This section describes the boundaries and the main physical and socio-economic characteristics of the region in order to define the area considered in the regional GIWA Assessment and to provide sufficient background information to establish the context within which the assessment was conducted.

**Boundaries of the Barents Sea region**

The boundaries of GIWA region 11 follow the traditional geographic boundaries of the Barents Sea and stretches from north to south between the latitudes 82° N and 59° N and from east to west between the longitudes 68° E and 15° E (Figure 1). To ensure the comparison of the Assessment results with other UNEP/GIWA regions, the Barents Sea region was considered as a single system of international waters.

The following systems of the Barents Sea drainage basin were considered in the Assessment:

- The Kola River and the Kola Bay;
- The White Sea and the Severnaya Dvina River;
- The Pechora River and the Pechenga River;
- The Barents Sea.

**Physical characteristics**

The Barents Sea region is situated in the extreme northeast of Europe (Figure 1). Its open water area is approximately 1.5 million km² (Barents Sea: 1 424 000 km², White Sea: 90 000 km²) and the catchment area is 1 386 000 km². The White Sea covers approximately 6% of the total open water area and comprises only 2% of the total volume of marine water, but it receives more than half of the river run-off in the region which is of great ecological importance.

The drainage basin lies almost entirely within the boundaries of Russia. In the extreme southwest of the Barents Sea, a small part of the basin belongs to Norway and Finland. However, these territories are sparsely populated and do not impose any considerable ecological burdens on...
the basin. The White Sea is a semi-enclosed (domestic) sea of Russia. The Barents Sea shelf belongs to Russia and Norway (its National delimitation is presently under discussion).

The Barents and the White Seas are entirely located on the Arctic shelf and thus, the geological structure of the continental and marine parts of the basin is considered as a single unit. The Kola Peninsula and Karelia lie completely within the limits of the Baltic crystalline shield, where bedrocks of Proterozoic and Archean ages predominate at the surface. The remaining terrestrial part of the basin, as well as the marine areas of the Barents and White Seas, lie within the limits of the Russian platform (Richter 1966). The modern terrestrial topography and the marine relief were formed during the Quaternary period under the influence of the continental and shelf glaciation.

The Barents and White Sea shelf is rather deep. In the Barents Sea more than 50% of the area have depths of 200-500 m. The average depth is approximately 200 m and the maximum depth in the Norwegian trench reaches 513 m and in the Franz Josef Land straits it exceeds 600 m. In the White Sea, a considerable part of the shelf consists of shallow bays with an average depth of only 67 m and a maximum of 350 m.

Generally, the terrestrial basin relief is formed by plains and low highlands (up to 450 m), fringed in the east by the meridian Ural Range and its continuation towards the north; the Novaya Zemlya mountains. In the west the Scandinavian mountains and low mountain massifs of the Kola Peninsula (up to 1 200 m) edge the basin, whereas in the southwest and south, the basin is limited by a low watershed.

**Climate**

The main climate-forming factors are latitudinal changes in the incidence of solar radiation and the influence of the warm Atlantic water masses, entering the Barents Sea in the west. In the terrestrial part of the region the climate is transitional from marine to continental, with the continental influence increasing with distance from the coast. The climatic impacts of increasing continental influence are decrease in cyclonic activity, increased range of air temperature, and decrease in number of cloudy days and days with precipitation (Terziev et al. 1990).

The main feature of the winter air temperature distribution (Figure 2) is the so-called warmth pole in the ice-free southwestern Barents Sea, where the average January sea temperature is close to 0°C. In the eastern part of the region, the severity of the winter regime both on land and in the southeastern Barents Sea increases sharply. The absolute air temperature minimum in the Barents Sea region reach 20°C below zero over the ice-free area of the Sea and 30°C below zero in the north and southeastern part. On land, in remote areas far from the Sea, air temperatures reach 50°C below zero.

Summer temperature distribution depends first of all on the solar radiation (Figure 3). Temperature maximum, close to 35°C, are attained in all parts of the land area, including the coastal zone. Corresponding values, calculated for offshore areas, vary from 30°C over the coastal water mass to 24°C at the boundary of Atlantic and Arctic water masses (74° N) (Matishov et al. 1998).

The total annual precipitation decreases northwards within the boundaries of the catchment area from 600 mm in the upper reaches of the Severnaya Dvina to 400 mm at the coast. At the same time, the humidity does not vary much, as evaporation decreases almost in the same proportion (from 250 to 100 mm per year). Over the Barents Sea, the total annual precipitation increases in the ice-free southwestern
transboundary. Among these rivers only the Pasvik River is transboundary. (Source: Richter 1966)

### Table 1  Characteristics of the largest rivers in the Barents Sea region.

<table>
<thead>
<tr>
<th>River</th>
<th>Location</th>
<th>Length (km)</th>
<th>Catchment area (km²)</th>
<th>Discharge (m³/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuloma</td>
<td>Barents Sea</td>
<td>64</td>
<td>22 800</td>
<td>200</td>
</tr>
<tr>
<td>Kola</td>
<td>Barents Sea</td>
<td>83</td>
<td>3 800</td>
<td>40</td>
</tr>
<tr>
<td>Voronya</td>
<td>Barents Sea</td>
<td>155</td>
<td>9 800</td>
<td>110</td>
</tr>
<tr>
<td>Iokan’ga</td>
<td>Barents Sea</td>
<td>197</td>
<td>6 020</td>
<td>60</td>
</tr>
<tr>
<td>Pomei</td>
<td>White Sea</td>
<td>410</td>
<td>15 200</td>
<td>140</td>
</tr>
<tr>
<td>Kem’</td>
<td>White Sea</td>
<td>200</td>
<td>28 000</td>
<td>270</td>
</tr>
<tr>
<td>Vyg (Belomorsko-Baltiysky canal)</td>
<td>White Sea</td>
<td>308</td>
<td>29 500</td>
<td>260</td>
</tr>
<tr>
<td>Omega</td>
<td>White Sea</td>
<td>416</td>
<td>57 600</td>
<td>575</td>
</tr>
<tr>
<td>Severnaya Divina (from the Sukhona entering the Vychegda)</td>
<td>White Sea</td>
<td>730</td>
<td>360 000</td>
<td>1 500</td>
</tr>
<tr>
<td>Mezen’</td>
<td>White Sea</td>
<td>910</td>
<td>76 500</td>
<td>840</td>
</tr>
<tr>
<td>Pechoria</td>
<td>Barents Sea</td>
<td>1 790</td>
<td>327 000</td>
<td>4 100</td>
</tr>
<tr>
<td>Pechenga</td>
<td>Barents Sea</td>
<td>–100</td>
<td>1 820</td>
<td>22.2</td>
</tr>
<tr>
<td>Pasvik</td>
<td>Barents Sea</td>
<td>143</td>
<td>18 340</td>
<td>201</td>
</tr>
</tbody>
</table>

Note: Among these rivers only the Pasvik River is transboundary. (Source: Richter 1966)

The main source for the rivers is melting waters that comprise 50-55% of the run-off. Strong increases in river flow during the period of snow melt, low run-off during summer and winter, and variable autumn floods, determined by high precipitation levels and decreased evaporation, are typical for the majority of rivers. The rivers of the Kola Peninsula and Karelia are characterised by a more even run-off throughout the year.

### Hydrological characteristics

The volume of the Barents Sea is, according to the most recent assessments, 282 000 km³ and that of the White Sea 6 000 km³. The Barents Sea is marginal; its water exchange with the Norwegian Sea and the Arctic basin is free and is part of a circulation involving the waters of the North Atlantic and the Arctic Ocean. The length of the cycle of Barents Sea water renewal is about 6 years (Terziev et al. 1990). For the White Sea water balance, the determining factor is river run-off, which is approximately 230 km³/year or 4% of the volume (Glukhovsky 1991).

The seasonal ice-cover, which is characterised by considerable inter- and intra-annual variability, is formed in the Barents and White Seas. The White Sea is covered by drift ice in November-December, followed by 5-6 winter months when the ice cover is close to 100%. In the Barents Sea, the ice conditions contrast between practically no ice at all in the southwestern part, to ice appearing also in the summer (under certain synoptic conditions), in the northern part. Processes of summer heating and autumn-winter convection determine the changes in water temperatures in both the Barents and the White Seas during the year.
Salinity in the Barents Sea is close to oceanic salinity (approximately 35‰ in the open areas and 34.5‰ in coastal waters). In the White Sea, as a result of intensive mixture of river and marine waters, it decreases to 25-26‰ in summer and 26-27‰ in winter (Matishov et al. 1998, Glukhovsky 1991).

**Marine biodiversity**

The composition and migratory habits of living organisms in the Barents Sea are determined by the contrast of the environmental conditions between the Atlantic and the local water masses (Matishov 1986a).

**Benthos**

All types of invertebrates, apart from chaetognaths, which are planktonic organisms, are represented in the Barents and White Seas benthos. At present, no less than 3 245 zoobenthos species have been identified (Sirenko 2001). The majority of species belongs to widely distributed Arctic boreal and Arctic high-boreal biogeographic groups. The taxonomic groups with highest species numbers are Polychaeta, Hydroidea, Mollusca, Crustacea and Bryozoa. Many of the White and Barents Seas invertebrates are commercially exploited e.g. Icelandic scallop (Chlamys islandica) and Common mussels (Mytilus edulis), or are potentially subject to exploitation e.g. the Northern sea urchin (Strongylocentrotus droebachiensis) and the sea cucumber Cucumaria frondosa. At present, there is a commercial fishery for the Red king crab (Paralithodes camtschatica) which was introduced in the 1960s and has since increased in abundance. This fishery is now under discussion (Kuzmin & Gudimova 2002).

**Plankton**

The list of Barents Sea phytoplankton includes at present more than 310 reliably distinguished species belonging to the Bacillorophyta, Dinophyta, Chrysophyta, Chlorophyta, Haptophyta, Prasinophyta, Euglenophyta and Cryptophyta. According to the phytogeographic characteristics, approximately 40% of the Barents Sea phytoplankton species can be characterised as Arctic species, more than 20% as boreal species and the rest as cosmopolitan or with an undesignated geographic distribution (Matishov et al. 2000).

A total of 145 marine species and varieties of phytoplankton are recorded for the White Sea (Semenia & Sergeeva 1983). There are fewer diatom species than in the Barents Sea but the number of dinoflagellates species is higher in the White Sea (Makarevich et al. 1991). In the Barents Sea pelagic fauna, more than 200 zooplankton species are represented. The most commonly observed and the most numerous are representatives of the crustacean class, including copepods (Copepoda). By its zoogeographic characteristic, the Barents Sea zooplankton consists of boreal, arctic, and transitional species (Matishov et al. 2000).

**Phytobenthos**

Algal macrophytes are an important source of raw materials for food and pharmaceutical industries. Fucoids (Ascophyllum nodosum, Fucus distichus, F. serratus, F. vesiculosus) and blade kelps (Laminaria saccharina, L. digitata) belong to the commercial algae of the Barents and White Seas. At present, the stocks of commercial algae in the investigated areas of the Barents Sea are estimated to 350 000-450 000 tonnes. Most of them are concentrated on the Murman coast (Matishov 1998).

**Ichthyooplankton**

The Atlantic waters, dominating in the west of the Barents Sea, are noted for high productivity and high diversity of commercial fish species (cod, haddock, Atlantic herring, catfish, plaice, halibut etc.). More simple food links are typical of the eastern and northern areas of the Sea where huge concentrations of Arctic cod and capelin, forming the feeding base for the Gadidae family, are recorded (Matishov & Denisov 2000). The most important commercial resource of the freshwater basin is the salmon, which enters the rivers of the Kola Peninsula, the Mezen River, the Pechora River and small rivers of the southeastern Barents Sea and the Norwegian coast.

**Birds and mammals**

Marine birds and mammals are top consumers in marine ecosystems. Many species are rare and endangered. There are 24 marine bird species in the Barents Sea (Krasnov et al. 1995). The marine ornithofauna in the southern part of the Barents Sea mainly consists of gulls; Herring gull (Larus argentatus) and Great black-backed gull (Larus marinus). In the northern Barents Sea Glaucous gull (Larus hyperboreus) and Fulmars (Fulmarus glacialis) dominate. The largest bird colonies of the Barents Sea are located along the western coast of Novaya Zemlya and along the coast of Murman. The most abundant species at these sites are Brunnich’s guillemot (Uria lomvia) and Kittiwake (Rissa tridactyla) (Anker-Nilssen et al. 2000).

Marine mammals, such as polar bears and different whales and pinnipeds, inhabit the Barents Sea region either seasonally or constantly. The majority of the Barents Sea pinnipeds and whales are representatives of rare or protected species included in the Red Books of the IUCN, USSR and RSFSR.

In total, there are 12 whale species in the Barents Sea (Matishov 1999). Among them five can be considered as regular inhabitants: the Arctic right whale (Balaena mysticetus), the Narwhal (Monodon monoceros), the
White whale (*Delphinapterus leucas*), the Bagridae family (e.g. *Orcinus orca*) and the Little piked whale (*Balaenoptera acutorostrata*). The most abundant species of the Barents and White Seas are white whales and little piked whales, which are the traditional commercial species.

The area of Murman and the Western Arctic is inhabited by seven species of pinnipeds. One of the most numerous species is the Harp seal (*Pagophilus groenlandica*), which is closely associated with cold waters and is of great economic importance in Russia (Isaksen & Wiig 1995).

The Polar bear (*Thalassarctos Ursus maritimus*) is a rare species, until recently listed as an endangered species in the Red Books of the IUCN, USSR, and RSFSR. Its distribution is related to the islands of Frantz Josef Land, Novaya Zemlya, and Svalbard.

**Terrestrial ecosystems**

Figure 4 shows the landcover in the terrestrial part of the region. More than two thirds of the territory of the basin are under taiga forests (needleleaf forest and broadleaf forest), where coniferous species are dominant. The western part of the region is dominated by Norway spruce, pine, and European larch and in the eastern part Siberian spruce, fir, cedar, and Siberian larch predominate.

The composition of the terrestrial fauna corresponds to two main landscape zones, the tundra and the taiga. The most dominant mammal species of the tundra are lemming and polar fox, among birds polar owl and tundra partridge predominate together with numerous passerines. Reindeer, which in the past were wild and widespread in the tundra and taiga, now survive in the form of domesticated populations and are the basis of economic activity in the Pechora tundra, as well as in the central areas of the Kola Peninsula. Fur-bearing mammals such as Blue hare, marten, squirrel, fox, stoat, etc. as well as moose, wolves, and bears are typical of the taiga zone. Typical bird species are tits and woodpeckers. Species of commercial value are Hazel hen, Black cock, Capercaillie and White grouse. Both landscape zones are characterised by large populations of waterfowl and near-water birds, e.g. woodcocks, teals, geese, ducks and swans.

Among the freshwater fishes, the most valuable are whitefish, burbot, and trout. Perch, ruff and pike are widely spread.

**Physical and geographical sectors**

For the purpose of this report, three geographic sectors were identified: the White Sea, Pechora and Fennoscandia (the northern and northeastern slopes of the Baltic shield). The boundaries of the sectors are shown in Figure 4.

The river basins of Fennoscandia belong to both the Barents and the White Seas, but in both cases, their influence on the marine waters is comparatively slight. The river run-off does not play a significant role for the western part of the Barents Sea. The state of the aquatic environment is determined by the water exchange with the deepwater oceanic basins, transboundary transfers of contaminants in the ocean and in the atmosphere, and on the discharges of contaminants directly from the coast to the coastal waters.

The main factor influencing the ecology of the White Sea sector is the run-off from the Severnaya Dvina, Mezen and Onega rivers. In total, they transport 80% of the freshwater entering the White Sea, comparable parts of particulate and dissolved run-off and practically the entire load of chemical contaminants. The impacts of these sources on the Barents Sea can be shown only indirectly through their impact on the White Sea water mass (Berger & Dahle 2001).
In the Pechora sector, the formation of water and the chemical balance is in principle determined by the run-off of the Pechora River. Here, unlike the other two marine sectors, seasonal changes in salinity and the chemical composition of marine waters are pronounced since the volume of the river run-off is comparable to the volume of coastal marine waters. The Pechora sector also differs in the character of its anthropogenic impact and its source distribution: there are fewer large industrial centres and the agricultural activity is negligible. However, the terrestrial and marine oil and gas complexes, present in all their aspects including geological and geophysical prospecting, exploratory drilling, and hydrocarbon extraction and transportation, have been developing quickly.

**Socio-economic characteristics**

Although the Barents Sea region is constituted as one geographic system, there are two separate socio-economic regions, Norway and Russia, which are discussed separately in this section as well as further in the Causal chain analysis.

Protection of the Barents Sea environment is a common responsibility of all border countries. Changes in environmental and social conditions are highly interdependent. Environmental conditions and trends affect human health and quality of life. Social conditions and outcomes need to be reviewed when designing and implementing environmental management activities and policies.

The state of water systems in the Barents Sea region is influenced by the water catchments of:

- Four administrative regions of the Russian Federation located on the coast of the Barents and White Seas: the Murmansk Region, the Arkhangelsk Region, Karelia, and the Nenets Autonomous Region;
- The easternmost county of Norway, Finnmark, located on the westcoast of the region.

In this report, socio-economic factors that can influence the state of aquatic ecosystems with respect to GIWA concerns, such as growth of industrial and agricultural production, fisheries development, population development and social problems, have been considered.

**Population**

The population density in the four Russian regions considered for the Barents Sea region is 3.5 persons per km², which is lower than the average Russian density of 8.5 (Figure 5 and Table 2) (State Statistics Committee 2002a). This is a consequence of the population decrease, including migration from these regions during the last two decades. In Finnmark, Norway, the population size decreased slightly over the same period and was 1.52 persons per km² in 2002 (Figure 5 and Table 2). However, the population density in Finnmark has always been significantly below the Norwegian average, which was 14.0 persons per km² in 2002 (State Statistics Committee 2002a).

The urban population in the Russian part of the region is rather high (79.9% in 2001) (Table 3) (State Statistics Committee 2002a). In Finnmark, the level of urbanisation is low. The population of the four regional centers Vadsø, Hammerfest, Alta and South-Varanger is about 42,000, compared to a total population of approximately 74,000 for Finnmark as a whole. The population development in the northern regions of Russia, 1990 being the starting point, is negative (Table 4) (State Statistics Committee 2002b).

The main reason for the decrease in population is natural population loss. In the four Russian regions considered for the region the number
of deaths exceeds the number of births. Analysis of the indices of birth and death per 1,000 persons showed that the number of persons born in all the regions of the Northwest Russia, starting since 1985, decreased. The other reason for the negative population development is the number of people migrating from the regions compared to the number of people immigrating, caused by state policy. In coastal settlements, negative tendencies in demographic and migration processes manifest themselves more severely. Life expectancy at birth is the most commonly used statistical value for assessing population health. This characteristic is directly dependent on the socio-economic development of the region. While for all northern Russian regions the life expectancy has decreased, it is increasing in Finnmark County, Norway (Table 5) (State Statistics Committee 2002b).

**Economic indicators**

The average material welfare can be defined by the Gross Domestic Product (GDP) per capita. Table 6 shows that the growth of GDP was broken by the crisis of 1998. In 2000, GDP per capita was 36.2% lower than in 1997 (State Statistics Committee 2001). The highest average level of the material welfare was in 1997. However, this does not reflect the late 1990s, as it was the time when the USD was very much undervalued in Russia (up to August 1998). Then in 1999 it was substantially overvalued, and the difference was significant (Table 6). At present, the GDP has not yet reached the level of 1997.

**Table 2** Population density.

<table>
<thead>
<tr>
<th>1985 (people/km²)</th>
<th>1990 (people/km²)</th>
<th>2002 (people/km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Russia (four regions considered)</td>
<td>3.77</td>
<td>3.93</td>
</tr>
<tr>
<td>Finnmark (Norway)</td>
<td>1.55</td>
<td>1.52</td>
</tr>
</tbody>
</table>

(Source: State Statistics Committee 2002a)

**Table 3** Urban population in the Russian sector of the region.

<table>
<thead>
<tr>
<th></th>
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<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total population</td>
<td>2,486,000</td>
<td>2,463,500</td>
<td>2,549,700</td>
<td>2,495,600</td>
<td>2,417,300</td>
<td>2,336,100</td>
<td>2,267,200</td>
<td>2,225,500</td>
</tr>
<tr>
<td>Urban population</td>
<td>1,598,000</td>
<td>1,767,100</td>
<td>1,898,300</td>
<td>1,778,400</td>
<td>1,771,300</td>
<td>1,648,300</td>
<td>1,598,500</td>
<td>1,548,100</td>
</tr>
<tr>
<td>Urban population (%)</td>
<td>64.3</td>
<td>79.9</td>
<td>81.6</td>
<td>79.5</td>
<td>79.3</td>
<td>79.4</td>
<td>79.5</td>
<td>79.0</td>
</tr>
</tbody>
</table>

(Source: State Statistics Committee 2002a)

**Table 4** Changes in population in the Russian sector of the region.

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Russia (four regions considered) (per 1,000 persons)</td>
<td>4.1</td>
<td>2.2</td>
<td>-0.9</td>
<td>-4.8</td>
<td>-5.9</td>
<td>-5.7</td>
<td>-4.3</td>
<td>-3.7</td>
<td>-3.3</td>
<td>-5.6</td>
<td>-5.8</td>
</tr>
</tbody>
</table>

Note: 1990 being the starting point. (Source: State Statistics Committee 2002b)

**Table 5** Life expectancy at birth.

<table>
<thead>
<tr>
<th>1999</th>
<th>2000</th>
<th>2001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Russia (four regions considered)</td>
<td>45.1</td>
<td>64.3</td>
</tr>
<tr>
<td>Finnmark</td>
<td>72.0</td>
<td>72.3</td>
</tr>
</tbody>
</table>

(Source: State Statistics Committee 2002b)

**Table 6** Gross Domestic Product per capita in Russia and the Russian sector of the region.

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Russia (four regions considered)</td>
<td>2,288</td>
<td>2,408</td>
<td>2,546</td>
<td>2,551</td>
<td>1,760</td>
<td>1,252</td>
<td>1,627</td>
<td>ND</td>
</tr>
<tr>
<td>Russia</td>
<td>ND</td>
<td>2,116</td>
<td>2,593</td>
<td>2,654</td>
<td>1,672</td>
<td>1,134</td>
<td>1,589</td>
<td>1,904</td>
</tr>
</tbody>
</table>

The number of unemployed in 2001 increased compared to 1992: in Karelia by 157.6%, in the Arkhangelsk Region by 164.4%, and in the Murmansk Region by 208.5%.

The unemployment (the ratio of unemployed compared to the number of the economically active) during these years varied: in Karelia from 5.0% in 1992 to 16.6% in 1998 and 8.7% in 2001, in the Arkhangelsk Region from 4.9% in 1992 to 14.9% in 1999 and 8.8% in 2001, in the Murmansk Region from 5.5% in 1992 to 21.1% in 1998 and 12.8% in 2001.

The economic crisis had an impact on the fishing industry as well, to which the majority of the population was connected and which solved many social problems in the region in the past. In the end of the 1980s approximately 75 000 people were employed in the fisheries sector. During the 1990s, the fishery outside the Barents Sea was stopped and coastal fish processing reduced, which resulted in an employment decrease in the sector of 60%.

The total number of employed in Finnmark County, Norway, increased in 2001, compared to 1994, by 822 persons (2.5%). The number of employed in the fisheries sector and aquaculture was at the same time reduced by 1 069 (22.1%). The unemployment in Norway in total decreased from 5.2% in 1994 to 2.7% in 2001, in Finnmark County the unemployment rate decreased from 5.6% in 1994 to 4.8% in 2001 (Table 10) (Finnmark County Statistical data). It should be noted that the unemployment rate in Finnmark is two times higher than in Norway as a whole, primarily caused by the reduction in the number employed in the fisheries sector.

The crisis in the Russian fisheries sector, together with a reduction in the number of units of the Northern Navy, which was the only support for some coastal settlements, has had the most negative impact on the coastal settlements and villages. Coastal fishery and appropriate social policy could raise the living standard on the coast. However, the coastal fishery declined in the 1960s and 1970s. The fishing kolkhozes (cooperative groups) were mainly occupied in oceanic trawling fishing, though supporting the social sphere of the coastal settlements and villages before the market reforms. During the last decade the quotas for the Barents Sea fisheries decreased, which resulted in the reduction of fishing subsidies. All this dramatically increased social and economic problems on the coast.

Table 11 shows the change of the population number in the coastal settlements and villages of the northern regions of Russia and Finnmark in Norway. In the Murmansk Region, in the fishing kolkhozes and coastal settlements previously occupied by the military, the population decreased from 1989 to 2000 by almost 12 000 persons (33.7%).

**Economic sectors**

The most important economic sectors in Finnmark County, Norway, are fishery and fish processing, reindeer breeding, the service sector and trade.
The four Russian regions considered for the Barents Sea region are industrially developed regions. Table 12 shows that agriculture constitutes an insignificant part of the total GDP: 4.4% (in Karelia 4.7%, in the Arkhangelsk Region 7.7%, in the Nenets Autonomous Region 0.4%, and in the Murmansk Region 1.5%) (Batchaev et al. 2002).

The determining factors for economic development of the Russian coast of the Barents Sea region are the exploitation of natural resources. The main branches of industry are the following (Figure 6):

- Mining industry and metallurgy (Karelia, Murmansk Region);
- Forestry, wood-processing, and pulp and paper industry (Karelia, Arkhangelsk Region);
- Oil and gas industry (Arkhangelsk Region, Nenets Autonomous Region);
- Fishery and fish-processing industry (Murmansk Region, Arkhangelsk Region, Nenets Autonomous Region);
- Electric power production (Murmansk Region);
- Production of building materials (Karelia, Murmansk Region).

The Murmansk and Arkhangelsk regions house shipbuilding enterprises, including those strategically important for the entire country. The ports of Murmansk and Arkhangelsk are among the largest ports of Russia. One of the main features of the Russian part of the region is insufficient development of the railway and motor transport infrastructure; the density of the road net decreases both from west to east and from south to north.

The following features of the economy of the northern Russian regions should be noted:

- Low economic development, poor infrastructure, dominance of mining and energy industries, insufficient development of energy-preserving and environmentally friendly technologies;
- Increased cost of goods due to increased expenses for the development of production and the social sphere, transport expenses, increase in the share of imported goods, and salary expenses;
- Low competition in many sectors of the economy on the local market;
- Lack of elasticity regarding the size of enterprises. Most of the enterprises are either very large or too small. For instance, in the Arkhangelsk Region there are practically no enterprises with 200 to 2,000 employees. Thus, an issue of great concern is the problem of so-called town-forming enterprises.

The structure of industrial production in the region is presented in Figure 7. The major industrial branches in the Murmansk Region are non-ferrous metallurgy, food industry, chemical industry, and electric power production.

Table 11  Population changes in the coastal villages and settlements of the northern regions of Russia and Finnmark, Norway.

<table>
<thead>
<tr>
<th>Coastal villages and settlements</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Karelia</td>
<td>2,073</td>
</tr>
<tr>
<td>Arkhangelsk Region</td>
<td>ND</td>
</tr>
<tr>
<td>Nenets Autonomous Region</td>
<td>ND</td>
</tr>
<tr>
<td>Murmansk Region</td>
<td>ND</td>
</tr>
<tr>
<td>Eastern Finnmark</td>
<td>12,000</td>
</tr>
</tbody>
</table>

Note: ND = No Data. (Source: Russia: Local administrations data, Finnmark: County statistical data)

Table 12  The share of economic sectors in GDP in the Russian sector of the region in 2000.

<table>
<thead>
<tr>
<th>Industry (%</th>
<th>Agriculture (%)</th>
<th>Building (%)</th>
<th>Retail trade (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Russia (four regions considered)</td>
<td>65.2</td>
<td>4.4</td>
<td>4.2</td>
</tr>
</tbody>
</table>

(Source: Batchaev et al. 2002)
The Murmansk Region provides (State Statistics Committee 2002c):
- 100% of the total Russian production of apatite and nepheline concentrate;
- 8.5% of iron-ore concentrate;
- 17% of copper;
- 45% of nickel;
- 11.5% of fish products;
- 2% of electric power (the share of the branch in the northwest Russia is 20.8%).

The backbone of the Murmansk Region’s economy is mining and metallurgy. The leading enterprises in the non-ferrous metallurgy are the Kola Mining Company (which, together with traditional productions like nickel, copper, cobalt, gold and platinum, is developing the production of non-traditional metals) and Kandalaksha Aluminium Plant (one of the two aluminium plants in the Northwest Russia). In the ferrous metallurgy industry, the largest enterprise is the Kovdor Ore Processing Plant producing iron ore concentrate.

The apatite ore processing plant in Apatity is the 12\textsuperscript{th} largest chemical enterprise in Northwest Russia. The Murmansk Shipping Company is the only shipping company in Russia able to work in the Arctic all year round. Possessing a unique fleet of nuclear powered icebreakers, it enables yearly navigation along the Northern Sea Rout. The port of Murmansk takes fourth place among 42 Russian ports and is the largest port in Northwest Russia, able to dock ships with dead-weights up to 250 000 tonnes.

In Karelia, the forestry sector is the most important and constitutes 55.4% of the regional production volume (Figure 7). The forestry sector is also the leading branch for the Arkhangelsk Region. In second place is the electric power production.

The oil industry is the backbone for the Nenets Autonomous Region; 4 million tonnes of oil were extracted in the region in 2000. In general, the Nenets Autonomous Region occupies second place in oil production in Northwest Russia (34.1%). A large volume of construction work in the region is linked to the exploitation of oil deposits.

Table 13 presents the production dynamics in the northern Russian regions. The data show that the production volumes in the region, including the dominant sectors, decreased during the 1990s. This can be explained by the economic crisis caused by the difficulties faced and the mistakes made during the transition period from a planned to a market economy. However, the production decrease is over and, except for food production, a slight increase is observed. Nevertheless, the growth rates are not high and a significant increase compared to the basic period (1985-1990) cannot be expected. In addition, the structure of industrial production has changed during the period analysed. In 1990, the share of the metallurgy complex in the region accounted for approximately 30% of the industrial production and the share of fishery accounted for up to 40%. During recent years, the share of metallurgy has increased while the share of fishery decreased (State Statistics Committee 2002c).

**Agriculture**

The most important agricultural branches in Northwest Russia are cattle breeding, poultry farming, breeding of animals for furs, reindeer breeding and growing potatoes and vegetables (Table 14) (State Statistics Committee 2002c).

The radical restructuring of the agricultural sector ended in 1995. Nowadays, 86% of agricultural production enterprises are private. About 15% of agricultural holdings have the form of kolkhozes (cooperative groups). Reforms in the agricultural sector caused the disruption of inter-regional and inter-sectorial connections. This has had a negative impact on large agricultural holdings specialising in beef and pork production, poultry, breeding of pedigree cattle, raising seeds of cereals, potato and perennial herbs. However, the past decrease in production in the agricultural sector is over and positive tendencies have been observed over the last few years. The dairy- and meat production slightly increased over the period 1997-2000. However, the agricultural sector in Northwest Russia still faces a number of problems such as:
Insufficient production volumes of some agricultural products for the local market (mainly meat and dairy products);

Inefficiency and unstable functioning of many agricultural enterprises;

Under-development, lack of modern equipment and a dramatic decrease in supplies of agricultural machines;

Social degradation in rural areas, low wages, decrease in living standard in most of the villages;

Lack of legislative and regulatory initiatives at state- and regional levels;

Inefficiency and under-development of private farms.

In Finnmark County, Norway, reindeer breeding dominates over agricultural production. However, a slight increase in the farmed areas was observed over the period 1994-2001 (Table 15).

### Table 13  Industrial production in the northern Russian regions.

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric power (TWh)</td>
<td>29.2</td>
<td>31.4</td>
<td>27.1</td>
<td>26.4</td>
<td>25.9</td>
<td>27.4</td>
<td>27.3</td>
<td>93.4</td>
</tr>
<tr>
<td>Iron ore (million tonnes)</td>
<td>20.6</td>
<td>41.6</td>
<td>13.1</td>
<td>13.8</td>
<td>14.5</td>
<td>7.1</td>
<td>7.0</td>
<td>34.0</td>
</tr>
<tr>
<td>Tractor (pieces)</td>
<td>11.841</td>
<td>10.661</td>
<td>1.419</td>
<td>903</td>
<td>1.409</td>
<td>1.300</td>
<td>700</td>
<td>5.9</td>
</tr>
<tr>
<td>Timber (million m³)</td>
<td>34.1</td>
<td>31.6</td>
<td>13.1</td>
<td>11.2</td>
<td>13.6</td>
<td>14.2</td>
<td>14.4</td>
<td>42.2</td>
</tr>
<tr>
<td>Saw-timber (m³)</td>
<td>2,299,800</td>
<td>2,009,000</td>
<td>875,800</td>
<td>490,500</td>
<td>710,800</td>
<td>890,000</td>
<td>807,100</td>
<td>35.1</td>
</tr>
<tr>
<td>Cellulose (tonnes)</td>
<td>787,100</td>
<td>768,200</td>
<td>325,300</td>
<td>233,200</td>
<td>308,500</td>
<td>383,700</td>
<td>410,800</td>
<td>52.2</td>
</tr>
<tr>
<td>Paper (tonnes)</td>
<td>1,592,000</td>
<td>1,617,000</td>
<td>843,000</td>
<td>733,000</td>
<td>912,000</td>
<td>1,022,000</td>
<td>1,001,000</td>
<td>62.9</td>
</tr>
<tr>
<td>Stock brick (million bricks)</td>
<td>435</td>
<td>462</td>
<td>114.2</td>
<td>34.9</td>
<td>35.4</td>
<td>40.0</td>
<td>40.6</td>
<td>9.3</td>
</tr>
<tr>
<td>Bakery (tonnes)</td>
<td>3,900</td>
<td>3,928</td>
<td>2,815</td>
<td>1,767</td>
<td>1,918</td>
<td>1,766</td>
<td>1,643</td>
<td>42.1</td>
</tr>
<tr>
<td>Meat (tonnes)</td>
<td>635</td>
<td>749</td>
<td>243</td>
<td>126</td>
<td>102</td>
<td>130</td>
<td>142</td>
<td>22.4</td>
</tr>
<tr>
<td>Unskimmed milk products (tonnes)</td>
<td>412,000</td>
<td>499,000</td>
<td>110,900</td>
<td>67,800</td>
<td>64,200</td>
<td>79,100</td>
<td>90,700</td>
<td>22.0</td>
</tr>
<tr>
<td>Oil and condensate (million tonnes)</td>
<td>0.0</td>
<td>1.2</td>
<td>2.7</td>
<td>3.4</td>
<td>3.8</td>
<td>4.3</td>
<td>4.6</td>
<td>383.3</td>
</tr>
<tr>
<td>Wooden slab (million conventional m³)</td>
<td>20.3</td>
<td>22.4</td>
<td>13.5</td>
<td>12.6</td>
<td>17.5</td>
<td>18.1</td>
<td>18.4</td>
<td>90.6</td>
</tr>
<tr>
<td>Pasteboard (tonnes)</td>
<td>602,000</td>
<td>628,000</td>
<td>400,000</td>
<td>460,000</td>
<td>575,000</td>
<td>620,000</td>
<td>627,000</td>
<td>104.2</td>
</tr>
<tr>
<td>Cement (tonnes)</td>
<td>1,325,000</td>
<td>1,355,000</td>
<td>335,000</td>
<td>289,000</td>
<td>272,000</td>
<td>225,000</td>
<td>327,000</td>
<td>24.7</td>
</tr>
<tr>
<td>Reinforced concrete constructions (m³)</td>
<td>610,000</td>
<td>720,000</td>
<td>577,000</td>
<td>42,300</td>
<td>36,900</td>
<td>49,800</td>
<td>73,800</td>
<td>12.1</td>
</tr>
<tr>
<td>Apatite concentrate (million tonnes)</td>
<td>8.1</td>
<td>8.1</td>
<td>3.3</td>
<td>3.7</td>
<td>4.2</td>
<td>4.2</td>
<td>3.9</td>
<td>48.1</td>
</tr>
<tr>
<td>Nepheline concentrate (million tonnes)</td>
<td>1.6</td>
<td>1.6</td>
<td>1.0</td>
<td>0.9</td>
<td>0.9</td>
<td>0.8</td>
<td>1.0</td>
<td>62.5</td>
</tr>
</tbody>
</table>

(Source: State Statistics Committee 2002c)

### Table 14  Production of the most important kinds of agricultural products in the northern Russian regions.

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Grain crops (tonnes)</td>
<td>106,300</td>
<td>100,000</td>
<td>46,000</td>
<td>18,300</td>
<td>12,900</td>
<td>14,700</td>
<td>14,700</td>
<td>13.8</td>
</tr>
<tr>
<td>Potatoes (tonnes)</td>
<td>327,300</td>
<td>276,600</td>
<td>610,900</td>
<td>545,300</td>
<td>608,500</td>
<td>591,300</td>
<td>591,800</td>
<td>180.8</td>
</tr>
<tr>
<td>Vegetables (tonnes)</td>
<td>65,800</td>
<td>52,000</td>
<td>95,600</td>
<td>102,700</td>
<td>123,500</td>
<td>133,700</td>
<td>132,600</td>
<td>201.5</td>
</tr>
<tr>
<td>Livestock and poultry, in slaughter weight (tonnes)</td>
<td>92,700</td>
<td>111,600</td>
<td>56,000</td>
<td>34,200</td>
<td>28,700</td>
<td>31,000</td>
<td>31,300</td>
<td>31.8</td>
</tr>
<tr>
<td>Milk (tonnes)</td>
<td>597,900</td>
<td>649,800</td>
<td>350,500</td>
<td>294,700</td>
<td>276,500</td>
<td>274,900</td>
<td>275,400</td>
<td>46.1</td>
</tr>
<tr>
<td>Cattle (heads)</td>
<td>509,100</td>
<td>524,800</td>
<td>332,800</td>
<td>217,800</td>
<td>206,600</td>
<td>181,400</td>
<td>180,800</td>
<td>35.5</td>
</tr>
<tr>
<td>Pigs (heads)</td>
<td>333,900</td>
<td>419,700</td>
<td>183,400</td>
<td>71,900</td>
<td>72,900</td>
<td>75,900</td>
<td>80,000</td>
<td>25.5</td>
</tr>
</tbody>
</table>

(Source: State Statistics Committee 2002c)

### Table 15  Farmed area and number of reindeer units in Finnmark 1994-2001.

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmed area (km²)</td>
<td>95.3</td>
<td>96.0</td>
<td>97.3</td>
<td>98.0</td>
<td>102.1</td>
<td>105.5</td>
<td>107.4</td>
<td>-</td>
</tr>
<tr>
<td>Reindeer units</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eastern Finnmark</td>
<td>201</td>
<td>184</td>
<td>168</td>
<td>169</td>
<td>172</td>
<td>179</td>
<td>173</td>
<td>182</td>
</tr>
<tr>
<td>Western Finnmark</td>
<td>274</td>
<td>264</td>
<td>217</td>
<td>215</td>
<td>216</td>
<td>220</td>
<td>227</td>
<td>236</td>
</tr>
</tbody>
</table>

(Source: Finnmark County statistical data)

**Forestry**

Forestry has a vital role in the economy of the Russian part of the region. First of all this is true for Karelia and the Arkhangelsk Region, where the share of the forestry sector in the total production volume constitutes 55.4% and 50.9% respectively. 60% of the whole export from Karelia comes from the forestry sector. The increase of the share of the forestry sector has been accompanied by an improvement in the structure of the production. The share of the pulp and paper
industry has increased while logging has been reduced. This is mainly caused by an increase in recycling. This enables forest resources to be used more effectively and increases local incomes. More than 70% of the potential logging areas in the region are exploited nowadays.

Karelia produces:
- Paper: 22.6% of the total production volume in Russia (first place in the Northwest Russia);
- Timber: 6.1% of the total production volume in Russia;
- Sawn timber: 4.3% of the total production volume in Russia.

The major products of the wood manufacturing industry in the region encompass:
- Sawn timber: 39.2%;
- Timber: 30.8%;
- Paper: 14.9%;
- Plywood: 8.3%.

The Murmansk Region is the northernmost of the four Russian regions considered for the Barents Sea region and its forest reserves are of low productivity. Thus, in spite of 67.5% of the territory being covered with forests, the share of the forestry sector in the economy of the region constitutes no more than 0.6%. However, it is of importance for the employment of the population as it is the only activity in a number of settlements.

After the financial crisis of 1998, the export of timber from the Russian sector of the region and from Russia as a whole was substantially increased. Russian timber companies were able to increase export of wood products significantly after the drop of the Ruble compared to the USD and other major international currencies by several hundred percents. Demand for Russian timber on Western markets increased (though it is still much lower than it used to be in mid-1980s). Demand for sawn timber also increased. Many Russian timber companies were able to build or upgrade their sawmills and obtained drying kilns (mostly from German and Italian producers). Production of timber and sawn timber in Russia went down practically every year since the late 1980s up to 1999. As a result of that, in different regions of Russia production decreased approximately 3-5 times during last 10-12 years of the past century. The wood-processing sector was especially affected and many sawmills were closed. In the meantime, since 1999 the trend has changed, and timber production and production of secondary wood products went up in practically all regions of Russia involved in forest industry and wood processing.

The major factors for the successful work of the forestry sector are favourable conditions for export and demand on the home market. The income from the exports of the wood manufacturing industry increased in 2000 by 19.3%. This was caused by an increase in sale volume (by 18.5%) and the increase in price of cellulose (by 33%). On the home market, there is an increase in demand for furniture and wood building materials.

Further perspectives of development of the forestry sector in Northwest Russia present an optimistic picture. The demand for the products of the wood manufacturing industry will have increased by a factor of 2 by year 2006 (State Statistics Committee 2002c).

However, there are a number of problems to be solved, which are hampered by the lack of funding:
- To increase the marketability and quality of the wood products;
- To increase the share of recycling;
- To increase the introduction of modern, environmentally friendly technologies.

Fishery

The fishing industry constitutes one of the backbones of the coast of northern Norway and is a sector for economic development in Northwest Russia. The commercially most important fisheries of the Barents Sea are for cod (Gadus morhua morhua L.), haddock (Melanogrammus aeglefinus L.), shrimp, capelin (Mallotus villosus villosus Muller) and saithe (Pollachius virens).

The economically and politically dominant fishery in the Barents Sea is for Northeast Arctic cod. The haddock fishery can be regarded as supplemental to the cod fishery. The capelin fishery undergoes substantial cyclical variations rendering it unreliable as a resource basis. The Norwegian spring-spawning herring spends part of its lifecycle in the Barents Sea, while mainly being caught in the Norwegian Sea. Saithe is an exclusively Norwegian stock, while shrimp is mainly caught west of Svalbard.

The above-mentioned fisheries constitute 90% of the total catch. Such species as Black halibut (Reinhardtius hippoglossoides hippoglossoides Walbaum), Polar cod (Boreogadus saida Lepechin), perch (Sebastes marinus L.), deep-water prawn (Pandalus borealis Kröyer), scallop (Chlamus islandica Müller) and others are caught with special gears in insignificant amounts. Plaice (Pleuronectes platessa L.), American plaice (Hippoglossoides platessoides limandoides L.), catfishes (genus Anarhichas), saithe (Pollachius virens L.) and others are mainly caught as by-catch during the cod fishery.
Several of the commercially important Barents Sea fisheries straddle the geographical boundaries of the Barents Sea and the Norwegian Sea. In the period 1992-2001 an average of 36-54% of cod was caught in the Barents Sea\(^1\). This illustrates that fishing beyond the Barents Sea has a substantial impact on the Barents Sea fisheries and the ecosystem in general. Available statistics from ICES do not overlap with the GIWA definition of the Barents Sea, complicating estimates on the geographical distribution of catches\(^2\) (ICES 2003a).

Figure 8 presents the catch dynamics of the main commercial fisheries in the Barents Sea over the past 50 years (ICES 2003a). The figure shows that from the 1960s, a continuous decrease in catches is observed reflecting the negative trend of the total catch and the spawning fish stocks.

There has been an overall decrease in catches both in Finnmark and Northwest Russia. The annual Russian catch by the end of the 1980s was 1.6-1.8 million tonnes including 50-70% outside the Barents Sea in the Northwest and Central Atlantic (Figures 9 and 10). In 2001 the total catch constituted 924 000 tonnes, thus it was reduced over the period considered by a factor of 2.

Reduced catches resulted in decreased importance of the fisheries sector in the economic structure of Northwest Russia, increased unemployment and aggravated social problems. At the end of the 1980s the contribution of fisheries to the GDP of the Murmansk Region was 30%, in the Arkhangelsk Region 8-10%, in Karelia 5-6%. Its present contribution to the GDP has decreased to 14-17% in the Murmansk Region, 4-5% in the Arkhangelsk Region and 3-4% in Karelia. Decreased catches in Russia can be explained by the reduction of fish stocks, the difficult market situation, as well as by political mistakes and miscalculations made during the period (State Statistics Committee 2002b).

There has been an overall reduction in annual catches for the fishing fleet of Finnmark as for the Norwegian fishing fleet in general, though there are substantial periodic variations. In terms of the landing of catches, the situation in Finnmark has seemingly not been as severe as in Northwest Russia. A main reason has been the Russian landings of catches in Finnmark. These landings constituted more than 50% of the total cod landings in the county and were of great importance to the Norwegian processing industry. However in recent years a substantial quantity of the Russian landings have gone to freezing terminals for further export to the international market, without being processed in Finnmark. As such, Finnmark for a large part functions as a portal for Russian fishing vessels to the international market. Figure 11 therefore presents a distorted picture of the actual situation. In 2003 the fishing industry in Finnmark underwent a serious crisis, with a series of bankruptcies (Norwegian Directorate of Fisheries 2003).

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\(^1\) Pending on whether ICES statistical Area IIb is included or not. Havets Ressurser, 2002:13.

\(^2\)ICES statistical areas in the region are the Barents Sea (Area I), Bear Island/Spitsbergen (Area IIb) and the Norwegian coast (Area IIa).
Aquaculture

The aquaculture industry is expected to grow rapidly both on the Norwegian and Russian side of the Barents Sea. Governments and the industry in both countries show great interest in increasing the production of farmed fish; there is also an excellent scientific potential in the region. Development of aquaculture in the Murmansk region is considered as one of the most important for the nearest 15 years. Aquaculture in Northwest Russia is traditionally developed in the following directions:

- Industrial fishery and fish-breeding in inland water reservoirs based on aquaculture;
- Breeding of commercial fish on natural and artificial food in fish farms;
- Reproduction of fish stocks.

The production of farmed salmon (Salmo salar) and Rainbow trout (Oncorhynchus mykiss) in northern Norway has seen a rapid growth in recent years. In Norway, fish farming is an important industry, providing jobs and income in rural Arctic areas. In Finnmark, according to official information from the Norwegian Directorate on Fisheries (2004), the total production of salmon was 20,292 tonnes in 2000, and 32,893 tonnes in 2001; Rainbow trout production was 0 and 282,000 tonnes, respectively. There is still growth potential in this market (LENKA 1990). Marine species such as cod (Gadus morhua), halibut (Hippoglossus hippoglossus), sea urchin, Red king crab (Paralithodes camtschaticus), Arctic char (Salvelinus alpinus) and wolfish (Anarhichas spp.) are also potential for aquaculture in addition to salmonids. Sea-based aquaculture activities are currently small in the Russian part of the region, primarily due to lack of investment funds (Larsen et al. 1994), but are expected to grow in the future in both the Barents and White Seas regions.

Oil and gas

Unique reserves of oil and gas on the Arctic shelf of Russia may constitute the basis for an increased development of Russia in the 21st century. At present, 62.5 trillion m$^3$ of natural gas and 9 billion tonnes of oil have been discovered in the seas of the Arctic Ocean and 3.5 billion tonnes of oil have been discovered on the coast (Figure 12). This constitutes 25% of the world reserves (Denisov 2002).

If the present average volumes per year of oil and gas extraction remain, these reserves will last for 250 years. The largest oil and gas deposits, the Stockman gas condensate deposit, the Pripazlomnoye oil deposit, and a number of coastal deposits are being exploited already. These deposits will determine the social and economic development of Northwest Russia for the next 25-50 years. The problem of extraction and transport of oil and gas is becoming a strategically important task.

It is planned to transport up to 7 million tonnes of oil each year from the Pripazlomnoye oil deposit in the Pechora Sea, which is now being developed by the Rosshelf and Gazprom companies. Considerable volumes of oil transport are also expected from other deposits located in the Pechora Sea, from the Timano-Pechora oil and gas province bordering the Pechora Sea, from the Ob Bay area, from the area of the Ob and Yenisey rivers, and from other areas. In addition to oil transport,
large volumes of gas condensate transport are also expected. There are large reserves of natural gas in the Stockman gas condensate deposit in the Barents Sea, as well as in Rusanovskoye and Leningradskoye deposits in the Kara Sea. Large gas fields have also been discovered in the Laptev and North Siberian Seas.

The development of oil and gas deposits in northern Russia will increase oil transport to 40 million tonnes by the year 2020. This will correspondingly increase the pressure on the Northern Sea Rout by a factor of 6. To develop only the enumerated deposits, 18 ice-resistant platforms, 10-12 ice-breakers, including three to four nuclear powered ice-breakers, about 60 vessels for technical maintenance, and large amounts of tankers with a total deadweight of 4 million tonnes, need to be constructed.

Tourism

The unique geopolitical location of the region and the opening of the Russian borders have contributed to increased cooperation across the borders during recent years, and transboundary tourism plays a significant role in this cooperation. A new project on international tourism within the EU programme MACIS "Development of tourism in the Russian part of the Barents Region" started in the year 2001 with a budget of 1.1 million EUR. This project is of fundamental importance for tourism in the region, especially for outdoor and adventure tourism, the two sectors with the fastest growth. There are seven national and nature parks in the Russian part of the region (one in the Arkhangels Region, one in the Nenets Autonomous Region, five in Karelia, and none in the Murmansk Region).

The development of the tourism sector is of great socio-economic importance for the development of the region. It stimulates new investments and leads to increased income for the local communities, creates new jobs, and improves international and inter-regional cultural cooperation. The main task is to include as many new areas as possible into the sector, create a positive tourist image and promote the region on the European market.

The most popular branch of tourism in the northwest, cruise travel, is growing. Western tour operators and ship owners are interested in voyages along the Belomorsko-Baltysky canal, as well as along the coast of the Barents Sea. The number of cruise tourists can be increased without implementing solid land based investment, but by adopting new laws, which allow foreign vessels in the internal waters of Russia.

Finnmark is also a very attractive tourist destination within the "Arctic triangle" (Sodankylä (Finland) – Alta (Finnmark) – Murmansk). In close cooperation between the authorities from northern Finland and Northwest Russia, Finnmark is a leader of a project to strengthen tourism in the north (the Image Project). The project aims at a joint profile for the area, which will be the basis for future promotion of the "Arctic triangle". The Regional Development Programme funds the initiative.

Three national parks exist in Finnmark and there are plans to extend their areas and increase the number of national parks by another three. Additionally, the landscape structure of many other areas is protected. These are of great potential for outdoor and adventure tourism.

The outdoor and adventure tourism in the Russian sector of the region has gained specific features: from all the branches of tourism offered to foreign tourists, the most profitable one is sport fishing and hunting. The reasons for increased profitability in this sector are that, firstly, most of the clients are foreigners. Secondly, there are no fees for the use of unique recreational resources in the region and the nature protection regulations are less strict compared to European countries. Thirdly, there is availability of a cheap labour force.

Since mid-late 1990s, many western tourists have visited places in the Murmansk Region to practise sport fishing, several Russian and some joint venture companies do business in the area. However, functions of tourist agents and tourist operators are not clearly defined between Russian and foreign firms. There is such a phenomenon as “capture of rent” by foreign firms and loss of income for both private Russian joint stock and for budgets at all levels.

Competition in the market of recreational branches of tourism in the region is hampered by interests of criminal circles in this sphere.

Cooperation on the protection of the environment

Environmental protection is part of the agenda of many of the international and national organisations in the Barents region and the Arctic. The integration of environmental issues into economic activities and the efforts to promote sustainable development have brought environmental challenges to the forefront in the activities of all of the main institutions and organisations in the Barents region. The main international organisations and bodies dealing with environmental issues in the Arctic and Barents region are described in the following.

The Barents Euro-Arctic Council

The Council has established a Task Force on the Environment. The Task Force handles issues concerning e.g. air pollution abatement, environmental technology, the foundation and maintenance of protected areas, radioactive pollution and clean water supply. The
Task Force works in close cooperation with the Barents Council’s Economic Working Group and an ad hoc Working Group on Energy. The Environmental Task Force adopted its Environment Action Programme in 1994, and the five main issue areas are prevention of radioactive pollution, environmental capacity building, reduction of pollution from industry, nature conservation and cooperation between regional authorities.

The Task Force has engaged the Nordic Environment Finance Corporation (NEFCO) to identify environmental hot spots in the Barents region and to make feasibility studies on the implementation of pollution reduction projects. Subsequently, the Task Force has followed the progress of these projects. Separately, the Environmental Task Force has, together with the Economic Working Group of the Barents Council, prioritised seven projects of environmental and economic significance in the Barents region. This so-called ‘Joint List of Environmentally Sustainable Investment Projects’, has also been studied by the Task Force. Furthermore, the Task Force has coordinated and promoted projects on biodiversity and forestry issues, as well as environmental capacity building.

The Barents Regional Council
The Regional Council has set up a Regional Environmental Committee, which consists of environmental officials from the administrations of all 10 member-regions. In addition, the Nenets Autonomous Region has its own representative, and the Sami population is also represented. The Committee has drawn up a regional environmental action programme for the Barents region, with priorities on human health, biodiversity and environmental awareness.

The Arctic Council
The work of the Arctic Council (AC) has two main pillars. One is the promotion of sustainable development. The other is to integrate and continue the Arctic Environmental Protection Strategy (the so-called Rovaniemi Process), which started originally in 1989 and officially in 1991, within the framework of the AC. There are five main programmes in the latter process: The Arctic Monitoring and Assessment Programme (AMAP), Conservation of Arctic Flora and Fauna (CAFF), Protection of the Arctic Marine Environment (PAME), Emergency Prevention, Preparedness and Response (EPPR), and Sustainable Development and Utilization (SDU).

The Northern Forum
The Northern Forum (NF) consists of administrative regions from Arctic countries including Japan. The NF concentrates on several issues such as economic development, the utilisation of natural resources, and research cooperation. In addition, the promotion of environmental sustainability is part of the NF’s agenda. The cooperation between the NF and the Barents Regional Council is being developed.

Bi-lateral programmes
Finland, Sweden, and Norway all have bi-lateral environmental programmes and projects under way with Russia in the Barents region. The countries in the Barents region are involved in around 150 bi- and multilateral environmental projects. For example, the Research Programme for Environmental Technology (PRIRODA) was started in 1991 between Russia and Norway. Finland has put efforts especially into the handling and storage of radioactive waste in the Murmansk Oblast, as well as water supply and cleaning projects.

The Nordic Council
The Nordic Council has also taken part in Arctic environmental cooperation. In 1993, the parliamentarians of the Nordic Council e.g. established a permanent Arctic committee, which has subsequently participated in the work of the Arctic Environmental Protection Strategy. The Nordic Council’s working group on the neighbouring areas has also worked in cooperation with the Barents region organisations.

Non-governmental organisations
Finally, there are many non-governmental organisations (NGOs) involved in environmental cooperation in the Barents region and the Arctic as a whole. Some of the most active are the WWF, the International Arctic Science Committee (IASC), the Sami Council, the Inuit Circumpolar Conference, the International Union for the Conservation of Nature (IUCN), as well as NGOs in the Nordic countries and Northwest Russia.

International programmes and agreements related to water
The water protection activities in the Barents Sea region are regulated by, and carried out through a number of international programmes and agreements.

Rovaniemi Declaration on the Protection of the Arctic Environment
In 1991, the Rovaniemi Declaration on the Protection of the Arctic Environment, was launched by the representatives of the governments of Canada, Denmark, Finland, Iceland, Norway, Sweden, the former Soviet Union and the United States. The Declaration addresses threats to the Arctic environment and the impact of pollution on fragile Arctic ecosystems. Within the framework of the Arctic Council, the Declaration adopted the Arctic Environmental Protection Strategy (AEPS) and elaborated a joint Action Plan for its implementation and further development. The major objectives of the Strategy are: to protect...
the Arctic ecosystems, including humans; to provide for the protection, enhancement and restoration of environmental quality and sustainable utilisation of natural resources; to review regularly the state of the Arctic environment; and to identify, reduce and, as a final goal, eliminate pollution. At least three of its five programmes deal with the protection of the marine environment: the Protection of the Arctic Marine Environment (PAME) addresses policy and non-emergency response measures related to protection of the marine environment from land and sea-based activities. The second programme, Arctic Monitoring and Assessment Programme (AMAP), deals with the research and control over the state of the Arctic marine environment. It has responsibilities to monitor the levels of, and assess the effect of, anthropogenic pollutants in all compartments of the Arctic environment, including humans. The third programme, Emergency Prevention, Preparedness and Response (EPPR), is responsible for the preparedness in cases of emergency in the Arctic region and is called to provide a framework for future cooperation in responding to the threat of environmental emergencies.

**Kirkenes Declaration**

In 1993 the Ministers of Foreign Affairs or representatives of Denmark, Finland, Iceland, Norway, the Russian Federation, Sweden and the Commission of the European Communities signed the Kirkenes Declaration at the conference on cooperation in the Barents Euro-Arctic region, which took place in Kirkenes, Norway. The conference was also attended by observers from the United States, Canada, France, Germany, Japan, Poland, and the United Kingdom. The participants expressed their conviction that expanded cooperation in the Barents Euro-Arctic region will substantially contribute to stability and progress in the area and in Europe as a whole, where partnership is now replacing the confrontation and division of the past. The participants felt that such cooperation will contribute to international peace and security. It was decided that regional cooperation in the Barents Euro-Arctic region would comprise the county of Lapland in Finland, the counties of Finnmark, Troms and Nordland in Norway, the counties of Murmansk and Arkhangelsk in Russia, and the county of Norrbotten in Sweden. It was also noted that the region might be extended to include other counties in the future. The participants recalled the Joint Declaration from the meeting of the Ministers of the Environment of the Nordic countries and the Russian Federation in Kirkenes on 3 September, 1993, and the Convention for the Protection of the Marine Environment of the Northeast Atlantic signed on 22 September, 1992, and underlined the importance of strengthening bi-lateral and multilateral cooperation to protect the vulnerable environment of the region. The participants also re-affirmed their commitment to the Strategy for Protection of the Arctic Environment, adopted at the Ministerial Meeting in Rovaniemi in 1991, and to the ongoing work in implementing that strategy, especially within the Arctic Monitoring and Assessment Programme (AMAP). The conference also raised the questions of radioactive pollution. The importance of international cooperation was noted in the following areas: expanded monitoring of ecology and radioactivity in the region; enhanced work on the operational safety of nuclear facilities; and rehabilitation of areas that have been polluted as a result of the operation of nuclear facilities.

**Fisheries management cooperation**

Most major fish stocks are shared with other countries, as is the case of the Barents Sea fisheries, with the exception of saithe. This means that key regulatory decisions are taken in bi- and multilateral arrangements. The Total Allowable Catch (TAC) is therefore a given factor that the national regulatory regime has to deal with.

Norway and Russia manage their shared fish stocks in the Barents Sea (cod, haddock and capelin) through the Joint Norwegian-Russian Fisheries Commission, established in 1975. The Commission sets TACs for the shared fish stocks, throughout their migratory routes across borders of jurisdiction in the Barents Sea. The TACs are based on scientific advice from the International Council for the Exploration of the Sea (ICES) and national research institutions (see Figure 13). The parties also allot a quota for third-countries with “historical rights” to the fisheries (e.g. EU and Iceland). The parties also exchange fishing quotas according to established fishing patterns and provide mutual access to fish in each other’s national Exclusive Economic Zones (EEZ). During the 1990s cooperation in control and enforcement and marine research has been strengthened (Hoel 1994).

**Figure 13** The scheme of setting of TACs for the shared stocks of the Barents Sea.
There is a border dispute between Russia and Norway in the Barents Sea. Norway and Russia (then the Soviet Union) established their EEZ in 1976, following the developments at the third United Nations Conference on the Law of the Sea (1973-1982). Due to disputes regarding the delimitation of the bordering EEZs, agreement was reached in 1977 on a temporary Grey Zone where both Norway and Russia regulate and control their own fishers. The Grey Zone agreement has been renewed annually by the parties. Another area of contention is the Fishery Protection Zone around Svalbard, established by Norway in 1977. The management of these waters is subject to the Svalbard Treaty of 1920. The Norwegian claims to sovereign rights over the Protection Zone have not been supported by the other signatories of the Svalbard Treaty. In practice, the regulations in the Protection Zone are similar to those of the Norwegian EEZ. However, fleets with fishing rights in the Barents Sea are not sanctioned. In the northeast of the Barents Sea there is an area of high seas beyond the jurisdiction of coastal states, the so-called loophole (Churchill & Ulfstein 1992).

**Cooperation on radiological protection**

The Barents Sea region is somewhat a unique world region in terms of nuclear energy. No other place in the world houses so many sources of potential radiological threats like the Murmansk Region of the Russian Federation, one of the four Russian regions considered for the Barents Sea region.

Major problems of radiological protection and safety in the Russian sector of the region that need active international cooperation and financial and technical support from foreign partners are the following:

- Safety of spent nuclear fuel and radioactive waste management;
- Complex dismantlement and remediation of decommissioned nuclear powered submarines and civilian vessels, nuclear support and service vessels and nuclear storage vessels, remediation of radioactively dangerous sites;
- Construction of storages for spent nuclear fuel and radioactive waste;
- Improvement and upgrading of systems for monitoring, control, prevention and response to emergencies, and protection against radiological terrorism;
- Improvement of safety systems for the transportation of radioactive material.

The radiological protection activities in the region are regulated by a number of national and international conventions and agreements:

**Convention on Nuclear Safety**

Russia is a signatory-state of the Convention on Nuclear Safety, provided for the re-enforcing of national measures and international cooperation in the field of safe exploitation of nuclear power plants, prevention of accidents and mitigation of their consequences.

**Convention on Early Notification of a Nuclear accident**

To develop the Convention on Early Notification of a Nuclear Accident (1986), bilateral agreements were reached, which exceed the limits of the Convention. The agreements are provided for mutual exchange of information on the status and exploitation of nuclear power plants located in the mutually agreed border areas of the corresponding states. Such agreements were reached with Great Britain, Germany, Norway, Poland, Finland, and Sweden. Nowadays negotiations are being carried out to reach such agreements with other countries.

**Convention on the Physical Protection of Nuclear Material**

Russia also ratified the Convention on the Physical Protection of Nuclear Material, which obliges contracting States to ensure during international nuclear transport the protection of nuclear material within their territory or on board their ships or aircrafts.

**Convention on Assistance in the Case of Nuclear Accident or Radiological Emergency**

Convention on Assistance in the Case of Nuclear Accident or Radiological Emergency sets out an international framework for cooperation among parties and with the International Atomic Energy Agency (IAEA) to facilitate prompt assistance and support in the event of nuclear accidents or radiological emergencies.

**Joint projects between Russia and other countries**

In June 2003, Russia signed the frame agreement on the multilateral nuclear ecological programme in the Russian Federation. The list of participants, in addition to the Russian Federation, includes Belgium, Great Britain, Germany, Denmark, Netherlands, Norway, the United States, Finland, France, Sweden, and EU. The Agreement provides for the cooperation in the field of safe handling of spent nuclear fuel and radioactive waste, dismantlement of decommissioned nuclear powered submarines and icebreakers in Northwest Russia. There is also a special fund managed by the European Bank for the Reconstruction and Development for these purposes.

In addition to the international projects, programmes and conventions functioning in the territory of the Russian Federation, there are special projects for Kola Peninsula. Germany assigned 300 million EUR for projects on dismantlement of Russian nuclear powered submarines.
including 25 million EUR for 2003. The Agreement between the Ministry of Atomic Energy of the Russian Federation and the German Ministry of Economy has been signed to construct a complex for the long-term storage of piles from dismantled nuclear powered submarines in the Saida Bay (Murmansk Region).

Agreements on the dismantlement of two multipurpose nuclear powered submarines have been reached with Norway. A number of joint projects between Russia, Norway, Great Britain and the U.S. are carried out to increase the capacity of storages and treatment plants for spent nuclear fuel and radioactive waste.

The EU has contributed to radiological protection projects in the Barents region. One of the most important projects the EU has been involved in concerns the removal of radioactive waste from a decommissioned carrier vessel, the Lepse, which is lying in the Kola Fjord near the city of Murmansk. The TACIS programme between Russia and EU aims at improving nuclear safety of nuclear power plants in the territory of Russia. The programme also includes the construction of a regional storage for radioactive waste and spent nuclear fuel in Northwest Russia.

**Arctic Military Environmental Cooperation**

Trilateral Norwegian-U.S.-Russian military environmental cooperation began in 1996. The aim of the cooperation is to clean polluted military areas in Northwest Russia, including radioactive pollution sites. It consists of several projects, part of them aimed at ensuring the appropriate security for military radioactive waste. One of the most promising projects in the framework of this programme is the elaboration and testing of a ferro-concrete container for the storage and transportation of spent nuclear fuel from out-of-duty nuclear powered submarines.

Nuclear safety has also been a priority of the Barents Council since its foundation. Several projects are under way. For example, Finnish and Norwegian authorities have cooperated with Russian experts to upgrade the safety of the Kola Nuclear Power Plant in Polyarnye Zori. A Finnish energy company, IVO Power Engineering, has also completed work on purifying and concentrating liquid radioactive waste generated by the ATOMFLOT’s nuclear-powered icebreakers.