terweed superfluous, to the extent that this is practicable.

Nature-oriented maintenance of private watercourses should be stimulated and encouraged, for instance, through advisory services.

Safeguarding of areas adjacent to watercourses

It is crucial that the statutory 2-metre zones be respected. In certain cases, there is also a need for appropriate management of the vegetation of these zones.

One vital contribution to the additional safeguarding of natural plant and animal life in areas adjacent to watercourses is the inclusion of these areas in the total watercourse protection programme. The potential for set-aside and extending the zones covered by the schemes of the EU CAP could, therefore, improve the preservation of biodiversity in many of our watercourses, if we make a purposeful effort.

Ideally, the establishment of uncultivated or extensively cultivated areas close to watercourses should encompass *entire* river valleys. Where this is possible, ditches and drains from more elevated, cultivated fields can be blocked so that meadows, bogs and swamp forests that are close to watercourses can have the opportunity to function as *root zone systems*. These will be able to retain and degrade the nitrogen (an average of about 400 kg/ha/year) that is leached out of the surrounding land. The establishment of *root zone systems* can, however, affect nature types that are covered by the Nature Protection Act. Consideration for this should threfore be included in the material assessments of individual systems.

The Ministry of Environment and Energy and Ministry of Agriculture and Fisheries have started a programme of investigation and research on the interaction between watercourses and their neighbouring areas. This extended scientific knowledge will be relevant when setting quality goals for the areas close to watercourses.

Safeguarding of free passage

Where present dams, waterfalls, fish farms and traffic constructions are concerned, the free passage of fish and other watercourse organisms should be safeguarded. The progress that has already been made in this area should be followed up by a purposeful effort to lessen the effects of the remaining barriers to the migration and spreading of aquatic organisms.

Passage facilities for animals, such as the otter (which lives close to, and travels along, watercourses) should be established in cases where watercourses pass under roads and railways. *Fauna passages* also create opportunities for spreading and limit the number of animals killed by traffic. Pursuant to the Government's Traffic Action Plan of 1993, fauna passages shall be established when constructing new roads.

Consideration for the protection of wild plant and animal life in connection with damming, together with consideration for the preservation of culture-historical assets in connection herewith, should be included in the specific planning of action taken to remove the barriers.

Safeguarding of water flows

Work should continue on improving the planning of catchment and water consumption. This could contribute to safeguarding sufficient water flows in our watercourses - not least in the critical summer months.

Dead river stretches

Large stretches of watercourses have been so affected by barriers and water catchment that they have either partially or completely dried up (dead stretches).

As the applicable legislation and contractual approaches have not proved suf-

ficient to solve the problem, amendments to the *Watercourse Act* and *Water Supply Act* have been proposed. These proposed amendments are part of the Government's „green" strategy and are a logical continuation of the watercourse restoration and nature restoration efforts that have been made so far.

Amendment of the Watercourse Act will make it possible for the county councils, in their capacity as authorities responsible for watercourse quality, to hasten restoration of naturally and environmentally well-functioning watercourse systems which, at present, still suffer from dead stretches and damming.

Release of fish

See Chapters 10 and 11 concerning the release and transfer of fish and other watercourse organisms.

Target areas

Lakes

- Reducing the discharge of nutrients into lakes and their catchment areas.
- Designating uncultivated or extensive ly cultivated areas, for instance, through set-aside and the subsidisation of environmentally oriented agricultural measures, around the few remaining *clean* and lightly polluted lakes.
- Increasing the nature restoration of drained lakes and ponds.
- Implementing the active restoration of lakes (e.g. sediment removal, biomanipulation and oxygenation) on the basis of an overall assessment of lakes that have already been restored.

Watercourses

- Reducing the input of nutrients and organic matter (such as liquid manure) into our watercourses.
- Improving the physical state of our watercourses by allowing natural processes to operate to a greater extent.
- Improving the opportunities for migration and spreading of fish and other aquatic creatures through the restoration of winding paths of watercourses and through the removal of fauna-barriers.
- Promoting nature-oriented maintenance of watercourses by avoiding as far as possible mechanical waterweed removal, when removal is required by quality goals.
- Promoting the designation of uncultivated or extensively cultivated areas out side the 2-metre zones along watercourses, in part through mandatory set-aside and subsidisation of environmentally-oriented agricultural measures.
- Improving the planning of water catchment and consumption in order to ensure sufficient flows in our watercourses.
- Amending the Watercourse Act in order to hasten the restoration of naturally and environmentally well-functioning watercourse systems. There is a need for action at about 380 fish-farms and 30 hydro-electric power stations.

Chapter 7
The open countryside

The open countryside is the foundation of several important Danish industries, of which agriculture is the most vital. Together with market gardening, agriculture covers 2,757,000 ha, which corresponds to 64% of the total area of the country. This area was even larger in earlier years and it peaked at 3,268,000 ha (76% of Denmark's total area) in the 1930s. The more than half-a-million hectares that has since been taken out of agricultural production has been used, for instance, for roads, urban development, silviculture and recreational purposes.

Despite the fact that the overall agricultural area has diminished over the last few decades, Denmark remains that European country in which agriculture claims the greatest percentage of its total area. More than 90% of today's agricultural area is in rotation, whereas the permanent pastures constitute about 7.5%; see Fig. 7.1.

The farming industry has been decisive to the conditions for wild plants and animals living on cultivated soil ever since agriculture was introduced into Denmark. For this reason, changes in the structure of the industry have a direct impact on the conditions for plants and animals.

Over the last 50 years in particular, agriculture has undergone major structural changes that have resulted in an extensive loss of biodiversity. In recent years, it has become possible to note an improvement in the conditions that are decisive to biodiversity in the cultural landscape - a trend that is the result, for instance, of the marginalisation of large agricultural areas. This beneficial trend must be maintained and extended.

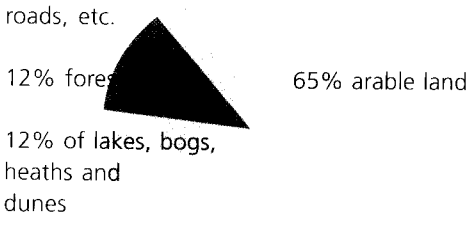


Fig. 7.1
Land use in Denmark

Growth of agriculture in Denmark

The basic form of the landscape that we still see today was created when the Danish equivalent of enclosure was carried out around the year 1800. The appearance of the landscape was quite different before this time. Farms were clustered in compact villages surrounded by fields. The ploughed land (split into small strips) lay innermost. The commons lay further out. The small biotopes that we know today were rare. On the other hand, extensively grazed commons, meadows and bogs were far more prevalent.

The primary reason for the major changes that took place in the structure of this landscape was the rapid population growth that started in the mid-1700s. Part of the excess population emigrated - mainly to America - but the greater part moved into the towns.

The towns' increased demand for agricultural products led not only to the in

troduction of more intensive forms of farming in cultivated areas, but also to the cultivation of hitherto uncultivated areas. Serfdom was abolished and farming families moved from the villages to the countryside, where the fields were clustered around their farms. There was extensive cultivation of commons and heathlands, and extensive draining of wetlands. Fences and dikes were built and thousands of kilometres of ditches were dug.

The practice of laying artificial ditches and natural streams in pipes was started during the second half of the 1800s, in order to facilitate the maintenance of watercourses and to increase the arable area. *Marling* - digging up and using the lime and mineral-rich clay that is to be found a few metres below the surface in most parts of the country - also became widespread during the 1800s. Almost every field had its own marl pit since the soil was heavy to transport.

During the 1920s, *hedgerows* were planted extensively in the western parts of the country and the gradual destruction of most types of small biotope started in the eastern parts of the country - a trend that grew stronger over the following decades.

The period following the Second World War was generally characterised by the *mechanisation, specialisation and improvement of the efficiency* of agriculture. Production increased and biotope variety decreased. The small biotopes suffered the greatest damage. On the whole, damage has been greater in wet biotopes than in dry. Many of them disappeared

Fig. 7.2
Arable land before 1917 (upper). Arable land in 1990 (lower), cf. Fig. 7.10. Watercolours by Beth Beyerholm.

and, of the remaining biotopes, many became polluted to a greater or lesser extent.

The trend of development of our dry biotopes has been somewhat different. Although hedgerows, field boundaries and dikes have become less common on the whole, this trend has not been even, either from period to period or from one part of the country to another. Field boundaries have shown the greatest improvement - also right up to the present day. On the other hand, small plantations, such as hedgerows and coverts, have become more common and their numbers are, in fact, still on the increase.

During the period since the Second World War, the total cultivated area has dropped back to about 64% of the country as a whole. The number of agricultural enterprises has dropped from about 200,000 in 1950 to about 72,000 in 1992, and the average area per enterprise has increased during this period from 15 ha to 36 ha; see Fig. 7.2.

Nature types

Cultural landscapes and biodiversity

There are only a few completely *virgin* nature types in Denmark; see Box 3.2. Almost everything that we usually call „nature" has been exposed to human influence to a greater or lesser extent or has evolved as a result of man's use of the open countryside.

Meadows, uncultivated dry grassland and heaths are predominantly semi-cultural types that primarily evolved as the result of agriculture and that can only be maintained through practising one form or another of agricultural operation. In step with the improvement of agricultural efficiency, many of these semi-cultural types (which we shall call *nature types* in conformity with current usage) became cultivated, planted or left to heal on their own after agricultural operation ceased. These nature types constituted almost half of the country's area at the

Fig. 7.3
Nature types in uncultivated areas of the open countryside

Nature type	Approx. area, ha	Definition
Humid permanent grassland	45,000	Semi-cultural type created by grazing or mowing of natural fens or felling of swamp forest.
Bog	50,000	Uncultivated or extensively used areas characterised by natural or mainly natural vegetation influenced by fresh water. It is associated with a high average water level and places where peat has formed.
Bog types:		
Raised bog		All water and nutrients come from the atmosphere.
Fen		Elevated, more or less level water table, in which the water is in contact with mineral soil.
Spring bog		Percolating or gushing water table.
Heath	70,000	Uncultivated areas of poor soil, usually covered with heather or other dwarf scrub.
Uncultivated dry grassland	10,000	Naturally well-drained, unrotated dry grassland with leached soil often covered with bushes.

beginning of the 1800s. Today, they account for less than 5%. Culture-historical and ecological considerations go hand-in-hand in our work on preserving and recreating these areas. With its mosaic of different nature types and arable land, the open countryside is at once a culture-historical testament to earlier forms of agriculture and the fundamental requisite of the biodiversity that we seek to preserve; see Fig. 7.3.

Bogs

Moist areas, such as bogs, have always been an obstacle to cultivation, travel and building. Bogs occur where surface water gathers naturally in hollows or where the water table is high. In these saturated hollows, we encounter vegetation, and therefore animal life, that is quite different from the plant and animal life encountered on dry soil.

The proportion of bogs in the open countryside up to the year 1800 has been estimated at about 25%. During the last and, in particular, the present centuries, draining and peat cutting have gradually reduced the area of the marshes to about 1-2%.

Meadows

Meadows are low-lying, grass-covered areas that often lie along watercourses (humid permanent grassland) or the coast (coastal marshes). In earlier years, uncultivated dry meadows were often exposed to flooding with nutrient-rich water from the river in the winter and spring months. The traditional form of operation was grazing and hay harvesting. This created the conditions for richly varied species of vegetation consisting of heliotropic, low, herbaceous plants, with which variegated animal life was associated.

The more efficient agricultural methods applied in recent times have rendered hay harvesting unprofitable. As watercourses became regulated and the level of the water table was reduced by draining, the meadows also became gradually drier and, thus, better able to bear the weight of heavy agricultural machinery. This created the conditions necessary for using the driest meadows for crop cultivation.

It has been estimated that the grassy areas not in operation, i.e. meadows and uncultivated dry grassland, have been

reduced by between 70 and 90% over the last 100 years, and that the remaining areas are in many cases threatened by overgrowth, as grazing and hay harvesting are no longer practised.

Uncultivated dry grassland

Uncultivated dry meadows were originally the outlying fields most remote from villages. The soil there was often stony and of low value. These areas were often used for summer grazing. This annual grazing meant that they were kept open to the light, with scattered shrubs, and they did not become overgrown by trees and bushes.

The parts that were open to the light were covered with species-rich, low vegetation dominated by herbaceous plants, which was also the habitat of abundant animal life. Subsequent improvements in agricultural methods meant that a large part of the easily accessible uncultivated dry meadows was ploughed and cultivated. Many were fertilised, with the result that more homogeneous vegetation was promoted at the expense of the species-rich uncultivated dry meadow vegetation, which also affected the assemblage of fauna.

In the comments on the Nature Protection Act, the remaining areas are estimated at less than 10,000 ha. However, the county councils' on-going registration of protected nature types suggests that the figure may be too low.

Heaths

Heaths are created by the interaction between the type of land use, composition of the soil and the prevailing climatic conditions. Heaths became especially widespread on the sandy, low-nutrient soil of Jutland and were most extensive in the 1700s. The heath farmers' sheep-keeping was the main cause of the expansion and sustaining of heaths.

Changed attitudes on agricultural policy, population growth and the reduction of agricultural areas, e.g. through the loss of South Jutland, Schleswig and Holstein (1/3 of the country's total area), resulted in the cultivation of large areas of heath, especially at the end of the 1800s and beginning of this century. In recent years, on the other hand, great efforts have been made to preserve the heath as a nature type.

It is estimated that our total heath area has been reduced by 90% within the last 100 years.

Small biotopes

Cultivated areas are characterised by a paucity of wild plants and animals. But oases can also be found in which wild flora and fauna thrive in such homogeneous landscapes. These are classified as *small biotopes* and include living hedgerows, dikes, grave mounds, game coverts, neglected lanes and paths, roadsides (verges), small ponds and bogs, raw-material pits, ditches and their banks, together with small watercourses and their surrounding uncultivated zones. Small biotopes are also of great importance as ecological corridors for many plants and animals.

Not more than a quarter of our arable land's small biotopes are the residues of earlier, larger nature areas. These are, for instance, natural small lakes, bogs and watercourses. The other 3/4 are directly or indirectly the products of present or earlier forms of agriculture, such as hedgerows, field barriers, ditches and lanes.

Our improved agriculture has resulted in increased field size through land amalgamation, which has had a heavy impact on small biotopes in many places. The hardest hit are the smallest and the wet biotopes. The total length of open ditches and small watercourses is estimated to have decreased by 90% within the last 100 years. Many watercourses have been laid in pipes, deepened or straightened and their uncultivated zones have become smaller.

Marl pits and other small pools that

obstruct rational use of the land have been filled in and the surrounding scrub has been cut. It is estimated that 3/4 of these pools have disappeared since the turn of the century.

Of the dry small biotopes, about 40% of the dikes and hedgerows have disappeared in conjunction with land amalgamation over a period of 100 years. Their loss has been compensated to a certain extent by the planting of hedgerows - although usually in areas other than those from which the hedgerows disappeared. The overgrowth of hitherto unvegetated dikes and ditches has also helped to counteract the drop in the total number of hedgerows to some extent. Many country lanes have also lost their original importance as motoring became more widespread and so they have been ploughed up. About 80% of our grave mounds have been destroyed as a result of the agricultural sector's need for land.

Demolition, fertilisation, lowering of the water table and draining are the major threats to these vulnerable small biotopes today.

Fields

Cultivated fields are, of course, also the habitats of plants and animals but cultivation means that a number of changes occur throughout the cultivation year, such as the spraying of plants, the spraying of insects that harm crops and ploughing. This generally renders fields unsuitable as the habitats of wild plants and animals. The *intensified plant production* of recent decades has further reduced the suitability of fields as the habitats of species that had earlier attained larger and more stable populations.

Wild plants and animals

Plants

Major changes have taken place in the assemblage of wild flora in our arable land. In general, the frequencies of a number of species have dropped, or the species have disappeared almost entirely. On the other hand, other species have flourished and attained higher frequencies in many crops, despite intensive modern agriculture. A number of factors affect the conditions of life of wild plants in our fields and in the assemblages of which they are a part.

If it is to survive in a field, a wild plant must have a life cycle that coincides exactly with the crop cultivated. Cornfields are suitable places for annual species that blossom, bear fruit and sow their seeds before the corn is harvested, but perennial species will be ploughed up. Perennials were favoured by the cultivation methods of earlier times.

Apart from the crop, about 200 different species of plant can be found in today's cultivated fields. Studies have shown that this number appears to have remained unchanged over the period 1960 to 1990. When their frequencies are studied, however, only five of the species account for 50%, while 15 species account for 75%, of the total number of wild species in the most commonly cultivated crops.

The seeds in the soil that are capable of germination are collectively known as the *seed bank*. This plays a vital part in sustaining a species-rich range of wild plants in cultivated soil. Studies of 37 fields conducted in 1989 showed that there are, on the average, 27,400 viable seeds/m^2. Over the past 25 years the average number of species of living seed in these 37 fields has dropped from 12.1 to 4.8. In other words, the *capital* of the seed bank in the individual fields has diminished markedly.

Animals

There has been a decline in the population sizes of many of the animal species that depend on the open countryside. In the case of game species, the game bag is a useful barometer of population trend. Well-known examples include the decline in bags of hare and partridge, by two-thirds and three-quarters, respectively,

from the 1950s to the 1990s; see Fig. 7.4. The populations of young birds dependent on arable land, such as the lapwing, lark, swallow, linnet and corn bunting, declined significantly from 1975 to the beginning of the 1990s, when a weak increase started to become detectable.

The group of animals that has suffered the greatest decline is the *amphibians*. Depending on the species considered, the amphibians have disappeared from between 30 and 90% of their spawning sites - typically ponds - at which they could be found in the 1940s. Chapter 10 contains a more detailed description of threatened plant and animal species and of the endeavours now being made to preserve them.

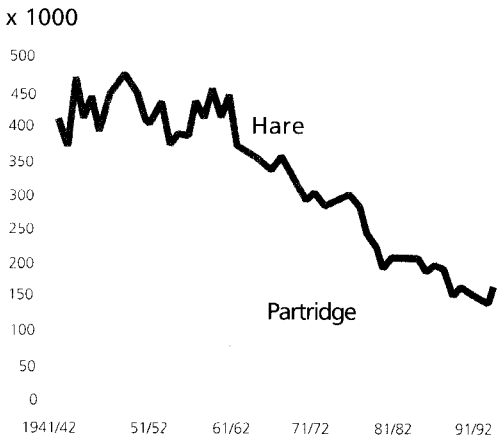


Fig. 7.4
Bags of hare and partridge. Ministry of Environment and Energy, 1994e.

Why have the conditions of plant and animal life been vitiated?

Agriculture has become homogeneous

The homogenisation of agriculture is taking place at all levels:

- in *crops*, through production being based on ever-fewer species and varieties;
- in *fields*, where the use of pesticides, fertilisers and of larger machines has reduced the variety of wild plants and animals, cf. below;
- on *individual farms*, through the concentration and specialisation of production and through increasing field size, in which intervening habitats of wild plants and animals have been removed;
- in the *landscape*, through the watering and draining of fields, cf. below, through taking semi-cultivated areas into intensive operation and through the regionalisation of production (e.g. the concentration of cattle-keeping in West Jutland), which reduces the crop variation in the landscape.

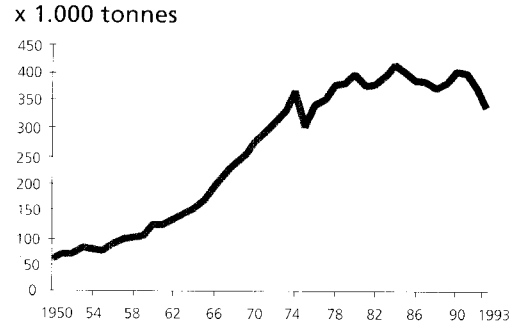


Fig. 7.5
Trend in consumption of nitrogen in artificial fertilisers. Ministry of Environment and Energy, 1994e.

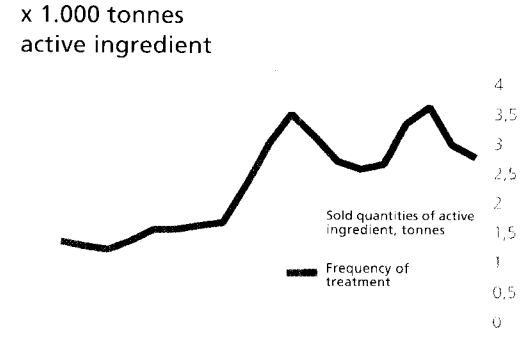


Fig. 7.6
Trend in consumption of pesticides. Ministry of Environment and Energy, 1994e.

Agriculture has become „dry"

The extension of wetlands into arable land has shrunk to a few per cent of its

magnitude prior to land amalgamation. Not unexpectedly, this has led to a decline of the species that depend on wetlands, such as amphibians and birds, and marsh and aquatic plants. Altogether, it is expected that about half (about 1.5 million ha) of our present agricultural area has been drained and that about 140,000 ha has been wholly or partially drained by pumping.

Intensified agriculture

The intensification of agriculture is expressed in increased reliance on fertilizers and pesticides. This has been vital to the increase in productivity that has occurred in agriculture. That it also has a significant impact on the life conditions of wild species is apparent, e.g. from the fact that ecological farming (i.e. without artificial fertilisers and pesticides) is accompanied by the presence of more birds than is conventional agriculture; see Fig. 7.12.

This intensification has also found expression in the fact that many years have elapsed since any economic incentive was offered to farmers to operate culturally-conditioned nature types in the way that is a condition for their continued existence, i.e. primarily through extensive grazing and hay harvesting. The meadows, uncultivated dry grassland and heaths that have not been brought into intensive agricultural operation are, therefore, threatened with overgrowth.

Fertilisers

The input to agricultural soil of nitrogen from fertilisers has increased by over 300% since 1960, whereas the production of manure by farm animals has remained fairly steady over the same period. The consumption of nitrogen from fertilisers has stabilised at a level of about 400,000 tonnes from the end of the 1970s up to 1993. The latest figures for 1993 show a drop in consumption; see Fig. 7.5.

The increase in the crop yield over the same period has been less than the increase in fertiliser use and, therefore, the proportion that is transported away in the harvested crops has dropped. The increased use of fertilisers has therefore resulted in increasing quantities of nitrogen being transported into the surrounding environment.

It is difficult to determine precisely the extent to which the use of fertilisers has affected biodiversity in the open countryside. However, it is clear that the increased use of fertilisers has been an underlying condition for the specialisation that has taken place in agriculture and, thus, in the homogenisation of arable land.

The use of fertilisers is also significant to our small biotopes, to which nutrients are easily spread by wind and rain. Here, species that can metabolise large quantities of nutrients are favoured over the many other, often specialised, species. This applies to both the dry and, especially, wet biotopes that have received nutrients from adjacent agricultural areas.

The significance of nitrogen leaching to biodiversity in our seas, lakes and watercourses is treated in Chapters 4 and 6.

Pesticides

The consumption of pesticides increased by a factor of five from the mid-1950s to 1984, when the greatest use was observed - a total of 7,500 tonnes active ingredient; see Fig. 7.6.

The use of pesticides has a detrimental effect on wild plant and animal life. An investigation of 64 pesticides showed that most of the insecticides that we use today kill not only the targeted pests but also many useful insects. Half of the weed-killers also had a powerful effect on useful insects, whereas fungicides had only little effect.

Air pollution

The biodiversity of the open countryside is also affected from the air, especially through nitrogen deposition. Increasing

motor traffic, the changeover from the oil-firing of power stations to coal-firing and the evaporation of ammonia from liquid manure have been the most important causes of the increasing quantity of nitrogen in the atmosphere.

A number of low-nutrient ecosystems, such as heaths and raised bogs, are especially sensitive to the increased nitrogen content of the atmosphere and the consequent deposition of nutrients from the air. These ecosystems are adapted to low-nitrogen conditions.

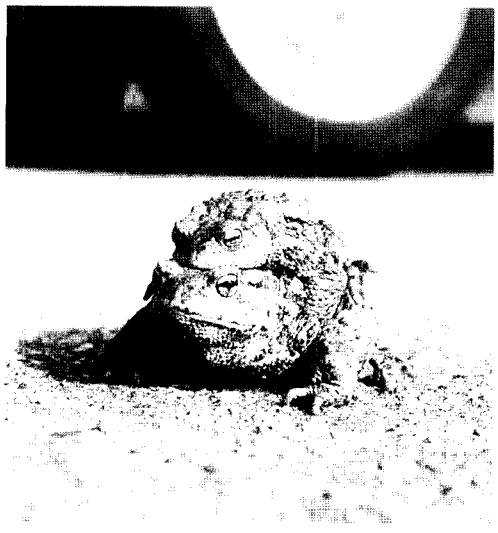
Damage to lichens and increasing immigration of grasses have been observed on Danish heaths that have rich growths of reindeer moss and heather. This overgrowth has taken place at the expense of the slow-growing lichens and heather. It has also been shown to coincide with increased concentrations of nitrogen in the lichens and soil. Studies of vegetation assemblages on Danish raised bogs have revealed the immigration of more nutrient-demanding types of grass, birch and willow on raised bogs. In the long term, maintenance of the characteristic flora of heaths and raised bogs is therefore dependent on our reducing the deposition of nitrogen.

The deposition of *sulphur* also has a harmful impact on biodiversity, not least in our lakes, although the amount of sulphur in the atmosphere has been significantly reduced over the last 15 years.

Ozone, which is occurring in ever-increasing concentrations, has shown itself to have a very harmful effect on many plant species. Volatile organic compounds (VOC) are a significant factor in the formation of ozone. VOCs are emitted from natural and artificial sources, with road traffic as the main artificial source.

Urban development and traffic constructions

Urban development and traffic constructions have taken over large areas of the open countryside over the past 50 years. Apart from the fact that habitats of flora and fauna have been lost, habitats have also been split and animal life has been disturbed. This has also been the indirect cause of the above-mentioned cultivation of natural areas, especially wetlands, since agriculture was to receive compensation for the *lost* areas.



A busy highway runs across the way to the breeding pond.

Traffic mortality

It has been estimated that about 8 to 10 million mammals, birds and amphibians are killed annually on Danish roads. Small birds and amphibians comprise the greater part.

Protective measures

A number of significant changes have been made in agricultural and environmental policy, particularly since the end of the 1980s. Together with the general structural development of agriculture, they have in the last few years brought about an improvement in the trend of the impact on plant and animal life on arable land that started after the Second World War. The measures taken have in several cases been expressions of major action plans and strategies.

There have been changes in economic

conditions and in the sets of rules that are important to agricultural land use. Because of this, only little direct intervention has taken place in semi-cultivated areas and small biotopes, e.g. in the form of rotation, plantation and urban development.

Physical planning

Since the mid-1970s, physical planning has been an important instrument for safeguarding not only the aesthetic qualities of the landscape but also the conditions of life of plants and animals in the open countryside. Certain types of land use are regulated through physical planning - building and construction activities, in particular and, to some extent, afforestation.

Attention is given to biological interests on two levels in our physical planning. Overall, in the form of regulations and guidelines for subsequent planning and administration, and materially, in the form of local plans and zone permits connected with projects or permits pursuant to other legislation, in cases where conformity with physical planning is required, for instance, the extraction of raw materials on dry land.

As far as physical planning is concerned, there are requirements at all levels on the publication of planning proposals, and on the availability of opportunities for commenting on such proposals, before a final decision is reached. This makes it possible throughout the entire process to include new scientific knowledge, e.g. on natural conditions, and to take it into account in any final project.

As an instrument of nature conservation, the quality of physical planning is tied to broad geographical coverage and to opportunities for including the interests of nature at an early stage in decisions on building, construction, etc. On the other hand, it is not possible to impose mandatory action through planning. Thus, although we can protect valuable areas against other use we cannot specify a desired condition for these areas. Neither are plans final. They can be changed (and thus become undermined from the standpoint of the environment) should the planning authorities find that other considerations have higher priority.

Conservation

The first Nature Conservation Act came into force in 1917. From that time up to the 1960s, the single most important instrument for protecting nature in the open countryside was the *conservation order*. Regardless of the other tools that

Fig. 7.7

Protection of the nature types and small biotopes of agricultural land under the Nature Conservation Act (now Nature Protection Act) from 1972 to 1991.

*Natur type**	1972	1978	1981	1991
Lakes	all natural lakes	all>0,10 ha	all >0,05 ha	all >0,01 ha
Watercourses	public watercourses	public+private	public+private	do. public+private+ 2m zones
Bogs	-	>0,50 ha	>0,50 ha	>0,25 ha
Salt marshes, seamps and coastal meadows		-	->3 ha>	0,25 ha
Heaths	-	-	>5ha>	0,25 ha
Humid permanent grassland and uncultivated dry grassland	-	-	-	>0,25
Stone and earth dikes	-	-	-	all

**Hedgerows, field barriers, ditches, scrub and small plantations are not protected.*

have become available since then, the conservation order has remained the central instrument in our nature protection programme. Conservation orders make it possible to specify provisions for the management of an area, for the purpose of sustaining or developing the qualities that comprise the underlying reason for which conservation is desired. Since the introduction of the instrument of the conservation order (in conjunction with the adoption of the first Nature Conservation Act), 190,000 ha of dry land, or 4% of Denmark's area, have been conserved. A large proportion of these conservation orders have been made for the purpose of protecting the habitats of plants and animals.

When the conservation effort started, there was still no awareness of just how dynamic was the natural succession of nature types, or of the relationship between grazing and the maintenance, e.g. of meadows, heaths and uncultivated dry grassland. Several of the oldest conservation orders therefore included prohibitions against doing anything at all. Although such categorical prohibitions more or less disappeared later, several decades were to elapse before it became normal to include management provisions in conservation orders. Most of these problems have now been resolved through amendments to the Nature Protection Act.

With a view to giving priority to the conservation effort during the coming years, the Ministry of the Environment promulgated an action plan in 1992, which was drafted in close collaboration with the county councils and the Danish Society for the Conservation of Nature. In the biological area, this action plan contains desires for the safeguarding of new areas through conservation, nature management, nature restoration and modernisation of the management provisions of certain old conservation orders. The areas that are covered by the action plan have, thus, been included largely for the purpose of safeguarding and improving the conditions of plant and animal life.

Protection of nature types

A number of nature types have been covered by a general conservation scheme since 1972. This scheme has the effect that nothing that changes the natural condition of the relevant areas can be carried out without obtaining exemption from the relevant county council in advance. Appeals against decisions made by the county councils can be lodged with the Nature Protection Board of Appeal, where they will be decided by the Board itself or referred to the Danish Forest and Nature Agency for a decision.

As a result of the advancing impairment and diminution of uncultivated or extensively cultivated nature areas, this scheme has been extended on several occasions - most recently through the adoption of the Nature Protection Act, which extends coverage to humid permanent grassland, uncultivated dry grassland, and stone and earth ditches.

It is estimated at present that about 40,000 ha of coastal meadow, 70,000 ha of heath, 45,000 ha of humid permanent grassland, less than 10,000 ha of uncultivated dry grassland, 50,000 ha of bogs and 200,000 lakes and ponds are within the scope of this legislation. This corresponds to just under 10% of Denmark's total area. About 28,000 ha of watercourses, which have been registered as worthy of conservation by our county councils, are also protected under the Nature Protection Act; see Fig. 7.7.

The 2-metre uncultivated zones along our watercourses, which were prescribed in an amendment to the Watercourse Act of 1992, are also part of the overall pattern of protected nature types in Denmark, even though their main purpose is not nature conservation.

The rules governing protected nature types are administered strictly and have been of considerable help in slowing the

rate of, or stopping, the phenomenon of elimination of nature.

Land reclamation, draining and watering stopped

State subsidies for the establishment of irrigation plants were stopped in 1983 and subsidies for draining, as of 1987. Prior to this, subsidies for new land reclamation works (draining, damming, diking and new cultivation of heaths, marshes, shallow lakes and suchlike) ceased when the Land Reclamation Act was repealed in 1967. Subsidised land reclamation projects totalling 161,800 ha were carried out before 1967.

With the adoption of the Ochre Act (1985), it was decided that draining without a permit was to be prohibited in specially-designated areas, the ochre potential of which was high. These areas cover a total of about 296,000 ha in Jutland. This legislation has helped to reduce draining activities in low-lying land and has also helped to increase the marginalisation of these areas.

Marginal Land Strategy

Parliament adopted the overall Marginal Land Strategy in 1987. Its main goals were:

- to preserve uncultivated and extensively cultivated areas;
- to protect areas of particular environmental sensitivity, such as watercourses, lakes and uncultivated dry meadows;
- to avert the consequences of marginalisation in cases where the cessation of cultivation is considered to be unacceptable for scenic reasons or out of consideration for local communities; see Box 7.8.

The points of departure of this strategy were increases in agricultural production, stiffer competition, and falling prices on the international markets, which were responsible for increasing marketing difficulties for a number of the traditionally important agricultural products within the EU. It was foreseen that developments could relatively quickly result in large parts of the agricultural area being taken out of conventional intensive operation - a new pattern that breaks with a century of development in European agriculture.

In relation to these areas,- the strategy was intended to promote extensification or other environmentally-oriented agricultural production, afforestation and the maintenance or restoration of these areas as nature areas.

Box 7.8

What is marginal land?

Marginal land is an area in which the certainty of cultivation and the profits gained therefrom are low, and in which the costs of cultivation are so high that agricultural use of the land is no longer profitable. Typically, marginal land includes dry, sandy soil (where much water is needed), areas close to watercourses, low-lying land (with a high need for draining) and steep slopes. In addition, there are the small biotopes, such as hedgerows, field barriers, ditches and ponds.

The concept of marginal land is dynamic. The cultivation value of the soil and the prices of agricultural products depend on international trends in agricultural policy and on international marketing conditions.

Nature restoration and nature conservation

The Marginal Land Strategy was the signal for a major nature improvement effort and brought with it a number of changes in the Ministry of the Environment's and Ministry of Agriculture's legislation. The most important was the *Nature Management Act* of 1989, which was an economic framework law that ensured that our annual budgets would include funds with which the Ministry of the Environment could promote the objectives of the law. Moreover, the act also enabled the State to exercise its option to buy and expropriate land. Apart from nature restoration, nature conservation and state afforestation programmes, the goal was also to improve the population's opportunities for outdoor activities. The Nature Management Act was integrated into the *Nature Protection Act* when the latter was adopted in 1991.

The restoration of destroyed ecosystems and conservation of ecosystems that, although threatened, still remain is one of the most vital measures in our efforts on behalf of biodiversity. Lakes, coastal meadows, humid permanent grassland, bogs, watercourses, uncultivated dry grassland and heaths have been conserved and restored since 1989. Finally, a large number of ponds have been established or re-established, cf. Chapter 6.

In many cases, *nature management* is a matter of maintaining such traditional agricultural practices as grazing and hay harvesting, in order to prevent areas from changing character. Pursuant to the Nature Protection Act, county councils *are permitted* to tend conserved areas, when such tending promotes the purposes of conservation. Otherwise, many new conservation orders set regulations on management. In addition, districts and counties have a *duty* to tend their own areas that fall within the scope of our general nature type protection legislation. This means that they are obliged to ensure that the nature content of such areas remains unimpaired.

Fig. 7.9
Sizes of areas in the individual categories of nature type that have been restored, acquired or conserved for State or county funds, 1989 to 1993.

Nature type	Total
Fjord (ha)	2450
Lake (ha)	1326
Watercourse/millpond (number)	1604
Watercourse (m)	59180
Barrier	6
Coastal meadow (ha)	2243
Humid permanent grassland (ha)	2295
Bog (ha)	1935
Heath (ha)	4784
Uncultivated dry grassland (ha)	1273
Oak underwood and suchlike (ha)	103
Ancient monuments	62 ha + 296 stk
Other nature (ha)	296

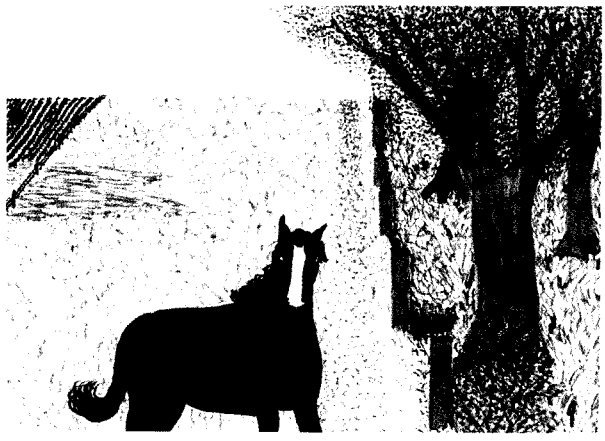
The Ministry of Environment and Energy's uncultivated areas total about 48,000 ha. They include bogs, humid permanent grassland, coastal meadows, uncultivated dry grassland, heaths, unused coppice forests and ancient monuments. About 2/3 of these areas were under regular management in 1993 and by far the greater part of our most delicate nature types, such as humid permanent grassland and uncultivated dry meadows, were being managed.

Other state authorities also dispose of nature areas. For instance, the *Ministry of Defence* has nature areas totalling 32,000 ha.

During the period 1989 to 1993, the nature restoration and management efforts of our county councils have covered, for instance, about 7,850 ha of bogs, coastal meadows and humid permanent grassland, about 4,100 ha of heath and more than 1,300 ancient monuments.

During the same period, DKK 278 mil-

lion (including EU subsidies) has been used for nature restoration and management, and about DKK 233 million, for afforestation. Altogether, about 5,550 ha of nature have been restored and 3,750 ha of state forest have been planted, of which 60% is deciduous forest; see Fig. 7.9.



Re-allocation of land

Most of the large nature restoration projects, and all of the afforestation projects, that are carried out with State nature management funds have had the result that the State has acquired the areas concerned. This has ensured full compensation to the land owners involved, long-term security for the implementation of projects and a fixed framework for the future management of these areas.

In this context, *the re-allocation of land* has been a vital measure that is currently being used for the implementation of about 10 large nature restoration and afforestation projects.

The advantage of re-allocating land is that it yields an overall solution, which satisfies the need for gathering - often marginal - agricultural land in project areas for public ownership. The property structure of the area is also improved since the surrounding properties gain better and more easily cultivated areas, in exchange for the low-lying areas that they give up.

Action plans for aquatic environment, sustainable agriculture and pesticides

Apart from the initiatives mentioned above, three major action plans have emerged over the past decade. Although each of them is of individual significance to biodiversity, the main accent is on the diffuse loading on the balance of the material cycle, rather than on the physical biotopes. The primary goal of these action plans has been to reduce the loading imposed by nutrients and substances alien to the environment on the ecologi cal material cycles. In recent decades, these substances have shown themselves to have detrimental effects, not only on the aquatic environment but also on plant and animal life on land.

The *Action Plan on the Aquatic Environment* of 1987 resulted in a number of initiatives intended to restrict the total discharges of nitrogen and phosphorus by 50% and 80%, respectively, in the *sewage* of agriculture, industry and urban areas, before 1993. According to the plan, agriculture shall reduce its discharge of nitrogen by an annual 127,000 tonnes, in part through the establishment of storage capacity for manure from domestic animals. However, it was noted in a status report of 1990 that it would not be possible to attain this goal through the initiatives that had been started. Against this background, the government at the time set forth the *Action Plan for Sustainable Development in Agriculture*, which contained a number of new initiatives. In this action plan, the goal of halving the input of nitrogen was retained, but the time allowed was extended to the turn of the century. This plan will be assessed during Parliamentary year 1995/1996. The measures used so far for reducing nitrogen input include,

for instance, requirements on the storage and application of manure from domestic animals, on the drafting of fertilisation and crop rotation plans and on the dissemination of information and advice.

A sharp increase in the use of pesticides was noted in the mid-1980s. For this reason, Parliament adopted a proposed resolution on the *Action Plan for the Reduction of Pesticide Use*, the goal of which was to reduce use by 25% before 1990 and by a further 25% before 1997. Use was to be restricted in terms of the quantity of active ingredient and the frequency of application. The frequency of application indicates the number of times an agricultural area can be treated in the course of a year, provided that the recommended dose is used. The primary means of attaining this goal were through advice, guidance and research.

The latest studies have shown that the reduction in pesticide *consumption* is now very close to the target, whereas the *frequency of treatment* is still very far from our set goal. Consumption can drop without a corresponding drop in treatment frequency because the tendency today is to use pesticides that are active in extremely small doses. Thus, lower consumption does not necessarily result in a lower loading on the environment.

EU Common Agricultural Policy

The EU Common Agricultural Policy (CAP) was adopted in 1992 and became effective as of the autumn of 1993. It has its background first and foremost in a number of unfortunate effects of the Common Agricultural Policy that had hitherto been pursued, in the form of budget problems, excess production, falling profits and environmental problems. The policy should also be seen in the light of the requirements set on the Union in the GATT agreement of 1993 (on the liberalisation and opening of the markets of the member states, e.g. for agricultural goods) and on the reduction of agricultural subsidies.

This policy contains two main elements: the restructuring of market organisations, including the introduction of a set-aside scheme, and its accompanying measures. The restructuring of the market schemes for vegetable products has the character of a transition from production subsidies to area subsidies. Where, formerly, the more a farmer produced, the greater the subsidy he received, subsidies are now calculated as fixed annual premiums/hectare that are dependent on what he produces and, to a certain extent, on how he produces it.

Set-aside scheme

This part of the policy is financed to 100% by the EU, and a 27% drop in the corn price over a three-year period is the central issue. In compensation for the loss of income this price drop causes the farmers, area-related aid can be payable. These subsidies are coupled to a set-aside requirement in the case of farms of over 17.6 ha.

Such set-aside can be implemented as either the annual rotation fallowing of 15% of the area for which subsidies are sought, or as the 5-year fallowing of 18%. The higher percentage has been set to ensure the same drop in production as in the case of 15% set-aside, as it is expected that farmers will set aside their least productive fields for five-year periods. Set-aside percentages have been reduced to 12% and 15%, respectively, for the 1995/1996 cultivation season. Danish set-aside subsidies were DKK 2,781/ha for the 1994/1995 season.

Set-aside fields shall be covered with vegetation and must not be cut during the period 1 May to 30 June, out of consideration for birds and young game animals. Set-aside fields can be used for non- food crops. They must not be fertilised or sprayed unless they are used for non-food. Set-aside fields must *not* be grazed or afforested. About 250,000 ha, or about 9% of our total agricultural area, were set aside during 1993/1994.

As of 1994/1995, the environmental effect of set-aside has been slightly improved through the possibility of extending access to the transfer of set-aside obligation to the environmentally sensitive areas (ESA) mentioned below.

Accompanying measures of EU CAP

The main purpose of the accompanying measures' forest, nature and environmental support schemes is to emphasise the double role of the farmer as a producer and manager of the environment. Another goal is the conservation of biodiversity. It is the subsidy schemes that advance the transition to a less intensive form of operation that gives greater consideration to natural conditions. These measures are also expected to contribute to a reduction in excess production, while they still ensure reasonable incomes for farmers.

Subsidies can be granted for:

- reduction of nitrogen consumption unsprayed marginal zones
- conversion of agricultural land to pasture
- maintenance of pasture areas
- sowing of Italian rye grass in grain crops
- setting aside agricultural land for 20 years
- demonstration projects that concern environmentally-oriented methods transition to organic farming
- development projects concerning or ganic farming
- afforestation
- forest improvement
- planting of hedgerows.

These schemes are voluntary, are financed half by the EU and half by Denmark and will be managed by the Ministry of Agriculture and Fisheries. The foundations of these schemes are to be found in the *Act on support for the structural development of agriculture and for organic farming* and *Act on hedgerows and subsidies for the planting of hedgerows, etc.*, which were adopted in 1993.

As a stage in setting targets for the subsidy schemes, the county councils designated 350,000 ha of land as *environmentally sensitive areas* (ESA) in 1994. The schemes of subsidies for unsprayed marginal zones can only be granted for areas within the designated ESAs, and the subsidies for the 20-year setting-aside of agricultural land can initially only be granted in ESAs in the Viborg and Århus counties of North Jutland. The other schemes are offered to all farmers, although with increased subsidies for land within the designated areas.

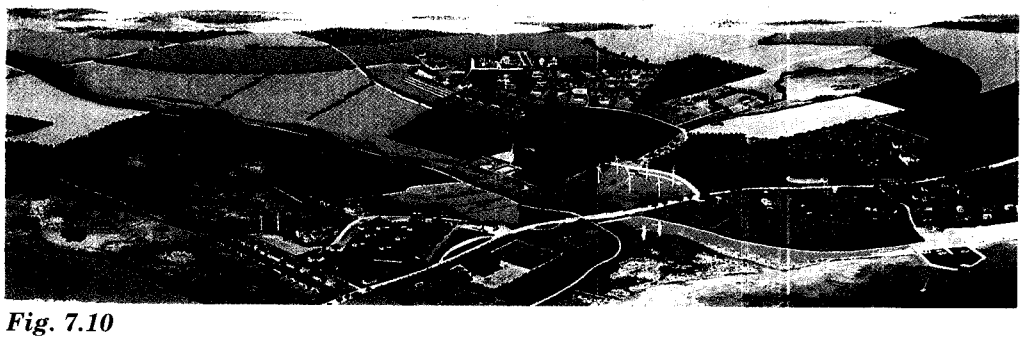


Fig. 7.10

Agricultural land 30 years hence; a vision of the future that has space for wild plants and animals, cf. Fig. 7.2, watercolour by Beth Beyerholm

The environmentally-conditioned transfer of set-aside obligation will be targetted to the ESAs.

Forthcoming efforts

Overall goals

In comparison with many other countries, Denmark is a fertile and relatively easily cultivated country. By far the greater part of its total area has been cultivated and, over the years, draining projects, watercourse regulation, heath cultivation, hedgerow plantation, etc., have created the open countryside that we know today.

The open countryside of the future will also be the result of cultural influences, exactly as is today's landscape. The cultural landscape is dynamic, as forms of operation are constantly changing which, once again, affects biodiversity. A meadow becomes overgrown if it is not grazed or harvested. Thus, it is not a question of whether or not we can permit any impact on the open countryside but, rather, of the nature and degree of our impact.

The basic point of departure for our forthcoming efforts is that the past 50 years of cultural impact on the open countryside has been excessive since it has resulted in a considerable loss of biodiversity and culture-historical evidence of earlier forms of operation.

353 plant and animal species have disappeared since 1850 - and five of them disappeared in the 1980s. There is reason today for being cautiously optimistic that we can turn this trend. The pronounced reduction of biodiversity that occurred in the open countryside, from around 1950 up to the end of the 1980s, appears to have been halted and, in some places, even transformed into an increase in the diversity of biotopes and plant and animal species that characterised the open countryside up to the middle of this century.

This trend must be sustained and reinforced. The goal of future development of the open countryside is that it does not take place at the expense of biodiversity but, on the contrary, that it contributes to sustaining it and also recovers the losses that have occurred over the past 50 to 100 years.

Farmers as nature managers

Many social factors have contributed to lowering the biodiversity of the open countryside. However, it is the structural development of agriculture that has had, and still has, the strongest influence on the present state of biodiversity.

Throughout the 1980s, EU agriculture has overproduced as a result of the subsidised prices of agricultural products. Moreover, its detrimental consequences to nature have become more pronounced as a result of ever-more intensified agriculture and of the specialised range of crops. The environmental costs of separating *production* and *protection* too widely have shown themselves to be high. For this reason, the agriculture of coming decades must combine to a higher degree the production of healthy products with the protection of nature and the environment. The central role of farmers will, of course, remain the production of wholesome, healthy foodstuffs but, at the same time, the farmer must also become a *manager of nature* to a greater extent than is now the case. He must therefore also be assured of payment for the environmental benefits that he will produce and that society demands in increasing quantities.

In the case of agricultural land in normal rotation, the instruments used will be the extensification of production, the sustenance of our small biotopes, the establishment and maintenance of new ecological corridors and the reduced application of fertilisers and pesticides. In the case of land that is taken out of rotation, more effort can be devoted to the actual restoration or recreation of small biotopes, and to the *in situ* conservation of cultivated plants and earlier types of domestic animal, as well as to the main-

Box 7.11

Vojens/Haderslev subglacial stream trench - an example of planning an ecological corridor through the coordination of tools

As one phase of the national planning memorandum „Denmark on the way to 2018", the Ministry of Environment and Energy launched a textbook project on the planning of an ecological corridor in the countryside in 1993. One of the areas within the scope of this project is the Vojens / Haderslev subglacial stream trench. Through the propagation of information and local cooperation between land owners, authorities and special interest organisations, this project is intended to illuminate ways in which a coherent network of nature areas can be established for the benefit of our flora and fauna, by the target-oriented application and coordination of the different economic support schemes and other tools.

The Vojens / Haderslev trench is an important agricultural area in which large pig farms, etc., are established, but it also contains a number of forests and other nature areas. The Vojens and Haderslev local councils, the Ministry of Environment and Energy and the South Jutland County Council have cooperated for several years on a variety of nature restoration projects prior to this project. Uncultivated dry grasslands and a lake have been restored and a major afforestation project has been launched. Biomanipulation, which has increased the visibility depth considerably, has been carried out in Haderslev Dam.

As nature and environmental improvements shall be spread into the agricultural areas, it is also vital that the individual farmers participate actively. The „neighbour effect" (understood here to refer to favourable mention and inspiration) is important. Information material has been prepared that describes the specific subsidy and support schemes available for the improvement of nature and the environment on agricultural land, and Haderslev local council has also established a „green corps" that can assist in minor felling and plantation operations.
This project ran until the end of 1995.

tenance of present small biotopes; see Fig. 7.10.

Goals for land use

Calculations carried out in connection with the Action Plan for the Sustainable Development of Agriculture show that between 250,000 and 438,000 ha will probably be taken out of production up to the year 2004. Of this, between 184,000 and 371,000 ha will be marginalised or set aside. Thus, the way is clear for us to link the changed pattern of land use together with the political goals set for our nature, environment and forestry while giving consideration to the conservation of our biodiversity.

The overall goal for the use of marginalised agricultural land is to safeguard our environmental and natural goals, including those for maintaining biodiversity and for ensuring a certain degree of flexibility in land use. Flexibility is included to provide for possible future needs for agricultural land.

Part of the marginalised land will be taken out of agricultural use entirely. The goal is to increase over the next 30 years the lake and watercourse area from 65,000 ha to 95,000 ha and the for-

est area, from 500,000 ha to 650,000 ha, cf. Chapter 8.

The remaining marginalised agricultural land, which must be assumed to amount to about 250,000 ha, should be transformed into permanent pasture. Such use of the land provides for natural considerations and considerations of flexibility, since the need for management should be taken into account in any deliberations on land use.

Ecological network through coordination of measures

Our forthcoming nature effort must be aimed to a greater extent at entire landscapes - at ecological landscape planning. The still-increasing agricultural areas that are being marginalised help us towards this goal.

The objective is to conserve and recreate true *ecological networks* all over the country, through a mosaic of core areas interconnected by corridors that are designated in the regional plans of the counties. Such an initiative within and across the regions could form the Danish contribution to the work in progress at the European level, which is intended to develop ecological networks in the EU, through the EC Habitats Directive and, at the Pan-European level, through following up the Nature Conservation Conference of Maastricht, in 1993.

We *do have* the necessary means today for attaining such a goal, in the form of physical planning, conservation orders, general habitat protection, designation of conservation areas pursuant to the EC Habitats Directive, nature restoration and management and the subsidy schemes for agriculture. These tools must be closely coordinated and interact smoothly, through efficient cooperation between the authorities involved, i.e. the Ministry of Agriculture and Fisheries, the Ministry of Environment and Energy and the county councils; see Box 7.11.

Such a coordinated effort could be advantageously aimed at *entire river valleys*, as was mentioned in Chapter 6. Through the establishment of protection zones along rivers, it will immediately become possible to create large, coherent biotopes and ecological corridors and to restrict the input of nutrient salts to the aquatic environment.

EU CAP as a tool

It should be possible to make greater use of the EU CAP for the benefit of biodiversity.

As has already been mentioned set-aside, which is linked to area-related aid, covered about 250,000 ha, or 9%, of our total agricultural area. The accompanying measures of the EU CAP also make it possible to grant subsidies for the setting

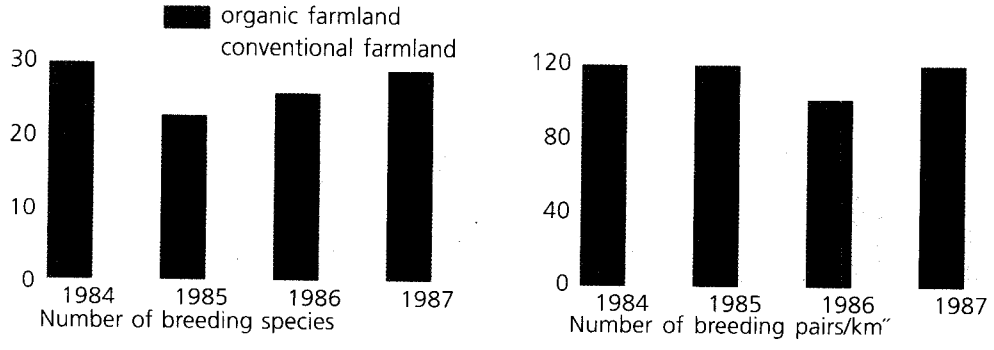
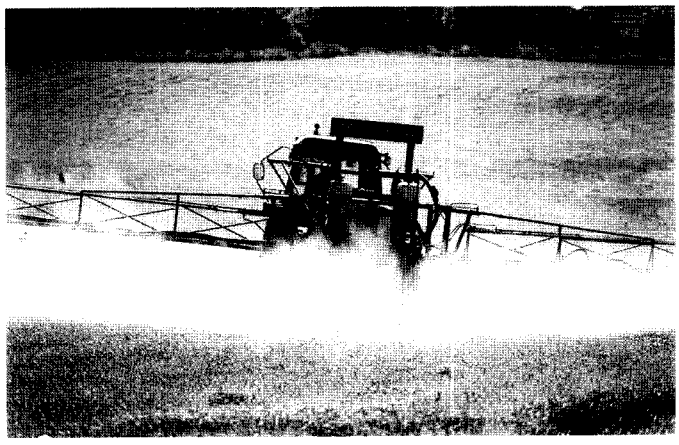


Fig. 7.12
Numbers of breeding birds in conventional and organic farmland.

aside of land for 20-year periods. It is expected that about 20,000 ha will be brought into the 20-year set-aside scheme.

In itself, the total setting aside of about 9-10% of our agricultural area offers potential for improving the living conditions of wild plants and animals in the open countryside - not least in the matter of permanent set-aside. The fact is that a permanent vegetation mantle gives better conditions for wild plants and animals. In addition, fertilisers and pesticides will no longer be used on the areas in question and the passage of machinery will be restricted. Finally, we can assume that the farmers will take out their least productive and most inaccessible areas, thereby creating or recreating a number of small biotopes.



The problem is however that, at the present relatively high set-aside subsidy (currently DKK 2,781/ha), there is little urgency in allowing areas to be taken out of agricultural operation completely. This means that the degree of marginalisation that could reasonably be expected, considering the drop in prices of vegetable products, is less pronounced than would otherwise be the case.

The environmental and nature effect of the set-aside scheme would be extended considerably if it were possible to include as satisfying set-aside obligations areas taken out of production for afforestation, grazing or other nature-promoting purposes. It must be assumed that many farmers abstain from taking advantage of the EU CAP accompanying measures precisely because they covered areas that cannot be counted as CAP set-aside.

Denmark wishes to work within the EU to promote these attitudes.

CAP accompanying measures

In contrast to the mandatory set-aside scheme, the subsidised schemes for different agricultural measures (which are an expression of the so-called *accompanying measures* of the EU CAP) clearly promote environmental and nature aims. In 1994, the scheme was expressed in 4 statutory orders governing subsidies for environmentally oriented agricultural measures, forestry schemes, planting of hedgerows and ecological agricultural production.

These subsidy schemes can be expected to promote the integration of considerations of the environment and nature into agricultural production, while they are also a useful supplement to the nature protection effort now in progress under the auspices of the Ministry of Environment and Energy and the counties. However, it should be emphasised that the approximately 800 million ECUs that are reserved for the CAP accompanying measures only constitute about 4% of the annual budgets for Common Agricultural Policy. The subsidy schemes first became effective during the spring of 1994. Their success will largely depend on whether or not they are perceived as a sound economic incentive by farmers.

Promoting organic farming

The accompanying measures' subsidy scheme for *ecological agriculture* represents a significant increase in the support available for this type of operation. Denmark is in the vanguard of organic farming in the EU and, from 1987 to 1992, about 14,500 ha have received subsidies for the transformation to ecological operation. The scheme can be expected to lead to a sharp increase in the number of areas that are transformed, while the possibilities of obtaining subsidies for development projects in production and marketing, research, training and presentation, are improved. As has been mentioned above, plant and animal life is more variegated on organically-farmed land than on conventionally-farmed land; see Fig. 7.12.

Recent years have witnessed a sharp increase in the demand for organically cultivated foodstuffs. The Ministry of Environment and Energy and the Ministry of Agriculture and Fisheries wish to support this trend and are working for the more widespread introduction of organically cultivated products in public purchasing agreements. These two ministries will also work to establish an *ecological advisory service* for industrial kitchens that wish to use organically cultivated products.

The Government decided on 1 November 1994, that transformation to organic farming shall be included as a part of the strategy for attaining a pesticide-free water table. As a result of this, the Ministry of Agriculture and Fisheries will present an action plan for organic farming during 1995.

The Ministry of Environment and Energy, which manages about 15,000 ha of agricultural land, will study the possibilities of operating these areas according to the guidelines for organic farming.

Nature restoration

In principle, it is only restrictions on appropriations that set the upper limit for our efforts on behalf of nature restoration. The interest and need for nature restoration and afforestation are both great. Thus, the number of applications for extremely well-founded nature-restoration projects far exceeds the number that can conceivably be supported by the State's nature restoration funding.

When the Marginal Land Strategy was presented in 1987, it was expected that about 162,000 ha of land would be taken out of agricultural production as we approach the year 2010. As mentioned above, the Ministry of Agriculture and Fisheries' calculations show that between 250,000 ha and 438,000 ha will be taken out of production by the year 2004.

As the setting aside and extensification of agricultural areas is proceeding faster than was expected when the Marginal Land Strategy was issued, and as there is a *demand* for nature restoration - even among the land owners involved - *the nature restoration effort should be reinforced in the future*; see Box 7.13.

Our effort should continue to be based on the goals of the Marginal Land Strategy: *the comprehensive recreation of the*

Box 7.13

Article 8f of the Convention on Biological Diversity, 5 June 1992:

„Each Contracting Party shall as far as possible and as appropriate: ... f) rehabilitate and restore degraded ecosystems and promote the recovery of threatened species, *inter alia*, through the development and implementation of plans or other management strategies."

habitats - biotopes - which have, in principle, characterised the Danish landscape up to the middle of this century, but which disappeared as a result of technical advances and structural changes in agriculture. This applies to wetlands in particular, but also to such nature types as uncultivated dry grassland and heath.

To the greatest possible extent, restoration should be coordinated with and supplement the subsidy schemes that support ecological agricultural measures. Restoration efforts should be directed in the first place towards the environmentally sensitive areas (ESA).

Great importance must also be attached to gaining the voluntary cooperation of land owners in the implementation of our projects. This means that, as has so far been the case, expropriation for nature restoration should only be used in quite extraordinary situations. The re-allocation of land, however, should remain an important means in the implementation of these projects.

Nature restoration of wetlands

So-called *pumped* areas - previously shallow lakes, arms of fjords, dammed coastal meadows and similar drained stretches of coast - constitute about 140,000 ha, or 5%, of our agricultural area.

These areas are especially interesting. In the first place, they represent nature types that have disappeared largely as the result of draining and land reclamation, and which exhibited richly varied biodiversity. Apart from their direct significance as habitats, recent studies have shown that they also have a highly significant, environmentally-improving effect on the retention of phosphorus and, in particular, on the degradation of nitrogen compounds. Meadows, reed swamps and other similar shallow wetlands will typically reduce the nitrogen loading in the freshwater recipient areas by about 400 kg/ha/year, so that a relatively small, shallow lake or reed swamp, for instance, of about 25 ha, could remove about 10 tonnes of nitrogen annually. Thus, the large-scale restoration of such areas is also of relevance as a contribution to attaining the goal of the Aquatic Environment Action Plan of reducing nitrogen input by *145,000 tonnes.*

Additionally, these areas have a mar-

Box 7.14

Alsønderup Meadows - a nature restoration project

The Alsønderup Meadows area lies in Northern Zealand, close to the highly polluted Lake Arresø. Up to 1986, the Meadows was a marginal agricultural area that could no longer be cultivated profitably. 57 ha were flooded in 1986 and turned into a shallow wetland.

Since 1986, Alsønderup Meadows has developed from an area that was becoming overgrown into a bird sanctuary of national importance. Today, it is possible to see, e.g. large populations of breeding ducks, grebes, ruffs and reeves and resting whooper swans.

Since 1987, 48 species of bird have been registered as breeding here, of which several are Red-Listed species, and a total of about 200 different species of bird have been observed in this relatively new nature reserve.

The development of Alsønderup Meadows corresponds to that which is happening in a number of other newly-restored nature areas. Active nature restoration re-establishes habitats in the countryside, to the benefit of wild plant and animal life.

ginal character in many - but not all - cases. This is because cultivation is too costly due to the recurring costs of pumping out water and for the maintenance of pumping and drainage systems, ditches, etc. Nowadays, several of the drainage associations that operate such areas have therefore become interested in stopping cultivation of these drained areas.

This means that the Marginal Land Strategy's goal, i.e. of restoring a minimum of 20,000 ha of previously drained wetlands, lakes, arms of fjords, etc., within the next 10 to 20 years, must be retained. Another goal is that 30,000 ha shall be restored in the course of 30 years; see Box 7.14.

The former wetlands that are to be restored should be given priority since this gives the greatest possible environment and nature gains, not least of which is the reduction in nitrogen input. The Ministry of Environment and Energy will invite the Ministry of Agriculture and Fisheries and the counties to cooperate on the drafting of a nation-wide action plan for the nature restoration of drained wetlands. In 1993, the regional plans were amended with guidelines, which ensure that areas that offer potential for nature restoration can be safeguarded against constructions that would be capable of preventing such a programme. Lakes that are too close to airports should not be restored due to the increased risk of collision between aircraft and birds.

Registration of protected nature types

The counties are in the process of recording protected nature types. Areas are being identified with the aid of aerial photography and through field work. Plant and animal life has also been recorded in many cases, as part of the field work.

It is expected that this registration programme will give a far better foundation on which to assess the country's nature resources than has previously been available. Consideration should also be given to following up the registration programme, which is to receive continuous maintenance, with a *quality assessment* of our protected nature types.

Conservation of state-owned areas

The Ministry of Environment and Energy increases the priority of nature conservation in its approximately 48,000 ha of nature areas. This programme is subject to economic constraints and it is therefore vital to specify the principles according to which priority will be assigned.

In the short term, a number of demonstration areas will be designated, in which the effects of different types of conservation can be observed and determined. Moreover, a set of indicators will be selected that can be useful in the task of choosing areas in which conservation efforts should be made.

In the long term, the Ministry of Environment and Energy will draft specific conservation regulations for all areas in need of conservation. The Ministry will also draft regulations to govern the documentation of nature-conservation costs and the changes in nature conditions that result from both conservation and natural development.

Ministry of Defence areas total about 32,000 ha and include in many cases distinctive, partially untouched nature areas rich in biodiversity. Pursuant to the Ministry of Defence environmental strategy of 1993, the Ministry will work to conserve, protect and, if possible, restore its nature areas. The implementation of this programme shall take into account the statutory requirements on the Ministry of Defence.

In cooperation with the Ministry of Environment and Energy, the Ministry of Defence has started to draft conservation plans for its areas. These plans will contain, e.g. guidelines on the use of the areas, with consideration for attaining an appropriate balance between the defence

forces' need for training activities and the interests of nature. These plans will also contain guidelines for the restoration of wetlands, the reduction of fertilisation and an extended conservation programme for the benefit of protected nature types.

Natural development

Our efforts to preserve biodiversity in the open countryside are not *just* a matter of the conservation and restoration of culturally-impacted nature types. It is also important that areas are designated in which unrestricted natural development can take place. This will create new and unusual variation in the countryside. It should be possible to designate such areas through conservation orders or by acquisition.

Research and development

There is still a considerable need for research into the biodiversity of the open countryside, including the way in which it is affected by the trend of agricultural production. Scientific co-operation groups, similar to the *Centre for Biodiversity on Arable Land*, which is financed under the Strategical Environmental Research Programme, are needed to reveal and document the impact of agricultural production methods on biodiversity in the open countryside.

Cultivation of crops for biomass

In 1983, a Parliamentary majority entered into an agreement on the increased use of biomass in energy production and for industrial purposes. The background of this was the *Energy 2000* action plan's recommendation that fossil fuels (such as oil and coal) be replaced as far as possible by biomass fuels.

The set-aside scheme of the EU CAP contains potential for offering significant incentives to cultivate crops for biomass or industrial use, since these so-called „non-food" crops can be cultivated as an alternative to set-aside.

Thus, this type of crop must be expected to attain a certain popularity in the future. For the same reason, it is also important that this type of agricultural production - even disregarding the implications of the provisions of the Nature Protection Act - be planned in a manner that does not lead to impairment of the conditions of life of wild plants and animals, including an undesirable admixture of alien material with the Danish species' gene pool, cf. Chapter 11.

Moreover, care should be taken to ensure that the cultivation of biomass crops does not take place on areas that offer potential for nature restoration.

In 1994, the Board of Technology published a report on the use of energy crops, drafted by an interministerial committee.

More areas of permanent pasturage improve the conditions of biodiversity.

Reduction of nitrogen consumption
To attain the goals of the Action Plan on the Aquatic Environment for the reduction of nitrogen leaching into the aquatic environment, agricultural nitrogen consumption (cf. the foregoing) must be cut and additional incentives must be offered to encourage reduced consumption. First and foremost, reduced nitrogen consumption would create better living conditions for plant and animal life in the aquatic environment, while it would also be beneficial to our terrestrial flora and fauna.

Reduction of pesticide consumption
As a phase in attaining the goals of the pesticide action plan, Parliament decided in May 1994, to amend the act governing chemical substances and products. This was done to make it possible to prohibit some of the most hazardous substances and, thus, to promote more environmentally-oriented pest control.

Otherwise, agriculture should be urged to take, for instance, the following measures, to reduce the environmental loading due to pesticides:

- more balanced crop rotation, e.g. through subsidy schemes that ensure satisfactory prices for varied crops, as is the case for rape, peas and seed crops;
- better matching of pesticide consump tion to prevailing conditions. Thus, work is in progress at the Ministry of Agriculture and Fisheries' Department of Plant Pathology and Pest Management on developing models which will, in the long term, be used by farmers to choose the optimum point in time for spraying;
- the use of alternative, more biologically appropriate, methods of pest control.

A charge, part of which is spent on research, is linked to the scheme for the approval of chemical pesticides. It is important to support this research so that we can learn how we can best promote preventive efforts.

Restriction of air pollution
The restriction of air pollution is largely tied to the air-pollution reduction requirements to which Denmark has committed itself through international agreements. For the most part, these requirements shall be satisfied within the next 10 to 40 years. Thus, Denmark has already fulfilled a declared commitment to reduce by 50% (relative to the 1980 level) the discharge of sulphur dioxide from all sources, before 1990. This commitment will probably be tightened to an 80% reduction before 2000. Denmark has also committed itself to reducing the discharge of nitrous oxides (NO_x) by 30% before 1998.

The tangible effect of this reduction will show up as more stringent discharge requirements on furnace plants and industry. The general reduction in energy consumption, the introduction of cleaner technology and environmental management, etc., are expected to contribute still further to the reduction of air pollution.

The requirements on the storage and application of manure from domestic animals, which have been set while following up the Action Plan on the Aquatic Environment and the Action Plan for Sustainable Agriculture, are expected to be able to restrict the nitrogen loading caused by the evaporation of ammonia.

Work is currently in progress in the ECE (the UN Economic Commission for Europe) on the specification of binding targets, e.g. for the reduction of ammonia evaporation.

More information
Information and education are important aids in our endeavours to persuade farmers to function not merely as producers, but also as nature managers, so that they also attend to various matters that are not always compatible with maximum productivity.

A variety of informative material, which is aimed at the individual farmer

and agricultural consultancy services, has been prepared over the last few years. This material describes different measures and forms of practical operation that can be beneficial to nature on each individual farm.

Farmers today are generally more motivated to undertake various nature- and environment-improving measures on their properties voluntarily. This applies to the establishment and maintenance of ponds and other small biotopes, as well as to abstaining from spraying close to hedgerows, etc.

This also applies in relation to nature management. Here, the farmer's performance is decisive in ensuring that the protected, culturally-conditioned nature types of meadow, common and heath can be preserved as such.

An effective information programme is also decisive in ensuring that the new subsidy schemes for environmentally-oriented agriculture have the desired effect. The Ministry of Agriculture and Fisheries launched such a programme in 1994.

The information programme that is aimed at agriculture should, thus, be continued and intensified - not least as a means of attaining the goals of limited nitrogen and pesticide consumption and of promoting nature management.

Similarly, the information campaign aimed at the general public, on natural and cultural relationships in the open countryside, should be reinforced.

Giving consideration to biodiversity in road installations and other major constructions

Large traffic constructions can have a devastating impact on nature, through the barrier they constitute to animals and people. Such constructions can split nature areas into smaller areas, thus making it impossible for animals to wander naturally in their search for food, wintering grounds, nursery areas, etc.

With the adoption of the Government's traffic plan, *Traffic 2005*, it has been decided that greater weight shall be attached to considerations of nature and the environment in our future *traffic planning*. According to the plan, the consequences to the landscape and nature of new road constructions shall be assessed thoroughly. Expropriations for replacement biotopes can be relevant in this context.

The point of departure of the plan is, moreover, that conservation orders shall be respected when planning new traffic constructions. But consideration shall also be given, for instance, to large, cohesive, undisturbed landscapes, so that they remain as free from noise as possible. According to the plan, it is also important that animals be given the opportunity of passage, through the establishment of fauna passages across constructions, especially in connection with road constructions in river valleys and ecological corridors.

According to Danish studies, *electric power cables* are responsible for at least a quarter of a million mortalities among birds annually. Thus, when planning power cables and wind power-generator farms, we need to give increased consideration to the bird species that occur in Denmark.

Target areas

- Working towards the extensive restoration of the habitats that characterised the Danish countryside up to the middle of this century, including:
  increasing the area of lakes and watercourses from 65,000 ha to 95,000 ha over the next 30 years (also as a measure relevant to the Action Plan on the Aquatic Environment);
  increasing the area of forests by 500,000 ha, to 650,000 ha, cf. Chapter 8
  increasing the area of permanent pasturage significantly from the current 250,000 ha.
- Promoting the development of true ecological networks, by integrating efforts and coordinating measures between the Ministry of Environment and Energy, Ministry of Agriculture and Fisheries and the counties.
- Channelling the EU CAP subsidies for set-aside and nature- and environmentally-oriented agricultural measures into the areas in which they will yield the greatest nature and environmental profit.
- Making a special effort for the consolidated protection of entire river valleys, cf. Chapter 6.
- Working within the EU, to open up the possibility of more flexible, nature-oriented application of the set-aside schemes.
- Expanding our nature management programme for State-owned areas (especially Ministry of Environment and Energy and Ministry of Defence areas).
- Designating more areas for unrestricted natural development.
- Creating additional incentives to reduce the consumption of nitrogen and pesticides in agriculture.
- Intensifying our agricultural information programme on the role of the farmer as a nature manager.
- Generally strengthening our programme of information and presentation on nature and cultural matters in the open countryside.
- Promoting the transformation to organic farming, e.g. through working towards the more widespread use of organically produced products in the public sector and by investigating the possibility of organic farming of state-owned agricultural land.
- Supporting and coordinating the counties in their mapping and registration of protected nature types and, possibly, following this up with a quality assessment of the protected nature types (by the counties).
- Promoting considerations of nature and the environment when planning new traffic constructions in large, undisturbed landscapes and through the establishment of fauna passages during the design phase of such constructions.