

## 1.4. Biodiversity Conservation and Management

At present, nearly 70% of the population actively cultivates and uses biodiversity components or habitats. This results in decline of soil productivity, pasture and forest productivity, and worsening of living conditions of the people.

The biodiversity conservation at the population-species and ecosystem levels is the basis for ensuring environment sustainability:

- The population-species approach makes it possible to preserve species and its genetic resources, closely related to populations.
- The ecosystem approach considers biological diversity in association with living conditions and accommodation to environment, and promotes more sustainable conservation of communities of various living organisms in different natural-geographic conditions.

Basing on approaches of biodiversity conservation considers species, biocoenoses, ecosystems, many domestic species, cultivated plants, agroecosystems, and genetically modified organisms in the light of particular botanico-geographical and zoogeographical zones. The possibility of biodiversity conservation concludes in:

- Providing conservation of rich and unique biodiversity in natural habitats (*in-situ*), protection and sustainable use of various species of agrobiodiversity by local people, conservation of collection materials, as well as development of active long-term measures.
- Conserving biodiversity at the level of organisms, which carry the inherited information on properties and features (genes).

The attempt to preserve the populations of wild rams – argali (*Ovis ammon*) and urial (*Ovis vignei*), Tajik markhur (*Capra falconeri*), Bukhara Red deer (*Cervus elaphus bactrianus*) is being taken in Tajikistan. The populations of other animals remained uncontrolled.

At the population level, *Ungernia tadshicorum*, walnut (*Juglans regia*), currants (*Ribes*) are under protection. Rare, endemic species of plants and animals have been inventoried and listed in the Red Data Book of Tajikistan.

The country still lacks Program on biodiversity conservation. To improve the biodiversity conservation, it is required:

- improve the structure of the protected areas management,
- attract investments for equipment, research and education,
- provide sufficient support for the existing botanical gardens, zoos, nurseries and farms,
- create new nurseries and farms for rare and endangered plants and animals, as well as for wild species (important for agrobiodiversity) conservation,
- raise the public awareness in biodiversity value,
- involve NGOs and local communities in actions on biodiversity conservation.

### Biodiversity Conservation at the Geosystem Level

In the mountainous Tajikistan, all the biodiversity components, except for circumpolar, invasive, and weed species, are assigned to geosystems – botanico-geographic zones with typical natural conditions and vegetation belts. Here, about 90% of the regional flora and fauna specific diversity and 60% of ecosystems occur.

Southern Tajikistan area still contains tугai forests, sand-desert, and wetland ecosystems, xerophytic light forest, and low-grass semisavanna. The most vulnerable are pomegranates (*Punica*), jujube forest (*Ziziphus jujuba*), fig (*Ficus carica*), persimmon (*Diopyros*), grapes (*Vitis*), and Sogd ash (*Fraxinus sogdiana*).



High-mountain meadows

The Hissar-Darvaz area is represented by broad-leaf forests, mountain steppes, and savannoide. This is the most diverse in species area.

The Zeravshan area is dominated with light forest-juniper and small-leaf forests. To conserve the valuable communities of birch forests and fragmentary Turkestan maple forests is most urgent in the juniper zone and below. The most valuable grass communities, which need urgent protection, are mountain meadows.

The most valuable communities of the Kuramin area are juniper forests and light forests.

In the Turkestan area, solely juniper-forest ecosystems prevail, which are in comparatively stable state. Here, it is urgent to conserve the valuable communities of Turkestan and hemispheric juniper forests.

The Western Pamirs still contains mainly meadow-steppe and small-leaf, light forest-juniper ecosystems, which are at the stage of degradation. Small juniper light forests, birch forests need protection, that could help to improve the habitats of rare endemics of mammals - snow leopard (*Uncia uncia*), argali (*Ovis ammon*).

The Eastern Pamirs needs protection of the wetlands of the Alichur valley meadows and swamps, as well as small woods along river valley.

The diversity of the country ecosystems can be observed all over Central Asia and is valuable for the total region. That is why, all Central Asian states are interested in Tajikistan biodiversity conservation.



*High-mountain meadow-steppe ecosystem*

## Biodiversity Conservation at the Ecosystem Level

Within mountain landscape of Tajikistan, where the natural-climatic conditions are quite variable within small areas, ecosystems have specific flora and fauna composition and conservation of species, communities, and living organisms is possible only within ecosystems.

Reserves and zakazniks include 50% of the total area of tugai, 0.5% - juniper, 0.01% - small-leaf, 0.2% - high-mountain-meadow and steppe, and 60% - high-mountain-desert ecosystems.

The almost inaccessible ecosystems of rocky mountains, glaciers, and, partly, high-mountain deserts are in relatively stable state. More than half of valuable ecosystems are under active human impact, 25% of them are degrading.

## Biodiversity Conservation at the Species Level

The specific diversity of flora and fauna has been studied irregularly. Best studied is the specific composition of high vascular plants and vertebrate animals. Among lower plants (including fungi) and invertebrates, the specific composition of some groups is relatively well studied. A drop in numbers is observed in many species, some of them are rare or endangered.

Considerable part of species and subspecies of plants and animals are assigned to endemics. High concentration of species per area unit is observed (table 1.12).

Numerous plant and animal species of Tajikistan appeared outside their communities, with reduced or fragmentary areas. The biodiversity conservation at the ecosystem level is one of the main forms of specific diversity preservation.

In the mountain landscapes, not many species live within their own communities, others adapted to other communities as associated species. To preserve rare and endemic species, nurseries, serpentaries, etc. are established. Work on species breeding is carried out in botanical gardens and biological stations. Zapovedniks and zakazniks make inventories of species listed in the Red Data Book.

Table 1.12. Specific Biodiversity and Species Concentration

Group	Number of species				% of the world total
	In the world		In Tajikistan		
	Total	Per 1 ths km <sup>2</sup>	Total	Per 1 ths km <sup>2</sup>	
Lower plants ( <i>Tallobionta</i> )	73883	0.145	5260	36.7	7.1
Higher plants ( <i>Embryobionta</i> )	248428	1.666	4511	31.5	1.81
Viruses, bacteria, protozoans ( <i>Virus, Bacteriophyta, Protozoa</i> )	5760	0.011	800	5.6	13.9
Worms ( <i>Vermes</i> )	36200	0.071	1400	9.8	3.9
Mollusks ( <i>Mollusca</i> )	50000	0.098	204	1.42	0.4
Arthropods ( <i>Arthropoda</i> )	~2000000	13.407	10715	75.0	0.53
Fish ( <i>Pisces</i> )	19056	0.041	52	0.36	0.3
Amphibians ( <i>Amphibia</i> )	4184	0.023	2	0.013	0.05
Reptiles ( <i>Reptilia</i> )	6300	0.047	47	0.33	0.75
Birds ( <i>Aves</i> )	9040	0.062	346	2.42	3.83
Mammals ( <i>Mammalia</i> )	4000	0.027	84	0.59	2.1

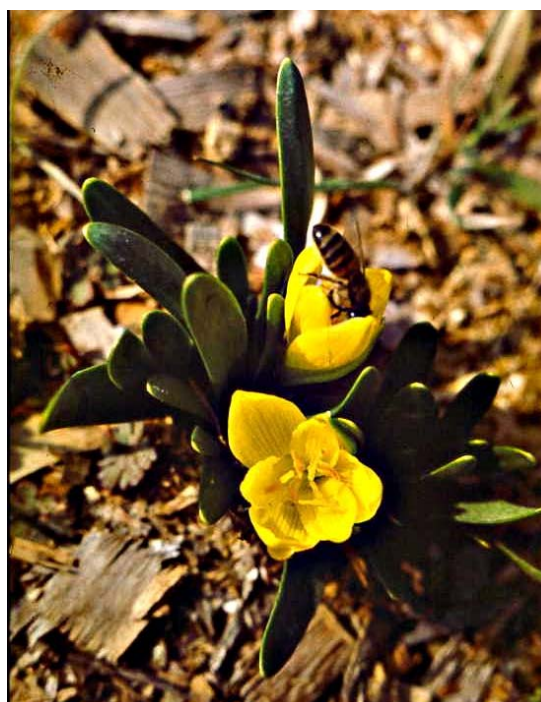
#### 1.4.1. Biodiversity conservation in natural habitats (*in-situ*)

Ensuring biodiversity conservation is possible only if the specific diversity is protected within *in-situ*, as most species have limited habitats. A decline of specific diversity is being observed at all natural zones. Thus the Turan tiger (*Panthera tigris virgata*) and Menzbier's marmot (*Marmota menzbieri*) completely disappeared from Tajikistan fauna.

Considerable drop in numbers of 5 ungulate species, which became rare: Tajik markhur (*Capra falconeri*), Bukhara Red deer (*Cervus elaphus*), Pamir wild sheep (argali) (*Ovis ammon*), Persian gazelle (*Gazella subgutturosa*), Bukhara wild ram (urial) (*Ovis vignei*); and 6 species of predatory mammals: snow leopard (*Uncia uncia*), *Mustela altaica*, jungle cat (*Felis chaus oxiana*), otter (*Lutra lutra*), striped hyena (*Hyaena hyaena*), leopard (*Panthera pardus ciscaucasica*), is observed. Most critical of 37 species of rare birds are: saker falcon (*Falco cherrug*), peregrine falcon (*Falco peregrinus*), bustard (*Otis tarda*), *Ibidoruncha struthersi*, brown-headed gull (*Larus brunnicephalus*), *Syr-*

*rhaptes tibetanus*, *Terpsiphone paradisi leucogaster*, *Miophonus caeruleus*, and bar-headed goose (*Anser indicus*).

The habitats of rare plants species – *Eremurus candidus* and *Salvia gontscharovii* – are hidden under the waters of the Nurek Reservoir.



*Sternbergia lutea*



**Animals the Red Data Book  
of the IUCN Include**

*Reptiles:*

- Gray monitor lizard (*Varanus griseus*)
- Central Asian cobra (*Naja oxiana*)

*Mammals:*

- Menzbier's marmot (*Marmota menzbieri*)
- Central Asian otter (*Lutra lutra*)
- Turan tiger (*Panthera tigris virgata*)
- Leopard (*Panthera pardus*)
- Snow leopard (*Uncia uncia*)
- Persian gazelle (*Gazella subgutturosa*)
- Tajik markhur (*Capra falconeri*)
- Bukhara wild ram (urial) (*Ovis vignei*)

The Red Data Book of Tajikistan includes 226 plant and 162 animal species, which are rare or endangered (table 1.13, 1.14).

One of the primary tasks in conserving rare and endangered animal species *in-situ* is a regular inventory aimed at estimating species populations. The reduction of research works in the recent decade and the species category systems, renewed by IUCN, predetermine the need in reediting of the Tajik Red Data Book.

Protected areas fund, including some nature-landscape zones and ecosystems, has been created in Tajikistan (table 1.15).

13 state zakazniks, 4 reserves and 1 micro-zakaznik are registered in Tajikistan by 01.01.2001. According to the data available by , the total area of zakazniks is 487 th. ha, or 3,4% of the country area (fig. 1.20, 1.21).

The total area of Tajik state reserves (according to the data available by 01.01.2002) is 173,4 th. hectares. Over 35% of animals' species diversity is protected in reserves areas.

Due to the measures taken, the unique wetland forests of the dry subtropics zone is preserved in Tigrovaya Balka Reserve. The most favorable area of 21 th. ha of tugai is the left bank of the Vakhsh River. Tugai forests contain rare animal species: pheasant (*Phasianus colchicus*), jungle cat (*Felis chaus oxiana*), Bukhara Red deer (*Cervus elaphus*) and hyena (*Hyaena hyaena*).



*Chapdara Peak*

**Table 1.13. Dynamics of Rare and Threatened Species of Plants (by IUCN categories)**

Name	1978					1988					1998						2002					
	Category				Total	Category				Total	Category					Total	Category					Total
	0	1	2	3		0	1	2	3		0	1	2	3	4		5	0	1	2	3	
Fungi ( <i>Fungi</i> )	-	-	1	-	1	-	-	4	-	4	-	-	4	-	-	4	-	-	4	-	-	4
Bryophytes ( <i>Bryophyta</i> )	-	4	2	2	8	-	4	2	2	8	-	4	2	2	-	8	-	4	2	2	-	8
Filices ( <i>Pteridophyta</i> )	-	-	-	-	-	1	3	2	-	6	1	3	2	-	-	6	1	3	4	-	-	8
Gymnosperms ( <i>Gymnospermae</i> )	-	-	1	-	1	-	1	-	-	1	-	1	-	-	-	1	-	1	-	3	-	4
Angiosperms ( <i>Angiospermae</i> ), including:	-	14	43	12	69	19	73	87	28	207	22	92	102	38	19	273	25	111	118	48	26	339
Trees	-	1	2	3	6	1	2	1	4	8	1	2	3	4	2	12	1	-	4	4	2	14
Shrubs	-	-	7	3	10	-	8	9	1	18	-	10	17	-	1	28	-	5	18	11	1	38
Grass, sub-shrubs, dwarf subshrubs	-	13	34	6	53	18	63	77	23	181	21	80	82	34	16	233	24	106	96	33	23	287
<b>Total:</b>	<b>-</b>	<b>18</b>	<b>47</b>	<b>14</b>	<b>79</b>	<b>20</b>	<b>81</b>	<b>95</b>	<b>30</b>	<b>226</b>	<b>23</b>	<b>100</b>	<b>110</b>	<b>40</b>	<b>19</b>	<b>292</b>	<b>26</b>	<b>119</b>	<b>128</b>	<b>53</b>	<b>26</b>	<b>363</b>

Table 1.14. Plants and Animals, Listed in the Red Data Book of Tajikistan (by IUCN categories)

Name	Category						Total
	0	1	2	3	4	5	
<b>PLANTS</b>							
Fungi ( <i>Fungi</i> )	–	–	4	–	–	–	4
Bryophytes ( <i>Bryophyta</i> )	–	4	2	2	–	–	8
Filices ( <i>Pteridophyta</i> )	1	3	2	–	1	–	7
Gymnosperms ( <i>Gymnospermae</i> )	–	1	–	–	–	–	1
Angiosperms ( <i>Angiospermae</i> )	16	68	75	25	7	15	206
<b>Total of plants:</b>	<b>17</b>	<b>76</b>	<b>83</b>	<b>27</b>	<b>8</b>	<b>15</b>	<b>226</b>
<b>VERTEBRATES</b>							
Fish ( <i>Pisces</i> )	1	–	2	1	–	–	4
Reptiles ( <i>Reptilia</i> )	–	5	12	4	–	–	21
Birds ( <i>Aves</i> )	–	9	10	11	7	–	37
Mammals ( <i>Mammalia</i> )	2	12	21	2	5	–	42
<b>Total of vertebrates:</b>	<b>3</b>	<b>26</b>	<b>45</b>	<b>18</b>	<b>12</b>	<b>–</b>	<b>104</b>
<b>INVERTEBRATES</b>							
Mantis ( <i>Mantoptera</i> )	–	6	1	–	–	–	7
Proboscidea ( <i>Homoptera</i> )	–	–	3	–	–	–	3
Bugs ( <i>Heteroptera</i> )	–	2	4	–	–	–	6
Coleopterous or beetles ( <i>Coleoptera</i> )	1	–	4	–	–	–	5
Lepidopterous ( <i>Lepidoptera</i> )	–	8	9	–	4	–	21
Hymenopterous ( <i>Hymenoptera</i> )	–	–	4	4	–	–	8
Mollusks ( <i>Mollusca</i> )	–	2	5	1	–	–	8
<b>Total of invertebrates:</b>	<b>1</b>	<b>18</b>	<b>30</b>	<b>5</b>	<b>4</b>	<b>–</b>	<b>58</b>
<b>Total of animals:</b>	<b>4</b>	<b>44</b>	<b>103</b>	<b>7</b>	<b>16</b>	<b>–</b>	<b>162</b>

Note: 0 – extinct; 1 – endangered; 2 – rare; 3 – declining; 4 – undetermined; 5 – restored.

Dashti-Jum Reserve preserves the last Central Asian valuable and viable populations of Tajik markhur (*Capra falconeri heptneri*).

The resources of fish in high-mountainous lakes are of great commercial importance. The protected areas of Zorkul Lake islands still contain bar-headed goose (*Ancer indicus*), totaling in 600 birds. The argali (*Ovis ammon*) is also preserved here.

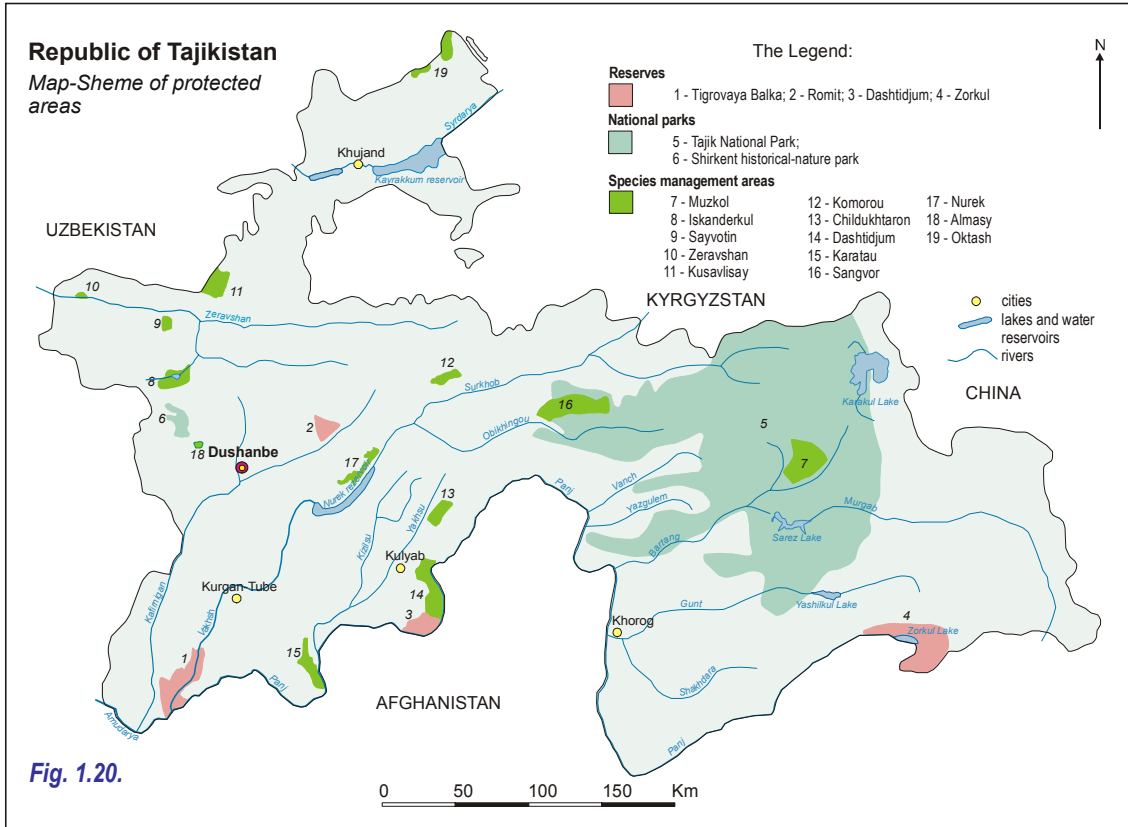
In recent years, the Romit Reserve does not have its conserving function any more.



Rare Junipers (*Juniperus*)

Table 1.15. Protected Area Resources (01.01.2002)

No.	Protected area category	IUCN category	Number	Area / ths ha
1.	Reserves	I	4	173.418
2.	National parks	II	2	2603.6
3.	Nature monuments	III	26	–
4.	Zakazniks	IV	14	313.390
5.	Tourism and recreation zone	–	3	15.3
6.	Botanical gardens	–	5	0.731
7.	Botanical stations, temporary and permanent points	–	13	10.0
<b>Total:</b>			<b>67</b>	<b>3116.439</b>

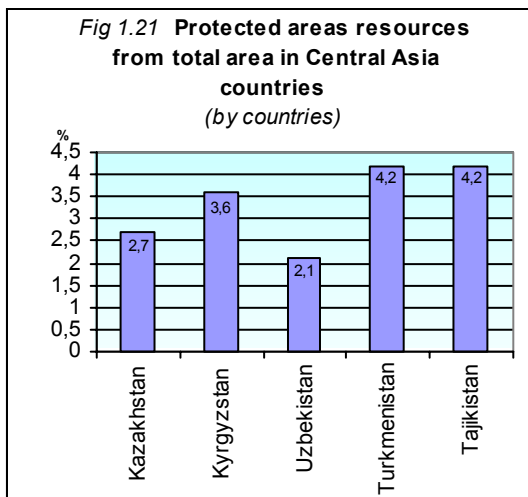


13 state zakazniks provide conservation of valuable animal and plant species almost in all nature-landscape zones of Tajikistan (table 1.16).

The protected areas of Tajikistan include 3 tourism and recreation zones, with the total area of 15.3 th. hectares. To preserve the landscapes, unique ecosystem elements and natural monuments, the national park and nature park are established in Tajikistan.

Almost all protected areas have environmental imbalance; one of the reasons is the socio-economic and political crisis of the recent decade.

The anthropogenic impact on the biological diversity of Tajikistan is steadily increasing, and the degradation of many nature-landscape complexes is becoming irreversible on a large scale. National ecological network of protected areas needs to be created.



*Tulipa turkestanica*

Table 1.16. Types of Protected Areas and Valuable Animal and Plant Species Conservation

No.	Name	Type	Species requiring protection
<b>Reserves</b>			
1.	Tigrovaya Balka	Tugai	Pheasant ( <i>Phasianus colchicus</i> ), hyena ( <i>Hyaena hyaena</i> ), Persian gazelle ( <i>Gazella subgutturosa</i> ), Bukhara Red deer ( <i>Cervus elaphus</i> ), gray monitor lizard ( <i>Varanus griseus</i> ) and waterfowls
2.	Romit	Complex	Golden eagle ( <i>Aquila chrysaetus laphanea</i> ), brown bear ( <i>Ursus arctos</i> ), snow leopard ( <i>Uncia uncia</i> ), Siberian ibex ( <i>Capra sibirica</i> )
3.	Dashti-Jum	Complex, Mountain-forest	Brown bear ( <i>Ursus arctos</i> ), Bukhara wild sheep (urial) ( <i>Ovis vignei</i> ), Tajik markhur ( <i>Capra falconeri</i> ), partridge ( <i>Alectorius keklik</i> ), snow leopard ( <i>Uncia uncia</i> )
4.	Zorkul	Zoological	Bar-headed goose ( <i>Anser indicus</i> ), Pamir wild ram (argali) ( <i>Ovis ammon</i> ), Siberian ibex ( <i>Capra sibirica</i> ), snow leopard ( <i>Uncia uncia</i> ), red wolf ( <i>Canis lupus</i> )
<b>Zakazniks</b>			
1.	Iskanderkul	Landscape, mountain-forest	Snow leopard ( <i>Uncia uncia</i> ), Bukhara wild sheep (urial) ( <i>Ovis vignei</i> ), birch ( <i>Betula</i> )
2.	Saivotin	Mountain-forest	Juniper forest ( <i>Juniperus</i> )
3.	Kamarov	Mountain-forest	Brown bear ( <i>Ursus arctos</i> ), Siberian ibex ( <i>Capra sibirica</i> ), trout ( <i>Salmo trutta morfa fario</i> )
4.	Childukhtaron	Landscape, mountain-forest	Juniper forest ( <i>Juniperus</i> ), brown bear ( <i>Ursus arctos</i> ), Bukhara wild ram (urial) ( <i>Ovis vignei</i> ), partridge ( <i>Ammoperdix griseogularis</i> ), wild boar ( <i>Sus scrofa</i> )
5.	Dashti-Jum	Landscape, mountain-forest	Juniper forest ( <i>Juniperus</i> ), brown bear ( <i>Ursus arctos</i> ), Bukhara wild ram (urial) ( <i>Ovis vignei</i> ), partridge ( <i>Ammoperdix griseogularis</i> ), wild boar ( <i>Sus scrofa</i> )
6.	KarataV	Zoological	Bukhara wild ram (urial) ( <i>Ovis vignei</i> ), partridge ( <i>Alectoris graeca</i> ), Bukhara Red deer ( <i>Cervus elaphus</i> )
7.	Sangvor	High-mountainous	Pamir wild ram (argali) ( <i>Ovis ammon</i> ), Tibetan snow partridge ( <i>Tetraogallus tibetanus tibetanus</i> )
8.	Muzkul	Zoological	Bar-headed goose ( <i>Anser indicus</i> ), Pamir wild ram (argali) ( <i>Ovis ammon</i> ), Siberian ibex ( <i>Capra sibirica</i> ), Snow leopard ( <i>Uncia uncia</i> )
9.	Kusavlisai	Mountain-forest	Juniper forests ( <i>Juniperus</i> )
10.	Oktash	Zoological	Bukhara wild ram (urial) ( <i>Ovis vignei</i> ), <i>Vipera lebetina</i> , peregrine falcon ( <i>Falco peregrinus</i> ), saker falcon ( <i>Falco cherrug</i> )
11.	Zeravshan	Complex, tugai forest	Pheasant ( <i>Phasianus colchicus</i> ), Bukhara Red deer ( <i>Cervus elaphus bactrianus</i> )
12.	Almasi	Botanical	<i>Ungernia victoris</i>
13.	Nurek	Complex, mountain-forest	Bukhara wild ram (urial) ( <i>Ovis vignei</i> ), brown bear ( <i>Ursus arctos</i> ), partridge ( <i>Ammoperdix griseogularis</i> ), snow leopard ( <i>Uncia uncia</i> )
<b>Parks</b>			
14.	National	Complex, landscape, botanical, zoological	High-mountain, meadow-steppe, desert ecosystems, tugai, Pamir wild ram (argali) ( <i>Ovis ammon</i> ), Siberian ibex ( <i>Capra sibirica</i> ), Snow leopard ( <i>Uncia uncia</i> ), red wolf ( <i>Canis lupus</i> )
15.	Shirkent historical natural	Mountain-forest, landscape biodiversity	Bukhara wild ram (urial) ( <i>Ovis vignei</i> ), Juniper forest ( <i>Juniperus</i> ), <i>Ungernia</i>

### 1.4.2. Biodiversity conservation outside natural habitats (*ex-situ*)

Conservation *ex-situ* is aimed at preserving genetic resources, accumulated in plant, animal, and microorganism collections.

Tajikistan has many institutions working on plant and animal conservation. Usually, these are botanical and dendrological gardens, zoo, public parks, introduction nurseries of research institutes, etc. Due to the socio-economic instability, the collection materials are not enriched; the state of the zoo, museum, herbarium, biostations, and botanical gardens is unsatisfactory.

The plant collections include about 5 thousand varieties, hybrids, lines, and local forms. The germ plasma collections of domestic animals include over 50 th. doses from 10 breeds. The microorganism collections consist of many bacteria, fungi, and algae species, including about 500 taxa.

The national herbarium includes about 350-400 th. plant specimens of existing flora, zoological collections – 3.7 th. species, includ-

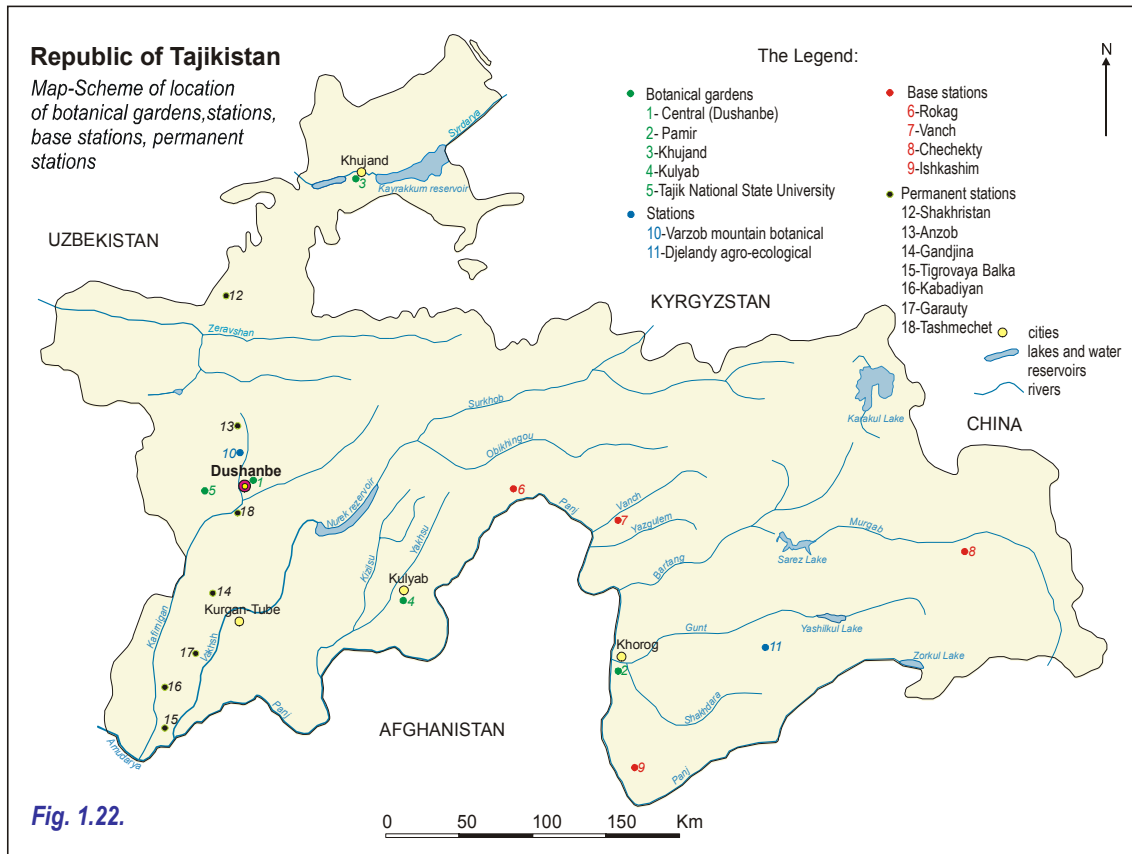
ing 280 species and 3.5 th. specimens of birds; and about 3.3 th. species and 18.8 th. specimens of insects.

The network of botanical institutions of Tajikistan has been developed since 1930.

5 botanical gardens, 2 stations, 4 temporary and 7 permanent points (fig. 1.22) carried out active biomorphological, ecological, physiological-biochemical, anatomical, phytocenotic, floristic and other research. At present, these works are restricted.

About 2.3 thousand tree and shrub species were put to introduction test at the Central Botanical Garden of the Tajik Academy of Science; 2.7 th. species of tropical and subtropical plants were tested at the hothouse complex. According to the data available by 01.01.2002, the tree and shrub collection of the Botanical Garden was 1,765 species, including 137 species of conifer breeds.

The plant resources of the Pamirs Botanical Garden (Tajik Academy of Science) are: over 4 th. species and intraspecific taxa, including 1.1 th. woody, 1.8 th. grass, 400 fruit species, and over 80 species of indigenous flora.







*Tulips in Botanical Station*

The Khudjand Botanical Garden preserves the area of nature tugai; over 40 plant species, listed in the Red Data Book of Tajikistan, have been tested here.

In the Kulyab Botanical Garden, introduct and reproducent nurseries are established; areas of medicinal and decorative grasses of the local flora are created. There are over 300 species of decorative-flowering and medicinal grasses.

The Varzob Mountainous Botanical Station (Institute of Botany, Academy of Science) preserves over 1.5 th. of high flowering plant species (over 30% of the total flora specific composition of Tajikistan). Such number of plant



*Botanical Garden in Dushanbe*

species may ensure a sustainable conservation of natural flora communities at southern slope of Gissar Range. Among them 32 species are listed in the Red Data Book of Tajikistan.

### 1.4.3. Genetic Resources and Biological Safety

The Republic of Tajikistan possesses great genetic resources of global importance. The genetic varieties of biodiversity are preserved *in-situ* and *ex-situ*. Considerable part of the wild plant and animal genetic resources occur within protected areas.

The main genetic resources are deposited in a number of research institutes of Academy of Science of the republic, part of these is preserved in nature reserves (table 1.17).

The genetic resources of cultivated plants and domestic animals are conserved by relevant branch research institutions of the Academy of Science, the Tajik Academy of Agricultural Sciences, and subordinate institutions of the Tajik Forestry Department, as living collections and germ plasma.

The genetic resources of domestic animals are conserved mainly at pedigree stock-breeding farms, households and by local population. The pedigree material of germ plasma is deposited in the stations of the Tajik Ministry of Agriculture.

#### Main Genetic Collections of Tajikistan:

- Fruit and berries (10.000 variety specimens of apricot, apple, cherry-plum, almond, etc.). Deposited in: Scientific and Production Enterprise "Bogparvar", Tajik Academy of Agricultural Sciences.
- Cereals, leguminous, and industrial crops, potato – 1.5 ths variety specimens, deposited in the Institute of Plant Physiology and Genetics, Tajik Academy of Science, 2.2 ths – in the Scientific and Production Enterprise "Ziroat", Tajik Academy of Agricultural Sciences.
- Germ plasma of pedigree animals – over 50 ths doses of cattle breeding, deposited in the Tajik Research Institute of Cattle-Breeding, Tajik Academy of Agricultural Sciences, Ministry of Agriculture, Republic of Tajikistan.

Table 1.17. Genetic Resources of Agricultural Crops

Crop	Grown		Bred			Collection available		
	varieties	hybrids	varieties	hybrids	lines	varieties	hybrids	lines
Fruit, including:	120	–	42	–	–	1143	–	–
Stone	52	–	–	–	–	394	–	–
Seed-bearing	31	–	–	–	–	224	–	–
Nuts	13	–	10	–	–	177	–	–
Subtropical	12	–	21	–	–	159	–	–
Citrus (hot-house crop)	6	–	–	–	–	47	–	–
Others	6	–	2	–	–	124	–	–
Berries	7	–	–	–	–	–	–	–
Grapes	21	–	11	–	–	350	–	–
Potato	6	–	1	–	–	70	–	–
Vegetables	57	–	10	–	–	70	4	–
Melons	15	–	7	–	–	51	–	–
Cereals	48	2	29	82	2	2045	238	110
Leguminous plants	32	–	20	302	4	921	–	–
Oil-bearing plants	28	2	23	–	81	8218	–	–

Medicinal plants are valuable genetic resource, 80 species being used in official medicine; 150 species, used in popular medicine, are still potential for further study. Most of 13 forage species are wild relatives of cultivated plants, preserving the species genetic resources in natural conditions.

Traditionally, the private farming sector uses local varieties and forms of plants and animals.

Use of biotechnologies and gene engineering is restricted to narrow spectrum of research carried out in recent 20 years. A number of plant varieties, highly adaptable sorts of potato, cotton, tobacco, and tomato are developed. Some positive data are obtained as a result of work on cattle embryo transplantation.

The absence of systematic work on maintaining the quality of local breeds causes the loss of plant genetic resources. There is sharp decline of the cattle genetic resources.

Being aware of the importance of genetic resources conservation, Tajikistan took a decision (No. 19/1-4 of 1.01.2002) to join the

Cartagena Protocol on Biosafety to the Convention on Biological Diversity. However, to provide biosafety while using GMO, and effective use of biotechnologies, the complex of urgent measures is to be taken:

- developing legislative and institutional base in this field;
- training specialists and creating a special body controlling the GMO management;
- developing special programs on informing the population of genetically modified organisms.



The Pamir Botanical Garden

#### 1.4.4. Use of Biological Resources

The natural communities of living organisms preserved in Tajikistan are the base for sustainable development of both mountainous and adjacent plain areas, where the human impact caused transformation of ecosystems.

Great volume of the biological resources of Tajikistan are widely used; they are the base for development of agricultural production.

Over 100 species of food and vitamin-bearing plants, and about 60 essential species grow in Tajikistan. The group of tanniferous plants includes about 100 species, dye plants – over 80, melliferous – over 100. Oil-bearing, fibrous, and cellulose plants are represented by great specific diversity. About 30% of natural floras consist of forage plants.

The forest resources are used most actively. The forests of Tajikistan, as a whole, are marked with low productivity; the higher growth classes are only 10%. The State Forest Resources (SFR) of Tajikistan (according to the data available by 01.01.2001) are 1,941 thousand hectares. Total forested area is 3%, or 0.1 ha of the forest area per person. Over 120 ths young plants were planted; forests were restored in the area of 4,660 ha. 72.6% of one-year-old forest plants take root (table 1.18, fig. 1.23-1.26).

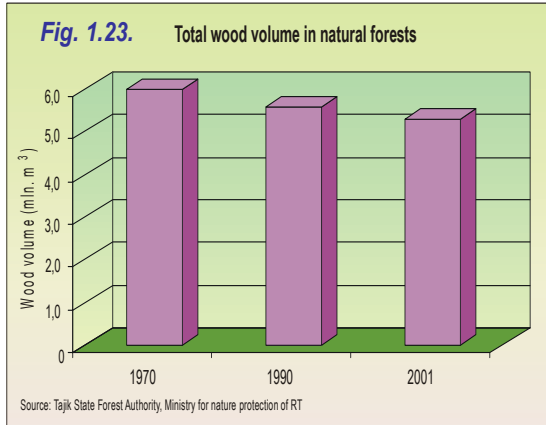
Nearly 6 th. ha of forested area are annually illegally cut over, with the total volume of timber 10-15 th. m<sup>3</sup>. Illegal forest cutting is observed almost everywhere.

#### Main Species of Medicinal Plants Used in Popular and Official Medicine

No.	Latin Names
1.	<i>Hippophae rhamnoides</i>
2.	<i>Ephedra equistena</i>
3.	<i>Rosa nanothamnus, R.beggeriana, R.maracandica, R.huntica, R.fedtshenkoana, R.achburensis, R.korshinskyana, R.canina, R.corymbifera</i>
4.	<i>Ungernia victoris</i>
5.	<i>Rhus coriaria</i>
6.	<i>Crataegus altaica, C.songorica</i>
7.	<i>Ribes meyeri, R.janczevskii</i>
8.	<i>Rhodiola gelida</i>
9.	<i>Plantago major, P.lanceolata</i>
10.	<i>Hypericum perforatum, H.scabrum</i>
11.	<i>Tussilago farfara</i>
12.	<i>Melissa officinalis</i>
13.	<i>Ziziphora brevicalyx</i>
14.	<i>Inula helenium, I.macrophylla</i>
15.	<i>Glycyrrhiza glabra</i>
16.	<i>Origanum tyttanthum</i>
17.	<i>Salvia sclarea</i>
18.	<i>Peganum harmala</i>
19.	<i>Thermopsis.doi chocarpa</i>
20.	<i>Polygonum aviculare</i>
21.	<i>Urtica diodica</i>
22.	<i>Achillea millefolium</i>
23.	<i>Artemisia vulgaris, A.mogoltavica</i>
24.	<i>Mentha asiatica</i>
25.	<i>Thymus serpyllum</i>
26.	<i>Ferula kuchistanica, F.sumbul, F.krialovii, F.grigoriewii</i>
27.	<i>Capsella bursa-pastoris</i>
28.	<i>Equisetum arvensis</i>
29.	<i>Allium graveolens</i>

Table 1.18. Dynamics of Forest Resource Indications for the Period from 1970 to 2001

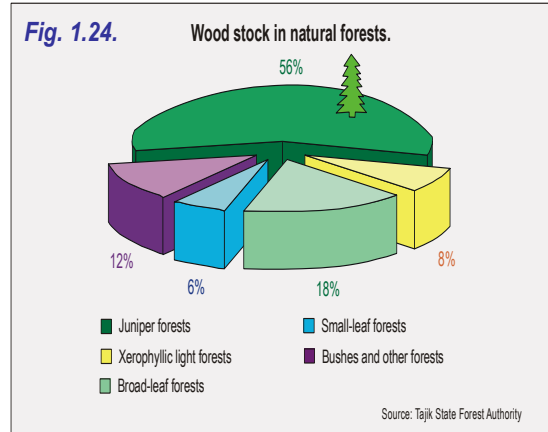
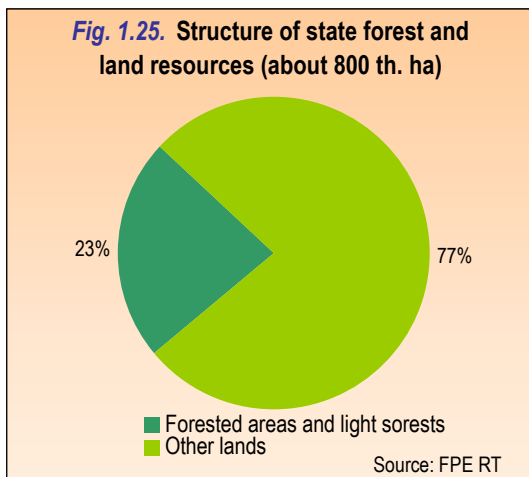
No.	Indications	Including (by years)			
		1970	1980	1990	2001
1.	Total SFR area (m. ha)	1.941	1.941	1.941	1.941
2.	Including area, managed by forestry institutions (FIC, RT) (m. ha)	1.820	1.820	1.820	1.820
3.	SFR lands, managed by FD, RT, assigned to collective and state farms for long-term use, as pastures (m. ha)	1.2	1.2	1.2	1.2
4.	Free SFR, managed by FD, RT (m. ha)	0.62	0.62	0.62	0.62
5.	Forested area in SFR lands (FD, RT) (ths ha), according to:				
	a. Aerocosmogeodesy	830	800	730	694
	b. State Statistic Agency and FD, RT	378	383	392.2	401



More than 60 species of wild medicinal plants, included into official pharmacopoeia, grow in forests of Tajikistan.

The annual resources of medicinal plants in the country are over 100 tonnes, 40 th. tonnes of them are accessible, and only 5 th. tonnes are gathered. The uncontrolled gathering causes the reduction of medicinal and food plant diversity and range.

Plants are gathered mainly in forest, steppe, semisavanna, rarely in desert communities. The main medicinal plants are: nettle (*Urtica*), coltsfoot (*Tussilago*), common horsetail (*Equisetum arvensis*), caraway (*Thymus seravshanicus*), *Ziziphora*, *Bunium*, St.-John's-wort (*Hypericum*), melissa (*Melissa*), wormwood (*Artemisia*), yarrow (*Achillea*), licorice (*Glycyrrhiza glabra*), inula (*Jnula*), rhubarb (*Rheum*), sage (*Salvia*), plantain (*Plantago*), harmel (*Peganum harmala*), tansy (*Tanacetum pseudoachillea*), *Rhodiola*, ferule (*Ferula*), *Lagochilus*, etc.



The most valuable communities of the group are the formations of licorice (*Glycyrrhiza*), origanum (*Origanum*), sage (*Salvia*), *Lagochilus*, *Ziziphora*, *Bunium*, rhubarb (*Rheum*), inula (*Jnula*), coltsfoot (*Tussilago*), *Ungernia*, *Rhodiola*, ferule (*Ferula*) – 5 species, onion (*Allium*) - 3 species, angelica (*Angelica sp.div*).

Considerable number of the following wild food plants is used: *Allium Rosenbachianum*, *Allium stipitatum*, *Allium Suworowii*, *Rheum Maximovichzii*, *Berberis heterobotrys*, *Berberis heteropoda*, *Berberis integerrima*, *Bunium persicum*, *Carum carvi*.

Wild nuts and other forest varieties are used as food species. In forest nurseries seed, stone, and subtropical fruits, as well as dried fruits, are stored (table 1.19).

Natural pastures, covering 3689.5 th. ha, are widely used. However, the uncontrolled overgrazing of domestic animals worsened their state greatly (table 1.20).

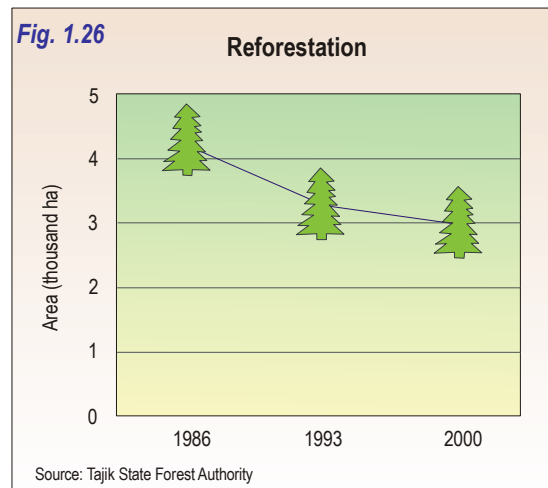




Table 1.19. Dynamics of Gathering Forest Products, 1991-2201 (tonnes)

Species	Year	
	1991	2001
Nuts, including:	112.4	45.7
Walnut ( <i>Juglans regia</i> )	41	36
Pistachio ( <i>Pistacia verae</i> )	63	0
Sweet almond ( <i>Amygdalus bucharica</i> )	1.5	1.7
Bitter almond ( <i>Amygdalus vavilovii</i> )	3.9	5
Anzur onion ( <i>Allium rosenbachinum</i> )	28	20
Rhubarb ( <i>Rheum maximovichii</i> )	322	60
Medicinal plants	470	6
<i>Bunium persicum</i>	0.2	0.1
Wild rose ( <i>Rosa sp.div</i> )	18.4	15
Barberry ( <i>Berberis sp. div</i> )	0.74	0.6
Sea buckthorn ( <i>Hippophae rhamnoides</i> )	55.8	3
Honey	6.63	3.8

The most valuable forage and ecologically important grass and dwarf sub-shrub communities make 70% of the arable lands of the country. In plains and intermountainous valleys, desert and semidesert communities prevail. Foothills are occupied by low grass ephemeroid semisavannas. In mid and high mountains, high-grass subalpine and alpine low-grass meadows with steppes are located (fig. 1.27).



*Achillea L.*

The perennial grass formations of steppes with sub-shrub vegetation are common on the Turkestan, Zeravshan, Hissar, Darvaz, and Peter-the-Great ranges. The major species of steppe vegetation are: meadow grass (*Poa*), feather grass (*Stipa*), fescue grass (*Festuca*), steppe timothy grass (*Phleum phleoides*), and others. The steppe forage yield (depending on grass composition) varies from 3.5 to 17.0 centners/ha of dry mass. The uncontrolled and unseasonable cattle grazing of domestic animals in recent years and numerous erosion processes made the steppes low-productive wormwood lands of steppe type. A premature cattle grazing promotes selection and conservation of weed, uneatable plants: *Cousinia sp.div.*, *Adonis turkestanicus*, *Rumex sp.div.*, *Acantholimon sp.div.*, etc.

Table 1.20. Pasture area and forage resources

Name	Summer		Spring-fall		Winter		All-the-year-round		Total	
	Area, ths ha	Forage resources ths tonnes	Area, ths ha	Forage resources ths tonnes	Area, ths ha	Forage resources ths tonnes	Area, ths ha	Forage resources ths tonnes	Area, ths ha	Forage resources ths tonnes
Districts of Republican subordination	729.1	539	194.7	41	41.1	17	–	–	964.9	597
Sogd Region	415.6	212	162.2	58	146	26	–	–	723.8	296
Khatlon Region	255.3	146	68.1	29	851.6	297	104.04	35	1279.1	507
Gorno-Badakhshan Autonomous Region	443.6	189	–	–	278.1	33	–	–	721.7	222
<b>Total in the Republic</b>	<b>1843.6</b>	<b>1086</b>	<b>425.0</b>	<b>128</b>	<b>1316.8</b>	<b>373</b>	<b>104.04</b>	<b>35</b>	<b>3689.5</b>	<b>1622</b>



**Cereals fields**

The high-grass semisavannas are represented mainly by high ephemeroid and umbelliferous plants – ferule and hay plant, compositae – inula, which are common in the Hissar, Darvaz, western Peter the Great ranges, and the Vakhsh Valley. The productivity of green mass is high, dried and standing plants are used even in the winter period. Overgrazing influences the plant composition of the pastures, increasing the role of umbelliferous plants.

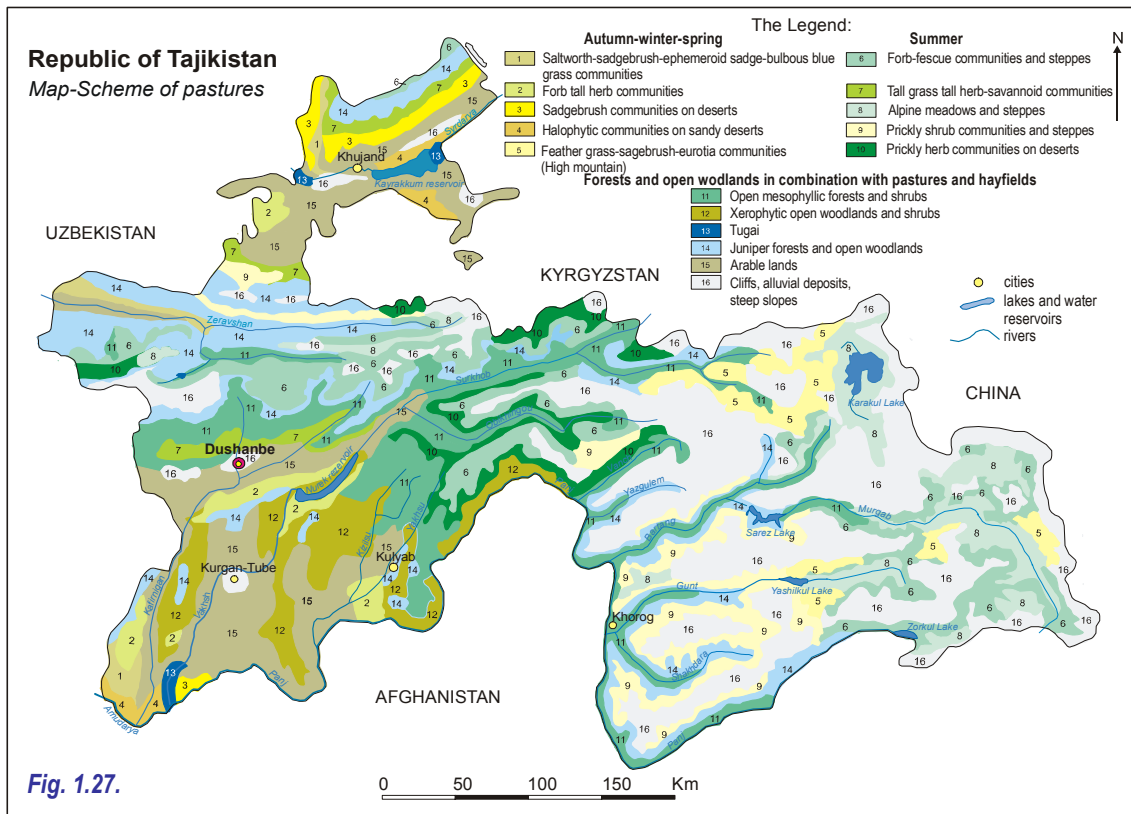
The waste lands are represented by perennial low grasses and dwarf sub-shrubs, resistant to low temperatures. They are located in

high-mountain areas of Tajikistan. The dominating species of the waste lands are: alkali grass (*Agrostis*), *Oxitropis*, Hissar pepper plant (*Polygonum hissaricum*), fescue grass (*Festuca*), *Cobresia*, and others. The yield of dried eatable mass of various formations varies from 2 to 12 centners/ha.

Great negative impact on the animal world has been caused by trade and individual international hunting. It is carried out at 6 state forestry-hunting enterprises (table 1.21, fig. 1.28).



**High-Mountain pastures**



**Table 1.21. State Forestry-hunting Enterprises of the Forestry Department, Republic of Tajikistan**

Name	Area, ths ha	Main species of game animals and birds
"Karatag"	24.0	Wild boar ( <i>Sus scrofa</i> ), partridge ( <i>Alectorius kakelik</i> ), badger ( <i>Meles meles</i> ), Siberian ibex ( <i>Capra sibirica</i> ), hare-tolai ( <i>Lepus tolai</i> ), Red marmot ( <i>Marmota caudata</i> ), etc.
"Kofarnihon"	25.5	
"Tavil-Dara"	96.0	
"Rasht"	18.0	
"Jirgatal"	97.0	
"Shakhristan"	57.0	

Annually, game shooting limit (from 5 to 20% of total number of animals) is allowed in the areas of hunting enterprises, after the data on animal numbers are summarized. The game shooting is limited for species declining in numbers (table 1.22).

In recent 10 years, due to insufficient hunting equipment and lack of technical means, the poaching has been increased considerably.

The unrestrained fishing and the destruction of fish habitats promote the decline of fish specific diversity (fig. 1.29, 1.30).

**Table 1.22. Limit of Game Shooting Wild Animals and Birds for the Period of 1990-2001 (individuals)**

Name	1991	2001
Wild boar ( <i>Sus scrofa</i> )	265	257
Badger ( <i>Meles meles</i> )	27	259
Hare-tolai ( <i>Lepus tolai</i> )	345	977
Partridge ( <i>Alectoris graeca</i> )	3490	14546
Pigeon ( <i>Columbia columba</i> )	5000	2895
Water fowls	1350	1492
Ibex ( <i>Capra sibirica</i> )	18	48

