



MINISTRY OF NATURE PROTECTION OF TURKMENISTAN

COUNTRY STUDY ON THE STATUS OF BIODIVERSITY OF TURKMENISTAN

ASHGABAT 2002



*The wonderful beauty of our beloved
Fatherland's nature has been preserved
until today. To pass on this beauty,
such a pleasure to the eye,
to succeeding generations is the task
of those living at present.*

Saparmurat TURKMENBASHI

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FOREWORD

Humanity entered the third millenium with huge scientific and technical achievements and an extremely contradictory relationship with the environment. That is why the most important problems that face the world community in modern society are the protection of the environment and rational use of natural resources. Sustainable development of the economy of any country and the well-being of the people depend on the solving of these urgent problems, at global, regional and national levels.

Turkmenistan is a young, independent neutral state, possessing a rich cultural and natural heritage. The enormous plains and deserts of our country, Hazar and Jeyhun, bordered in the south by the comparatively young Turkmen Horasan mountain chain and the eastern spurs of the Pamir - Alai are considered to be the centre of origin of a number of the world's species of fauna and flora. The ancient Turkmen land is rich in wild relatives of cultivated plants and breeds of domestic animals. The well-known Akhelteke horses, tazy-borzoi hunting dog, grapes, pomegranates and unique Turkmen sorts of melon and others have all won worldwide fame.

Our country is naturally generously endowed with endemic species of animals and plants and is therefore of unique importance to the conservation of the world's biological and landscape diversity.

Over centuries the Turkmen people have developed a national form of peaceful co-existence with nature that com-

prises part of their cultural heritage and has a positive social and moral function. The beauty of the country's natural heritage is closely inter-woven with national traditions and customs and has found its reflection in the emblems used in Turkmen carpets and jewellery. Beauty and harmony should exist in the spirit of every human being. This high spiritual ideal is enshrined in the sacred book of the Turkmen people - Ruhnama - that incorporates folk wisdom tried and tested over centuries.

Our aim is to make Turkmenistan into a prosperous country and turn it into a secure home for every inhabitant. The main task for all state programmes in neutral independent Turkmenistan is to increase levels of human welfare, which cannot be attained without maintaining an environmental balance.

The ratification of the Convention on Biological Diversity in 1996 expressed our concern and commitment to solve the problems of the conservation of national and global biodiversity. Consequently research work is being undertaken in our country to conserve and increase fauna and flora. The Red Data Book of Turkmenistan has been published; a network of zapovedniks and zakazniks has been created and considerable work on the conservation of rare species of animals and plants has been carried out. In all adopted nature-oriented documents biodiversity conservation is considered one of the most important targets of the Government, which underlines its commitment to addressing this problem.

The publication of this national report "Country Study on the Status of Biodiversity of Turkmenistan" is the result of a huge collective effort under the aegis of the government and UNDP. The next step is the development of the Biodiversity Strategy and Action Plan for the country.

State flag of Turkmenistan



National emblem



President's flag



Turkmenistan is a neutral state in Central Asia

Area – 491,200 km²

Political division – 5 velayats

Capital – Ashgabat

The highest representative body – Halk Maslahaty (People's Council)

The highest legislative body – Mejlis (Parliament)

The President is the Head of State

Population – 5,640,000 (as of 01.01.2002)

State language – Turkmen

National currency – manat

INTRODUCTION

Activities related to problems of ecology, environmental protection and sustainable use of natural resources play an important role in the development of Turkmenistan as an independent neutral state, and in its economy oriented to international integration and mutually beneficial cooperation.

Turkmenistan has gained a rich experience of developing and implementing state policies in the field of environmental protection.

Since becoming a member of the UN, Turkmenistan has taken the commitment to steadily follow the principles enshrined in the Declaration of Human Rights. Having joined the international community, it declared its adherence to international commitments affiliated to a number of Conventions: on Biological Diversity, to Combat Desertification, on Climate Change, Aarhus and others.

The execution of international agreements and conventions will contribute to the protection of the environment, and will help to prevent ecological calamities. Each country must, first of all, take into account its national interests, protecting its intentions and actions by the force of law, and devising and implementing its own national programmes.

Turkmenistan can proudly confirm that it has adopted the best attitudes to environmental protection. During the years of independence a number of state laws have been adopted: since 1998 a National Programme of Environmental Protection of Turkmenistan (NPEP) has been put into action, a programme of sustainable development (Capacity-21), Caspian Ecological Programme, and others.

A vivid example of specific targeted actions in the field of environmental protection is given in the programme of our great President Saparmurat Turkmenbashi: “Strategy of socio-economic reforms in Turkmenistan for the period till 2010”. The maintenance of environmental security is given a priority rank in state policy.

The efforts of the government and its branches relevant for biodiversity conservation have been developed in the “Biodiversity Strategy and Action Plan” Project. It has been worked out in accordance with the country’s commitments in the framework of the Convention on Biological Diversity.

The project envisages the necessary actions for biodiversity conservation in the country, the establishment of the necessary socio-economic, legal, institutional, information sharing and other preconditions for sustainable use of biological resources for current and future generations.

EXECUTIVE SUMMARY

Turkmenistan ratified the Convention on Biological Diversity (CBD) on 18th June 1996, thus showing its concern and interest in solving the problems of the conservation of national and global biodiversity.

Globally, the loss of biodiversity is the most serious ecological problem today. Since 1600, 484 animal and 654 plant species have become extinct. Currently more than 9,000 animal and almost 7,000 plant species are listed in the IUCN Red List (IUCN, 2000). In reality, many more species have become extinct or are close to extinction since a large part of the global species diversity has yet to be described.

The major goals of the CBD are the *conservation of biological diversity*, in particular the diversity of all living things at the genetic, species and ecosystem levels; the *promotion of sustainable use of resources* by countries; and the fair and equitable *sharing of benefits* relating to the use of genetic resources and transfer of relevant technologies. A key concept of the CBD is the transfer of environmental, resource-efficient, energy-efficient, and information technologies from developed to developing countries, thus diminishing the threats to natural ecosystems [40].

The biological diversity of Turkmenistan is part of its national heritage, and remains closely connected with other global ecosystems. It became obvious long ago that it was impossible to increase the rate of development because of the already heavy exploitation of natural resources. The most recent achievements in the field of biotechnology have proved the importance of the genetic material carried by plants, animals and micro-organisms. Every country needs to have an effective strategy for balancing economic activities with the maintenance of natural ecosystems. The threat of the loss of a number of elements of biodiversity, primarily species and ecosystems, and their substitution by non-native species, has led to the recognition of biological diversity as a strategic element required for sustainable development in the 21st Century.

This concept is recognised in the national policy of Turkmenistan, which aims at the harmonisation of society, and corresponds to the requirements of Agenda 21 regarding biodiversity. The ratification of the CBD – an international legal instrument – allowed Turkmenistan, in accordance with Article 6 of the CBD, to start developing a National Biodiversity Strategy and Action Plan (BSAP) for biodiversity conservation. The first step in the formulation of the BSAP is the compilation of this Country Study on the Status of Biodiversity (CS) which has been circulated for widespread review. The CS describes the natural diversity of ecosystems within the country (e.g., desert, mountain, and wetland) as well as the different degrees of human impact on them. The necessary conditions for the development of a long-term strategy for their conservation, restoration and use are also considered. In the current difficult socio-economic conditions of the country, biodiversity can become one of the potential mainstays of the country's revival. The development of Turkmenistan's National Environmental Action Plan (NEAP) will allow the formation of institutional and legal mechanisms for the implementation of both the CBD and the Pan-European Strategy on Biological and Landscape Diversity, including the development of environmental legislation.

1. COUNTRY CONTEXT

1.1. Geographical Location and Borders

Turkmenistan is located in the western part of Central Asia, lying between 38°08'N and 42°48'N and 52°07'E and 66°41'E. It extends 1,100 km from west to east and 650 km from north to south. Its area is 491,200 km² (excluding the Caspian Sea) [68]. To the north it borders Kazakhstan, to the east and northeast, Uzbekistan, to the south, the Islamic Republic of Iran, and to the southeast, Afghanistan. In the west, Turkmenistan adjoins the Caspian Sea. Ashgabat is the capital of Turkmenistan and has a population of 730,000 [68].

The natural borders of Turkmenistan are formed by the lower and middle courses of the Amudarya River in the east, the Caspian Sea in the west (from Garabogaz to the foothills of the Astrabad Mountains), the southern part of the Usturt Plateau in the north and the Kopetdag in the south. The highest point, Aiyrbaba peak (3,139 m) is situated in the Kugitangtau mountain range. The lowest point, Akdjaya depression in the Zaunguz Karakum, is 81 m below sea level.

1.2. Physical Geography

The natural conditions of Turkmenistan are diverse. Topographically, the country can be divided into two unequal areas: the larger is occupied by the desert plain and the smaller by



Ashgabat: Turkmenbashi's Palace



Fig. 1.1. Geopolitical map of Turkmenistan

foothills and mountains. Geographically, the plains of Turkmenistan belong to the Turanian Plain within which three landscape sub-zones can be identified: a) Tertiary plateaux; b) sandy deserts; and c) loess piedmont plains. The Tertiary plateaux include the Krasnovodsk Plateau and parts of the Ustyurt and Mangyshlak. The sandy deserts include the Central, Southeast and Zaunguzsky Karakum. The loess plains are well developed along the whole northern piedmont of the Kopetdag and Paropamiz Mountains.

Less than one fifth of Turkmenistan is covered by mountains. The Kopetdag range stretches along the southern border. The Greater and Lesser Balhans rise in isolation to the northwest of the Kopetdag. In the extreme east of Turkmenistan lie the Kugitangtau Mountains, which are connected to the Gissar mountain system.

The river network in Turkmenistan is limited. No large rivers originate within the country. Small rivers originate in the Kopetdag and Kugitangtau Mountains, and all of their waters are used for irrigation. The Murgab and Tedjen rivers are lost in the Karakum Desert. Only the large Amudarya River at times reaches the end of its course – the Aral Sea. During a year with average precipitation, the combined water resources of all rivers equals approximately 32.9 km³. Temporary surface runoff from takyr and takyr-like soils averages 0.8 km³. Despite the usually high salinity of groundwater in the Karakum Desert, there are some places where fresh groundwater accumulates, with total resources estimated as approximately 80 km³.

1.3. Climate

Turkmenistan has a typical continental climate, which is however milder along the Caspian Sea and in the mountains. The climate is arid with a high range of annual and daily temperatures, low humidity, high evaporation and low precipitation. The summer is hot and dry, autumn is cool and wet, and winters are mild with minimal snowfall. In the extreme south and

southwest winter lasts for just one month, while in the extreme north and northeast it lasts more than four months. The average temperature in January in the northeast is -5°C , while in the southeast and southwest it is $+4^{\circ}\text{C}$. The average July temperature is $+30^{\circ}\text{C}$. The highest recorded air temperature is $+45^{\circ}\text{C}$ while the lowest is -22°C .

Turkmenistan is located in an arid zone. In the plains, annual precipitation does not exceed 150 mm. In the Circum-Aral and the Karabogazgol areas it is less than 100 mm, while in the mountains it may attain 350 mm. Because of the arid conditions, artificial irrigation is almost universally needed for farming. Average annual precipitation is 220 mm [35] (Fig.1.3).

Westerly and south-westerly winds with velocities of 4.3 – 5.7 m/sec are typical in Turkmenistan. The strongest winds occur from March to June, and the lightest winds occur in September.

1.4. Population and Demographic Characteristics

The half million (491,200) square kilometres of Turkmenistan are sparsely populated in comparison with other Central Asian countries. On 1st January, 2002 the total population was approximately 5,640,000 (Fig.1.4).

Over 100 ethnic groups reside in Turkmenistan and Turkmens make up 90% of the population. The remainder are Uzbeks, Russians, Kazakhs, Tatars and Ukrainians and others [68].

The geographical variation, stark contrasts in natural conditions, complexity of historical and ethnographical processes, ethnic peculiarities and the inequality of the “economic potential” define the unevenness in settlement of the population over the territory of Turkmenistan. The average population density in the country is 11.5 people per km^2 (as of 01.01.2001). In valleys, river deltas, and other oasis areas population densities can reach 100

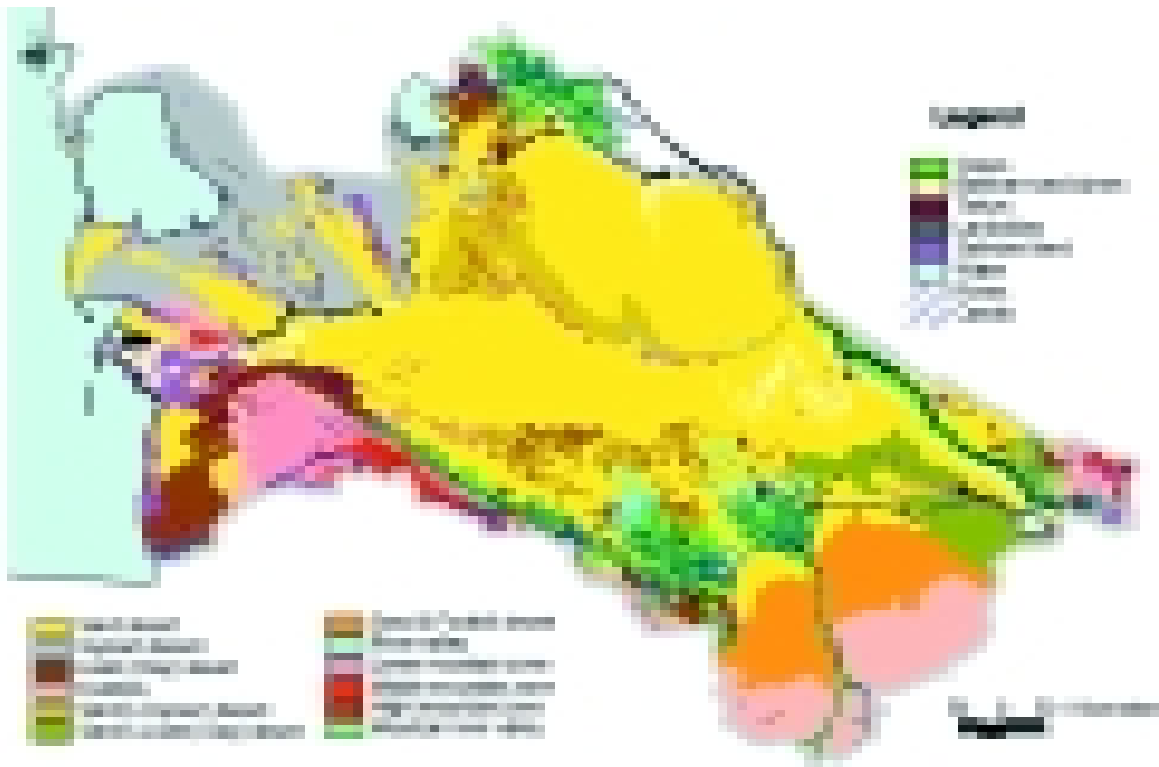


Fig. 1.2. Ecosystems of Turkmenistan

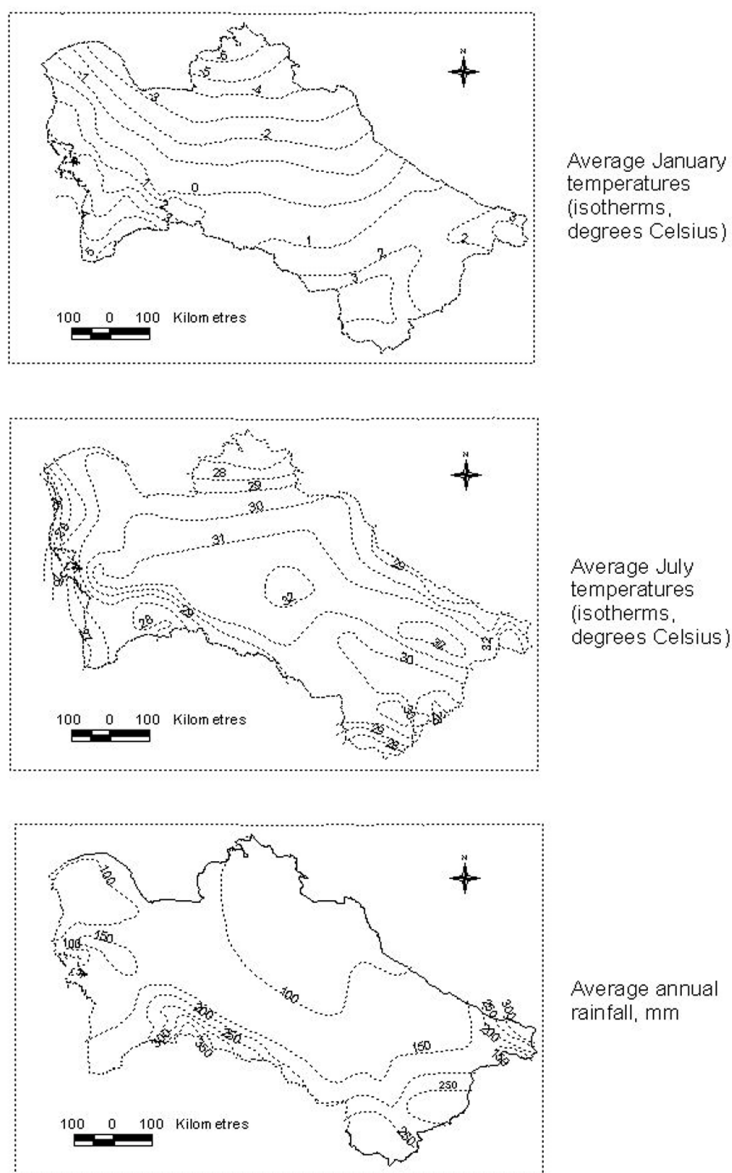


Fig. 1.3.

the Jeytun, began here in 4000 BC. Ancient Merv (present-day Mary) was a large Eastern scientific and cultural centre where renowned schools of science and literature were created. It has been proved that the Turkmens and their ancestors have lived on the territory of contemporary Turkmenistan for thousands of years. The legendary Oguz-khan is the patriarch of the Turkmens. Another legendary figure, the sage Gorgut-Ata, is also highly esteemed by people.

From his first day in office, the President of Turkmenistan Saparmurat Turkmenbashi has promoted a policy of spiritual rebirth and social development of the nation of Turkmenistan. This policy has deep scientific and theoretical roots and is based on the great historical heritage of the Turkmen people, their culture and traditions, ideology and lifestyle.

The social life of the Turkmens has favoured the creation of their own style in all spheres of life including culture and art, the economy and business. The unique achievements of the Turkmen people in horse breeding, carpet weaving, music, poetry, and arts and crafts are good evidence of this [37].

– 150 people per km², while in the deserts it may be less than one per km². A large part of the desert is uninhabited [66].

Turkmenistan has mostly small and medium-sized cities (21) and there are also many urban-style villages (77). [68]. A large proportion of the urban population is in the five cities with more than 100,000 inhabitants - Ashgabat, Turkmenabat, Dashoguz, Mary and Balkanabat (Fig. 1.4).

Turkmenistan is characterised by an oasis pattern of settlement. The Karakum Canal and other irrigation systems have doubled the size of the irrigated area and helped create new rural settlements on previously undeveloped land.

1.5. Culture

Turkmenistan has a long cultural heritage as witnessed by the presence of numerous features of architectural, cultural and artistic importance. The country boasts one of the first centres of human civilisation. One of the oldest-known settled-agricultural cultures,

1.6. Political and Legal Framework

State policy

Turkmenistan is a Presidential Republic with a Constitution. The role of the President is key - he is the Head of State and the Government and acts as a guarantor of national independence, territorial integrity, observation of the Constitution and commitments to international agreements. The President and the Cabinet of Ministers approve state ecological programmes and determine the state's ecological policy. The legislative body is the Majlis or Parliament of Turkmenistan.

The protection of the environment, the sustainable use of natural resources and the provision of environmental security for the people are policy priorities for Turkmenistan. In 2000 a "Strategy of Socio-economic reforms in Turkmenistan for the period till 2010" drafted by the President was approved. It aims to convert Turkmenistan into a developed country with a socially orientated market economy. Turkmenistan's foreign policy is based around its principle of positive neutrality, which was unanimously adopted in 1995 at the 50th Jubilee session of the United Nations General Assembly.

1.7. Infrastructure

Together with the country's increase in productivity, a programme of social construction and infrastructure development is being implemented.

The railway network includes more than 2,500 km of track. The Tedjen-Serahs-Meshed railway line connects the world's two largest railway systems (Europe and Asia) and completes the Trans-Asian Line of the Great Silk Road. The Turkmenabat-Atamurat

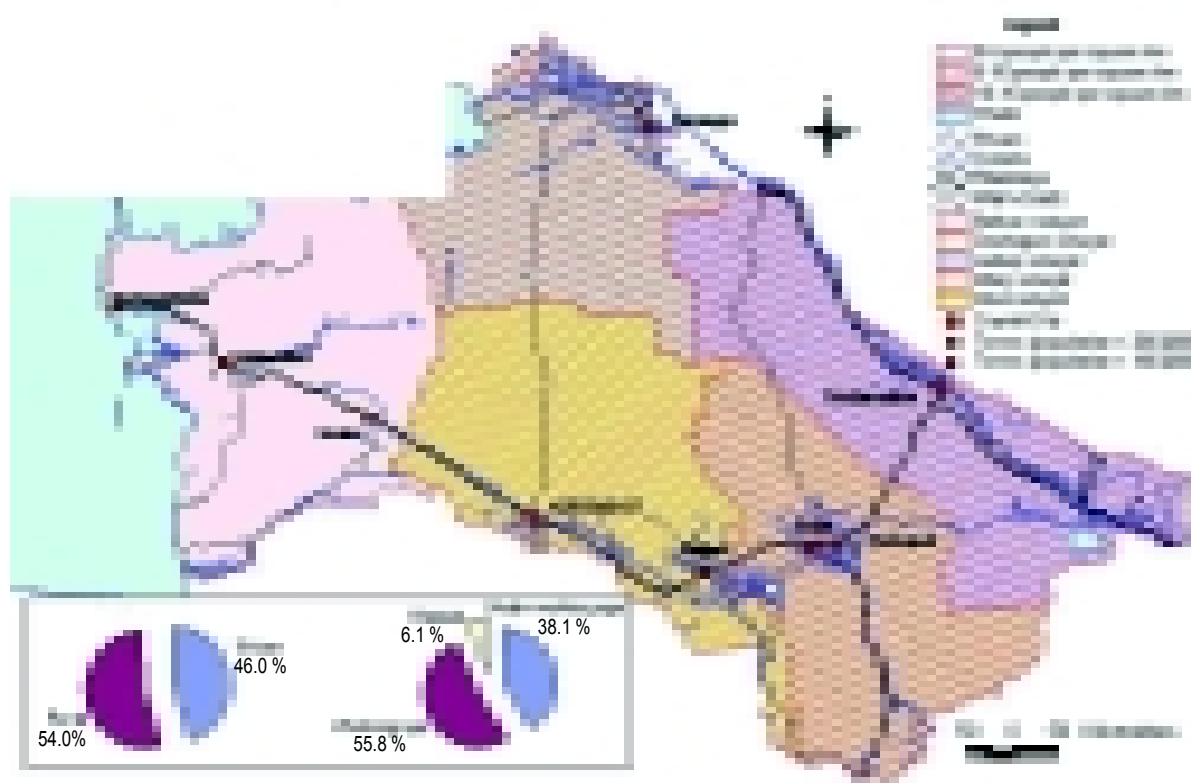


Fig. 1.4. Population of Turkmenistan

line has been completed and the branch line between Ashgabat, Karakum and Dashoguz is under construction.

The road network covers over 13,600 km and links the capital with other cities and regional centres.

There is a comparatively extensive **airline network** in Turkmenistan. An International Airport was constructed at Ashgabat in 1994, capable of receiving all types of aircraft. The capital is linked both with neighbouring and more distant countries.

Waterborne traffic travels via the Caspian Sea and the Amudarya River and Karakum Canal. Today there are sea routes via the Caspian Sea to Iran, Azerbaijan, Kazakhstan and Russia. Crude oil, oil products and chemicals are exported by sea. Upon completion of the Astrakhan ferry, there will be an opportunity to streamline the transport system through the port of Turkmenbashi allowing connections between Europe, Central Asia and the Persian Gulf countries.

In the development of the fuel and energy complex (FEC), priority is being given to pipeline construction. The existing system provides links in a northerly direction via Uzbekistan and Kazakhstan, and in a southerly direction to Iran. The question of new pipelines via Iran and the Caspian Sea is being discussed. There is also a plan for gas transportation via China to Japan.

The Karakum Canal and associated irrigation canals total 35,000 km and 16 water reservoirs have been constructed. This has allowed an increase in the area of land under irrigation. About 40,000 km of a **collector-drainage network** and other works have been built to improve soil conditions in the irrigated lands.

Since 1995 a 118 km **drinking-water conduit** has operated between Yaskhan and Balkanabat. In 1996, construction of the second stage of the Yaskhan water intake began. Five **electric power stations** with up to 17 billion kWh capacity are now operating in the country. In 1995 the first stage of Power Line 500 Seidi - Dashoguz that connects the northern velayat of the country to the national power grid came into operation. The future



Saparmurat Turkmenbashi holding a conversation with elders



Spring in the Kopetdag

of the branch is connected with the development of export power lines to Turkey, Pakistan, and Afghanistan.

Every year about 7 million tonnes of all types of *wastes* are stored in the country. Industrial wastes come mainly from the construction and mining industries, oil refineries, and public-utility discharges. Wastes include such recyclable components as lint, cotton peelings and ginned cotton products, as well as wastepaper, automobile tyres, glass, textile and crop wastes, reusable textile material and bricks.. A garbage recycling plant is planned for Ashgabat.

1.8. Land Tenure and Property Rights

As part of the President's "New Village" Programme, a market economy in the agro-industrial sector is being developed. Independent farmers' associations and agroservice structures are being created. To facilitate this process, new laws are being adopted. The laws "Of Farmers' Associations" (1995) and "Of Daykhan Farms" (1994) will regulate the transformation of defunct agricultural enterprises into the new style farmers' associations and joint stock companies. People engaged in agricultural activities voluntarily form these associations, which can be run on state, co-operative or other forms of property; the members of the association have a right to run their own businesses on a contractual basis.

The new Law "Of Farmers' Associations" (1995) says "the land, the capital assets and other property handed over to a farmers' association belong to it by right of exploitation and full self-management.

1.9. Land Use

As of 01.01.2001 the total area of Turkmenistan is 49,315,000 ha of which 40,201,000 ha are used for some kind of agricultural or pastoral activity. To date, about

83% of the land under irrigation has been handed over to 39,570 tenant farmers and land-owners (Fig. 1.5). The total area of pasture on 01.01.2002 was 38,500,000 ha, of which 95% consisted of plains and about 5% mountains (Figure 1.2).

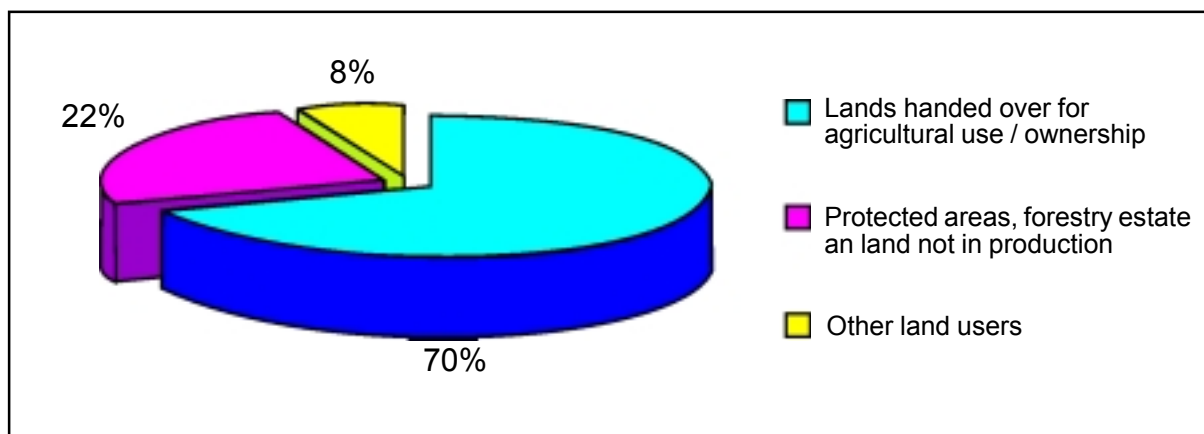


Figure 1.5. Land ownership as of 1 January 2001

1.10. Agriculture

Agriculture plays an important role in the development of the country's economy. More than half of the population lives in rural areas and about 48% of the manpower is involved in agriculture.

The agricultural sector includes a large number of agricultural and processing enterprises accounting for a third of the Gross National Product. Natural resources boost agricultural output and not only cover internal demands but also provide an export potential. Therefore, current agricultural policy aims to accelerate the reform of the agricultural sector and ensure the country's self-sufficiency in food.

One of the main objectives of agricultural policy is to increase production of such strategically important crops as wheat and cotton. In 2001 more than 2,010,000 tonnes of wheat and 1,137,000 tonnes of cotton were produced. Livestock and crop production are shown in Figs. 1.6 and 1.7

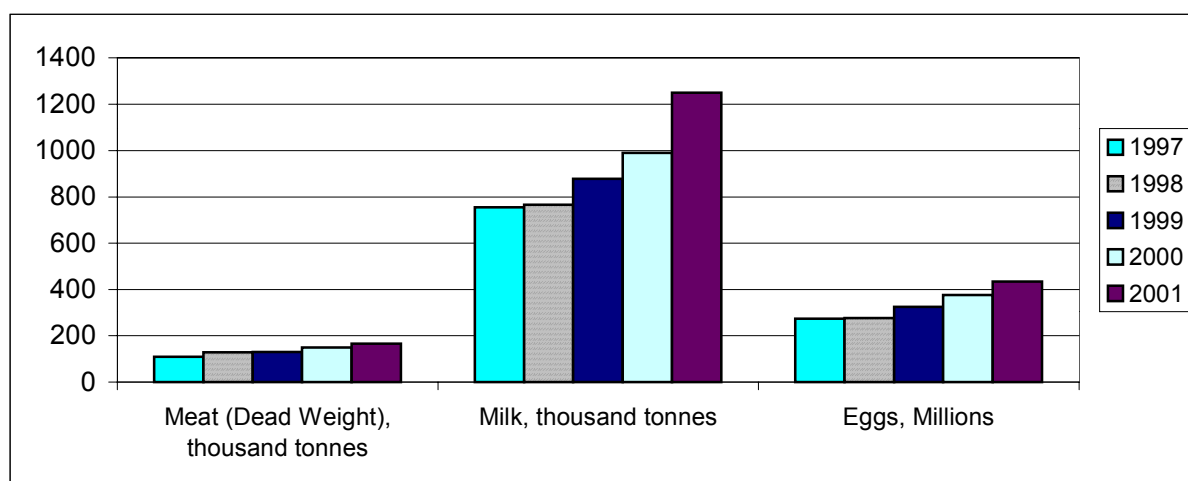


Figure 1.6. Livestock Production

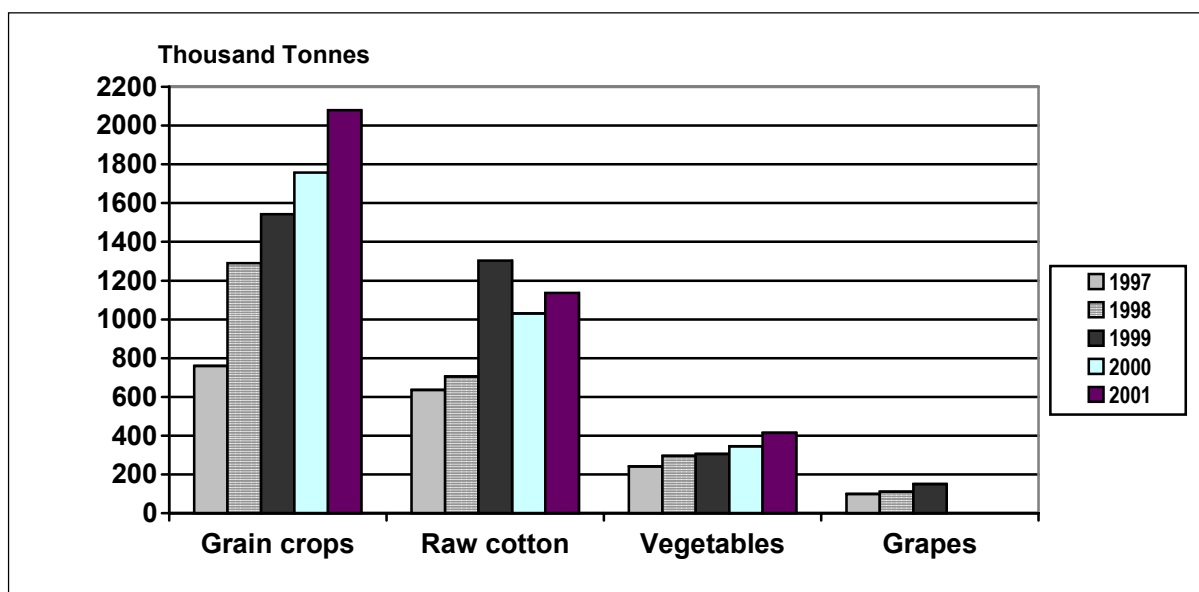


Figure 1.7. Crop Production

1.11. Fisheries

Fisheries are of great importance to the national economy of Turkmenistan. Fish are traditionally caught both in inland basins and in the Caspian Sea.

The Caspian Sea, and the estuaries of the rivers flowing into it, is the most important area for fish in the region. Saltwater species (e.g. mullet, sprat and species of herrings) and anadromous species (e.g. sturgeons and salmon) are the main catches [51] (Fig.1.8).

Almost all the inland basins of Turkmenistan have been affected by human activity. The deliberate or occasional stocking of these basins to increase productivity has been prac-



Wheat harvesting time

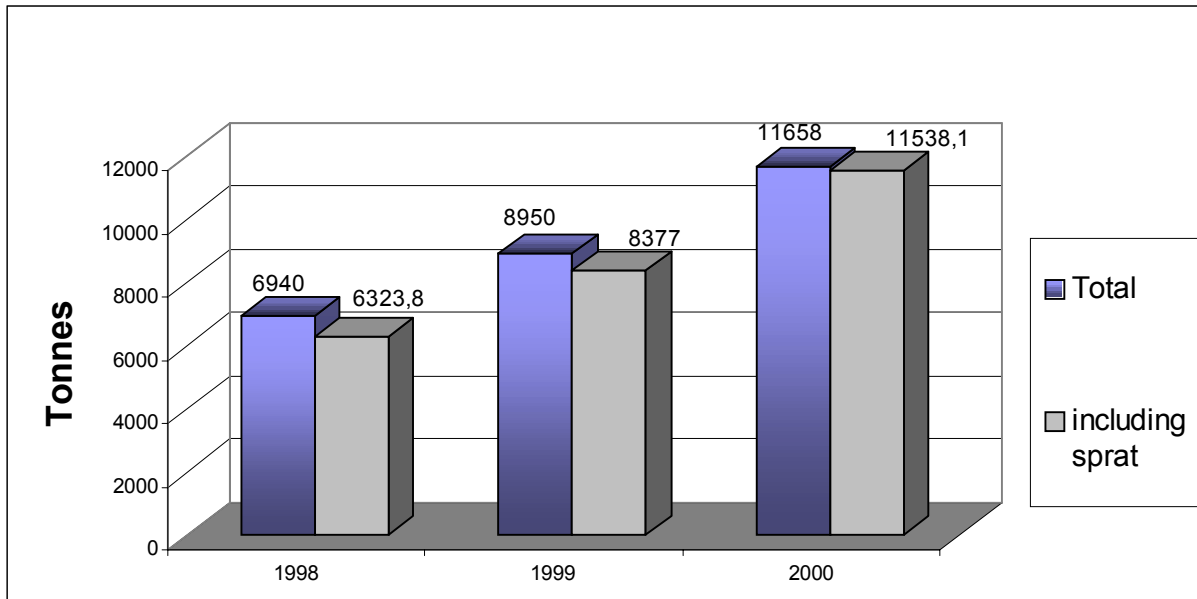


Figure 1.8. Caspian Sea Fishery

tised for more than 100 years. The biggest impact of these activities in Turkmenistan has been through the introduction of Far-Eastern herbivorous fishes such as white and dappled silver carp (*Hypophthalmichthys molitrix*) and white Amur bream (*Parabramis pekinensis*). [64] (Fig.1.9).

1.12. Industry

Over 4,800 industrial enterprises, producing 80% of the national income, are operating today in Turkmenistan [20]. The country is an exporter of energy resources such as natural gas, oil products and electricity.

Extractive enterprises (mainly the oil-and-gas sector) account for 59% of industrial output. In recent years new industries such as textiles and pharmaceuticals have appeared and the contribution of processing enterprises to the industrial sector has been increasing.

The chemical and petrochemical sector includes mining-chemical, chemical, plastic and household chemical goods industries. The manufacturing sector is represented by three indus-

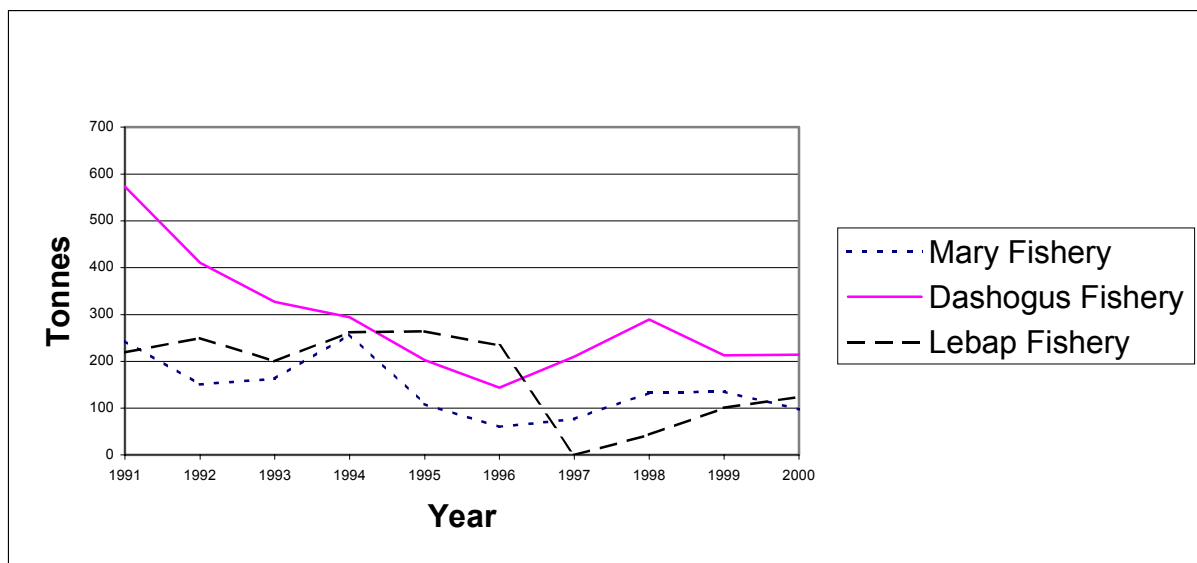


Figure 1.9. Inland Fishery

tries: machine assembly; production of metal constructions and goods; and maintenance of machines and equipment.

The volume of oil production amounts to more than 7 million tonnes with a good part of it being processed by the two oil-refineries in Turkmenistan (Turkmenbashi and Seidi). The volume of gas produced is limited by export capabilities. At the same time, the diversification of the economy is aiming at increasing the share of processing and import-substituting industries (currently standing at 41% of industrial production) [68, 9].

The development of resources in the Caspian Sea shelf is the primary focus of the oil production industry. There are plans for the construction of fertiliser plants in the cities of Mary, Turkmenabat and Tedjen, an aluminium complex in Mary, a pulp and paper plant in the city of Shatlyk, a soda ash producing plant in the city of Guwurdak, and three iodine plants.

1.13 Tourism

The ecotourism industry is in the early stages of development. Turkmenistan is attractive for its man-made and natural features such as the Caspian Sea, Kugitang massif with a famous plateau containing dinosaurs' footprints, Kyrk gyz cave, Daraydere gorge, and the great Central Asian Amudarya River. The tourism development programme adopted by the Government in 1995 and recognised by the World Tourism Organisation envisages wide support from potential foreign investors through the creation of a favourable investment regime [9]. A Decree "About Tourism" was ratified by the Parliament in 1995. In 2002 it is expected to increase the volume of tourism services to US \$15 million. The tourism industry favours the rebirth of the manufacture of artisanal products and helps to solve the problem of employment.

The State Tourism and Sports Committee oversees the tourist industry in the country. About 20 tourist routes have been developed by the Committee. It has representatives in Germany, Russia, Turkey, Saudi Arabia, Pakistan and Great Britain [9].



One of the tourist routes

1.14. Socio-Economic Situation

The structural reorganisation and reforms in all spheres of the economy have favoured a gradual increase in economic activity as well as promoting a stable socio-economic situation in the country. The state budget is the main source of finance for the social sector.

Current macroeconomic reforms have led to an increase in the Gross Domestic Product (GDP). The GDP in 2001 was 31.0 trillion mantas (»6.0 billion USD) and its rate of growth (120.5%) turned out to be an all-time high even among developed countries of the world. The record increase in GDP has been attained mainly on account of the rapid increase in the outputs of industry (116%) and agriculture (123%). Favourable legal and economic conditions as well as the necessary infrastructure have been created for foreign investors and businessmen. This has encouraged great progress in the development of foreign economic relations. As of today, more than 840 enterprises with foreign shareholders have been registered, and 118 projects with 70 foreign firms involved are under development [9, 20, 76]. Turkmenistan currently has 82 countries as trade partners. The network of foreign economic links is continuously expanding.

1.14.1. Healthcare System

A health insurance system, along with a guaranteed free medical service, has been recently introduced. The primary healthcare service is run on a family service principle. Private practice, self-financing medical institutions, and a national pharmaceutical industry are all well developed.

1.14.2. Education

Literacy rates are high in Turkmenistan. According to the World Bank, the literacy rate among 9 to 49 year olds is 99.3% [76]. The level of education is high amongst both the urban and rural population and almost a third of people of working age have a higher or special education.

The social orientation of economic policy is fixed in the State budget. Today, social-related spending comprises 67% of the State budget, an increase of 5% over 1999. Expressed as a percentage of GDP these expenses made up almost 20%. A vast network of educational institutions consisting of 1,119 preschools, 1,922 secondary schools, 118 specialized primary, 16 specialized secondary and 16 higher education institutions is functioning today in Turkmenistan. Besides this, a number of training courses in languages and other subjects are organized throughout the country. About 1.1 million young people are currently being educated; of these 123,000 are in preschools, 1,017,000 are in schools, over 4,000 in specialized schools, and over 21,000 in higher education establishments [9, 20, 68, 76].

Reforms in education are directed towards further increasing the educational and cultural level of the population, improving standards of teaching, raising intellectual potential

Turkmenistan's status of permanent neutrality provides wide opportunities for the development of international cooperation in the field of education. Today, in accordance with various interstate agreements, over 2,000 young Turkmen citizens are studying in different countries of the world. [9, 20, 68, 76].

and levels of professional skill, continuing to provide universal free education, and the development of spiritual values in society.

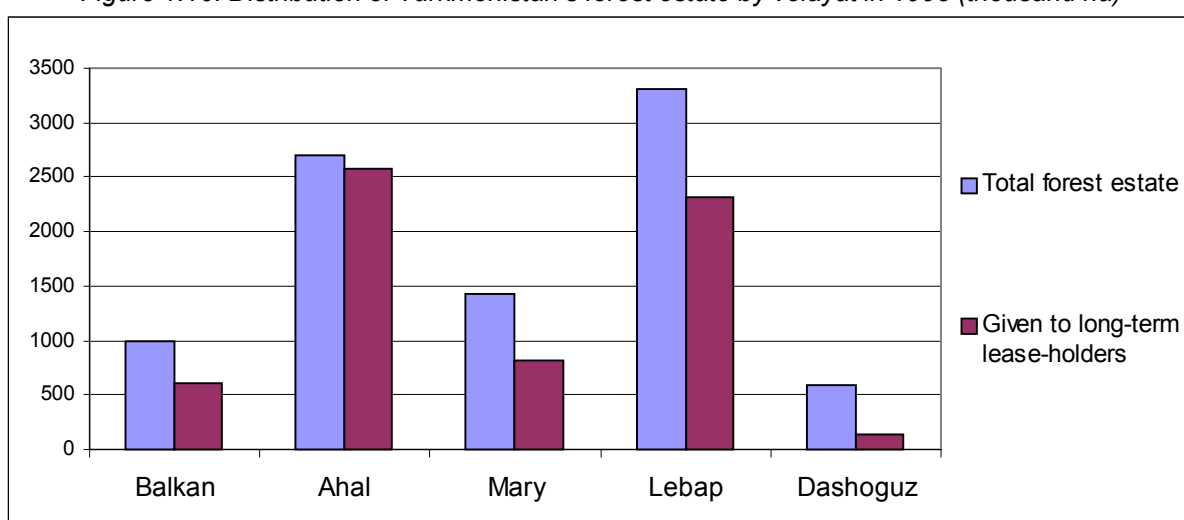
1.15. Forestry

Arid Turkmenistan is one of the least forested regions of Central Asia. Its forest plantations (e.g. for the prevention of erosion, protection of water resources, recreation, and protection of arable lands) are an important national asset.

The forests of Turkmenistan constitute a state resource that in 1990 made up 9,900,000 ha (including SPAs) or 20.2% of the country's total area. The area of timber makes up 4,129,900 ha of which 3,081,600 ha has been earmarked for a long-term use [39, 45] (Fig. 1.10).

The forests of Turkmenistan perform an important function from an environmental viewpoint [39, 45]. The importance of forest plantations has been legally recognised in the Forest

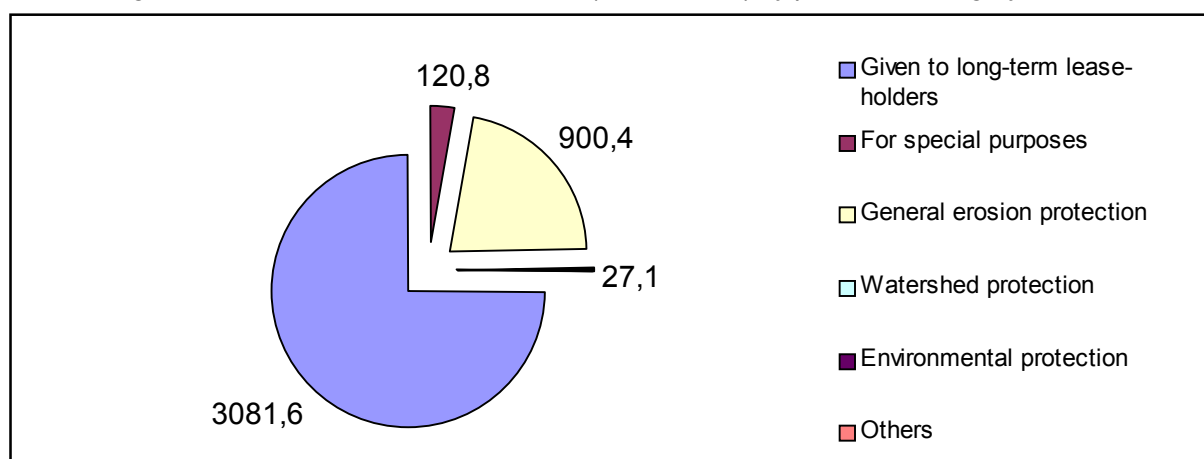
Figure 1.10. Distribution of Turkmenistan's forest estate by velayat in 1998 (thousand ha)



Code of Turkmenistan (1993) and in a number of the President's decrees directed towards sustainable use of forests, their reclamation, protection and conservation [61] (see section 7.5).

Most of the forest estate of Turkmenistan is managed by the forestry institutions, which have been affiliated into a public limited company "Geok Gushak", and enterprises and organisations of the Ministry of Nature Protection of Turkmenistan.

Figure 1.11. Distribution of forested area (thousand ha) by protection category in 1998



The forests of Turkmenistan are of great importance in the regulation of the climate and water balance of submontane areas and perform important roles in stabilising soils, protecting water resources, preventing erosion and safeguarding environmental health (Fig.1.11). Arid forests, unlike other natural resources, are able to recover but their reforestation process takes much time because of water deficiency.

1.16. Importance of Biodiversity for the Country

Biodiversity plays an important role in the creation and maintenance of an environment fit for humans. Natural ecosystems maintain biological processes important for human life such as soil-formation, surface water purification, control of run-off and precipitation, maintenance of the gaseous composition of the atmosphere and many others.

The fisheries, tourism, forestry and agricultural industries depend directly on the sustainable use of ecological resources, while others are connected with them indirectly. Wild relatives of cultivated plants and numerous medicinal and economically important species are currently used or will be used in the future for the benefit of society and the country. An economic assessment of biodiversity has yet to be conducted, but the Turkmenistan Government recognises that its protection and support is an investment for future generations.

* * *

Thus the economy of Turkmenistan developed slowly before independence. The monocultural character of agriculture, centralisation of industry and failure to take into account local conditions led to serious threats to the country's biodiversity. Correspondingly the nature protection system was based on the command economy / central administration format that quite often led to conflicts between SPAs and the local population and damaged the development interests of the regions.

Despite the relatively low population density, some areas favourable for human settlement have suffered from overpopulation.

Today the internal and foreign policy of Turkmenistan promotes biodiversity conservation and sustainable use of resources. With the growth of industry and infrastructure, effects on the quality of biodiversity are expected to increase. In these conditions socio-economic policy provided by the government in the field of nature protection forms the foundation for the successful solution of the problems connected with biodiversity conservation.

2. STATUS OF TURKMENISTAN'S BIOLOGICAL DIVERSITY

2.1. Description of Biodiversity

Turkmenistan became the first republic of the Central Asian region to have a complete published flora. The seven-volume *Flora of Turkmenistan* was completed before the last volumes of the *Flora of the USSR* were published. As a result a wealth of factual material on the flora and floristic composition of the majority of Turkmenistan, including the mountains and the Karakum desert, has been collected. Separate scientific monographs and vegetation keys [53] have been prepared. This allows floral composition to be used as an indicator of habitat quality.

The terrestrial vertebrate fauna has also been well studied. These studies have resulted in the publication of a number of monographs: *Reptiles of Turkmenistan* (Bogdanov, 1962); *Reptiles of the Turkmenistan Plains* (Shammakov, 1981); *Reptiles of the Turkmenistan Mountains* (Atayev, 1985); *Mammals of Middle Turkmenistan and the Adjacent Plain* (Ognev and Geptner, 1929); *Mammals of the Karakum Canal Zone* (Nurgeldiev and others, 1986); *Mammals of Turkmenistan, Volume 1* (1995); *Avifauna of the Transcaspian Region* (Zarudny, 1986); *Birds of Turkmenistan, Volume 1* (Dementyev, 1952); and *Birds of Turkmenistan, Volume 2* (Rustamov, 1958).

The same is true for the ichthyofauna of inland waters, which is covered in two monographs: *Fauna of the inland waters of Turkmenistan* (Starostin, 1992) and *Fishes of the inland waters of Turkmenistan* (Aliev and others, 1988). The ichthyofauna of the Turkmen part of the Caspian Sea has been less well studied than that of the inland waters, mainly because in the former Soviet Union fisheries research in the Caspian was traditionally based in Astrakhan and Baku.

Among the vast number of scientific works dedicated to the invertebrates it is worth mentioning *Fauna and ecology of the grasshoppers of Turkmenistan* (Tokgaev, 1973), *Beetles of Turkmenistan (biology and ecology)* (Nepesova, 1980), *Parasitic wasps of the Encyrtidae family of Turkmenistan and contiguous regions of Central Asia* (Myarzseva, 1984), *Ants of Turkmenistan* (Dlussky and others, 1989), *Insect complexes of the northern*



Coluber ataevi
(described from Turkmenistan in 1986)



Asiatic cheetah (*Acinonyx jubatus ssp. venaticus*)

Karakums (Soyunov, 1991) and *Biogeography and Ecology of Turkmenistan* (Atamuradov, 1994).

2.2. Historical Perspective on Biodiversity

In ancient times forests were probably more widespread in Turkmenistan. In the chronicles of different authors there are descriptions of the rich forests of Gerkani, Parthia, and the Amudarya delta.

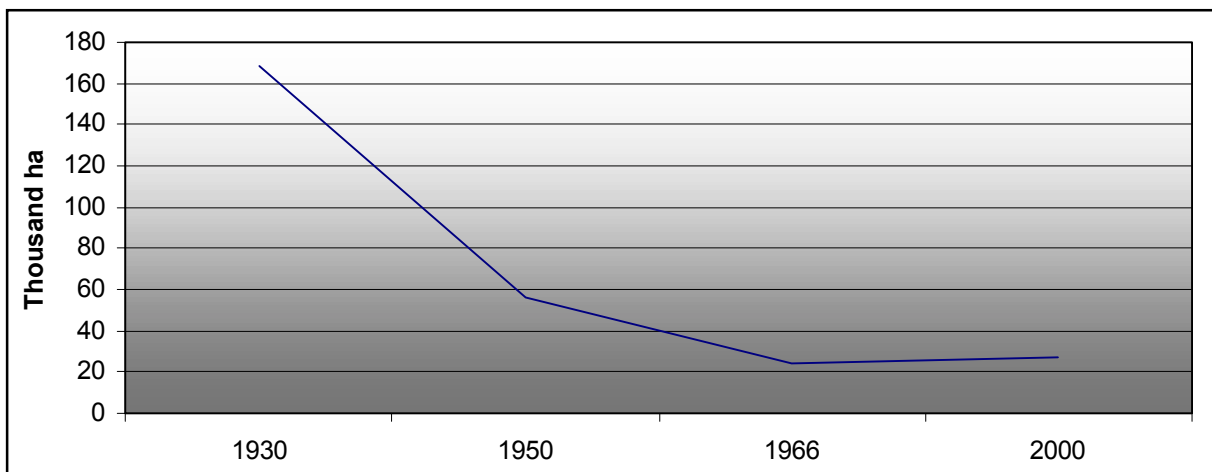
More recently, there have been repeated climatic changes, and the diversion of the Amudarya River and fluctuations in the level of the Caspian Sea have also considerably affected the country's environment. These changes have been described in a number of publications [4].

The major impact on the biodiversity of Turkmenistan has been through human activities. Cattle-breeders have intentionally burnt pastures in order to kill parasites and to improve grazing. Invading armies destroyed the forests so that the local population could not use them as shelter. During cultivation, humans burnt vegetation in the river valleys and wetlands. For instance, in Badkhyz, there is evidence of the use of fire [21]. Considerable areas of forest were destroyed during the construction of ancient cities (wood was used for brick kilns, construction timber, fuel etc.). As well as these changes, humans also created artificial plantations of, for example, walnut (*Juglans regia*), mulberry (*Morus spp.*), willow (*Salix spp.*), elm (*Ulmus spp.*), oriental plane (*Platanus orientalis*), and poplar (*Populus spp.*).

Since prehistoric times timber has been used extensively in the mining industries. The remains of ancient iron-ore and lead-ore smelters are found in Badkhyz, Kopetdag, and Kugitang.

After the construction of the Transcaspian railway at the end of 19th Century, saxaul (*Haloxylon spp.*) and archa were the main sources of firewood. A considerable decline in the area of forests also took place during World War II when archa as well as saxaul was burnt in the

Figure 2.1. Changes in archa forest cover over the last 70 years



furnaces of the sulphur factories in the Central Karakum (Fig. 2.1). In 1941-1945 alone, 6 million hectares of saxaul, including 0.5 million hectares of black saxaul (*Haloxylon aphyllum*), were cut down for use in the agricultural and defence industries. The harvesting methods used (clear cutting and felling in large quantities) hampered the natural reforestation of these vast areas.

During the same period, large amounts of wild meat and furs were used by the military. This led to a severe decline in numbers of ungulates and fur-bearing animals. The fur-bearing animals have since been able to recover while the majority of ungulate species are still rare.

The centuries-old break down of ecosystem links caused by anthropogenic impacts has led to the decline of a number of floral and faunal species, many of which have already disappeared while others are close to extinction. Thus, during the last 100 years such animals as the Turan or Caspian tiger (*Panthera tigris virgata*), Asiatic cheetah (*Acinonyx jubatus venaticus*), and scaly-bellied green woodpecker (*Picus squamatus*) have become extinct in Turkmenistan. From the ichthyofauna of the Caspian basin Transcaspian dace (*Leuciscus latis*), Aral barbel (*Barbus brachycephalus brachycephalus*) and Kessler's loach (*Nemacheilus kessleri*) have also disappeared.

Such vascular plants of Turkmenistan as *Phyllitis scolopendrium*, *Telephium orientalis*, *Peltariopsis planisiliqua*, *Alcea karakalensis*, *Reaumuria botschantzevii*, *Mespilis germanica*, *Astragalus arianus*, *Pseudolinosyris sintenisii*, and *Echinops transcaspicus* might have disappeared; whilst Iranian floral species such as *Astragalus chrysostachys*, *A. kucanensis*, and *Dionysia kossinskyi* which were previously found in the Kopetdag have totally disappeared.

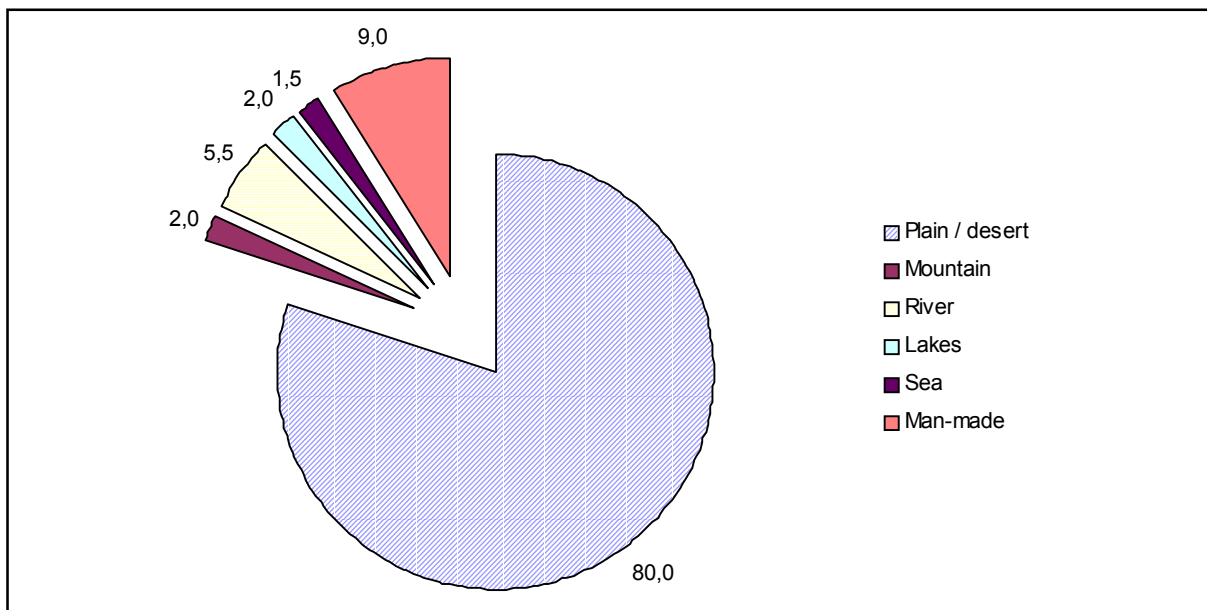
2.3. Ecosystems / Habitat Diversity

The major ecosystem types of Turkmenistan are shown below in Figure 2.2.

2.3.1. Deserts

Up to 80% of Turkmenistan is desert (Fig. 2.2). A major part of the biodiversity in deserts is in areas such as the barkhan dune fields (which cover 350,000 km²). Forty-one species of vascular plants are found in the barkhan sands, ten of these are typical sand dune species such as

Figure 2.2. Major Ecosystems of Turkmenistan





Barkhan sand dunes in the Karakum Desert

Stipagrostis karelinii, *Ammodendron conollyni*, and *Acanthophyllum elatius*. Eighty-seven typical species (for example *Zygophyllum turcomanicum*) grow on the fixed sandy-pebble and gypsum sands. Thirty typical species (for example *Calligonum bubyri*, *C. muravljanskyi*, *Artemisia leucodes*) are found on kyr (= mixed clay and sand desert) ridges of strata in Zaunguz, however they are not found in other Karakum regions. *Salsola gemmascens*, *Anabasis salsa* and other species, 25 in total, are typical of takyrs (= clay desert. Takyrs make up about 5,000,000 ha or 10% of the territory), where blue-green algae and lichens are predominant, with occasional annual saltwort (*Salsola* spp.). In saline areas, 53 typical salt-tolerant species, mainly bushes (for example common glasswort (*Salicornia europaea*) and *Halostachys belangeriana*) are found. Clay badlands [15] are vegetated by scattered annual saltwort plants (*Salsola* spp.) [18].

Almost 90 species of lichens are found in the loamy deserts of Turkmenistan: 20 species in gypsiferous deserts, and 68 species in sand deserts. The desert moss *Tortula caninervis* is a typical species of desert ecosystems.

Deserts are home to amphibians such as the Eurasian green toad (*Bufo viridis*) as well as more than 40 species of reptiles including agamas, race-runners or fringe-toed geckos (*Eremias* spp.), agamid lizards (*Phrynocephalus* spp.), rock geckos (*Cyrtopodion* spp.), snakes, desert



Sand gazelle (*Gazella subgutturosa*) - a symbol of the Karakum Desert

monitor lizard (*Varanus griseus*) and steppe tortoise (*Agrionemys horsfieldi*) [78]. Two hundred and twenty species of birds live in the Karakum desert, 60 of which are breeding species. These include species such as long-legged buzzard (*Buteo rufinus*), little owl (*Athene noctua*), eagle owl (*Bubo bubo*), saxaul sparrow (*Passer ammodendri*), and Pander's ground jay (*Podoces panderi*). More than 40 species of mammal are recorded from the deserts of Turkmenistan. These include long-eared desert hedgehog (*Hemiechi-*

mus auritus), Tolai hare (*Lepus tolai*), kulan (*Equus hemionus kulan*), goitred or sand gazelle (*Gazella subgutturosa*) and others. Rodents are the most representative mammalian group in deserts. Predators include the red fox (*Vulpes vulpes*), Corsac fox (*V. corsac*), golden jackal (*Canis aureus*), wolf (*Canis lupus*), European weasel (*Mustela nivalis*), marbled polecat (*Vormela peregusna*), caracal (*Lynx caracal*), sand cat (*Felis margarita*) and wild cat (*Felis lybica*). The characteristic species of the sand desert is the piebald or sand shrew (*Diplomesodon pulchellum*). More than 1,500 species of insects are recorded including many species of locust, ants, termites and beetles (especially family *Tenebrionidae*). The national symbols of the desert are the kulan and sand gazelle.

2.3.2. Mountains

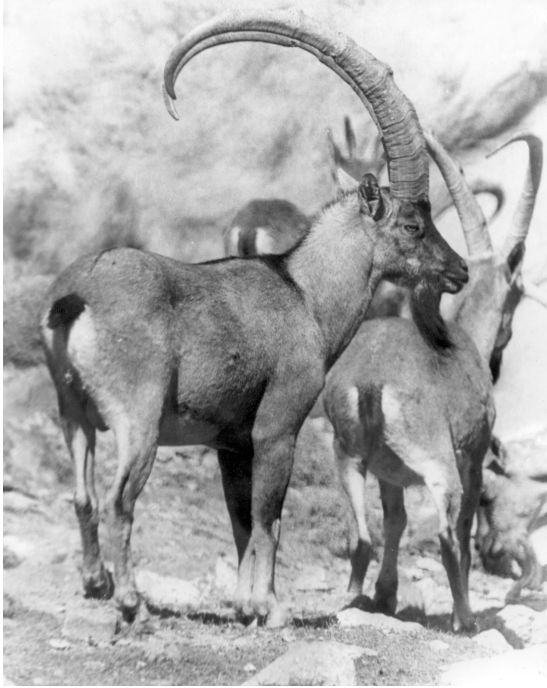
Mountain ecosystems can be divided into three regions: 1) above 600-650 m lie areas sparsely wooded with deciduous trees; 2) above 1000 m juniper (archa) woods are found; and 3) above 2700-3000 m are mountain steppes. The sparsely wooded deciduous areas are characterised by species such as *Celtis griffithii*, *Acer turcomanicum*, *Acer pubescens*, *Celtis caucasica*, pistachio (*Pistacia vera*), *Colutea buhsei*, and *Paliurus spina-christi*, which typically grow on dry stony and scree slopes. These areas are heavily influenced by human activities such as tree-cutting and game hunting that reduce their species diversity. Habitats dominated by *Celtis* are more stable. Habitats dominated by maples (*Acer* spp.), members of the Zygophyllaceae and, in the south-western Kopetdag *Paliurus spina-christi*, are widespread. There are also scattered areas of pistachio savannah, but these do not form any large continuous tracts.

The juniper woods adjoin the mountain steppes. Again, these are fragmented without any large continuous tracts, and are mostly found in the border area from the Arvaza-Messinev region up to the Tekechengasy range near Kuruhaudan.

The mountain steppes are found at higher altitudes than the juniper woods. They are often found in small inter-montane valleys or the bases of canyons. The best-preserved exam-



Sparse juniper (archa) woodland



Turkmen wild goats
(*Capra aegagrus ssp. turcmenicus*)

ples are in the Kopetdag. In the Kopetdag steppes, xerophytic plants are encroaching on feather-grass habitat [81].

Two thirds of Turkmenistan's terrestrial vertebrate species are found in mountain ecosystems, including almost all amphibian species (four species). Nearly 50 species of reptile are found in the mountains, including agamas (*Trapelus* spp.), armoured glass-lizard (*Pseudopus apodus*), skinks (*Mabuya* spp.), Schneider's skink (*Eumeces schneideri*), mountain racer (*Coluber ravergieri*), the Oxus cobra (*Naja oxiana*), and the blunt-nosed or Levantine viper (*Vipera lebetina*). Species such as the gecko *Eublepharis turcmenicus*, cat snake (*Telascopus rhinopoma*), Grozny lizard (*Lacerta defilippii*) and ocellated skink (*Chalcides ocellatus*) are endemic to the Kopetdag [3]. There are 290 bird species recorded from the mountains, 150 of which are breeding species. Typical mountain birds include choughs (*Pyrrhocorax* spp.), white-winged grosbeak (*Mycerobas carnipes*), *Petronia petro-*

nia, Eastern rock-nuthatch (*Sitta tephronota*), Chukar partridge (*Alectoris chukar*), lammergeier or bearded vulture (*Gypaetus barbatus*), Caspian snowcock (*Tetraogallus caspius*) [24].

Nearly 75 mammal species are found in the mountains including North Persian leopard (*Panthera pardus ciscaucasica* = *P. p. saxicolor*), Pallas' or steppe cat (*Otocolobus* (= *Felis*) *manul*), *Ovis orientalis*, Turkmen wild goat or bezoar (*Capra aegagrus turcmenicus*), Tadjik markhor (*Capra falconeri heptneri*), Blanford's fox (*Vulpes cana*), Afghan pika (*Ochotona rufescens*) and other rodents. Common species in this habitat include wolf, jackal, fox, and others. More than 10 fish species inhabit the mountain rivers of Kugitang and Kopetdag. More than 1,500 invertebrate species have been recorded including many species of Frenata, Hymenoptera, Hemiptera and Diptera.

2.3.3. Rivers

The riverine ecosystem (wetlands of the rivers Amudarya, Murgab, Tejen, Sumbar, Chandyr, Atrek and small mountain rivers of the Kopetdag and Kugitang) includes areas of tugai (thickly-vegetated ecosystems in river-valleys in arid regions), wormwood (*Artemisia* spp.) saltwort (*Salsola* spp.) and water-meadow vegetation [15]. The tugai vegetation includes *Populus pruinosa*, *P. euphratica*, *Salix acmophylla*, *S. songarica*, a number of tamarisk species, *Halimodendron halodendron* and, rarely, *Ulmus carpinifolia*. Grasses such as *Erianthus ravennae*, *Saccharum spontaneum* and a number of rushes (*Juncus* spp.) constitute the understorey. Salt-tolerant plants such as *Aeluropus littoralis*, *Limonium otolepis*, and *Karelinia caspica* grow beneath trees and bushes in the saltmarsh areas. Rare species such as *Astragalus kelifi*, *Eulophia turkestanica* and *Zeuxine strateumatica* are also found there.

The forests of the montane river valleys have unique features. Blackberry bushes (*Rubus caesius*) are common and giant reed (*Arundo donax*) and horsemint or long-leafed mint (*Mentha longifolia*) are found along the edges of the rivers. At higher levels, species such as iron tree (*Celtis caucasica*), walnut, willows (*Salix aegyptiaca*, *Salix babilonica*), poplars (*Populus* spp.), and elms (*Ulmus* spp.) are found.

Water meadows include species such as *Calamagrostis* spp., *Polypogon* spp., *Phalaris minor*, as well as reed mace *Typha* spp., *Erianthus ravennae*, *Saccharum spontaneum*, *Imperata cylindrica* and other sedges and grasses. Areas of bamboo grass include common species such as *Phragmites australis* and *Arundo donax*. In riverbeds, reeds form single-species habitat patches extending for several tens of metres. Birds, reptiles and mammals use these areas. Regular floods occurring after winter snowmelt affect the riverine saltwort-wormwood ecosystems. They are home to various species of *Salsola*, such as *S. dendroides* and *Artemisia*. In the saltmarsh areas, *Kalidium caspicum*, *Salsola aucheri* and *S. botschantzevii* are found. Other species present in river ecosystems include willows, poplars and water-loving herbs. Annual and perennial grasses and rare species of fern are also present.

Freshwater fishes found in rivers include all representatives of inland waters excluding the blind cave loach (*Nemacheilus starostini*), roach (*Rutilus rutilus uzboicus*), goby sp. (*Neogobius iljini*) and carp bream (*Abramis brama orientalis*). Species that use the Atrek River for spawning include roach (*Rutilus rutilus caspius*) and common carp (*Cyprinus carpio*). Amphibians found in Turkmenistan's rivers include the Eurasian green toad, the Middle Asiatic toad (*Bufo danatensis*), marsh frog (*Rana ridibunda*), black-spotted pond frog (*R. nigromaculata*) and Caucasian frog (*R. macrocnemis*). The Caspian turtle (*Mauremys caspica*) and European pond turtle (*Emys orbicularis*) are found in the Sumbar, Chandyr and Atrek Rivers. Many lizard and snake species are also recorded such as the European legless lizard (*Pseudopus apodus*), grass snake (*Natrix natrix*), dice snake (*N. tessellata*), Oxus cobra and the blunt-nosed viper. More than 200 bird species have been recorded from the floodplains. These include grebes, cormorants, pelicans, geese, ducks, coots, gulls, waders, waterfowl, and sparrows.

Mammals recorded from the river systems include wild boar and Eurasian otter (*Lutra lutra*) as well as species that have become established in the second half of the 20th Century (musk-rats *Ondatra zibethicus* and the nutria or coypu, *Myocastor coypus* [56]). Bukhara deer (*Cervus elaphus bactrianus*) are now only found on the floodplains of the Amudarya River. Invertebrate species recorded include Rotatoria, Hirudinea, Cladocera, Copepoda, Ephemeroptera and Trichoptera. There are also many mosquito species (Culicidae, *Phlebotomus*). The exact number of invertebrate species in the river systems is unknown.

2.3.4. Lakes

Species of grasses (Poaceae), reed mace (*Typha* spp.) and goosefoot (Chenopodiaceae) dominate the coastal flora of lake ecosystems. (In Lake Karategelek the dominant species of the freshwater plankton are *Pediastrum*, *Scinodermus* and *Nitzschia* mixed with some



A mountain brook



Caspian seals (*Phoca caspica*)

saltwater species, as well as *Ceratophyllum demersum*. In total ninety-six species of algae are found in the lake ecosystems of Turkmenistan (the dominant ones are diatoms and Chlorophyta) including species of *Sinedra*, *Nitzschia*, *Lyngbya* and *Oscillatoria*.

Greater bladderwort (*Urticularia vulgaris*) is a rare insectivorous plant found in Lake Karategelek. It is listed in the Red Data Book of Turkmenistan 1999 [43, 44]. Bacillariophyta and green alga dominate Lake Topiyatan.

Ten fish species are recorded from the lakes of the western Uzboy, two of which, roach and bighead goby (*Neogobius iljini*) are not found in other inland waters. Lake Yashkan contains the only population of carp bream. Seventeen fish species are present in Lake Minor Delili and in the estuary of the Atrek River. These include a subspecies of Bulatmai barbel (*Barbus capito capito*), Kura barbel (*Barbus lacerta cyri*), Transcaucasian barb (*Capoeta capoeta gracilis*), European chub (*Leuciscus cephalus orientalis*), kutum (*Rhodeus frisii kutum*), and crested loach (*Nemacheilus malapterurus malapterurus*). Amphibians recorded include the Eurasian green toad and marsh frog. The European pond turtle is also common. The Caspian turtle is found in the Atrek estuary and in Lake Minor Delili. There are also many bird species including coots (*Fulica atra*), ducks, gulls and terns, and grebes. Insects flying over water serve as food for swallows, martins and bee-eaters. Starlings, sparrows and desert finches (*Rhodospiza obsoleta*) spend their nights in thickets of *Phragmites australis*, which grow along the banks of the lakes. Some species of reed warbler (*Acrocephalus* sp.) also nest here. A small population of the rare black francolin (*Francolinus francolinus*) is found in the vicinity of Lake Minor Delili. Mammal species commonly recorded include wild boar, Eurasian badger (*Meles meles*), Eurasian otter, and striped hyaena (*Hyaena hyaena*). The Corsac fox and marbled polecat are found along the western Uzboy. Mammals commonly recorded here include golden jackal, red fox (*Vulpes vulpes*), sand cat and wild cat.



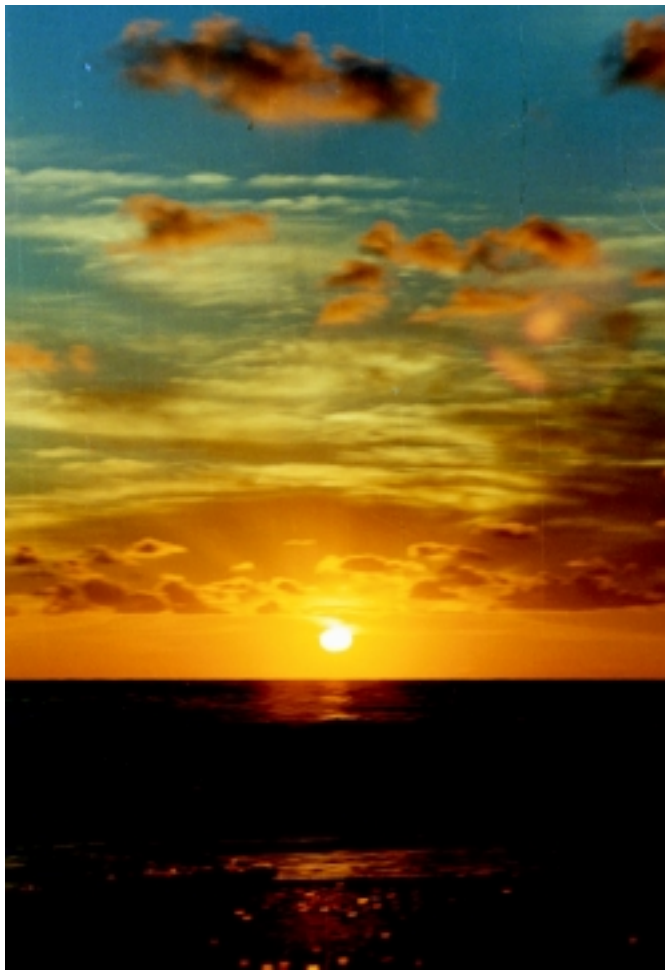
Caspian turtle (*Mauremys caspica*)

2.3.5. Sea and Coastal Ecosystems

The territory of Turkmenistan includes the underwater shelf area of the eastern half of the southern Caspian Sea down to a depth of 200 m. A total of 854 species of animals and plants are

found in the Turkmen part of the Caspian Sea. Of these, 600 are animal species, including 60 species of bacterioplankton, 120 species of zooplankton, 59 species of zoobenthos, 80 fishes, 289 birds, two reptiles and one mammal: the Caspian seal (*Phoca caspica*).

Four species of higher flowering plants as well as Chara algae are found. The zoobenthos includes 29 worm species, crustaceans, molluscs and insect larvae. Large numbers of birds are recorded. In summer, the dense reedbeds are breeding areas for ducks, coots, moorhens and bitterns. Thousands of nests of gulls and terns are found on the numerous islands and bays. The fry of herring and grey mullet feed in estuaries. Five species of pigfish and other small non-trade fish species breed in the estuaries and provide food for sturgeons and other valuable trade species and Caspian seals. In winter, about 80 fish species, including sturgeon, herring, common carp, and grey mullet gather in the south-eastern part of the Caspian Sea (south of Ogurchinsky Island to the Iranian border) [60].



The Caspian Sea

2.3.6. Man-made Ecosystems

The man-made ecosystems of Turkmenistan include oases, water-storage reservoirs and discharge basins (Khovuzkhan, Tashkeprinsky, Iolotansky, Saryayzinsky, Gindikushsky, Sarykamys, and Kelifsky Lakes) in the floodplains of the Amudarya and Murgab Rivers and Karakum Canal.

The biodiversity of the water-storage reservoirs includes 886 algae and higher plant species. Plants growing around the edges of these reservoirs include *Calligonum eriopodum*, *C. arborescens*, *C. caput-medusae*, *Salsola richteri*, *Phragmites australis*, *Typha australis*, various members of the Juncaceae, tamarisks, and white and black saxaul. Fish species recorded include Aral barbel, a subspecies of Bulatmai barbel (*B. capito conocephalus*), carp bream, white-eye bream (*A. sapa aralensis*), ziege (*Pelecus cultratus*), roach, ide (*Leuciscus idus oxianus*), gudgeon (*Gobio gobio lepidolaemus*) and silver carp. Almost all the reservoirs are important for fisheries and as habitats for migrating birds.

The oases (Lower and Middle Amudarya, Murgab-Tedjen, near Kopetdag – Murgab, Atrek-Sumbar) with their rich natural vegetation are important for the interaction between wild and cultivated species. From the perspective of biodiversity conservation, the natural vegetation of disturbed ground in areas that have been clear-felled, and meadows and steppes which have been ploughed and heavily used for agriculture, is particularly important.



Floodplain forest (tugai)

2.4. Key Ecosystems / Habitats

In this review the term “key ecosystem” refers to the importance of habitats both in terms of their biodiversity (i.e. total number of species, level of endemism, importance for migratory species, regional and global importance) and economic value. The mountains, sea, and coastal and relict tugais of river ecosystems are considered to be the most important key ecosystems [15].

The importance of mountain ecosystems cannot be over-exaggerated in terms of the conservation of arid ecosystems as a whole. Conserving mountain ecosystems helps protect the great diversity of montane flora and fauna. The conservation of mountain rivers and springs also helps prevent soil erosion and thus increases the sustainability of the ecosystems in the plains. The level of endemism in Kopetdag, Paropamiz and Kugitang is very high, with Kopetdag alone containing 332 endemic plant species, which identifies their unique role in biodiversity preservation. (In the whole of Turkmenistan there are 92 endemic and near-endemic vertebrate taxa, many of which are montane). Accelerated rates of evolution and higher rates of new species formation are characteristic of the mountains [33]. Besides this, a great diversity of historic ethnic and cultural complexes with unique traditions of nature consumption and cultural peculiarities is concentrated in the mountains.

The conservation of juniper forests is an important indicator of the sustainability of mountain ecosystems [31]. The loss of juniper forests began in the 6th to 5th Century BC with the rise of Jeytun settlements in submontane valleys. In the last 100 years the area of Kopetdag juniper forests has decreased by 30-40% and the forest edge is now 500-700 m above its optimum level of 500 m above sea level. Only traces of the natural steppes are preserved in the Kopetdag, consisting of *Stipa* and *Festuca* grasses.

The wetlands of the Caspian Sea play an important role in the conservation of biodiversity in general and game resources [51] in particular, not only for Turkmenistan, but other bordering countries too. The wetlands are important habitats for more than 30 bird species, numerous mammals, reptiles, fish and plants that are listed in the Red Data Book of Turkmenistan and

IUCN Red Lists (Appendix 3). Coastal shallow waters serve as feeding and wintering areas for most species of Caspian fish including sturgeon.

The banks of rivers are protected from erosion and landslides by the well-developed root systems of plants. The tugai forests are traditional habitats for mammals such as jungle cat (*Felis chaus*), Tolai hare, red fox and golden jackal, as well as the rare and important Bukhara deer. Russian olive (*Elaeagnus angustifolia*) and wild liquorice (*Glycyrrhiza glabra*), which grow in the gallery forests are important medicinal plants providing a stock of industrial raw materials.

Deserts occupy 80% of the whole area of the country and play a key role in the conservation of many endemic species of invertebrates and some rare vertebrates.

2.5. Threatened Ecosystems / Habitats

Many of the habitats in montane ecosystems are considered threatened. A total of 122 rare habitats have been defined as in need of protection. In the relict walnut forests in the valleys of Aidere, Khozly, Pordere, Ipaikala, Niyazym, Kara-Yalchy and Prokhladnoye in the south-western Kopetdag, nut harvesting is hampering natural regeneration. In Badkhyz, major pistachio forests, (a unique habitat which combines both desert and montane elements, and at 76,000 ha is the second largest after Tajikistan) are found from Pulikhatum to the Gyazgyadik ridge and adjacent high plateaux (Akarcheshme, Pynkhancheshme and Kepele), as well as near Kushka and a small area near Marchak at the junction of Badkhyz and Karabil. Small pistachio forests are found in some areas of the Kopetdag and Kugitang. Parts of these montane pistachio forests are in the protected areas of Syunt-Hasardag, Kopetdag and Kugitang zapovedniks and their zakazniks.

The lower courses of the Atrek River include breeding areas for anadromous and semi-anadromous fishes, as well as breeding and migratory stopovers for estuarine birds and resident species such as purple gallinule (*Porphyrio porphyrio*) and black francolin. These areas have become less important as they have silted up following the extraction of water for irrigation purposes in Iran.

Wild pomegranate (*Punica granatum*) forms dense impenetrable forests in the south-western Kopetdag. Relict vineyards with both cultivated (*Vitis vinifera*) and wild (*V. sylvestris*) grapes are occasionally found in the valleys of the central and south-western Kopetdag (e.g. Gyuen, Kuraty, Yoldere and Arpaklen). Wild pear-tree and apple-tree forests are found in the canyons of the south-western Kopetdag and Kugitang. Eight species of hawthorn grow on limestone outcrops.

Relict communities of *Ziziphus jujuba* occupy the lower belt of the south-western Kopetdag and are occasionally found in the eastern Kopetdag and Kugitang. Communities of oriental plane occupy the riverbeds of the Kopetdag mountain valleys, and can also be found near population centres. Juniper (archa) forests include the Turkmen juniper (*Juniperus turcomanica*) and Zaravshan juniper (*J. seravschanica*) and cover the lower and middle montane elevations, sometimes forming a more or less closed canopy. The



Pomegranate (*Punica granatum*)



Turkmen juniper (*Juniperus turcomanica*)

Kopetdag-Horasan endemic juniper species is spread from the Greater Balhans in the west to Badkhyz in the east. Juniper habitats have been lost through human activities but in some inaccessible areas (cliffs and deep canyons) natural communities with many dominant juniper trees have been preserved. *Juniperus turcomanica* and other deciduous trees are rarely recorded. Small areas of *Juniperus seravschanica* are found in Turkmenistan at various densities along the crest of the Kugitang. The main habitats are semi-savannah and semi-savannah wormwood-juniper woodland in which the dominant species are *Astragalus pulvinatus*, *A. meschedensis*, *Ferula kuhistanica*, *F. nevskii*, *Acer pubescens*, *Amygdalus bucharica*, *Pyrus regelii*, etc. The highest Zaravshan juniper trees are at almost 2,650 m: above this height is a treeless plateau.

2.6. Species Diversity

Three large floristic provinces meet in Turkmenistan: the Kopetdag-Horasan (Kopetdag, Greater and Lesser Balhans), the Montane Central Asian (Kugitang) and Turan (Karakum) with the transitional region of Badkhyz and Karabil. This accounts for the unique characteristics of biological and landscape diversity, which simultaneously exhibit features of both the Central Asian, Mediterranean and Turan desert flora. Eighty percent of Turkmenistan is desert or semi-desert and sandy desert forests mainly cover the remaining 20%.

Natural ecosystems are characterized by the species diversity of living organisms. More than 20,000 species are recorded from Turkmenistan: 7,064 plants and nearly 13,000 species of vertebrates and invertebrates. The species diversity increases in transition from the desert regions to the mountains. There are a large number of rare species and relict habitats with a high degree of endemism that are characteristic of ancient arid ecosystems. The level of endemism is lower in desert communities. For instance, in the Karakums there are 757 species of higher plants, 1.3% of which are endemic [18], while in the Turkmen part of the Kopetdag there are 1,800 plant species, 332 (12.9%) of which are endemic [33].

2.6.1. Flora

Flora There are 3,140 higher plant species (2,969 vascular plants, 2 Equisetaceae, 17 horse-tails and ferns, 12 gymnosperms, 140 mosses) and 3,924 lower plant species (470 lichens, 827 algae, 2,585 fungi) giving a total of 7,064 plant species. These have been identified over more than a century of botanical research (figures provided by Prof. D.K. Kurbanov, including some information from [77]).

Fauna There are approximately 13,000 animal species, of which 683 are vertebrates (104 mammals, 376 birds, 82 reptiles, 5 amphibians, 115 fishes, and 1 lamprey). There are 12,000 invertebrate species including 500 Protozoa, 1,100 Platyhelminthes, Nematodes and Annelida, over 20 Crustacea, 600 Arachnida and 8,000 species of insects.

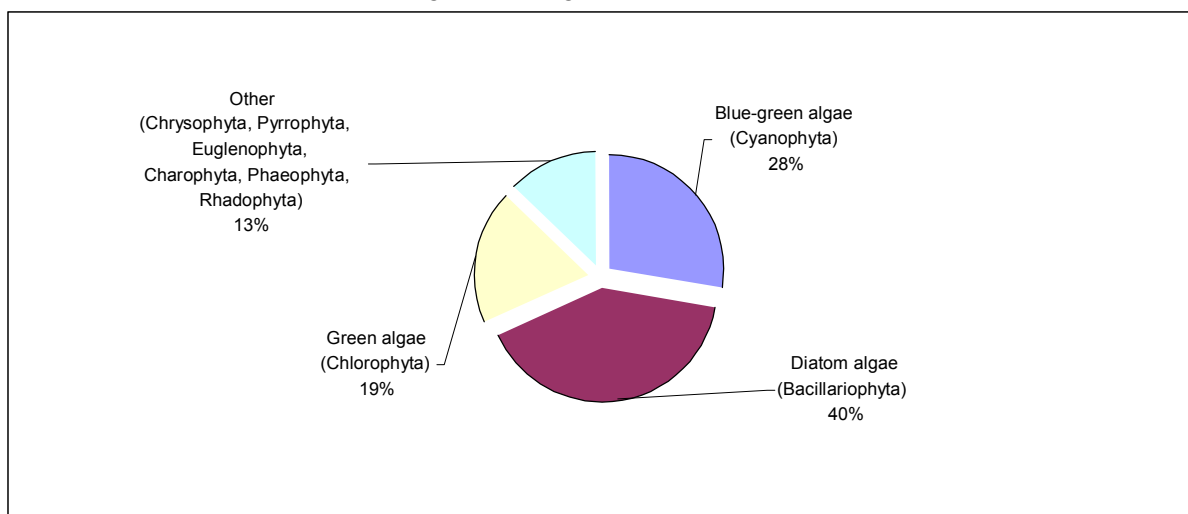
Lower Plants

Amongst the lower plants, fungi and algae have been studied in detail. In contrast, there is almost no information about bacteria and viruses, although 42 species of soil bacteria have been identified.

Fungi are one of the most widespread lower plant groups in Turkmenistan and have been well studied. There are about 2,585 species of fungi [42], including 165 mushrooms in the Central Kopetdag [11]. On the cultivated soils of Turkmenistan 213 species have been identified, including saprophytes and a number of faunal and floral pathogens [42].

A total of 827 species of algae have been recorded in the water bodies of Turkmenistan (Figure 2.3). Diatoms, blue-green and green algae are the dominant groups with 636 species [38].

Figure 2.3. Algae of Turkmenistan



There are 470 species of lichen in Turkmenistan. A total of 442 species are found in the Kopetdag, 240 in Kugitang, and considerably fewer in the desert ecosystems with 90 in clay deserts, 20 in gypsum deserts, and 68 in sandy deserts. Lichens are pioneer species in areas where little else grows.

Higher plants

There are 2,969 species of vascular (or higher) plants in Turkmenistan. Of the 467 species of monocotyledons (Monocotyledonae), the families of grasses (Poaceae), sedges (Cyperaceae), rushes (Juncaceae), and lilies (Liliaceae) dominate many of the plant communities. In desert plant communities, species diversity is high with many dicotyledons (2,502 species) such as Asteraceae, Fabaceae, Poaceae, Brassicaceae, and Chenopodiaceae present. The core of Turkmenistan's flora is made up of Ancient Mediterranean, East Mediterranean, Iranian, and Central Asian - Iranian species.

The moss flora includes 140 species: seven species of liverwort (Hepaticae) and 133 species of (moss) Musci. The moss flora in arid environments is dominated by perennial species with drought-adapted structures, such as *Tortula*, a species with succulent leaves that has a turf-like habit. Forest mosses are relatively few in number and are represented by two groups, those that grow on the soil and those that grow on rocks or other plants. In aquatic habitats calcium-loving species may be found around the outlets of springs or in rock cracks, for example *Distichium capillaceum* [65].

2.6.2. Fauna

Invertebrates. Many of the invertebrate groups have been poorly studied. There are thought to be more than 2,000 species of beetles (Coleoptera), over 1,000 species of butterflies and moths (Lepidoptera), up to 1,000 species of aphids, scale insects etc. (Homoptera) and 800 species of flies (Diptera). In total, over 8,000 species of insects in 27 orders have been recorded, though this is thought to be only half of the actual number present [72]. In the 1980s, studies on insects resulted on average in the description of 10 new species each year.



Scorpions are common in Turkmenistan

Vertebrates. Including species in the Caspian Sea, there are 683 vertebrate species recorded in Turkmenistan: (Fig. 2.1).

The fish fauna comprises 63 purely freshwater species, and more than 80 species are found in the Caspian Sea [60]. Of the 82 reptile species 25 are found only in the deserts, 25 only in the mountains and 32 species in both habitats.

The 376 bird species include 255 breeding species (64%) and 117 resident species [13, 14]. There are 220 bird species in the Karakum desert, 60 (27%) of which are breeding species [62].

The 104 mammal species [49] are found in all habitats though their greatest species diversity is attained in the mountains. The only aquatic mammal is the Caspian seal, endemic to the Caspian Sea. Mammals have generally been well studied, though the question of species isolation amongst wild sheep in the Kopetdag and Ustyurt mountains has not been resolved.

2.7. Species of Key Importance

The species of key importance include the so-called dominants - the main components of ecosystems - and endemics, which characterise the distinctiveness of a given natural region.

Amongst the dominant species, 130 plants are considered to be of key importance. In the desert communities of the Karakums, the key species are black and white saxauls. In the semi-

Table 2.1. Taxonomic composition of Turkmenistan's vertebrates

Class	Orders	Families	Genera	Species	Subspecies
Lamprey	1	1	1	1	0
Fishes	12	19	63	115	137
Amphibians	1	2	2	5	0
Reptiles	2	14	41	82	89
Birds	18	54	168	376	516
Mammals	7	14	44	104	110
Total:	41	104	319	683	852

savannah, key species are *Poa bulbosa*, and *Carex pachystylis*. In the mountains *Juniperus turcomanica*, *J. seravschanica*, *Ephedra intermedia* and *E. equisetina* are key species while in the mountain steppes it is species of *Festuca* and *Elytrigia*, *Artemisia ciniformis*, *A. gypsaceae*, and *A. badhysi* and saltworts such as *Salsola dendroides*, *S. orientalis* and *S. gemmascens*.

Of the 393 rare plant species, 370 are found in the mountains including 255 that are endemic. There are 100 endemic or rare species in the lichen flora of Turkmenistan.

Most of the regional endemic amphibians and reptiles are found in the mountains, foothills and river valleys (25 taxa in total). A gecko (*Eublepharis turcmenicus*) and a lizard (*Lacerta defilippii*) are endemic to the Turkmen-Horasan and the Elbur Mountains. The

greater part of the natural range of the straight-fingered gecko species *Alsophylax laevis* is in the southwest while the range of a subspecies of another straight-fingered gecko, *Alsophylax lorica-tus szczerbaki*, is in the north-east of Turkmenistan. Some lizard species, for example the Baluch stone gecko (*Bunopus tuberculatus*), rock gecko (*Cyrtopodion longipes*) and the steppe racerunner (*Eremias arguta*) are at the edge of their natural range in Turkmenistan. A local population of the spotted toad-headed agama (*Phrynocephalus maculatus*) is found in a 10 km² area of saltmarsh in Ulyshor and in the foothills of the western Kopetdag.

Though there are no national endemics, the bird fauna of Turkmenistan is important in terms of the conservation of rare and threatened birds (19 taxa). Most of the regionally endemic species breed in the central or south-western Kopetdag.

There are many endemic mammal species (19 taxa) in Turkmenistan including the mouse-like or Asiatic dormouse in the Kopetdag, the rare jerboa (*Allactodipus bobrinskii*) in the Turan lowlands, and the mouse-like hamster (*Calomyscus mystax*) in the Turkmen-Horasan Mountains. There are also regional endemics including the comb-toed jerboa (*Paradipus ctenodactylus*), Blanford's or greater three-toed jerboa (*Jaculus blanfordi*), and the long-clawed ground squirrel (*Spermophilopsis leptodactylus*).

Zarudny's jird or gerbil (*Meriones zarudnyi*) is at the northernmost end of its range in southern Turkmenistan.

Ungulates are key species that provide a source of food for mammalian and avian predators and as such are of great significance in the preservation of the country's biodiversity. The three subspecies of urial, the Afghan urial (*Ovis orientalis* (= *vignei*) *cycloceros*), the Bukhara urial (*O. o. bochariensis*) and the Transcaspian urial (*O. o. arkal*) as well as the Bukhara deer are regional endemics. The red deer subspecies *Cervus*



Saxaul (*Haloxylon* spp.)



Turkmen urial (*Ovis orientalis* ssp. *cycloceros*)



a



b

Endemics of the Amudarya River: a) the large Amu-Dar shovelnose sturgeon (*Pseudoscaphirhynchus kaufmanni*); b) the small Amu-Dar shovelnose sturgeon (*Pseudoscaphirhynchus hermanni*)

elaphus maral formerly inhabited the western Kopetdag, but is now extinct in Turkmenistan. In desert ecosystems, kulan and sand gazelle are of key importance (see Appendix 1).

On a regional level there are 28 species and subspecies of fish that are restricted to aquatic ecosystems of adjacent countries, and one lamprey (*Caspiomyzon wagneri*). For example, the Aral Sea basin contains the following endemics: the striped bystranka (*Alburnoides taeniatatus*); the pike asp (*Aspiolucius esocinus*); the asp (*Aspius aspius*); Aral barbel; Bulatmai barbel; the sharpray (*Capoetobrama kuschakewitschi*); and subspecies of the Danube bleak (*Chalcalburnus chalcoides aralensis*); the ide; and the roach (*Rutilus rutilus aralensis*).

The following fish species are found only in the rivers of Kopetdag and Paropamiz, and also in Iran and Afghanistan: the Transcaspian marinka (*Schizotorax pelzami*), the Turkmenian loach (*Nemacheilus sargadensis*) and Turkmenian crested loach (*N. cristata*). A blind cave loach (*Nemacheilus starostini*) is the only endemic fish species in Turkmenistan. Two species of sturgeon in the river basins of Turkmenistan are regional endemics: the small Amu-Dar shovelnose sturgeon (*Pseudoscaphirhynchus hermanni*) and the large Amu-Dar or false shovelnose sturgeon (*P. kaufmanni*), as is a subspecies of the roach (*Rutilus rutilus uzboicus*). The only population of the dwarf form of carp bream is found in Lake Yazkhan in western Uzboy (Appendix 1).

2.8. Invasive / Alien Species

Invasive species found in Turkmenistan can be divided into two groups. The first contains species, for instance, freshwater fishes, which were intentionally introduced to increase productivity in aquatic ecosystems and combat the excessive growth of aquatic plants. Many ornamental plants have also been deliberately imported, and have then escaped into the wild. The second group is represented by those species accidentally introduced to the country through, for example, the emptying of ships' ballast water in the Caspian Sea. The natural flora is being affected by alien trees such as the osage-orange or bowwood (*Maclura pomifera*), *Gleditsia triacanthos* and the tree of heaven (*Ailantus altissima*) from China, which is establishing itself in mountain valleys.

2.8.1 Alien Species in the Caspian Sea

Some aquatic species have been deliberately introduced into the Caspian Sea. Among them were the Black Sea plaice (*Pleuronectes flesus luscus*), the golden grey mullet (*Liza aurata*) and the leaping mullet (*Liza saliens*), which were introduced in 1930-1931 to boost fish production, though the former has not been seen since the 1940s. The successful introduction of mullet increased fish production by 40,000 tonnes without affecting other fish species. Between 1939 and 1941 a marine polychaete worm *Nereis diversicolor* was translocated from the Azov

Sea to the Caspian Sea – this species is now very important as a food source for sturgeon. In the same period the bivalve mollusc *Abra ovata* was translocated from the Azov Sea to the Caspian Sea. This species has become a major component of the marine fauna. It plays a key role not only as a source of food for sturgeon, but also as a water purifier.

At the same time occasional exotics appeared in the Caspian Sea following the construction of the Volga-Don Canal. Thus, the shellfish *Mytilaster lineatus* appeared in the Caspian Sea at the end of the 1930s after being transported from Batumi by rail. At the end of the 1950s *Conopeum seurarati*, a tubeworm *Mercierella enigmatica*, and *Berentsia benedeni* were introduced as biological de-fouling agents of the undersides of ships along the Volga-Don Canal.

One of the most detrimental introductions into the Caspian Sea has been that of the three-spined stickleback (*Gasterosteus aculeatus*) which was first recorded in 1981. It has no value as a fishery species but it competes with young fish of other native species and can adversely affect the spawning efficiency of commercially important species. However, *Mnemiopsis leidyi*, a jellyfish that has appeared in recent years, has turned out to be the most dangerous exotic species in the Caspian.

The impact of each introduced species is unpredictable and based on a number of factors. Species that are not detrimental in their natural habitat can seriously damage the ecology of the habitat into which they are deliberately or accidentally introduced. The negative impacts from introduced species include competition for food with native species and the importation of parasites and pathogenic organisms. The study of introduced species has practical and scientific value as it can be used to model the changes to aquatic ecosystems resulting from introductions. In general deliberate introductions have had a number of negative results including hybridisation amongst native and non-native animal and plant populations and gene pools leading to a loss of genetic diversity, which could ultimately lead to the loss of native species.

2.9 Agrobiodiversity

Agrobiodiversity or “cultivated biodiversity” is the genetic diversity of cultivated plants and domestic animals that have evolved from wild ancestors.

2.9.1. Wild Relatives of Cultivated Plants

In Turkmenistan, especially in the mountain regions (Kopetdag, Kugitang, Greater and Lesser Balhans and Badkhyz), wild ancestors of Central Asian cultivated species have been preserved *in situ*; their cultivation began several thousand years ago. Wild species (including weeds) are important reservoirs of genetic material for the development of new cultivated varieties. It is difficult to overestimate the importance of preserving populations of wild ancestors directly in their natural centres of genetic diversity and origin [16, 28].

Among the wild native ancestors of fruit and vegetables there is rather a high diversity of weeds, especially species of *Aegilops* (*A. biuncialis*), barley (*Hordeum bulbosum*), oats (*Avena barbata*), and rye (*Secale cereale*). A great number of onions (*Allium altissimum*), almonds



Wild fig tree (*Ficus carica*) - a relative of the cultivated plant

(*Amygdalus bucharica*), and pears (*Pyrus boissieriana*) were widely used in the past and are used at present in horticulture.

A total of 249 species of wild relatives of cultivated plants have been found in the Central Asian Centre of Genetic Diversity, of which 172 are plants found in Turkmenistan (89 genera, 28 families). In addition there are 100 ornamental species that are of direct importance in the development of cultivated varieties and that provide a rich source of genetic material [41, 52] (see Appendix 2).

Wild ancestors are considered to be the species that were used to develop cultivated species (for example, *Aegilops* species that contributed genomic material to wheat) or were taxonomically close enough to cultivated species to be used for hybridization purposes (e.g. rye which is couch-grass crossed with wheat). Theoretically, wild ornamental species, widely used in the selection of cultivated forms, can also be considered wild ancestors.

There are more than 40 wild ancestors of tree species, such as walnut, pomegranate, and mulberry (*Morus alba*, *M. nigra*). Wild species of grapes (*Vitis sylvestris*) have hybridised with cultivated species (*Vitis vinifera*), resulting in a huge number of varieties. Thus, the wild ancestors of the cultivated plants of Turkmenistan represent an inexhaustible supply of genetic material, which should ensure the long-term survival of cultivated species.

2.9.2. Wild Relatives of Domestic Animals

There are a great variety of wild relatives of modern domestic species: Tadjik markhor and Turkmen wild goat. At present one issue remains unresolved: whether the subspecies of wild sheep - the Turkmen urial (*Ovis orientalis* (= *vignei*) *cycloceros*), the Bukhara urial (*O. o. bochariensis*) and the Transcaspian urial (*O. o. arkal*) – are the ancestors of the domestic sheep. All of them could potentially act as donors in the improvement of existing and selection of new breeds of domestic animals.

The kulan is the only representative of the *Equus* genus that has been preserved in the wild fauna of Turkmenistan. This subspecies has existed for about 800,000 years. Biochemical research has proved that kulans should be put into a separate subgenus closer to horses rather than to donkeys [48]. In ecological terms, kulans differ from horses by their better adaptations to arid conditions. They need less water than horses and can tolerate water with a higher salinity. Kulans are also more adapted to the country's relatively cold and snowy winters than horses. In the CIS countries in historical times kulans were wiped out in Kazakhstan, Uzbekistan, Transcaucasia, Transbaikalia in the south of Russia, and Ukraine. The Turkmen population plays a key role in conserving the species' gene pool, since kulans survived only in the south of Turkmenistan in the Badkhyz zapovednik. Kulans are breeding well in Turkmenistan and have been reintroduced to Kazakhstan. They are also breeding well in zoos in Europe, Asia and North America [49].



Kulan (*Equus hemionus* ssp. *onager*)

2.9.3. Local Breeds of Domestic Animals

There are problems in conserving local domestic breeds that have been developed over many years of selection. Some local breeds such as the Akhalteke horse, karakule and sarja sheep breeds, one-humped camel (dromedary), borzoi tazy dog, and Turkmen alabai (Central Asian sheep dog) are used not only in neighbouring and distant countries, but have also influenced the creation of new breeds. Locally selected breeds must be preserved for current and future selection.



The Akhalteke horse

The Akhalteke horse is one of the most ancient breeds of saddle horse, which influenced the creation of many other breeds, including Arab, English thoroughbred, Orlov's saddle horse, Karabakh, and Trakenen. On the basis of cultural evidence, the works of ancient authors and travellers' descriptions, scientists have convincingly proved the distinctiveness of this breed from the original southern form of the horse inhabiting Central Asia. The Akhalteke breed is distinguished by its beauty, speed, endurance and ability to undertake long journeys [63]. On 1st January 1999 there were 1,926 Akhalteke horses in Turkmenistan, which are bred on stud farms in all velayats and belong to the State Association "Turkmen Atlary" (Turkmen Horses). In the other CIS countries there were 326 horses, and there were more than 300 in countries outside the CIS [73].

The Youmud horse is similar to the Akhalteke breed and is one of the most ancient horse breeds. Originally they were bred as saddle horses, but more recently they have started to be used in agriculture and for transportation. Youmud horses are bred mainly in the Dashoguz and Balkan velayats of Turkmenistan, and the best horses are found in Dashoguz State Stable. There are 830 Youmud horses in total [20, 73].



Domestic camel

The Turkmen one-humped camel or dromedary (arvan) was bred as a result of many centuries of selection by local people [70]. Fossil footprints of wild camels from 2.5 million years ago are found in the Western Kopetdag in Gyaurli of Kazangik etrap. At present it is bred in all velayats in Turkmenistan. The biggest camel-breeding farm is "Sakar-Chage". The total number of camels on 1st January 2001 was 119,000 [68].

The Sarja sheep is the only kurdyuk (a type of fat-tailed) breed in Turkmenistan, and provides



Sarja sheep

semi-coarse composite wool used in carpet making [23]. The Sarja sheep has been considered as a means of improving the breeding of kurdyuk sheep in Central Asia and Kazakhstan. Using this breed, many other breeds have been created including the Tajik breed, Altay meat-and-wool breeds, and the Kargamin group in Kazakhstan. Sarja sheep were bred by local people. There are different opinions on the origin of the breed. For example, the local population believes this breed was created in

the second part of the 19th Century through the breeding of the kurdyuk Turkmen sheep. Some scientists consider that the Afghan kurdyuk breed and the ancient Greek and Mongolian breeds were used to create the Sarja sheep. Nowadays this sheep is mainly bred in Akhal velayat. Taking into account the great historic, national and economic value of this breed, the President of Turkmenistan issued a special Decree “On the Development of the Sarja Sheep Breed in Turkmenistan”. This decree provides for a dramatic increase in the number of sheep, general breeding, and further improvement of their breeding characteristics. Today there are over 3 million Sarja sheep [68].

The Karakul (astrakhan) sheep, which gives the best astrakhan sheep skin in the world, is one of the most ancient breeds of fat-tailed sheep. The initial material for creating the karakul breed was evidently from kurdyuk and fat-tailed sheep, as these sheep had and still have some curly-haired features, which from generation to generation were systematically developed through selection. There are three different colour varieties of this sheep (black, grey and golden-brown), which are bred in farms in Mary, Lebap and Dashoguz velayats, and in more than 50 countries in Asia, Africa, Europe and America. There are nearly 6.5 million Karakul sheep in Turkmenistan [17, 54, 68].

Cattle During excavations in Annau (several km from Ashgabat), which was one of the most ancient cultural centres, evidence was uncovered of the presence of Turkmenistan cattle (Turkmen zebu-like cattle), which have been bred in the area since 3000 BC. The Turkmen zebu-like cattle is one of the groups of Central Asian zebu-like cattle which combines features of zebu and Central Asian cattle, and is found in Uzbekistan, Tajikistan and the south-western part of Kyrgyzstan. There is very little evidence in the literature about the origin and history of cattle-breeding in Central Asia and Turkmenistan. In spite of its low productivity, the cattle were distinguished by the high butterfat content of their milk, their tolerance of the hot climate and resistance to blood parasite diseases. Because of its low productivity the cattle was crossed with red-steep and shvits breeds in the 1930s. As a result of this crossing, the genes of the original Turkmen zebu-like breed were lost and it would now be practically impossible to restore the pure form.

The Borzoi hound (tazy) and Turkmen alabai (Central-Asian sheepdog) are considered to be local dog breeds and are well known in the general world of dog breeding. The **tazy** is one of the ancient borzoi types that were the ancestors of all contemporary borzoi dogs. It is thought that their ancestors arrived in Central Asia with trade caravans, pilgrims and nomads from Arabia and mixed with local breeds to form two lines, the Kazakh and Turkmen tazys. Turkmen tazys are well adapted to the hot climate and cold winters and this



Turkmen borzoi tazy dog

distinguishes them from Iranian borzois or salukis. They also possess a keen sense of smell, not found in other borzoi dogs, which could be used to improve the working abilities of other borzois. On the 1st January 1990 the number of tazy in Turkmenistan was around 80-100 dogs. Pure-bred tazy have been preserved only in the Central Karakum. In the last 10 years traditional hunting with tazy has reappeared in Turkmenistan and the number of tazy has increased remarkably. Currently efforts are being conducted to restore traditional falcon hunting with tazy.

A more widespread breed is the **Turkmen alabai (Central-Asian sheepdog)**. Historically, Turkmens used dogs for guarding livestock and dwellings. Four thousand years ago, alabais did not differ from contemporary sheepdogs. Archaeological evidence bears witness to this - the findings of bones and sculptures shows that male dogs were very strongly-built with docked ears and tail. It is likely that ancient sheepdogs originated in the region, and spread from there in two directions: eastwards to Iran, Turkmenistan, Afghanistan, Mongolia, China and neighbouring countries, and also westwards to Turkey, the Balkan peninsula and to Spain. In each region there are distinct breeds. From these original sheepdog types other breeds such as mastiffs, St Bernard, rottweiler, boxer and bulldogs etc. were developed. Many of these have become quite different from the original Asian sheepdog type.



Turkmen alabai or Central Asian sheepdog

The breed's characteristics mean it can be used not only for guarding herds and people's property but also as a watchdog. A special conference held in Ashgabat in April 1990 was dedicated to this breed. Many issues of pedigree work and breeding standards were discussed there [25, 30, 46, 47]. There is a club called "Turkmen Iti" dedicated to the preservation and breeding of alabai. There is also a Tazy Breeding Centre at the National Falconers' Club. Our indigenous breeds of domestic animals are genetic resources belonging to all humanity.

2.9.4. Traditional Cultivated Plant Varieties

In spite of severe arid conditions and the limited water resources in Turkmenistan, different plants have been adapted and cultivated for centuries. Ancient forms of cultivated plants (such as wheat, barley, melon, grapes, apple and figs) which have been preserved and are currently cultivated by local people, are of great significance in the cultivation of new varieties. Today, over 100 ancient forms of 19 main species of cultivated plants selected and known in Turkmenistan for many years, have been preserved. A local sort of white wheat - Ak bugdai - was first cultivated 5,000 years ago (Table 2.2).

Table 2.2.

Ancient cultivars

Culture	Type / Local name
Wheat (<i>Triticum aestivum</i>)	Ak bugdai [27, 74]
Barley (<i>Hordeum vulgare</i>)	Hasylyly
Cabbage (<i>Brassica oleraceae</i>)	Bagir local
Bulb onion (<i>Allium cepa</i>)	Red or Kaahka local; White or Farab local; Yellow or green local
Garlic (<i>Allium sativum</i> , <i>A. longicuspis</i>)	Turkmen white local; Bayram-Ali
Apple tree (<i>Malus turkmenorum</i>)	Variety of Babarab forms (yuvan, kyzylja, eshek, akcha, akdji, suidji and others)
Plum (<i>Prunus domestica</i>)	Saraly
Pomegranate (<i>Punica granatum</i>)	Karakala
Fig (<i>Ficus carica</i>)	Konekesirski, Ak injir Konekesir, Shih-bedir, Gury-gol, Sary injir nohur, Nohur, Shevlan, Chekishliyar, White nohur, Kara injir nohur
Grapes (<i>Vitis vinifera</i>)	Terbash, Ashgabat gara uzum, Halili (white, black), Gyrmyzy kishmish, Han halan, Melei, Nohur
Melon (<i>Melo sativus</i>)	Handalyak (varieties: kyrkgulik, zamy, zamcha, handalyak, and others); Ameri (ak tarlavuk, vaharman, gotur gavun, saragty, hytaiy, chal mesek, shekerpalak, gurbek, beshek and others); Zard (karry gyz, sary gulyabi, gyzyly gulyabi, gok gulyabi and others) [79]
Lucerne (<i>Medicago sativa</i>)	Khiva local, Iolotan local, Geoktepe
Sorgo (<i>Sorghum sp.</i>)	Yasmyk, Katty-bash, Alty aylyk
Carrot (<i>Daucus carota</i>)	Kunyaurgench, Yellow khiva

2.9.5. Modern Locally Selected Plant Varieties

Besides ancient kinds of local selection, new varieties are being produced synthetically with modern techniques. They include a number of varieties of cotton, wheat, corn, pumpkin, grapes, watermelon and melon [57], which are now being cultivated in the fields.

Local types selected on the basis of wild growing forms provide excellent initial material for the production of further varieties.

Cotton At present in Turkmenistan there are ten predominant types of middle-fibre cotton *Gossypium hirsutum* (including four local types), as well as five local types of fine-fibre Peruvian cotton, *G. peruvianum* that are cultivated. Ten wilt-resistant, four drought-resistant, seven resistant to sucking insects, three naturally deciduous and five ultra-fast-ripening cotton varieties have been created [1,27,53,75].

Wheat At present there are seven main soft wheat types of *Triticum aestivum* (three of which are local types) [27, 74]; five (one local) types of multi-row barley (*Hordeum vulgare*); types of rye (*Secale L.*) and oats (*Avena L.*) that are cultivated in Turkmenistan.

Fruit Turkmenistan has favourable soil and climatic conditions and is the country of origin for fruit varieties grown worldwide. The dry subtropical climate of southwestern Turkmenistan, where there is a wide assortment of local types of fruit cultivars, offers great opportunities for growing a high-quality assortment of fruits such as apple, pear, quince, cherry-plum, plum, apricot, peach, cherry, olive, pomegranate, fig, persimmon, and jujube (*Ziziphus jujuba*); nuts such as almond and pistachio; and citrus fruits [71].

Viniculture Turkmenistan is one of the genetic centres for the cultivation of grapes (*Vitis vinifera*). Vine cultivation has been recorded as early as 2-3 centuries BC: the most ancient variety of vine is supposedly the Ter-Bash. About 200 grape varieties are known in Turkmenistan, of which 50 are regional (including 15 local) types. Regional types comprise 75% of all vine plantations in Turkmenistan [71].

Melons The main centre of melon cultivation of Central Asian varieties of *Melo sativus* ssp. *rigidus* is concentrated in the lower courses of the Amudarya River. There is a huge variety of forms and sorts of melons (800 sorts, of which 130 are local). Local varieties of these melons (e.g. vaharman, gulyabi, garrygyz, gurbek and others) have won gold and silver medals at international competitions. From 250 known varieties of *Citrullus* watermelons, 28 are grown, including two locally-selected varieties; also 200 varieties of pumpkins *Cucurbita* sp. (eight locally-selected ones) [52, 79, 57].

Vegetables and forage crops. Local types of vegetables are cultivated throughout the country: white cabbage (*Brassica* sp.), eggplant (*Solanum melongena*), tomatoes (*Lycopersicon esculentum*), bulb onion (*Allium cerea*), garlic (*Allium sativum*), potatoes (*Solanum tuberosum*), paprika (*Capiscum annuum*), pea (*Pisum elatius*), lentil (*Lens orientalis*), spinach (*Spinacia turkestanica*), carrots (*Daucus carota*), cucumbers (*Cucumis* sp.), chick-peas (*Cicer arietinum*), golden haricot or corn salad (*Phaseolus aureus*) and haricot (*P. vulgaris*) and others [57]. The following pure forage crops are cultivated: lucerne (*Medicago sativa*), corn (*Zea mays*), sorgho (*Sorghum* sp.), vetch (*Vicia ervilia*), clover (*Trifolium campestre*), flax (*Linum turcomanicum*) and others. Lucerne is an ancient forage crop in Turkmenistan, and is able to produce a good seed-stock for future years. Two out of three lucerne types sown are local types. Eleven new types of lucerne and six of sorghum (four of which are local) have been selected.

2.10. Threatened Species

The Red Data Book of Turkmenistan was published to provide information about the conservation of threatened plant and animal species. The increase in the number of species listed from 1985 (152 species) to 1999 (261 species) was due to the inclusion of invertebrates, fungi, lichens, mosses, ferns, and gymnosperms. Ninety-eight species of animals and plants from Turkmenistan were included in the IUCN Red List (1996, 1998, 2000). The most threatened category in the Red Data Book of Turkme-



Transcaspien marinka (*Schizothorax pelzami*) – a declining species

nistan (1999), species endangered or threatened with extinction, included 17 animals and 28 plants (Appendix 3).

According to these publications the population status of the following taxa is causing concern: North Persian leopard, kulan, Bukhara deer, sand gazelle, Turkmen wild goat or bezoar, Afghan urial, Caspian snowcock, saker falcon (*Falco cherrug*), lammergeier, houbara bustard (*Chlamydotis undulata*), great bustard (*Otis tarda*), the agamid lizard (*Phrynocephalus rosikowi*), and the small and large Amu-Dar shovelnose sturgeons. Among plants the following should be noted: *Calligonum triste*, *Sibera nana*, *Atrops komarovii*, Turkmen mandrake (*Mandragora turcomanica*), and *Epipactis turcomanica*.

2.11. Access to Information Sources on Biodiversity

At present the main sources of information on the status of biodiversity are scientific publications, the herbarium, the archives of the state reserves / zapovedniks, institutes of the former Academy of Sciences and a number of departmental institutions. The annals or “Nature Chronicles” of the zapovedniks are not always accessible or their availability is often limited for technical or departmental reasons.

Information on the status of biodiversity outside Turkmenistan is mainly obtained through personal contacts with specialists or through joint programs and is restricted mainly by technical limitations [67]. Poor access to sources of information outside Turkmenistan is caused by the lack of opportunities to systematize and structure information sets in biodiversity monitoring. Besides this, regulations on the terms and procedures for foreign citizens to access the biodiversity information and collections of Turkmenistan is also lacking.

* * *

Thus the extent of research on different floral and faunal taxonomic groups in Turkmenistan is not equal. While it is estimated that around 95% of vascular plants, gymnosperms and ferns as well as vertebrates have been investigated, for invertebrates the figure is only around 60%. For Annelida, Crustacea and insects it is 50%, while molluscs have not been studied at all.

Besides species richness, the biodiversity of Turkmenistan is characterised by the existence of a large number of restricted-range species, endemics, wild relatives of cultivated plants and domestic animals and valuable medicinal herbs. Natural ecosystems of key importance in the conservation of biodiversity and its sustainable use have helped conserve wildlife in Turkmenistan.

3. STATUS OF BIOLOGICAL RESOURCES

3.1. Consumers of Biological Resources

Turkmenistan possesses a rich and diverse fauna and flora and many species are of importance for the development of branches of the national economy such as medicine and food production, perfume manufacture or other local industries such as hunting and fishing. The number of species of plants and animals that are of economic importance is increasing (Table 3.1).

Other scientific and research institutes and universities that can use natural resources for scientific and educational purposes as well as ecotourism could also be included in the above list.

3.2. Economically Important Species and Habitats

3.2.1. Game Species

In Turkmenistan, nearly 100 species of animal are hunted. There are strict hunting regulations covering open seasons, species that can be hunted and acceptable bag limits. Hunting is regulated by the Ministry of Nature Protection Decree “On the Opening of the Hunting Season”. In the 2000-2001 season, hunting was permitted for 35 species, including wild boar (with a licence), wolf, jackal, fox, wild cat, tolai hare, pheasant (with a licence), pigeons, turtle dove, sandgrouse, Chukar partridge, coot, ducks, cormorant, grebe, waders and geese. Species in the Red Data Book of Turkmenistan are protected from hunting.

Since 1993 the hunting of wild boar has been regulated through the issuing of licences. The construction of the Karakum Canal provided extra natural habitat for wild boar in the deserts of Turkmenistan and linked the natural habitats of isolated populations along the Amudarya River, the Murgab River and the Tejen River, as well as the Western Usboy. Populations of wild boar are increasing in the foothills of the western Kopetdag.

Wolves, jackals, foxes and Pallas’ cat are also widespread species. Their populations have increased following the cessation of the fur trade. The nutria and musk-rat are two fur-bearing animals that have been artificially introduced into Turkmenistan comparatively recently. Optimal natural conditions and the banning of hunting quickly allowed the establishment of stable populations of these species in the west and south of the country. The extension of drainage and irrigation systems has allowed nutria to colonise new areas [55,56]. Tolai hares were historically, and remain today, the most popular game species in Turkmenistan and are widespread on the plains.

Table 3.1

Main consumers of biological resources in Turkmenistan

Consumer	Sub-division	Line of activity
State Fishery Committee of Turkmenistan	SIA "Balkanbalyk"	Caspian Sea fishing
	SIA "Marybalyk"	Inland waters of Mary velayat
	SIA "Dashoguzbalyk"	Inland waters of Dashoguz velayat;
	SIA "Lebapbalyk"	Inland waters of Lebap velayat
	"Ahalbalyk"	Pond fishing
"Turkmendermansenagat" Association at the Ministry of Health and Medical Industry	"Buyan" Agro-Industrial Association, comprising four storage depots and a scientific – research experimental station "Ylym"	Cultivation and collection of liquorice and other medicinal plants
	"Derman" Farmers' Association "Saglyk" Chemistry - Pharmaceutical Plant	Cultivation of medicinal plants Production of pharmaceuticals
Turkmen Society of Hunters and Fishermen (TSHF); Turkmen Society of Falconers	51 designated hunting areas, total area 3,216,060 ha.	Hunting and fishing
Timber Enterprises at "Geok Gushak" Association; Department of reforestation and protection of nature parks; Forest research station	Forest enterprises	Reforestation and cultivation of tree seedlings
"Turkmenmallary" Association at the Ministry of Agriculture		Pasture use
Local population		Collection of nuts, fruits, berries, mushrooms, and herbs; hunting, fishing and production of agricultural crops

More than 20 species of birds are hunted. The most popular species are rock pigeon (*Columba livia*), European turtle-dove (*Streptopelia turtur*), Chukar partridge, pin-tailed and black-bellied sandgrouse (*Pterocles alchata* and *P. orientalis*) and waterfowl such as coot, river and diving ducks and geese. In 2001, licensed hunting was not allowed for pheasant (for the Murgab River subspecies *Phasianus colchicus principalis*). The rock pigeon is hunted by local people throughout Turkmenistan. It is estimated that there are between 2 and 3 million pigeons and numbers are increasing as more areas are used to grow cereals. Another resident species, the Chukar partridge, is found in the mountains, along the Caspian Sea, in Western Uzboy, and Central and Zaunguz Karakums. Its population is thought to be between 50,000 and 70,000 individuals. In recent years there has been an increase in numbers of pin-tailed and black-bellied sandgrouse, especially in the Akhal and Balkan velayats.

Most waterfowl are wintering visitors and are popular species for hunters. As a result of intensive economic activity, land improvement and the opening up of the desert regions of Central, North-Eastern and Northern Turkmenistan, a new area for wintering waterbirds has been developed. The traditionally important area for wintering birds is the Caspian Sea coast.

Until recently, two species of venomous snakes, the Oxus cobra and the blunt-nosed viper, were captured in order to extract their venom. In the last few years cobras have not been used in this way. The Kopetdag mountains, particularly the eastern areas, are a major habitat for the blunt-nosed viper.



Levantine viper (*Vipera lebetina*)

3.2.2. Fishery Species

Sturgeons are of particular importance in the Caspian Sea. There are no spawning grounds in the Turkmen part of the Caspian Sea, but the coast from Esenguly to Ogurchinsky Island is a major fattening and wintering place for sturgeon which were born and spawned in the area from the Volga river in the north to Sefidruda in the south.

The other important habitat for the fish of the Caspian Sea is the Ajiyab spawning grounds in the floodplains of the Atrek River. Other valuable fish species in the Caspian Sea include sprats (*Clupeonella* spp.), grey mullet, common carp, and roach. Since 1996, fishing of the brine shrimp (*Artemia salina*) on an industrial scale has begun in Karabogazgol Bay. In the inland waters of Turkmenistan, introduced Far Eastern herbivorous fishes such as white-eye bream and white Amur bream are the species that are mainly caught [64].

3.2.3. Forest Resources

As has been mentioned above, Turkmenistan's forests provide environmental stability. But they are also an economic resource as some woody species provide fruit and nuts (for example pistachio, walnut and almond). Timber is also used from trees felled during thinning operations [39, 45]. Forests are divided into mountain, desert and tugai (riparian) types (Table 3.2)[45].

The forests of Turkmenistan (Fig. 3.1) play an important role in the socio-economic life of the country. They act in a water-retaining capacity, help moderate dramatic changes in weather patterns and provide a primary source of renewable resources [61]. The retention of water both at the surface of the soil and underground is dependent on the maintenance of forests. The main tree species in the mountain forests are *Juniperus*, *Acer*, *Ulmus*, *Pistacia*, *Paliurus*, and *Celtis*. The forests are fragmented and there are no continuous tracts.

The desert forests include species such as white and black saxaul, and a number of species of *Tamarix*, *Salsola* and *Calligonum*. These forests are mainly concentrated in the South-eastern, Central and Zaunguz Karakums.

Tugai forests are mainly found in the river valleys. The main species are *Populus pruinosa*, *Elaeagnus*, *Tamarix*, and *Salix*. These tugai communities contain trees, shrubs and grasses.

3.2.4. Valuable Plants

Numerous wild plants provide valuable resources for the food and pharmaceutical industry and other local industries. Around 1,600 species contain biologically active elements (potential medicinal raw materials), including 600 used in the perfume industry, 700 used in food-

Table 3.2.

Forest types and areas in 1998

Forest types	Total area of forest estate (ha)	Forested area (ha)	Major species	Timber stock (million m ³)
Mountain forests	524,0	146,0		3,9
			<i>Juniperus</i> <i>Acer</i> <i>Ulmus</i> <i>Pistacia</i> <i>Paliurus</i> <i>Celtis</i>	1,5 0,203 0,148 1,44 0,66 Insignificant
Desert forests	9351,1	3957,9	Saxauls:	9,53
			<i>Haloxylon persicum</i> <i>H. aphyllum</i> <i>Salsola richterii</i> <i>Tamarix</i> <i>Calligonum</i>	7,5 1,8 0,05 >0,05 0,13
Tugai forests	44,5	26,0		0,27
			<i>Populus euphratica</i> , <i>P. pruinosa</i> , <i>Elaeagnus</i> , <i>Tamarix</i> <i>Salix</i>	
TOTAL	9919,6	4129,9		13,7

stuffs, 160 used in the dyeing industry, nearly 50 containing potash and more than 800 used as food.

Medicinal plants are an important component of the wild flora. Turkmenistan mountains are important sources of medicinal plants.

The valleys and water meadows of Turkmenistan's rivers are also a significant source of economically useful plants. The Tugai flora is a valuable source of plants and the most significant plant in the flora of the Amudarya River is liquorice.



Tamarisk in blossom

There are also large areas of essential-oil plants. The most important area for these plants is the Kopetdag, particularly the western part which contains all of the essential oil plants known from Turkmenistan (Fig. 3.1). Potential sources of these raw materials are given in Appendix 4.

At present the **food industry** of Turkmenistan utilises raw materials from 53 species of wild and cultivated plants. There are factories producing non-alcoholic beverages such as tonic and fizzy drinks as well as breweries producing alcoholic drinks, all of which utilise raw materials from local plants.

Some of the most economically valuable plants are the saponin-producing species such as the Turkestan soap root (*Allochrysa gypsophilioides*) that is endemic to Central

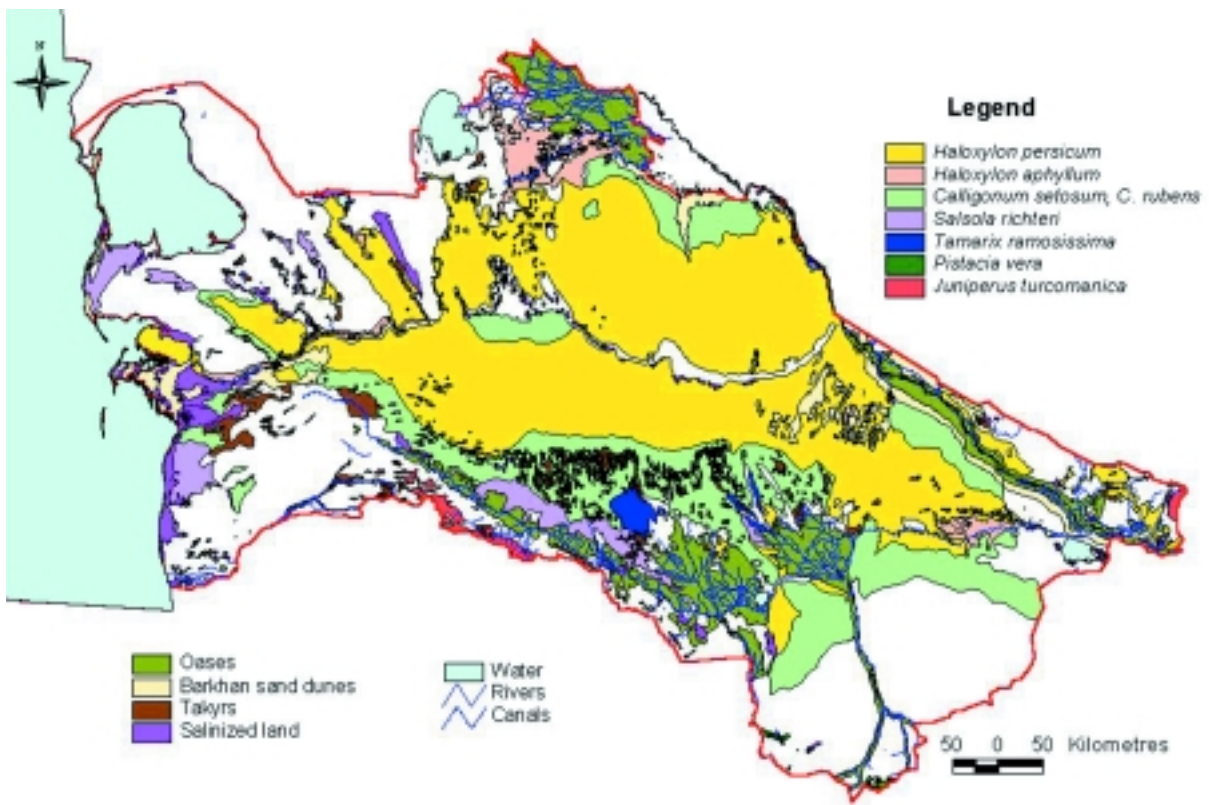


Figure 3.1. Forest resources

Asia. Roots of these plants are used within Turkmenistan as well as being exported. These species occur in the mountainous areas of the Kopetdag and Kugitang as well as the foothills.

Nearly 5% of all Turkmenistan’s flora are *dye plants* that are used in the textile, food and pharmaceutical industries.

A number of algae species (microphytes and macrophytes) are a valuable food source for herbivorous fish and the nutria, a valuable fur-bearing animal. They can also be used as fertilizers and play an important role in the natural purification of water basins. Most species of Turkmenistan lichens are used to produce lichen acids, which are used in a number of countries for drug production. A large part of the lichen flora is concentrated in the highlands.



Pistachio (*Pistachio vera*);



Berberis turcomanica;



Blackberry (*Rubus caesius*)

3.3. Extent of Use of Biological Resources

3.3.1. Fisheries

According to official statistics of the State Fishery Committee, nearly 12,000 tonnes of fish were caught in the year 2000, of which 500 tonnes were caught in inland waters (see Figs 1.8, 1.9). Calculations show that the fishing potential of inland waters may be at least 6,000 tonnes a year [64].

In recent years, there has been an increase in the volume of fish catches in the Caspian Sea, reaching a maximum of 11,500 tonnes. But in the first quarter of 2001 there was a rapid decrease. This was due to a decrease in the sprat catch. In 2000, Turkmenistan had the smallest quota for sturgeon among the Caspian States (with the exception of Iran). Its quota was only 77.3 tonnes, compared to 499.7 tonnes for Russia, 108.35 for Azerbaijan and 311.0 for Kazakhstan, although 22.3% of the Caspian Sea area belongs to Turkmenistan.

3.3.2. Hunting

Turkmenistan has a rich diversity of faunal resources [69]. The tolai hare is the main mammal that is hunted. On average 117,000 hares are officially hunted each year, out of a total population of 1 million.

Since 1993, wild boar has been included on the list of species whose hunting is regulated by the use of licences. According to the TSHF 80-90 animals are hunted every year. The total population is estimated to be between 45,000 and 50,000.

A total of 28 bird species can be hunted legally. Pheasants required a licence. In 2000, the cost of a licence was fixed at 40,000 manats (US \$7) for one bird. In 2000, 12 pheasants were officially hunted and hunting was only allowed in the Ahal velayat. In 2001 hunting of pheasants was prohibited. A total of 1,234,000 other birds (pigeons, doves, turtledoves, sandgrouse, ducks and geese) were hunted.

The fur trade has recently ceased although according to TSHF data at least 60,000 skins could be harvested without damaging populations
Estimated potential skin harvest: Fox - 30,000; Jackal -15,000; Pallas' cat -10,000; Wolf -700; Nutria - 2,000. In total - 57,700 skins.

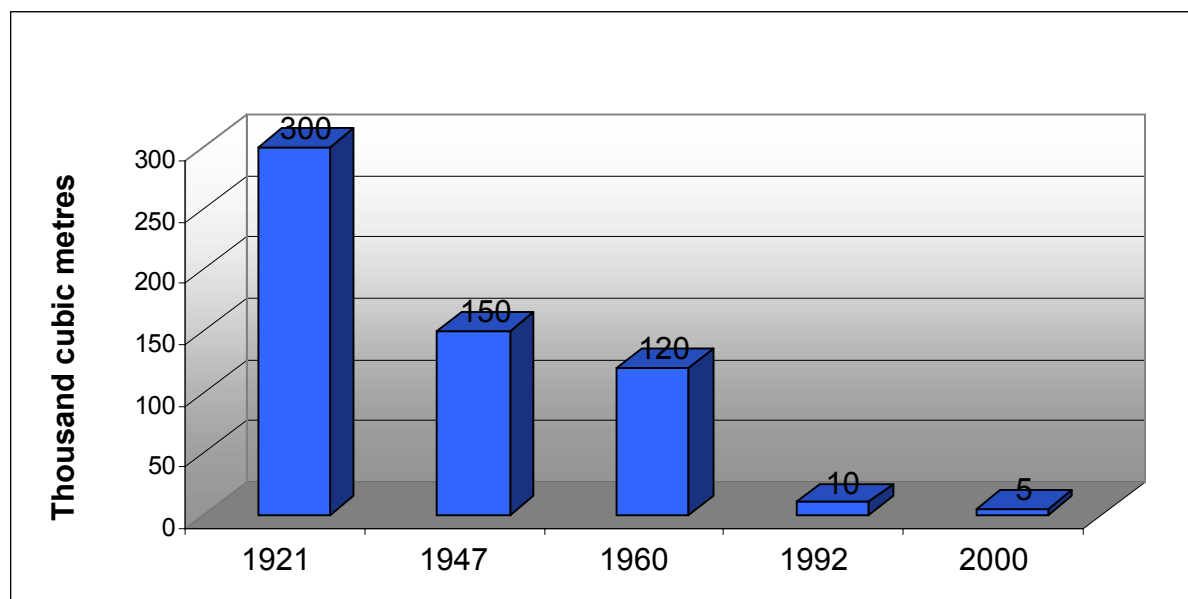
At present amateur hunting by local people is allowed. 3.3.3. Forest Resources

At present the total stock of timber in the forest plantations of Turkmenistan is 13.7 million m³, including 4.2 million m³ or 30.7% of mature and senescent plantations [10] (Table 3.2). The volume of timber planting is being decreased from year to year due to projects planned to give remote villages access to the centralised supply of fuel and gas (Fig. 3.2). For the time being, only timber from thinning operations is being harvested, which favours the natural restoration of forest resources.

The density of the pistachio forests is resulting in low yields and some management of these areas is required. In the best harvest years, only 500 tonnes of nuts were collected from the Kushka and Polikhatum woods (20,000 ha) of the Badkhyz zapovednik. In recent years the harvest of pistachio has not exceeded 50 tonnes [45].

Bitter almond is used in the pharmaceutical industry and is stored as seed. There are considerable resources and the annual volume of production is around one tonne. However,

Figure 3.2. Volume of timber-stocks in different years



there are only small areas of sweet almonds. The productivity of walnut is very low and fluctuates between 500 and 1,000 kg/year [61].

According to Ministry of Agriculture data there are 10,000,000 ha of non-developed pasture and 3,000,000 ha of degraded and useless pasture highly sensitive to desertification in the Karakum desert. Only 18% of pastures in the plains are suitable for use during the whole year and grass production fluctuates from 57 to 280 kg/ha [2].

3.3.4. Valuable Plants

In estimating the extent of usage of useful plants, it should be noted that there are many species that are potentially valuable but are currently exploited at low levels. This is particularly true with medicinal plants (Appendix 4).

The total number of livestock in Turkmenistan on 1st Jan 2002 was 12,000,000 sheep and goats and 100,000 camels.

3.4. Sustainability Assessment

The most valuable sources of forage in the agricultural sector are natural pastures, the greater part of which (93.6% according to 1999 figures) are desert pastures, with only 2,300,000 ha of mountain pastures. Increasing desertification has considerably increased the economic importance of natural pastures [58] whose sustainability is defined by the presence of species able to retain the moisture of subsoil waters. This is not always considered when estimating their economic value. Cattle are the major consumers of forage from the plain and montane pastures and represent one of the most pressing anthropogenic factors. Due to the irregular distribution of herds on the vast areas of pasture, considerable overgrazing takes place. As crepitose grasses die off, the wormwoods (which are not able to accumulate a productive underground mass to

prevent soil degradation) spread [31]. All these factors and the high level of forage consumption (over 50% of the gross forage mass) and the lack of rational rotational grazing lead to the displacement of wild herbivorous mammals (kulan, Bukhara deer, sand gazelle and others) from natural pastures.

The volume of local and commercial fishery enterprises' catches plays a significant role in determining changes in the marine ecosystems. Catches of sturgeon and other traditional species such as roach and common carp have been declining in recent years [60], but the catches of Caspian herring have been increasing and the population of pike-perch (*Stizostedion marina*) is recovering. The stocks of golden grey mullet are in good condition. Sprat fishing in Turkmenistan was stable until the end of 2000. In the first quarter of 2001 it fell by more than half. The causes of this decline are being investigated.

The stocks of game species (i.e. those which are legally hunted) are stable. Their populations are monitored by many interested organisations and the Ministry of Nature Protection of Turkmenistan adjusts the hunting quotas each year.

3.5. Application of Biotechnology and Access to Genetic Resources

Studies in biotechnology and the use of genetic resources are not being conducted in Turkmenistan. Therefore appropriate legislation and administrative regulations have not been developed.

* * *

Thus as is clear from the aforesaid, Turkmenistan is rich in biological resources, but their stocks can be damaged as a result of anthropogenic pressure. The irrational exploitation of populations of useful plants can lead to the impoverishment of their gene pools. Creation of improved pastures and areas for growing medicinal and commercially used plants are needed, together with the establishment of specialised game farms.

4. VALUES OF BIODIVERSITY

4.1. Economic Values: Direct and Indirect

Various elements of the rich and diverse fauna and flora of Turkmenistan are of great importance for the development of such branches of the national economy as local medicinal, perfumery, and food processing industries, and for hunting and fishing. There are a great many direct economic benefits from the use of natural resources. These benefits are mainly connected with fishing, apiculture, cattle-breeding, hunting, trapping, consumption of medicines, food, dyeing, perfume and other herbal uses, forest resources (timber and berry collection) and others. The number of species used for economic purposes continues to increase.

4.1.1. *Hunting and Fishing*

Since 1990s, the fur industry has not been active. The lack of an efficient approach to the exploitation of fur-bearing animals is an obstacle to the development of this activity, though Turkmenistan has all the necessary preconditions for hunting, processing and producing quality furs. The export of furs would generate US \$1 million a year for Turkmenistan. The creation of specialised fur farms would also be a benefit for the country.

Marine products from the Caspian Sea represent a great economic resource not only for the coastal population, but also for the whole of Turkmenistan [51]. Fishing is traditional in the Caspian region. Sturgeons (Russian, spiny, Persian and stellate sturgeons and beluga) are particularly valuable species.

4.1.2. *Plant Species of Economic Importance*

Plants of economic importance are those that are used in the drug, food, perfume and dyeing industries. Plants used in the production of drugs and medicines are critical for maintaining the health of the nation. Around 40% of the drugs used in Turkmenistan today contain ingredients derived from plants.

Liquorice is a particularly important plant for export. The demand for liquorice increases every year. Methods for producing liquorice on an industrial scale are being developed and used. Liquorice and its by-products are one of the main preparations produced by the Turkmen pharmaceutical industry and exported worldwide. Turkmenistan exports only two drugs, liquorice and the introduced *Cassia senna*, which is used as a laxative. In the year 2000, export sales of liquorice totalled 4,800 million manats.

Many medicinal products have been developed from local flora, but for various reasons, only some of them are still produced. In the past few years about 50 species of local flora have

been cultivated. It has been proved that nearly 40 of the most valuable drug plants can produce high and stable yields in irrigated areas. This will allow Turkmenistan to reduce the level of medicinal plant imports and also export some of its own production.

Plant dyes are widely used in many industries. The Government of Turkmenistan has taken measures to restore and to re-introduce ancient natural dyes into the carpet industry, as they are more stable and colourful than modern artificial dyes. The value of the carpet as an export product depends on these characteristics. In addition to the carpet industry natural dyes may be used for dyeing more expensive and refined fabrics such as silk, and others. It is possible to get many different colours and tints (60 tints) from plant dyes including red, yellow, brown, chestnut, black, grey, green, olive, violet, lilac and blue. Combining the different colours gives an even greater variety of hues.

Many plants are widely used in the food industry of Turkmenistan. More than 100 species of wild plants and nearly 50 species of wild fruit trees and bushes are consumed by people. More detailed research is needed to broaden the number of plants that can be used in local economies. Some wild plants are a source of alkali, soda, and potash and can be used in the soap, textile, dyeing, wood pulp, medicinal and confectionery industries.

4.2. Non-Economic Values of Biodiversity

Obviously the “economic valuation of biodiversity” means the values which are paid in the market. In addition to the direct economic value of biological resources, such traditional values of biodiversity as spiritual, cultural, community, scientific, educational and recreational values, together with communication with nature, are all also of great importance and are impossible to express in financial terms.

Natural ecosystems maintain the conditions necessary for human life on the Earth, without which existence would be impossible. In other words natural ecosystems provide a “biological service”: for example plants purify the air and water, oxygenate the air, stabilise and mediate the climate, restore soil fertility and eliminate wastes. Such diverse activities as the supply of freshwater, prevention of desertification, and the role of insects as pollinators can also be referred to as “biological services”. Natural ecosystems are composed of



Sparse pistachio woodland in Badkhyz