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# 1. Introduction

The environmental baseline is a comprehensive description of the physical and biological characteristics of the environment of the Samtskhe-Javakheti region composed on the base of literature data prior to the proposed exploration of medicinal plants by GSNE "Orchis" in the framework of the project "Conservation and Sustainable Utilization of the Endangered Medicinal Plants in Samtskhe-Javakheti", which is part of the ELKANA agrobiodiversity program. The purpose of the environmental baseline characterisation is to document the condition of the environment, evaluate the sensitive issues and enable the evaluation of the potential impacts of unsustainable utilization of medicinal plants in the region and develop appropriate methodology for inventory of medicinal plant species, which need protection and development of mitigation measures that would minimize or eliminate the impacts.

The objective of the proposed project is to improve the livelihood and health of rural communities through the conservation, management, and sustainable use of medicinal and herbal plants for human and livestock needs in specific areas while ensuring effective *in-situ* protection of threatened species, habitats and ecosystems. An essential feature of this conservation initiative is the benefit sharing with the local stakeholder communities, so that they also gain from the programme for conservation of medicinal plants. It is based on the understanding that rural communities are the key custodians and conservators of the medicinal plants and indigenous knowledge. The project has also pioneered documentation, rapid assessment and revitalisation of local health practices in rural communities. As a result of this initiative, number of home herbal gardens has to be established by the local farmers. In-situ and *ex-situ* conservation measures have to be developed and recommendations have to be prepared for official bodies responsible for nature conservation in Georgia. Public education and training of local stakeholders are necessary to undertake for successful realization of the project.

The environmental objective is to improve conservation and sustainable use of medicinal and herbal plants of global importance at the national and the local levels for the selected areas through achieving the following objectives over and above the Baseline Scenario: (1) Assess existing environmental conditions in the region and determine main threats to the local flora; (2) Determine main gaps in existing knowledge on medicinal plant distribution and conditions of their populations; (3) Analyze regional baseline data and the identified short list of the rare plant species that have medicinal/decorative properties and are known to be threatened on a global level by anthropogenic stresses and/or impacted locally by natural hazards.

## 2. Environmental Data

### 2.1. Area of the field surveys

Samtskhe and Javakheti regions represent provinces of Southwest Georgia (Neidze, 2003). It adjoins to Turkey and Armenia in the south, Adjara (Khulo district) and Guria (Chokhatauri district) in the west-northwest, Imereti (Kharagauli and Bagdati districts) and Kartli (Borjomi district) in the north and Kmevo Kartli (Tsalka and Dmanisi districts) in the east. The territory of Samtskhe-Javakheti region is 5 200 km<sup>2</sup> (Neidze, 2003), which represents 7,5 % of the entire territory of Georgia - 69 700 km<sup>2</sup>.

Administratively Samtskhe is represented by three districts - Akhaltsikhe, Adigeni and Aspindza with a total square of 2 610 km<sup>2</sup>. Javakheti contains two districts - Akhalkalaki and Ninotsminda with a total territory of 2 590 km<sup>2</sup> (Neidze, 2003). Currently Borjomi district is included in Samtskhe-Javakheti administrative region. Although, this territory historically belongs to Kartli.

Geographically Samtskhe is represented by Akhaltsikhe depression with average elevation 800-1500 m a.s.l., mountain systems are Meskhети, Arsiani, Erusheti, Kasri, Gumbati and Vani ranges and southwestern-western slopes of Trialeti range (Klopotovski, 1950, Nemanishvili, 1960, Maruashvili et al. 1971). The highest peak is Kiumbet (2964 m a.s.l.). Main rivers are Mtkvari, Potskhovi, Kvabliani, Uraveli, Otskhe and

Tsinubnistskali. Several lakes are in Samtskhe - Lake Satakhve or Karageli (1940 m a.s.l.) near v. Zarzma, Lake Tsunda (1340 m a.s.l.) near v. Tsunda in Aspindza district, as well, artificial three Jaji Lakes (2240 m a.s.l.) and Triala Lake near v. Lelovani in Adigeni district.

Javakheti is located on volcanic plateau with average elevation of 1800 m a.s.l. Mountain systems are Niala range in the south, Javakheti range in the east, southern slopes of Trialeti range in the north, and Abul-Samsari range in the middle. There is Tetrobi-Chobareti range with the Tetrobi Plateau in the north-west and composed of limestone. Highest peaks are Didi Abuli (3304 m a.s.l.), Samsari (3284 m a.s.l.), Godorebi (3188 m a.s.l.), and Patara Abuli (2801 m a.s.l.). There are 56 lakes on Javakheti Plateau. The largest are Paravani (37,5 km<sup>2</sup>), Kartsakhi, Tabatskuri, Khanchali, Madatafa, Saghamo, etc. Main river is Paravani, with many minor tributaries such as Abulistskali, Murjaketistskali, Baraletistskali, Chobaretistskali, etc.

Land use of the territory of Samtskhe-Javakheti region shows following pattern: agricultural land 68,5%, forest 20,1%, shrubland 0,9%, water bodies - 1,8%, urban territory - 5,0% and arable land - 3,7% (Neidze, 2003).

### 2.2. Geomorphology and Geology

This section is based on an Engineering-Geology literature review for the BTC pipeline (Oniani 2000, see in Kikodze, 2002). Geologically, the territory of Georgia belongs to the Alpine System of Eurasia. Georgia as a part of Caucasus is located between the Euro-Asiatic and Afro-Arabian plates at the junction of European and Asiatic branches of the Mediterranean (Alpine-Himalayan) fold belt. Its geological structure is built up mainly by Mesozoic and Cenozoic deposits (Klopotovski, 1950). Early Precambrian and Paleozoic formations spread over a smaller area. Its geological and geomorphologic structure reveals a great genetic diversity, as a result of tectonic, volcanic, petrological, gravitational, erosional and other processes.

Structurally, the area can be divided into the fol-

lowing major landforms (Klopotovski, 1950):

- 1) The range of the Greater Caucasus (Kavkasioni);
- 2) The Georgian Intermountain Area (between the Greater and the Minor Caucasus);
- 3) The Mountain System of the Minor Caucasus (Meskhети-Trialeti Mountain Systems), including the South Georgian Volcanic Upland.

The Javakheti Volcanic plateau forms the largest geomorphologic zone and comprises steep peaks, a volcanic plain and historic lava flows (Klopotovski, 1950, Maruashvili et al., 1971). The plateau is composed of Upper Cretaceous and Tertiary igneous rocks including lavas and shallow intrusive rocks such as andesite, basalt and dolerite.

The plateau is comprised of lava flows and by an undulating volcanic plain with quaternary lake basins such as Paravani, Kartsakhi, Sagamo, Khanchali, Madatafa etc. and their associated unconsolidated deposits. Steeply undulating high volcanic peaks are noted in the area of Trialeti and Samsari ranges.

The Akhaltsikhe synclinal basin (see in: Kikodze, 2002) is composed of undulating hills and valleys and forms the geomorphologic zone between the Trialeti and Erusheti ranges. The hills are composed of Tertiary sedimentary rocks dissected by river valleys and their associated deposits. Adjara-Trialeti mountain system in the north of Samtskhe

is represented by a volcanogenic suite with calcalkaline basaltic composition, which in the lower part also contains the Albian Stage. The Western Trialeti range represents a fold of the Minor Caucasus Mountains and comprises a deeply dissected steep mountain terrain. The high peaks are composed of Tertiary igneous rocks including pyroclastic deposits (such as tuff conglomerate, tuff breccia, tuff sandstone and tuff mudstone) and shallow intrusive rocks for example andesite sheets. Tertiary sedimentary rocks (such as limestone, sandstone and mudstone) and clays are noted in the lower mountains at Tiseli and unconsolidated quaternary deposits are noted at the base of the steep mountain valleys.



Fig. 1. Hills near Arali village in Meskheti

In the south of Samtskhe and Javakheti the Artvin-Bolnisi Block and Lock-Karabach Zone transgressive upper Cretaceous sediments are present, which are subdivided cenomanian volcanogenic-carbonate series (900-1200m) overlap directly the Khrami and Locki massifs and Jurassic rocks. In ascending section there is a basalt-andesite-dacite-rhyolite series (1100-3300m) of Turonian-Santonian age.

Quaternary deposits are widespread in the region. These recent deposits are generally unconsolidated but may be locally cemented. They are represented by the following depositional facies:

- ❁ Fluvial Deposits: These floodplain and floodplain overlying deposits are noted in the gorges and valleys of the rivers such as the Mtkvari and Potskhovi. The lithological composition of these deposits includes boulders, pebbles, gravels, sands, loams and clays.

- ❁ Floodplain Deposits: These deposits are characterised by stratified deposits of sands, gravels and clays. Deluvial-proluvial sediments on the slopes of the Ajara-Imereti range include slightly rounded pebbles and gravel with some sandy clay. Other types of alluvial sediments include of weakly cemented conglomerates, cobbles, coarse gravel, silts and sandy, silty clay.
- ❁ Flysch/Molasse Deposits: These deposits are formed from the sediments produced by the uplift, deformation and erosion of mountains. Such deposits are represented by Palaeogene deposits and include clays, gypsiferous clays, sand stones, marls and limestones. These deposits are found in the gorges and valleys of the Rivers Mtkvari and Potskhovi and along the north of the Akhaltsikhe basin.
- ❁ Intrusive formations are created when a

body of rock forces itself into existing rocks, either along a definite structural feature such as bedding planes, cleavage or joints or by deformation or cross cutting of the invaded rocks. Intrusive formations include Tertiary gabbros and Palaeozoic granitoids. Gabbro outcrops are noted in the volcanic plateau region. Granite outcrops are located on the southern slopes of Trialeti range southern of Tsalka depression.

- ❁ Effusive or extrusive formations occur when igneous rock has flowed at the surface of the Earth and commonly include rocks formed by volcanic eruptions such as ash and lavas. Effusive formations occur over a large part of Samtskhe-Javakheti region and are represented by Tertiary & Quaternary basalt, andesite, dolerite and dacite deposits. The Javakheti volcanic plateau is composed mainly of lava flows whilst the

rocks forming the Kashuri mountains and those near the Turkish border also include Pyroclastic deposits such as tuff, breccia, tuff breccia, tuff sandstones and conglomerates interbedded with lava flows.

- ❁ Outcrops of Tertiary sedimentary rocks occur on the undulating hills and valleys of the Akhaltsikhe Basin and the deeply dissected valleys of the Kashuri mountains. Outcrops of Palaeogenic sediments are located in the outcrops of Goderdzi Pass. Similar sediments are found in the areas adjacent to the Turkish border.

The geology of this region is reflected in the landforms described above. The lithological types are generally Tertiary volcanic and sedimentary deposits and Quaternary fluvial or terrigenous deposits. This section is based on an Engineering-Geology literature review (Oniani 2000, see in Kikodze, 2002).

## 2.3. Climate



Generally, Georgia is known for its favorable climate, with the Greater Caucasus Range serving as a barrier to the cold air from the north, producing a high thermal regime and a small number of extreme meteorological events. As a whole, the country can be divided into two distinctive climatic zones: humid subtropical in the west of the country, and dry subtropical in the east, naturally separated by the Surami range. The climate in Eastern Georgia is largely a product of the Surami Mountain Range, located in western Georgia, and the dry plains of Azerbaijan to the east. The predominantly west-to-east transfer of air masses over the region, along with orographic lifting of the air associated with the mountain ranges, produce a damp climate in the western parts of Georgia, with almost uniform precipitation throughout the year. Consequently, the eastern side of the mountain ranges experience lower relative humidity, resulting in a dry-subtropical climate.

The climate in the Samtskhe-Javakheti region is determined as continental. However, more recent survey is defining it as subtropical (Oniani 2000, see in Kikodze, 2002) characterised by moderate precipitation, pronounced seasonal variations in climatic parameters, and a high level of solar radiation. According to these data region comprises two sub-climatic zones, mainly owing to the differing relief and orography. They are described as follows:

- ❁ The humid-subtropical mountainous climate with cold winter ( $<-5^{\circ}\text{C}$ ) and cool summer ( $<20^{\circ}\text{C}$ ), located in the Trialeti and Samsari Mountain ranges and Javakheti Plateau. The altitude, approximately 2,500 metres, largely explains the lower temperatures in this region. The high-mountain profile of the area accounts for its near extreme climatic conditions. The estimated mean annual temperature for the area is  $9.5^{\circ}\text{C}$ , with an estimated average of  $-1.4^{\circ}\text{C}$  in January and  $19.5^{\circ}\text{C}$  in July. Generally, the region experiences cold and occasionally snowy winters and long, but mild, summers. Precipitation increases westward with proximity to the Trialeti range.
- ❁ A humid subtropical mountainous climate with cool winters and mild summers is characteristically to the transient climatic zone located south-west of the Adjara-Trialeti Mountain System and west of Samsari Mountain ranges in Meskheta up to the Turkey-Georgia border and Arsiani ranges. Mean annual precipitation in the transitional climate region is approximately 508 mm, and 654mm at the Georgian-Turkish border. The majority of the precipitation falls between April and October, with May and June being considered the months with most rainfall (82mm/month and 88mm/month,



accordingly). The driest months of the year in these parts are December (32mm/month) and January (30mm/month). Precipitation data specific to the mountains and mountainous steppes near the Georgia-Turkey border are scarce. However, existing data and reports suggest that heavy and frequent rainfalls do not commonly occur in this region. Data related to snow cover in the area are poor, although the highlands can be covered with snow for as long as 90 days per year. There is a strong correlation between altitude and snow cover. Typically, air temperature decreases with rising altitude, leading to increasing amounts of snowfall and duration of snow cover. Precipitation can usually be expected in the form of snow when ground temperatures are below 1-2°C, although this relationship is complicated by other meteorological influ-

ences, such as the atmospheric temperature profile.

Wind speeds are reported with an estimated annual average of 5.4m/s, although still predominantly northerly and northwesterly. However, speeds in excess of 12 m/s can occur for up to 50% of the year, with maximum wind speeds reaching as high as 30m/s. The mean number of gale days (days in which wind speeds are approximately 17-20m/s) for the Javakheti region is relatively low, compared to the Meskheta, at 21 days per annum. The last climatic zone are affected by both easterly and westerly winds, becoming increasingly strong in the high mountains (greater or equal to 15m/s). Available data suggests that average wind speed recorded near the Metering and Pressure Reduction Station (PRS) at the Georgia-Turkey border is 6.7m/s. The maximum wind speed recorded in this area over 20 years of observation was 57m/s.

## 2.4. Hydrology and Main Water Bodies

The hydrographic system of the Samtskhe includes the upper reaches of the River Mtkvari, from the state border with Turkey to the beginning of Borjomi gorge. Within this area, the Rivers Postkhovi and Kvabliani (left tributaries) flow into the River Mtkvari. Water-bearing horizon of recent alluvial sediments of river bed and floodplain have a wide distribution on the wide valley areas of the Mtkvari, Tsinubnistskali, Otskhe, Potskhovi and Kvabliani. Water-bearing complex of Upper Miocene-Lower Pliocene (lower part of Ksatibi series) lava layers is exposed over a large area, namely south of the village Arali, between the villages Skhvlisi and Tskaltbila and south of the village Varkhani. The lithology of the complex includes andesite, andesite-dacitic and dacitic tuff and tuffaceous breccia lava layers. Majority of tectonic structures in Akhaltsikhe depression and its adjacent areas are comprised of Middle Eocene volcanogenic-sedimentary strata. These strata comprise the Tsnisi and Akhaltsikhe anticlines complicated by the secondary disjunctive dislocations (see Kikodze, 2002).

The River Mtkvari starts at the springs on the northern-eastern slopes of Kizil Giadik Mountain in Turkey, at an altitude of 2,720m. The total length of the river is 1,364 km, the area of the water catchment basin is 188,000km<sup>2</sup>. The river length is 360km in Georgia while the area of the catchment basin is 26,200km<sup>2</sup>. The river is recharged by snow

melt, rain and groundwater; contribution of glacial runoff is negligible. Highest water levels are observed during spring when discharge is at its greatest with approximately 53% of the annual discharge occurring. Summer discharge makes up 25% of the annual figure with low-flow conditions experienced in autumn and winter when seasonal discharges constitute just 12% and 10% respectively of annual discharge. The maximum recorded flow rate of the River Mtkvari was observed in April 1968. The return period of this event ranges from 100 to 150 years, depending which observation station is used for the estimation. The solid sediment load in the River Mtkvari is closely related to the river's discharge rate. Maximum average daily loads range from 470kg/sec to 32,000kg/sec at various observation stations. Water turbidity is also significant, with maximum levels recorded to fluctuate from 2,700g/m<sup>3</sup> to 120,000g/m<sup>3</sup> at various monitoring stations (see Kikodze, 2002).

The River Potskhovi starts on the eastern slopes of Arsiani ridge in Turkey, at an altitude of 2,720m a.s.l. It flows into the River Mtkvari from the left bank at the village of Kotlakhevi. The river is approximately 64km long, the water catchment basin occupies 1,840km<sup>2</sup>. The river length in Georgia is approximately 35km while the catchment basin is 1,331km<sup>2</sup>. The river is recharged by snow melt, rain and groundwater. It is characterised by spring floods and flashfloods owing to heavy

summer-autumn precipitation rains and low-flow conditions in winter. Spring discharge is 55% of the annual volume, summer discharge 25%, 13% in autumn and 7% in winter. Long term average solid sediment load is estimated to be 10kg/sec. A maximum solid sediment load of 230kg/sec was observed in May 1968 under flood conditions. Water turbidity typically fluctuates from 670g/m<sup>3</sup> to 9,800g/m<sup>3</sup>. Average duration of ice cover is 55

days whilst the maximum, 90 days, was observed in 1956- 1957.

The minor rivers, streams and gorges within the region are typically mountainous rivers, some of which are characterised by sudden flash floods of a catastrophic nature during rapid snow melt and are highly responsive to heavy precipitation events.

## 2.5. Soils



There is a great diversity of soil types in Georgia. The following soil provinces can be distinguished:

- 1) the soil province of Western Georgia;
- 2) the soil province of Eastern Georgia;
- 3) the soil province of Southern Georgia.

The main types of soil are allocated in accordance with the altitudinal zones. In the Western Georgia soil province (between the Black Sea and Likhi Mts.) it is possible to distinguish the bog and podzolic soil zone in the lowlands, the krasnozem and zheltzem zone in the hilly piedmonts, the zone of mountain-forest and the mountain-meadow soils.

The soil province of Eastern Georgia comprises the plains, piedmonts and mountain massifs, situated eastwards from Likhi mountain range. Chestnut soils, chernozems, brown humic-sulphates, saline soils of steppes and semi-deserts, as well as intermediate forest-steppe and mountain-meadow soils occur in this province.

The Southern Georgia soil province includes Javakheti, Tsalka-Dmanisi and Erusheti uplands, the hollow of Akhaltsikhe, etc. A considerable part of this area is covered both with the mountain chernozems (which are formed at altitudes from 1200-2200m) and meadow chernozem-like soils. In highlands they are replaced by mountain-meadow soils. Besides, the alluvial soils, redzinas, brown as well as the meadow-brown soils occur here, with the predominance of brown forest type of soil in the mountain forest belt.

The types of soils (Oniani 2000, see in Kikodze, 2002) present in the region are briefly described below:

- ❁ Brown soils: Brown soils are mostly found on the southern slopes of the Trialeti Range and east-southern slopes of Meskheti range.

Such soils are formed in relatively mild and humid climatic conditions. Groundwater is located at a significant depth below ground level and does not participate in the soil formation process. Characteristic relief forms are ridges and slopes with different aspect and gradient, dissected by deeply cut river gorges and ravines. Soil forming strata are: sandstones, clays, shales, abyssal strata and scree. Deluvial-proluvial and in some places skeletal non-carbonate sediments occur at the base of slopes. Typical brown soils mainly occur in beech forests. However, they can sometimes be found in hornbeam forests or hornbeam forests with oak. Dark brown soils are developed in spruce forests while skeletal brown soils are weakly developed in pine forests. Strata are intensively weathered in the brown soil zone and therefore, scree and overlying topsoil are of heavy loamy mechanical composition. The profile of brown soils is well differentiated. Humus content varies between 3 and 10%. The soils are characterised by an acid reaction, which decreases with depth; approaching neutral with depth. The brown soils are prone to washout (surface) erosion.

- ❁ Black and peat-rich mountainous-meadow soils of southern mountainous region: These soils are mostly found in sub-alpine and alpine zones at higher elevations than the brown soils. Soil formation is very slow under the cold climatic conditions. The soils are protected from surface erosion by the extensive root system of herbaceous plants that forms a strong turf. The root system also provides ample organic matter for humus formation, which results in these soils being rich. In some cases organic matter accumulates in the form of peat. These soils are characterised by well-developed humus of granular structure, a mostly weak acid or acid reaction and good physical





properties. Since the soils support a good vegetation cover with a good diversity of plants, they provide valuable summer pastures and hay fields. Erosion processes are ongoing in these soils, particularly when the vegetation on these soils is grazed intensively.

- ❁ Weathered carbonate black mountainous soils. The relief in the zone of mountainous black soils (Javakheti) is a volcanic plateau formed with layers of the Neogene Quaternary period consisting of andesite-basalt. The carbonate black soils occurring in this area have no silica content and are characterised by a dark grey upper horizon, with thickness varying from 30 to 50cm and good structure. The lower horizon is relatively carbonaceous. Typically, the soil thickness is 100 - 120cm. The average humus content is 3 - 15% and decreases with depth. Black soils are highly fertile.
- ❁ Peat-rich and primitive mountainous-meadow soils of Trialeti range. These soils occur in the sub-alpine and alpine zone of Kodiana massif and are formed under humid and relatively cold climatic conditions. An extensive system of herbaceous plants forms a strong turf, which protects the soil from surface erosion and provides ample organic material for the formation of

humus. As a result, mountain-meadow soils are relatively rich in humus and are prone to the formation of peat if organic matter accumulates. Skeletal and primitive varieties of this soil type are developed in debris cones and alluvial fans. They are characterised by a solid matrix, relatively low thickness, and differentiated profile.

- ❁ Brown forest soil. This soil type occurs mainly in the Akhaltsikhe depression, at altitudes of 900 - 1,200m, on slopes of different aspect and gradient, alluvial fans and on sloping plains. Brown forest soils mainly develop on weathered crusts of sandstones and deluvial-proluvial sediments. Vegetation cover includes oak forests and oak forests with hornbeam. Mean annual precipitation varies within 500 - 800mm in the zone of forest brown soils. The water table is located at a significant depth below ground level and does not participate in soil-formation processes. Leached brown soils are found at the upper altitudes in the distribution zone for the soil type. Carbonate-brown soils occupy the lower zone where there are favourable conditions for calcium carbonate accumulation. The upper horizon is characterised by granular structure. Humus content varies from 3 to 5%. Brown soils are fertile.



### 3. Vegetation and Flora

Samtskhe-Javakheti region is a distinct geomorphological formation. Its vegetation is characterised by peculiarity and, to a certain degree, contrasts (Sosnovski, 1933). It represents crossroads of geographical-genetic elements characteristic to the Mediterranean, Iran-Turkish and northern hemispheric ancient flora. This landscape-geobotanical zone comprises wetlands, unique lakes and marshes, various modifications of mountainous steppes, mountainous xerophytic communities, dry and mesophilous meadows and relict remnants of forests once common in Javakheti upland, etc (Sosnovski, 1933, Ketskhoveli, 1959).

There are two relief forms in the upland of southern mountainous region - plateau formed by lava flows and volcanogenic cones (peaks). Volcanogenic and orogenic process coincided with the glaciation (Pliocene-Pleistocene), which resulted in total destruction of the Tertiary vegetation (Sosnovski, 1933). Recent flora was also developed as a result of complex processes - glaciation was followed by xerothermal periods, which determined formation of mesophytic, xeromesophytic and xerophytic meadows. In parallel wetland vegetation was developed. According to the historical sources, forests used to occupy large areas on Javakheti upland (Troizki, 1927). These were almost entirely destroyed due to human activities and survive only in minor fragments.

There are following vegetation zones in southern mountainous region of Georgia (Dolukhanov, 1989, Khintibidze, 1990):

1. Middle montane zone (800-1500 m a.s.l.) - largely used as arable land. The natural vegetation survives as riparian forests, oak-hornbeam forests, mountain xerophytic shrublands, mountain steppes;
2. Upper montane zone with beach-coniferous mixed forests (1200-2050 m a.s.l.);
3. Subalpine zone (1900 (2050)-2400(2500) m a.s.l.) - represented by treeline ecotone, tall herbaceous vegetation, shrublands and polydominant subalpine grass and herb meadows. This zone is typologically diverse;
4. Alpine zone (above 2500 - 2900 m a.s.l.) - alpine meadows and snowbed communities are present. Vegetation is mostly used for grazing and is of considerably lower quality than the subalpine vegetation, both by bio-

mass volume and typological diversity.

5. Subnival zone (2900-3300 m a.s.l.) is represented only on Abul-Samsari range.
6. Azonal vegetation type is represented by fragments of wetlands rich in boreal type flora, halophilous desert vegetation and rocky areas. It should be noted that xerophytic rock vegetation supports high number of endemic species.

The region is divided into three floristic provinces - Euxine, Armeno-Iranian and Caucasian (Grossheim, Sosnovski, 1928; Takhtajian, 1986). Euxine province enters in the extreme western part of this region on Arsiani range and partly on Adjara-Imereti range. Armeno-Iranian province comprises the southern part of Meskheta and Javakheti Plateau characterized by xerophytic vegetation and mountain steppes. Caucasian province occupies the most part including almost all mountain systems.

Two floristically distinct regions are distinguished for Samtskhe-Javakheti by A. Doluchanov (1989) - Adigeni-Borjomi region and Javakheti upland. The first includes north-west slopes of Trialeti range, southern slopes of Meskheta range, Akhaltsikhe depression and river Kvabliani gorge. R. Mtkvari above v. Khashuri divides Adjara-Trialeti mountain system into two ranges Trialeti and Meskheta. Elevation in this section ranges from 750-800 m a.s.l. to 2700 (2900) m a.s.l. Most prominent part of Mtkvari valley represents Akhaltsikhe depression. Elevation at the base of the depression near town Akhaltsikhe is 950-1000 m a.s.l. It increases considerably to the south to Turkish border.

The following biomes are distinguished in Samtskhe: Riparian forests in floodplains (800-1150 m a.s.l.), xerophytic shrublands and semi-deserts (800-1200 m a.s.l.), Oak-Oriental Hornbeam and Oak-Hornbeam forests (900-1200 m a.s.l.), Beech-coniferous forest (1100-2050 m a.s.l.), treeline ecotone (2050-2200 m a.s.l.), tall herbaceous vegetation and subalpine meadows (2100-2500 m a.s.l.) in the subalpine zone; azonal rock vegetation, and alpine meadows (2500-2900 m a.s.l.) and snowbed communities in the alpine zone. The boundaries of biomes and vegetation zones vary considerably depending on precipitation and slope exposition.

Javakheti volcanic upland supports the following



biomes- pine forests, xerophytic shrublands, high-mountain steppes of South Georgia, subalpine and alpine meadows, rock vegetation and wetlands.

Small area of subnival vegetation above 2900 m a.s.l. is characteristic of high peaks of Abul-Samsari range (Nakhutsrishvili, 1966).

### 3.1. Main Biomes of Samtskhe-Javakheti



#### 3.1.1. Mountain xerophytic shrublands and arid vegetation

Mountain xerophytic vegetation is widely distributed in Samtskhe-Javakheti region from 900 up to 2200 m a.s.l. It mainly occurs in the R. Mtkvari gorge and other gorges of Meskheti. They are characteristics of limestone Plateau Tetrobi in Javakheti. There are tragacanthic phryganoid, shibliak and semi-desert communities (Khintibidze, 1990). Tragacanthic community is represented by

edificator species *Astragalus microcephalus*, *Acantholimon armenum*, *A. glumaceum*, and elements of shibliak *Paliurus spina-christi*, *Rhamnus pallasii*, *Cotinus coggygria*, *Berberis vulgaris*, *Atraphaxis caucasica*, *Cotoneaster krasnovii*, *C. integerrimus*, *Crataegus orientalis*, *Amelanchier ovalis*, *Lonicera iberica* etc. (Ivanishvili, 1973; Khintibidze, 1990).



Fig. 2. *Rhamnus pallasii* in flowering near Akhaltsikhe

Middle montane and upper montane types of tragacanthic communities are distinguished (Khintibidze, 1990). The first with 199 species of vascular plants is spread along the Mtkvari River (900-1300 m a.s.l.) and in gorges of rivers Uraveli, Otskhe, Potskhovi, Kvabliani and Tsinubnistskhali. Tragacanthic vegetation enters pine forest in vicinity of v. Damala. This plant community contains rare species *Astragalus arguricus*, *A. raddeanus*, *Onobrychis sosnovskyi*, *Vicia akhmaganica*, *Salvia compar*, *Scutellaria sosnovskyi*, *Psephellus meskheticus* etc. In some places tragacanth enters

oak forest. The following rare species occur in this community: *Dianthus calocephalus*, *Silene brotherana*, *Erysimum caucasicum*, *Coronilla orientalis*, *Satureja spicigera*, *S. laxiflora*, *Teucrium polium*, *T. nuchense*, *T. orientale*, *Sideritis comosa*, *Bupleurum exaltatum*, *Convolvulus lineatus*, *Campanula hohenackeri* etc.

Upper mountain type of tragacanthic community with 157 species of vascular plants is present in Javakheti Plateau in the vicinity of v. Azavreti, Aragva, Kartsakhi and in R. Paravani gorge. As

well in south-east part of Meskheti near v. Niala, Busmareti, in the gorge of Kazamretistskali and Mt. Ziareti. Edificatory species of this community is *Astragalus glumaceum*.

Phryganoid communities support species *Ephedra procera* and *Tanacetum argyrophyllum* and are spread in eastern part of Akhaltsikhe depression. Peculiar population of *Ephedra procera* occurs in the vicinity of v. Khertvisi. Other characteristic

species of this community are *Cytisus caucasicus*, *Caragana grandiflora*, *Dianthus calocephalus*, *Hedysarum turkeviczii*, *Onobrychis meskhetica*, *Teucrium polium*, *Thymus sosnovskyi*, *Stachys atherocalyx*, *S. iberica*, *Festuca valesiaca*, *Campanula hohenackeri*, *C. raddeana*, *C. alliariifolia*, *Artemisia sosnovskyi*, *Stipa capillata*, *S. pulcherrima*, *Koeleria macrantha*, *Elymus elongatus*, *E. trychophora*, *E. caespitosa*, *Agropyron repens var. subulatus*, *Valerianella plagiostephana*.



Fig. 3. *Ephedra procera* near v. Khertvisi

Semi-desert plant communities are present in R. Mtkvari gorge near v. Rustavi and v. Aspindza. Outstanding species in this community is RDB species *Nitraria schoberi* with other 39 species of the community *Reamuria kuznetzovii*, *Astragalus cyri*, *A. kozlovskyi*, *Caccinia rauvolffii var. meskhetica*, *Ceratocarpus arenarius*, *Ceratoides papposa*, *Eremopyron orientale*, *Gamanthus pilosus*, *Kochia prostrata*, *Camphorasma monspeliaca*, *Limonium meyeri*, *Picnomon acarna*, *Sterigmostemum incanum*, *S. tomentosum*, *Tragopogon meskheticus*, *Stizolophus coronopifolius*, *Callicephalus nitans*, *Crepis pannonica* etc. (Bobrov, 1946; Kikodze, 1967; Khintibidze, 1990). Many species of the genus *Artemisia* are characteristics for this type of

vegetation.

Shibliak is widespread in middle montane zone mixed with tragacantic vegetation. Dominant species are *Cotinus coggygria*, *Atraphaxis caucasica*, *Rhamnus pallasii*, *Cytisus caucasicus*, *Paliurus spina-christi*, etc.

Yellow blue-stem grass (*Bothriochloa ischaemum*) community presents mainly secondary vegetation developed in disturbed areas replacing natural vegetation. Associated species are *Veronica orientalis*, *Galium verum*, *Achillea micrantha*, *A. millefolium*, *Cleistogenes bulgarica*, *Elymus repens*, *Festuca valesiaca*, *Koeleria macrantha*, *Poa pratensis* etc.





### 3.1.2. Forests

#### 3.1.2.1. Riparian forests

The habitat along the rivers Mtkvari, Potskhovi, Kvabliani, Tsinubnistskali and Otskhe is characterised by a primary riparian forest and partly by relict tugay forest (Kikodze, 2002), which is extensively fragmented and does not constitute a continuous habitat. It is significantly degraded and is not particularly vulnerable to anthropogenic activities given the existing level of disturbance. In addition large areas of forest have been cleared to make room for orchard or agricultural crops. Dominant species in riparian forest is *Alnus barbata* associated with *Quercus pedunculiflora*, *Populus hybrida*, *P. nigra*, *Crataegus monogyna*, *C. pentagyna*, *Cornus mas*, *Prunus spinosa*, *Ligustrum vulgare*, *Lonicera caprifolium* etc. (Gvritishvili, Kimeridze, 2001).



Fig. 4. Riparian forest of Mtkvari River near Akhaltsikhe

#### 3.1.2.2. Oak and Hornbeam Forests

Oak forests, dominated by Georgian oak, *Quercus iberica* occupy western and northern slopes of middle montane zone (Dolukhanov, 1989; Khintibidze, 1990). It occurs in slopes of Meskheta range, in R. Uraveli and R. Kvabliani gorges. Oak in some areas is mixed with Hornbeam *Carpinus betulus*, in other mainly occurs with Oriental Hornbeam *Carpinus orientalis*. The other characteristic species are *Acer platanoides*, *Cornus mas*, *Corylus avellana*, *Crataegus pentagyna*, *C. monogyna*, *Malus orientalis*, *Pinus kochiana*, *Pyrus caucasica*, *Swida australis*, *Ulmus glabra*, etc. Outstanding peculiarity of oak forests in Samtskhe is the fact that in upper boundary of this type of forests hornbeam is substituted by *Ostrya carpinifolia*, such forest occupies considerable territory in R. Uraveli and R. Kvabliani gorges. The components of shibliak, such as *Paliurus spinachristi*, *Rhamnus pallasii*, *Spiraea hypericifolia* etc., are admixed on lower boundary of the oak forest, as a result of degradation of this natural stand. *Lonicera iberica* is rarely found in the oak forest.



Fig. 5. Oak-Hornbeam forest near Closter Safara with *Ostrya carpinifolia*.

### 3.1.2.3. Beech-coniferous forests

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Beech forests (*Fagus orientalis*) with the elements of Kolkhic flora are well developed in the west of Meskheti in upper areas of R. Kvabliani gorge on Arsiani range and on the eastern slopes of Meskheti range. It forms subalpine krummholz in Goderzi Pass reaching elevation 2100 m a.s.l. (Khintibidze, 1990). Small population is found on Oshora range

above v. Damala (Mukbaniani, 1976). Western and north-western regions of Meskheti are characterized by dark coniferous forests (Dolukhanov, 1989) in upper montane zone representing by *Picea orientalis* and *Abies nordmanniana* mixed with beech. Almost virgin dark coniferous forest occurs in Abastumani along the road to the observatory.

### 3.1.2.4. Pine forests

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Pine forests (*Pinus kochiana*) are usually developed on southern slopes of Meskheti, Adjara-Imereti and Trialeti ranges (Khintibidze, 1990). Pine forest has more limited distribution than spruce forests. Although, pine frequently occurs in spruce forests on the northern slopes (Khintibidze, 1990). Pine forests on Erusheti and Tetrobi-Chobareti ranges (1800-2000 m a.s.l.) have little distinguished composition. This pine was before determined as separate endemic species *P. kochiana*, while more widely distributed one was called *P. sosnowskyi*. Now these two species are unified. However, Tetrobi pine forest by composition is considered as outstanding refuge, where pine is mixed with the elements of mountain steppes

(Troitski, 1927). Total 48 vascular plant species are distinguished in this community. The following herbaceous species are associated with *Pinus kochiana*: *Arenaria steveniana*, *Cerastium sosnowskyi*, *Minuartia woronowii*, *Silene dianthoides*, *Sempervivum sosnowskyi*, *Astragalus arguricus*, *A. campylosema*, *Medicago dzhawakhetica*, *Helianthemum nummularium*, *H. orientale*, *Daphne transcucasica*, *Acantholimon glumaceum*, *Heracleum antasiaticum*, *Galium grusinum*, *Centaurea bella*, *Crepis pinnatifida*, *Muscari sosnowskyi* etc. This community is very rich in endemic species occurring mainly on calcareous rocks of Tetrobi Plateau. Peculiar species are parasitic *Philippaea coccinea* and *Asphodeline taurica*.

### 3.1.3. Mountain Steppes

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Mountain steppes are peculiar to South Georgia. They cover Javakheti volcanic Plateau. Steppe vegetation is represented by different plant communities. Most characteristic species of polydominant grass-forb steppes are: *Festuca ovina*, *F. sulcata*, *Stipa tirsia*, *S. pulcherrima*, *Bothriochloa ischaemum*, *Filipendula hexapetala*, *Falcaria vulgaris*, *Galium cruciatum*, *Koeleria macrantha*, *Medicago hemicycla*, *Phleum phleoides*, *Polygala anatolica*, *Thymus caucasicus*, etc.

Besides, there are secondary meadows developed mainly on sites once occupied by primary forests. Like previous communities these meadows are composed by the variants of polydominant grass-forb vegetation with participation of *Agrostis planifolia*, *Alchemilla erythropoda*, *Brachypodium sylvaticum*, *Bromopsis variegata*, *Calamagrostis arundinacea*, *Centaurea salicifolia*, *Dactylis glomerata*, *Lotus caucasicus*, *Trifolium ambiguum*, *T. canescens*, etc. From monodominant meadows can be mentioned communities with such dominant species as *Nardus glabriculumis* (dzigviani in Georgian), *Anemone fasciculata* (frintiani),

*Agrostis planifolia* (namikrephiani), *Brachypodium sylvaticum* (barseliani), *Bromopsis variegata* (shvrieliiani), etc. (Kvachakidze, 1996).

Natural herbaceous vegetation of Javakheti Plateau has been transformed and is represented by various modifications of secondary stepped meadows and mountainous polydominant steppes. Stepped meadows are comprised of *Carex humilis*, *Festuca valesiaca*, *F. ovina*, *Filipendula hexapetala*, *Polygala anatolica*, *Stipa tirsia*, etc. Secondary post-forest meadows are dominated by *Agrostis planifolia*, *Alchemilla erythropoda*, *Bromopsis variegata*, *Calamagrostis arundinacea*, *Dactylis glomerata*, *Geranium sylvaticum*, *Lotus caucasicus*, *Ranunculus caucasicus*, *Trifolium canescens*, etc. The southern slopes are occupied by polydominant steppes mainly formed by grasses *Festuca ovina*, *F. valesiaca*, *Stipa pulcherrima*, *Stipa tirsia*, *Koeleria macrantha*, *Phleum phleoides*. Forbs are represented by *Filipendula hexapetala*, *Cruciata laevipes*, *Medicago hemicycla*, *Thymus rariflorus*, etc.





Subalpine grass and grass forb meadows are found in the subalpine forest complexes. Grass meadows are formed by *Festuca ovina*, *Festuca woronowii*, *Bromopsis variegata*, *Calamagrostis arundinacea*.

These species form coenoses both independently and in co-dominance. The subalpine meadows occur above the subalpine forest zone, at the altitudes of 2100-2200 m a.s.l.

### 3.1.4. Subalpine Vegetation

Subalpine zone is represented by krummholz, subalpine shrublands, tall herbaceous vegetation and polydominant subalpine meadows. Subalpine krummholz is represented by *Betula litwinowii* and *B. pendula*, *Acer trautvetteri*, *Sorbus aucuparia*, *Salix caprea* etc. Shrubland is composed by Caucasian Rhododendron, *Rhododendron caucasicum*, *Vaccinium myrtillus*, *Empetrum hermaphroditum* etc.

Subalpine birch and maple forests are found on the northern slopes while pine forests are developed on the southern slopes at the altitudes of 1800-1900 m a.s.l..

Javakheti upland used to be covered by forests, which were entirely destroyed due to high anthropogenic pressure in XVIII-XIX cc (Troizki, 1927). Only minor fragments of the subalpine forests survive mostly on northern slopes of the high-moun-

tainous areas. These fragments are formed by species typical for the Caucasian subalpine forests, namely: Litvinov's birch (*Betula litwinowii*), mountain ash (*Sorbus aucuparia*), goat willow (*Salix caprea*), Bieberstein's rock currant (*Ribes biebersteinii*), alpine currant (*Ribes alpinum*), in some areas - European aspen (*Populus tremula*), etc. Litvinov's birch and mountain ash form communities over small areas in the rocky relief.

Tall herbaceous vegetation is composed of 3-4 m high herbs, mainly dicots (Nakhutsrishvili, 1999). Typical species forming subalpine tall herbaceous vegetation are as follows: *Anemone fasciculata*, *Geranium ibericum*, *Scabiosa caucasica*, *Senecio rhombifolius*, *Betonica macrantha*, *Cephalaria gigantea*, *Doronicum macrophyllum*, *Aconitum nasutum*, *Campanula lactiflora*, *Delphinium flexuosum*, *Heracleum wilhelmsii*, *Grossheimia macrocephala*, etc.



Fig. 6. *Betonica macrantha* and *Grossheimia macrocephala* in subalpine meadow.

Subalpine grass and grass forb meadows are found in the subalpine forest complexes. Grass meadows are formed by *Festuca ovina*, *Festuca woronowii*, *Bromopsis variegata*, *Calamagrostis arundinacea*.

These species form coenoses both independently and in co-dominance. The subalpine meadows occur above the subalpine forest zone, at the altitudes of 2100-2200 m a.s.l.

### 3.1.5. Alpine vegetation

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The vegetation of the alpine zone is comprised of *Festuca valesiaca*, *F. ovina*, *F. woronowii*, *Alchemilla erythropoda*, *A. caucasica*, *Sibbaldia semiglabra*, *Nardus stricta*, *Cirsium arvense*, sedge *Carex tristis*, mat nardusgrass *Nardus stricta*, and

various grasses. Snowbed communities supports *Carex meinshauseniana*, *Festuca supina*, *F. woronowii*, *Minuartia circassica*, *Corydalis alpestris*, *Senecio taraxacifolius*, *Matricaria caucasica* etc.

### 3.1.6. Subnival vegetation

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It is well represented on Mt. Didi Abuli (3304 m a.s.l.). Besides subnival vegetation, among graves and morens here are alpine snowbed communities dominated by *Carex meinshauseniana*, *Festuca supina*, *F. woronowii* etc. (Nakhutsrishvili, 1966; Khintibidze, 1990). Among subnival plant communities should be mentioned fragments of *Astragalus*

*vavilovii* and *Erysimum krynitzkyi* associations. Total number of species in the subnival zone of Samsari range is 62 (Khintibidze, 1990). Among them are 3 local endemics, 14 endemics of the Caucasus, and others with wider area of distribution in Minor Caucasus and in Asia Minor.

### 3.1.7. Rock - scree vegetation

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Rock-scrub vegetation in Samtskhe-Javakheti reveals properties of xerophytic vegetation. It is spread in Akhaltsikhe depression (900-1500 m a.s.l.) and in Tetrobi Plateau (1800-2000 m a.s.l.). Total 80 species present in this biome.

Among them are: *Erysimum szowitzianum*, *Campanula crispa*, *Veronica livanensis*, *Centaurea bella*, *Minuartia micrantha*, *Jurinea carthaliniana*, *Matricaria rupestris* etc.

### 3.1.8. Wetlands

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Wetland vegetation is of highest significance on Javakheti volcanic upland. In general, peat bog vegetation is found in all climatic zones including tropics, deserts and the arctic zone. It is regarded as intrazonal or azonal vegetation type due to wide range of occurrence. Wetlands of lacustrine origin are found in the mountainous region of the Caucasus. According to K. Kimeridze (1966), wetlands of Tsalka basin and adjacent areas have been mostly formed as a result of tussock swamping of lakes. This swamping type is extremely rare on the main ridge of the Caucasus. It characterizes lakes with dramatic seasonal changes in water level. Tussock sedge (*Cariceta*) formation communities are found on silty or coarse-peat wet substrata, which are frequently waterlogged. The surface water level changes considerably by seasons and years.

Peat formation process is fairly intensive in most tussock sedge formations. This process is characterized by certain peculiarities in wetlands located in Javakheti volcanic upland, namely - at the early stages of wetland formation of this type organic mass is mostly accumulated at the roots of evenly

distributed main coenotype (sedge - *Carex*), gradually forming tussocks. Tussock height is dependent on the duration of swamping and maximum water-logging level of the surface. Having reached this level, tussock height does not increase and organogenic material is mainly accumulated between the tussocks. Tussock sedge communities are characterized by mosaic structure due to formation of microrelief. The above demonstrates the uniqueness of the natural properties idiosyncratic to the eutrophic and oligotrophic wetlands developed on Javakheti volcanic upland. Javakheti wetlands are unique ecosystems, therefore, particular attention should be attached to this vegetation type.

Tussock sedge wetlands occur from the sea level up to the subalpine zone (2000-2200 m a.s.l.). Several types of tussock sedge wetlands are located in this area. Wetland fragment located in the vicinity of Mt. Tavkvetili is fairly large. This tufted sedge wetland is dominated by *Carex acuta* and *C. disticha*. The associated species are as follows: *Carex vesicaria*, *Alopecurus armenus*, *Ranunculus lingua*, *Poa palustris*, etc. Mt. Tavkvetili, Narianis Veli and adjacent areas are characterized by plant com-





munities of scientific interest. A tufted sedge wetland fragment is developed on peat relief at the bottom of Mt. Tavkvetili. The wetland is mainly fed by atmospheric precipitation. Therefore, it frequently dries out. Relatively dry areas are characterized by mesophilous meadow elements. The dominant species is *Carex vesicaria*. Associated species are as follows: *Calamagrostis neglecta*, *Scilla rosenii*, *Comarum palustre*, *Carex huetiana*, *Polygonum carneum*, *Eleocharis meridionalis*, *Carex medwedewii*, *Luzula spicata*, *Carum carvi*, *Ranunculus caucasicus*, *Rumex acetosa*, etc. Mosses *Calliergonella cuspidata*, *Drepanocladus aduncus* and *Climacium dendroides* form synusium.

Peat moss (*Sphagnum palustre*) is developed among Rhododendron (*Rhododendron caucasicum*) shrubs on Tavkvetili plateau. Mosses *Drepanocladus exannulatus* and *D. fluitans* form synusium. Associated species are as follows: *Vaccinium myrtillus*, *Vaccinium vitis-idaea*, *Heleocharis meridionalis*, *Cardamine uliginosa*, *Comarum palustre*, *Anthoxanthum odoratum*, etc. Narianis Veli comprises a flat-bottomed catchment basin of the Ktsia upper reaches. Its vegetation is entirely comprised of the wetland vegetation with various communities dominated by hydrophilous plant species.

According to literature sources (Zedelmaier, 1929, 1933; Kimeridze, 1975), one of the widely distributed wetland plant community on the volcanic upland of the southern Caucasus is that of *Carex dichroandra*. The most widely distributed association are pure tufted sedge communities (*Caricetum acutae purum*). As a rule, it is developed on lacustrine sediments and coarse-peat deposits, waterlogged almost throughout the year. Fairly frequently aquatic plant synusium is developed in pure tufted sedge communities, forming a distinct layer composed of *Potamogeton gramineus*, *Utricularia vulgaris*, *Lemna minor*, etc. The herbaceous cover on tufts (tussocks) is mostly formed by main coenotype (*Carex acuta*). Two types of herbaceous sedge wetlands - *Caricetum acutae comariosum palustrae* and *Caricetum acutae equisetosum heleocharidis* - are rare associations. The former is usually found at the maturity stage of swamping. In this case tufted microrelief is slightly developed, the surface is not waterlogged or waterlogging depth is minor, which facilitates development of moss synusium comprised of *Climacium dendroides*, *Drepanocladus vernicosus* and *Meesia triquetra*. The herbaceous cover includes two layers with *Carex acuta* being a dominant species in the upper layer while *Comarum palustre* is dominant in

the lower. The latter is associated with *Carex diandra*, *C. limosa*, etc. The peculiarity of this association is absence of mosaic structure characteristic to the tufted sedge communities. This type of sedge communities are extremely rare. They are found in the vicinity of Mt. Tavkvetili.

The second association is developed on swampy south-west shores of lake Tabatskuri and is characterized by mosaic structure. Apart from the dominant and subdominant species, the following are present: *Carex disticha*, *C. vesicaria*, *Ranunculus lingua*, *Alisma plantago-aquatica*, etc.

Among the tufted sedge communities of the mountainous region of Georgia *Cariceta wiliucae* is of high scientific interest. Information on distribution and ecocoenotypic peculiarities of *Carex wiliucae* in Georgia was collected and published by K. Kimeridze (1975). According to the author, *Carex wiliucae* occurs only on Javakheti upland, mainly - the upper reaches of the Ktsia, Narianis Veli and adjacent areas, north-west swampy shores of lake Tabatskuri. The upper distribution limit is 2500 m a.s.l.. It normally occurs at the altitudes of 2000-2100 m. The species is of fragmentary distribution in the wetlands. According to the same author, there are only three associations of this formation on Javakheti upland:

Pure tufted sedge community (*Caricetum wiliucae purum*) has the widest distribution of the three associations. The largest areas are occupied at Narianis Veli and higher altitudes. This association is mostly developed on coarse-peat substrata within extinct bogs. Tuft height is more or less low and rarely waterlogged. Therefore, aquatic plant synusium is never developed, which distinguishes this association from other types of tufted sedge communities. In addition to dominant-edificators, the following herbaceous species are present: *Calamagrostis neglecta*, *Ligularia sibirica*, *Deschampsia caespitosa*, *Poa palustris*, *Agrostis gigantea*, *Geranium palustre*, *Aconitum nasutum*. Sedges - *Carex vesicaria* and *Carex rostrata* occur in waterlogged places. Other herbaceous species present are as follows: *Comarum palustre*, *Galium palustre*, *Carex cinerea*, *Epilobium palustre*, etc. Mosses are developed on tuft edges - *Aulacomnium palustre*, *Drepanocladus aduncus*, *Hypnum lindbergii*. This association transforms into a meadow over a time as tufts are subject to digression.

In summary, the tufted sedge community type formed by an extremely rare species - *Carex wiliucae* substantially differs from other types of

tufted sedge wetlands, first of all, by floristic composition. Tufted moss sedge community (*Caricetum wiluicae hypnosum*) is the second association of the *Cariceta wiluicae* community. It occurs at Narianis Veli, left bank of the Ktsia and former lake located between Bebera and Tavkvetili. The moss synusium is formed by *Drepanocladus sendtneri*, *D. aduncus*, *Caliergonella cuspidata* and *Hypnum lindbergii*. In addition, the following species are present: *Aulacomnium palustre*, *Climacium dendroides*, *Cratoneurum decipins*, etc.

Coenoses dominated by *Carex lasiocarpa* comprise a rare type of tufted sedge wetlands. Pure tufted sedge wetlands - *Carex lasiocarpae pura* are found in Narianis Veli and wetlands in the vicinity of Mt. Tavkvetili. The main coenotype - *Carex lasiocarpa* is an *obligate heliophyte*, which occurs on peat substrata both in eutrophic and meso-oligotrophic wetlands. This association mainly develops in former lakes, on the waterlogged peat substrata. Some aquatic plants could also be present, such as *Utricularia vulgaris* and *Potamogeton gramineus*. The constant species of the association are as follows: *Carex rostrata*, *C. vesicaria*, *C. acuta*, *Comarum palustre*, *Menianthes trifoliata*, *Equisetum heleocharis*, etc.

Another sedge species - *Carex vesicaria* is widely distributed in the high-mountainous wetlands described above. Its distribution range extends from lowlands to the upper montane zone, however, coenoses dominated by this species are known only for few locations. Such coenoses occur in the lacustrine wetlands of the southern mountainous region of Georgia. Sedge communities dominated by *Carex vesicaria* have a fragmentary distribution in lakes and wetlands of Ktsia-Tabatskuri. They mainly occur in eutrophic and mesotrophic wetland complexes. This species occurs up to 2000 m a.s.l. and mostly participates in thermophilous vegetation communities. It is extremely rare in wetlands with cold waterlogged soils. The only association of this species - *Caricetum vesicariae purum* is frequent for this area. *Carex vesicaria* is an absolute dominant in the sedge communities of this type where the following species could also be present in small numbers: *Equisetum eleocharis*, *Eleocharis eupalastris*, *E. intersita*, *Sparganium emersum*, *S. minimum*, *Carex rostrata*, *Comarum palustre*, *Menyanthes trifoliata*, *Alisma plantago-aquatica*. The following aquatic species are frequent: *Utricularia vulgaris*, *Callitriche palustris*, *Polygonum amphibium*, *Potamogeton natans*. As a rule, *Caricetum vesicariae purum* develops in waterlogged areas, at the initial stages of swamp-

ing. *Carex vesicaria* also participates in the sedge community types described above; however, it is always of secondary importance.

Lake Paravani is the largest among the natural reservoirs of Javakheti volcanic upland; its banks are not almost boggy and therefore, it is less interesting from botanical point of view. The river Paravani flows out from Lake Paravani and falls into Lake Sagamo. This lake is not almost boggy as well. Here is developed pure tufted (tussock) sedge community, which is spread on the shores of Lake Paravani as well. Wetland vegetation is represented near Lake Sagamo on the place of former Lake Didi Avchala. Wetland vegetation of this area is homogeneous. Most of the area is occupied with pure tufted sedge community, in which *Carex acuta* dominates. It grows in complex with *Caricetum vesicariae purum* on smaller sites and with pure communities composed by *Eleocharis*, *Caricetum acutae purum* and *Sparganietum emersumae purum* on the banks. *Utricularia vulgaris*, *Potamogeton gramineus*, *Elatine alsinistrum* and others, are mixed in different amounts into communities mentioned above, *Ranunculus flammula*, *Beckmannia eruciformis* etc. are mixed in coenoses on the shores. Such kind of homogeneous swamp on large area is very rare in mountainous regions of Georgia.

South to the above-described wetlands is situated quite a big lake, Madatapa with flat bed, which is at the die-off stage. It is completely covered with aquatic vegetation, among which *Potamogeton natans*, *P. gramineus* or *P. lucens* are dominants. *Polygonum amphibium* is spread on lesser area. *Utricularia vulgaris*, *Lemna trisulca*, *Myriophyllum spicatum* and some plants of wetland vegetation are mixed with them in a quite large amount. The northwest and southeast banks of Lake Chaobiani are boggy than other banks, where *Caricetum vesicariae purum*, *Caricetum acutae purum* or communities of order *Aquiherbosa* are dominated on boggy banks. Overgrowth of *Eleocharis spp.* and *Sagittaria sagittifolia* are also developed on the banks. Above-mentioned aquatic vegetation is represented in all types of wetland associations. In the northern part of lake-wetland on large areas are developed wet meadows represented with *Deschampsia caespitosa* and *Festuca spp.* Perhaps, in the future on the area of former Lake Madatapa will be formed the largest wetland in Javakheti.

Lakes Bugdasheni and Mrgvali, which are partly boggy, are not large; only southern part of





Bugdashi is boggy, where pure tufted (tussock) sedge dominates. *Caricetum rostratae purum* is spread on quite large area and *Caricetum vesicariae purum* on lesser area. This wetland area is characterized with abundance of tall herbaceous vegetation and is very poor floristically. On wet meadows are grown with *Deschampsia caespitosa*, *Agrostis* and *Alopecurus* are adjacent to this wetland. Communities of pure tufted sedge and *Heleocharis sp.* are represented on northern boggy bank of Lake Mrgvali.

The largest area of wetland vegetation occupies the banks of Lake Khanchali, which is situated in the southern part of Javakheti. Southern and north-eastern banks of the lake are mostly boggy. In deep water areas are spread analogous aquatic vegetation as those in Madatapa, and in areas with less water groups of *Sagittaria sagittifolia* are developed in narrow stripe. It is mainly adjacent to community of horsetail among which dominates *Equisetum heleocharis*. Some aquatic plants are also mixed with components of wetland vegetation, and on some sites abundant of *Ranunculus lingua* are observed.

Usually, there is topoecological connection between *Scolochloetum festucaceae* and horse-tail communities. Transitive associations are often formed in their contact zone. Sometimes, zone grown with *Equisetum* is omitted and community of *Scolochloetum festucaceae purum* is adjacent to aquatic vegetation directly. In that case, aquatic plants are often mixed to it and quite often community of *Scolochloetum aquiherbosum* is formed. Complex of sedge communities, where major components are *Cariceta vesicariae* and *Cariceta acutae*, is adjacent to the associations mentioned above. The topoecological order also makes clear successional development of the described wetland area. On rude peat and silt substrata *Caricetum diandrae purum* and *Caricetum rostratae calliergonellosum* are in complex with the above-mentioned sedge communities. Sinusium of moss, in the latter, is formed by *Calliergonella cuspidata*, *Hypnum lindbergii*, *Aulacomnium palustre* etc. It seems that these associations are formed at the last

stage of bogging and at the next stage, communities of *Deschampsia caespitosa*, *Festuca spp.* and poly-dominant cereal meadows will substitute them.

Among the large lakes of Javakheti, Lake Kartsakhi (Khozapini) should be mentioned. In the boundaries of Georgia its banks are not boggy for their steepness. But in its vicinity there is a former lake called the Kartsakhi wetland, most part of which is covered with pure tufted sedge and horsetail communities. In some sites of contact zones, sedge-horsetail communities are formed, where *Carex acuta* and *Equisetum heleocharis* dominate. Such coenoses are mosaic. In the community, height of grass vegetation is approximately 80 cm above water level, and coverage reaches 90%. *Carex disticha* and *Carex vesicaria* are mixed into them in quite big amount and *Ranunculus lingua*, *Potamogeton gramineus* and others are in less amount. Small amount of *Typha latifolia* is mixed in pure horsetail communities in some areas and there are also fragments with horsetail and *Typha* communities. Communities of aquatic plants and horsetails are spread on larger sites of rude peat surfaces with excess of water. On the banks of the wetland area, in the neighbourhood of village Kartsakhi, on silt substrate, *Hippuriteum vulgare purum* is spread. It occupies quite large areas in some places. Described wetland site is poor floristically. In addition to the above-mentioned plants, *Calamagrostis neglecta* and *Comarum palustre* are found in this area, which are usually developed on sedge tussocks.

The Javakheti plateau is the richest region of Georgia with lakes and wetlands. By the size of wetland areas it is the second region after the Kolkheti lowland. Although, rare, endemic and relic species (except *Carex wiluica*, which is considered as rare species for Caucasus and is known only from Javakheti and Bakuriani, Kartli) are not represented in the wetlands of Javakheti plateau, wetland vegetation of the area significantly differs from those of other regions of Georgia. Most of wetlands are young and formed on places of former lakes.

### 3.1.9. Halophilous vegetation

Original type of halophilous vegetation, which is spread on 500-1500 m a. s. l., is rare in Georgia montane zone. Special attention should be paid to it because it is developed mainly in the forest ecosystem, where on the corresponding ecotope montane

zone xerophytic communities is represented fragmentally. Halophilous vegetation complexes occur in Meskheti in the upper part of the river Mtkvari. Halophilous vegetation phytocoenoses are developed on badlands, on various slopes of nearly all

exposition, on the exhausted cortex of easy soluble, salty, gypseous basic rocks and on salty clay soil. Such places are characterized by physical and physiologic dryness and dry microclimate. According to the common position of ecotope vegetation is fluctuated within wide limits, which depends on gypseous composition and salting degree in the substrata. By the structure of vegetation and species composition it is similar to desert vegetation; it is characterized by poor flora, inlay and complexity. The vegetation of upper parts of badland slopes and rocks is actually undeveloped. It is caused by the intensive rain and wind erosion. Some typical desert and semi-desert plants, such as *Reaumuria alternifolia*, and *Camphorosma monspeliaca* grow scatter on such ecotopes. Open unconnected phytocoenose *Reaumurioso-salsolito-camphorosmetum* are created by these semi-bushes.

The common coverage of phytomass in such phytocoenose is not more than 5-10%. *Scorzonera ideae* is mixed diffusely in it; on the comparatively calm surfaces sinusia of ephemerical nature are developed like spotted fragments that are created in some places by dwarf grasses- *Eremopyrum orientale* or *Trachynia distachya* but in some places by succulent biomorpha *Gamanthus pilosus* or *Bupleurum exaltatum*. The last species and dwarf grasses often fade in the second half of summer and the track of their existence in phytocoenoses is not really seen. The spotted sinusia of the named plants are represented mainly by monodominant micro-coenoses. Most of the above-mentioned species are quite constant; from the less constant species we can name *Zygophyllum fabago* etc. It must be said that the vitality of this species in the mentioned

phytocoenoses is mostly fallen. It can be explained by the extreme severeness of the edaphic conditions.

The halophilous vegetation coverage is about 50-60% on proluvial-deluvial deposits of the lower parts of slopes. In such places we often meet *Puccinellioso-atriplexeto-nitrarietum* community. Its flora is comparatively rich, heterogenic and complex. Except typical halophytes some of such species takes part in phytocoenose, the ecophytocoenotic area of which is connected with other types of vegetation. From the constant species of the mentioned phytocoenose we can name *Nitraria schoberi*, *Atriplex tatarica*, *Puccinellia distans*, *Kochia prostrata*, *Sosnowskya amblyolepis*, *Amberboa moschata*, *Ceratoides papposa* (= *Eurotia ceratoides*) etc. From non-constant species, one can name *Astragalus argillosus*, *Callicephalus nitens*, a very rare species growing on the surface of dry ravine- *Rhamnus spathulifolia* etc. The last species is considered to be of hybrid origin and undoubtedly, more attention should be paid to it. Such phytocoenoses are connected mostly with slopes of northern and western exposition. They are comparatively better provided with moisture because of their close position to the surface of salty soil water. Such type of phytocoenoses is characterized by comparatively complex sinusial and morphologic structure.

The mentioned type of edaphogenic desert and semi-desert flora is represented by comparatively narrower endemics and widespread species with disjuncted areas, which have a great importance in research of geographic connections and study of Georgian flora and vegetation formation history.

### 3.2. Rural vegetation

Rural vegetation is one of the most interesting in terms of medicinal plants. Many invasive, roadside and adventive cosmopolitan plant species are used in traditional and scientific medicine world-wide. Among them are *Cichorium intybus*, *Melilotus officinalis*, *Achillea millefolium*, *Agrimonia eupatoria*, *Agropyron repens*, *Bryonia dioica*, *Capsella bursa-pastoris*, *Chelidonium majus*, *Cuscuta europaea*, *Hyoscyamus niger*, *Lamium album*,

*Malva sylvestris*, *Mentha arvensis*, *Plantago major*, *Stellaria media*, *Taraxacum officinale*, *Tussilago farfara*, *Urtica dioica* etc. These plants are distributed throughout in urban and rural areas, along roadsides and in disturbed habitats. Many of them are pioneer plants forming primary successions in eroded slopes resulted by construction works and other industrial activities.





### 3.3. Pastures



Subalpine and alpine meadows are mainly used as summer pastures for sheep and cattle in Javakheti and to the some extent in Meskheta (Magakian, 1933; Nakhutsrishvili, 1966). Grass, sedge and polydominant grass-forb meadows are characteristic of this type of vegetation. Grass-forb and legume dominated meadow communities are characterized by high diversity, containing more than 30 species in one community. There are several types of grass meadows where dominant species might be *Festuca ovina*, *Bromopsis variegata*, *Poa alpina*, *Koeleria caucasica*, *Nardus stricta* or *Festuca woronowii*. Associated species in these plant communities are *Ranunculus oreophilus*, *Bromus adjaricus*, *Trifolium ambiguum*, *T. trichoccephalum*, *T. alpestre*, *Betonica macrantha*, *Anemone albana*, *Gentianella caucasea*, *Aster alpinus*, *Phleum alpinus*, *Veronica gentianoides* etc. dominated species in sedge meadows are *Carex humilis* or *Carex brevicollis*. Associated species are: *Koeleria caucasica*, *Inula glandulosa*, *Myosotis alpestris*, *Carex tristis*, *Poa alpina*,

*Phleum alpinum*, *Pedicularis caucasica*, *Draba nemorosa*, *Scabiosa caucasica*, *Cerastium purpurescens* etc. Dominant species in legume meadows is *Trifolium ambiguum* associated with *Carex humilis*, *Bromopsis adjaricus*, *Poa alpina*, *Arenaria steveniana*, *Achillea sericea*, *Avena versicolor*, *Bromopsis variegata*, *Centaurea fischeri*, *Gentiana septemfida* etc. Polydominant grass-forb meadows are composed by *Sibbaldia procumbens*, *Alopecurus vaginatus*, *Bromopsis variegata*, *Phleum alpinum*, *Trifolium ambiguum*, *Festuca ovina*, *Galium verum*, *Betonica macrantha* etc. Polydominant alpine meadows contain *Festuca ovina*, *Potentilla alpestris*, *Gentiana septemfida*, *Carum caucasicum*, *Trifolium repens*, *Aster alpinus*, *Luzula spicata*, *Campanula collina*, *Potentilla gelida* etc. *Veratrum lobelianum* is indicator of pasture degradation and represents weed almost on the entire territory of pastures. It is poisonous plant not to be grazed by domestic animals. Therefore it is widespread in subalpine and alpine meadows.



## 4 Endemic- rare and relict species

Caucasus is characterized by high endemism and is considered to be one of the 25 hot spots of biodiversity worldwide. Flora of Georgia is very rich in endemic and unique plant species many of which are threatened and endangered. Samtskhe-Javakheti region has a wealth of biodiversity. The Javakheti Plateau and different mountain systems of the Minor Caucasus have been the centers of evolution for many unique life forms and are a natural museum for rich genetic resources, much of which has been lost due to loss of forest coverage and over-exploitation of certain species of plants for trade and local use. Resources overuse is usually associated with the loss of biodiversity. A number of threats emanate from the over exploitation of natural resources for fuel, fodder, manure, grazing and collecting of ornamental and medicinal plants.

Taxonomic survey of the flora of Samtskhe-Javakheti is very scarce. Most detailed study is done of wetlands (Zedelmeier, 1929, 1933; Kimeridze, 1966, 1975) and xerophytic communities (Khintibidze, 1990). Overall evaluation is done on forest species (Dolukhanov, 1989). However, there is almost no complete study of the flora of Samtskhe-Javakheti giving overall statistic of the species number, composition and distribution in the region. Number of species has been determined only for mountain xerophytic shrubland biome (Khintibidze, 1990) as to be 284 species of vascular plants. They belong to 45 families and 156 genera. Leading position according to the number of species has following plant families: *Asteraceae* (48), *Fabaceae* (39), *Lamiaceae* (24), *Apiaceae* (24), *Caryophyllaceae* (22), *Poaceae* (18), *Liliaceae* (13), *Boraginaceae* (8), *Rosaceae* (7). Most species contained the genera - *Astragalus* (24), *Alyssum* (7), *Allium* (7), *Dianthus* (6), *Artemisia* (5). Such statistical analysis is not known for other biomes.

Samtskhe-Javakheti region is rich in endemic, rare and relict species. There are different definitions of endemics depending on size of geographic area of distribution. Following definitions are developed for the endemics of xerophytic shrubland ecosystems of South Georgia (Khintibidze, 1990) - local endemics - microarealophytes (e.g. endemics of Tetrobi Plateau), endemics of Meskhети, Meskhети-Kartli, Meskhети-Artvin, Javakheti, Minor Caucasus, Georgia, Caucasus, Asia Minor and Asia Anterior.

Local endemics of Tetrobi Plateau are: *Scorzonera dzavakhetica*, *S. ketzkhovelii* and *S. kozlovskiyi*. High conservation value on Tetrobi Plateau has oldest Mediterranean community *Asphodeline taurica-Stipa pulcherrima*, which is characteristic as well for Crimea (Maleev, 1940). 6 species growing on Tetrobi Plateau are included in the Red Data Book of Georgia (1982) and in the Red List of Endangered Species of Georgia (2003) - *Asphodeline taurica*, *Scorzonera dzavakhetica*, *S. ketzkhovelii*, *S. kozlovskiyi* and *Anchonium elichrysofolium*.

Endemics of Meskhети: *Dianthus azkurensis*, *D. ketzkhovelii*, *Draba meskhetica*, *Astragalus argillosus*, *A. kozlovskiyi*, *A. raddeanus*, *A. leonidae*, *A. aspindzicus*, *A. meskheticus*, *A. vardziae*, *Campanula raddeana*, *Scabiosa meskhetica*, *Helichrysum glandulosum*, *Podospermum idae*, *Tragopogon meskhetikus*, *Salvia compar*, *Onobrychis meschetica*, *Cerastium sosnovskiyi*.

Endemics of Meskhети and Kartli: *Cerastium argenteum*, *Sempervivum sosnovskiyi*, *Genista transcucasica*, *Erysimum caucasicum*, *Reaumuria kuznetzovii*, *Helianthemum georgicum*, *Nepeta iberica*, *Scrophularia diffusa*, *Matricaria rupestris*, *Psephellus carthalinicus*, *Ziziphora borzhomica*.

Endemics of Meskhети and Artvin: *Minuartia micrantha*, *Astragalus trychocalyx*, *Coronilla charadzeae*, *Hedysarum turkeviczii*, *Thymus sosnovskiyi*, *Jurinea carthaliniana*, *Centaurea simplicaulis*, *Psephellus meskheticus*, *P. taochius*, *Cirsium adjaricum*, *Elytrigia sinuata*, *Onobrychis sosnovskiyi*.

Endemics of Javakheti: *Scorzonera dzavakhetica*, *S. ketzkhovelii*, *S. kozlovskiyi*.

Endemics of Minor Caucasus: *Gypsophylla stevenii*, *Minuartia akinfievii*, *Pyrus georgica*, *Anthyllis irenae*, *Astragalus goktschaicus*, *A. iljinii*, *A. kodschorensis*, *A. massalskyi*, *Vicia akhmaganica*, *Euphorbia armena*, *Daphne transcucasica*, *Bupleurum sosnovskiyi*, *Pimpinella aromatica*, *Linaria schirvanica*, *Cephalaria armeniaca*, *Centaurea gulissaschvilii*, *C. transcucasica*, *Tragopogon serotinus*, *Cirsium caucasicum*, *Psephellus dealbatus*.

Endemics of Caucasus: *Sempervivum pumilum*, *Cytisus caucasicus*, *Hedysarum sericeum*, *Linaria*



*media*, *Senecio massagetovii*, *Allium kunthenum*, *Gagea alexeenkoana*, *G. chanae*, *Bromopsis biebersteinii*.

It should be noted that the oldest desert and semi-desert relicts, such as *Nitraria schoberi* and *Reaumuria kuznetzovii* are present in this area.

Subalpine and alpine zones support numerous endemics including the following endemic species of Georgia - *Cerastium sosnowskyi*, *Onobrychis kemulariae*, *Pulsatilla georgica*, *Delphinium tamarae*, *Euphrasia grossheimii*, *E. sosnowskyi*, *Alchemilla aurata*, *A. pascualis*, *A. pycnotricha*, *A. indurata*, *A. bacurianica*, *A. grandidens*, *A. hypotricha*, *A. erectilis*, *A. microdictya*, *A. adelodictya*, *Ranunculus dzavakheticus*, *Delphinium tamarae*. The endemics of Caucasus growing here are also numerous - *Primula cordifolia*, *Androsace albana*, *Potentilla caucasica*, *Vicia grossheimii*, *Papaver oreophilum*, *Arenaria stewartiana*, *A. dianthoides*, *Stellaria anagaloides*, *Ranunculus transcaucasicus*, *Aquilegia caucasica*, *Pulsatilla violacea*, *Aconitum natusum*, *Astragalus irinae*, *Teucrium nuchense*, *Nepeta grossheimii*, *Ligularia caucasica*, *Cherophyllum humile*, *Sorbus caucasigena*, *Scilla rosenii*, *Fritillaria lutea*, *Symphytum causicum*, *Ranunculus buschii*, *Aconitum nasutum*, *Vicia grossheimii*, *Primula ruprechtii*, *Dianthus subulosus*, *Cephalaria gigantea*, *Arenaria dianthoides* etc.

The rock-scrub vegetation is especially rich in endemic species: *Dianthus azkurensis*, *D. ketzkhoveli*, *Draba meskhetica*, *Sempervivum sosnowskyi*, *Astragalus raddeanus*, *Salvia compar*, *Scrophularia diffusa*, *Campanula raddeana*, *Senecio massagetovii*, *Matricaria rupestris*, *Jurinea carthaliniana* etc. Relict species *Erysimum szowitzianum*, *Campanula crispa*, *Veronica livanensis*, *Centaurea bella* etc. occur on rocks between Atskuri and Borjomi along R. Mtkvari.

Wetland biome in Samtskhe-Javakheti supports only one local endemic species *Carex wiluica* distributed only in the upper reaches of r. Ktsia. This species forms original coenoses in the wetland vegetation of Narianis Veli, vicinity of Tabatskuri lake and adjacent mountains.

Three rare local endemics - *Lilium kesselringianum*, *Gladiolus dzavakheticus*, *Onobrychis meskhetica* occur on the northern shore of Tabatskuri lake. In addition, there are one endemic of Georgia (*Ranunculus dzavakheticus*) and 9 endemic species of Caucasus (*Nepeta grossheimii*,

*Pulsatilla violacea*, *Vicia grossheimii*, *Arenaria dianthoides*, *Corydalis alexeenkoana*, *Hedysarum armeniacum*, *Orobanchia ciliatidentata*, *Androsace raddeana*, *Polygala mariamae*) in the vicinity of the lake. Rare coenoses of *Carex wiluica* and endemics of Georgia - *Urticularia minor* and *Menyanthes trifoliata* are found in this area.

Meskheta depression also supports endemic and relict species of arboreal plants, such as pear *Pyrus georgica*, spindletree *Euonymus leiophloea*, european hop hornbeam *Ostrya carpinifolia*, which require special protection measures.

The areas located between village Tsnisi and Georgia-Turkey border (altitudes range from 900 to 1400 m a.s.l.) are characterised by high endemism. Akhaltsikhe (Meskheta) depression supports fossilized Tertiary flora (referred to as "Goderdzi Flora") on the eastern slope of Goderdzi pass, r. Dzindze gorge. Tertiary forest comprised of palms, magnolias, etc., was buried in volcanic ash.

The following 19 species distributed in Samtskhe-Javakheti region are included in the Red Data Book of Georgia (1982) and in the Red List of Endangered Species of Georgia (2003): *Anchonium elichrysofolium*, *Asphodeline taurica*, *Astragalus cyri*, *Campanula crispa*, *Corydalis erdelii*, *Dianthus ketzkhoveli*, *Gladiolus dzavakheticus*, *Hippophae rhamnoides*, *Hypericum thethrobicum*, *Juglans regia*, *Ostrya carpinifolia*, *Papaver pseudo-orientale*, *Quercus macranthera*, *Scorzonera dzavakhetica*, *Scorzonera ketzkhoveli*, *Scorzonera kozlowskyi*, *Senecio massagetovii*, *Senecio rhombifolius*, *Tragopogon meskheticus*.

45 species of the Samtskhe-Javakheti region are included in the list of rare species of Georgia (Ketskhoveli, 1977): *Acer trautvetteri*, *Amelanchier rotundifolia*, *Astragalus argillosus*, *Astragalus leonidae*, *Astragalus meskheticus*, *Astragalus trichocalyx*, *Atropa caucasica*, *Bupleurum sosnowskyi*, *Centaurea adjarica*, *Cerastium sosnowskyi*, *Ceratiodes papposa*, *Crataegus caucasica*, *Crataegus orientalis*, *Dactylorhiza euxina*, *D. sambucina*, *D. unvilleana*, *Digitalis ferruginea*, *Elaeagnus angustifolia*, *Ephedra procera*, *Fritillaria latifolia*, *Grossheimia macrocephala*, *Gymnadenia conopsea*, *Heracleum wilhelmii*, *Jurinea carthaliniana*, *Lonicera iberica*, *Menyanthes trifoliata*, *Neottia nidus-avis*, *Onobrychis meskhetica*, *Orchis coriophora*, *Paeonia steveniana*, *Psephellus meskheticus*, *Pulsatilla georgica*, *Pulsatilla violacea*, *Pyrus cau-*

*casica*, *Pyrus salicifolia*, *Rhamnus imeretina*, *Rosa spinosissima*, *Scabiosa columbaria*, *Sobolevskia clavata*, *Sorbus caucasigena*, *Stipa stenophylla*, *Tilia begoniifolia*, *Tragopogon marginatus*, *Valeriana alliariifolia*, *Valeriana officinalis*.

List of endemic plant species distributed in Samtskhe-Javakheti region is given in Appendix 1. In addition to the crop plants represented on agricultural lands, many wild species also have considerable economic importance providing food, fuel, timber, forage (fodder), pasture, etc., and habitats for animal life. Economically valuable plants also include large amount of species and forms used in folk and officinal medicine. The incomplete list of economically valuable plants occurred in the Sam-

tskhe-Javakheti region is shown in Appendix 2.

Only two species from the IUCN Red List are present in Samtskhe-Javakheti region: *Galanthus alpinus* and *Sambucus tigranii*. The first is used as medicinal plant. The second is very rare, found only occasionally in Aspindza district.

Several plant species are included in the CITES list of Georgia (Bitsadze, Rukhadze, 2001): *Galanthus alpinus* (= *G. caucasicus*), *Cyclamen coum subsp. caucasicum*, *Taxus baccata*, *Coeloglossum viride*, *Platanthera montana*, *Gymnadenia conopsea*, *Traunsteinera sphaerica*, *Orchis pseudolaxiflora*, *O. coriophora*, *Dactylorhiza euxina*, *D. urvilleana*.





## 5 Medicinal Plants

Medicinal plants occur in all plant communities. The total number of plant species used both in scientific and traditional medicine is about 200 (Shotadze, 1944; Grossheim, 1946; Shengelia, 1952; Aneli et al., 1969; Ketskhoveli, 1969; Kikava et al., 1997; Chirgadze, 2001; Kvachakidze, 2003; see Appendix 3). The local population uses different plant species for medicinal purposes. Most of them are herbs, rarely woody plants, fungi and algae are in use. Most plants are harvested in the nature what threatens plant populations. This fact leads to strong decline in diversity by loss of medicinal plant species.

To contribute in conservation of rare medicinal plants in Samtskhe-Javakheti region we selected several species from the complete list, which will be monitored during field trips in 2005, resources will be evaluated and mapping will be conducted. The cultivation methodology will be developed for these plant species.

The following criteria have been used in the species selection procedure:

1. The use for medical purposes of plant species by local population. Priority is given to the plants which are collected most intensively in the region e.g. for pharmaceutical industry or for the green apothecia.
2. Species status: abundant, rare, threatened, Red Data Book species, included in the IUCN and CITES lists, protected by Bern Convention, or species about which there

are data deficit (DD). Priority is given to species which are protected, globally threatened or endemics and overuse might lead to their extinction;

3. Ornamental properties of species. High ornamental value of plant species is considered as additional benefit for successful marketing, which will increase chances of local farmers to bring products to the market.
4. Species potential for cultivation. Priority is given to plants easy to cultivate and bringing immense financial benefit to the farmers.
5. Market requirements for a species. Priority is given to species which are used in pharmaceutical industry world-wide and when there is some deficit in their production. Special consideration is given to medicinal plants used as nutriment supplements and food.

These criteria have been applied to all known species of medicinal plants distributed in the Samtskhe-Javakheti region (Appendix 3). It will be reasonable to use scoring system for evaluation of these criteria. However, almost completely lack of quantitative information on resources of plant species in Georgia and concretely in this region made it impossible to conduct such procedure. Therefore, the overall evaluation has been done and 20 species presented in the Table 1 have been selected.

**Table 1.** Short list of medicinal plants distributed in Samtskhe-Javakheti region. Status of a species is determined according to literature date as rare, Red Data Book species (RDB), IUCN, CITES, globally threatened (included in RDB of other countries), threatened (determined for species intensively collected in the nature), DD (data deficit) and endemics. Ornamental value of a species is indicated. Nomenclature is used according to Czerepanov, 1995; for Orchidaceae, according to Akhalkatsi et al., 2003.

| N  | Scientific name  | Georgian common name | English common name | Status                    |
|----|--|----------------------|---------------------|---------------------------|
| 1. | <i>Allium victorialis</i> L. ( <i>Liliaceae</i> )          | მთის<br>ლანძორი      | Alpine Leek         | Rare, Ornamental          |
| 2. | <i>Althaea officinalis</i> L. ( <i>Malvaceae</i> )         | ტუხტი                | Mallow              | RDB Georgia<br>Ornamental |
| 3. | <i>Artemisia absinthium</i> L. ( <i>Asteraceae</i> )       | აბზინდა              | Absinthe            | DD, Poisonous             |
| 4. | <i>Colchicum speciosum</i> Steven ( <i>Liliaceae</i> )     | ჯუნა                 | Naked Ladies        | Threatened, Ornamental    |
| 5. | <i>Crocus speciosus</i> M. Bieb. ( <i>Iridaceae</i> )      | ზაფხანა              | Crocus              | Threatened, Ornamental    |
| 6. | <i>Daphne glomerata</i> Lam. ( <i>Thymelaeaceae</i> )      | ნობა                 | Daphne              | Rare, Ornamental          |
| 7. | <i>Digitalis ferruginea</i> L. ( <i>Scrophulariaceae</i> ) | ფურჯაჰა              | Rusty Foxglove      | Rare, Ornamental          |
| 8. | <i>Gagea chanae</i> grossh. ( <i>Liliaceae</i> )           | ჩიტისთავა            | Yellow Star         | Cauc. Endemic             |

| N   | Scientific name   | Georgian common name | English common name        | Status  |
|-----|---|----------------------|----------------------------|---|
| 9.  | <i>Galanthus alpinus</i> Sosn. ( <i>Amaryllidaceae</i> )                          | თეთრყვავილა          | Snowdrop                   | Geor. endemic, IUCN (DD), RDB USSR, CITES, Ornamental |
| 10. | <i>Gentiana septemfida</i> Pallas ( <i>Gentianaceae</i> )                         | ნაღველა              | Gentian                    | Rare, Ornamental                                      |
| 11. | <i>Ephedra procera</i> Fisch. & C.A. Mey. ( <i>Ephedraceae</i> )                  | ჭოჩხიბი              | Ephedra                    | Rare  |
| 12. | <i>Helichrisum graveolens</i> (M. Bieb.) Sweet ( <i>Asteraceae</i> )              | ქვებავა              | Yellow Daisy               | DD  |
| 13. | <i>Orchis coriophora</i> L. ( <i>Orchidaceae</i> )                                | ნეგო<br>ჭავჭავი      | Orchid                     | CITES- Rare<br>Ornamental                             |
| 14. | <i>Pulsatilla violacea</i> Rupr. (= <i>P. georgica</i> ) ( <i>Ranunculaceae</i> ) | მდეგახი              | Violet Pasque Flower       | Rare, Ornamental                                      |
| 15. | <i>Rhododendron caucasicum</i> Pall. ( <i>Ericaceae</i> )                         | ღეჩა                 | Caucasian Rhododendron     | DD, ornamental  |
| 16. | <i>Scabiosa caucasica</i> M.Bieb. ( <i>Dipsacaceae</i> )                          | ცნობელი              | Caucasian Scabious         | DD, ornamental  |
| 17. | <i>Scorzonera dzhavakhetica</i> Sosn. ex Grossh. ( <i>Asteraceae</i> )            | ჭავჭავთის<br>ფაშაქი  | Djavakhetian Viper's Grass | RDB Georgia<br>Georg. Endemic,<br>ornamental          |
| 18. | <i>Senecio rhombifolius</i> (Adams) Sch. Bip. ( <i>Asteraceae</i> )               | სახისმუბლა           | Groundsel                  | Cauc. Endemic,<br>RDB Georgia                         |
| 19. | <i>Taxus baccata</i> L. ( <i>Taxaceae</i> )                                       | ქობოჭავი             | Common Yew                 | RDB Georgia<br>RDB USSR,<br>CITES                     |
| 20. | <i>Viola suavis</i> M. Bieb. ( <i>Violaceae</i> )                                 | ნა                   | Violet                     | DD  |

The status of species was determined according to pure literature data given in the Key of Georgian Vegetation (Ketskhoveli, 1969); Plants of Georgia Needed Protection (Ketskhoveli, 1977); Red Data Book of Georgia (1982); Red Data Book of the USSR (1984); IUCN Red Data Book (2001); CITES list of Georgia (Bitsadze, Rukhadze, 2001) and The Bern Convention (2000).

The analyses have shown that only 7 species from the complete list of medicinal plants of Samtskhe-Javakheti region are included in the RDB of Georgia and 4 in the RDB of USSR, as a total 9 species. We have included 4 RDB species in the short list - *Galanthus alpinus*, *Senecio rhombifolius*, *Scorzonera dzhavakhetica* and *Taxus baccata*.



Fig. 7. *Galanthus alpinus* in Meskheta



All of them are extremely vulnerable, easy to cultivate, have high requirements on the market and have high ornamental value. 5 other RDB species were rejected - *Ficus carica*, *Juglans regia* and *Punica granatum* are nonnative, cultivated and naturalized species, *Hippophae rhamnoides* and *Quercus macranthera* are difficult to cultivate.

11 species from the list are endemics for the Caucasus or only for Georgia - *Anthemis iberica*, *Crataegus caucasica*, *Erigeron caucasicus*, *Gagea chanae*, *Galanthus alpinus*, *Gentiana angulosa*, *Gentianella caucasea*, *Heracleum sosnowskyi*, *Pyrus caucasica*, *Sempervivum caucasicum* and *Senecio rhombifolius*. We have four species in the short list *Gagea chanae*, *Galanthus alpinus*,

*Scorzonera dzhawakhetica* and *Senecio rhombifolius*. Some other species such as *Crataegus caucasica*, *Heracleum sosnowskyi* and *Sempervivum caucasicum* are potential candidates for inclusion in the list but they occurred less prioritized when compared to other plants.

The same *Galanthus alpinus* is the only species from the complete list included in the IUCN list of threatened plants. It is included as well in CITES list together with *Taxus baccata* and *Orchis coriophora*. We have included all these species in the short list. It should be noted, however, that without applying of special technology it will not be possible to cultivate any orchid species.



Fig. 8. *Taxus baccata* in fruits

Status was determined as "globally threatened" if the species is included in any RDB of other countries. We have checked the RDB of Switzerland and Germany. Status threatened and rare are given according to Ketskhoveri (1977), or determined on the base of information if these species are collected intensively in nature. There are number of non-native species naturalized from gardens and intensively used in the traditional medicine. We think they have big potential for cultivation in the farms. However, we did not include them in the list as this not directly coincides to our goals.

It should be mentioned, that there is no information on abundance of number of species included in the list. We determined their status as DD (data deficit). We have several species with undetermined status

in the list. All of them are highly valuable medicinal plants, which are most extensively collected in the nature and sold in green apothecia and on the market. We think they need urgent protection. In general this survey has revealed lack of information on any quantitative data about species resources in Georgian flora. It makes difficult to undertake more exact evaluation of the status of plant species for this time.

Finally, we have to mention, that indeed all medicinal plants need special conservation measures to be undertaken for their protection. All species are collected in the nature and independent on their amount increase of intensity of their collection may lead to the drastic results and cause their extinction. However, for the beginning of conservation works

on medicinal plants in Georgia priority should be given to rare and endangered species which at the same time have high ornamental value simplifying their utilization on the market.

Fig. 9. *Orchis coriophora*.





## 6. Threats to Biodiversity

The main underlying causes of biodiversity losses originate in some of the most basic social, economic, political, cultural and historical features of society. The driving forces are numerous and interdependent, and although many of them depend strongly on international decisions and activities, the approaches to dealing with them are specific to countries and local settings and will therefore vary. The causes can be local, national, regional or global, transmitting their effects through economic or political actions. They include:

- ❁ Broad social, economic and political processes such as unsustainable production and consumption patterns, human population growth, inadequate economic valuation of biodiversity, globalization of trade, poverty, inappropriate structural adjustment policies, harmful subsidies and incentives, lack of clear land use rights, lack of political will, political unrest and wars;
- ❁ Institutional and social weaknesses such as poor governance, lack of intersectoral coordination and effective partnership, fragmented decisionmaking, lack of secure land tenure and uneven distribution of ownership, loss of cultural identity and spiritual value, insufficient scientific and implementation capacities, lack of information, limited use of scientific and local knowledge and lack of awareness and poor understanding of the role of biodiversity in providing goods and services and in defining sustainable development;
- ❁ Market and economic policy failures such as lack or nonenforcement of appropriate regulatory mechanisms, prevalence of harmful subsidies and incentives, absence of appropriate local and global markets for biodiversity goods and services and lack of clear environmental and development policies and of environmental impact assessments;
- ❁ Lack of knowledge, particularly among those directly involved in the management of biodiversity and those who make decisions on economic activities and development projects that affect biodiversity and ecosystems. The influence of human activities on wild species has grown at an unprecedented rate. Although some species respond positively to anthropogenic pres-

ures, the great majority show only limited tolerance of increasingly widespread and rapid changes to ecosystems worldwide. The major human induced impacts on biodiversity are: habitat destruction and fragmentation; invasive alien species; over-utilization; disease; pollution and contaminants; incidental mortality; and climate change. The primary causes of plant species endangerment are habitat destruction, commercial exploitation (such as overgrazing, plant collecting in undisturbed habitat, road and pipeline constructions, deforestation, land degradation, urbanization, etc.), damaged caused by non-native plants and animals introduced into an area, and pollution. The elaboration of mitigation and compensation measures is necessary to develop in situ conservation needs of plant diversity.

It is estimated that since historical times the world has lost c. 40% of its original 60 million km<sup>2</sup> of forest cover through human activity (FAO 1997). This loss continues today with c. 14.6 million hectares of forests destroyed each year, totaling a 4.2% loss of natural forest cover during the 1990s, with the rates of loss being highest in Africa and South America (FAO 2000). It is no surprise therefore, that habitat destruction is a major threat to the world's biodiversity. For many species the habitat degradation that accompanies selective resource exploitation, or that occurs in habitats next to cleared areas, can have serious negative consequences too.

Humans have harvested and traded species since time immemorial: for food, medicine, fuel, material use (especially timber), and for cultural, scientific and leisure (i.e., sport) activities. This use of nature is fundamental to the economies and cultures of many nations (e.g., Mainka and Trivedi 2002). For example, medicinal plants are not only a vital source of biologically active substances, but also generates valuable income for rural populations. However, expanding markets and increasing demand, combined with improved access and techniques for harvesting, and increased ease of transportation and techniques of preservation, are causing the exploitation of many species beyond sustainable levels.

Humans have been transporting animals and plants

from one part of the world to another for thousands of years, sometimes deliberately (e.g., livestock released by sailors onto islands as a source of food) and sometimes accidentally (e.g., rats escaping from boats). In most cases, such introductions are unsuccessful, but when they do become established as an invasive alien species defined by IUCN (2000) as "an alien species which becomes established in natural or semi-natural ecosystems or habitat, is an agent of change, and threatens native biological diversity", the consequences can be catastrophic. Invasives can affect native species directly by competing with them, and introducing pathogens or pests that sicken or kill them or, indirectly, by destroying or degrading their habitat.

Diseases can cause chronic population declines, dramatic die-offs or reductions in the reproductive success and survival of individual species. Some diseases now appear to be spreading to populations previously unaffected, including to species already seriously threatened by other factors. Invasive diseases have already been implicated in the extinction of some species.

Pollution directly affects species through mortality and sublethal effects such as reduced fertility. Pollution can also have strong indirect effects by degrading habitats or reducing food supplies.

The Earth is undergoing profound changes to its climate. There is now little doubt that this results from human activities, mainly the burning of fossil fuels. Climatic changes have occurred throughout Earth's history. However, these recent changes are different because they are taking place faster and

are unlikely to be reversed by natural processes. As yet few species have been identified as being threatened on the IUCN Red List specifically owing to climate change. However, there are many examples of the effects of climate change on species from around the world, which taken together, provide compelling evidence that climate change will be catastrophic for many species. Climate change may alter species' distribution, abundance, phenology, morphology (size and shape), and genetic composition.

Modeling studies show that the ranges occupied by many species will become unsuitable for them as the climate changes. The climate space that is suitable for particular species may shift in latitude or altitude, contract or even disappear. Many species will probably not be able to keep up with their changing climate space. As species move at different rates, the community structure of ecosystems will also become disrupted. Both local and global extinctions are likely. One recent global study estimated that 15-37% of regionally endemic species could be committed to extinction by 2050 (Thomas et al. 2004), while another study in Queensland, northern Australia, shows that the number of extinctions will increase rapidly if temperatures rise by more than c. 2.C (Williams et al. 2003).

Therefore, urgent conservation measures have to be undertaken to preserve native rare species impacted by human activity or climate change. With this concern, most important activity is determination of species status and steps to be done for their preservation.





## 7. Conservation of Biodiversity

Human society is highly dependent on genetic resources, including those from wild and semi-domesticated sources, for the productivity of its agriculture. Conventional wisdom holds that modern farming is largely incompatible with wildlife conservation. Thus, policies to protect wildlife typically rely on land use segregation, establishing protected areas from which agriculture is officially excluded. Farmers are seen as problems by those promoting this view of wildlife conservation. It is necessary, however, to enhance the contribution of farming systems as essential part of any biodiversity conservation strategy, and to require new technical research, support for local farmer innovation, and adoption of new agricultural and environmental policies at local, national and international levels.

For conservation action to be effective, it is important to understand not just the needs of individual species, but also the context in which conservation efforts will need to take place. A better understanding of human demand and impact on natural resources can help inform decisions and guide conservation efforts so that conflicts in interests between humans and biodiversity can be minimized.

Most threats to biodiversity are the result of human

actions, and human actions alone can prevent many species from becoming extinct. This section provides an overview of the main types of responses that can be applied to the conservation of the world's species, with a focus on those at greatest risk of extinction. It is mostly based on information on conservation measures required or in place for each species, collected through the Red List assessment process.

Here, five broad groups of conservation responses are considered:

- ❁ Research action, which provides the knowledge on which other conservation responses are based;
- ❁ Communication and education, which creates the public awareness needed to support most conservation practice, and the human capacity required for implementing it;
- ❁ Policy-based actions, fundamental to provide the institutional support, human and financial resources, and legal framework required for effective species conservation;
- ❁ Habitat and site-based actions, which protect species in their natural habitats; and
- ❁ Species-based actions, addressing species-specific threats and conservation needs required for ensuring the species' long-term persistence.

### 7.1. Research Action



Conservation action frequently needs to be tailored to the specific circumstances affecting particular species. It is thus more effective if supported by adequate knowledge on the species (taxonomy, biology and ecology, population numbers and trends, range, and habitat status), on the threats affecting the species, and the most effective measures for addressing those threats. Although the IUCN Red List is biased towards the better-studied groups and regions, many species already assessed by the Red List still require substantial improvement in the knowledge base to support effective conservation action.

The Red List Category Data Deficient (DD) is assigned to a species when there is inadequate information to make a direct, or indirect, assess-

ment of its risk of extinction based on its distribution and/or population status (IUCN 2001). There are currently 3,580 species listed on the IUCN Red List as DD including 2,882 animals and 698 plants. Data Deficient species are mainly concentrated in regions with high biodiversity that have been poorly studied. In many cases, this information is very limited, and further research is urgently needed to guide conservation actions aimed at improving species' conservation status.

Most species in need of research action require baseline information on their population numbers and range (fundamental to guiding in situ conservation action, establishing baselines for monitoring), and knowledge of the species' population and range trends critical for the application of the IUCN Red

List Criteria. Monitoring of range and population trends is frequently needed, and this will contribute directly to the development of biodiversity indicators. Many species lack basic data on biology and ecology needed to understand habitat requirements, capacity for population recovery, dispersal ability, and vulnerability to environmental change. In some

cases, further research is needed to clarify the taxonomic status of species, which may reveal currently unknown species that face high extinction risk. Better data are frequently needed on the threats affecting species' populations and on the effectiveness of conservation measures.

## **7.2. Communication and Education**



Communication and education actions are fundamental to promoting responsible decisions. These include: recognizing and being willing to pay higher prices for products (such as wood) and services (such as tourism) obtained in ways that promote habitat protection; reducing patterns of over-consumption; providing public support for policies that promote conservation; and providing private support to conservation action. Zoos, aquariums and botanical gardens play an important role in raising the public awareness and understanding of the threats and conservation needs of threatened species (Miller et al. 2004).

technical capacity, which is frequently lacking in those parts of the world that need it the most. Local technical capacity is fundamental to: the collection and interpretation of data on the conservation status of, and threats to, species; supporting decisions on effective conservation responses; and guiding the implementation of conservation programmes. Capacity development also includes institutional strengthening, the development of legal and policy frameworks, and ensuring that a variety of stakeholders have an active role in decisionmaking on protected areas and their management (Carabias and Rao 2003).

Effective conservation action requires adequate

## **7.3. Policy-Based Actions**



Policy-based actions are essential for providing the institutional support, human and financial resources, and legal framework required to ensure effective species conservation. Frequently, such actions occur through the development and implementation of legislation at the national or sub-national levels, or through international agreements. Legislation is sometimes directed at the protection of particular species, such as by regulating the harvesting of individuals, their trade (e.g., CITES); or alterations in their habitat (e.g., Ramsar Convention). Legislation can also promote habitat protection, most noticeably through the creation of protected areas: 241 countries or territories are recognized by the 2004 World Database on Protected Areas as having officially designated protected areas of some type (WDPA Consortium 2004). Legislation may also protect habitat by regulating land use patterns at a broader scale (e.g., Forest Code), or through the regulation of anthropogenic activities that are frequently the least direct but most pervasive causes of species declines (e.g., pollution generated by industry, transport leading to the introduction of invasive species, consumption of fossil fuels leading to climate change).

The role of multilateral environmental agreements has grown during the last decade, as human impacts intensify and span across national boundaries more often. There are now more than 500 international treaties that concern the environment and most countries have ratified key international treaties (although significant gaps remain). These agreements are a means to adopt harmonized approaches and resolve trans-boundary problems with neighboring states. They increasingly offer access to worldwide knowledge, tools and financial resources, and they can give conservation agencies a stronger mandate domestically (Steiner et al. 2003).

Nevertheless, most conservation action takes place at the national level, and the national legal framework remains crucial in the effective implementation of the vast majority of conservation programmes. Naturally, legislation is only useful if adequately implemented and such implementation is lacking in many cases. Policy-based actions are frequently implemented as a top-down approach, but their effectiveness is in many cases hindered by a lack of involvement with the local communities





that are the direct users of biodiversity. Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES; 1975; Universal) regulates international trade of the species listed. Convention on Biological Diversity (1992; universal): the programmes of work developed under the CBD encourage Parties to take a wide range of actions to biodiversity conservation and sustainable use. European Union Habitats Directive (1992; regional): the natural habitat listed must be maintained at a favourable status, particularly through the creation of a network of protected sites. Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar Convention; 1975; universal): provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources, in particular through the designation of sites under the Ramsar List of Wetlands of International Importance. Convention concerning the Protection of the World Cultural

and Natural Heritage (World Heritage Convention; 1972; universal): provides for the identification, protection and preservation of cultural and natural heritage (including habitats of threatened species) around the world considered to be of outstanding value to humanity. Countries submit places for designation under the World Heritage List. United Nations Framework Convention on Climate Change (1994; universal) and Kyoto Protocol (adopted in 1997, not yet into force; universal): caps greenhouse gas emissions in participating industrialized nations from 2008 to 2012 and establishes an international market in emissions credits that will allow these nations to seek out the most cost-effective means to reduce atmospheric concentrations of greenhouse gases.

Georgia's general wild flora and fauna conservation measures are regulated by several legislative acts adopted by the Georgian Parliament in 1994-2000 (Tab. 2).

Table 2. Main environmental laws of Georgia.

| Law  | Date       |
|--|------------|
| Law on Protection of Flora from Harmful Organisms  | 12.10.1994 |
| The Constitution of Georgia  | 24.08.1995 |
| Law on Protected Area System   | 07.01.1996 |
| Law on Normative Acts  | 29.10.1996 |
| Law on Environmental Protection  | 10.12.1996 |
| Law on Wildlife  | 26.12.1996 |
| Law on State Ecological Expertise  | 01.01.1997 |
| Law on Environmental Permits   | 01.01.1997 |
| Law on Creation and Management of the Kolkheti Protected Areas   | 09.12.1998 |
| Law on Changes and Amendments into the Law on Protection of Flora from Harmful Organisms                                 | 16.04.1999 |
| The Forest Code  | 22.06.1999 |
| National Environmental Action Plan of Georgia  | 19.06.2000 |
| Law on Melioration of Lands  | 16.10.2000 |
| Law on Special Preservation of State Forest Fund and the Plantation within the Tbilisi City and Neighbouring Territories | 10.11.2000 |

## 7.4. Habitat and Site-Based Actions



Retaining viable populations in their native habitats is an essential conservation response for ensuring the long-term persistence of species. A finer-scale approach for investigating species coverage protected areas is by mapping sites known to be essential for the persistence of each species and investigating their level of formal protection. For these species, in situ conservation requires the establishment of networks of protected areas, adequately

connected though a matrix of favourable habitat that allows for species movement through, and persistence in, the broader landscape.

The following protected areas occur on the territory of Samtskhe-Javakheti:



### **7.4.1. Borjomi-Kharagauli National Park**

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The Borjomi-Kharagauli National Park was designated in 1995 under Resolution No. 447 of the Cabinet of Ministers. The main purpose of the designation is the conservation of existing ecosystems; restoration of degraded areas; facilitation and control of sustainable use of renewable resources; awareness / educational activities and ecotourism. According to the Park Management Plan compiled by WWF, the Park is divided into a number of zones: core zone (strict nature protection zone); wilderness zone; traditional use zone; recuperation zone and support zone (covering the five Districts that share a common boundary with the Park). The National Park extends to 50,400 hectares, having been extended in 2000. It covers primary forest and sub-alpine meadows typical of the central region of the Lesser Caucasus. The Park supports a good variety of flora and fauna including several rare and endangered species, relic species and species endemic to the central Caucasus region. The Support Zone covers 150,000 hectares and consisting of various land uses including agriculture, industry, infra-structure and areas of natural and semi-natural habitat. The rationale for the establishment of the Support Zone is to secure the support of park neighbours for the sustainable protection of the park. This is achieved through the economic support and assistance to Park neighbours in

recognition of sacrifices made in giving up certain user rights for areas converted to a National Park and by involving Park neighbours in the planning and Park management process. Land and resource use in the Support Zone should be compatible with the conservation objectives for the Park. The development of the Support Zone should be based on a well designed, Regional Development Plan aimed at sustainable economic development for the benefit of Support Zone Communities and biodiversity conservation. The Support Zone does not correspond to an IUCN category and as such is not listed on the IUCN international list of protected areas. In December 1998, the governments of Germany and Georgia signed a bilateral agreement regarding financial co-operation for the project concerning 'Environment and Protection of Natural Resources Borjomi-Kharagauli National Park'. Further details of the co-operation are provided in the Decree of the President of Georgia (13th July 2001) on 'Co-ordinated Planning and Implementation of Ongoing and Prospective Programs of Borjomi-Kharagauli National Park and It's Support Zone'. The German government provides funds for three programmes in the Park - implementation of infra-structure; training/education and a Support Zone development programme.

### **7.4.2. Expansion of Borjomi-Kharagauli National Park**

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The Borjomi-Kharagauli national Park was expanded towards Samtskhe-Javakheti region, namely Akhaltsikhe and Adigeni districts. It includes slopes of Meskheti and Vani ranges, Abastumani and Zekari Pass. Area is 10,846 ha. Legal Basis is Law of Georgia on Protected Areas, Agreement on 'Financial Co-operation within the Project "Protection of Environment /Borjomi-Kharagauli National Park' between Georgia and

Germany, approved by Resolution of Cabinet of Ministers of Georgia No. 447, dated 28/07/1995, 'On Activities Facilitating Formation of System of Protected Areas and Establishment of Borjomi-Kharagauli National Park' Transitional Adigeni district authorities, State Department of Land Management and Adigeni Forestry of State department of Forestry. IUCN Category Equivalent to IUCN Category II

### **7.4.3. Tetrobi Managed Reserve**

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Tetrobi Plateau represents refuge for many endemic and relict species. It is part of Tetrobi-Chobareti range and is composed of limestone. Its area is 3,100 ha. Date of Establishment 1995. Purpose Protection and restoration of unique plant species and their biodiversity, protection of unique Tetrobi forest Activity Protection / conservation,

restoration, monitoring, restricted tourism; Management State Department of Protected Areas, Nature Reserves and Hunting Economies Level of Designation National IUCN Category Equivalent to IUCN Category IV 'Habitat / Species Management Area'.





#### 7.4.4. Other protected areas

Erusheti mountain systems and several wetlands are proposed to receive managed reserve status. Wetland vegetation of the area is mainly used for haymaking. Therefore, 5 managed reserves and one area of restricted use (Ktsia-Tabatskuri managed reserve, Paravani Lake proposed managed reserve, Khanchali Lake proposed managed reserve,

Madatapa Lake proposed managed reserve, Kartsakhi (Khozapini) Lake managed reserve, Saghamo Lake proposed area of restricted use) on the Javakheti volcanic upland were proposed to establish, which will play an important role for protecting of wetland vegetation of Georgia.

### 7.5. Species-Based Actions

In many cases, habitat protection on its own is not sufficient, and direct intervention is required to mitigate or eliminate specific threats to species. Ex situ conservation can offer insurance against extinctions by providing a source population for future re-introductions or reinforcement of wild populations. These can be either re-introduction into previous habitat from where the species has been lost or begin introductions into areas of suitable habitat that have not been previously colonized by the species. Species threatened by over-exploitation typically require conservation measures that either prevent or discourage harvesting (e.g., trade control through CITES), or promote sustainable use. The latter may involve harvest management or commercialization of farmed individuals to reduce pressure on wild populations.

Species based actions for conservation includes ex-situ conservation in living collections (e.g. in botanical gardens), seed banks and other propagule and germplasm preservation. One of the most effective conservation measure is encouragement of local population to cultivate in home gardens

and in grounds species, which are harvesting in wild populations to extreme degree.

The purpose of the living collections is conservation of rare and endangered plants and observations for development of on-farm cultivation technology of selected species. The territory for living collection to be design for the current project is c. 200m<sup>2</sup>. The bulbous plants will be replanted from the wild, other species will be grown from seeds. From 10 to 100 plants in one sample depending on population status and species endangerment will be planted. The plant material will be originated from 3 to 5 different populations of a species. Necessary spacing and when needed flower bagging will be used to avoid intraspecific hybridization and genetic pollution.

Seed collections will be done from all populations visited during field trips. Up to 100 seeds will be collected per population depending on the endangerment of the species. The seeds will be given to ELKANA for long-term preservation in the seed bank.



## 8. Methodology

### 8.1. Nature of the IUCN categories and criteria



The IUCN Red List Categories and Criteria were first published in 1994 following six years of research and broad consultation (IUCN 1994). The 1994 IUCN Categories and Criteria were developed to improve objectivity and transparency in assessing the conservation status of species, and therefore to improve consistency and understanding among users. The 1994 categories and criteria were applied to a large number of species in compiling the 1996 Red List of Threatened Animals. The assessment of many species for the 1996 Red

List drew attention to certain areas of difficulty, which led IUCN to initiate a review of the 1994 categories and criteria, which was undertaken during 1998 to 1999. This review was completed and the IUCN Red List Categories and Criteria (version 3.1) was published (IUCN 2001). The Red List Guidelines appeared in 2004 defining methods of determination of IUCN categories. In 2004 was published as "2004 IUCN Red List of Threatened Species: A Global Species Assessment".

#### 8.1.1. Taxonomic scale of categorization

The criteria may be applied to any taxonomic unit at or below the species level. In the IUCN guidelines, the terms 'taxon' and 'taxa' are used to represent species or lower taxonomic levels, including forms that are not yet fully described. There is sufficient range among the different criteria to enable appropriate listing of taxa from the complete taxonomic spectrum, with the exception of micro-organisms. In presenting the results of applying cri-

teria, the taxonomic unit used (species, subspecies, etc.) should be specified. It should be noted that taxa below the rank of variety (e.g., forma, morph, cultivar), are NOT included on the IUCN Red List, with the exception of assessments of isolated subpopulations. Before assessments of units below the species level (subspecies, variety or subpopulation) that can be included in the IUCN Red List, an assessment of the full species is also required.

#### 8.1.2. Geographical scale of categorization

The IUCN criteria are designed for global taxon assessments. However many people are interested in applying them to subsets of global data, especially at regional, national or local levels. To do this it is important to refer to guidelines prepared by the IUCN/SSC Regional Applications Working Group. When applied at national or regional levels it must be recognized that a global category may not be the same as a national or regional category for a particular taxon. For example, taxa classified as Least Concern globally might be Critically Endangered within a particular region where numbers are very small or declining, perhaps only because they are at

the margins of their global range. Conversely, taxa classified as Vulnerable on the basis of their global declines in numbers or range might, within a particular region where their populations are stable, not even nearly meet the criteria for Vulnerable, i.e. be Least Concern. Although this appears illogical, it is a result of the structure of the criteria. When such a situation occurs, interactions among sub-units should be carefully considered when planning recovery. It is also important to note that taxa endemic to regions or nations will be assessed globally in any regional or national applications of the criteria.

#### 8.1.3 Introduced taxa

The categorization process should only be applied to wild populations inside their natural range, and to populations resulting from benign introductions. Benign introductions are defined in the IUCN Guidelines for Re-Introductions (IUCN 1998) as '...an attempt to establish a species, for the

purpose of conservation, outside its recorded distribution, but within an appropriate habitat and eco-geographical area. This is a feasible conservation tool only when there is no remaining area left within a species' historic range'. If the only individuals left are in a naturalized population or a population





resulting from a benign introduction, then the taxon should be considered Extinct in the Wild. In some cases, taxa have successfully expanded their natural ranges into urban or semi-urban areas. In these instances urban areas should be considered as part of the natural range, as the taxa have not been introduced. The original non-urban occurrence may only be assessed as a separate subpopulation (which then must be clearly indicated) if there is little demographic or genetic exchange (typically one successful migrant individual or gamete per year or less) between the original and urbanized occurrences.

In addition to taxa within their natural range and subpopulations resulting from benign introductions (outside the taxon's natural range), the criteria should also be applied to self-sustaining translocated or re-introduced subpopulations (within the taxon's natural range), regardless of the original goal of such translocations or re-introductions. In such cases, the listing should indicate whether all or part of the assessed population has been introduced. Populations introduced for non-conservation purposes, outside the natural range of the taxon are not assessed globally, but they may be assessed regionally.

#### 8.1.4. The IUCN categories

There are nine clearly defined categories into which every taxon in the world (excluding micro-organisms) can be classified. Extinct means that there is no reasonable doubt that the last individual has died. Extinct in the Wild means that the taxon is extinct in its natural habitat. The following three categories, Critically Endangered, Endangered and Vulnerable, are assigned to taxa on the basis of quantitative criteria that are designed to reflect varying degrees of threat of extinction. These criteria will be discussed further in the next section. The category Near Threatened is applied to taxa that do not qualify as threatened now, but may be close to qualifying as threatened. The category Least Concern is applied to taxa that do not qualify (and are not close to qualifying) as threatened or near threatened. The remaining two categories do not reflect the threat status of taxa. The category Data Deficient highlights taxa for which sufficient information is lacking to make a sound status assessment. The inclination to assess taxa as Data Deficient may be very strong; it should be emphasised that assessors must use all data available in full when making a Red List assessment. Precise information on scarce taxa is usually lacking, and although the criteria are highly quantitative and defined, one can use projections, assumptions and inferences in order to place a taxon in the appropriate category. Since Data Deficient is not a category of threat, taxa placed in this category are not so obviously targets for conservation action, although their needs might be very great. Assessors should use whatever information is available and relevant to make assessments and place taxa into the Data Deficient category only when there is really no alternative. Guidance on handling uncertainty is especially relevant in the case of poorly known

taxa. The category Not Evaluated applies to taxa that have not yet been evaluated against the Red List Criteria.

The following descriptions might be used for the IUCN categories:

##### EXTINCT (EX)

A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycles and life form.

##### EXTINCT IN THE WILD (EW)

A taxon is Extinct in the Wild when it is known only to survive in cultivation, or as a naturalised population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

##### CRITICALLY ENDANGERED (CR)

A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered, and it is therefore considered to be facing an extremely high risk of extinction in the wild.

#### ENDANGERED (EN)

A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered, and it is therefore considered to be facing a very high risk of extinction in the wild.

#### VULNERABLE (VU)

A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable, and it is therefore considered to be facing a high risk of extinction in the wild.

#### NEAR THREATENED (NT)

A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

#### LEAST CONCERN (LC)

A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.

#### DATA DEFICIENT (DD)

A taxon is Data Deficient when there is inadequate information to make a direct or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, if a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

#### NOT EVALUATED (NE)

A taxon is Not Evaluated when it has not yet been evaluated against the criteria.

### **8.1.5. The IUCN criteria**

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There are five quantitative criteria which are used to determine whether a taxon is threatened or not, and if threatened, which category of threat it belongs in (Critically Endangered, Endangered or Vulnerable). These criteria are based around the biological indicators of populations that are threatened with extinction, such as rapid population decline or very small population size. Most of the criteria also include subcriteria that must be used to justify more specifically the listing of a taxon under a particular category. For example, a taxon listed as "Vulnerable C2a(i)" has been placed in the Vulnerable category because its population is fewer than 10,000 mature individuals (criterion C) and

the population is undergoing a continuing decline and all its mature individuals are in one subpopulation (subcriterion a(i) of criterion C2).

The five criteria are:

- A. Declining population (past, present and/or projected);
- B. Geographic range size, and fragmentation, decline or fluctuations;
- C. Small population size and fragmentation, decline, or fluctuations;
- D. Very small population or very restricted distribution;
- E. Quantitative analysis of extinction risk (e.g., Population Viability Analysis)

### **8.1.6. Conservation priorities and actions**

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The category of threat is not necessarily sufficient to determine priorities for conservation action. The category of threat simply provides an assessment of the extinction risk under current circumstances, whereas a system for assessing priorities for action will include numerous other factors

concerning conservation action such as costs, logistics, chances of success, and other biological characteristics. The Red List should therefore not be interpreted as a means of priority setting. The difference between measuring threats and assessing conservation priorities needs to be appreciated.





However, assessment of taxa using Red List Criteria represents a critical first step in setting priorities for conservation action.

Many taxa assessed under the IUCN Red List Criteria will already be subject to some level of conservation action. The criteria for the threatened categories are to be applied to a taxon whatever the level of conservation action affecting it, and any

conservation measures must be included with the assessment documentation. It is important to emphasise here that a taxon may require conservation action even if it is not listed as threatened, and that effectively conserved threatened taxa may, as their status improves over time, cease to qualify for listing.

### 8.1.7. Regional Red Lists

A large number of regional (i.e., sub-national, national and regional) Red Data Books and Red Data Lists have been published around the world. In some of these publications, the Red List assessments are based on classification systems of threat developed and adopted within the country concerned; many of the older publications are based on the pre-1994 system of qualitative IUCN Red List Categories; but an ever increasing number of regional Red List assessments are based on the IUCN Red List Categories and Criteria (IUCN 1994a,b, 2001). The IUCN Red List Categories and Criteria, however, were developed primarily for application at the global level. Hence assessments of non-endemic species at national levels based on these criteria could result in incorrect and even misleading (especially when linked to conservation priority setting schemes) listings. As a result, IUCN through the Red List Programme has formulated regional guidelines to guide the assessment of endemic and non-endemic species (IUCN 2003).

The regional application guidelines are not a fixed set of rules that must be followed but a set of best-practice guidelines that indicate the preferred approaches to be followed and the issues that need to be addressed. Adoption of the regional guidelines is encouraged as they help make regional Red Lists more comparable, they promote the sharing of

species information between neighboring countries, and they promote better flow of information between the regional and global levels. A National Red List Advisory Group (NRLAG) has been established by the IUCN/SSC Red List Committee to actively promote the use of the guidelines, and to act as an advisory group on best practice. The NRLAG intends developing three inter-related projects: (1) a survey of the Convention on Biological Diversity focal points to evaluate their approach to national threatened species lists; (2) an evaluation and analysis of several countries which have or are planning to apply the IUCN Red List Criteria at a national level; and (3) to hold a workshop involving the selected test countries where the different experiences and problems can be shared and solutions developed. The NRLAG is particularly interested in the linkages between Red Lists and conservation policy and priority setting for conservation actions.

Compilers of regional Red Lists are encouraged to submit assessments of all endemic species for possible inclusion in the IUCN Red List. All submissions must include the necessary supporting documentation (IUCN 2001; see <http://www.iucn-redlist.org/info/organization.html>) and are subject to peer review by the relevant Red List Authorities.

## 8.2. Mapping

The geographic range of a species can be assessed using a variety of techniques (Gaston 1994). First, and at the coarsest resolution, species distributions have traditionally been mapped through known occurrence in predefined geographic units, such as countries (Mittermeier, 1988) or geopolitical units (Brummitt, 2001), and ecological systems and biomes (Olson et al. 2001). Second, are polygon range maps ("Extent of Occurrence" (EOO) defined in IUCN (2001), based on a combination of known records and specialist knowledge, although these

are greatly overestimate occupancy within the range (Corsi et al. 2000). Third, the finest resolution approach is to compile point data - known point occurrences (often supported by museum or herbarium specimens) of a given species in a given place at a given time - but uneven sampling is a serious problem for the assessment of point data (Peterson et al. 1998; Peterson and Watson 1998). These sampling problems can be reduced by development of inductive range models (Peterson et al. 2002) or the establishment of grid based sampling



systems to produce atlas data (Udvardy 1975). Data limitations mean that it has not yet been possible to use these latter two approaches across entire taxonomic groups, worldwide.

The distribution of threatened species is summarized according to following predetermined geographic classifications:

- ❁ Countries: The richness of threatened species per country is useful to give context as a coarse measure of threats to biodiversity, but is heavily conflated by area (Balmford and Long 1995) and driven by the occurrence of widespread species (Lennon et al. 2004). Dividing threatened species richness by total numbers of species per country does give a useful measure of relative threat to a nation's biodiversity. The presentation of threatened species occurrences by country is also useful in providing a crosscheck to national Red Lists, and vice versa (Hilton-Taylor et al. 2000; Rodriguez et al. 2000), given the important implications of these for national conservation policy. Particularly informative are the numbers of threatened species endemic to each country, because they can guide a "doctrine of ultimate responsibility" for each nation's contribution to global biological heritage (Mittermeier et al. 1998).
- ❁ Ecological Systems: The most straightforward framework for assessing the ecological distributions of threatened species is to divide the planet's surface into three systems: terrestrial, freshwater, and marine. This classification is complicated by those species that live in the interface between systems and those that live in multiple systems. These are a small proportion of species overall, however - most species occur only in one of the three ecological systems.
- ❁ Biogeographic Realms: Biogeographic realms are the eight continent-scale terrestrial and freshwater regions distinguished by characteristic biota that reflect shared evolutionary histories, these are: the Neotropical, Afrotropical, Indomalayan, Australasian, Palearctic, Nearctic, Antarctic and Oceanic.
- ❁ Biomes: At a finer scale, it is possible to assess the distributions of threatened species across biomes. Biomes represent global scale variation in the structure, dynamics and complexity of terrestrial and

freshwater communities and ecosystems that are driven by key global-scale patterns such as temperature and precipitation. Olson et al. (2001) identified 14 biomes worldwide: Tropical/Subtropical Moist Broadleaf Forest; Tropical/Subtropical Dry Broadleaf Forest, Tropical/Subtropical Grassland, Savanna and Shrubland, Montane Grassland and Shrubland, and Desert and Xeric Shrubland all hold moderately large numbers of species and threatened species for all taxa. The high-latitude biomes of Boreal Forests/Taiga and Tundra hold very few species, and even the Mediterranean Forest, Woodland and Scrub are remarkably poor.

- ❁ Habitats: The finest ecological scale at which one can assess the distribution of threatened species is the scale of habitats, and, indeed, coding species up to their habitat preferences is part of the required documentation in the Red List assessment process (IUCN 2001).

As the spatial resolution of data on the geographic distributions of threatened species increases, so does the utility of these data for conservation, but, unfortunately, the effort required to compile the data does as well. Nevertheless, the world's museums and herbaria represent a vast storehouse of such fine-scale geographic biodiversity data, and a number of initiatives are underway that suggest that these data will become increasingly available in the future. This said, synthesis of the numerous point data already available not only provides much finer resolution insight into the distribution of threatened species, but also provides a basis for establishing targets for site-scale conservation actions on the ground. The effort necessary to compile such data means that we are a long way from being able to show localities globally for all threatened species across multiple taxa. It is now possible to map localities for all threatened species within an individual taxon continentally, and at a finer, regional scale, to map localities for all threatened species in the region of interest. Mapping in the framework of this project will be done for two purposes. To identify the area of distribution of studied species in the region and to determine IUCN categories of them on the base of quantitative analyses of frequency of their occurrence in the country. Our proposal is to use the database-driven cartography approach for the development of all required floristic maps. This approach means that the development of geo-databases of the crop plants and rare plant species that have medicinal/decorative properties should take





place first. Database-oriented approach simplifies and facilitates the generation and maintenance of the product and ensures the data consistency. The database can be used later for multiple cartographic products by employing different symbol schemas. The lists of digital maps and charts produced will be easy to modify. Main advantage of the proposed approach is flexibility in choosing the content and structure of hard- and softcopy outputs. Traditional floristic maps have been produced manually without following standardized requirements for the map contents and layout. Modern GIS technologies enable a complete revision of the mapping techniques. Having the data stored in a database, one can print a copy of map when it is needed and with a layout adopted to specific requirements of the user as well as capabilities of the producer. Any kind of thematic maps can be easily prepared having a well structured and consistent GIS database available.

We plan to produce following maps:

- ❁ Distribution of crop plants and rare plant species that have medicinal/decorative properties and are known to be threatened on a global level by anthropogenic stresses and/or impacted by natural hazards will be displayed in the form of paper maps and digital versions in .tiff or .jpg format.
- ❁ Frequency maps will be done for determination of IUCN categories (Akhalkatsi et al., 2003). Paper maps and digital versions in

.tiff or .jpg format in UTM grids will be done in 2 scales 5x5 and 10x10 km<sup>2</sup>. Based on the number of 10x10 km<sup>2</sup> UTM squares inhabited by concrete species on the territory of Georgia, the attempt will be made to give the status of rare species according to Criteria by the World Conservation Union (IUCN, 2001). For listing concrete categories is a number of 10x10 km<sup>2</sup> UTM squares as quantitative criteria appropriate for assessing threat levels for any taxon. The following ratios between the number of 10x10 km<sup>2</sup> UTM squares and categories are determined: 1-2, critically endangered (CR); 3-9, endangered (EN); 10-49, vulnerable (VU); 50-99, near threatened (NT); >100, least concern (LC). At the same time, the size of populations and stability of their habitats have been considered. 5x5 km<sup>2</sup> maps will be prepared only for Samtskhe-Javakheti region for evaluation of resources of each studied species available in the region. The GPS data on species localities will be obtained during the field trips undertaken in the Samtskhe-Javakheti region and from the herbaria and the data base of GSNE "Orchis" when the distribution along the country should be incorporated.

Basic topographic information (hydrographs, roads, railways, settlements, etc.) will be presented by topographical maps, which will be used as a background for printed maps.

### 8.3. Inventory of Medicinal Plant species



The aim of inventory is to provide an indication of the number and diversity of medicinal plant species in the Samtskhe-Javakheti region. Inventory will be done of the species included in existing short list of rare plant species that have medicinal/decorative properties and are known to be threatened on a global level by anthropogenic stresses and/or impacted by natural hazards in the region, on the bases of quantitative evaluation of threat levels according to literature data. The short list composed mainly on the base of Red Data Book of Georgia needs to be revised using data, which will be collected during field trips. Quantitative evaluation will be used for determination of threat levels of separate plant species included in the short list. Species overall status and threats on the country

and global levels will be determined using methodology provided in IUCN Red List Guidlinece (2001, 2003, 2004) for determination of IUCN categories and criteria and information indicated in International Conventions, such as Biodiversity, Desertification, Climate Change, and Conservation of Wetlands. As well as lists of CITES (The Convention on International Trade in Endangered Species of the Wild Fauna and Flora) and, Environmental Laws of Georgia. Analyses and collection of phytosociological data on vegetation of Samtskhe-Javakheti region and on species characteristics of the short listed plants will be done on the base of accepted phytosociological methods (Braun-Blanquet, 1964; Tuxen, 1970; Dierschke, 1994).

### 8.3.1. Data collection

The approach suggests collection of quantitative data on species abundance, genetic diversity and overall status (vitality and fertility). The investigation will be carried out using methods of plot recording. For this purpose three 1m<sup>2</sup> plots will be

chosen within each population of high conservation value herbaceous species. In case of shrubs, trees or other life forms different sizes of plots will be used. The sizes of plots are shown in the Table 3 according to R. Tuxen, (1970):

Table 3. Area (m<sup>2</sup>) of Permanent Plots for Different Habitats

| N | Size (m <sup>2</sup> ) | Habitat type |
|---|------------------------|--------------|
| 1 | 1                      | Meadows      |
| 2 | 4                      | Wetland      |
| 3 | 25                     | Scrub        |
| 4 | 100                    | Forest       |

Preference is given to the square shape of the recording plots. GPS (Global Positioning System) co-ordinates of each plot will be recorded. For the purpose of delimitation of plot surfaces, frame and tape are used for 1m<sup>2</sup> plots. The time of inventory will be coincided to two phenological phases in

each population at flowering and fruiting stages. For each plot, photos will be taken from fixed points during each visit. The following table is developed for recording the data for each recording plot (Table 4).

Table 4. Data on species inventory for 1m<sup>2</sup> plot

| Target species                    |  |
|-----------------------------------|--|
| Plot No., Population no.          |  |
| Figure(s) ref.                    |  |
| Map                               |  |
| Date of field data collection     |  |
| Environmental Data                |  |
| Population size (m <sup>2</sup> ) |  |
| Number of plants                  |  |
| Plot size (m <sup>2</sup> )       |  |
| Location                          |  |
| GPS Coordinates (UTM)             |  |
| Altitude (m a.s.l.)               |  |
| Aspect                            |  |
| Inclination                       |  |
| Coverage (%)                      |  |
| Canopy height (cm)                |  |
| Habitat                           |  |
| Existing habitat disturbances     |  |
| Population Characteristics        |  |
| Number of individuals in plot     |  |
| Vitality and fertility            |  |
| Sociability                       |  |
| Pattern                           |  |
| Genetic diversity                 |  |
| Hybridization                     |  |

During the field studies, the following data have to be collected:

1. Data for documentation of the record: target species name, plot No., population no., figure(s), ref. Map, date of field data collection. Majority of plant Latin names given in this report are in accordance with Cherepanov (1995) and II edition of Flora of Georgia; nomenclature of representatives

of family Orchidaceae follows Akhalkatsi et al. (2003).

2. Environmental data:

- ❁ Size (m<sup>2</sup>) of entire population of target species;
- ❁ Total number of individuals of target species in the plot;





- ❁ Location, exact GPS coordinates, altitude and sloping characters (inclination, exposition);
  - ❁ Vegetation cover (%) and canopy height (cm);
  - ❁ Habitat type and description of existing disturbances. The following grades will be used to identify level of modification/disturbance of communities found within the plots:
    1. Relatively stable or undisturbed communities. Example: old growth, ungrazed forest.
    2. Late successional or lightly disturbed communities. Example: old growth forest that was selectively logged in recent years.
    3. Mid-successional or moderately to heavily disturbed communities. Example: young to mature secondgrowth forest.
    4. Early successional or severely disturbed communities. Example: severely grazed forest of any age.
    5. Very early successional or very severely disturbed communities. Example: cropland.
3. Population characteristics:
1. Numbers of individuals of target species within the plot; Number of individuals is calculated within the frame boundary in each plot. In case of polycormel species it is possible to calculate each shoot instead of individuals.
  2. Sociability will be measured as an expression of horizontal pattern of the species and degree of clustering (contagion) of the plant units (in our case-individuals) of a species. In accordance with floristic-sociological approach of Braun-Blanquet (1964), sociability has been estimated with the following scale:
    - 1 growing solitary, singly;
    - 2 growing in small groups of a few individuals;
    - 3 growing in small patches;
    - 4 growing in extensive patches;
    - 5 growing in great crowds.
3. Vitality and fertility; Vitality and fertility, representing plant vegetative and generative development respectively, are important parameters of the species' performance. Vitality and fertility of target populations will be measured using a scale of relative "thriving" with four categories developed by Braun-Blanquet (1964):
- 1 well developed, regularly completing the life cycle
  - 2 with vegetative propagation but not completing the life cycle
  - 3 feeble with low vegetative propagation, not completing the life cycle
  - 4 occasionally germinating but not vegetative propagating.
4. Distribution pattern: The pattern or the manners in which the individuals of a given species are distributed within a plot have been recorded. Clustered, random, regular patterns and their transitional variants exhibited by individuals of different species have been identified within the permanent plots.
5. Genetic diversity: Genetic diversity will be observed as phenotypic modification of individuals within the population and recorded;
6. Hybridization: Hybridization will be recorded in case if the individuals of target species will reveal intermediate morphological features.
- In addition, for development of long term in situ conservation management needs the following indicators for habitats and population protection such as ecological, demographic and genetic indicators representing in Table 5 will be recorded:



Table 5. Environmental indicators and threats.

| N | Indicator   | Threat   |
|---|---|--|
| 1 | <b>Ecological indicators:</b><br>" Habitat degradation;<br>" Soil erosion;<br>" Herbivory;<br>" Pollution.  | Degradation of the environment by external factors where the population is situated.                         |
| 2 | <b>Demographic indicators:</b><br>" Abundance and spatial distribution of seedlings;<br>" Number of adult individuals;<br>" Number of flowering individuals;<br>" Spatial distribution. | Decline in the survival of regeneration of the population due to non-genetic factors (non heritable).        |
| 3 | <b>Genetic indicators:</b><br>" Genetic diversity;<br>" Differentiation among populations;<br>" Hybridization.  | Reduction in the genetic resilience and, therefore, survival of the population in the long term perspective. |

- The impact factors on the environment threatening population survival will be determined (Table 6):

Table 6. Impact factors and their influence on populations.

| N | Impact factor   | Impact on the populations  |
|---|---|--|
| 1 | <b>Human-made habitat disturbances:</b><br>" Road and pipeline constructions;<br>" Physical impact - removing of the populations;<br>" Chemical impact -pollution by oil and gas releases to air, water and land.<br>" Deforestation;<br>" Land degradation;<br>" Urbanization;<br>" Damaged caused by non-native plants and animals introduced into an area;<br>" Pollution. | Population disappearance and fragmentation;<br>Species extinction.   |
| 2 | <b>Collection of medicinal/ornamental plants in the wild</b>  | Population disappearance;<br>Species extinction.   |
| 3 | <b>Grazing</b>  | Age structure;<br>Competition;<br>Genetic diversity.   |
| 4 | <b>Climate change:</b><br>" Disturbance of wetland ecosystem<br><br>" Global warming and desertification.<br><br>" Global warming effect on alpine  | Threat for species distributed in the aquatic habitats.<br><br>Threat for species distributed in the extremely dry areas.<br><br>Threat for species distributed in the alpine. |





### 8.3.2. Data analyses

The following parameters will be determined on the base of data collected during field observations:

1. Area of distribution of target species;
2. Number of populations of target species;
3. Total number of individuals of a species in all studied populations;
4. Overall ecological state of target species;
5. Main threats impacted the species;

The data on population and habitat characteristics

will be gained in data base using program MS access. The complete data base on species inventory will be used for mapping.

The data obtained during species inventory procedure will be used for mapping of a target species. This combination, species distribution and population characterization will be used for determination of a species status according to the criteria of IUCN (2001, 2004).



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# Appendixes



**Appendix 1.** Endemic plant species occurring in Samtskhe-Javakheti region (according to Gvritishvili, Kimeridze, 2002; Aneli et al. 1969). ❁ Endemics of Georgia ❁ Endemics of Caucasus.

| N   | Endemic | Latin Name                                      | Botanical Geographic Region                                       |
|-----|---------|---|---|
| 1   | 2       | 3   | 4   |
| 1.  | ❁       | <i>Aconitum nasutum</i> Fisch. ex Rchb.         | Kartli, Javakheti, Meskheta                                       |
| 2.  | ❁       | <i>Achillea sedelmeyerana</i> Sosn.             | Javakheti,  |
| 3.  | ❁       | <i>Agasy llis latifolia</i> (M. Bieb.) Boiss.   | Kartli, Trialeti, Javakheti,                                      |
| 4.  | ❁       | <i>Alchemilla alexandri</i> Juz.                | Javakheti,  |
| 5.  | ❁       | <i>Alchemilla georgica</i> Juz.                 | Javakheti,  |
| 6.  | ❁       | <i>Alchemilla insignis</i> Juz.                 | Javakheti,  |
| 7.  | ❁       | <i>Alchemilla pycnotricha</i> Juz.              | Kartli, Javakhet  |
| 8.  | ❁       | <i>Alchemilla subsplendens</i> Bus.             | Javakheti   |
| 9.  | ❁       | <i>Allium karsianum</i> Fomin                   | Trialeti, Javakheti,  |
| 10. | ❁       | <i>Alopecurus tiflisiensis</i> (Westb.) Grossh. | Kartli, Meskheta  |
| 11. | ❁       | <i>Androsace raddeana</i> Somm. & Levier        | Javakheti   |
| 12. | ❁       | <i>Anthemis dumetorum</i> Sosn.                 | Kartli, Trialeti, Kvemo Kartli, Meskheta,                         |
| 13. | ❁       | <i>Anthemis iberica</i> M. Bieb.                | Trialeti, Javakheti   |
| 14. | ❁       | <i>Anthyllis lachnophora</i> Juz.               | Over Georgia  |
| 15. | ❁       | <i>Aster ibericus</i> Steven                    | Kartli, Gardabani, Trialeti, Kvemo Kartli,<br>Javakheti, Meskheta |
| 16. | ❁       | <i>Astragalus argillosus</i> Manden.            | Meskheta  |
| 17. | ❁       | <i>Astragalus aspindzicus</i> Manden. & Chinth. | Meskheta  |
| 18. | ❁       | <i>Astragalus goktschaicus</i> Grossh.          | Javakheti, Meskheta   |
| 19. | ❁       | <i>Astragalus kadshorensis</i> Grossh.          | Kartli, Trialeti, Kvemo Kartli, Javakheti                         |
| 20. | ❁       | <i>Astragalus leonidae</i> Manden.              | Meskheta  |
| 21. | ❁       | <i>Astragalus meskheticus</i> Manden.           | Meskheta  |
| 22. | ❁       | <i>Astragalus raddeanus</i> Regel               | Kartli, Trialeti, Meskheta  |
| 23. | ❁       | <i>Astragalus vavilovii</i> Tamamsch. & Fed.    | Javakheti   |
| 24. | ❁       | <i>Astrantia trifida</i> Hoffm.                 | Kartli, Trialeti, Kvemo Kartli, Javakheti                         |
| 25. | ❁       | <i>Atropa caucasica</i> Kreyer                  | Kartli, Trialeti, Meskheta  |
| 26. | ❁       | <i>Bupleurum sosnowskyi</i> Manden.             | Kartli, Meskheta  |
| 27. | ❁       | <i>Carduus adpressus</i> C. A. Mey.             | Trialeti, Javakheti   |
| 28. | ❁       | <i>Carduus onopordioides</i> Fisch. ex M. Bieb. | Kartli, Trialeti, Meskheta  |
| 29. | ❁       | <i>Centaurea glehnii</i> Trautv.                | Kartli, Trialeti, Kvemo Kartli, Javakheti<br>Meskheta             |
| 30. | ❁       | <i>Centaurea gulissaschvilii</i> Dumb.          | Meskheta  |
| 31. | ❁       | <i>Cephalaria gigantea</i> (Ledeb. ) Bobr.      | Kartli, Gardabani, Trialeti, Kvemo Kartli,<br>Javakheti, Meskheta |
| 32. | ❁       | <i>Cerastium sosnowskyi</i> Schischk.           | Kartli, Javakheti, Meskheta                                       |
| 33. | ❁       | <i>Chaerophyllum confusum</i> Woronow           | Meskheta  |
| 34. | ❁       | <i>Chaerophyllum roseum</i> M. Bieb.            | Kartli, Trialeti, Kvemo Kartli, Javakheti<br>Meskheta             |
| 35. | ❁       | <i>Cirsium caucasicum</i> (Adams) Petrak        | Kartli, Trialeti, Meskheta  |
| 36. | ❁       | <i>Cirsium osseticum</i> (Adams) Petrak         | Kartli, Trialeti  |
| 37. | ❁       | <i>Cirsium simplex</i> C. A. Mey.               | Kartli, Gardabani, Trialeti, Kvemo Kartli,<br>Javakheti, Meskheta |

| 1   | 2 | 3  | 4  |
|-----|---|--|--|
| 38. | ✿ | <i>Convallaria transcaucasica</i> Utkin ex Grossh. | Kartli, Trialeti, Meskheta                                     |
| 39. | ✿ | <i>Corydalis alexeenkoana</i> N. Busch             | Kartli, Javakheti, Meskheta                                    |
| 40. | ✿ | <i>Crataegus caucasica</i> C. Koch                 | Kartli, Trialeti, Meskheta                                     |
| 41. | ✿ | <i>Cytisus caucasicus</i> Grossh.                  | Kartli, Trialeti, Meskheta                                     |
| 42. | ✿ | <i>Daphne axilliflora</i> (Keissl.) Pobed.         | Kartli, Gardabani, Meskheta                                    |
| 43. | ✿ | <i>Delphinium flexuosum</i> M. Bieb.               | Javakheti, Meskheta  |
| 44. | ✿ | <i>Delphinium schmalhauseni</i> Albov              | Javakheti, Meskheta  |
| 45. | ✿ | <i>Dianthus caucaseus</i> Smith                    | Almost in all mountain regions of Georgia                      |
| 46. | ✿ | <i>Dianthus inamoenus</i> Schischk.                | Kartli, Gardabani, Meskheta                                    |
| 47. | ✿ | <i>Dianthus subulosus</i> Freyn & Conrath          | Kartli, Gardabani, Trialeti, Kvemo Kartli, Javakheti, Meskheta |
| 48. | ✿ | <i>Echinops cirsiifolius</i> C. Koch               | Javakheti, Meskheta  |
| 49. | ✿ | <i>Echinops transcausicus</i> Iljin                | Meskheta   |
| 50. | ✿ | <i>Erigeron caucasicus</i> Steven                  | Kartli, Gardabani, Trialeti, Kvemo Kartli, Javakheti, Meskheta |
| 51. | ✿ | <i>Erysimum aureum</i> M. Bieb.                    | Kartli, Trialeti, Javakheti, Meskheta                          |
| 52. | ✿ | <i>Erysimum caucasicum</i> Trautv.                 | Kartli, Meskheta   |
| 53. | ✿ | <i>Eunomia rotundifolia</i> C. A. Mey.             | Javakheti  |
| 54. | ✿ | <i>Euphorbia armena</i> Prokh.                     | Kartli, Meskheta   |
| 55. | ✿ | <i>Euphorbia macroceras</i> Fisch. & C. A. Mey.    | Kartli, Trialeti, Meskheta                                     |
| 56. | ✿ | <i>Euphrasia caucasica</i> Juz.                    | Kartli, Meskheta   |
| 57. | ✿ | <i>Fritillaria latifolia</i> Willd.                | Kartli, Meskheta   |
| 58. | ✿ | <i>Gagea alexeenkoana</i> Misch.                   | Kartli, Javakheti  |
| 59. | ✿ | <i>Gladiolus caucasicus</i> Herb.                  | Kartli, Trialeti, Javakheti                                    |
| 60. | ✿ | <i>Gypsophila tenuifolia</i> M. Bieb.              | Almost in all mountain regions of Georgia                      |
| 61. | ✿ | <i>Helianthemum georgicum</i> Juz. & Pozd.         | Kartli, Trialeti, Javakheti, Meskheta                          |
| 62. | ✿ | <i>Helichrysum polyphyllum</i> Ledeb.              | Meskheta   |
| 63. | ✿ | <i>Helichrysum plintocalyx</i> (C. Koch) Sosn.     | Kartli, Gardabani, Meskheta                                    |
| 64. | ✿ | <i>Heracleum chorodanum</i> (Hoffm.) DC.           | Gardabani, Meskheta  |
| 65. | ✿ | <i>Heracleum sosnowskyi</i> Manden.                | Kartli, Trialeti, Kvemo Kartli, Meskheta                       |
| 66. | ✿ | <i>Heracleum transcaucasicum</i> Manden.           | Kartli, Trialeti, Javakheti                                    |
| 67. | ✿ | <i>Heracleum wilhelmsii</i> Fisch. & Ave-Lall.     | Kartli, Meskheta   |
| 68. | ✿ | <i>Hieracium incarniforme</i> Litv. & Zahn         | Javakheti, Meskheta  |
| 69. | ✿ | <i>Hieracium pannoniciforme</i> Litv. & Zahn       | Kartli, Gardabani, Trialeti, Kvemo Kartli, Javakheti           |
| 70. | ✿ | <i>Hieracium ruprechtii</i> Boiss.                 | Javakheti, Meskheta  |
| 71. | ✿ | <i>Isatis brachycarpa</i> C. A. Mey.               | Javakheti, Meskheta  |
| 72. | ✿ | <i>Koeleria fominii</i> (Domin) Gontsch.           | Kartli, Trialeti, Javakheti                                    |
| 73. | ✿ | <i>Ligularia caucasica</i> Pojark.                 | Kartli, Javakheti, Meskheta                                    |
| 74. | ✿ | <i>Lotus caucasicus</i> Kuprian ex Juz.            | Over all Georgia   |
| 75. | ✿ | <i>Medicago hemicycla</i> Grossh.                  | Javakheti, Meskheta  |
| 76. | ✿ | <i>Melampyrum caucasicum</i> Bunge                 | Javakheti, Meskheta  |
| 77. | ✿ | <i>Minuartia akinfiewii</i> (Schmalh.) Woronow     | Kartli, Meskheta   |
| 78. | ✿ | <i>Muscari sosnowskyi</i> Schchian                 | Kartli, Javakheti  |
| 79. | ✿ | <i>Nepeta grossheimii</i> Pojark.                  | Kartli, Trialeti, Kvemo Kartli, Javakheti                      |
| 80. | ✿ | <i>Nepeta iberica</i> Pojark.                      | Kartli, Meskheta   |
| 81. | ✿ | <i>Nonea intermedia</i> Ledeb.                     | Kartli, Javakheti, Meskheta                                    |





| 1    | 2 | 3  | 4  |
|------|---|--|--|
| 82.  | ✿ | <i>Onobrychis meschetica</i> Grossh.   | Kartli, Javakheti, Meskheta                                    |
| 83.  | ✿ | <i>Onobrychis oxytropoides</i> Bunge   | Kartli, Javakheti  |
| 84.  | ✿ | <i>Ornithogalum schmalhauseni</i> Albov                                      | Kartli, Meskheta   |
| 85.  | ✿ | <i>Orobancha gamosepala</i> Reut.  | Javakheti, Meskheta  |
| 86.  | ✿ | <i>Orobancha pulchella</i> (C. A. Mey.) Novopokr.                            | Kartli, Trialeti, Javakheti, Meskheta                          |
| 87.  | ✿ | <i>Orobancha ciliadentata</i> (Czeffr.) Avasneli                             | Kartli, Trialeti, Javakheti                                    |
| 88.  | ✿ | <i>Paederotella pontica</i> Rupr. ex Boiss. Kem.-Nath.                       | Meskheta   |
| 89.  | ✿ | <i>Paeonia steveniana</i> Kem.-Nath.   | Kartli, Meskheta   |
| 90.  | ✿ | <i>Pimpinella aromatica</i> M. Bieb.   | Kartli, Trialeti, Meskheta                                     |
| 91.  | ✿ | <i>Podospermum idae</i> Sosn.  | Kartli, Meskheta   |
| 92.  | ✿ | <i>Polygala mariamae</i> Tamamsch.   | Kartli, Trialeti, Javakheti, Meskheta                          |
| 93.  | ✿ | <i>Polygala transcaucasica</i> Tamamsch.                                     | Kartli, Meskheta   |
| 94.  | ✿ | <i>Polygonum dshawachischwili</i> Charkev.                                   | Kartli, Trialeti, Javakheti                                    |
| 95.  | ✿ | <i>Potentilla brachypetala</i>   | Meskheta   |
| 96.  | ✿ | <i>Potentilla caucasica</i> Juz.   | Kartli, Javakheti, Meskheta                                    |
| 97.  | ✿ | <i>Potentilla sosnowskyi</i> Kapell.   | Meskheta   |
| 98.  | ✿ | <i>Primula cordifolia</i> Rupr.  | Kartli, Javakheti  |
| 99.  | ✿ | <i>Primula ruprechtii</i> Kusn.  | Kartli, Trialeti, Kvemo Kartli, Javakheti, Meskheta            |
| 100. | ✿ | <i>Psephellus carthalinicus</i> Sosn. (=Centaurea carthalinica (Sosn.)Sosn.) | Meskheta   |
| 101. | ✿ | <i>Psephellus meskheticus</i> (Sosn.)Sosn. (=Centaurea meskhetica Sosn.)     | Meskheta   |
| 102. | ✿ | <i>Psephellus transcausicus</i> (=Centaurea transcaucasica Sosn. ex Grossh.) | Trialeti, Meskheta   |
| 103. | ✿ | <i>Pulsatilla violacea</i> Rupr.   | Kartli, Javakheti  |
| 104. | ✿ | <i>Pyrus caucasica</i> Fed.  | Kartli, Gardabani, Trialeti, Kvemo Kartli, Meskheta            |
| 105. | ✿ | <i>Pyrus georgica</i> Kuthatheladze  | Kartli, Meskheta   |
| 106. | ✿ | <i>Ranunculus grandiflorus</i> L.)<br>=R. elegans C. Koch                    | Kartli, Gardabani, Trialeti, Kvemo Kartli, Javakheti, Meskheta |
| 107. | ✿ | <i>Ranunculus brachylobus</i> Boiss. & Hohen. )<br>(=R. dzhavacheticus Ovcz. | Kartli, Trialeti, Javakheti                                    |
| 108. | ✿ | <i>Ranunculus caucasicus</i> M. Bieb. )<br>(=R. transcausicus Kem.-Nath.     | Kartli, Trialeti, Javakheti, Meskheta                          |
| 109. | ✿ | <i>Reaumuria kuznetzovii</i> Sosn. & Manden.                                 | Kartli, Meskheta   |
| 110. | ✿ | <i>Salvia compar</i> Trautv. ex Grossh.                                      | Kartli, Meskheta   |
| 111. | ✿ | <i>Scilla rosenii</i> C. Koch  | Kartli, Javakheti, Meskheta                                    |
| 112. | ✿ | <i>Scilla winogradovii</i> Sosn.   | Meskheta   |
| 113. | ✿ | <i>Scorzonera dzhawakhetica</i> Sosn. ex Grossh.                             | Javakheti, Meskheta  |
| 114. | ✿ | <i>Scorzonera ketzkhoveli</i> Sosn. ex Grossh.                               | Javakheti  |
| 115. | ✿ | <i>Senecio propinquus</i> Schischk.  | Kartli, Trialeti, Meskheta                                     |
| 116. | ✿ | <i>Senecio rhombifolius</i> (Adams) Sch. Bip.                                | Kartli, Meskheta   |
| 117. | ✿ | <i>Tephrosia subfloccosa</i> Schischk.<br>(=Senecio subfloccosus Schischk.)  | Kartli, Trialeti, Javakheti, Meskheta                          |
| 118. | ✿ | <i>Seseli grandivittatum</i> (Somm. & Levier).<br>Schischk                   | Kartli, Gardabani, Kvemo Kartli, Meskheta                      |
| 119. | ✿ | <i>Solidago caucasica</i> Kem.-Nath.   | Kartli, Gardabani, Trialeti, Kvemo Kartli, Javakheti, Meskheta |

| 1    | 2 | 3  | 4  |
|------|---|--|--|
| 120. | ✿ | <i>Sonchus ketzkhovelii</i> Schischk.                              | Javakheti  |
| 121. | ✿ | <i>Sorbus caucasigena</i> Zinserl.                                 | Kartli, Trialeti, Javakheti, Meskheta                          |
| 122. | ✿ | <i>Sosnowskya amblyolepis</i> (Ledeb.) Takht.                      | Kartli, Meskheta   |
| 123. | ✿ | <i>Symphytum caucasicum</i> M. Bieb.                               | Kartli, Trialeti, Meskheta                                     |
| 124. | ✿ | <i>Taraxacum confusum</i> Schischk.                                | Kvemo Kartli, Meskheta   |
| 125. | ✿ | <i>Teucrium nuchense</i> C. Koch                                   | Kartli, Gardabani, Trialeti, Kvemo Kartli, Javakheti, Meskheta |
| 126. | ✿ | <i>Thymus collinus</i> M. Bieb                                     | Over Georgia   |
| 127. | ✿ | <i>Thymus coriifolius</i> Ronn.<br>(= <i>T. sosnowskyi</i> Grossh. | Kartli, Meskheta   |
| 128. | ✿ | <i>Tragopogon kemulariae</i> Kuthatheladze                         | Javakheti  |
| 129. | ✿ | <i>Tragopogon ketzkhovelii</i> Kuthatheladze                       | Javakheti  |
| 130. | ✿ | <i>Tragopogon makaschwilii</i> Kuthatheladze                       | Javakheti  |
| 131. | ✿ | <i>Tragopogon marginatus</i> Boiss. & Buhse                        | Kartli, Meskheta   |
| 132. | ✿ | <i>Tragopogon meskheticus</i> Kuthatheladze                        | Meskheta   |
| 133. | ✿ | <i>Tragopogon serotinus</i> Sosn.                                  | Kartli, Trialeti, Javakheti, Meskheta                          |
| 134. | ✿ | <i>Tripleurospermum rupestre</i><br>(Somm. & Levier) Pobed.        | Kartli, Meskheta   |
| 135. | ✿ | <i>Tripleurospermum transcaucasicum</i><br>(Manden.) Pobed.        | Kartli, Trialeti, Javakheti                                    |
| 136. | ✿ | <i>Valeriana eriophylla</i> (Ledeb.) Utkin                         | Kartli, Trialeti, Javakheti, Meskheta                          |
| 137. | ✿ | <i>Valeriana tiliifolia</i> Troitzk.                               | Kartli, Trialeti, Meskheta                                     |
| 138. | ✿ | <i>Vicia grossheimii</i> Ekvtim.                                   | Kartli, Trialeti, Javakheti                                    |
| 139. | ✿ | <i>Viola somchetica</i> C. Koch                                    | Kartli, Trialeti, Meskheta                                     |





**Appendix 2.** List of economically valuable plant species of Samtskhe-Javakheti and Kartli regions (according to Gvritishvili, Kimeridze, 2002).

A. Trees and Shrubs

- |   |   |
|---|---|
| 1. <i>Acer campestre</i> L.   | 45. <i>Picea orientalis</i> (L.)Link                                    |
| 2. <i>Acer laetum</i> C. A. Mey.  | 46. <i>Pinus kochiana</i> Klotzsch ex C.Koch                            |
| 3. <i>Acer platanoides</i> L.   | 47. <i>Populus alba</i> L.  |
| 4. <i>Acer trautvetteri</i> Medw.   | 48. <i>Populus nigra</i> L.   |
| 5. <i>Alnus barbata</i> C. A. Mey.  | 49. <i>Populus tremula</i> L.   |
| 6. <i>Amelanchier ovalis</i> Medik.(- <i>A. rotundifolia</i> (Lam.)Dum.-Cours.  | 50. <i>Prunus divaricata</i> Ledeb.                                     |
| 7. <i>Berberis vulgaris</i> L.  | 51. <i>Prunus spinosa</i> L.  |
| 8. <i>Betula litwinowii</i> Doluch.   | 52. <i>Punica granatum</i> L.   |
| 9. <i>Betula pendula</i> Roth   | 53. <i>Pyrus caucasica</i> Fed.   |
| 10. <i>Carpinus betulus</i> L.(- <i>C. caucasica</i> Grossh.)                   | 54. <i>Quercus iberica</i> Steven                                       |
| 11. <i>Carpinus orientalis</i> Mill.  | 55. <i>Quercus macranthera</i> Fisch. & C. A. Mey. ex Hohen.            |
| 12. <i>Cerasus avium</i> (L.) Moench  | 56. <i>Quercus pedunculiflora</i> Steven                                |
| 13. <i>Cerasus incana</i> (Pall.) Spach   | 57. <i>Rhamnus cathartica</i> L.  |
| 14. <i>Padellus mahaleb</i> (L.)Vass. [- <i>Cerasus mahaleb</i> (L.)Mill.]      | 58. <i>Rhamnus imeretina</i> Booth                                      |
| 15. <i>Cytisus ruthenicus</i> Wol.(- <i>Cytisus caucasicus</i> Grossh.)         | 59. <i>Rhododendron caucasicum</i> Pall.                                |
| 16. <i>Cornus mas</i> L.  | 60. <i>Rhus coriaria</i> L.   |
| 17. <i>Corylus avellana</i> L.  | 61. <i>Ribes alpinum</i> L.   |
| 18. <i>Cotinus coggygria</i> Scop.  | 62. <i>Ribes biebersteinii</i> Berl. ex DC.                             |
| 19. <i>Cotoneaster integerrimus</i> Medik.                                      | 63. <i>Rosa canina</i> L.   |
| 20. <i>Crataegus curvisepala</i> Lindm.   | 64. <i>Rosa</i> spp.  |
| 21. <i>Crataegus orientalis</i> Pall. ex M. Bieb.                               | 65. <i>Rubus idaeus</i> L.(- <i>R. buschii</i> Grossh.ex Sinjkova)      |
| 22. <i>Crataegus pentagyna</i> Waldst. & Kit.                                   | 66. <i>Rubus caesius</i> L.   |
| 23. <i>Crataegus pontica</i> C. Koch  | 67. <i>Rubus idaeus</i> L.  |
| 24. <i>Cydonia oblonga</i> Mill.  | 68. <i>Salix alba</i> L.  |
| 25. <i>Elaeagnus angustifolia</i> L.  | 69. <i>Salix caprea</i> L.  |
| 26. <i>Empetrum hermaphroditum</i> Hagerup                                      | 70. <i>Salix excelsa</i> S. G. Gmel.                                    |
| 27. <i>Ephedra distachya</i> L.   | 71. <i>Sambucus nigra</i> L.  |
| 28. <i>Ephedra procera</i> Fisch. & C.A. Mey.                                   | 72. <i>Smilax excelsa</i> L.  |
| 29. <i>Euonymus europaea</i> L.   | 73. <i>Sorbus aucuparia</i> L.(- <i>S. caucasigena</i> Kom. ex Gatsch.) |
| 30. <i>Fagus orientalis</i> Lipsky  | 74. <i>Sorbus torminalis</i> (L.)Crantz                                 |
| 31. <i>Ficus carica</i> L.  | 75. <i>Swida australis</i> (C. A. Mey.) Pojark. ex Grossh.              |
| 32. <i>Frangula alnus</i> Mill.   | 76. <i>Tilia begoniifolia</i> Steven(- <i>T. caucasica</i> Rupr.)       |
| 33. <i>Fraxinus excelsior</i> L.  | 77. <i>Ulmus minor</i> Mill.(- <i>U. carpinifolia</i> upp. ex Suckow)   |
| 34. <i>Grossularia reclinata</i> (L.)Mill.                                      | 78. <i>Ulmus glabra</i> Huds.   |
| 35. <i>Hippophae rhamnoides</i> L.  | 79. <i>Vaccinium myrtillus</i> L.                                       |
| 36. <i>Juniperus hemisphaerica</i> C. Presl(- <i>Juniperus depressa</i> Steven) | 80. <i>Vaccinium uliginosum</i> L.                                      |
| 37. <i>Juniperus oblonga</i> M. Bieb.   | 81. <i>Vaccinium vitis-idaea</i> L.                                     |
| 38. <i>Ligustrum vulgare</i> L.   | 82. <i>Viburnum lantana</i> L.  |
| 39. <i>Lonicera caprifolium</i> L.  | 83. <i>Viburnum opulus</i> L.   |
| 40. <i>Lonicera caucasica</i> L.  |   |
| 41. <i>Malus orientalis</i> Uglitzk.  |   |
| 42. <i>Mespilus germanica</i> L.  |   |
| 43. <i>Paliurus spina-christi</i> Mill.   |   |
| 44. <i>Philadelphus caucasicus</i> Koehne                                       |   |

**B. Herbaceous plants**

|  |  |
|--|--|
| 1. <i>Achillea millefolium</i> L.  | 55. <i>Filipendula vulgaris</i> Moench (- <i>F. hexapetala</i> Gilib.)       |
| 2. <i>Aconitum confertiflorum</i> (DC.) Gayer (- <i>A. anthora</i> L.)   | 56. <i>Fragaria vesca</i> L.   |
| 3. <i>Aconitum nasutum</i> Fisch. ex Rehb.   | 57. <i>Gadellia lactiflora</i> (M. Bieb.) Schulkina                          |
| 4. <i>Aconitum orientale</i> Mill.   | 58. <i>Galium odoratum</i> (L.) Scop. ( <i>Asperula odorata</i> L.)          |
| 5. <i>Aconogonon alpinum</i> (All.) Schur. (- <i>Polygonum alpinum</i> All.)   | 59. <i>Geranium ibericum</i> Cav.  |
| 6. <i>Adonis aestivalis</i> L.   | 60. <i>Geranium robertianum</i> L.   |
| 7. <i>Agrimonia eupatoria</i> L.   | 61. <i>Geum rivale</i> L.  |
| 8. <i>Agrostis gigantea</i> Roth (- <i>A. alba</i> L.)   | 62. <i>Geum urbanum</i> L.   |
| 9. <i>Agrostis planifolia</i> C. Koch  | 63. <i>Gladiolus caucasicus</i> Herb.  |
| 10. <i>Agrostis tenuis</i> Sibth. (- <i>A. capillaris</i> L.)  | 64. <i>Glyceria</i> spp.   |
| 11. <i>Alisma plantago-aquatica</i> L.   | 65. <i>Glycyrrhiza glabra</i> L.   |
| 12. <i>Allium victorialis</i> L.   | 66. <i>Grossheimia macrocephala</i> (Muss.-Puschk. ex Willd.) Sosn. & Takht. |
| 13. <i>Alopecurus myosuroides</i> Huds.  | 67. <i>Gymnadenia conopsea</i> (L.) R. Br.                                   |
| 14. <i>Anisantha sterilis</i> (L.) Nevski (- <i>Bromus sterilis</i> L.)  | 68. <i>Heliotropium europaeum</i> L.   |
| 15. <i>Anthriscus nemorosa</i> (M. Bieb.) Spreng.  | 69. <i>Helleborus caucasicus</i> A. Br.                                      |
| 16. <i>Arctium lappa</i> L.  | 70. <i>Heracleum antasiaticum</i> Manden.                                    |
| 17. <i>Arrhenatherum elatius</i> (L.) J. & C. Presl  | 71. <i>Heracleum sosnowsky</i> Manden.                                       |
| 18. <i>Artemisia absinthium</i> L.   | 72. <i>Hordeum leporinum</i> Link  |
| 19. <i>Artemisia fragrans</i> Willd.   | 73. <i>Hordeum violaceum</i> Boiss. & Huet                                   |
| 20. <i>Aster amelloides</i> Bess.  | 74. <i>Hypericum perforatum</i> L.   |
| 21. <i>Astrantia maxima</i> Mill.  | 75. <i>Inula helenium</i> L.   |
| 22. <i>Atropa caucasica</i> Kreyer   | 76. <i>Juncus articulatus</i> L.   |
| 23. <i>Betonica officinalis</i> L.   | 77. <i>Koeleria</i> spp.   |
| 24. <i>Bilacunaria microcarpa</i> (M. Bieb.) M. Pimen. & V. Tichomirov [- <i>Hippomarathrum microcarpum</i> (M. Bieb.) V.Petrov] | 78. <i>Lavatera thuringiaca</i> L.   |
| 25. <i>Brachypodium pinnatum</i> (L.) P. Beauv.  | 79. <i>Leonurus quinquelobatus</i> Gilib.                                    |
| 26. <i>Brachypodium sylvaticum</i> (Huds.) P. Beauv.   | 80. <i>Lilium szovitsianum</i> Fisch. & Ave-Lall.                            |
| 27. <i>Briza elatior</i> Sibth. & Smith (- <i>B. media</i> L.)   | 81. <i>Lolium perenne</i> L.   |
| 28. <i>Bromopsis inermis</i> (Leys.) Holub (- <i>Bromus inermis</i> Leys.)   | 82. <i>Lolium rigidum</i> Gaudin   |
| 29. <i>Bromopsis variegata</i> (M. Bieb.) Holub  | 83. <i>Lotus corniculatus</i> L.   |
| 30. <i>Bromus japonicus</i> Thunb.   | 84. <i>Lythrum salicaria</i> L.  |
| 31. <i>Calamagrostis arundinacea</i> (L.) Roth   | 85. <i>Malva sylvestris</i> L.   |
| 32. <i>Capparis herbacea</i> Willd.  | 86. <i>Medicago caucasica</i> Vass.  |
| 33. <i>Cardamine impatiens</i> L.  | 87. <i>Medicago hemicycla</i> Grossh.  |
| 34. <i>Carlina vulgaris</i> L.   | 88. <i>Medicago lupulina</i> L.  |
| 35. <i>Carum carvi</i> L.  | 89. <i>Medicago minima</i> (L.) Bartalini                                    |
| 36. <i>Centaurea cheiranthifolia</i> Willd. (- <i>C. fishcheri</i> Schlecht.)  | 90. <i>Melilotus officinalis</i> (L.) Pall.                                  |
| 37. <i>Chenopodium album</i> L.  | 91. <i>Melissa officinalis</i> L.  |
| 38. <i>Cichorium intybus</i> L.  | 92. <i>Mentha arvensis</i> L.  |
| 39. <i>Colchicum speciosum</i> Steven  | 93. <i>Mentha longifolia</i> (L.) Huds.                                      |
| 40. <i>Coronilla orientalis</i> Mill.  | 94. <i>Onobrychis radiata</i> (Desf.) M. Bieb.                               |
| 41. <i>Coronilla varia</i> L.  | 95. <i>Origanum vulgare</i> L.   |
| 42. <i>Dactylis glomerata</i> L.   | 96. <i>Oxalis acetosella</i> L.  |
| 43. <i>Delphinium flexuosum</i> M. Bieb.   | 97. <i>Phleum alpinum</i> L.   |
| 44. <i>Digitalis ferruginea</i> L.   | 98. <i>Phleum phleoides</i> (L.) Karst.                                      |
| 45. <i>Dryopteris filix-mas</i> (L.) Schott  | 99. <i>Phleum pratense</i> L.  |
| 46. <i>Equisetum arvense</i> L.  | 100. <i>Phragmites australis</i> (Cav.) Trin. ex Steud.                      |
| 47. <i>Erigeron alpinus</i> L.   | 101. <i>Physalis alkekengi</i> L.  |
| 48. <i>Falcaria vulgaris</i> Bernh.  | 102. <i>Pimpinella saxifraga</i> L.  |
| 49. <i>Festuca airoides</i> Lam. (- <i>F. supina</i> Schur)  | 103. <i>Plantago lanceolata</i> L.   |
| 50. <i>Festuca arundinacea</i> Schreb.   | 104. <i>Plantago major</i> L.  |
| 51. <i>Festuca pratensis</i> Huds.   | 105. <i>Poa alpina</i> L.  |
| 52. <i>Festuca valesiaca</i> Gaudin  | 106. <i>Poa bulbosa</i> L.   |
| 53. <i>Festuca woronowii</i> Hack. (- <i>F. varia</i> Haenke)  | 107. <i>Poa nemoralis</i> L.   |
| 54. <i>Filipendula ulmaria</i> (L.) Maxim.   | 108. <i>Poa pratensis</i> L.   |
|  | 109. <i>Polemonium caucasicum</i> N. Busch                                   |
|  | 110. <i>Polygala alpicola</i> Rupr.  |
|  | 111. <i>Polygonum amphibium</i> L.   |
|  | 112. <i>Polygonum carneum</i> C. Koch  |
|  | 113. <i>Polygonum aviculare</i> L.   |





- |   |   |
|---|---|
| 114. <i>Polygonum persicaria</i> L.   | 139. <i>Solanum nigrum</i> L.                   |
| 115. <i>Polypodium vulgare</i> L.   | 140. <i>Solanum pseudopersicum</i> Pojark.      |
| 116. <i>Potamogeton natans</i> L.   | 141. <i>Solidago virgaurea</i> L.               |
| 117. <i>Potentilla erecta</i> (L.)Raeusch.  | 142. <i>Stachys sylvatica</i> L.                |
| 118. <i>Potentilla foliosa</i> Somm. & Levier ex Keller   | 143. <i>Swertia iberica</i> Fisch. & C. A. Mey. |
| 119. <i>Prangos ferulacea</i> (L.) Lindl.   | 144. <i>Taraxacum officinale</i> Wigg.          |
| 120. <i>Primula macrocalyx</i> Bunge  | 145. <i>Thalictrum buschianum</i> Kem.-Nath.    |
| 121. <i>Pyrethrum carneum</i> M. Bieb.  | 146. <i>Tribulus terrestris</i> L.              |
| 122. <i>Pyrethrum coccineum</i> (Willd.) Worosch. [-<br>P. roseum (Adams) M. Bieb.]                                 | 147. <i>Trifolium ambiguum</i> M. Beib.         |
| 123. <i>Pyrethrum macrophyllum</i> (Waldst. & Kit.)<br>Willd.   | 148. <i>Trifolium arvense</i> L.                |
| 124. <i>Rubia tinctorum</i> L. (-R. iberica Fisch. ex<br>DC.) C. Koch   | 149. <i>Trifolium campestre</i> Schreb.         |
| 125. <i>Rumex acetosa</i> L.  | 150. <i>Trifolium canescens</i> Willd.          |
| 126. <i>Rumex alpinus</i> L.  | 151. <i>Trifolium pratense</i> L.               |
| 127. <i>Salvia glutinosa</i> L.   | 152. <i>Trifolium repens</i> L.                 |
| 128. <i>Sambucus ebulus</i> L.  | 153. <i>Tussilago farfara</i> L.                |
| 129. <i>Sanguisorba officinalis</i> L.  | 154. <i>Typha latifolia</i> L.                  |
| 130. <i>Saponaria officinalis</i> L.  | 155. <i>Urtica dioica</i> L.                    |
| 131. <i>Saxifraga repanda</i> Willd. ex Sternb. (-S.<br>coriifolia(Somm. & Levier) Grossh.                          | 156. <i>Valeriana officinalis</i> L.            |
| 132. <i>Scabiosa caucasica</i> M. Bieb.   | 157. <i>Veratrum lobelianum</i> Bernh.          |
| 133. <i>Scilla rosenii</i> C. Koch  | 158. <i>Vicia sativa</i> L.                     |
| 134. <i>Sedum caucasicum</i> (Grossh.) Boriss. [-S.<br>maximum (L.)Hoffm.]  |   |
| 135. <i>Sempervivum transcaucasicum</i> Muirhead (-<br>S. globiferum auct. non L.                                   |   |
| 136. <i>Senecio rhombifolius</i> (Adams)Sch.<br>Bip.(=Adenostyles rhombifolia (Adams)M.<br>Pimen.)                  |   |
| 137. <i>Senecio phatyphylloides</i> Somm. & Levier(-<br>Adenostyles phatyphylloides (Somm. &<br>Levier Czer.)       |   |
| 138. <i>Seseli transcaucasicum</i> (Schischk.) M.<br>Pimen. & Sdobnina (-Libanotis a.transcau-<br>casica Schischk.) |   |





| 1   | 2  | 3                     | 4                     | 5  |
|-----|--|-----------------------|-----------------------|--|
| 31. | <i>Caltha palustris</i> L. (Ranunculaceae)   | Ornamental<br>ღებდაია | Marsh Marigold        | DD,<br>Ornamental  |
| 32. | <i>Caltha polypetala</i> Hochst.(Ranunculaceae)  | წყლის ბუჩხა           | Marigold              | Rare   |
| 33. | <i>Capsella bursa pastoris</i> (L.)Medik.<br>(Brassicaceae)                              | წინმამკუჩხა           | Shepherd's Purse      | Abundant   |
| 34. | <i>Carduus thoermeri</i> Weinm.(Asteraceae)  | ნახშიავი              | Thistle               | DD   |
| 35. | <i>Carlina vulgaris</i> L. (Asteraceae)  | ნახისხვადა            | Carlina Thistle       | DD   |
| 36. | <i>Carum carvi</i> L.(Apiaceae)  | კვლიავი               | Caraway               | DD   |
| 37. | <i>Carum caucasicum</i> (M. Bieb. Boiss.<br>(Apiaceae)                                   | კავკასიური კვლიავი    | Caucasian Caraway     | DD   |
| 38. | <i>Carum meifolium</i> (M. Bieb.)Boiss.<br>(Apiaceae)                                    | კვლიავი               | Caraway               | Rare   |
| 39. | <i>Centaurea solstitialis</i> L.(Asteraceae)   | ეკლემოცი              | St. Barnaby's Thistle | Invasive   |
| 40. | <i>Centaureum pulchellum</i> (Sw.)Druce<br>(Gentianaceae)                                | სისხთავა              | Centauray             | Rare   |
| 41. | <i>Cerasus avium</i> (L.)Moench (Rosaceae)   | ბაღი                  | Wild Cherry           | DD   |
| 42. | <i>Chamaescidium acaule</i> M. Bieb.)Boiss.<br>(Apiaceae)                                | ცხვიის კვლიავი        | Chamaescidium         | DD   |
| 43. | <i>Chelidonium majus</i> L.(Papaveraceae)  | ქისტენისხდა           | Greater Celandine     | DD   |
| 44. | <i>Chenopodium glaucum</i> L.(Chenopodiaceae)  | ნაცხიქათამა           | Chenopodium           | Abundant   |
| 45. | <i>Cicerbita grandis</i> (C. Koch.)Schischk.<br>(Asteraceae)                             | დათვიშხადა            | Sow Thistle           | DD   |
| 46. | <i>Cichorium intybus</i> L.(Asteraceae)  | ვახდაჭაჭა             | Chicory               | Abundant   |
| 47. | <i>Cirsium arvense</i> (L.)Scop.(Asteraceae)   | მინდვლის ნახი         | Meadow Thistle        | DD   |
| 48. | <i>Colchicum speciosum</i> Steven(Liliaceae)   | სუცნა                 | Naked Ladies          | Threatened,<br>Ornamental  |
| 49. | <i>Conium maculatum</i> L.(Apiaceae)   | კონიომ                | Poison Hemlock        | DD   |
| 50. | <i>Coriandrum sativum</i> L.(Apiaceae)   | ქინძი                 | Coriander             | Cultivated,<br>Naturalized   |
| 51. | <i>Cornus mas</i> L. (Cornaceae)   | შინდღი                | Cornelian Cherry      | Abundant   |
| 52. | <i>Corydalis angustifolia</i> (M. Bieb.)DC.<br>(Fumariaceae)                             | ბუნქისძიხა            | Corydalis             | DD,<br>Ornamental  |
| 53. | <i>Corylus avellana</i> L.(Betulaceae)   | თხილი                 | Hazel                 | DD   |
| 54. | <i>Crambe orientalis</i> L.(Brassicaceae)  | კრამბა                | Kale                  | DD   |
| 55. | <i>Crataegus caucasica</i> C. Koch(Rosaceae)   | კავკასიური კენკელი    | Caucasian Hawthorn    | Cauc. endemic  |
| 56. | <i>Crataegus pentagyna</i> Waldst. & Kit.<br>(Rosaceae)                                  | მავი კენკელი          | Hawthorn              | DD   |
| 57. | <i>Crocus speciosus</i> M. Bieb. (Iridaceae)   | ზაფხანა               | Crocus                | Threatened,<br>Ornamental  |
| 58. | <i>Cuscuta europaea</i> L.(Convolvulaceae)   | აბიქუმა               | European Dodder       | Invasive   |
| 59. | <i>Cyclamen coum</i> Mill. subsp. caucasicum<br>(C. Koch)O. Schwarz (= C. vernum Sweet,) | ყორივახდა             | Cyclamen              | Threatened,<br>Protected by<br>Bern<br>Convention,<br>Primulaceae)<br>CITES,<br>Ornamental |
| 60. | <i>Cydonia oblonga</i> Mill.(Rosaceae)   | კომში                 | Quince                | Cultivated,<br>Naturalized   |
| 61. | <i>Cynoglossum officinale</i> L.(Boraginaceae)   | ძაღლისენა             | Hound's Tongue        | Abundant   |
| 62. | <i>Daphne glomerata</i> Lam.(Thymelaeaceae)  | წიბა                  | Daphne                | Rare,<br>Ornamental  |
| 63. | <i>Daphne mezereum</i> L.(Thymelaeaceae)   | მარტვილი              | February Daphne       | Rare,<br>Ornamental  |
| 64. | <i>Datisca cannabina</i> L.(Datisceae)   | დათვის კანათი         | False Hemp            | Rare   |
| 65. | <i>Datura stramonium</i> L. (Solanaceae)   | ღუმა                  | Thorn Apple           | DD   |
| 66. | <i>Daucus carota</i> L. (Apiaceae)   | ფუხისცვადა            | Wild Carrot           | DD   |
| 67. | <i>Delphinium schmalhauseni</i> N. Alb.<br>(Asteraceae)                                  | ღუბუჩა                | Larkspur              | DD   |
| 68. | <i>Digitalis ferruginea</i> L.(Scrophulariaceae)   | ფუტკაჩა               | Rusty Foxglove        | Rare,<br>Ornamental  |

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| 69.  | Dryopteris filix-mas (L.)Schott<br>(Dryopteridaceae)        | ჩაღუნა             | Mountain Male Fern      | Abundant  |
| 70.  | Echium vulgare L.(Boraginaceae)                             | ღუჭი ძიხნიტელა     | Viper's Burgloss        | DD.   |
| 71.  | Elaeagnus angustifolia L.(Elaeagnaceae)                     | ფშაკი              | Oleaster, Russian Olive | Rare  |
| 72.  | Ephedra procera Fisch. & C.A. Mey.<br>(Ephedraceae)         | ჭოხის ძვა          | Ephedra                 | Rare  |
| 73.  | Epilobium hirsutum L.(Onagraceae)                           | წყინანყენი         | Epilobium               | Rare<br>Ornamental  |
| 74.  | Epilobium nervosum Boiss. & Buhse                           | წყინანყენი         | Epilobium               | Rare<br>Ornamental  |
| 75.  | Epilobium palustre L.(Onagraceae)                           | წყინანყენი         | Epilobium               | Rare<br>Ornamental  |
| 76.  | Equisetum arvense L.(Equisetaceae)                          | შვიტა              | Common Horsetail        | DD.   |
| 77.  | Erigeron caucasicus Steven<br>(Asteraceae)                  | ცხენისხედა         | Caucasian Daisy         | Cauc. endemic,<br>Rare<br>Ornamental                                  |
| 78.  | Erigeron orientalis Boiss.<br>(Asteraceae)                  | ცხენისხედა         | Oriental Daisy          | Rare<br>Ornamental  |
| 79.  | Erigeron venustus Botsch.<br>(Asteraceae)                   | ცხენისხედა         | Venus Daisy             | Rare<br>Ornamental  |
| 80.  | Euphorbia helioscopia L.(Euphorbiaceae)                     | ხინანა             | Sun Spurge              | Rare<br>Ornamental  |
| 81.  | Euphrasia stricta Host.(Scrophulariaceae)                   | უჩიღისუბილა        | Eufrasia                | DD.   |
| 82.  | Ficus carica L.(Moraceae)                                   | ღეღვი              | Fig                     | RDB USSR,<br>Cultivated,<br>Naturalized                               |
| 83.  | Filipendula ulmaria (L.)Maxim.<br>(Rosaceae)                | ქაფუხა             | Meadow Sweet            | DD.   |
| 84.  | Fragaria vesca L.(Rosaceae)                                 | მახწყვი            | Wild Strawberry         | DD.   |
| 85.  | Frangula alnus Mill.(Rhamnaceae)                            | სეჭიქლი            | Alder Buckthorn         | DD.   |
| 86.  | Gagea chanae grossh. (Liliaceae)                            | ჩიტისთავა          | Yellow Star             | Cauc. endemic,  |
| 87.  | Galanthus alpinus Sosn.<br>(Amaryllidaceae)                 | თეთსყვავილა        | Snowdrop                | Geor. endemic,<br>IUCN<br>(DD.),<br>RDB USSR,<br>CITES,<br>Ornamental |
| 88.  | Galium verum L.(Rubiaceae)                                  | ენფიონიკა          | Lady's Bedstraw         | DD  |
| 89.  | Gentiana cruciata L.(Gentianaceae)                          | ნალველა            | Gentian                 | Rare  |
| 90.  | Gentiana angulosa M.Bieb.<br>(Gentianaceae)                 | ნალველა            | Gentian                 | Rare, Cauc.<br>endemic<br>Ornamental                                  |
| 91.  | Gentiana pontica Soltok.<br>(Gentianaceae)                  | ნალველა            | Gentian                 | Rare<br>Ornamental  |
| 92.  | Gentiana pyrenaica L.<br>(Gentianaceae)                     | ნალველა            | Gentian                 | Rare  |
| 93.  | Gentiana septemfida Pallas<br>(Gentianaceae)                | ნალველა            | Gentian                 | Rare<br>Ornamental  |
| 94.  | Gentianella caucasea (Lodd. ex Sims)<br>Holub(Gentianaceae) | კავკასიური ნალველა | Caucasian Gentian       | Rare<br>Cauc. endemic,<br>Ornamental                                  |
| 95.  | Geranium finitimum Woron.<br>(Geraniaceae)                  | ნემსინვეხა         | Herb Robert             | DD.   |
| 96.  | Geranium robertianum L.<br>(Geraniaceae)                    | ნემსინვეხა         | Herb Robert             | DD<br>Ornamental  |
| 97.  | Glaucium corniculatum L.(Papaveraceae)                      | ყაყაჩხა            | Horned Poppy            | DD  |
| 98.  | Helichrisum graveolens (M. Bieb.)Sweet<br>(Asteraceae)      | უნჯდავა, ნებო      | Yellow Daisy            | DD  |
| 99.  | Heracleum sosnowskyi Manden.<br>(Apiaceae)                  | ღიყი               | Sosnowskyi's Hogweed    | Cauc. endemic,<br>Rare  |
| 100. | Heracleum chorodanum(Hoffm.)D.C.<br>(Apiaceae)              | ღიყი               | Hogweed                 | DD  |





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| 101. | <i>Hesperis matronalis</i> L.(Brassicaceae)   | ლამის ია          | Sweet Rocket                  | DD  |
| 102. | <i>Hieracium pilosella</i> L. (Asteraceae)  | სახნეყა           | Hawkweed                      | DD  |
| 103. | <i>Hippophae rhamnoides</i> L. (Elaeagnaceae)   | ქაცვი             | Sea Buckthorn                 | RDB Georgia                                     |
| 104. | <i>Humulus lupulus</i> L.(Cannabaceae)  | სვითა             | Common Hop                    | DD  |
| 105. | <i>Hyoscyamus niger</i> L.(Solanaceae)  | ღუნცოფა           | Black Henbane                 | Rare, Poisenous                                 |
| 106. | <i>Hypericum linarioides</i> Bosse(= <i>Hypericum polygonifolium</i> Rupr.; Hypericaceae)                     | ქიანანა           | St. John's Wort               | DD  |
| 107. | <i>Hypericum perforatum</i> L.(Hypericaceae)  | ქიანანა           | St. John's Wort               | DD  |
| 108. | <i>Hyssopus angustifolius</i> M. Bieb. (Lamiaceae)  | ესეპი             | Hyssop                        | DD  |
| 109. | <i>Inula helenium</i> L.(Asteraceae)  | ენღმეხი           | Scabwort                      | DD  |
| 110. | <i>Juglans regia</i> L. (Juglandaceae)  | კაკალი            | Walnut                        | Ornamental RDB Georgia, Cultivated, Naturalized |
| 111. | <i>Juniperus communis</i> L.(Cupressaceae)  | ღვია              | Juniper                       | DD  |
| 112. | <i>Lamium album</i> L. (Lamiaceae)  | ჭინჭრის დედა      | White Dead Nettle             | DD  |
| 113. | <i>Leonurus quinquelobatus</i> Gilib. (=Leonurus villosus Desf.; Lamiaceae)                                   | შავბაღასა         | Motherwort                    | DD  |
| 114. | <i>Linum usitatissimum</i> L.(Linaceae)   | ჩვეულებრივი სელი  | Common Flax                   | Cultivated, Naturalized                         |
| 115. | <i>Lonicera orientalis</i> Lam.(= <i>Lonicera caucasica</i> Pall.; Caprifoliaceae)                            | ნეჩნა             | Oriental Honeysuckle          | DD  |
| 116. | <i>Lotus caucasicus</i> Rupr.(= <i>Lotus ciliatus</i> Koch; Fabaceae)   | კუჩღლის სამყუჩა   | Caucasian Bird's Foot Trefoil | DD  |
| 117. | <i>Lycopus europeus</i> L.(Lamiaceae)   | ღიკოპუნი          | Gipsywort                     | DD  |
| 118. | <i>Lythrum salicaria</i> L.(Lythraceae)   | ცოცხმაგასა        | Purple Loosestrife            | DD  |
| 119. | <i>Malva sylvestris</i> L.(Malvaceae)   | ბაღასა            | Blue Mallow                   | DD  |
| 120. | <i>Marrubium vulgare</i> L.(Lamiaceae)  | ფოლმოსის ბაღასი   | Common Horehound              | DD  |
| 121. | <i>Melilotus officinalis</i> (L.)Pall. (Fabaceae)   | ყვითული ძიძი      | Sweet Clover                  | Abundant  |
| 122. | <i>Mentha arvensis</i> L.(Lamiaceae)  | პიკნა             | Corn Mint                     | DD  |
| 123. | <i>Mentha pulegium</i> L. (Lamiaceae)   | მამბალი           | Pennyroyal                    | Cultivated, Naturalized                         |
| 124. | <i>Menyanthes trifoliata</i> L.(Menyanthaceae)  | წყის სამყუჩა      | Bogbean                       | DD  |
| 125. | <i>Morus alba</i> L. (Moraceae)   | თეთრი თუთა        | White Mulberry                | Cultivated, Naturalized                         |
| 126. | <i>Nepeta betonicifolia</i> C.A.Mey.(Lamiaceae)   | კატაპიკნა         | Catmint                       | DD  |
| 127. | <i>Ocimum basilicum</i> L.(Lamiaceae)   | ჩუპანა            | Basil                         | Cultivated, Naturalized                         |
| 128. | <i>Omalotheca caucasica</i> (Somm. & Levier) Czer.(= <i>Gnaphallum caucasicum</i> Somm. & Levier; Asteraceae) | ბეხედა            | Cudweed                       | DD  |
| 129. | <i>Onobrychis meschetica</i> Grossh (Fabaceae)  | მესხეთი უსახეცეტი | Sainfoin                      | Georg. endemic                                  |
| 130. | <i>Onosma sericeum</i> (Boraginaceae)   | ონოსმა            | Onosma                        | DD  |
| 132. | <i>Orchis coriophora</i> L.(Orchidaceae)  | ჭაფუჩი            | Orchid                        | CITES, Rare, Ornamental                         |
| 131. | <i>Origanum vulgare</i> L.(Lamiaceae)   | ოვანკა            | Oregano                       | DD  |
| 132. | <i>Padus borealis</i> Schubel (=Prunus padus L.; Rosaceae)  | შოთხვი            | Grapes Cherry                 | DD  |
| 133. | <i>Papaver orientale</i> L.(Papaveraceae)   | ყაყარ             | Oriental Poppy                | DD  |
| 134. | <i>Papaver rhoeas</i> L.(Papaveraceae)  | ყაყარ             | Corn Poppy                    | DD  |
| 135. | <i>Peganum harmala</i> L.   | მასიამსა ემელა    | Wild Rue                      | DD  |
| 136. | <i>Peplis alternifolia</i> M.Bieb.(Lythraceae)  | პეპლისი           | Loosesrife                    | DD  |
| 137. | <i>Persicaria hydropiper</i> (L. Spach (=Polygonum hydropiper L.; Polygonaceae)                               | ნალიკა            | Red Knees                     | DD  |
| 138. | <i>Petroselinum crispum</i> (Mill.) Nyman ex A.W. Hill(Apiaceae)  | მხახხუმი          | Parsley                       | Cultivated, Naturalized                         |
| 139. | <i>Pimpinella saxifraga</i> L. (Apiaceae)   | ბუჩქედა           | Burnet Saxifrage              | DD  |
| 140. | <i>Pinus kochiana</i> Klotzsch ex C. Koch (=P. hamata(Steven)Sosn. non L.; Pinaceae)                          | ფიჭვი             | Pine                          | DD  |

| 1    | 2  | 3                    | 4                      | 5                                  |
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| 141. | <i>Plantago lanceolata</i> L. (Plantaginaceae)                     | ღანყეტა შავაღძახლვა  | English Plantain       | DD                                 |
| 142. | <i>Plantago major</i> L.(Plantaginaceae)                           | შავაღძახლვა          | Common Plantain        | Abundant                           |
| 143. | <i>Plantago media</i> L.(Plantaginaceae)                           | შავაღძახლვა          | Hoary Plantain         | DD                                 |
| 144. | <i>Polygala alpicola</i> Rupr. (Polygalaceae)                      | წინნაუჩი             | Alpine Milkwort        | DD                                 |
| 145. | <i>Polygala anatolica</i> Boiss. & Held. (Polygalaceae)            | წინნაუჩი             | Anatolian Milkwort     | DD                                 |
| 146. | <i>Polygonum alpinum</i> All.(Polygonaceae)                        | წახობანი             | Knotweed               | DD.                                |
| 147. | <i>Polygonum aviculare</i> L.(Polygonaceae)                        | ჩვეულებივი მატყელა   | Knotweed               | Abundant                           |
| 148. | <i>Polygonum carneum</i> C. Koch(Polygonaceae)                     | ფვალუხა              | Meadow Bistort         | Abundant                           |
| 149. | <i>Polypodium vulgare</i> L.(Polypodiaceae)                        | აილაშუა              | Common Polypody        | DD                                 |
| 150. | <i>Populus tremula</i> L.(Salicaceae)                              | მთითოღავი ვუხვი      | Aspen                  | DD                                 |
| 151. | <i>Potentilla anserina</i> L.(Rosaceae)                            | ბატის მახწყვა ბაღახი | Silverweed             | DD                                 |
| 152. | <i>Potentilla reptans</i> L.(Rosaceae)                             | მახწყვა ბაღახი       | Creeping Cinquefoil    | DD                                 |
| 153. | <i>Primula macrocalyx</i> Bunge(Primulaceae)                       | ღიფჯამა ფუჩისელა     | Primerose              | Threatened, Ornamental             |
| 154. | <i>Pulsatilla violacea</i> Rupr. (Ranunculaceae) (Gentianaceae)    | მუღგახი              | Violet Pasque Flower   | Rare Ornamental                    |
| 155. | <i>Punica granatum</i> L.  | ბიწმურელი            | Pomegranate            | RDB Georgia, RDB USSR, DD          |
| 156. | <i>Pyrethrum balsamita</i> (L.) Willd.(Asteraceae)                 | სუსამბახი            | Alecost                | DD                                 |
| 157. | <i>Pyrethrum carneum</i> M.Bieb.(Asteraceae)                       | წითელი გუჩიღა        | Painted Daisy          | DD                                 |
| 158. | <i>Pyrus caucasica</i> A. Fed.(Rosaceae)                           | პანტა                | Pear                   | Cauc. endemic                      |
| 159. | <i>Quercus macranthera</i> Fisch. & C. A. Mey. ex Hohen.(Fagaceae) | მალღმთის მუხა        | Mountain Oak           | RDB Georgia                        |
| 160. | <i>Ranunculus arvensiss</i> L.(Ranunculaceae)                      | ბაი                  | Buttercup              | DD                                 |
| 161. | <i>Ranunculus sceleratus</i> L.(Ranunculaceae)                     | ბაი                  | Buttercup              | DD                                 |
| 162. | <i>Rhamnus catharticus</i> L.(Rhamnaceae)                          | ბუშავი               | Buckthorn              | DD                                 |
| 163. | <i>Rhododendron caucasicum</i> Pall.(Ericaceae)                    | ღუჯა                 | Caucasian Rhododendron | DD                                 |
| 164. | <i>Ribes alpinum</i> L.(Grossulariaceae)                           | მთის მოყვახი         | Alpine Currant         | DD                                 |
| 165. | <i>Ribes biebersteinii</i> Berl. ex DC.) (Grossulariaceae)         | ქედის მოყვახი        | Rock Currant           | DD                                 |
| 166. | <i>Rosa canina</i> L.(Rosaceae)                                    | ასელი                | Dog Rose               | Abundant                           |
| 167. | <i>Rosa pimpinellifolia</i> L.(Rosaceae)                           | ასელი                | Scotch Rose            | DD                                 |
| 168. | <i>Rosa spinosissima</i> L.(Rosaceae)                              | ასელი                | Dog Rose               | DD                                 |
| 169. | <i>Rosularia sempervivoides</i> (Fisch.) Boris.(Crassulaceae)      | ჩოხელაჩი             | ლახელაჩი               | Rare Ornamental                    |
| 170. | <i>Rubus idaeus</i> L.(Rosaceae)                                   | ფოლი                 | Raspberry              | DD                                 |
| 171. | <i>Rumex acetosa</i> L.(Polygonaceae)                              | მუჯუნა               | Sorrel                 | DD                                 |
| 172. | <i>Rumex crispus</i> L.(Polygonaceae)                              | ჩვეულებივი ლოლი      | Curly Dock             | DD                                 |
| 173. | <i>Ruta graveolens</i> L.(Rutaceae)                                | ტუგანი               | Rue                    | Cultivated, Naturalized            |
| 174. | <i>Salix caprea</i> L.(Salicaceae)                                 | ტიჩიფი               | Goat Willow            | DD                                 |
| 175. | <i>Salvia sclarea</i> L. (Lamiaceae)                               | სახიზახიდა           | Clary                  | DD                                 |
| 176. | <i>Sambucus nigra</i> L.(Caprifoliaceae;)                          | ღიფჯელა              | Elderberry             | DD                                 |
| 177. | <i>Sanguisorba officinalis</i> L.(Rosaceae)                        | სავსიხელა            | Burnet                 | DD                                 |
| 178. | <i>Saponaria officinalis</i> L.(Caryophyllaceae)                   | საპონა               | Common Soapwort        | DD                                 |
| 179. | <i>Satureja hortensis</i> L.(Lamiaceae)                            | ბალის ქონდაჩი        | Savory                 | Ornamental Cultivated, Naturalized |
| 180. | <i>Satureja laxiflora</i> C. Koch.(Lamiaceae)                      | ტყის ქონდაჩი         | Savory                 | DD                                 |
| 181. | <i>Scabiosa caucasica</i> M.Bieb.(Dipsacaceae)                     | ციხტოლი              | Caucasian Scabious     | DD                                 |
| 182. | <i>Scabiosa meskhetica</i> Schchian(Dipsacaceae)                   | მესხეთის ფოლი        | Meskhetian Scabious    | Ornamental Rare                    |
| 183. | <i>Scrophularia chrysantha</i> Jaub. & Spach (Scrophulariaceae)    | ჩუ                   | Figwort                | DD                                 |
| 184. | <i>Scrophularia nodosa</i> L.(Scrophulariaceae)                    | შავწამალა            | Figwort                | DD                                 |
| 185. | <i>Scrophularia orientalis</i> L.(Scrophulariaceae)                | სეჩოფუელაჩი          | Oriental Figwort       | DD                                 |





| 1    | 2  | 3                       | 4                        | 5                                  |
|------|--|-------------------------|--------------------------|------------------------------------|
| 186. | <i>Scrophularia rupestris</i> M.Bieb. ex Willd.<br>(Scrophulariaceae)                        | სქიმოტედასი             | Figwort                  | DD                                 |
| 187. | <i>Scrophularia rutaefolia</i> Boiss.<br>(Scrophulariaceae)                                  | სქიმოტედასი             | Figwort                  | DD                                 |
| 188. | <i>Sedum caucasicum</i> (Grossh.)Boris.<br>(Crassulaceae)                                    | ჯღისბუბა                | Caucasian Stonecrop      | DD                                 |
| 189. | <i>Sempervivum caucasicum</i> Rupr.<br>(Crassulaceae)  | ჯღისბუბა                | Caucasian<br>Sempervivum | Cauc. endemic,<br>Ornamental       |
| 190. | <i>Senecio rhombifolius</i> (Adams)<br>Sch. Bip.(Asteraceae)                                 | ბახისმუბლა              | Groundsel                | Cauc. endemic,<br>RDB Georgia      |
| 191. | <i>Sideritis montana</i> L.(Lamiaceae)   | საყვიტო                 | Sideritis                | DD                                 |
| 192. | <i>Silybum marianum</i> (L.)Gaertn.(Asteraceae)  | ბაყყუხა                 | Milk Thistle             | DD                                 |
| 193. | <i>Smilax excelsa</i> L. (Liliaceae)   | ვუკლიჭი                 | Green Brier              | DD                                 |
| 194. | <i>Solidago virgaurea</i> L.(Asteraceae)   | ოქროსკვამლე             | European Goldenrod       | DD                                 |
| 195. | <i>Sorbus caucasigena</i> Kom. ex Gatsch.<br>(Rosaceae)                                      | სიხტედი<br>Mountain Ash | Caucasian                | Rare                               |
| 196. | <i>Spiraea hypericifolia</i> L.(Rosaceae)  | გუბლა                   | Meadow Sweet             | DD                                 |
| 197. | <i>Stachys macrantha</i> (C. Koch)Stearn<br>(= <i>Betonica grandiflora</i> Willd. Lamiaceae) | მთის ბახისპიხა          | Betony                   | DD<br>Ornamental                   |
| 198. | <i>Stachys officinalis</i> (L.) Trevis.<br>(= <i>Betonica officinalis</i> L.; Lamiaceae)     | სამეჯინალო ბახისპიხა    | Betony                   | DD<br>Ornamental                   |
| 199. | <i>Stellaria media</i> (L.)Vill.(Caryophyllaceae)  | ვეწვიქი                 | Common Chickweed         | Abundant                           |
| 200. | <i>Tamarix hohenackeri</i> Bunge (Tamaricaceae)  | ნაღლე                   | Tamarisk                 | DD                                 |
| 201. | <i>Tanacetum vulgare</i> L. (Asteraceae)   | ასუქსეცა                | Tansy                    | DD                                 |
| 202. | <i>Taraxacum officinale</i> Wigg.(Asteraceae)  | ბაბუნაქი                | Dandelion                | Abundant                           |
| 203. | <i>Taxus baccata</i> L.(Taxaceae)  | უბოვუხი                 | Common Yew               | RDB Georgia,<br>RDB USSR,<br>CITES |
| 204. | <i>Thalictrum minus</i> L.(Ranunculaceae)  | მეფა                    | Lesser Meadow Rue        | Rare                               |
| 205. | <i>Thymus serpyllum</i> L.(Lamiaceae)  | ბუკონდასი               | Wild Thyme               | DD                                 |
| 206. | <i>Tilia begoniifolia</i> Steven<br>(= <i>T. caucasica</i> Rupr.; Tiliaceae)                 | ცაცვი                   | Linden                   | DD                                 |
| 207. | <i>Trifolium pratense</i> L.(Fabaceae)   | სამეყი                  | Red Clover               | Abundant                           |
| 208. | <i>Trigonella coerulea</i> (L.)Ser.(Fabaceae)  | ვეღმი                   | Fenugreek                | Cultivated,<br>Naturalized         |
| 209. | <i>Tussilago farfara</i> L.  | ვიხისეჭყა               | Coltsfoot                | DD                                 |
| 210. | <i>Urtica dioica</i> L.(Urticaceae)  | ჭინჭა                   | Nettle                   | Abundant                           |
| 211. | <i>Urtica urens</i> L.(Urticaceae)   | ჭინჭა                   | Dog Nettle               | DD                                 |
| 212. | <i>Vaccinium myrtillus</i> L.(Ericaceae)   | მთის მოცვი              | Bilberry                 | Rare                               |
| 213. | <i>Vaccinium vitis-idaea</i> L.  | წითელი მოცვი            | Cowberry                 | Rare                               |
| 214. | <i>Valeriana officinalis</i> L.(Valerianaceae)   | კატაბადა                | Common Valerian          | Rare                               |
| 215. | <i>eratrum lobelianum</i> Bernh. (Liliaceae)   | შხამა                   | Veratrum                 | Abundant                           |
| 216. | <i>Verbascum pyramidatum</i> M. Bieb.<br>(Scrophulariaceae)                                  | ქიტიქა                  | Pyramidal Mullein        | DD                                 |
| 217. | <i>Veronica anagallis-aquatica</i> L.<br>(Scrophulariaceae)                                  | ჩალანგი                 | Veronica                 | DD                                 |
| 218. | <i>Veronica baccabunga</i> L.<br>(Scrophulariaceae)  | ჩალანგი                 | Brooklime                | DD                                 |
| 219. | <i>Veronica officinalis</i> L.(Scrophulariaceae)   | დემოტისთის              | Brooklime                | DD                                 |
| 220. | <i>Viburnum opulus</i> L. (Caprifoliaceae)   | ძახველი                 | Guelder Rose             | Rare                               |
| 221. | <i>Viola odorata</i> L.(Violaceae)   | სუხნელოვანი ნა          | Sweet Violet             | Ornamental                         |
| 222. | <i>Viola oreades</i> M. Bieb.(Violaceae)   | ნა                      | Violet                   | DD<br>Ornamental                   |
| 223. | <i>Viola suavis</i> M. Bieb. (Violaceae)   | ნა                      | Violt                    | DD                                 |
| 224. | <i>Viscum album</i> L.(Loranthaceae)   | ფიჭი                    | Mistletoe                | DD                                 |
| 225. | <i>Ziziphora capitata</i> L.   | ქიცი                    | Ziziphora                | DD                                 |
| 226. | <i>Ziziphora sarpyllacea</i> M. Bieb   | ქიცი                    | Ziziphora                | DD                                 |