	26800	842	M		B		
		POLICE	33000	18049	1295	M		B		
		SWINOUJSCIE	37603	31160	3089	M				
		SZCZECIN (POD)	10000	12145	981	M				
		SZCZECIN (SCZ)	45000	78500	4814	M				
		USTKA	35000	22200	1484	M	C	B		
		WLADYSLAWOWO	25700	24000	1334	M		B		
		Small settlements: monitored (2)		8500	757					
		Small settlements:non-systematically monitored (41)	66324	65261	4506					
SUM BAP MONITORED			1338127	1213370	108917					
		GDANSK: By-passes			3					
		GDYNIA: By-passes			31					
		POLICE: By-passes			65					
		SZCZECIN: Untreated	393000	347300	37977					
		Small settlements: untreated	8015	6224	607					
SUM BAP UNMONITORED AND UNTREATED			**401015**	**353524**	**38683**					
SUM POLAND MONITORED (including non-systematicallymonitored settlements)			**1338127**	**1213370**	**108917**					
SUM POLAND UNMONITORED AND UNTREATED			**401015**	**353524**	**38683**					
GERMANY	BAP	ANKLAM	20000	29000	1004	M	C	B	88	0
		BERGEN	42000	70000	2930	M	C	B	94	78
		GREIFSWALD	63000	80000	4200	M	C	B	90	82
		GÖHREN	6300	11000	690	M		B	14	14
		RIBNITZ-DAMGARTEN	15000	27000	1760	M	C	B	92	72
		STRALSUND	72000	94000	5209	M	C	B	90	73
SUM BAP MONITORED			**218300**	**311000**	**15793**					
	WEB	BAD DOBERAN	11000	15000	498	M	C	B	91	88
		BURG AUF FEHMARN		26000	760	M	C	B		
		ECKERNFÖRDE	38250	45000	1680	M	C	B	97	84
		FLENSBURG	101250	280000	11900	M	C	B	95	
		GLÜCKSBURG	6295	12000	640	M		B	30	
		GROSSENBRODE	29500	40000	1840	M	C	B	98	74
		GRÖMITZ		70000	1750	M	C	B		
		KAPPELN	9600	33000	790	M	C	B		
		KIEL460000	525000	23900	M	C	B	93	16	
		LÜBECK (WAR)	208836	500000	18600	M	C	B	93	72
		LÜBECK (OCH)	25678	120000	2010	M	C	B	89	72
		LÜBECK (TRA)	11874	30000	1550	M	C	B	98	82
		NEUSTADT IN HOLSTEIN		45000	1500	M	C	B		
		ROSTOCK	226000	305000	16490	M	C		76	28
		SCHLESWIG		150000	3140	M	C	B		
		TIMMENDORFER STRAND		60000	790	M	C	B		
		WESTFEHMARN	2800	15500	183	M	C	B	97	18
		WISMAR	51000	91000	3539	M			76	35
SUM WEB MONITORED			**1182083**	**2362500**	**91560**					
SUM GERMANY MONITORED			**1400383**	**2673500**	**107353**					

Annex 4/4

	SUBREGION	NAME	NUMBER OF INHABITANTS CONNEC-TED	NUMBER OF PE CONNEC-TED	AMOUNT OF WASTE-WATER in 1000 m³/a	TREATMENT METHOD MEC.	CHEM.	BIOL.	PHOSPO-RUS REMOVAL in %	NITROGEN REMOVAL in %
DENMARK	WEB	AABENRAA		51344	5410	M	C	B	89	89
		AARHUS (EGA)		80278	7447	M	C	B	97	90
		AARHUS (MAR)		228412	14019	M	C	B	91	94
		AARHUS (VIB)		56584	5511	M	C	B	97	82
		FREDERICIA		114363	10358	M	C	B	91	86
		HORSENS		132339	8910	M	C	B	97	73
		KOLDING		72676	10738	M	C	B	90	84
		ODENSE		429979	20875	M	C	B	99	95
		SVENDBORG		54217	6992	M	C	B	94	91
		VEJLE	116484		11771	M	C	B	88	84
SUM WEB MONITORED			**116484**	**1220192**	**102031**					
	SOU	COPENHAGEN (AVE)		320000	29236	M	C	B	87	81
		COPENHAGEN (LYN)		820000	95150	M	C	B	47	26
		GREVE		52200	5434	M	C	B	87	88
		HELSINGOER		76300	3771	M	C	B	87	82
		KOEGE		70000	7203	M	C	B	87	83
		LYNGBY-TAARBAEK		115660	9808	M	C	B	90	85
SUM SOU MONITORED				**1454160**	**150602**					
	KAT	AALBORG (OES)		60367	7506	M	C	B	94	85
		AALBORG (VES)		219848	22619	M	C	B	94	85
		FREDERIKSHAVN		61413	6533	M	C	B	83	74
		RANDERS		168120	8902	M	C	B	97	93
		ROSKILDE		80000	5728	M	C	B	92	91
		SKAGEN		65512	3079	M	C	B	82	67
		SKIVE		57935	5913	M	C	B	94	88
		THISTED		108272	5160	M	C	B	93	92
SUM KAT MONITORED				**821467**	**65440**					
SUM DENMARK MONITORED				**3495819**	**318073**					
SWEDEN	BOB	HAPARANDA	21500		3615	M	C	B	90	20
		LULEÅ	67000		9654	M	C		90	20
		PITEÅ	30000		4284	M	C		90	10
		SKELLEFTEÅ	38000		5346	M	C	B	94	20
		Small settlements: monitored (7)	18100		2692					
SUM BOB MONITORED			**174600**		**25591**					
	BOS	ESSVIK	13000	13000	2242	M	C	B	90	20
		GÄVLE	81430	89800	12125	M	C	B	90	20
		HUDIKSVALL	20600		3954	M	C	B	90	20
		HÄRNÖSAND	20400		2695	M	C	B	90	20
		SUNDSVALL (FIL)	18000		3182	M	C	B	90	20
		SUNDSVALL (TIV)	43100		8935	M	C	B	95	20
		SÖDERHAMN	14500		3637	M	C	B	94	50
		TIMRÅ	11400		1500	M	C	B	90	20
		UMEÅ	66000	90000	8490	M	C	B	90	20
		ÖRNSKÖLDSVIK (BOD)	13300		1744	M	C	B	95	20
		ÖRNSKÖLDSVIK (KNO)	15300		1807	M	C	B	85	20
		ÖRNSKÖLDSVIK (PRÄ)	14500		1334	M	C	B	95	20
		Small settlements: monitored (19)	50300	11020						
SUM BOS MONITORED			**381830**	**192800**	**62665**					

SUBREGION	NAME	NUMBER OF INHABITANTS CONNEC-TED	NUMBER OF PE CONNEC-TED	AMOUNT OF WASTE-WATER in 1000 m^3/a	TREATMENT METHOD MEC.	CHEM.	BIOL.	PHOSPO-RUS REMOVAL in %	NITROGEN REMOVAL in %
BAP	BORGHOLM	15000	25000	1243	M	C	B	80	20
	BOTKYRKA	237000		39420	M	C	B	95	50
	FÄRJESTADEN	12700	26200	998	M	C	B	95	45
	HANINGE	15500		1895	M	C	B	90	40
	KALMAR	71300	92460	7425	M	C	B	95	20
	KARLSHAMN	13000		1777	M	C	B	90	20
	KARLSKRONA (KOH)	40200		4636	M	C	B	90	20
	KARLSKRONA (LIN)	12000		2496	M	C	B	95	20
	LIDINGÖ	336000	440000	52600	M	C	B	95	20
	NACKA	31000	31000	4927	M	C	B	95	20
	NORRKÖPING	126200	149000	17793	M	C	B	90	50
	NORRTÄLJE	15500		2918	M	C	B	94	20
	NYKÖPING	33500		6755	M	C	B	95	20
	NYNÄSHAMN	12400		1687	M	C		85	20
	OSKARSHAMN	19500	19500	3992	M	C	B	95	45
	OXELÖSUND	13000		2328	M	C	B	95	20
	RONNEBY	21000		3889	M	C	B	95	70
	SIMRISHAMN	12000		2250	M	C	B	95	20
	STOCKHOLM (BRO)	267700		53500	M	C	B	97	50
	STOCKHOLM (HEN)	602700		93600	M	C	B	95	44
	STOCKHOLM (LOU)	23600		4530	M	C	B	94	30
	SÖLVESBORG	11500		2543	M	C	B	95	20
	TRELLEBORG	31100		4069	M	C	B	95	20
	VISBY	36400		3508	M	C	B	90	20
	VÄSTERVIK	25000		4519	M	C	B	95	50
	YSTAD	30000		6130	M	C	B	90	20
	Small settlements: monitored (20)	63700		11368					
SUM BAP MONITORED		**2128500**	**783160**	**342796**					
SOU	HELSINGBORG	166000		20383	M	C	B	93	50
	HÖGANÄS	20600		3176	M	C	B	95	70
	LANDSKRONA	35000		5700	M	C	B	90	20
	LOMMA	17000		940	M	C	B	95	50
	MALMÖ (KLA)	44500		6957	M	C	B	85	70
	MALMÖ (SJÖ)	255000	365000	45730	M	C	B	93	31
	Small settlements: monitored (1)	8000		939					
SUM SOU MONITORED		**546100**	**365000**	**83825**					
KAT	FALKENBERG	61600	104600	5457	M	C	B	90	50
	GÖTEBORG	572235		126000	M	C	B	90	41
	HALMSTAD	87000	109000	10983	M	C	B	90	50
	KUNGSBACKA	27100		4294	M	C	B	92	20
	LAHOLM	17300		1673	M	C	B	92	70
	VARBERG	33700		5860	M	C	B	96	70
	ÄNGELHOLM	35000		3871	M	C	B	92	50
	Small settlements: monitored (4)	9200		1192					
SUM KAT MONITORED		**1380035**	**578600**	**159330**					
SUM SWEDEN		**4611065**	**1919560**	**674207**					

Annex 5: Main information on industrial plants in 1995

SUBREGION		NAME	BRANCH	AMOUNT OF WASTEWATER in 1000 m^3/a	TREATMENT METHOD MECH.	CHEM.	BIOL.
FINLAND	BOB	ENSO OULU	PULP/PAPER	39000			B
		KEMIRA KOKKOLA	CHEMICAL	33000			
		M-B KEMI	PULP/PAPER	64000			B
		ENSO VEITSILUOTO	PULP/PAPER	53000			B
		OUTOKUMPU KOKKOLA	OTHER METAL	6000			
		OUTOKUMPU TORNIO	OTHER METAL	15000			
		RAUTARUUKKI RAAHE	IRON/STEEL	141000			
		WISAFOREST	PULP/PAPER	63000			B
SUM BOB MONITORED				**414000**			
	BOS	M-B KASKINEN	PULP/PAPER	20000			B
		UPM RAUMA	PULP/PAPER	18000			B
		VUORIKEMIA	CHEMICAL	53000			
SUM BOS MONITORED				**91000**			
	ARC	FORCIT	CHEMICAL	300			
		NESTE NAANTALI	PETROCHEMICAL	15000			
SUM ARC MONITORED				**15300**			
	GUF	ENSO KOTKA	PULP/PAPER	13000			B
		ENSO SUMMA	PULP/PAPER	9000			B
		GENENCOR HANKO	CHEMICAL				
		NESTE PORVOO	PETROCHEMICAL	6000			
		SUNILA	PULP/PAPER	44000			B
SUM GUF MONITORED				**72000**			
SUM FINLAND MONITORED				**592300**			
RUSSIA	GUF		LEATHER/TEXTILE	0,305			
			PULP/PAPER	125495			
			OTHER	83184			
			FOOD	1,496			
			CHEMICAL	0,232			
SUM GUF MONITORED				**208681**			
SUM RUSSIA MONITORED				**208681**			
ESTONIA	GUF	EESTI FOSFORIIT-BIO	CHEMICAL	1030			B
		EESTI FOSFORIIT-MECH	CHEMICAL	1943	M		
		VIRU RAND	FOOD	100	M		
SUM GUF MONITORED				**3073**			
		untreated	CHEMICAL	132			
SUM GUF UNMONITORED AND UNTREATED				**132**			
SUM ESTONIA MONITORED				**3073**			
SUM ESTONIA UNMONITORED AND UNTREATED				**132**			
LATVIA	GUR	A/S BOLDERAJA	PULP/PAPER	10237	M		B
		A/S RIGAS PIENA KOMBINATS	FOOD	582	M		B
		LAKU-KRASU RUPNICA	CHEMICAL	110,92	M		
		ROJAS ZKR	FOOD	285	M		B
		SLOKAS CPK	PULP/PAPER	5518	M		B
		Small plants: treated	PULP/PAPER	85			
			FOOD	1141			
			OTHER	767			
SUM GUR MONITORED				**18726**			
		Small plants: untreated	PULP/PAPER	17			
			OTHER	74			
SUM GUR UNMONITORED AND UNTREATED				**90**			

SUBREGION		NAME	BRANCH	AMOUNT OF WASTEWATER in 1000 m^3/a	TREATMENT METHOD MECH.	CHEM.	BIOL.
	BAP	SIA KONSALUS	FOOD	10,5	M		B
		SIA VENTSPILS KOKS	PULP/PAPER	16	M		B
		Small plants: treated	OTHER	40			
		VAS VENTSPILS NAFTA	OTHER	1622	M		B
		VENTSPILS OSTAS RUPNICA	OTHER	8495	M		B
SUM BAP MONITORED				**10184**			
SUM LATVIA MONITORED				**28910**			
SUM LATVIA UNMONITORED AND UNTREATED				**90**			
LITHUANIA	BAP	OIL REFINERY	PETROCHEMICAL	7114	M		B
		SC OIL TERMINAL	OTHER	337	M		
SUM BAP MONITORED				**7451**			
SUM LITHUANIA MONITORED				**7451**			
POLAND	BAP	Plants: treated	CHEMICAL	133280	M	C (97 %)	
			PETROCHEMICAL	3217	M	C (30 %)	C (30 %)
		Small plants: treated	PULP/PAPER	4731	M	C (98 %)	B (1.6 %)
			IRON/STEEL	99	M		B
			FOOD	1237	M	C (37 %)	
			OTHER	7771	M	C (13 %)	B (11 %)
SUM BAP MONITORED				**150336**			
		Small plants: untreated	CHEMICAL	14			
			FOOD	155			
			OTHER	33			
SUM BAP UNMONITORED AND UNTREATED				**202**			
SUM POLAND MONITORED				**150336**			
SUM POLAND UNMONITORED AND UNTREATED				**202**			
GERMANY	BAP	ZUCKERFABRIK ANKLAM	FOOD	461	M		
SUM BAP MONITORED				**461**			
	WEB	GLÜCKSKLEE GMBH	FOOD	103	M		
		POMOSINWERKE GROSSENBRODE	FOOD	192	M		B
		ZUCKERFABRIK SCHLESWIG	FOOD	361	M	C	B
SUM WEB MONITORED				**656**			
SUM GERMANY MONITORED				**1117**			
DENMARK	BAP	H & C PROM KEMI	CHEMICAL	117			
		BORNFISH	FOOD	23,8			
		BORNHOLMS KONSERVESFABRIK	FOOD	14,4			
		NORDFILET	FOOD	24,6			
SUM BAB MONITORED				**180**			
	WEB	DOW-DANMARK	CHEMICAL	197			
		ASSENS SUKKERFABRIK	FOOD	2 000			
		GERLEV SUKKERFABRIK	FOOD	269			
		KØBENHAVNS SALATFABRIK	FOOD	183			
		NAKSKOV SUKKERFABRIK	FOOD	895			
		RAHBEKFISK	FOOD	67			
		SLAGERIREGION SYD-BLANS	FOOD	419			
		SUKKERFABRIKKEN, NYKØBING	FOOD	516			
		SUKKERFABRIKKEN, NYKØBING	FOOD	3 000			
		SUKKERFABRIKKEN, NYKØBING	FOOD	235			
		TAFFEL FOODS	FOOD	57			
		VAN DEN BERGH FOODS	FOOD	1 000			
		ASN	OTHER	200			
		DANFOSS	OTHER	147			
		FYNSVÆRKET	OTHER	96			

Annex 5/3

SUBREGION		NAME	BRANCH	AMOUNT OF WASTEWATER in 1000 m³/a	TREATMENT METHOD MECH.	CHEM.	BIOL.
		MIDTKRAFT - STUDSTRUPVÆRKET	OTHER	0			
		K. K. MILJØTEKNIK	OTHER	58			
		KUWAIT PETROLEUM	OTHER	946			
		NKT TRÅDVÆRKET	OTHER	35			
		STATOIL	OTHER	1 000			
		STIGE Ø LOSSEPLADS	OTHER	135			
		SIGSNÆS INDUSTRIMILJØ	OTHER	178			
		SEAS - STIGSNÆSVÆRKET	OTHER	83			
		STORA DALUM	OTHER	776			
		ÅRHUS OLIEFABRIK	OTHER	5 000			
SUM WEB MONITORED				**17496**			
	SOU	FEF CHEMICALS	CHEMICAL	67,1			
		SUN CHEMICAL	CHEMICAL	506			
		CODAN GUMMI	OTHER	40			
		COPENHAGEN PECTIN	OTHER	1 000			
		DTH - KEMIAFD. RENSEANLÆG	OTHER	54			
		JUNCKERS INDUSTRIER	OTHER	2 000			
		KØBENHAVNS LUFTHAVN KASTRUP	OTHER	0,0			
		STEVNS KRIDTBRUD	OTHER	552			
SUM SOU MONITORED				**4219**			
	KAT	BASF HEALTH & NUTRITION	CHEMICAL	463			
		DANSK SALT	CHEMICAL	101			
		H. LUNDBECK	CHEMICAL	111,0			
		KEMIRA DANMARK	CHEMICAL	210,6			
		DANISCO DISTILLERS	FOOD	344,2			
		DANSK MUSLINGERENSERI	FOOD	3 000			
		ERIK TAABBEL FISKEEKSPORT	FOOD	118,0			
		FISKERNES FILETFABRIK	FOOD	11,5			
		HAVFISK	FOOD	39,2			
		LAUNIS FISKEKONSERVES	FOOD	25,0			
		NIELSEN FISKEKONSERVES	FOOD	80,0			
		P. ANTHONISEN	FOOD	79,0			
		SÆBY FISKEINDUSTRI	FOOD	113,3			
		UNI FISK	FOOD	34,0			
		UNI FISK (N. B. THOMSEN)	FOOD	12,1			
		VILDSUND MUSLINGEINDUSTRI	FOOD	5 000			
		VINDERUP FJERKRÆSLAGTERI	FOOD	325			
		DAKA AMBA RANDERS	OTHER	226			
		FISKERNES FISKEINDUSTRI	OTHER	8 000			
		FLYVESTATION AALBORG	OTHER	85,6			
		NVA - AALBORGVÆRKET	OTHER	20 000			
		NVA - VENDSYSSELVÆRKET	OTHER	20 000			
		THYBORØN ANDELS FISKEINDUSTRI	OTHER	4 000			
SUM KAT MONITORED				**422378**			
SUM DENMARK MONITORED				**444273**			
SWEDEN	BOB	LÖVHOLMEN	PULP/PAPER	13040	M		B
		MUNKSUND	PULP/PAPER	13027	M		
		KARLSBORG	PULP/PAPER	22384	M		B
		RÖNNSKÄRSVERKEN	MINING	27000	M	C	
		SSAB LULEÅ	IRON/STEEL	53000	M	C	B
SUM BOB MONITORED				**128451**			
	BOS	BERGVIK KEMI	CHEMICAL		M	C	B
		CASCO NOBEL SUNDSVALL	CHEMICAL	144,3	M	C	B
		DOMSJÖ	PULP/PAPER	7647	M		B
		DYNÄS	PULP/PAPER	13557	M		B
		HALLSTAVIK	PULP/PAPER	8882	M		B
		HUSUM	PULP/PAPER	50608	M	C	
		IGGESUNDS BRUK	PULP/PAPER	29086	M		B
		KORSNÄS GÄVLE	PULP/PAPER	58480			
		NORRSUNDET	PULP/PAPER	16616	M		B

SUBREGION	NAME	BRANCH	AMOUNT OF WASTEWATER in 1000 m^3/a	TREATMENT METHOD MECH.	CHEM.	BIOL.
	OBBOLA	PULP/PAPER	4032	M		B
	ORTVIKEN	PULP/PAPER	10672	M	C	B
	SKUTSKÄR	PULP/PAPER	43,5	M		B
	Small plants: treated	PULP/PAPER	3137	M	C	
	UTANSJÖ	PULP/PAPER	2540	M		
	VALLVIK	PULP/PAPER	19254	M		
	ÖSTRAND	PULP/PAPER	36524	M		
SUM BOS MONITORED			**261223**			
BAP	BRAVIKEN	PULP/PAPER	6821	M	C	B
	DJUPAFORS	PULP/PAPER	541	M	C	B
	KARLSHAMN	FOOD	777,9	M	C	B
	MÖNSTERÅS BRUK	PULP/PAPER	17035	M		B
	MÖRRUMS BRUK	PULP/PAPER	27200	M		
	NYMÖLLA	PULP/PAPER	30082	M		
	NYNÄSHAMN REFINERY	PETROCHEMICAL	1340	M		B
	SSAB OXELÖSUND	IRON/STEEL	1000	M		B
	Small plants: treated	PULP/PAPER	613	M	C	B
SUM BAB MONITORED			**85410**			
SOU	KEMIRA	CHEMICAL	2573	M	C	
SUM SOU MONITORED			**2573**	**M**	**C**	
KAT	PREAN RAFF	PETROCHEMICAL	729	M		B
	SHELL RAFF	PETROCHEMICAL	946	M	C	B
	VÄRÖ BRUK	PULP/PAPER	32398	M		
	AKZO NOBEL S-SUND	CHEMICAL	186,2	M	C	
	NYNÄS RAFF II	PETROCHEMICAL	136	M	C	B
SUM KAT MONITORED			**34395**			
SUM SWEDEN MONITORED			**512052**			

Annex 6. Pollution Load Data in 1995

SOURCE	SUBREGION	BRANCH	NAME	BOD_7 (t/a)	COD_{Mn} (t/a)	COD_{Cr} (t/a)	TOC (t/a)	SS (t/a)	AOX (t/a)	P_{total} (t/a)	P_{PO4} (t/a)	N_{total} (t/a)	N_{NH4} (t/a)	N_{NO2} (t/a)	N_{NO3} (t/a)	Hg (kg/a)	Cd (kg/a)	Zn (kg/a)	Cu (kg/a)	Pb (kg/a)	Ni (kg/a)	Cr (kg/a)
FINLAND																						
AQUACULTURE	BOB	-	Small plants							3,4		29,2										
	BOS	-	Small plants							19,3		152										
	ARC	-	Small plants							88,3		661										
	GUF	-	Small plants							14,5		107										
Sum										**126**		**949**										
INDUSTRY	BOB	CHEMICAL	KEMIRA KOKKOLA			2609				2,3		23,4				5						
			Small plants: treated	327		1313				1,1		9,2				13,5						316
		FOOD	Small plants: treated	31		4				1,2		12,7										
		IRON/STEEL	RAUTARUUKKI RAAHE			246				2,6		89,8						4250				
		LEATHER/TEXTILE	Small plants: treated	7		18				0,01		1										6
		OTHER METAL	OUTOKUMPU KOKKOLA									135,7				4	94	2150	166		4194	
			OUTOKUMPU TORNIO	0,7						0,063		197,4						1275			885	3029
			Small plants: treated	0,3								34,5								9	12,2	7,3
		PULP/PAPER	ENSO OULU	888		12037			127	14,3		90,6										
			M-B KEMI	619		15201			62	17,1		162										
			ENSO VEITSILUOTO	2965		20022			57	21,6		145										
			WISAFOREST	1524		25008			162	26		250										
			Small plants: treated	184		4			1	0,6		12										
	BOS	CHEMICAL	VUORIKEMIA							8,2		25,6										
			Small plants: treated							1		76				4	4	37800	944	1228	2991	13900
		FOOD	Small plants: treated	1		1				0,1		0,8										
		OTHER	Small plants: treated	2		2				0,15		7,9				0,08	0,36	36	3	3	15	38
		OTHER METAL	Small plants: treated															38			0,05	
		PULP/PAPER	M-B KASKINEN	2034		15160			58	22,5		200										
			UPM RAUMA	105		1701			1,6	3		36										
			Small plants: treated			4			534													
	ARC	CHEMICAL	FORCIT	0,3		53				0,01		15,1										
			Small plants: treated	12		43				0,19		3,1										
		FOOD	Small plants: treated	71		120				1,5		14,1										
		MINING	Small plants: treated	22		260				0,02		1										
		OTHER	Small plants: treated			3											0,29	11	27	2	28	
		OTHER METAL	Small plants: treated			1						0,2						97	72	73	48	2
		PETROCHEMICAL	NESTE NAANTALI	45						0,64		68,3										
	GUF	CHEMICAL	GENENCOR HANKO	11		146				0,4		26,4										
		FOOD	Small plants: treated	18		66				0,18		3,5										
		IRON/STEEL	Small plants: treated							0,09		1,3					0,05	30	31	3		
		MINING	Small plants: treated	0		1											0,05	23	0,6	0,7		1
		OTHER	Small plants: treated	1						0,17		6,6						0,18	0,23	0,1	0,53	0,56
		OTHER METAL	Small plants: treated	1		21				0,043		1,8										
		PETROCHEMICAL	NESTE PORVOO	68		656				2		29,7					0,05	10	6	1	6	4
			Small plants: treated	23		206				0,45		10,7								30		
		PULP/PAPER	ENSO KOTKA	943		4264				13,2		70,3										
			ENSO SUMMA	471		1425				4,7		44,6										
			KIERRÄTYSKUITU	83																		
			SUNILA	2055		12200			225	18		126										
			Small plants: treated	11		365				0,4		7										
Sum				**12523**						**164**		**1939**										

SOURCE	SUBREGION	BRANCH	NAME	BOD_7 (t/a)	COD_{Mn} (t/a)	COD_{Cr} (t/a)	TOC (t/a)	SS (t/a)	AOX (t/a)	P_{total} (t/a)	P_{PO4} (t/a)	N_{total} (t/a)	N_{NH4} (t/a)	N_{NO2} (t/a)	N_{NO3} (t/a)	Hg (kg/a)	Cd (kg/a)	Zn (kg/a)	Cu (kg/a)	Pb (kg/a)	Ni (kg/a)	Cr (kg/a)
RIVER *)	BOB		IIJOKI	7509	75587		51788		102	122	40	1978	65		307	41	76	17880	2670	1010		2801
			KALAJOKI	2928	26982		20191			139	53	1566	192		558		40	11860	2760	520		1919
			KEMIJOKI	20228	178256		139503		366	383	124	6783	201		1253	369	269	52300	11730	2000		11768
			KIIMINGINJOKI	2798	26150		19299		36	39	14	731	24		129	9	25	7760	850	420		847
			KYRÖNJOKI	2745	25261		18928			111	68,3	2360	285		1102	11	50	7990	4880	820		2000
			LAPUANJOKI	2203	19512		15193		37	87	59	1542	221		610	10	40	12960	2030	620		1125
			LESTIJOKI	965	9380		6654			65	30	467	71,1		133		9	3340	800	280		828
			OULUJOKI	9455	76274		65208		134	135	53	2570	177		389	99	121	23270	4730	770		3601
			PERHONJOKI	1571	15728		10833			58	24	686	105,5		185		20	6390	890	310		1332
			PYHÄJOKI	2037	18325		14048		34	55	29	880	91		262	11	32	11370	1900	280		1359
			SIIKAJOKI	2696	25220		18596			88	51	1020	106		300		28	9710	1610	390		1591
			SIMOJOKI	2462	21964		16979		44	34	10	685	29		98	25	21	4910	800	300		823
			TORNIONJOKI	12255	113754		84517		171	289	79	4200	147		524	196	278	32900	12410	1150		6440
			unmonitored	8162	72409		56288		310	270	135	3975	450		2431	10	100	30500	6600	1600		4700
	BOS		EURAJOKI	585	4300		4034			24	13,8	657	95,5		317		35	8910	1350	260		1019
			ISOJOKI	1109	11192		7648			39	20,8	489	43,4		146		20	6470	1290	150		1050
			KOKEMÄENJOKI	11422	85599		78771		169	406	214	8492	516		4116	94	509	118000		8570		16299
			LAIHIANJOKI		2021					5,6		276										
			unmonitored	6437	52539		44392			206	131	4266	528		1759		210	58400		1500		7800
	ARC		AURAJOKI	503	4105		3472		12,9	41	23,6	522	25,3		318	4	20	8910	1450	460		1483
			KISKONJOKI	492	3828		3391			22	12	358	7,8		171		19	8460	920	230		461
			PAIMIONJOKI	601	4846		4145			60	37,7	819	23,8		546		13	7750	2320	740		2826
			unmonitored	3192	25558		22016			246	147	3398	114		2070		100	50200	9400	2900		9500
	GUF		KARJAANJOKI	739	4989		5095		12,4	22	7,5	619	34,6		309	4	11	2700	1340	180		558
			KOSKENKYLÄNJOKI	391	2846		2698			24	12,3	397	12,9		238		7	2270	920	210		750
			KYMIJOKI	11931	74748		82286		375	229	48	6439	284		2330	70	17	46700	11800	2450		4830
			MÄNTSÄLÄNJOKI	502	4016		3459			26		497	28,4		308		9	3460	1130	300		1152
			PORVOONJOKI	585	4529		4033			47	13,1	1191	69,5		867		12	6300	2032	460		1754
			VANTAANJOKI	939	7057		6476		17,9	53	26,9	1042	37,3		698	4	21	7710	2440	730		2314
			VIROJOKI	335	2609		2313			9,4	4,1	210	13,5		98,6							
			unmonitored	2723	20316		18778		76	113	49,5	1174	142		747		53	23200	6900	1650		5740
Sum				**120500**	**1019900**					**3448**		**60289**										
URBAN	BOB	-	KEMI	36,9						2,16		108										
			KEMPELE	207						0,77		90,9										
			KOKKOLA	92						0,86		127										
			OULU	799						4,2		533										
			PIETARSAARI	28,8						1,27		96,7										
			RAAHE	15,2						0,46		72,3										
			TORNIO	0,9						0,03		1,3										
		-	Small settlements: mon.	90,3						3,5		136										
	BOS	-	PORI	815						8,12		256										
			RAUMA	35,7						2,83		67,2										
			VAASA	104						4,78		239										
		-	Small settlements: mon.	45,7						2,7		75,9										
	ARC	-	KAARINA	48,9						1,5		97,8										
			MAARIANHAMINA	27,8						0,88		59,3										
			NAANTALI	86,1						0,66		57,7										
			PARAINEN	50,7						0,73		38										
			RAISIO	36,9						3,76		77										
			SALO	26,6						1,64		87,2										
			TURKU	492						13,5		609				4	2	1170	200	60	1850	66
			UUSIKAUPUNKI	63,3						0,71		68,7										
		-	Small settlements: mon.	34,3						2,39		62,6										

SOURCE	SUBREGION	BRANCH	NAME	BOD_7 (t/a)	COD_{Mn} (t/a)	COD_{Cr} (t/a)	TOC (t/a)	SS (t/a)	AOX (t/a)	P_{total} (t/a)	P_{PO4} (t/a)	N_{total} (t/a)	N_{NH4} (t/a)	N_{NO2} (t/a)	N_{NO3} (t/a)	Hg (kg/a)	Cd (kg/a)	Zn (kg/a)	Cu (kg/a)	Pb (kg/a)	Ni (kg/a)	Cr (kg/a)
	GUF	-	ESPOO	251						10,8		1060										
			HAMINA	17,7						0,81		75,2										
			HANKO	14,6						0,73		38,3										
			HELSINKI	877						31,9		2460										
			KIRKKONUMMI	9,3						0,71		74,8										
			KOTKA (MUS)	51,8						2,5		111										
			KOTKA (SUN)	149						3,9		61,7										
			PORVOO (KOK)	146						0,87		99,6										
			PORVOO (HER)	11,1						0,49		51,8										
			TAMMISAARI	8,2						0,4		24,8										
		-	Small settlements: mon.	40,8						1,41		78,5										
Sum				**4714**						**112**		**7096**										
Finland Total				**137737**						**3849**		**70274**										
FINLAND TOTAL without Tornio Joki				125482						3560		66074										
RUSSIA																						
INDUSTRY	GUF	CHEMICAL		80,4		612	0,53	2310		500		180	0,003	0,002	0,057			183	9			
		FOOD				62,3		29,6				2,5	3,4	0,5	1,9							
		LEATHER/TEXTILE				31,0		16,5				5,3	0,6		0,2		27	2	2	6		11,4
		MINING		174				1292		95		356										
		OTHER		3,06		2009		4153	0,05	39		1898	122	8,136	515		300	33660	46060	31	426	18472
		PULP/PAPER						5990		113		472	596	2,0	133							
	BAP			10663						156		491										
Sum				**10920**				**13791**		**902**		**3406**										
RIVER	GUF		B.NEVA							1978	534,6	34480	4704					465200	412000	42800		92000
			B.NEVKA							71,28	28,96	1214	100,2					14040	7320	1120		2440
			GOROKHOVKA							11,93	6,39	218,37	37,5					2460	500	150		190
			KARASTA							0,13	0,11		14,69					44	126	13		623
			KOVASHI							6,37	1,88	173,75	7,478					500	440	38		63
			KRASNENSKAYA							8,45	5,99	182,09	43,18					1160	1200	40		160
			LEBIACSHYE							0,76		46,15	5,748					182	240	25		13
			LUGA							43,73	25,4	2085,8	66,15					6600	5920	530		600
			M.NEVA							423,2	152,4	9903,1	948					45600	22000	11840		22000
			M.NEVKA							230,9	136,9	4747	453,3					32480	24800	5960		17960
			MALINOVKA							0,83	0,15	35,06	2,925					240	220	200		90
			POLEVAYA							0,9	0,12	63,89	7,564					570	97	40		57
			SESTRA							2,78	0,37	44,51	5,369					460	180	30		370
			SHINGARKA							0,12	0,05	38,1	0,755					63	19	13		13
			SISTA							2,77	1,11	273,86	5,107					8600	2100	50		100
			STRELKA							3,54	2,18	198,33	6,208					250	190	57		63
			TCHERNAYA							9,25	5,49	243,49	17,34					1100	800	70		90
			TCHULKOVKA							0,48	0,09	6,81	1,184					110	28	11		23
			VORONKA							1,21	0,72	93,77	2,59					350	100	20		20
			BALTIETZ							0,41		15,31	1,684					23	63	17		385
			PESCHANAYA							0,65	0,25	21,18	2,466					15	40	6		11
			SELEZNEVKA							5,5	2,09	87,79	16,82					1100	460	60		130
			unmonitored					4970		507		2916	1226	35,41	957,3		120	4190	5670	190	3080	730
	BAP		PREGOLYA	29789				2603		260		3100						190	200			50
Sum				**29789**						**3570**		**60188**						**585527**	**484713**			**138181**
URBAN	GUF		WHOLE POINT SOURCES	44876				8917		2442		19676	17839	12	682	548	5468	260745	55624	25825	50679	45262
	BAP		WHOLE POINT SOURCES	16651						193		1376										
Sum				**61527**						**2635**		**21052**										
Russia Total				**102236**						**7108**		**84646**										

SOURCE	SUBREGION	BRANCH	NAME	BOD_7 (t/a)	COD_{Mn} (t/a)	COD_{Cr} (t/a)	TOC (t/a)	SS (t/a)	AOX (t/a)	P_{total} (t/a)	P_{PO4} (t/a)	N_{total} (t/a)	N_{NH4} (t/a)	N_{NO2} (t/a)	N_{NO3} (t/a)	Hg (kg/a)	Cd (kg/a)	Zn (kg/a)	Cu (kg/a)	Pb (kg/a)	Ni (kg/a)	Cr (kg/a)
ESTONIA																						
AQUACULTURE	GUF	-	PÄRISPEA							1,5		11,7										
	BAP	-	KESKNÕMME							1,1		8,6										
Sum										**2,6**		**20,3**										
INDUSTRY	GUF	CHEMICAL	EESTI FOSFORIIT-BIO	12						0,7		8,6										
			EESTI FOSFORIIT-MECH	8						18		11										
			SILMET WD									1534										
		PULP/PAPER	VIRU RAND	33,6						0,8		2,5										
Sum												1556										
RIVER *)	GUF	-	JÄGALA	780	7230			7140		13,2	5,7	880	8,8	2,7	545	10	35	5110	7160	738		
			KEILA	640	3630			1940		25,6	15,8	1044	23,6	5,3	760	14	31	1560	6200	630		
			KUNDA	290	1340			620		5,4	3,4	480	4,2	1,4	230	57	14	1330	3940	145		
			LOOBU	155	830			520		5,3	2,9	230	3,1	0,9	180	2,8	7	1000	1470	164		
			NARVA	35170	120700			133900		670	390	24950	330	150	2630	720	1300	125000	320000	19000		
			PUDISOO	43	550			60		3,1	1,3	50	0,9	0,2	27							
			PURTSE	670	3620			900		5,4	3,6	790	59,5	4,6	260	61	33	1450	4000	350		
			PÜHAJÕGI	205	720			330		18,1	13,9	215	22,5	2,7	78	1,4	26	350	1070	155		
			SELJAJÕGI	250	830			740		25,4	21,8	555	6,1	3,7	380	7	14	1130	2250	110		
			VALGEJÕGI	180	1320			605		6,4	3,4	230	2,7	0,8	160	10	10	2480	2160	148		
			VASALEMMA	250	1780			1100		7,6	3,9	320	7,8	1,2	200							
			VIHTERPALU	285	3855			4050		11,5	7,2	340	5,1	0,7	120							
			VÄÄNA	380	1350			1135		11	6,2	450	66	2,3	290	2,6	50	1250	1950	240		
			unmonitored	2530	16570			11730		85	55	3400	130	16,2	1980							
	GUR	-	KASARI	1785	14470			12160		59	26,5	2120	25,6	6,2	1230	46	97	6020	19600	1780		
			PÄRNU	4030	34450			24440		75,3	41,7	3060	35	10,1	1720	71	280	13000	57200	2860		
			unmonitored	4590	38630			28900		106	54	4090	48	12,9	2330							
Sum				**52233**	**251875**			**230270**		**1133**	**656**	**43204**	**779**	**222**	**13120**							
URBAN	GUF	-	KOHTLA-JÄRVE	367						12		352										
			PALDISKI	14,3						0,7		4,3										
			SILLAMÄE	13						7,2		37										
			TALLINN	559						38,9		1175										
			TALLINN: Untreated	5				8,1		0,18		1,68										
			Small settlements: mon.	67,9						56,1		6,4										
			Small settlements: untrea	1,5				1,1		0,1		0,5										
	GUR	-	HAAPSALU	53						2,5		17										
			KURESSAARE	29						5,3		38										
			PÄRNU	59						6		30										
			Small settlements: mon.	51,1				33,4		4,2		21,1										
	BAP	-	Small settlements: mon.	7,8				3,2		1,2		4,2										
Sum				**1228**						**134**		**1687**										
Estonia Total				**53514**						**1290**		**46468**										

*) Data for heavy metal load in rivers is from 1994.

SOURCE	SUBREGION	BRANCH	NAME	BOD_7 (t/a)	COD_{Mn} (t/a)	COD_{Cr} (t/a)	TOC (t/a)	SS (t/a)	AOX (t/a)	P_{total} (t/a)	P_{PO4} (t/a)	N_{total} (t/a)	N_{NH4} (t/a)	N_{NO2} (t/a)	N_{NO3} (t/a)	Hg (kg/a)	Cd (kg/a)	Zn (kg/a)	Cu (kg/a)	Pb (kg/a)	Ni (kg/a)	Cr (kg/a)
LATVIA																						
INDUSTRY	GUR	CHEMICAL	LAKU-KRASU RUPNICA	4,461		12,762				0,009		0,263										
		FOOD	A/S RIGAS PIENA KOMBINATS	49,631		137,24				1,783		12,882										
			ROJAS ZKR	10,3		38,05				0,98		7,32	7,32	0,02								
			Small plants: treated	9,34		83,219				4,614	1,93	17,06	7,686	0,701	8,801							
		OTHER	Small plants: treated	9,23		74,45				3,11	1,91	21,07	6,24	1,69	4,82							
			Small plants: untreated	3,4		11,16		5,62		0,26	0,76	1,28	0,88		0,07			6	0,3			
		PULP/PAPER	A/S BOLDERAJA	42,474		792,2					15,1		13,9	0,43	65,4		45	210	160		89	64
			SLOKAS CPK	37,611		847,37				15,44		92,919	15,08	1,135	52,652		19	144	43	147	87	66
			Small plants: treated	6,62		16,64				0,25	0,11	2,1	1,41									
			Small plants: untreated	0,22		1,678				0,022		0,286										
	BAP	FOOD	SIA KONSALUS	0,039						0,02	0,015	0,011	0,028	0,029								
		OTHER	VAS VENTSPILS NAFTA	27,895						0,19		2,29	1	0,02			8	78	48	34	50	79
			VENTSPILS OSTAS RUPNICA	34,211		476				20		109	7,5	0,9	101,98							
			Small plants: treated	0,585																		
		PULP/PAPER	SIA VENTSPILS KOKS	0,782		3,64				0,02		0,41	0,28	0,07	0,023							
Sum				**237**						**47**		**267**										
RIVER	GUR	-	DAUGAVA	39200		739000		71600		1010	780	41300	2320	170	18700		999	69500	20400	4420		
			GAUJA	4310		80900		16100		88	64	7030	234	35	4480		80	9100	1600	350		
			IRBE	829		22700		2190		12,1	8,1	863	46	2,3	271		13	2880	410	130		
			LIELUPE	6110		109000		20700		245	204	17200	637	60	10000		118	10200	5090	1150		
			SALACA	1900		42200		7280		35	26	3280	91	27	1960		23	4550	850	170		
			unmonitored	2210		42000		5020		182,2	46	6247,2	144	12	1510		52	4080	1200	260		
	BAP	-	BARTA	1100		16700		5420		30,5	19	1770	68,7	4,6	1100		19	2440	916	130		
			SAKA	537		6570		1720		12	8,6	678	31	2,8	409		12	1380	340	86		
			VENTA	4970		76950		10800		122	78	8690	405	30	5670		51	8100	2100	680		
			unmonitored	543		8300		1460		66,81	9	2359,9	41	3,0	595		7	980	270	72		
Sum				**61709**		**1144320**		**142290**		**1804**	**1243**	**89418**	**4018**	**347**	**44695**		**1374**	**113210**	**33176**	**7448**		
URBAN	GUR	-	RIGA	1239,89						207,8		653,76					80	2632	540	365	604	1068
			RIGA: Untreated	3722,4				2384,26		88,75		409,4					48	4012	553	477	285	847
			Small settlements: mon.	68,89				9,78		11,05		79,145	40,52	0,048	1,796		19	121	65	44	49	27
			Small settlements: untrea	0,48				0,64		0,06		0,42	0,31		0,09							
	BAP	-	LIEPAJA	307,83						22,14		200	159,6	1,09	11,56			54	48		69	76
			Small settlements: mon.	163,89				92,21		3,47		37	46,76	0,22	17,62							
Sum				**5503**						**333**		**1380**										
Latvia Total				**67449**						**2184**		**91065**										
LITHUANIA																						
INDUSTRY	BAP	OTHER	SC OIL TERMINAL	2,76							0,15	3,07										
		PETROCHEMICAL	OIL REFINERY	65						16	12,9	293	105	3,9	38							
Sum				67,8						16	13,05	296										
RIVER	BAP	-	AKMENA-DANE	903	2231,8			2035		25,5	13,43	949	115	4,849	392		12	1751	1247	116	460	525
			NEMUNAS	91880	181804			262395		1228	1057	34191	3869	124	19569		812	88 000	27770	17860	15750	1560
			unmonitored	484,18	1192			984		16,8	15,98	491	38,2	1,555	207							
Sum				93267	185228			265414		1270	1086	35631	4022	130	20168							
URBAN	BAP	-	KLAIPEDA	2799,1						90,1	62,8	799,3	564,9	2,1	30,5			3400	700		700	130
			PALANGA	216,2						17		91	75									
			Small settlements: mon.	1,5						0,21	0,13	1,08	0,39	0,02	1,05							
			Small settlements: untrea	64,2						11,78		4,77										
Sum				**3081**						**119**		**896**										
Lithuania Total				**96416**						**1405**		**36823**										

SOURCE	SUBREGION	BRANCH	NAME	BOD_7 (t/a)	COD_{Mn} (t/a)	COD_{Cr} (t/a)	TOC (t/a)	SS (t/a)	AOX (t/a)	P_{total} (t/a)	P_{PO4} (t/a)	N_{total} (t/a)	N_{NH4} (t/a)	N_{NO2} (t/a)	N_{NO3} (t/a)	Hg (kg/a)	Cd (kg/a)	Zn (kg/a)	Cu (kg/a)	Pb (kg/a)	Ni (kg/a)	Cr (kg/a)
POLAND																						
INDUSTRY	BAP	CHEMICAL	Plants: treated	857,5		3894,4				120,9		665,8				320	38	2843	844	573	550	217
			Plants: untreated	0,2		0,4		1,9		6		0,2										
		FOOD	Small plants: treated	195,4		394,3				33,8		42,2				0.3	0.5	72	91	5	1	4
			Small plants: untreated	23,4		44,2		9,9		0,2		1,3				0.004	0.1	62	2	2	0,3	0,2
		IRON/STEE	Small plants: treated	0,4		3				0,009		0,2				0.025	0.1	5	1	4	0,38	0,15
		OTHER	Small plants: treated	51,9		250,7				3,6		25,2				14	25	320	59	89	34	41
			Small plants: untreated	1,4		3,1		2,2		0,00075		0,1						10				
		PETROCHEMICAL	Plants: treated	22,9		194				1,2		16										
		PULP/PAPER	Small plants: treated	621,3		1184,4				2		19,5				8	1	332	56	37	22	6
Sum				**1774**		**5969**				**168**		**771**										
RIVER	BAP	-	GRABOWA	468	1822			2388		23	11	501	41	5	291	250	230	1370	510	260		380
			INA	2037	4313			7692		142	34	1880	66	14	1107	130	10	7550	1160	830	310	20
			LEBA	1619	3994			7069		102	50	1427	73	11	556	90	120	2310	740	1590	140	130
			LUPAWA	1066	2028			3697		66	28	997	20	6	499	50	50	1250	300	1110	30	30
			ODRA	87638	142489			313722		4922	1489	76973	3810	301	46082	3150	2890	387620	66190	55120	53490	17450
			PARSETA	2060	8291			8957		106	52	2499	225	26	1548	960	900	5390	2640	920		1910
			PASLEKA	3179	4714			8093		127	57	1440	192	13	757	230	720	35710	1330	6640	590	1270
			REDA	546	1075			1642		20	12	310	27	3	185	10	10	1030	110	110	50	20
			REGA	2876	5996			7755		135	39	2539	104	19	1524	10	30	8410	1580	1000	580	10
			SLUPIA	2101	3833			6468		134	74	1702	128	16	623	140	90	3170	820	2750	170	120
			WISLA	164621	255146			567272		7321	4428	112793	7639	563	65618	4100	3870	345430	51860	52670	65720	27200
			WIEPRZA	1665	4590			5858		108	56	1615	43	10	684	150	70	2090	460	1630	130	180
			unmonitored							67		3448										
Sum				**269876**	**438291**			**940613**		**13273**	**6330**	**208124**	**12368**	**987**	**119474**	**9270**	**8990**	**801330**	**127700**	**124630**		**48720**
URBAN	BAP	-	GDANSK (W)	5369						97		1634	1325	4	5	20	200	4100	580	2030	1200	560
			GDANSK (Z)	261,8						72,5		369,1	298,6	10,1	26,9	9	96	340	40	276	188	123
			GDANSK: By-passes	0,83				0,84		0,03		0,16	0,13									
			GDYNIA	591,5						79,5	55,2	1226,1	838,2	2,8	5	18	68	2933	341	437	259	40
			GDYNIA: By-passes	8,3				8,8		2							0,2	3	2	1	0,5	
			GRYFINO	268						9,6		35,8				2	0,2	50	5	4	4	1
			JASTRZEBIA GORA	13						5		12,7	6,1		0,8	0.035	0,17	7	0.1	2	0,7	0.05
			KOLOBRZEG	145,2						12,1		245,7						962	82		124	53
			LEBA	6,5						4,2		19,7										
			POLICE	129						10,4		75					3,9	180	15,5	33,7	22	
			POLICE: By-passes	21,8				7,6		0,7		4,2				0.0015	0,5	20	4	4	1,5	0,9
			SWINOUJSCIE	453,1						147,2		22				15	2	1319	62	43	16	4
			SZCZECIN (POD)	251						6,3		42,2				1	0,5	278	19	19	5	2
			SZCZECIN (SZC)	740,6						18,9		239,1				5	0,9	741	38	19	29	5
			SZCZECIN : Utreated	8017				6609		237,8		1522,8				76	30	19900	1210	830	547	212
			USTKA	25						4,6		37,8	8,9		9,5							
			WLADYSLAWOWO	10,5						8,6	9,22	70,5	55,9			7	2	19	3	14	2	4
			Small settlements: mon.	19,6				9,3		2,8		38				0,2	0,2	63	3	4	0,4	1
			Small settl.: non-systema. mo.	437,3				175		45		228,3						84	4	17	3	0,2
			Small settlements: untrea	185,5						3		29										
Sum				**16955**				**6811**		**767**	**64**	**5823**	**2533**	**17**	**47**	**153**	**405**	**30999**	**2409**	**3734**	**2402**	**1006**
Poland Total				**288605**	**438291**			**947438**		**14208**	**6394**	**214747**	**14901**	**1004**	**119521**	**9765**	**9459**	**8E+05**	**131162**	**129074**	**124220**	**49994**

SOURCE	SUBREGION	BRANCH	NAME	BOD_7 (t/a)	COD_{Mn} (t/a)	COD_{Cr} (t/a)	TOC (t/a)	SS (t/a)	AOX (t/a)	P_{total} (t/a)	P_{PO4} (t/a)	N_{total} (t/a)	N_{NH4} (t/a)	N_{NO2} (t/a)	N_{NO3} (t/a)	Hg (kg/a)	Cd (kg/a)	Zn (kg/a)	Cu (kg/a)	Pb (kg/a)	Ni (kg/a)	Cr (kg/a)
GERMANY																						
INDUSTRY	BAP	FOOD	ZUCKERFABRIK ANKLAM	2,8		29	12	4,61	0,02	0,415	0,203	4,74	0,74	0,23	1,84	0,034	0,9	13	3	16	9	1
	WEB	FOOD	GLÜCKSKLEE GMBH	1,11			3,27	2,05	0,01	0,07	0,02	8,89	0,9	0,24	6,96	0,001	0,007	4	1,451	0,045	1	0,088
			POMOSINWERKEGROSSENBRODE	1,16			0,84	0,98	0,01	0,04	0,02	0,11	0,005	0	0,04	0,0004	0,004	21	0,518	0,454	0,062	0,119
			ZUCKERFABRIK SCHLESWIG	3,25			29,33	11,3	0,02	3,31	3,03	34,32	0,06	0,08	29,61	0,001	0,042	3	6	0,074	4	3
Sum				**8,3**			**45,4**	**18,9**	**0,1**	**3,8**	**3,3**	**48,1**	**1,7**	**0,6**	**38,5**	**0,0**	**1,0**	**41,0**	**11,0**	**16,6**	**14,1**	**4,2**
RIVER	BAP	-	BARTHE	186	746		861	492	2,59	4,31	1,6	354	23,6	3,61	301	4	2	685	230	30	35	17
			DUVENBAEK	48,6	105		133	61,8	0,33	2,53	1,53	74,1	4,03	0,857	66,2							
			KAROWER BACH	11,1	45,4		52	23,4	0,15	0,272	0,1	20,5	1,03	0,329	17,1							
			KÖRCKWITZER BACH	49,2	289		307	92,9	1,06	2,45	0,773	185	4,28	1,62	157							
			PEENE	3068	7733		11742	11325	28,9	88	37,8	3411	310	53	2647	23	32	4478	4441	226	233	283
			PROHNER BACH	65,7	128		157	67	0,71	1,59	0,494	146	11	1,48	124							
			RECKNITZ	438	1549		1782	867	5,86	14,4	5,13	466	79	7,57	347	4	4	1727	852	38	378	36
			RYCK	121	297		330	184	1,23	1,4	0,433	266	22,1	2,53	230	2	2	199	202	23	19	9
			SAALER BACH	29,4	71,4		84,1	58,6	0,42	1,33	0,609	86,1	4,27	0,796	75,7							
			SEHROWER BACH	75,7	193		284	106	0,86	2,25	0,842	112	8,08	1,68	92,7							
			UECKER	1310	2903		3912	2799	10,4	43,9	16	875	131	20,4	600	11	10	529	610	65	79	76
			ZAROW	555	1403		2014	1029	4,02	13,5	3,67	424	54,6	7,56	305	2	15	400	261	33	47	28
			ZIESE	121	272		351	73,5	0,97	3,27	1,12	110	22,9	1,71	72,9							
	WEB	-	AALBEK	87,05			201,51	223,1		2,762	1,197	44,62	8,576	0,435	16,8	0,0647	0,8608	72	34	15	20	3
			FÜSINGER AU	633,8			1009,5	702,6	3,17	14,5	8,112	813,5	17,8	4,086	683,1	0,2	4	582	202	56	127	34
			GODDERSTORFER AU	55,56			115,4	124,6		1,482	0,512	61,58	2,461	0,489	47,57	0,03689	0,1838	33	20	6	10	2
			GRIMSAU	57,51			122,7	150,5		4,532	2,941	99,2	13,02	0,872	72,93							
			HAGENER AU	173,1			385,5	256,6		4,872	2,838	142,8	13,46	1,57	244,9	0,1139	1	97	46	24	38	8
			HELLBACH	222	554		624	492	1,91	9,6	4,56	523	24,9	4,25	456	6	4	333	97	7	34	22
			HÜTTENER AU	164,8			316,7	335,4		3,621	1,904	98,68	13,56	1,115	67,8							
			KOSELER AU	118,5			203,8	160,3		2,99	1,487	183,3	7,806	1,96	151,5	0,1257	0,7301	100	45	8	28	6
			KOSSAU	200,9			405,1	258,5		6,389	3,28	204,4	17,09	3,968	319,7	0,1584	0,52	228	97	49	64	7
			LANGBALLIGAU	74,71			112	210,2		4,658	2,522	94,13	10,74	0,742	67,47	0,05	0,7	103	30	17	29	5
			LIPPINGAU	90			169,3	179,6		5,156	3,534	126,3	5,299	1,67	99,53	0,1144	2	112	48	14	37	8
			MAURINE	104	200		254			3,88	1,54	201	8	1,09	183							
			MÜHLENSTROM	102,8			132,7	133		1,353	0,349	57,51	6,731	0,727	36,44							
			OLDENBURGER GRABEN	161,2			540,3	359,6		12,77	9,346	131,6	7,368	0,853	76,86	0,1042	0,9921	107	54	21	44	5
			PEEZER BACH	88,8	154		160	111		2,59	1,32	151	11,4	2,24	128							
			SCHWARTAU	358,2			780,4	1287	1,7	12,31	4,392	526,8	10,65	4,902	424	0,4105	1	377	184	52	136	24
			SCHWENNAU	75,07			145	143,6		3,24	1,439	59,19	3,142	0,694	40,87							
			SCHWENTINE	1151,9			2228,7	2126,3	4,16	30,28	18,37	721,7	28,23	5,24	462,8	0,63	3	1000	310	160	190	74,2
			STEPENITZ	696	934		1131		3,04	19,9	8,18	947	19,4	5,56	861	9	8	338	289	58	43	42
			TRAVE	1225,7			2348,1	2502,4	4,92	38,19	17,2	1634,8	49,06	12,92	1305,8	0,6	5	1201	549	177	268	115
			WAKENITZ	412,5			773,1	801,2	1,12	8,25	3,543	207,7	6,8	2	127,6	0,14	2	185	87	30	52	13
			WALLENSTEINGRABEN	429	571		712	821	1,37	20,8	13,4	309	15,8	2,06	243	4	3	265	112	115	25	18
			WARNOW	2314	5154		6022	4628	14,1	59	21,5	2165	184	18,8	1585	35	38	1324	577	160	210	141
			unmonitored	764			1577	1657	1,01	27	14	730	45	7,9	642	0,5	3,5	506	231	84	163	29
Sum				**15840**			**42479**			**479**	**218**	**16764**	**1206**	**189**	**13379**	**103**	**143**	**14981**	**9608**	**1468**	**2309**	**1005**
URBAN	BAP	-	ANKLAM	5		47	19	8	0,084	1,54	1,25	48	2,7	0,2	44	0,04	0,9	77	7	16	13	4
			BERGEN	22		123	50	23	0,287	1,38	0,67	76	64	0,3	5	0,1	2	381	14	35	28	13
			GREIFSWALD	20		160	55	13	0,281	4,62	3,78	77,3	5	0,4	28,1	0,24	3	102	14	61	47	12
			GÖHREN	16,6		63	24	15	0,053	3,95	3,52	37	35	0,1	0,1	0,05	0,55	24	4	11	4	2
			RIBNITZ-DAMGARTEN	18,7		144	49	22	0,114	1,7	1,16	51	26	0,5	21	0,07	1	67	9	18	20	6
			STRALSUND	49		240	99	31	0,464	4	2,6	81	53	2	21	0,2	8	245	38	70	63	28

SOURCE	SUBREGION	BRANCH	NAME	BOD_7 (t/a)	COD_{Mn} (t/a)	COD_{Cr} (t/a)	TOC (t/a)	SS (t/a)	AOX (t/a)	P_{total} (t/a)	P_{PO4} (t/a)	N_{total} (t/a)	N_{NH4} (t/a)	N_{NO2} (t/a)	N_{NO3} (t/a)	Hg (kg/a)	Cd (kg/a)	Zn (kg/a)	Cu (kg/a)	Pb (kg/a)	Ni (kg/a)	Cr (kg/a)
	WEB	-	BAD DOBERAN	3		22	10	4	0,042	0,6	0,4	6,6	1,7	0,2	1,7	0,04	0,5	37	6	6	9	3
			BURG AUF FEHMARN	3,01			7,78	3,89	0,03	0,25	0,18	4,83	0,12	0,06	3,74	0,002	0,036	11	6	0,097	2	0,229
			ECKERNFÖRDE	8,28			17,33	10,64	0,06	0,2	0,11	24,68	3,52	0,09	17,56	0,007	0,081	35	4	0,276	3	0,925
			FLENSBURG	152,9			210,68	153,52	0,34	4,22	0,58	363,31	309,2	1,67	5,82	0,094	0,38	169	33	4	58	7
			GLÜCKSBURG	6,86			9,73	18,15	0,02	1,01	0,26	13,15	1,48	0,18	9,53	0,002	0,058	19	36	2	2	0,434
			GROSSENBRODE	6,82			23,9	0,98	0,01	0,26	0,07	82,23	0,51	0,09	76,79	0,016	0,112	26	12	0,374	20	2
			GRÖMITZ	9,24			24,61	9,65	0,05	0,56	0,25	24,98	1,48	0,47	15,74	0,013	0,132	40	14	0,385	12	1
			KAPPELN	3,44			9,35	14,15	0,02	0,22	0,05	40,25	2,4	0,1	34,68	0,005	0,077	4	4	0,262	5	1
			KIEL	260,12			455,09	594,75	0,76	8,78	0,65	1429,8	1302	8,53	5,6	0,392	2	377	344	21	166	22
			LÜBECK (WAR)	260,77			448,86	370,98	0,86	12,04	2,28	869,49	710,2	13,89	29,78	0,211	1	1180	860	14,5	96	19
			LÜBECK (OCH)	14,89			30,38	15,32	0,06	1,24	0,7	17,26	5,62	1,03	6,21	0,018	0,222	36	14	0,804	25	2
			LÜBECK (TRA)	5,13			15,09	6,87	0,05	0,38	0,25	19,9	0,08	0,04	17,73	0,009	0,1	14	8	0,398	5	0,422
			NEUSTADT IN HOLSTEIN	7,18			17,79	8,06	0,05	0,46	0,17	50,13	2,52	1,01	42,94	0,007	0,077	24	21	0,313	4	0,894
			ROSTOCK	2886		4914	1665	808	1,649	38,2	21,1	890	676	8	26	1	15	1270	195	246	198	59
			SCHLESWIG	21,25			35,37	11,03	0,11	1,34	0,1	85,73	8,8	1,51	68,8	0,02	0,16	54	16	3	13	3
			TIMMENDORFER STRAND	5,81			11,66	11,77	0,03	0,16	0,01	22,57	2,84	0,89	16,86	0,008	0,047	5	9	0,378	8	2
			WESTFEHMARN	3,84			9,91	19,16	0,009	0,36	0,15	7,26	0,04	0,04	5,24	0,003	0,022	8	0,678	0,272	3	0,467
			WISMAR	234		513	159	46	0,134	8,25	4,25	237	228	0,1	2	0,34	2	72	103	51	104	10
Sum				**4024**			**3458**			**95,7**	**44,5**	**4559**	**3442**	**41,4**	**506**	**2,9**	**37,5**	**4277**	**1772**	**562**	**908**	**199**
Germany Total				**19872**			**45982**			**579**	**265**	**21371**	**4650**	**231**	**13924**							
DENMARK																						
INDUSTRY	BAP	CHEMICAL	H & C Prom Kemi	27,4		201,6				0,0		1,1										
		FOOD	Bornfish	31,1		27,0				0,5		4,4										
			Bornholms Konservesfabrik	26,8		23,3				0,4		1,2										
			Nordfilet	45,1		39,3				1,5		6,6										
			Other point sources	13,3						0,7		4,7										
	WEB	CHEMICAL	DOW- Danmark	0,8		1,5				0,0		0,3										
			Novo Nordisk	3,8		47,4				0,0		0,0										
		FOOD	Assens Sukkerfabrik	83,3		118,3				0,4		11,4										
			Gørlev Sukkerfabrik	690		798,5				1,9		14,0										
			Københavns Salatfabrik	5,8		20,4				0,2		1,1										
			Nakskov Sukkerfabrik	2300		4 000,0				4,1		48,4										
			Rahbekfisk	36,6		55,3				0,5		1,3										
			Slageriregion Syd - Blans	4,1		26,7				1,0		3,6										
			Sukkerfabrikken, Nykøbing	31,1		178,2				0,1		4,2										
			Sukkerfabrikken, Nykøbing	230		1 000,0				0,3		26,8										
			Sukkerfabrikken, Nykøbing	1150		1 000,0				3,1		23,6										
			Taffel Foods	7,2		18,5				0,2		0,4										
			Van Den Bergh Foods	4,1		3,6				0,0		0,0										
		OTHER	Asnæsværket	0,0		0,0				0,0		8,7										
			Danfoss	0,0		8,1				2,2		9,1										
			Fynsværket	0,3		4,2				0,0		0,3										
			Midtkraft - Studstrupværket	0,0		0,0				0,0		1,6										
			K. K. Miljøteknik	0,1		3,1				0,0		0,1										
			Kuwait Petroleum	109		255,3				0,7		69,0										
			NKT Trådværket	0,0		0,0				0,0		5,1										
			Statoil	0,0		62,0				0,7		16,3										
			Stige Ø Losseplads	29,9		264,0				1,1		100,0										
			Sigsnæs Industrimiljø	7,8		6,7				0,8		14,4										
			SEAS - Stigsnæsværket	0,0		0,0				0,0		1,8										
			Stora Dalum	6,6		152,8				2,1		7,9										
			Århus Oliefabrik	1,3		1,2				0,0		0,0										
			Other point sources	2136						53,0		391,0										

SOURCE	SUBREGION	BRANCH	NAME	BOD_7 (t/a)	COD_{Mn} (t/a)	COD_{Cr} (t/a)	TOC (t/a)	SS (t/a)	AOX (t/a)	P_{total} (t/a)	P_{PO4} (t/a)	N_{total} (t/a)	N_{NH4} (t/a)	N_{NO2} (t/a)	N_{NO3} (t/a)	Hg (kg/a)	Cd (kg/a)	Zn (kg/a)	Cu (kg/a)	Pb (kg/a)	Ni (kg/a)	Cr (kg/a)
	SOU	CHEMICAL	FEF Chemicals	0,2		2,9				0,0		0,4										
			Sun Chemical	37,9		193,4				0,7		24,1										
		OTHER	Codan Gummi	0,0		2,0				0,1		0,4										
			Copenhagen Pectin	81,6		618,4				2,8		63,7										
			DTH - Kemiafd. Renseanlæg	4,6		8,7				0,0		0,0										
			Junckers Industrier	2300		20 000,0				42,0		400,0										
			Københavns Lufthavn Kastrup	66,7		58,0				0,0		100,0										
			Stevns Kridtbrud	2,1		40,9				0,5		4,0										
			Other point sources	407,0						22,0		161,4										
	KAT	CHEMICAL	BASF Health & Nutrition	70,3		1 009,8				2,0		24,4										
			Dansk Salt	5,9		16,6				0,4		11,5										
			H. Lundbeck	0,0		64,5				0,0		2,8										
			Kemira Danmark	0,0		0,0				0,0		0,0										
		FOOD	DANISCO Distillers	10,5		163,9				1,1		6,8										
			Dansk Muslingerenseri	82,3		220,7				2,3		16,7										
			Erik Taabbel Fiskeeksport	690		1 000,0				9,8		53,0										
			Fiskernes Filetfabrik	1,8		1,6				0,2		1,7										
			Havfisk	230		380,9				3,3		17,6										
			Launis Fiskekonserves	345		480,0				5,1		19,4										
			Nielsen Fiskekonserves	805		1 000,0				11,7		55,6										
			P. Anthonisen	115		263,3				3,1		16,1										
			Sæby Fiskeindustri	1,2		19,6				4,7		4,6										
			Uni Fisk	230		406,6				4,5		19,4										
			Uni Fisk (N. B. Thomsen)	25,6		37,3				1,3		4,1										
			Vildsund Muslingeindustri	95,8		180,5				5,1		33,1										
			Vinderup Fjerkræslagteri	6,5		16,1				0,4		5,6										
		OTHER	Daka Amba Randers	2,1		10,0				0,1		13,5										
			Fiskernes Fiskeindustri	575		289,2				0,9		100,0										
			Flyvestation Aalborg	6,2		34,7				1,2		58,6										
			NVA - Aalborgværket	0,0		0,0				0,0		1,0										
			NVA - Vendsysselværket	3,8		5,2				0,3		2,0										
			Thyborøn Andels Fiskeindustri	345		250,0				1,8		72,0										
			Other point sources	220						20,7		118,0										
Sum				**13748**						**223**		**2190**										
RIVER	BAP	-	BAGGE Å							1,593	0,502	97,003			86,748							
			FAKSE Å	47,4						3,848	2,364	45,429	3,083		38,189							
			HERREDSBÆK	2,4						0,172	0,056	5,95	0,091		5,812							
			HULEBÆK	4,3						0,265	0,134	16,074	0,13		15,511							
			KOBBE Å							1,155	0,432	43,07			36,992							
			ØLE Å							0,931	0,456	64,681			57,945							
			MERN Å	23,5						1,456	0,822	74,05	1,08		70,189							
			TRANEGÅRD LILLE Å	9,3						1,039	0,386	31,45	0,553		32,066							
			unmonitored	453,7						29	14	1872	53		1827							
	WEB	-	BJERGE Å	23,1						2,458	1,723	166,87	1,067		148,439							
			BRENDE Å	76,2						4,858	2,258	205,76	2,47		174,639							
			BYGHOLM Å							5,917	3,021	451,06			423,97							
			ELSTED BÆK	7,4						0,808	0,464	25,489	0,492		18,303							
			FISKBÆK	10,3						1,73	0,733	39,801	1,582		29,86							
			FLADMOSE Å	5,8						0,269	0,155	38,828	1,483		33,437							
			FRIBRØDRE Å	21,1						1,528	0,84	90,645	1,514		86,826							
			FRUERSKOV BÆK	1,0						0,134	0,051	2,815	0,04		1,769							
			GIBER Å	36,2						2,37	1,352	100,24	1,913		85,517							
			GREJS Å							5,106	1,79	140,01										
			HØJEN Å							1,5	0,636	80,265										
			HADERSLEV MØLLESTRØM	306						10,77	3,156	205,36	7,071		125,034							
			HANSTED Å							5,152	1,978	335,76										
			HOVEDKANAL	67,0						7,139	4,446	352,08	5,978		345,74							
			HÅRBY Å	52,4						3,238	1,45	134,7	2,221		117,506							

SOURCE	SUBREGION	BRANCH	NAME	BOD_7 (t/a)	COD_{Mn} (t/a)	COD_{Cr} (t/a)	TOC (t/a)	SS (t/a)	AOX (t/a)	P_{total} (t/a)	P_{PO4} (t/a)	N_{total} (t/a)	N_{NH4} (t/a)	N_{NO2} (t/a)	N_{NO3} (t/a)	Hg (kg/a)	Cd (kg/a)	Zn (kg/a)	Cu (kg/a)	Pb (kg/a)	Ni (kg/a)	Cr (kg/a)
			JERNHYT BÆK	11,8						0,748	0,333	32,744	1,715		26,233							
			KÆR MØLLE Å	2,6						0,278	0,085	11,429	0,327		7,469							
			KOLDING Å							17,65	4,617	705,98			639,22							
			KONGSHØJ Å	39,8						2,839	1,596	142,31	1,55		125,015							
			LINDVED Å	35,8						1,441	0,599	88,465	0,636									
			LUNDE Å	30,0						2,178	1,335	119,94	1,944		104,309							
			MARREBÆKSRENDE	7,9						0,716	0,571	44,587	0,211		45,149							
			NÆLDEVADS Å	23,1						1,554	1,047	116,09	0,602		112,91							
			NDR. HALLEBY Å	196,3						6,651	2,972	485,12	2,704		356,648							
			ODENSE Å	652,9						39,17	13,68	1143	54,21		928,642							
			PUGE MØLLEÅ	35,4						2,599	1,189	150,35	1,716		132,948							
			PULVERBÆK	5,5						0,706	0,314	34,782	0,369		28,642							
			RINGE Å	12,0						0,834	0,308	45,13	0,616		38,941							
			ROHDEN Å							7,429	4,792	320,59										
			RYDE Å	30,2						2,395	1,655	152,99	1,154		150,94							
			RYDS Å	36,4						2,089	0,905	77,066	1,862		63,714							
			SALTØ Å	53,3						7,262	4,938	325,76	3,897		318,53							
			SEERDRUP Å	22,7						2,466	1,616	145,23	1,507		128,584							
			SKALLEBÆK	16,2						0,939	0,291	56,777	0,849		48,797							
			SOLKÆR Å							1,514	0,533	56,671			52,32							
			SPANG Å							2,748	0,978	127,49			115,82							
			STAVIS Å	52,2						3,005	1,254	145,31	2,266		123,565							
			STOKKEBÆKKEN	35,2						2,381	1,333	134,79	0,974		119,662							
			STORÅ	107						5,708	2,437	364	4,446		313,338							
			SUSÅ	340						30,93	20,79	1414,8	10,28		1330,7							
			SYLTEMAE Å	34,3						1,291	0,556	58,89	0,896		49,761							
			TAPS Å	43,2						6,152	2,462	144,59	3,553		110,798							
			TRANEMOSE Å	6,2						0,505	0,358	47,347	0,497		41,628							
			TUDE Å	140						14,55	9,766	540,16	6,299		470,968							
			VEJLE Å							16,91	7,467	453,67			375,19							
			VEJRUP Å	18,9						0,99	0,246	58,465	0,974		49,822							
			VEJSTRUP Å	26,1						1,828	0,784	81,733	0,574		70,8							
			VIBY Å	27,5						1,28	0,801	70,653	2,71		59,614							
			VINDINGE Å	72,4						4,12	2,087	268,01	2,938		239,355							
			ÅRHUS Å	571						25,33	8,173	530,75	16,75		371,73							
			unmonitored	5102						348	164	14285	248		12159							
	SOU	-	DAMHUSÅEN	45						1,144	0,355	30,233	1,916		19,784							
			ESRUM Å	63,1						4,897	2,795	54,339	1,947		33,072							
			KØGE Å	64,6						4,013	2,113	256,25			216,208							
			KIGHANERENDEN	8,6						0,65	0,382	15,441	0,7		12,428							
			LADEGÅRDSÅEN	2,8						0,053	0,013	1,382	0,187		0,475							
			LL.VEJLE Å	13,7						0,46	0,309	34,627	0,388		30,271							
			MØLLE Å	105						4,236	2,449	24,303	5,117		6,655							
			NIVE Å	34,5						3,169	1,558	59,717	2,008		45,271							
			SØBORG KANAL	44,0						4,471	2,723	109,46	3,216		92,191							
			SKENSVED Å	1,9						0,153	0,116	6,288	0,112		5,307							
			ST. VEJLE Å	63,3						1,232	0,49	46,734	2,584		32,604							
			ØSTERBÆK	1,3						0,133	0,058	5,978	0,09		5,179							
			USSERØD Å	107						8,703	5,321	89,05	9,751		57,765							
			unmonitored	260						117	66	1116	51		849							
	KAT	-	ARRESØ KANAL	565						23,28	0,588	205,57	1,517		29,182							
			BREDKÆR BÆK	19,6						0,769	0,41	55,668			47,008							
			ELLING Å	133						7,406	3,419	194,63	9,793		154,68							
			GERÅ	180						9,204	2,793	236,98	12,56		179,71							
			GRÆSE Å	18,5						1,807	0,707	27,584	2,024		20,413							
			GRENÅEN	223						11,73	6,013	659,69	13,65		554,027							
			GUDEN Å	3152						127,2	33,02	3940,1	92,79		2893,51							

SOURCE	SUBREGION BRANCH	NAME	BOD_7 (t/a)	COD_{Mn} (t/a)	COD_{Cr} (t/a)	TOC (t/a)	SS (t/a)	AOX (t/a)	P_{total} (t/a)	P_{PO4} (t/a)	N_{total} (t/a)	N_{NH4} (t/a)	N_{NO2} (t/a)	N_{NO3} (t/a)	Hg (kg/a)	Cd (kg/a)	Zn (kg/a)	Cu (kg/a)	Pb (kg/a)	Ni (kg/a)	Cr (kg/a)
		HØJBRO Å	21,3						2,284	0,927	49,784	1,054		41,526							
		HASLEVGÅRDS Å	67,9						6,565	4,714	147,26	4,035		118,24							
		HAVELSE Å	34,3						5,44	3,502	134,2	1,787		119,596							
		HEVRING Å							2,295	1,161	121,25										
		HOVE Å	53,0						2,341	1,096	69,09										
		JORDBRO Å							4,805	1,728	147,45			110,885							
		KÆRS MØLLEÅ	79,7						3,769	2,085	157,49	1,824		136,73							
		KARUP Å							28,12	5,496	933,39			739,667							
		LAMMEFJORD SØKANAL	28,6						3,018	1,625	193,67	2,603		157,06							
		LANGVAD Å	92,0						7,234	4,544	251,39			204,48							
		LERKENFELD Å							4,921	2,816	289,48			257,3							
		LINDHOLM Å	8,3						0,425	0,204	14,24	0,634		10,589							
		MADEMOSE Å	1,3						0,08	0,045	7,959	0,058		7,526							
		MAGLEMOSE Å	8,3						0,315	0,148	32,55	0,709		27,064							
		ROMDRUP Å	15,4						0,609	0,207	46,675	0,325		42,394							
		RY Å	331						22,29	8,516	563,61	17,91		453,6							
		SØRENDE	2,9						0,217	0,128	11,106	0,28		9,248							
		SIMESTED Å							14,59	9,432	932,1			848,24							
		SKALS Å							18,49	6,337	855,64			705,37							
		TUSE Å	50,2						3,663	1,396	211,68	2,659		176,15							
		UDESUNDBY Å	10,7						0,995	0,527	36,151	0,856		29,522							
		VÆREBRO Å	70,1						7,26	5,194	109,02	17,97		70,429							
		VALSGÅRD BÆK	8,9						0,337	0,268	37,054	0,203		36,01							
		VILLESTRUP Å	162						7,073	4,826	357,15	10,81		321,63							
		VOER Å	263						16,59	6,693	545,7	13,55		474,95							
		unmonitored	6989						405	139	20125	506		15929							
Sum			**22340**						**1560**	**654**	**61150**										
URBAN	WEB	AABENRAA	24,15						5,9		26				5	7	314	27	9	124	21
		AARHUS (EGA)	17,25						2,7		36				7	10	432	37	12	171	28
		AARHUS (MAR)	56,35						20,6		63				14	18	813	70	22	320	53
		AARHUS (VIB)	10,35						1,6		45				6	7	320	28	9	127	21
		FREDERICIA	66,7						10,8		68				10	13	600	52	17	240	39
		HORSENS	65,55						4,1		159				9	12	517	45	14	205	34
		KOLDING	28,75						7,1		50				11	14	623	54	17	247	41
		ODENSE	35,65						6,3		92				21	27	1200	100	33	480	79
		SVENDBORG	33,35						3,5		21				7	9	406	35	11	161	27
		VEJLE	86,25						14,4		83				12	15	683	59	19	271	45
		Small settlements	647,45						59		345										
	SOU	COPENHAGEN (AVE)	269,1						40,9		269				29	38	1700	150	5	670	110
		COPENHAGEN (LYN)	1969,95						438		2664				100	120	5500	480	150	2190	360
		GREVE	24,15						6,7		27				5	7	315	27	9	125	21
		HELSINGOER	31,05						10,2		62				4	5	219	19	6	87	14
		KOEGE	40,25						9,3		51				7	9	418	36	12	166	27
		LYNGBY-TAARBAEK	79,35						11,8		78				10	13	570	49	16	226	37
		Small settlements	162						30,1		220										
	KAT	AALBORG (OES)	16,1						3,5		39				8	10	435	38	12	173	29
		AALBORG (VES)	78,2						13,5		149				23	29	1300	113	36	520	86
		FREDERIKSHAVN	121,9						10,4		71				7	8	379	33	10	150	25
		RANDERS	27,6						5		55				9	12	520	45	14	210	34
		ROSKILDE	27,6						6,2		31				6	7	332	29	9	132	22
		SKAGEN	143,75						11,9		96				3	4	179	15	5	71	12
		SKIVE	21,85						3,3		32				6	8	343	30	9	136	22
		THISTED	31,05						7,9		40				5	7	299	26	8	119	20
		Small settlements	442,75						23,3		234										
	BAP	Small settlements	1282,25						47		234										
Sum			**5841**						**815**		**5340**				**324**	**409**	**18417**	**1597**	**464**	**7321**	**1207**
Denmark Total			**41929**						**2598**		**68680**										

SOURCE	SUBREGION	BRANCH	NAME	BOD_7 (t/a)	COD_{Mn} (t/a)	COD_{Cr} (t/a)	TOC (t/a)	SS (t/a)	AOX (t/a)	P_{total} (t/a)	P_{PO4} (t/a)	N_{total} (t/a)	N_{NH4} (t/a)	N_{NO2} (t/a)	N_{NO3} (t/a)	Hg (kg/a)	Cd (kg/a)	Zn (kg/a)	Cu (kg/a)	Pb (kg/a)	Ni (kg/a)	Cr (kg/a)
SWEDEN																						
AQUACULTURE	BOB		Small plants							2		15										
	BOS		Small plants							3		24										
	BAP		Small plants							14		114										
Sum										**19**		**153**										
INDUSTRY	BOB	IRON/STEE	SSAB LULEÅ			84	77			0,8		68	17	1,3	1,7		2	1000	150	140	20	45
		MINING	RÖNNSKÄRSVERKEN			335										20	20	1800	600	1300	100	
		PULP/PAPER	KARLSBORG	2000		11800			44	21		172										
			LÖVHOLMEN	3440		7400			0,6	5		40										
			MUNKSUND	2620		5475			1,3	4,7		20										
	BOS	CHEMICAL	BERGVIK KEMI			137																
			CASCO NOBEL SUNDSVALL	68		323				0,001		111										4
		PULP/PAPER	DOMSJÖ	2041		11107				17,3		193										
			DYNÄS	2513		5793			0,57	4,7		70										
			HALLSTAVIK	577		4343			0,98	2,57		46										
			HUSUM	10600		28300			220	34,4		117										
			IGGESUNDS BRUK	930		8141			57,9	14,5		126										
			KORSNÄS GÄVLE	2470		18213			47	26		309										
			NORRSUNDET	1856		8264			65	14		114					15	1030	168	50	143	82
			OBBOLA	2939		6624			2,1	5,7		52,7										
			ORTVIKEN	135		1642			1	2		39										
			SKUTSKÄR	5840		21754			146	25		124										
			UTANSJÖ	653		9346			0	32		182										
			VALLVIK	3168		9152			123	8,8		42,2										
			ÖSTRAND	5950		20161			87,5	21,7		147										
			Small plants: treated	1320		2980			0,4	5,3		67										
	BAP	FOOD	KARLSHAMN	25		255				6,2		2,1										
		IRON/STEE	SSAB OXELÖSUND			105				1,3			181					200		60		
		PETROCHEMICAL	NYNÄSHAMN REFINERY	30		663						6,1										
		PULP/PAPER	BRAVIKEN	146		1059			0,36	2,6		91										
			DJUPAFORS	195		371			0,04	0,14		2,89					5	47	10	54	27	27
			MÖNSTERÅS BRUK	675		5477			0	14		140										
			MÖRRUMS BRUK	5800		17200			230	14		100										
			NYMÖLLA	779		20019			0	17		226										
			Small plants: treated	32		108			0,41	0,04		1,1										
	SOU	CHEMICAL	HYDRO AGRI							0,9		200										
			KEMIRA							4,3						0,1	0,6					
	KAT	PETROCHEMICAL	NYNÄS RAFF II	3		10						1,5										
			NYNÄS RAFF II, GBG	0,95		5,72			0,01	0,099		2,03	1,07			0,27	0,14	22	3	0,68	7	7
			PREEM RAFF	15		80			0,12	0,15		5,2	3,4			0,3	0,2	64	26	3	5	64
			SHELL RAFF	7,4		68,9			0,32	0,8		42,3	3			1	1	43	29	62	18	11
		PULP/PAPER	VÄRÖ BRUK	5600		15000			0	12		120										
Sum				**62428,4**						**319**		**2980,12**										
RIVER *)	BOB		ALTERÄLVEN	218	7655		1505			4,23	1,21	75,8	4,94	1,09	6,29							
			RICKLEÅN	648	22259		4469			9,08	2,65	241	10,5	13,4	54,9	1	3	1970	514	69		
			RÅNE ÄLV	1406	48175		9699			30,6	8,25	540	21,4	9,86	50,7			3870	2870			
			TÖRE Å	231	8190		1593			3,81	1,08	83,8	5,46	1,24	8,95							
			KALIX ÄLV	6776	267156		46729			252	51,1	3399	274	58,8	560			40100	13800			
			LULE ÄLV	5301	185718		36562			179	42,8	2568	196	33,4	442	29	85	52700	23700	2140		
			PITE ÄLV	2698	86512		18604			180	18,1	1362	81,3	13,6	154	16	40	31400	9220	2220		
			SKELLEFTE ÄLV	3058	87393		21090			50,2	12,8	1051	56,2	13,4	138	24	52	21000	4650	645		
			TORNE ÄLV	11715	449327		80794			303	70,3	4767	197	84,8	601	48	46	116000	9960			
			unmonitored	4664	164383		32168			118	23	2202	83	26	169			17100	5000			
	BOS		DELÅNGERSÅN	584	17463		4029			8,44	2,26	278	6,7	2,43	92,7			1870	722			
			FORSMARKSÅN	260	7929		1793			1,92	0,4	88,7	1,38	0,87	9,88			4000	300			
			GAVLEÅN	1203	41779		8296			23,6	4,95	640	33,4	6,93	178	3	9	13400	2830	668		
			GIDE ÄLV	1214	45649		8371			22	5,74	387	17,7	6,32	41,2			4130	1020			
			LÖGDE ÄLV	628	22614		4333			16,2	3,04	180	7,2	4,03	19,6			2030	470			

SOURCE	SUBREGION BRANCH	NAME	BOD_7 (t/a)	COD_{Mn} (t/a)	COD_{Cr} (t/a)	TOC (t/a)	SS (t/a)	AOX (t/a)	P_{total} (t/a)	P_{PO4} (t/a)	N_{total} (t/a)	N_{NH4} (t/a)	N_{NO2} (t/a)	N_{NO3} (t/a)	Hg (kg/a)	Cd (kg/a)	Zn (kg/a)	Cu (kg/a)	Pb (kg/a)	Ni (kg/a)	Cr (kg/a)
		ÖRE ÄLV	1474	50235		10163			23,3	5,44	400	9,7	9,24	38,9	5	6	3820	880	191		
		DALÄLVEN	12375	430883		85343			259	79	5797	221	72,6	1508	26	155	289000	19200	3480		
		INDALSÄLVEN	8809	280372		60749			138	35,1	4475	150	43,6	1584	58	43	40900	15200	1700		
		LJUNGAN	4148	122591		28607			54,5	11,9	1956	119	20,8	311	12	67	23100	8700	925		
		LJUSNAN	7582	265439		52289			128	30,8	2928	117	41,4	605			36500	13200			
		UME ÄLV	7577	283623		52252			202	52,7	3523	241	45,1	518	40	93	70900	28000	3790		
		ÅNGERMANÄLVEN	11617	394975		80118			237	50,5	4198	162	67,7	933			63600	14900			
		unmonitored	6262	210838		43185			150	22	3608	76	32	372			43000	6900			
	BAP	ALSTERÅN	776	24447		5349			6,96	1,79	315	5,8	7,16	63,7			6560	960			
		BOTORPSSTRÖMMEN	350	9125		2413			4,1	0,847	193	2,87	9,28	53,3			852	502			
		EMÅN	1965	56843		13552			22,7	4,58	1140	29,6	9,84	428	5	50	3890	1790	344		
		GOTHEMSÅN	235	7008		1620			13,2	7,9	684	11,3	4	462							
		HELGE Å	3399	118483		23444			61,1	11,2	3059	76,3	37,9	1656			14300	2820			
		LJUNGBYÅN	348	10677		2400			4,16	0,964	261	4,06	1,88	134			21600	1580			
		LYCKEBYÅN	658	19204		4535			7,24	1,72	246	11,7	2,61	52,6	2	5	1730	360	105		
		MÖRRUMSÅN	1761	51562		12143			27	4,49	1068	30,8	7,81	338	8	16	5080	2100	387		
		NYKÖPINGSÅN	1234	33946		8510			37,7	8,3	878	24,1	5,95	188	2	13	7180	2320	373		
		MOTALA STRÖM	4340	124613		29928			177	55,7	3733	134	38,4	1487	8	31	31800	7950	843		
		NORRSTRÖM	6001	149195		41383			199	64,1	4261	117	17,9	1031	37	236	26700	21800	2160		
		unmonitored	4079	122218		28133			293	31	13317	87	35	2254			114000	11000			
	SOU	RÅÅN	36	1010		250			6,49	3,81	554	6,43	3,16	507	0,3	0,9	601	111	25		
		unmonitored	662	22153		4563			103	41	4982	79	39	3351			7000	1000			
	KAT	FYLLEÅN		9080					5,01	1,38	280	10,8		182							
		GENEVADSÅN		3717					4,23	1,42	334	8,37		270							
		LAGAN	3711	121205		25594			65,2	14,9	2754	90	20,6	1372	17	37	12700	2920	760		
		NISSAN	1918	71944		13229			31,3	7,83	1113	85,9	12,1	478	12	31	13300	1420	488		
		RÖNNE Å	785	25210		5417			47,4	22	2663	51,4	24,1	2074			6880	1250			
		STENSÅN		5689					6,66	2,08	404	7,71		304							
		VISKAN	1261	41886		8695			53,4	14,3	1556	116	17,3	813			12700	2920			
		ÄTRAN	1843	63693		12713			35,9	7,39	2017	119	13,5	1143	8	26	8460	1910	424		
		GÖTA ÄLV	12955	373953		89348			401	86	17678	412	108	11082	80	126	82000	25300	6380		
		unmonitored	139	61075		960			94	20	6531	98	24	3007			2300	400			
Sum			**148903**	**5029094**					**4101**	**950**	**114769**	**3711**		**41127**							
URBAN	BOB	HAPARANDA	262						8,7		92				1	0,79	395	77	4	33	14
		LULEÅ	530						4,9		270				6	2	304	50	15	57	55
		PITEÅ	267						2		130				2	0,3	209	27	4	12	4
		SKELLEFTEÅ	96						1,8		182				0,85	0,69	182	117	5	45	6
		Small settlements: mon.	90						1		68										
	BOS	ESSVIK	10						0,9		41				0,5	0,1	146	35	2	9	5
		GÄVLE	88						4		292				0,6	0,1	488	219	0,6	47	13
		HUDIKSVALL	24						0,96		70				0,4	0,8	81	37	5	15	9
		HÄRNÖSAND	36						0,7		59				0,1	0,5	76	62	4	27	5
		SUNDSVALL (FIL)	23						1,4		61				0,5	0,1	146	35	2	9	5
		SUNDSVALL (TIV)	72						2,7		214				0,9	0,9	402	197	13	47	25
		SÖDERHAMN	33						1,2		57				0,35	0,35	120	41	5	13	16
		TIMRÅ	16						0,9		28										
		UMEÅ	145						4		204				0,5	1	297	53	24	79	24
		ÖRNSKÖLDSVIK (BOD)	14						0,5		45										
		ÖRNSKÖLDSVIK (PRÄ)	12						0,4		32										
		ÖRNSKÖLDSVIK (KNO)	26						1,2		47										
		Small settlements: mon.	104						3,2		153										
	BAP	BORGHOLM	11,3						1,4		34				0.1	0,1	107	22	0,6	5	3
		BOTKYRKA	200						11		630				4	4	1170	394	20	315	39
		FÄRJESTADEN	8,8						0,2		14,6				0.1	0,2	419	747	16	13	9
		HANINGE	5,7						0,1		16,7				2	0,1	27	4	1	3	0,7
		KALMAR	53						2,4		208				2	0,2	445	70	3	43	85
		KARLSHAMN	11						0,6		42				0,4	0,3	216	43	4	32	46

SOURCE	SUBREGION BRANCH	NAME	BOD_7 (t/a)	COD_{Mn} (t/a)	COD_{Cr} (t/a)	TOC (t/a)	SS (t/a)	AOX (t/a)	P_{total} (t/a)	P_{PO4} (t/a)	N_{total} (t/a)	N_{NH4} (t/a)	N_{NO2} (t/a)	N_{NO3} (t/a)	Hg (kg/a)	Cd (kg/a)	Zn (kg/a)	Cu (kg/a)	Pb (kg/a)	Ni (kg/a)	Cr (kg/a)
		KARLSKRONA (KOH)	29						1,9		122				1	23	130	54	59	50	23
		KARLSKRONA (LIN)	22						0,6		57				0,6	13	160	170	58	25	13
		LIDINGÖ	360						11		1150					3	2200	1000	3	450	8
		NACKA	19,7						1,3		133				0,2	0,2	99	17	5	29	15
		NORRKÖPING	123						6,2		252				2	4	1720	552	57	171	27
		NORRTÄLJE	29						1,1		67				2	0,2	69	45	3	18	3
		NYKÖPING	68						1,6		236					0,46	96	330	10	27	5
		NYNÄSHAMN	70						1,6		56										
		OSKARSHAMN	23,2						1,2		23,2				0,8	2	107	55	4	52	9
		OXELÖSUND	42						0,71		49										
		RONNEBY	12						0,7		24				0,7	1	14	5	2	0,5	13
		SIMRISHAMN	11						0,6		52				0,7	1	90	16	9	14	11
		STOCKHOLM (BRO)	170						6,7		800				5	2	1470	486	25	630	50
		STOCKHOLM (HEN)	550						26		1760				10	5	4240	437	50	770	187
		STOCKHOLM (LOU)	30						1,6		90				0,5	0,25	220	80	3	30	5
		SÖLVESBORG	9,5						0,6		56				0,5	0,8	102	28	15	25	14
		TRELLEBORG	20						1,3		122				0,4	0,2	101	20	2	32	187
		VISBY	42,1						2		123				1	0,3	130	203	18	25	5
		VÄSTERVIK	27,1						1,2		71				1	0,2	99	33	4	37	5
		YSTAD	27						2,7		150				0,6	1	239	54	24	36	30
		Small settlements: mon.	63						3		244										
	SOU	HELSINGBORG	87						8,1		135				2	3	730	357	14	62	21
		HÖGANÄS	11						1,1		28										
		LANDSKRONA	39						2,7		177				3	0,9	165	137	20	15	6
		LOMMA	3,7						0,3		10,5										
		MALMÖ (KLA)	67						5,3		53				0,7	0,3	120	150	0,6	48	5
		MALMÖ (SJÖ)	500						13		940				0,2	0,3	470	920	5	260	31
		Small settlements: mon.	6						0,1		18										
	KAT	FALKENBERG	42						2,7		69				6	6	272	26	9	26	9
		GÖTEBORG	1150						48		2000				20	11	3700	1300	250	1000	230
		GÖTEBORG: Overflows	1390						55		510				11	15	1800	970	120	300	150
		HALMSTAD	93						7,2		143				0,55	0,66	494	58	11	132	14
		KUNGSBACKA	30						1,7		99				0,86	0,48	236	49	16	22	4
		LAHOLM	5,2						0,6		11,5				1	0,07	37	22	2	6	3
		VARBERG	19						1,16		59				1	0,6	209	219	6	24	18
		ÄNGELHOLM	5,9						1,5		62				0,4	0,4	90	16	9	14	11
		Small settlements: mon.	14						1		27										
Sum			**7348**						**279**		**12970**										
Sweden Total			**218680**						**4718**		**130872**										

*) Riverine BOD_7 load in Sweden has been calculated from the TOC load using the coefficient 0.145.

BALTIC SEA ENVIRONMENT PROCEEDINGS

No. 1 JOINT ACTIVITIES OF THE BALTIC SEA STATES WITHIN THE FRAMEWORK OF THE CONVENTION ON THE PRO TECTION OF THE MARINE ENVIRONMENT OF THE BALTIC SEA AREA 1974-1978
(1979)*

No. 2 REPORT OF THE INTERIM COMMISSION (IC) TO THE BALTIC MARINE ENVIRONMENT PROTECTION COMMISSION
(1981)*

No. 3 ACTIVITIES OF THE COMMISSION 1980
-Report on the activities of the Baltic Marine Environment Protection Commission during 1980
-HELCOM Recommendations passed during 1980
(1981)*

No. 4 BALTIC MARINE ENVIRONMENT BIBLIOGRAPHY 1970-1979
(1981)*

No. 5A ASSESSMENT OF THE EFFECTS OF POLLUTION ON THE NATURAL RESOURCES OF THE BALTIC SEA, 1980
PART A-1: OVERALL CONCLUSIONS
(1981)*

No. 5B ASSESSMENT OF THE EFFECTS OF POLLUTION ON THE NATURAL RESOURCES OF THE BALTIC SEA, 1980
PART A-1: OVERALL CONCLUSIONS
PART A-2: SUMMARY OF RESULTS
PART B: SCIENTIFIC MATERIAL
(1981)

No. 6 WORKSHOP ON THE ANALYSIS OF HYDROCARBONS IN SEAWATER
Institut für Meereskunde an der Universität Kiel, Department of Marine Chemistry, March 23 -April 3, 1981
(1982)

No. 7A CTIVITIES OF THE COMMISSION 1981
-Report of the activities of the Baltic Marine Environment Protection Commission during 1981 including the Third Meeting of the Commission held in Helsinki 16-19 February 1982
-HELCOM Recommendations passed during 1981 and 1982
(1982)

No. 8 ACTIVITIES OF THE COMMISSION 1982
-Report of the activities of the Baltic Marine Environment Protection Commission during 1982 including the Fourth Meeting of the Commission held in Helsinki 1-3 February 1983
-HELCOM Recommendations passed during 1982 and 1983
(1983)

No. 9 SECOND BIOLOGICAL INTERCALIBRATION WORKSHOP
Marine Pollution Laboratory and Marine Division of the National Agency of Environmental Protection, Denmark, August 17-20, 1982, Rønne, Denmark
(1983)

No. 10 TEN YEARS AFTER THE SIGNING OF THE HELSINKI CONVENTION
National Statements by the Contracting Parties on the Achievements in Implementing the Goals of the Convention on the Protection of the Marine Environment of the Baltic Sea Area
(1984)

No. 11 STUDIES ON SHIP CASUALTIES IN THE BALTIC SEA 1979-1981
Helsinki University of Technology, Ship Hydrodynamics Laboratory, Otaniemi, Finland
P. Tuovinen, V. Kostilainen and A. Hämäläinen
(1984)

*out of print

No. 12 GUIDELINES FOR THE BALTIC MONITORING PROGRAMME FOR THE SECOND STAGE
(1984)*

No. 13 ACTIVITIES OF THE COMMISSION 1983
-Report of the activities of the Baltic Marine Environment Protection Commission during 1983 including the Fifth Meeting of the Commission held in Helsinki 13-16 March 1984
-HELCOM Recommendations passed during 1983 and 1984
(1984)

No. 14 SEMINAR ON REVIEW OF PROGRESS MADE IN WATER PROTECTION MEASURES
17-21 October 1983, Espoo, Finland
(1985)

No. 15 ACTIVITIES OF THE COMMISSION 1984
-Report of the activities of the Baltic Marine Environment Protection Commission during 1984 including the Sixth Meeting of the Commission held in Helsinki 12-15 March 1985
-HELCOM Recommendations passed during 1984 and 1985
(1985)

No. 16 WATER BALANCE OF THE BALTIC SEA
A Regional Cooperation Project of the Baltic Sea States;
International Summary Report
(1986)

No. 17A FIRST PERIODIC ASSESSMENT OF THE STATE OF THE MARINE ENVIRONMENT OF THE BALTIC SEA AREA, 1980-1985; GENERAL CONCLUSIONS
(1986)

No. 17B FIRST PERIODIC ASSESSMENT OF THE STATE OF THE MARINE ENVIRONMENT OF THE BALTIC SEA AREA, 1980-1985; BACKGROUND DOCUMENT
(1987)

No. 18 ACTIVITIES OF THE COMMISSION 1985
-Report of the activities of the Baltic Marine Environment Protection Commission during 1985 including the Seventh Meeting of the Commission held in Helsinki 11-14 February 1986
-HELCOM Recommendations passed during 1986
(1986)*

No. 19 BALTIC SEA MONITORING SYMPOSIUM
Tallinn, USSR, 10-15 March 1986
(1986)

No. 20 FIRST BALTIC SEA POLLUTION LOAD COMPILATION
(1987)

No. 21 SEMINAR ON REGULATIONS CONTAINED IN ANNEX II OF MARPOL 73/78 AND REGULATION 5 OF AN NEX IV OF THE HELSINKI CONVENTION
National Swedish Administration of Shipping and Navigation;
17-18 November 1986, Norrköping, Sweden
(1987)

No. 22 SEMINAR ON OIL POLLUTION QUESTIONS
19-20 November 1986, Norrköping, Sweden
(1987)

*out of print

No. 23 ACTIVITIES OF THE COMMISSION 1986
-Report on the activities of the Baltic Marine Environment Protection Commission during 1986 including the Eighth Meeting of the Commission held in Helsinki 24-27 February 1987
-HELCOM Recommendations passed during 1987
(1987)*

No. 24 PROGRESS REPORTS ON CADMIUM, MERCURY, COPPER AND ZINC
(1987)

No. 25 SEMINAR ON WASTEWATER TREATMENT IN URBAN AREAS
7-9 September 1986, Visby, Sweden
(1987)

No. 26 ACTIVITIES OF THE COMMISSION 1987
-Report on the activities of the Baltic Marine Environment Protection Commission during 1987 including the Ninth Meeting of the Commission held in Helsinki 15-19 February 1988
-HELCOM Recommendations passed during 1988
(1988)

No. 27A GUIDELINES FOR THE BALTIC MONITORING PROGRAMME FOR THE THIRD STAGE; PART A. INTRO DUCTORY CHAPTERS
(1988)

No. 27B GUIDELINES FOR THE BALTIC MONITORING PROGRAMME FOR THE THIRD STAGE; PART B. PHYSICAL AND CHEMICAL DETERMINANDS IN SEA WATER
(1988)

No. 27C GUIDELINES FOR THE BALTIC MONITORING PROGRAMME FOR THE THIRD STAGE; PART C. HARMFUL SUBSTANCES IN BIOTA AND SEDIMENTS
(1988)

No. 27D GUIDELINES FOR THE BALTIC MONITORING PROGRAMME FOR THE THIRD STAGE; PART D. BIOLOG ICAL DETERMINANDS
(1988)

No. 28 RECEPTION OF WASTES FROM SHIPS IN THE BALTIC SEA AREA
- A MARPOL 73/78 SPECIAL AREA
(1989)

No. 29 ACTIVITIES OF THE COMMISSION 1988
-Report on the activities of the Baltic Marine Environment Protection Commission during 1988 including the Tenth Meeting of the Commission held in Helsinki 14-17 February 1989
-HELCOM Recommendations passed during 1989
(1989)

No. 30 SECOND SEMINAR ON WASTEWATER TREATMENT IN URBAN AREAS
6-8 September 1987, Visby, Sweden
(1989)

No. 31 THREE YEARS OBSERVATIONS OF THE LEVELS OF SOME RADIONUCLIDES IN THE BALTIC SEA AFTER THE CHERNOBYL ACCIDENT
Seminar on Radionuclides in the Baltic Sea
29 May 1989, Rostock-Warnemünde, German Democratic Republic
(1989)

No. 32 DEPOSITION OF AIRBORNE POLLUTANTS TO THE BALTIC SEA AREA 1983-1985 AND 1986
(1989)

*out of print

No. 33 ACTIVITIES OF THE COMMISSION 1989
-Report on the activities of the Baltic Marine Environment Protection Commission during 1989 including the Eleventh Meeting of the Commission held in Helsinki 13-16 February 1990
-HELCOM Recommendations passed during 1990
(1990)*

No. 34 STUDY OF THE RISK FOR ACCIDENTS AND THE RELATED ENVIRONMENTAL HAZARDS FROM THE TRANSPOR TATION OF CHEMICALS BY TANKERS IN THE BALTIC SEA AREA
(1990)

No. 35A SECOND PERIODIC ASSESSMENT OF THE STATE OF THE MARINE ENVIRONMENT OF THE BALTIC SEA, 1984-1988; GENERAL CONCLUSIONS
(1990)

No. 35B SECOND PERIODIC ASSESSMENT OF THE STATE OF THE MARINE ENVIRONMENT OF THE BALTIC SEA, 1984-1988; BACKGROUND DOCUMENT
(1990)

No. 36 SEMINAR ON NUTRIENTS REMOVAL FROM MUNICIPAL WASTE WATER
4-6 September 1989, Tampere, Finland
(1990)

No. 37 ACTIVITIES OF THE COMMISSION 1990
-Report on the activities of the Baltic Marine Environment Protection Commission during 1990 including the Twelfth Meeting of the Commission held in Helsinki 19-22 February 1991
-HELCOM Recommendations passed during 1991
(1991)

No. 38 THIRD BIOLOGICAL INTERCALIBRATION WORKSHOP
27-31 August 1990, Visby, Sweden
(1991)

No. 39 AIRBORNE POLLUTION LOAD TO THE BALTIC SEA 1986-1990
(1991)

No. 40 INTERIM REPORT ON THE STATE OF THE COASTAL WATERS OF THE BALTIC SEA
(1991)

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(1992)

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-HELCOM Recommendations passed during 1992
(1992)

No. 43 BALTIC MARINE ENVIRONMENT BIBLIOGRAPHY 1986-1990
(1992)

No. 44 NITROGEN AND AGRICULTURE, INTERNATIONAL WORKSHOP
9-12 April 1991, Schleswig, Germany
(1993)

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(1993)

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Prepared for the Baltic Sea Joint Comprehensive Environmental Action Programme
(1993) *

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Gdansk, Poland, 24-25 March 1993
Compilation of Presentations and Statements
(1993)

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(1993)

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(1993)

No. 53 BALTIC MARINE ENVIRONMENT BIBLIOGRAPHY 1991-1992
(1993)

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(1993)

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-HELCOM Recommendations passed during 1994
(1994)

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5-8 October 1993, Hamburg, Germany
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30 August - 3 September 1993, Riga, Latvia
(1994)

No. 60 ACTIVITIES OF THE COMMISSION 1994
-Report on the activities of the Baltic Marine Environment Protection Commission during 1994 including the 16th meeting of the Commission held in Helsinki 14-17 March 1995
-HELCOM Recommendations passed during 1995
(1995)

*out of print

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(1995)

No. 62 ACTIVITIES OF THE COMMISSION 1995
-Report on the activities of the Baltic Marine Environment Protection Commission during 1995
including the 17th meeting of the Commission held in Helsinki 12-14 March 1996
-HELCOM Recommendations passed during 1996
(1996)

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(1996)

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(1996)

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(1996)

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(1997)

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(1997)

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(1997)

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