DRAINAGE BASIN OF THE MEDITERRANEAN SEA

This chapter deals with major transboundary rivers discharging into the Mediterranean Sea and some of their transboundary tributaries. It also includes lakes located within the basin of the Mediterranean Sea.

TRANSBOUNDARY WATERS IN THE BASIN OF THE MEDITERRANEAN SEA[1]

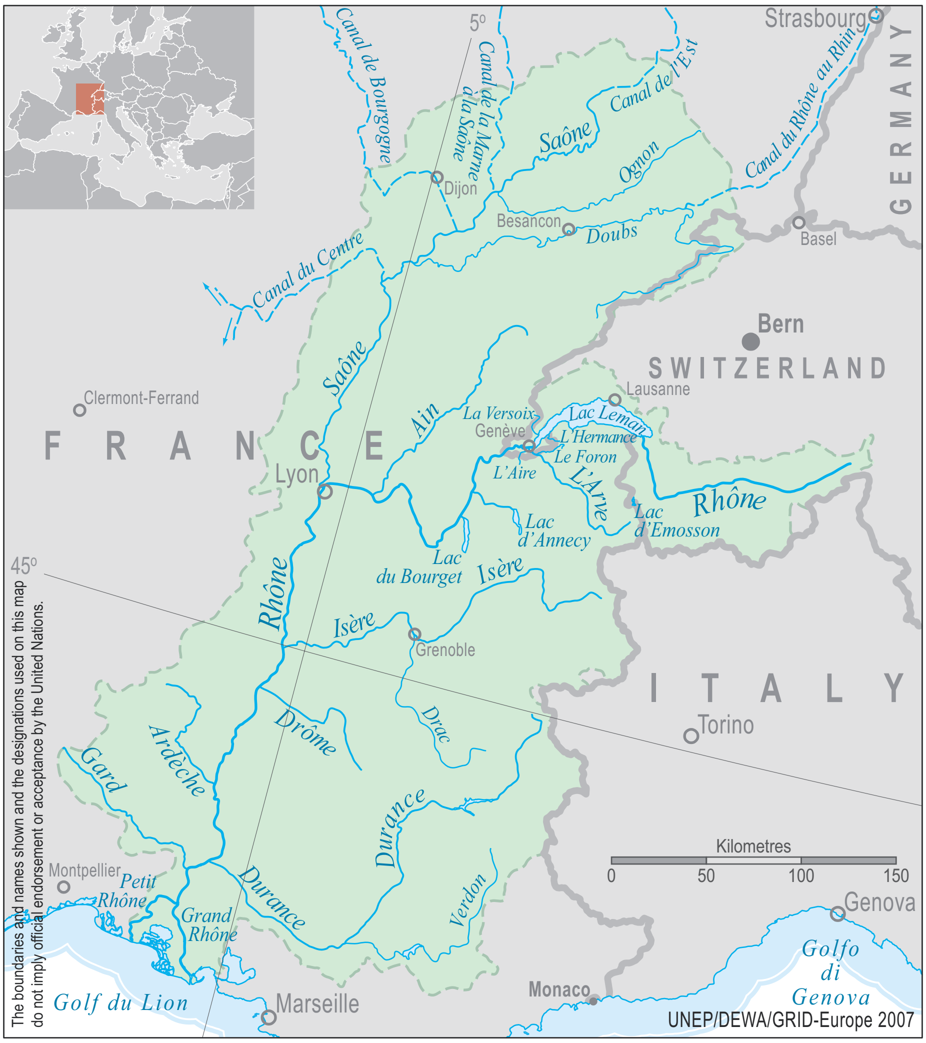
Basin/sub-basin(s)	Total area (km²)	Recipient	Riparian countries	Lakes in the basin
Ebro	85,800	Mediter. Sea	AD, ES, FR	…
Rhone	98,000	Mediter. Sea	CH, FR, IT	Lake Emosson, Lake Geneva
Roia	*600*	*Mediter. Sea*	*FR, IT*	…
Po	74,000	Mediter. Sea	AT, CH, FR, IT	Lake Maggiore, Lake Lugano
Isonzo	3,400	Mediter. Sea	IT, SI	
Krka	2,500	Mediter. Sea	BA, HR	
Neretva	8,100	Mediter. Sea	BA, HR	
Drin	17,900	Mediter. Sea	AL, GR, ME, MK, RS	Lake Ohrid, Lake Prespa, Lake Skadar
Vijose	6,519	Mediter. Sea	AL, GR	
Vardar	23,750	Mediter. Sea	GR, MK	Lake Dojran
Struma	18,079	Mediter. Sea	BG, GR, MK, RS	
Nestos	5,613	Mediter. Sea	BG, GR	
Maritza	52,600	Mediter. Sea	BG, GR, TR	
- Arda	…	Maritza	BG, GR	
- Tundja	…	Maritza	BG, TR	

[1] The assessment of water bodies in italics was not included in the present publication.

EBRO RIVER BASIN[1]

The Ebro River rises near the Atlantic coast in the Cantabrian Mountains in northern Spain, drains an area of 86,000 km² between the Pyrenees and the Iberian mountains, and empties through a wide delta into the Mediterranean Sea. Andorra, France and Spain are the riparian countries. Due to the very small share of Andorra and France in the total basin area (86,000 km²), the assessment of the status of the Ebro was not included in the present publication.

RHONE RIVER BASIN[2]



Switzerland (upstream country) and France (downstream country) share the Rhone River basin; the Italian part of the basin is negligible.

Lake Geneva and Lake Emosson (see assessments below) are transboundary lakes in the basin. Lake Emosson (located in the Swiss part of the Rhone basin) is formed by a dam, which is jointly operated by France and Switzerland for hydropower generation.

Basin of the Rhone River			
Area	**Country**	**Country's share**	
98,00 km²	France	90,000 km²	92%
	Italy	50 km²	…
	Switzerland	8,000 km²	8%

Source: Freshwater in Europe – Facts, Figures and Maps. UNEP/DEWA-Europe, 2004.

[1] Information based on the publication of the United Nations Environment Programme Division of Early Warning and Assessment, Office for Europe titled Freshwater in Europe – Facts, Figures and Maps. (UNEP/DEWA-Europe, 2004).
[2] Information based on publications of the International Commission for the Protection of Lake Geneva.

RHONE RIVER

Hydrology

The river rises from the Rhone glacier at an altitude of 1,765 m. Major transboundary rivers in the basin include the Arve, which joins the Rhone downstream from Lake Geneva, and the Doubs (a transboundary tributary of the Saône); a number of small transboundary rivers end up in Lake Geneva.

Other main tributaries of the Rhone, completely located in France, include the Ain, Saône, Ardèche, Gard, Isère, Drôme and Durance.

The average annual discharge from Lake Geneva is 570 m^3/s and at Beaucaire, upstream Arles (France) near the end of the river course, it is 2,300 m^3/s.

Typically, the Rhone develops floods in spring and autumn. Flood peaks of 13,000 m^3/s were recorded in autumn of 2003. The river also has a relatively high gradient (0.625°/°°). These characteristics help explain why the Rhone has been known for its poor navigability, but good hydroelectric potential.

Pressure factors[3]

Today, the flow regime of the Rhone is regulated by several large storage reservoirs (7 billion m^3, which represent about 7.3 % of the annual runoff of 96 billion m^3). Nearly 80% of this storage capacity is located downstream of Geneva and is provided by such dams as the Vouglans dam on the Upper Ain River, several dams on Isère River (which together account for 30% of total storage capacity) and the Serre-Ponçon dam on the Durance River. The Serre-Ponçon dam is one of the largest in Europe and it provides 43% of the basin's storage capacity.

The Rhone basin is a densely populated, industrialized and agricultural area with some 15 million inhabitants in France and Switzerland (more than 2.5 million inhabitants in the "river corridor" in France). The Rhone has contributed to the economic prosperity of the riverside cities and their inhabitants.

In ecological terms, the effects of change in physical habitat have been particularly considerable: the morphology of the river channel has changed from braided to straight and canalized, often eroded and incised; the level of the groundwater has been lowered; several natural biotopes disappeared; the riparian forest evolved to hardwood forest due to groundwater depletion; and dams block the migration of amphibiotic fish (shads, eel, lampreys), where numerous lateral communications with tributaries or side channels have been modified, sometimes cut off. Overall the biodiversity of the river has been reduced. There is scarcity of species whose life histories are linked to a dynamic fluvial system. Rheophilic species have declined and communities shifted to more limnophilic habitat species.

The Rhone delta is known as the Camargue with a surface area of 800 km^2. This region is one of the major wildlife areas of Europe.

LAKE GENEVA/LAC LEMAN[4]

Lake Geneva is a transboundary lake (580 km^2) shared between Switzerland (345.3 km^2) and France (234.8 km^2). It is the largest lake of Western Europe and a vast drinking-water reservoir. Lake Geneva is a deep lake; the mean depth is 152.7 m and the maximum depth 309.7 m. It represents a privileged habitat and recreation area. The anthropogenic impact is strong on both sides of the lake. Only 3% of the lakeshores are still natural.

As 20% of the lake basin (total area 7,975 km^2), which is mostly located in Switzerland, consists of cultivated land; agriculture is clearly one of the pressure factors. The others are industries and urbanization.

In 1957, concerned by the growing pollution in Lake Geneva, a group of scientists introduced systematic monitoring of the water quality. Subsequently, the Governments of France and Switzerland founded the International Commission for the Protection of Lake Geneva (CIPEL), following an agreement signed in 1962. Today, CIPEL's efforts include not only the protection of the lake water but also the renaturation of the rivers in the lake basin, whose biodiversity is threatened.

[3] Based on the IUCN publication by Yves Souchon: "The Rhone river: hydromorphological and ecological rehabilitation of a heavily man-used hydrosystem".
[4] Based on information by the International Commission for the Protection of Lake Geneva (CIPEL).

Eutrophication and industrial pesticides are the most serious water-quality problems. The lake has a good ecological status. Due to the long retention time (11.4 years), the restoration of the lake is slow, making it vulnerable to alteration.

LAKE EMOSSON[5]

Lake Emosson (located in the Swiss part of the Rhone basin) is formed by a dam, which is jointly operated by France and Switzerland (Electricité d'Emosson SA) for hydropower generation. The company collects water from the Mont Blanc Massif, which it channels into the reservoir located at an altitude of 1930 meters.

The water comes from the high valleys of the river Arve and Eau Noire (France) and from the Ferret and Trient valleys (Switzerland). Through collectors located on the French side, the water is routed to the reservoir by gravity. The water from the Swiss side must be pumped into the reservoir.

The two stations of the scheme - Châtelard-Vallorcine (France, 189 MW) and La Bâtiaz (Martigny, Switzerland, 162 MW) - annually generate 612 GWh of energy, of which 94 % in the winter. The energy used for pumping represents 110 GWh per year.

[5] Based on information by Electricité d'Emosson SA .

PO RIVER BASIN[6]

France, Italy and Switzerland share the basin of the Po River.

Basin of the Po River			
Area	Country	Country's share	
≈ 74,000 km^2	France	230 km^2	0.4%
	Italy	70,000 km^2	94.4%
	Switzerland	3,900 km^2	5.2%

Source: Po River Basin Authority, Italy.

The Po River rises from Mount Monviso at 2,022 m above sea level and flows towards the Adriatic Sea, where its delta represents a habitat of precious environmental and landscape value.

The Po basin is divided into three areas: an Alpine sector, prevalently of crystalline metamorphic origin; an Apennine sector, mostly of sedimentary origin with a high clay content (as a consequence, several areas are affected by erosion and landslides); and a central alluvial area, including the Padanian Plain and the Adriatic lowlands.

The transboundary rivers and lakes in the Po basin are located in the Alpine sector. The most prominent transboundary river, the Ticino River, as well as Lake Maggiore and Lake Lugano, are shared by Italy and Switzerland. In general, watercourses in the Alpine sector and their sub-basins have "glacio-nival and lacustrine environments": they are able to regulate flows, have a considerable size of plain reaches, and a moderate transport of solids (compared to the watercourses in the Appenine sector). The glacial regime of the Alpine rivers is characterized by maximum flows from late spring to early autumn and low flows in winter.

The surface water data available in the entire Po hydrographic system cover a period of roughly 30 years. All the water resources of the basin are exposed to a high level of anhropogenic pressure, generating an organic load equivalent to that produced by 100 million inhabitants (although only 17 million people live in the basin), approximately 15% of which can be attributed to municipal sources, 52% to industrial wastewaters, and 33 % to agriculture and animal husbandry. The combined effect of polluting agents makes many rivers unsuitable for bathing, prevents the development of a balanced aquatic life, and requires deep water purification before drinking-water supply.

LAKE LUGANO[7]

Lake Lugano, a transboundary lake shared by Italy and Switzerland, belongs to the Po River basin. The lake is a popular place for recreation activities.

The lake has a surface of 48.9 km^2 and basin area of 565 km^2. Lake Lugano is divided into two main parts, the northern part being deep and the southern part relatively shallow. The volume of the lake is 6.5 km^3 and its theoretical retention time is approximately 8.2 years (11.9 years in the northern part and 2.3 years in the southern part).

In the 1960s, the lake was heavily polluted by anthropogenic sources and became eutrophic. The period was characterized by high phosphorus concentration and oxygen deficiency in the bottom water layers. Since the 1970s, the lake has recovered substantially, mainly due to eight wastewater treatment plants that gradually came into operation and use mechanical, chemical and biological treatments. In 1986, Italy and Switzerland began to eliminate the phosphorus in detergents and cleaning products. Since 1995, the main sewage treatment plants have improved their efficiency by introducing phosphorus post-precipitation, denitrification and filtration treatments. During the last 20 years, recovery measures have reduced the external phosphorus load from about 250 to 70-80 tons/year. The improved water status is also visible in the Secchi-disk transparency, which has increased from 3.5 to 5.5 m. Currently, the external nutrient load derives from anthropogenic (85%), industrial (10%) and agricultural (5%) sources.

[6] Based on information by the Po River Basin Authority, Italy.
[7] Based on Monitoring of International Lakes - Background document for the Guidelines on Monitoring and Assessment of Transboundary and International Lakes, UNECE, 2002.

LAKE MAGGIORE[8]

Lake Maggiore (Lago Maggiore) is a large pre-Alpine lake situated west of Lake Lugano on the border between Italy and Switzerland. It offers good possibilities for fisheries, navigation, tourism and recreation (swimming, sportfishing, yachting). The lake belongs to the sub-basin of the Ticino River, a tributary of the Po River.

Lake Maggiore has a relatively large drainage basin (6,600 km^2) covered, inter alia, by woody vegetation (20 %), rocky outcrops and depris (20 %), permanent snow, and glaciers and lakes. The lake is 65 km long and 2–4.5 km wide and has a surface area of 213 km^2. The total volume of this deep lake (mean depth 177 m, maximum depth 372 m) is 37.5 km^3, and its theoretical retention time is 4 years.

Lake Maggiore underwent a process of eutrophication in the course of the 1960s and 1970s due to phosphorus inputs from municipal sewage, changing its status from oligotrophic to meso-eutrophic. Starting from the late 1970s, the phosphorus load has been gradually reduced; the total phosphorus in-lake concentration is currently below 10 μg/l (at winter mixing), compared to a maximum value of 30 μg/l in 1978.

ISONZO RIVER BASIN[9]

Slovenia (upstream country) and Italy (downstream country) share the Isonzo basin

Basin of the Isonzo River			
Area	**Country**	**Country's share**	
3,400 km^2	Italy	1,150 km^2	34%
	Slovenia	2,250km^2	66%

Source: Ministry of the Environment, Land and Sea, Italy.

The river Isonzo, in Slovenia known as the Soča, has its source in Slovenia and empties into the Adriatic Sea. The basin has a pronounced mountainous character with an average elevation of about 599 m above sea level.

Major transboundary tributaries include the rivers Natisone, Vipoacco and Iudrio.

Discharge characteristics of the Isonzo River at the gauging station Pieris		
Discharge characteristics	**Discharge**	**Period of time or date**
Q_{av}	172 m^3/s	…
Q_{max}	4,400 m^3/s	1925-1953
Q_{min}	12.1 m^3/s	3 August 1904
Discharge characteristics of the Isonzo River at the gauging station Ponte Piuma (Italy)		
Q_{av}	21 m^3/s	…
Mean monthly values		
October: 18 m^3/s	November: 22 m^3/s	December: 20 m^3/s
January: 14 m^3/s	February: 13 m^3/s	March: 18 m^3/s
April: 21 m^3/s	May: 24 m^3/s	June: 23 m^3/s
July: 21 m^3/s	August: 17 m^3/s	September: 15 m^3/s

Source: Ministry of the Environment, Land and Sea, Italy.

[8] Based on Monitoring of International Lakes - Background document for the Guidelines on Monitoring and Assessment of Transboundary and International Lakes, UNECE, 2002.
[9] Based on information submitted by the Ministry of the Environment, Land and Sea, Italy.

Dams include the Salcano, Sottosella and Canale Dams in Slovenia and the Crosis Dam in Italy. The lakes Doberdò amd Pietrarossa are natural water bodies in Italy.

In the Italian part of the basin, the main forms of land use are forests (40%), cropland (45%) and grassland (6%). 227 km^2 are protected areas.

Organic matter from wastewater discharges and heavy metals cause a transboundary impact and affect the water quality in the Adriatic.

According to recent Italian data,[10] eight monitoring stations show a "good status" of surface waters, and one station an "elevated status".

Water use in the Italian part of the Isonzo River basin (%)			
Agriculture	Urban	Industry	Energy
64	5	4	27

Source: Ministry of the Environment, Land and Sea, Italy.

KRKA RIVER BASIN[11]

Croatia and Bosnia and Herzegovina are the two riparian countries in the Krka River basin.

[10] Source: Ministry of the Environment, Land and Sea, Italy. Database "Quality Data D.Lgs. 152/99".
[11] Based on information provided by the Croatian Waters/Water Management Department (Split, Croatia) on behalf of both Croatia and Bosnia and Herzegovina.

Basin of the Krka River			
Area	Country	Country's share	
2,500 km²	Bosnia and Herzegovina	300 km²	12%
	Croatia	2,200 km²	88%

Source: Croatian Waters/Water Management Department (Split, Croatia).

Hydrology

The river has its source in Croatia and ends up in the Adriatic Sea in Croatia. The basin has a pronounced mountainous character with an average elevation of about 100 m above sea level. Major lakes are Lake Brljan (man-made), Lake Golubić (man-made), Lake Visovac (natural) and Lake Prokljan (natural). The National Park "Krka" covers 4.5% of the basin area.

A major transboundary tributary is the river Butišnica.

There are three hydropower stations located on the Krka, and two located on the tributaries Butišnica and Krčić.

Discharge characteristics of the Krka River at the gauging station Marjanovići (Croatia)		
Discharge characteristics	**Discharge**	**Period of time or date**
Q_{av}	21.2 m³/s	1963–1990
Q_{av}	18.4 m³/s	1979–1991
Q_{max}	125 m³/s	1961–1990
Q_{min}	3.3 m³/s	1961–1990
Mean monthly values		
October: 11.8 m³/s	November: 17.9 m³/s	December: 24.3 m³/s
January: 22.0 m³/s	February: 23.8 m³/s	March: 25.0 m³/s
April: 28.2 m³/s	May: 24.6 m³/s	June: 17.6 m³/s
July: 11.7 m³/s	August: 8.06 m³/s	September: 8.67 m³/s

Source: Croatian Waters/Water Management Department (Split, Croatia).

Pressure factors

The main forms of land use include grasslands (44%), forests (30%) and cropland (15%). In Croatia, the population density is 34 persons/km². No data were available from Bosnia and Herzegovina.

Industry uses 27% of the water from the public water supply systems, and the urban sector, 73%.

The pressure from agriculture is insignificant due to the still low agricultural production of fruits, vegetables and olives as well as a very low animal production (sheep, pigs, poultry). However, the production is slowly increasing, which in turn may lead to increasing pressure and transboundary impact.

There are 18 small sites for stone and alabaster excavations. The intensity of exploitation and the number of sites are slowly increasing.

Intensive aluminum production and shipyards are located in the coastal area in Croatia. Other industry sectors are less intensive and not recovered after the war. They are mostly connected to the sewer systems. The number of industrial zones is rapidly increasing, but they are all required by law to have adequate wastewater treatment or to be connected to municipal wastewater treatment plants.

There are still unfinished sewerage systems and untreated urban wastewaters from the towns Knin (40,000 p.e.) and Drniš (10,000 p.e.).[12] The three controlled dumping sites

[12] The abbreviation "p.e." means population equivalent.

do not cause significant impact; however, there are also several small illegal dumpsites.

Storm waters from highways are treated by oil-separators and disposed into underground or discharged into the rivers. However, the treated waters cannot be disposed of into the underground in the vicinity of water abstraction sites (sanitary protection zones).

Minimum, maximum and mean values of water-quality determinands at the water-quality station Lake Visovac

Year	Values	Determinands						
		COD_{Mn} mgO_2/l	BOD_5 mgO_2/l	Ammonia mgN/l	Nitrite mgN/l	Nitrate mgN/l	Total N mgN/l	Total P mgP/l
2001	Min	0.9000	1.1000	0.0000	0.0000	0.1420	0.3800	0.0000
	Max	6.0000	4.3000	0.1100	0.0420	1.0340	1.2370	0.0920
	Mean	2.9000	2.7909	0.0285	0.0079	0.4951	0.8729	0.0373
2002	Min	1.1000	0.5000	0.0000	0.0000	0.0440	0.2780	0.0110
	Max	2.8000	5.3000	0.0750	0.0170	0.6960	1.1180	0.1340
	Mean	1.9833	2.3917	0.0298	0.0053	0.4307	0.7558	0.0364
2003	Min	0.8000	0.9000	0.0100	0.0050	0.1700	0.4400	0.0100
	Max	6.0000	5.0000	0.0800	0.0190	1.0300	1.3250	0.0800
	Mean	2.5500	2.4273	0.0317	0.0085	0.4750	0.8285	0.0375
2004	Min	0.6000	0.4300	0.0100	0.0030	0.1000	0.2720	0.0100
	Max	2.4000	2.6000	0.0700	0.0130	0.7300	1.0500	0.0450

Source: Croatian Waters/Water Management Department (Split, Croatia).

The water bodies have mostly a “good ecological status”. The surface waters in the National Park “Krka” have a “moderate status” because of the ecological requirements of the National Park for high water quality and the untreated urban wastewater discharges from the towns Drniš and Knin, which are located upstream.

NERETVA RIVER BASIN[13]

Bosnia and Herzegovina and Croatia are the riparian countries in the Neretva River basin

Basin of the Neretva River			
Area	Country	Country's share	
8,100 km^2	Bosnia and Herzegovina	7,900 km^2	97.5%
	Croatia	200 km^2	2.5%

Source: Ministry of Foreign Trade and Economic Relations, Bosnia and Herzegovina, and Croatian Waters/Water Management Department (Split, Croatia).

Hydrology

The river has its source in the Jabuka Mountains and empties into the Adriatic Sea. The basin has a pronounced mountainous character in its upper part and a lowland character further downstream.

Major transboundary tributaries include the rivers Ljuta, Rama, Drežanjka, Rdaobolja, Jasenica, Buna, Bregava, Trebižat, Krupa, Bistrica, Žabljak, Sturba and Trebišnjica.

Discharge characteristics of the Neretva River at the gauging station Mostar		
Discharge characteristics	Discharge	Period of time or date
Q_{av}	180 m^3/s	…
Q_{max}	1,900 m^3/s	…
Q_{min}	50 m^3/s	…

Source: Croatian Waters/Water Management Department (Split, Croatia).

Dams and reservoirs include those of Jablanica, Grabovica, Salakovac and Mostar.

Pressure factors

Pressures on water resources result from aluminum production, untreated municipal wastewaters and uncontrolled dumpsites, both for municipal and industrial wastes.

[13] Based on information provided by the Ministry of Foreign Trade and Economic Relations, Bosnia and Herzegovina, and Croatian Waters/Water Management Department (Split, Croatia).

Minimum, maximum and mean values for water-quality determinands at the station Rogotin/Croatia						
Determinands	**2001**			**2002**		
	Min.	**Max.**	**Mean**	**Min.**	**Max.**	**Mean**
BOD_5, mgO_2/l	0.3	5.4	2.245	0.3	4.9	2.9
COD, mgO_2/l	1.7	5.1	3.04	1.4	4.1	2.3
Ammonium, mgN/l	0	0.08	0.038	0	0.107	0.03
Nitrites, mg/l	0	0.025	0.011	0	0.017	0.01
Nitrates, mgN/l	0.339	0.733	0.515	0.16	0.89	0.524
Total Kjehldal nitrogen, mgN/l	0.703	1.229	0.896	0.601	1.217	0.95
Total phosphorus, mgP/l	0	0.116	0.034	0.01	0.152	0.068
Mineral oils, mg/l	0	0.04	0.0136	0	0.039	0.0175
Phenols, mg/l	0	0.004	0.001	0	0.09	0.008
Chlorides, mg/l	16	2,100	983	10	1,350	604
Determinands	**2005**			**2006**		
	Min.	**Max.**	**Mean**	**Min.**	**Max.**	**Mean**
BOD_5, mgO_2/l	1.5	4.4	1.84	1.5	1.5	1.5
COD, mgO_2/l	1.5	3.1	1.97	1.5	3.9	2.19
Ammonium, mgN/l	0.01	0.13	0.032	0.01	0.07	0.02
Nitrites, mg/l	0.005	0.005	0.005	0.005	0.005	0.005
Nitrates, mgN/l	0,32	0.96	0.64	0.33	0.9	0.57
Total Kjehldal nitrogen, mgN/l	0.46	1.28	0.92	0.44	1.19	0.82
Total phosphorus, mgP/l	0.01	0.04	0.022	0.005	0.073	0.03
Mineral oils, mg/l	0.001	0.009	0.003	0.001	0.025	0.009
Phenols, mg/l	0.001	0.004	0.001	0.001	0.004	0.001
Chlorides, mg/l	13	1,600	525	13	1,330	403

Source: Croatian Waters/Water Management Department (Split, Croatia).

Bosnia and Herzegovina reported that water pollution by pesticides, heavy metals and industrial organic compounds, as well as salinization, are issues of great concern.

DRIN RIVER BASIN[14]

The Drin starts at the confluence of its two headwaters, the transboundary river Black Drin (Crn Drim) and the transboundary river White Drin (Beli Drim) at Kukës in Albania.

The interconnected hydrological system of the Drin River basin comprises three major transboundary sub-basins: the sub-basin of the Black Drin, the sub-basin of the White Drin and the sub-basin of Lake Skadar, which is a transboundary lake. The two other transboundary lakes (Lake Ohrid and Lake Prespa) are part of the Black Drin's sub-basin.

Albania, Greece, Montenegro, Serbia and The former Yugoslav Republic of Macedonia share the Drin basin.

BLACK DRIN[15]

The Black Drin originates from Lake Ohrid and runs through The former Yugoslav Republic of Macedonia and Albania. A major transboundary tributary is the river Radika.

The Black Drin sub-basin in The former Yugoslav Republic of Macedonia is mainly covered by forests (52%) and agricultural land (16%).

The two natural lakes in the sub-basin of the Black Drin (Lake Ohrid and Lake Prespa) are transboundary lakes. The dams at Spilja and Globocica form reservoirs on the Black Drin, used for hydropower production.

According to information by The former Yugoslav Republic of Macedonia, there is an extensive cattle production, but low crop production due to the mountainous character of the sub-basin in the country. There are no subsurface mining activities though there is mineral surface mining. The great number of illegal dumpsites is of particular concern.

The intensive tourism around Lake Ohrid and Lake Prespa and in the National Park Mavrovo is another pressure factor.

The pressure from tourism and human settlements has started to decrease due to the construction of a wastewater treatment plant which treats sewage from the vicinity of Lake Ohrid.

LAKE OHRID[16] AND LAKE PRESPA[17]

Lake Ohrid (358 km^2) is located at an altitude of 695 m and encircled by mountains exceeding 2,000 m in height. The lake is deep (mean depth 163.7 m, maximum depth 288.7 m). Some 249 km^2 (67%) of the lake belongs to The former Yugoslav Republic of Macedonia and 109 km^2 (33%) to Albania. Some 650 km^2 (62%) of the lake basin is in The former Yugoslav Republic of Macedonia and 392 km^2 (38%) in Albania.

Lake Prespa (274 km^2) is a transboundary lake shared by The former Yugoslav Republic of Macedonia (178 km^2), Albania (49 km^2) and Greece (47 km^2). The lake basin is some 2,800 km^2, and the mean depth is 16 m (the maximum is 47 m). The lake is characterized by eutrophication, industrial pollution, toxic substances and other relevant pollution factors.

Lake Prespa is situated at an altitude of 845 m, i.e. above Lake Ohrid, and its waters drain into Lake Ohrid through very porous karst mountains. The water system of Lake Ohrid is rather complex because of the underground links with Lake Prespa. The mean theoretical retention time is 83.6 years.

Lake Ohrid is one of the oldest lakes in the world. It was formed 2 to 3 million years ago. Because the lake has been isolated by surrounding mountains, a unique collection of plants and animals have evolved. Some of these plants and animals were common species millions of years ago but are now considered relics or "living fossils" because they can be found only in Lake Ohrid. The Lake Ohrid area has been a World Natural Heritage Site since 1980.

[14] Based on information submitted by the Ministry of Urban Planning, Construction and Environment, The former Yugoslav Republic of Macedonia. For the lake assessment, use was also made of: Faloutsos D., Constantianos V., and Scoullos M., Assessment of the management of shared lake basins in South-eastern Europe. A report within GEF IW:LEARN, Activity D2. GWP-Med, Athens, 2006.
[15] Based on information by the Ministry of Urban Planning, Construction and Environment, The former Yugoslav Republic of Macedonia.
[16] Based on information submitted by the Ministry for the Environment, Physical Planning and Public Works of Greece; Environmental Performance Review of Albania, UNECE. 2002; Environmental Performance Review of the former Yugoslav Republic of Macedonia, UNECE, 2002; Assessment of the Management of Shared Lake Basins in Southeast Europe, D. Faloutsos, V. Constantianos, M. Scoullos; GEF IW: LEARN Activity D2, 2006.
[17] Based on information submitted by the Ministry for the Environment, Physical Planning and Public Works of Greece.

The water quality monitoring shows significant organic loading to Lake Ohrid from municipal waste, agricultural and urban runoff. Although the phosphorus concentrations and water transparency still suggest an oligotrophic condition, the living organisms tell a different story.

The commercially important fish species in Lake Ohrid, including the famous Lake Ohrid trout, have been over-harvested in recent years and are in immediate danger of collapse. Human activities along the shoreline also threaten the spawning and wintering grounds of these fish. Because the fish in the lake are a single, linked population, they must be managed collectively, with similar requirements in both The former Yugoslav Republic of Macedonia and Albania.

Both the phytoplankton and zooplankton communities are shifting to a species composition more characteristic of a mesotrophic, or more polluted, condition. The macrophytic plants and benthic fauna have also responded to the nutrient loading and contamination present in the shallow-water zone. These bioindicators are sending a clear message that the unique biodiversity of the lake may be permanently altered unless more stringent management actions are taken to reduce the amount of pollution loaded into the lake.

The industrial activities in the town of Pogradec (Albania) include alimentary, textile, metal and wood processing and other light industries. As wastewaters from these plants are discharged without treatment, they may be a significant source of pollution.

The major industries in The former Yugoslav Republic of Macedonia region include the production of automobile spare parts, metal and ceramic processing, plastics, textiles, shoes, electrical parts (including transformers, transmission equipment, circuit boards, fuses, and other parts), and food processing.

In the 1980s, the construction of a sewage collection system for towns in The former Yugoslav Republic of Macedonia along the shores of Lake Ohrid reduced the levels of faecal pathogens. This was a very positive step for the health of the people using the lake for drinking water and recreation. Unfortunately, there are still sections of the coast in both countries where pathogens from human waste pose a significant risk. The problem is most acute in the region around Pogradec, where faecal contamination is extremely high. The planned wastewater treatment plant will help solve this problem as well as reduce the amount of phosphorus and organic material entering the lake.

The sewerage from the town of Pogradec is a major contributor of phosphorus, and the planned wastewater treatment plant will significantly reduce the phosphorus load. Other sources of phosphorus are present throughout the lake basin. Because phosphorus detergents may be one of the largest contributors of phosphorus to wastewater, efforts to reduce their use should be strongly encouraged. Other management actions might include additional wastewater treatment, storm water management, stream bank stabilization measures, and other agricultural best management practices.

In the surrounding villages, the sewage is discharged directly into streams or onto the soil. Thus, the wastewater produced by over 60,000 inhabitants is discharged directly or indirectly into Lake Ohrid.

LAKE SKADAR[18]

Lake Skadar (also known as Shkoder), one of the largest lakes on the Balkan Peninsula, is shared by Albania and Montenegro. It belongs to the Drin River basin. Lake Skadar discharges through the transboundary Bojana/Buna River (44 km; average flow 320 m³/s) into the Adriatic Sea.

The total size of the lake varies considerably due to varying water inflow and use, from 369.7 km² at low water to up to 530 km² at high water. The lake has a transboundary catchment area of 5,180 km², with a medium elevation of 770 m above sea level.

Lake Skadar receives its waters mainly by the 99-km-long Moraca River, which has its source in the central Montenegrin mountains and is altered by four hydropower plants. The lake is famous for a wide range of endemic and rare, or even endangered, plant and animal species. About half of the 250 recorded bird species breed on the lake, including the westernmost breeding site for the Dalmatian Pelicans in Europe and the second largest colony of the Pygmy Cormorant world-wide. Especially due to the bird fauna, the lake has a highly significant international importance. The

[18] Environmental Performance Review of Albania, UNECE. 2002; Environmental Performance Review of Serbia and Montenegro, UNECE. 2002.

lake is also home for some endemic reptiles. Its northern shores are flat with extensive reed beds around the Montenegrin tributaries. The Montenegrin side is protected as a national park (40,000 ha) and a Ramsar site.

Human activities have a considerable impact on the Lake Skadar ecosystem, either directly or indirectly. Major direct factors are irrigation, drainage, poaching and overfishing, and major indirect factors are poor wastewater management and illegal landfills. The only substantial industrial area is the Lake Skadar region.

Approximately 40% of the lake basin is agricultural land and 10% pastures. Due to the high nutrient loading, the lake has eutrophied slightly. One of the basic problems is insufficiently treated sewage water. For example, the Podgorica wastewater treatment plant is designed for 55,000 people, but is currently servicing 150,000. Besides eutrophication, intensive fishing has led to a decline of food for fish-eating birds. Especially due to its international importance for many bird species, Lake Skadar still needs special attention and protection measures to guarantee the proper state of this unique lake ecosystem.

VIJOSE RIVER BASIN[19]

The Vijose River basin is shared by Greece (upstream country) and Albania (downstream country). The river is known as Vjosa in Albania and Aoos in Greece.

Basin of the Vijose River			
Area	Country	Country's share	
6,519 km²	Albania	4,365 km²	67%
	Greece	2,154 km²	33%

Source: Ministry for the Environment, Physical Planning and Public Works/Central Water Agency, Greece.

Hydrology

The 260-km-long river (70 km in upstream Greece) has its source in Northern Pindos Mountains and ends up in Adriatic Sea. The basin has a pronounced mountainous character with an average elevation of about 885 m above sea level.

Major transboundary tributaries include the rivers Sarantaporos (870 km²) and Voidomatis (384 km²).

Discharge characteristics of the Vijose River upstream of the Greek-Albanian border		
Discharge characteristics	Discharge	Period of time or date
Q_{av}	52 m^3/s	1951-1988
Q_{max}	125.5 m^3/s	…
Q_{min}	15.5 m^3/s	…
Mean monthly values		
October: 25.8 m^3/s	November: 69.2 m^3/s	December: 100.7 m^3/s
January: 105.7 m^3/s	February: 125.5 m^3/s	March: 120 m^3/s
April: 116.2 m^3/s	May: 74.7 m^3/s	June: 44.6 mv/s
July: 26.8 m^3/s	August: 20.6 m^3/s	September: 15.5 m^3/s

Source: Ministry for the Environment, Physical Planning and Public Works/Central Water Agency, Greece.

[19] Based on information submitted by the Ministry for the Environment, Physical Planning and Public Works/Central Water Agency, Greece.

In Greece, the Aoos Springs Hydroelectric Dam (Public Power Corporation) was built on the river.

Pressure factors

Approximately 350,000 people live in the basin (some 328,000 in Albania and 20,000 in Greece).
Of the basin, 47% is covered with forests. Other forms of land use include: cropland (3.5%), grassland (13.6%), barren (6.4%) and shrubs (29.5%). In Greece, the Aoos is part of the Vikos-Aoos National Park, a NATURA 2000 site.

The main pressures result from agricultural activities, animal production and aquaculture.

Transboundary impact

An agreement has recently been concluded between Albania and Greece and entered into force on 21 November 2005. This agreement provides for the establishment of a Permanent Greek-Albanian Commission on transboundary freshwater issues with such specific tasks as the setting of joint water-quality objectives and criteria, the drafting of proposals for relevant measures to achieve the water-quality objectives, and the organization and promotion of national networks for water-quality monitoring.

Trends

The river has a "very good water quality", which is appropriate for all uses in the basin.

Despite the Vijose's very good status, an integrated approach of all environmental, social, economic and technical aspects of water resources management is needed in order to ensure water preservation and environmental integrity in the region.

VARDAR RIVER BASIN[20]

The former Yugoslav Republic of Macedonia (upstream country) and Greece (downstream country) share the basin of the Vardar River, known in Greece as Axios.

Lake Dojran is located in this basin.

Basin of the Vardar River			
Area	**Country**	**Country's share**	
23,750 km^2	Greece	2,513 km^2	11.3%
	The former Yugoslav Republic of Macedonia	19,737 km^2	88.7%

Source: Ministry for the Environment, Physical Planning and Public Works/Central Water Agency, Greece.

VARDAR RIVER

Hydrology

The total length of the river is 389 km, with the 87 km in Greece. The river has its source in the Shara massif (a mountainous area between Albania and The former Yugoslav Republic of Macedonia) and empties into the Aegean Sea at Thermaikos Gulf.

The basin has a pronounced mountainous character with an average elevation of about 790 m above sea level. There are about 120 large and small dams in The former Yugoslav Republic of Macedonia. Floods in the downstream area were considerably reduced due to these dams.

Major transboundary tributaries include the rivers Gorgopis (sub-basin 70 km^2), Sakoulevas (sub-basin 901 km^2) and Vardarovasi (sub-basin 102 km^2).

[20] Based on information submitted by the Ministry for the Environment, Physical Planning and Public Works/Central Water Agency, Greece, and the Ministry of Urban Planning, Construction and Environment, The former Yugoslav Republic of Macedonia.

Discharge characteristics of the Vardar in Greece (measuring station Kafkasos Railway Bridge/Tributary Sakoulevas)		
Discharge characteristics	**Discharge**	**Period of time or date**
Q_{av}	3.5 m^3/s	1950-1990
Q_{max}	0.3 m^3/s	…
Q_{min}	8.5 m^3/s	…
Mean monthly values		
October: 1.2 m^3/s	November: 2.2 m^3/s	December: 5.1 m^3/s
January: 3.8 m^3/s	February: 8.5 m^3/s	March: 8.1 m^3/s
April: 5.8 m^3/s	May: 6.5 m^3/s	June: 2.3 m^3/s
July: 0.7 m^3/s	August: 0.3 m^3/s	September: 0.4 m^3/s

Source: Ministry for the Environment, Physical Planning and Public Works/Central Water Agency, Greece.

Pressure factors

Approximately 3.14 million people live in the basin, among them 1.8 million in The former Yugoslav Republic of Macedonia (91 persons/km²) and 1.6 million in Greece (637 persons/km²).

The main forms of land use are cropland (68.7%), grassland (7.4%) and forests (7.9%). In Greece, a large part of the basin is a protected NATURA 2000 site.

The main pressure on water resources stems from agriculture. In The former Yugoslav Republic of Macedonia, crop and animal production takes place in river valleys, especially the Pelagonija, Polog and Kumanovo valleys, as well as in the whole Bregalnica catchment area.

A few industrial installations also affect the aquatic ecosystem. In The former Yugoslav Republic of Macedonia, mining and quarrying activities are particularly located in the catchments area of the eastern tributaries (rivers Bregalnica and Pcinja). Metal industry at Tetovo and heavy metal industry at Veles, as well as chemical industry, petroleum refineries and pharmaceutical industry at Skopje, are additional pressure factors.

In The former Yugoslav Republic of Macedonia, a number of illegal dumpsites for solid waste from the villages in the sub-basin are of concern; however, there are also controlled land fields for solid wastes from bigger cities. For the time being, the only properly working wastewater treatment plant is located at Makedonski Brod in the Treska River catchment.

Water is abstracted from the Vardar for irrigation (63%), fishponds (11%) and drinking water (12%) as well as for municipal and industrial uses (15%). There is an overuse of water in many parts of the river, mainly for agricultural purposes.

Transboundary impact and trends[21]

In general, the surface water quality can be classified as "good/moderate". The water is appropriate for irrigation purposes. It can be used for water supply after treatment. The quality of groundwater in general is very good. Often, it is used for water supply without or very little treatment.

The treatment and disposal of solid waste and wastewater and their management at communal level, especially in The former Yugoslav Republic of Macedonia, is still a problem and has to be improved. Organic matter from wastewater discharges results in a transboundary impact.

Greece and The former Yugoslav Republic of Macedonia are considering drawing up a bilateral agreement to replace the existing 1959 agreement, which dealt primarily with the establishment of a joint body for the joint water resources management. The new agreement will be based on the most recent developments in international law and European Union legislation.

[21] Based on information submitted by the Ministry for the Environment, Physical Planning and Public Works/Central Water Agency, Greece.

LAKE DOJRAN[22]

Lake Dojran is a small (total area 43.10 km^2) tectonic lake with a basin of 271.8 km^2. The lake is shared between The former Yugoslav Republic of Macedonia (27.4 km^2) and Greece (15.7 km^2). The lake is rich with fish – 16 species. The "Aquatic Forest of Mouria" has been listed as a "Natural Monument" and also proposed, together with a small part (200 ha) of Lake Dojran, for inclusion in the EU NATURA 2000 network.

Over the last 20 years, the lake's level has dropped continuously due to reduced precipitation and increasing Greek abstraction, mainly for irrigation purposes. The most extreme water level and water volume decrease have occurred since 1988. From 262 million m^3 in 1988, the volume decreased to 80 million m^3 in 2000.

Water quality is characterized by high alkalinity and elevated carbonate and magnesium hardness. Additionally, concentrations of certain toxic substances are near or even beyond toxic levels. In Greece, there are high values of phosphates.

Pollution is caused by municipal wastewater, municipal solid wastes, sewage from tourist facilities, and agricultural point source and non–point source pollution, including transboundary pollution.

In recent years, the lake has been struggling for survival. Since 1988, because of the decrease in water level and volume, according to biologists over 140 species of flora and fauna have disappeared. The water level has dropped 1.5 metres below its permitted hydro-biological minimum. Lake Dojran has been affected by quantity decrease and quality reduction since the early 1990s due to activities in both countries, such as water abstraction and municipal wastewater disposal. The situation was aggravated by the low precipitation in the period 1989-1993 and high evaporation rates observed in the lake basin.

[22] Based on information submitted by the Ministry for the Environment, Physical Planning and Public Works of Greece.

STRUMA RIVER BASIN[23]

Bulgaria (upstream country) and Greece (downstream country) are typically considered to be the riparian countries in the basin of the Struma River, known in Greece as the Strymónas. The share of Serbia and The former Yugoslav Republic of Macedonia in the total basin area is very small.

Basin of the Struma River			
Area	**Country**	**Country's share**	
18,079 km²	Bulgaria	10.797 km²	59.7%
	Greece	7.282 km²	40.3%
	Serbia	…	…
	The former Yugoslav Republic of Macedonia	…	…

Source: Ministry for the Environment, Physical Planning and Public Works/Central Water Agency, Greece.

Hydrology

The total length of the river is 400 km, with the last 110 km in downstream Greece. The river has its source in western Bulgaria (Vitosha Mountain, south of Sofia) and ends up in Aegean Sea (Strymonikos Gulf).

The basin has a pronounced mountainous character with an average elevation of about 900 m above sea level. There is a high risk of flooding.

Major transboundary tributaries include the rivers Butkovas, Exavis, Krousovitis, Xiropotamos and Aggitis (see discharge characteristics below). A few tributaries extend to Serbia and The former Yugoslav Republic of Macedonia. These include the transboundary river Dragovishtitsa (Serbia and Bulgaria) as well as the transboundary rivers Lebnitsa and Strumeshnitsa (The former Yugoslav Republic of Macedonia and Bulgaria).

[23] Based on information submitted by the Ministry of Environment and Water, Bulgaria, and the Ministry for the Environment, Physical Planning and Public Works/Central Water Agency, Greece.

Discharge characteristics of the Struma River at the gauging station Marino Pole (Bulgaria)		
Discharge characteristics	**Discharge**	**Period of time or date**
Q_{av}	75.57 m^3/s	1961 – 1998
Q_{max}	149.00 m^3/s	1961 – 1998
Q_{min}	24.13 m^3/s	1961 – 1998
Mean monthly values		
October: 54.79 m^3/s	November: 62.58 m^3/s	December: 70.04 m^3/s
January: 74.99 m^3/s	February: 85.86 m^3/s	March: 92.22 m^3/s
April: 101.30 m^3/s	May: 119.10 m^3/s	June: 88.89 m^3/s
July: 57.02 m^3/s	August: 51.06 m^3/s	September: 49.18 m^3/s

Source: Ministry of Environment and Water, Bulgaria.

Discharge characteristics of the Aggitis River (a tributary to the Struma) at the gauging station Krinida in Greece		
Q_{av}	27.76 m^3/s	Average for: 1987-1988 & 1997-1998
Mean monthly values		
October: 16 m^3/s	November 18.7 m^3/s	December: 36.4 m^3/s
January: 40.2 m^3/s	February: 42.2 m^3/s	March: 47.4 m^3/s
April: 49 m^3/s	May: 36.2 m^3/s	June: 21.8 m^3/s
July: 7.8 m^3/s	August: 6.7 m^3/s	September: 10.7 m^3/s

Source: Ministry for the Environment, Physical Planning and Public Works/Central Water Agency, Greece.

There are about 60 artificial lakes in the Bulgarian part of the river basin, which were built for water supply, power generation and irrigation. The Kerkini Reservoir in Greece was created with the construction of a levee in 1933 for regulating the river discharges, irrigation purposes and flood protection (a new levee was constructed in 1982). The Kerkini Reservoir was finally developed into an important wetland, protected under the Ramsar Convention on Wetlands.

In Greece, irrigation dams exist also at Lefkogeia and Katafyto.

Over the last 20 years, precipitation decreased by some 30%, which resulted in shrinking water resources.

Pressure factors

In Bulgaria, about 430,000 people (39.83 persons/km^2) live in the basin, whereas 192,828 persons (26.49 persons/km^2) live in the Greek part of the basin (according to 1991 Greek statistics).

Bulgaria reports that agriculture uses 2% of the available water resources in the Bulgarian part of the basin, whereas industry uses 6%, the urban sector 10%, and the energy sector 82%. Cropland (42.1%) is the prevailing form of land use. Grassland covers 8.7% of the area, and forests 20.6%. A large part (24.6%) is shrub land. In Bulgaria, mining sites and dumpsites occupy some 40 km^2.

The main pressure results from agriculture and fish farming. Some industrial activities are concentrated in the sub-basin of the river Aggitis.

Untreated wastewaters have a significant impact in the Bulgarian part of the basin. Wastewater treatment installations exist in all major Greek towns (Serres and Kavala, Drama).

Water-quality characteristics (minimum and maximum values for the period 2000-2005) of the Struma River upstream from the Bulgarian-Greek border (Monitoring station 30065124)					
Value	BOD_5 (mg/l)	Ammonia (mg/l)	Nitrites (mg/l)	Nitrates (mg/l)	Phosphates (mg/l)
Maximum	6.5	1.7	0.07	3.5	1.7
Minimum	1	0.1	0.01	1	0.5

Source: Ministry of Environment and Water, Bulgaria.

Transboundary impact

The river receives wastewater from agricultural run-offs and effluents from livestock breeding units. Organic matter from wastewater discharges is also of concern.

An agreement between Greece and Bulgaria, dealing with the mutual utilization and management of the shared water resources, was concluded in 1964. According to this bilateral agreement, both countries are bound, inter alia, not to cause significant damage to each other, arising from the construction and operation of projects and installations on the transboundary river and to exchange of hydrological and technical data.

In 1971, an agreement was signed between the two countries for the establishment of a Greek-Bulgarian Committee dealing with electrical energy issues and with the use of waters of the transboundary river. This Committee has been assigned to follow up the proper application of the 1964 agreement.

The existing cooperation framework between the two riparian countries is linked to the development of a joint integrated water resources management plan for each transboundary river basin following the provisions of the Water Framework Directive.

Trends

The water quality is generally “good”. The water is suitable for use, especially for irrigational agriculture. Decreasing industrial activity after 1990 in Bulgaria resulted in water-quality improvements.

NESTOS RIVER BASIN[24]

Bulgaria (upstream country) and Greece (downstream country) share the basin of the Nestos River, also known as Mesta in Bulgaria.

Basin of the Nestos River			
Area	Country	Country’s share	
5,613 km^2	Bulgaria	2,770 km^2	49.4%
	Greece	2,834 km^2	50.6%

Source: Ministry for the Environment, Physical Planning and Public Works/Central Water Agency, Greece.

Hydrology

The river has its source in the Rila Mountains in the vicinity of Sofia (Bulgaria) and ends up in the North Aegean-Sea. The basin has a pronounced mountainous character.

A major transboundary tributary is the river Dospatska, also known as Dospat.

[24] Based on information submitted by the Ministry of Environment and Water, Bulgaria, and the Ministry for the Environment, Physical Planning and Public Works/Central Water Agency, Greece.

Discharge characteristics of the Nestos/Mesta River at the gauging station 52 850 (Hadjidimovo, Bulgaria)		
Discharge characteristics	**Discharge**	**Period of time or date**
Q_{av}	23.36 m^3/s	1961 – 1998
Q_{max}	66.30 m^3/s	1961 – 1998
Q_{min}	12.39 m^3/s	1961 – 1998
Mean monthly values		
October: 14.26 m^3/s	November: 18.77 m^3/s	December: 25.14 m^3/s
January: 22.76 m^3/s	February: 26.99 m^3/s	March: 28.70 m^3/s
April: 41.52 m^3/s	May: 48.03 m^3/s	June: 29.22 m^3/s
July: 10.20 m^3/s	August: 6.88 m^3/s	September: 8.33 m^3/s

Source: Ministry of Environment and Water, Bulgaria.

Major dams on Greek territory for hydropower generation and irrigation include the Thisavros (built in 1997), Platanovrisi (built in 1999) and Temenos Dams (planned).

The Nestos delta in Greece is a Ramsar site of 440 km^2. A large part of the Nestos in Greece also belongs to the NATURA 2000 sites.

Discharge characteristics of the Nestos River at two gauging stations in Greece (first figure refers to station Thisavros, the second figure to station Temenos)		
Discharge characteristics	**Discharge**	**Period of time or date**
Q_{av}	40.7 and 45.33 m^3/s	Thisavros 1965-1990, Temenos 1964-1963
Q_{max}	68.4 and 75.7 m^3/s	
Q_{min}	12.7 and 13.8 m^3/s	
Mean monthly values		
October: 19.9 and 21.2 m^3/s	November: 29.6 and 22.9 m^3/s	December: 47.2 and 54.8 m^3/s
January: 47.4 and 54.7 m^3/s	February: 53.7 and 62.9 m^3/s	March: 57.5 and 65 m^3/s
April: 67.8 and 75.7 m^3/s	May: 68.4 and 73.3 m^3/s	June: 49.3 and 52.4m^3/s
July: 21.9 and 23.7 m^3/s	August: 12.7 and 13.5 m^3/s	September: 13.2 and 13.8 m^3/s

Source: Ministry for the Environment, Physical Planning and Public Works/Central Water Agency, Greece.

Pressure factors

Forests cover 39% of the basin, croplands 23.5%, and shrubs 25.5%.

In Greece, 42,164 people live in the basin (14.83 persons/km^2) following the 1991 statistics, and around 137,000 persons (49.46 persons/km^2) live in the Bulgarian part.

The main pressure factor in the basin is agriculture. Uncontrolled solid waste disposal in some parts of the river causes water pollution and environmental problems, especially in times of heavy precipitation.

Wastewater treatment installations exist in the area. In Bulgaria, however, organic matter discharged from these installations and untreated wastewaters has a transboundary impact.

Water-quality determinands in the Nestos River downstream from the city of Hadzhidimovo (Monitoring station 30064117) in Bulgaria					
Date	BOD_5 (mg/l)	Ammonia (mg/l)	Nitrites (mg/l)	Nitrates (mg/l)	Phosphates (mg/l)
Water quality in 2000					
17.1.2000	0.7	0.5	0	0.4	0.2
01.2.2000	2	0.2	0.08	0.3	0.4
06.3.2000	0.5	1.7	0.04	2.3	0.3
03.4.2000	2	0.3	0.02	1.5	0.2
16.5.2000	2.5	0.4	0.04	0.3	0.3
12.6.2000	2	0.1	0.03	0.5	0.3
04.7.2000	4	0.4	0.04	0.4	0.3
01.8.2000	2.6	0	0.03	0.5	0.3
05.9.2000	2	0.12	0.04	0.43	0.31
02.10.2000	2.4	0	0.01	0.2	0.2
07.11.2000	5.2	0.1	0.02	0.4	0.2
04.12.2000	1.8	0.2	0.01	0.5	0.2
Water quality in 2005					
17.1.2005	0.9	0.14	0.007	0.83	0.22
02.2.2005	1.54	0.13	0.007	0.78	0.27
01.3.2005	1.4	0.09	0.016	1	0.51
14.4.2005	1.29	0.05	0.009	0.39	0.12
03.5.2005	1.15	0.06	0.01	0.08	0.09
14.6.2005	1.2	0,09	0.011	0.52	0.19
05.7.2005	1.33	0	0.018	0.4057	0.0738
02.8.2005	1.13	0	0.0238	0.4675	0.1128
14.9.2005	4.34	0.003	0.0196	0.4808	0.0495
04.10.2005	3.54	0.0674	0.0126	0.0569	0.3155
17.11.2005	14.02	0.043	0.019	0.5525	0.1524
06.12.2005	1.66	0.143	0.01	0.533	0.0846

Source: Ministry of Environment and Water, Bulgaria.

Trends

The water quality is "suitable for irrigation and water supply for other users". In recent years, the quality of the Nestos has improved as a result of reduced industrial activity in Bulgaria.

Global climate change has affected the basin over the last 20 years, resulting in an approximately 30% decrease in precipitation and a subsequent decrease in water resources.

Besides the 1964 and 1971 agreements between Bulgaria and Greece, already mentioned in the assessment of the status of the Struma River, an agreement was concluded between Bulgaria and Greece on 22 December 1995, dealing, inter alia, with the exchange of information on water quality and quantity and any development plans that would affect the natural flow of the river. By virtue of this agreement, a Joint Commission has been established.

MARITZA RIVER BASIN[25]

Bulgaria, Greece and Turkey share the basin of the Maritza River, which is also known as Meriç and Evros.

Basin of the Maritza River			
Area	**Country**	**Country's share**	
52,600 km²	Bulgaria	34,067 km²	65%
	Greece	3,685 km²	7%
	Turkey	14,850 km²	28%

Source: Ministry for the Environment, Physical Planning and Public Works/Central Water Agency, Greece.

MARITZA RIVER

Hydrology

The river has its source in the Rila Mountain (Bulgaria) and flows into in the Aegean Sea (Greece). Major transboundary tributaries include the rivers Arda/Ardas (Bulgaria, Greece and Turkey), Tundja (Bulgaria and Turkey) and Erithropotamos (Bulgaria and Greece). The river Ergene is an important tributary, which is located in Turkey.

The total number of man-made and natural water bodies in the Bulgarian part of the basin has been as high as 722. Hydropower production is common in the upper part of the basin, and a cascade of dams with hydropower generators forms big reservoirs. In Greece, dams for irrigation purposes include those on the rivers Arda/Ardas, Lyra, Provatonas, Ardanio and Komara (the last being under construction).

Discharge characteristics of the Maritza River (Monitoring site: Maritza River, close to the border with Greece)		
Discharge characteristics	**Discharge**	**Period of time or date**
Q_{av}	107.92 m³/s	1961–1998
Q_{max}	204.81 m³/s	1961–1998
Q_{min}	43.05 m³/s	1961–1998
Mean monthly values		
October: 54.84 m³/s	November: 69.01 m³/s	December: 96.61 m³/s
January: 99.76 m³/s	February: 140.66 m³/s	March: 163.11 m³/s
April: 186.99 m³/s	May: 184.89 m³/s	June: 127.38 m³/s
July: 74.17 m³/s	August: 54.73 m³/s	September: 46.72 m³/s

Source: Ministry of Environment and Water, Bulgaria.

[25] Based on information submitted by the Ministry of Environment and Water, Bulgaria, and the Ministry for the Environment, Physical Planning and Public Works/Central Water Agency, Greece and the Ministry of Foreign Affairs of Turkey.

Discharge characteristics of the Maritza River (Monitoring site: Evros-Pythio, Greece)		
Discharge characteristics	**Discharge**	**Period of time or date**
Q_{av}	383 m^3/s	1951–1956
Q_{max}	921 m^3/s	1951–1956
Q_{min}	234 m^3/s	…

Source: Ministry for the Environment, Physical Planning and Public Works/Central Water Agency, Greece.

The climatic and geographical characteristics of the Maritza basin lead to specific run-off conditions. Floods may cause severe damage in Bulgaria and downstream Greece and Turkey; among the most disastrous were the floods in 2005 (recurrence interval, 1,000 years) and in 2006.

As the downstream countries, Turkey and Greece, are highly vulnerable to floods, it is evident that measures for flood prevention can only be improved and their effects be mitigate through cooperation and use of common information sources.

The operation of the dams should also be carried out in a coordinated manner among the riparian countries as better dam operation techniques and rules can considerably mitigate floods. The dams should be operated in accordance with correct precipitation data and the conditions in the downstream countries. The establishment of "Flood Early Warning System" is essential.

Pressure factors and transboundary impact

According to Greek assessments for the entire basin, the main pressure stems from farming and irrigated agriculture. Industrial facilities have grown over the last decade. Sewerage and waste management (controlled and un-controlled dump sites) have a significant impact.

Population data for the Maritza River basin		
Bulgaria *	1,613,241 (year 2003)	77 persons/km^2
Turkey **	98,7216	67 persons/km^2
Greece **	133,048 (year 1991)	36 persons/km^2

Sources: (*) Ministry of Environment and Water, Bulgaria. (**) Ministry for the Environment, Physical Planning and Public Works/Central Water Agency, Greece.

The assessment of pressure factors by Bulgaria is in line with this overall statement.

Crop and animal (mainly pigs, but also ducks, sheep and cows) production in Bulgaria is located in the lowland part of the Maritza. By magnitude, diffuse sources are the second biggest pressure factor in the Bulgarian part of the basin; 74% of diffuse pollution comes from agriculture. There is a need for restoration of the existing irrigation infrastructure.

There are also mining activities in the mountainous Bulgarian part of the basin. Essentially, they have only local impacts, with pollution by heavy metals. There are 11 tailing ponds for mining waste in the area. The largest open cast mining for coal in the country is also located in the basin.

Main industrial activities in Bulgaria include food production and production of non-ferrous metals and chemicals. Thermal power plants use the coal produced in the basin. There are 38 waste sites in the Bulgarian part; however, information on the percentage of the population with organized waste management is not yet known.

The sewerage system services 78% of the Bulgarian population in the basin and wastewater treatment plants treat 62% of urban wastewaters.

Trends

According to Greek assessments, the water in the basin is "appropriate for irrigation" and "appropriate for other supply after treatment".

Although the status of waters is "generally good", a number of water pollution control measures are foreseen by the riparian countries. There is also a need for an early warning system for floods as well as accidental pollution (see also the assessments of the tributaries below).

Global climate change has affected the basin over the last 20 years, resulting in approximately 30% decrease in precipitation and a subsequent decrease in water resources.

As far as Greece and Bulgaria are concerned, an agreement between the two countries dealing with the mutual utilization and management of the shared water resource was concluded in 1964. According to this bilateral agreement, both countries are bound, inter alia, not to cause significant damage to each other, arising from the construction and operation of projects and installations on the transboundary river and to exchange hydrological and technical data. In 1971, an agreement was signed between the two countries for the establishment of a Greek-Bulgarian Committee, dealing with electrical energy issues and with the use of waters of the transboundary river. This Committee has been assigned to follow up the proper application of the 1964 agreement.

As far as Greece and Turkey are concerned, mention should be made of the 1934 bilateral agreement pertaining to the regulation of hydraulic facilities on both banks/shores of Evros/Meriç river. This agreement provides, inter alia, the conditions for constructing dikes and other hydraulic facilities

The establishment of a cooperation mechanism in the Maritza River basin, besides the existing bilateral frameworks, involving all three riparian countries, should be considered.

Currently, there is an on-going cooperation process to prevent and limit floods and their damaging effects in the Maritza basin. In addition, a coordination committee including the experts of three riparian countries should be established.

ARDA RIVER

Bulgaria, Greece and Turkey share the sub-basin of the river Arda (5,201 km^2 in Bulgaria), also known as Ardas.

The Arda has its source in Rodopi Mountains (Bulgaria) and discharges into the Maritza river. The sub-basin has a pronounced mountain character.

Floods cause severe local and transboundary damage; among the most disastrous floods was the 2005 flood event, caused by intensive rainfalls in the upper part of the sub-basin.

Discharge characteristics of the Arda/Ardas River at the boundary gauging station in Bulgaria		
Discharge characteristics	**Discharge**	**Period of time or date**
Q_{av}	72.63 m^3/s	1961-1998
Q_{max}	148.63 m^3/s	1961-1998
Q_{min}	27.61 m^3/s	1961-1998
Mean monthly values		
October: 23.03 m^3/s	November: 60.34 m^3/s	December: 129.21 m^3/s
January: 114.72 m^3/s	February: 154.94 m^3/s	March: 126.03 m^3/s
April: 100.41 m^3/s	May: 71.91m^3/s	June: 47.37 m^3/s
July: 22.51 m^3/s	August: 11.50 m^3/s	September: 10.95 m^3/s

Source: Ministry of Environment and Water, Bulgaria.

According to Bulgarian statistics for the years 2000, 2005 and 2006, respectively, forests cover 59% of the Bulgarian part of the sub-basin, cropland 16.8% and grassland 10%. Almost 45% of the Bulgarian part of the sub-basin is a protected area.

Dams are common for the Arda sub-basin; 100 are located in Bulgarian territory. The largest serve multiple purposes: energy production, irrigation, industrial water supply and drinking-water supply.

The population density for the Bulgarian part of the sub-basin is 51 persons/km^2 (total number in 2003: 262,736 inhabitants).

Animal husbandry (cattle, cows and sheep) is a typical activity in the Bulgarian part of the sub-basin. Pollution from agricultural production is insignificant.

Mining activities cause local impact due to heavy metals in the discharges from mines. There are also five tailing ponds containing mining waste, which are a potential source of pollution. Main industrial activities in the area include food production and production of non-ferrous metals and chemicals. At times industrial accidents have occurred due to technological problems, but they have had only local effects. There are nine waste disposal sites in the Bulgarian part; however, information on the percentage of the population with organized waste management is not yet known.

A sewerage system connecting 49% of the population was built, but the wastewater treatment plants are still under construction.

TUNDJA RIVER

Bulgaria and Turkey share the Tundja sub-basin (7,884 km^2 in Bulgaria). The river has its source in the Stara Planina Mountain (Bulgaria) and flows into the Maritza River.

Discharge characteristics of the Tundja River at the boundary gauging station (Bulgaria)		
Discharge characteristics	**Discharge**	**Period of time or date**
Q_{av}	32.09 m^3/s	1961-1998
Q_{max}	69.36 m^3/s	1961-1998
Q_{min}	18.81 m^3/s	1961-1998
Mean monthly values		
October: 12.93 m^3/s	November: 21.89 m^3/s	December: 32.82 m^3/s
January: 38.40 m^3/s	February: 57.87 m^3/s	March: 61.70 m^3/s
April: 53.23 m^3/s	May: 46.85 m^3/s	June: 28.09 m^3/s
July: 12.94 m^3/s	August: 10.29 m^3/s	September: 9.94 m^3/s

Source: Ministry of Environment and Water, Bulgaria.

Dams are common in Tundja sub-basin: there are 264 located in Bulgarian part. The larger dams/reservoirs serve multi-purpose functions, providing energy production, irrigation, industrial water supply and drinking-water supply.

Floods may cause severe local and transboundary damage; among the most disastrous was the 2005 flood, caused by intensive rainfall in the upper part of the sub-basin.

The population density in the Bulgarian part of the sub-basin is 62 persons/km^2. In 2003, the total number of the population was 488,296 inhabitants.

According to Bulgarian statistics for 2000, 2005 and 2006, respectively, forests cover 30% of the Bulgarian part of the sub-basin, cropland 36% and grassland 5%.

In the lowland area of the Tundja, Bulgaria is growing crops and there is animal husbandry (mainly pigs, but also sheep and cows). Almost 26% of the Bulgarian part of the sub-basin is a protected area.

Among pollution sources, wastewater discharge from municipalities and industry ranks in first place, followed by diffuse pollution, with 78% of diffuse pollution coming from agriculture. The sewerage system currently serves 74% of the population in the Bulgarian part of the sub-basin. Wastewater treatment plants treat 54% of the urban wastewaters.

There are 11 waste disposal sites in the Bulgarian part; however, information on the percentage of the population with organized waste management is not yet known. Sometimes industrial accidents occur due to technological problems, but they have only local effects.