complex, inter-linked relationships and the elimination of what is at first sight an insignificant element might lead to the destruction of the whole system.

A rare plant species *Dionysia tapetodes*

We should remember that potential profits that could be obtained in the future from species which are not used today are also part of the non-market value of biodiversity. We do not know about the useful characteristics of plants and animals, which could (if we do not lose them) be applied in the future in agriculture, medicine and other areas of the economy. Biodiversity is also of great importance for recreation, for which there is still no accepted means of determining economic value. Methods of calculating non-market value are currently being developed. This is a complex calculation, which has yet to be used in Turkmenistan. In the 1990s there were attempts to economically evaluate the non-market value of biodiversity of the earth, which showed that the total economic value of the world's ecosystem functions is US $16-54 trillion each year, a sum that considerably exceeds the World Gross Product.

4.3. Cultural and Traditional Values of Biodiversity

Throughout the history of the Turkmen people natural resources have always been highly treasured. Animals and plants were used for food, construction and heating of homes, fabric production and household dishes, in carpet weaving and so on. Many medicinal plants were used by wise men (tebibs) as remedies for different diseases.

Over time, the natural and climatic conditions in Turkmenistan helped form the particular attitude of the Turkmen people to the surrounding wildlife, which was part of their life and culture. The saying "A drop of water is a grain of gold," conveys the respect of the Turkmen people for water. The attitude to animals and plants, and wise and careful use of natural resources were developed from the earliest times. It was prohibited to hunt animals during bad weather such as heavy snow or rains, or during the breeding season. While hunting, individual isolated birds and mammals were not shot.

The most valuable animal species for the original inhabitants of Turkmenistan were: kulan, Bukhara deer, argali, Turkmen wild goat, markhor, sand gazelle, Tolai hare, bustard, Chukar partridge, and falcon. Fish and waterfowl were traditionally valuable species for people of the pre-Caspian region. Important timber species are: archa, saxaul, maple, oriental plane, poplar, oleaster, mulberry tree, and nuts such as almond, walnut, and pistachio. Other plants of importance are spinach, wild onions, Syrian rue (*Peganum harmala*), liquorice, saponin-bearing plants (Turkestan soaproot and *Gypsophila*).

Hunters would not disturb a helpless sand gazelle, which had joined a herd going to water. An animal which managed to outstrip the hunter's pursuit was not hunted repeatedly. The sayings "A hunter must know his measure" or "Hunt, but know the measure" represented the careful attitude to animals. Even insects, sparrows and starlings that damaged plants were not destroyed as it was felt that every being takes from nature only what is needed, its particular share.

The same careful attitude was developed with regard to plants. Only dead trees and bushes were used as fuelwood; living plants were not destroyed. It was prohibited to use growing fruit trees for making household things and even for making a shepherd's crook.

From ancient times people communicated with nature through hunting. Falconry was very popular and has been deeply rooted since antiquity. Falconery was preserved as part of the culture for thousand of years and methods of falcon training were improved from generation to generation. Observance of a particular hunting etiquette and traditions was socially and morally important, performing educational as well as conservation functions. The strict observation of conservation traditions started from the moment when a falconer took a falcon's chick from the nest. A real hunter would never take a nestling if it was the only one present. Old hunters never took with them those who were known as nest destroyers and they did not divulge secrets to them concerning falcon training methods and nesting places. The principle of biodiversity preservation is manifest in one other tradition of Turkmen falconers: the falconer frees his falcon after 5-6 years of use.

One of the components of the rich ethnic heritage of the Turkmen people is their traditional careful attitude to nature. The life and historic development of the Turkmen are close and indissoluble from the environment. Humanity, love of peace and cordiality

For our ancestors the tulip was a "divine" flower – a symbol of awaking nature. According to the archaeologist M.E. Masson and the art critic G.A. Pugachenkova, in ancient times in Central Asia (including Turkmenistan) there was a tulip holiday dedicated to the coming of spring. In the architectural décor of Turkmenistan and Central Asia and Iran, conventionalised grape leaves and the lotus-like tulip took an ascendant position in the 5th to 7th Centuries AD. Even in later times in the 10th to 11th Centuries, motifs of conventionalised tulips are often seen in decorative painting on ceramics. Throughout the whole Turkmen-Osman Empire, the tulip was identified with the cult of spring and became a source of inspiration for Turkmen poetry and again acquired a notable place among the motifs on glazed tiles and in other arts. The tulip was used as an image or symbol for a long time until the 20th Century.

Saker falcon (*Falco cherrug*)

are the characteristics of a Turkmen-oguz, developed during hundreds of years due to the harmonious merging of human beings with nature.

Turkmen sayings and proverbs are remarkable monuments to folk creativeness and, at the same time, are an active means of propaganda for biodiversity conservation. Examples include: "If you take a flower it will last a thousand days, if you take a root it will last for a day"; "The beauty of the desert is water, the beauty of the water is a swan"; "A live mouse is better than a dead lion"; "When there are no ducks on the lake, a stint is the master"; "A frog is a nightingale where there are no birds"; "Deer and bear like forests; kulan and sand gazelle like deserts; flies and mosquitoes like honey"; "An eagle is free when it is winged" and so on [8, 34].

The beauty of nature lives in customs and national traditions, in names and geographic names, in the pictoral motifs of Turkmen carpets and women's jewellery. On the ancient Turkmen carpets the "tazy-guyrugy" (tazy's tail) design and birds' tracks can be seen. This proves the close relationship of falcons and tazy / borzoi dogs to the everyday life of Turkmen people.

As a tribute to the importance and values of water, the Akhalteke horse, melons and wheat, the following national holidays have been proclaimed: "A drop of water is a grain of gold" Day, the Day of the Akhalteke Racer, National Melon Day, the harvest festival and so on. The Turkmens' love of nature found its reflection in the symbols of the President's flag and in the State Emblem of neutral Turkmenistan; they are decorated with images of yellow-gold ears of Turkmen wheat and a proudly posing Akhalteke horse – the national heritage of Turkmenistan.

Nowadays President Saparmurat Turkmenbashi's concept of national revival has been incorporated in the "Ruhnama" spiritual book. It is aimed at reviving the cultural heritage of the Turkmen people based on spiritual and educational activity directed towards changing the way of thinking to an aesthetic system unifying human beings with the environment.

* * *

As outlined above, national traditions, aesthetic taste and philosophy find their place in integration with nature. It is very important that we, today in the "Computer Age", do not forget the beauties of nature with its mountains and rivers, steppes and deserts. As long as we do not, then every year after the winter sleep the whole length and breadth of our native earth will wake, the birds will sing, and the flowers will bloom.

There are all the prerequisites in the country for sustainable development, in which nature and the economy are two interrelated components. The basis for such an approach is founded in the national and cultural traditions of the nation, which will be revived by means of the President's "Ruhnama" Program. Nature is not merely a source of raw materials but, above all, the environment that defines the opportunities for sustainable development.

Using the peoples' great experience of and careful attitude to nature, and studying the national heritage we should learn to know and appreciate the natural world surrounding us, preserve and enhance it for future generations.

The tulip, known as "the divine flower" is the symbol of awakening nature

5. EXISTING AGENCIES FOR BIODIVERSITY CONSERVATION AND THEIR ROLES

5.1. Government Agencies and Executive Bodies

In accordance with the legislation of Turkmenistan, the Ministry of Nature Protection is a specialised independent department that oversees the efficient consumption of natural resources and environmental protection as well as the development of the national forest estate. The State Fishery Committee is authorised to regulate fisheries and is responsible for the effective management and rational use of fish resources, maintenance of fish stocks and their protection. The institutional structure of government agencies involved with the conservation and rational use of national biodiversity as of the 1st January 2001 is shown below (Figure 5.1).

The main executive bodies of the Ministry of Nature Protection responsible for biodiversity conservation are the velayat departments of nature protection, and two specialised departments: the Department for Protection of Fauna and Flora of Zapovedniks, and the Environmental Programmes Coordination Department. The State Fishery Committee has velayat and sea inspectorates that directly carry out the protection, control and evaluation of fishery resources.

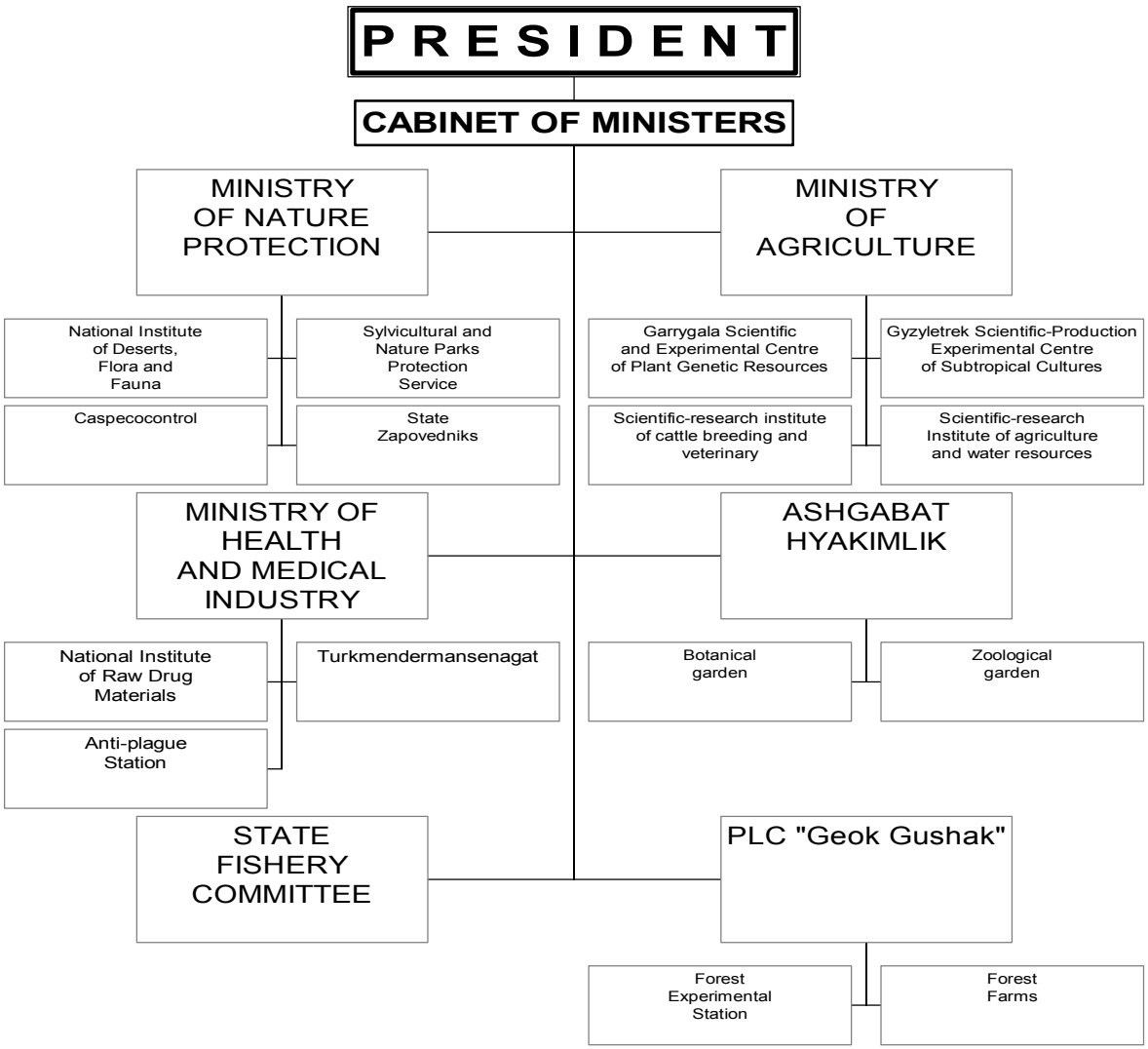
5.2. Public Organisations (NGOs)

The oldest NGOs concerned with biodiversity are the Turkmen Society for Nature Protection (TSNP) and the Turkmen Society of Hunters and Fishermen (TSHF). For several decades TSNP has been conducting public awareness initiatives, publishing articles and undertaking other activities in the field of biodiversity conservation. The Society published a number of articles and scientific works and made considerable contributions to the first and second editions of the Red Data Book of Turkmenistan. Its activities achieved worldwide recognition and it was incorporated into IUCN. Besides this the TSNP has a system of public inspectors who assist the Ministry of Nature Protection in its day-to-day work. Professional scientists' associations, such as the Geographic, Hydrobiological and Ornithological Associations, continue their activities today.

Since Turkmenistan's independence many new public organisations have been founded such as the Falconers' club, the environmental education group "Green Team" and the Ecocentre at the State University, and the youth groups "Young ecologist" and "Ecology and tourism" at the Palace of Youth and Children. Environmental education activities are conducted in close co-operation with the state authorities and international public organisations such as IUCN, WWF, SEU, and others.

Numerous unincorporated initiative groups, aimed at environmental education and in-

Figure 5.1. Organogram of governmental agencies concerned with the conservation and use of biodiversity in Turkmenistan (as of 01/01/2001)



creasing awareness in the field of biodiversity conservation, carry out activities in all the velayats in the country. The priorities among public organisations' activities are: (1) propaganda and environmental educational activities with children in kindergartens and schools, students, and other segments of the population; (2) development and realisation of concrete activities directed towards environmental protection and biodiversity conservation. The initiative of public organisations, supported by their partnership with state authorities, is able to lay the groundwork for maintaining national biodiversity, which is an essential component of the sustainable development of society. Support from the local population is a key requirement for the effectiveness of nature conservation projects.

5.3. Educational and Research Institutes

After the reorganisation of the National Academy of Sciences in 1997 the National Institute of Deserts, Flora and Fauna, which had unified three earlier independent institutes (the Institute of Deserts, the Institute of Zoology and the Institute of Botany) was incorporated into the structure of the Ministry of Nature Protection in order to encourage close co-operation between scientists and industry. The Botanical and Zoological Gardens, and the Scientific Re-

search Institute of Cattle Breeding and Veterinary Medicine and the Scientific Research Institute of Agriculture and Water Resources within the Ministry of Agriculture carry out research into genetic resources. Direct biodiversity conservation research is implemented by the zapovedniks (*in situ*), and Garrygala Scientific and Experimental Centre of Plant Genetic Resources (*ex situ*), formerly one of the departments of the Soviet Union Institute of Crop Production. It is necessary to mention that in accordance with national legislation zapovedniks have the status of scientific research organisations.

During their period of operation the scientific research institutes have gained great scientific and management experience in the fields of biodiversity research and use of animal and plant resources. In 1967 the Institute of Deserts acquired the status of the lead scientific research establishment dealing with the complex problems of research and development in the arid territories of Central Asia and Kazakhstan. Leading scientists of the Institute take an active part in the implementation of international projects with UNDP, ESCAPO, FAO, CEP and others, all of which concern biodiversity to some extent.

The country has several higher education institutions under the Ministry of Education. These include the State Medical Institute, the Niyazov Agricultural University, the Mahtumkuli Turkmen State University, and the Polytechnic Institute, the Seidi State Teachers' Institute which train ecological specialists.

5.4. Community Groups

The major groups of the rural population, such as hunters, fishermen and shepherds are not only the consumers of biological resources but at the same time their preservers. This is expressed not only in the traditional careful attitude towards nature but in the existence of "sacred places" such as the 1,500 ha pistachio wood in Hoja Burji Belent, Kugitang; Ibrahim-Edkhem and Shevlan groves; Nyazym canyon etc. The local population always kept and still keeps such areas in a virgin state. People come there to pray, to celebrate festive events, to heal, to bury the dead and to recover from misfortunes. Sacred groves are peculiar natural "sanctuaries" and remain nowadays an important element of spiritual kinship between man and his origins. One of the guiding principles in the Islamic religion (the al-Mizan) states: "Everything in the universe has sense and order, everything is balanced and this balance should not be disturbed". Therefore such places of ancient traditions and customs allow centres of wildlife to be preserved for pilgrims, tourists and travellers.

Mountain steppe

5.5. Business Involvement

In spite of the fact that many organisations and individuals in Turkmenistan are involved in the exploitation of natural resources, in practice incomes and profits are not seen as connected with the need to take measures to preserve biodiversity. In the era of the centrally planned economy the commercial consumption of mammals, snakes, fish, pasture, and medicinal raw materials was in the hands of the State and was based on scientifically developed norms and quotas. At the moment the existing operations have become obsolete and new ones taking into account decentralisation and the market economy have not yet been developed.

The areas with the most potential for involving the commercial sector in the process of biodiversity preservation are marine fisheries and hunting. A well-managed hunting concession may be a good means for biodiversity conservation, as hunted species are efficiently consumed and, moreover, such concessions create the necessary conditions to preserve other flora and fauna. The existing hunting concessions do not have enough skills and expertise to evolve into stable high-profit activities. Several companies and international hunting associations show interest in licensed hunting on the territory of Turkmenistan; however, their real conservation plans are unclear. Ungulates are the major target species of commercial hunting.

The most interesting project in the sphere of commercialisation of biodiversity conservation is a proposed fish farm for the production sturgeon. Production of young beluga, Russian, Persian and spiny sturgeon at this farm will be combined with production of caviar and fish for trade. Finance for the fish farm may be obtained from compensation paid for environmental damage by foreign oil companies. The fish farm will be an artificially preserved component of biodiversity, urgently required given the background of the decline in the status of reserves and the development of mass oil extraction in the northern Caspian. This project will be a starting point for the development of marine aquaculture on the whole Turkmen Caspian coast, where there are favourable ecological conditions and a labour force surplus.

5.6. International Co-operation

International co-operation in the sphere of biodiversity conservation within Turkmenistan is mainly implemented via UNDP. There are also some proposals from UNEP, TACIS, and the World Bank, which have only recently become more specific and turned into the form of real projects. The most significant projects are the National Environmental Action Plan for Turkmenistan (NEAPT) and Capacity-21.

Regional co-operation is mainly of a data-sharing character, though biodiversity problems were touched upon in the Nukus and Almaty Declarations at the level of the Ministers of Environment. Several existing regional projects should be mentioned: the Aral Sea Project (World Bank, UNDP) and the "Biodiversity" part of the Caspian Environmental Program (CEP). A set of Central-Asian projects "Consvervation of biodiversity of the Kugitang Mountains in Turkmenistan", "Conservation of desert ecosystems in the north-west of Turkmenistan" are at the stage of development and approval, including several trans-boundary projects: "Preservation of Saiga (*Saiga tatarica*) and its Habitats on Migration Routes, Wintering and Summering Places"; "Biodiversity Preservation *in-situ* / on Farm in Central Asia"; and "Development of an Ecological Network as a Basis for Long-term Preservation of Ecosystems in Central Asia". In the framework of the Caspian Ecological Programme (ECOTOX) it is planned to implement work on the conservation of the Caspian seal and sturgeons in the Caspian Sea.

All these projects fulfil the commitments undertaken by Turkmenistan as part of the "Pan-European Strategy for Preservation of Biological and Landscape Diversity" adopted in

International co-operation

1995 at Sophia at the Conference of the Environment Ministers of the European countries, and more importantly, fulfil the country's commitments under the CBD.

Through the support of WWF a package of urgent measures for the preservation of the biodiversity of Turkmenistan was prepared. With the support of the McArthur Fund in 1995-1996 research was carried out on the status of Bukhara deer along the tugais of the Amudarya River. Work on the creation of a livestock reserve and the preparation of an intergovernmental agreement on transboundary protection of Bukhara deer are presently underway.

At present several projects have obtained finance and are being implemented. Among them are the following: "Conservation of the Leopard in Turkmenistan" and "Conservation and Restoration of the Bukhara Deer in Turkmenistan, Uzbekistan, Tajikistan and Kazakhstan"; from 2001 "Conservation and Management of the Kulan". Several projects have been implemented with the financial support of the Central Asian division of the Initiative for Social Action and Renewal (ISAR) Fund.

5.7. Capacity for Biodiversity Conservation

In general, the substantial research infrastructure in Turkmenistan is able to work efficiently to carry out specific research programmes [67]. The availability of a wealth of basic research materials (including collections of fauna and flora) maintained as part of the country's national heritage, enables successful progress in the implementation of ecological projects, and the conduct of high-quality work aimed at supporting biodiversity in the field. Today the centre of the specialists in biodiversity *research* is the National Institute of Deserts, Flora and Fauna at the Ministry of Nature Protection, and the centres of *preservation* are the zapovedniks of the

Ministry of Nature Protection and Garrygala Scientific and Experimental Centre of Plant Genetic Resources.

The reduction of staff in the scientific departments of the zapovedniks and the noticeable lack of specialists in the conservation of specific elements of biodiversity are directly connected with the decline in quality of conservation research in recent years. A lack of demand for scientific recommendations from the research departments of the zapovedniks on conservation and restoration of rare species has reduced the importance of their scientific and research work. Insufficient experience of participation in international projects, and the condition of the transitional economy, have also limited the possibilities of implementing activities in the sphere of inter-sector co-operation (for example, co-operation with public organisations, business organisations, etc.).

A rare endemic species *Allium vavilovii*

The scientific centres of the research institutes and zapovedniks have lost touch with the practical management of biodiversity conservation activities and are unable to attract external financial resources to manage biodiversity. At the same time up-to-date information on the status of biodiversity is required for objective management decisions.

5.8. Training for Biodiversity Conservation

Until recently, little importance had been attached in the framework of the state to environmental education and training in biodiversity conservation. Educational programmes in biodiversity are usually addressed through *general training courses in nature protection*, which are not targeted towards training specialists for zapovedniks.

Major subjects connected with ecology include the following: “Basics of Ecology and Nature Protection”, “Ecological Expertise”, “Administration of Zapovedniks in Turkmenistan”, “Plant Ecology”, “Biogeography”, “Ecology and Efficient Consumption of Natural Resources”, «Saparmurat Turkmenbashi’s Policy in the Field of Ecology», “Forestry and Forest Irrigation”, “Assessment and Charging for Natural Resources”, “Statistics for Conservation of Natural Resources”, “Economics of Nature Consumption” and “Environmental Economics”etc.

At schools, vocational schools and colleges, the teaching of ecology mainly concentrates on courses in Natural History, Biology and Geography, but without specific study of biodiversity in general. Environmental and conservation education of pre-school children is improving.

In general, environmental education activities are implemented in the framework of Trans-European co-operation under the TEMPUS TACIS programme or through environmental education initiatives (for example, the “game ecology” programme) of the public ecological organisations and actions (Park Marches, Earth Day etc.).

Workshop on the problems of biodiversity conservation

5.9. Financial Resources for Biodiversity Conservation

The financial means allocated by the state budget of Turkmenistan to the Ministry of Nature Protection form the essential basis for tackling regional and inter-state ecological problems. In 2000 environmental protection expenditure totalled 95,711.6 million manats (over 18.4 million USD), of which investments made up 53,906.9 million manats (over 10.4 million USD). In Turkmenistan there is a special Nature Protection Fund, which is compiled from various payments for waste and disposal, fines, fees for expertise and other services. The fund is allocated for environment protection purposes by agreement of the Cabinet of Ministers and the Ministry of Finance.

The major factor influencing investments into nature protection is the existence of legislation, regulations and rules. The "polluter pays" principle is implemented by means of charging for standard levels of waste and disposal, and penalty sanctions for exceeding these.

The Nature Protection Fund of Turkmenistan was founded by the Presidential Decree of 15/04/1996 to solve the problems of financing environmental protection during the transitional period to a market economy. This Fund is a state establishment and is part of the State Budget of Turkmenistan for financing measures on nature protection, renewal of nature resources, rehabilitation of the environment, mitigation of ecological consequences of accidents and disasters, and compensation of damage caused. The main shareholders of the Fund are the Ministry of Nature Protection and the State Fishery Committee; both have their subaccounts. The Fund is financed from non-budget income but is under the control of the Ministry of Economy and Finance.

In spite of the money the state spends on biodiversity conservation, there is a need to attract additional resources. During recent years extra finance has come from international organisations (UNDP, UNEP, World Bank and others) within the framework of joint ecological projects, which concern the problems of biodiversity conservation to different extents.

* * *

Thus the existing ecological departments of the management bodies within the wide network of zapovedniks, institutional and educational establishments represent a positive heritage required for the development of Turkmenistan's Biodiversity Strategy and Action Plan (BSAP) for sustainable use of the country's biodiversity.

6. EXISTING BIODIVERSITY CONSERVATION PROGRAMMES

6.1. Research Relating to Biodiversity Conservation

The problems of biodiversity conservation *in situ* fall under the remit of the scientific departments of the zapovedniks which for many years have been research centres implementing all-year round research on the natural ecosystems of Turkmenistan. Scientific work in all protected areas is focused on a single problem, the "Scientific basis of conservation and restoration of the major ecosystems of Turkmenistan" based on one general manual of scientific methods encapsulated in the programme of compiling the "Nature Chronicles".

The paramount role of the research activities in Turkmenistan's protected areas is to ensure the preservation of their genetic resources and to gather data on changes in ecological variables as a basis for making informed management decisions. The initial stage entails conducting floral and faunal assessments at each zapovednik, where up to 70-85% of species including more than half of the species listed in the 1999 Red Data Book of Turkmenistan are preserved. Annotated lists (summaries) of the flora of Repetek [29] and Badkhyz zapovedniks [22] and breeding birds [13] have been published. However, to date even this data-gathering stage has not been completed: either lists have not been published or the key elements of fauna and flora in all zapovedniks and zakazniks have not been fully assessed.

In a number of cases the science departments' activities have shifted from all-year-round observation of nature to environmental education of the population. This change is only to be expected, because scientific monitoring is currently accorded a low priority and only partially fulfils its tasks. In addition, the wildlife itself in combination with the qualifications of the specialists creates a unique educational opportunity for public awareness activities. This improves the status of SPAs in the estimation of the population, enhances their environmental awareness and raises public awareness of conservation.

The second (1999) edition of the Red Data Book of Turkmenistan [7] reflects the extent of current study of the biota and the state of its protection. A total of 261 taxa have been listed: 152 animal and 109 plant taxa. More than half (64 species or 59%) of the listed plant species are endemic to Turkmenistan. The publication of the Red Data Book is an incentive to strengthen the protection of rare species and is the basis for the allocation of the nature protection budget to prevent damage to biodiversity [6]. At the same time rather than concentrating on the enlargement of the network of protected areas, measures recommended for species conservation and rehabilitation should accentuate the need to conduct ecological impact assessments on any economic activity which might cause damage to wild populations.

6.2. *In-situ* Measures for Conservation of Species and Habitats

Measures required for *in situ* conservation of species include *regenerative activities* (where biodiversity is heavily damaged) and *protective measures* such as:

- conservation of the population structure of a species
- protection of the population in specially protected areas
- conservation of populations of domestic animals and cultivated plants
- conservation of habitats and the environment
- regulation of utilisation of exploited species
- prevention of hybridisation with Genetically Modified Organisms
- prevention of animal mortality on man-made structures
- control of agricultural and other anthropogenic activities.

Turkmenistan has a well-developed *legal system* for biodiversity conservation (see Section 7) and a network of *eight zapovedniks* (Section 6.3) *with zakazniks* providing an effective form of protection and control of anthropogenic pressures in regard to habitat-restricted species and species listed in the Red Data Book. Outside protected areas, the Ministry of Nature Protection in co-operation with the State Fishery Committee and their regional sub-departments, the Department of Public Security of the Ministry of Internal Affairs (MIA), the National Security Committee (NSC) and the Frontier Troops Administration, have worked out an Action Plan for joint activities to enforce the law on protection of fauna and flora, including fish stocks, for the years 2001-2005. Environmental protection legislation to preserve populations *in situ* is enforced by patrolling, specific ecological actions, raids and ambushes, confiscation of poaching equipment, and organisation of public meetings.

Among *regenerative activities* on *in situ* conservation of species and their habitats the successful work on the reintroduction of kulan [19] into the protected Meana-Chaachinskiy and Kalininskiy zakazniks of the Kopetdag zapovednik from 1978-1985 must be considered. In 1982-1983 kulans were introduced to the Sarakamysh Lake area, and in 1988 to the right bank of the Sumbar River in Syunt-Hasardag zapovednik. In order to preserve sand gazelle two captive-breeding centres were created at Gyaurs (in Kopetdag zapovednik) and Garrygala (in Syunt-Hasardag zapovednik); however, neither is functional at present. An independent population of

Kulans reintroduced to their former habitat

sand gazelle was created in the 1980s on Ogurchinsky Island in the Caspian Sea. In 2000 the population totalled 410 head (data from statistical reports). Besides this pistachio trees were planted in Meana-Chaachinskiy zakaznik and the protected zone of Kopetdag zapovednik. Some experimental initiatives were implemented on the captive breeding of Caspian snowcock, black francolin, common pheasant, houbara bustard, Chukar partridge and wild quail (*Coturnix coturnix*). Attempts in 1981 to translocate the isolated relict Turkmen population of the spotted toad-headed agama lizard to new habitat failed (a large portion of its natural habitat was flooded by water from the Karakum Canal).

6.3. Protected Areas

6.3.1. System of Specially Protected Areas (SPAs)

One of the priority tasks for the implementation by Turkmenistan of its commitments to *in-situ* conservation under the Convention on Biological Diversity is the creation of a system of specially protected areas (SPAs), as a positive measure for the restoration of degraded ecosystems, and the protection of rare and endangered species [5]. In accordance with the Law "On Nature Protection" (Article 21) SPAs in Turkmenistan are defined as *state zapovedniks, zakazniks (sanctuaries) national, historic-natural and memorial parks, natural monuments, botanical and zoological gardens and arboreta, natural sanatoria (spas etc.) as well as fauna and flora listed in the Red Data Books*. All zakazniks and cultural monuments are under the supervision of zapovedniks and the latter in their turn are accountable to the Ministry of Nature Protection.

The IUCN classification is aimed at international use, and recognizes the competence and importance of all national categories of SPA. Turkmenistan's zapovedniks come under IUCN category I, zakazniks are under IUCN category IV and natural monuments are under IUCN category III.

National definitions of SPAs often do not correspond to the international classification developed by IUCN in 1978 and revised in 1994 [12]. In the current system of SPAs there are no "National Parks" (IUCN category II), and "Protected Landscapes / Seascapes" (IUCN category V) are provisionally considered analogous to the existing "protection zone" category of the state zapovedniks. IUCN category VI "Managed Resource Protected Areas" are also absent in Turkmenistan, but "captive-breeding centres for rare and endangered fauna and flora" could be considered as falling under this category (see Appendix 5).

Data from the Flora and Fauna Protection Department at the Ministry of Nature Protection show that of 250 registered natural monuments only 17 have official legal status, designated on

The total area of SPAs of all categories is 1,978,300 ha or 4.02% of the whole territory of the country: zapovedniks constitute 39.7% (784,600 ha) or 1.6% of the whole area of Turkmenistan; zakazniks 58.4% (1,155,900 ha) or 2.35% of the country's area; protected zones 1.8% (35,400 ha) or 0.07% of Turkmenistan's area; natural monuments 0.1% (2,300 ha) .

the basis of their protective, scientific and educational values. The Botanical and Zoological Gardens play an important though modest role as depositories of biological diversity. Ashgabat Botanical Garden is a member of the International Association of Botanical Gardens. The National Nature Park of Turkmenistan's Independence (3,000 ha) and the Park and Forest zone [20] of the closed green belt (Geok Gushak) around Ashgabat in the foothills of the Kopetdag (10,000 ha) are also both protected as natural monuments.

6.3.2 Zapovedniks and Zakazniks

Zapovedniks and zakazniks are the most important protected areas in Turkmenistan, by virtue of their degree of protection and their biological significance. They mainly protect desert, mountain and aquatic ecosystems (see Appendix 6 and Fig.6.1).

Repetek zapovednik (established in 1928), Turkmenistan's only biosphere reserve, is located at the junction of the Central and South-Eastern Karakum sand deserts, covering 34,600 hectares. About 2,000 ha of natural black saxaul are present. The protected ecosystem is predominantly desert [36]. Sand gazelle, caracal, Indian porcupine, desert sparrow (*Passer simplex*), houbara bustard, short-toed snake-eagle (*Circaetus gallicus*) and saker falcon all occur.

Young short-toed eagle in the nest (*Circaetus gallicus*)

Hazar (until 1994 called Krasnovodskiy) was established in 1932 on the south-eastern coast of the Caspian Sea at the juncture of typically dry Transcaspian desert and the saltwater area of the Caspian. The total area is 262,037 ha, consisting of a 226,589 ha strictly zapovednik zone, a 35,448 ha protection zone and 192,047 ha of the Caspian Sea itself. It is composed of two sections: Esenguly (established in 1933 and covering 69,700 ha) and Turkmenbashy (established in1968 covering 192,300 ha). The zapovednik has a 7,000 ha zakaznik (sanctuary) on Ogurchinsky Island (established in 1990), inhabited by thousands of Caspian seals. There are also the marsh frog, 29 reptile species, 48 species of fish and 293 bird species, almost half of which are waterfowl and water-dependent species (68 species have been recorded from the southeast Caspian coast and lowlands of the Atrek River), including greater flamingo (*Phoenicopterus ruber*), cranes, pigeons (*Columba* spp.), great bustard, nightjars (*Caprimulgus* spp.) and others. *Salsola transchyrcanica, S. tragus, Climacoptera czelekenica, Nitraria komarovii* and other plants are quite common in remnant patches along the coast.

Badkhyz zapovednik (established in 1941, covering 87,680 ha) is located in the Kushkinsko-Tedjensky inter-river territory in the foothills of the Eastern Kopetdag (mountain range Gezgyadyk) and Paropamiz (the saline Eroylanduz lake basin) in the southeast of Turkmenistan. Three state zakazniks were created in 1956: Kyzyljarsky (30,000 ha) protecting the calving grounds of kulan and sand gazelle; and Pulihatumsky (15,000 ha) and Chemenabitsky (12,000 ha) protecting watering points for kulan. The zapovednik contains 76,000 ha of pistachio woodland; populations of leopard, kulan, argali and sand gazelle; and 696 species of vascular plants [22]. It is recommended for inclusion as a UNESCO World Heritage site.

Kopetdag zapovednik (established in 1976, 49,793 ha) is located in the Central Kopetdag and consists of a cluster of small reserves (Aselma, Babazo, Firuza, Messinev). Mountain forest (mainly of *Juniperus turcomanica*) covers 21,814 ha (1982 data). Kalininskiy (established in 1976 covering 15,000 ha) and Meana-Chaachinskiy zakazniks (created in 1976 covering 60,000 ha) were established to protect common cranes (*Grus grus*) and to restore the population of kulan. Two *natural monuments* have been created in Kopetdag zapovednik to preserve the Charlyk

Fig.6.1. Zapovedniks of Turkmenistan (map)

pistachio grove in the Eastern Kopetdag and the Kara-Alcha nut grove (320 ha) in the south-western Kopetdag. Turkmen wild goat, argali, blunt-nosed viper, the Oxus cobra and rare endemic plants species are protected there.

Syunt-Hasardag zapovednik (established in 1978 covering 26,461 ha) fully represents the main landscape and ecological types of the middle elevations of the South-western Kopetdag dry subtropics (with the exception of foothill plains and upper levels of the mountains), which face high levels of anthropogenic threat. Syunt-Hasardag zakaznik covering 3,800 ha was established in 1990. Relict plants such as Turkmen mandrake, wild pomegranate and wild grapes occur. Leopard, argali and saker falcon are also found.

Kaplankyr zapovednik (created in 1979 covering 282,800 ha) is located in the north-east of Turkmenistan at the juncture between the south-eastern flanks of the Ustyurt hills (Kaplankyr plateau), the Zaunguzsky Karakum and the Sarykamyshsky basin. The zapovednik is located at the junction of the borders of Turkmenistan, Kazakhstan and Karakalpakiya, in the transition zone between the northern and southern deserts. To protect the lake ecosystems, migrating waterfowl and the calving grounds of sand gazelles, Sarykamyshsky zakaznik was established in 1980. From 18/01/91, its borders were re-defined, and it now covers 551,066 ha. In order to breed and to introduce kulans,

Mountain racer (*Coluber ravergieri*)

Shahsenemsky zakaznik was created in 1984, covering 270,000 ha). Black saxaul, *Ammodendron* sp., and *Calligonum* sp. are quite common: there are also rare species such as *Salsola chiwensis* and *Malacocarpus crithmofilius*, scorpions (*Buthus eupeus*), lizards, *Galeodes turcmenicus*, spiders (including *Lathrodectus tredecimguttatus*), ticks (*Tetranychus urticae*) and insects of different colour and size. Sand gazelle are often observed; Indian porcupine, saiga, Transcaspian urial and wild boar are rare, and very occasionally houbara bustard and pheasant (*Phasianus colchicus* ssp. *chrysomelas*) are seen.

Caucasian agama (*Agama caucasica*)

Amudarya zapovednik (established in 1982 covering 49,514 ha) consists of three areas in the middle course of the Amudarya River and consists of three zones: Nargizsky (45,100 ha), Gereldi (2,200 ha) and Kabaklinsky (1,200 ha), in which the valley flood plain tugais, ridge-hillocks and barkhan sands, and salt pans of the Turan lowland are well represented. The territory of the zapovednik includes part of the Amudarya River. In the tugai thickets, wild liquorice grows. *Eulophia turkestanica* and *Ophioglossum bucharicum*, two species of Orchidaceae are occasionally found. In the water, the spiny sturgeon, the small Amu-Dar and large Amu-Dar shovelnose sturgeons and the pike asp can be found. The wild boar, Bukhara deer and 104 nesting bird species occur including the Amudarya pheasant (*Phasianus colchicus* ssp.) and hypocolius (*Hypocolius ampelinus*) [13]. In the seepage zone near the Karakum Canal the 103,000 ha Kelifsky zakaznik was established in 1970 in order to protect natural ecosystems and create favourable conditions for wintering waterfowl and migrating species. Up to 55,000 waterfowl winter.

Kugitang zapovednik (established in 1986, 27,139 ha) is located on the territory of the western (Turkmen) scarp slope of the Kugitang ridge of the Pamir-Alai mountain range. Karlyuksky zakaznik (established in 1986, 40,000 ha) was created to protect unique caves and other geological features (marble onyx), as well as to protect archa forest and species of rare plants and animals such as the blind cave loach *(Nemacheilus starostini)* which inhabits underground lakes in the karstic caves. Hodjaburdjibelendsky zakaznik (established in 1986 covering 17,532 ha) was established to preserve and to restore pistachio forests. Hodjapilsky zakaznik (established in 1986 covering 31,635 ha) was created to preserve and to restore the general ecological balance of montane ecosystems. Hodjakaraulsky zakaznik (6,000 ha), legally designated in 1990, has not been implemented on the ground. Notable elements of the flora include *Juniperus seravschanica*, tulip (*Tulipa ingens*), almond (*Amygdalus spinosissima*), *Cleome gordjaginii*, and *Ungernia victoris*. Some woods are composed of oriental plane, jujube and pistachio. The beautiful mountains and caves are supplemented by the presence of markhor and Barbary falcon (*Falco pelegrinoides*).

6.3.3. Ranger Service

The degree of protection of biodiversity in the zapovedniks mainly depends on the state of the ranger service. The major enforcement activity is vehicle patrolling, in which a group of inspectors consisting of 5-7 people police their territory by car. In addition to vehicle patrolling

in Hazar, Amudarya, Badkhyz and Syunt-Hasardag zapovedniks, static guard posts are maintained and the rangers conduct patrols along fixed routes. The zapovedniks have telephone connections and computer facilities.

In 2001, the total staff of all eight zapovedniks was 385 people (wages and salaries made up 3,884,404,700 manats, or US $446,900). The ratio of guards to researchers was 9:1 (159 guards comprising 52.3% of the workforce, 22 researchers comprising 5.9%). The majority of the guards had technical secondary and secondary education.

The main indicator of the effectiveness of the ranger service is the availability of means of transport, particularly cars, motorcycles and boats in comparison with the area under protection. In Hazar zapovednik the motorboats are beyond serviceable age and the motor ship "Tebigat" has broken down. Overall this zapovednik has the lowest level of technical equipment. Three zapovedniks are relatively well equipped with transport: Syunt-Hasardag (2,900 ha per vehicle), Kugitang (3,000) and Kopetdag (3,500). Kaplankyr (35,100) and Amudarya (16,500) and the remaining zapovedniks are ill equipped. However according to data from the Ministry of Nature Protection (01/02/2001) the number of regime infringements registered in each zapovednik over the period 1998-2000 is not correlated with the technical equipment available to the ranger service. The infringements recorded included the following: hunting and trapping of animals, tree-cutting, hay-mowing, and collection of fruit and berries.

The difficult conditions of Turkmenistan's transitional economic period (1988-1989) have reflected in the work of the zapovedniks. Forest surveys to assess logging practices have not been conducted and since 1990 professional censuses of animals have not been carried out. Examination of statistics of the zapovedniks for the period 1995-2000 proves this fact (Table 6.1). Changes in populations of threatened and economically valuable species in zapovedniks are one indicator of changes in ecological variables and the degree of threat to the area.

6.4. *Ex-situ* Species Conservation Measures

The conservation of biodiversity *ex-situ* (i.e. outside natural habitats in breeding centres, nurseries, gardens and other specialised places) is no less important than its conservation in natural conditions.

There are 1,117 samples in the pomegranate collection, and 1,010 grape (*Vitis* spp.) samples. The only world collection of pistachio is represented by 53 samples, and there are unique collections of apple (*Malus*) - 273; pea (*Pyrus*) - 127; apricot (*Armeniaca*) - 517; peach (*Persica*) - 101; plum (*Prunus*) - 28; quince (*Cydonia*) - 78; almond (*Amygdalus*) - 160; fig (*Ficus*) - 180; olives (*Olea*) - 200; jujube - 92; and persimmon (*Diospyros*) - 106.

Scientific-Production Experimental Centre of Plant Genetic Resources

Academician N.I. Vavilov identified the western Kopetdag as a notable centre of biodiversity for wild-growing dry subtropical fruit trees. In Garrygala Scientific and Experimental Centre of Plant Genetic Resources a unique gene pool (4,040 samples) of wild fruit trees has been collected. These are wild relatives of Central Asian cultivated plant species. The high number of endemic species emphasises the global significance of the region. The core collection consists of 450 samples from Turkmenistan and there are 1,000 samples in the regional collection.

The Centre has played a highly significant role in the creation of regional varieties of fruit cultivars for the country: up to 90% of regional varieties were recommended by it. The

Table 6.1

Changes in populations of key animal species in Turkmenistan's zapovedniks (1976-2000)

Animals	1976-1980	1980-1990	1990-1995	1995-2000
Repetek zapovednik				
Sand gazelle	No data	No data	No data	20-25
Hazar zapovednik				
Greater flamingo	9,800	12,300	No data	7,484
Purple gallinule	54	127	No data	145 in 1998
Black francolin	140	230	No data	165 in 1998
Coot	60,200	147,800	No data	37,500
Badkhyz zapovednik				
Kulan	1,250	2,615	No data	3,500 in 1998
Sand gazelle	800-1,000	3,000-4,000	1,500-2,000	931 in 2000
Kopetdag zapovednik				
Turkmen wild goat	1927	5,500	1500	2,567
Urial	1989	8,000	2,000-2,500	4,050
Kulan (reintroduced)	No data	38	700-750	630
Syunt-Hasardag zapovednik				
Urial	60-70	270-280	60-70	100
Leopard	No data	3-4	3-4	4-5
Kaplankyr zapovednik				
Urial	No data	100	100-150	290 in 2000
Sand gazelle	No data	170	99	295 in 2000
Kulan (reintroduced)	No data	80	No data	239
Amudarya zapovednik				
Bukhara deer	20	12-15	35	40
Sand gazelle	No data	No data	No data	30
Kugitang zapovednik				
Urial	No data	No data	100	104
Markhor	No data	No data	207	303

Centre supplies the selection centres of neighbouring and foreign countries with the best varieties for the creation of experimental collections and constantly provides them with sources and donors for selection purposes. However, at present the Centre has certain difficulties due to the socio-economic conditions of the transitional economic period, which have already caused a decrease in the number of varieties and samples in the collection and might become a cause of their complete loss.

Scientific-Production Experimental Centre of Subtropical Cultures

The Gyzyletrek Scientific-Production Experimental Centre of Subtropical Cultures conducts industrial tests on subtropical cultivars (olives, jujube, persimmon, date palms and various citrus species). The Centre has recently been conducting field tests on the open-ground cultivation of oranges.

Ashgabat Botanical Garden

The Ashgabat Botanical Garden was established in 1929 and covers 18.5 ha, of which 12 ha are occupied by the arboretum which contains 1,200 species, sorts and varieties of trees and bushes. The Garden's collection comprises 5,000 species, sorts and varieties, of which there are 157 species and 67 sorts of highly ornamental exotic gymnosperms (pine trees, juniper, cypress etc.) and 1,196 species, sorts and varieties of tropical and subtropical plants (including 15 species and sorts of water plants). The ornamental plant collection consists of 352 species and 1,109 sorts and more than 600 local floral species. Among them the collection of relict and threatened "Red Data Book" species of local flora is of particular interest. A genetic seed bank of nearly 3,000 species has been created, mainly of Turkmenistan's flora but including plants from other parts of the world obtained on an exchange basis. Scientific research in the garden is mainly directed towards the introduction and acclimatisation of plants for the enrichment of Turkmenistan's cultivated flora, *ex situ* conservation, promotion of botanical knowledge and the aesthetic enrichment of the population.

Forest Nurseries

There are seven permanent and nearly 20 temporary nurseries in the forests of Turkmenistan. In the permanent tree nurseries, covering a total area of 1,250 ha, up to 20 million saplings of various species are grown annually. The forest stations of Turkmenistan are pioneers in growing

Saxaul forest

A common flower (*Rhinopetalum karelinii*)

seedlings of conifer species (in particular archa) in tree nurseries. There are 9,000 ha of saxaul planted from seed, 1,590 ha of pistachio and 3.3 ha of mulberry trees.

Herbarium

The National Herbarium of Turkmenistan consists of the herbarium of the National Institute of Deserts, Flora and Fauna (more than 250,000 samples of higher plants including 36 holotypes and isotypes), as well as the herbaria of higher educational establishments and zapovedniks. Besides these, mycological, lichen and bryophyte herbaria are held in the Institute. The herbarium has been collected over 200 years from all regions of Turkmenistan and adjoining regions of Iran. The National Herbarium is a scientific resource confirming the collection of plants from their type locations, and a reference collection for future taxonomic research, study of botanical resources, ecology, introduction and acclimatisation etc. The herbarium material was used while preparing the "Flora of the USSR", the "Flora of Turkmenistan", the regional and national series of botanical keys, the Red Data Books of Turkmenistan and the former Soviet Union as well as the unique "Flora Iranica", which is still being published. The Herbarium is part of the national heritage of Turkmenistan.

Scientific and Educational Collections

All collections of insects and vertebrates are an important information source for scientific research and educating biology students.

Captive Breeding of Rare Animals

The breeding of rare faunal species in Turkmenistan (sand gazelle, Caspian snowcock, black francolin, common pheasant, houbara bustard) has not progressed beyond certain experimental trials, which were conducted by the Turkmen Society of Nature Protection, higher education establishments and some zapovedniks. Since 2000 the Ministry of Nature Protection has decided to conduct planned research in this field in the zapovedniks.

6.5. Invasive Species Prevention

The responsibility for preventing the influx of alien species into Turkmenistan is divided between various authorities: Customs, Plant Quarantine Inspectorate, "Caspecocontrol" and others. Since invasive species may pose a threat to agriculture, the majority of these organisations are under the supervision of the Ministry of Agriculture. "Caspecocontrol" is the most important organisation acting in this sphere within the Ministry of Nature Protection and is responsible for the conservation of the Turkmen sector of the Caspian Sea. Moreover, the Ministry gives decisions on suggestions for introducing new varieties of flora and fauna to Turkmenistan.

6.6. Biodiversity Information Systems

The "Nature Chronicles" of the state zapovedniks, archives and reports of the Ministry of Nature Protection, the Institutes of the former Academy of Sciences and a

number of other institutions are the background sources of information on the status of biodiversity. In principle access to this information is not restricted, however in reality it is difficult to access because of technical reasons (lack of photocopiers, computer facilities, and etc.).

During decades of activity by the Academy of Sciences of Turkmenistan, higher education establishments and public conservation organisations, research data and generalisations on different aspects of the country's biodiversity have been published in a number of monographs and articles [80, 81]. Today two journal are published: "The problems of desert development" (in Russian) and "Science and Technology" (in Turkmen). The most significant publications of recent years are: "The National Report on the State of Environment" (1999), "Red Data Book of Turkmenistan" (1999), "Mammals of Turkmenistan" (1995) and a variety of project documents including the "Action Plan on the Conservation of Habitats of the Caspian Sea" (2001).

The situation is much worse in regard to internet access to information on biodiversity in Turkmenistan. Biodiversity data are spread out on the websites of several international organisations (for instance, Grid-Arendal, Turkmenistan UNDP office, WWF and others). This information was mainly created by public organisations (for instance the MAB Fauna of Turkmenistan database was designed by the TSNP). A number of documents have been hosted in an electronic edition of Ecostan News on the LEEP website, and on CaspInfo ISAR website. Most recently within the framework of CEP a website on biodiversity of the CRTC has been developed.

6.7. Education and Public Awareness

There are some special courses on botany and zoology in the higher educational establishments of Turkmenistan. This specialist knowledge is applied by experts in practice in the zapovedniks, forestry or in carrying out impact assessments on the exploitation of natural resources. At school level, environmental education programmes are either being developed or are already given as optional subjects. Environmental education of children is also carried out within the framework of school groups, summer ecological camps etc.

There is a special Department for Ecological Programme Coordination at the Ministry of Nature Protection, which is concerned with the dissemination of information in local and international news, seminars, and also handles environmental disasters. It publishes a monthly bulletin called "Tebigat habarlary" or "Nature news".

Recently businesses have shown a trend to involve the public and local communities in decisions, in particular "Dragon Oil" has held the first public environmental hearing in Turkmenistan, concerning an oil extraction project on the Caspian coast of Cheleken peninsula. Considerable efforts in education and public awareness are also conducted by public organisations (see Section 6.2).

6.8. Monitoring Systems

Each Ministry collects data on the status of biological resources under its responsibility: agriculture, forestry, fisheries, hunting, quarantine-epidemiological service etc. Some of these data are presented in the National Report on the State of the Environment. However, there is no specific system of biodiversity monitoring in Turkmenistan. Some elements of monitoring, particularly of desertification in certain regions of the country, do exist in the work conducted by the National Institute of Deserts, Fauna and Flora, and by some industrial organisations (Turkmengiprozem, Turkmengiprovodhoz and others).

Besides this a scientific-industrial Centre for Ecological Monitoring has been created at the Ministry of Nature Protection. It monitors air, water and soil pollution and also conducts background monitoring in Repetek zapovednik.

In the framework of the biodiversity assessment of Turkmenistan conducted by several generations of Turkmen scientists, taxonomic research on various groups of living organisms, species catalogues and identification keys, regional reports on soils, flora and fauna, and especially monographs on flora and fauna are of great value. Fundamental research on biodiversity, supplemented with the series of observations from the research stations of the institutes of the former Academy of Sciences, provide the scientific groundwork and methods for the monitoring of certain groups of organisms and types of ecosystems. At the same time one of the elements of functioning environmental monitoring systems is to track changes in biodiversity, reported in the "Nature Chronicles" of the zapovedniks.

A herbarium or museum specimen is also a scientific datum, which confirms the results of a previous biodiversity assessment and which enables changes in a species (e.g. its presence or absence) to be monitored. The annual population censuses of animal species are also scientific monitoring data.

In the framework of this programme of the scientific departments of the zapovedniks, the principles of repeated and fixed-point observations, choice of monitoring parameters, methods of data collection etc. have been standardized.

In particular, data from many years of monitoring allowed scientists in the past to identify unfavourable tendencies in some SPAs (in Hazar, Kopetdag and Badkhyz zapovedniks) and take measures to prevent them. Unfortunately monitoring results are not always analysed to produce recommendations of national or regional significance.

6.9. Incentive Systems

Incentive economic systems have proved their effectiveness throughout the world. Nevertheless such measures have not yet been developed and have therefore never been applied in Turkmenistan. For instance, the lack of such incentive systems was a problem during the reintroduction of the kulan. Farmers exterminated the animals because they were trampling the farmers' fields and causing crop damage.

To some extent the efforts of WWF to create a compensation scheme for livestock damage caused by leopard in the Sumbar valley of Garrygala etrap can be regarded as an *incentive* measure. In this case the initial capital provided by WWF enabled the creation of a self-recompensing mechanism of compensation, a flock of sheep, to replace any losses due to leopard suffered by individual livestock owners.

The Ministry of Nature Protection has signed a cooperation agreement with the Worldwide Fund for Nature (WWF) for the project "Conservation of Leopard in Turkmenistan" (1999-2002), part of which involves working out a compensation mechanism for the damage caused by leopard to domestic livestock belonging to the local people of the Sumbar valley in Garrygala etrap. Within the framework of the project an "insurance flock" of 200 head of domestic livestock (sheep) has been formed. It is planned to increase this flock more than 3-4 times over the next year. The decision to form the compensation fund, taken in November 2000, for damage caused by leopard was supported by the district hyakim and the association of cattle owners of the Sumbar valley in Garrygala etrap.

Work supported by the ISAR Fund serves as another pilot example of reducing anthropogenic impact on mountain pastures. This was achieved through providing local people with the seeds and technology for growing new highly productive legume forage crops. Such an approach will encourage the population to switch from pasturing to stabling livestock.

* * *

Thus there is some successful experience in Turkmenistan in the development of incentive systems of biodiversity conservation. Thus existing programmes for the conservation of national biodiversity both *in situ* and *ex situ* (scientific research, monitoring, the network of SPAs, incentive systems, Botanical Garden, Gene Pool Centres) are able to ensure protection both of its major components and the environment in general. Many of Turkmenistan's natural ecosystems are in practically pristine condition and can serve as models of natural ecosystems and processes. Public awareness activities and the creation of databases, combined with a broad partnership interaction with educational institutions, will help find positive solutions to the problems of biodiversity conservation.

7. LEGISLATION AND POLICY

7.1. Legal Grounds for Biodiversity Conservation

Legal measures are of key significance in biodiversity conservation. In Turkmenistan they consist of particular provisions of the general legislation, together with specific legislation on nature protection covering all aspects of the interaction between society, individuals, legal entities and nature. Since independence in 1991 the nature protection laws have been improved in accordance with the new sovereign status of the country. The 1992 Constitution defines the legal system. In the Criminal Code (Environmental Crimes) the responsibility for environmental crimes is defined. The relevant articles are contained in the Administrative Offence Code (1984).

The main provisions of state policy and the practical implementation of nature protection are defined by the Laws of Turkmenistan: "On Nature Protection" (1991), "On Protection and Rational Use of Flora" (1983); "On Protection and Rational Use of Fauna" (1997). The Forest (1993) and Sanitary (1992) Codes of Turkmenistan were also adopted and act as independent laws governing biodiversity conservation.

The Law of Turkmenistan "On Property" grants the State exclusive ownership of "forest and water resources, …protected or specially used nature areas, objects of historic and cultural heritage of Turkmenistan". The Law of Turkmenistan "On De-nationalisation and Privatisation of Property in Turkmenistan" (1992) imposes limitations on the list of objects subject to de-nationalisation and privatisation. International conventions relating to biodiversity conservation are part of the national legal system. Existing laws in the field of biodiversity conservation and sustainable use can be considered relatively well developed, and in accordance with the legislation of Turkmenistan the State bears the full and exclusive responsibility for environmental protection and thus, biodiversity conservation [50, 59].

7.2. Legislation on Protected Areas

The protected areas legislation of Turkmenistan provides thorough legal protection of biological diversity, but laws are not always well implemented and enforced. There are some gaps and contradictions that require targeted work and reform to bring national legislation into line with the CBD.

Unlike in many other CIS countries, the zapovedniks of Turkmenistan are exempt from land tax. However it should be noted that the notion of a "national park", which has been widely adopted in international conservation, is not represented in the nature protection legislation of

Turkmenistan, although Repetek zapovednik was awarded the status of "Biosphere Reserve" in 1979 under the MAB programme of UNESCO.

7.3. Legislation on Biosafety

The Cartagena Protocol on Biosafety is one of the documents specifying the implementation of the CBD.

National Legislation contains the Law "Concerning State Specially Protected Natural Areas" (1992) and the following associated standard provisions, which fix the status and regime of zapovedniks and other protected areas: "Standard Provision for State Reserves / Zapovedniks of Turkmenistan" (15/12/1995); "Standard Provision for the State Sanctuaries / Zakazniks of Turkmenistan" (15/12/1995); "Standard Provision for the Conservation Zones of the State Zapovedniks of Turkmenistan" (15/12/1995); "Standard Provision for the State Natural Monuments of Turkmenistan" (15/12/1995); "Standard Provision for State Nurseries of Rare and Threatened Floral and Faunal Species of Turkmenistan" (15/12/1995); "Provision on Hunting and Hunting Regulations" (15/12/1995); "Provision on the State Fund for Nature Protection of Turkmenistan" (1996); "Provision on the Red Data Book of Turkmenistan" (25/03/1997)"; and "Provision on the Protection of Fish Stocks and Regulation of Fisheries in Territorial and Inland Waters of Turkmenistan" (20/03/1998). A package of in-house documents and taxes for calculation of penalties for damages, etc. is also a part of the national legislative system.

The State Commission of the Ministry of Nature Protection for ensuring implementation of the commitments of Turkmenistan under the UN Environment Conventions and Programmes applied on 20/12/2000 to the Cabinet of Ministers of Turkmenistan with a proposal to adhere to the Protocol. At the present time this document is being prepared for ratification by Turkmenistan's Mejlis.

7.4. Legislation on Access and Benefit Sharing

Specific laws on access and benefit sharing with regard to biological and genetic resources have not been developed in Turkmenistan.

7.5. Legislation on Environmental Impacts and Liability

Since Turkmenistan's independence it has been legally enshrined that natural resources of the country are national property. Their protection and sustainable use is part of government policy.

The environmental legislation consists of the following Laws: "On Nature Protection of Turkmenistan" (1991); "On the Interior of the Earth" (1992); "On Foreign Investments" (1992); "Sanitary Code" (1992); "On Foreign Concessions" (1993); "On State Ecological Expertise" (1995); "On Atmospheric Air Protection" (1996); "On Hydrocarbon Resources" (1996); "On Hyakimliks (Local Authority Bodies)" (1997).

Given that in the near future most of Turkmenistan will be subject to intense anthropogenic pressures on the environment, national standards on Environmental Impact Assessment (EIA) have been adopted (2000) by the President. In 2002 the National Environmental Action Plan (NEAP) will be approved. Moreover a number of Decrees based on existing Laws, which are aimed at environmental improvement, have been adopted. Their means of implementation are realised in the "National Report on the State of Environment" (1999).

The park and forest zone around Ashgabat

Presidential Decrees: "În the development of horticulture and tree planting in Turkmenistan" (9/11/1992); "On measures for the protection of wild-growing liquorice, poisonous snakes and derived products" (5/08/1992); "On the creation of a park zone in the foothills of Kopetdag" (22/07/1998); "On the development of the park zone in the foothills of Kopetdag" (10/10/1998); "On the complex activity of planting trees in the green belt around Ashgabat under the motto Geok Gushak" (26/08/1999); "On measures to further improve the state of the environment and creation of favourable climatic conditions" (10/10/2000).

7.6. Harmonisation of Environmental Legislation

Harmonisation of environmental legislation implies two processes. Firstly, it involves the harmonisation of national and international laws, namely bringing national legislation into line with international treaties and agreements, ensuring that international legislation has primacy over national law. Secondly, it involves the harmonisation of national laws. In this case it requires consistency of the national laws in related areas (rationalisation of land, water and nature protection laws with tax and economic laws etc.). Existing laws are in general adequate for the modern situation, however it is necessary to strengthen certain existing laws and reform weak ones. What is important is that the laws should be brought into line with international commitments to biodiversity conservation undertaken by Turkmenistan after the signing and ratification of various international Conventions. This is confirmed by the Law "To introduce changes and additions to some legal texts of Turkmenistan" (1999).

In order to co-ordinate the activity of Ministers and departments in the implementation of Turkmenistan's commitments arising from Conventions and UN Programmes on the Environment, a State inter-ministerial committee was established in 1999 according to Presidential Decree. This Commission co-ordinates the activity of all work groups, and controls the development of the National Environmental Action Plan (NEAP). The NEAP is a permanent planning document covering environmental protection and envisages concrete activities in the improvement of environmental management and sustainable use of natural

resources.It is an essential part of the Presidential Programme "Strategy of socio-economic reforms in Turkmenistan for the period till 2010". A special working group on the problem of biodiversity conservation was created under the framework of the NEAP.

7.7. International Conventions and Legislation

Turkmenistan always sets great store by participation in international conventions, implementation of universally recognised norms and principles of international law in the field of environmental protection. The Mejlis of Turkmenistan was one of the first to ratify the international Convention on Biological Diversity on June 18, 1996.

> Turkmenistan's actions under the CBD will strengthen its existing commitments under other international conventions, including the "World Heritage Convention" (26/09/1994), Basle Convention "On the control of transboundary transportation of hazardous wastes and their elimination" (18/06/1996); "Convention to combat desertification" (18/06/1996); Aarhus Convention "On access to information and public involvement in the process of decision making and access to justice on environmental issues" (30/04/1999).

Turkmenistan has joined various international conservation agreements and become a part of the Framework Convention on Climate Change, Vienna Convention and Montreal Protocol on ozone-depleting substances. In 1979 Repetek zapovednik was awarded the status of a Biosphere Reserve. Ministry of Nature Protection officers have also submitted nominations for three sites (Syunt-Hasardag, Badkhyz and Kugitang zapovedniks) to the Secretariat of the World Heritage Committee for possible inclusion into the World Heritage List of UNESCO.

Before the collapse of the Soviet Union the central part of Hazar zapovednik on the south-eastern coast of the Caspian (north Cheleken, Turkmenbashy, Balhan and Mihailovski bays) was designated as a Ramsar site (a wetland of international significance as waterfowl habitat) under the Ramsar Convention. In practice this status has now been lost since Turkmenistan has not ratified the Ramsar Convention. In this particular case Turkmenistan can automatically inherit this right or use according to the international law "tabula rasa" which translated from the Latin means "clean board".

Turkmenistan has not joined the Bonn Convention on Migratory Species (CMS) or the Washington Convention on International Trade in Endangered Species (CITES), but implements the latter's requirements.

* * *

On the whole, the basic prerequisites for the harmonisation of national legislation and international conservation conventions in Turkmenistan are in place. The existing legislation in the field of conservation and sustainable use of biodiversity can be considered relatively well developed, especially with regard to SPAs, which constitute an established system of legal protection of biological diversity.

8. THREATS TO BIODIVERSITY

Loss of habitats as a result of industrial and agricultural development is the main cause of declining biodiversity. Pollution, introduction of non-native species, and over-consumption (overgrazing, tree felling and poaching) are among the threats. There are also threats from natural events, in particular climate change, sea level fluctuations, and natural disasters.

8.1. Habitat Loss and Degradation

Loss of habitat is the most common reason for reduction in biodiversity. This happens both as a result of human activities (such as ploughing up soils, changing the hydrological regime, overgrazing, tree felling, the construction of roads and mining activities) or natural events (such as fluctuations in the level of the Caspian Sea and natural climate change). In the case of natural events, the extent of human activity in neighbouring areas greatly affects the conservation of wildlife populations (Fig.8.1).

Historically, agriculture developed in the river valleys, which led to a considerable reduction of tugai habitats along the Amudarya River, the Murgab and its tributaries, and other small rivers. It should be noted that if anthropogenic pressures are removed, tugai communities are very good at re-establishing themselves. However, the effects of losing whole groups of species, particularly larger animals, cannot be reversed. In spite of the fact that the majority of tugais in Turkmenistan are protected, some animals such as the Turan tiger and scaly-bellied green woodpecker are now extinct, and it is impossible to imagine how impoverished the invertebrate fauna has become. The recovery of Bukhara deer is proceeding with great difficulty.

The expansion of cultivation is always accompanied by the loss of natural landscapes. Though in Turkmenistan, the lack of water is a restraining factor when ploughing up virgin soils, an inefficient system of irrigation influences the preservation of landscapes. Given their large size, the threat to desert ecosystems is not generally great, though some specific rare and endemic species or communities may be lost.

A peculiar situation exists in the foothills of the Kopetdag. This is one of the major agriculture regions of the country. At present more than half of the country's mineral resources are extracted here and used in the production of construction materials. The dominant activity is exploitation and use of raw mineral materials (for instance, gravel-sand mixtures and loam). Their production is characterised by the loss of one of the fundamental requirements for biodiversity – the soil.

The foothill plain of the Kopetdag is 10-50 km in width and 600 km in length and lies at the junction of two landscapes, mountain and desert. It is one of the biggest oases in Central Asia. It is characterised by favourable conditions for humans, diverse natural resources (soil,

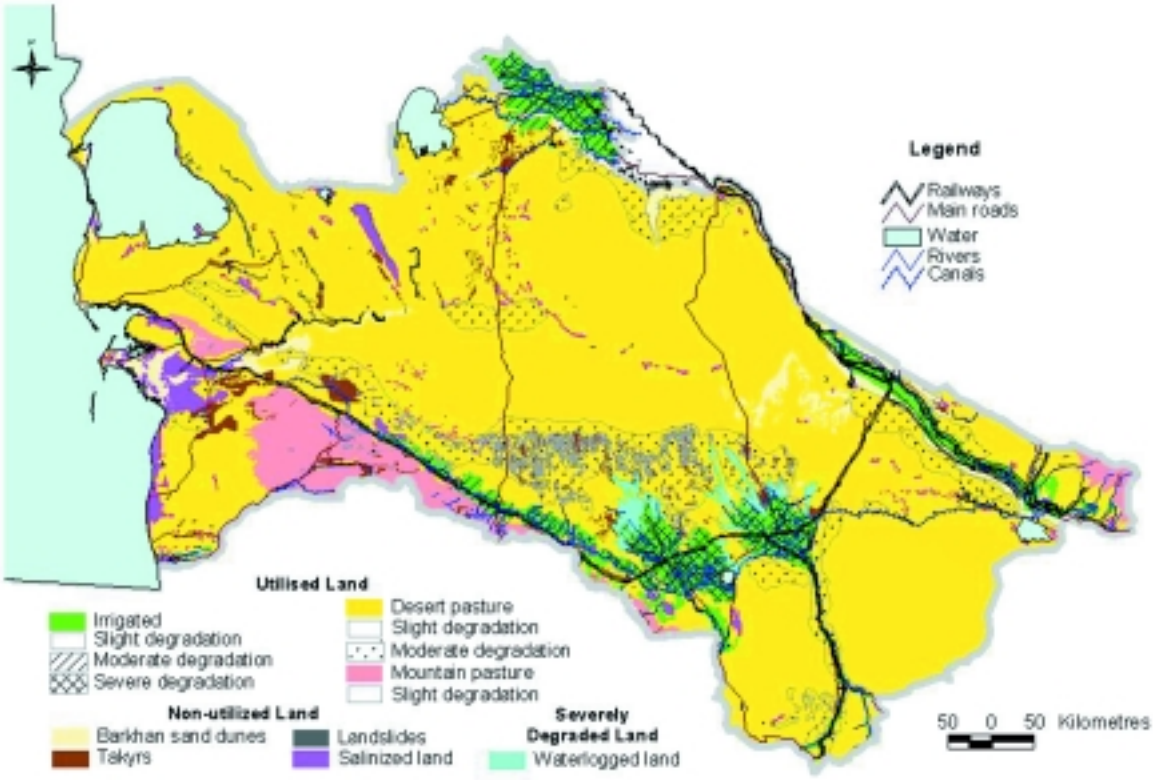


Fig.8.1. Degradation of lands (map)

water) and unique biological diversity. All these together play an important role in the economic and social life not only of the region but the whole country. Due to its geographic position and natural peculiarities, the foothill plain, covering 132,100 km² (26.9%) of the country, is the most densely populated part of Turkmenistan. Population growth here is higher than in other regions of the country. There is considerable industrial and agricultural development, as well as social infrastructure and mining.

There are more than 40 mining and processing enterprises, plants and factories based on worked mineral deposits. The region produces 100% of the country's cement, asbestos cement and window glass production, 70% of non-metallic material production, 65% of lightweight clay aggregate, 60% of prefabricated reinforced concrete, over 50% of lime, and 40% of walling materials. In other words the region represents the main zone for the extraction of mineral resources and production of materials for the construction industry of Turkmenistan.

Prospects for the development of irrigated agriculture in Turkmenistan focus on the foothills of the Kopetdag. Currently, 29.5% of all cultivated land lies in this region. However, because of the topography, this area is under considerable threat from erosion. In the mountains competition occurs between wild animals and domestic cattle for the use of pasture and watering points. In the current prolonged drought conditions the number of domestic livestock should be regulated.

8.2. Pollution

The economy of Turkmenistan is unusual. There is no heavy industry based around metals or manufacturing. The economy is based upon the extraction and processing of hydrocarbons, the production of construction materials, energy production and agriculture. A major part of the population is concentrated in big cities. Therefore there are many areas of "unused" land. These peculiarities affect the character of waste accumulation and the disposal of pollutants.

The main sources of pollution are extraction and processing of hydrocarbons, the chemical industry, agriculture, energy production, transport, and household wastes. The most important elements are considered below.

8.2.1. Pollution through Oil Extraction

The major oil-extraction region is in western Turkmenistan, where both on-land and marine extraction is undertaken. Major pollution sources include the drilling equipment associated with bore-holes, leakage and emergency discharges, as well as discharge of oil waste.

> In the near future the "Dragon Oil" company is planning to modernize and increase facilities for oil extraction in the Caspian Sea. According to generally accepted oil industry figures, for each million tonnes of extracted oil 131.4 tonnes are lost. The planned expansion of oil extraction near Cheleken will produce 4 million tonnes of oil and it is expected that more than 500 tonnes of crude oil will leak into the sea, and the total amount of leakage for the whole western coast will be 5,000 tonnes. It should be mentioned that before the planned modernization, "Dragon Oil" first held a public enquiry in Turkmenistan involving NGOs and local communities.

Lesser threats come from oil production and transportation. It should be noted that to a certain extent the Caspian Sea biota is adapted to high levels of hydrocarbons, because of natural hydrocarbon sources in the sea such as mud volcanoes.

Besides the oil, an underestimated risk comes from the associated water. As a rule, after water and oil separation, the remaining water is poured out into so-called "evaporation ponds" which are natural depressions (usually takyrs and salt pans, less commonly inter-dunal depressions). These accompanying waters have a high level of salinity (100 g/l and above) and as well as evaporating slowly, percolate into soils and mix with underground waters. As for liquid wastes, considerable amounts are produced not only in the gas and oil enterprises, but also in the extraction of iodine and bromine (which produces highly concentrated brines).

A Turkmenistan national plan on oil spill control and clean-up exists, approved by the President (21/08/2001). There are also some subjective factors that need to be mentioned: the low degree of preparedness of the state authorities to react to serious damage or accidents; and a lack of projects directly connected with the elimination of pollution (while there are numerous projects aimed at educating the population).

8.2.2. Pollution through the Extraction of Solid Natural Resources

The mining industry of Turkmenistan is mainly focused on the extraction of construction materials. The chemical industry and related enterprises for extraction of sulphur, salts, iodine-bromine, brines and so on are less well developed.

There are a number of mining companies in Turkmenistan which produce large amounts of waste during their operations. Solid wastes are produced at Gaurdak sulphur plant (dumps of

> The Gaurdak Sulphur Plant, even after suspension of its operations, is in a "leading" position in the field of pollution. There are nearly 350 million tonnes of waste (dumps of crushed rocks, poor quality ore and tailings). Areas that are now occupied by dumps were once used by local people for pasture. However, dumps and quarries have practically completely changed the natural relief of the Gaurdak plateau. Of most concern are the 3.5 million tonnes of poor quality ore and tailings that have a sulphur content of 12% and 3.5% respectively.

split rocks, poor quality ore and tailings), Turkmenbashi quarry (remains from rock crushing), Turkmenbashi Construction Materials Enterprise (waste from dressing stones), and Byuzmein Production Association of Construction Materials (remains from crushing stones at the Archabil (Firuza) Stone Crushing plant).

However until now there has not been a system of assessing the amount of such waste, both industrial and household. Only those industrial wastes used as secondary raw materials are accounted for. The amount of such waste in Turkmenistan is measured in hundreds of thousand of tonnes. These figures cannot compare to the huge volumes of waste accumulated in the Gaurdak Sulphur Plant alone.

8.2.3. Agricultural Pollution

There are two key problems, salinity and pesticides. Salinity can impact agriculture itself, causing falling yields, and can lead to the abandonment of agricultural areas. Besides that, salinity creates a situation where more and more lands are required for cultivation because of salty soils and thus the area available for wild biodiversity decreases.

A more complicated problem is pesticide pollution. The low availability of agricultural equipment means that weeds and pests have to be combated by using various pesticides on a widespread scale. These accumulate in soils and drainage waters and later get into the food of people and animals. As the majority of them dissolve in fat they consistently accumulate in the food chain. It should be mentioned though that compared with many European countries, pesticides and artificial fertilisers are used sparingly.

8.2.4. Household Wastes

As mentioned above the large amount of "unused" land creates an illusion of an easy solution to the problem of waste disposal. In the majority of cities there are systems of disinfecting sewage that eventually drains into the desert. Solid wastes are accumulated in dumps. In recent times the condition of sewage drainage has not changed much, with the exception of those population centres where the infrastructure was flooded or destroyed when the Caspian Sea level increased. However, the situation for solid wastes has changed qualitatively and quantitatively. This first of all is connected with the appearance of numerous products in disposable packages made of chlorine organic polymer materials. The old system of waste disposal is unable to process such materials. The dumps started to expand very rapidly, and at the same time local authorities had to decrease payment fees for waste transportation in order to get rid of non-regulated dumps. It should be mentioned that there is some experience in Turkmenistan of creating a system of biological processing of waste (vermiculture) to produce natural fertilisers.

The problem of **transboundary transportation** of pollutants is of limited significance in Turkmenistan. The biggest concern is discharge of drainage waters from Khorezm oasis in Uzbekistan into Turkmenistan. In addition to direct transboundary pollution, drainage systems are over-used causing flooding and increased salinity on adjacent lands. For both countries, the discharge of irrigation wastewater and untreated sewage into the Amudarya River is also a potential problem.

Transboundary pollution in the Caspian Sea has not been considered seriously until now, though the wastes of the oil-industry and agricultural and industrial pollutants from the Volga and Kura reach the coast of all Caspian states. If one considers the giant oil refineries, and the proposed oil pipe-line with a 50 million tonnes/year capacity, then the potential risk of transboundary pollution in the Caspian Sea is potentially very high - and is set to increase in the future.

8.3. Invasive Species

In recent years in Turkmenistan research has focused on the issue of introducing species, in particular fish. These introductions had a good scientific base and did not threaten biodiversity. A series of species have increased the biological productivity in ponds (e.g. the grass carp *Ctenopharyngodon idella,* bighead carp *Aristichthys nobilis*, and silver carp *Hypophthalmichthys molitrix*), and in marine fisheries (e.g. the golden grey mullet) [51]. However, with the introduced species came associated species and parasites (for example, an unwanted fish, the northern or Amur snakehead *Channa argus* accompanied live fish).

The threat from non-native species in agriculture is well understood, but the threat to biodiversity remains underestimated. In particular, in the Caspian Sea alone there are up to 50 non-native exotics, including species which in the past have devastated the Black and Azov Seas. The problem of non-native species has not previously been considered one of the more serious threats to the Caspian biota; however analysis of the actual indirect data puts this problem at the top of the list of threats.

According to data from the State Fishery Committee of Turkmenistan, in recent years the sprat catch was stable at 6,000 to 9,000 tonnes, but in 2000 it dropped dramatically. The production of one Turkmen fishing vessel is now six tonnes per day instead of 20-25 tonnes per day. As sprat fishing is undertaken by all Caspian countries in the same areas (following the migration of sprat shoals (*Clupeonella engrauliformis* and *C. grimmi*) neighbouring countries have experienced similar declines. Such considerable reduction in catches cannot be explained by the deterioration of fishing equipment and nets.

Mnemiopsis leidyi appeared for the first time in the Azov Sea (part of the Black Sea) ten years ago. Apparently it was brought in with ballast water in ships arriving from the coast of North America. *Mnemiopsis leidyi* is an invertebrate similar to a jellyfish, but smaller in size. It feeds on plankton and removes practically all organic substances from the sea surface. Nowadays *Mnemiopsis leidyi* has expanded throughout the Black and Azov Seas. In 1989 up to 160,000 tonnes of sprats were caught in the Azov Sea whereas in 2000 only 6,000 tonnes were caught. Damage caused by *Mnemiopsis leidyi* in the Black and Azov Seas is estimated in to have cost US $350 million. In the Caspian Sea its impact will be even more dramatic.

At the same time information on the invasion of the jellyfish *Mnemiopsis leidyi* into the Caspian Sea has become available. Based on data from the Caspian Fisheries Research Institute (CaspNIRH), *Mnemiopsis leidyi* was first seen in the Caspian Sea in the autumn of 1999. It is difficult to know when *Mnemiopsis leidyi* actually got into the Caspian Sea for the first time, because there have been no special research expeditions in the Turkmen and Azerbaijan sectors in recent years. It is only known that by July 2000 this species was already present in large numbers and was seen in the south and mid Caspian. By autumn 2000 it had invaded the northern Caspian. Judging by the fragmentary information available the amount of *Mnemiopsis leidyi* fluctuates dramatically. Thus, in June 2000 Turkmen specialists observed a huge concentration of *Mnemiopsis leidyi* at Avaza, but in August it was not seen there.

8.4. Over-Consumption

Over-grazing. Statistical data reveal that the number of domestic animals in Turkmenistan does not exceed acceptable stocking levels. However, in some areas (in places where the population is concentrated in mountain or desert regions around waterpoints) large numbers of domestic animals can damage fragile arid ecosystems and lead to local desertification and degradation of natural ecosystems.

Poaching. Illegal hunting and fishing are the most important threats to large mammals and many bird and fish species.

Illegal felling. This has been sharply reduced by gasification schemes in rural areas. In tugai forests the most dangerous impact is from clearing for liquorice plantations.

Non-compliance with protective regulations. This covers a wide range of activities, including illegal grazing of livestock, forage harvesting [32], hunting, collection of berries and nuts, tourism, and extraction of natural resources in protected areas.

8.5. Climate Change

The problem of climate change is closely associated with desertification and deterioration in the living conditions of the population, and is one of the most important threats to biodiversity. The main reason for climate change is considered to be an increase in the level of greenhouse gases (particularly CO_2) in the atmosphere. The major source of CO_2 in the atmosphere is from the burning of fossil fuels in the developed countries of the world.

Meteorological observations in Turkmenistan over many years reveal that since the 1960s winters have become warmer by 0.2 - 0.8°C, and average annual temperatures have increased by 0.1 - 0.2°C. The amount of rainfall has decreased slightly; at the same time water levels in the country's main rivers have been falling. The negative balance between moisture and warmth causes a decrease in the moisture supply for plants and the degradation of pasture over huge areas of the country.

The existing models of climate change forecast that a 100% increase in CO_2 in the atmosphere will cause a warming of 4 - 8°C with a simultaneous decrease in rainfall over practically the whole country, especially in spring. The predicted climate change will therefore have the following negative consequences:

1. Increase in the number of days with very high temperatures, causing depression of plant growth;
2. Increase in water required for irrigation by 40-65%;
3. Reduction of rain-fed agriculture;
4. Deterioration of pasture;
5. More frequent mountain landslides.

The south-western Kopetdag, where severe drought has been experienced over a period of several years, may be used as an example. Changes in humidity have caused a re-distribution of pasture and extensive loss of water catchments. As a result of over-grazing some dominant plants have started to disappear and the ability of soils to retain moisture during rainy periods has been reduced. The severity of flooding and landslides has increased, the flow of springs has decreased, and more fires have occurred.

8.6. Natural Disasters

Natural phenomena may also have an impact on biodiversity. In some cases this impact may be catastrophic. The most obvious example is **natural tectonic activity** on a global level, which is accompanied by volcanic mudflows and oil discharges.

Besides this, as a result of earthquakes pipeline leakages might occur.

Droughts. As the main watercourses of Turkmenistan originate outside its borders and flow into the country, it is unlikely that the moisture debt can be recovered. In connection with this there will be a need to use more intensive agricultural methods (drip-irrigation systems, subsoil irrigation and others).

Sometimes volcanic mudflows along the coast of the Caspian Sea cause pollution of the water basin with oil and the destruction of birds and fish. Such phenomena have also been observed offshore on the Gryazny Vulkan and Gubkin banks. According to "Caspecocontrol" data, after the recent strong earthquake in western Turkmenistan, in some areas the hydrocarbon content of seawater had increased. In general though it can be stated that volcanic mudflows have decreased due to the exploration of oil deposits.

In the oil-bearing areas of Turkmenistan, the appearance of islands and active mud volcanoes has been repeatedly registered (the last time an island was seen on Livanov's bank was in 1960, and the last eruption was registered on June 12, 1982). On the Cheleken peninsula the last noticeable eruption happened in 1992-1993, when flows of mud covered the highway.

8.7. Natural Pathogens

Diseases. In spite of the generally rather high level of wildlife research in Turkmenistan, the effects of wild plant and animal diseases remain little understood (for example, the mass mortality of the Caspian seal in 2000). More or less regular observations are conducted on rodents at the anti-plague station. Existing research efforts in the sphere of parasitology (of rodents, reptiles, etc.) are uncoordinated and do not give a complete picture. The importance of this factor may be significant when combined with other factors such as habitat loss, reduction of available food supply and pollution. Thus, according to ECOTOX, the main reason for the destruction of 10% of the Caspian seal population in 2000 was a *morbillovirus* (a disease which affects carnivores). However, compared with habitat loss, it does not seem that disease is an important factor threatening the existence of wildlife populations.

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For the time being, the loss of habitat, overconsumption (over-grazing, poaching, illegal felling, etc.) and in some instances proliferation of invasive species are the main threats to the biodiversity of Turkmenistan.

9. PROBLEM ANALYSIS

9.1. Socio-Economic Context

A number of favourable natural and socio-economic features are unique to Turkmenistan: a large geographical area, warm climate that means low power consumption, rich natural resources, relatively high level of education of the population, and an absence of social unrest and frontier conflicts. Under Soviet rule, Turkmenistan's economy was integrated into the Soviet Union's system of division of labour and had a monopolistic industry based on the production of raw commodities. As a result insufficient attention was given to the development of local potential and resources for the domestic market. After Turkmenistan gained independence, the Government mainly directed its efforts towards overcoming these tendencies. In the process of the transformation of the economy and society Turkmenistan has managed to avoid dramatic falls in industrial output, a reduction of income and rising unemployment.

In comparison with other regions Turkmenistan has a relatively small population. The characteristic feature of the labour force is its high level of education – almost one third of the population has a specialised secondary or high education.

Turkmenistan is rich in natural resources and is an exporter of energy (natural gas, oil products and electricity). With the reconstruction of the oil and gas industries, the export of crude oil has been overtaken by export of its products (e.g. petrol, kerosene, oil, and diesel fuel).

Turkmenistan possesses a high agricultural potential. Efficient market reforms and land privatisation are being implemented in this sector. Since independence the specialisation in monoculture crops such as cotton has been removed and cereal production has been developed at a rapid pace, resulting in the attainment of self-sufficiency in food. The lack of irrigation water is a restraint on extending agriculture development and stimulates the further intensification of farming and efficient use of water.

Desert monitor lizard or varan (*Varanus griseus*)

Turkmenistan has a well-developed transport system and communications network. Its favourable setting at the junction of north-south and east-west trade routes allows it easy access to regional and world markets.

Floodplain of the Amudarya River

The huge resources of intellectual and industrial potential create real possibilities for radical reforms and modernisation of Turkmenistan's economy, through attracting foreign investment and integration into the world community. Moreover they favour and encourage the conservation and rational use of the nation's heritage – the biological diversity of the country.

9.2. Human Pressure on the Environment

The development of the economy is impossible without the use of natural resources. They can be divided into exhaustible (for instance, mineral resources) and renewable (soil, biological resources and others). However, improper use may cause the degradation even of renewable resources.

In Turkmenistan human activity is irregular in character: agricultural production is concentrated in oasis areas and industry mainly within urbanised areas. This peculiarity has both positive and negative benefits. On the one hand, the concentration of industry in a restricted area makes it possible to preserve vast areas for wildlife, on the other hand, fragile arid ecosystems can be destroyed if they fail to withstand the accumulating pressures. Therefore the objective of the transitional economic period is to lay the foundation for the sustainable development of the country whilst preserving the available natural potential, initially through strengthening the use of mineral and other resources in a renewable way.

9.3. Key Sectors Affecting Biodiversity

Agriculture. The production of the main crops and cattle have increased in recent years in both output and financial terms. Meanwhile the amount of water used for irrigation has decreased by 10% - a positive change. It should be noted that owing to economic reasons, consumption of agrochemicals (fertilisers, herbicides, and insecticides) has decreased. The problem of recycling irrigation drainage waters is gradually being solved.

Oil and gas sector. During recent years, oil production has noticeably increased due largely to the intensive development of existing oil fields rather than the development of new ones. Activities that have begun on the Caspian Sea shelf are properly conducted and

accompanied by the necessary precautionary measures against accidental oil spills. At the same time processed oil products are becoming more important in the export market. The high cost of these products not only increases Turkmenistan's income from oil production, but also increases the need to prevent oil spills. Emissions of pollutants by the oil and gas industry are being reduced. The problem of associated wastewater, which is one of the causes of degradation of the general environment, and mortality of birds near oil and gas plants, remains unsolved.

The chemical industry is now experiencing a noticeable decline, connected both with the difficulties of the transitional economic period and the loss of traditional trade ties and downturn in the demand for chemical products. At the same time the industry's potential and its ability to attract investments remain high. Among other projects, the construction of ammoniac and carbide plants in the cities of Mary, Turkmenabat and Tejen, a pulp-and-paper mill in the city of Shatlyk, a soda ash producing plant in Govurdak, and three iodine plants is planned. These products are saleable in the world market; there are also qualified specialists, experience and infrastructure in the country. It is necessary to give more attention to the environmental aspects of developments, both while reconstructing existing industries and when planning new ones.

The sectors engaged in the direct legal use of biological resources (fishery, hunting and fur trade, collection of medicinal plants) at present only slightly affect biodiversity, while the scale of illegal use of biological resources (poaching, and other activities) poses a greater danger.

9.4. Key Threats to Biodiversity

Reduction / loss of habitat is the most common cause of biodiversity loss. However, the large area of sparsely developed land in Turkmenistan provides habitats for many different species of flora and fauna.

Pollution causes the reduction of biodiversity on the local as well as on the regional level. The main sources of pollution are the extraction and processing of hydrocarbons, the chemical industry, agriculture, electricity generation and household waste. The most hazardous pollution is connected with oil production, processing and transportation. According to standard world figures, on average 131.4 tonnes of oil are lost per million tonnes extracted. Moreover, there is always a risk of major accidents in which the scale of losses will be much higher. Oil pollution of the Caspian Sea is a transboundary problem that requires emergency measures on an international level.

Non-native species have not previously been considered as a serious threat to the biodiversity of Turkmenistan. However, this factor has been proved to be important. Unfortunately methods to combat non-native species have not been developed and the existing systems of control cannot be relied upon to stop their spread within Turkmenistan. It should be noted that the problem of non-native species has hitherto been considered with regard to their negative impacts on agriculture rather than biodiversity.

Overexploitation of biological resources is also one of the most serious problems for biodiversity conservation. The legal system of Turkmenistan prohibits, in principle, the consumption of biological resources above sustainable limits. These limits are exceeded as a result of illegal activities such as poaching and wood-cutting, which underlines the need to strengthen and improve the capacity of the organisations working in nature protection. This problem is also of a transboundary character; in particular, the biodiversity of the Turkmen sector of the Caspian Sea suffers from the poaching of sturgeons in the northern Caspian and the estuaries of the Volga and Ural Rivers.

9.5. Underlying Causes of Biodiversity Loss

There are some instances where the reduction of the population of a wildlife species (particularly localised or endemic species) has taken place on a comparatively small scale as a result of anthropogenic activities (for example, the grass *Aethionema kopetdaghi* during reconstruction of the Goudan highway, and the spotted toad-headed agama lizard as a result of the discharge of drainage waters onto the Ulyshor saltmarsh). In all these instances the key problem was that planners and project executors were unaware of these species. Lessons like these highlight the necessity for more detailed analysis of planned projects at the EIA stage, development of geographic information systems, wide dissemination of information on the value of biodiversity conservation, and an improvement in environmental education.

9.6. Current Constraints on Biodiversity Conservation

In spite of progress in the field of nature protection in Turkmenistan, biodiversity conservation faces some difficulties, the overcoming of which will considerably improve the situation. There is insufficient understanding in the field of nature management of the role of biodiversity as a basis of sustainable development. In particular, nature conservation issues are not fully incorporated into prospective plans for industrial development. Methods of evaluating the economic significance of natural resources have still not been developed. This leads to their underestimation. Soviet economic methods caused sufficient imbalances in ecosystems in some regions that many species were brought to the edge of extinction in the former Soviet Union and were registered in the Red Data Books of Turkmenistan.

Oxus cobra (*Naja naja* ssp. *oxiana*)

Among the major threats to species diversity there are: destruction and degradation of habitats, overexploitation of natural populations of animals and plants and, in some cases, the introduction of non-native species. As a result of man's impacts therefore, a direct reduction in the populations of key species has been observed, leading to an unacceptably high probability of the occasional extinction of a species or population [32].

In the field of nature protection there are also a number of factors that reduce the efficiency of current activities. The SPA system in Turkmenistan is primarily aimed at conserving objects and areas; at present there is a lack of a number of criteria accepted in foreign practice that allow for the combining of protective, cultural-educational and recreational functions. In Turkmenistan, no national parks have been established and appropriate laws have not been developed. An adequate nature protection system at comparatively low cost could be established by means of connecting existing SPAs through a system of *green corridors*. At the moment this function is partly performed by river valleys, coastline, tracts of native forest and bush and other elements of the natural landscape that are not specially protected.

The legal basis for *interaction* between SPAs and adjoining areas, and limitations on some kinds of activities during wildlife breeding and migrating seasons is incomplete.

The specialist training system for biodiversity conservation has not been effective. A reduction in staffing of scientific departments has led to a decrease in the quality of monitoring, and weakened their role as scientific research organisations. The poor *research and development facilities* of zapovedniks (a shortage of transport, lack of computers and modern communication facilities) hinders the compilation of data sets and efficient data exchange. It should be noted that the lack of scientifically-grounded, cheap and reliable *indicators* of biodiversity influences the quality of monitoring. In addition, emergency measures should be taken to improve public awareness of environmental issues.

Thus, though the existing system of SPAs in Turkmenistan does not fully and representatively cover all biogeographic regions, this is not currently the major problem. It is more important in the coming years to establish an integrated multifunctional system (protected areas network) to include mutually complementary SPAs and different forms of economic activity.

9.7. Current Opportunities for Biodiversity Conservation

The declaration of Turkmenistan's independence, and the country's integration into the world economy, provided a true incentive for the improvement of the people's well being and for solving ecological problems. Environmental protection is now considered an integral part of economic reform. The social and economic policy of the state is based on the principles of harmonisation of industry and the environment and awareness of the severity of the ecological problems the country faces. On the whole, the general status of biodiversity can be considered relatively satisfactory: the major elements of the flora and fauna of all terrestrial landscape zones of the country and freshwater and marine ecosystems have been preserved.

At the moment the environmental security of all citizens is guaranteed by the Constitution of Turkmenistan. Legislation on nature protection is based on the generally accepted principle of rational use of natural resources. According to the Constitution, land, water, wild animals, plants and other natural resources are a part of the national heritage and come under the protection of the state. Turkmenistan has joined most of the main international nature protection conventions and meets its commitments under them.

There is a developed environmental legislation and nature protection infrastructure that includes, *inter alia*, a network of SPAs. The total area of SPAs of Turkmenistan comprises 4.2% of the country's total area, which considerably exceeds that of other countries in the region. Through the coverage of biogeographic regions, the SPA network of Turkmenistan is one of the most representative throughout the CIS [14]. This is also supported by the high intellectual potential of conservation science in the country. In order to increase the effectiveness of conservation in the zapovedniks it is necessary given the new socio-economic conditions, firstly to set priorities, and secondly to introduce new regulations guiding scientific research activity. In order to organise a rational interaction between man and nature based on a precise knowledge of natural processes and human society, it is necessary to gradually convert the zapovedniks to system-defined ecological monitoring, which will permit an increase in species and *ecosystem biodiversity*, and the monitoring of natural processes and changes of an anthropogenic character. *System-defined ecological monitoring* can be a concrete instrument contributing to the economic stability of the country.

The Turkmenistan Government devotes considerable resources to nature protection. Funds directed for social programmes also contribute positively to biodiversity conservation. In particular, the connection of remote villages to the national gas pipeline system promotes the conservation and restoration of forests. Mutual understanding between the government and interna-

tional organisations and financial institutions (UNDP, UNEP, World Bank and others) means that the State's efforts in this sphere will be supported by foreign investment. A considerable part of the population of Turkmenistan is well aware of the importance of nature protection and takes an active role in the realisation of ecological initiatives and activities. The traditional outlook of the people living in the country plays a significant role as well. Public organisations (NGOs) provide the link between government authorities, the population and the international conservation community.

Turkmenistan's considerable efforts so far in the field of biodiversity conservation have been based almost entirely on the requirements of the Convention on Biological Diversity (identification and monitoring; *in situ* and *ex situ* conservation; sustainable use of components of biological diversity; incentive measures; research and training of specialists; public education and awareness; data exchange; technical-scientific co-operation and others). In addition in Turkmenistan the process of creating a unified informational network about the environment has already started. Some legal reforms and policy changes are nonetheless required to bring Turkmenistan into closer harmonisation with the CBD.

OVERALL CONCLUSION

In summary the main considerations for the development of a National Biodiversity Strategy and Action Plan (BSAP) for biodiversity conservation are:

- In general, there are sufficient data on biological diversity though some special investigations for the identification of trends and their causes are required;
- Priority requirements for protection have been defined (rare species and natural ecosystems);
- The origin of natural and anthropogenic factors and the character of their impacts on biological diversity have been identified;
- The causes (both natural and anthropogenic in character) of the poor state of protected areas have been considered;
- There is a well-developed system of SPAs, which should be preserved, maintained and augmented in accordance with IUCN provisions;
- There is some experience in the development of economic mechanisms and public awareness to promote biodiversity conservation;
- Turkmenistan has a successful record of international co-operation in the field of environmental protection and biodiversity conservation, and state policy is to promote further international collaboration.

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GLOSSARY

Anadromous – (of fishes and other aquatic organisms) living part of the life cycle in freshwater and part in saltwater;

Anthropogenic – produced or dependent on man's activity;

Archa – juniper tree species belonging to the genus *Juniperus*;

Avifauna – population of birds of a given area;

Badland – area of broken ground, useless for agriculture;

Barkhan – crescent-shaped sand dune [15];

Benthos – organisms living on the bed of a water body (e.g. lake, river etc.);

Biodiversity or biological diversity - the variability of living organisms from all sources including terrestrial, marine and other water ecosystems and ecological complexes which they are a part of; this notion includes the diversity within a species, between species and the diversity of ecosystems [40];

Biological resources - the genetic resources, organisms or their parts, populations or any other biotic components of ecosystems, which have actual or potential utility and value for man;

Biosphere reserve - a protected area that meets the requirements of the UNESCO MAB Programme and has an appropriate international certificate [26];

Biotechnology - any kind of technology related to the use of biological systems, living organisms or their derivatives;

BSAP / NBSAP - (National) Biodiversity Strategy and Action Plan;

CBD - Convention on Biological Diversity;

Caspecocontrol – Caspian Ecological Control Administration, a branch of the Ministry of Nature Protection which undertakes state control of the aquatic and atmospheric resources of the Caspian Sea;

CEP - Caspian Environmental Programme;

CIS – Commonwealth of Independent States i.e. the countries that comprised the former Soviet Union with the exception of Latvia, Lithuania and Estonia;

CITES - Convention on International Trade in Endangered Species of Wild Fauna and Flora;

CRTC – Caspian Regional Thematic Centre;

CS - Country Study;

Dominant - a species quantitatively prevailing in the community;

Ecosystem – a dynamic complex of flora, fauna and micro-organisms, together with their physical environment;

ECOTOX – Ecotoxicology Project of the CEP;

EIA – environmental impact assessment;

Endemic – restricted to a particular localised distribution;

ESCAPO - Economic and Social Commission for Asia and the Pacific Ocean;

Etrap – administrative territorial / political division corresponding to a district**;**

Exotic – alien, not native to a given area;

***Ex-situ* conservation -** the conservation of biodiversity outside its natural habitat;

Fauna – animals;

FAO - Food and Agricultural Organisation of the United Nations;

Flora – plants;

GEF – Global Environment Facility**;**

Gene pool – an assemblage of genetic material of different species, types, varieties, breeds etc.;

Habitat – the area or place in which an organism lives;

Herpetofauna – amphibians and reptiles**;**

Hyakim – head of an administrative body, mayor;

Ichthyofauna – fish;

***In-situ* conservation -** the conservation of ecosystems and natural habitats as well as the maintenance and restoration of viable species populations in their natural environment;

Introduction – deliberate or accidental transfer of individuals of a species to a new area**;**

IUCN – World Conservation Union (still known by the acronym of its former name, the International Union for the Conservation of Nature and Natural Resources);

ISAR - Initiative for Social Action and Renewal;

"Geok Gushak" – a public limited company (Geok Gushak = Green Belt) which plants trees;

Kyariz – underground gallery of wells;

Kyr ridges – alternating ridges in stone, clay, and sand deserts with one steep slope and one shallow slope;

LEEP - Law and Environment Eurasia Partnership;

MAB – "Man and the Biosphere" Programme of UNESCO;

Manat - unit of currency of Turkmenistan;

Mariculture – cultivation of algae, molluscs, fish or other aquatic organisms in seas, lagoons, etc.;

Mejlis – Council of Deputies (= parliament of Turkmenistan);

Monoculture – cultivation of a single species;

National park – a protected area that combines protective and recreational functions and takes into consideration the interests of the population living in the vicinity [12,26];

Natural monuments – natural objects or sites of aesthetic, educational, and historical value, which are designated without expropriation of land, the responsibility for their conservation being fixed on their owner / user [26];

NEAP – National Environmental Action Plan;

NGO – Non-Governmental ("public") Organisation;

Plankton – aquatic micro-organisms;

Protected area – geographically delimited zone, which is allotted, regulated and used for nature conservation;

Relict – a species that was formerly widespread and has now been preserved in a restricted area;

Saxaul – woody plants of the genus *Haloxylon*: White saxaul = *Haloxylon persicum*; Black saxaul = *Haloxylon aphyllum*;

SEU – Socio-Ecological Union;

SIA – State Industrial Association;

Specially protected area (SPA) - a territorial form of nature protection that excludes, or strictly regulates all forms of direct use of natural resources, and provides opportunities for conservation and restoration of different forms of biodiversity [26];

Sustainable use – exploitation of components of biological diversity in a way that maintains them in the long-term, thus preserving their capacity to cover the needs of present and future generations and to meet their expectations;

TACIS - Technical Assistance to the CIS;

Takyr – a clay desert**;**

Taxon – a group of evolutionarily-related organisms, for example a genus, a species or a sub-species;

Tugai – densely vegetated thickets and woodlands along river valleys in arid regions, consisting of various poplars, thorny shrubs and reeds [15];

"Turkmendermansenagat" – an association that produces medical drugs;

"Turkmenmallary" – an association for livestock breeding;

TSHF - Turkmenistan Society of Hunters and Fishermen;

TSNP - Turkmen Society for Nature Protection;

UNDP – United Nations Development Programme;

UNEP - United Nations Environment Programme;

UNESCO - United Nations Educational, Scientific and Cultural Organisation;

Velayat – an administrative unit corresponding to a region / province;

WWF - Worldwide Fund for Nature (still known by the acronym of its former name, World Wildlife Fund);

Zakaznik - a state conservation area, a type of protected area permitting certain forms of direct use of natural resources under strict regulation, providing they do not conflict with the main purpose of nature conservation (= a sanctuary) [26];

Zapovednik – a strict nature reserve, a strictly protected area in which no human activities are allowed, created to preserve biological processes and ecosystems [26].

Appendix 1.

VERTEBRATES OF KEY IMPORTANCE
(National and Regional Endemics)

English common name	Scientific name	Distribution
Class Cyclostomata (Lampreys)		
Caspian lamprey	*Caspiomyzon wagneri*	Caspian Sea basin
Class Pisces (Fish)		
Small Amu-Dar shovelnose sturgeon	*Pseudoscaphirhynchus hermanni*	Amudarya basin
Large Amu-Dar (or false) shovelnose sturgeon	*Pseudoscaphirhynchus kaufmanni*	Amudarya basin
Anchovy sprat	*Clupeonella engrauliformis*	Caspian Sea basin
Southern Caspian sprat	*Clupeonella grimmi*	Caspian Sea basin
Caspian sea trout	*Salmo trutta caspicus*	Caspian Sea basin
Beloribitsa	*Stenodus leucichthys leucichthys*	Caspian Sea basin
Striped bystranka	*Alburnoides taeniatus*	Aral Sea basin
Pike asp	*Aspiolucius esocinus*	Aral Sea basin
Asp ssp.	*Aspius aspius iblioides*	Aral Sea basin
Aral barbel	*Barbus brachycephalus brachycephalus*	Aral Sea basin
Bulatmai barbel ssp.	*Barbus capito conocephalus*	Aral Sea basin
Transcaucasian barb ssp.	*Capoeta capoeta gracilis*	Caspian Sea basin
Sharpray ssp.	*Capoetobrama kuschakewitschi kuschakewitschi*	Aral Sea basin
Danube bleak ssp.	*Chalcalburnus chalcoides aralensis*	Aral Sea basin
Ide	*Leuciscus idus oxianus*	Aral Sea basin
Roach ssp.	*Rutilus rutilus aralensis*	Aral Sea basin
* Roach ssp.	*Rutilus rutilus uzboicus*	Turkmenistan
Transcaspian marinka	*Schizothorax pelzami*	Turkmenistan, Afghanistan, Iran
Golden-spined loach ssp.	*Sabanejewia aurata aralensis*	Aral Sea basin
Bukhara stone loach	*Nemacheilus amudarjensis amudarjensis*	Aral Sea basin
Khorezm loach	*Nemacheilus amudarjensis choresmi*	Aral Sea basin
Turkmenian crested loach	*Nemacheilus cristata*	Turkmenistan, Iran, Afghanistan
Gray loach	*Nemacheilus dorsalis*	Aral Sea basin
Amudarya stone loach	*Nemacheilus oxianus*	Aral Sea basin
Turkmenian loach	*Nemacheilus sargadensis turcmenicus*	Turkmenistan, Iran, Afghanistan
* Blind cave loach sp.	*Nemacheilus starostini*	Turkmenistan
Southern ninespine stickleback ssp.	*Pungitius platygaster aralensis*	Aral Sea basin
Tadpole-goby sp.	*Anatirostrum profundorum*	Caspian Sea basin
Class Reptilia (Reptiles)		
Steppe tortoise	*Agrionemys horsfieldi*	Turkmenistan, Iran, Kazakhstan, Uzbekistan, Tadjikistan, Kyrgyzstan
*European pond turtle ssp.	*Emys orbicularis orientalis*	Turkmenistan
Gecko sp.	*Eublepharis turcmenicus*	Turkmenistan, northen Iran
Straight-fingered gecko sp.	*Alsophylax laevis*	Turkmenistan, Uzbekistan
* Straight-fingered gecko sp.	*Alsophylax loricatus szczerbaki*	Turkmenistan
Rock gecko sp.	*Cyrtopodion turcmenicus*	Turkmenistan, Afghanistan
Rock gecko sp.	*Cyrtopodion spinicauda*	Turkmenistan, Iran
*Yellow-bellied skink ssp.	*Eumeces taeniolatus parthianicus*	Turkmenistan
*Skink ssp.	*Mabuya aurata affinis*	Turkmenistan

English common name	Scientific name	Distribution
*Caucasian agama ssp.	*Laudakia* (*Agama*) *caucasica triannulatus*	Turkmenistan
*Agama lizard ssp.	*Laudakia* (*Agama*) *erythrogastra nurgeldievi*	Turkmenistan
*Agama lizard ssp.	*Phrynocephalus rossikowi shammakowi*	Turkmenistan
* Agama lizard ssp.	*Phrynocephalus guttatus salsatus*	Turkmenistan
* Agama lizard ssp.	*Phrynocephalus reticulatus bannikovi*	Turkmenistan
Agama lizard sp.	*Phrynocephalus raddei*	Turkmenistan, Uzbekistan Tadjikistan
Legless skink (sand swimmer sp.)	*Ophiomorus chernovi*	Turkmenistan, Iran
Race-runner or fringe-toed gecko sp.	*Eremias persica*	Turkmenistan, Iran
Race-runner or fringe-toed gecko sp.	*Eremias regeli*	Tadjikistan, Turkmenistan, Uzbekistan, Afghanistan
Race-runner or fringe-toed gecko sp.	*Eremias lineolata*	Turkmenistan, Uzbekistan, Kazakhstan, Tadjikistan, Iran
Lizard sp.	*Lacerta defilippii*	Turkmenistan, Northen Iran
Elegant sand boa	*Eryx elegans*	Turkmenistan, Iran
Russian sand boa ssp.	*Eryx miliaris speciosus*	Turkmenistan, Kazakhstan, Uzbekistan, Tadjikistan, Iran, Afghanistan
* Oriental rat snake ssp.	*Ptyas mucosus nigricens*	Turkmenistan
Cat snake	*Telescopus rhynopoma*	Turkmenistan, Iran
Oxus cobra	*Naja naja oxiana* (= *Naja oxiana*)	Turkmenistan, Uzbekistan, Iran, Tadjikistan, Afghanistan
Class Aves (Birds)		
Caspian snowcock ssp.	*Tetraogallus caspius caspius*	Turkmenistan, Iran
Chukar partridge ssp.	*Alectoris chukar shestoperovi*	Turkmenistan, Iran
Common pheasant ssp.	*Phasianus colchicus persicus*	Turkmenistan, Iran
Murgab River pheasant	*Phasianus colchicus principalis*	Turkmenistan, Afghanistan
Common pheasant ssp.	*Phasianus colchicus zarudnyi*	Turkmenistan, Uzbekistan
Common pheasant ssp.	*Phasianus colchicus chrysomelas*	Turkmenistan, Uzbekistan
Wood pigeon ssp.	*Columba palumbus iranica*	Turkmenistan, Iran
Northern eagle-owl ssp.	*Bubo bubo omissus*	Turkmenistan. Uzbekistan
Desert lark ssp.	*Ammomanes deserti parvirostris*	Turkmenistan, Kazakhstan
Pander's ground jay ssp.	*Podoces panderi panderi*	Turkmenistan, Uzbekistan, Kazakhstan
Northern wren ssp.	*Troglodytes troglodytes subpallidus*	Turkmenistan, Iran
Chifchaff ssp.	*Phylloscopus collybita menzbieri*	Turkmenistan, Iran
Coal tit ssp.	*Parus ater chorassanicus*	Turkmenistan, Iran
Turkestan tit ssp.	*Parus bokharensis* (*cinereus*) *intermedius*	Turkmenistan, Iran
Greater rock nuthatch ssp.	*Sitta tephronota iranica*	Turkmenistan, Iran
House sparrow ssp.	*Passer domesticus hyrcanus*	Turkmenistan, Iran
Desert sparrow ssp.	*Passer simplex* ssp.*zarudnyi*	Turkmenistan, Uzbekistan
Chaffinch ssp.	*Fringilla coelebs* ssp. *transcaspius*	Turkmenistan, Iran
White-winged grosbeak ssp.	*Mycerobas carnipes speculigerus*	Turkmenistan, Iran
Class Mammalia (Mammals)		
Horseshoe bat sp.	*Rhinolophus bocharicus*	Turkmenistan, Uzbekistan, Afghanistan
* Natterer's bat ssp.	*Myotis nattereri tschuliensis*	Turkmenistan
Geoffroy's bat ssp.	*Myotis emarginatus desertorum*	Turkmenistan, Iran, Afghanistan
Long-clawed ground squirrel	*Spermophilopsis leptodactylus*	Turkmenistan, Kazakhstan, Uzbekistan, Iran, Afghanistan

English common name	Scientific name	Distribution
Mouse-like or Asiatic dormouse	*Myomimus personatus*	Turkmenistan, northen Iran
Severtzov's jerboa	*Allactaga severtzovi*	Turkmenistan,Kazakhstan, Uzbekistan, Tadjikistan
Jerboa sp.	*Allactodipus bobrinskii*	Turkmenistan, Kazakhstan, Uzbekistan
Comb-toed jerboa	*Paradipus ctenodactylus*	Turkmenistan, Uzbekistan
*Jerboa ssp.	*Jaculus blanfordi margianus*	Turkmenistan
Jerboa sp.	*Eremodipus lichtensteini*	Turkmenistan, Kazakhstan, Uzbekistan
Mouse-like hamster	*Calomyscus mystax*	Turkmenistan, Iran
Zarudny's jird or gerbil	*Meriones zarudnyi*	Turkmenistan, Iran, Afghanistan
Caspian seal	*Phoca* (= *Pusa*) *caspica*	Caspian Sea basin
Bukhara deer	*Cervus elaphus bactrianus*	Turkmenistan, Uzbekistan, Tadjikistan
Turkmen wild goat	*Capra aegagrus turcmenicus*	Turkmenistan, Iran
Afghan urial	*Ovis orientalis* (=*vignei*) ssp. *cycloceros*	Turkmenistan, Uzbekistan
Bukhara urial	*O. o. bochariensis*	Turkmenistan, Uzbekistan, Tadjikistan
Transcaspian urial	*O. o. arcal*	Turkmenistan, Kazakhstan, Uzbekistan
Piebald or sand shrew	*Diplomesodon pulchellum*	Turkmenistan, Uzbekistan, Kazakhstan, pre-Caspian part of Russia

NOTE: Taxa marked with * are found only in Turkmenistan

Appendix 2.

WILD RELATIVES OF CULTIVATED PLANTS

Family	**Genera (no. of species)**
Poaceae (24 genera, 49 species)	*Aegilops* (7), *Agropyron* (5), *Agrostis* (1), *Alopecurus* (2), *Arrhenatherum* (1), *Arundo* (1), *Avena* (3), *Bromopsis* (3), *Dactylis* (1) *Digitaria* (1), *Echinochloa* (2), *Eleusine* (1), *Festuca* (2), *Hordeum* (3) *Leymus* (1), *Lolium* (2), *Panicum* (1), *Phalaroides* (1), *Poa* (4), **Psathyrostachys* (1), *Saccharum* (1), *Secale* (2), *Setaria* (2), *Sorghum* (1)
Alliaceae	*Allium* (11)
Asparagaceae	*Asparagus* (1)
Juglandaceae	*Juglans* (1)
Celtidaceae	*Celtis* (1)
Moraceae (2 genera, 5 species)	*Ficus* (3), *Morus* (2)
Cannabaceae	*Cannabis* (1)
Polygonaceae	*Rumex* (2)
Chenopodiaceae (3 genera, 4 species)	*Beta* (2), *Kochia* (1), *Spinacia* (1)
Portulacaceae	*Portulaca* (1)
Berberidaceae	*Berberis* (2)
Brassicaceae (6 genera, 7 species)	*Brassica* (2), *Ñrambe* (1), *Eruca* (1), *Erucastrum* (1), *Lepidium* (1), *Sinapis* (1)
Grossulariaceae	**Ribes* (1)
Rosaceae (10 genera, 26 species)	*Amygdalus* (6), *Cerasus* (4), *Crataegus* (1), *Cydonia* (1), *Malus* (1), ***Mespillis* (1), *Prunus* (3), *Pyrus* (4), *Rubus* (3), *Sorbus* (2)
Fabaceae (10 genera, 31)	*Lathyrus* (6), *Lens* (1), *Lotus* (1), **Medicago* (5), *Melilotus* (4), **Onobrychis* (1), *Pisum* (1), *Trifolium* (4), **Trigonella* (1), *Vicia* (7)
Peganaceae	*Malacocarpus* (1)
Anacardiaceae	*Pistacia* (1)
Rhamnaceae	*Ziziphus* (1)
Vitaceae	*Vitis* (2)
Malvaceae (2 genera, 2 species)	*Abutilon* (1), *Hibiscus* (1)
Elaeagnaceae	*Elaeagnus* (3)
Punicaceae	*Punica* (1)
Apiaceae (8 genera, 8 species)	*Anethum* (1), *Apium* (1), **Carum* (1), *Coriandrum* (1), *Daucus* (1), *Foeniculum* (1), *Pimpinella* (1), *Trachyspermum* (1)
Ebenaceae	*Diospyros* (1)
Lamiaceae (2 genera, 2 species)	*Lallemantia* (1), *Ocimum* (1)
Solanaceae	****Mandragora* (1)
Cucurbitaceae (2 genera, 2 species)	*Citrullus* (1), *Melo* (1)
Asteraceae (3 genera, 4 species)	*Narthamus* (2), *Cichorium* (1), *Lactuca* (1)
Total:	**28 families, 89 genera, 172 species**

Key: * - only known from one location; ** - extinct; *** - endangered.

Appendix 3.

THREATENED FLORA AND FAUNA
Plants and animals listed in the Red Data Books of Turkmenistan and the IUCN Red Lists

№ п/п	Taxon	English common name	Red Data Book category	
			Turkmen	IUCN
		Flora (IUCN, 1998)		
**	*Ophioglossum vulgatum*	Adder's-tongue	I*	-
**	*Anogramma leptophylla*	Jersey fern	I*	-
**	*Asplenium adianthum- nigrum*	Black spleenwort	I*	-
1	*Eremurus kopetdaghensis*	-	I*	I
2	*Fritillaria raddeana*	Crown imperial sp.	II	I
3	*Tulipa hoogiana*	Tulip sp.	II	EN
4	*Tulipa kuschkensis*	Tulip sp.	II	EN
5	*Tulipa ingens*	Tulip sp.	II	I
6	*Tulipa wilsoniana*	Tulip sp.	II	VU
**	*Tulipa botschantzevae*	Tulip sp.	I*	-
7	*Hyacinthus transcaspicus*	Hyacinth sp.	I*	I
8	*Allium transvestiens*	Leek sp.	I*	LR
9	*Allium eugenii*	Leek sp.	II	I
10	*Ungernia spiralis*	-	I*	I
11	*Ungernia victoris*	-	II	I
12	**Iris ewbankiana*	Iris sp.	-	I
**	*Eulophia turkestanica*	Orchid sp.	I*	-
13	**Orchis fedtschenkoi*	Orchid sp.	-	I
**	*Epipactis turcomanica*	Helleborine sp.	I*	-
**	*Listera ovata*	Twayblade sp.	I*	-
**	*Juglans regia*	Walnut	I*	-
**	*Calligonum triste*	-	I*	-
14	**Polygonum arianum*	Knotgrass sp.	-	I
**	*Salsola iljinii*	Saltwort sp.	I*	-
15	*Salsola chiwensis*	Saltwort sp.	III	EN
16	**Allochrusa gypsophiloides*	Soap root	-	I
**	*Corydalis kamelinii*	-	I*	-
17	*Prionotrichon gaudanense*	-	III	I
**	*Homalodiscus ochradeni*	-	I*	-
**	*Ribes melananthum*	Currant sp.	I*	-
**	*Sorbus graeca*	Greek ash	I*	-
**	*Sorbus turkestanica*	Ash / rowan sp.	I*	-
**	*Pyrus turcomanica*	Pear sp.	I*	-
**	*Malus sieversii* ssp. *turkmenorum*	Apple sp.	I*	-
18	**Cerasus blinovskii*	Wild cherry sp.	-	I
19	*Colutea atabaevii*	Bladder senna sp.	II	I
20	**Astragalus arianus*	-	-	Ex
21	**Euphorbia sclerocyathium*	-	-	LR
**	*Pistacia badghysi*	Pistachio sp.	I*	-
**	*Alcea karakalensis*	Kara-Kala Rod Rose	I*	-
**	*Reaumuria botschantzevii*	-	I*	-
22	**Reaumuria badhysi*	-	-	LR
23	**Frankenia pulverulenta*	-	-	VU

№ п/п	Taxon	English common name	Red Data Book category	
			Turkmen	IUCN
24	**Ferula turcomanica*	Giant fennel sp.	-	I
**	*Mandragora turcomanica*	Turkmen mandrake	I*	-
25	*Atropa komarovii*	Nightshade sp.	I*	I
26	*Lepidolopha fedtschenkoana*	-	III	I
**	*Cousinia tscherneviae*	Thistle sp.	I*	-
27	*Cousinia badhysi*	Thistle sp.	-	I
28	*Centaurea androssovii*	Knapweed sp.	I*	LR
	Fauna (IUCN, 2000)			
Insecta - Insects				
**	*Catocola lesbia*	Moth sp.	I*	-
**	*Taragama faina*	Moth sp.	I*	-
29	*Chalepoxenus zabelini*	Ant sp.	-	VU
30	*Saga pedo*	Grasshopper sp.	II	VU
Pisces - Fish				
31	** Acipenser gueldenstaedtii*	Russian sturgeon	-	EN
32	*Acipenser nudiventris*	Spiny sturgeon	I*	EN
33	** Acipenser persicus*	Persian sturgeon	-	VU
34	** Acipenser stellatus*	Stellate or star sturgeon	-	VU
35	** Huso huso*	Beluga	-	EN
36	** Sabanejewia* (*Cobitis*) *aurata*	Golden-spined loach	-	DD
37	*Pseudoscaphirhynchus kaufmanni*	Large Amu-Dar (or false) shovelnose sturgeon	II	EN
38	*Pseudoscaphirhynchus hermanni*	Small Amu-Dar shovelnose sturgeon	I*	CR
39	** Stenodus leucichthys*	Beloribitsa	III	EN
40	** Aspiolucius esocinus*	Pike asp	II	VU
41	** Aspius aspius*	Asp	-	DD
42	** Cyprinus carpio*	Common carp	-	DD
43	*Nemacheilus starostini*	Blind cave loach sp.	III	VU
Reptilia – Reptiles				
44	** Testudo* (*Agrionemys*) *horsfieldi*	Steppe tortoise	-	VU
45	** Emys orbicularis*	European pond turtle	-	LR
**	*Phrynocephalus maculatus*	Spotted toad-headed agama	I*	-
**	*Alsophylax laevis*	Straight-fingered gecko sp.	I*	-
46	*Naja naja oxiana*	Oxus cobra	II	DD
Aves – Birds				
47	*Pelecanus crispus*	Dalmatian pelican	III	LR
48	** Phalacrocorax pygmeus*	Pygmy cormorant	-	LR
49	*Anser erythropus*	Lesser white-fronted goose	IV	VU
50	** Branta ruficollis*	Red-breasted goose	-	VU
51	** Aythya nyroca*	Ferruginous duck	-	LR
52	*Oxyura leucocephala*	White-headed duck	II	EN
53	*Marmaronetta* (= *Anas*) *angustirostris*	Marbled teal	I*	VU
54	** Gallinago media*	Great snipe	-	LR
55	** Crex crex*	Corncrake	-	VU
56	*Vanellus gregarius*	Sociable plover	III	VU
57	** Columba eversmanni*	Eastern stock dove	-	VU
58	*Grus leucogeranus*	Siberian white crane	I*	CR
59	*Chlamydotis undulata*	Houbara bustard	I*	LR

№ п/п	Taxon	English common name	Red Data Book category	
			Turkmen	IUCN
60	*Otis tarda*	Great bustard	I*	VU
61	*Tetrax tetrax*	Little bustard	II	LR
62	*Picus squamatus*	Scaly-bellied green woodpecker	I*	EX
63	*Aegypius monachus*	Black or cinereous vulture	III	LR
64	* *Circus macrourus*	Pallid harrier	-	LR
65	* *Aquila clanga*	Greater spotted eagle	-	VU
66	*Aquila heliaca*	Imperial eagle	II	VU
67	*Falco naumanni*	Lesser kestrel	III	VU
68	*Haliaeetus leucoryphus*	Pallas' sea eagle	II	VU
69	* *Haliaeetus albicilla*	Grey or white-tailed sea eagle	-	LR
Mammalia - Mammals				
70	*Rhinolophus blasii*	Blasius' horseshoe bat	II	LR
71	*Rhinolophus euryale*	Mediterranean horseshoe bat	III	VU
72	* *Rhinolophus ferrumequinum*	Greater horseshoe bat	-	LR
73	*Rhinolophus hipposideros*	Lesser horseshoe bat	III	VU
74	*Myotis emarginatus*	Geoffroy's bat	III	VU
75	* *Dryomys nitedula*	Forest or tree dormouse	-	LR
76	* *Glis glis*	Edible dormouse	-	LR
77	*Myomimus personatus*	Mouse-like or Asiatic dormouse	III	VU
78	*Calomyscus mystax*	Mouse-like hamster	III	LR
79	*Meriones zarudnyi*	Zarudny's jird or gerbil	III	EN
80	*Capra falconeri heptneri*	Tadjik markhor	I*	CR
81	*Capra aegagrus turcmenicus*	Turkmen wild goat	II	VU
82	*Equus hemionus kulan* (*E. h. onager*)	Kulan	II	EN
83	*Ursus arctos*	Brown bear	I*	VU
84	*Hyaena hyaena*	Striped hyaena	I*	LR
**	*Lynx lynx*	European lynx	I*	-
85	*Panthera pardus saxicolor (P. p. ciscaucasica*)	North Persian leopard	I*	EN
86	* *P. tigris*	Tiger	-	EN
87	*Cervus elaphus bactrianus*	Bukhara deer	I*	VU
88	*Gazella subgutturosa*	Sand gazelle	II	LR
89	*Lutra lutra*	Eursian otter	II	VU
90	*Ovis orientalis arcal*	Transcaspian urial	II	VU
91	*O. o. bocharensis*	Bukhara urial	II	EN
92	*O. o. cycloceros*	Afghan urial	II	VU
93	* *Phoca caspica*	Caspian seal	-.	VU
94	*Saiga tatarica tatarica*	Saiga	II	LR
95	*Vulpes cana*	Blanford's fox	IV	DD
96	* *V. corsac*	Corsac fox	-	DD
97	*Otocolobus* (*Felis*) *manul ferrugineus*	Pallas' or steppe cat	III	LR
98	* *Acinonyx jubatus venaticus*	Asiatic cheetah	-	VU

Key: numbered taxa are listed by IUCN (1998; 2000) for Turkmenistan; taxa marked by "**" are plants listed in the Red Data Book of Turkmenistan (1999), but not by IUCN. Taxa marked by "*" are taxa listed by IUCN, but not included in the Red Data Book of Turkmenistan (1999).

Turkmenistan Red Data Book categories: I – extinct or endangered species (marked by "*"), II - declining, III – rare, and IV – data deficient.

IUCN Red List Categories (2000): EX - extinct, CR – critically endangered, EN – endangered, VU - vulnerable, LR – taxon of lower risk, DD – data deficient, NE – not evaluated; I (Indeterminate) – not defined.

Appendix 4.

STOCKS AND EXTENT OF USE OF ECONOMICALLY IMPORTANT PLANTS

Plant name		Plantations of industrial significance	Annual stock	Essential oil content
Taxon	English common name			
MEDICINAL PLANTS				
Glycyrrhiza glabra	Liqourice	Flood plains of the Amudarya and Karagum Rivers (Chaskak)	6-8,000 tonnes	-
Peganum harmala	Syrian rue	Sayvan-Desht; countrywide in overgrazed pastures	50 tonnes	-
Anabasis aphylla	-	Ustyurt, Near-Caspian deserts, Kyurendag, total area - 2 - 2,500 ha	300 kg/ha	-
Astragalus turkmenorum, *A. pulvinatus*	-	* Central Kopetdag	Over 50 tonnes	-
Artemisia badhysi	Wormwood sp.	Darvaza mountain range	Over 300 tonnes of raw material from 1,000 ha	-
Salsola richteri	Saltwort sp.	Northwestern Kopetdag; Reserves are unlimited	About 10 tonnes	-
Psoralea drupacea	Scurf pea sp.	Badhyz, Kugitang, Kopetdag; Total area - 20,000 ha	500-1,100 kg/ha	-
Rosa canina and others (total 14 species)	Dog rose (and others)	Mountain regions	2 tonnes/year	-
Ferula gummosa	Giant fennel sp.	Arvaza part of Baharden Forest, 250 ha	20 tonnes/year of surface and 70 tonnes/year of subsurface mass	-
ESSENTIAL-OIL PLANTS				
Artemisia balchanorum	Wormwood sp. over 25,000 ha	Greater Balhan,	400-800 kg/ha	Con-side-rable
Perovskia abrotanoides	Caspian sage	Kopetdag, area not known	Reserves are considerable	0.47-0.77%
Juniperus turcomanica	Juniper sp.	Greater Balhan, Kopetdag, area unknown	Reserves are limited	Up to 2%
Achillea kermanica	-	Foothills, area unknown		Contains
Salvia sclarea	Clary	Kopetdag, area unknown	About 6,000 ha annually cultivated	Contains
Mentha longifolia	Horsemint or long-leafed mint	Mountain rivers valleys, by springs, area has not been defined	Not defined	0.3-1.0% (including 57.4% menthol)

Key: * = area of occurrence has not been defined

List of the most commonly used plants

1). ***Food plants***: Onions (*Allium*: 62 species); foxtail lily sp. (*Eremurus luteus*), *Rheum turkestanicum*; spinach sp. (*Spinacia turkestanica*); orache sp. (*Atriplex turcomanica*); common purslane (*Portulaca oleracea*); giant fennel sp. (*Ferula foetida*); walnut (*Juglans regia*); almond (*Amygdalus communis*); pistachio (*Pistacia vera*); pomegranate (*Punica granatum*); hawthorn sp. (*Crataegus pontica*); barberry sp. (*Berberis turcomanica*); common fig (*Ficus carica*); raspberry sp. (*Rubus anatolicus*); wild and cultivated grapes (*Vitis vinifera, V. sylvestris*); Oriental olive (*Elaeagnus orientalis*).

2). ***Dye plants***: dyers' madder (*Rubia tinctorum*); walnut (*Juglans regia*); foxtail lily sp. (*Eremurus olgae*); *Rheum turkestanicum*; barberry sp. (*Berberis turcomanica*); liqourice (*Glycyrrhiza glabra*); Syrian rue (*Peganum harmala*); pistachio (*Pistacia vera*); pomegranate (*Punica granatum*).

3). ***Plants from which chemicals are extracted****:* soap root (*Allochrusa gypsophiloides*), white saxaul (*Haloxylon persicum*) black saxaul (*H. aphyllum*), *Kalidium caspicum*, *Holostachys belangeriana*, jointed glasswort (*Halocnemum strobilaceum*), common glasswort (*Salicornia europaea*), *Anabasis salsa*, *Anabasis aphylla*, saltwort spp. (*Salsola richteri, S. arbuscula* and *S. dendroides*).

4). ***Poisonous plants*** can be used for the extermination of pests and production of toxins: *Anabasis* sp., *Holostachys belangeriana*, jointed glasswort (*Halocnemum strobilaceum*), walnut (*Juglans regia*), Chinese clematis (*Clematis orientalis*), chilli pepper (*Capsicum annuum*), *Colchicum luteum*; Syrian rue (*Peganum harmala*).

Appendix 5.

SPA CATEGORIES ACCORDING TO IUCN CLASSIFICATION (1994)

SPA categories as defined by IUCN		SPA area	
		Hectares	%
I	*Strict Nature Reserve / Wilderness Area*: protected area managed mainly for science or wilderness protection (= zapovedniks)	784,600	1.6
II	*National Park*: protected area managed mainly for ecosystem protection and recreation	0	0
III	*Natural Monument*: protected area managed mainly for conservation of specific natural features	2,300	0.005
IV	*Habitat / Species Management Area*: protected area managed mainly for conservation through management intervention (= zakaznik)	1,155,900	2.35
V	*Protected Landscape / Seascape*: protected area managed mainly for landscape / seascape conservation and recreation	35,400	0.07
VI	*Managed Resource Protected Area*: protected area managed mainly for sustainable use of natural ecosystems	0	0
	Total area:	**1,978,300**	**4.02**

Note: % refers to % of the total area of Turkmenistan

Appendix 6.

MAJOR ECOSYSTEMS PROTECTED IN ZAPOVEDNIKS

Zapovednik	Area (ha)	Desert	Mountain	Wetland	Coastal / Marine	Valley / tugai	Fresh water / Riverine
Repetek	34,600	34,600	-	-	-	-	-
Hazar	269,000	52,000	-	25,000	192,000	-	-
Badkhyz	144,700	94,000	39,000	-	-	12,000	-
Kopetdag	127,100	-	127,100	-	-	-	-
Syunt-Hasardag	30,300	5,150	23,900	-	-	1,200	-
Kaplankyr	1,103,800	900,000	-	-	-	-	203,600
Amudarya	152,500	39,800	-	-	-	4,200	108,500
Kugitang	116,300	-	116,300	-	-	-	-
Total	**1,978,300**	**1,125,500**	**306,300**	**25,000**	**192,000**	**17,400**	**312,100**
% of Total		***56.9***	***15.5***	***1.3***	***9.7***	***0.9***	***15.5***

Appendix 7.

LIST OF CONTRIBUTORS TO THE COUNTRY STUDY DISCUSSIONS

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MASS MEDIA

Pasevyev I.R.	"Neytralny Turkmenistan" newspaper

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