Vital Caspian Graphics 2

Opportunities, Aspirations and Challenges

The Geneva-based **Zoï Environment network** is a new answer to some stubborn old questions. An international non-profit organization, Zoï's mission is to reveal, explain and communicate connections between the environment and society. *www.zoinet.org*

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For the purposes of this publication, the names Iran and Russia have been used to refer to the Islamic Republic of Iran and the Russian Federation, respectively.

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The Caspian Sea runs north and south, extending over 1 200 kilometres, with an average width of 320 kilometres, with 7 000 km coastline. It covers approximately 400 000 square kilometres (an area slightly larger than Germany). The population of the region is about 14 million, distributed over the coastal provinces of five countries: 6.5 million in Iran, 3.9 million in Russia, 2.2 million in Azerbaijan, 0.8 million in Kazakhstan and 0.4 million in Turkmenistan.

Contents

The Caspian Sea region represented in the Catalan Atlas (1375) (Bibliothèque Nationale de France, Paris)

A medieval perception of the Caspian Sea or as it was named then Bahr al-Khazar, the Sea of Khazar. The North and the East appear empty, uncharted and unknown. In the South the Deylam Mountain Range, now named Elburz Range. In the West the worthy landmark is the Gate of the Gates (Ar. Bâb al-Abwâb), the present Derbent which was a wall separating and defending the Southern Caucasus from the invading northern tribes. Two big islands have caught the attention of the geographer, Siakoh and Albab, none of which of any importance today. Abu Zayd al-Balkhi the Persian scholar drew the map possibly based on the basis of travellers' tales mixed with fiction and mystery.

(Bodleian Library, Oxford, UK.)

Foreword

More than five years ago we published the first edition of Vital Caspian Graphics, which impressed readers with its abundance of new material presented in a synthesized and visually appealing format. Our goal that it be read in the streets of Astrakhan and Aktau may, however, have been too ambitious – or visionary – despite the numerous electronic tools that usually increase the circulation of our publications.

Undeterred, and flush with revolutionary spirit to create a better world, we decided to produce a second edition. The world is changing, including the region around the Caspian Sea, and we are determined to capture and report these changes. The adoption of a protocol on oil pollution and the presentation of the first State of the Environment report at the third Conference of the Parties in Aktau in August 2011 mark the further evolution of the Caspian Convention. These vital graphics are a reader friendly publication which present lesser-known aspects of the region while covering the broader picture in an attractive format. One of the highlights are the photographic essays by Rena Effendi and Mila Teshaieva.

Our uncompromising attitude and our ambitions to reach out to communities beyond environmental professionals remain, and our inspiration from the first edition stays unchanged:

I wanted to write a book as purely geographical in character, as dry and uncompromising as a travel report, and no more attractive than a rough-and-ready map sketched out with a lump of coal on a piece of packing paper.

– Konstantin Paustovsky,
Story of a Life, vol 6, The Restless Years

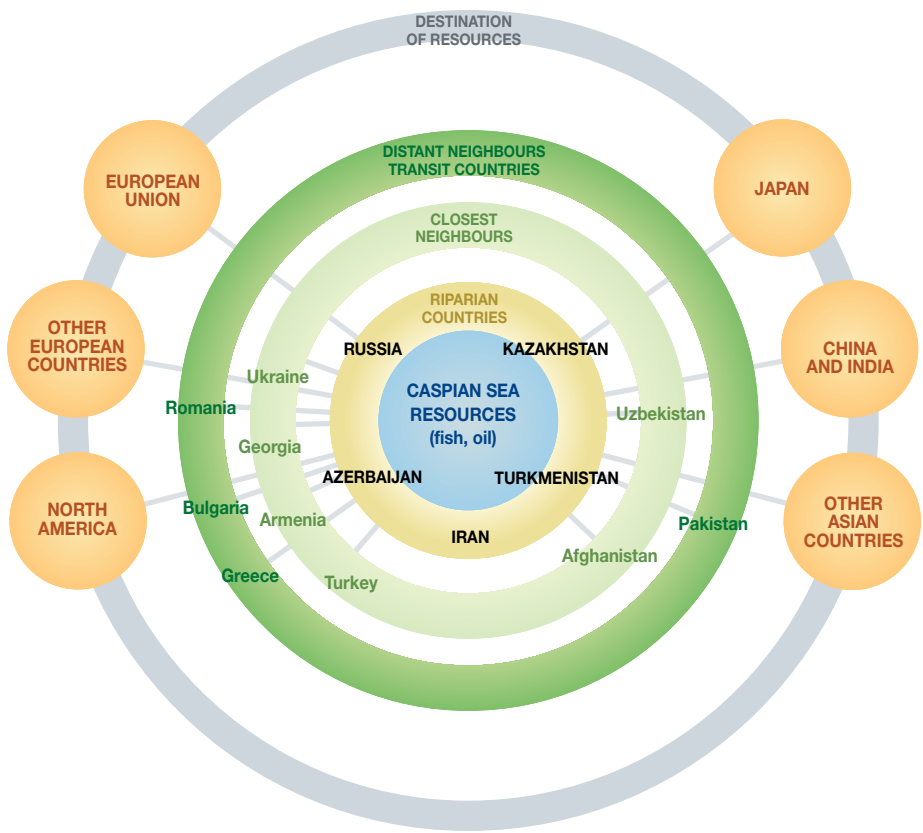
Otto Simonett,
Geneva
February 29th, 2012

1 Sea of opportunities, aspirations and challenges

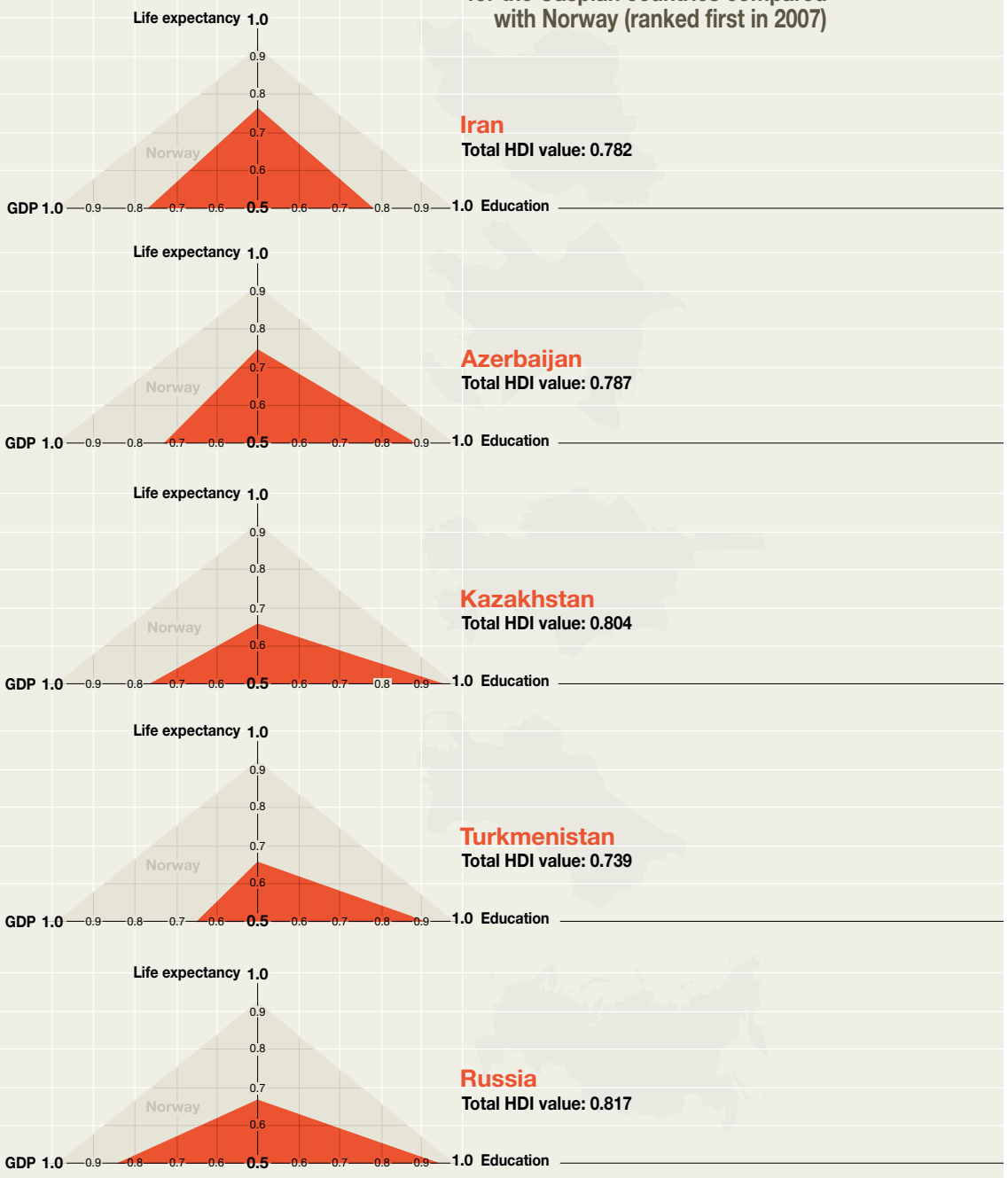
In recent years the Caspian Sea has been the focus of increased global attention. The world-wide decline in oil and gas reserves and the corresponding rise in the price of hydrocarbon derivatives have heightened interest in an area where there is still growth potential in oil and gas exploration. In addition, the region presents a wealth of opportunities in other areas, including bioresources, transport corridors, and not least tourism. These new ventures may bring increased prosperity, but they also put pressure on traditional rural communities and the environment.

The surge in the exploitation of hydrocarbons in the Caspian region has changed the rules for development and engagement in many sectors, in particular oil, land and sea transport, and services. National interests multiplied after the breakdown of the Soviet Union as Azerbaijan, Kazakhstan and Turkmenistan gained independence. Relationships between these states are being tested as the possibility of large profits emerges. Additionally, with China entering the game as an increasingly strong economic player, the centre of gravity is moving east, demanding that new transport and communication routes are considered across the region.

The Caspian Sea: neighbours and players



Human Development Index (HDI) composition for the Caspian countries compared with Norway (ranked first in 2007)



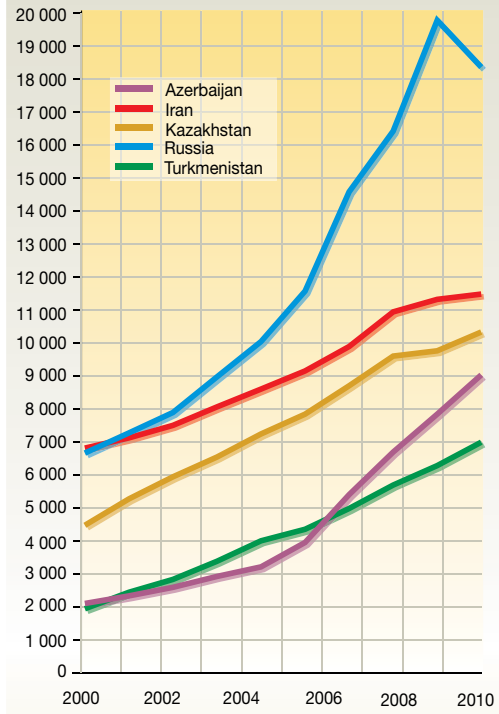
Source: *Human Development Report 2009*, United Nations Development Programme (UNDP), New York.

Figure: Composition of human development index. The characteristic feature in all four post-Soviet countries is a relatively high level of education in relation to national income and rather low life expectancy, indicating high levels of poverty and deficient healthcare. In contrast the level for all three indicators in Iran is fairly balanced.

Figure: Purchasing power parity (PPP) measures how much a currency can buy in terms of an international benchmark (usually dollars), since the cost of goods and services differs between countries. PPP is below the value of a US dollar in countries where the general price index is lower than in the US (as is the case for all five Caspian states, to varying extents), and above it where the prices are higher. A dollar thus buys much more in the Caspian countries than in the US, which only marginally compensates for the much lower income per person. These curves do not allow any conclusions on the wealth of individuals or income distribution among the population.

Gross National Income (GNI) in Purchasing Power Parity (PPP) per capita

US dollars



The **Gross National Income** (GNI), formerly Gross National Product (GNP), represents the broadest measure of national income. It measures the total value added from domestic and foreign sources claimed by residents.

The **Purchasing Power Parity (PPP)** dollar estimates the cost required to buy the same amount of goods in any country. The PPP is below the value of the US dollar in countries where the general price index is lower than that of the United States, and above it where prices are higher.

Source: World Bank online database, accessed in April 2010.

The Caspian Sea region once only played a minor role in world politics. Interest focused exclusively on the Absheron peninsula and Baku, where the oil industry started developing in the last quarter of the 19th century, providing the only significant economic growth in the region. Otherwise the region remained largely rural, on the margins of two vast states (Tsarist Russia and Persia, subsequently the Soviet Union and Iran) and well away from the centres of industry. It often lagged behind in terms of development and infrastructure. North-south trade between Moscow and Tehran was limited, particularly as both countries had other much more significant coastlines.

Since 2001 the economy has bottomed out of post-Soviet fatigue and started rising steadily in Azerbaijan, Kazakhstan, Russia and Turkmenistan.

In 2005 regional oil production reached roughly 1.9 million barrels a day (EIA 2006), comparable to South America's second largest oil producer, Brazil. The BP Statistical Review of World Energy 2009 estimated the Caspian's share of oil and gas proved reserves in 2008 at 3.8 per cent[1] and 5.9 per cent, respectively, of the world total, with oil and gas production at 3.2 per cent and 3.6 per cent.

Despite the oil-related increase in national incomes, investment in the environment has not substantially increased. This reflects the national priorities for jobs, housing, education and health. The impact of the 2007-09 financial crisis is of equal importance, leaving its mark on all five countries. Almost everywhere the environment has been among the first sectors to feel the cuts in investment.

As a result of the arid and semi-arid continental climatic conditions many of the coastal areas have specialized in extensive stock raising, essentially sheep and camels. Only in a few foothills with higher rainfall in the Eastern Caucasus and the Iranian provinces of Gilan, Mazandaran and Gulistan has prosperous mixed farming developed with orchards and market gardens.

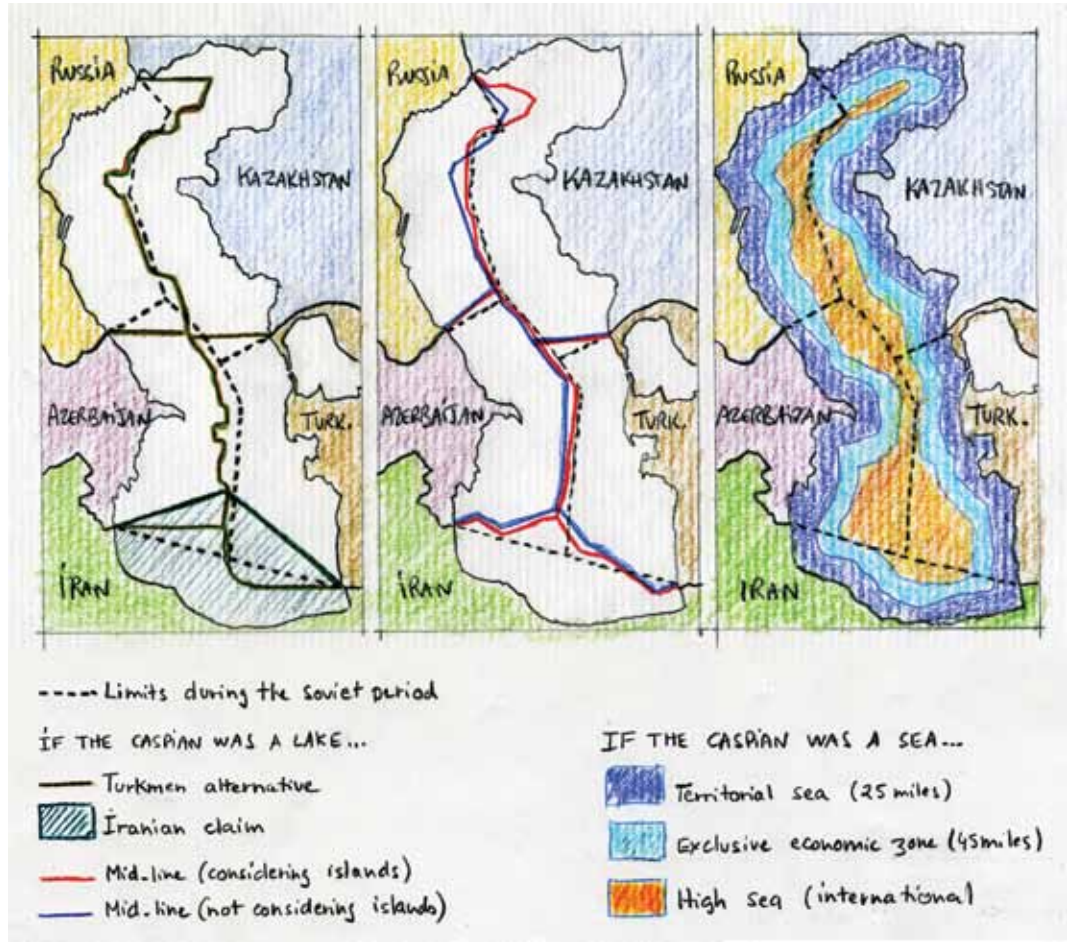
[1] In this case Caspian share includes Azerbaijan, Kazakhstan and Turkmenistan.

The Caspian region has plenty to choose from when exploring past and present civilizations and cultures, historical monuments and the beauty of its natural resources. With unspoilt beaches in the east and west, lush mountain forests in the south, and the majestic Volga in the north, coupled with a mosaic of ethnic origins and cultures, it has the potential to attract thousands of visitors. Yet, the travel trade faces major challenges in the Caspian region. Sustainable tourism is still an unexplored opportunity but inadequate infrastructure, including improper waste management or water facilities, and stress on residential areas hinder growth in this sector. The Iranian part of the Caspian Sea, with its verdant plain and high mountains, accommodates twice its 'normal' population in the summer when tourists from other parts of Iran flock to the area. Some residences are set back only a few metres from the water line. In 2007 Turkmenistan approved a contract for Avaza, a huge national tourist resort involving the construction of an island on the shore of Caspian. All these developments pay little attention to the rise in sea level, which continues to be a real threat to the coastal area. Some parts of the region, such as Dagestan, are subject to limitations for security reasons. With an arid or semi-arid climate and difficult accessibility, parts of Kazakhstan and Turkmenistan would also face problems in opening up for tourism.

The coastal regions of the Caspian Sea support various forms of agriculture. The dry steppe of the Russian part (northern Daghestan, Kalmukia) and the arid areas of Kazakhstan and Turkmenistan specialize in sheep farming. With rising demand for meat and wool, this reputedly difficult activity is increasingly attractive, particularly for enterprising stock raisers.

The shores of southern Daghestan, the plains of Azerbaijan and the Volga delta have traditionally concentrated on subsistence farming and horticulture, dependent on properly maintained irrigation systems. Local vineyards, cotton fields, orchards (apples and peaches, but also mulberry for silk worms) and market gardening, have long supplied nearby towns and cities, and buyers further afield in northern Russia.

Further south the more humid shores of the Lankaran area of Azerbaijan and the foothills of northern Iran have developed other specialities: tea, citrus fruit, walnuts and hazelnuts, all of which are still key resources.



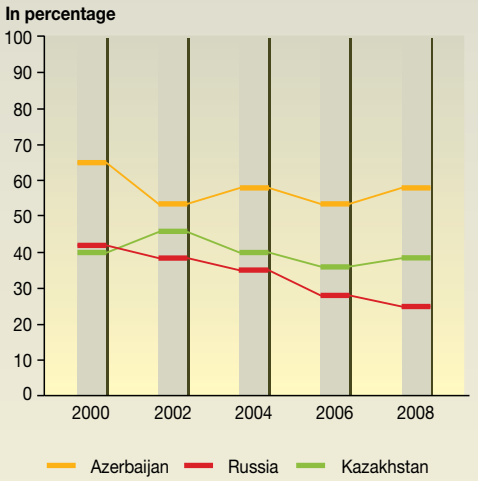
The uncertain status of the Caspian Sea

The high economic expectations and the newfound quest for national identity partly explain the obstacles to agreement over the legal status of the Caspian Sea. Existing maritime agreements between Iran and the Soviet Union, formerly the only countries bordering the sea, needed re-negotiation as the three new republics of Azerbaijan, Kazakhstan and Turkmenistan emerged. Negotiations among the five countries are underway for a regional convention on the legal status of the Caspian Sea, but an over-arching agreement has yet to be reached on the division of the Caspian waters and – indirectly – its natural and mineral resources. But the northern states – Russia, Azerbaijan and Kazakhstan – signed a trilateral agreement in 2003 that allows them to proceed with the development of the hydrocarbon potential of the northern Caspian. The vital economic interests provide third parties and international stakeholders with a good reason to downplay the tensions between states bordering on the sea.

Impoverished by successive crises, the rural population has been tempted to move to the region's overpopulated cities, in keeping with a widespread trend, but overall the balance is beginning to tip in favour of farming. Greater investment is nevertheless needed to sustain this sector and downstream agrifood industries, which are currently outdated and ill equipped.

Fishing is important for all the littoral countries. The catch of fish from the Caspian contributes a significant share of the regional economy. Fisheries provide more than 7 000 jobs in Iran and perhaps an equal number in related activities. However, with fisheries cutting back due to the declining fish stocks, environmental degradation and changes in the ecosystem, the sector is losing its importance, leaving many of those who depended on it jobless.

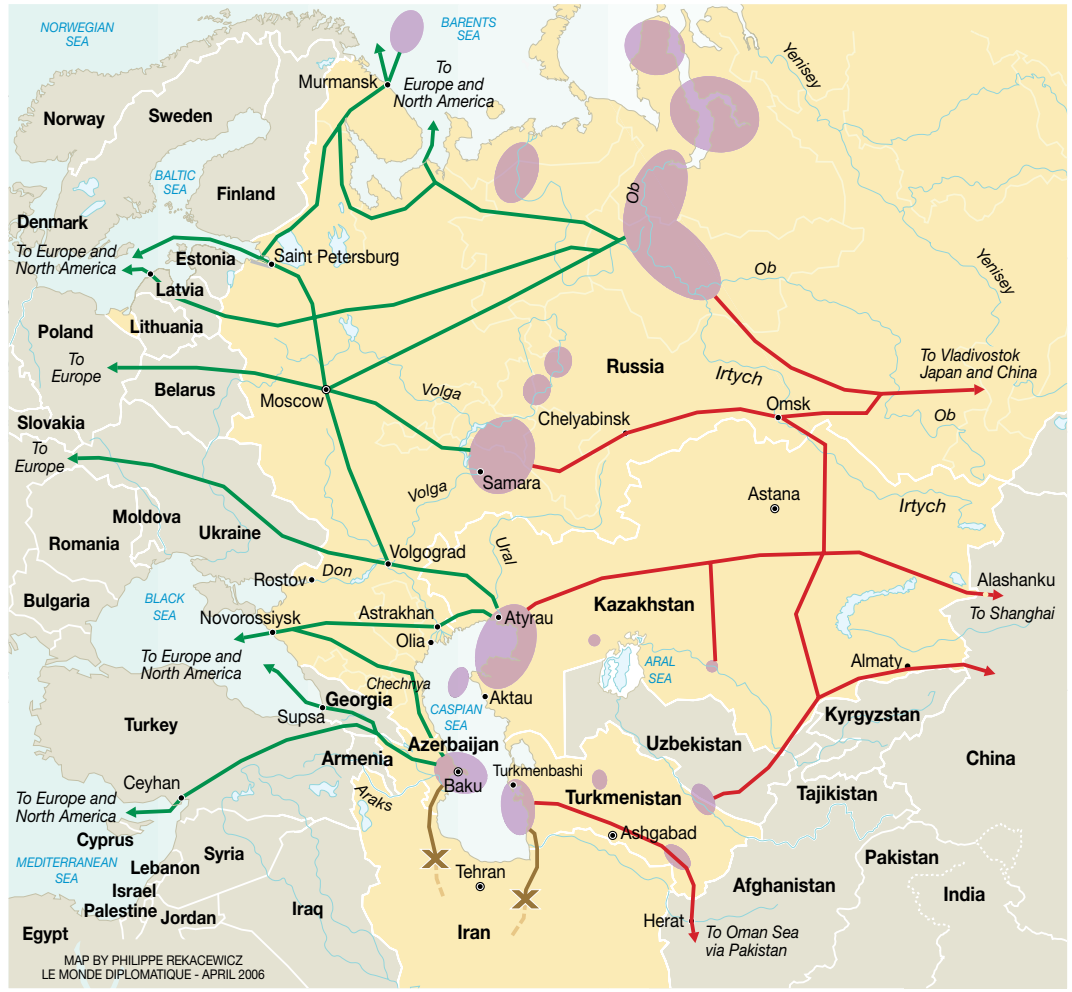
Share of food in total household expenses



Source: *CIS Statistical Yearbook*, Statistical Committee of the Commonwealth of Independent States (CIS).

Figure: Share of food in total household expenses. In the 1990s following the collapse of the Soviet regime and massive market deregulation, the breakdown of total household expenditure radically changed. Its focus shifted towards basic human needs, such as food, for which spending increased two or threefold in 10 years, reducing funds available for other essentials such as education and health.

Markets competing for Caspian oil and gas



Sources: Stephen Blank, *Central Asia's energy game intensifies*, Eurasianet, September 2005; United States Energy Information Administration (EIA); Sylvaine Pasquier, "Pressions sur l'or noir", *l'Express*, 1st August 2005; Interstate Oil and Gas Transport to Europe (INOGATE); Energy Map of the Middle East and Caspian Sea Areas, Petroleum Economist, London, 2003; International Energy Agency (IEA); Jean Radvanyi, Institut National des Langues et Civilisations Orientales (INALCO), IEA, World Energy Outlook 2010.

Transportation projects converging on the Caspian

Countries bordering on Caspian

- Russia
- Other countries

Transcontinental transportation projects

MULTIMODAL ROUTES (highways, road, railroad and possibly pipelines) combined

- Projects developed with Russia
- Projects developed without Russia

SINGLE-MODE ROUTES (railway only)

- Projects developed with Russia
- Projects developed without Russia

Sources: Jean Radvanyi, "La bataille des liaisons transasiatiques", in *Atlas du Monde diplomatique*, Paris, January 2003; Transport Corridor Europe Caucasus Asia (TRACECA), European Union, TACIS Programme, 2005.

Sharing the new oil wealth

The prospects for rapid oil wealth contrast with fast spreading poverty following the collapse of the Soviet economy. Although massive investment has been channelled into the area, its effect is still both geographically and socially very limited, with little widespread impact on society. Nor does it fully compensate for the crisis in older, more traditional activities such as fisheries and agriculture and in the case of former Soviet republics, the closure of inefficient industrial complexes. In many countries the benefits of oil revenue are still restricted to the "happy few". Some cities – Baku, and to a lesser extent Makhachkala and Astrakhan – have enjoyed spectacular growth. In the meantime much of the infrastructure – transport, telecommunications, drinking water – in small towns and rural areas is very poor. The poverty gap is widening, with much of the population increasingly excluded from services and wealth as privatization of social services progresses.

In all the areas bordering on the Caspian Sea, priority should be given to diversifying activities and investment. Particular attention should be given to sectors such as tourism, agriculture and food production as well as services. Oil and gas alone cannot be expected to provide sufficient jobs for the fast-growing population. Only widespread diversification can contain rising unemployment, which is severely affecting several areas around the Caspian and forcing many young people to find work elsewhere.

Transportation on the move

For many years, coastal navigation has connected republics in the former Soviet Union. It used the only outlet from the Caspian, the Volga-Don canal, which connects the Black Sea and the Russian canal system to the Baltic. It is still used to transport raw materials, timber, coal, grain, fertilisers, and other products.

However, the oil boom has changed the way the Caspian Sea is used as a transport route. In the absence of an agreement on the use of the seabed, including the laying of pipelines, crude oil is transported in tanker wagons rolled onto ferries or in small tankers. This has stimulated the ferry business. The shipyards at Nizhny Novgorod have recently delivered several 8 000 or 13 000 deadweight tonnage tankers, the largest that can be used given the limitations on access to the sea and its ports. Ferry services connecting Aktau and Turkmenbashi to Baku, and Olia to the coast of Iran are being supplemented by coastal rail links, all impacting on and introducing new risks to the natural and living environment of the growing population in the coastal areas of the Caspian Sea.

The European Union's TRACECA programme (TRAnsport Corridor Europe-Caucasus-Asia) modernized the Baku-Turkmenbashi ferry line, for long the only one, and added a Baku-Aktau service to Kazakhstan. To counter competition from this new Silk Road, Russia has launched a project to build a north-south link, connecting the Baltic and Russia to Iran and the Persian Gulf. It has opened a new port at Olia, on the Volga delta, connected to the river and canal system, and to the rail network that runs parallel to the river, providing for fast container transport. It also has plans to supplement the maritime route by developing a coastal rail link, modernizing the existing track between Azerbaijan and Iran.

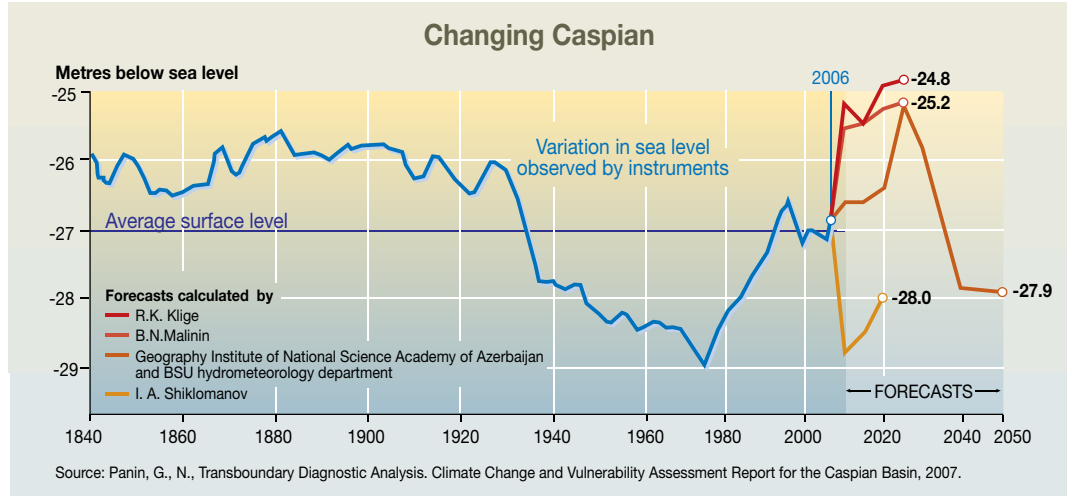
Following the gas dispute between Russia and Ukraine in January 2009 and the war opposing Russia and Georgia in August 2008, Western Europe is showing an increasing interest in Azerbaijan, in particular the proposed Nabucco pipeline project which would supply Europe with gas by-passing Russia altogether. But although keen to look west, Baku is prepared to consider alternative political and commercial options (ISS, 2009).

2 Fluctuations in the level of the Caspian Sea

The Caspian Sea is the largest closed body of water on the surface of the Earth. Its complete lack of any natural connection with the oceans makes it a very special ecosystem, and as such particularly vulnerable to external forces, such as climatic conditions or man-made changes to inflow. Fluctuation in sea level, associated with climate change, puts the environment, economic development and human security at risk.

The Caspian Sea has been endoreic – inwardly draining – since the Pliocene era (about 5 million years ago), prompting some specialists to treat it as the world's largest lake. Studies of its geomorphology and hydrology have revealed alternating cycles of rising and falling water levels, raising many questions, scientific for some, more down-to-earth for those living on its shores.

In a century, between 1880 and 1977, the level of the sea dropped four metres (from -25 metres to -29 metres below mean sea level) apart from short periods during which it rose slightly. During this time local people became accustomed to the gradual drop in the water level, carrying out all sorts of work on the shores, particularly after the Second World War: port infrastructures, roads and railways, construction of housing and holiday facilities. In the Soviet Union the dramatic drying up of the Azov Sea, a side-basin of the Black Sea, which occurred at the same time, gave rise to genuine fears that the Caspian – or at least its very shallow northern part, which is less than 25 metres deep – would in turn shrink significantly. This led to hasty, misguided decisions such as the construction of a dyke in 1983 to close the Kara Bogaz Gol gulf.

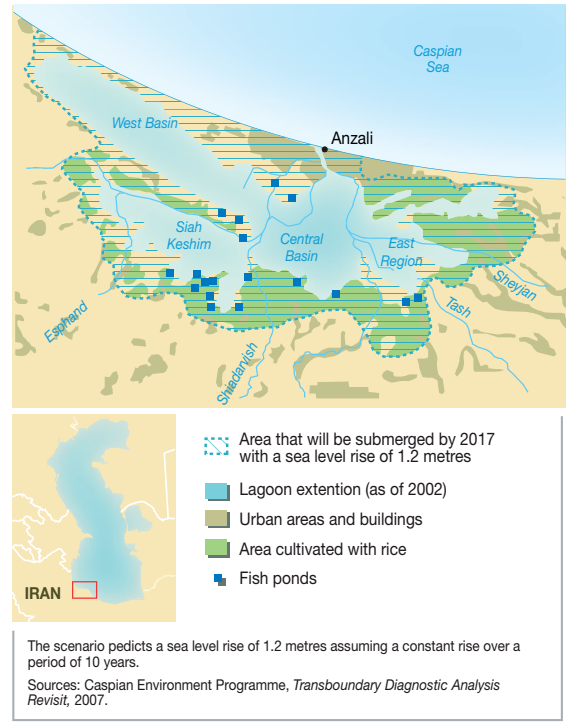


Source: Panin, G., N., Transboundary Diagnostic Analysis. Climate Change and Vulnerability Assessment Report for the Caspian Basin, 2007.

The sudden reversal of the trend after 1977, with a rise in the water level of about two metres, took many by surprise and caused widespread problems in several areas: flooding of urban facilities, destruction of roads and railways, damage to industrial infrastructure on land and offshore, and destruction of beaches. Several tens of thousands of people in the lowlands of Azerbaijan, Daghestan and the Volga delta had to move. In Azerbaijan alone, damage resulting from the rise in sea level is estimated at US$2bn. In Kazakhstan the encroaching sea has directly affected some 20 000 square kilometres of land, including the abandoned oil wells.

Fluctuating water levels will affect the population of the coastline and can cause substantial economic damage if appropriate measurements are not taken. A rise in sea level of 1.2 metres would flood Anzali, an Iranian city on the low-lying coastal plain in the south-west corner of the Caspian, and turn it into an island, according to forecasts. This would cost the city billions of dollars and cause massive population displacement. The scenario for rising sea level and subsequent events could very well repeat itself in the other major ports around the Caspian Sea including Baku. In the absence of preparedness, flooding could wreak havoc in the capital of Azerbaijan and cause billions of dollars worth of damage and untold human suffering leading to possible social unrest and conflict.

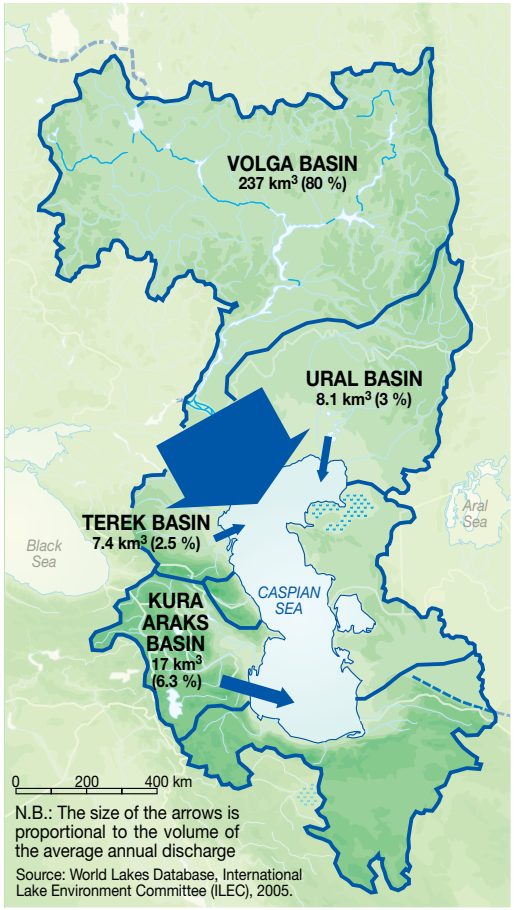
Sea level rise in Anzali Lagoon, Iran



The scenario pedicts a sea level rise of 1.2 metres assuming a constant rise over a period of 10 years.

Sources: Caspian Environment Programme, *Transboundary Diagnostic Analysis Revisit*, 2007.

Annual discharge into the Caspian Sea



Fragmentation of the Volga river over the last 60 years

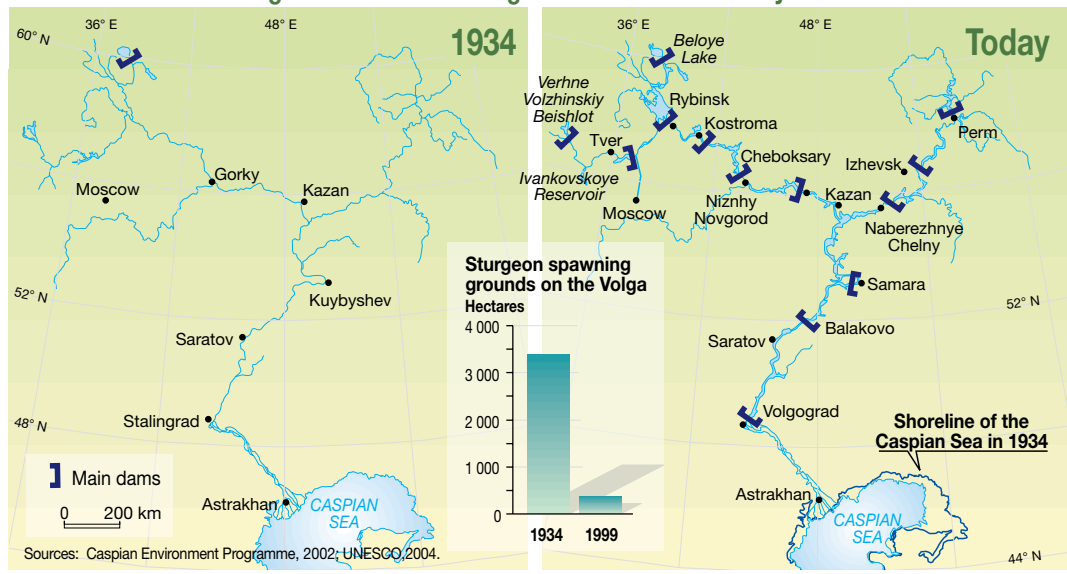


Figure: Most of the water flowing into the sea comes from coastal rivers –

currently supplying 300 to 310 km³ a year. The Volga alone accounts for 80% of inflow. But it has dropped substantially during the 20th century, declining from about 400 km³ in the 1920-30s to from 260 to 270 km³ at present, due to various climatic factors and human activities such as dams built for hydroelectric energy production. Rainfall over the sea itself is estimated to contribute 130 km³ a year. Water loss through infiltration into the ground accounts for less than 5 km³ and flow into the Kara Bogaz Gol gulf about 18 km³, since the destruction of the dyke. Natural evaporation from the sea is estimated to cause a loss of between 350 and 375 km³ a year. Combining these estimates for water input (about 440 km³) and loss (about 373 km³) suggests that the water level in the Caspian Sea should still be rising.

The factors behind the changes in the level of the Caspian Sea are still the focus of debate. Scientists have not ruled out the involvement of tectonic (movement of the Earth's crust below the sea) or geomorphologic causes (rate of sedimentation). However, these would appear to have a minor impact in comparison to changing climatic factors, combined with the effects of human management of surface water in the Caspian basin. Most of the water flowing into the sea comes from coastal rivers. The quantity and quality of this water, particularly that of the Volga, are key variables in the balance of the Caspian. To this must be added rainfall over the sea itself. Water may also be lost through infiltration into the ground and flow into the Kara Bogaz Gol gulf, but these factors are insignificant compared with natural evaporation from the sea.

The construction of a large number of dams and industrial facilities on the rivers feeding the Caspian Sea has caused a significant change in the quantity of water inflow. The creation of a succession of large reservoirs, especially on the lower and middle Volga, has led to significant losses in flow rate due to additional evaporation from the surface of the water. Coupled with unsustainable water consumption, in particular in connection with irrigation, the river flow rate is now only 10 per cent of the natural levels.

Uncertainty regarding future variations in the sea level is holding back the development of many coastal zones suitable for holiday amenities or the construction of ports. But stretches of the Caspian coast are already packed with unsustainable tourist developments. The Iranian coastal area, home to some 7 million people, has registered a 5 per cent annual increase in population over the past decade. Demographic pressure has turned the area close to the sea into residential property, despite the risk of flooding. In 2007 the government of Turkmenistan approved the start of the Avaza national tourism zone, a special economic space occupying 5 000 hectares on the shore of the Caspian. It also authorized the complete modernization of a seaport in Turkmenbashi.

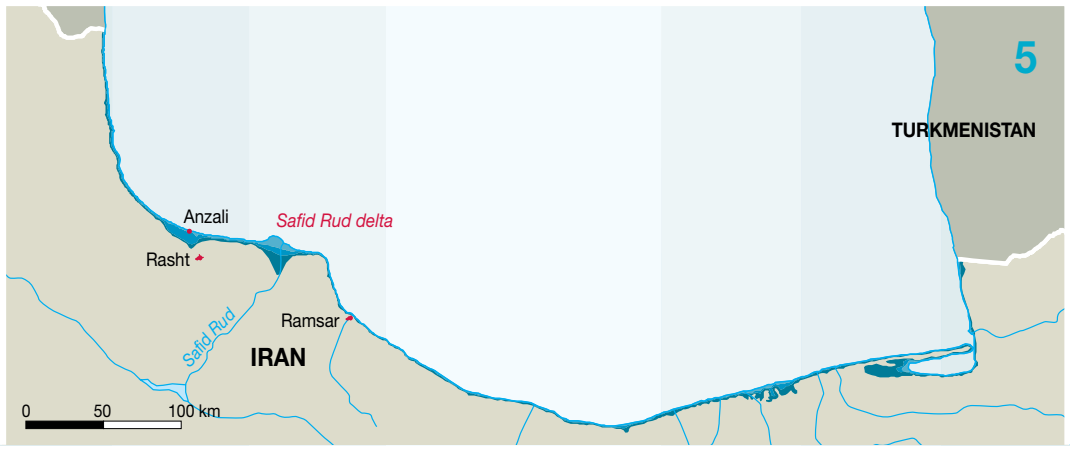
The rising sea level also complicates further offshore oil prospecting, currently expanding in the north-east corner of the sea, off the coasts of Kazakhstan and Russia. The very shallow water in this part poses problems for access and safety.

Caspian coastline vulnerable to flooding

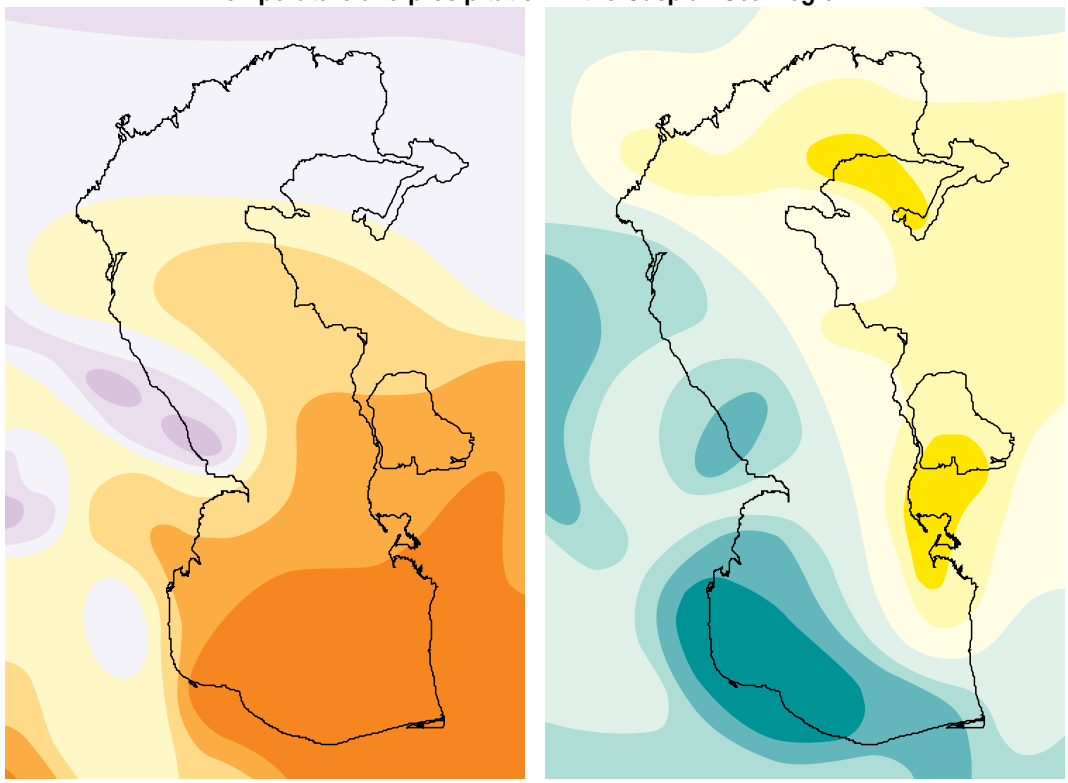
Potential inundated areas if water level rises:

- +5 metres
- +2 metres
- +1 metre
- Reference level (-27 metres)
- Qobustan — Vulnerable area in case of flooding

Source: *Transboundary Diagnostic Analysis for the Caspian Sea*, Caspian Environment Programme, 2002.



Temperature and precipitation in the Caspian Sea Region



1.5 6.5 8.5 10.5 12 14 15.5 20 °C

Mean annual temperature (°C)

90 170 220 330 500 700 1 300 1 650 mm

Mean annual precipitation (millimetres)

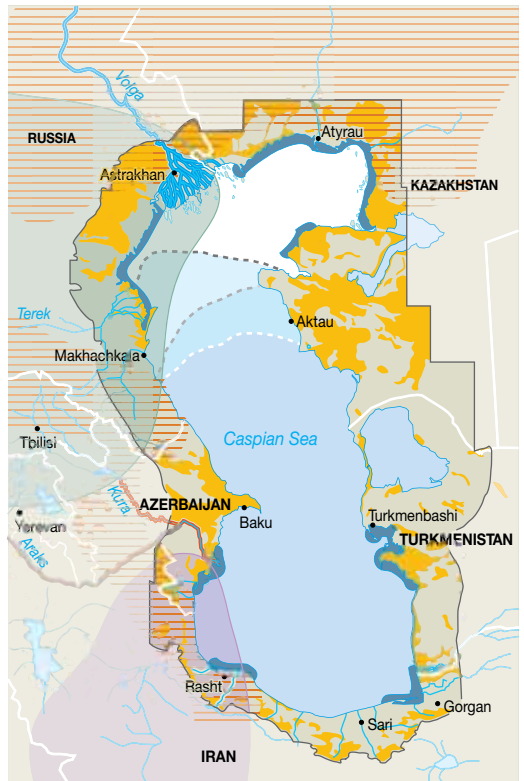
Source: UNEP/DEWA/GRID-Europe, Geneva, 2005.

Climate change

The Caspian Sea region is climatically diverse encompassing the basins of the Volga and Ural rivers in the North, the vast semi-arid and hot arid plains of northern Kazakhstan and Turkmenistan in the east, and the humid Caucasus and Elburz mountains in the south-west. The Caspian Sea plays an important role in atmospheric processes, regional water balance and microclimate.

Climatic phenomena in the Caspian are linked to the Northern Atlantic Oscillation (fluctuations in atmospheric air pressure). These variations affect temperatures, moisture and winter storms all across Europe including the Volga basin, as well as rainfall over the Caspian basin.

As in most parts of the globe, the climate is changing, with consequences for human activities and the sea itself.



Selected impacts of climate change in the Caspian basin

Coastal zone defined by the Caspian Environment Programme

On atmosphere

- Strong increase in temperature during the cold season (more than 4.5 °C) for 2070-2099 period

On land and sea

- Severe desertification
- Precipitation increase recorded in 2010
- Precipitation decrease recorded in 2010
- Risk of flooding due to storm surges and sea level fluctuation

On sea ice

- Boundaries of drifting ice during severe winters, late 1990s
- Boundaries of drifting ice during moderate winters, late 1990s
- Ice extent (including drifting ice) as of 01 February 2010

On water basins

- River runoff increasing
- Reduction of water resources due to temperature increase

Note: Precipitation variations indicate the increase or decrease between August-October 2010 and August-October's mean for 1979-2000.

0 100 200 km

Sources: Caspian Environment Programme, *Transboundary Diagnostic Analysis Revisit*, 2007; Panin, G. N., Climate Change and Vulnerability Assessment Report for the Caspian Basin, 2006; Kuderov, T., Climate Change and Vulnerability Assessment Report for Kazakhstan, 2006, and *Sea ice cover in the Caspian and Aral Seas, 2004*; Elguindi N. and Giorgi F. Simulating future Caspian sea level changes using regional climate model outputs, 2006; Global Forest Watch, on-line database, accessed on May 2010; Philippe Rekacewicz, Vital Caspian Graphics, 2006; International Research Institute for Climate and Society, maps on line, accessed november 2010; De Martino and Novikov, Environment and Security, the case of the Eastern Caspian Region, 2008. .

Several severe droughts have affected various parts of the region in recent years. They seem to confirm scientific models, which, in addition to higher mean temperatures, generally predict more extreme weather events. Droughts affect both crop production and the health of livestock. For example, the economically important Karakul sheep of Turkmenistan, which are raised for wool production, are sensitive to heat stress. In addition to the loss of agricultural productivity, droughts can increase the frequency and severity of fires, which may destroy grassland and crops.

Contrasting rainfall trends have been observed in the north and south. Whereas rainfall over Russia has increased over the last century, already dry areas such as the coasts of Turkmenistan have become even drier. Changes are also visible at the coast of Iran that becomes drier with climate change. Dust storms pick up large amounts of salt and dust as they pass over the Kara-Kum desert and the Caspian shore, depositing it in the Volga valley where it impairs the fertility of arable land.

But the availability of freshwater, on which many sectors of the economy – and human well-being – depend, is also linked to more remote climatic processes. If glaciers in the Caucasus and Elburz mountains recede and the periods of snow cover become shorter, as has been the case in recent years, less water will be available for use in irrigation and homes.

Climate change has increased the frequency and intensity of weather-related events and natural disasters such as floods, droughts, landslides, avalanches, debris flows and mud flows. For example, in the last 30 years mudflows in the Terek river basin in the north-eastern Caucasus have occurred almost annually. The most

Source: *Transboundary Diagnostic Analysis for the Caspian Sea*, Caspian Environment Programme, 2002.

destructive mudflows were recorded in 2000 and were perhaps linked to persistent above-average summer temperatures. In September 2002 the Kolka glacier near Mount Kazbek, the highest peak in the eastern Caucasus, collapsed. The water which had accumulated inside and below the glacier triggered an avalanche that travelled more than 24 kilometres at very high speed killing over 120 people. In 2003 a flood in the Ismayilli-Gobustan region of Azerbaijan affected 31 500 people.

Finally, scientists note that human-induced climate change, which has become evident in recent decades, is now playing a major part in the fluctuation of the Caspian Sea level, as well as changing the entire ecosystem. Preliminary research under the Caspian Environmental Programme linked several environmental phenomena to climate change, among others unforeseen algae bloom in 2005, changes in food chain and the morphology, increasing groundwater salinity and diminishing wetland.

The human factor

Human activities can have a powerful influence on the local climate. Widespread irrigation networks and dams are depleting the soil, exposing it to erosion. Ground water supplies are thereby reduced, which can cause the whole water regime to change. This can influence local temperatures and consequently the evaporation potential.

Oil and gas exploration activities can not only cause localised pollution of air, soil and sea, but also emissions of greenhouse gases such as methane (CH_4) and carbon dioxide (CO_2) that add to the global greenhouse effect and lead to warming of the atmosphere. It is estimated that on and offshore fossil fuel production in the Caspian area emits 15 to 20 million tonnes of CO_2-equivalent annually. The expected rise in fuel production will further increase greenhouse gas emissions unless appropriate countermeasures are taken.

Uncertain weather

It is difficult to predict how climatic changes at a global level will affect the climate of a particular region. Although climate scenarios commonly suggest warming and increased rainfall over the north of the Caspian and its vicinity, with lower rainfall to the south, there is considerable uncertainty as to the influence of the sea, the effects of the complex topography, cloud cover, and other factors.

The critical point is that there is no way of predicting whether the climate system will react in a linear way or if it will suddenly collapse in one way or another once a critical threshold is reached. As the concentration of greenhouse gases in the atmosphere increases, the temperature in the European part of the Caspian region will continue to rise, at least at first. Some researchers have recently expressed fears that the warm Gulf Stream current in the Atlantic Ocean may slow down due to the changes in the Arctic environment and oceanic circulation. As a result, the regional temperatures could drop significantly creating an extremely harsh climate.

3 Big projects, big consequences

In the 1930s, the Soviet state launched a succession of Herculean public works projects, all over the Soviet Union, to tame nature. Their aim was to facilitate access to resources and improve industrial and agricultural productivity at any cost. Gigantic dams, enormous canals and vast irrigation systems were consequently built. These massive infrastructures had a significant effect on nearby ecosystems, often inflicting lasting damage. The Caspian Sea is no exception and the work carried out in its vicinity has jeopardised its fragile ecological balance.

Numerous dams and hydroelectric power stations have fragmented the great rivers of the Volga. This has altered their hydrological regime and caused variations in the level of the sea and the intensity of sediment transport, in the Volga delta and at its mouth. It has also cut off the caviar-producing sturgeons from their spawning grounds. The 101-kilometre Volga-Don canal, which opened in 1952, links the Caspian to the world's seas. After negotiating a system involving some 15 locks, hundreds of thousands of ships have, over the last 50 years, transported oil and raw materials from the Caspian all over the Soviet Union, and to markets in Europe and the United States.

In Azerbaijan the lower reaches and mouth of the Kura river were no more fortunate. The development of a vast irrigation system, covering more than 100 square kilometres – and left without maintenance for many years – led to the destruction of farmland and polluted much of the sea along the coastline with pesticides and heavy metals, a situation aggravated by the presence upstream of the Kura-Araks system of gigantic industrial facilities (Alaverdi and Megri-Kajaran-Kafan in Armenia, Rustavi-Madneuli-Tbilisi in Georgia).

To this list we might add other plans, which never came to fruition, such as the project to transfer water from the Caspian or the Ob and Irtych rivers to the Aral Sea. However Turkmenistan is planning to extend the Kara-Kum (currently Turkmenbashi) canal by about 300 kilometres as far as the port of Turkmenbashi (former Krasnovodsk). The canal, already in very poor repair, would require a huge amount of work to operate normally. It connects the Amu-Daria river to the western regions of the country, extending over 1 300 kilometres.

The disappearing sea

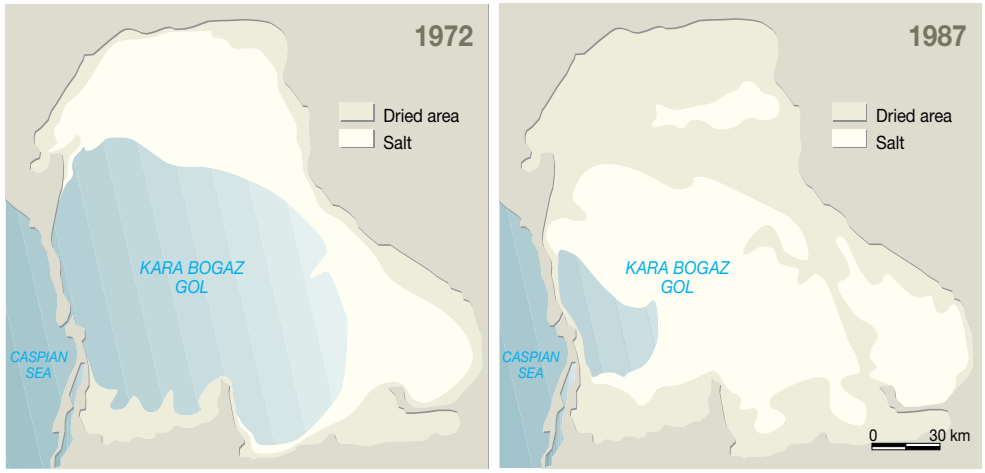
Comparing a series of satellite images from different periods a Californian hydrologist discovered in 1983 that a huge white spot had taken the place of the vast Kara Bogaz Gol gulf (literally "dark gullet" in Turkmen) in the south-east corner of the Caspian. The gulf had simply disappeared. What, he wondered, had happened? How could such a large volume of water have evaporated in just a few years, only to be replaced by a salty dustbowl?

As Frank Westerman relates in his book "Ingenieurs van de ziel", it wasn't the first time the Kara Bogaz Gol gulf had been at the centre of a mystery. For more than three centuries it has inspired extravagant tales told by local sailors. In 1727, for instance, a Russian navigator tried to explore the gulf, starting from the Caspian Sea, but gave up, because his crew saw a foaming gully, into which the sea water was rushing with untold force, and refused to go any further. A century later, in 1847, Lieutenant Jerebtsov, a maritime explorer and cartographer of the Tsar, undertook to map the contours of the Caspian, discovering, according to Konstantin Paustovsky, the gloomy coastline and entrance to the gulf. Many traders and sailors have given accounts of their terror at the entry to the Kara Bogaz Gol gulf. Awesome tales were common, peppered with claims that the inlet was a whirlpool leading to a gulf where the water disappeared

N.B.: The current level of the Kara Bogaz Gol is the same as in 1930.

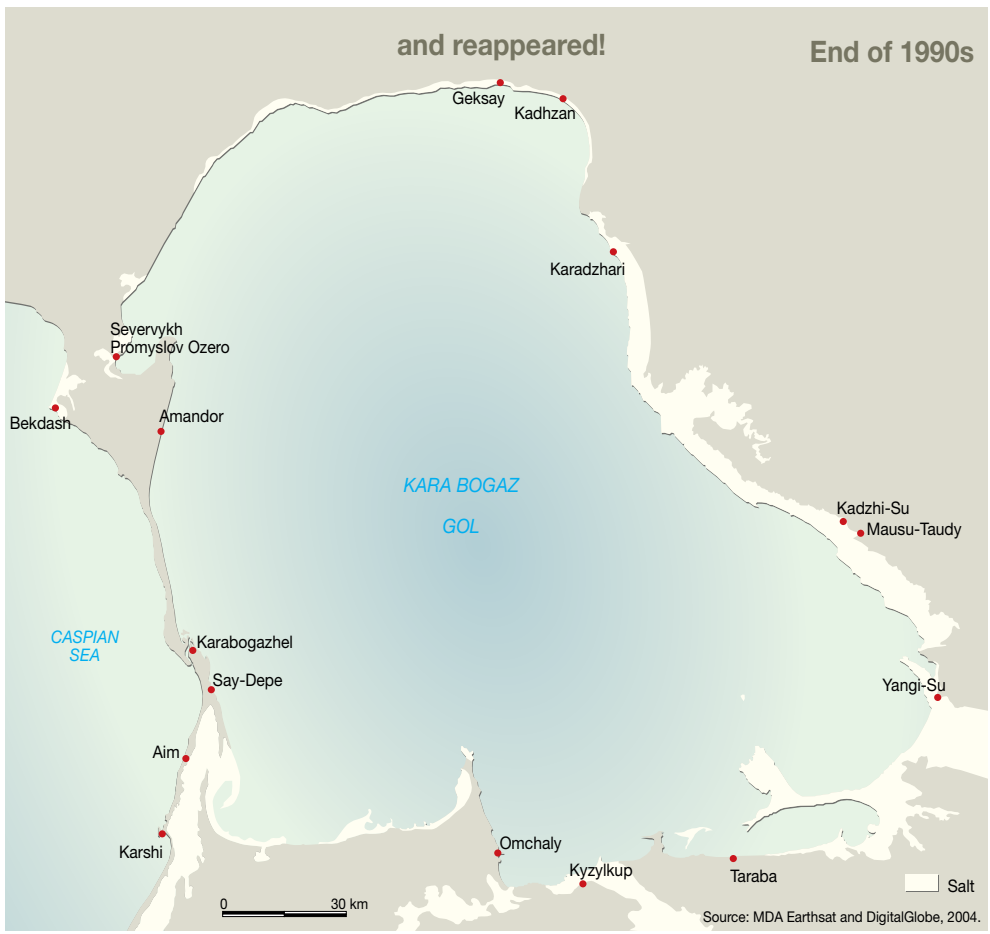
Sources: A. N. Varushchenko, S. A. Lukyanova, G. D. Solovieva, A.N. Kosarev and A. V. Kurayev, "Evolution of the Gulf of Kara-Bogaz-Gol in the past century" , in Kamlesh P. Lulla, Lev V. Dessinov, Cynthia A. Evans, Patricia W. Dickerson and Julie A. Robinson, *Dynamic Earth Environments: Remote Sensing Observations from Shuttle-Mir Missions*, John Wiley & Sons, Inc., 2000 (figure adapted from Dzens-Litovskiy, 1959).

When the Kara Bogaz Gol vanished



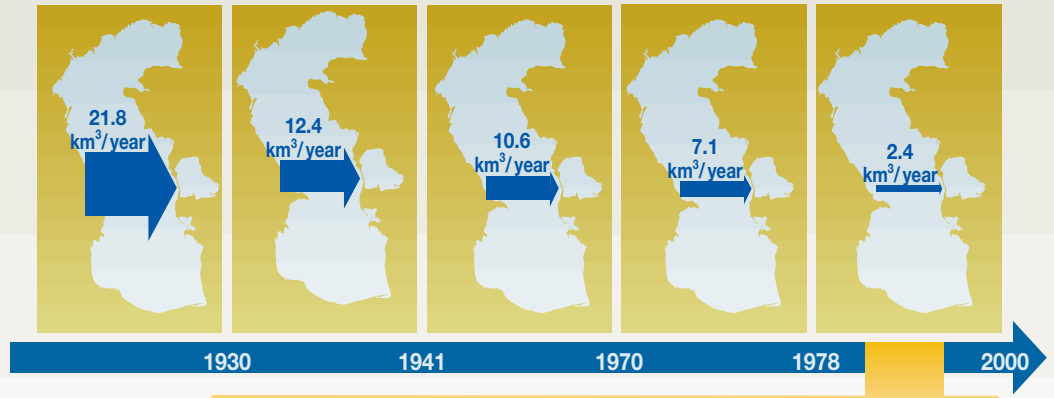
Source: Earthshots - Satellite images for environmental change, United States Geological Survey (USGS): Kara Bogaz Gol, Turkmenistan 1972, 1987.

and reappeared!



Source: MDA Earthsat and DigitalGlobe, 2004.

A century of outflow into Kara Bogaz Gol, km³/ year



The channel between the Caspian Sea and Kara Bogaz Gol was closed between 1982 and 1992. Water stopped flowing into the Kara Bogaz Gol which dried up within three years.

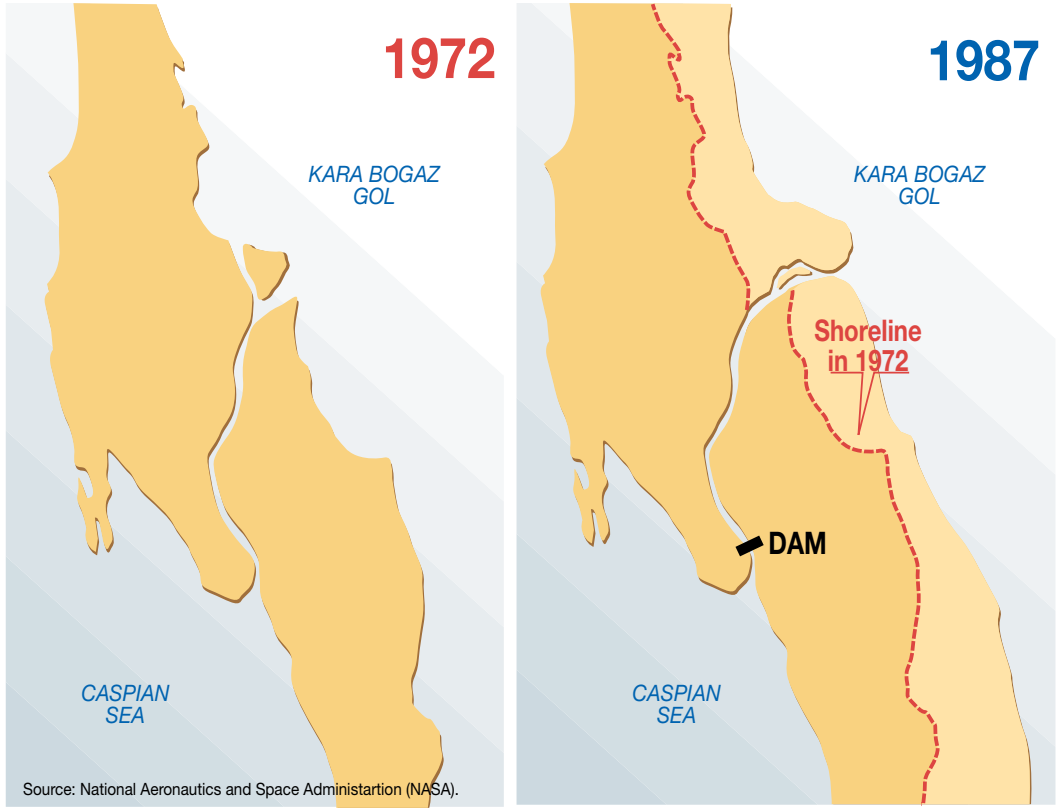
Source: Frank Westerman, *Ingenieurs van de ziel*, Atlas, Amsterdam, 2002.

into the depths. Boats sank there without trace and fishermen who ventured there were swallowed up and dissolved, as if they had fallen into an acid bath. Mariners would avoid at any price the "salty chute that made so much noise they were afraid of being dragged down into hell". But it took more than its sinister reputation to impress Lieutenant Jerebtsov. He decided to carry on through the famous narrows and subsequently described in his diary how the ship was carried forward, shaken by the powerful current, until it finally reached an expanse of calm and silent water. He discovered a "salty world" and colonies of pink flamingos.

But should we conclude that sailors in the past knew that the Caspian Sea was subject to sudden changes in level? As the water in the Kara Bogaz Gol gulf evaporates faster than it can be replaced it is always a few metres lower than its larger neighbour, which may at times have turned the narrow defile into a veritable waterfall. Be that as it may, much of the gulf's misfortunes are due to the scale and speed at which its level fluctuated and the steps taken by the Soviet authorities to control variations. The scientists were unable to agree on the reasons for the drop in sea level that was roughly equivalent to a 10 per cent reduction in its surface area between 1930 and 1977. Among the possible explanations, one was particularly favoured by the authorities in the 1970s. The gulf, they maintained, was "a useless caldron for evaporation, an insatiable mouth swallowing up the precious water of the Caspian" and obviously to blame. For the water managers this was a political issue. Kara Bogaz Gol gulf should be allowed to die a hero's death, like a soldier at the front. The lagoon should be sacrificed so that the water, now so rare, could be used elsewhere, said the deputy minister in charge of water and forests. The suggestion prompted a disagreement with the Ministry of Chemical Industry, which was exploiting the mirabilite found there, the region being the Soviet salt industry's main centre.

It was decided to close the passage. Work proceeded in February 1980 despite the fact that the level of the Caspian had started to rise again three years earlier.

The inlet to the Kara Bogaz Gol before and after construction of the dam



Source: National Aeronautics and Space Administartion (NASA).

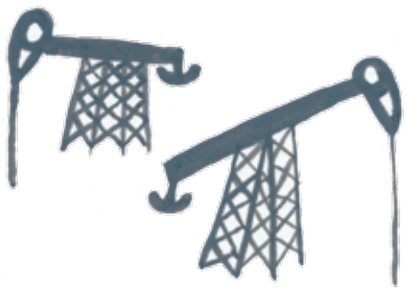
The Soviet engineers apparently assumed it was only a temporary change. Only a narrow canal was left allowing a small amount of water to pass, thanks to which the water in the Kara Bogaz Gol gulf was expected to last a further 25 years. Much to everyone's surprise the gulf dried up 10 times faster than had been forecast by the Water Problems Institute and by autumn 1983 it was all over. The pink flamingos died in droves, the little brine shrimp on which they fed having disappeared. The lagoon turned into a vast desert covered with a 50-centimetre layer of precipitated salt, which was picked up by the wind and blown for hundreds of kilometres, as far as the Chernoziem (fertile soil) area of Russia, raising the salt content of the soil. With the closure of the strait, the gulf also stopped acting as a natural hydrological regulation system (keeping the salt content at a relatively low level). The ensuing increase in the salt content of the southern part of the Caspian, to levels exceeding 15 grams per litre, had disastrous consequences for the sturgeon population. In the spring of 1992, in view of the scale of the disaster, Turkmenistan, which had just declared its independence, decided to recover the Kara Bogaz Gol gulf from the desert. It therefore destroyed the dyke, restoring the connection between the sea and the gulf.

In the meantime closing the gulf had resulted in the collapse of the salt industry. The area around the Kara Bogaz Gol gulf nevertheless remains the world's biggest source of the raw material for the chemical industry. Exploitation started at the beginning of the 20th century along fairly traditional lines and only switched to more industrial techniques in the early 1930s. Annual production capacity is enormous: 400 000 tonnes of mirabilite (a hydrous sodium sulfate mineral) (used in the glass industry, feed for livestock and detergents), 100 000 tonnes of bischofite (a defoliant used for machine-harvesting of cotton), 35 000 tonnes of epsomite (used in paper-making, tanning – to treat leather – and the textile industry), 10 000 tonnes of glauberite (pharmaceutical industry) and 20 000 tonnes of sodium chloride (cooking salt). From the 1930s onwards the drop in the level of the Caspian and the change in the chemical conditions led to deterioration in the quality of the salt. As the brine thickened it accelerated precipitation of the salt as sodium chloride, a less valuable product than sodium sulphate. In the 1940s and 1950s the industry switched from the exploitation of open-air reserves to underground resources trapped below several metres of sediment.

The story almost came to a happy end. After destruction of the dam, the water flowed in at a rate of 700 cubic metres a second and it only took a few months to refill the lagoon (during which time the level of the Caspian happened to go on rising). The crust of salt dissolved and the pink flamingos, ducks and pelicans returned. The Kara Bogaz Gol gulf almost completely recovered its ecological balance. Only the chemical industry, which depended on a system of management that had disappeared, did not survive this unusual episode in the life of the lagoon.

Sea surface salinity

Source: Caspian Environment Programme, 2002.



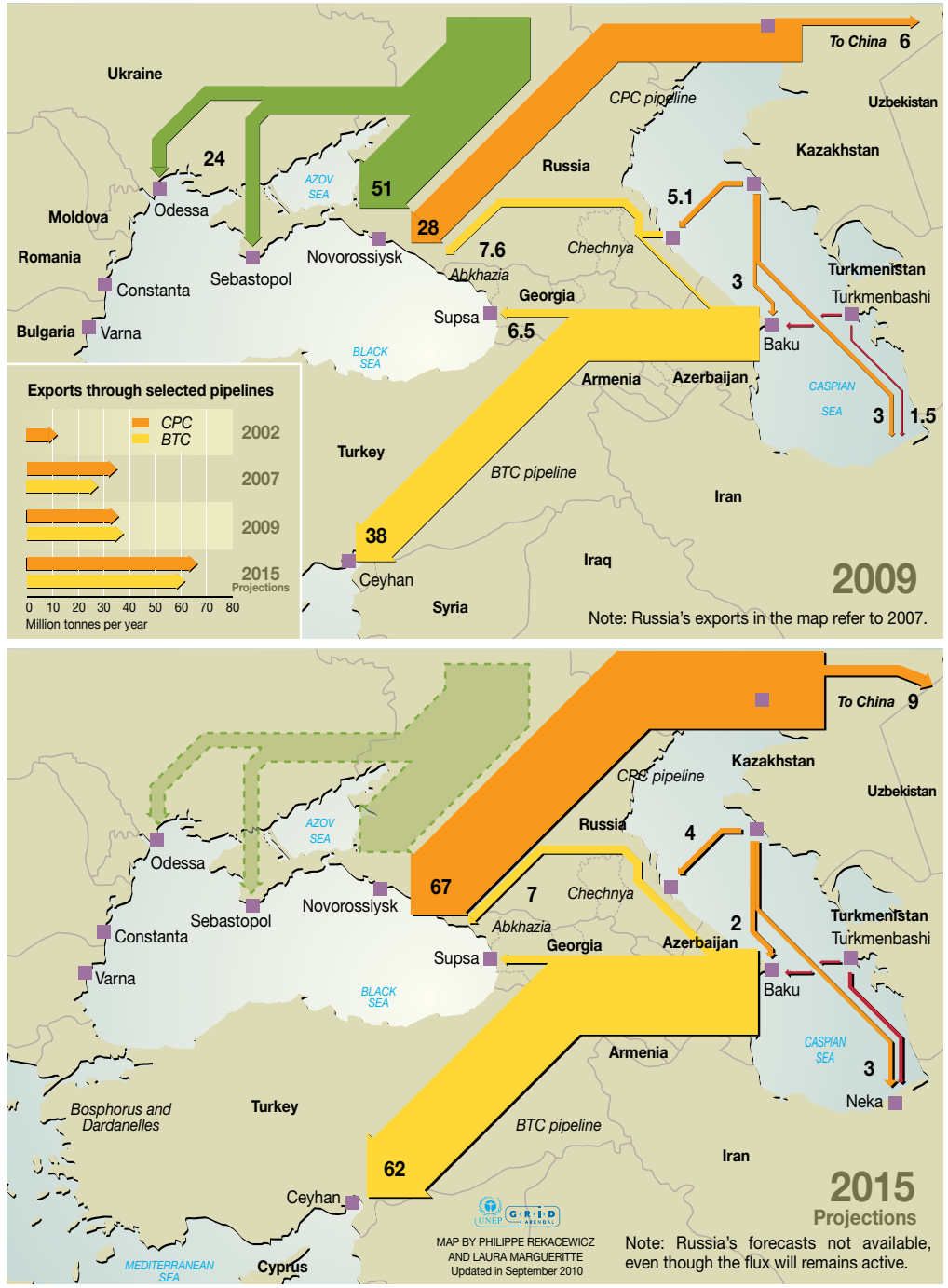
4 The marks of human activity

Oil slicks glittering on the surface of the sea and thousands of hectares of soil penetrated by leakage from abandoned wells are just part of the pollution that people living around the Caspian Sea must endure. In addition there are various industries, particularly chemicals and mining, large-scale irrigated farming and untreated household waste. Combined with the effects of the oil, all these forms of pollution have a serious impact on the well-being of humans and wildlife.

Many opportunities are offered by the Caspian Sea region. It is important that they are handled with care in order to maintain the rich biological and mineral resources over a long time. The natural wealth of the region around the Caspian Sea in mineral resources also involves high metal concentrations. Industrial activities, in particular mining, are raising the metal concentration in sediments to levels exceeding permissible limits.

The increased activity on oil drilling platforms and the extension of transport options is important for economic development and employment. But if it is not managed sustainably it is bound to heighten the risk of accidents at sea. Exploitation of the offshore reserves in the northern part of the sea, where the water is very shallow, involves specific risks. Depending on the season (ice forms in some places in winter) access may be very difficult in the event of an accident.

Oil exports via The Black and Mediterranean Seas



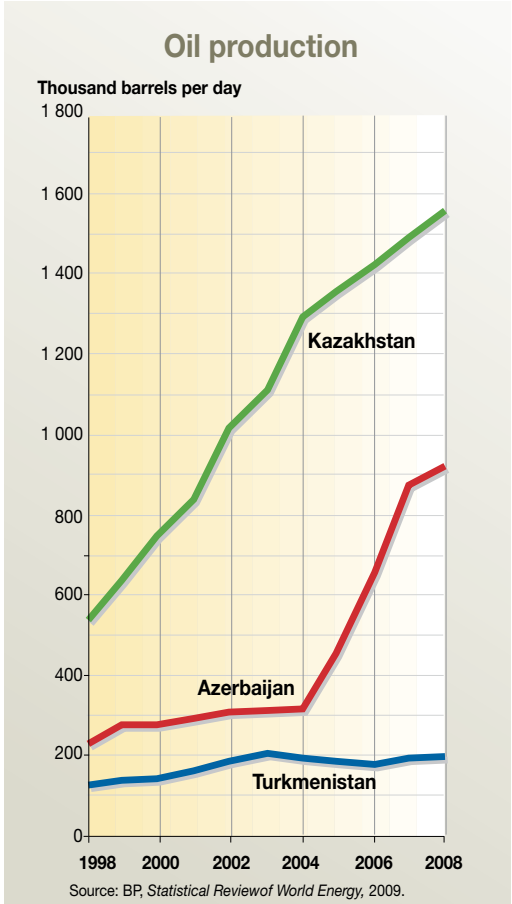
Source: vv, Oil Flows and Export Capacity in the Caspian Sea and Black Sea Regions, 2008; IEA, World Energy Outlook 2010; EIA on line database, 2008.

Until now, however, in the absence of particular accidents or incidents, the land-based activities of the oil and gas industry have had a much more severe impact on the environment than marine activity. In particular the growth in hydrocarbon-related activity has negatively affected the environmental balance of whole areas throughout the region. In the past, the hydrocarbon industries generated toxic by-products, which in many places were not properly stored or have already been dispersed into the surroundings, as for example in some parts of the Absheron peninsula and around the city of Aktau.

The crude oil and gaseous condensates from the North Caspian oilfields have a very high sulphur content. The refining process, in particular to produce liquid petroleum gas, leaves large mounds of sulphur deposited in the open where it contaminates the surrounding environment. Large amounts of toxic gas are released into the atmosphere too. Due to toxic pollution some settlements even had to be relocated. In Kazakhstan more than 10 million tonnes of sulphur have accumulated near the Tengiz oilfield, as a by-product of crude oil extraction. This pollution has forced the evacuation of two villages – Karaton, Sarykamysh and Ken-Aral 20-40 kilometres from the oilfield.

Often, once the oil extraction activity stops, waste remains and constitutes a hazard. In Kazakhstan there are 19 oilfields with 1485 oil wells in the coastal zone of the Caspian Sea, including 148 in the flooded zone. Drilling technology in the 1960s to 1980s did not account for the corrosive nature of seawater and its effects on metal casing and lay head. Over time, wells have become considerable sources of marine pollution. Some 600 000 hectares of land in the Atyrau and Mangystau Oblasts of Kazakhstan are polluted with a thick layer of oil penetrating the soil to a depth 8 to 10 metres and polluting the ground water.

About 30 000 hectares of soil on Azerbaijan's Absheron peninsula is polluted by oil products and various forms of industrial waste. In 2008 the World Bank approved three projects under the Absheron Rehabilitation Programme (ARP) that will improve environmental conditions.



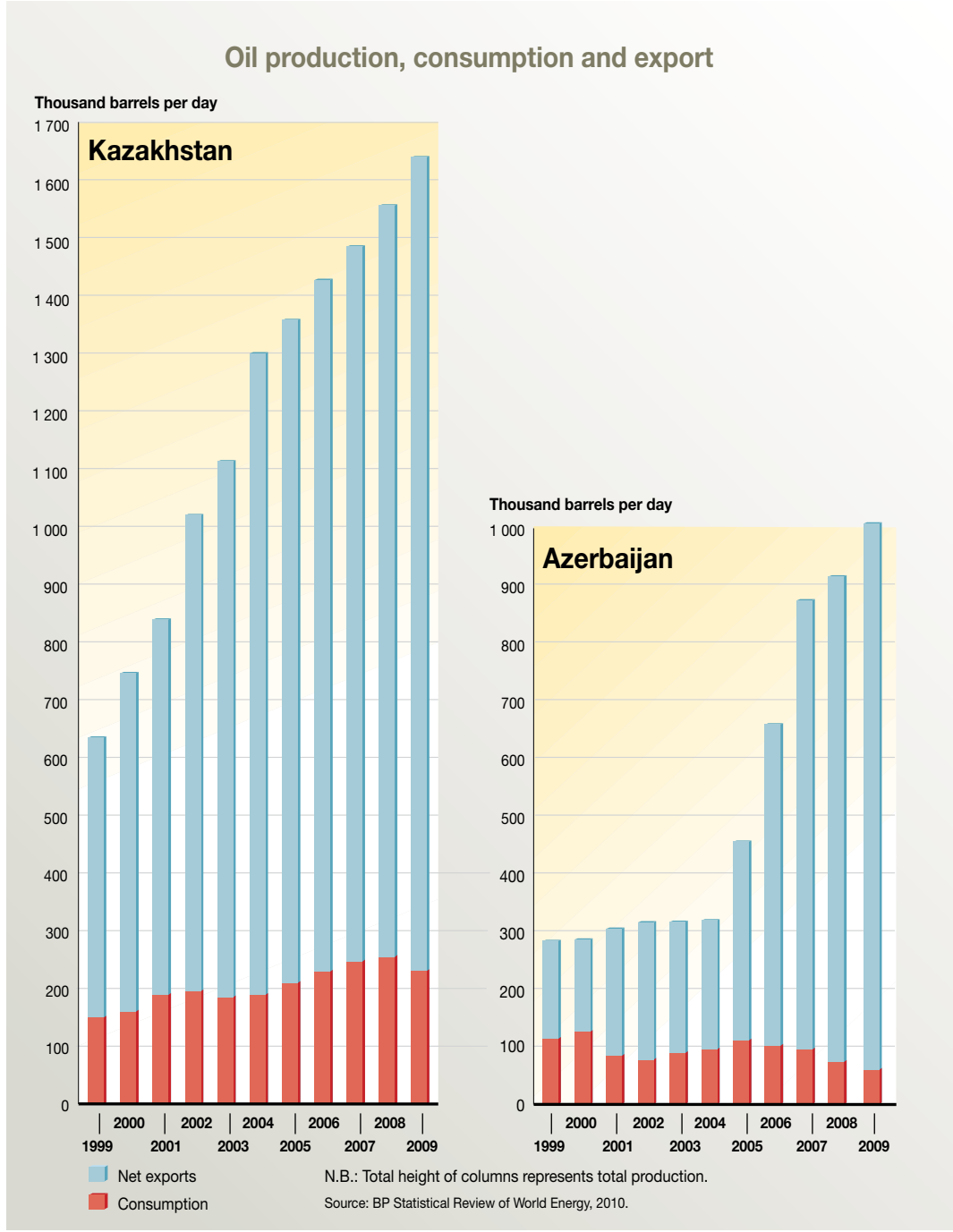
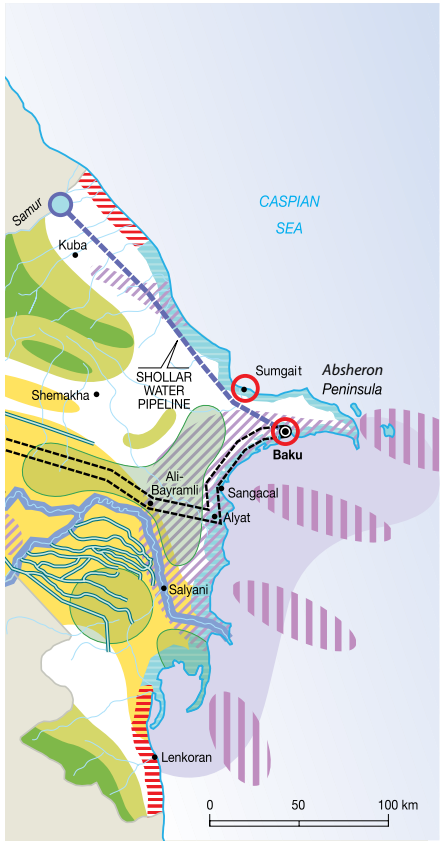


Figure: Oil production in Azerbaijan, Kazakhstan and Turkmenistan.

The region has significantly expended its oil and gas production, and it is set to grow. The increases in outputs so far have been associated with, and encouraged by, an emerging diversity of export routes and markets, supported by large investments.



Land degradation

- Soil degradation and erosion: pollution due to pesticides and/or heavy metals. Salinisation due to poorly maintained irrigation system and rise of water table
- Area affected by deforestation

Pasture degraded by overgrazing

- Summer pasture
- Winter pasture

Pollution due to oil production and industrial activities

- Soils contaminated by pollution from oil production
- Obsolete Soviet drilling platforms threatened by Caspian Sea level rise.
- Dispersed oil pollution
- Large ageing Soviet industrial complex still generating pollution (mines, chemical and cement factories, thermal and metallurgical plants). Significant heavy metal contamination (soil and water).

Water issues

- Transboundary polluted waters

Caspian Sea level rise

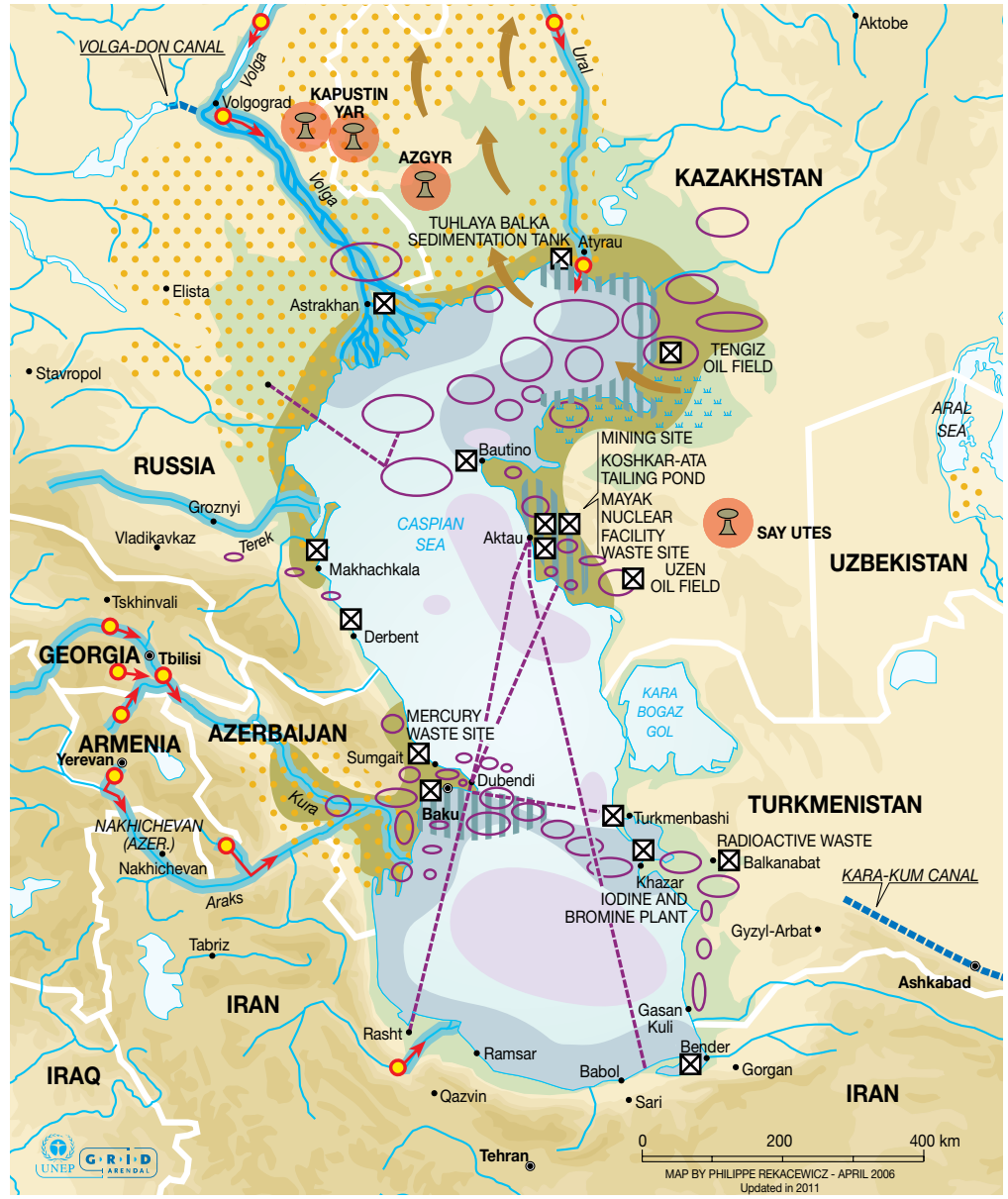
- Coastline already submerged (destruction of certain infrastructure)
- Coastline at risk of flooding
- Drinking water canal
- Tension between Russia and Azerbaijan due to diversion of water from Samur River
- Decaying Soviet irrigation infrastructure damaging soil

Transportation and communication

- TRACECA (Transport Corridor Europe Caucasus Asia): Renovated or new multimodal transportation corridor (road, railroad, pipeline) and BTC (Baku-Tbilisi-Ceyhan): main oil pipeline route

MAP BY PHILIPPE REKACEWICZ - UNEP/GRID-ARENDAL - JULY 2004

Hazards in and around the Caspian



Topography, metres

Below sea level
0
200
500
1,000
2,000
3,000
4,000

- Oil and gas drilling
- Projected off-shore pipelines
- Oil wells flooded and leaking
- Area under exploration for oil and gas (high potential)
- Polluted sea (oil, pesticides, chemicals, heavy metals or bacteriological pollution)
- Polluted soils and land degradation
- Soil salinisation
- Polluted rivers (industry and municipal sewage water)
- Land-based source of river pollution (mainly heavy industries)
- Identified poorly stored hazardous industrial waste site or polluting industrial activities
- Former nuclear testing site
- Main direction of sandstorm causing salt transfers toward arable lands of the Volga region

Sources: National Caspian Action Plan of Azerbaijan, 2002; National Action Programme on Enhancement of the Environment of the Caspian Sea, Kazakhstan 2003-2012; *Environmental Performance Review of Kazakhstan*, UNECE, 2000; *Environmental Performance Review of Azerbaijan*, UNECE, 2003; *Study for Safe Management of Radioactive Sites in Turkmenistan*, NATO, 2005; *Environment and Security: Transforming Risks into Cooperation, Case of Central Asia*, UNEP/UNDP/OSCE, 2003 ; *Global Alarm: Dust and Sandstorms from the WorldTs Drylands*, UNCCD, 2001; IEA, World Energy Outlook 2010.

Pesticides and heavy metals in sediments

- Sampling areas
- **DDT** concentration above ERL (1 600 pg/g)
- **Lindane** concentration above ERL (300 pg/g)

- Sampling areas
- **Nickel** concentration above ERL (21 µg/g)

N.B.: Maximum nickel concentration in analyses measured was 68 µg/g.

- Sampling areas
- **Chromium** concentration above ERL (81 µg/g)

N.B.: Maximum chromium concentration in analyses measured was 128 µg/g.

The Effects Range Low (ERL) is an indicator of concentrations above which adverse effects occur (National Oceanic Atmospheric Administration (NOAA) Marine Sediment Quality Guideline Values).

Source: Interpretation of Caspian Sea Sediment Data, Caspian Environment Programme, 2002.

- Sampling areas
- **Arsenic** concentration above ERL (8.2 µg/g)

Note: Maximum arsenic concentration in analyses measured was 22.6 µg/g

- Sampling areas
- **Mercury** concentration above ERL (0.15 µg/g)

Note: Maximum mercury concentration in analyses measured was 0.45 µg/g

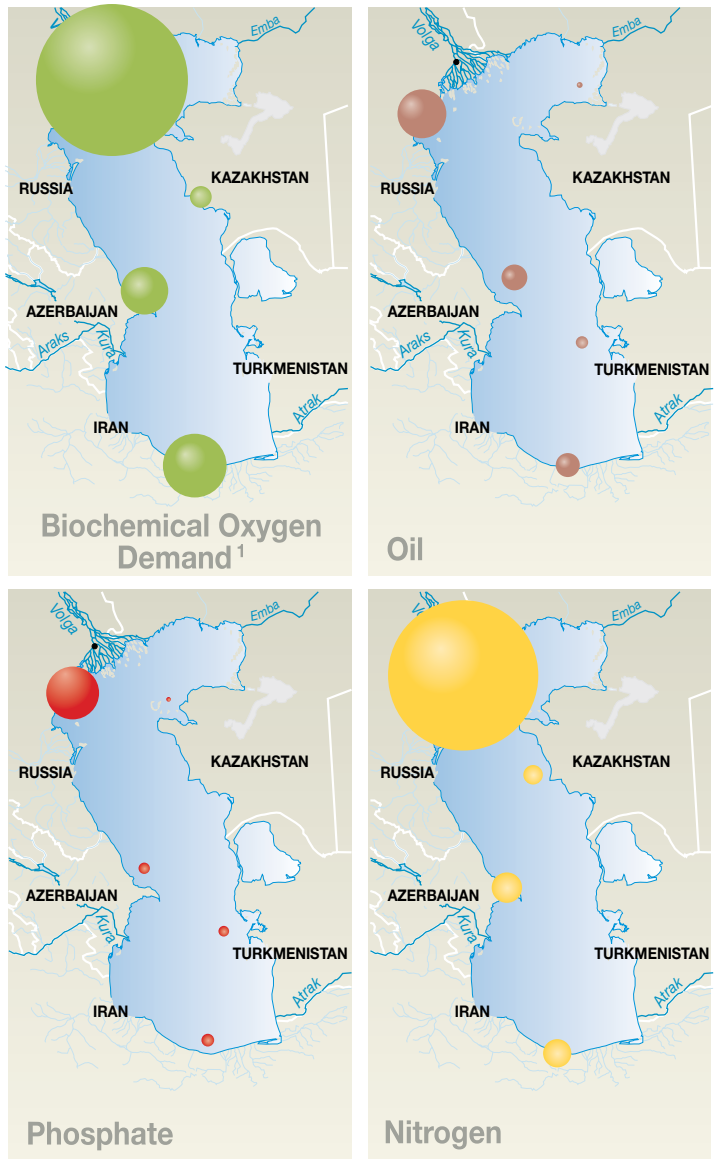
- Sampling areas
- **Copper** concentration above ERL (34 µg/g)

Note: Maximum copper concentration in analyses measured was 57.6 µg/g

The Effects Range Low (ERL) is an indicator of concentrations above which adverse effects occur (National Oceanic Atmospheric Administration (NOAA) Marine Sediment Quality Guideline Values).

Source: Interpretation of Caspian Sea Sediment Data, Caspian Environment Programme, 2002; Transboundary Diagnostic Analysis Revisit, 2007

Discharge of selected pollutants



1. Measure determining the extent to which oxygen within a sample can support microbial life.

Source: CEP, Caspian Water Quality Monitoring and Action Plan for Areas of Pollution Concern, 2009.

Imported problems

The Volga, the main river flowing into the Caspian, brings polluted water from locations as far as 3 500 kilometres away. Nearly 45 per cent of the Russian industry and 50 per cent of its agricultural production are located in the vast river basin. Inadequately treated waste water – among others from the entire Moscow urban area and industrial centres such as Ekaterinburg and Perm – spills into tributaries of the Volga. Any waste that does not silt up behind a dam or soak into the Volga estuary ends up in the Caspian.

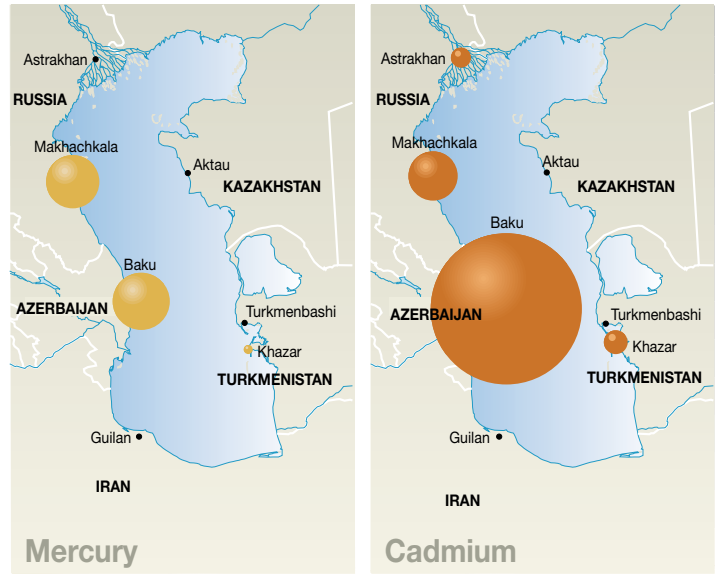
The situation at the mouth of the Kura-Araks River on the Absheron Peninsula is similar, with a rising pollution load accumulating on the way through Georgia and Armenia. It then combines with the waste from two-thirds of Azerbaijan's industrial production and more than a third of its population. The wastewater treatment facilities serving the major urban areas of Baku and Sumgait are not up to the task, unable to cope with the rapidly growing population.

Air quality has generally improved in recent years, mainly because industrial production has dropped drastically since the collapse of the Soviet economic system. But increasing emissions from the expanding oil and gas sector, and a growing number of cars in cities, not only affect the health of local people but contribute to the accumulation of greenhouse gases in the atmosphere, in turn driving observed trends in global warming.

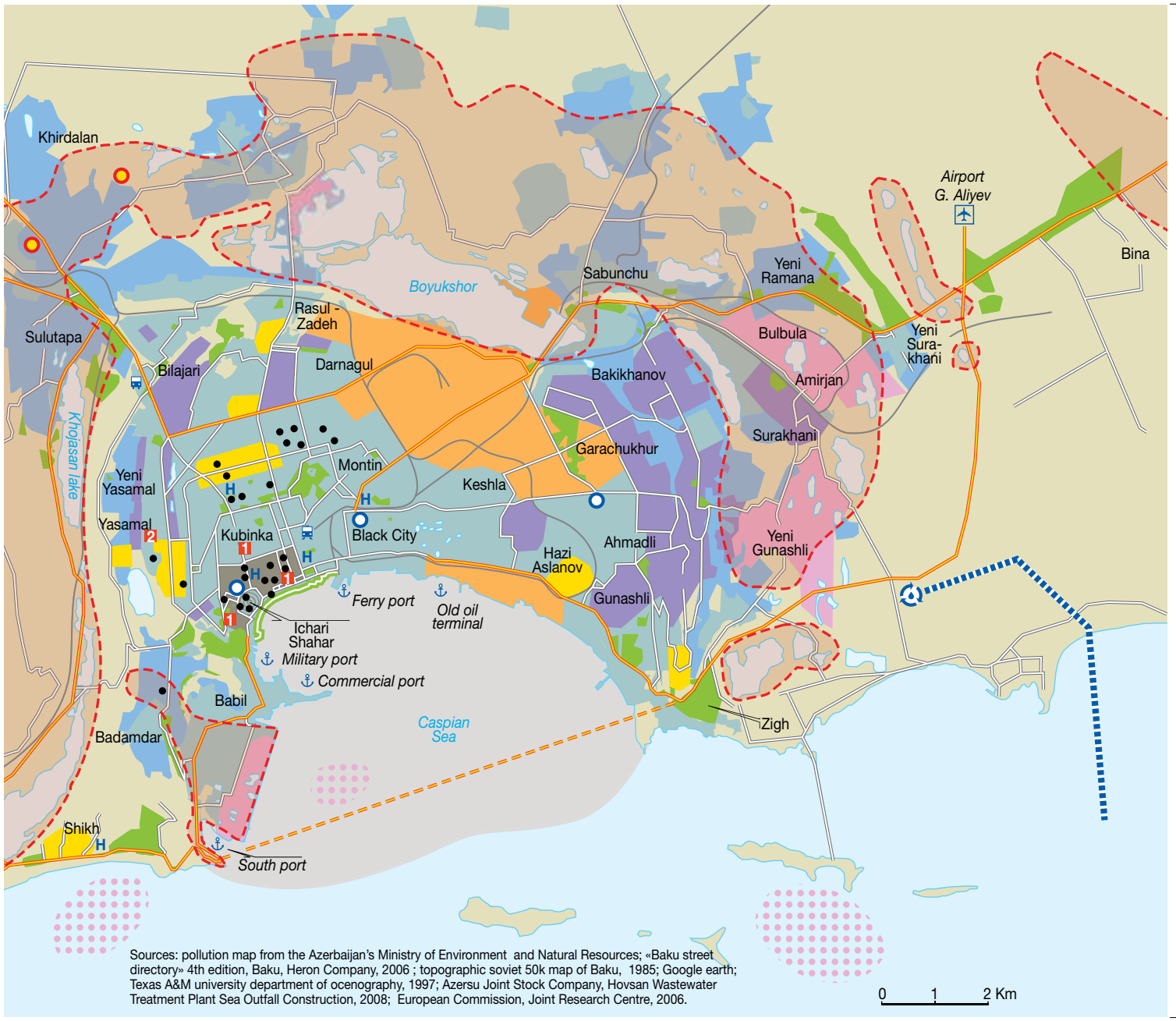
The type and severity of pollution must be deduced from analysis of data from selected cases. They provide an indication of accumulated pollution. For example, traces of the pesticide DDT in fish tissue and seals lead to the conclusion that DDT may be still in use despite an international agreement to stop its application, with the risks it involves for animals and humans. Azerbaijan, Iran and Kazakhstan have ratified or adhered to the Convention on Persistent Organic Pollutants and Russia has signed it. The convention seeks to ban chemicals that are absorbed by fatty tissue and accumulate there, as is the case for DDT, enabling them to travel long distances. The drastically restricted use of DDT raises a new problem: the unused material is stockpiled without the necessary safety measures, and as such poses an additional health and environmental hazard.

The accumulation of pollution from all these different sources and the fact that several countries are involved makes it particularly difficult to manage.

Discharge of selected pollutants



Source: Caspian Regional Thematic Center (CRTC) for Pollution Control: coastal and offshore industry, Azerbaijan, Febuary 2003.



Sources: pollution map from the Azerbaijan's Ministry of Environment and Natural Resources; «Baku street directory» 4th edition, Baku, Heron Company, 2006 ; topographic soviet 50k map of Baku, 1985; Google earth; Texas A&M university department of ocenography, 1997; Azersu Joint Stock Company, Hovsan Wastewater Treatment Plant Sea Outfall Construction, 2008; European Commission, Joint Research Centre, 2006.

Urban development

- Big hotels
- Railway stations
- Bus station terminal
- Big commercial malls
- Government buildings
- University
- Main city roads
- High speed roads
- Projected bridge across the gulf
- Seafront promenade
- Foreign embassies
- Inner old city
- "Destructured" historic town
- Mixed construction building areas (as in 1985)
- "Big soviet blocs of flats"
- New construction building areas (from 1990 to 2006)
- "Gentrified" areas
- Parks and green areas
- Main industrial areas

Hazards and consequences on environment

- Mud volcanoes Dangerous mud flows
- Heavily polluted land and waters due to oil extraction, industrial waste and mining
- Dead sea zone
- Oil extraction areas
- Offshore oil rigs
- Projected wastewater treatment plant...
- ... and sea outfall pipeline

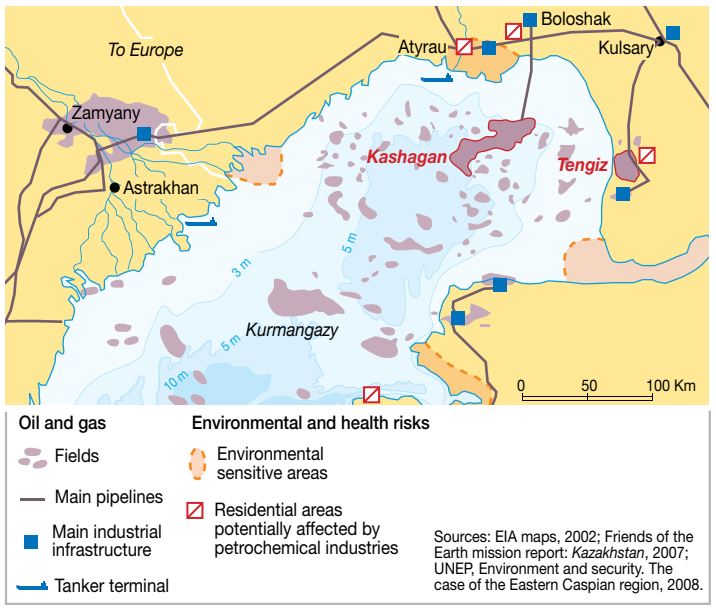
The Azerbaijan capital Baku

Northern Caspian oilfields – Kashagan and Tengiz, Kazakhstan

The giant Kashagan offshore field was discovered in July 2000, 80 kilometres south of Atyrau. It is the largest Caspian offshore field and one of the largest fields discovered anywhere in the world in the past 30 years. Named after a prominent 19th century Kazakh poet, it covers an area 75 kilometres long and 45 wide. The Kashagan field was formed 350 million years ago in shallow warm sea conditions, lying below salt fields at a depth of 4 000 to 4 500 metres. The oilfield is estimated to contain reserves of about 38 billion barrels, 9 to 13 billion of which can be extracted using the gas re-injection method. Analysts hope that Kashagan will prove to be one of the world's largest offshore fields and also provide a reliable indicator of the Caspian's potential oil supply (German, 2008). Its oil is characterised by very high pressure (800 bars), temperature (125°C), hydrogen sulphide content (15-20%), and the presence of naturally occurring toxic substances (mercaptanes). This creates major logistical difficulties and could even turn a small emergency into a large environmental disaster. For example, in 2000 and 2001, minor emergencies during exploratory drilling reportedly led to the discharge of pollutants into the sea. In August 2007 the Ministry of Environmental Protection of Kazakhstan stopped exploration of the Kashagan oilfield due to alleged violations of environmental legislation. On 14 January 2008 a new Memorandum of Understanding was signed between the companies in the Kashagan consortium.

The estimated cost of developing the Kashagan field is likely to rise from US$50 billion to more than US$136 billion, with the start of operations now delayed from 2008 to 2013. Oil and gas production at the Kashagan field will be based on several artificial islands, currently being built. An underwater pipeline will transport hydrocarbons to the Boloshak oil and gas terminal 30 kilometres from Atyrau. It is estimated the oilfield will operate for 30 to 40 years. If all goes according to plan Kashagan oil output should increase from an initial 75 000 barrels a day to 1.2 million barrels a day (more than 55 million tonnes a year) at the peak of production in 2015-2045. For the sake of comparison, in 2006 total oil production in Kazakhstan amounted to 1.43 million barrels a day, with 0.22 million barrels daily consumption (BP, 2007). Overall, in the coming decades, offshore energy production in the Kazakh sector of the Caspian Sea could jump from almost zero to more than 88 million tonnes of oil and 80 billion cubic metres of gas a year (Atyrau Oil and Gas, 2007). Bautino Base, located in the Mangystau province 265 kilometres south of the Kashagan field, is the main maritime support base and oil-waste recycling centre.

North Caspian giant oilfields



Tengiz, another giant oilfield (size 19 x 21 km) was discovered in 1979, but large-scale exploitation only started in 1993 due to technology problems similar to those encountered at Kashagan. The Tengiz field is expected to contain about 3 billion tonnes of oil and will be exploited over the next two decades. In 2006 oil output from the Tengiz field amounted 291 000 barrels a day. By 2008-2010 the volume of oil production is scheduled to double. A new processing plant is planned to come online by then.

One of the main problems encountered on Tengiz is that sulphur accumulates during oil and gas extraction at the rate of more than 5 000 tonnes a day. Yet the total storage capacity currently is 9 million tonnes (Ministry of Environment Protection of the Republic of Kazakhstan 2007). This means that with lower demand for sulphur and fewer exports the heap of sulphur stored in the open air may continue to increase, prompting concerns among local authorities and in the community. The Kazakh environmental authorities have recently imposed a US$309 million fine on TengizChevroil (TCO) – the field operator and a Chevron-led venture – for breaches of environmental regulations – including stockpiling sulphur.

In 2006 local authorities and TCO carried out an assessment of environmental and health effects of storing sulphur in the open air at Tengiz. The Kazakh Institute of Oil and Gas admitted that increased sulphur accumulation and storage could raise environmental pressures, and risks for public and occupational health. With the introduction of stricter environmental targets, modernization of production methods and facilities, gas flaring on the Tengiz field was reduced from 1 800 million cubic metres in 1999 to 420 million cubic metres in 2006 (TCO Environmental Bulletin 2006). Further cuts in this type of pollution are planned after 2008, when a new plant will start producing granulated and block sulphur using the deposits stored on the Tengiz oilfield. Finally the new ecological legislation (Environmental Code of Kazakhstan 2007), coupled with stricter enforcement, will also contribute to improving the situation in the region.

On the other hand changes at Kashagan and Tengiz indicate that the Kazakh authorities – perhaps following the Russian example on the Sakhalin-2 oilfields in Siberia – seem to be stepping up pressure on energy multinationals operating in the Caspian region.

Ref.: The Environment and Security: Transforming risks into cooperation. The Case of the Eastern Caspian Region, 2008

Koshkar-Ata lake

The hazardous legacy of an uranium mine

Koshkar-Ata is one of the largest industrial tailings in the world occupying an area of approximately 77 square kilometres. Located in a natural depression about 5 kilometres from the outskirts of the Kazakh town of Aktau and 8 kilometres from the shore of the Caspian Sea, the enormous dump is a serious environmental and health hazard.

Before industrial operations started in the 1960s, the Koshkar-Ata hollow was a periodic lake rich in natural salt, making it unsuitable for farming. The discovery of vast uranium deposits in the deserts of western Kazakhstan lead to the establishment and rapid development of a uranium extraction and processing industry. At its peak in the 1980s Kazakhstan was producing more than a third of Soviet uranium, with more than 30 uranium mines.

The Koshkar-Ata depression was chosen as a convenient location to accumulate radioactive and toxic waste from the chemical and hydrometallurgical complex in the newly founded city of Shevchenko (now Aktau, with about 176 000 inhabitants). The complex produced, among others, uranium concentrate mostly for Soviet military purposes. Falling prices on the uranium market due to changes in military priorities, gradually decreasing uranium concentrations in the mines and the overall

economic crisis in the post-Soviet world of the 1990s led to reduced output and ultimately complete stoppage of uranium milling in 1999. The lake is still used as a dumping ground for commercial and production waste, oil extraction sludge, etc.

In the years of uranium production, 356 million tonnes of mining waste with a total radiation activity of 11 242 Curie were channelled into the Koshkar-Ata tailing pond. Uranium mill tailings with low to medium-level radioactivity account for almost 105 million tonnes of the total. Significantly increased exposure rates at 80 to 150 micro roentgen per hour (μR/h) were measured in the southern part.

To prevent the wind from dispersing radioactive waste, it was kept immersed underwater. About half the tailing surface is currently covered with water from industrial operations, but it is estimated that the tailing pond will dry out in a few years due to high evaporation and the lack of water, with no more wastewater flowing in from the shut-down factories. An estimated 24 square kilometres of the tailing bottom has dried up and is already exposed to the air. This part has the highest concentration of contaminants, covered with solid waste emitting high levels of radioactivity. Constantly swept by strong winds, there is a serious risk of pollutant dispersal. Large amounts of phosphoric gypsum, a by-product of fertiliser production, have been discharged into the lake and the gypsum has formed a crust on the surface, preventing dusting and the escape of radon. As a result, dispersal of dust-blown substances and radon emissions are limited, and local scientists conclude they do not currently constitute a health hazard.

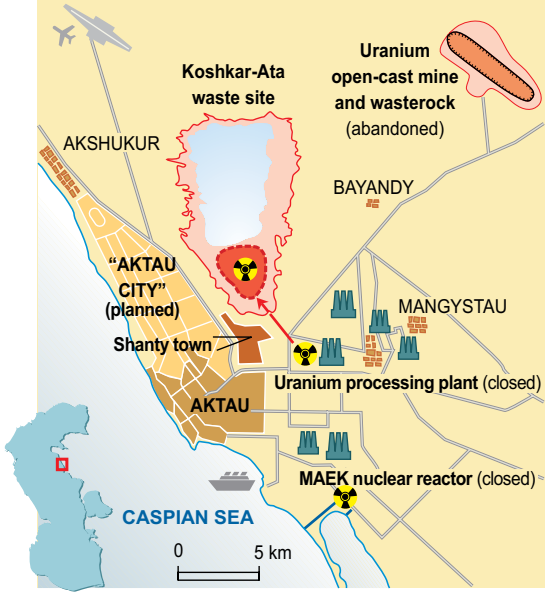
The obsolete infrastructure from former uranium open-cast mines and processing facilities constitutes an additional risk of exposure to radioactive material. Among the industrial dumps and derelict industrial equipment there are several radiation hotspots exceeding 1 500 to 3 000 μR/h, as against natural radiation in Kazakhstan of 10 to 15 μR/h. The local population and temporary migrants from the neighbouring Uzbek Republic of Karakalpakia are illegally dismantling the infrastructure, to sell the scrap metal as a raw material for new construction. But potential customers are inclined to reject highly radioactive parts, and the sellers simply dispose of the material elsewhere in the countryside.

Aktau is also home to a nuclear power station, now shut down. Decommissioning of the fast-breeder reactor is under way, with extensive international support. Spent fuel is stored on-site, as are 1 000 tonnes of radioactive sodium.

But radiation does not seem to be the most important concern for the local authorities. They are more concerned that pollutants might migrate through groundwater and contaminate the Caspian Sea located just eight kilometres away. At present, there seems to be no hard evidence that pollutants have reached the Caspian Sea. According to recent monitoring data, high levels of contaminants in the groundwater as well as the soil are currently limited to a strip two to four kilometres wide around the lake. Contamination includes high concentrations of toxic metals (molybdenum, lead, manganese, strontium, etc.), rare-earth elements and radio nuclides. The situation is clearly precarious, as a rise in the level of groundwater could cause more widespread dispersal of pollutants.

Reclamation is costly. In Kazakhstan, the State Programme for Conservation of uranium-mining enterprises and eliminating the consequences of uranium deposits' exploitation for 2001-10, contributes US$3 million a year. In 2007 125 million tenge (about US$1 million) was allocated from the local budget for the first phase of reclamation. The total cost of initial reclamation measures in Koshkar-Ata is estimated at US$8 to 10 million.

Aktau nuclear complex



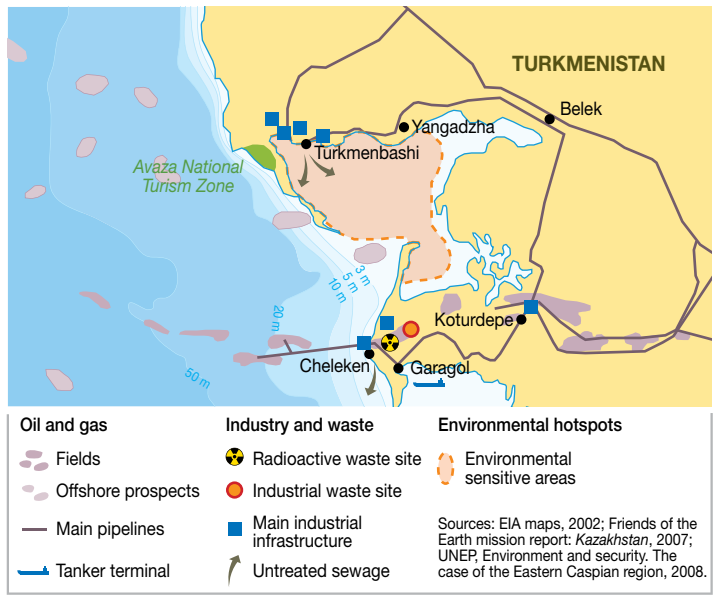
Source: ENVSEC East Caspian assessment (field mission to Aktau, April 2006)
Map produced by UNEP/GRID-Arendal, August 2008

Cheleken peninsula

Industrial activities engulfed by the rising sea

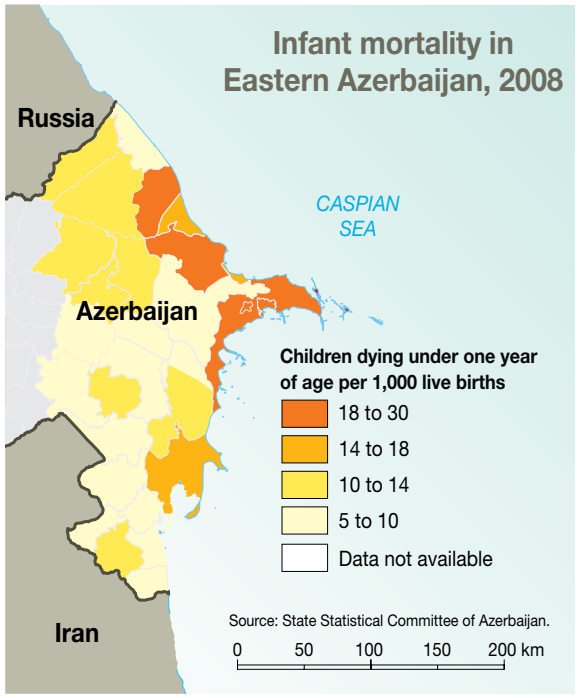
Khazar (formerly Cheleken) is a town of 10 000 people (once 16 000), located on the Cheleken peninsula on the Caspian shore. Iron bromide ($FeBr_2$) production started at the Cheleken plant in 1940, followed by iodine production in 1976. The production capacity of the plant is about 250 tonnes of iodine a year. The natural water (brine) found here contains radioactive elements. During iodine processing, with the coal-absorption method, radionuclides (mostly Ra) in the brine are deposited on the surface of pipes and equipment, and in the coal used in the process itself. About 18 000 tonnes of radioactive waste have accumulated and are now deposited in an open storage area less than 200 metres from the sea. Some of the plant's facilities have already been engulfed by the rising sea. The radiation dose on the plant's dump varies from 2 500 to 4 000 micro-roentgen an hour [μR/h], and in the surroundings 250 to 750 μR/h, posing an occupational health risk for workers mainly through inhalation. Radon concentrations in the local air are 1 000 times higher than the average for Turkmenistan and close to the permissible limit values for exposure. Strong winds and dust storms may disperse the materials and contaminated carbon particles in the dump. Liquid acid effluents from the plant pose an additional environmental problem. Due to the appalling state of the pumping and neutralisation stations these effluents are discharged almost untreated. The authorities have issued a call for tenders to neutralise the site and build a radioactive waste storage unit in Aligul, a safer location 17 kilometres away from Khazar. A NATO project implemented under the Environment and Security Initiative in Central Asia is assisting Turkmenistan in the safe handling of radioactive waste, including support to a radiochemical laboratory in Ashgabat and training in waste characterisation and radio protection.

Cheleken Peninsula pollution sources



5 Changing population profile

The combination of pollution and a deteriorating public health system causes concern for the health of many people living around the Caspian Sea. Socio-political and economic changes in the former Soviet countries are largely to blame.

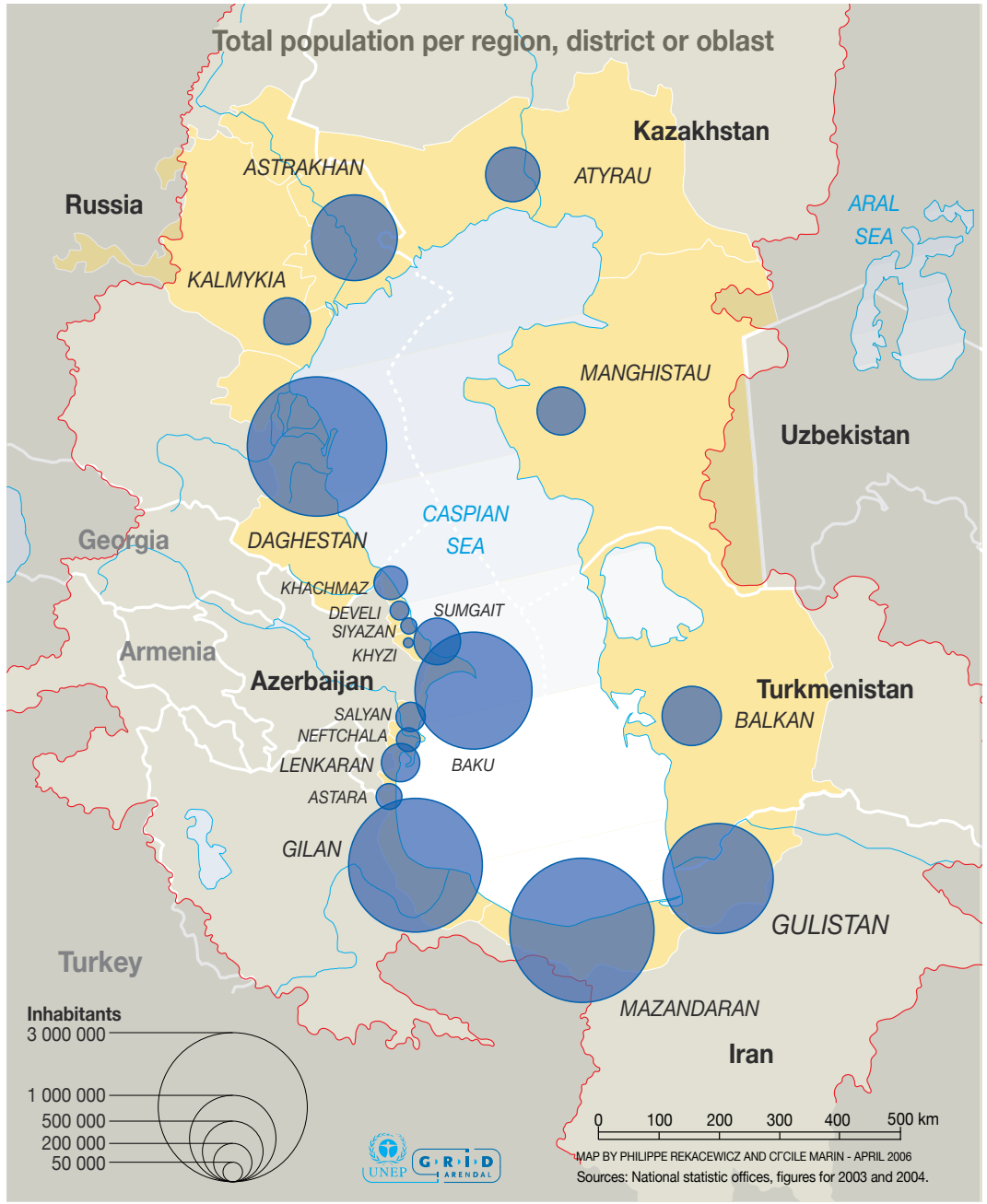


Apart from two large urban areas – Baku-Sumgait and Makhachkala-Kaspisk – and the Iranian coast on the southern shore, a very densely populated coastal strip where one agglomeration leads into the next, most of the population living on the shores of the Caspian is rural, with strong religious and family traditions actively maintained. Some cities such as Baku have experienced very rapid urbanisation. In the early 1900s Baku was a city of 248 300 inhabitants, whereas the population now stands at about 2 million.

It is consequently not surprising that several countries and provinces – Iran, Daghestan, Turkmenistan and parts of Azerbaijan – still

	rate	year
Iran	12	2004
Azerbaijan	12	2007
Daghestan	14,5	2007
Kalmykia	13,9	2003
Astrakhan	12,6	2007
Atyrau	22	2007
Manghistau	28	2007
Balkan	28	2001


Population density and urban centres
Oral
Volgograd
Kazakhstan
ATYRAU
Atyrau
Russia
ASTRAKHAN
Astrakhan
Elista
KALMYKIA
MANGHISTAU
DAGHESTAN
Aktau
Uzbekistan
Makhachkala
Georgia
Derbent
Sumgait
Azerbaijan
Armenia
Turkmenbashi
BALKAN
Turkmenistan
Balkanabat
(Nebit-Dag)
Baku
GILAN
Gorgan
GULISTAN
Sari
Rasht
Babol
MAZANDARAN
Turkey
Iran
Population in urban center
2 000 000
1 000 000
500 000
200 000
70 000
Population density per km2
20
50
100
0
100
200
300
400
500 km
MAP BY PHILIPPE REKACEWICZ AND CÉCILE MARIN - APRIL 2006
Sources: National statistic offices, figures for 2003 and 2004.


Total population per region, district or oblast
Kazakhstan
ASTRAKHAN
ATYRAU
Russia
ARAL
SEA
KALMYKIA
MANGHISTAU
Uzbekistan
CASPIAN
SEA
Georgia
DAGHESTAN
KHACHMAZ
DEVELI
SIYAZAN
KHYZI
SUMGAIT
Armenia
Azerbaijan
Turkmenistan
BALKAN
SALYAN
NEFTCHALA
LENKARAN
BAKU
ASTARA
GILAN
GULISTAN
Turkey
MAZANDARAN
Iran
Inhabitants
3 000 000
1 000 000
500 000
200 000
50 000
0
100
200
300
400
500 km
MAP BY PHILIPPE REKACEWICZ AND CÉCILE MARIN - APRIL 2006
Sources: National statistic offices, figures for 2003 and 2004.

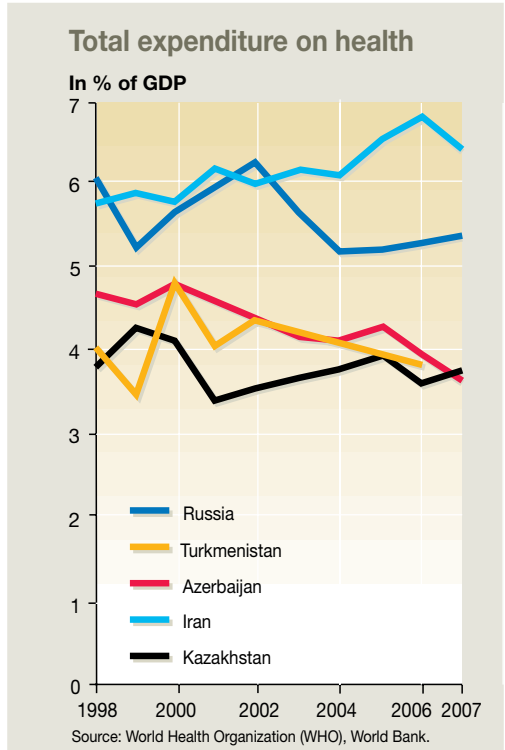
enjoy very high population growth rates (in excess of 10 per 1 000). Although the fertility rate has dropped significantly over the past two decades, or perhaps longer, the authorities must nevertheless cope with all the health, education and employment problems associated with a rapidly rising, youthful population.

Public health policies during the Soviet period eliminated several traditional diseases. But for lack of adequate investment in medical equipment and drugs in the 1970s and 1980s they failed to effectively halt a worrying rise in the death rate, for infants and for the population as a whole. This setback is very noticeable all over Russia, but in much of the Caspian basin it went hand in hand with a shortage of amenities, due to the distance from the country's main economic centres. Iran is gradually catching up lost time and supplying rural areas with adequate medical equipment, but the opposite is happening in other countries. There, with the decline in public expenditure on health and education, the general level of public health is either steady or actually declining. Inequality is on the rise, with the switch to a two-tier health service under which payment is demanded for an increasing range of treatments, putting them out of the reach of much of the population.

Several additional factors have contributed to the emergence of new health problems, in particular the increase in perinatal or infant mortality, the reappearance of diseases such as tuberculosis or polio that had almost been eradicated, and an increase in the number of hepatitis and cholera foci. In Azerbaijan, the highest morbidity rate is related to diseases of the respiratory organs (11 274 cases per 100 000 people), with a similar situation in Atyrau and figures twice as bad in the Mangistau oblasts, linked to exposure to pollution. There are still problems obtaining a supply of good quality drinking water, except in a few hilly regions. In the country and in many cities the water pipes and sewage systems are urgently in need of improvement, contributing to unsatisfactory public hygiene. Azerbaijan's programme on Poverty Reduction and Economic Development also recognizes that one of the primary causes of morbidity and mortality in children is diarrhoeal disease, usually caused by contaminated water.

Furthermore the number of industrial facilities with a high risk of pollution is tending to increase due to exploitation of new oil and gas fields. The concentration of heavy metals and toxic or even radioactive materials is a recurrent problem in old industrial centres such as the Absheron peninsula. Similar sources of pollution have existed since the 1960s and 1970s in the west of Turkmenistan and in the Astrakhan and Atyrau areas. Little is known about the radiation exposure of people living in areas of high radioactive pollution, in the Atyrau oblast, home to a former nuclear testing site.

Total expenditure on health



Source: World Health Organization (WHO), World Bank.

6 Ecosystems paying the price

Soviet industrial practice and disregard for the external effects of an aggressive market economy have significantly jeopardized the lives of plants and animals in and around the Caspian Sea. The steep decline in fish resources due to overfishing, pollution and other human-related factors, such as the introduction of alien species, is negatively affecting the balance of ecosystems and threatening several species.

With the opening of the Volga-Don canal in 1952 navigation between the oceans and the Caspian became possible. Contact between the previously secluded Caspian marine ecosystem and the outside world was consequently inevitable.

The connection led to the introduction of various alien species (plants and animals not native to the habitat). The most threatening event for the Caspian ecosystem was

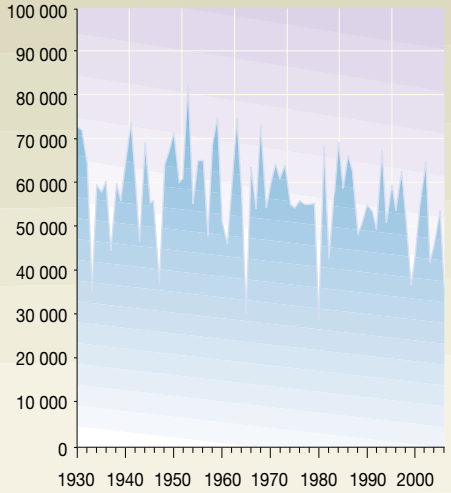
Biodiversity in the Caspian Sea

Biota group	Total species in the Caspian Sea	Endemic species	Alien species	Listed species (Red Book)
Phytoplankton	441	17	6	?
Zooplankton	315	64+	7	10
Zoobenthos	380	190	12	20
Fishes	133	54	17	27
Marine and land mammals	125	1	3	41
Birds	466	?	?	63

N.B.: figures are estimates since the literature does not agree on values.
Source: *Transboundary Diagnostic Analysis for the Caspian Sea*, Caspian Environment Programme, 2002.

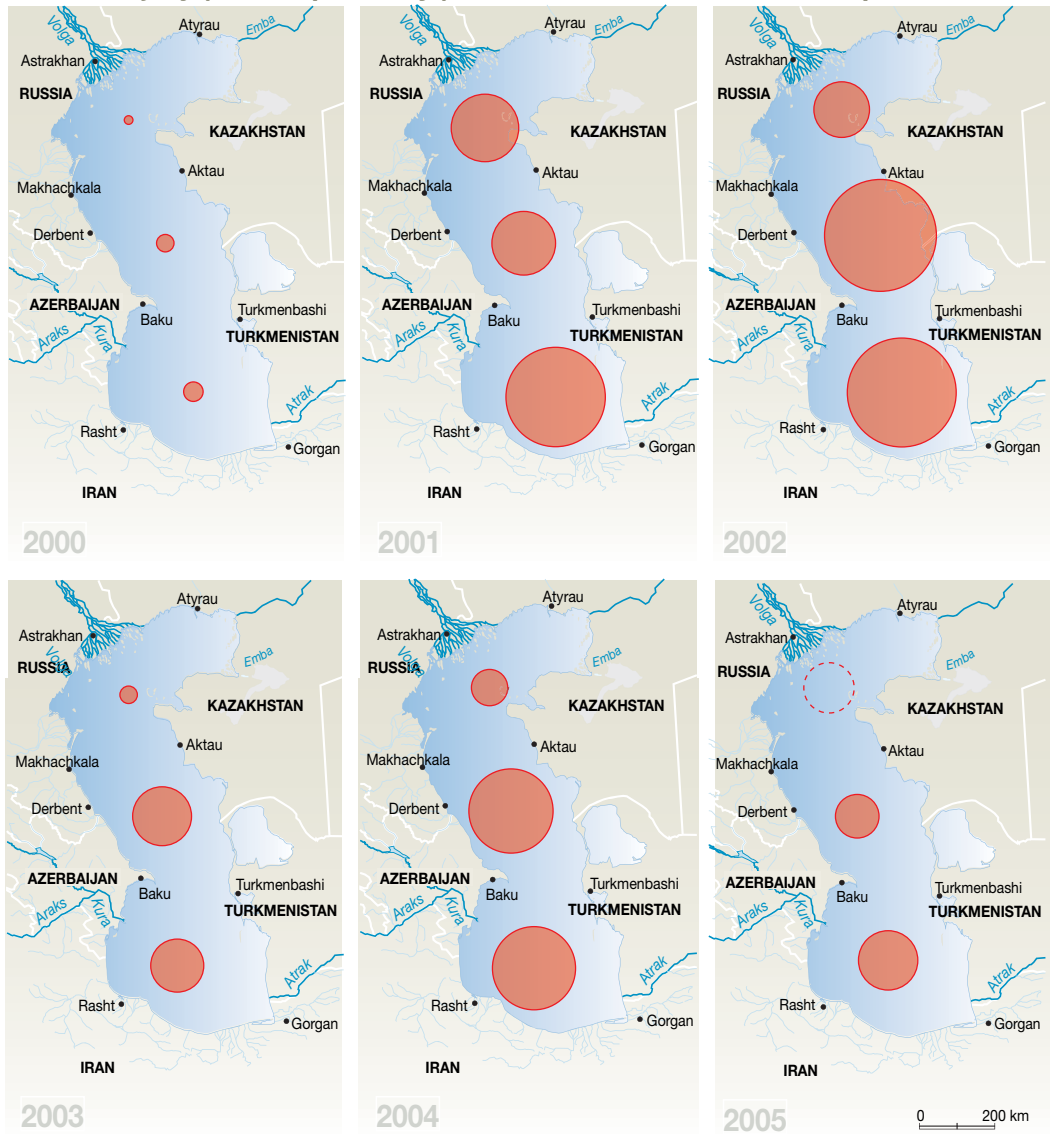
the arrival of the North American comb jelly (*Mnemiopsis leidyi*). It was brought accidentally to the Caspian in the ballast water of oil tankers. A voracious feeder on zooplankton and fish larvae, it first arrived in the Black Sea in the early 1980s where it changed the whole ecosystem and contributed to the collapse of more than two dozen major fishing grounds. From there the comb jelly also invaded the Azov, Marmara and Aegean Seas and most recently the Caspian.

Ice cover on the North Caspian



Sources: Kouraev, A., Comparison of historical and satellite derived data of the Northern Caspian ice cover, 2008.

Comb jelly (*Mnemiopsis leidyi*) abundance variation in the Caspian Sea



Specie abundance
Number of individuals for cubic metre

500 250 100 50 10

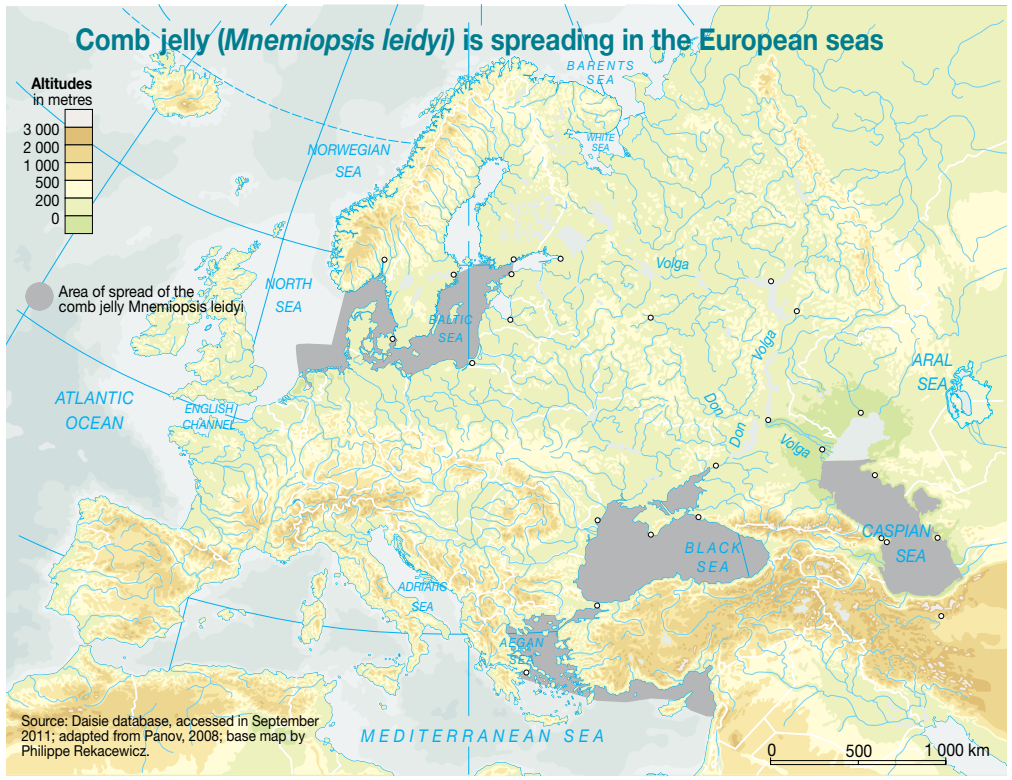
Data not available

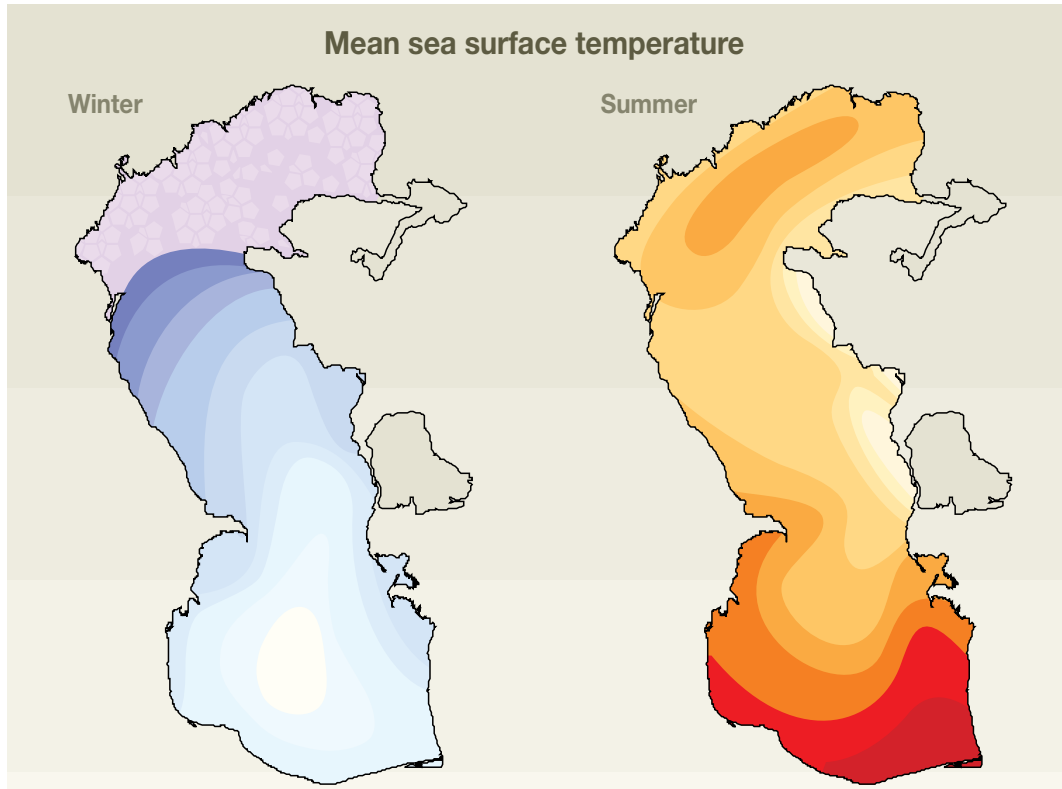
Source: CEP, *Monitoring study of Beroe ovata and Mnemiopsis leidyi in the Southern Caspian Summer-Autumn 2005, personal communication with Igor Mitrofanov*

The comb jelly is well adapted to the habitat (salinity, temperature, and food range) and reproduces faster than endemic species. As it eats the same food as them, it has had a drastic effect on their numbers, upsetting the entire food chain. The commercial fishing industry is afraid of losing the kilka, (*g. Clupeonella*) and other valuable catches, with consequent effects on human livelihoods and food sources for the Caspian seal and sturgeon population (*Huso huso*). Studies show that between 1998 and 2001, kilka catches by Iranian fishermen dropped by almost 50 per cent, representing a loss of at least $20 million per year.

In 2003-06, a small decrease and stabilisation of jelly biomass was observed. However, in some areas huge blooms still occur, as recorded in summer 2005.

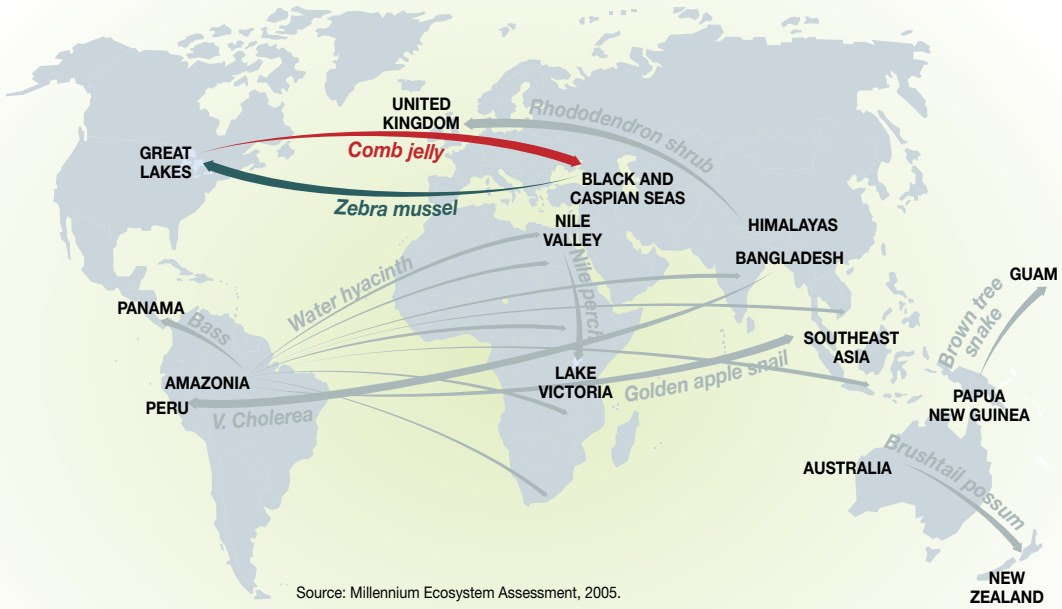
Combating the intruder is a delicate task. Introducing another foreign species, a natural enemy of the newcomer, might just postpone or redirect the problem. However experience from other parts of the world shows that foreign species have not always been successful in the long run, although a few have durably conquered the new environment. There is currently no agreement on the deliberate introduction of another foreign species.





Sources: After Kosarev and Yablonska, 1994 and Dumont 1998 in Fabienne Marret, Suzanne Leroy, FranHoise ChaliO, FranHoise Gasse, "New organic-walled dinoflagellate cvysts from recent sediments of Central Asian seas", *Review of Palaeobotany and Palynology 129*, 2004; N.V. Aladin, Y.S.Chikov, V.E. Panov and I.S. Plotnikov, Chronology of Mnemiopsis and Beroe invasions to the Black, Azov and Caspian Seas, Presentation to the HELCOM-BSRP Meeting on Ballast Waters, Klaipada-Palanga, February 2005.

Origin and destination of selected species

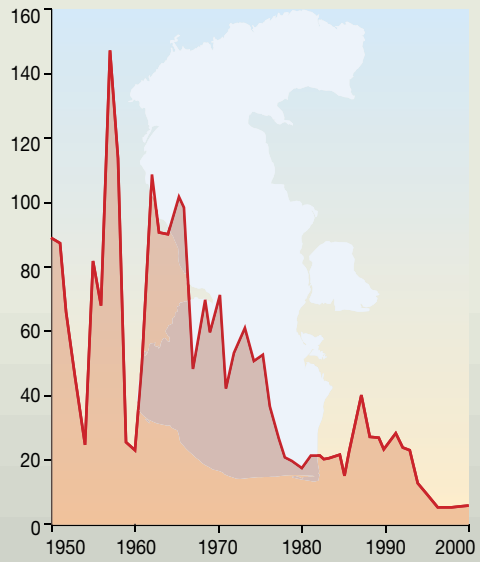


Source: Millennium Ecosystem Assessment, 2005.

Caspian seals fight for survival

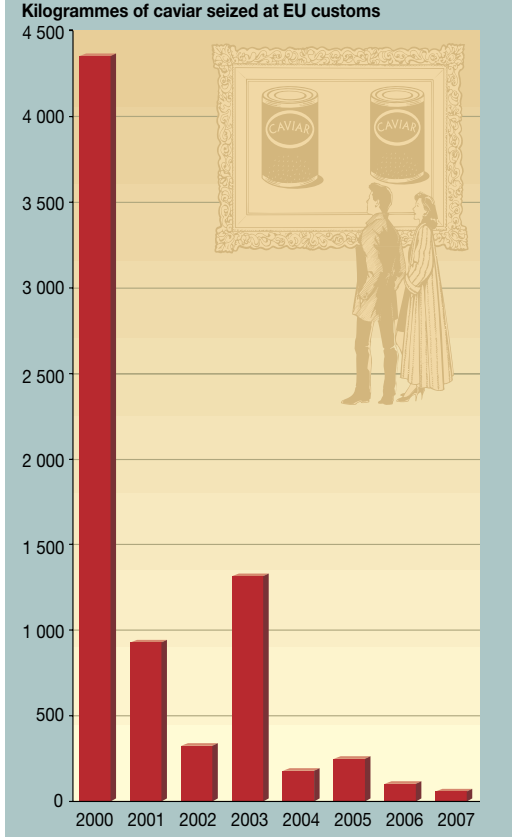
The Caspian seal (*Pusa caspica*) population has declined by more than 90 per cent since the start of the 20th century, falling from more than 1 million individuals in 1900 to around 100 000 today (CEP, 2007). However, at present there are only around 7 to 15 thousand breeding females, meaning the population has very low reproductive capacity. The principle cause of the decline was unsustainable levels of hunting for seal oil and fur through much of the 20th century. Large-scale commercial hunting ceased in the early 1990s, but mortality caused by humans still continues to be the greatest threat to the population. Sporadic commercial hunts restarted from 2004, and currently by-catch in illegal sturgeon fisheries may be killing more than 10 000 seals per year.

Historical decline of the Caspian seal (*Pusa caspica*)



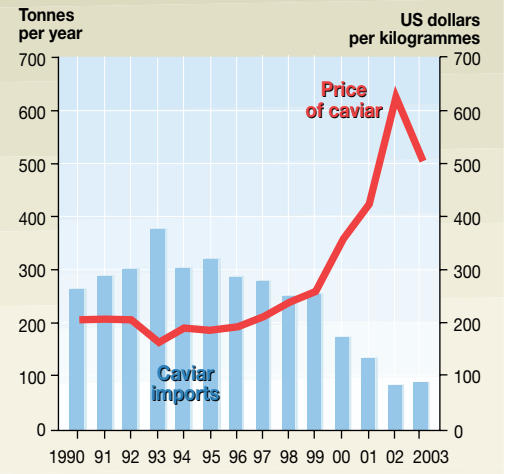
Source: FAO Fishtat on line database.

Illegal caviar trade in the EU



Source: Engler, M., Knapp, A., Briefing On the Evolution of the Caviar Trade and Range State Implementation of Resolution Conf. 12.7 (Rev. Cop 14). A TRAFFIC Europe Report for the European Commission, 2008.

Caviar imports as reported by three main consumer markets (Japan, European Union and United States)



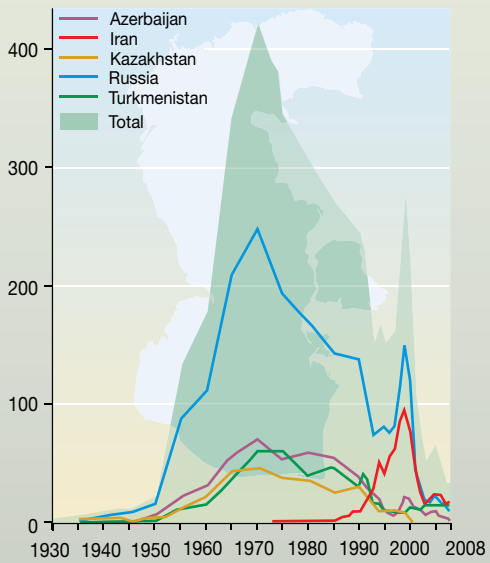
Source: TRAFFIC Europe, 5th International Symposium on Sturgeon, 2005.

Other causes for concern include disease, pollution, disruption to the Caspian food chain due to invasive species, over fishing, climate change and industrial development. In 2000, an outbreak of Canine Distemper virus killed around 10 000 seals. While pollution due to pesticides and other persistent organic pollutants is an important consideration for the whole Caspian ecosystem, and high levels of pollutants have been found in a few individual seals, current evidence shows there is no direct link between pollution and the CDV mass mortalities. Invasive species such as the comb jellyfish and overfishing may have reduced the abundance of key prey species for seals, which might reduce the ability of some females to achieve breeding condition.

In the coming decades, fluctuations in Caspian Sea level could remove important areas of seal habitat, while climate warming will reduce the extent and duration of the winter ice field Caspian seals depend on for breeding. Industrial development in an around the Caspian Sea, including the oil industry, in each of the Caspian countries, has led to the loss of seal habitat or causes disturbance in areas where seals are still present. At present more research is needed to understand the full impacts of these potential threats in detail, and their relative importance in the continuing population decline in order to develop informed policy decisions.

Due to the rapid population decline and multiple on going threats, Caspian seals have been listed by IUCN as endangered in the international Red Book since 2008. Reducing mortality from human sources and establishing protected areas for seals are the priority conservation actions needed. Through the Caspian Environment Programme the Caspian countries have adopted the Caspian Seal Conservation Action Plan, and are working towards its implementation.

Collapse of Tulka in the Caspian



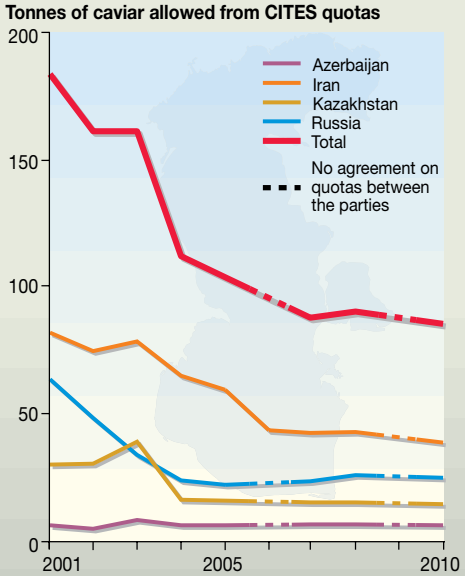
Source: personal communication with Igor Mitrofanov

Catching the last sturgeon

The Caspian area is the world's main producer of wild caviar (83% in 2003) and supplies the four largest markets, the European Union, United States, Switzerland and Japan. The construction of several hydroelectric power plants and dams along the Volga river significantly altered the flow of water into the delta and destroyed about 90 per cent of the sturgeon's spawning grounds, which can be as far as several hundreds of kilometres upstream. With high levels of water pollution, sturgeons also suffer from various diseases. According to the survey of the Food and Agriculture Organization, reported data from Caspian states excluding Iran indicate that the wild sturgeon catch has dropped from an average of about 22 000 tonnes a year in the 1970s to about 373 tonnes in 2008.

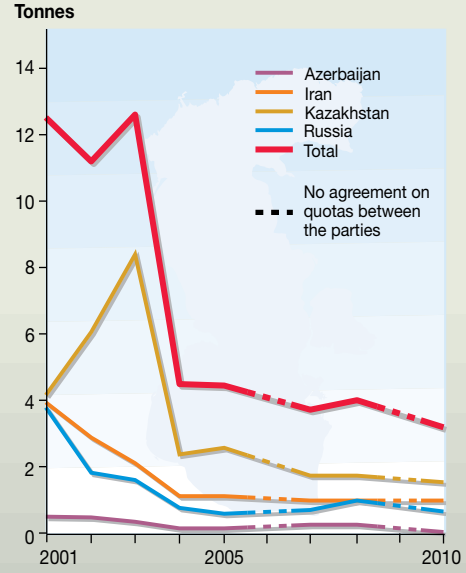
The region is now struggling to save the sturgeon. The countries enhance natural reproduction improving existing and installing new fish passes in dams, and opening ways to upstream spawning grounds. To protect the vulnerable fish species more than 100 million sturgeon and bony fish juveniles have been released into the Caspian in recent years. In 2001 Azerbaijan, Kazakhstan and Russia agreed to restrict further export of commercial fish stocks. All three countries, as well as Iran, are party to the UN Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). According to official information received by the CITES secretariat, the temporary ban on caviar trade issued in 2001 has prompted a set of measures lifting the immediate risk of extinction. The caviar trade reportedly fell by about 70 per cent between 1999 and 2003 but there is still every reason to monitor development of the sturgeon population and keep it on the list of endangered species. However, it is not clear to what extent the temporary ban on caviar exports has boosted well established illegal domestic and international trafficking, obviously not accounted for in the official figures. To combat the illegal trade in caviar, governments around the world have agreed to a universal caviar labelling system to inform traders and consumers.

Total trade in sturgeon caviar



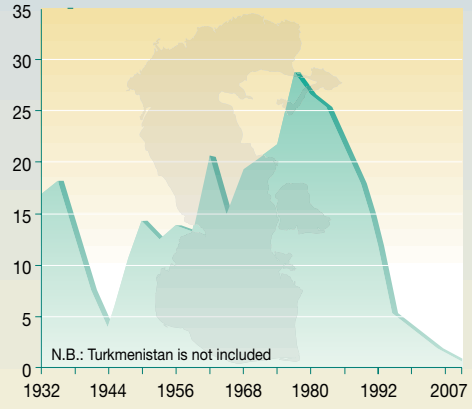
Source: CITES online database, accessed in September 2010.

Trade in sturgeon caviar *Huso huso*



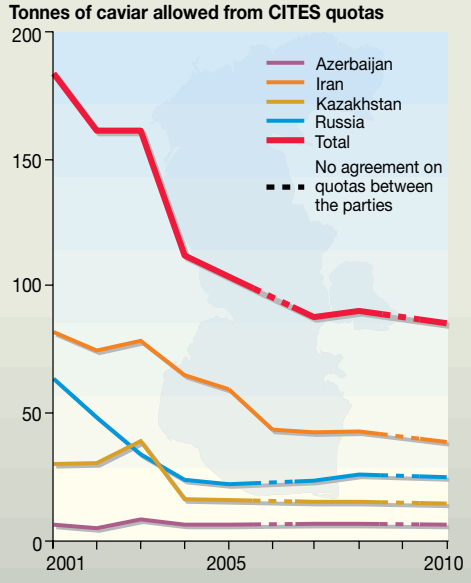
Source: CITES online database, accessed on September 2010.

Total sturgeon catch in the Caspian



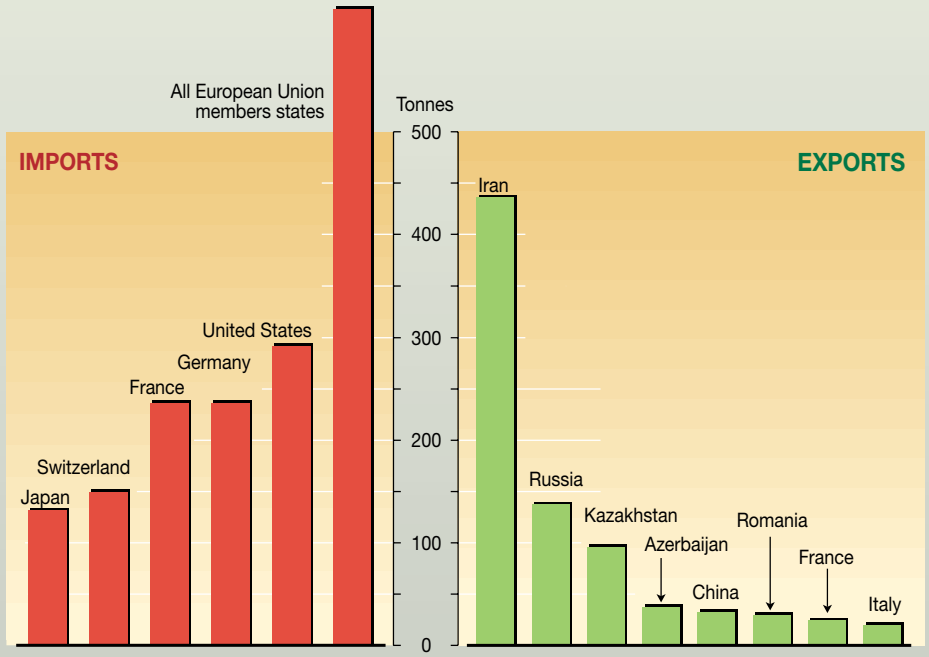
Source: *Transboundary Diagnostic Analysis for the Caspian Sea,* Caspian Environment Programme, 2002. Updated in 2010 with data from the United Nations Food and Agriculture Organization (FAO).

Total trade in sturgeon caviar



Source: CITES online database, accessed in September 2010.

Overview of legal international caviar trade, 1998-2006



Sources: Engler, M & Knapp, A., Briefing On the Evolution of the Caviar Trade and Range State Implementation of Resolution Conf. 12.7 (Rev. Cop 14). A TRAFFIC Europe Report for the European Commission, 2008.

7 Environment and security – a fragile balance

As a source of potential wealth the environment with its natural resources can easily fuel tensions between neighbours and endanger the security of people living in the region. Threats may stem directly from environmental impacts on health and well-being, but also from conflicts triggered by the associated pressures. To further complicate matters, the region's political order has recently been reshuffled and there remains an unresolved dispute about territorial claims to the sea basin and the natural resources that may be found there.

In areas where the economic interests vested in natural and mineral resources are as strong as around the Caspian Sea, environmental protection tends to be a low priority. But some of the natural resources such as fish, which form the basis for human survival and economic activities in the region, depend on an intact environment. The exploitation of other natural resources is particularly profitable, because little account is made for possible negative side-effects.

The region's valuable natural resources – some non-renewable such as oil and gas, others renewable such as fish – are an important factor in relations between states and the various communities living around the Caspian sea. In particular they may create international tension, as for instance with the ongoing discussions about sustainable exploitation of fish resources.

With dwindling overall oil resources, enduring instability in the Middle East, new markets and rising demand for energy, many players have good reason to be interested in the Caspian basin and the export of its resources: states (the producers themselves, the countries through which products transit, and end users), and oil and gas companies. In principle it is in the interest of such players to maintain regional stability in order to secure investments in the energy sector.

Clarifying territorial limits to prevent conflict

Access to hydrocarbon resources has caused several disputes between the five states bordering on the Caspian. The uneven distribution of hydrocarbon resources gives rise to disputes over oilfield ownership. There is also disagreement as to how best to use the sea (separate or joint exploitation). The inadequate legal framework and overlapping claims to ownership have made it more difficult to find solutions to these disputes. Preference has so far been given to bilateral agreements to facilitate the exploitation of the Caspian's energy resources.

Transport of oil and gas further complicates conflicting interests and claims, and brings additional players into the game. So far the main export pipelines run through Russia. A recently developed alternative, the Baku-Tbilisi-Ceyhan (BTC) pipeline that started operation in 2005, opened a new possibility for transporting 1 million barrels of oil daily. Other similar pipeline projects are also being developed like the one that goes through Kazakhstan to China.

Managing natural resources fairly: a challenge for energy-producing states

The skill with which a state manages its natural resources (a capability that may vary with time) will impact on its economic and political stability. Overemphasising the development of the energy extraction resources can weaken an economy's manufacturing sector – an error also known as Dutch disease or resource curse. Dependency on a small number of commodities for export earnings may increase the country's vulnerability to trade shocks, which may in turn cause instability and dissatisfaction among groups affected by such shocks.

Conflicting interests

The natural conditions in the Caspian Sea region are harsh, with the exception of the southern and western coast. The dry climate, with large variations in temperature between summer and winter, severe winter storms and a shortage of drinking water makes it difficult to sustain human life. Every activity leaves its mark and the environment is particularly vulnerable.

The quality of drinking water along the coastline depends on groundwater resources and desalinized water from the sea. Exploitation of petroleum reserves or faulty operation of the corresponding facilities pollutes both surface and groundwater. Sturgeon, from which caviar is produced, and other commercially important fisheries need an intact environment. But this requirement conflicts with large-scale water management projects, such as irrigation and dams for hydroelectric power stations, and the exploitation of offshore oil and gas fields, with the heavy oil tanker traffic it entails.

In many places around the Caspian tourism plays an important part in the local economy. It will only continue to do so if the beaches stay free from pollution and are attractive to tourists.

Impact of smouldering conflicts

The frozen conflict in Nagorno-Karabakh and adjacent regions of Azerbaijan, as well as over a decade of unrest and military operations in Chechnya, Russia, has triggered flows of refugees and led to the neglect of environmental management in these areas. While the latter resulted in more uncontrolled pollution, certain environmental issues such as deforestation and the alleged burial of hazardous wastes in Nagorno-Karabakh have become politicized. Both areas are linked to the Caspian environment through shared surface and ground water systems.

Unpredictable risks

Allowance must also be made for unpredictable risk factors. Over and above conflicting interests, some scenarios suggest that drilling for oil and gas could seriously affect the sea level and, worse, trigger earthquakes in this seismically active region.

Furthermore, however clean modern oil production may be, it involves the risk of accidents causing serious pollution, typically oil spills during transportation. Nor can it completely avoid continuous emissions during operation. Pollution pays no attention to borders, and pollutants carried over large distances by tributaries aggravate already acute local pollution downstream. Environmental pollution has transboundary effects that need to be tackled multilaterally.

At another level, although scientific models of the effects of rising temperatures are improving, it is not yet possible to predict exactly what will happen when nature adapts to changing climatic conditions.

The need for multilateral solutions

Ongoing disputes and disagreements over the management of natural resources shared by two or more states can deepen divides and lead to hostilities. But common problems regarding the use of natural resources may also bring people together in a positive way. Communities and nations can build mutual confidence through joint efforts to improve the state and management of nature. Environmental cooperation can be an important way of preventing conflicts and promoting peace between communities. Furthermore the environment is a suitable topic to focus people's attention, in particular when they are personally affected. Raising people's awareness of the stakes may be a way of promoting more active participation in political life, and ultimately democracy and shared economic prosperity.

By signing and ratifying the Framework Convention on the Protection of the Marine Environment of the Caspian Sea (Tehran Convention) the signatories – all five bordering states – signalled that they are willing to search for common strategies to protect the Caspian environment. Having agreed in principle on common action towards the control of activities impacting the environment they made a step towards stability in the region.

The Tehran Convention is an example of how the strategy of using the environment as a means to create a multilateral dialogue can be successful. Whereas the countries are still negotiating their offshore territories with little hope of a settlement in the near future, overall agreement on the environment has proved possible, temporarily working around the sensitive topics. Even if the Convention expresses nothing more than the will to address an issue, it is a successful achievement as such. It now needs to be followed by more concrete commitments.

The efforts to realise the promises of the Tehran Convention are reflected in the preparation of several protocols to the Convention: the Conservation of Biological Diversity, the Protocol on Regional Preparedness, Response and Co-operation in Combating Oil Pollution Incidents, Protocol for the Protection of the Caspian Sea against Pollution from Land-based Sources and Activities, and the Protocol on Environmental Impact Assessment in a Transboundary Context. These protocols, once adopted, will become binding legislation with which the countries must comply. The process is supported financially and thematically by the (Tehran) Framework Convention on the Protection of the Marine Environment of the Caspian Sea, with UNEP providing secretariat services, the UNDP GEF CaspEco project, the European Commission, and a number of multilateral agencies and organizations, including FAO, IMO and the World Bank. At the national level, the governments of all the Caspian states have committed themselves to implement National Convention Action Plans.

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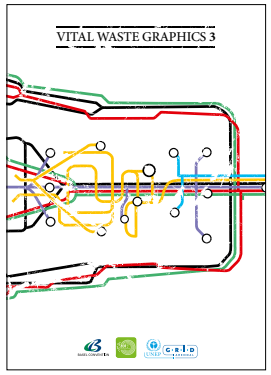

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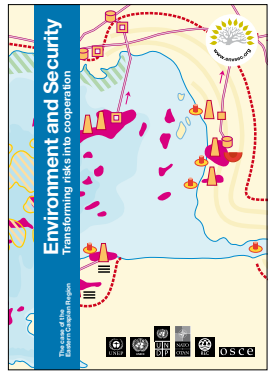

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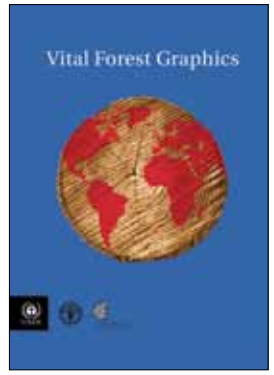

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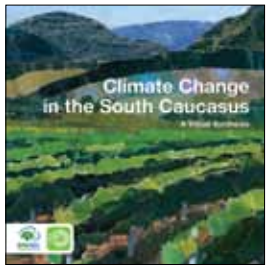

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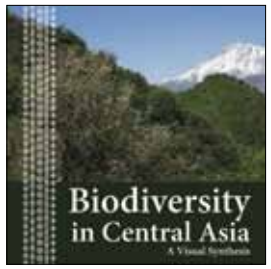

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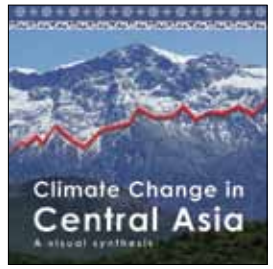

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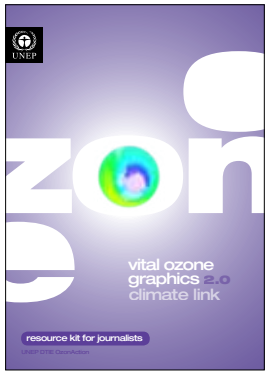

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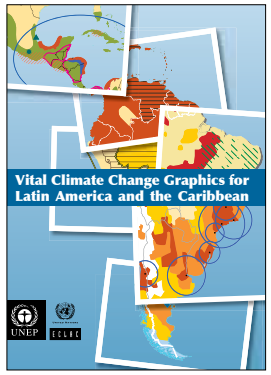

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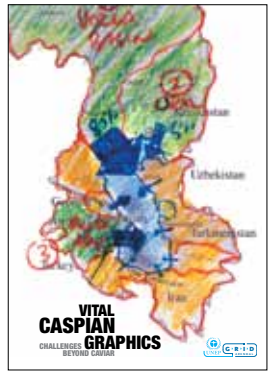

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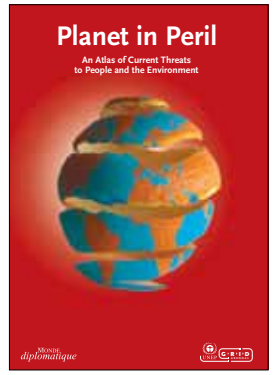

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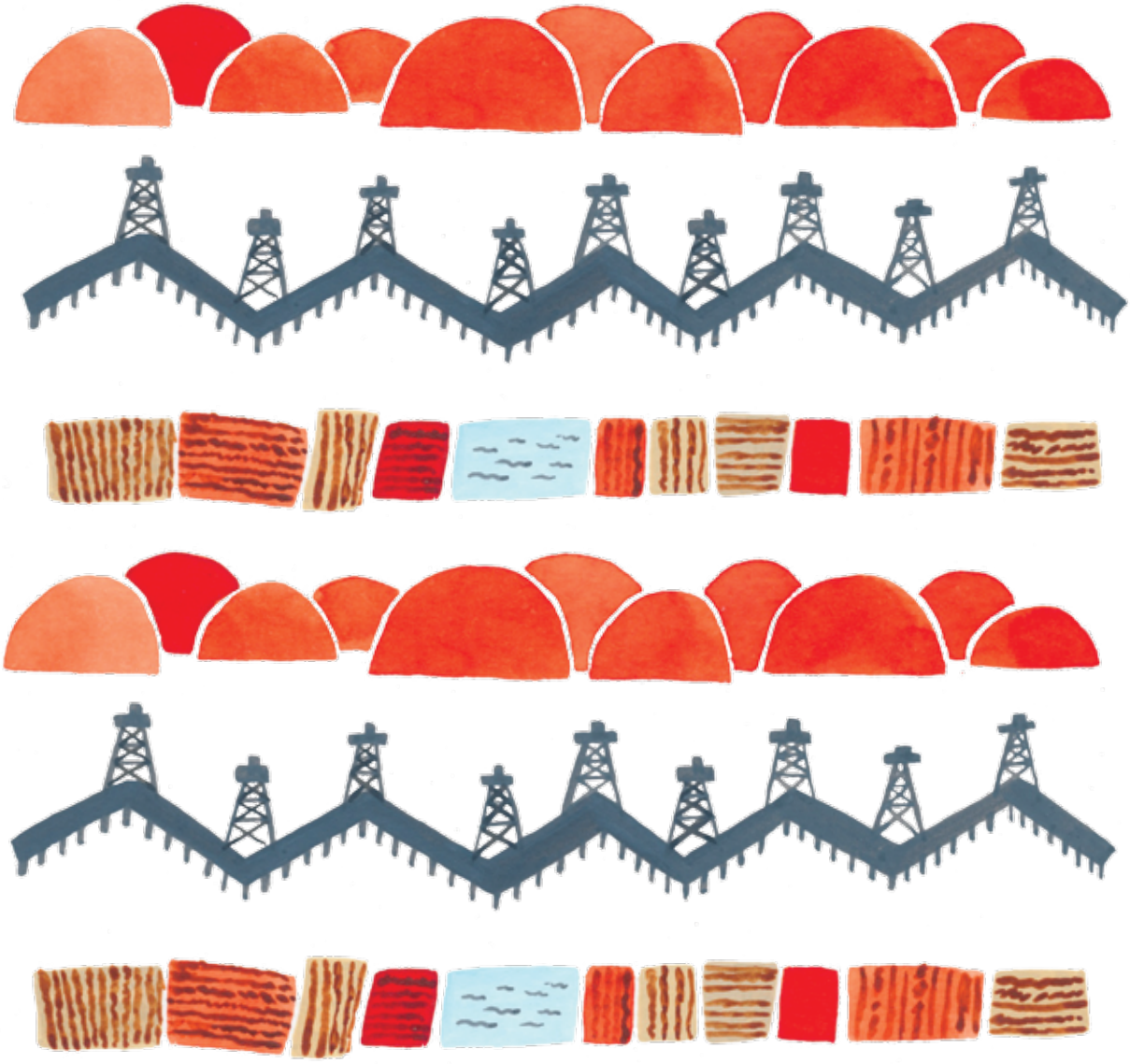

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