in flocks of up to 100,000 birds in the autumn. Reptiles are common in the desert: of particular interest are the agamid lizards, *Stellio stoliczkanus* and *Phrynocephalus versicolor*.

2. Desert-steppe

Mongolia's desert-steppe or semi-desert is characterized by a dry climate with mean annual precipitation of 100-125 mm and vegetation dominated by low grasses and shrubs such as *Cleistogenes songorica* and the Taana onion (*Allium polyrrhizum*). Many of Central Asia's endemic plants occur in this zone, which stretches from the Great Lakes Depression in the west through the northern Gobi-Altai to Dornogobi in the east. Frequent high winds and dust storms hinder the growth of plants. Characteristic mammals include the wild ass, the goitered gazelle (*Gazella subgutturosa*) and the long-eared hedgehog (*Erinaceus dauuricus*). Birds such as the Mongolian trumpeter finch (*Rhodopechys mongolicus*), the chukar (*Alectoris chukar*) and the houbara bustard (*Chlamydotis undulata*) occur in this zone.

3. Steppe

The Steppe zone extends from the western Great Lakes Depression past Khangai and the middle Khalkha highlands to the steppes of Khentii, Dornogobi and Dornod. It is characterized by flat plains and rolling hills covered in feather grass and shrubs. Typical species of grass include *Stipa krylovii* and *Agropyron cristatum*, and unpalatable shrubs such as *Caragana* species and *Artemisia* species are abundant. Large mammals of the steppe include saiga (*Saiga tatarica*), Mongolian gazelle (*Procapra gutturosa*) and corsac fox (*Vulpes corsac*); birds include the steppe eagle (*Aquila nipalensis*), the rough-legged buzzard (*Buteo lagopus*) and the pied wheatear (*Oenanthe pleschanka*). Smaller mammals such as the Daurian pika (*Ochotona dauurica*), the Siberian marmot (*Marmota sibirica*) and Brandt's vole (*Lasiopodomys brandtii*) are common in places. Enormous herds of the migratory Mongolian gazelle provide one of the last spectacles of mass migration of ungulates on earth, something now found on such a scale only on the Serengeti plains of Tanzania.

4. Forest-steppe

This zone lies between the steppe and the taiga, in the Khangai, and Altai mountain chains, including parts of the Orkhon and Selenge river basins and the Khyangan mountains of eastern Mongolia. Coniferous forests are found on the northern slopes, while the southern slopes are covered with open steppe vegetation. The vegetation is therefore a combination of Siberian taiga forest and Mongolian steppe flora, including species such as pine (*Pinus sylvestris*), aspen (*Populus tremula*) and edelweiss (*Leontopodium ochroleucum*). The forest-steppe is inhabited by such species as elk (*Cervus elaphus*), wolf (*Canis lupus*), marmots (*Marmota* spp), sousliks (*Spermophilus* spp), black kite (*Milvus migrans*), buzzards (*Buteo* spp) and black grouse (*Lyrurus tetrix*). The Siberian wood frog (*Rana amurensis*) and the sand lizard (*Lacerta agilis*) also occur there.

5. Taiga

Mountain taiga forest covers areas of the Khovsgol and Khentii mountains, the area north of the Tarbagatai mountains, the upper reaches of the Orkhon Gol, and the Khan Khokhii range. It is the southern edge of the Siberian taiga, the largest continuous forest system in the world. The cold climate severely limits the growing season for plants, and the mean annual precipitation in this zone is 300-400 mm. It holds a relatively rich flora and fauna: the forests consist mainly of larch (*Larix sibirica*) and, at higher altitudes, of Siberian pine (*Pinus sibirica*), and at their edges, especially on the lower mountains, have some steppe features.

Musk deer (*Moschus moschiferus*), reindeer (*Rangifer tarandus*), sable (*Martes zibellina*), snow leopard (*Uncia uncia*), moose (*Alces alces*) and brown bear (*Ursus arctos*) are found in the taiga zone, and a total of 62 species of mammals and 277 species of birds have been recorded. Mountain taiga plays an important role in the water regime, prevention of soil erosion and maintenance of ecological balance.

6. Alpine

High mountains rising above the tree line occur in the Altai, Khangai, Khentii and Khovsgol ranges. The tops of these mountains are relatively flat, with few sharp peaks. Vegetation consists of low shrubs and herbs, sedges, grasses, mosses, algae and lichens, and there are few birds and mammals at this altitude. Argali sheep (*Ovis ammon*), Siberian ibex (*Capra sibirica*), snowcock (*Tetraogallus altaicus*), dotterel (*Eudromias morinellus*), Himalayan accentor (*Prunella himalayana*) and lammergeyer (*Gypaetus barbatus*) are among the species of animals that occur there. Plant species include ground birch (*Betula rotundifolia*), alpine meadow-rue (*Thalictrum alpinum*), mountain saxifrage (*Saxifraga oppositifolia*) and white gentian (*Gentiana algida*).

Wetlands

Although the rainfall is generally low, Mongolia is rich in water resources originating from the precipitation in the high mountains. There are 3,500 freshwater and saline lakes, 3,811 rivers, and 187 glaciers. There are approximately 1.5 million hectares of standing water bodies and 50,000 km of rivers. Surface area and volume of Mongolia's largest lakes are 11,021 sq km and 436.7 cu km respectively. Surface area of all waters is 13,630 sq km.

Seventy-eight percent of the water resources are concentrated in thirty percent of the territory, in the enclosed Central Asian Inland Drainage Basin, from which there are no losses by flowing water. Here there are freshwater lakes in the Altai mountains, mostly above 2000m (above mean sea level), with streams flowing to lower lakes. There is a series of large lakes, some saline, some freshwater, in the semi-arid depression between the Altai and the western Khangai mountains. The largest lakes are the Hyargas and Ayrag. Further north lie the saline Uvs Nuur and Uureg Nuur. There are also lakes in the Gobi Valley and on the Khangai plateau; these are mostly

saline and the latter lie at relatively high altitude. All these lakes depend on precipitation in the Altai and Khangai mountains for their existence; and as they shrink in summer and have considerable inflow in spring, they show a wide diversity of wetland habitats, ranging from salt marshes and salt pans to freshwater marshes and braided river deltas. They have a particularly interesting fish fauna which is considered to be a relict left over from a single impoverished lake that once covered the entire basin. For example, *Oreoleuciscus* is a cyprinid genus that is endemic to the basin and the upper reaches of the Ob Gol.

The Arctic Ocean Drainage Basin has many large lakes and rivers, fed by water from the northern Khangai mountains and the western slopes of the Khentii range. Almost all water flows to Lake Baikal, except the Shishid Gol, which drains into the Yenisei. The lakes have been formed by volcanic, glacial or tectonic activity, as in the case of the largest, Khovsgol. These freshwater lakes range from mesotrophic to ultra-oligotrophic and support a sparse but interesting fish fauna of cyprinids, coregonids and salmonids. For example, Khovsgol Nuur has nine species of fish, one of them endemic to the lake.

The Pacific Ocean Drainage Basin is characterized by many rivers and marshes, notably the Kherlen in the Khentii, and the Onon, which drain east to the Amur River, and the Khankh Gol that drains north into the Buir Nuur on the Chinese border. Khokh Nuur and Buir Nuur both have typical Chinese lowland fish fauna.

The wetlands of Mongolia, apart from providing habitat for fish, also provide important breeding areas and migration staging areas for large numbers of waterfowl and waders. They are not widely used as wintering grounds, due to the severity of the winter, but small numbers of ducks do overwinter on the few lakes that remain unfrozen. There are about 50 breeding species of waterfowl or shorebirds, including the Dalmatian pelican (*Pelecanus crispus*), four species of cranes (including *Grus vipio*, *Grus grus*, *Grus leucogeranus* and *Grus virgo*) and the very rare relict gull (*Larus relictus*), and another thirty-five passage migrants.

#### 1.1.1.2 *Anthropogenic diversity*

New ecosystems are being formed as a result of human activities, especially agriculture and stock grazing, and natural ecosystems have been modified by infrastructure development such as road-building, communication lines, railway construction, industry, mining and urban development.

(a) Pasture

Grasslands and arid grasslands are estimated to cover 125 million hectares (ca 80%) of Mongolia, and forest and scrubland fifteen million hectares (ca 10%). About 122 million hectares of the country is devoted to nomadic pastoralism: 4.6 % of this lies in the alpine zone, 22.9% in the forest-steppe zone, 28 % in the steppe zone, 23.3% in the semi-desert zone and 16.2% in the desert. Grazing of livestock is the major

form of land use in Mongolia and has been the traditional way of life for Mongolians for thousands of years. Grazing of large herds of yak, horses, cattle, sheep, goats and camels has played a large role in determining the vegetation cover and species composition of the grasslands.

There are a total of more than twenty-eight million head of domestic livestock in Mongolia, a figure that has increased from about twenty to twenty-six million between 1945 and 1990. This sharp increase in livestock numbers is causing overgrazing in certain places and has led to a marked overall decline in adult fertility and survival of young stock. Overgrazing results in more bare ground, and lower species diversity. Table 2 shows a reduction in numbers of pasture species from eighteen to nine, and in yield from 0.32 to 0.23 tons per ha, in semi-arid pasture, between 1970 and 1990. In degraded pastures there is an increase in poisonous and thorny shrubs and an influx of rodents which can then cause more land degradation.

**Table 2 Degradation of pastureland in arid and semi-arid regions**

| | Numbers of pasture species | | Yield in tons per hectare | |
|---|---|---|---|---|
| | Semi-arid | Arid | Semi-arid | Arid |
| 1970 | 18 | 15 | 0.32 | 0.15 |
| 1980 | 12 | 10 | 0.28 | 0.12 |
| 1990 | 9 | 7 | 0.23 | 0.10 |

Source: Asian Development Bank (1991)

Hay production increased steadily from 1970 to 1990 to meet the demand of the growing livestock herds. Between 1966 and 1970 a mean of 550,000 tons of hay were harvested annually, from 1971 to 1975 800,000 tons, from 1976-1980 1,062,000 tons and from 1980 to 1990 1,073,500 tons. The increase in production was achieved by doubling the area of land used for hay production from 974,000 hectares in 1970 to 2,000,000 hectares in 1980-1990 which is just over the area (1,969,000 hectares) determined to be suitable for hay production. Since 1990, hay production has decreased drastically to between 500,000 and 600,000 tons per year. This is partly due to price increases for machinery, fuel and lubricants, and partly due to the central planning system that led to haycrops being taken with no rotation system, causing decreased harvests and severe damage to the land.

(b) Agriculture

From ancient times Mongolians have cultivated land, without irrigation in the Great Lakes Basin and in the Kharaa, Orkhon and Selenge river basins, and with irrigation systems in the Altai and South Gobi. Zhang De in 1259 mentions the existence of wheat, oat and millet crops in various parts of Mongolia. Relatively small areas were cultivated by hand and there was little impact on the natural environment. Since the 1960's however, increasing amounts of land were brought under cultivation, first for wheat, in the Selenge and Orkhon river basins, and then, in the 1970's, for fodder in

the Gobi and western aimags. Heavy machinery was used to plow up grasslands, leading to soil erosion and a decrease in species diversity. By 1990, 1.34 million hectares were being cultivated and yields had been increased through the use of herbicides and fertilizers and improved management. The years 1991-1994 saw a steady decrease in both the area of cultivated land and the crop yields per hectare, due to economic difficulties and the reorganization of farms. Additionally, soil protection programs were not in existence, and soil quality was seriously degraded as a result of poor agricultural practices. Mongolian soils are thin, light, and low in organic matter, and have poor fertility. Although the lands selected for agriculture were reasonably fertile, with relatively dense vegetation, when they were plowed up the natural vegetation was replaced with cultivated plants with weak root masses. Efforts to increase harvests as much as possible caused losses of soil by wind erosion. In 1992, 113,300 hectares of land (including 8,500 hectares of irrigated land) were rendered uncultivatable as a result of soil erosion by wind and water. From 1990 to 1993, the Land Policy Institute surveyed 145 arable farms in twelve aimags and found that 46.5% of the land surveyed (561,500 hectares) was affected by erosion. Such widespread erosion has left areas of degraded land with reduced and altered biological diversity. The present area under cultivation is less than one million hectares.

(c) Forestry

Forests and scrubland cover fifteen million hectares (about 10%) of the country. This includes two million hectares of sparse saxaul (*Haloxylon*) forests in nine southern aimags. There are considerable human influences on forest ecosystems, including timber cutting, livestock grazing and burning. During the last thirty to forty years, timber felling was carried out in an unsustainable way and 250,000 hectares of forest were improperly cut.

Mongolians have traditionally used wood for making ger frames, furniture, fences and sheds for animals. The first sawmill was built in 1926 in the region of the Yeruu Gol and by 1928 there were nine mills. Until 1940, such sawmills were used for preparation of logs for construction work, pit props, firewood and fence poles. Only selected trees were cut, in a limited area, and the natural reproduction process and ecosystem in the tree felling areas were only lightly disturbed. Between 1940 and 1975, however, many modern sawmills were installed and old sawmills were strengthened using new technology. There was an enormous increase in tree felling to feed these sawmills, and the timber industry grew from 3.3% of the total industrial production of the country in 1940 to 10.8% in 1950, 16% in 1960 and 13.9% in 1980, when timber products were in fourth place after food, leather and energy in contributions to gross national product. Between 1991 and 1994, 742,000 to 865,000 cu m of wood were processed annually.

Afforestation activities started in 1972 and since then 52,300 hectares have been planted. Forty-five to ninety hectares of forest shelter-belts ordered by the Agriculture Department were planted between 1976 and 1986. In total only nine to fifteen percent of logged areas have been replanted, and the survival rate of saplings

is very low, less than twenty-five percent even when good care is given, and this is mostly not possible.

(d) Other activities

Alteration of natural habitats in and around cities, towns and industrial complexes is increasing with economic development and the rise in the urban population. Cities and towns now occupy 222,900 hectares and there is little organized landscaping or tree planting in many of these places. Where tree planting takes place in town or city centers it is often with larch, which is bare in winter.

Mining is the cause of a considerable amount of land degradation and little has been done in most cases to rehabilitate land destroyed by mining or oil drilling operations. Large bare spoil heaps and scarred landscapes remain behind, and oil contaminates areas around test drilling sites.

Multiple tracking by vehicles that are driven without any regard for sticking to established routes is causing changes to the ecosystems and there is little or no public or official perception of the damage that this is doing.

1.1.2 Species diversity

Mongolia's position at the northern edge of the Central Asian deserts and the southern edge of the vast Siberian taiga, and its wide range of transitional ecosystems is reflected in the diversity of its wild species. The number of species that occur in Mongolia is, of course, low compared with tropical or sub-tropical countries of a similar size, and there are relatively few endemic species, but the particular assemblages of species and the intact functioning ecosystems in which they live are found nowhere else.

Table 3 shows the numbers of species of various groups of living organisms.

Detailed plant collections have still not been made for some regions so it is likely that there are over 3,000 species of flowering plants in Mongolia. Invertebrate collections are also incomplete.

**Table 3 Number of species described according to major groups**

| Group | No of species | No of genera | No of families |
|---|---|---|---|
| Vascular plants | 2710 | 641 | 122 |
| Lichens | 930 | 133 | 39 |
| Moss | 417 | 162 | 38 |
| Algae | 647 | 168 | 59 |
| Fungi | 875 | 136 | 28 |
| Mammals | 136 | 22 | 8 |
| Birds | 426 | 181 | 58 |
| Reptiles | 22 | 14 | 7 |
| Amphibians | 8 | 4 | 4 |
| Fish | 75 | 39 | 12 |
| Molluscs | 36 | --- | --- |
| Insects | 12,000 | 3200 | 350 |

The mammals of Mongolia consist of fourteen species of insectivores, mainly shrews, twelve species of bats, which is a relatively small number in comparison with most countries, four species of pika and three of hares, and sixty-five species of rodents, twenty-two species of carnivores and fourteen species of ungulates. Among the rodents are eight species of *Sciuridae*, including marmots and ground squirrels, one flying squirrel, the beaver, eight species of hamster and numerous species of voles (fifteen), gerbils (four), lemmings (three), mice (five), and jerboas (twelve), plus the brown rat, the muskrat and two species of tsokor. The carnivores consist of twelve species of mustelids, half of them *Mustela* species, five species of canids, including the wolf and the red and corsac foxes, four species of felids including the lynx and snow leopard, and one species of bear, *Ursus arctos*, which has two very distinct populations in Mongolia. The ungulates consist of the Bactrian camel, the khulan or Asiatic wild ass, Przewalskii's horse (*Equus przewalskii*), the wild pig (*Sus scrofa*), five species of deer, including the elk and the moose, and five species of bovid, namely Mongolian gazelle, goitered gazelle, saiga, ibex and argali sheep.

Mongolia's 426 species of birds include 108 species of passage migrants, seventy-four species of residents, 231 species of summer visitors and thirteen species of winter visitors that breed in Siberia. The bird fauna is particularly rich in waterfowl and shorebirds which, including gulls and terns, number 120 species, and birds of prey (thirty-eight species). There are thirty-four species of warblers, fifty-four species of buntings, finches and sparrows, and six species of accentors.

The reptiles consist of thirteen species of agamids, gekkonids and lacertids and nine species of snakes in four families. Of particular note are the tatar sand boa (*Eryx tataricus*) and the Mongolian agama (*Stellio stoliczkanus*).

Eight species of amphibians have been positively recorded - one species of salamander and seven species of frogs and toads, but a further two species, *Bufo viridis* and *Rana arvalis*, are almost certainly present also, and are included in the Dictionary of the Vertebrates of Mongolia (1994).

The fish are interesting because there are such clear differences between the fauna in each of the three main drainage basins. There are four endemic salt water species in the inland drainage basin where only five species of fish occur in all, the fifth being a loach, *Noemacheilus strauchi*. The Arctic Ocean basin has twenty-six species of fish, dominated by cyprinids, coregonids and salmonids. For example, Khovsgol Nuur supports nine species of fish, including the grayling *Thymallus arcticus*, the hucho, *Hucho taimen*, and *T. nigrescens* classified by some as a subspecies of *T. arcticus*, *T. arcticus nigrescens)* that is thought to be endemic to Khovsgol Nuur. The Bulgan Gol in the extreme south-west of the country has an aquatic fauna similar to that of the Arctic Ocean Drainage basin despite the fact that it flows south to China. This is because it was previously connected to the Arctic ocean but has changed its course. The Pacific Ocean drainage supports about forty species of fish, all ones that are typical of Chinese lakes and rivers.

The numbers of invertebrate species are poorly known, but it is thought that there are over 12,000 species of insects. This compares favorably with 40,000 species in neighboring the People's Republic of China, despite China having tropical areas.

Of particular significance when assessing biodiversity are species that are wild relatives of domestic species. Mongolia is home to Przewalskii's horse, and also to the ibex, a relative of the domestic goat. Southern Mongolia is considered to be part of a region of great crop-plant diversity that extends into China.

### 1.1.3 Genetic diversity

Genes are the blueprints that make all organisms what they are. They consist of a segment of deoxyribonucleic acid (DNA), a linear molecule composed of sequences of four different nucleotide bases. From the code contained in these sequences comes the diversity of the living world. The genetic diversity inherent in most species leads to species changing in response to circumstances. Change is accelerating in the world today due to environmental pollution, species over-exploitation, and habitat fragmentation and destruction. Knowledge about how these changes affect genetic variation is essential.

#### 1.1.3.1 *Wild animals and plants.*

Few genetic studies have been carried out to determine, for instance, the genetic bases for subspecies classifications. Recently studies of genetic material from museum specimens of Gobi bears have been started in order to help settle the question of the status of that taxon. Proposals have been made to study genetic

differences between populations, in Mongolian gazelles, and in other large mammals. The subspecies of saker falcon (*Falco cherrug*) found in the Altai mountains is particularly sought after by Arab falconers, whereas the other subspecies are not. Genetic research will be vital in the future in support of conservation action plans and determining priorities for action.

### 1.1.3.2 *Domestic animals and plants*

There were an estimated 28,572,300 head of livestock in Mongolia in 1995, a 6.6% increase from 26,808,100 in 1985. The species composition in 1995 islisted in Table 4

**Table 4 Numbers of Domestic Livestock**

| Species | Number of head |
|---|---|
| Sheep | 13,718,600 |
| Goats | 8,520,700 |
| Cattle (including yaks) | 3,317,100 |
| Horses | 2,648,400 |
| Camels | 367,500 |

There are thirty-two recognized breeds of domestic livestock, four each of horses, camels and cattle, fifteen of sheep and five of goats. Mongolian livestock breeds are particularly resistant to extremes of temperature and show rapid weight gain in summer to compensate for their poor conditions after the lean winter and spring, although it is not known whether this is a genetic trait. Mongolian meat keeps well when frozen. It has thinner muscle fibers than meat of many foreign breeds. Some livestock products such as cashmere compete well on the world market and cashmere is the basis of a local garment export industry. Mongolian goats are also a genetic resource sought after by breeders for improving the quality of foreign cashmere.

Examples of local breeds' characteristics include the horses from Tes and Galshar, renowned for their speed and endurance, and the sheep from Gobi Altai and Bayad, known for their large size and high-quality fleeces. The relative roles of genes and environment in creating these differences has still to be investigated. In some cases they are the result of deliberate breeding, for instance in wheat, barley and potatoes.

### 1.1.4 Special features of Mongolia's biodiversity

Mongolia is at the convergence of the great Siberian taiga, the Central Asian steppe and the Central Asian desert, so it is rich in transitional ecosystems that occur nowhere else and has its own unique assemblage of species. Also, because human influence on the country has been relatively light, the taiga, steppe and desert

ecosystems have been less affected by man than in neighboring countries. Of special note is the Gobi desert ecosystem which is of global significance because it is the least changed part of the Gobi area and supports processes and species or subspecies that are already extinct or nearly so in neighboring China. Similarly, the eastern steppe ecosystem is still the home to hundreds of thousands of migratory Mongolian gazelles. The mass migration of these gazelles rivals the spectacle of the Serengeti wildebeest migrations, but severe hunting and habitat destruction in China and Russia have reduced the distribution of the species and the length of the migration. There are problems in Mongolia too, but without the Mongolian steppes there would be no migration and the gazelles would be reduced to semi-wild populations.

Mongolia's bird life is of special interest as the country supports such a large number of migratory birds. Of the breeding birds the falcons, the Chinese parrotbill (*Paradoxornis heudei*), and the relict gull are of particular interest or rarity. Mongolia is rich in waterfowl and shorebirds in summer, and the cranes *Grus vipio*, *Grus grus* and *Grus leucogeranus* and *Grus virgo* are important breeding birds.

Mongolia's ecosystems are still relatively intact, but the long history of pastoral use over most of the country has resulted in anthropogenic grassland ecosystems. These are interesting in their own right and are not found on such a scale anywhere else in the world.

In Mongolia certain ecosystems have been less affected by man than in China or Russia. Although relatively lacking in endemic species, Mongolia is an important population base for many Central Asian desert, steppe and taiga species with wider, but decreasing, distributions outside the country.

#### 1.1.4.1 *Ecological and evolutionary features.*

Through a process called plate tectonics, in geological time the earth's land mass joined together into a super-continent, and again drifted apart. The movements of continents over the past 200 million years have profoundly affected the distribution of organisms on earth. Asia and the North American continent collided in the late Cretaceous period in the region of Beringia. The single northern continent that stood at the beginning of the Cenozoic era lasted until the early Eocene epoch when Europe and North America separated. Because of this long connection, many plant species in Mongolia bear similarities to those in North America. During the Eocene, India, which had earlier separated from the African continent, collided with Asia, producing the uplift that continues to form the Himalayas and other great mountain ranges today. These giant, mostly east-west, mountain ranges have had profound effects on the climate and biogeography of Central Asia.

The Pliocene climate was more humid both compared to the present and remoter past. Thus, prior to the glacial period in the Pliocene the high plateau of Central Asia must have contained, at the very least, quite extensive oases feeding moisture-loving fauna. Forests were also extensive. Since the Miocene, representative species of

northern taiga forest spread over Mongolia including *Picea ovobata, Pinus sibirica, Larix sibirica* and deciduous species. Fossil rats have been discovered from Miocene sediment and in the late Tertiary period fauna such as horse, giraffe, elk, antelope, mice species, and jerboas are known to have existed. Such conditions existed for a long time before the advent of glaciation.

In the Pliocene epoch, the climate changed with the onset of glaciation and conditions changed to preclude animal life at times. The southern fauna of the Tertiary which had existed was annihilated or displaced so that only relicts of it survived on the southwest margins of the Altai or other regions of Mongolia. The ancient fauna was displaced during this period by animals originating in the subarctic zone, which have now died out or been displaced from their own region of origin. A good example is reindeer. It is apparent that the glacial period and the subsequent xerothermic period were of considerable importance in the formation of the present day flora and fauna. The period was marked by sharp changes of conditions which, although fluctuating, showed a long-term trend towards greater aridity, up to the present day. This has important consequences for regional biodiversity.

Most of the boreal forms of mammals characteristic of Mongolian forests do not reappear on the south side of the Gobi and are not found as relict colonies at higher elevations further south. It seems that species, if driven south by the cold of the glacial period, were unable to cross the intervening desert -- which apparently formed an effective barrier.

The aquatic environment has changed dramatically in post-glacial times. Formerly fresh-water lakes were desiccated and salinized (Uvs Nuur, Khirgis Nuur, Biger Nuur) or even completely disappeared as shown by extensive tracts of salt marsh and thick layers of buried salt. Rivers also dried out.

The Central Asian flora of deserts and steppes consist of xerophytized immigrants representing originally diverse mountain floras. The desert-steppe flora arose from the xerophytized immigrants coming out of diverse mountain countries. While the process of xerophytization can be considered ended a long time ago in the western part of the Eurasian steppe, the process is still continuing on the heights of Central Asia. B. B. Polynov stated that, "We meet here with a kind of natural lab for the development of steppe associated at the margins of a subalpine region."

Mongolia's flora and fauna have been shaped over geologic time by continental joining and separations, giant mountain building, volcanoes, glaciation and climate characterized by low precipitation, temperature extremes and high winds.

### 1.1.4.2 *Species endemism*

Mongolia has 229 endemic species of higher plants. The genera *Astragalus* and *Oxytropis* are particularly high in endemic species. Among the vertebrates there are

relatively few endemic species: only five species of fish.

Species endemism is therefore generally low: 9.4 % in plants, 7.6 % in fish and, for all vertebrates, 0.7%.

The endemism percentage of flowering plants is low compared with other countries in the region, and the endemism percentage of vertebrates is even lower, but this is to be expected in a country at this latitude which shares its main ecosystems with neighboring countries.

Of special note among the endemic species are the fish. There are three species of the endemic genus *Oreoleuciscus*, cyprinids that live in the mainly saline lakes of the Inland Drainage Basin, and the Mongolian grayling (*Thymallus brevirostus*), in the Great Lakes Basin, and the Khovsgol Nuur grayling (*Thymallus nigrescens*), which is thought to be endemic to Khovsgol Nuur. There are no other species of vertebrates endemic to the country.

### 1.1.4.3 *Endangered species*

According to the IUCN categories of threatened species, twenty-seven species are listed.

**Table 5 The number of species by taxa according to protection status.**[1]

| Taxa | Mongolian Red Book | Legal Protection Status | IUCN Threatened Classification | CITES Appendices I or II |
|---|---|---|---|---|
| Amphibians | 4 | | | |
| Aves | 30 | 28 | 19 | 52 |
| Mammals | 28 (27)[2] | 22 | 8 | 12 |
| Reptiles | 5 | | | 1 |
| Total | 67 | 50 | 27 | 65 |

Table 5 also shows the numbers of species listed in Appendices I and II of the Convention on International Trade in Endangered Species (CITES), in the Mongolian Red Book, and those that have legal protection in Mongolia. Seventy species that are listed in one or more of the categories have no legal protection within Mongolia. (These numbers do not invertebrates: 12 species or subspecies of fish are listed in the Mongolian Red Book) (Appendix 2).

[1] Species may occur in one or more authority

[2] The number in parentheses represents the number of species used in the analysis. The subspecies of *Saiga tartica* appeared in the revision of the Mongolian Red Book after the analysis.

Domestic legislation identifies species that are endangered locally. The lists are biased towards species of economic importance, for instance, medicinal plants.

#### 1.1.4.4 *Economically important wild species*

(a) Plants

As the basis for the main form of land use, pasture plants and hay plants, mainly grasses, are vitally important economically. There are 845 species of medicinal plants, sixty-eight species of soil-binding plants and 120 species of important food plants. For example, *Polygonum alopecuroides* seeds are used for a cereal and *Agriophyllum squarrosum* seeds are made into bread. Pine nuts are a popular treat. As a country with a small area of forests, all tree species are ecologically and economically important.

(b) Animals

Many species of animals are hunted for their meat, fur, or, in the case of pelicans, for their beaks, which are used as sweat blades to wipe the sweat from the flanks of horses. Some mammals are also hunted for sporting trophies.

Between 1960 and 1989 an average per year of 20,500 squirrels, 1,400,000 marmots, 8,000 foxes and 14,500 wolves were hunted under permit for meat and fur. Illegal hunting adds further to such harvests. Sport hunting brings in considerable trophy fees for argali, moose and elk. A total of 224 sport-hunting permits were issued to foreign hunters in 1995. Musk deer, although protected by law, are poached for the valuable pods of the males. If snared, there is no discrimination between the sexes in the animals killed. Quotas are set for harvests of Mongolian gazelle: in 1995, the quota was 12,000 animals.

#### 1.1.4.5 *Regional and global importance of Mongolia's biodiversity*

Mongolia has the opportunity to protect large, relatively intact ecosystems, thus conserving regional biodiversity that is already lacking in adjacent countries. This is of great global importance. The steppes of eastern Mongolia, and the Gobi desert with its characteristic saxaul forests, are specific examples of such ecosystems. Charismatic and rare species such as the Bactrian camel and the snow leopard have important populations in Mongolia. Reintroduction of Przewalskii's horse has its highest chance of success in Mongolia. The closed inland drainage of Mongolia, with its endemic fish species and its influence on regional climate, is also of global importance.

## 1.2 Threatened status of biodiversity

### 1.2.1 The threats

Human activities have led to changes in ecosystems and number and distribution of species. Some of these activities are inside Mongolia; other threats originate in neighboring countries or even further afield.

#### 1.2.1.1 *Ecosystems*

(a) Grasslands

Grasslands account for 80% of Mongolia's territory and, although estimates vary, it is certain that a significant proportion of these lands is overgrazed, causing loss of biological diversity, soil erosion and economic losses that could become very serious if present trends continue. (According to the Mongolian Academy of Sciences, 33.5% or 41.9 million ha is overgrazed.) Table 2 shows declines in numbers of pasture species and pasture yield in semi-arid and arid regions from 1970 to 1990.

Information on current livestock numbers and estimates of forage availability and an indicative feed balance have been made for all provinces of Mongolia. These show that many provinces are overstocked and those provinces with an apparent surplus of forage are usually those where water supply limits grazing. Furthermore, the annual yields of herbage are in most cases less than 500 kg of dry matter per hectare, and this is usually considered to be the optimum amount to be left after grazing to allow regrowth of palatable species and prevent desiccation of soils in dry environments. The current intensity of livestock grazing in Mongolia appears to be unsustainable. Additionally, grasslands are being degraded by multiple vehicle tracks, mining, cultivation, and pollution.

(b) Wetlands

Despite low rainfall, Mongolia is rich in water resources and its wetlands are extremely diverse. However, because of its rapidly growing population, and industrialization, including mineral exploitation, aquatic ecosystems are at threat from pollution. The rivers and lakes are also threatened by dams and diversions, and ground water is threatened by pollution and drawdowns. For example, groundwater resources are estimated to be 12.6 cu km, but in 1993 alone 283 million cu.m (2.25% of the total resource) were withdrawn for irrigation, livestock, human consumption and industrial processes.

(c) Desertification

Desertification is increasing, as shown by the growing frequency of dust storms. There were an average of sixteen days with dust storms per year from 1960-1969,

twenty-three per year in 1970-1979 and forty-one per year between 1980-1989. Land covered with sand increased by 38,000 hectares between 1941 and 1990.

(d) Forests

The small forested area of Mongolia, now 7% of the country, has been reduced and degraded by overexploitation and poor forestry and logging practices. Forest ecology is mostly ignored in forest management. Forest management practices focus on commercially exploitable species with little attention to forest ecology concerns.

(e) Climate change

Climate change has potentially serious consequences for Mongolia's biodiversity. Studies suggest that during the last fifty years there has been a significant rise in mean temperature of 0.7°C. Maximum temperature increases of nearly 3°C have been recorded in winter, but the annual precipitation, which decreased from the 1940's to the mid 1980's, has recently shown increases in most areas except the Gobi. Sustained trends in warming and drying could increase the area of arid lands and have significant effects on plant growing seasons and, in turn, on species diversity and distribution.

### 1.2.1.2 *Species*

The major threats to wildlife species in Mongolia are:

- Poaching (illegal harvests) due to poor enforcement of laws. Some poachers come from across the national borders, and there is also cross-border trade in poached animals and plants.
- Over-utilization (unsustainable harvests) due to lack of species-population information to establish sensible harvest quotas, or established quotas for political or economic reasons which ignore available population information.
- Loss of habitat due to overgrazing, mining, cultivation, multiple tracks, stream channelization, dams, and stream and lake sedimentation.
- Air and water pollution arising from increased industrialization and population growth.
- Unsound management practices for conservation that may put biodiversity at risk rather than protect it, including the cross breeding of domestic species with wild species, and allowing diseases of domestic species to infect wild populations.

### 1.2.1.3 *Genetic varieties*

The degradation of ecosystems, loss of species, and reduction in species populations results also in the loss of genetic diversity. Introduction of exotic species and varieties, along with improper breeding or management programs, further affects

genetic diversity. Not only does this loss have important consequences for wild populations, but the loss of genetic diversity could imperil agriculture.

### 1.2.2 Causes of threats

#### 1.2.2.1 *Population increases*

Largely as a result of governmental policies to encourage growth, Mongolia's population exploded from 758,900 people in 1950 to 2,250,000 people in 1994. Much of the growth has occurred in urban areas, which now have 54.6% of the total population. It is estimated that Mongolia's population will reach approximately 3.5 million people by 2019. The previously relatively undisturbed natural environment has been damaged as a consequence of the rapid population growth. Continued population growth will cause irreversible changes to the natural and cultural heritage of Mongolia, through increased consumption of natural resources in a country with a limited carrying capacity and fragile ecosystems.

Since 1960 the construction materials requirements for the rapidly growing population led to an increased production of ger frames, concrete and bricks. Forests were cut down without being replanted. Substandard ger frames have been made on factory production lines and the consumption of timber is going up accordingly as replacements become necessary sooner. Tree felling is often done illegally.

Families living in accommodation without central heating use annually 600,000 tons of coal, 1,350,000 cubic meters of wood, 1,000 tons of saxaul and a large amount of dung collected from pasturelands. The main fuel woods are larch, willow, pine and saxaul. Families living in the Gobi who were previously supplied with fuel now collect saxaul and *Artemisia*, and thereby contribute to the loss of vegetation, soil erosion and the shifting of sand. People living in the western aimags use willow growing near the rivers and this has resulted in the disappearance of most of the riparian woodland.

#### 1.2.2.2 *Industrialization, past and present economic policies, and pollution*

As a consequence of its undeveloped state at the beginning of the 20th century, Mongolia was one of the few countries where a relatively pristine natural environment was preserved. There was minimal damage to biodiversity resulting from industry and industrial wastes. Starting from 1930, small heating stations, wool processing factories and tanneries were established and these were followed in the 1960's and 1970's by cashmere processing and boot and garment manufacturing facilities. Due to their extensive use of water and hazardous chemicals these factories caused an increase in soil and water pollution, and outdated water-treatment technology is resulting in continued pollution at present.

Since the 1960's energy production has been given high priority, in order to meet the ever increasing demand for energy. Power stations were built and coal mining and exploration intensified. This, together with development of mining for metal ores led to an increase in soil erosion and pollution and the destruction of natural habitats. There has been little or no habitat restoration.

Timber felling units established in the 1960's and the 1970's cut about 1.2 million cubic meters of wood annually for domestic use and for export, and substantially reduced the country's timber resources.

An increase in construction during this period led to the building of concrete and brick factories; these also caused extensive damage to soil, rivers and the landscape, as gravel, clay and limestone were exploited. The industrial development policy pursued by the country from the 1930's to the 1980's disregarded environmental protection issues, and led to extensive damage to biodiversity. Only since the change in government in 1990 has the growth in industrial output decreased, partly as a result of the collapse of the central raw materials supply system, and has attention been paid to the destructive effects of industrialization on biodiversity. Systematic measures are now being taken to revive industry; the risks to the environment remain, despite the legislation that is in place to protect it.

Power

Since 1990, the power industry has been given the same priority as earlier, despite the sudden fall in industrial output. Much foreign financial aid has been allocated to the power sector, particularly to the outdated and highly inefficient coal-fired power stations that provide 90% of the country's energy supply. Even after rehabilitation through international donor projects, the major power stations will still fall far short of environmental protection standards required in developed countries. The total capacity of Mongolia's power system is around 1000 megawatts. Apart from the coal-fired power stations there are diesel power stations in aimag centers and small power generators in 300 sum centers and other settlements. There is an encouraging trend towards an increasing number of wind and solar generators fitted to individual gers.

Coal

Mongolia is believed to have coal resources of fifty billion tons. Most mining is by strip methods which result in soil destruction and extensive pollution of the surrounding area.

Minerals

Mongolia has rich mineral resources: 15-20% of gross domestic product and 50% of the country's exports have been produced by the mining industry. Copper, gold, iron, uranium, lead and molybdenum are particularly important in the industry. Many private enterprises have engaged in gold mining in the last three years.

Mining is causing substantial soil destruction and water pollution, especially as a result of water use in the gold extraction process.

Light industry

Light industry has traditionally specialized in processing raw materials of animal origin, such as wool-washing, weaving, felt making, knitting and tanning. Many new enterprises have been established since 1990 that do not have adequate environmental safeguards and are often poorly sited. The same is true of the food industry and of the other branches of industry, such as metal processing, drug preparation, printing, and glass and china production.

Pollution

Due to incorrect social and economic policies not adjusted to ecological realities, the pristine environment has been damaged and polluted, and people's health has been affected. The main air pollutants are emissions from vehicles, smoke from power plants and houses, and dust, which are common in cities and some aimag centers. During the winter, Ulaanbaatar, which has the highest pollution levels, burns 3.3 million tons of coal in its power stations, 190,000 tons of coal and 160 cubic meters of wood in its gers, and 236,000 tons of coal and other fuel in its 143 small heating plants. This releases very large quantities of pollutants into the atmosphere. The number of cars and trucks in the country is growing rapidly. Many of these are imported second-hand vehicles and are badly maintained; they use fuel with a high heavy-metal content, resulting in high levels of toxic emissions. There are now 24,683 motor vehicles in the city and over 42,000 in the country - twice as many as in 1990. The heavy metal content of the snow near Ulaanbaatar has increased to dangerous levels and the $NO_2$ content of the air doubled between 1987 and 1993. The $SO_2$ content exceeds the permitted level by two or three times in winter and spring. The pH of the rain fluctuates between 6.7 and 7.5. Background air radiation levels are 12-17 mk rad/hour. Air pollution is undoubtedly causing damage to the environment but Mongolia lacks effective systems to control it.

Water pollution is also a serious problem, particularly as a result of industry and mining. Water consumption increases with population growth and affluence, and although there are about one hundred water-treatment plants with a capacity to clean 130 million cubic meters annually, 54% of these are malfunctioning and cannot clean water to acceptable levels. Many improper activities such as cutting down trees along river beds, and diverting streams and rivers can cause declines in water quantity and quality.

### 1.2.2.3 *Increase in per capita consumption of resources*

Per capita consumption and total consumption of resources increased dramatically during Mongolia's industrialization period, although consumption has fallen for

some resources and products during the recent economic transition period. This may be a temporary phenomenon.
In addition to the long-term increase in consumption, there is an imbalance in resource distribution. For example, 160,000 cubic meters of water are supplied daily to apartments and industrial units in Ulaanbaatar, but 300,000 people (approximately one-half of Ulaanbaatar), living in gers in and around the city, get only 1,500 cubic meters daily.

The most dynamic rise is in energy and in consumer goods. The per capita commercial energy consumption of 1.5 tons of oil equivalents is relatively high compared with that of most countries in the region, due mostly to inefficient use of energy and the recent industrialization.

Electricity consumption from the central energy system increased from 1,204 GWh to 2,257 GWh between 1980 and 1990. This is an increase in per capita electricity consumption from 0.73 KWh in 1980 to 1.08 KWh in 1990: a 48% increase. However, between 1991 and 1993 per capita electricity consumption actually dropped approximately 20 %. In addition, between 1990 and 1993 coal consumption fell by 23% and timber consumption by 50%. Flour consumption between 1991 and 1993 was stable, increasing less than 1%.

As the economy grows, the country would be wise to minimize per capita growth in consumption of non-renewable resources, meeting needs through use of renewable and environmentally clean sources.

1.2.2.4. *Destruction of habitat*

(a) Cultivation

Less than one million hectares of land is cultivated in Mongolia, and much of this land is severely degraded. Six hundred thousand hectares have been abandoned due to being degraded or due to economic difficulties. This trend is increasing. The "crop-land" program of the 1950's created serious problems, destroying habitat, causing erosion and leading to 'sands' covering up other lands. It took pastures out of production, reducing grazing capacity, thus putting additional pressure on the remaining pasturelands.

Approximately ninety percent of cultivated land has lost its original fertility. Degradation is continuing as a result of poor agricultural practices in some places, but is being halted by the use of traditional soil conservation methods in others.

(b) Mining

Strip mining and dumping of waste from other types of mining has led to widespread destruction of natural habitats. However, as a result of improvements in

the law new mining projects have begun to follow the regulations on Environmental Impact Assessment.

(c) Transport

The industrialization policy of the 1960's to the 1980's should have included provision for development of a road network to support increased need for cargo and passenger traffic. No road network was developed, however, and the present chaotic sprawl of unpaved multiple tracks that scar the landscape is causing severe damage to soil and plant cover. At present, despite this poor base, road transport accounts for 93.4% of the cargo volume of the country and 47.1% of passengers. Apart from the problems of multiple tracking along well used routes, tracks run anywhere that people want to go: there is no control. Only 1,400 km of road are paved in Mongolia, and 3,000 km are gravelled. Between 1970 and 1990 about 10 km of road were paved annually, and 10 km of newly constructed road was built in 1994.

Railways have a much lesser impact than roads on biodiversity in terms of loss of habitat, but they disrupt migration routes. The Mongolian gazelle population has suffered from being split effectively into two separate units, with important habitat requirements denied them by being on the other side of a railway line that they cannot cross because it is lined by high fences. Hundreds of gazelles are killed each year by flinging themselves against the fence running along the main Ulaanbaatar-Beijing railway line.

(d) Water developments: dams, wells, irrigation

Dams can have a devastating effect on biodiversity through destruction of habitat and disruption of migration patterns of aquatic species.

1.2.2.5 *Over-exploitation*

(a) Grazing

The area of pastureland decreased by 6.9 million hectares between 1970 and 1994. The Botanical Institute of the Academy of Sciences estimates that one third (41.9 million hectares) of grazing land has been degraded by poor management, although the Land Policy Institute puts the figure at only seven million hectares. Overgrazing is particularly severe near settlements and administrative centers where herdsmen are settling in order to find markets under the new free-market economy. Increased freedom of movement has resulted in people moving to better grazing land, especially in the central regions, that are now becoming overcrowded. Near Ulaanbaatar there is particularly severe overgrazing, exacerbated by cattle being driven to market from distant aimags, and the increase in numbers of cattle owned by city residents, since 1991 from 180,000 to 270,000 head today. Traditional grazing-land management was abandoned during the years of the cooperative

campaign: even then, large numbers of cattle were kept near the administrative centers without consideration of carrying capacity.

(b) Timber

Economic pressures led to the felling of 11,655 cubic meters of timber between 1970 and 1994. There was no consideration by government of the environmental effects. A ban on export of timber and most felling for local use has now been imposed, but illegal felling still continues.

(c) Wildlife

Legal harvest of wild animals has been increasing despite inadequate knowledge of population sizes and the effects of harvests. There is a developing trade in falcons, particularly the saker falcon (*Falco cherrug)*, which is much prized by Arab falconers. Poaching has increased due to weak implementation of the law.

The following items have been intercepted by customs officials: since the 1950's, fifty-nine leopard skins; in the last three years, 729 deer testicles and penises, 4,483 kgs of velvet antlers, 137 musk pods, twenty-three gazelle horns and twenty-one bear gall-bladders. This is believed to be a small proportion of the total exported. An average of 223,400 birds were killed annually for export from 1979 to 1990 including Pallas's sandgrouse (*Syrrhaptes paradoxus)*, Daurian partridge (*Perdix dauuricae)*, hazel grouse (*Bonasa bonasia)*, willow grouse (*Lagopus lagopus)*, black grouse (*Lyrurus tetrix)*, black-billed capercaillie (*Tetrao parvirostris)*, chukar (*Alectoris chukar)*. Export of these birds has now been stopped.

One sub-species of fish, *Coregonus autumnalis migratorius,* has been introduced to eight lakes in Uvorkhangai aimag where they did not previously occur. In addition Khovsgol and Tsagaan Nuur have three kinds of introduced fish: 1) *Coregonus autumnalis migratorius*, 2) *Coregonus peled* and 3) *Coregonus sardinella.*

A growing wildlife enterprise in Mongolia involves harvesting antlers and antler velvet from wild elk (red deer): in 1995, 150 tons of antlers and 200 kg of dried antler velvet were produced for export. Three so-called farms operated during this year. Their operations involve a large wooden-pole-fenced pen into which elk are driven for subsequent antler harvest. The fences require a large quantity of poles: 1,920 4.2-meter poles per kilometer. Pens have up to 80-kilometer boundaries. In addition, plans are underway to establish an antler farm consisting of a permanent population of "tamed" wild elk. The consequences to wild populations are unstudied.

1.2.2.6. *Inadequate natural resource management*

Mongolia has had an inadequate number of trained staff to cope with the growing threats to its biodiversity. Between 1994 and 1995, Mongolia passed new

environmental and natural resource laws and reorganized the government to provide more effective management, but these measures in the short term have probably compounded the problem. There is confusion about lines of authority and areas of jurisdiction, and lack of training among new staff members. In addition, Mongolia has been suffering severe budgetary constraints.

### 1.2.2.7 *Threats from outside national borders*

Direct and indirect threats to the environment and biodiversity of Mongolia are being posed from neighboring and other countries. Major problems include climate change, water pollution, toxic wastes, nuclear-weapons testing near the border, industrial accidents in neighboring countries, parasites and diseases brought in with imported animals and plants, the introduction of exotic species of animals and plants, and market forces raising the value of native Mongolian species and thereby increasing the incentive for illegal exploitation.

Water pollution

Most rivers of Mongolia flow out rather than into the country: the ones that flow in are mostly in the west in the Inland Drainage Basin. There is a border-water agreement between Mongolia and the People's Republic of China and another between Mongolia and the Russian Federation, aimed at controlling the pollution and exploitation of transboundary waters.

Poaching and trade

Increased access to traditional Chinese-medicine markets has brought greater poaching pressure on species such as musk deer, brown bear, saiga, elk (red deer) and certain plant species such as the blue-green alga (*Nematonostoc flagelliforme*), known as 'black grass.' There are incursions by poachers from Russia for bear, and fur-bearing species.

Sport hunting

Sport hunting can be a sustainable industry, but there are indications that some species are becoming so rare in certain areas that the quotas have had to be reduced.

Tourism development

Only one (state) tourist agency existed up to 1990. Now there are more than 200, with 100 of them active in wildlife and wild-areas tourism. The rapid increase in numbers of foreign tourists (there were 131,000 in 1994) will put increasing pressure on wild areas and wildlife unless adequate controls are put in place. Off-road driving, inadequate sanitary facilities, and overuse of water where water is scarce, are just a few examples of problem areas which have to be controlled.

Exotic species and quarantine

There is the constant threat of diseases and parasites brought in with plant or animal material, and of exotic species that could displace native species through competition, disease transmission or predation.

Radiation

In Ulaanbaatar, the radiation levels were over one hundred times higher than normal in the days following the Chernobyl nuclear reactor accident. Chinese nuclear-weapon testing takes place at Lop Nur, very near to Mongolia's southern border.

Chemicals and toxic waste

Prior to 1994, Mongolia imported more than 1,000 different chemicals (more than 3,000, including medicines) and over 100 different pesticides. A 1994 survey indicates that this figure now totals 7,276 different chemicals with amounts exceeding 3,774 tons annually. At least 1,297 different companies and organizations use chemicals in their work.

Of the chemicals used annually, 57.4 tons are simply being dumped, 68 tons are discharged into the air, 790 tons into the water and 602 tons into the soil.

Mongolia has a new Law on Toxic Chemicals, but no procedures in place to regulate chemicals effectively. Mongolia has already received requests from other countries to establish land fills in the Gobi for hazardous and solid wastes. With the over 100,000 chemicals currently in world trade, the regulation of these is an enormous and critical task for the protection of human health and Mongolia's biodiversity.

#### 1.2.2.8 *Climate Change*

Climate change is thought to be due to increased emission of greenhouse gases, such as carbon dioxide, and is therefore another threat that is caused by combined country, regional and even global emissions.

### 1.2.3 Need for sustainable development of resources

Conservation of biological diversity is essential for sustainable development, which in itself is necessary to achieve real social and economic progress. Sustainable development entails improving and maintaining the wellbeing of people and ecosystems. Agenda 21, the Action Plan of the United Nations Conference on Environment and Development, Rio de Janeiro, 1992, addresses many sustainable development issues and attempts to integrate environment and development. The Mongolia Action Plan for the 21st Century, or MAP 21, is the program to implement Agenda 21 in Mongolia and is due to start in 1996.

Mongolia is changing quickly but since the country has mostly intact ecosystems, there is still a rare opportunity, not available to many countries, to practice conservation biology. This can be done by:

- setting aside substantial areas of the country in protected areas
- restoring wildlife populations by regulating harvests
- controlling pollution

- adequately regulating land use
- enforcing strict regulations on mining and other developments
- insisting on only sustainable development of resources
- limiting population growth and immigration.

Time is running out, however, and there is an urgent need to act now to make sure that unsustainable economic development does not result in the destruction of Mongolia's magnificent natural heritage.