



Figure 103. Catch of a deep-sea trawl net
(photo by I. Jardas)

1.4. Impacts of natural resource management on biological diversity

Natural resources of Croatia have been systematically exploited for centuries. The biological resources are managed mainly within the context of forestry, agriculture, hunting and fishing. All these activities are regulated by the law, with the existing regulations taking into consideration the need for a sustainable management of natural resources. In practice, however, **the economic component of exploitation is much more emphasized in relation to implementation of protection measures.** A relatively preserved condition of the country's biological resources in European proportions is a result, in the first line, of a general economic situation and other causes from the past. Over the last years, under the influence of new knowledge and international trends, there has been an ever-increasing need for a change in the principles of preservation and economical use of nature.

In the forthcoming years the impacts of technology and production of genetically modified organisms on biological diversity will present an ever-growing problem. In Croatia this problem area is yet to be governed by the law.

FORESTRY

The methods of forest management in Croatia are based on the so-called Zagreb school of growing forests which prefers **the natural composition of forests.** The Croatia's Forest Act forbids the clear cutting of woods, supports its natural

composition, supports the general protection of nature and respects the sustainability of management. The principles of the Helsinki Convention on Forests have been already to the most part incorporated into corresponding regulations. Since Croatia's forestry sector used to emphasize these principles before, the preserved condition of forests in Croatia, owing to a reasonable management, serves as an example for the entire central and western Europe.

However, despite a comparatively good state of the country's forests and the management methods there are **a number of defects from the aspect of biological diversity protection.** It is therefore necessary to analyze them and incorporate new protection guidelines into legislation and forest management programmes.

The total stock of wood amounts to about 320,000,000 m³. In the years preceding the Homeland War (1973–1989) the intensity of cutting woods was constantly increasing. During the war period this trend was stopped. In recent years the share of sanitary cutting has suddenly increased both in commonly managed forests and in the protected areas due to an extensive drying of trees, particularly fir-trees, common oaks and other species.

Another problem from the aspect of the protection of biological diversity lies in a too short rotation (**cutting maturity**) for the majority of forest trees. For example, the cutting maturity of the common oak has in recent years been prolonged from 120 to 140 or 160 years, but the natural

lifetime of this species is over 400 years. At the age of 200 oaks are only just “at their full strength” and give the best yield. A too short rotation renders the natural rejuvenation of forests difficult and reduces the diversity of species.

These forests are also faced with the problem of increasingly noticeable **changes in watercourse regimen**, caused to the most part by various watercourse regulations and the disturbance of the flooding system. In order to protect these habitats the rotation is reduced, and so is the use of heavy machinery that compacts the ground and depletes the forest offsprings.

An even poorer state of forest health results in the increased need for the **use of chemicals**, which is again adversely affecting the overall biological diversity. Viewing this danger chemicals are used only as an extreme measure.

In view of all this it is necessary to bring the watercourse regimen back to the former level and other habitat conditions into the original state wherever possible, with the final objective to raise the cutting maturity, or rather the rotation, in accordance with the biological and economic features.

Insufficient attention is paid to species that are not economically significant. In compliance with the international convention there is an obligation prescribed that when cutting trees at least two dried or old trees per hectare are to be left for the purpose of conservation of biological diversity (habitats of a number of fungi, microorganisms, insects and birds). The number of such trees should be much higher, because their number to date was not sufficient for preservation of threatened species. In this way the Republic of Croatia would continue to be in the forefront of efforts to increase the stability of ecological systems.

In protected parts of the nature, even in national parks and special reserves, too **intensive sanitary cutting** is observed. This problem area is to be thoroughly analyzed and legal provisions set out more precisely.

HUNTING

Hunting grounds in Croatia occupy an area of 4,000,000 hectares and cover practically the entire inland part of the country, with the exception of a portion of protected areas (national parks, strict and special reserves), settlements and a 300 m wide belt surrounding them, as well as some other public areas. The state hunting grounds are established on the state owned land, and on the rest of the grounds the so-called common hunting grounds are established by county assemblies. Concessions or hunting ground lease are provided through the system of public competitions and based on the submission of hunting management programmes.

Although the Act on Hunting has distinctly stressed the “protective” component and hunting concept, the hunting itself represents in practice one of the major problems in protecting the animal life of the country.

The **list of game** species included in the Act on Hunting contains species of mammals and birds that are hunted, but partly protected by a close season or exceptionally by permanent hunting bans. Economically most significant mammals hunted are red deer, roe-deer and wild boar (Fig. 106). The population of some 400 brown bears is also exploited for hunting – about 10% of the population is killed or in any other way hurt yearly. By the accession of the Republic Croatia to the Bern Convention the status of bears will have to be changed and the species managed on the basis of a special management plan.

Several species were introduced into Croatia by hunters for hunting purposes and are still daily introduced into new hunting grounds, which is very harmful from the aspect of



Figure 104. Cutting of trees on Bilogora mountain

(photo by D. Grlica)

protecting the indigenous species. A special threat is posed by parasites and some diseases that by introduction of new species may be transferred and potentially threaten domestic species. The species most often introduced are the mouflon and fallow deer, and to a lesser extent the spotted deer and white-tailed deer. Hunters are also interested in introducing the alpine ibex and Barbary sheep as well. The reintroduction of beaver was carried out exactly for the purpose of restoring it as the hunting game and therefore it had been included into the game list as a species with a permanent close season even before the reintroduction itself. There are similar intentions regarding the black grouse. Among foreign birds pheasant, chukar partridge and northern bobwhite are considered domesticated species, and there are some more species artificially reared and released into hunting grounds such as gray partridge and rock partridge. In some fishponds mallard ducks are reared. The **release of farm-raised specimens** has a harmful effect on natural populations due to genetic pollution. The most typical example is hare. Island



Figure 105. Curlew shot on Lake Vransko near Biograd n/m by Italian hunters in March 1999 – all three species of curlew are protected by the Nature Protection Act and the special memorandum of the Bonn Convention

(photo by D. Brala)

populations of this species which is highly peculiar (there is a scientific project in progress to identify the level of that peculiarity) are threatened in all places by introducing “continental” hares from Hungary and some other countries. By crossbreeding with islands populations the genetic diversity and peculiarity of indigenous populations are lost, causing the impoverishment of the total biological diversity.



Figure 106. Red deer belongs to economically most significant hunting game

(photo by M. Schneider-Jacoby)

The hunting game still includes **some threatened species** such as gray partridge, rock partridge, hare and chamois.

The concept of hunting is theoretically based on the assumption that hunting means in the first line the protection of nature, meaning all the habitats and all species inhabiting a hunting ground. A considerable number of hunters believe to be the only persons capable of assessing the state of population and taking steps to protect the ecological balance, including the maintaining of the optimal condition of individual species in the hunting ground. However, it is a fact that this attitude is not implemented in practice. **The hunting economy principles mostly do not take into account the overall ecological system** and are exclusively economically oriented. In most cases they are even not based on the state of the hunting ground known. An active role in their development should be played by science, particularly when there is a pressing need to renew the stock of threatened species.

A special problem is **intolerance of large predators in hunting grounds** – primarily wolf and lynx that are in a direct competition with hunters for prey. Some time ago lynx was exterminated by hunting, but in the 1970s, after reintroduction into Slovenia, the lynx spread again in mountain forests of Croatia. According to data on wolf catch, this species has been literally decimated over the last twenty years and, consequently, permanently protected in 1995 (Box 50). Despite their being protected by law a great number of wolves and lynxes get killed by poaching, but the solving of this problem is to a high degree aggravated by the impossibility of a field control and the ineffectiveness of inspections and penalty measures.

After passage of the 1994 Act on Hunting a new model of hunting grounds lease was introduced according to which leaseholders pay high rents. A great number of hunting societies that used to run the hunting grounds were in this way eliminated and an ever-larger number of hunting grounds are managed solely according to economic principles. The situation is further aggravated by a small number of game that was killed by massive poaching during the war. Such leaseholders do not tolerate large predators in the hunting ground and consider each red deer or roe-deer

shot down to be their own damage for which they even require compensation from the state.

In protected areas such as national parks all animals are protected. However, they are also threatened by intensified feeding of game in bordering hunting grounds which attracts animals from protected areas. Therefore the 1999 Amendments to the Act on Hunting banned such activities in a 300 meters wide area along the borders of national and nature parks.

The **excessive feeding of game** in general results in an unnaturally high concentration of individual species in the hunting ground and disturbs the natural balance. A special problem arises in **hunting grounds established within certain protected areas** (nature parks, forest parks, and significant landscapes). One of the major purposes of these areas is recreation and tourism, which is the cause of a direct conflict between the hunting and ecological tourism in the same place at the same time. On one side there are visitors wishing to walk peacefully and watch the nature, and on the other are leaseholders fencing the hunting grounds and placing swing-gates to prevent any access.

Hunting tourism brings benefit to individuals and the community, but the population in nature parks, for example, sees its progress in rural tourism, which to a large degree depends on nature lovers. For these reasons hunting should certainly be brought in line with protection categories and the hunting economy principles that do not comply with nature protection conditions harmonized with the Act on Hunting and the Nature Protection Act in the shortest time possible.

The hunting tourism associated with wild fowling – concerning primarily Italian hunters – is to be more strictly controlled. The non-observance of regulations by Italian hunters is well known and many times documented, particularly the cases of shooting “everything that flies” and taking out of Croatia great numbers of protected birds, both water-fowls and song-birds (Fig. 105).

Poaching and inefficient controll of hunting grounds in general represent a very serious problem. The utmost example is poaching in the area of lower Neretva which is considered something usual, with waterbird hunting taking place in every season of the year, regardless of the protection status or the close season.

AGRICULTURE

In ancient times agriculture did not have any distinctly harmful effect on the biological and landscape diversity. The development of meadows and pastures in naturally wooded areas even increased the diversity of habitats and species. However, with modernization and intensification of agriculture this state has constantly grown worse.

The problem of intensive agriculture is particularly serious in Europe. In this country the situation is comparatively better. In the western, mountainous and littoral part of Croatia where there is no intensive agriculture small private farms, parcels edged with rich hedges and vast pastures prevail. The intensive agriculture developed predominantly in the area of eastern Croatia. The most part of agricultural land used to be managed by large socially owned agribusinesses. By land consolidation and reclamation great areas were converted into monoculture arable land, without hedges and groves which would at least slightly mitigate the effects of a disastrous reduction of the biological and landscape diversity. The consequence of such a management, combined with the **excessive use of chemicals** was a considerable **degradation of land**. At the same time the private sector was completely neglected. The average size of private farms was only some 2.5 hectares.

In recent years considerable changes took place. During the period of war the intensity of agricultural



Figure 107. Cattle breeding in the mountainous area is constantly declining; a flock of sheep on Dinara mountain (photo by J. Kusak)

activities dropped dramatically. A lot of land was left uncared-for and gradually overgrown by natural vegetation. **Reprivatization** of agricultural land and former agribusinesses has started, but the process is very slow.

In general, within agriculture **too little attention is paid to the diversity of domesticated taxa**, particularly to the protection of indigenous plant sorts and animal breeds.

For the most part cereals are grown, chiefly corn and wheat followed by oleiferous plants (soya bean, sunflower, oilseed rape) and sugar beet. Of the fruits grown apples and plums are the most important, including olives, vine and some citrus fruits, mostly mandarin oranges, in the Mediterranean part. Numerous domestic sorts of grapes and fruits are completely neglected and are gradually dying out.

The cattle breeding is based on breeding a very limited number of cattle and pig breeds. Poultry, horses, sheep, goats and bees are less produced. The majority of cattle are raised in stables, with the **natural breeding on pastures being neglected**, particularly in northern Croatia. The majority of cattle farms in Croatia have not solved the problem of waste water disposal which causes soil and water pollution.

The cattle breeding in the mountainous and littoral Croatia has been steadily and drastically declining (Fig. 107). The number of cattle decreases, mountainous and island areas are depopulated and vast pastures gradually overgrown with the pioneer forest vegetation. The problem lies also in the fact that the majority of pastures are socially owned and the way of their utilization is not systematically solved.

The disappearing of vast mowing meadows and pastures has impoverished the biological and landscape diversity and threatens numerous plant and animal taxa connected with them.

In 1995 the Croatian National Parliament adopted the document entitled **An Overview of the State and Strategy of Agricultural Development of the Republic of Croatia**. A general objective of the Strategy is to encourage a more effective production and marketing of agricultural products in the manner that improves the welfare of farmers and consumers, contributes to the growth of Croatia's economy, protects natural potentials of the Republic of Croatia and ensures competitiveness of Croatia's agriculture in the world market. Special emphasis is put on family farming units that form the basis of Croatia's agriculture. It needs to be stressed that there are areas of Croatia with the unpolluted

soil that enables the production of environmentally friendly agricultural and food products. It is planned to stop the degradation of smallholdings and the depopulation of valuable agrarian areas, and to encourage the extension of real property. It is also necessary to support selectively specific productions and development of agriculture in certain regions.

FRESHWATER FISHERY

The freshwater fisheries include fisheries in inland waters for economic and sports purposes and breeding in fishponds.

Economic **fishing** is practically negligible, related chiefly to great rivers such as the Danube. The sportfishing is regulated in such a manner that certain parts of fishing waters are managed by sportfishing societies on the basis of special fishing rules. The problem as seen from the aspect of biological diversity lies in the regular **introduction of the brood** produced, often of allochthonous species, **into the waters**, thus causing the genetic pollution of natural populations or a direct competition among the species introduced.

The **pisciculture** is to the most part related to **carp fishponds** which are very numerous in the lowland Croatia and occupy an area of nearly **13,000 hectares**. Less numerous are trout fishponds – about twenty of them with the total production of some 800 tons yearly.

In carp fishponds 85% of the production account for carps, including mostly tench, pike, wels and zander. **The production in these fishponds has drastically declined in recent years**. Its peak year was 1989 with 12,300 tons dropping to 7,300 tons during the war years (1992) and to as little as 2,512 tons in 1996. The production per hectare has fallen to 175 kg and the breakeven point is considered to be 750 kg/hectare. The problems underlying this state are multiple, with the main being transition to the market-oriented economy, loss of traditional markets of the countries lying farther in the east, too high production costs and ownership transformation of fishponds. **These problems have a direct impact on the biological diversity and protection primarily of waterbirds** for which the vast, semi-intensively or extensively managed fishponds in Croatia represent extremely valuable "substitute" wetland habitats. The interruption of production in fishponds brings about a

Figure 108. Production in carp fishpond near Okučani (photo M. Schneider-Jacoby)



rapid overgrowing of shallow water areas and the disappearing of both the habitats and food for a number of fish-eating waterbirds. Therefore **it is in the best interests of the nature protection to resume this production**, including its harmonization with the needs of the protection of birds. One of the **top-priority action plans** is the preparation of a programme for maintaining this production which should be based on two equally important objectives: fish farming and protection of biological and landscape diversity. The non-profitability of the production in at least those fishponds that have chosen the "ecological" concept should be compensated for by incentive measures taken by the state and by a parallel development of a special kind of tourism.

MARINE FISHERY

The Adriatic Sea is used for sea fishing by several countries: Italy, Croatia, Slovenia, Albania and the SR Yugoslavia. Croatia's share in the total catch amounts to approximately 16–17%. According to the data of FAO the Adriatic is one of the most intensively exploited areas of the Mediterranean Sea, although by its surface it lags behind some other areas. The major share in the catch coming from eastern Adriatic belongs to **small pelagic species** (pilchard, sprat, anchovy and mackerel). Other species including big pelagic fish (Atlantic bluefin tuna and bonito) participate in sea fishing with 20.5 – 28.9%. For some time now the bluefish catch has drastically declined. In the period between 1990 and 1996 the catch dropped, but **in recent years trawling has been showing a sudden upward trend, with the considerable decline of pelagic sea fishing at the same time**. Over the last years Croatia's catch amounted to 24,000–25,600 tons. In 1993 the share of small pelagic species in the catch was 55.3%, of which the pilchard itself accounts for 49.4%, big pelagic (blue) fish for 1.4% and all the remaining fish, including the fish caught by trawling for 43.3.% of the total catch (Graphs 11, 12 and 13).

A part of Croatia's salt-water fish is bred in the **mariculture**. Of all the fish in the Mediterranean the species most frequently bred are guilthead sea-bream, European sea bass and grey mullets. In the last few years there is a trend of establishing new fish farms. In the course of the environmental impact assessment procedure negative impacts of the mariculture on the sea and biological diversity in the sea is analyzed for each individual bigger fish farm planned.

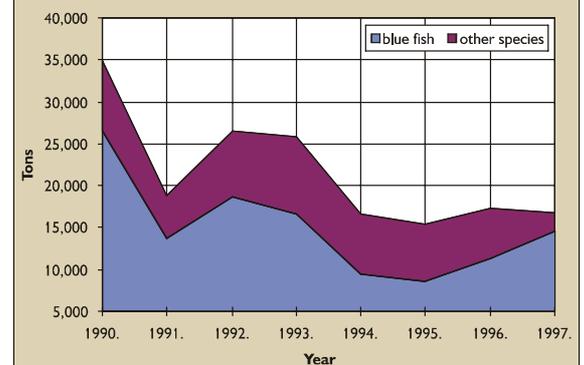
For a longer period of time a **need has been felt for a more efficient protection of some fishing areas and fish species** of the sea bottom used for trawling. In the Croatian part of the Adriatic this refers to trawling areas of the entire

Figure 109.
Common spider crab is an economically significant species
(photo by A. Jaklin)



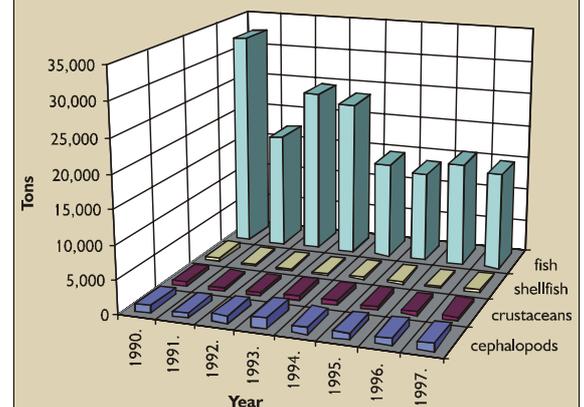
Graph 11. Changes in the total catch in sea fishing waters of the Republic of Croatia in the period from 1990–1997

("Communication", National Bureau of Statistics)



Graph 12. Relation between the catch of bluefish and other species in sea fishing waters of the Republic of Croatia in the period from 1990–1997

("Communication", National Bureau of Statistics)



Graph 13. Composition of sea catch in the Republic of Croatia by fishing targets in the period from 1990–1997

("Communication", National Bureau of Statistics)

open sea, particularly of the fishing area of Blitvenice and some channels, and as regards fish species to hake and red mullet.

The major part of the **hake** catch in the Adriatic consists of immature specimen one or two years old (16 or 19 cm long). From the biological aspect this is impermissible and this fishing unreasonable. The catch of another economically significant species in the trawling area of the Adriatic, i.e. **red mullet**, has fallen, because the number of population declined to about 50% of the former catch. Beside the species mentioned, almost all species of

cartilaginous fish have drastically dropped in number in the same areas too. The research work carried out recently for the purpose of identifying the distribution and abundance of cartilaginous fish in the Adriatic Sea showed that these fish had almost completely disappeared from the sea bottom of the west part of the Adriatic exposed to intensive and long-lasting trawling.

The coastal area of eastern Adriatic is also showing distinct signs of overfishing. In the course of the last thirty years the catch by “poponica” net has constantly reduced. Such a reduction of catch is a result of many years of uncontrolled fishing that caused the disturbing impoverishment of the biological foundations of inshore fishing. In the area of the Kornati islands, Split, Central-Dalmatian islands and the island of Palagruža the catch by “poponica” net dropped by approximately 63–69% in the last thirty years. In the coastal area of eastern Adriatic populations of numerous fish species have also declined in number. This refers primarily to sea horse, green wrasse, brown wrasse, moray, brown meagre, red scorpionfish, some sparids, etc. In northern Adriatic, particularly in the rivers of northern Italy, the population of the Adriatic endemic species of **sturgeon** (*Acipenser naccarii*) is threatened, partly due to the ever-increasing pollution of the rivers and the construction of hydropower plants. For some time now the catch of sole along the western coast of Istria has been also declining.

The non-observance of regulations and the inefficient control at the sea are here major problems.

GATHERING OF UNPROTECTED SPECIES

All plant, fungi and animal species which are not especially protected or whose exploitation is not regulated by any other regulations are protected on the basis of the Nature Protection Act. Their gathering for commercial purposes is governed by **issuing special licences and adopting special protection measures**. This problem area lies within the competence of the Ministry of Environmental Protection and Physical Planning.

Wild growing fungi, medicinal herbs, snails of the genus *Helix* and edible frogs are gathered to a high extent. Since processing and consumption of these species in this country (with the exception of medicinal herbs) are negligible, nearly the entire volume is exported into other countries. Until 1998 cray-fish and leech used to be gathered, but now they are protected by the law. In recent times some interest has been shown in gathering sea cucumbers, but viewing the insufficient knowledge of their role in marine ecological system and negative experience of the first attempts of gathering (total devastation of the areas concerned) this activity is for the time being not permitted. The traditional **gathering of red corals and sponges** is not very frequent, but it takes place without any control in terms of nature protection (Fig. 110).

Little is known about the **consequences** of gathering to populations of individual species, because a systematic monitoring and data collecting has only just started.

BIOTECHNOLOGY

The pharmaceutical and foodstuffs industry and scientific institutions are applying biotechnological methods in production of living organisms and parts of organisms whose natural genetic basis has been modified for the purpose of creating the properties required. Such **genetically modified organisms (GMO)** may upset the natural balance, therefore a systematic control of their release into the environment is



necessary, which is also a commitment arising from the Convention on Biological Diversity.

The development of the recombinant DNA methodology has enabled the transfer of genes between genetically very remote species. In this manner a series of **modified sorts of plant species** with exceptional features were obtained, such as, for example, the resistance to specific pesticides and stress conditions of the environment, to modified properties of plant organs, fruit, stem, etc. Apart from genetically modified plants the pharmaceutical industry frequently uses **genetically modified micro-organisms** as a substitution for complex processes that earlier required the application of toxic and environmentally harmful chemicals. In the last ten years much progress has been made in introduction of foreign genes into **domestic animals** (pig, cattle, sheep). In most cases genes for the human growth hormone are introduced to increase the growth of the body and fleshiness of thus genetically modified animals known as transgenic animals. Although this is still at the stage of laboratory research or production of transgenic animals without any commercial application for the time being, their number is growing very rapidly.



Figure 110. Unconscientious autonomous divers may become a threat to the natural heritage

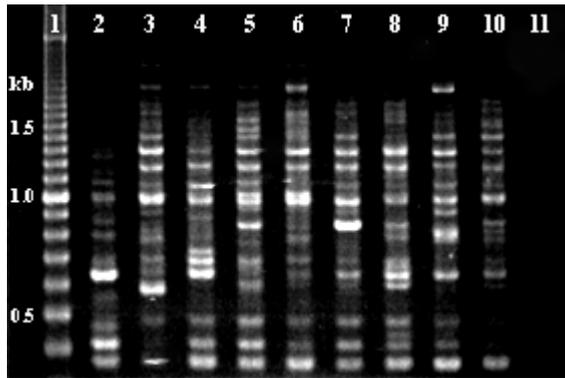
(photo by D. Zavodnik)

Figure 111. Rapid development of molecular biology opens the doors to biotechnology

(photo by S. D. Jelaska)

Figure 112.
*Fragments of the
plant DNA
separated by gel
electrophoresis*

(photo and data by Z.
Liber)



In recent years biotechnology has been developing extremely rapidly. In the USA and Canada the transgenic plants, primarily soya and corn, have been already grown commercially on a massive scale. However, there is an ever-larger number of scientists who are warning of the danger of such artificially produced organisms for human health and biological diversity. The extraordinary resistance of laboratory bacteria and viruses used in the GMO production is underlining the problem of the uncontrolled release of transgenic wastes, taking place probably since the early 1980s.

In 1998 the USA Ministry of Agriculture approved the patent widely known as the “terminator technology”. This method is applied to implant a “suicidal” mechanism which prevents farmers from sowing again the seeds of the same plant, forcing them to buy new seeds each year. The profit made by companies producing such seeds is guaranteed, but one can only speculate on all other consequences.

With the exception of industrial biotechnology that includes the genetic modification of microorganisms

important for industry carried out in the Research Institute of Pliva, Croatia’s experts are not working on genetic modifications of plants and animals for commercial purposes. For scientific purposes only a limited growing of genetically modified corn crops has started. However, there is a real possibility of introducing genetically modified organisms or food from foreign countries. For that reason a number of countries have already introduced regulations into their legislation to prevent the uncontrolled import of GMOs and set up expert committees to examine concrete cases, or rather the justifiability of a possible introduction of individual modified organisms. Numerous countries with an advanced biotechnological industry have already adopted legislation to ensure a safe transfer, handling, use and disposal of GMOs and their products. In the European Union this problem area has been regulated by a special Directive. A draft **Protocol on Biological Safety** prepared within the framework of the Convention on Biological Diversity will constitute a framework for the international co-operation aiming at safety in the field of biotechnology. Unfortunately, the protocol has not been adopted yet, because efforts made in the protection of biological diversity were once again overpowered by the struggle for profit of megacompanies.

For the purpose of protecting the indigenous sorts and biological diversity it is necessary for **Croatia to adopt adequate regulations** for the control of a possible introduction of GMOs, or rather to set up expert teams that should be consulted in cases of a possible import of individual modified organisms.

It is necessary for Croatia to initiate the enactment of laws concerning the safe transport, utilization, storing and destroying of modified organisms and their products. The law should cover both the organisms destined for research work that do not leave the laboratory and those of commercial significance destined for introduction into the environment.

Figure 113. *Smoke
stack of the sugar
mills in Virovitica*
(photo by D. Grlica)



OTHER ACTIVITIES

This review describes in detail the impact of the activities directly using biological resources. Other activities and their impacts will be outlined in the Environmental Protection Strategy of the Republic of Croatia that is in preparation. Some of the most evident adverse effects are the following:

- **water management** – regulation of watercourses, reduction of natural flood areas, construction of storage lakes, hydroamelioration
- **tourism and recreation** – construction of buildings and infrastructure facilities in valuable natural areas, disturbance and devastation of fauna and flora by visitors of valuable natural areas, etc.
- **transport** – splitting natural habitats by roads, noise, disturbing the fauna, air pollution
- **building** – destruction of natural habitats, insufficient care for the “urban ecology” when preparing physical plans
- **industry** – destruction of habitats, air, water and soil pollution
- **energy** – destruction or degradation of existing habitats (hydropower plants): air pollution (thermal power plants)
- **trade** – “plundering” plants and animals from the nature for trading purposes (pets, private breeders and collectors of rare fauna and flora, persons processing the medicinal herbs, export of edible snails, frogs, fungi, forest fruits).