

100-300 km in width and shared between China, Mongolia, Russia and North Korea. Other basins draining into the Okhotsk Sea include those of the Khabarovskiy Kray, Magadanskaya and Kamchatskaya oblasts in Russia.

The Okhotsk Sea is situated at the margin of the northwestern Pacific Ocean between 43°43' and 62°42' N, and 135°10' and 164°54' E. It is separated from the open ocean by the chain of the Kuril Islands and the Kamchatka Peninsula. The Sea's limits are demarked by Hokkaido Island to the south and west, and the coast of Sakhalin and the Asian mainland to the east. The Sea's maximum length and width are 2 463 km and 1 500 km, respectively. It has an area of approximately 1.6 million km², a coastline 10 460 km in length and a total water volume of approximately 1.3 million km³ (Arzamastsev et al. 2001). The Okhotsk Sea is connected to the Pacific Ocean by the numerous straits of the Kuril Islands, to the Sea of Japan by La Perouse Strait and to the Amur estuary by the Nevelskoy and Tatar straits. The depth of the sea averages 821 m but reaches a maximum of between 3 374 m and 3 521 m within the Kuril hollow (Alekseev & Bogdanov 1991, Dobrovolsky & Zalogin 1982).

Physical characteristics

Approximately 70% of the region's land is characterised by mountains 1 000-2 000 m above sea level. Low-lying areas are found mainly in the Kamchatka coastal zone, the Penzhinskaya Gulf and in the middle and lower reaches of the Amur River. In these regions of low relief there are extensive swamps and marshes. The watershed of the Sea of Okhotsk region is formed by the Middle Ridge of the Kamchatka, Koryak and Kolyma highlands, and the Dzugdzur, Stanovoi and Yablonovy ridges. The Sikhote-Alin Mountains separate the Okhotsk Sea from the Japanese basins.

Okhotsk Sea sub-system

Climate and meteorological characteristics

The Okhotsk Sea sub-system is located within the monsoon climatic zone of the moderate latitudes. The northern region of the Sea is strongly influenced by the Arctic climate. Average July temperatures range from 8 to 16°C, while, in January, temperatures fluctuate between 8 and -32°C (Rostov et al. 2002). The Kamchatka coast, the western coast of the Okhotsk Sea and eastern Sakhalin form parts of the cold agroclimatic belt. The eastern portion of the Amur River Basin sub-system is within the monsoonal climate zone, whereas its western portion has continental climatic features.

Changes to the distribution and interactions of baric formations, as well as the Sea's position between continental Asia and the Pacific Ocean, are major factors forming the monsoonal climate and Sea's hydrological conditions. The dominant meteorological features that determine atmospheric circulation in the region are the Aleutian Low, North Pacific High and Siberian anticyclone in winter, and the Far-Eastern depression and Okhotsk anticyclone in summer. The generally monsoonal climatic conditions are often disturbed by cyclones which traverse the region from southwest to northeast. The winter, particularly in the northern Sea, is long and severe, with frequent wind and snow storms. In the summer, high precipitation rates, mist and fog are typical, whereas the spring and autumn seasons are short, cold and cloudy. The cold period lasts 120-130 days in the south and 210-220 days in the north of the region (Rostov et al. 2002). The cool, northern air masses have greater influence than the warmer air masses from the south, resulting in a negative heat exchange on the surface. As a result of these distinct meteorological characteristics, the Okhotsk Sea is the coldest of the Far-Eastern seas.

From May to September, light southerly winds (2-5 m/s) prevail. These winds can intensify to over 20 m/s up to four times a year as a result of cyclones and typhoons, with a maximum frequency from August to September. During the cold season, strong northerly winds with velocities of 5-10 m/s prevail. Wind speed and direction differ markedly in the various areas of the Sea. Maximum wind speeds reach 25-30 m/s in the northeastern and western parts of the Okhotsk Sea, 30-35 m/s in the central and eastern areas, and over 40 m/s in the south. The autumn-winter storm winds are characterised by greater strength and duration than those in the summer. The southern and south-eastern areas of the Okhotsk Sea are the most prone to unstable weather systems. The considerable spatial extent of the Sea, in combination with frequent and strong winds, allows intense seas and swell (waves are 4-11 m high) to develop (Rostov et al. 2002). The hydro-meteorological characteristics of the region create treacherous conditions for marine-based human activities.

Hydrology

The hydrological conditions of the Okhotsk Sea are determined by the particularities of its geographical location; its considerable meridional extent; its vulnerability to severe climatic conditions; the nature of vertical and horizontal circulation; the seabed relief, and its water exchange with the Pacific Ocean and Sea of Japan. The hydrology of the coastal waters is additionally influenced by continental discharges, tides and the geographic configuration of the coastline.

In general, the surface water temperature decreases from south to north except during certain summer months when a more mixed pattern is observed (August; Figure 3). Average annual temperatures in the north and south reach 5-7°C and 2-3°C, respectively. Significant annual variations of surface water temperatures exist throughout the Sea (10-19°C) which attenuate with depth. Between May and November, the average monthly water temperatures remain positive. The warmest waters are found in the southernmost part of the sea near the La Perouse Strait and Hokkaido Island. In October, the surface water temperature decreases approximately two-fold and in November changes to its winter spatial distribution. In February and March, surface water temperatures of -1.0 to -1.8°C result in a considerable part of the Sea being covered by ice (February; Figure 3) (Rostov et al. 2002). In the southeastern area of the Sea and to the northwest of the Kuril Islands, the water temperatures seldom register negative values (PICES 2004).

General cyclonic water circulation occurs around the periphery of the Okhotsk Sea (Figure 2). In addition, there are localised gyres and smaller eddies. Stable anti-cyclonic circulation is active over the TINRO hollow, to the west of the southern extremity of Kamchatka and in close proximity to the Kuril Hollow fall. The major currents in the region include the Penzhinskoye, Yamskoye, North-Okhotsk currents and counter-currents, and the East-Sakhalin, Middle and Soya currents.

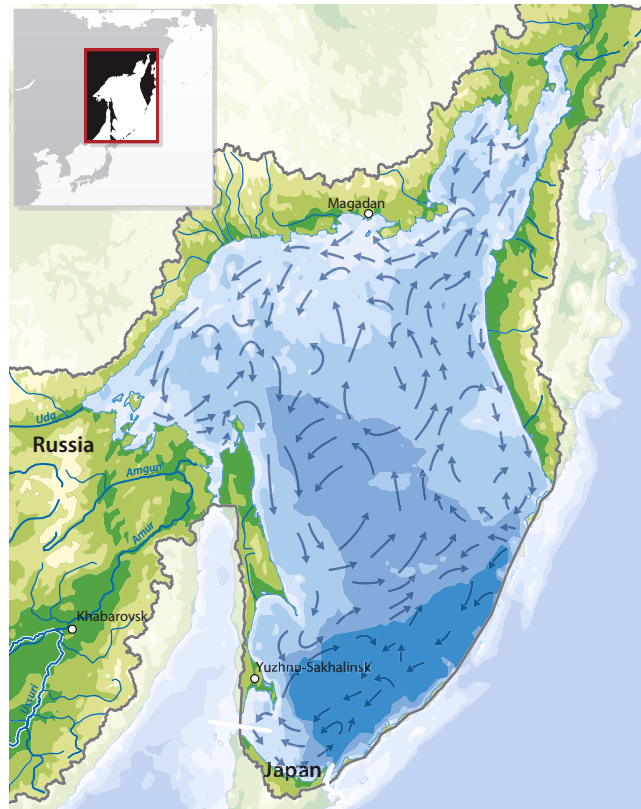


Figure 2 General water circulation.
(Source: Arzamastsev et al. 2001)

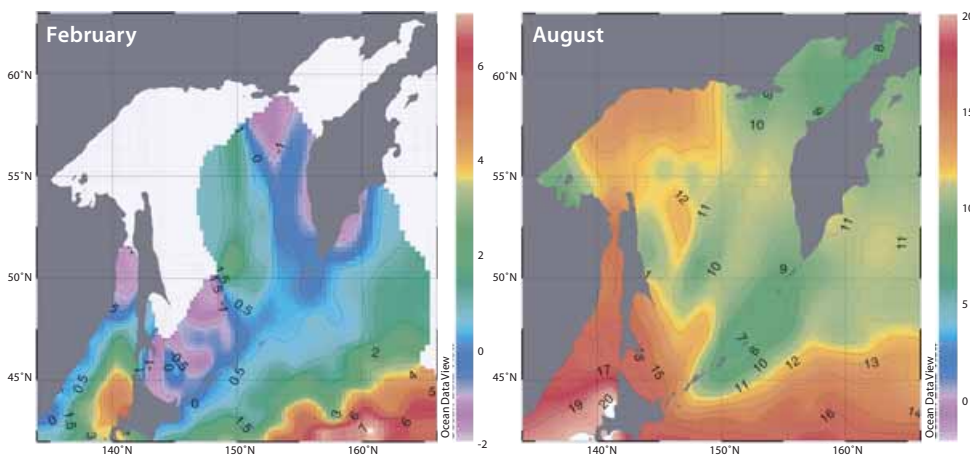


Figure 3 Sea surface water temperatures in February and August.
(Source: Arzamastsev et al. 2001)

The straits connecting the Okhotsk Sea to the Sea of Japan and the Pacific Ocean allow water exchange. The Nevelskoy and La Perouse straits are relatively narrow and shallow, which limits water exchange with the Sea of Japan. Conversely, the straits of the Kuril Islands ridge facilitate greater water exchange as they are approximately 500 km wide and are considerably deeper. The Bussol and Kruzenshtern straits are

the deepest, 3 000 m and 1 900 m, respectively (Lapko & Radchenko 2000).

The general pattern of water circulation is subject to considerable seasonal variation. In autumn, the flow rates of the currents increase, and, in winter, currents flowing south and southwest are observed in areas free from sea ice. Periodic currents have greatest velocity in the south and around the periphery of the sea, including the coastal belt, bays, straits and narrow

waters. Offshore tidal currents are weak, approximately 5-10 cm/s, while tidal currents near the coast, in bays and straits, and over submerged shoals are stronger (Zalogin & Kosarev 1999).

Severe winter frosts and sea ice cause intense cooling of sea surface waters. The sea ice is formed locally, and both stagnant and drift ice are

present. The severity of ice conditions in the Okhotsk Sea is comparable to the Arctic seas (Lapko & Radchenko 2000). The annual ice period lasts for a maximum of 290 days, an average of 260 days in the northwest, 190-200 days in the north and the Sakhalin coasts, and 110-120 days in the south. During severe winters, ice cover can occupy up to 99% of the water area and, in milder winters, about 65%. Generally, ice formation begins in the northwestern part of the sea in November, but as early as October in areas with considerable water freshening. The ice cover gradually extends southwards along the western and eastern coasts, and eventually to the open sea. In December, the consolidated fast ice is formed in the bays and bights (Lapko & Radchenko 2000). In January and February, the ice fields occupy the northwestern and central parts of the sea. The drift ice reaches a great density and is subject to intense compression and hummocking.

Salinity

The salinity of the Okhotsk Sea is largely determined by the hydrological cycle in terms of the balance between precipitation and evaporation; the effect of sea ice formation and melting processes; continental discharges to the coastal zone; and water exchange with adjacent seas. The salinity of coastal surface waters in the northwestern part of the Sea has a large annual variance of 20-25‰ to 30-33‰. In summer and early autumn, the salinity of the Sea is less than in winter when it increases as a result of ice formation and a reduction in continental discharge (see Figure 4). Offshore and in the southwestern sea, salinity variations are less pronounced (31.0-33.5‰) (Rostov et al. 2002) due to water exchange via the La Perouse and Kuril straits. The seasonal fluctuations in salinity differ depending on location. There is a general trend of increasing salinity down the water column in all seasons and there are comparably few spatial and temporal variations.

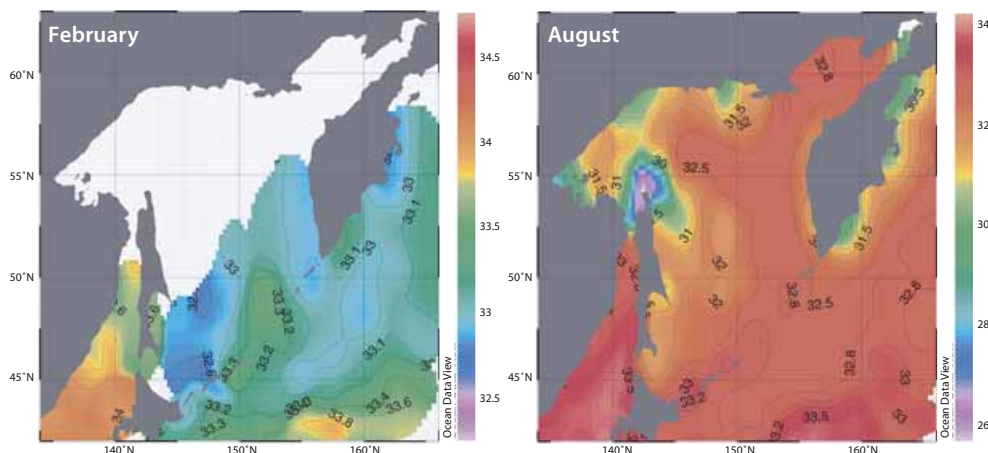


Figure 4 Salinity of surface water in February and August.
(Source: Arzamastsev et al. 2001)

Amur River Basin sub-system

The sub-system Amur River Basin, known in China as the Heilong Jiang, is one of the largest river systems in Asia, covering about 2 million km².

The River is one of the ten longest in the world (approximately 4 345 km) and its course forms the boundary between Russia and China for 3 000 km. It originates from the Argun/Urgun (Russia-China border) and Shilka (Russia) rivers, is joined by the Songhua River (China), and later meets the Ussuri/Wusuli River (Russia-China border) and the Zeya and Bureya Rivers (Russia). The Amur then flows north until it reaches its mouth on the Tatar Strait from where it flows into the Okhotsk Sea.

Table 1 Basic hydrological and water quality characteristics of the Amur River

Characteristic	Value
Water run-off, average, long-term, km ³	369.1
Run-off maximum, annual, km ³	459.2
Run-off minimum, annual, km ³	135.0
Maximum water discharge, m ³ /s	40 000
Minimum water discharge, m ³ /s	153
Average annual flow of detritus, millions of tonnes	24.0
Average annual water turbidity, mg/dm ³	90.0
Maximum water turbidity, mg/dm ³	517.0
Average annual flow of dissolved matter, millions of tonnes	20.23
including Ca ²⁺	2.34
Mg ²⁺	0.74
Na ⁺ + K ⁺	1.60
HCO ₃ ⁻	10.40
SO ₄ ²⁻	2.10
Cl ⁻	1.10
Average annual flow of organic matter, millions of tonnes	5.3

(Source: Estimates of Institute of Water and Ecological Problems, FEB RAS)

The average discharge of the Amur River is 11 700 m³/s (369 km³/year). During spring and summer (April-September) almost 75% of the annual discharge is recorded, while only about 14-25% flows during autumn and winter (October-March). Among the major tributaries contributing to the Amur River's total discharge are the Zeya (17%), Ussuri/Wusuli (12%), Bureya (7.7%), Amgun (5.7%), Shilka (4.7%), Tunguska (3.5%), Argun/Urgun (2.9%), Anyui (1.9%), Gorin (1.6%) and Gur (1.4%). The smaller tributaries contribute between 0.1 and 1.0% to the annual discharge. The smaller river basins of Khabarovskiy Kray,

Magadanskaya and Kamchatskaya oblasts also drain into the Okhotsk Sea. Table 1 shows the basic hydrological and water quality characteristics of the Amur River.

There are more than 60 000 lakes in the Amur River Basin sub-system, the largest being Khanka, Chukchagirskoye, Bolon, Udyl, Bolshoe Kizi, Evoron, Chlya (Voronov 2003). The Lake Khanka Basin, known as Lake Xingkai in China, is located in the upper part

of the Ussuri/Wusuli River system. It is the largest freshwater lake in East Asia – shared by China (Heilongjiang province) and Russia (Primorskiy Kray).

Biodiversity and critical habitats

The Amur River Basin sub-system hosts some of the world's most diverse and productive habitats and encompasses extensive areas of complex and unique ecosystems. The Russian section of the Amur River Basin is situated in a temperate mixed broadleaved and coniferous forest zone, and forest steppe zone. The Amur River supports more fish species than any other Russian river, with more than 120 species (WWF 2001), 18 of which are endemic and eight are endangered, including Kaluga sturgeon (*Huso dauric*). There are also seven migratory salmon species (GEF Concept paper 2005). Lake Khanka and its surrounding wetlands have particularly high species diversity. The Lake's basin hosts 342 bird species which account for 65% of the total bird species found in Far-Eastern Russia and 48% in Russia. 12 species are included in the International Red Book. The variety of fish species in the Lake and its inflow and outflow (only Songacha) rivers represents 73% of the fish species in the Amur basin. The wetlands around the lake are used for a spring and autumn resting place for migratory species and for spawning grounds for commercial species, such as Predatory carp (*Erythroculter erythropterus*) and Mongolian redbfin (*Erythroculter mongolicus*) (GEF Concept paper 2005).

About 61 species of mesopelagic fish belonging to 53 genera and 33 families have been recorded in the Okhotsk Sea sub-system (PICES 2004). There are known to be 16 species of squid – an important component of the food web of the Sea's ecosystem – belonging to nine genera and six families. Regarding groundfish, 50% are flatfish, 21% cods, and 11% sculpins. These three groups are a major determinant of the fish productivity of the Okhotsk Sea shelf. The Sea is home to 11 endangered species including the Western Pacific gray whale which is critically endangered in this region. At least 16 species of marine mammals inhabit the Okhotsk Sea sub-system. There are four species of the true seal (Phocidae) and two species of eared seal. Whales that inhabit the Sea include, among others, Gray whales (*Eschrichtius robustus*), Southern baleen whales (*Eubalaena japonica*), Bowhead whales (*Balaena mysticetus*), Northern fin whales (*Balaenoptera physalus*), Little picked whales (Minke's) (*Balaenoptera acutorostrata*), Humpback whales (*Megaptera novaeangliae*), Baird's beaked whales (*Berardius baridii*) and Killer whales (*Orcinus orca*).

Socio-economic characteristics

Population

The population of the Okhotsk Sea sub-system is approximately 8.7 million, of which 2.7 million live in Russia and about 6 million in Japan. The Russian coast, except for Sakhalin Island, is sparsely populated, with a population density of approximately 1.5 people per km² (Figure 5). The only Russian cities with a significant population size (60 000-200 000 inhabitants) are Yuzhno-Sakhalinsk, Magadan, Nikolaevsk-on-Amur and Okha. The majority of the rural and urban population lives within the permafrost zone, tolerating severe or extreme natural conditions. The far eastern Russian economy experienced a severe and long recession in the 1990s which led to emigration and a decline in population. The largest decline in population out of all the Pacific coastal regions between 1991 and 2000 was observed in the Magadanskaya Oblast' (40% decline), Kamchatskaya Oblast' (20%) and Sakhalinskaya Oblast' (18%).



Figure 5 Population density of the Sea of Okhotsk region. (Source: Data from ORNL 2003)

The population of the Amur River Basin sub-system fluctuates between 70 and 80 million people, 5 million of whom live in Russia, 65-75 million in China and less than 50 000 in Mongolia. The North Korean part of the Basin is largely unpopulated (Voronov 2003). The catchment of the Songhua River (a tributary of the Amur River) has a population density of 105 people/km² (compared to 35 people/km² in the whole of the Amur Basin) and includes most of the large cities in the Amur basin, such as Harbin, Jilin and Mudanjiang (GEF Concept paper 2005).

Economy

In the Russian coastal areas of the Sea of Okhotsk region there is a developed mining industry. The fishing industry is found in Kamchatka, Magadan, Okhotsk, Ayan and Nikolaevsk-on-Amur (Khabarovskiy Kray).

In Sakhalin, hydrocarbon is exploited and there are coal mining, and wood and pulp-and-paper industries. Figure 6 shows the distribution of industrial activities in the Okhotsk Sea sub-system. In the Amur River Basin sub-system, ship building and repair, carpentry, construction and coal mining are the predominant industries. Further, power generation using coal, gas and hydroenergy is a major sector. The sectoral structure of industrial output in the Far East of Russia in 2000 is shown in Table 3.

Table 2 Basic economic characteristics of the administrative regions of the Sea of Okhotsk basin.

Sectors of the Sea of Okhotsk basin	Population in sector (people)	Share of total population of administrative territory (%)	Gross regional product (million USD)	Industrial output (million USD)	Volume of agricultural production (million USD)	Cost of basic assets of economics branches (million USD)
Sakhalin and Kuril	335 000	61.24	722.9	615.8	38.1	2169.4
Magadan	125 000	68.41	286.6	244.6	8.5	1110.1
Khabarovsk	407 000	28.4	642.2	557.6	36.4	2931.5
Kamchatka	24 000	6.3	37.2	32.7	3.5	134.3
Japanese (Hokkaido Island)	310 000	6.1	10 200			

(Source: Russian Regions 2001)



Figure 6 Distribution of industries in the Sea of Okhotsk Basin.

(Source: Prepared by the authors using Russian Regions 2002)

During a period of market reforms between 1990 and 1998, there was a significant decrease in investment and industrial production. Since 1999, the Russian economy, including that of the Far East, has stabilised and industrial production has increased. GDP growth has averaged 5-7% for the period 2000-2004 (Lvov 2004).

According to the GIWA regional experts, the socio-economic development of the region has been determined by the following:

1. The collapse of economic relations with the western regions of Russia;
2. Aggravation of social problems. Transport tariffs increased by 10-12 times making voyages to the western regions of Russia unaffordable for most people;
3. Limited market in Far-Eastern Russia for primary and manufactured products;
4. Factors increasing the cost of production. For example, harsh natural conditions, remoteness of settlements and poor infrastructure development;
5. Marginal location of region; it is a considerable distance from the industrial centres of Russia, thus increasing transportation costs;
6. Periodic emigration from the region; and

Table 3 Sectoral structure of industrial output in the Far East of Russia in 2000.

Region	Electric power industry	Fuel industry	Nonferrous metallurgy	Chemical and petro-chemical industry	Mechanical engineering including shipbuilding and ship repair	Wood, woodworking and pulp and paper industry	Food-processing industry including fish complex	Other
Primorsky Krai	16.4	2.1	3.7	1.0	16.3	6.8	46.7	7.0
Khabarovsk Krai	8.5	7.9	8.4	1.6	50.4	8.0	8.5	6.7
Amur Oblast	34.4	4.7	29.6	0.1	6.3	5.7	10.2	9.1
Kamchatka Oblast	20.1	0.3	8.3	0.1	4.0	0.6	63.3	3.3
Magadan Oblast	15.3	1.1	66.4	0.0	1.5	0.3	14.0	1.4
Sakhalin Oblast	6.0	60.6	0.2	0.1	1.2	3.2	27.4	1.3
Jewish Autonomous Oblast	13.5	0.2	4.7	0.5	25.4	5.5	13.3	36.9
The Far East as a whole	11.4	13.2	29.8	0.6	16.7	4.1	19.8	4.4

(Russian Regions 2001)

7. The socio-economic conditions contrast with neighbouring countries in terms of population density, market characteristics and infrastructure development.

The Russian section of the Amur River Basin is one of the most developed territories in the Russian Far East. During the 18th and 19th centuries, development was concentrated on the north side of the Amur River. Economic development was further stimulated following the construction of the Trans-Siberian Railway in the 20th century, which crosses the Amur River. The Basin has an estimated 35% of the industrial potential and over 75% of the agricultural potential of the Russian Far East.

In Northeast China, the GRPs in 1999 of the Heilongjiang and Jilin provinces totalled 2.4 billion USD (14th position out of 32 Chinese provinces) and 1.4 billion USD (19th position), respectively (Baklanov et al. 2002a). As a result of economic reforms, there has been a shift in the employment structure of the region from the primary to the secondary and tertiary (service) economic sectors. This trend continued in subsequent years as a result of the state funded manufacturing industries of Northeast China (Baklanov et al. 2002a). There has also been significant investment in transport and communication infrastructure in order to stimulate trade with regions outside Northeast China. In Jilin, agriculture remains the largest sector, both in terms of production output and employment rates. There is major domestic and foreign investment in the Heilongjiang and Jilin provinces, particularly in agriculture, engineering and transport infrastructure.

Future economic development in the Sea of Okhotsk region will be based upon the exploitation of the region's mineral resources, such as oil, gas and coal, and possibly the development of hydropower. In addition, there are abundant forest resources and considerable land resources.

Economic sectors

Oil and gas industry

The Sea of Okhotsk region includes the Okhotsk oil and gas fields, making its hydrocarbon resources particularly important economically. Significant reserves of oil and gas are predicted to exist in the northeastern and northern shelves of Sakhalin, the western Kamchatka shelf and in the middle and lower reaches of the Amur River Basin. Only a small proportion of the large hydrocarbon reserves of the Russian Far East is exploited. The dynamics of oil production is shown in Figure 7. Although the volume of oil exploited continues to increase, with oil production reaching 3.4 million tonnes in 2004, only 20% of regional consumption is met by regional production.

An evaluation of hydrocarbon resources made by Dalmorneftegeofizika in 1994, concluded that the Sea of Okhotsk shelf has the equivalent of 14 462 million tonnes of fuel. In Sakhalin Island and on its shelf there are estimated to be 324 million tonnes of oil and 997 million tonnes of gas. By 2000, 23 oil and gas-oil, and 5 gas fields had been developed. Figure 8 shows the areas of prospective development of the oil and gas fields in the Sea of Okhotsk region.

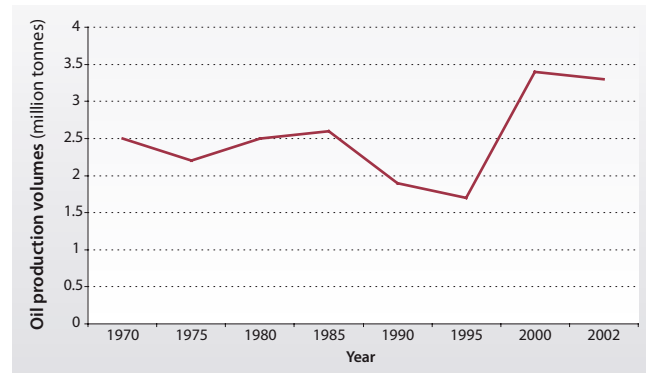


Figure 7 Oil production volumes.
(Source: Russian Statistical Yearbook 2001)

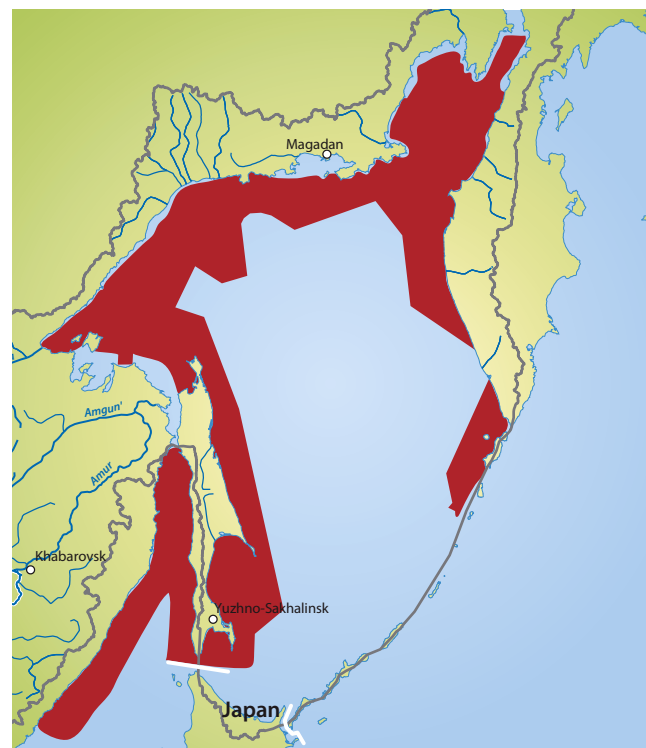


Figure 8 Areas of prospective development of the oil and gas fields in the Sea of Okhotsk region.
(Source: Alekseev et al. 2001)

Renewable resources

The region's renewable energy sector also has development potential. Shelikhov Bay and the Penzhinskaya Gulf have large tidal ranges of up

to 10-12 m and are thus suitable for tidal energy projects. The Amur River and its tributaries, including the Zeya, Selemdzha and Burea rivers, have significant hydropower potential (Alekseev et al. 2001). In the Russian part of the watershed, there are hydroelectric plants such as the Somninskaya located on the watercourse of the Amgun and the Zeiskaya on the Zeya. Additionally, the Bureiskaya hydroelectric plant was recently constructed near the Talakan River mouth and further hydro-electric projects are planned for the Selemzha and Gilyui rivers. The region also has an abundance and diversity of wood resources.

Mineral resources

The Sea of Okhotsk region contains a wealth of mineral resources. In some of the region's mountains and river valleys, gold has been discovered and ferrous and non-ferrous metals and polymetallic ores are exploited. There is great mining potential in the coastal areas where substantial mineral reserves, particularly of boron, antimony and fluor spar, are found. Large reserves of brown and hard coal have been discovered in Sakhalin and in the Amur River Basin. In a zone adjacent to the lower reaches of the Uda, Amgun and Amur rivers there are considerable phosphorite reserves. Figure 9 shows the distribution of natural resources in the region.

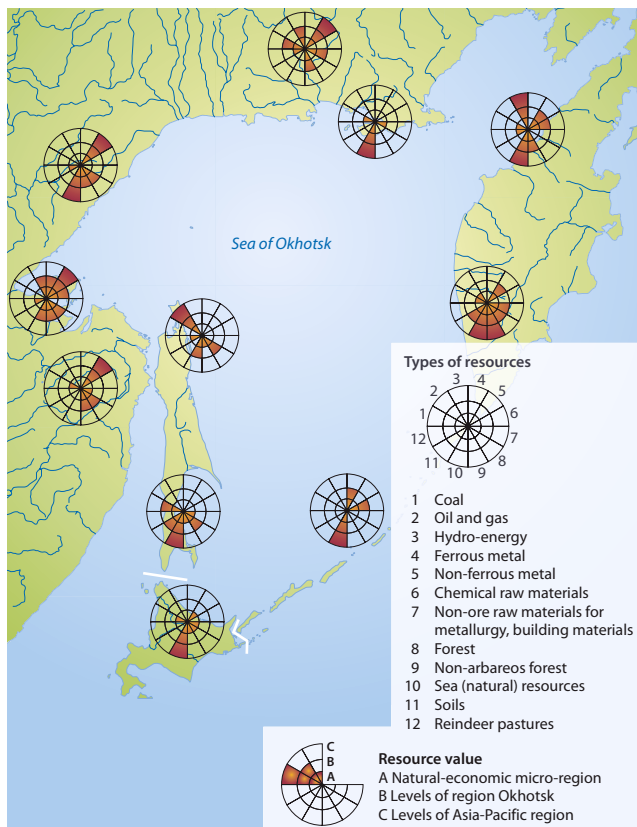


Figure 9 Natural resources of the Sea of Okhotsk sub-system. (Compiled by the authors)

Agriculture

The agricultural sector (mainly grain and soybean production, and cattle-breeding) has been developed primarily in the middle and lower reaches of the Amur. In other areas of the Sea of Okhotsk region, deer-breeding, local arable farming and cattle-breeding are common, particularly in the south of Sakhalin and southwestern Kamchatka. The Amur River Basin sub-system is a major agricultural zone of the Russian Far East. The most fertile agricultural lands are located on the Zeya-Bureinskaya Plain and Lake Khanka lowlands.

Fisheries

The Okhotsk Sea sub-system is regarded as the richest fishery region in the world. The volume of biological resources in the Sea constitutes 46% of all marine biological resources in the northern Pacific. It has an estimated 11 million tonnes of biological resources, including approximately 7 million tonnes of cod, 2.5 million tonnes of herring and about 1.5 million tonnes of other seafood (e.g. molluscs and algae) (Shuntov 2001). Approximately 340 fish species inhabit the Okhotsk Sea (Froese & Pauly 2005). The main fish products are flounders, herring, capelin, halibut, pollock and crab. Walleye pollock (*Theragra chalcogramma*) is the most abundant commercial species in the Sea. Catch volumes average 1.2-1.5 tonnes per km², but in productive years reach between 8 and 22 tonnes per km² on the western Kamchatka shelf. In comparison, fisheries production is about 0.7-1.1 tonnes per km² in the North Atlantic (The Seas 1998). Russian catches of commercial fish between 1992 and 2003 in the Okhotsk Sea are given in Figure 10.

Until recently, numerous vessels from various countries fished intensively in the Okhotsk Sea. The Sea's non-Russian fishery has been closed since 2003 with the exception of Japanese gill net fishing for Pacific salmon. In 2005, the foreign fleet was not allocated any quotas for fish in the Okhotsk Sea sub-system (Governmental Resolution 2004).

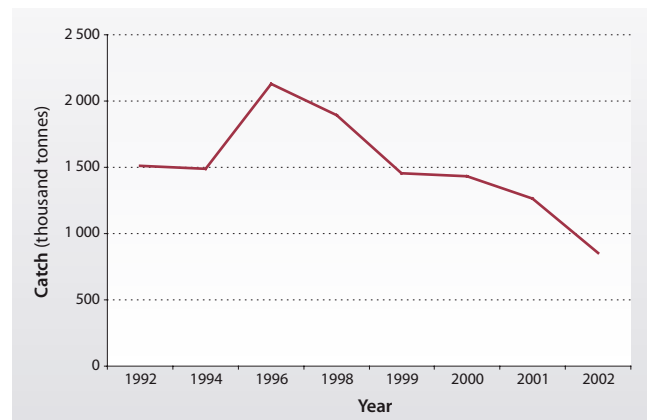


Figure 10 Catches of commercial fish by the Russian fleet in the Okhotsk Sea. (Source: Barushko 2005)

In 2000, the fishing industry contributed 1.2 billion USD to the economy of the Russian Far-East. It accounted for 18.2% of gross regional product (GRP) in 1999, and as much as 63.5% in the Koryak Autonomous Region, 49.3% in Kamchatka, 27.3% in Primorskiy Kray, and 18.3% in Sakhalinskaya Oblast'. The fisheries industry therefore plays an important role not only for the local economy, with one fisherman creating 6-7 workplaces onshore, but also in the development of the social and cultural characteristics of the region and the distribution of fishing settlements.

The riparian population of the Amur River has depended throughout history on fishing and hunting as its major source of food supply. The Amur River Basin sub-system contains one of the largest inland fishing industries in Russia. The most important commercial fish species in the Amur are the migratory salmon (Humpback, *Oncorhynchus gorbuscha* and Chum, *O. keta*), sturgeons (Amur, *Acipenser schrenckii* and Kaluga, *Huso huso*), smelt, and lamprey (*Lethenteron* sp.). Sturgeon fishing is an important part of the regional fish industry but, due to the depletion of stocks, bans were enforced on Kaluga sturgeon between 1976 and 1991. The Amur is one of the richest rivers for salmon in the world; in 1910 the total catch of salmon was over 100 000 tonnes. The majority of catches of salmonids consist of Humpback salmon (Novomodny et al. 2004).

Aquaculture

In Russia, aquaculture is poorly developed. According to the GIWA experts, only 40 fish breeding factories operate in the entire Russian Far East which release 0.5 billion juvenile fish. In comparison, Japan has 350 factories which release approximately 2 billion juvenile fish. Most commonly, Chum salmon, Humpback salmon and other species of salmon are bred, mainly in Sakhalin. Most enterprises have become obsolete as they failed to achieve their anticipated production capacities due to poor management. Only 1% of the total output of the fisheries industry is produced by aquaculture (Baklanov et al. 2002b).

Water use

There is an irregular distribution of water resources in the Basin between the oblasts and krays of Russia and the territories of Mongolia and China. The majority of freshwater originates from Khabarovskiy Kray (34%), Amurskaya Oblast' (22%) and from China (28%). Water resources in the basin are extensively used for agricultural, industrial, energy production and domestic purposes. In Khabarovskiy and Primorskiy krays and Priamurye, more than 80% of the total water abstracted is used for production and domestic purposes. In other regions, irrigation and domestic supply are the most significant consumers. In Chitinskaya Oblast', within the watersheds of Argun/Urgun, Onon and Ingoda rivers, as well as practically all the administrative districts of Primorskiy Kray,

more than 90% of water resources are used for these purposes. Table 4 shows how water consumption generally decreased in the Russian administrative regions during the 1990s.

Table 4 Consumption of freshwater in the Russian administrative regions of the Okhotsk sea.

Region	1991 (million m ³)	1995 (million m ³)	2000 (million m ³)	2001 (million m ³)
Khabarovsk Kray	714	558	465	467
Kamchatka Oblast	309	276	261	252
Magadan Oblast	144	137	90	96
Sakhalin Oblast	455	376	275	273

(Source: Russian Regions. 2002. Moscow, 2002.)

International cooperation

The three riparian countries of the Amur River Basin sub-system have established bilateral cooperation agreements in the field of protection and use of transboundary water resources. These include:

- Agreement between the USSR and China on joint research operations to determine the natural resources of the Amur River Basin and the prospects for development of its productive potentials and on planning and survey operations to prepare a scheme for the multi-purpose exploitation of the Argun River and the Upper Amur River, 1956;
- Agreement between the governments of Russia and China on cooperation in the field of conservation of transboundary water resources.
- Agreement between the governments of Russia and China on cooperating in the preservation of the environment, 1994.
- Agreement between the governments of Russia and China on cooperating in the conservation, regulation and protection of living aquatic resources in the boundary waters of the Amur and Ussuri Rivers, 1994.
- Agreement between the governments of China and Mongolia on the protection and utilisation of transboundary waters and environmental management (1994); and
- Agreement between the governments of Mongolia and Russia on the protection and use of transboundary waters, 1995.

International treaties relevant to the Okhotsk Sea sub-system:

- The international convention for the regulation of whaling, 1946;
- The international convention for the prevention of pollution of the sea by oil, 1954;
- The convention on the continental shelf, 1958;
- The Ramsar convention on wetlands, 1971;

- The convention on international trade in endangered species of wild fauna and flora, (CITES), 1973;
- The convention on the prohibition of military or any other hostile use of environmental modification techniques, 1977;
- The United Nations convention on the Law of the Sea (UNCLOS), 1982; and
- The agreement for the implementation of the United Nations convention on the Law of the Sea of December 10, 1982, relating to the conservation and management of straddling fish stocks and highly migratory fish stocks, 1995.

Regional agreements relevant to the Okhotsk Sea sub-system

- The agreement between the governments of USSR and Japan about mutual relations in the sphere of fishery at coasts of both countries, 1984;
- The agreement between the governments of USSR and Japan about cooperation in the sphere of fishery, 1985;
- The agreement between the governments of USSR and North Korea about cooperation in the sphere of fishery, 1987;
- The agreement between the governments USSR and Chinese about cooperation in the sphere of fishery, 1988;
- The agreement between the governments USSR and South Korea about mutual relations in the sphere of fishery, 1991;

- The convention for the conservation of anadromous stocks in the North Pacific Ocean, (Russia, United States, Canada, Japan, South Korea), 1992;
- The North Pacific Marine Science Organization (PICES), (Russia, Canada, United States, Japan, China, South Korea), 1992; and
- The agreement between the governments of Japan and Russia on matters of cooperation in the field of fishing operations for marine living resources, 1998.

Protected areas – case of Lake Khanka

The two Lake Khanka basin riparian countries, Russia and China, initiated specific measures to protect species and their habitats, particularly the wetland areas around the lake. Two protected areas were established for this purpose: Lake Xingkai National Nature Reserve (China) and Khankaisky National Nature Reserve (Russia). The Russian side of the lakeshore wetlands have been designated as a Ramsar site. However, the national legislations and restricted activities applicable to them differ, and it is expected that more harmonised management and regulations for the protected areas will be developed between the two national nature parks.