



Danube Facts and Figures

MONTENEGRO

(March 2010)

General Overview

Montenegro, literally meaning the "black mountain", is a small upland country of 13,812 km² with a population of 620,145 (2003 census). Rising from sea level to 2582 m, it has a diverse landscape including some of the most rugged terrain in Europe. In terms of geography, the country is famous for its dramatic gorges, fast-flowing rivers, karst scenery, numerous lakes and coastline.

52.5% of Montenegrin territory lies within the Danube Catchment. Notable Danube rivers are the Tara, Piva, Lim and Ćehotina (which flow to the Danube via the Drina and Sava) and the Ibar, a tributary of the Zapadna Morava. Their tributaries include the Komarnica, Bukovica, Bijela and Šavnik rivers, which flow into the Piva, and the Lješnica and Ljuboviđa rivers which flow into the Lim.

Montenegro shares a border with Croatia (in the west), Bosnia and Herzegovina (to the north-west), Serbia (to the north-east) and Albania (to the south-east) and has 294 km of coastline along the Adriatic Sea. The Convention on Cooperation for the Protection and Sustainable Use of the Danube River came into force in Montenegro in October 2008.

Topography

The majority of Montenegro's relief is mountainous, with a landscape governed by sedimentary, tectonic and erosion processes. Geomorphologically, it is extremely interesting: large areas of karst erosion have resulted in remarkable underground features and the mountain ranges are among the most ice-eroded sections of the Balkan Peninsula (concerning the last glacial period). The terrain is diverse: high mountain ranges in the north, large karst areas in central and western parts and areas of flat land and coast to the south. 70% of the land is located between 500 m and 1500 m a.s.l., with a mean elevation of 1050 m.

The upland areas are characterised by significant variations in elevation, with deep gorges (the deepest being 1300 m: the Tara River Canyon) and high mountain peaks. The mountainous zone averages above 2000 m, with the highest peak being Bobotov Kuk (2582 m) located in the Durmitor Mountains, part of the Dinaric range situated in the north. Also notable is Zla Kolata (rising to 2534 m) in Prokletije, on the border with Albania in the south-east.

The karst areas in the centre and west of the country are generally around 900 m a.s.l., rising to 1800 m. The lowest part of this region occurs in the Zeta River Valley, located in a long, flat karstic basin.

Areas of low altitude, situated below 200 m, cover less than 10% of the country and are concentrated in the south and south-east: the narrow Adriatic coastal zone, the flat plains of Ćemovsko and Crmnicko and the valleys of Zeta to Danilovgrad (including Podgorica, the capital city). The Zeta River Valley (or Bjelopavlići Plain) is the most significant area of flat land in the country and merges with the Zeta Plain, located north of Lake Skadar (also known as Skadarsko Jezero (in Montenegrin) and Lake Scutari). The lake is the largest in the Balkans at 391 km². Near to the coast and extending into northern Albania, it occupies a karstic polje depression situated below sea level.

Precipitation, climate and water flow

Montenegro's climate is diverse with continental, maritime and orographic influences determining the climate to varying degrees in different regions. Adding further complexity is the presence of large water areas (in addition to the Adriatic Sea) such as Lake Skadar; a deeply indented coastline (at the Bay of Kotor) and the location of mountain areas close to the coast (Orjen, Lovćen and Rumija Mountains; the Ulcinj Plain and Durmitor, Bjelasica and Prokletije ranges).

A Mediterranean climate exists in southern areas and the Zetsko-Bjelopavlićka Valley (long, hot, dry summers and relatively mild and rainy winters), with the warmest summers occurring in the Zeta Plain. Large karst valleys located 40-80 km from the Adriatic have a more severe climate, with colder winters and warmer summers. This is also true of the karst areas located closer to the Adriatic but separated by relatively high mountains: in winter, cold mountain air descends into the valleys; in the summer these areas experience higher temperatures. Central and northern Montenegro has certain characteristics of a mountain climate but with a moderating influence from the Mediterranean. This is reflected in higher precipitation levels. In the very north of the country, the climate is continental, with large daily and annual temperature variations and small annual precipitation levels, which are equitably distributed through the year. In the mountainous areas in the north, summers are relatively cold and humid and winters long and severe with frequent frosts and low temperatures.

Regarding precipitation, the mountainous area north of Kotor Bay is considered to be the rainiest area of Europe, with annual precipitation levels of 4600 mm. Levels on the steep slopes of the Orjen in Crkvice (940m) reach 5000 mm/annum and in peak years almost 7000 mm/annum. Besides orographic rainfall, Montenegro's climate is significantly affected by *Genoa Lows*, cyclonic systems which form south of the Alps and bring intense rainfall, lasting just a few days. Longer periods of rainfall are the result of strong high-altitude south-westerly air-flow associated with the passage of depressions across Western Europe. Where the precipitation regime is affected by Mediterranean influences, areas tend to experience autumn and winter precipitation (with highest levels in late autumn) and dry summers. For example, in south-western Montenegro, only 10% of annual quantities are recorded in the summer.

The north-easterly katabatic wind, the Bora, and the southerly Sirocco both affect Montenegro. The cold, strong Bora is most frequent and strongest in the colder half of the year, affecting the eastern coast of the Adriatic and causing a decrease in temperature and humidity. The Sirocco generally brings dry, warm air from North Africa, which contains significant quantities of dust. On reaching the mountain barrier, it results in cloud and rain – contributing significantly to the high rainfall levels in Crkvice.

Concerning long-term climate variations, studies of the second half of the 20th century indicate the last decade was the warmest, with a peak in 2003.

Roughly half of Montenegro belongs to the Black Sea catchment (52.5% or 7251 km²) and half to the Adriatic (47.5% or 6561 km²) in a north-south divide. Rivers flowing to the Adriatic include the Bojana and its tributary the Morača (fed by the Zeta, Sitnica, Ribnica, Cijevna, Orahovštica and Rijeka Crnojevića) and several torrent rivers. Much of the drainage of the karstic region is underground.

Montenegro experiences high river discharge levels, with an average total of 40 l/s/km² (c. 19.5 km³/year) and, as such, is in the top 4% of the world's territory in terms of average outflow. Given that 95% of Montenegrin watercourses are formed within the country (i.e. both the sources and a major part of the drainage basins occur within national boundaries), it could be said that water is Montenegro's biggest natural resource.

Land use and settlements

36% (4972 km²) of the land area is under agriculture; 47% (6492 km²) woodland and 17% (2348 km²) is classified as settlements, roads and other categories. (NB a small part of the territory is recorded as both woodland and agricultural land). Of the 1240 settlements in the 21 municipalities of Montenegro, 40 are urban, home to 62% of the population.

Population density varies considerably from region to region. Average population density is 26.6 inhabitants per km² but densities are considerably higher in the central and southern regions (56.8 inhabitants per km² and 91.8 inhabitants per km² respectively). The Zeta River Valley and Zeta Plain, located north of Lake Skadar, are the most densely populated areas of Montenegro, and include two of its largest cities, Podgorica and Nikšić.

Natural highlights

Montenegro has designated five national parks (covering 7% of the country), which contain outstanding natural, landscape and cultural features, many of international importance (internationally designated sites cover 17% of Montenegro).

Biogradska Gora National Park, covering 54 km², comprises virgin forest and glacial lakes with stunning mountain scenery and is of considerable geomorphological interest.

Durmitor National Park and UNESCO World Heritage Site, 390 km² in area, includes the spectacular scenery of the Tara river canyon, with its deep gorges, dense pine forest, underground streams, stunning lakes and rich endemic flora. *The Tara River Basin* is also a UNESCO Biosphere Reserve.

Lovćen National Park, covering 64 km², comprises the twin-peaked Mount Lovćen, famous for its rocky slopes, fissures and deep depressions. Its rich biodiversity (1158 plant species recorded) is a feature of its location, situated on the interface of the Adriatic and the mainland.

Lake Skadar National Park and Ramsar site) at 391 km² is the largest natural freshwater lake in the Balkans, supporting a verdant wetland vegetation, woodlands, sub-Mediterranean communities and diverse flora and fauna. It is a vital nesting, staging and wintering spot for globally threatened water birds.

Prokletije National Park is part of the Prokletije Mountains, a 70 km range which spans part of northern Albania, north-western Kosovo and eastern Montenegro. The latter covers approximately 250 km², extending from Skadar to Bogicevica on the border with Kosovo, with its highest peak being Zla Kolata (2534 m).

Human uses of water resources

Montenegro has an abundance of high quality underground and surface waters.

▪ Flood and high discharge management

Floodwater potentially threatens 24,500 ha of farmland and urban areas in the country. This is particularly pronounced in areas surrounding Lake Skadar and the Bojana River, Zeta Valley, Bjelopavlici, Plav ravine and areas around the Lim, Tara and Cehotina river valleys. Most of the existing land reclamation systems are currently not operational. In Kotor, pavements are situated at 96cm a.s.l. and yet spring high tides can reach 130cm, resulting in the flooding of parts of the city during periods of heavy rainfall and southerly winds. Central and northern parts of the country (specifically the upper Tara and Lim regions) were hit by large floods during the last century (e.g. 1963 and 1979 and again in 1999 and 2000).

The need for flood protection measures is particularly apparent in those areas near the larger rivers (the Morača, Lim, Tara, Cehotina, Ibar and Bojana) and the large flat karst plain areas (e.g. Barsko, Cetinjsko and the groves of the Matica valley). Work completed to date on river regulation and flood protection is modest, mainly of local importance and not adequate in size and functionality. All Montenegro's rivers are of torrential character in at least their upper course and measures taken

to regulate these stretches are mainly of a technical nature; biological and erosion protection measures have rarely been used.

▪ Use of hydroelectric power and water for cooling purposes

Hydropower is Montenegro's most important energy resource and the country is ranked high in terms of availability of hydropower resources. However, environmental protection requirements and seismic risks reduce the potential use and, at present, only 17% of the potential is being utilised. Theoretically, the hydropower potential of the country's main rivers is around 9846 GW h/year. Total technically available power at present (which can be, or already has been, realised) is 5219–6202 GW h (includes plants outside the country). Increasing hydropower use requires careful handling and should be viewed as only one element in a mixed energy supply scenario. Energy supply is no longer just an issue of exploitation, transformation and utilisation, but also involves consideration of the interdependence of the *triple E's*: Energy, Ecology and Economy.

Existing hydropower plants include: two large plants on the Zeta and Piva rivers (the *Perucica* and *Piva* plants) and seven small plants: *Glava Zete* and *Slap Zete* on the Zeta River; *Rijeka Mušovica*, *Kolašin*, *Šavnik*, *Lijeva Rijeka* and *Podgor* on the Orahovštica River; and *Rijeka Crnojevića* at Obodsko vrelo). These generate a total annual production of 1665 GW h (average annual generation during the period 1976-2004). The potential technically usable hydropower from the tributaries has been calculated at 599 GW h/year (considering the development of small hydropower plants) and estimates suggest that for tributaries not yet investigated, a further 358 GW h/year would be likely.

Regarding the use of water in industry, mining and thermo-energy facilities, 60-142 million m³ of water was used per year (based on the years 1978 to 1993 when production was at its most intense) and average intake was approx. 97 million m³ (3.1 m³/s). Industrial water consumption from the public water system in the given period was on average approx. 9.5 million m³/year, the rest being supplied from their own resources (including water recycling). Due to economic sanctions and the reduced operation of many industries, total water use has reduced significantly in recent years: in 1996, total industrial water use was approx. 55 million m³/year.

Pressures and impacts on rivers

▪ Pollution

Prevailing pollutants are mainly the result of wastewater from point sources – settlements and industry. The water quality of rivers, lakes, sea and groundwater is considered satisfactory. The quality of groundwater in natural conditions is classified as class I for the majority of the year (with the exception of coastal aquifers influenced by the sea). On the mainland, the quality of waters in aquifers of inter-granular structure is jeopardized at only a few locations, downstream from large settlements and industry.

For a long period, this sector has been characterised by a lack of investment. Taking into account, on the one hand, the limitations of capacities available to local government units and the amount of investments needed, and, on the other hand, the necessity to preserve the environment and decrease the risk to public health, the Montenegrin Government has developed (with the support of the European Agency for Reconstruction) two significant planning documents in the field of wastewater management: *The Master Plan for Wastewater Collection and Treatment for the Coastal Region and Municipality of Cetinje* and *The Strategic Master Plan for Sewage and Wastewaters of the Central and Northern Region*.

Useful web links

Directorate for Water: www.upravazavode.gov.me

Ministry of Agriculture, Forestry and Water Management: www.minpolj.gov.me

Ministry of Tourism and Environmental Protection: www.mte.gov.me

Ministry for Spatial Planning and Environment: www.mse.gov.me

Morsko Dobro (Coastal Zone Management Agency): www.morskodobro.com

Hydrological and Meteorological Service of Montenegro: www.meteo.co.me

National Parks of Montenegro: www.nparkovi.co.me