Chief Inspectorate for Environmental Protection

STATE OF THE ENVIRONMENT IN POLAND

2011 Signals

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The Report
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for Environmental Protection
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On cover: photos of works rewarded in competition
entitled „I also can be environmental protection inspector"
organised for children of employee of the Inspection
for Environmental Protection by Chief Inspectorate for
Environmental Protection:
„Give help to ill Earth" - Oliwia Suryś, 13 years old (award)
„Earth is our life so take care about it properly" - Sandra
Zaskórska, 10 years old (I prize)
„Save the blue planet" - Mateusz Suryś, 10 years old
(award)
„Save water when washing your teeth" - Aleksandra
Podlaska, 10 years old (award)
„Dead fishes" - Maria Bujko, 12 years old (consolation
prize)

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CONTENTS

INTRODUCTION

The appropriate state of the environment guarantees the safe functioning of people in various dimensions: social, economic and cultural. The state of the environment is determined by various pressure factors, i.e. virtually all human activities and their measures. Therefore, the presentation of the state of selected components of the environment is preceded by an attempt at describing the pressure from the national economy and its assessment in terms of environmental effectiveness.

The year 2011 is undoubtedly very important for the presence of Poland within the European Union structures, as in its second half Poland holds the Presidency of the Council of the European Union (EU) for the first time. Therefore, the priorities of the Presidency must also be addressed. The environmental protection issues constitute one of the major topics of the Polish Presidency and the objectives in this area include: (1) preventing climate change and adaptation of Europe to such change, (2) protection of biodiversity, (3) effective use of resources and (4) support for the global sustainable development process (Rio +20). Irrespective of the priorities set by Poland, other important tasks include the participation in the debate on directions of the EU environmental protection policy, in relation to ongoing work on next programme for the environment of the European Union, which is due to enter into force in 2013, and on the 7th Framework Programme of the R&D financing.

The environment, its condition, diversity and resources are becoming increasingly important elements of the policy at virtually every stage of its creation. The impact of the recent global economic crisis, which redefined the thinking about the environment and its resources, also remains noticeable. The result is a number of initiatives undertaken by various international organisations with the aim to transform the economy in order to improve its environmental effectiveness („greening"). The common feature of those initiatives is decoupling, i.e. achieving economic growth at the same time reducing pressure on the environment, which includes both excessive exploitation of resources and emissions of substances and energy to the environment. The environment and its resources also need to be included in the total economic balance and in measurements of development and growth of economies and societies.

There are no standardised models at the international level for analysing "green economy" and taking it into account in the state of the environment assessments. Nevertheless, greening and environmental effectiveness of the economy may be roughly estimated using available statistical data, without the need to create new reporting tasks and defining new sets of indicators. The first part of this Report includes an attempt at such estimation of the national economy. The assessment of the environmental effectiveness of the Polish economy highlighted the major sources of pressure on the environment and its resources.

The above considerations form the background for the presentation of the state of the environment in Poland, including the state of its selected components, namely, nature, air, water and acoustic climate. Individual chapters were modelled on information included in the statutory publication entitled „Report on the state of the environment in Poland 2008" and constitute an update to the report. The state of the environment is presented based on the most recent available and verified data and information obtained in the course of the state environmental monitoring system (SEM) conducted by the Inspection for Environmental Protection. The information is credible, accurate and reliable. The state of the environment is an independent and objective indicator of efficiency of environmental protection measures, both those preventive and remedying ones, and should be used for their correction or improvement. Achieving and maintaining the good state of the environment is the overriding objective of the environmental policy and all policy tools and instruments, including such initiatives as "greening" of the economy, should ultimately lead to accomplishment of this objective.

The principles governing the studies and observations, as well as assessments of the environment in individual subsystems, are based on the national law, which, in overwhelming majority of cases, results from transposition of the EU law and the UN system treaties. The current scope and method of the SEM tasks performance stem from modification and expansion of monitoring programmes in line with the changing EU requirements. It is best visible in the case of water monitoring, which was modified by the Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (Water Framework Directive - WFD). The new requirements resulted in the necessity to revise the network of monitoring points, and to adjust their location to the arrangement of sub-basins and water bodies, as well as to modify the measurement programmes. New biological parameters became more important, as they became a basis for the assessment of the status of surface waters. This significant modification of the system made it much more difficult to compare multi-annual trends concerning the quality of waters, as well as to present the state of all water categories in the same timeframe, due to the specificity of measurement programmes.

Important changes were implemented in the air quality assessment system. In 2007, the scope of assessment was extended with new substances: benzo(a)pyrene and heavy metals (arsenic, nickel, cadmium) in PM10. In 2010, the programme was extended to include PM2,5 matter, pursuant to the requirements of the Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe (CAFE). A new breakdown of the country into zones where air quality is assessed was introduced in 2008.

The Report also contains the results of two nature monitoring programmes launched in 2006: birds monitoring, including the monitoring of Natura 2000 special protection areas and species and habitats monitoring with a focus on the Natura 2000 Special Areas of Conservation, which take account of the requirements of the Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (Habitats Directive) and the Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (Birds Directive).

Moreover, the part concerning the impact of noise uses the results of noise maps drawn up across Europe under the first stage of implementation of the Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise (Noise Directive).

The Report is concluded with the presentation of the state environmental monitoring as an essential source of environmental information.

Hoping you will find this Report both interesting and useful!
Chief Inspector for Environmental Protection
Andrzej Jagusiewicz, PhD Eng.

GREEN ECONOMY

GREEN ECONOMY

The global economic crisis of 2008 cast new light on the perception of the environment, its condition, diversity and resources, as key elements determining the welfare of societies. Although the concept of sustainable development has been in place for several decades, existing economic circumstances allowed to extend its founding assumptions beyond the scope of environmental policy.

The fundamental goal of the functioning of the state is to ensure prosperity and security of its citizens. It will not be fully possible without taking into account the good state of the environment and security of its resources. Natural resources are the basis for the functioning of human being, as they provide raw materials for the economy and affect the quality of life. Therefore, this fact should be reflected both in development goals and the methods for measuring their achievement.

Reflections on the economic crisis, in particular on the role of the environment as an element of economic balance, provided foundations for initiatives called the "green economy" or "green growth". Such initiatives are undertaken both by international organisations, such as the European Union, the Organisation for Economic Co-operation and Development (OECD), the United Nations (UN), and by individual countries. Although this topic has been on the international agenda uninterruptedly for many months, the common definition of those terms is still lacking as is the uniform approach to analysis and assessment. The common denominator is to achieve economic growth by means of increasing environmental efficiency and reducing pressure caused by exploitation of resources, including energy, and emissions of substances and energy to the environment.

The European Union's response to the crisis is the Europe 2020 strategy[1]. One of the three priorities defined in the document is sustainable growth: promoting a more resource efficient, greener and more competitive economy. The main instruments to accomplish the objectives of the Europe 2020 strategy include National Reform Programmes[2] elaborated by Member States and flagship initiatives prepared by the European Commission and implemented at the level of the EU, Member States, regional and local authorities. One of the flagship initiatives is to support the shift towards a low carbon and resource-efficient economy and to decouple economic growth from the degradation of the environment.

Therefore, a major challenge faced by Poland is to reconcile economic growth and care for the environment. The latter should be understood as widely as possible, as the reduction of various pressures, sustainable use of natural capital and preservation of the ecosystems' ability to provide specific services, ensure good quality of all elements of the environment in order to eliminate negative impacts on human life and health.

Almost every activity of people as individuals and the society, i.e. economic development and demographic changes, is a source of pressure on the environment and its resources. The environment can overcome some negative impacts, but when a certain threshold is exceeded, there occurs a risk of irreversible changes posing a threat to the functioning of the planet. Therefore, it is important to reduce or minimize such pressures. Further part of this chapter attempts at analysing the environmental impact of socio-economic processes taking place in the country, including the abovementioned aspects of the "green economy". The analysis will undoubtedly be limited due to the availability of data and the lack of internationally standardised methods of assessment.

Poland is a large country according to the European standards. The area of Poland amounts to 312 679 km^2, which accounts for 7.4 % of the European Union area and makes Poland the fifth largest EU Member State. The population of the country is 38 167 300 (as at 1 January 2010, according to the Central Statistical Office), i.e. 7.6 % of the total EU population. Starting from 2008, the population has been growing each year, after a period of prevailing downward tendency since the second half of the 1990s. Since 2006, the birth rate had been positive and amounted to 0.9 per 1000 people in 2009.

At the same time, the age structure of the population undergoes some disadvantageous changes. Since the beginning of the 21st century, the share of post-working age population (men above 65 years of age and women above 60 years of age) in total population increased by 1.7 percentage point, whereas the share of pre-working population declined by 4 percentage points. This phenomenon is related to postponed decisions on setting up a family and to having fewer children in the family, as a result of both economic factors and the changing lifestyle, as well as an increased average life expectancy thanks to improved living conditions. Emigration, which intensified after Poland's accession to the EU, is also relevant. In spite of the fact that the fertility rate has been growing (to 1.398 in 2009), it does not guarantee the replacement of generations. Average population density is 122 persons per 1 km^2, with 61 % of the population living in urban areas. The percentage has been decreasingly slightly each year as a result of migrations from larger cities to suburban areas.

Poland's macroeconomic situation has been systematically improving. A process of strong economic growth, covering all major sectors, started in 2004, upon accession to the EU. An increased economic activity continued over the next years, reaching its top in 2007 when the annual GDP growth totalled 6.8 %. The growing trend slowed down in 2008 as a result of the global economic crisis. The impact of the crisis was particularly severe in the second half of 2008 and the first half of 2009. In 2009, all macroeconomic factors deteriorated as compared to the previous year. The economic growth rate slowed down and the GDP grew by 1.8 % in 2009. Nevertheless, Poland was the only country in the EU with a positive economic growth rate.

The economic growth in Poland, although lower than in the previous years, accompanied by a GDP decline in other European Union Member States, reduced the differences in the level of economic development. The GDP per capita in Poland (according to PPP) grew from 56 % of the EU average in 2008 to 62 % in 2010. However, the difference in the development of Poland and the leading EU Member States remains significant (Fig. 1.). As of 1 January 2010, the population of Poland accounted for ca. 7.6 % of the European

Union population, whereas Poland's contribution to the EU GDP amounted to 2.9 % in nominal terms and to 4.7 % in terms of PPP.

Positive economic trends observed in the recent decade have resulted in the improved quality of life, as evidenced by the UNDP's Human Development Index (HDI)[3], which covers such aspects as income, health, education or poverty. "Human Development Report 2010" by the UNDP ranked Poland at 41st place, at the end of the group of countries facing very high human development. The total negative environmental impact may be presented using the ecological footprint (EF) index[4]. The comparison of both those indicators provides certain approximate information about the environmental cost incurred to obtain a relevant level of social and economic development. Fig. 2 presents the correlation between development and pressure on the environment for selected UN ECE countries.

Ecological footprint of Poland in 2007 amounted to 4.3 global hectares (gha) per capita. Although this is only slightly less than the European average amounting to 4.7 gha per capita, Poland is rather at the end of the EU Member States ranking in terms of social and economic growth. The fact that Poland uses twice more resources than available on its territory for its development (since biocapacity of Poland is 2.1 gha per capita) should also be alarming.

Although significant progress has been made in reducing pressure on the environment in the recent 20 years, the social and economic development of Poland still takes place at the expense of the resources and quality of the environment. Therefore, all sectors of the economy must fully implement the principles of sustainable development and increase their environmental effectiveness in order to reduce the use of resources and emissions of various substances and energy to the environment.

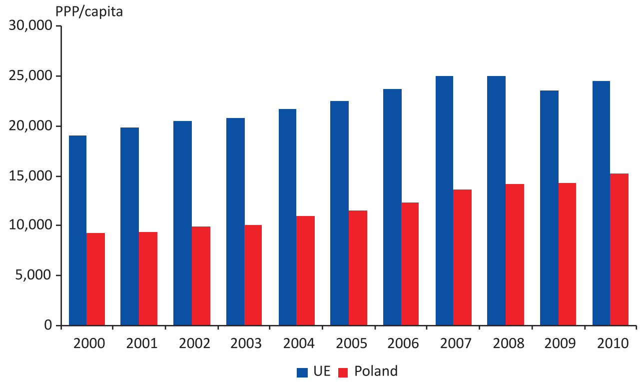

Fig. 1. Gross Domestic Product per capita according to Purchasing Power Parity (PPP) in Poland and in EU Member countries (source: Eurostat)

Fig. 2. Comparison of Human Development Index (for 2010) and ecological footprint (for 2007) for selected UN ECE countries (source: UNDP, Footprint Network). Country abbreviations explained on page 72.

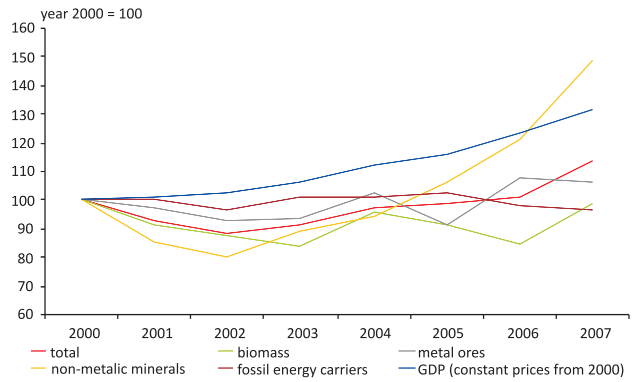

Fig. 3. Domestic material consumption (source: Eurostat)

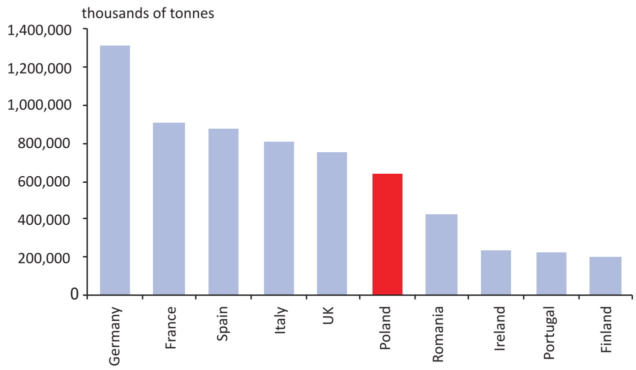

Fig. 4. Domestic material consumption in the EU countries with the highest value of DMC in 2007 (source: Eurostat)

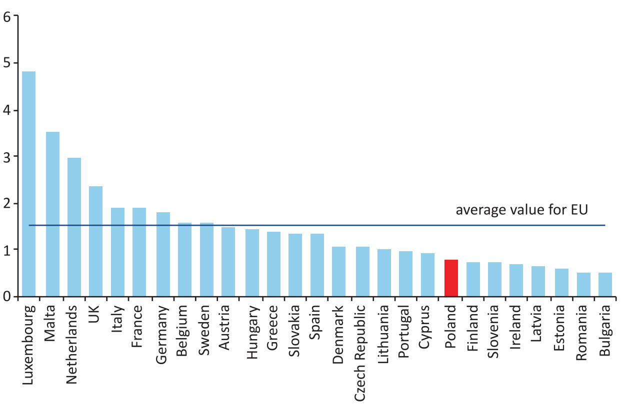

Fig. 5. Resource productivity ratio (GDP in PPP/ DMC) in the EU countries in 2007 (source: Eurostat)

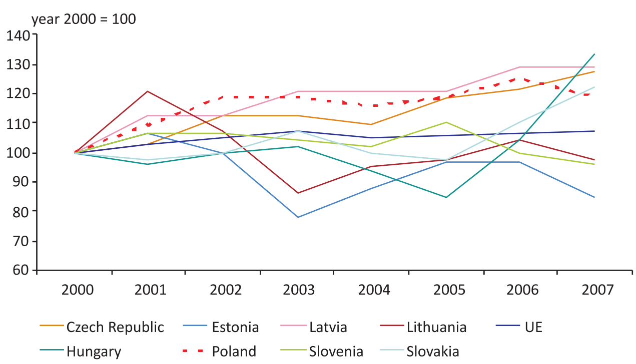

Fig. 6. Dynamics of resource productivity changes in selected new EU member countries vis-a-vis average values for EU (source: Eurostat)

Use of resources and energy

The use of resources is an important indicator of environmental effectiveness of the economy. Natural resources provide raw materials for the economy and impact the quality of life. Both the extraction and processing of resources, and then using the resulting products and disposal of waste cause a multidimensional pressure on all environmental components. Therefore, it is important to manage the resources in their entire life-cycle in a way which is the least harmful and ensures access to the resources for future generations. Resources are raw materials for the economy. Their effective use is the key element of welfare in the long-term.

Domestic material consumption (DMC)[5] had been growing from 2004 and reached 642,11 mln tonnes in 2007. Non-metallic materials account for almost 40 % of DMC (they include construction materials such as sand or gravel), biomass for 28 %, fossil fuels for 25 % and metal ores constitute the remaining percentage. In the years 2000-2007, domestic material consumption grew by 13 %, while the GDP increased by 30 %. The increasing trend in the material consumption was attributed mainly to an almost 50 % growth in non-metallic material consumption in the years 2005-2007, which was largely related to the implementation of infrastructural projects using the EU funds (Fig. 3.). Although the growth of domestic material consumption was less dynamic that the economic growth in the entire analysed period, the DMC growth rate after 2005 may start a negative trend in future and needs to be analysed in the following years. In 2007, the DMC for Poland was among the highest in the European Union (Fig. 4.).

Material consumption of the economy is measured by material productivity calculated as the GDP to DMC ratio. The higher the indicator, the less materials are used to generate a GDP unit. The indicator for Poland, as for the majority of other new EU Member States, is lower than the EU average, which proves that the economy is characterised by high material consumption (Fig. 5.). Eurostat data reveal that in the years 2000-2007 the material productivity ratio grew faster in Poland (almost 20 %) than the EU average (ca. 7 %) (Fig. 6.). This indicator will increase further, as the structure of the economy changes, leading to a more common use of modern technologies. However, measures aimed at sustainable use of resources must be intensified further. It has to be admitted that the above information is a generalisation, since over 60 % of GDP is generated by the sector of services whose contribution to the use of resources is minimal.

Energy consumption is an important indicator of eco-effectiveness, as the “zero-energy” growth, i.e. the economic growth without the increased demand for primary energy, is one of the challenges of the „green economy”. Non-renewable resources are the main source of energy in Poland. Hard coal remains the dominant primary energy carrier in the Polish economy (almost 45 % of the total use of energy carriers in 2009), though its share in total use of energy carriers has been declining slightly year on year (Fig. 7.). Dependence on coal is even more visible in the case of electricity production, since almost 90 % of it is generated from this very carrier.

Energy consumption in the economy has been increasing since 2002, but its growth rate is much lower than the GDP growth rate. The year 2009 was an exception, since both those rates declined, most likely as a result of the economic crisis and reduced economic activity (Fig. 8.). The structure of final energy consumption in Poland changes year to year. Restructuring of the industry and activities of enterprises in order to reduce energy intensity resulted in the decreased energy consumption in the sector. The development of road transport and the services sector increase the share of those sectors in the domestic energy consumption. The introduction of the insulation systems and improved effectiveness of the heating systems resulted in the reduced energy consumption in the household sectors in the recent decade (Fig. 9.).

In spite of numerous measures undertaken to reduce energy consumption in the Polish economy, it remains one of the most energy-intensive economies in the European Union, with its energy intensity ratio exceeding the EU average more than two-fold (Fig. 10.). However, the ratio decreases faster than its average value for all EU Member States (Fig. 11.). One of the objectives of the Europe 2020 strategy is to achieve a 20 % increase in energy efficiency.

The greatest potential in Poland is related to fossil fuels which will remain the main source of energy in the coming years. However, the concern for the state of the environment, in particular air quality, the necessity to reduce the impact on climate change and the scantiness of deposits, as well as the growing prices of conventional energy carriers, result in an increased interest in renewable energy sources. One of the elements of the European Union's energy policy is to increase the share of energy from renewable sources in total energy production. Furthermore, pursuant to the "Energy policy of Poland until 2030" adopted in 2009, the share of energy from renewable sources in total energy consumption in Poland should grow to 15 % by 2020 and 20 % by 2030, while biofuels should account for 10 % of the total consumption of petrol and diesel oil in transport by 2020.

According to CSO data, the recent decade saw a constant increase in the amount of energy generated from renewable sources, accompanied by a decrease in primary energy production. The share of energy from renewable sources in the total energy production amounted to 9 % in 2009. Due to the geological and climatic characteristics of the country, energy from solid biomass accounted for the major part of the renewable energy balance in 2009, i.e. 85.5 % of production from

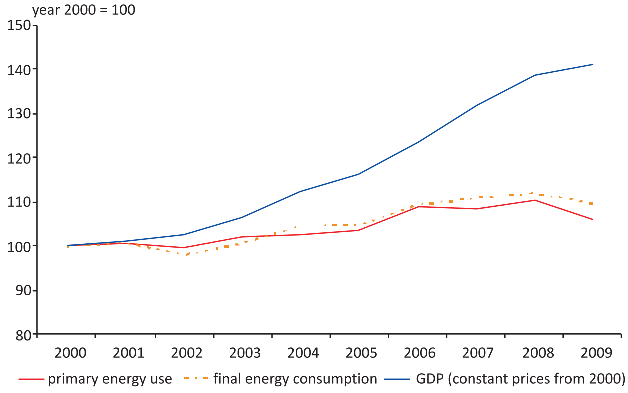

Fig. 8. Dynamics of energy use in the Polish domestic economy vis-à-vis GDP (source: GUS)

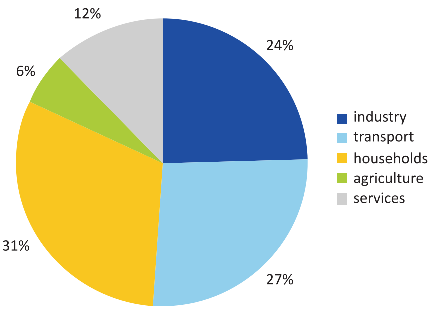

Fig. 9. The structure of final energy consumption according to reporting activity to Eurostat (source: Eurostat)

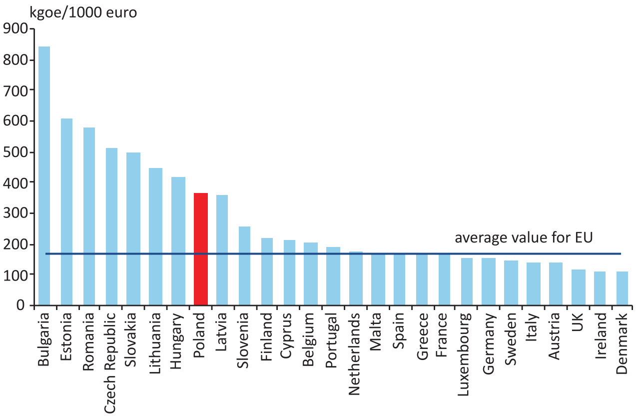

Fig. 10. Energy intensity of economy of EU member states in 2009, expressed as ratio of energy use to GDP (source: Eurostat)

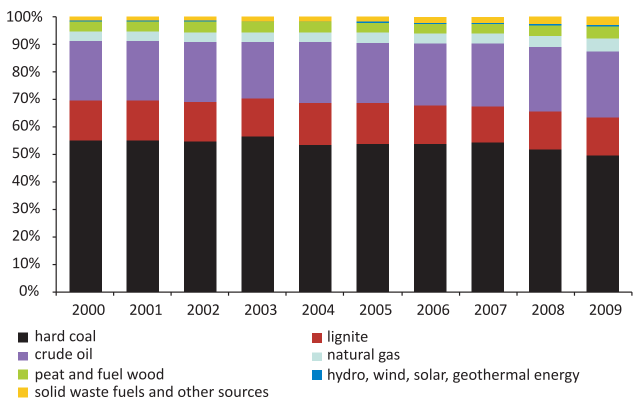

Fig. 7. The structure of primary energy carriers' use in domestic economy (source: GUS)

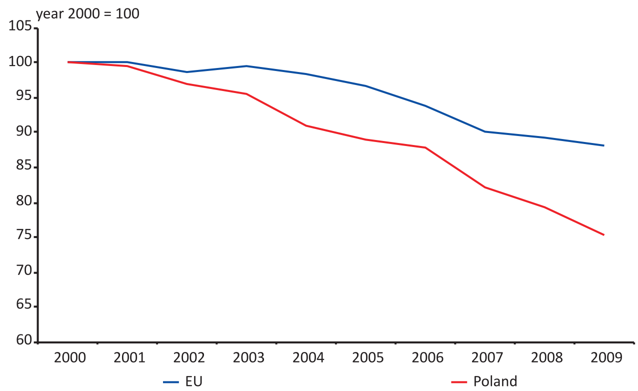

Fig. 11. Dynamics of energy intensity changes in Poland and in EU (source: Eurostat)

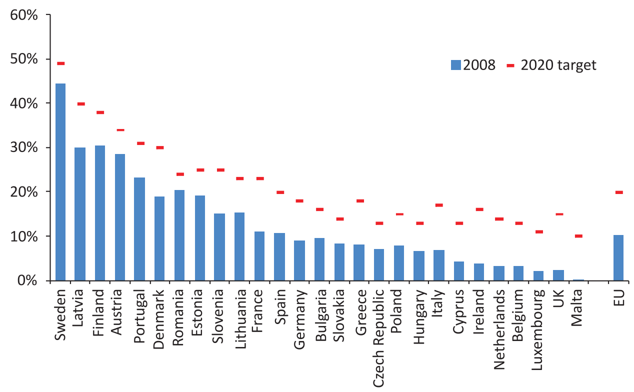

Fig. 12. Share of renewable energy to final energy consumption in 2008 vis-à-vis target value for 2020 indicated in the directive 2009/28/EC7 (source: Eurostat)

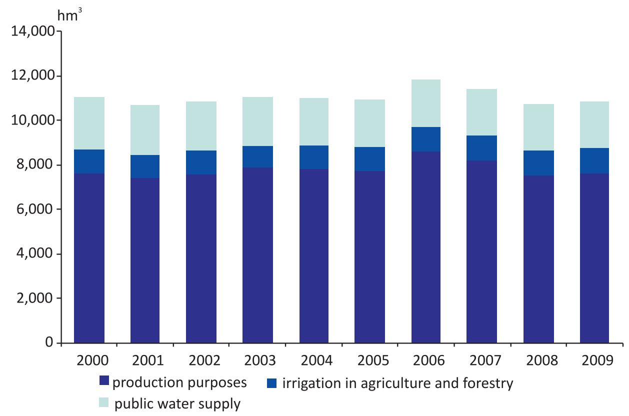

Fig. 13. Abstraction of water in Poland for the needs of domestic economy and population (source: CSO)

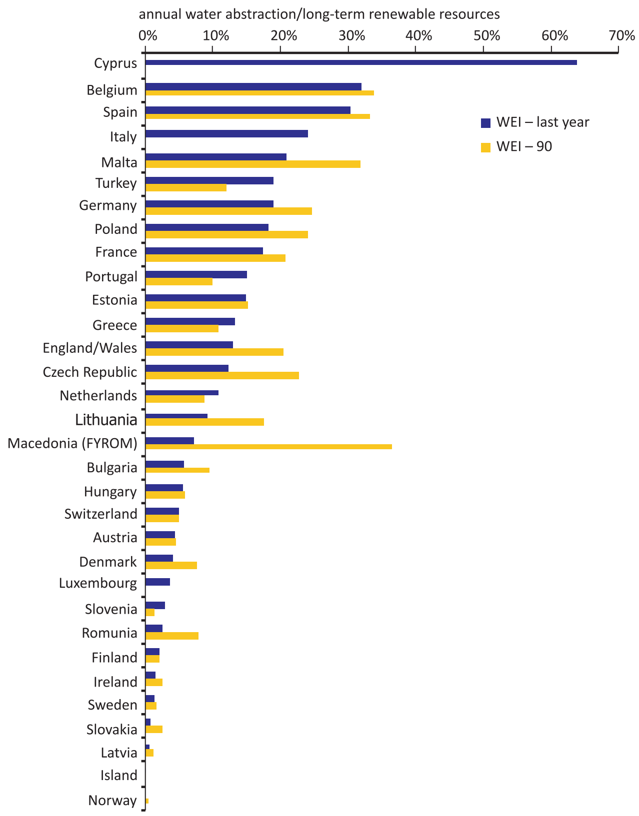

Fig. 14. Percentage share of annual water abstraction in long-term renewable freshwater resources for 1990 and the last available year (WEI-last year) (source: EEA)

all renewable energy carriers. The share of electricity generated from renewable energy sources in the gross domestic electricity consumption grew from 2.58 % in 2005 to 5.75 % in 2009 (according to a report by the Ministry of Economy)[6]. The electricity generation structure with the use of renewable resources in the years 2005-2009 shows that power plants and heat and power plants using energy from biomass have the largest share in electricity generation (57 %), followed by hydropower plants (almost 28 %). Wind and biogas sources are also becoming increasingly important.

One of the objectives of the Europe 2020 strategy is to increase the share of renewable energy sources in total energy consumption to 20 % in the European Union. Targets for individual countries are specified in the Directive 2009/28/EC. In 2008, the European Union achieved half of the target from the Directive, i.e. 10.4 % share of energy from renewable sources in total energy consumption. The figures for individual objectives amounted to 11.8 % for heating, 17 % for electricity and 3.4 % for transport fuels. In Poland, the share of RES in total energy consumption amounted to 7.9 %, as compared to the target of 15 % for 2020 (Fig. 12.).

Poland is a country with scarce water resources. The resources per capita are among the smallest in Europe (ca. 1 400 m³ per capita in 2009). Therefore, their rational management should remain one of the top national priorities.

The main source of water for the purposes of national economy and population is surface water which accounts for more 84 % of the total water abstraction. Groundwater, as water of a much better quality, is used as drinking water for the population. In the years 2000-2009, water abstraction remained stable (Fig. 13.). Stabilization of water abstraction results from rationalization of water management. Poland is a country with low water consumption in terms of water abstraction per capita (234 m³ per inhabitant in 2009, according to Eurostat), as compared to other European countries.

The Water Exploitation Index (WEI), used by the European Environment Agency, is an important indicator for assessing the rationality of water management. The index presents the percentage share of the annual water abstraction in long-term renewable water resources (Fig. 14.). The WEI for Poland decreased in recent years, which means that the pressure on water resources was reduced, but the index still amounts to slightly less than 20 %. If the threshold of 20 % is exceeded, the water stress occurs.

In spite of the fact that recent years have seen a stabilization in water abstraction, activities aimed at further rationalization of water management are necessary and must be treated as one of the priority areas of the environmental policy. It is of utmost importance, since water deficit in the country may become more severe in the wake of the observed climate changes.

Emissions

The above-described use of resources results in manufacturing of goods and services which improve the quality of life. Resource processing results in by-products, such as emissions to air and water, which have adverse impact on the environment and people, and also in the production of waste.

During the 1990s and at the beginning of the 21st century, Poland saw a continuing fall in emissions of all basic air pollutants, in particular the emission of sulphur dioxide and nitrogen oxides. This decline was largely due to the restructuring and modernisation of energy and industry sectors, as well as to the improvement in the quality of coal.

Since 2003 the emissions of most pollutants have remained on a similar level or, as is the case of sulphur dioxide, are on the decrease. In the former case however, this decline is not as substantial as it was in the 1990s (Fig. 15.).

The structure of pollutant emissions in Poland is a consequence of the structure of fuel consumption and the quality of fuels. These factors determine the extent of air pollution. The volume of emissions is determined by the production technologies used in the energy sector and by the structure of fuels in the municipal and housing sector (Fig. 16. and 17.).

The main reason for atmospheric emissions of gas and particular matter is the lack of significant changes in the structure of energy carriers consumption in Poland. Hard coal is still the basic primary energy carrier in the national economy.

Due to an increasing use of pro-environmental technologies in the industry, the energy and transport sectors, the current economic growth is accompanied by a fall in emissions of basic pollutants to ambient air. In terms of the entire country, one can speak of a complete decoupling of the economic growth from the emissions (Fig. 54.).

Emissions to water come from point sources, e.g. municipal and industrial sewage systems, and from surface sources, chiefly from agricultural and forest areas. During the last decade, the volume of discharged sewage has stabilised at the level of ca. 9 000 hm^3 per year. Industrial waste water constitutes the overwhelming majority of that volume, with almost 90 % of it falling into the category of the so-called ‘relatively clean’ cooling water, which in a large part does not require biological treatment. The share of untreated waste water in the waste water requiring treatment was falling from year to year and reached the level of 6 % in 2009. Approximately 90 % of waste water needing treatment comes from municipal sewage systems and the remaining 10 % is discharged by industrial plants.

Various pollutants are discharged to waters along with sewage and are subsequently transported by rivers to the Baltic Sea. In comparison to the year 2000, the load of BOD5 transported by rivers to the Baltic Sea fell by approx. 31 % and amounted to 148.5 thousand tonnes in 2009. During the same period, nitrogen emissions declined by ca. 21 % (148.6 thousand tonnes in 2009), whereas the total phosphorus emissions dropped by ca. 20 % (9.8 thousand tonnes in 2009) (Fig.19.). This result is mainly a consequence of substantial investments in municipal waste water treatment, removal of various industrial ‘hot-spot’ sources and implementation of the Code of Good Agricultural Practice. At the same time, recent years were marked by relatively small flows (although in 2009 larger flows than those in 2008 were reported). The downward trend in the loads discharged to the Baltic Sea may change in the subsequent years depending on hydro-meteorological conditions.

Volume of waste generated in Poland has been decreasing every year. Over 90 % of all waste is industrial waste. Its main sources include: industrial processing (over 45 % of total volume of generated waste), mainly production of metals

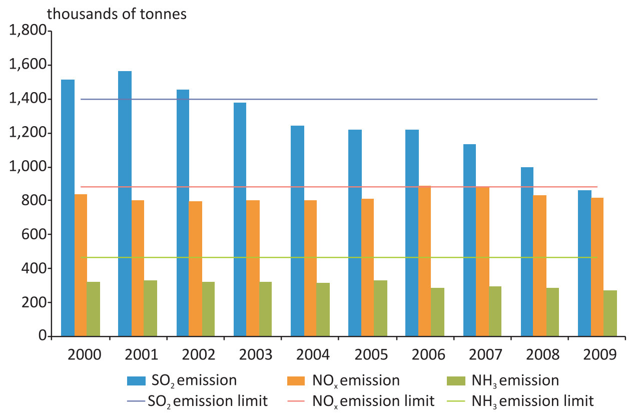

Fig. 15. Emission volumes of SO_2, NO_x, NH_3 against national emission limits of the substances stated in the Treaty of Accession of the Republic of Poland to the European Union, in the scope of directive 2001/81/EC on national emission ceilings for certain atmospheric pollutants (source: ME)

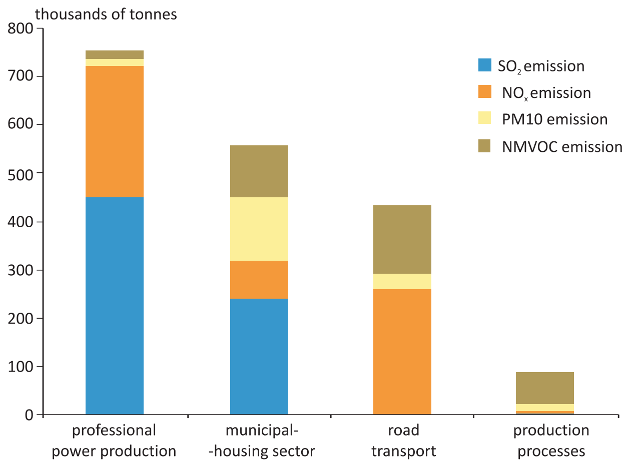

Fig. 16. Emissions of major pollutants by sector in Poland in 2009 (source: ME)

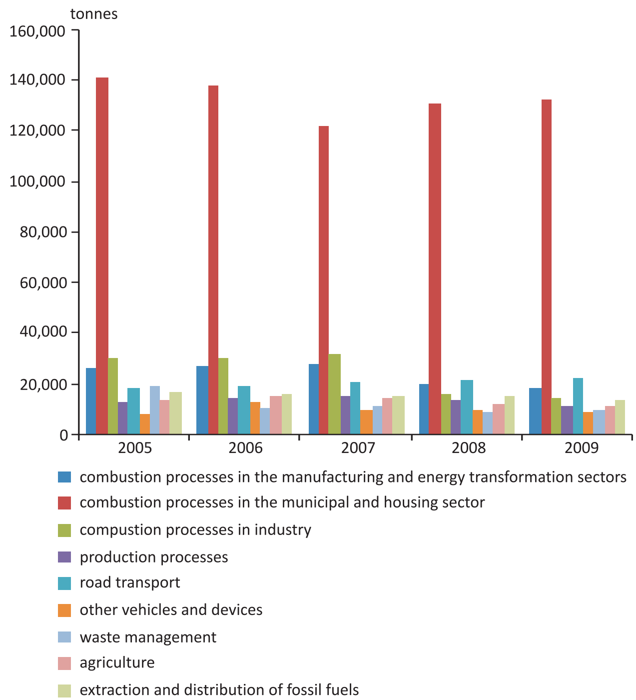

Fig.17. Emissions of primary particulate matter PM10 in Poland (source: ME)

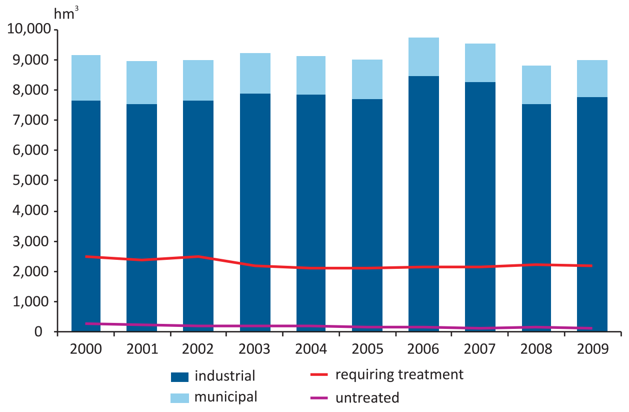

Fig. 18. Industrial and municipal sewage discharged to water or to the ground (source: CSO)

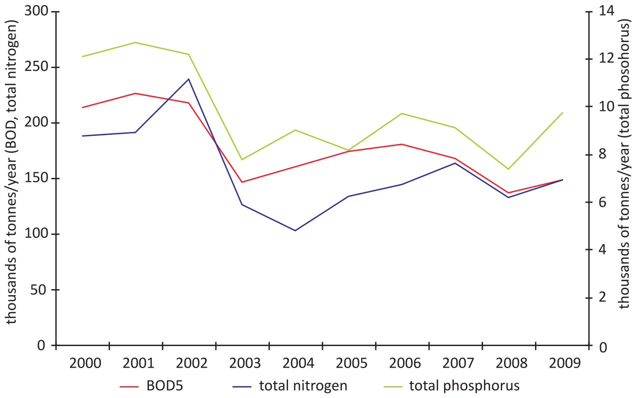

Fig. 19. Loads of BOD5, total nitrogen and total phosphorus transported through rivers from the territory of Poland to the Baltic Sea (source: CIEP/SEM)

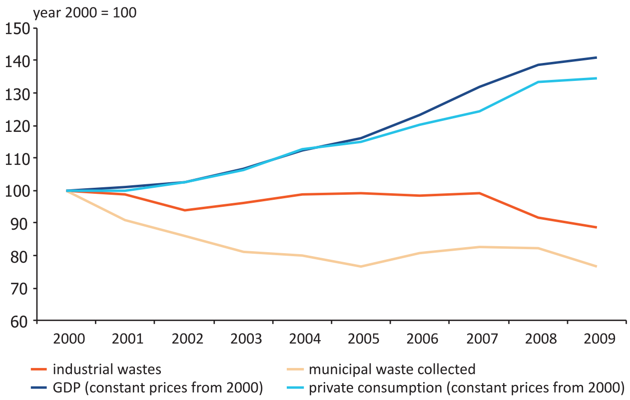

Fig. 20. Dynamics of changes in generation of industrial and municipal wastes against GDP and private consumption (source: CSO)

(over 30 %); mining (approx. 29 %), in particular hard coal mining (approx. 26 %); and also production and distribution of electricity (approx. 14 %). The greatest share in generated waste is accounted for by waste from flotation enrichment of non-ferrous metal ores (27 %), waste originating from rinsing and cleaning of minerals (25 %), and slag and ash mixtures from wet removal of furnace waste (8 %).

The main factor determining the volume of generated waste is economic development, which affects both the intensity of production and the level of individual consumption and consumption patterns. Analysing the dynamic of changes in generated waste in relation to GDP changes, one may notice a positive tendency - with a constant GDP growth, the volume of industrial waste has remained at a similar level for the last ten years, which may be considered an effect of actions undertaken to rationalise waste management in Poland (Fig. 20.).

The volume of generated municipal waste is closely connected to the level of individual consumption and its patterns. Analysing the dynamics of the changes of both indicators, one should notice that the private consumption index increased by almost 34 % in the years 2000-2009, whereas the volume of collected municipal waste decreased by almost 23 % in the analysed period (Fig. 20.).

Sectors - municipal sector

Households and municipal sector are one of the main sources of pressures on the environment. These pressures include generation of municipal waste, water pollution by dumping untreated household sewage, air pollution (the so-called low emission problem), as well as water and energy consumption. It goes without saying that social and economic changes, which also entailed a growth in affluence (the annual growth of average income per 1 household member), had a significant impact on the lifestyle and the level of consumption. The number of households is on the rise and their structure is changing with the share of one or two-person households increasing and the number of multi-person households falling. Private consumption increases along with the GDP growth. Every year there is an improvement in the number of durable goods in the households. These goods include especially computers with an access to internet, mobile phones, cars, cutting-edge audio and video equipment and home appliances. On the one hand, consumption has a positive impact on the economy, driving the production and sales. On the other hand, however, unbalanced consumption may have negative consequences for the environment.

An important issue is the use of energy and fuels in the municipal sector, which is directly related to burning fuel in home furnaces and in central heating systems, consumption of energy by home appliances and the use of fuel by individual means of transport. All these processes are connected with the emission of pollutants into the ambient air, significantly affecting its quality. Households are the largest consumer of energy – in 2009 this sector's share in the total energy consumption amounted to 31 % (Fig. 9.). Households use approx. 19 % of electricity and over 50 % of heat generated in Poland. The last decade has seen a decline in energy consumption for heating and meal preparation, which can be explained by substituting inefficient coal stoves with modern electric and gas cookers. At the same time, a rise in electricity consumption can be observed, related most likely to an improvement in the quality of life. More electric appliances at households and a change in behaviour of household members have undoubtedly played a significant role here.

Fuel burning in local and particularly in individual heating systems constitutes a substantial source of emissions into the air (the so-called low emission) and significantly affects, along with transport, the quality of air in cities. The municipal sector is responsible for almost 30 % of total SO_2 emissions, over 50 % of PM10 particulate matter emissions and almost 20 % of emissions of non-methane volatile organic compounds (NMVOC) (these values do not include mobile sources). The data from the EMEP emissions inventory show that there has not been any substantial change in the volume of emissions from the municipal sector in the recent years, in contrast to the industry sector. This is worrying, especially since the low emission is the main reason for exceeding the PM10 limit values in Poland.

Water consumption for water supply system (without water utilised by the industry) declines every year and in 2009 reached a level of approx. 1.5 thousand hm^3, which constitutes 15 % of total water consumption in Poland. The volume of municipal waste has been falling along with decreasing water consumption, by approx. 18 % since the beginning of the 21st century. Municipal waste water constitutes 90 % of all waste water which requires treatment, therefore the method of treatment is of utmost importance. Every year the volume of waste water which was treated using methods involving increased biogenes removal is increasing. In 2009, approx. 47 % of waste water was treated with this method. Despite measures aimed at reducing pressure coming from the municipal sector, which, along with the pollution from agriculture, is the main source of nutrients, the large part of surface waters, including waters of the Baltic Sea, is still threatened by eutrophication.

Household and municipal sector wastes constitute an important pressure factor. In 2009, approx. 12 million tonnes of municipal waste was generated in Poland, i.e. 316 kg per one inhabitant. This figure is much lower than the EU average, which amounts to 512 kg per capita per year. Disposal by landfilling remains the main method of municipal waste disposal. In 2009, 78 % of all collected municipal waste was transported to landfill sites. When improperly managed, landfill sites may contaminate soil and water due to leakages or pollute air by emitting odours and methane. Additionally, they also contribute to the loss of land and significant deterioration of the aesthetic quality of landscapes.

Sectors - agriculture

Agriculture constitutes a strategic sector of Polish economy, catering for the food products and delivering resources to the industry. Polish agriculture is characterised by substantial fragmentation, with a large number of small area farms on which the traditional farming is performed. In 2009, there were ca. 2.5 million agricultural holdings in Poland. The area structure of Polish farms has been changing, with the area of farms increasing and highly specialised farming methods becoming increasingly popular. In 2009, for example, 1 ha farms constituted 29.3 % of all agricultural holdings, whereas in 2000 their share amounted to 34 %. On the one hand, reparcelling and creating monocultures increases economic effectiveness and productivity, but, on the other hand, it can be a source of an increased pressure on environmental components.

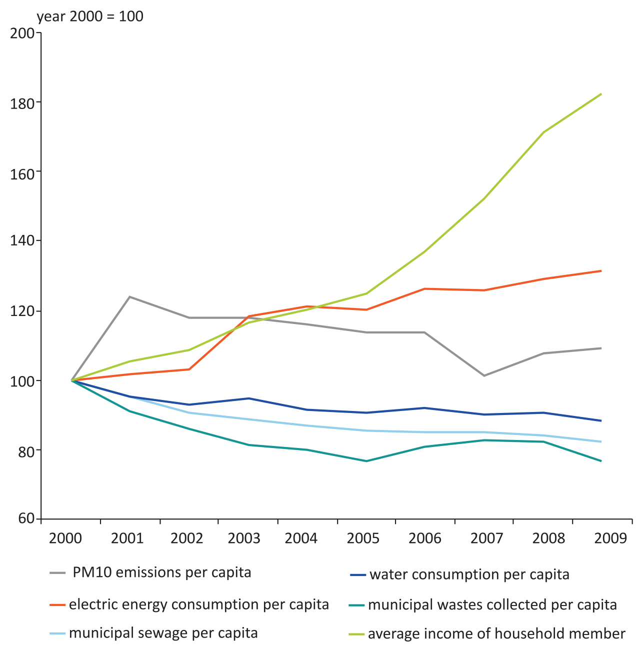

Fig. 21. Eco-efficiency of municipal sector (source: CSO, Eurostat, EMEP)

The value of agricultural production in the recent years has been rising, with both prices and volume of production undergoing large fluctuations. According to the Economic Accounts for Agriculture, the value of production of the Polish agriculture sector in 2009 rose by 16.9 % (calculated in fixed prices from 2000) comparing to 2000.

Having the largest share in the country's area (60.5 %), agricultural land covered 18,931 thousand ha on 1 January 2010. Their structure is dominated by arable land, which constitutes 74 % of all agricultural land. The last decade saw a marked reduction in the area of arable land, mainly due to the fact that fallow and idle land has been continuously afforested.

Development of intensive large-area farming and monoculture farming may lead to diminishing the biodiversity of agricultural landscape. The intensification of agricultural production is accompanied by an increased use of chemicals, which may lead to an increased soil environment pollution and to contamination of surface and ground waters.

Poland is a country characterised with a moderate use of artificial fertilizers. In the economic year 2008/2009, the average use of mineral fertilizers (NPK) in Poland was 118 kg per 1 ha of arable land and was ca. 30 % higher than at the beginning of the 21st century. At the same time, the use of lime fertilizers decreased by 66 % and amounted to 33 kg of active substance per 1 ha of arable land. Such change is unfavourable, since nitrogen fertilizers acidify soil and acidification is one of major problems for soil protection in Poland. During the last 10 years, sales of plant protection products doubled. An increase in the use of both mineral fertilizers and sales of pesticides grew dynamically after 2004.

Diffuse pollution, which is a side-effect of using fertilizers, plant protection products and manure coming from animal breeding facilities, affects the quality of ground and

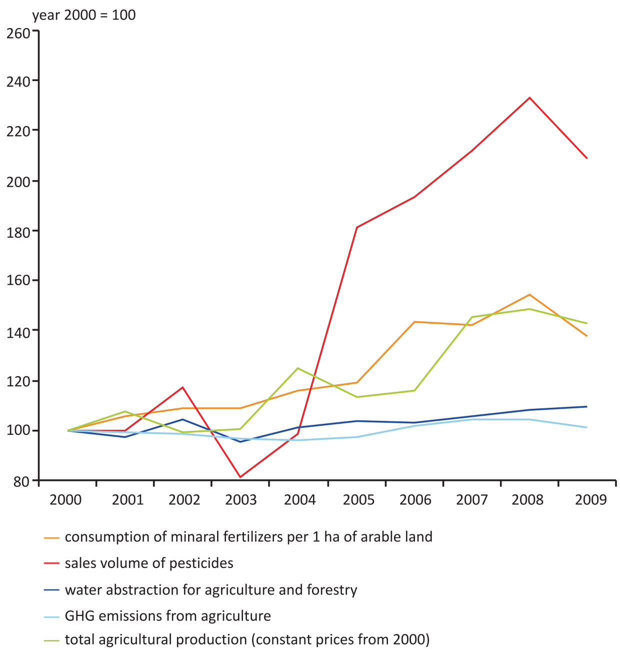

Fig. 22. Eco-efficiency of agriculture (source: CSO, Eurostat, EMEP)

surface waters. Nutrients are washed out from agricultural land and enter surface waters, thus contributing to an increased risk of eutrophication. The negative impact of farming on the quality of ground and surface waters is mitigated by implementing measures provided for in the Nitrates Directive. An important factor influencing the quality of waters is the sanitation of rural areas. It has been improving, but its level is still insufficient. Almost 27 % of people living in the rural areas use sewage treatment, 23.5 % are connected to the sewage system. During the last 10 years, the length of sewage network in rural areas increased over three-fold, whereas the number of sewage treatment plants using biological methods and methods with increased biogenes removal rose by 50 %.

Water abstraction for irrigation in agriculture and forestry amounts to approx. 10 % of total water abstraction in Poland. During the last 10 years, it remained on a similar level of 1 100 hm^3 (except for year 2006, when water abstraction was much higher).

An important issue which is directly connected with infrastructure in rural areas is the so-called low emission – emissions from small boiler rooms and home furnaces, where certain kinds of waste are still used as fuel.

Agricultural activity is the main source of ammonia emission, which is a by-product of animal farming and using nitrogen fertilizers. According to the national emissions inventory prepared for EMEP in 2009, the total volume of ammonia emission in Poland amounted to 273.4 Gg, 98 % of which was generated by agriculture. Agricultural sector also contributes to the emission of greenhouse gases, in particular methane and nitrous oxide. In 2009, the share of emissions generated by farming in the total emissions of greenhouse gases, methane and nitrous oxide amounted to 4.9 %, 35.5 % and 84.2 % respectively. The total emission from the agricultural sector in 2009 amounted to 35 512 Gg of CO_2 equivalent and was 29.9 % lower than in the reference year 1998.

Organic farming is a specific method of farming, constituting a system of sustainable plant and animal production within an agricultural holding, based on biological and mineral resources which were not subjected to technological processing. The basic principle is the rejection of agricultural, veterinary and food chemistry agents in the process of food production. In 2009, there were almost 17 000 organic farms in Poland (certified and in the course of conversion), covering a total of 370 thousand hectares. The growth of the area of organic farms was particularly after 2004. It is related to the effective implementation of agri-environmental programmes, as well as an increasing environmental awareness, which results in the consistently growing demand for organic food.

Sectors - transport

The development of transport networks is essential for a country's development, but it also negatively affects the environment. Transport networks, including communication routes, have an impact on landscape and biological diversity, contribute to soil sealing, lead to fragmentation of natural habitats and cut through ecological corridors thus making it difficult for many animal species to move freely. Transport is a source of noise and emissions of exhaust gases polluting the air.

During the last decade, the transport sector has undergone dynamic changes and developments. This concerns in particular road and air transport. Road transport has the largest share in the transportation of goods and passengers (69 % in the freight transport and 48 % in passenger transport).

Poland has a relatively well developed road network, but it still lacks motorways and expressways. The length of public roads in Poland amounts to approx. 385 thousand km, 70 % of which are hard-surfaced roads. Density of hard-surfaced public roads network amounted to almost 86 km per 100 km^2. In 2009, there were over 22 million of registered motor vehicles and tractors in Poland. The last decade saw a dynamic increase in the number of registered vehicles – number of cars rose by 65 % in comparison to 2000, number of trucks and tractors increased by almost 50 %.

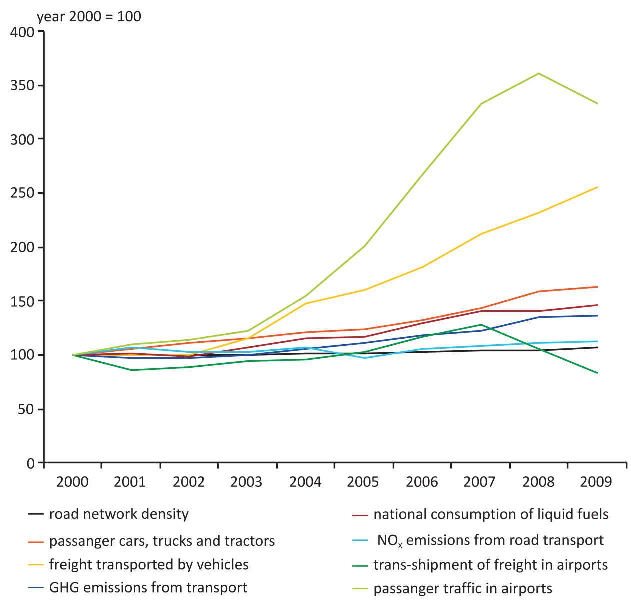

Fig. 23. Eco-efficiency of municipal sector (source: CSO, Eurostat, EMEP)

The number of vehicles grows faster than the modernisation of the road networks, which results in traffic congestions not only in the city centres, but also on access roads to cities. In the places where traffic jams are frequent and a dense network of buildings does not allow the pollutants to disperse quickly, limit values of air pollutants concentration may be exceeded. A larger number of vehicles on the roads contributes to the deterioration of acoustic climate. Although the general technical condition of vehicles is improving, the vehicles manufactured after 2001 constitute only approx. 30 % of the total number of vehicles. The increased pressure exercised by road transport is also evidenced by an almost 2.5 times growth in vehicle transport of freight during the last ten years. In 2009, the value of such transport amounted to 191 484 million tonne-kilometres.

Transport is responsible for 10.8 % of total greenhouse gas emissions in Poland, out of which 95.6 % is attributed to road transport. It is disturbing that the emissions of these gases doubled in comparison to the reference year 1989. As total greenhouse gas emissions in Poland decrease, this trends results in a continuous increase of emissions generated by transport in the total volume of greenhouse gas emission. Road transport accounts for a major share of atmospheric emissions of main air pollutants. Transport-generated emissions of NO_X, CO, NMVOC, and PM10 amounted to 31.6 %, 26.5 %, 23 % and 9.1 % respectively.

The Polish railway network is 20 thousand km long. Its significance is decreasing, both in terms of the mass of transported freight and in terms of number of travelling passengers. Nevertheless, railway still constitutes one of the main sources of transport noise.

Air transport is gaining importance and in consequence its pressure on the environment is also on the rise. During the last decade, the number of passengers flying to and out of Poland tripled. Noise is the main nuisance caused by the air transport. On a global scale, however, more attention is paid to an increasing contribution of air transport to the emission of greenhouse gases. In comparison to road transport, emissions generated by the Polish air transport are relatively small.

Sectors - industry and energy

Industry has always been one of the main sources of pollution and environmental pressures, affecting significantly all environment components. During the last 20 years, there has been a significant increase in the industrial output and in the GDP. At the same time, the development of the industry sector is accompanied by a decrease or stabilization of its main pressures on the environment.

The power generation sector is one of the most important sectors of the Polish economy. As far as the air quality is concerned, Poland's structure of energy production is unfavourable. Hard coal accounts for almost 45 % of energy carriers consumption. However, the actions undertaken in the last decade resulted in the reduction of pressure from the power generating plants reflected in the basic emission indicators. These trends concern both the power generating plants and industrial power plants. The power industry is the main source of greenhouse gas emissions and its share in the total volume of emissions amounts to approx. 80 %. The emissions of greenhouse gases generated by the power industry decreased in the last decade, with industrial output and energy consumption rising at the same time.

Industry generates the largest volume of waste. In Poland, industrial waste constitutes over 90 % of total volume of waste produced. 111.6 million tonnes of waste were generated in 2009. The amount of generated waste decreased during the last 10 years by approx. 11 %, with industrial production levels rising at the same time. This is a consequence of increasingly widespread use of low-waste technologies by the industry. Generated waste constitutes a potential threat for all environmental components, which can become very real when

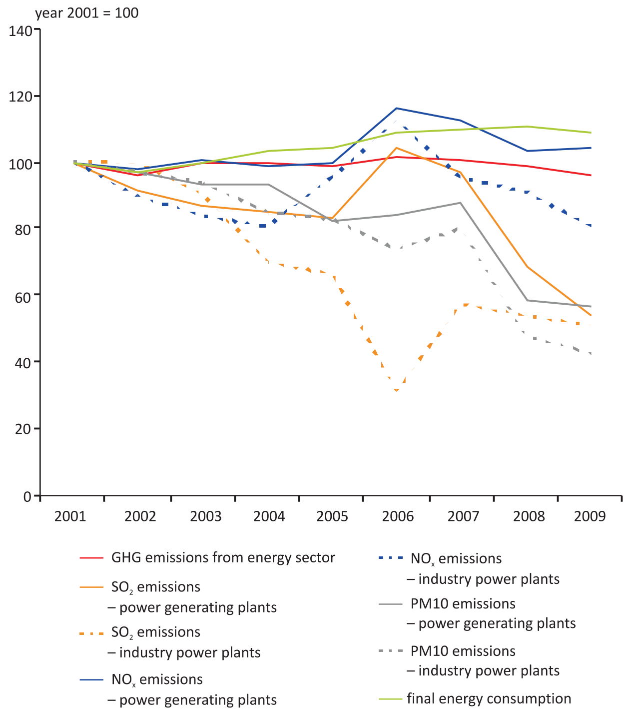

Fig. 24. Emissions generated by industry sector (source: CSO, Eurostat, UNFCC, EMEP)

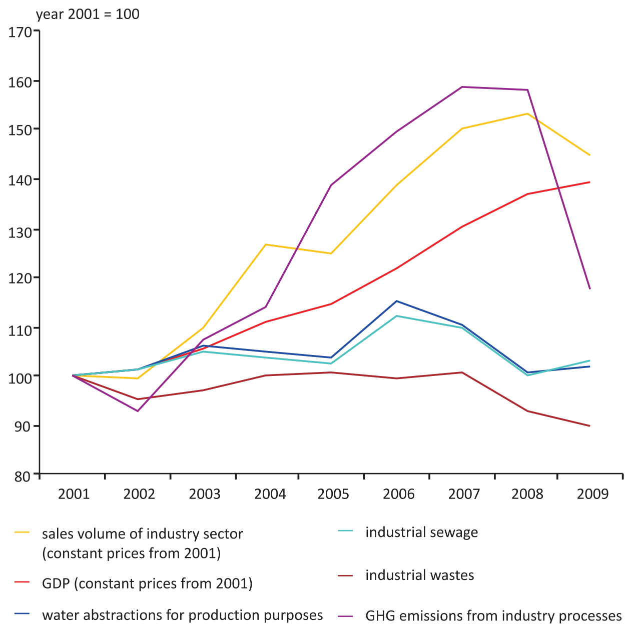

Fig. 25. Eco-efficiency of industry sector (source: CSO, Eurostat, UNFCC, EMEP)

waste is handled inappropriately. The major part of industrial waste (approx. 73.4 %) is recycled, while 19.2 % is disposed by landfilling. The last years saw an alarming increase in the share of landfilling of industrial waste in various waste disposal methods (for ex. in 2005 15 % industrial wastes was landfilled).

Industry is also a leader as far as the consumption of water and the amount of generated sewage is concerned. The abstraction of water for production purposes accounts for 70 % of total water abstraction. Pro-ecological investments made in the 1990s (implementation of closed cycles) led to a decrease in water abstraction. Its level remained constant and consequently the amount of produced industrial sewage stabilised.

Cost optimization related to the functioning of businesses and organizations necessitates savings in the area of raw material and utilities use. Therefore, it is the economic calculation that may be expected to stimulate the reduction of materials, energy and water consumption by the economy. Implementation of certified environmental management system also aids this process. As of 30 June 2011, 25 Polish organizations and 33 Polish facilities were registered in the EU eco-management and audit scheme (EMAS). Germany may serve as a point of reference here - there were 1393 organizations and 1903 facilities registered with EMAS.

Innovative solutions, especially clean technologies, are important factors which can improve the effectiveness of Polish economy. The Innovation Union Scoreboard 2010 classifies Poland (along with the Czech Republic, Greece, Malta, Portugal, Slovakia, Hungary and Italy) among 'moderate innovators', which means that Poland advanced from the group of 'modest innovators' in which it was in the previous year. The position of Poland in the ranking is still rather distant - Poland is 22nd among all EU-27 Member States. Between 2007 and 2009, R&D expenditure in relation to GDP in Poland rose systematically from 0.56 % in 2006 to 0.68 % in 2009. Nevertheless, it was still lower than in 1999 (0.69 %) and almost three-times lower than the EU-27 average (2.01 % in 2009).

Development of green technologies is supported under i.a. the GreenEvo – the Green Technology Accelerator project of the Ministry of the Environment. Its aim is to promote Polish environmentally friendly technologies and to support enterprises in implementing them. It is also to help Polish companies developing green technologies in operating on international markets and in preparing to competitively manage their projects.

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1 "A strategy for smart, sustainable and inclusive growth" [Communication from the Commission, Brussels 3.3.2010 COM(2010) 2020].

2 National Reform Programme to implement the Europe 2020 strategy, adopted by the Council of Ministers on 26 April 2011.

3 HDI – Human Development Index.

4 EF – Ecological Footprint assesses our demand for natural resources of biosphere in hectares of land and sea area, which we use for consumption and absorption of our pollution.

5 DMC (domestic material consumption) measures the materials directly used by an economy and is defined as the domestic extraction (DE), plus imports minus exports. The DMC indicator provides an assessment of the absolute level of the use of resources.

6 http://www.mg.gov.pl/files/upload/13211/Raport%20OZE%20przyjety%20przez%20RM%20w%20dniu%2012%20kwietnia%202011 %20r..pdf

7 Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC (Text with EEA relevance).

Although significant progress has been made in reducing pressure on the environment in the recent 20 years, the social and economic development of Poland still takes place at the expense of the resources and the quality of the environment. Therefore, all sectors of the economy must fully implement the principles of sustainable development and increase their eco-efficiency in order to limit the use of resources and reduce emissions of various substances and energy to the environment.

In order to ensure a long-term prosperity of the economy, protection of natural resources and their sustainable management are a must. Poland still has much to do in this area. This concerns in particular resource and energy consumption, which is considerably higher than the EU average. Reducing the use of resources and energy will result not only in decreasing the costs of economy in the future, but also in mitigating pressure exercised on all environment components. Despite the fact that water abstraction has stabilised in recent years, actions aimed at further rationalization of water management should be a priority of the environmental policy. This is even more important, since the observed climate change is expected to further increase the water scarcity in Poland.

Investments in the industry and stricter requirements for operators using the environment allowed to reduce or stabilize emissions from the sector and improve the indicators of the use of various resources. The pressure from the municipal sector remains a challenge which is difficult to handle due to the lack of appropriate environmental policy instruments. Further improvement of living conditions will entail an increase in individual consumption and thus it will contribute to an increased adverse impact on the environment. Therefore, measures aimed at promoting environmentally friendly attitudes among consumers must be intensified.

The impact of transport on the environment and the quality of life is growing. Increasing number of vehicles adversely affects the acoustic climate of urban areas and air quality. Increase in the greenhouse gas emissions from transport is also a cause of concern.

The Polish agriculture remains fragmented and the use of mineral fertilizers and plant protection products is moderate. The growth of economic effectiveness and productivity of agriculture may result in the reduction of biodiversity of agricultural landscape and an increased pressure on aquatic and soil environment.

BIODIVERSITY

BIODIVERSITY

Nature determines the human life by supplying food, raw materials, oxygen, clean water, unpolluted soil and many other goods. It reduces the amount of carbon dioxide in natural processes, it creates living conditions for the organisms, it is an environment for a healthy life and rest for men. A superior feature of nature involves its biodiversity which ensures balance at the level of individuals, species and ecosystems. Loss of biological diversity of ecosystems poses a threat to the proper functioning of our planet, and as a consequence to the economy and humankind.

Poland has relatively a reach biological diversity. It is a result of its transitory climate, diversified relief, geological structure and soil, with no natural barriers. Biodiversity in Poland is characterized by a relatively large area of forests (9.1 million hectares), wetlands (1.8 million hectares, including 455 thousand hectares of inland waters), as well as by a relatively extensive use of agricultural areas. The nature state of ecosystems related to the latter group can be assessed using Farmland Bird Index (FBI)[1]. The index presents the abundance of birds, as compared to the reference year, which is the year 2000 for Poland. In 2000-2003 this index showed a 15 % fall in bird population, followed by a slow growth from 2005 onwards to the starting level in 2008 and then a fall of approx. 5 % in 2009 (Fig. 26.).

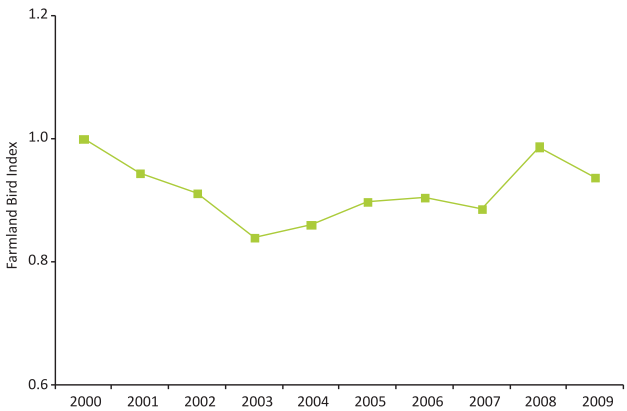

Fig. 26. Changes of the Farmland Bird Index in 2000 - 2008 (source: CIEP/SEM)

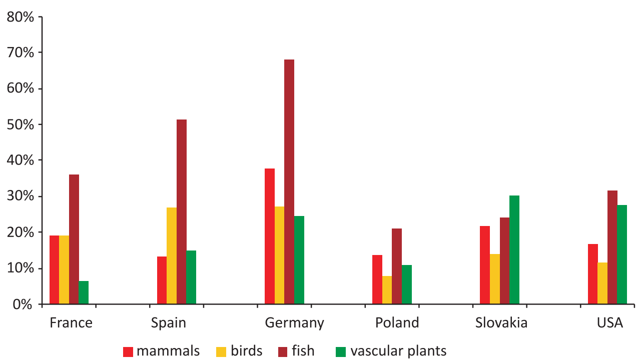

Fig. 27. Percentage share of endangered species: fish, birds and mammals, as well as vascular plants with reference to the number of species identified in selected countries (source: OECD)

485 plant communities[2] were identified in Poland, of which ca 12 % are considered to be endemic. According to current data there are 2844 angiospermous species, 13 gymnospermous species, 13 lycophytina species, 10 equisetopsida species, 52 polypodiopsida species, 700 moss species in Poland. Estimated data mention the presence of: 250 hepatics species, ca 10 000 algae species, 1 900 lichen and lichenicolous fungi species, as well as 12 500 fungi species. It is also estimated that in Poland there are 47 000 species of wild living fauna (of which approx. 35 400 were registered), including 98 % of invertebrates, among which insects are the most populous group (as much as 75 % of all animals). Vertebrates include: 18 amphibian species, 11 reptile species, 448 bird species, 105 mammal species, 138 fish species and 4 cyclostomata species.

Among all species present in Poland 1 159 animal species were in danger of extinction[3] [critically endangered (CR), endangered (EN) or vulnerable (VU)], including: 1 080 invertebrate species (including 784 insect species) and 79 vertebrate species (13 mammal species, 34 bird species, 3 reptile species, 29 fish species) and 328 vascular plant species, 62 moss species, 545 lichens species, 637 macrofungi species, 232 algae species. Compared to other countries the percentage share of all endangered mammals, birds and fish, as well as vascular plants among the species identified in Poland is relatively low (Fig. 27.).

Natural habitats and plant and animal species which are rare and endangered across Europe are subject to protection pursuant to the Habitats Directive. In Poland these are 80 types of natural habitats, 92 plant species, including 7 species which are allowed to be taken in the wild and 143 animal species (excluding birds), including 20 species which are allowed to be taken in the wild. The Habitats Directive requires that the conservation status of all these habitats and species be supervised, taking account of both their current conservation state, as well as perspectives of protection foreseeable in the future. Conservation status is evaluated on the basis of the results of monitoring and any other knowledge available on a three level scale: FV - favourable status, U1 - inadequate and U2 - bad. Assessments are carried out at the level of the so called biogeographical regions outlined in Europe. Poland is located at the area of three such regions: continental, Alpine and Baltic region.

The existing results of monitoring of species and natural habitats, taking special account of the special areas of conservation, as well as the report on the conservation status of species and natural habitats 2007 point out that the majority of habitats and species at the territory of the continental region (96.2 % of Poland's area) have inadequate conservation status (U1). Alpine region (Carpathian Mountains) was identified to have a better conservation status of species and habitats, but it only accounts for 3.2 % of Poland's area. The status of species was assessed higher than the status of natural habitats in both regions (Fig. 28.).

In the Polish continental region 12 % of 69 types of natural habitats have a favourable conservation status. The situation is much better in the Alpine region with 38 % out of 40 types being in favourable conservation status. The best

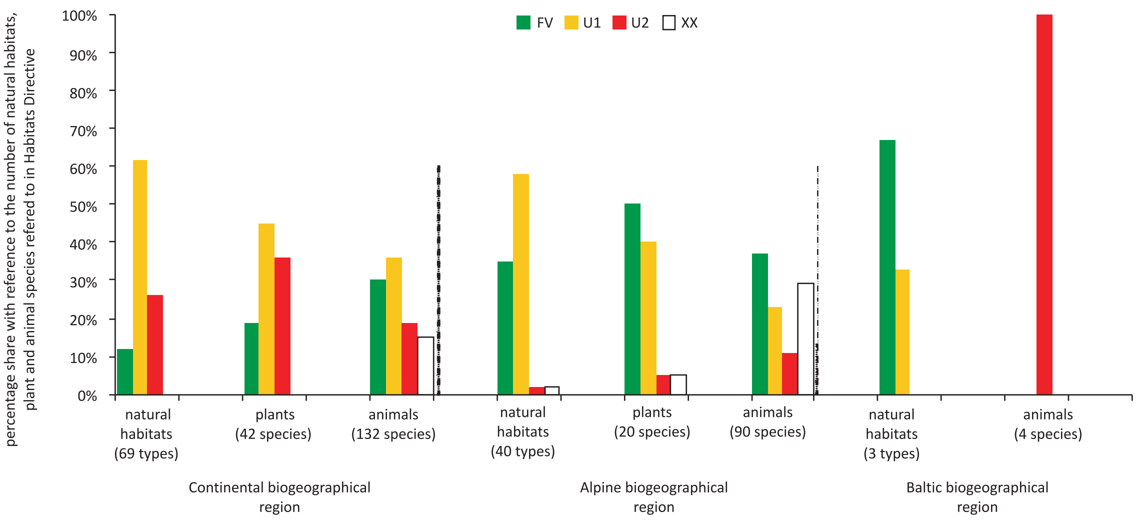

Fig. 28. Assessment of the conservation status of species and natural habitats occurring in Poland based on expert knowledge and results of the state environmental monitoring 2006-2010 (source: CIEP/SEM)

preserved habitats in Poland have high-mountain-like characteristics, they are relatively stable or are related to a specific substratum. The status of seminatural communities is much worse, as they are at risk of no use or intensification of use (e.g. semi-natural dry grasslands and scrubland facies on calcareous substratum and species-rich *Nardus* grasslands on silicious substrates in mountain areas [and submountain areas in Continental Europe]), as is the status of habitats which are sensitive to changes of hydrological conditions (peat land, spring areas, swamp coniferous forests or riparian forests).

One in two of 42 plant species in the Polish part of the continental region has an inadequate conservation status. These are mainly species related to wet and seminatural habitats, as these plants are the fastest to undergo negative changes. The status of more than 30 % was assessed as bad (this applies mostly to the species known only from individual sites), while 19 % was assessed as favourable, e.g. *Liparis loeselii* or *Cochlearia polonica* (but mainly species with a relatively broad ecological spectrum and almost all that are allowed to be taken in the wild according to Annex V of Habitats Directive). One in two of 22 plant species in the Alpine region has been conserved well (favourable conservation status).

When it comes to animals, 30 % of 132 species occurring in the continental region in Poland have a favourable conservation status, 36 % inadequate status and 19 % bad status. Favourable conservation status in this region applies among others to 7 odonata species, 11 fish species and 16 mammal species (including otter and beaver, 9 bat species). Bad conservation status applies to: 12 species of invertebrates (including Large Blue butterflies), 5 species of fish (including sea lamprey), 1 species of reptiles (European pond terrapin) and 7 species of mammals (e.g. speckled ground squirrel and European hamster). Animal species living in the Alpine biogeographical region enjoy a better conservation status. Here, out of 90 animal species 37 % have a favourable status (including 17 species of mammals and 5 species of amphibians), 23 % have an inadequate status and 11 % a bad status (among others Aesculapian Snake). The conservation status of four species of marine mammals in the Baltic

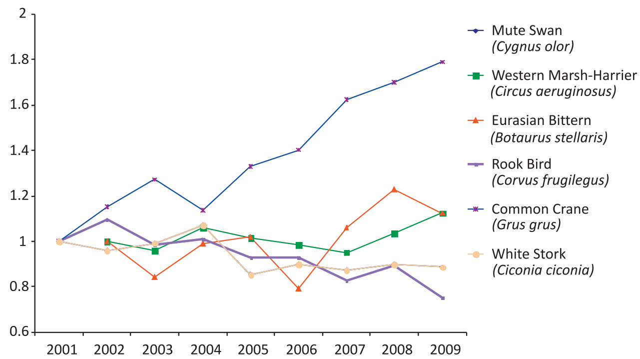

Fig. 29. Indicator of abundance of selected flagship bird species (source: CIEP/SEM)

region (among others grey seal and harbour porpoise) was assessed as bad.

A significant share of species which it was impossible to define (29 % in the Alpine region, 15 % in the continental region) shows that the knowledge about Polish fauna resources is insufficient, in particular when it comes to invertebrates.

A relatively high number of well conserved species and well preserved natural habitats, which were considered endangered in Europe, obliges Poland to take special responsibility for their conservation.

One of European SEBI2010 indicators assessing progress in halting the loss of biological diversity is the abundance and distribution of birds. Based on the results of bird monitoring, including monitoring of Natura 2000 special protection areas one may conclude that in 2000-2009 there was an increase in the abundance of the most popular bird species (Fig. 35.).

A representative example of changes in the natural environment involves changes in the abundance of bird species selected as flagship ones (Fig. 29.), is an indicator of an extensive landscape use:

– in 2005-2009 the domestic population of White Stork (*Ciconia ciconia*) was 20 % lower than in 2004 when its abundance was estimated to be 52500 breeding pairs;

– the population of Common Crane (*Grus grus*) and Mute Swan (*Cygnus olor*) has been increasing since 2001 at an annual rate of 7-8 %;
– the number of breeding Rook birds (*Corvus frugilegus*) has been decreasing since 2001 at almost 3 % annually;
– the populations of Western Marsh-harrier (*Circus aeruginosus*) have not shown any clear tendencies in their abundance for the past 8 years.

Changes in the abundance of rare birds species inform the fastest about the changes of the environmental state. The results of bird monitoring point out to the following tendencies:

– population of the Baltic Dunlin (*Calidris alpina)* is at the verge of extinction within Poland's borders;
– abundance of Ferruginous Duck (*Aythya nyroca*) has been assessed to be 80-90 pairs in both observed years, which points out to a slight population recovery after a dramatic fall over the past two decades (only about 40 breeding pairs at the end of 1990's);
– Whooper Swan (*Cygnus cygnus*) has constantly increased its population in Poland - over the last two seasons its breeding population was estimated to be 40-50 and 51-57 pairs;
– Mediterranean Gull (*Larus melanocephalus*) has continued its expansion in Poland - 2007 saw the highest abundance of its breeding population - 96 pairs, and 55 pairs in the years 2008-2009;
– the population of Golden Eagle (*Aquila chrysaetos*) has had a slight growing tendency since the beginning of 21st century; in 2007 were 27 pairs, in 2008 – 28 pairs and in 2009 – 30 pairs; its nesting area has also been on the increase in Poland;
– the Osprey (*Pandion haliaetus*) has had a declining tendency to 31 breeding pairs in 2008 and 29 in 2009. Since 2000, the domestic population has decreased by 3 % annually, which shows that the decline in the Osprey population is not the result of the deterioration of habitats.

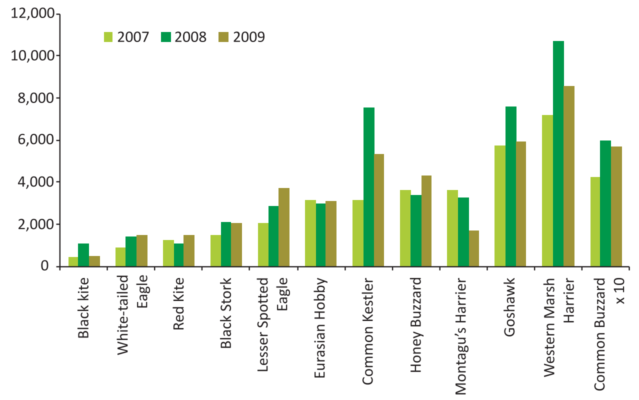

Fig. 30. Estimated abundance of breeding populations using the method of extrapolation of results from Birds-of-Prey Monitoring areas obtained between 2007 and 2009 (source: CIEP/SEM)

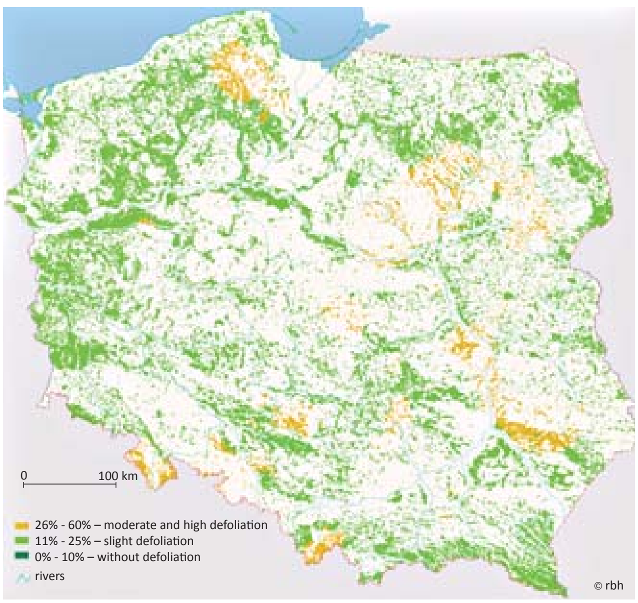

Fig. 31. Level of forest damage in Poland in 2010 with focus on 3 defoliation classes (source: CIEP/SEM)

Due to their high position in trophic systems, birds of prey are species that are very sensitive to changes in the environment and thus are good indicators of its state. According to estimations[4], there were 60 140 pairs of Common Buzzard (*Buteo buteo)* in Poland in 2008, and their number dropped to 57 220 pairs in 2009. The species with high populations, whose estimated number of pair exhibits a downward tendency compared to 2008, include Western Marsh-harrier *(Circus aeruginosus)* and Northern Goshawk (*Accipiter gentilis)*, whose populations in 2009 declined (as compared to 2008) by 2 170 pairs and 1 630 pairs, respectively. An almost twofold decline in the domestic population of Montagu's Harrier (*Circus pygargus*) and Black Kite (*Milvus migrans*) was recorded in 2009, as compared to the previous year. Increasing tendencies were observed in the case of Lesser Spotted Eagle, Red Kite (*Milvus milvus*) and White-tailed Eagle (*Haliaetus albicilla*) (Fig. 30.).

Forests are an integral element of the natural environment. Forests fulfil a lot of environmental functions, among others by stabilizing water circulation in nature, protecting soils from erosion, shaping global and local climate, as well as creating conditions for the maintenance of biological potential of a large number of species, ecosystems and genetic values of organisms. Forests play important production functions, by supplying timber, as well as fruit, herbs and mushrooms. They also fulfil vital social functions.

Forests in Poland cover the area of 9,088.6 thousand hectares (according to the Central Statistical Office - state as at 31.12.2009), which corresponds to 29.1 % of country forest cover (Fig. 4.2.1.). Forests being public property account for 81.8 % of the forest area, whereas private forests for 18.2 %.

Health condition of forests in Poland in 2010 (Fig. 31.), assessed based on monitoring studies conducted on approx. 2000 permanent observation plots, reveals some deterioration as compared to previous years. The share of healthy trees (defoliation up to 10 %) between 2007 and 2010 amounted to 25.14 %, 24.45 %, 24.16 % and 20.98 %, respectively, while the share of damaged trees (defoliation over 25 %) to 19.47 %, 18.01 %, 17.70 % and 20.67 %. Damages were the most extensive in the case of oak and high in the case of spruce. The damage was the lowest in beech and alder was in good condition.

Average defoliation of trees (species in total) aged over 20 years amounted to 20.85 %, aged up to 60 years to 20.46 %, and aged over 60 years to 21.23 %, which demonstrates that the condition of trees deteriorates with age. The greatest age-related deterioration of the condition among coniferous trees was observed in fir stands and among broadleaved trees in oak stands. The differences in health condition between younger and older trees among coniferous species were the smallest in pine and among broadleaved trees in alder. Health condition of forests in Poland is better than average when compared to other European countries. The damages to tree stands in 15 countries were greater than in Poland.

The main adverse changes in nature, observed among others within the framework of monitoring of species and natural habitats, include: loss of birds habitats especially non-forest and wetland, fragmentation of habitats, including breaking down of ecological corridors, distortion of composition of species in natural habitats (in particular non-forest, marsh and seminatural habitats), secondary succession of non-forest habitats via tree and bush encroachments, as well as eutriphication of lakes and plant communities, displacement of typical and native species by invasive and foreign ones, pollution of waters as flora and fauna environment, mechanical damages to the rare plants and natural habitats, degradation of landscape features. The main driving forces which may pose a threat in the future include: melioration, abandonment of agricultural use, improper hydro-technical development and regulation of rivers, construction of communication and tourist infrastructure, urbanization, excessive fertilization, as well as hurricanes and forest fires.

An extremely fast development of communication and transport significantly facilitates moving of species across the world, and thus contributes to an increased number of foreign species. In Poland 10 % of new alien species recognised as invasive species. The impact of 3/4 of foreign species is not known (Fig. 32.).

The most numerous species which are foreign to the Polish biocenosis include 477 plant and 422 invertebrate species. Arthropods were the most numerous in the latter group (323 species) (table 1.).

In order to preserve Poland's natural heritage 10 104 thousand hectares of Poland's area was covered with the national forms of nature conservation at the end of 2009 (according do data of the Central Statistical Office), which comprised 3.1 % national parks, 24.9 % landscape parks, 1.6 % nature reserves and 69 % of areas of protected landscape. A large part of legally protected natural sites, in particular all national parks and some landscape parks form a part of the Natura 2000 network (Fig. 33.).

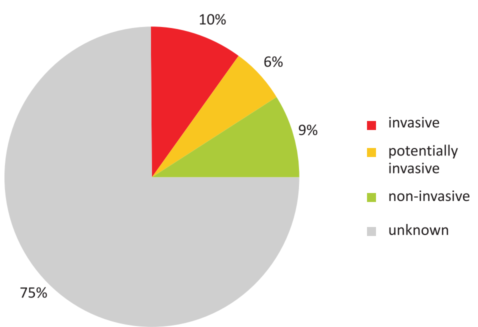

Fig. 32. Share of invasive species in foreign species in Poland (source: NOBANIS, state as at 31.05.2011)

Tab. 1. Number of foreign species of fungi, plants and animals in Poland in 2011, state as at 31.05.2001 (source: Nature Protection Institute, Polish Academy of Sciences)

Vertebrates	Mammals	19
	Birds	68
	Reptiles	8
	Fish	40
Invertebrates	Molluscs	34
	Arthropods	323
	other invertebrates	65
Vascular plants		477
Fungi		8
Microorganisms (viruses, bacteria, microfungi, protozoans, etc. itp)		112
Other		30

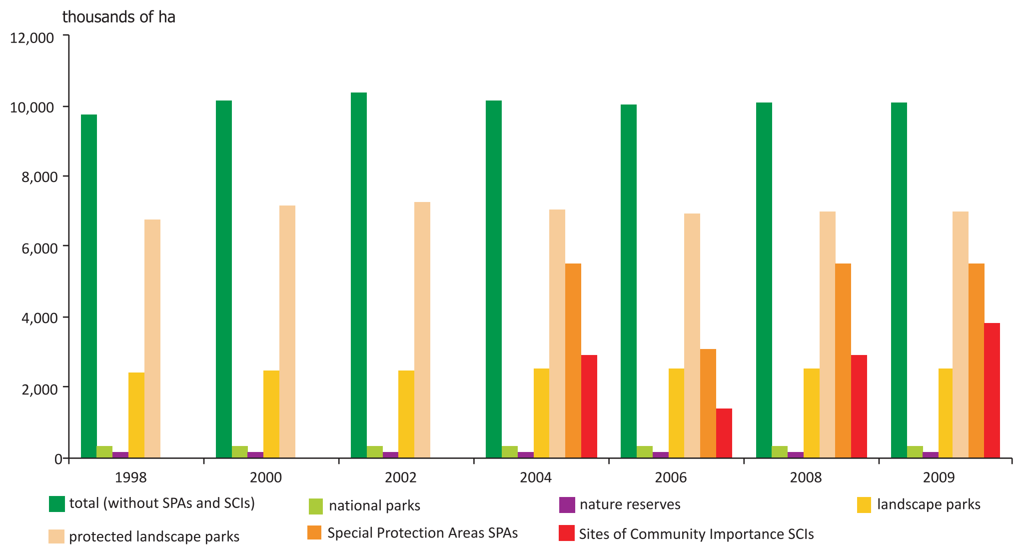

Fig. 33. Area of legally protected areas of special nature value and Natura 2000 site network (source: CSO)

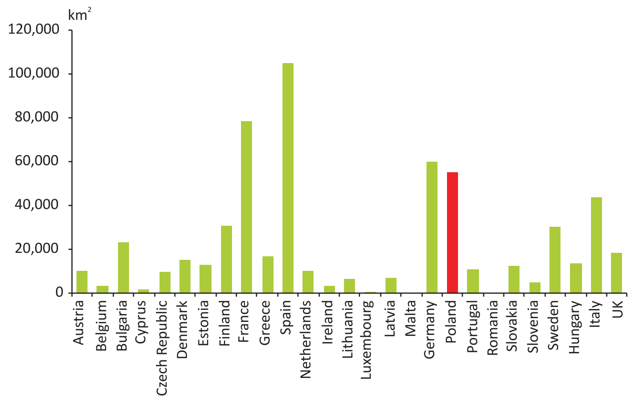

Fig. 34. Total area of Natura 2000 special protection areas as in May 2010 (source: http://ec.europa.eu/environment/nature/natura2000/barometer/docs/spa.pdf)

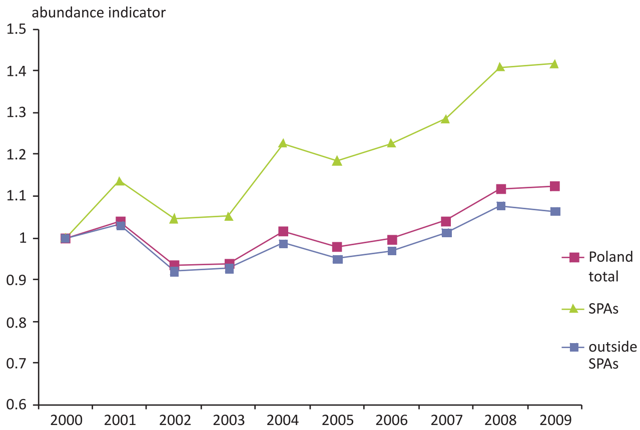

Fig. 35. Changes of aggregated abundance indicator of 93 common bird species registered in the CBBM programme, broken down into protection areas: SPAs, sites outside SPA network and the whole country (source: CIEP/SEM)

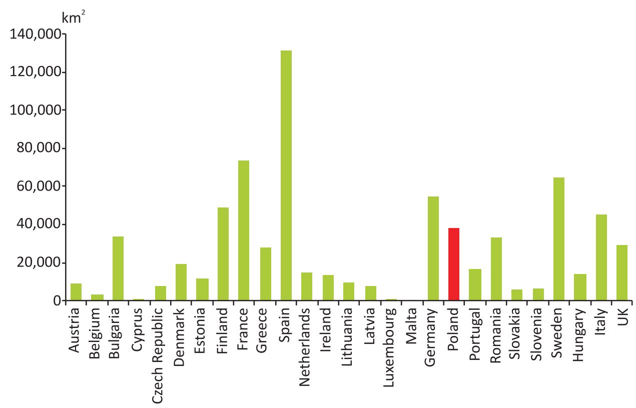

Fig. 36. Total area of Natura 2000 special areas of conservation as of May 2010 (source: http://ec.europa.eu/environment/nature/natura2000/barometer/docs/sci.pdf)

Due to the obligations resulting from Poland's accession to the European Union, Natura 2000 network has been designed from 2001 and implemented from 2004. The network comprises Special Protection Areas (SPAs) and Sites of Community Importance (SCIs) which will become Special Areas of Conservation (SACs) under the regulation of the Minister of the Environment. Natura 2000 sites are created in order to protect natural habitats, as well as rare plant and animal species on European scale, which are listed in relevant Annexes to the Habitats and Birds Directive. Such species and natural habitats are to be protected by means of sufficient (60 % of the area for non-priority and 80 % for priority species and habitats) coverage of Natura 2000 network, encompassing the areas where such species and habitats occur, taking into account their geographical variation. In the case of the abovementioned species of birds, the network should cover all areas which are the most suitable for their protection. Currently (as of 31 May 2011), the network of "bird" sites (SPA) in Poland comprises 144 areas covering a total of 49 229 km^2, which accounts for 15.8 % of Poland's land area, while the network of "habitat" sites includes 823 SCIs covering 34 320 km^2, i.e. 11 % of Poland's land area. The above number of sites covers waters, including sea areas. Both types of Natura 2000 sites, i.e. birds and habitats areas, coincide in approx. 25 %.

Correctness of Natura 2000 special protection areas designation is proven by the results of common breeding birds monitoring (CBBM) (Fig. 35.). The results show that the abundance trend for 93 most common species registered under the programme (being above 10 %) is higher in SPA sites than outside them.

Since 1998 the area of other international valuable natural sites has been extended. Ramsar list was extended with five new wetland sites which are important as a waterfowl habitat, covering a total of 35 305 hectares (Wigierski National Park, Poleski National Park, Narwiański National Park, Drużno Lake Reserve and Subalpine peat land in the Karkonoski National Park). Moreover, two new biosphere reserves were established: Kampinoska Forest (covering 76 232 hectares) and Polesie Zachodnie (covering 139 917 hectares).

New species and their habitats were granted protection, genetic resources in zoological and botanical gardens were enriched, restitution was carried out in selected sites, involving among others Peregrine Falcon in Pieniny Mountains, wisent in Carpathian mountains, Atlantic sturgeon, the Zarte, Atlantic salmon and brown trout in Northern Poland and in the drainage area of upper Vistula river, European Silver Fir in Sudety mountains, Taxus in Poland; there was reintroduction of Eurasian lynx in Polesie region, Apollo butterfly in Peniński National Park, Black Grouse and Western Capercaillie in Wisła forest division, plant species in Western Poland (e.g. *Gladiolus palustris* or *Saxifraga nivalis* in the South).

It needs pointing out that in Poland there is relatively a lot of rare species on a European or global scale, which obliges Poland to take special responsibility for their protection. A spectacular example involves Aquatic Warbler (*Acrocephalus paludicola*), a bird endangered globally, whose 25 % of global population occurs in Poland (Fig. 37.).

In spite of the fact that the abundance of Aquatic Warbler on a national scale maintains at a level of 3 070 "pairs" (Fig. 37.), with minor fluctuations, its status has been dramatically deteriorating since 2003. This is proven by a reduction of abundance or disappearance of Aquatic Warbler in the so called small sites. They include an isolated Western-Pomeranian population which reduced dramatically from 142 "pairs" in 1999 to 64 in 2009, thus posing a risk of extinction in this region (Fig. 38.).

Reintroduction of Peregrine Falcon (*Falco peregrinus*) has been carried out from 1990. The first nest of free living individuals (active pairs) was observed in 1998. The first pairs with breeding success were recorded already in 1999. The population oscillated at the level of 11 active pairs, 9 pairs with yield and 15 young individuals in 2009 (Fig. 39.).

The number of wisents (*Bison bonasus*) individuals grew from 715 in 2000 to 1139 individuals in 2009, number of chamois (*Rupicapra rupicapra*) increased from 87 individuals in 2000 to 186 in 2009. The number of brown bears (*Ursus arctos*) was 119 in 2009 (Fig. 40.).

There was a very big increase in the number of beavers (*Castor fiber*) from ca. 12 740 in 1995 to ca 64,254 in 2009. It needs pointing out that the increase in beaver population is on the one hand related to the improved state of nature (among others improvement of water relations) and on the other hand leads to intensification of damages done by beaver (among others drowning of land, in particular meadows and crops, as well as by cutting and damaging of trees).

In order to increase knowledge about the resources and condition of nature in 2006 two national monitoring programmes were launched, adjusted to the requirements of the Habitats Directive and Birds Directive, i.e. monitoring with the assessment of species and natural habitats conservation status, as well as bird monitoring. National nature-forest inventory of species and natural habitats was also carried out and a database of foreign species was developed along with more precise principles of handling these species.

Some important changes in nature conservation management were implemented. General Directorate for Environmental Protection (GDEP) and regional directorates for environmental protection (RDEP) reporting to it were created. They are responsible for managing Natura 2000 network, handling the environmental impact assessments and species protection. RDEP substituted the existing the voivodship nature conservator which comprised the services of voivods (heads of voivodship). Landscape parks and protected landscape sites matters were shifted from competences of voivods to voivodship assemblies, while ecological sites, natural and landscape communities and natural monuments matters were shifted to the competences of municipality councils.

The management of site and species protection was simplified among others by facilitating the method of working out conservation plans. In order to facilitate the protection of species and natural habitats covered by Natura 2000 network conservation plans of selected Natura 2000 sites as well as selected plant and animal species listed in the Annexes of the Habitats Directive are worked out. A mechanism of nature compensation of investments with negative environmental impact was also implemented.

Fig. 37. Abundance of Aquatic Warbler „pairs"[5] *(Acrocephalus paludicola)* in Poland over 12 years - results of national stocktaking dated 1997, 2003 and 2009 (source: OTOP)

Fig. 38. Population of Aquatic Warbler „pairs" *(Acrocephalus paludicola)* in Western Pomeranian region (source: OTOP)

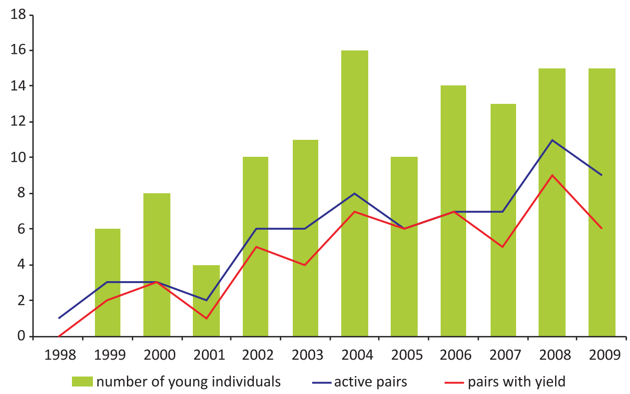

Fig. 39. Population of Peregrine Falcon *(Falco peregrinus)* pairs (source: (Sokół Association for Wild Animals)

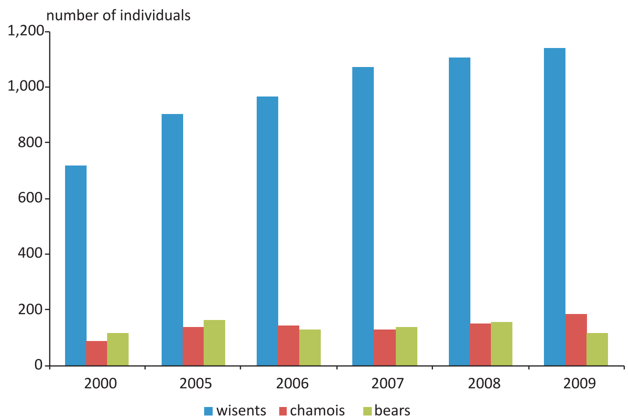

Fig. 40. Wisent *(Bison bonasus)*, chamois *(Rucicapra rupicapra)* and brown bear *(Ursus arctos)* population in Poland (source: CSO)

Launching agri-environmental programmes that promote pro-natural agricultural use in rural high nature value areas is of great importance for the protection of species and habitats. A broad environmental education, among others in schools, at the territory of protected sites and in forests has an important impact on the social awareness and as a consequence on the decisions taken in the future.

[1] Farmland Bird Index - official index of structural changes in the environmental state of EU Member States (*structural indicator*) approved by the European Commission in 2004. In Poland, it is based on the population of 23 species of birds typical for agricultural landscape habitats, which illustrates mainly the changes in populations of bird species characteristic for agricultural landscape (arable land, meadows, pastures). For example, the index of 0.80 means that in a given year the FBI is 20 % lower than in the reference year when it amounts to 1. FBI 23 is an arithmetic average of its component species, which include White Stork, Northern Lapwing, Common Whitethroat, Crested Lark, Hoopoe, Barn Swallow, Rook, European Stonechat, Serin, Linnet, Tree sparrow, Ortolan, Yellow Wagtail, Whinchat, Corn Bunting, Common Kestrel, Skylark, Common Starling, Meadow Pipit, Yellowhammer, European Turtle Dove and Black-tailed Godwit. In the case of Poland, the index does not include Rook, since the colonies of this species are scarce on the analysed areas, which does not provide the appropriate reliability of calculations of this bird's population.

[2] This applies to plant communities described according to Braun Blanquet's phytosociologic principles.

[3] Data provided according to the classification of the International Union for Conservation of Nature (IUCN).

[4] Based on extrapolation of bird monitoring results (SEM).

[5] Simplified wording - *Acrocephalus paludicola* does not form pairs, stocktaking covers males responding with a mating sound, and the total gender proportion is 1:1, that is why the text refers to "pairs".

Poland is characterized by huge natural values, including large biological diversity. The number of protected valuable natural sites has been increasing. A large area of Natura 2000 sites which is being designed and covers 20 % of Poland's area is also a proof of the values of nature. The sites were created to protect species and natural habitats endangered on a European scale. Growing populations of many bird species point out to the improvement of the natural status of agricultural areas and other extensively utilized areas.

However, the conservation status of the majority of species and natural habitats endangered on a European scale is assessed as inadequate. Since it is an intermediate assessment, there is a large chance that after implementing respective conservation measures the status may improve to a favourable level. The state of threat of species, assessed in line with IUCN classification, is not high when compared to other countries. The presence of many rare flora and fauna species (e.g. Aquatic Warbler, bear, wisent or chamois, many rare plants on a European scale, e.g. Polish scurvy-grass, liparis loeselii) imposes a special responsibility on Poland for the protection of natural heritage, particularly when the conservation status is bad (e.g. Aesculapian Snake) or is vehemently deteriorating (e.g. Aquatic Warbler).

Forests, covering 9.1 million ha in Poland, are an integral element of the natural environment. Their health condition in 2010 reveals a slight deterioration as compared to previous years.

At the same time, resignation from the use of valuable non-forest sites, meliorations, development of road-, tourist-, industrial- and energy infrastructure (small water power plants, wind power plants) pose some serious threats to the maintenance of habitats and species, contributing in particular to the fragmentation of habitats and secondary succession.

Those negative phenomena are supposed to be prevented among others by agri-environmental programmes supporting environmentally friendly agriculture, by working out and implementing conservation tasks, as well as by conservation plans for the protected sites and species, and by facilitating the process of issuing of decisions on the location of projects which may have a major environmental impact, as well as by nature compensation.

AIR POLLUTION

AIR POLLUTION

Air pollution significantly affects human health, causing many illnesses of the respiratory and circulatory systems. The greatest impact of air pollution on human and animal health is observed in industrial and urban areas. The most vulnerable groups include: children, elderly people and people with respiratory system diseases. Polluted air has also negative impact on the condition of ecosystems and destruction of materials (such as corrosion of metals).

Due to the adverse impacts of air pollutants on human health and the condition of ecosystems, there is carried out an annual air quality assessment in terms of its pollution with sulphur dioxide, nitrogen dioxide, carbon monoxide, benzene and ozone, as well as PM10 particulate matter and pollutants identified in the PM10 particulate matter: lead, arsenic, cadmium, nickel and benzo(a)pyrene[1].

Despite systematic improvement of ambient air quality in Poland, there still exist significant problems: in summer – too high concentration of tropospheric ozone, and in winter – excessive concentrations of PM10 particulate matter and benzo(a)pyrene.

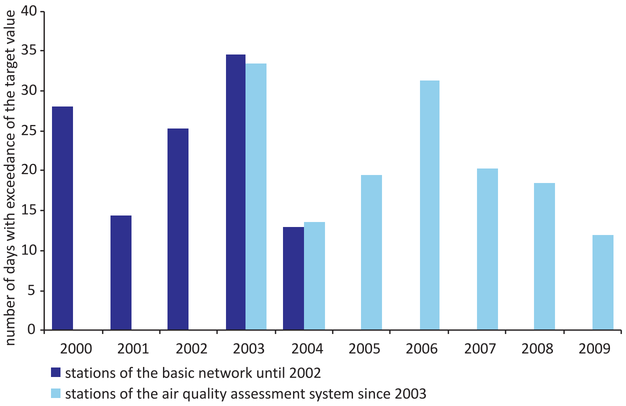

Fig. 41. Arithmetic mean of days with 8-hour concentrations of ozone higher than 120 μg/m^3 (source: CIEP/SEM)

Fig. 42. Classification of zones in Poland for ozone on the basis of air quality assessment for 2009 (target value, human health protection) (source: CIEP/SEM)

Ozone is a strong photochemical oxidiser, which causes serious health problems, destroys materials and crops. Exposure of humans to a slightly increased ozone concentration may lead to an inflammatory response of the eyes, the respiratory tract, as well as decreasing lung capacity. It is the reason for the occurrence of the symptoms of sleepiness, headache and fatigue, as well as it causes a fall in blood pleasure. At higher concentrations, there occur the symptoms of malaise, headaches intensify, excitability, fatigue and exhaustion increase, the symptoms of apathy appear.

Tropospheric ozone is created as a result of photochemical reactions of nitrogen oxides and volatile organic compounds and has the ability to move over long distances, so the concentrations of that pollutant on the territory of Poland depend to a high extent on its concentrations in the air masses flowing into the territory of Poland – mainly from southern and south-western Europe. The other causes of the occurrence of high 8-hour concentrations of ozone, exceeding the level of 120 μg/m^3, are believed to include:

- photochemical changes of ozone precursors under the influence of UV-B radiation,
- adverse meteorological conditions,
- natural emission sources of ozone precursors.

Maximum 8-hour concentration is the basis for classification of zones in the annual air quality assessment in terms of ozone concentration. The past results of ambient air ozone measurements indicate that the number of days with exceedance of the target value is variable. Interestingly, the number of days with exceedance of the target value in 2009 was one of the lowest in the last decade (Fig. 41.).

Of the 28 zones assessed in Poland for ozone in 2009 in terms of health protection, 22 zones (ca. 79 %) were included in class A. The other 6 zones were classified as C[2]. Class C included zones located in south-western and central Poland (Fig. 42.).

In recent years, exceedances of the maximum 8-hour ozone concentrations have taken place in most areas in Europe (Fig. 43.).

In 2008, the value of the "Urban population exposure to air pollution by ozone" indicator in Poland (Fig. 44.) was lower than the average value of that indicator for 27 states of the European Union.

The indicator of urban population exposure to air pollution by ozone in Poland was characterised by lack of a clear downwards trend in the years 2000-2008. Interestingly, the lowest value of that indicator in the period under analysis was observed in 2004 (Fig. 45.).

It should be remembered that the values of ozone concentrations at ground level – thus the value of the exposure indicator – are significantly influenced, beside the emission of ozone precursors, by meteorological conditions: high air temperature, high insolation and lack of precipitation.

The impact of small (PM10) and very small (PM2.5) particles on health depends on the number of particles retained in various areas in the respiratory system. However, PM2.5 has the ability to penetrate into the deepest sections of the lungs, where they are accumulated or dissolved in biological liquids. As a result, they cause: aggravation of asthma, acute respiratory responses, impairment of the lung activity, etc.

Particulate matter – in which a fraction of particles with a diameter less than 10 μm (PM10) is differentiated, which includes a fraction with a diameter of less than 2.5 μm (PM2.5) – is a mixture of very small solid and liquid particles, composed of both organic and inorganic compounds (e.g. hydrocarbons, silicon compounds, aluminium, iron, trace metals, sulphates, nitrates and ammonium compounds). The composition of particulate matter changes depending on the origin, season and weather conditions.

Particulate matter (including fine particles) come from direct emissions – mainly from municipal and household sources – or is created in the atmosphere as a result of reactions between substances in the atmosphere. Precursors of the latter (the so-called secondary aerosols) include in particular: sulphur dioxide (SO_2), nitrogen oxides (NO_x), hydrocarbons (NMVOCs) and ammonia (NH_3).

Despite the recorded reduction in emissions of precursors of particulate matter and the actions undertaken to reduce the concentrations of particulate matter in ambient air, in particular the smallest fractions, exceedances of the standards for PM10 remain the key problem of air quality in Poland. The exceedances take place both in terms of the daily standard and the annual standard and pertain in particular to downtown areas of cities and agglomerations.

Exceedances of the daily limit value of PM10 concentrations usually take place in the winter season. In all voivodships, exceedances are most often related to the emission of particulate matter from heating of individual buildings and transport. Further sources include the impact of emissions from industrial plants, heating plants, power plants and unfavourable meteorological conditions. In this respect, 2006 was marked as a very unfortunate year, when several high-pressure systems occurred in the winter period, characterised by very low temperatures, which were accompanied by long periods of stillness and the phenomenon of inversion.

The location of some Polish cities has a significant impact on air pollution with respect to PM10 particulate matter, such as location in mountain valleys or river depressions, which hinders dispersion of pollutants, as well as concentration of industry in agglomerations or in their direct vicinity (e.g. the Cracow or Upper Silesian agglomerations).

In the annual air quality assessment for 2009 in terms of PM10 particulate matter, of 170 zones covered by assessment, 91 zones (ca. 54 %) were classified into class A and 79 zones (46 % zones) into class C[4] based on 24-hour concentrations (Fig. 46.).

The issue of exceedances of 24-hour concentrations of PM10 particulate matter exists not only in Poland, but also in other European countries (Fig. 47.).

Based on average annual PM10 concentrations in 2009, 141 zones were classified into class A (ca. 83 % of all zones) and 29 zones (ca. 17 %) - to class C.

The number of zones classified into class C as a result of the assessment for 2009 based on 24-hour concentrations of particulate matter is more than three times higher than the number of zones obtained on the basis of average annual concentrations. Similar proportions were also recorded in the previous years. They are a result of problems with meeting the strict standard for 24-hour PM10 concentrations.

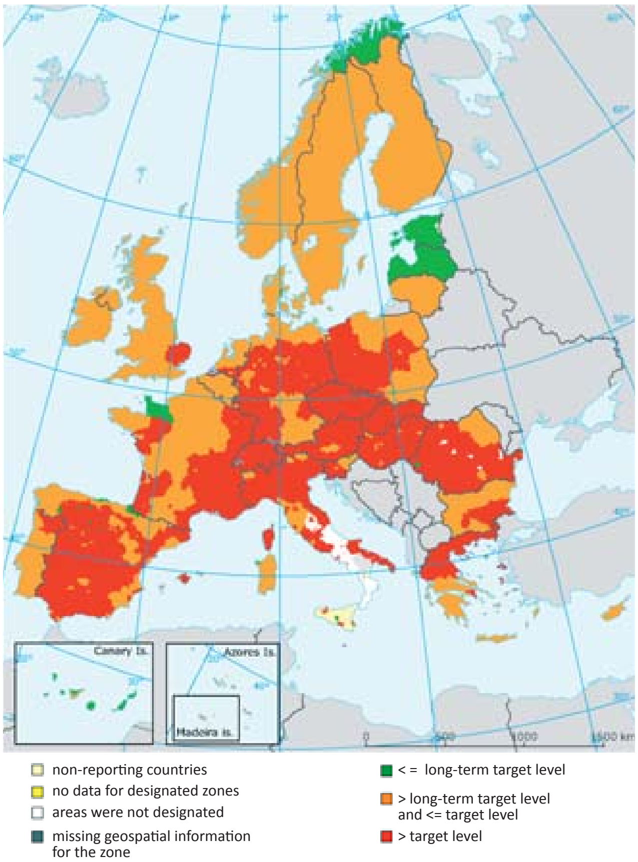

Fig. 43. Classification of zones in the EU for maximum 8-hour ozone concentrations with reference to human health protection for 2008 (source: EEA)

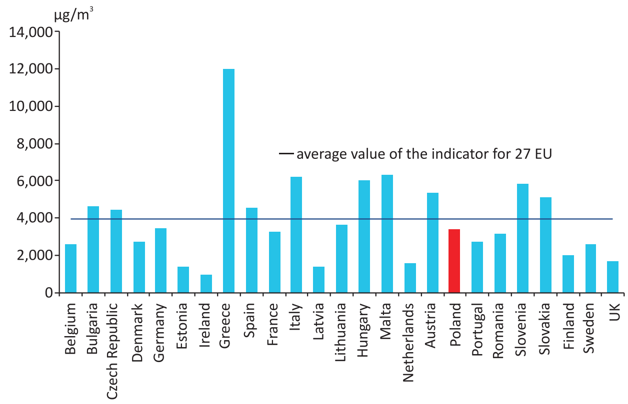

Fig. 44. Population exposure indicator SOMO353 based on monitoring results from urban background stations in EU agglomerations in 2008 (source: Eurostat, based on SEM data submitted to the AirBase)

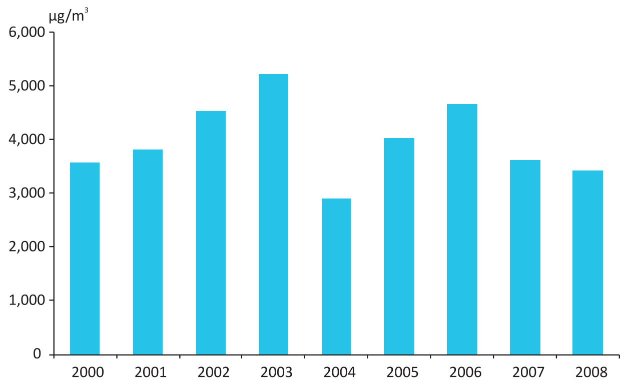

Fig. 45. Population exposure indicator SOMO35 based on monitoring results from urban background stations in agglomerations in Poland (source: Eurostat, based on data of the SEM submitted to the AirBase)

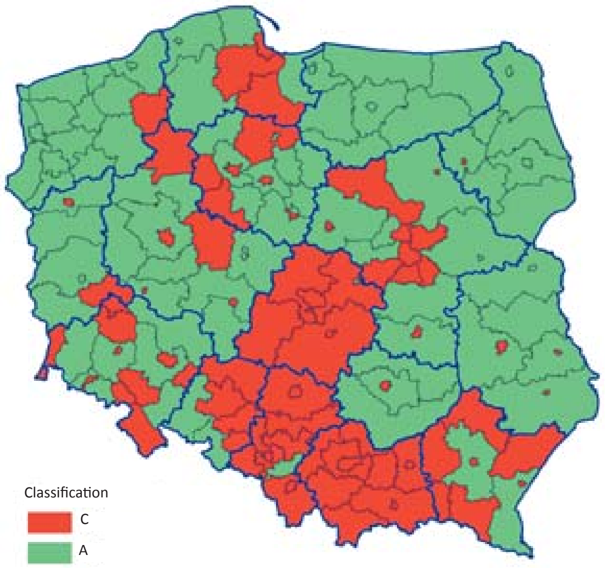

Fig. 46. Classes of zones determined on the basis of 24-hour concentrations of PM10 particulate matter as a result of ambient air quality assessment for 2009 (according to criteria pertinent to human health protection) (source: CIEP/SEM)

Fig. 47. Classification of zones in the EU for exceedances of 24-hour PM10 particulate matter concentrations in 2008 (source: EEA)

In the years 2001-2009, PM10 measurement results from selected sampling points in agglomerations showed decreases and increases in annual mean concentrations. From 2004 to 2006, at most of the considered stations, an upwards trend for PM10 concentrations was recorded. In 2006, the annual average concentrations at the considered stations were the highest in the period under analysis. High concentration of particulate matter in 2006 was, however, connected to very unfavourable meteorological conditions in the winter season that year. In 2007, annual mean concentration of PM10 was significantly lower than in the previous year. Falls in the annual mean concentrations occurred at all stations covered by the analysis. Lower concentrations in 2007 were the result of better meteorological conditions in the cool season of 2007 in relation to the previous year. In January and February 2007, there took place no significant falls in air temperature (stimulating emission of particulate matter related to heating) as in January 2006, nor did there occur long-lasting inversion conditions contributing to accumulation of pollutants at the ground-level. After the fall in 2009, the increase of average of PM10 concentrations occurred at most analysed stations when comparing to values from 2008. The greatest increase, by 8.2 $\mu g/m^3$, was recorded at the station in Gdańsk (Fig. 48.).

Analyses of the EU indicator: "Urban population exposure to air pollution by particles based on annual mean concentration of PM10 particulate matter demonstrated that the share of population exposed in Poland exceeded the European average in 2008 (Fig. 49.).

The indicator of population exposure to PM10 particulate matter at urban background stations in Polish agglomerations over the years 2000-2008 reached the lowest value for 2008 (Fig. 50.).

Air pollutants important for their negative health effects include also compounds from the group of polycyclic aromatic hydrocarbons (PAHs). Scientific evidence shows that the compounds have cancerous and mutagenic properties. Benzo(a)pyrene identified in PM10 particulate matter is used as an indicator for PAHs in the air quality assessment.

Ambient air quality assessment for 2009 in terms of benzo(a)pyrene demonstrated that, of the 170 zones covered by assessment, 97 were classified in class A (about 57 % of all zones). As many as 73 zones (almost 43 %) were classified into class C. All zones in the following voivodships were assigned to that class: Mazowieckie, Małopolskie and Śląskie and most of zones in the Opolskie and Podkarpackie voivodships. Such a high number of zones classified into class C is related to very low and hard to meet target value determined for benzo(a)pyrene[5] and household fuel use patterns (Fig. 51.).

What is an important indicator of the degree of pollution of ambient air is the quality of precipitation, which is one of the meteorological elements gathering and transporting pollutants, thus affecting ecosystems by the processes of eutrophication and acidifiaction of soil and water. The processes are related to the presence of such substances in the air as: sulphur dioxide, nitrogen oxides, ammonia and their deposition to the ground.

Precipitation is the source of minerals coming not only directly from the atmosphere, but also rinsed from the surface of plants and other objects. It must be borne in mind though that concentrations of particular substances depend

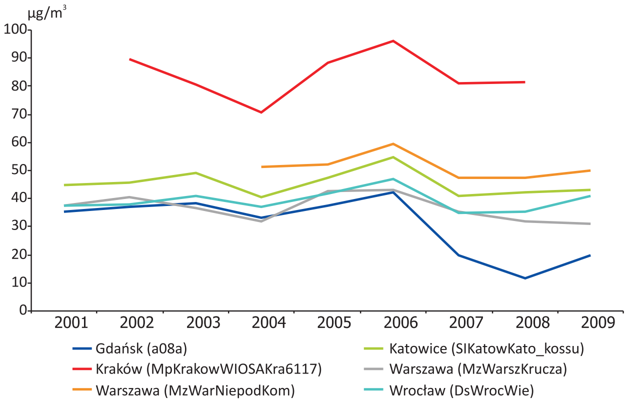

Fig. 48. Annual mean concentration of PM10 particulate matter at selected stations in agglomerations in Poland (source: CIEP/SEM)

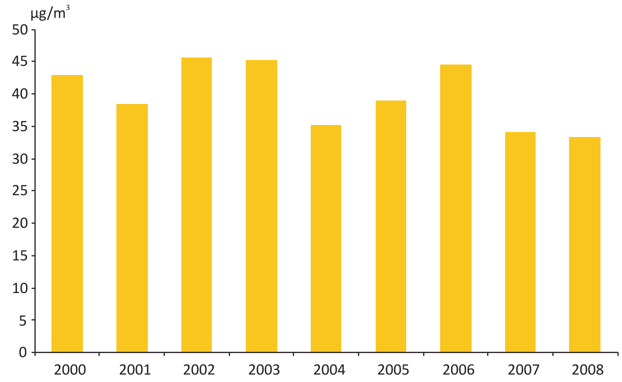

Fig. 50. Indicator: Urban population exposure to air pollution by particles calculated as population weighed annual mean concentration of PM10 particular matter measured at urban background stations in agglomerations in Poland (source: Eurostat, based on SEM data submitted to the AirBase)

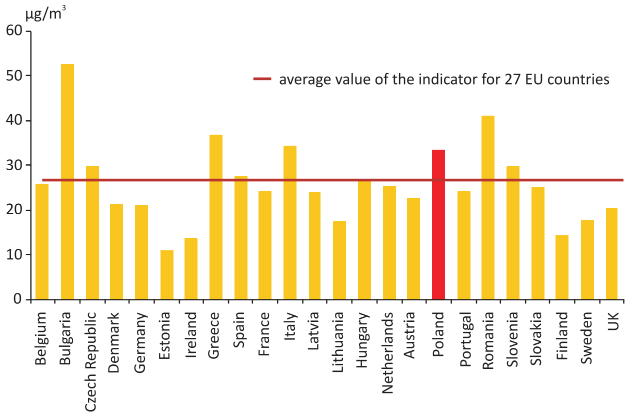

Fig. 49. Indicator: Urban population exposure to air pollution by particles calculated as annual mean concentration of PM10 particulate matter at urban background stations in agglomerations of the EU in 2008 (source: Eurostat, based on SEM data submitted to the AirBase)

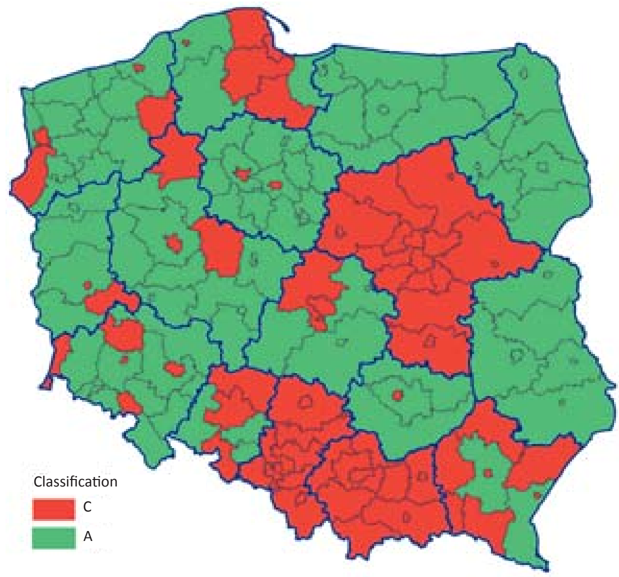

Fig. 51. Classification of zones in Poland for benzo(a)pyrene on the basis of annual ambient air quality assessment for 2009 (human health protection) (source: CIEP/SEM)

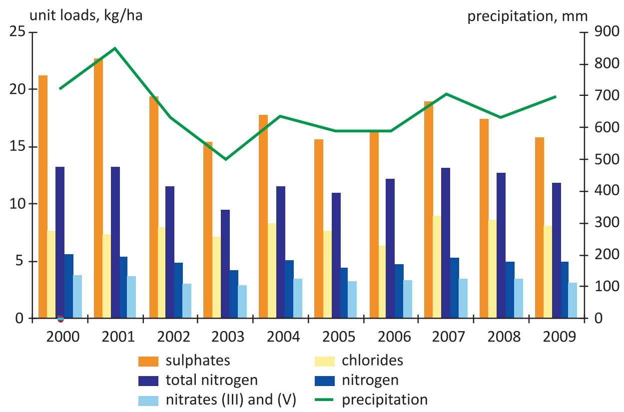

Fig. 52. Deposition of substances introduced with precipitation to the area of Poland against the average annual precipitation (source: CIEP/SEM)

on many factors, such as: duration of precipitation, intensity of precipitation or the duration of precipitation-free period preceding precipitation.

Results of the study on chemical composition precipitation and deposition of pollutants to the ground in Poland, carried out over the last 10 years, reveal gradual diminishing of the deposition of some pollutants to the ground. The process is perceptible in relation to the deposition of sulphates. At the same time, in the case of pollutants causing eutrophication, lack of such a tendency should be noted (Fig. 52.).

The recorded downwards trend in acidification of precipitation, expressed by the growth of the pH value of precipitation, is an effect of gradual reduction of emission of acidifying pollutants to the atmosphere at the scale of the continent, which leads to gradual lowering of the concentrations of those pollutants in the atmosphere (Fig. 53.).

To protect human health and protect vegetation, there have been established in Poland numerous instruments to reduce emissions of pollutants to ambient air which are to help achieve good air quality. The most important of them are: permits for introduction of gases and particles to ambient air, integrated permits, standards for emission from installations, fuel quality standards. Furthermore, the share of energy from renewable sources in the total energy production is being gradually increased and the energy-consumption of the Polish economy is being decreased (Fig. 11.).

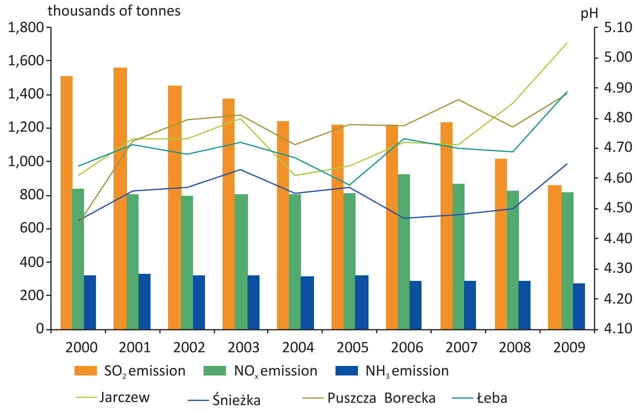

Fig. 53. Annual average pH of precipitation in Poland for background measurement stations against the emission volumes of SO_2, NO_x, NH_3 (source: ME and CIEP/SEM

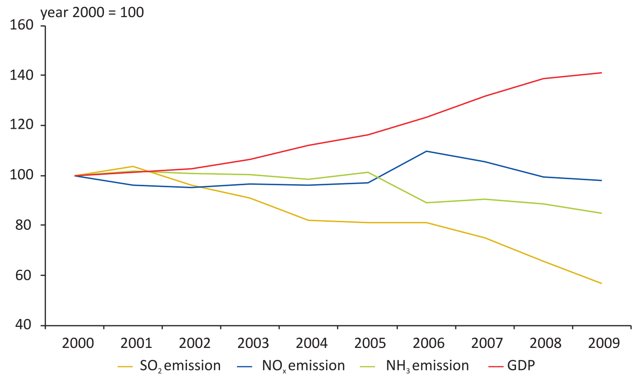

Fig. 54. Changes in the emission of the basic gaseous air pollutants against changes in the GDP in Poland (source: ME, CSO)

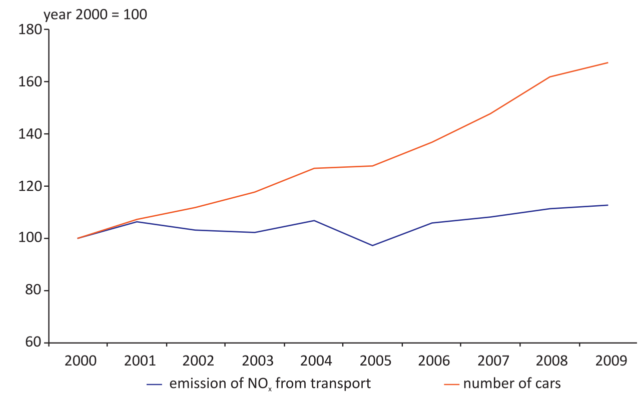

Fig. 55. Change in the emission of NO_x from road transport in Poland in relation to the change in the number of vehicles (source: ME, CSO)

Considering the current state of air pollution in Poland and the necessity to meet ambient air quality standards established in the Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe, Poland is facing the task of implementation of many measures aimed at ambient air quality improvement. The basic regulation of the Directive is the introduction of new air quality standards concerning fine particles (PM2.5) in ambient air and verification and consolidation of existing EU acts in the scope of air protection. It also introduces new mechanisms concerning air quality management in zones and agglomerations.

It is worth emphasising that the systematic development of the Polish economy in the period of the last two decades, expressed by the growth of the GDP, does not lead to increased air emissions of pollutants. It is an effect of more common application of pro-environmental technologies in the industry, the energy and transport sectors (Fig. 54.).

During the last decade, the number of vehicles in Poland rose by ca. 6.5 million, which, however, did not find expression in increased emissions of pollutants from that sector (Fig. 55.). It is caused by gradual increase in the share of passenger cars and lorries meeting the EURO standards. However, it must be borne in mind that the EURO standards coming into force concern new vehicles, which, due to their high technological advancement as well as good technical condition, are characterised by low levels of emission of toxic components of exhaustion fumes.

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1 Regulation of the Minister of the Environment of 17 December 2008 on carrying out the assessment of the levels of substances in ambient air.

2 Zones are classified in accordance with the Regulation of the Minister of the Environment of 6 March 2008 on zones, in which air quality is assessed, where for class A concentration levels do not exceed the target value, and the concentration levels exceed the target value for class C. As regards the target value of ozone concentration:
- the period of averaging of concentrations amounts to 8 hours (eight-hour running averages are calculated from 1-hour concentrations),
- the target value in ambient air is 120 $\mu g/m^3$,
- the permissible number of days with exceedance of the target value in a calendar year is 25 days (the number of days with exceedance of the target value in a calendar year averaged during three subsequent years; in the case of lack of measurement data from three years, meeting the permissible frequency of exceedances is verified on the basis of measurement data from at least one year).

3 SOMO35 – indicator calculated as the sum of differences between a concentration of 70 $\mu g/m^3$ (35 ppb) and maximum daily 8-hour running mean concentrations greater than 70 $\mu g/m^3$ (= 35 parts per billion) .

4 Zones in Poland are classified in accordance with the Regulation of the Minister of the Environment of 6 March 2008 on zones, in which air quality is assessed, where for class A concentration do not exceed the limit value, and the concentration exceed the limit value for class C. For averaging period amounting to:
- 24 hours – the limit value for PM10 particulate matter in ambient air amounts to 50 $\mu g/m^3$, which can be exceeded up to 35 days in a calendar year,
- calendar year – limit value for concentration of PM10 particulate matter in ambient air is 40 $\mu g/m^3$.

5 Zones in Poland are classified in accordance with the Regulation of the Minister of the Environment of 6 March 2008 on zones, in which air quality is assessed, where for class A concentration do not exceed the target value, and the concentration exceed the target value for class C. For the averaging period amounting to a calendar year – the target value of benzo(a)pyrene in ambient air is 1 ng/m^3.

The impact of air pollutants on the environment is an especially important issue with respect to the general commonness of the phenomenon, the volumes of emitted pollutants, the wide scope of impact, as well as due to the fact that the pollutants affect other elements of the environment. The significant adverse effect of pollution of the environment on human health cannot be omitted. Taking the above into consideration, it must be stressed that to protect ambient air synergy of actions within many policies and sectors, both at a local and global scale, is necessary. It is particularly important to ensure cohesion of actions aimed at air protection with actions aimed at counteracting climate change, since not all measures contributing to climate protection lead to improvement of air quality (e.g. burning biomass).

At a regional and local scale, implementation of air protection programmes is of great importance for air quality, and their development, pursuant to the Environmental Protection Law Act, is the responsibility of marshals of voivodships. The programmes should contribute to permanent and systematic air quality improvement through actions undertaken under implementation of sustainable development of regions.

Taking into account the current state of air pollution in Poland and the necessity to meet air quality standards established by Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe and the limits of emissions of certain pollutants into the air from large combustion plants, Poland is facing the task of implementation of many measures aimed at ambient air quality improvement.

WATER QUALITY

WATER QUALITY

Life in all its forms and human health are dependant on the availability of water of appropriate quality and in appropriate quantity. Water (in particular fresh water) resources, characterised by high quality, are an necessary element for the development of ecosystems, increase of tourist attractiveness of a region, which in turn is reflected in the development of some branches of the economy and affects the civilisation development of a country, being at the same time a factor that determines the standard of living of a society to a high extent.

Low water quality limits the possibility of its application for particular purposes, including for the needs of industry, tourism and supplying the population with water for consumption, which generates additional costs for the whole sectors of the national economy. It pertains both to inland and marine waters.

Poland is distinguished by relatively small water resources to ca. 1400 m^3/year/capita[1] and a high population and varied state of urbanisation and management of the area. National water resources per capita are low and constitute more than 30 % of the European average. The state of water resources results in difficulties with water supply in some areas of Poland. The mining and processing industries are concentrated in southern Poland and are characterised by a significant impact on water quality and water management of that region and the whole country. The water-intensive industry and development of demographic processes, as well as natural geographic and hydrographic conditions lead to the occurrence of serious water deficiencies. In the southern part of Poland, there also exists a significant variability of water flow in rivers during heavy rain and the movement of large volumes of flooding water constituting, among others, runoff from the mountains. All the factors make reasonable water management difficult, and the relatively small retention volume of artificial reservoirs does not allow artificial elimination of the problems arising from periodical surpluses and deficits of surface waters. What is the basic problem in the scope of supplying population with water is the small availability of water of high quality, whereas due to the stabilization in consumption from industry and households, the problems with quantity have become less important.

Rivers, lakes and groundwater

The basic environmental objectives with reference to waters is maintenance or improvement of water quality, the biological relations in the water environment and on wetlands, so as to achieve or maintain the good ecological status (or environmental potential) and chemical status of surface water bodies, as well as maintain or achieve a good quantitative and chemical status of groundwater bodies. Implementing the above objectives, one should ensure that the waters, depending on the needs, are fit in particular for: supplying population with water for consumption; recreation and water sports; habitation of fish and other water organisms in natural conditions, enabling their migration.

Status of surface waters

The status of surface waters is assessed by comparison of the monitoring results with criteria expressed as threshold values of water quality indicators[2]. The overall status incorporates the ecological status (which includes biological elements and physicochemical and hydromorphological elements as supporting indicators) and the chemical status (assessed on the basis of chemical indicators, characterised by the occurrence of hazardous substances to the water environment, including the so-called priority substances).

The ecological status is determined for water bodies, constituting the basic unit in water management, while the term ecological status is applied for natural water bodies, and in the case of artificial or heavily modified water bodies – ecological potential. Ecological status and ecological potential are classified by assigning a water body to one of five water quality classes[3].

Three types of monitoring of surface waters have been carried out since 2007: surveillance monitoring (aimed at establishing the status of surface water bodies, determination of the types and assessment of the intensity of significant influence resulting from human activity, performing assessments of long-term changes in the status of surface water bodies in natural conditions and performing assessments of long-term changes in the status of surface waters bodies in the conditions of broadly understood influences resulting from human activity), operational monitoring (carried out to establish the status of surface water bodies, which has been identified as endangered with failure to meet the environmental objectives set for them and water bodies, for which a specific usage goal has been established, as well as making an assessment of the changes in the status of surface waters resulting from implementation of action plans) and investigative monitoring (undertaken on an *ad hoc* basis, among others, to determine the size and influences of accidental pollution or establish the causes of clear discrepancies between the results of the assessment of the ecological status on the basis of biological and physicochemical quality elements).

Due to the implementation of a new system of water status assessment, changing not only the method of assessment, but also the threshold values for particular indicators and introducing the principle of a six-year monitoring cycle (it means that in every year of cycle a different group of water bodies is assessed), it is impossible to compare the assessments for the period 2007-2009 with prior assessments.

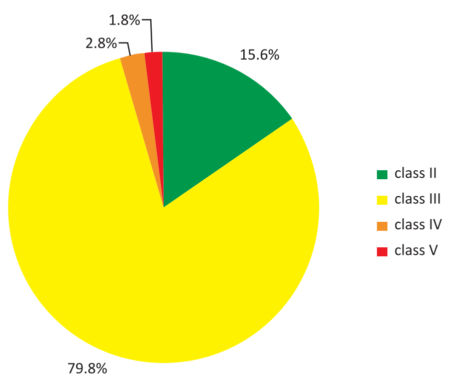

Fig. 56. Classification of the ecological status of river water bodies covered by surveillance monitoring in the years 2007-2009 (source: CIEP/SEM)

Tab. 2. Classification of the ecological status of river water bodies covered by surveillance monitoring in the years 2007-2009 (source: CIEP/SEM)

status	Vistula	Odra	Dniestr	Dunaj	Jarft	Łaba	Niemen	Pregoła	Świeża	Ucker	total
very good	-	-									-
good	7	8				1	1				17
moderate	53	25	1			1	4	3			87
poor	2	1									3
bad	1	1									2
TOTAL	63	35	1			2	5	3			109

It is also not possible, on the basis of the results from the three years, to make conclusions concerning tendencies in the changes in water quality, since different surface water bodies and groundwater bodies were evaluated in individual years[4].

In 2007-2009, of 109 river water bodies covered by assessment, on the basis of the results of surveillance monitoring, only 17 (15.6 %) achieved the good status, thus met the requirements set of class II. Most of the assessed river water bodies (79.8 %) were assigned to class III, thus their ecological status was moderate (Fig. 56).

The assessment of artificial and heavily modified flowing water bodies made on the base of surveillance monitoring measurements from 2007 to 2009 was much better. In this period almost 20 % of water bodies achieved good or more than good (I-II class) ecological potential, about 70 % of them were assigned to III class, thus were of moderate ecological potential and somewhat above 10 % - poor or bad potential.

In general, it can be concluded that the results of surveillance monitoring, after the first three years of functioning of the new monitoring system and water status classification indicate that 15.6 % of bodies of flowing waters meet the identified environmental objective, thus achieve the good or very good ecological status (Table 2.). The assessment results of ecological potential of artificial and heavily modified flowing water bodies are better: about 19.6 % of water bodies covered by monitoring meet the environmental objectives (Table 3.).

Beside regular monitoring measurements and the results of classification of the status of waters, also the data concerning concentrations of pollutants transported by rivers from the territory of Poland to the Baltic Sea are a source of information on their quality. The results obtained for nitrogen suggest that its concentration in the last three years

Table 3.Classification of the ecological potential of artificial and heavily modified river water bodies covered by surveillance monitoring in the years 2007-2009 (source: CIEP/SEM)

status	Vistula	Odra	Dniestr	Dunaj	Jarft	Łaba	Niemen	Pregoła	Świeża	Ucker	total
good and above	10	10					1				21
moderate	44	31									75
poor	3	5									8
bad	1	2									3
TOTAL	58	48					1				107

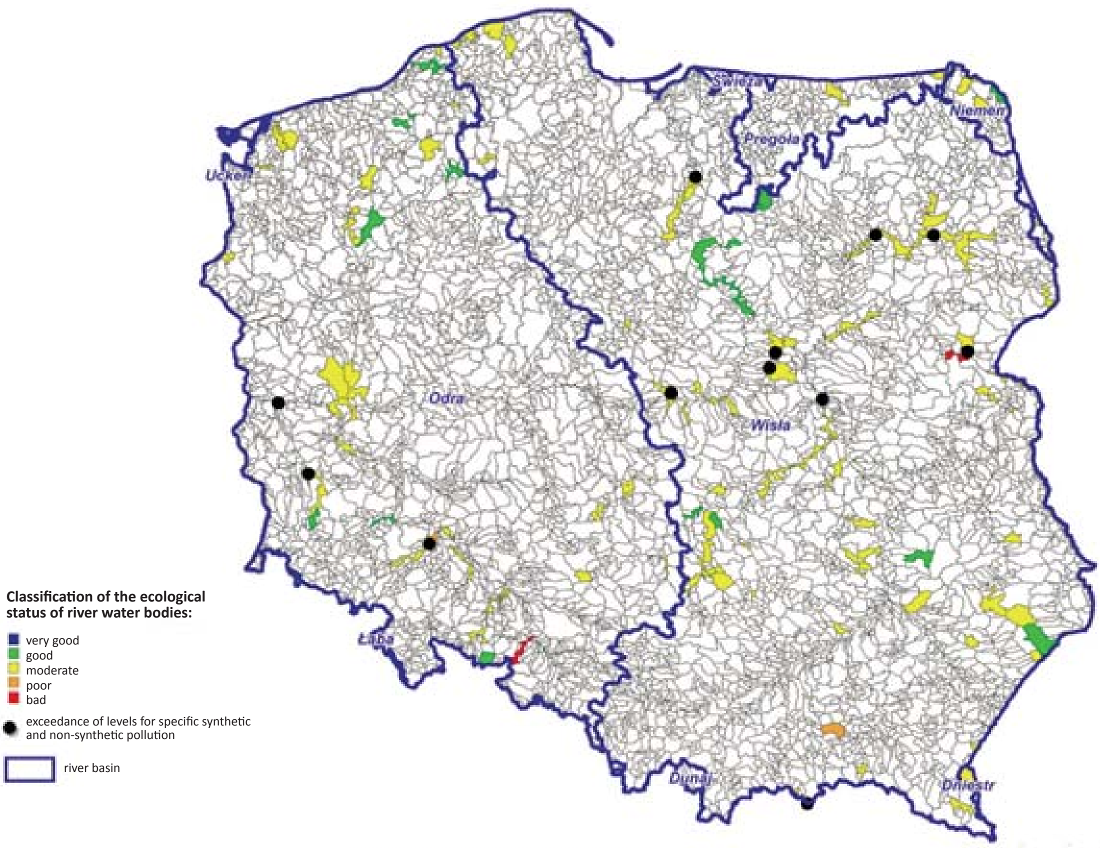

Fig. 57. Map of division of river basins into water bodies and classification of the ecological status of river water bodies in the years 2007-2009; surveillance monitoring (source: CIEP/SEM)

has remained at a relatively stable level, much lower than at the end of the 1990s, with simultaneous fall in the medium flows (Fig. 58.). Also the significant drop in the size of BOD5, phosphorus and nitrogen transported from Poland to the Baltic Sea in comparison to 2000 leads to the conclusion about an improvement of the status of the rivers in the scope of physicochemical elements.

In 2010, there was performed, based on the data from the years 2007-2009, the water eutrophication assessment. The assessment was carried out on the basis of results from monitoring obtained for biological elements (chlorophyll "a", phytobenthos or macrophytes) and physicochemical elements (indicators characterising the nutrients conditions, oxygen conditions and organic pollutants), whereas the choice of biological indicators for eutrophication assessment depended on the abiotic type of the river, where the monitoring point was located. The assessment was carried out on the basis of the provisions of Regulation of the Minister of the Environment of 20 August 2008 on the method of classification of the status of surface water bodies, and it was performed only for monitoring stations closing water bodies areas and not for whole, all the monitoring stations in water bodies areas. Monitoring station like this was considered to be eutrophicated if one or more indicators taken into account exceeded the threshold value determined for class II (good status).

The eutrophication assessment of flowing waters performed in this way indicates that the phenomenon concerns ca. 78 % of water bodies.

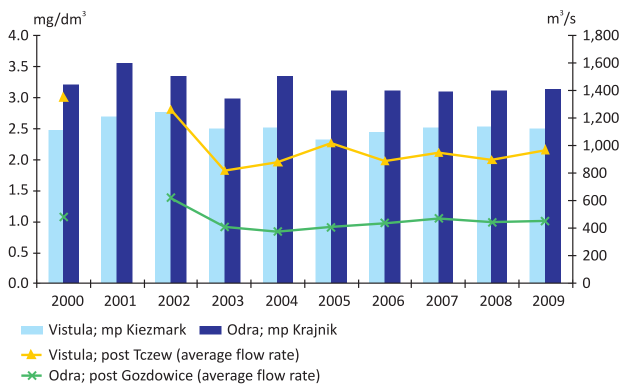

Fig. 58. Average concentration of total nitrogen at monitoring points Vistula Kiezmark and Odra Krajnik Dolny against average flow rates (source: CIEP/SEM)

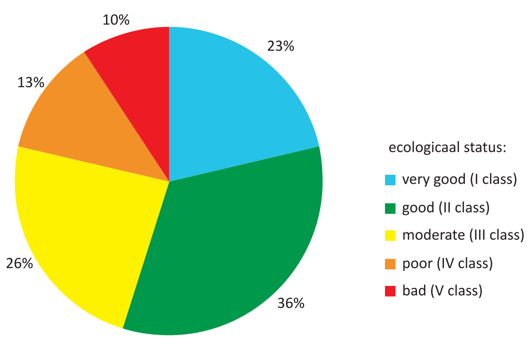

Fig. 59. Collective results of classification of lakes covered by monitoring in 2009 by ecological status (source: CIEP/SEM)

Most of Polish lakes are generally eutrophic. About half of them are characterised by morphometric and hydrographic features and geomorphological conditions that contribute to the natural aging process of lakes. It means that the eutrophic state is a natural state for many Polish lakes. The state of purity of lake waters is obviously determined not only by natural features, but also the diverse anthropogenic pressure, and, most of all, the delivery of biogenes from point and area sources, deepening and speeding up water eutrophication processes (also natural eutrophication). In addition, degradation of lakes and related ecosystems may be the result of implementation of improper environmental policy.

In total, 108 lakes were tested and assessed in 2009. Usually the biological indicators determined assessments. There were 59 lakes with very good and good status, what amounted to 54.6 % of the total number of monitored lakes (Fig. 59.). With reference to the total surface area of the lakes and the volume of their water, there were respectively 50.8 % and 54.7 % lakes with good or higher state. The greatest part of it was the lakes with good status. There where 10 lakes with bad status (9.3 % of total monitored lakes, however with reference to the total surface area of the lakes and the volume of their water - 11.8 % and 3.9 % respectively). It should be indicated, however, that the above assessment was carried out according to the expert judgement, in some cases diverting from the criteria determined in the Regulation of the Minister of the Environment of 20 August 2008 on the method of classification of the status of surface water bodies.

Measurements carried out in 2009 confirm previous observation that the lakes in the Vistula river basin are characterised by a much better status than in the Odra river basin. Almost 67.3 % of lakes were assigned the good and very good ecological status there. In the Odra river basin, such bodies accounted for just 36.4 %.

The observed diversity of the quality of lake water between the drainage basins results to a high extent (but not exclusively) from natural conditions. Water bodies may represent a wide range of background (reference) concentrations of nutrients, which depend mostly on the geological conditions of the basin. For example, high concentrations of nutrients, which are not related to adverse changes to biological elements, do not have to point to moderate or worse ecological status. Thus, assessment of the ecological status focuses on biological effects of the pressure, and the thresholds defined for particular status account for the natural conditions characteristic for a particular lake (its type).

An analysis of long-term trends was carried out for nine lakes covered by the fundamental monitoring from 1999. Analyses of the changes to the state of waters were performed for those lakes in the years 1999-2009. Although the lakes are located in the areas subject to relatively low anthropogenic impact on the environment, the comparison reveals large differences in the variability of phosphorus and total nitrogen concentrations, concentration of chlorophyll "a" and water transparency. Morphological diversity of lakes, use of their basins and pollutants transported by their tributaries, as well as meteorological changes and implementation of new research methods make it difficult to determine explicit trends for all those water bodies. However, the continued monitoring of the quality of those lakes

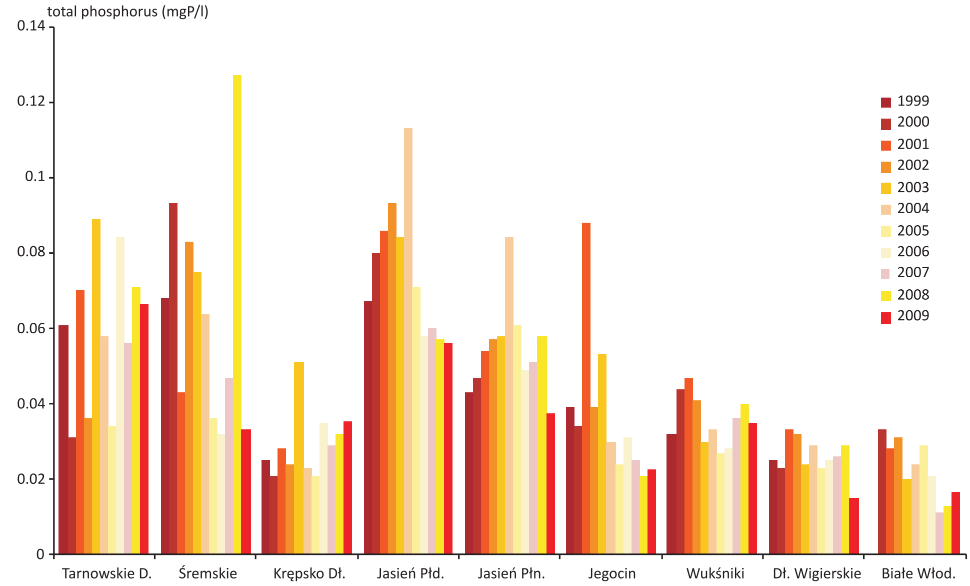

Fig. 60. Changes to the concentration of total phosphorus in the water of benchmark lakes (source: CIEP/SEM)

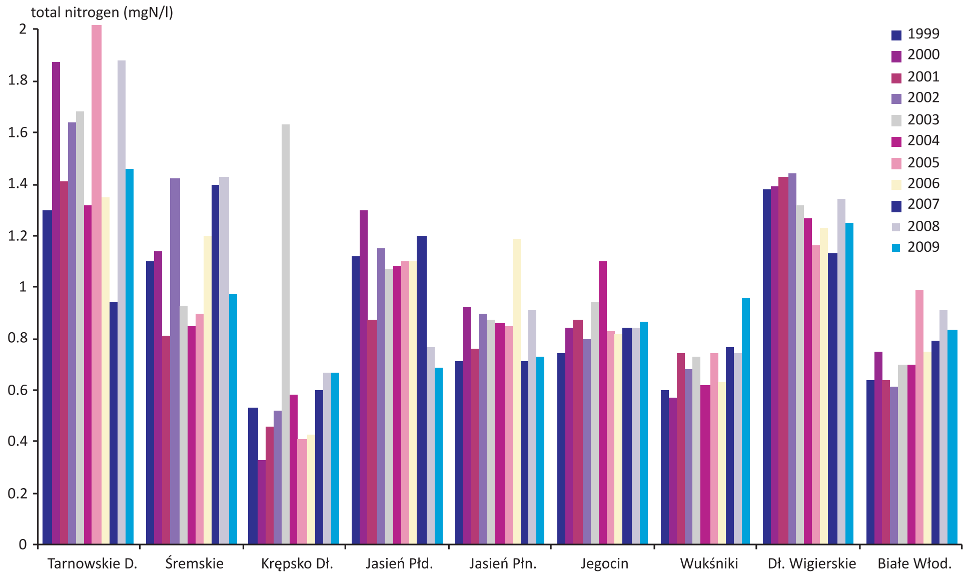

Fig. 61. Changes to the concentration of total nitrogen in the water of benchmark lakes (source: CIEP/SEM)

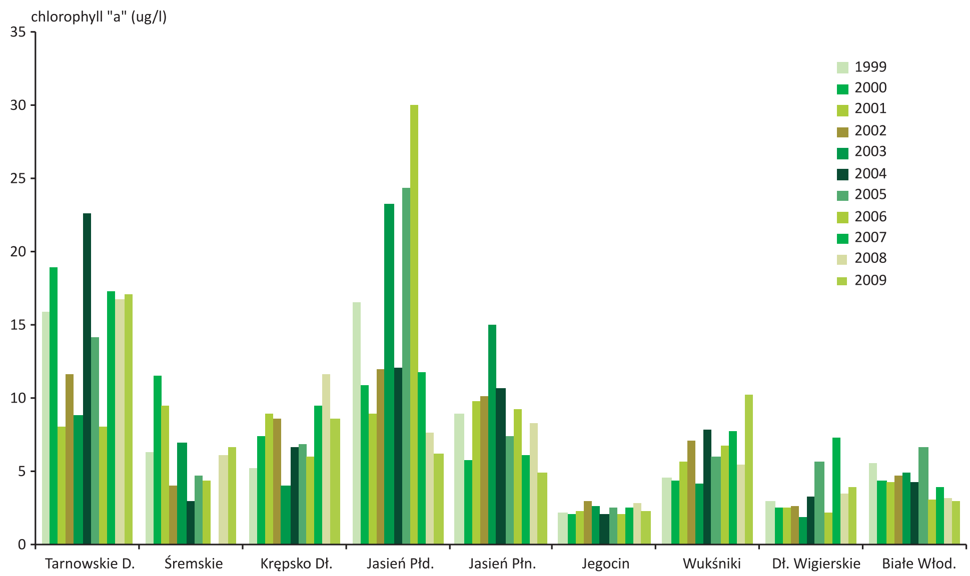

Fig. 62. Changes to the concentration of chlorophyll “a” in the water of benchmark lakes (source: CIEP/SEM)

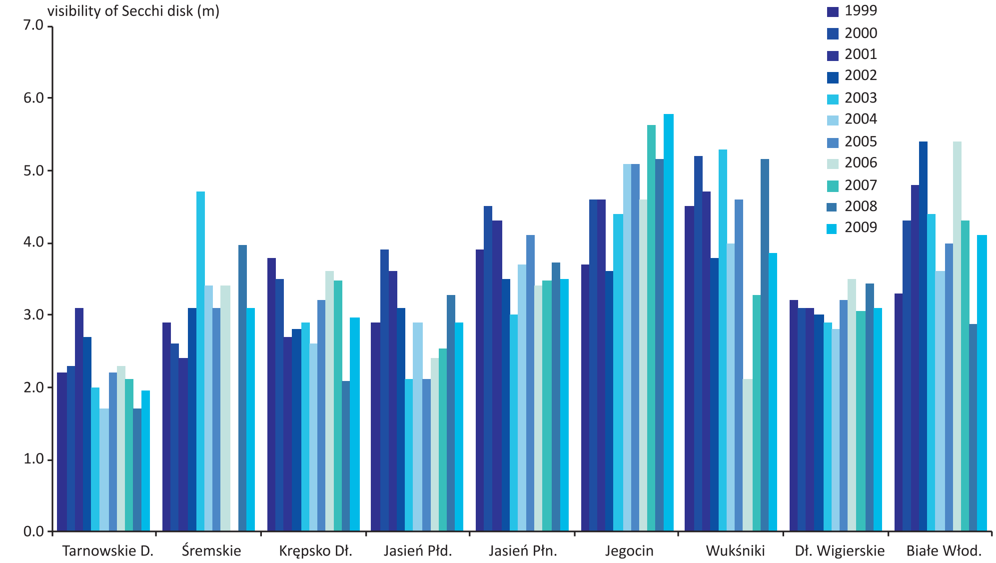

Fig. 63. Changes of transparency of the water of benchmark lakes (source: CIEP/SEM)

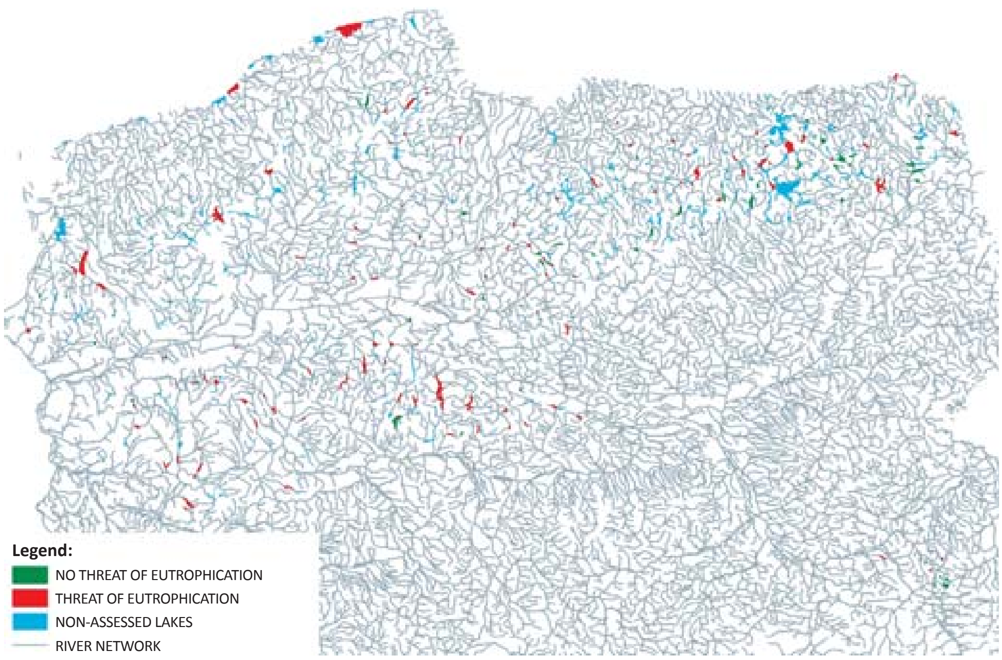

Fig. 64. Results of lakes eutrophication assessment on the basis of data from the years 2007-2009 (source: CIEP/SEM)

and collecting more data seem to be the only way to obtain clear information about the trends, which will allow to apply appropriate repair programmes.

In 2010, the lake water eutrophication assessment was performed based on data for the years 2007-2009. Eutrophication was assessed based on the results obtained for biological elements (chlorophyll “a”, phytobenthos - OIJ (diatom index for lakes) and macrophytes - the Ecological State Macrophyte Index – ESMI) and physico-chemical elements (transparency, total nitrogen and total phosphorus). The assessment was made based on the provisions of the Regulation of the Minister of the Environment of 20 August 2008 on the method of classification of the status of surface water bodies. When several monitoring stations were located on a lake, one average value for the entire lake was calculated. If, in the analysed period, a particular lake was tested more than once, the results coming from various years were also averaged out. Only the results from measurement which fulfilled the criterion of at least 3 results for a given indicator in at least one analysed year were taken into account. A lake was deemed eutrophic, if one or more indicators taken into consideration exceeded the threshold value determined for class II (good status), although in some cases exceedance of the thresholds for one indicator was not the decisive factor in the overall assessment, but the general character of the natural conditions of the lake, anthropogenic and biological factors were also taken into account. The assessment of eutrophication of the lake waters revealed that this phenomenon occurred in 117 of 171 analysed lakes, which means that 68.4 % of these water bodies is at risk of eutrophication (Fig. 64.).

Status of groundwater

The examination of the groundwater quality carried out in 2010 revealed a good chemical status of groundwater (classes I, II, III) in ca. 72 % of the examined measurement points, whereas ca. 28 % measurement points were characterised by a poor chemical status (class IV, V) (Table 4.) (Fig. 65.).

Table. 4. Collective results of the examination of the groundwater quality at measurement points (source: CIEP/SEM)

Groundwater quality class	Number of measurement points	% share of measurement points
I (very good)	7	0.79
II (good)	152	17.19
III (favourable)	481	54.41
IV (unfavourable)	148	16.74
V (poor)	96	10.86
	884	100.00

The quality of waters in Poland depends significantly on the way of managing their drainage basins. The state of rivers is mostly determined by the drainage of and improperly treated municipal and industrial waste water, including discharge of saline water from coal mines (Fig. 18.). Rearing animals and agriculture still are a source of pollutants. It often happens that fields are adjacent to the shores of rivers or lakes, and there are no protective barriers in the form of belts of trees or shrubs along the shoreline, which is conducive to the transfer of agricultural pollutants to the water.

High concentration of industry, in particular on areas located in the upper courses of Odra and Vistula, causes significant changes to the relief and changes to the water relations, as well as the necessity to discharge sewage to the surface river network transporting small volumes of water.

Also in the case of groundwater, abstraction of water through large municipal and industrial intakes, as well as mine drainage were the main causes of its poor quantitative status, which caused adverse changes to the location of the groundwater level (Fig. 13.).

As regards the main factors determining poor chemical status of groundwater, they included total iron. The problem of the presence of iron in groundwater is a national one, and is related to the natural presence of iron in numerous minerals of both igneous and sedimentary rocks.

What is the main manifestation of degradation of lakes is the process of eutrophication. Eutrophication consists in the growth of fertility of water bodies through increased inflow of biogenes, that is phosphorus and nitrogen compounds. The concentrations of biogenic compounds found in lakes in the recent years, although lower than a dozen years ago, still are high enough to stimulate intensive water bloom.

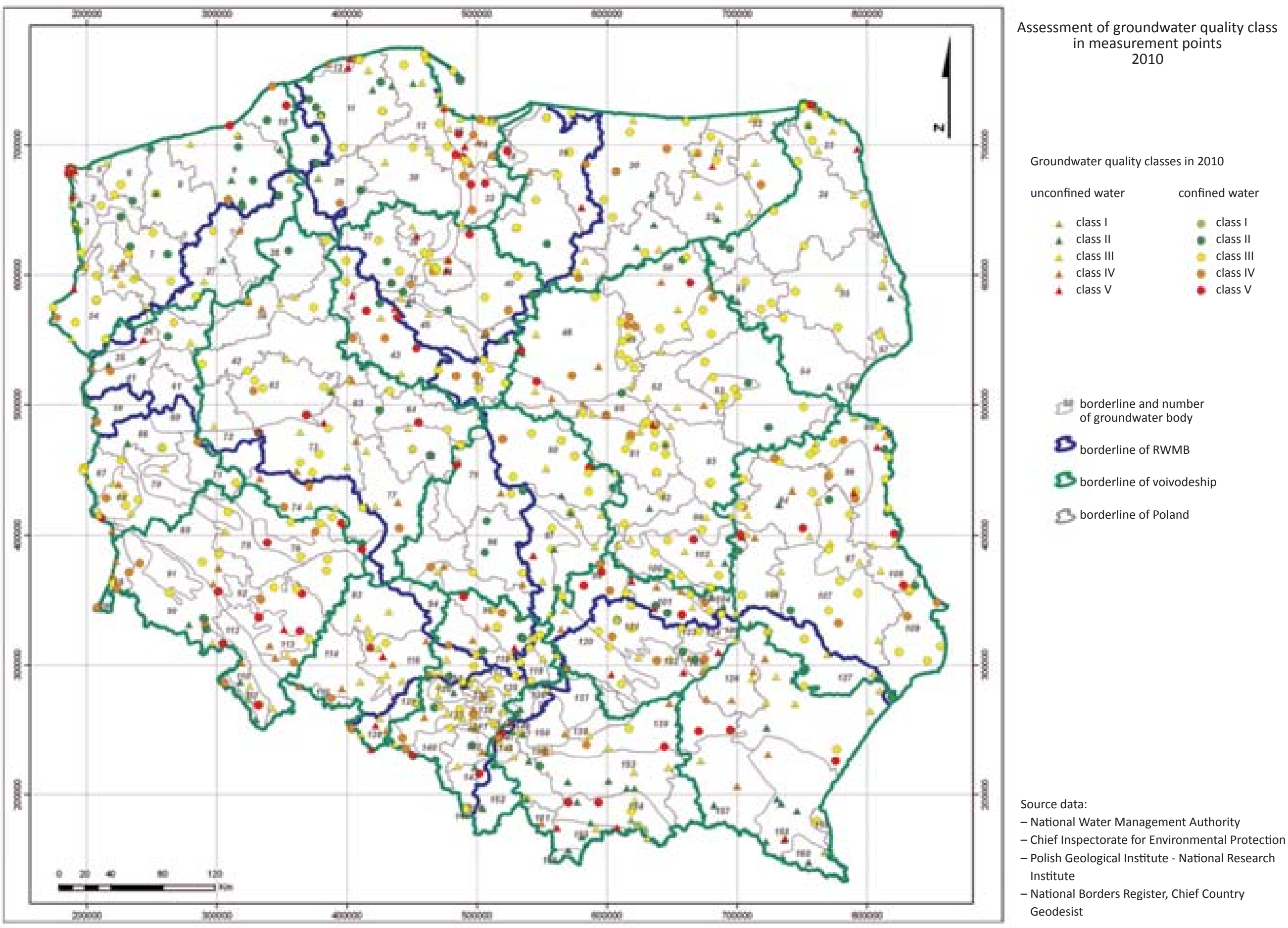

Fig. 65. Groundwater quality at measurement points in 2010 (source: CIEP/SEM)

The Balic Sea

The marine environment is a precious heritage, which must be protected, preserved and, as far as possible, recovered in a way enabling, in the end, maintenance of biodiversity and preservation of diversified and dynamic character of oceans and seas, which are clear, healthy and fertile.

The Baltic is called the Mediterranean Sea of Northern Europe, as it is surrounded by land from all sides and connected to the Northern Sea only by a few shallow straits. Being about 12 000 years old, it is one of the youngest seas of the Atlantic Ocean. The Baltic Sea belongs to the largest brackish seas in the world, whose characteristics make them particularly vulnerable to pollution and eutrophication. It is a relatively shallow regional sea with an average depth of 50 metres (for comparison, the average depth of the Mediterranean Sea is 1500 m). The Baltic Sea is almost entirely closed (only 3 % of the volume of water is exchanged during each year). The very long period of total exchange of water in the sea (25-30 years) is one of the factors making the Baltic one of the most polluted seas in the world.

The Polish Baltic Sea monitoring programme provides for regular control of the state of marine environment in the Polish zone of the southern Baltic at stations located in the deep-sea zone – in the area of the Gdańsk Deep, the Bornholm Deep, at the south-eastern slope of the Gotland Deep and at stations located in the coastal zone under the HELCOM COMBINE programme, as well as in the measurement and control points of the monitoring implemented in line with the requirements of the Water Framework Directive, which are located in the transitional and coastal waters (Fig. 66, Fig. 67).

The year 2010 in the Polish zone of the Baltic Sea was characterised by incidental natural phenomena, namely the outflow of several flood waves of the catastrophic spring flood from the Vistula river basin to the Gulf of Gdańsk and a relatively strong ingression from the North Sea (in the deep water zone) in autumn 2009.

During the 2010 flood, the main peak waves on the Vistula river reached the Gulf of Gdańsk on 24 May (first flood wave) and 12 June (second flood wave). Flood waters were visible on the surface of the Gulf due to lower salinity and increased silicate concentrations, but also to the significant amount of mineral suspension (different colour of water) stretching beyond the geographical border of the Bay (central part of the Gdańsk Deep). As a result of suspension and intensified primary production, the transparency of water was dramatically reduced.

Following the entry of the flood wave on 12 June, significantly lower oxygen saturation was recorded in the surface layer. Such a low oxygen saturation, despite high primary production, demonstrates that flood waters contain large amounts of reducing substances. Flood waters brought huge quantities of mineral and organic suspension, as well as dissolved biogenic substances to the Gulf of Gdańsk. Average concentrations of the main nutrients and chlorophyll "a" in the surface layer (0-10 m), measured at three stations, which are located at the smallest distance from the Vistula estuary, on 7-11 and 14-15 June are

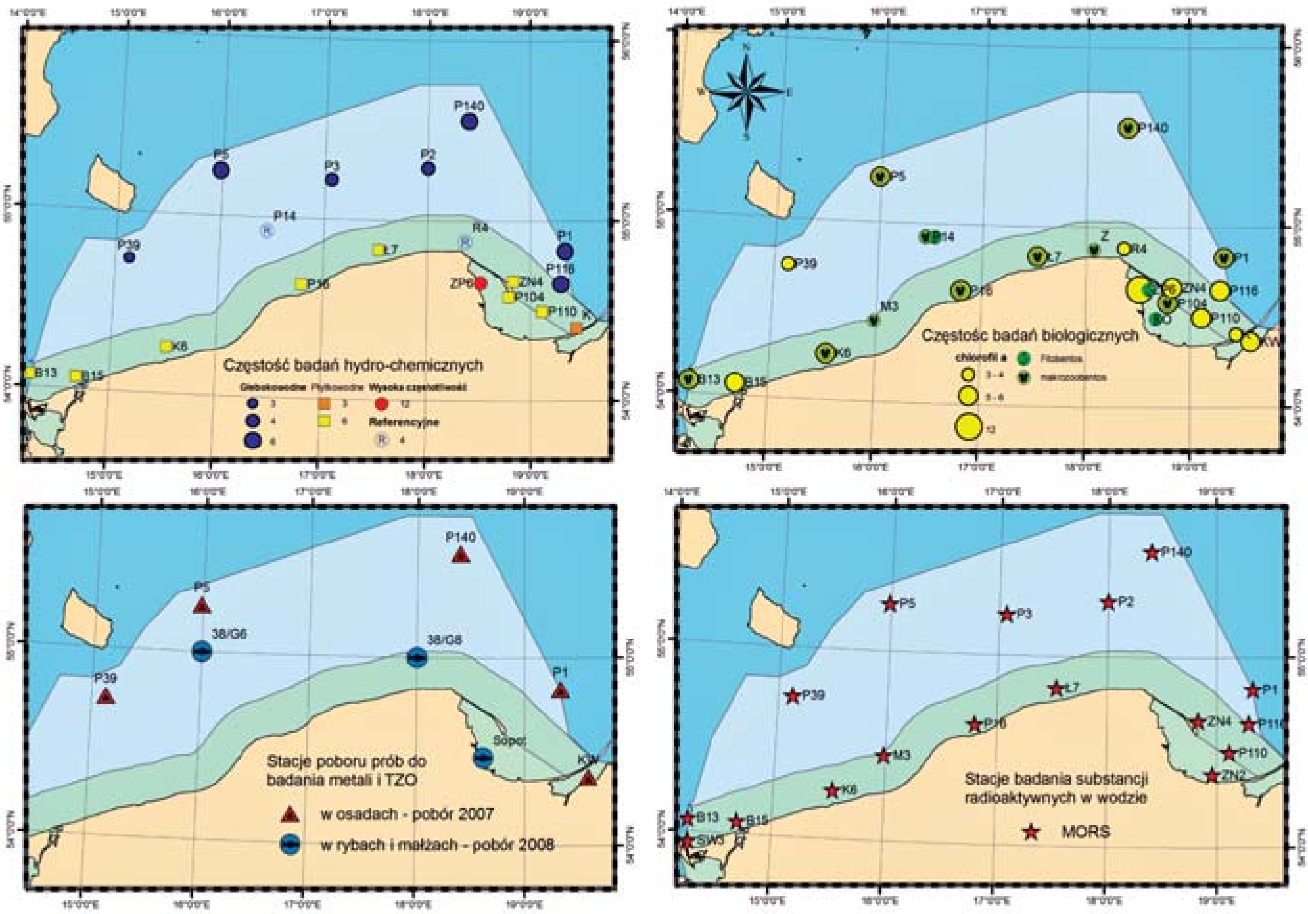

Fig.66. Monitoring stations and monitoring frequency in 2010 within HELCOM COMBINE monitoring of the Baltic (source: CIEP/SEM)

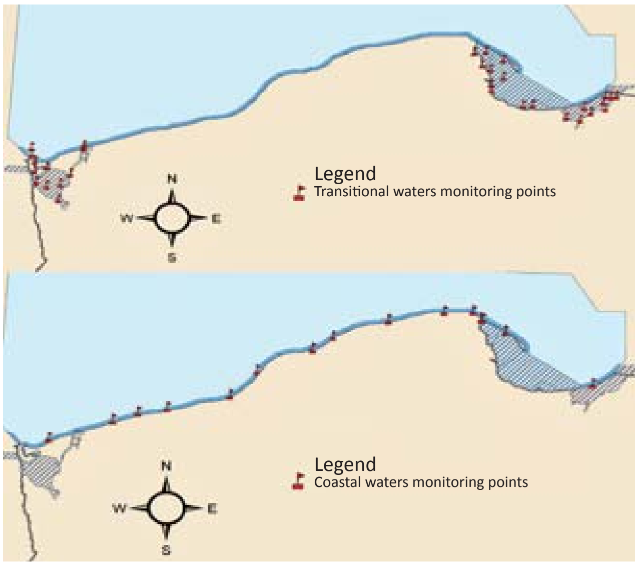

Fig. 67. Network of monitoring points of the transitional and coastal waters monitoring programme (source: CIEP/SEM)

Table 5. Average concentrations of nutrients [mmol m^{-3}] and chlorophyll "a" in the Gulf of Gdańsk following the inflow of the Vistula flood waters in 2010.

Station	DIP	TP	DIN	NO_3	NO_2	TN	SiO_4	Chl-a
7-11 June 2010								
ZN2	0,25	2,90	105,87	104,60	0,56	131,45	137,62	17,9
P124	0,95	1,54	44,00	42,54	0,89	81,12	109,85	16,8
P126	0,12	1,44	46,86	44,70	1,68	84,56	125,73	63,3
14-15 June 2010								
ZN2	1,89	4,06	31,84	26,68	1,98	54,19	54,84	7,68
P124	0,66	2,54	27,62	25,48	1,13	67,83	68,23	8,06
P126	0,27	1,83	38,65	34,02	1,34	67,83	68,23	8,06

DIP – dissolved phosphates; TP – total phosphorus; DIN – mineral nitrogen (NO_3+NO_2+NH_4); TN – total nitrogen, chl-a – chlorophyll "a"

presented in Table 5. The presented concentrations reveal a strong pressure on the environment of the Gulf of Gdańsk and its reaction, namely, exceptionally high content of chlorophyll "a".

Maximum concentration of nutrients remained within the limits recorded during large floods in 2001 and 1997 (figures in brackets):

– nitrates: 71.3 μmol N-NO_3 dm^{-3} (139.4),
– phosphates: 1.1 μmol P-PO_4 dm^{-3} (2.3),
– silicates: 108.92 μmol SiO_2 dm^{-3} (192.4).

Deficits in oxygen saturation of bottom waters were observed in the central part of the Gulf of Gdańsk in 2010.

No significant changes in the total nitrogen and phosphorus concentrations were observed in the open sea zone, south-eastern Gotland Basin and the Bornholm Deep in summer months of 2010 as compared to the years 2000-2009. However, the concentrations of both those elements slightly increased in the Gdańsk Deep. Other regions experienced irregular shifts, i.e. an increase in total nitrogen accompanied by a decrease in total phosphorus, which may be related to the changes in the structure of dominant phytoplankton functional groups in summer months.

The results for biological elements show that chlorophyll "a" concentration changed in line with the seasonal cycle in 2010. Due to the rather cold first half of the year, chlorophyll "a" concentrations were in general higher from August to November.

The comparison of the average benthic invertebrate fauna in samples collected from the stations with the most complete data series shows an increase in the zoobenthos in 2010 as compared to the previous decade (2000-2009).

Between 2003 and 2008, the number of phytobenthos[5] species around the Cliff of Orłowo remained at a similar level, with red algae constituting 50 % of them. In the years 2002-2009, the percentage of Chlorophyta in total biomass of macrophytobenthos in the summer ranged from 23 % to 60 %. In 2009, filamentous brown algae and an increased number of Chlorophyta were observed for the first time in the analysed period. The large number of Chlorophyta in the summer resulted mainly from high temperatures, conducive

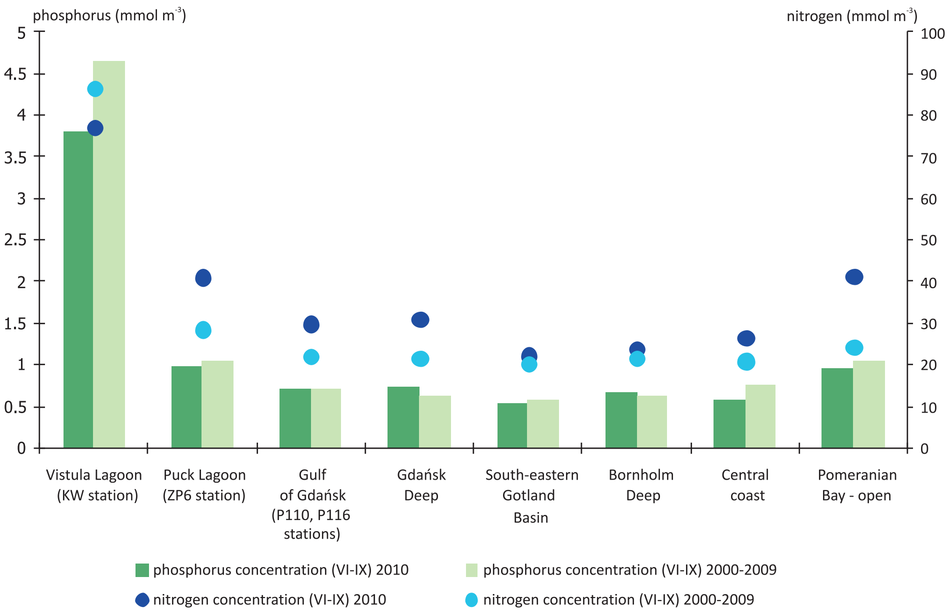

Fig. 68. Average concentrations of total nitrogen and phosphorus in summer months (June -September) in the Polish zone of the southern Baltic Sea in 2010, compared to average values of the 2000-2009 decade (source: CIEP/SEM).

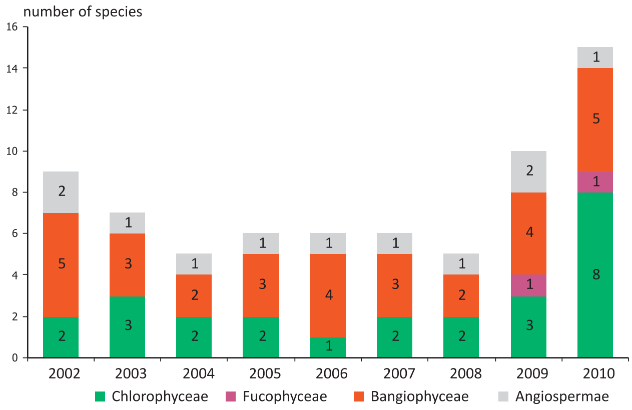

Fig. 69. Change in the number of species in individual macrophytobenthos groups in the Cliff of Orłowo profile (source: CIEP/SEM)

to the proliferation of those species. As many as 7 species of Chlorophyta were recorded in the summer of 2010, with their biomass accounting for 71 % of total mass of macroalgae in the 1-7 m depth range (Fig. 69.).

The issue of pollution of the Baltic Sea with hazardous substances is, most of all, the problem of the enormous number of various substances of anthropogenic origin flowing to it through rivers. Despite the fact that monitoring shows that the loads of some hazardous substances flowing to the Baltic have been significantly reduced in the last 20-30 years, the problem still exists.

The analysis of the complete data series (1998-2010) on individual persistent organic pollutants (POP) in muscles of fish from the Władysławowo fishery zone shows a marked and significant decline in the HCB and ΣPCB concentration. The ΣHCH and ΣDDT concentrations had been decreasing from the beginning of the analysed period until 2007, but from then on their concentrations in fish tissues have slightly increased (Fig. 70.).

In 2010, average heavy metal concentrations in livers of herrings caught in the Władysławowo fishery zone were lower than the average concentration in the years 2000-2009 by 22.3 % in the case of cadmium, 38.6 % for lead, 8.0 % for zinc and 14.0 % for copper. The mercury concentration in muscle tissue was 3.6 % higher as compared to the average for the decade (Fig. 71.).

Since 1986, after the Chernobyl nuclear plant disaster, the radioactivity level in the waters of the Baltic Sea has been shaped mainly by the presence of two radionuclides of anthropogenic origin: caesium 137 (^{137}Cs) and strontium 90 (^{90}Sr). Both isotopes are characterised by relatively long periods of half life amounting to 30 and 28 years respectively, which, among other things, are responsible for the still elevated activity of the said isotopes in relation to the time before the Chernobyl disaster. After 1986, the activity of ^{137}Cs in the Baltic waters was growing to maximum values, which were recorded in 1991. From that time, there has been observed a virtually uninterrupted fall in the concentrations of the said isotopes in the Baltic waters. The fall is related most of all with the radioactive decay of isotopes, the processes of bioaccumulation in animated elements of the marine environment, the processes of sedimentation and exchange of the waters between the Baltic and the Northern Sea (Fig. 72.). Compared to the year 2000, average activity of ^{137}Cs declined by 23.6 Bq m^{-3}. Taking into account the exponential downward trend of ^{137}Cs activity, which started in 1991, the value of 12 Bq m^{-3} corresponding to the average concentration of ^{137}Cs before 1986 may be achieved in the Baltic waters around the year 2025.Average ^{90}Sr concentration in 2010 was only slightly lower than the value established in 2000 (8.3 Bq m^{-3}).

The catchment area of the Baltic Sea is four times larger than the Sea itself and is inhabited by about 85 million people. Of the 14 countries of the catchment area of the Baltic, nine have direct access to the Sea. Eight of 9 coastal countries are members of the European Union. During the last century, there was recorded a significant negative impact on the environment of the Baltic Sea due to the growth in

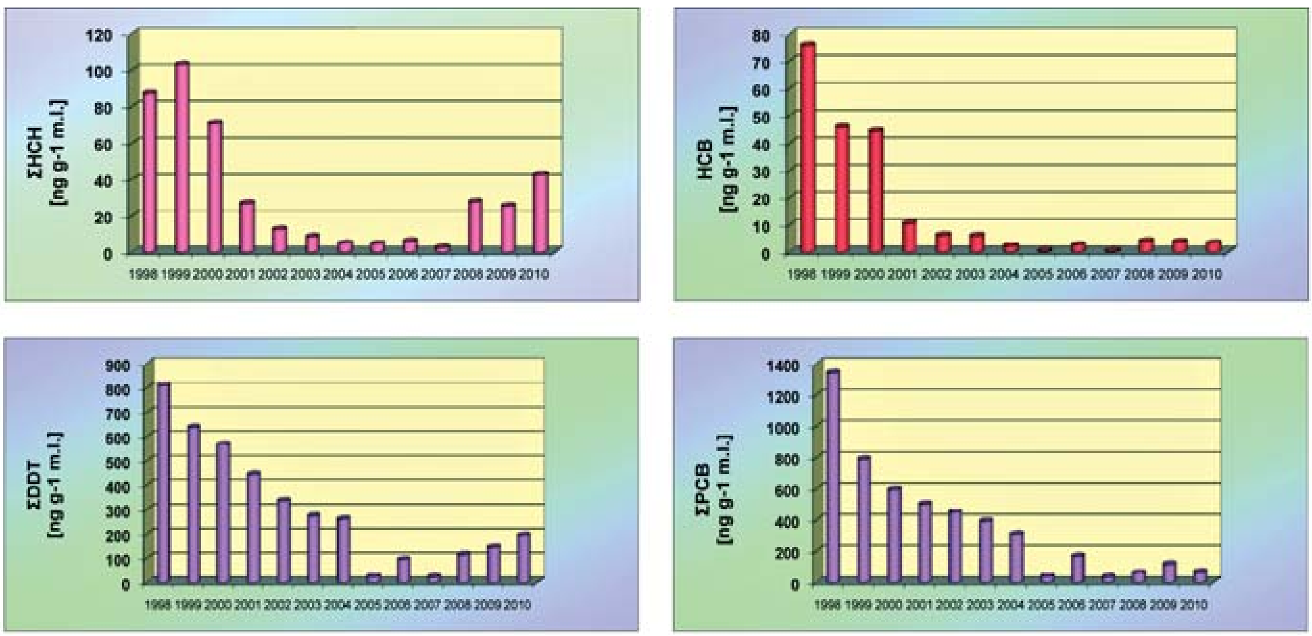

Fig. 70. Changes of average POP (ΣHCH, HCB, ΣDDT and ΣPCB) concentrations in muscle tissue of herring *(Clupea harengus)* from the Władysławowo fishery zone (source: CIEP/SEM)

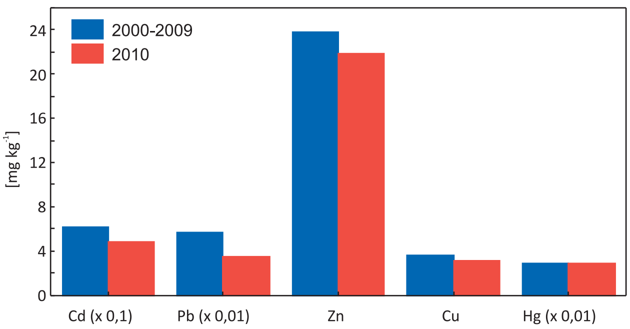

Fig. 71. Heavy metal concentration in herring tissues in 2010, compared to the average concentration in the years 2000-2009 (source: CIEP/SEM)

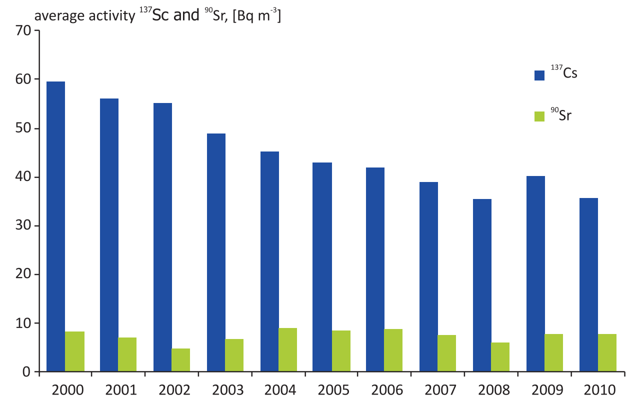

Fig. 72. Changes in average ^{137}Cs and ^{90}Sr concentrations in the Polish zone of the Baltic in the years 2000- 2010 (source: CIEP/SEM)

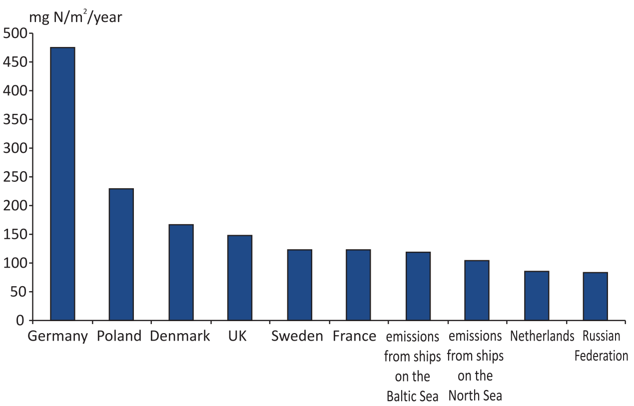

Fig. 73. Top ten contributors of nitrogen emissions to annual deposition of total nitrogen into the Baltic Sea basin in the year 2008 (source: EMEP)

population and urbanisation, industrialisation and increase in the activity in agriculture. What is optimistic is the fact that there was recorded at the same time a constant downwards tendency in the total loads of nutrient substances from 1990 (according to the data of the Helsinki Commission HELCOM).

Despite of the decrease in pollution loads transported to the Baltic Sea (Fig. 19.), eutrophication is still the greatest problem in the context of protection of the Baltic. The environment of the sea has changed over the last century from oligotrophic (with transparent waters) to strongly eutrophic

Excessive loads of nitrogen and phosphorus originating from land sources, located on the area of the catchment area of the Baltic Sea and from outside of that area are the main cause of eutrophication. About 75 % of the load of nitrogen, as well as at least 95 % of the load of phosphorus, is introduced to the Baltic through rivers and direct point discharges from municipal installations. About 25 % of the load of nitrogen originates from atmospheric deposition which, beside pressure from the land, is the second important source of pollution (Fig. 73.).

Actions aimed at improvement of water quality

In December 2003, the Government of Poland adopted the National Programme for Municipal Waste Water Treatment. The Programme was prepared to build, extend and modernise the collective sewage systems and municipal sewage treatment plants, as well as to define the deadlines for implementation of them, necessary for implementation of the provisions of the Treaty of Accession, referring to Council Directive 91/271/EEC of 21 May 1991 concerning urban waste-water treatment. It means, among other things, achievement of the quality standards of sewage discharged to the water environment from sewage treatment plants required by the EU and ensuring 75 % reduction of the total load of nitrogen and phosphorus in municipal wastewater from the territory of the whole country to protect surface waters, including sea waters from eutrophication.

The actions determined in the National Programme for Municipal Waste Water Treatment shall also contribute to the improvement of the investment attractiveness of Poland and its regions by the development of technical infrastructure, with simultaneous protection and improvement of the state of the environment, health, preservation of cultural identity and development of territorial cohesion.

In the period from 1995 to 2009, the efficiency of municipal sewage treatment plants increased in Poland by more than 35 %. The share of population covered by the services of municipal sewage treatment plants increased to 64.2 % (Fig. 74.), assuming a value of 88.1 % for urban areas, and 26.9 % for rural areas.

The HELCOM Baltic Sea Action Plan (BSAP) is a project meant to contribute to improvement of the state of inland and sea waters. It was adopted in 2007 at a Ministry Conference under the Convention on the Protection of the Marine Environment of the Baltic Sea Area, called the Helsinki Convention (executive authority of the convention is Helsinki Commission - HELCOM). Its main objective is to achieve a good ecological status of the Baltic Sea by 2021. The objective is to be attained thanks to measures included in 4 segments and focusing on eutrophication, hazardous substances, biodiversity and nature conservation and

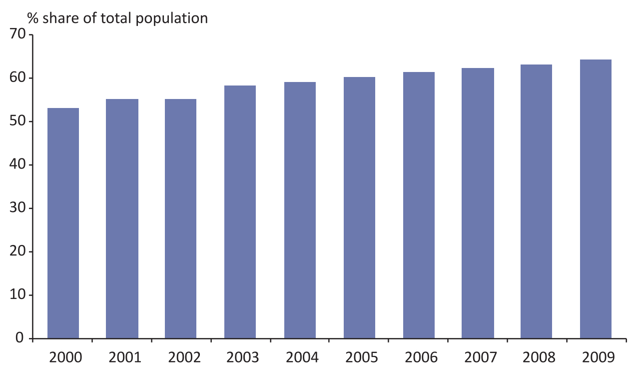

Fig. 74. Share of the total population of Poland serviced by sewage treatment plants (source: CSO)

maritime activities. The Initial National Implementation Programme for the Baltic Sea Action Plan HELCOM was drawn up by CIEP in 2010 and its final version is to be prepared by 2013. The BSAP assumes i.a. gradual reduction of the discharge of nutrients, i.e. nitrogen and phosphorus loads coming from land-based sources within the catchment area or coming as wet and dry atmospheric deposition.

According to the preliminary allocation scheme of discharges of nutrients to the waters of the Baltic, as expressed in the BSAP, based, *inter alia*, on the use of physico-biogeochemical models (NEST), Poland has to limit the discharge of nitrogen by at least 63 400 tonnes and phosphorus by about 8 760 tonnes by 2021 in relation to the average discharges from the years 1997-2003 (adopted as base data for 2000), amounting to 191 170 tonnes and 12 650 tonnes respectively.

Measures to reduce eutrophication of the Baltic Sea are included also in the Priority Area 1 of the EU Strategy for the Baltic Sea Region, "Reduction of nutrient inputs to the sea to acceptable levels", which is coordinated by Poland (CIEP) and the Finish Ministry of the Environment.

The Baltic Sea Action Plan is a project consistent with other projects and programmes aimed at water protection. Implementation of the provisions of the National Water-Environment Programme, water management plans or the National Programme for Municipal Waste Water Treatment shall contribute to improvement of the quality of inland waters, and thus it shall have a positive impact on the state of the ecosystem of the Baltic Sea, as the recipient of the pollutants flowing down rivers or directly from the land.

Improvement of marine environment and coastline protection is one of priorities of national marine policy directions until 2020, as was indicated in the governmental document „Assumptions for marine policy of the Republic of Poland until 2020".

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1 Data for 2009

2 Regulation of the Minister of the Environment of 20 August 2008 on the method of classification of the status of surface water bodies.

3 Class I – very good ecological status, class II – good ecological status, class III – moderate ecological status, class IV – poor ecological status, class V – bad ecological status.

4 A new cycle of research on river water bodies began in 2010.Only the assessment of water bodies at risk of failing to achieve a good status of water was performed under the operational monitoring.

5 The monitoring of phytobenthos takes place in three depth transects. The research series for the Cliff of Orłowo is the longest.

Water quality, especially the quality of water dedicated to supplying people with drinking water, has an great impact on the health of the society, as well as proper functioning of ecosystems. Despite the significant improvement of water quality recorded in recent years, which is the effect of limitation of production in many industries, modernisation of processes and building industrial and municipal sewage treatment plants, the state of purity of surface flowing waters and lakes is still insufficient.

Achievement and maintenance of a good status of waters and reasonable management of water resources requires undertaking and implementing a series of actions in the scope of: industry, agriculture, wastewater management, spatial management, formation of water relations and protection of the water environment, as well as organisational, legal, and educational actions.

The main middle-term objective, to be achieved until 2016, is to increase the self-financing of water management and rationalise the management of surface water and groundwater resources in order to protect the national economy from water deficiencies and secure against the effects of floods. What shall be the main task is striving at maximisation of saving water resources for industrial and consumption purposes, as well as increasing retention of water.

As regards protection of waters against pollution until the end of 2015, Poland shall ensure 75% reduction of the total loads of nitrogen and phosphorus in municipal sewage, continuing the process of modernisation, extension and building new sewage treatment plants within the National Programme for Municipal Waste Water Treatment. The execution of BSAP and actions performed in the framework of 1 priority area of EU strategy for Baltic Sea Region will be of key importance with regards to prevention of the Baltic Sea from eutrophication.

There shall also be undertaken further actions aimed at protection of waters against pollution caused by nitrates originating from agricultural sources in compliance with Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources.

It is the overall goal of the environmental policy of Poland in the scope of protection of water resources to maintain or achieve good state of all waters, including also maintenance and recovery of ecological continuity of watercourses. Implementation of the goal shall be ensured by implementation, for each separated river basin area in Poland, a water management plan and a water-environmental programme for Poland.

NOISE

NOISE

Noise seems to be the environmental factor that causes the greatest nuisance. One of the most popular definitions states that noise is any sound that is not welcome, causes nuisance or even harmful in particular conditions. The effect of environmental noise on people is considered by international organisations, in particular the WHO, to be one of the most important health related problems. It is particularly disadvantageous during the night-time. By disturbing sleep, it causes not only the conditions of chronic fatigue, but also impairment of the immune and vegetative systems. With respect to the origins of its source noise may be divided into two general categories like installation (industrial) and traffic noise. Traffic noise includes: road traffic (street), rail traffic and aircraft noise. The major threat influencing the state of acoustic climate both in Poland and the other EU countries is the impact of traffic noise.

One of the most important tasks of all developed countries, Poland included, is the limitation of noise to the permissible levels[1]. Due to the commonness of occurrence of noise exposure, the task is a long-term one, the implementation of which shall be spread over many years (long-term perspective).

Trends in changes in the acoustic climate are assessed within the state environmental monitoring on the basis of accumulated results in 5-year periods.

Road traffic noise is related to the car traffic and constitutes the major threat in urbanised areas.

Comparison of the exceedances distribution indicate a small decline in noise in the range of 65-70 dB (exceeding the noise limits by 5.1-10 dB) in the years 2007-2009[2] in comparison to the previous 5-year period (2002-2006). As regards high and the highest levels (exceeding by more than 10 dB), after the growth of the number of such cases until the end of the 1990s, a slow fall started to be recorded. From that time, a moderate increase in the levels of road traffic noise is accompanied by the positive trend of the fall in the number of cases of the highest levels exceedances (Fig. 75.). A significant increase of traffic noise measurements without exceedances of noise limits has been also recorded.

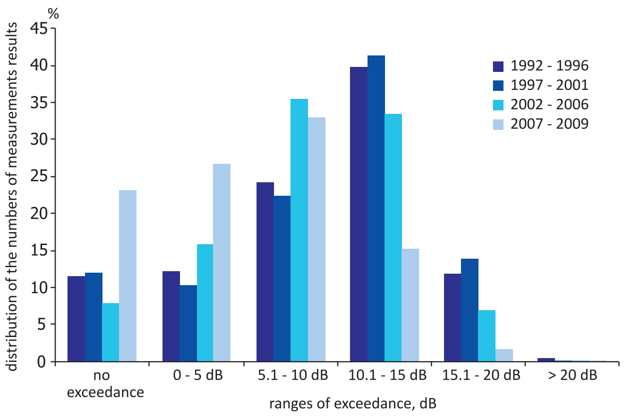


Fig. 75. Percentage distribution of exceedances of permitted day-time noise level $L_{Aeq\ D}$, for road traffic noise (including street noise) for four time periods (100% - number of measurement results with exceedances) (source: CIEP/SEM)

The numeric illustration of the thesis is shown in the table 6. The table includes results of the two ways of analysis of the road traffic noise trends. The trends were analyzed with adoption two criteria of the noise distribution:

– the first criterion – distribution of the noise levels in two groups: less or higher than the $L_{Aeq\ D}$ = 60 dB (limit for day-time traffic noise level),
– the second criterion – distribution of the noise levels in two ranges: less or higher than the $L_{Aeq\ D}$ = 70 dB (very high exposure to traffic noise).

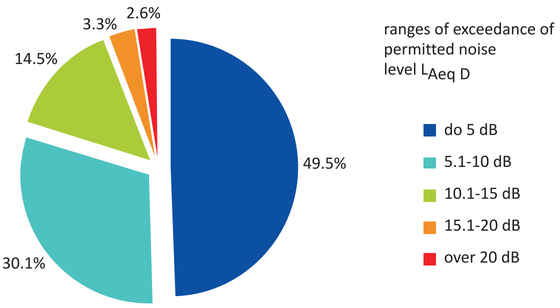
Tab. 6. Percentage distributions of the numbers of road traffic noise measurement results with the application of various criteria (source: CIEP/SEM)

Period	Distribution of the noise measurements results' number [%]			
	First criterion of the analysis ($L_{Aeq\ D}$)		Second criterion of the analysis ($L_{Aeq\ D}$)	
	< 60 dB	> 60 dB	< 70 dB	> 70 dB
1993 – 1996	11.6	88.4	47.9	52.1
1997 – 2001	12.0	88.0	44.7	55.4
2002 – 2006	7.9	92.1	59.3	40.7
2007 – 2009	23.1	76.9	82.8	17.2

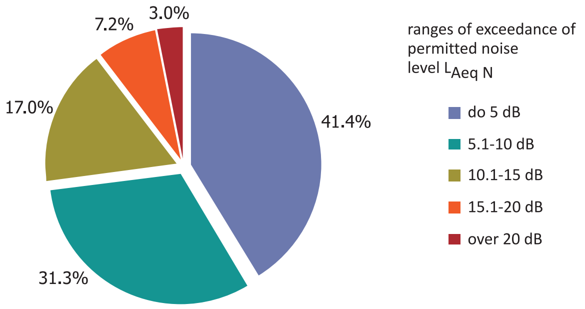
The above data indicate a decrease, by ca. 15.2 percentage points, in the number of the permitted sound levels exceedances (over 60 dB) and as well decrease, by 23.5 percentage points, in number of cases with sound level exceeding 70 dB, in the comparison to the previous 5-year period (2002-2006).

In 2009 exposure to rail traffic noise was estimated in Poland on the basis of the timetables of trains travelling along the major national railways net of the total length of about 13 000 km. The general assessment indicate that about 500 000 people living along railways are exposed to rail traffic noise at a level of over 60 dB in the day-time and over 50 dB in the night-time. Further analyses show a slow, though in some cases significant (especially with reference to main lines) decrease in the exposure of population to noise emitted by rail traffic. The basic causes include a decrease in traffic intensity, revitalisation of many sections or railways and systematic, though slow exchange of the rail stock into less noisy.

Air traffic noise in the areas surrounding airports belongs to the most annoying acoustic phenomena in the environment. In Poland, exists one major airport Warszawa-Okęcie, several medium-size ones: Kraków-Balice, Gdańsk-Rębiechowo, Poznań-Ławica and a dozen small, which have the prospects of intensive expansion. The data for the Warszawa-Okęcie airport coming from the noise map of the airport developed in 2007, obtained with the use of the L_{den} level, that is the day-evening-night level, indicate that the exposed area for conditions corresponding to values of the equivalent noise level L_{AeqD} = 60 dB ranges from 20 to 24 km^2.



Rys. 76. Distribution of the exceedances of the permitted noise levels expressed by indicator $L_{Aeq\ D}$ (dB) measured around industrial plants in particular classes of exceedances in the years 2007-2009 (100% - all plants exceeding the permissible day time levels) (source: CIEP/SEM)



Rys. 77. Distribution of the exceedances of the permitted noise levels expressed by indicator $L_{Aeq\ N}$ (dB) measured around industrial plants in particular classes of exceedances in the years 2007-2009 (100% - all plants exceeding the permitted noise night-time levels) (source: CIEP/SEM)

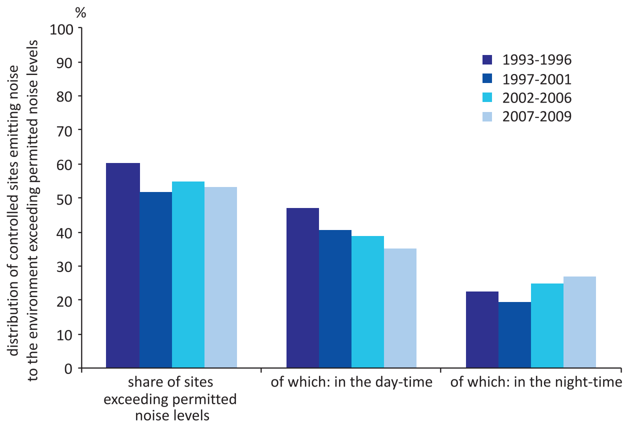


Fig. 78. Results of controls of exceedances of permitted equivalent industrial noise levels in four time periods (source: CIEP/SEM)

Industrial noise monitoring carried out in the recent years have shown that there occurs the greatest number of small exceedances up to 5 dB in the day-time. Exceedances in the range from 15 dB to more than 20 dB constitute a small proportion of all examined cases (Fig. 76.). In the night-time, the situation is more diverse. Almost 73 % of exceedances of the noise limits not only are included in the class of exceedances by up to 5 dB, but also in the upper class – exceedances by up to 10 dB. There are also more exceedances of permitted levels in the highest classes, i.e. for exceedances of the permitted levels by 15 dB and more (Fig. 77.).

The results of industrial noise surveys in the years 1992-2009, with reference to all examined plants, indicate that the downward trend in the exposure to this kind of noise has been stopped. Studies of the distribution of permitted noise levels exceedance cases concerning the day-time confirm the constant downward trend in exceedances. A small increase in the number of exceedances in the night-time has been recorded (Fig. 78.).

After a decrease in the percentage of sites not meeting the noise standards, which started from 1997, the studies carried out by voivodship inspectors for environmental protection revealed a slight upwards trend of exceedances of the permitted level up to 5 dB, in particular in the night-time. This is in most cases attributable to sites causing relatively low acoustic nuisance, but located near residential areas (Fig. 79. and Fig. 80.).

However, there is no point in comparing the previous cycles (the years 1993-1996, 1997-2001 and 2002-2006) to the current one (the years 2007-2009), since the noise standards changed twice in recent years (in 2004 and 2007). If the stricter standards of the previous monitoring cycles were applied to the current monitoring cycle (the years 2007-2009), the exceedance statistics for the years 2007-2009 would look much worse than the statistics presented in this chapter.

The state of the acoustic climate is related to the state of social-economic development of the country. Key indicators include that relation in particular with the development of transport infrastructure and reflect changes in the exploited sources. For the most frequent source of environmental noise, i.e. the road traffic (street) noise, the so-called *motorisation environmental pressure index*, is used in analyses of the acoustic climate. The index links the streams of road

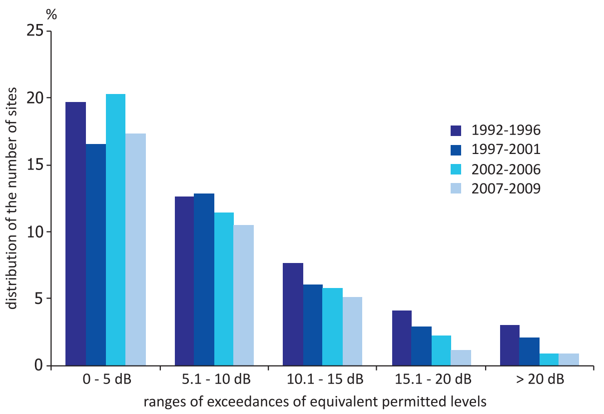


Fig. 79. Distribution of the number of sites emitting noise which exceeds the equivalent permitted day-time levels (100% - all sites covered by measurements) (source: CIEP/SEM)

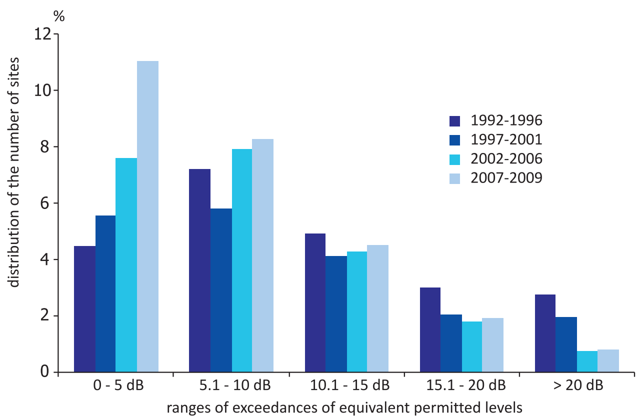


Fig. 80. Distribution of the number of sites emitting noise which exceeds the equivalent permitted night-time levels (100% - all sites covered by measurements) (source: CIEP/SEM)

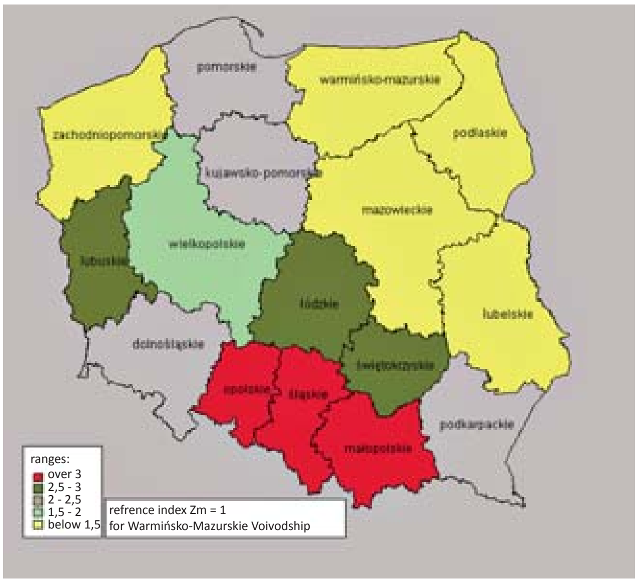


Fig. 81. Motorisation pressure index in 2008 (source: CIEP/SEM)

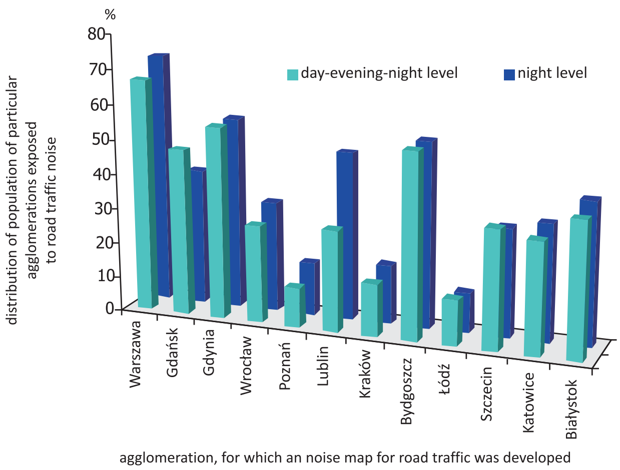


Fig. 82. Distribution of population of particular agglomerations (population over 250 000) exposed to road noise at a level of L_{den} > 60 dB and L_n > 50 dB (source: acoustic maps for cities >250 000 population)

traffic to the density of (road) infrastructure, whereby its value becomes proportional to the exposure to noise. The value of the motorisation pressure index has been gradually growing from the start of its development, that is for the total of 10 years, which leads to a constant increase in the exposure to road traffic noise in Poland. The phenomenon is related to the changes in the length of roads of the national communication network and the growth in density of those communication routes, as well as the growth in the number of vehicles used. In 2008, higher values of the index were recorded in the following voivodships: Śląskie, Małopolskie and Opolskie, and the highest in the Warmińsko-Mazurskie Voivodship (Fig. 81.).

What is one of the basic causes of the recorded trends of changes in the motorisation pressure index, thus also noise, is the rapid growth in the number of vehicles in Poland (Fig. 23.).

As regards the pressure caused by the rail traffic, there has been observed virtual stagnation in the development of the railway network in Poland. A fall in the number of rail connections, and at the same time actions in the scope of modernisation of the stock and replacement of rails with new ones of a more modern structure (also with reference to minimisation of noise emission) may lead in general to the fall in rail noise nuisance.

The increase in air traffic noise in Poland has been a growing problem. It is related to:

- the development of regional airports and a significant intensification in air traffic on them, in particular intensification in international connections,
- growth in the tonnage of the carried cargoes,
- construction of new airports (for example Modlin airport),
- development of air transport handled by small aeroplanes and helicopters; this kind of air stock is not as noisy as big aeroplanes used for regular flights, but due to their growing numbers and flying at relatively low altitudes, it is becoming a serious acoustic problem.

The growing number of service and commercial buildings (supermarkets, petrol stations, activities related to entertainment, crafts, home employment, repair shops, etc.) in the recent years has contributed to noise nuisance. More and more of such activities are located near protected (housing) development. In this situation, even relatively low levels of noise emitted from a source may cause great nuisance for local residents. The growth in acoustic nuisance in the vicinity of residential buildings is related to the development of technology, for example, many offices and shops have air conditioning, which cause deterioration of the noise condition near them.

Noise maps, developed in accordance with the requirements of Noise Directive relating to the assessment and management of environmental noise on the basis of long term indexes L_{den} and L_n are the source of additional information on the noise conditions of the environment. Noise maps, showing the current state of the acoustic climate and the population exposed to noise, present indirectly the pressure of particular kinds of noise sources. Starting from 2007, noise maps have been developed in accordance with the provisions for:

- agglomerations with population of 250 000 (12 cities accounting for ca. 30% of population in Poland),
- sections of major roads, where more than 6 million cars travel per year (ca. 1500 km of roads in Poland),
- sections of major railways, where more 60 000 trains travel per year,
- airports with over 50 000 air operations per year.

Due to the very limited scope of the examination of rail noise (ca. 17 km of sections of railways), the obtained results are of almost no significance for national estimates.

The results of studies of air noise in Warsaw – the Frederic Chopin Airport, as the only major airport in Poland, are of high importance for those living in the vicinity.

For the total population of the 12 examined agglomerations, the average share of people exposed to excessive noise amounts:

- according to the assessments performed on the basis of indicator L_{den} – ca. 36%,
- according to the assessments performed on the basis of indicator L_n – ca. 38%.

The greatest number of population living in conditions of exceedance of the noise limits takes place in Warsaw, then come Bydgoszcz, Gdynia, and Lublin. On the other hand, the best acoustic conditions, in the light of the results of noise mapping, exist in Łódź, Poznań and Kraków[3] (Fig. 82.).

The non-urban population exposed to excessive road noise along the most used transport routes is presented in the following diagrams (Fig. 83., Fig. 84.).

The level of risk of excessive noise is in this case much lower (in comparison to agglomerations) and reaches the number of less than 500 000 population. It should, however, be taken into account that the studies covered less than 5 % of national and voivodship roads and possibly others causing high nuisance, thus the represented sample reflected only a fraction of the phenomenon.

The results of the development of noise maps in the EU countries (including Norway), developed obligatorily, in compliance with the regulations of Noise Directive, have been submitted to the European Commission. A qualitative analysis of the obtain information reveals that, according to average national data, Poland does not belong to countries with significant noise exposure. The shares of population at risk of noise in Poland against the EU average are illustrated in the two diagrams below (Fig. 85., Fig. 86.).

Reduction of the exposure caused by noise is mostly related to the noise sources. In that scope, significant achievements have been recorded, especially in relation to silencing road and rail vehicles, the application of modern road surfaces and rails, the introduction to exploitation of a modern generation of transport aircraft of reduced noise generation, the introduction to the market of new industrial devices and installations with reduced level of acoustic power, including additional noise reducing solutions (sound suppressors, casings etc.). The above-mentioned technical actions of a basic character are necessary for long-term activity related to limitation of environmental noise. They are not, however, sufficient at present, due to the large number of exploited noise sources, which is growing fast.

The spatial scale of the phenomenon of degradation of the acoustic environment by means of transport in particular road transport, requires the application of efficient solutions and consistent actions. The directions of those actions and the methods of proceeding are mainly determined by Noise Directive. The risk of traffic noise is actually so significant in all EU countries that it has become necessary to establish long-term programmes of protection actions. There is no country with financial ability to quickly bring the parameters of the acoustic climate to the limit values. At present, the centre of gravity of fighting noise has been moved from *ad hoc* actions to implementation of noise protection programmes, which must list the proposed protection actions.

Beside the above-mentioned long-term programme actions, there are applied, as far as possible (mostly within modernisation and rebuilding of transport routes) *ad hoc* actions, such as:

– building ring-roads[4],
– limitations in traffic and other actions related to traffic engineering (setting speed limitations have been the most frequent measures recently),
– building acoustic screens,
– application of increased insulation of windows,
– application of silent surfaces (that is, unfortunately, marginal action in Poland, but with a prospect of development).

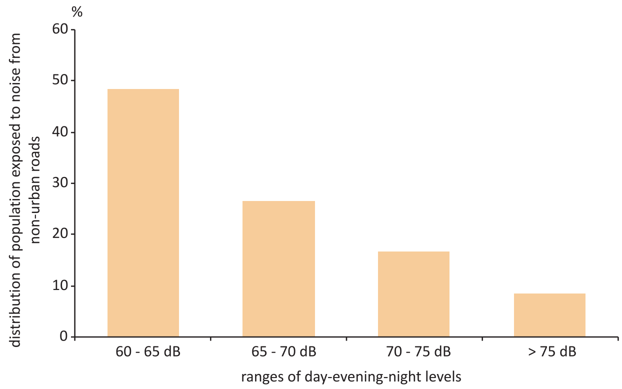


Fig. 83. Distribution of population exposed to noise from non-urban roads, assessed with L_{den} > 60 dB (100% corresponds to 230 000 population exposed at all examined sections of roads altogether) (source: CIEP/SEM)

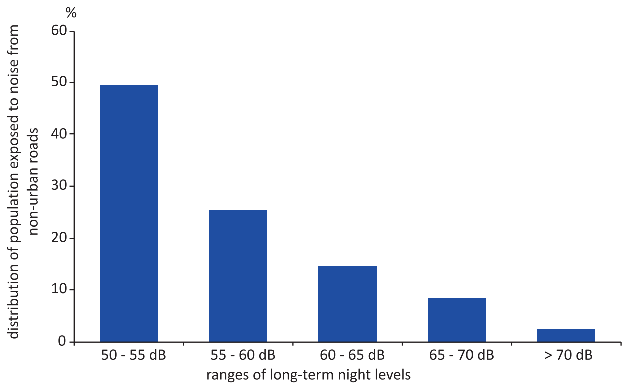


Fig. 84. Distribution of population exposed to noise from non-urban roads, assessed with L_n > 50 dB (100% corresponds to 440 000 population exposed at all examined sections of roads altogether) (source: CIEP/SEM)

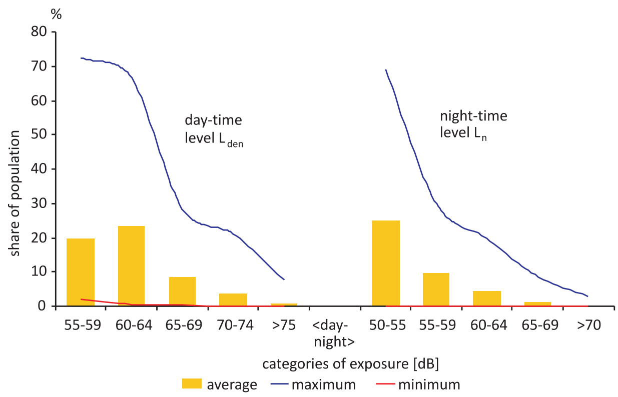


Fig. 85. Percentage distribution of exposure to road traffic noise of EU residents in agglomerations with population of over 250 000 (source: EEA)

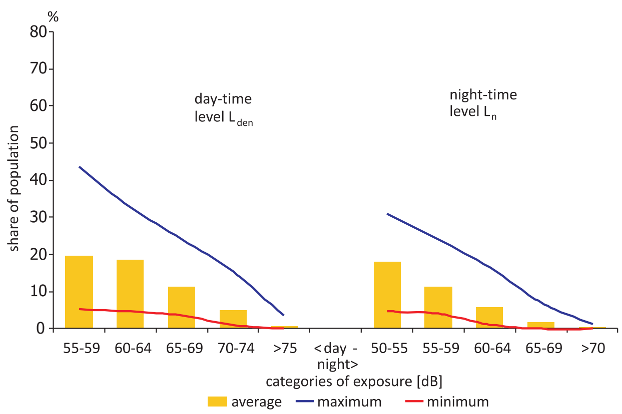


Fig. 86. Distribution of exposure to road traffic noise of Polish residents in agglomerations with population of over 250,000 (source: EEA)

Counteractions in the scope of industrial noise are mainly related to the introduction of a modern machine park and modernisation of old, annoying industrial sites.

In local land use plans, the provisions considering protection against noise must be taken into account, with indication of areas of limited development around airports, industrial areas and major roads and main railways, where the equivalent noise level amounting to 55 dB in the night-time is exceeded.

[1] Regulation of the Minister of the Environment of 14 June 2007 on permitted environmental noise levels.

[2] It is not a full 5-year comparative period, but some trends can be clearly recorded.

[3] It is an interesting phenomenon, since the group also includes three largest Polish agglomerations beside Warsaw.

[4] Construction of a ring-road is not undertaken as an anti-noise measure in most cases, yet it has a significant impact on noise reduction.

Trends in environmental noise in Poland indicate, on the one hand, an increase in the risk of traffic noise and, on the other hand, a reduction of the growth and existence of downwards trends with respect to industrial noise.

The upwards trends in traffic noise are most of all true for road- and air traffic noise. The growth in the risk of road traffic noise is related above all to the rapid increase in the number of cars in Poland over the last 15 years. Despite the already recorded tendency to approach the level of saturation, the growth is still significant. In the case of air traffic noise, there are recorded growing trends in the level of noise due to taking over some of international traffic by local, intensely extended airports. Furthermore, there is observed an increased in the number of national connections from airlines operating small aeroplanes, the "air taxis", helicopters, etc. In the case of industrial noise, the past actions seem right and there seems to be a chance for gradual elimination of that type of nuisance.

CLIMATE CHANGES

CLIMATE CHANGES

Recent decades saw marked changes in the global and European climate. They manifest themselves as the rising sea level and temperatures, changes of precipitation regime, as well as intensity and frequency of extreme weather phenomena. Due to their multidimensional and complex nature, as well as currently observed and future consequences for the environment, human health and economies, climate changes are considered to be one of the major threats and challenges faced by humankind. Over the next decades these changes can contribute among others to the reduction of water resources, increase in the frequency and intensity of floods, melting of icebergs, erosion of soils, as well as intensification of such extreme phenomena as whirlwinds, hailstorms or frost and heat waves.

Climate system warming is visible in the growth of average European and global air temperature and ocean temperature (Fig. 87., 88.), ubiquitous melting of snow and ice, as well as rising of the global mean sea level. The global (land and ocean) average temperature increase between 1850 and 2010 was 0.81 °C[1] comparing to average from the period 1895-1899. The last decade (2001-2010) was the warmest in that period. It has been observed that inland areas get warmer faster than oceans, and the increase in temperature is higher at high latitudes of the northern hemisphere. Global sea level was increasing from 1961 onwards at an average rate of 1.8 mm annually, and 3.1 mm from 1993 as a result of thermal expansion, melting of icebergs and polar continental glaciers. Global warming also results in shrinking occurrence of snow and ice - satellite data show that average annual occurrence of sea ice in the Arctic decreased by 2.7 % from 1978 over a decade, with a stronger fall in the summer period, ca. 7.4 % per decade. Changes of other climatic elements are also visible, e.g. size and distribution of precipitation in Eastern North and South America or Northern Europe, length and intensity of heat or frost waves, or tropical cyclones in the North Atlantic.

Europe has warmed more than the global average. The average temperature for the European land area for the last decade (2001-2010) was 1.2 °C above the 1850-1899 average, and for the combined land and ocean area 1.0 °C above. Considering the land area, 8 out of the last 13 years were among the warmest years since 1850 (Fig. 88).

An increase in temperature has also been visible in Poland. Growing trend of the average annual temperature is both visible at meteorological stations located in the suburbs, as well as at ones located in areas with limited anthropogenic impact, e.g. Śnieżka mountain, where the increase was 0.6 °C/100 years. Similar increase in average annual temperature was recorded at stations situated at the Baltic Sea, which have long measurement series (Gdańsk-Wrzeszcz, Hel and Koszalin), as well as at Warsaw Okęcie station (Fig. 89.). Comparison of the mean annual temperature for the whole area of Poland in the period 1991-2000 with reference to 1961-1990 (WMO reference period) showed that the last decade of the 20th century was 0.6 °C warmer, and the largest increase in temperature occurred in winter months: 1.9 °C in January and 1.5 °C in February. In December temperature values were identical in comparable periods, but lower in October and November by 0.2 °C and 0.7 °C respectively. A similar tendency - bigger increase in temperature in winter than in summer - has been observed across Europe.

The IPPC Fourth Assessment Report states with high confidence that starting from 1750, human activity, apart from natural factors, has been and is the main reason behind the current and possible future changes in climate. The primary source of the changes is fossil fuel use, which results in the emission of carbon to the atmosphere. Other factors

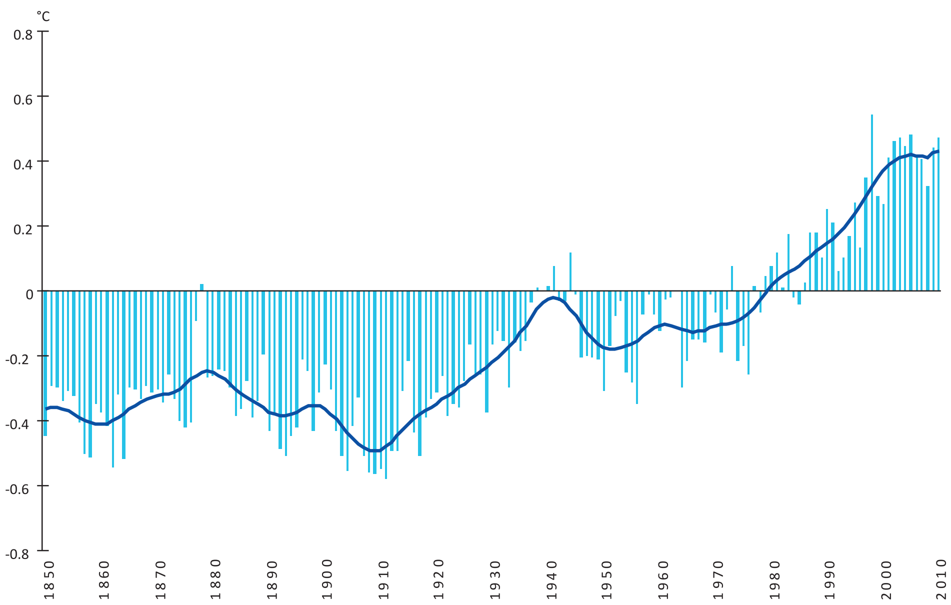


Fig. 87. Changes of average global annual temperature in 1850-2010 presented as mean deviation from 1961-1990 (source: Climatic Research Unit)

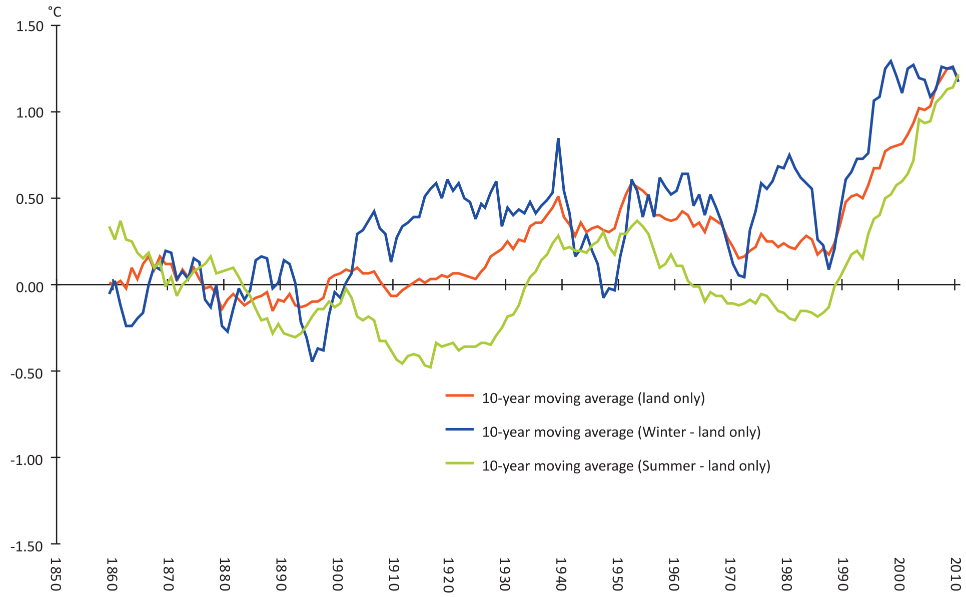


Fig. 88. Changes of average seasonal European (inland) temperature in 1850-2010 presented as mean deviation from 1850-1899 (source: EEA)

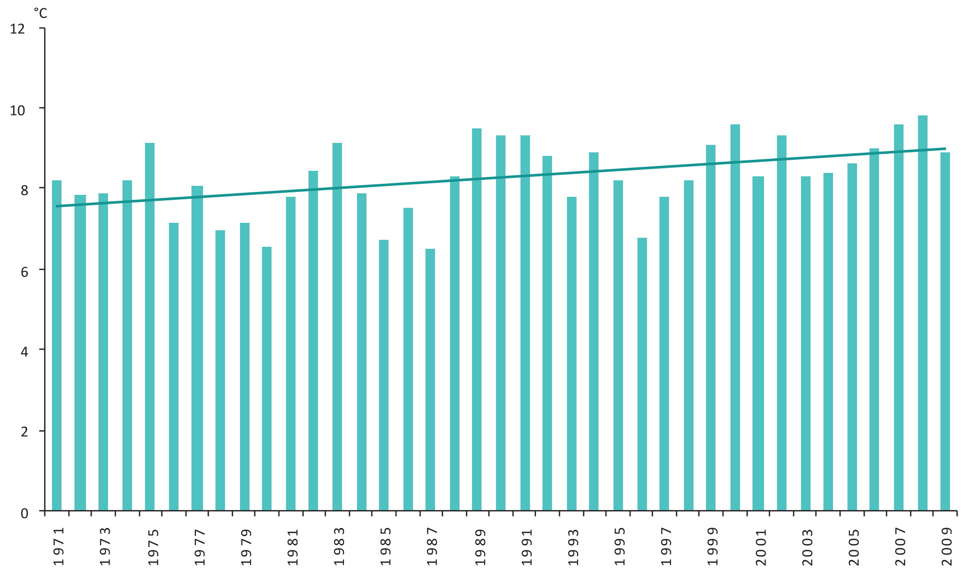


Fig. 89. Average annual air temperature at Warsaw Okęcie station in 1971-2009 (source: Institute of Meteorology and Water Management IMGW)

adversely affecting the climate include changes in the form of land use, agricultural activities and deforestation. The measurements of global greenhouse gas concentrations in the atmosphere reveal that they have grown significantly since the pre-industrial era, with carbon dioxide concentrations markedly exceeding their natural ranges from the last 650 000 years. The CO_2 atmospheric concentration had increased from ca. 280 ppm in the pre-industrial era to over 387 ppm in 2009.

Changes in the atmospheric concentration of greenhouse gases and aerosols, inland flora cover and solar radiation result in changes in energy balance of the climate system. It needs pointing out here, that bigger concentrations of greenhouse gases in the atmosphere lead to the warming of Earth surface, while greater concentrations of aerosols result in its cooling. It is estimated that as a result of human economic activity from the pre-industrial era warming amounted on average to + 1.6 W/m^2, while at the same time changes in solar activity caused a small radiative forcing[2] on average amounting to +0.12 W/m^2.

According to the best current projections, average global temperature may increase by as much as 1.8-4.0 °C or 1.1-6.4 °C over this century, if global measures aimed at reducing greenhouse gas emissions prove to be ineffective.

Climate change will result in increased frequency and intensity of extreme weather phenomena, such as heavy storms, droughts and heat waves. Europe already experiences an increased number and intensity of such phenomena. There are reasons to believe that they are the consequence of climate changes.

Heavy storms are among the threats generating the highest costs in the recent decade. Such storms are characterised by high volatility, exhibiting no clear trend since the beginning of the 1950s. Increasing costs result mainly from social and economic factors, as well as a greater exposure (e.g. a higher number of people living in the areas exposed to storms). Some scientific publications suggest that intensity of storms in terms of maximum wind speed has increased in recent years, while others point to the decreased frequency of low pressure systems starting from the 1950s. Although scientific reports do not reveal an explicit link between climate changes and occurrence of violent storms over the last 60 years, some climate models project that storm intensity will grow until the end of this century and that they will move from middle to higher geographical latitudes. Violent storms caused the death of 729 people in Europe in the years 1998-2009. Hurricane Kyrill, which formed in January 2007, was particularly strong and caused widespread damage.

Phenomena involving extreme temperatures cause the highest risk for human life and health. Days with extremely high temperatures occur more often on the European continent, while days with extremely low temperatures became less frequent. From mid 20th century, the average duration of heat waves in Western Europe doubled and the frequency of days with high temperature tripled. According to projections, such phenomena will be more frequent, longer and more intensive in the next decades (Fig. 89.).For example, some climate change scenarios predict that by the end of this century the number of hot days in the Central Europe will be the same as in Sicily or Spain now. According to WHO estimations, mortality increases by approx. 1-4 % with a 1 °C increase in temperature above thresholds specific for a given location. Risk groups comprise the elderly, children and people from poor social groups. Heat waves in 2003 had tragic consequences, with fatalities amounting to ca. 70 000 in 12 countries of Western and Central Europe.

The anticipated increased frequency of the occurrence of high pressure conditions and related high air temperatures, with simultaneous increase in insolation and air pollution, will contribute to deterioration of air quality, among others by increasing concentration of ozone in the lower atmosphere. It is estimated that the temperature upwards trend in Central Europe is responsible for the occurrence of the average of eight additional days per year, on which the maximum permissible level of concentration of ozone in the lower troposphere (120 $\mu g/m^3$) is exceeded, which accounts for 17 % of the total number of days above the target value in that region.

Vast parts of Europe already experience water deficit and droughts. Climate changes will intensify those phenomena, not only in the south of Europe. They can result in significant changes to annual and seasonal availability of water in Europe. Water availability will increase in the northern part of the continent, although summer river flows may be reduced. Southern and south-eastern regions will be at a particular risk of decline in water availability and increased intensity and frequency of droughts as a result of decreased precipitation and increased evaporation. The phenomena will significantly affect agriculture and may increase demand for water in numerous regions. Agro-climatic zones will

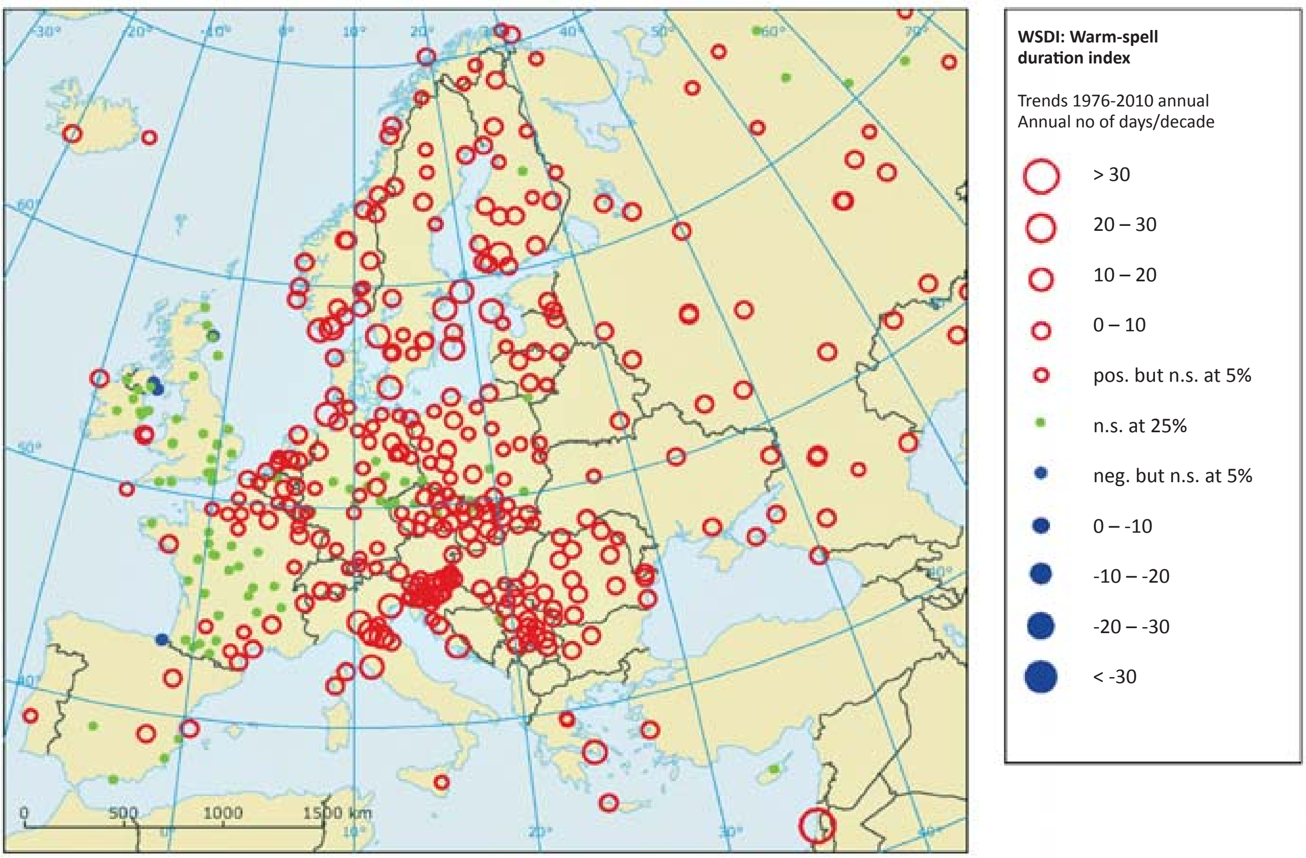


Fig. 90. Observed changes in warm spells indices 1976-2010 (in days per decade). Warm spell duration index is defined as a period (number of days) of six consecutive days with the mean daily temperature exceeding 90th percentile of the baseline temperature (average daily temperature the 1961-1990 period). Stations with negative trends are blue and stations with positive trends are in red colour. When stations are in green colour trends are not statistically significant (source: EEA following Royal Netherlands Meteorological Institute (KNMI) http://eca.knmi.nl/ensembles)

most likely move north. Climate change will increase the demand for water on the part of households and the tourist sector. Droughts and deficits will also significantly affect ecosystems. The anticipated impact of climate change in Poland may manifest itself mainly by changes of the water balance, in particular increased discharge, increased evaporation, deterioration of the quality of inland waters and increase of the frequency of occurring of extreme hydrological events (droughts and floods).

The changing climatic conditions, in particular more moderate winters, influence migration of many species of plants towards the North and uphill. The scope of changes of climatic conditions may exceed the adaptation ability of species, particularly in view of the growing fragmentation of landscapes, which may be an obstacle in migration. There have already been recorded changes of the dates of phenological patterns of appearance due to earlier spring and summer by the average of 2.5 days per decade in the period of 1971-2000.

The upwards tendency of the temperature of sea surface is especially noticeable in the Baltic and North Seas, where the increase reached 0.06-0.07 °C/year and their further warming is expected. The changes may affect biodiversity of the maritime ecosystems and fishery. Subtropical species appear more and more frequently in European waters, while subarctic species move to the north. For instance, the significant increase in the volume of phytoplankton biomass and the extension of its vegetation period are indicators of the changes occurring in the maritime environment.

In the fresh water environments, along with the changes of thermal conditions, the period with ice cover will shorten, as well as there will be taking place changes in life cycles of living organisms, such as earlier blooming of phytoplankton, the emergence of the clear water phase (since the greatest zooplankton emerges later), the first day of flight of water insects or advancing of the spawning period of fish. Already now there is recorded earlier blooming of phytoplankton and zooplankton in European lakes, which starts a month earlier than 30-40 years ago.

Changing climatic conditions may have many different impacts on European and also Polish agriculture. Some of the positive effects of the expected climate change are prolonged vegetation period and the possibility of introduction of new varieties and species of crops. The negative consequences comprise limited accessibility of water, thermal stress for plants and livestock caused by heat waves, significant variability in yields of crops related to the effects of extreme events, change of the occurrence range of new pests and diseases requiring increased use of pesticides.

Climate changes will also affect spatial distribution of forests. The changing climatic conditions will be more favourable for some species and less favourable for others, which will cause changes in the spatial distribution of vegetation. Changes in the spatial and seasonal distribution will in turn influence the living conditions of pests and pollen carriers, which will shape the future form of forest ecosystems. Prolonged dry periods and warmer winters may increase the numbers of pests leading to further weakening of the forests. Higher temperatures in the summer period may cause increased fire threat.

The expected climate changes will have a negative impact on many systems and sectors. That is why countries cooperate on an international level to limit the emissions of GHG by working out a United Nations Framework Convention on Climate Changes and its Kyoto Protocol (UNFCCC). Global response to climate changes stimulates the implementation of new policies, development of an international carbon market and establishment of new institutional mechanisms that support future activities aimed at prevention of climate changes.

Poland ratified the United Nations Framework Convention on Climate Change in 1994, and Kyoto Protocol to the Convention in 2002, obliging itself to reduce GHG emissions (CO_2, CH_4 and N_2O) over 2008-2012 by 6 % vis-à-vis emissions in 1988 base year. Poland adopted 1995 as base year for fluorinated industrial gases. The size of emission reductions vis-à-vis the base year differs depending on the country and ranges from 8 % for EU, 7 % for USA, 6 % for Japan, Canada, Hungary and Poland. Russian Federation and Ukraine have a possibility to stabilize emissions at the level of the base year, while Norway, Australia and Iceland have the possibility to increase emissions by 1 %, 8 % and 10 % respectively. Countries can ensure reduction individually or jointly (like for example the European Union 15).

The European Community has used the opportunity of joint reduction. 15 Member States that constituted the Community back then (EU-15) jointly obliged themselves to reduce GHG by 8 % between 1990 and the annual average of 2008-2012. However, the responsibility of individual Member States varies from 28 % reduction for Luxembourg to 27 % increase for Portugal. Decision on this matter was agreed and adopted in 2002 in the process of the so called burden sharing, under decision of the European Council 2002/358/EC of 25 April 2002 concerning the approval, on behalf of the European Community, of the Kyoto Protocol to the UNFCCC and the joint fulfilment commitments thereunder.

It needs pointing out that commitments concerning emission reductions apply exclusively to industrialized countries and countries with economy in transformation (this category included among others Poland due to the ongoing systemic and economic changes). Developing countries did not adopt any commitments under the Convention referring to the principle of no historic responsibility for the existing anthropogenic GHG emissions and to the right to sovereign socio-economic development, necessary to improve welfare in those countries.

Total GHG emissions in UE, without Land Use, Land-Use Change and Forestry (LULUCF), decreased by 17.4 % between 1990 and 2009 (974 million tones CO2-equivalents). Significant decrease in emission (7.1 %) was observed between 2008 and 2009, mainly due to economic crisis and decreased production activities. The EU GHG emission trend is dominated by the two largest emitters, Germany and the United Kingdom, together accounting for about one third of total EU GHG emissions.

Poland is fifth largest GHG emitter in the EU with 8 % share in total EU GHG emissions in 2009. Poland decreased GHG emissions by almost 16.8 % between 1990 and 2009 (and by 33.2 % since its base year of 1988). In 1988-1990

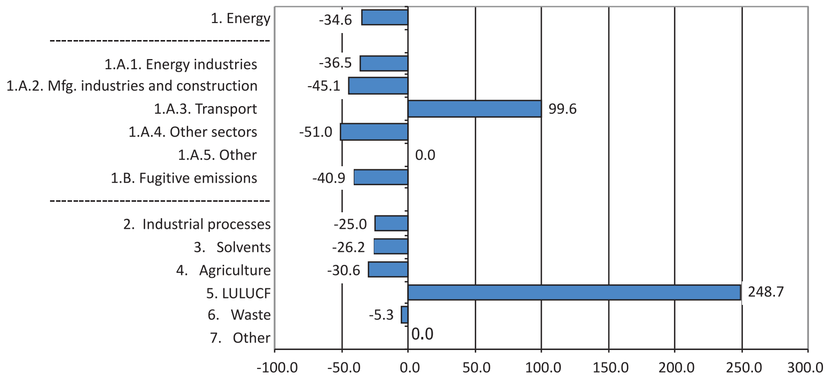


Fig. 91. Changes of GHG emissions in Poland between 1988 and 2009 (UNFCCC)

there was a major fall in the emissions and it was related to system- and economic changes, which resulted in the breakdown of many energy-intensive and emission-intensive industry branches. However, it needs pointing out that in spite of dynamic economic growth during the last 20 years the level of greenhouse gas emissions remained on a stable level of ca. 30% below the level from 1988. It was possible as a result of large-scale implementation of modern technologies in the industry and introduction of many instruments, including legal ones, which promote low emission and energy saving solutions The main greenhouse gas released in Poland is CO_2 (82% of emissions).

The majority of CO_2 stems from burning of fuels, both in stationary sources (e.g. power plants, combined heat and power generating plants), as well as mobile ones (transportation). When analysing GHG emissions data for Poland two-time increase of emission from transport, mainly from road transport, is drawing attention (Fig. 91.).

The main activities that support the efforts of countries aimed at reducing GHG emissions include primarily improved energy efficiency of the economy, promoting and implementing technologies that use renewable energy sources and capture carbon dioxide, activities aimed at limiting transport emissions, as well as promoting sustainable forms of waste management, agriculture and forestry. A governmental document that forms national environmental policy, including climate protection activities, is the national environmental policy for 2009-2012 and its 2016 outlook, adopted by the Sejm (lower chamber of the Parliament) on 22 May 2009. This document outlines the objectives, challenges and directions of actions, as well as the most important priorities of the Polish environmental policy for the next 4-8 years, including the national reduction target under the Kyoto Protocol.

A decisive element of the Polish energy policy until 2030, adopted by the Council of Ministers on 10 November 2009, that determines the limitation of emissions involves launching highly efficient technologies for energy generation and transfer, including the modernization of current technologies. A very important element of the GHG reduction strategy involves stimulating an increased use of renewable energy sources in the energy industry. Another important element of the energy policy involves increasing energy effectiveness of the economy, realized among other by the implementation of Directive 2006/32/EC of the European Parliament and of the Council of 5 April 2006 on energy end-use efficiency and energy services and repealing Council directive 93/76/EEC (Text with EEA relevance) as well as diversification of energy production structure through implementation of nuclear energy.

Other policies and activities carried out domestically in order to limit GHG emissions involve among others:

- in transport - promotion and use of biofuels and promotion of "ecologically friendly" vehicles;
- in construction - extending and modifying technical and construction provisions pertaining to the thermal protection of buildings in terms of permeation of heat through external partitions, performance of heating-, ventilation and air conditioning installations, as well as preparation of warm drinking water;
- in agriculture - rationalization of the use of fertilizers, including nitrogen ones (a system of fertilizer consultancy has been introduced to help determine precise fertilizer doses), rationalization of energy management, including production of energy from biomass waste or pig slurry, dissemination of small dispersed sources of electrical energy;
- in waste management - the national waste management plan until 2014 promotes activities aimed at preventing and minimising the generation of waste, ensuring their recovery (recycling), disposal and landfill which is safe for human health and the environment.

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1 According to methodology of Met Office Hadley Centre and East England University – Climate Research Unit.

2 Radiative forcing is a change of radiation balance in the atmosphere, related to distortion of the climatic system, expressed in W/m^2. The distortion can be caused by both natural, as well as anthropogenic factors, e.g. emission of greenhouse gases as a result of human activity.

3 Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community (Text with EEA relevance).

Due to a global character of the phenomenon, measures aimed at preventing climate changes can bring effects only as a result of joint activities of the whole international community. That is why counteracting climate changes is one of the priorities of the EU policy. EU Member States carry out versatile activities aimed at reducing GHG emissions, including ones aimed at integrating climate-, air protection- and energy policy through the implementation of an energy and climate package. As a member of the European Union Poland participates in the implementation of a whole range of these measures, and counteracting climate changes is one of the most important objectives of Polish environmental policy. In 1988-2009 Poland managed to reduce GHG emissions by ca. 33 %, which is much above the 6 % reduction level required under the Kyoto Protocol. This will allow to meet and exceed the national reduction target set forth under the Protocol within the required deadline until the end of 2012. At the same time, as the effects of climate changes are irreversible, it will be necessary for the international community, including Poland, to undertake adaptation measures in the years to come.

In March 2007 the European Council - when defining the measures that should be undertaken to reduce GHG after 2012 - adopted the assumptions to the so called climate and energy package, including assumption on the joint emission reduction by 20 % until 2020 vis-à-vis 1990. Final package was adopted in December 2008. At the same time, in its standing the European Commission declared that it is ready to increase the joint reduction target until 2020 to 30 %, on condition that comparable commitments are undertaken by the remaining developed countries and provided that the most advanced developing countries (China, India, Brazil, Republic of South Africa, Korean Republic, Indonesia, Mexico) declare a 15-30 % limitation of emissions vis-à-vis the currently foretasted emissions.

The principles for implementation of the aforementioned EU reduction obligation were outlined in the EU ETS3 directive and in the decision of the European Parliament and Council No 2009/406/EC of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020 (non-ETS decision). In order to implement the Community commitment pertaining to GHG emission reduction by at least 20% below the levels from 1990 in a cost-effective way, one should reduce the amount of emission allowances granted to those installations by 21 % below their emission levels in 2005.

STATE ENVIRONMENTAL MONITORING AS AN BASIC SOURCE OF ENVIRONMENTAL INFORMATION

STATE ENVIRONMENTAL MONITORING AS AN BASIC SOURCE OF ENVIRONMENTAL INFORMATION

Information on the state of environment is of vital significance both for the economy (management of natural resources and space) and for the social life (care for the quality of life and for health). The state environment monitoring (SEM) - an institutionalized system of management of data on environment state in Poland, coordinated and implemented by the services of the Inspection for Environmental Protection - is a major source of reliable data in this respect. The state environmental monitoring was established pursuant to the Law of 20 July 1991 on the Inspection for Environmental Protection in order to provide reliable information of the state of environment. Ten years later, the Environmental Protection Law of 27 April 2001 defined SEM as a system covering not only the environment state diagnosis but also the outlooks of this state, additionally reinforcing the position of SEM thereby, and imposed an obligation to collect, process and disseminate information on the environment systematically.

SEM is implemented based on multiannual programmes of state environment monitoring developed by Chief Inspector for Environmental Protection (CIEP) and approved by the Minister of the Environment, and on the Voivodship environment monitoring programmes developed by Voivodship Inspectors and approved by CIEP.

Taking into account the nature of collected and processed data the SEM tasks are carried out as a system of interconnected blocks. SEM comprises 3 blocks: pressures block, state block, assessments and outlooks block – their arrangement allows generating comprehensive environmental information on the values of relevance for the customers, i.e. for the policy-makers at different management levels who formulate environmental protection policy, and for the public. Within the pressures block information on sources and loads of substances and energy discharged into the environment are acquired and collected. Within the state block, information on the levels of substances and other indicators identifying the condition of nature elements is processed. Information on the state and pressures is fed into the assessments and outlooks block where integrated analyses which associate the existing environment state and its determinants, i.e. the social and economic activities of humans.

It should be stressed that the SEM mainly implements the tasks which result from the obligation to fulfil environmental protection conventions signed and ratified by Poland, and helps carry out the growing responsibilities in respect of reporting on the state of particular environment elements to the EU institutions and agencies (the European Commission and the European Environment Agency).

The SEM system is fed with data from different sources, in particular from the systems monitoring of the quality of nature elements and environmental impacts. The measurements are carried out periodically using standard methods for data collecting and processing – in many cases determined in the legislation. The majority of data are acquired directly by the voivodship inspectorates which investigate air quality, chemical composition of precipitations, surface water quality, measurements of noise and electromagnetic fields, and optionally the quality of groundwater and soil. As far as the tasks implemented only at the national level are concerned (such as nature monitoring) the checks are also carried out by the scientific and research institutes and

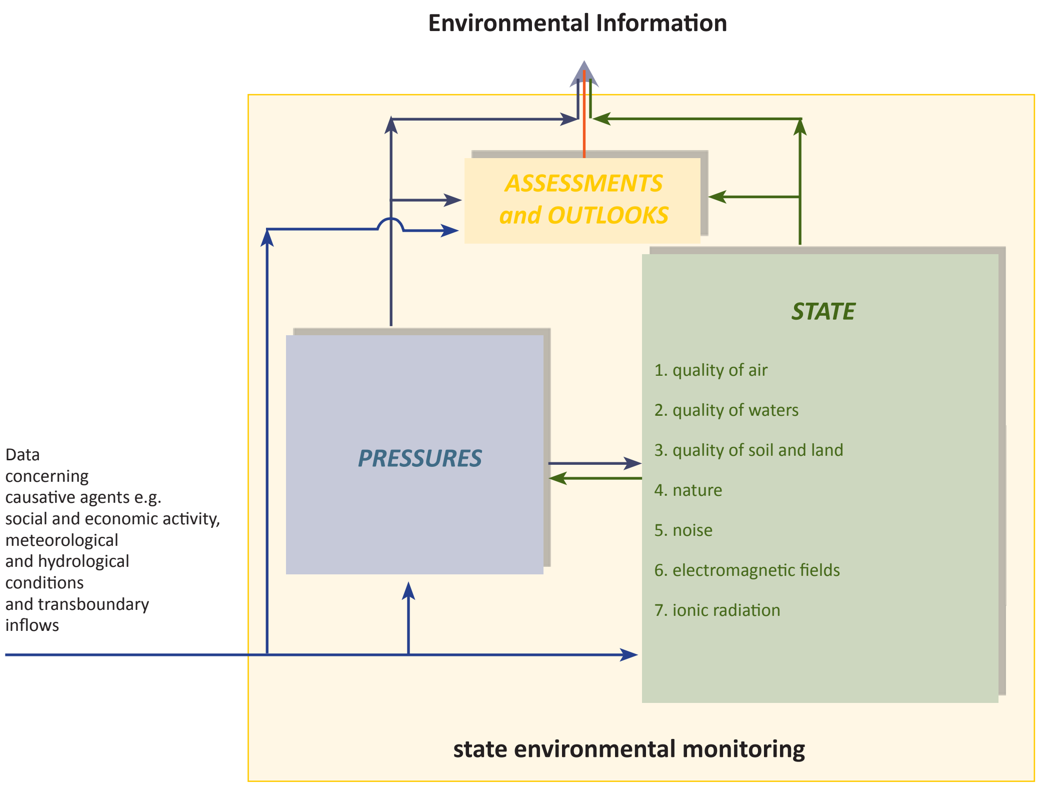

Fig. 92. Structure of state environmental monitoring

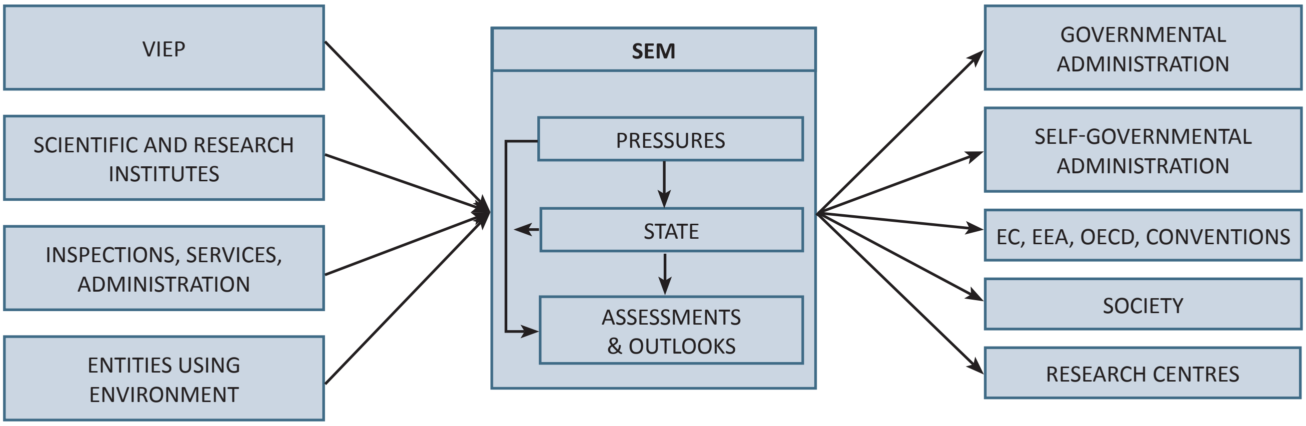

Fig. 93. State environmental monitoring – data and information sources and their use

universities whose activities in this area are coordinated by CIEP. The data are also acquired by a number of other entities which are required to carry out such monitoring by law.

In order to ensure high quality of data obtained the activities are carried out to ensure quality systems implementation within the monitoring subsystems, accreditation of research and measurement laboratories as well as the modernisation of the measuring infrastructure. The data reliability is a prerequisite for SEM to achieve the objectives imposed by law.

SEM system is also fed with data collected within the framework of official statistics which are still a significant source of information of the environmental pressures, though the administration system under development are becoming more and more important. Information is also provided for SEM by the entities using the environment which have to carry out monitoring of the environment state and to determine the type and level of emissions pursuant to the legislation or administrative decisions.

The in-situ measurements are complemented with the computing techniques and mathematical models. On the basis of atmospheric emission data some VIEPs calculate the spatial distribution of immission fields within an agglomeration or voivodship area. The satellite imaging is also an important source of data, in particular for land surface monitoring. It may be exemplified by the European project Corine Land Cover for a database concerning land cover in Europe. The use of satellite technologies for environmental monitoring is expected to expand, in particular on the account of EU GMES programme (Global Monitoring for Environment and Security).

Data and information delivered as a result of SEM research-measurement programmes implementation and collected in the thematic databases require adequate processing in order to obtain clear information adjusted for the needs of two major groups of users: policy-makers and society. The way the data and information are processed and the final processing products depend on the purpose they are to be used for. First of all, analyses and assessments of the environmental elements state are made based on the existing immission standards and classification systems imposed by law or developed by the scientific and research units, taking into account the pressures; also the areas with exceeded standards are determined. Additionally, analyses and assessments of specific problems and effects in the environment and the forecast of their consequences are made mainly based on the trend analysis. There also analyses and assessments of relationships between environmental processes and the socio-economic development of the country. A commonly used assessment system is based on D-P-S-I-R model (Driving Forces – Presures – State – Impact – Response) which helps identify the causes of the existing state and remedies to be applied.

The use of GIS is of significance for the method of data collection and management. Information delivered by the Inspection for Environmental Protection will be gradually adjusted to the requirements of Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE).

SEM provides information to be used at different levels of administration for strategic management based on environmental protection plans and programmes for which information on the trends in environmental changes are needed. The administration bodies provided for by the law have to draw up plans in terms of the general protection of environment or of its elements, such as air or acoustic climate, for the areas where the immission standards are exceeded as determined under the SEM assessment procedure. Data collected within the framework of river basin monitoring are used for development of water management plans in the river basins. SEM unit records are used for the operational environment management supported with the instruments such as environmental impact assessments and permits for release of substances and energy into the environment.

Since the SEM analyses and assessments provide an independent and unbiased source of information on the state of environment, they are used for monitoring of the efficiency of environmental protection plans and actions, including the State environmental policy. They are also used for efficiency assessment of structural and cohesion funds allocation. SEM information is also an important element of the national official statistics. Moreover, they are used by Poland to negotiate EU proposals for new legal regulations concerning environmental protection.

SEM information is also used at the European and global level to improve new legal and economic instruments to be applied for sustainable environmental management. Pursuant to the EU legislation and international agreements the majority of data on the state of environment are delivered to the competent bodies, such as the European Commission, EEA, OECD and convention competent bodies. Thus, they contribute to a supranational system of environmental state assessment and are used to draw up global analyses and reports (such as EEA Reports “The European Environment. State and Outlook”, reports prepared under the UN ECE process “Environment for Europe”).

The results of SEM assessments and outlooks provide a basis for the reports on the state of environment in Poland at the national and voivodship level drawn up by the Inspection for Environmental Protection. Information on the state of environment may also take the form of thematic, feature, indicators reports and communications. The studies and reports use indicators elaborated by the international institutions, such as the European Environment Agency. The results of work are also disseminated on the internet sites of Inspection bodies, which provide more and more often access to interactive tools for data review and compilation. For example, the air pollution level data that are made accessible on-line by the voivodship inspectorates are generated by an automatic air monitoring system in near-real time.

The society is also an important recipient of SEM information available in the processed data form (reports) through the teleinformatics networks; also data compilations are delivered at the individual request pursuant to general rules established in the Act of 3 October 2008 on sharing information about the environment and its protection, public participation in environmental protection and environmental impact assessment.

SUMMARY

SUMMARY

Poland is in the group of highest developed countries. The main sources of threats to its environment are: the industry, in particular energy, municipal economy and transport. Both the degree and type of threats differ significantly depending on the location. The biggest pressure is observed in the area of big agglomerations. At the same time, due to its geographical location, the country is characterized by exceptionally rich nature and landscape. The fact that Poland is a natural habitat of rare animal and plant species in the scale of the continent, makes it particularly responsible for the protection of natural heritage.

Although significant progress has been made in reducing the pressure on the environment in the recent 20 years, the social and economic development of Poland still takes place at the expense of the resources and quality of the environment. Investments in the industry and stricter requirements for operators using the environment allowed to reduce or stabilize emissions from the sector and to improve the indicators of the use of various resources. Due to its nature the Polish economy remains one of the most material- and energy-consuming economies of the European Union. However, one may assume that the costs and benefits analysis will dictate the necessity to implement eco-innovations and savings related to raw materials and energy.

The pressure from the municipal sector remains a challenge, which is difficult to handle due to the lack of appropriate environmental policy instruments. Further improvement of living conditions will entail an increase in individual consumption and thus in adverse impact on the environment. Therefore, measures aimed at promoting environmentally friendly attitudes among consumers must be enhanced.

The impact of transport on the environment and the quality of life is growing. The increasing number of vehicles adversely affects the acoustic climate of urban areas and air quality. Rising greenhouse gas emissions from transport are another cause of concern.

The Polish agriculture remains fragmented with moderate use of mineral fertilizers and plant protection products. The growth of economic effectiveness and productivity of agriculture may result in the reduction of biodiversity of agricultural landscape and an increased pressure on aquatic and soil environment.

All sectors of the economy must fully implement the principles of sustainable development and improve their eco-effectiveness in order to limit the use of resources and reduce emissions of various substances and energy to the environment.

A lot has been done to protect the quality of air in Poland in recent years, many instruments were introduced to reduce the emissions of pollutants to air (modernizations, improvement of fuel quality, inspection activities), which in 1990's and at the beginning of 2000 bore fruit in the form of reduced emissions of the basic pollutants to air (in particular sulphur dioxide and nitrogen oxides). It is also visible in the reduced deposits of some pollutants (sulphates) in the ground. Gradual reduction of emissions of acid pollutants to the atmosphere resulted in a falling trend in terms of acidity of precipitation expressed with a higher pH of precipitation.

In spite of systematic improvement of the air quality in Poland, the concentration of tropospheric ozone in the summer season and over-normative concentrations of PM10 and benzo(a)pyrene in the winter season remain a serious problem. An important factor related to exceeded ash norms involves the so called low emission from individual heating of buildings, which remains unregulated, as well as obsolete transport.

Taking into account the current state of air pollution in Poland and the necessity to meet air quality standards established by Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe and the limits of emissions of certain pollutants into the air from large combustion plants, Poland is facing the task of implementation of many measures aimed at ambient air quality improvement. It is particularly important to ensure cohesion of actions aimed at air protection with actions aimed at counteracting climate change, since not all measures contributing to climate protection lead to improvement of air quality.

Positive trends are also visible in the area of water management. For many years now water abstraction, but also waste discharges have stayed on a similar level. A whole range of investments were implemented in the area of municipal waste water treatment (effectiveness of waste water treatment plants increased, sewerage system is longer, more people use the services of waste water treatment plants), as well as in the area of limiting the negative impact of various industrial sources. It is also not without meaning that the Code of good agricultural practices has become more popular, as there are a lot of agricultural holdings and their location is fragmented. Nitrogen and phosphorus discharges released through rivers at the territory of Poland to the Baltic Sea have also visibly reduced. However, this parameter is dependent on hydro-meteorological conditions (volume of flows), which means that the trend could reverse in the future. In spite of positive changes, still the most serious problem of the Baltic Sea involved eutrophication, mainly caused by excessive loads of nitrogen and phosphorus, stemming from inland sources located in the area of the Baltic Sea basin. Eutrophication applies to majority of water-courses and lakes located at the territory of the country.

According to results of ground water quality measurements done in 2010 good chemical status was identified in ca. 72 % measurement points (I-III classes). In the case of surface waters 15.6 % of flowing water bodies investigated in 2007-2009 had a good ecological status, and in the case of artificial water bodies and heavily modified water bodies – 19.6 % of water bodies covered by monitoring meet the environmental objectives. On the other hand lakes with a very good and good status accounted for almost 54.6 % of all lakes surveyed in 2009.

In spite of the fact that water abstraction has recently become stable, activities related to further rationalization of water management should be treated as one of the priorities of environmental policy, particularly as water resources are scarce and in the wake of observed climate changes one can expect deepening of water deficit at the territory of the country. It is also important to meet and maintain a good status of waters in order to ensure proper quality of water used as drinking water, recreational- and economic purposes. This long-term purpose should be met by 2015, according to the provisions of the Water Framework Directive. This objective will be met by implementing, for each separated river basin area in Poland, a water management plan and a water-environmental programme for Poland.

The trends in the area of environmental noise in Poland point out to an increase in traffic noise on the one hand, and to a limited growth and falling tendencies in the area of industrial noise on the other. Upward tendencies in traffic noise are mainly related to road noise and air traffic noise. Increased threat of road noise is mainly related to a steep increase in the number of cars over the past 15 years. In spite of the fact that the level has almost reached saturation, the growth is still significant. Based on data from noise maps drawn up for 12 agglomerations with more than 250 000 inhabitants, average rate of persons exposed to risk of noise that exceeds the permitted level was ca. 36 % according to assessments carried out on the basis of the indicator for day-evening-night time and 38 % - according to assessments carried out on the basis of the indicator for night time.

The spatial scale of acoustic environment degradation due to traffic means, mostly road traffic, requires effective solutions and persistent measures. At present the focus in the fight with noise is being shifted from temporary activities in favour of programs aimed at noise protection, which have to contain the proposed protection measures.

The issue of climate changes is particularly important due to its multi-dimensional and global nature. As a member of the European Union Poland participates in a whole range of activities aimed at reduction of GHG, including activities targeted at integrating climate-, air protection- and energy policy through the implementation of the climate and energy package. Counteracting climate changes is one of the most important objectives of the Polish ecological policy. In the period 1988-2009 Poland managed to reduce GHG emissions by 33 %, i.e. much above the 6 % reduction level required under the Kyoto Protocol. This will allow to exceed the reduction objective under the Protocol required until the end of 2012. At the same time, as the effects of climate changes are inevitable over the next years, it will be necessary for the international community, including Poland, to undertake adaptation measures.

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LIST OF ABBREVIATIONS

BOD5 – biological oxygen demand over five days
BSAP – Baltic Sea Action Plan
CAFE – Clean Air for Europe
CBBM – common breeding birds monitoring
CIEP – Chief Inspectorate for Environmental Protection
CR – critically endangered species in the IUCN classification
CSO – Central Statistical Office
DDT – dichlorodiphenyltrichloroethane
DMC – Domestic Material Consumption
EEA – European Environment Agency
EF – Ecological Footprint
EMAS – Eco-Management and Audit Scheme
EMEP – European Monitoring and Evaluation Programme (of the long range transmission of air pollutants)
EN – endangered species in the IUCN classification
eq. – equivalent
ETC ACC – European Topic Centre for Air and Climate Change
EU – the European Union
Eurostat – Statistical Office of European Communities
FBI – Farmland Bird Index
FV – favourable (conservation status) of plant species/animal species/natural habitats
GDEP – General Directorate for Environmental Protection
GDP – gross domestic product
gha – global hectare
GHG – greenhouse gases
HCB – hexachlorobenzene
HCH – hexachlorocyclohexane
HDI – Human Development Index
HELCOM – Helsinki Commission
IMWM – Institute of Meteorology and Water Management
IOP PAN – Nature Conservation Institute Polish Academy of Sciences
IPCC – Intergovernmental Panel on Climate Change
IUCN – International Union for Conservation of Nature
IUS – Innovation Union Scoreboard
kgoe – kilogram oil-equivalent
$L_{Aeq\,D}$ – equivalent continuous noise level for day-time (from 6.00 h to 22.00 h)
$L_{Aeq\,N}$ – equivalent continuous noise level for night-time (from 22.00 h to. 6.00 h)
L_{den} – long-term average noise level A expressed in decibels, determined throughout the year, taking account of daytime (from 6.00 h to 18.00 h), evening (from 18^{00} to 22^{00}) and night-time (from 22^{00} to 6^{00})
L_n – long-term average noise level A expressed in decibels, determined throughout all night-times in a year (from 22^{00} to 6^{00})
LULUCF – Land Use, Land-Use Change and Forestry
ME – Ministry of the Environment
Mtoe – million tonnes oil-equivalent
NEST – NEST Decision Support System, run by Nest Baltic Institute
NMVOC – non-methane volatile organic compounds
NOBANIS – European Network on Invasive Alien Species
NPK – nitric-phosphoric-potassium (mineral fertilizers)
OECD – Organisation for Economic Cooperation and Development
ONZ – Unated Nation
OTOP – The National Bird Protection Society
PAH – Polycyclic Aromatic Hydrocarbons
PCB – polychlorinated biphenyls
PM10 – particulate matter with particles up to 10 μm in diameter
PM2,5 – particulate matter with particles up to 2.5 μm in diameter
POP – permanent organic pollution
ppm – parts per million
PPP – purchasing power parity
RDEP – Regional Directorate of Environmental Protection
RES – renewable energy sources
SAC – special areas of conservation
SCI – Natura 2000 Sites of Community Importance
SEBI 2010 – streamlining European 2010 biodiversity indicators for the assessment of progress in meeting targets set for 2010 i.e. stopping the loss of biodiversity until 2010
SEM – state environmental monitoring
SOMO35 – indicator for ozone, the sum of differences between70 $\mu g/m^3$ (35 ppb) and daily maximum 8-hour running mean concentrations greater than 70 $\mu g/m^3$
SPA – Special Protection Areas
U1 – unfavourable (conservation status) – unsatisfactory status of plant species/animal species/natural habitats
U2 – unfavourable (conservation status) – bad status of plant species/animal species/natural habitats
UN ECE – Unated Nation Economic Commission for Europe
UNDP – United Nations Development Programme
UNFCCC – United Nations Framework Convention on Climate Change
VIEP – Voivodship Inspectorate for Environmental Protection
VU – vulnerable species according to IUCN classification
WEI – water exploitation index
WFD – Water Framework Directive
WHO – World Health Organization
XX – unknown conservation status (of species/habitats)
Zm – pressure of motorization on the environment

Abbreviations for Fig. 2 on p. 9:

ALB – Albania
ARM – Armenia
AUT – Austria
AZE – Azerbaijan
BEL – Belgium
BGR – Bulgaria
BIH – Bosna and Herzegovina
BLR – Belarus
CAN – Canada
CHE – Switzerland
CZ – Czech Republic
DEU – Germany
DNK – Denmark
ESP – Spain
EST – Estonia
FIN – Finland
FRA – France
GBR – Great Britain
GRC – Greece
HRV – Croatia
HUN – Hungary
IRL – Ireland
ISR – Israel
ITA – Italy
KAZ – Kazakhstan
LTU – Lithuania
LVA – Latvia
MDA – Moldova
MKD – Macedonia - FYROM
NLD – Netherlands
NOR – Norway
POL – Poland
PRT – Portugal
ROU – Romania
RUS – Russian Federation
SVK – Slovakia
SVN – Slovenia
SWE – Sweden
TKM – Turkmenistan
TUR – Turkey
UKR – Ukraine
UZB – Uzbekistan

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