

STATUS AND PROTECTION OF GLOBALLY THREATENED SPECIES IN THE CAUCASUS



CRITICAL ECOSYSTEM
PARTNERSHIP FUND



**STATUS AND PROTECTION OF
GLOBALLY THREATENED SPECIES
IN THE CAUCASUS**

CEPF Biodiversity Investments in the Caucasus Hotspot 2004-2009

Edited by Nugzar Zazanashvili and David Mallon

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The Critical Ecosystem Partnership Fund (CEPF) is a joint initiative of l'Agence Française de Développement, Conservation International, the Global Environment Facility, the Government of Japan, the MacArthur Foundation and the World Bank.

This book shows the effort of the Caucasus NGOs, experts, scientific institutions and governmental agencies for conserving globally threatened species in the Caucasus: CEPF investments in the region made it possible for the first time to carry out simultaneous assessments of species' populations at national and regional scales, setting up strategies and developing action plans for their survival, as well as implementation of some urgent conservation measures.

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Foreword

The Caucasus is among the top 34 biologically richest and most endangered biodiversity hotspots in the world. Two of these hotspots are found in Europe, the Mediterranean and the Caucasus. Illegal logging, uncontrolled hunting, oil and gas developments, agriculture and overgrazing contribute to an ever increasing degradation of the spectacular and fragile mountainous regions of the Caucasus, with effects on wildlife and people. Only 12% of the region's natural ecosystems are in their original state.

The collapse of the Soviet Union led to dramatic changes in the region. Newly-independent countries became a focus of international attention; conservation of the natural and cultural heritage became a high priority. The first major initiative came from WWF in 1990. Support was provided to identify a system of protected areas in Georgia. This led to the establishment of WWF's first office in the Caucasus which soon expanded its activities to neighboring countries and initiated the "Analysis of Biodiversity and Current Threats of the Caucasus Ecoregion" and the elaboration of an "Ecoregion Conservation Plan" (ECP) for the entire Caucasus. More than 150 scientists and conservationists were involved from all six countries. Both studies became major instruments for raising support for conservation from the international donor community.

The most important contributor to the implementation of the ECP was the Critical Ecosystem Partnership Fund (CEPF). This support came at a critical time with funding for projects to strengthen civil society and the NGO network, maintain and upgrade important wildlife corridors, improve the status of globally threatened species and important landscapes and natural sites. All these activities contribute to the creation of an effective ecological network of protected areas which is the basis for improving protection and management of the region's biological resources. Promotion of the ecological network for the Caucasus with particular emphasis on trans-boundary conservation is also helping governments to meet their obligations within the framework of the Convention on Biological Diversity.

This publication is a 'thank you' to CEPF and presents some of the striking results of CEPF's support over the past five years. It portrays the outstanding beauty and biological importance of the region, the lives of its inhabitants as well as the challenges which governments and NGOs face in promoting conservation and sustainable resource use for the benefits of nature and the wildlife and people who depend on it.

Dr. Hartmut Jungius, Chairman, Caucasus Biodiversity Council

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Executive Summary

The Critical Ecosystem Partnership Fund (CEPF) is a joint initiative of l'Agence Française de Développement, Conservation International, the Global Environment Facility, the Government of Japan, the MacArthur Foundation and the World Bank. CEPF is a global leader in enabling civil society to participate in and benefit from conserving biodiversity hotspots, the biologically richest and most threatened areas in the world. Since 2000, CEPF's investments have encompassed 18 biodiversity hotspots, and CEPF aims to expand to new hotspots over the next five years. Prior to investment in each hotspot, CEPF determines its niche based on a stakeholder-driven prioritization process that factors in socioeconomic features, threats and current investments, together with conservation outcomes based on biodiversity science. CEPF's investment strategy for a particular hotspot, together with the justification that underpins it, is presented in a document known as an Ecosystem Profile (CEPF 2003).

The Caucasus Hotspot is one of 34 biodiversity hotspots in the world. The hotspot spans 580,000 km² of mountains in Eurasia, between the Black and Caspian Seas. The hotspot includes all of Armenia, Azerbaijan and Georgia, the North Caucasus portion of the Russian Federation, north-eastern Turkey and part of north-western Iran (Williams et al. 2006). The Caucasus biodiversity hotspot has the greatest biological diversity of any temperate forest region in the world, including more than 6,500 species of vascular plants, at least 1,600 of which (25%) are unique to the region. Its forests, high mountains, wetlands, steppes and semi-deserts contain more than twice the plant and animal diversity found in adjacent regions of Europe and Asia.

CEPF commenced its work in the Caucasus in August 2003, following the approval of an Ecosystem Profile developed with stakeholder input and a grant allocation of US\$8.5 million to be awarded over five years.

There is a wide range of CEPF conservation outcomes in the Caucasus attained through its investment in this region. The results presented in this book cover the part of CEPF Caucasus Investments directly targeting the conservation of globally threatened species.

CEPF Investment Niche

Through the leadership of the WWF Caucasus Programme Office (WWF Caucasus PO), the CEPF Ecosystem Profile for the Caucasus Hotspot was developed. A science-based, conservation outcomes definition process was used to set targets for CEPF investment. This, combined with WWF's ability to guide regional-scale strategy development (expertise gained in part through its experience putting together an Ecoregional Conservation Plan for the Caucasus), resulted in a clear investment strategy

with broad stakeholder support. WWF brought together more than 130 experts from the six Caucasus countries to consider how CEPF could best add value to the region's conservation efforts. The Ecosystem Profile focused on conserving the hotspot's globally threatened species, most of which are found in key sites within conservation corridors.

As a result of the conservation outcomes definition process, a total of 50 species outcomes were identified across six taxonomic groups (mammals, birds, reptiles, amphibians, fish and plants). These comprised 18 mammals, 11 birds, 10 reptiles, 3 amphibians, 7 fishes and 1 plant. Site outcomes were defined for each target species and, in total, 205 site outcomes were identified for the Caucasus, covering 19% of the hotspot. Ten conservation corridors were identified in the Caucasus Hotspot based on their importance for biodiversity conservation. Of these, five were determined to be priority (target) corridors for CEPF investment (Williams et al. 2006). These comprised: the Greater Caucasus Corridor (4.68 million ha), which covers the middle and high mountain areas of the Greater Caucasus Range, extending from the Black Sea almost to the Caspian; the Caspian Corridor (3.23 million ha), located along the Caspian Sea coast from the Talysh Mountains in the south to the northern border of the hotspot, including parts of Azerbaijan and Russia; the West Lesser Caucasus Corridor (2.99 million ha), situated in the western part of the Lesser Caucasus Mountain Range, where it extends along the Black Sea from north-eastern Turkey to south-western Georgia, ending in central Georgia; the East Lesser Caucasus Corridor (1.43 million ha) in Armenia and the Nakhichevan Autonomous Republic of Azerbaijan, situated mainly in the eastern and southern parts of the Lesser Caucasus Mountain Chain; and the Hyrcan Corridor (1.85 million ha), which includes the Talysh Mountains in Azerbaijan and the north-western part of the Alborz Mountains in Iran, along with a section of the Caspian coast.

Through a participatory approach adopted during the Ecosystem Profile, four thematic Strategic Directions were identified for CEPF investment, each with its own nested Investment Priorities:

- 1) Support civil society efforts to promote transboundary cooperation and improve protected area systems in five target corridors.
- 2) Strengthen mechanisms to conserve biodiversity of the Caucasus Hotspot with emphasis on species, site, and corridor outcomes.
- 3) Implement models demonstrating sustainable resource use in five target corridors.
- 4) Increase the awareness and commitment of decision makers to biodiversity conservation in five target corridors.

Thus, the Ecosystem Profile defined priorities for CEPF grant making in the region at three levels: taxonomic (species), geographic (sites and corridors) and thematic (Strategic Directions and Investment Priorities). Specifically, there were 50 priority species (30 Vulnerable, 14 Endangered and six Critically Endangered species), 107 priority sites under five priority corridors (Greater Caucasus, West Lesser Caucasus, East Lesser Caucasus, Caspian and Hyrcan), and four Strategic Directions.

Implementing the Strategy

The CEPF Investment / Regional Programme was officially launched in May 2004. CEPF committed around US\$8.5 million over five years for biodiversity conservation in the Caucasus Hotspot. This investment was coordinated and managed through the mutual efforts of CEPF and WWF Caucasus PO.

CEPF successfully established a coordination and grant-making system in the Caucasus. Prior to the CEPF investment period, WWF Caucasus PO had been working to protect biodiversity landscapes in the region for more than a decade. Given its breadth of experience, and commitment and coverage in the region, the organization was selected to be CEPF's local coordination partner. Based at WWF's offices in the Caucasus countries, the WWF Caucasus PO established a local Coordination Unit, consisting

of Regional and Country Coordinators, a Communications Officer, a Small Grants Manager and a Programme Administrator. Tasks and responsibilities were clearly delegated among members of the Coordination Unit. The Coordination Unit managed and led development of the CEPF grants portfolio, in close cooperation with CEPF staff.

In addition to the local Coordination Unit, an external reviewers group was established. This group involved over 100 experts, drawn from all countries of the hotspot, representing NGOs, government agencies, scientific institutions and donor organizations. The external reviewers group was responsible for review and evaluation of project proposals. Reviewers' feedback was considered as part of final decision-making on project selection and funding.

The CEPF Regional Programme in the Caucasus was implemented through grant making, and the main beneficiaries were the NGO sector and scientific institutions. Within the overall investment portfolio of US\$8.5 million, two types of grant were made: small grants of up to US\$20,000 and large grants above that amount. With a few exceptions, small grants were contracted and managed by the WWF Caucasus Programme Office, while large grants were contracted and managed directly by CEPF.

The CEPF grant portfolio in the Caucasus was balanced and well aligned to the Strategic Directions set out in the Ecosystem Profile. The grant portfolio consisted of: one large umbrella grant for the overall program coordination and leadership, issued to the WWF Caucasus Programme Office; a modest number of relatively large grants, issued to capable national and international NGOs for strategic, high-priority projects; and a larger number of smaller grants, mostly below US\$20,000 and mainly to national and local NGOs.

During the investment period, CEPF awarded 42 grants to civil society organizations active in the Caucasus Hotspot, with a total value of US\$8,498,783. Ten international organizations received grants totaling US\$5,418,079, while 21 local organizations received grants totaling US\$3,080,704. Grants ranged in size from US\$4,586 to US\$2,920,000; the median grant size was US\$100,000. The grants to international organizations included a grant of US\$2,920,000 to WWF. Under this grant, the WWF Caucasus Programme Office contracted and managed 87 small grants (up to US\$20,000) within the framework of the CEPF/WWF Small Grants Program. Almost all of these small grants were made to local organizations.

CEPF Impact Summary

The CEPF Investment in the Caucasus Hotspot was a unique and valuable opportunity for the region to strengthen and coordinate transboundary cooperation and initiate new regional interactions for biodiversity conservation. The corridor approach provided unprecedented opportunities for promoting regional and transboundary partnership, as each priority corridor crosses the boundaries of two or more countries of the hotspot. The full range of conservation outcomes attained through CEPF investment included: (i) contributions to the establishment, extension and strengthening of protected area systems; (ii) species-focused and site-specific conservation activities; (iii) strengthened capacity of civil society to become directly involved in biodiversity conservation; (iv) establishment of a regional biodiversity monitoring network; (v) raised public environmental awareness, with a special focus on biodiversity values and conservation issues; (vi) demonstration of approaches for sustainable natural resources use; (vii) promotion of national, transboundary, regional and international cooperation and partnerships to support biodiversity conservation; (viii) promotion of policy changes to support biodiversity conservation and (ix) development of alternative livelihoods for local communities.

During the CEPF investment period, large investments were made in the West Lesser Caucasus, East

Lesser Caucasus and Greater Caucasus Corridors, with considerably smaller investments in the Caspian and Hyrcan Corridors. As for multi-corridor projects, generally they covered all five priority corridors but, again, there was a skew towards the Greater Caucasus, West Lesser Caucasus and East Lesser Caucasus Corridors.

CEPF funding succeeded in reaching civil society organizations from the grassroots to the international level, and significantly increased their capacity to contribute to conservation. This increased capacity provides a strong foundation for future conservation initiatives in the region. Around 90 organizations were involved in the implementation of the CEPF Regional Programme and, among these, over 75 local NGOs and scientific institutions received CEPF grants. In most cases, local organizations, having less capacity in managing even small grants, were trained in proposal writing, reporting and project management by the Coordination Unit.

CEPF invested heavily in the protected area system of the Caucasus, on which other conservation efforts are anchored. CEPF investment contributed to system-level planning, expansion and creation of new protected areas, strengthening of management at existing protected areas, and development of sustainable financing mechanisms. All of these grants featured an awareness-raising component and adopted participatory approaches.

Of the 50 priority species identified in the Ecosystem Profile, 94% were targeted by CEPF-funded projects, including: (i) field-studies and population status assessments; (ii) global and national Red List assessments of poorly represented taxa; (iii) creation of databases and populating them with newly available data; (iv) formulation of regional or national species conservation action plans; (v) involvement of local people in species conservation projects, through creation of volunteer or caretaker networks; (vi) consultations with key stakeholders, including representatives from government, NGOs and academia, to promote recommendations; and (vii) regional and transboundary cooperation.

Although only one of the 50 species outcomes identified in the Caucasus was a plant, this reflected the state of knowledge at the time the Ecosystem Profile was prepared, not the status of the hotspot's plant species. Consequently, CEPF invested in filling the major information gap that existed with regard to the endemic plants of the Caucasus. These efforts were led by IUCN, in close cooperation with Missouri Botanical Garden, USA, which established an effective network of Caucasian plant specialists in the form of a Caucasus Plant Red List Authority under the IUCN Species Survival Commission. A comprehensive list of Caucasian endemic plant species, subspecies and varieties, comprising 2,800 taxa, was compiled. Of these, 1,100 taxa were assessed according to the IUCN Red List categories and criteria, of which around 600 taxa (mostly ones with very restricted distributions) were assessed as globally threatened. The results of this exercise were compiled as the Caucasus Plant Red List, which is scheduled to be published in 2010. The IUCN project also led to the identification of Important Plant Areas (IPAs) in the Caucasus, which made a major contribution to updating the list of Key Biodiversity Areas in the hotspot. Also, a draft Regional Plant Conservation Strategy for the Caucasus, corresponding to the aims of the Global Plant Conservation Strategy, was developed.

CEPF investment made a significant contribution to sustainable forestry and sustainable natural resource use in the Greater Caucasus, West Lesser Caucasus and East Lesser Caucasus Corridors. The full range of activities included (i) development of a sustainable forestry training manual; (ii) establishment and application of different models of sustainable forestry and sustainable natural resource use; (iii) training of governmental officials in sustainable forestry, biodiversity assessment and monitoring; and (iv) planting of forestry demonstration plots.

The CEPF portfolio included several grants to civil society organizations in support of their efforts to advocate for policy improvements with regard to biodiversity conservation and, also, provided significant

support to improve the implementation of MEAs related to biodiversity, comprising the Convention on Biological Diversity (CBD), the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar), and the Convention on Migratory Species (CMS) and its agreements.

CEPF assisted civil society in the South Caucasus region (Armenia, Azerbaijan and Georgia) to engage in the European Neighborhood Policy (ENP) process. The ENP offers the prospect of an increasingly close relationship with the EU, involving a significant degree of economic integration and a deepening of political cooperation. Taking into account the complex character of existing transnational political, social, economic and environmental problems, NGOs active in the entire South Caucasus region agreed on the need for a Regional NGO Platform to promote formulation of a regional vision on ENP implementation with regard to environmental and sustainable development issues. Through the Regional NGO Platform, recommendations were elaborated and adopted on regional scale priorities and actions for inclusion into the National ENP Action Plans of the South Caucasus countries.

CEPF invested significantly in developing alternative livelihoods for local communities in the East Lesser Caucasus, Greater Caucasus, Hyrcan and Caspian Corridors. A range of activities included (i) development of a bee-keeping, covering trainings in special bee-keeping techniques and creation of selective-tribal bee families; (ii) creation of rabbit, goat, sheep, goose and duck farms; (iii) establishment of a sustainable hunting area and (iv) training in ecotourism issues through which representatives of local communities explored new ways of making alternative livelihoods by working as ecotourism guides in PAs according to demand.

CEPF invested widely in raising public environmental awareness, with a special focus on biodiversity values and conservation issues through applying different communications techniques. CEPF invested in public-awareness-raising activities in all corridors, with a main focus on Armenia, Azerbaijan, Georgia and Turkey. These activities contributed significantly to increased awareness and understanding among local populations on environmental protection and the value of biodiversity.

CEPF made impressive investments in training for a wide range of stakeholders, including government officials, civil society representatives and local community members. Besides, in the hotspot, more than 200 journalists were trained in environmental and biodiversity conservation issues, communication and writing techniques and reporting from the field.

CEPF contributed significantly to the effective functioning of the Caucasus Biodiversity Council (CBC), which was established in 2004 with financial support from the MacArthur Foundation. The CBC is a regional body, consisting of officially nominated government representatives and NGO delegates from all countries of the hotspot. The council also invites academics to participate in its meetings, which are organized twice a year. Since its establishment, the Council has proved itself invaluable to conservation in the region, not only by promoting and monitoring the implementation of an Ecoregion Conservation Plan (ECP) for the Caucasus but also by facilitating implementation of regional programmes and projects, providing a forum for exchange of opinion and promoting transboundary activities. The CBC has become an important mechanism for promoting conservation in the hotspot, and for building confidence *vis-à-vis* donor agencies and the conservation community. This role is expected to become more and more important in years to come, in view of the growing development pressures that are being felt in the hotspot.

The CEPF investment conservation impact in the Caucasus Hotspot was reviewed, summarized and validated at the final regional assessment workshop convened on 28-29 September 2009 in Tbilisi, Georgia. The workshop was attended by over 60 participants, including CEPF grantees, governmental officials and representatives of donor institutions donated to CEPF.

Conclusion

CEPF played a crucial role in building partnership between the government, non-governmental and scientific sectors, as well as with mass media at both national and regional levels. The CEPF investment in the Caucasus illustrated how the joint effort and strengthened networking of civil society groups across the Hotspot can help achieve important conservation outcomes on the ground. The CEPF investment has significantly strengthened the foundations of capacity, knowledge and partnership in the region and future conservation efforts can be built on this strong basis.

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Introduction

The Caucasus region^a covers a total area of some 580,000 km² in the nations of Armenia, Azerbaijan and Georgia, the North Caucasus portion of the Russian Federation, the northeastern part of Turkey, and a relatively small part of northwestern Iran^b (Fig. 1). One of the most biologically rich regions on Earth, especially in the temperate context, the Caucasus is ranked among the planet's 34 most diverse and endangered hotspots by Conservation International (Mittermeier et al. 2004). The Caucasus, as part of the newly defined Greater Black Sea region, is one of WWF's 35 Priority Places, identified as focal among globally outstanding Ecoregions (WWF 2008).

An Ecoregion Conservation Plan for the Caucasus (Williams et al. 2006) was based on outcomes of a series of stakeholder workshops held from 2000-2003, combined with background reports and assessments coordinated by the WWF Caucasus Programme Office. More than 130 experts from the six countries participated in preparation of the Conservation Plan representing a variety of scientific, governmental, and non-governmental organizations. The purpose of the Ecoregion Conservation Plan (ECP) is to create a roadmap, including a vision and long-term goals for conservation of the unique biodiversity of the Caucasus Ecoregion, which will be achieved through implementation of a concrete set of short- and medium-term actions.

Despite differences between approaches and methodologies of ECP and the Critical Ecosystem Partnership Fund's Ecosystem Profile for the Caucasus Biodiversity Hotspot (CEPF 2003), the latter was developed considering the ECP vision and the long-term goals significantly contributed to the final document. In particular, around 60% of medium-term targets of the ECP have been addressed to a certain extent during implementation of the CEPF Ecosystem Profile.

Biophysical Description

In terms of its origin, the Caucasus isthmus is part of the huge mountain belt, formed during the Alpine Orogeny that embraces the whole of Eurasia from the Pyrenees and the Atlas Mountains in the west to the Malay Peninsula and Vietnam in the East. The Caucasus is a region of natural contrasts, and is composed of several prominent elements. These include the North Caucasus Plain (the eastern part of which is below sea level), the Greater Caucasus Range (highest peak Mt. Elbrus at 5,642 m), the South Caucasian Depression (from the Black Sea coastal, Colchic lowlands in the west to Absheron peninsula on the Caspian), the Lesser Caucasus Mountain Range (to 4,500 m) and the South Caucasian Uplands (covering parts of the Asia Minor, the Armenian and Iranian Upland, with the highest point being Great Ararat at 5,165 m). There is relief, with erosional-tectonic and accumulation forms being sequenced by volcanic,

^a For the purpose of this publication, the definition of the region is as was presented in Zazanashvili et al. (1999), in CEPF Ecosystem Profile for the Caucasus Biodiversity Hotspot (2003) and Ecoregional Conservation Plan for the Caucasus (Williams et al. 2006). Later boundaries of the region have been somewhat revised, part of the southern volcanic highlands have been intergraded with the newly defined Irano-Anatolian Hotspot and the eastern part of Hyrcan forests has been added to the region (Zazanashvili et al. 2004).

^b Unfortunately, Iran was not covered by CEPF investments.

glacier, and karst (limestone) forms. Glaciers are concentrated mainly in the Greater Caucasus Range, with over 2,000 of them covering 1,450 km². Not surprisingly, the climate is very variable. Mean annual rainfall in the southwestern part of the region is quite high, exceeding 2,000 mm in the coastal area of the Black Sea (up to 4,500 mm), while in the southeastern part of the Caspian coast it rarely exceeds 150 mm. Mean annual temperature in the South Caucasus part of the Black Sea coasts and the Caspian Sea coast is 15°C, declining from south to north, from the seacoasts to inland and with increasing altitude.



Fig. 1. Caucasus Ecoregion/Hotspot (Zazanashvili et al. 1999; CEPF 2003; Williams et al. 2006)

The vegetation of the Caucasus is quite diverse, and depends on both physical features discussed above and the evolutionary history of the flora. There are two Tertiary refugia in the region – centres of plant endemism: the Colchic in the catchment basin of the Black Sea and the Hyrcanian at the extreme southeastern end of the Caucasus, covering the eastern slopes of the Talysh Mountains and northern slopes of the Alborz Mountains at the southern coastal area of the Caspian Sea. Even now, many relicts, including evergreen, forms still appear as dominants or co-dominants in a number of plant communities. These include *Quercus pontica*, *Betula medwedewii*, *Epigaea gaultherioides*, *Rhododendron ungerii*, and *Rh. smirnowii* in the Colchic; and *Quercus castaneifolia*, *Albizia julibrissin*, *Gleditsia caspia*, *Parrotia persica*, and *Danae racemosa* in the Hyrcan (Doluchanov and Nachoutcrishvili 2003).

At the same time these unique forests can mostly be classified as temperate rainforests, due to the same principal reasons as for other temperate rainforest regions: relevant slopes of barrier-mountains located along coastlines that trap a large portion of the humidity from oceanic air masses. In the Caucasus, these barriers are formed by a topographical triangle created by the intersection of the western part of the Greater Caucasus Mountain Range (Georgia, Russia), western part of the Lesser Caucasus Mountain Chain (Turkey, Georgia) and Likhi ridge (bridge ridge between Greater and Lesser Caucasus, Georgia) at the Black Sea, and by the Talysh-Alborz Mountain Range at the southern-southwestern coast of the

Caspian (Iran, Azerbaijan). Montane barriers also contribute to a warm and humid climate that has been present since the late Tertiary and is the primary reason that the Caucasus has acted as a shelter for humid- and warm-requiring (hygro-thermophilous) relicts during the previous ice age. Consequently, Colchic and Hyrcan forests are the oldest forests in Western Eurasia in terms of their origin and evolutionary history, the most diverse in terms of relict and endemic woody species and tree diversity, and the most natural in terms of transformation of historic structure (Nomination 2009).

On the North Caucasus Plain, the vegetation transitions from steppes in the west, characterized by grasses such as *Stipa* spp. and *Festuca valesiaca*, to semideserts and eventually deserts in the east with *Artemisia taurica* and other species. Going from west to east in the South Caucasus Depression, one goes from *Alnus barbata*-*Pterocarya pterocarpa* swamp forests, to steppes (with *Botriochloa ischaemum* and *Stipa* spp.), to arid woodlands (with *Juniperus* spp. and *Pistacia mutica*), to semideserts, and finally deserts (with *Artemisia fragrans* and *Salsola* spp.). Relict oak species are dominant in flood plains and along riverside terraces, among them relict endemics *Quercus imeretina* and *Q. hartwissiana* in the western part of South Caucasus and relict *Q. pedunculiflora* in the eastern, drier part of the region.

The mountain belts are divided as follows: In the foothills, up to 500-600 m, one encounters Colchic poly-dominant broadleaf forest in the western part of South Caucasus, *Quercus iberica*-*Carpinus orientalis* forests in the eastern part, and mostly steppes in the North Caucasus. In the submontane belt, at 500-1,000 m, the forests are composed of *Castanea sativa*-*Fagus orientalis* in the western part, *Quercus iberica*-*Carpinus caucasica* in the eastern part of South Caucasus, and *Quercus petraea* in the North Caucasus. In the montane belt itself, at 1,400-1,800 m, there are dark coniferous forests of *Abies nordmanniana* and *Picea orientalis*, which in some places extend up to 2,000-2,100 m, and also forests of *Fagus orientalis*, *Quercus macranthera* or *Pinus kochiana*. In the subalpine belt, at 1,800-2,500 m, there are forests composed mainly of endemic species of *Betula*, shrub communities, tall herbaceous vegetation rich in endemics like *Heracleum* spp., and grasslands. The alpine belt, at 2,500-3,000 m is occupied by various grasslands and thickets of the relict endemic *Rhododendron caucasicum*. There are also many endemics in the belt above 3,000 m. The vegetation of the South Caucasus volcanic uplands is different in composition, and does not correspond to this general scheme. There, the principal features are woodlands of *Quercus macranthera* and other species, steppes, and thorn-cushion steppes with *Astragalus aureus*, *Onobrychis cornuta*, and other species (Zazanashvili et al. 2000).

In terms of vascular plant diversity, the estimated number of species is around 7,500, of which more than 2,600 (around 35%) are endemics (Nakhutsrishvili et al. 2009) - the highest level of vascular plant endemism in the Temperate Zone of the Northern Hemisphere (Myers et al. 2000). In addition, there are 17 endemic genera in the Caucasus, of which nine are associated with high mountains. About 25% of the endemic species are thought to have originated in the Greater Caucasus Range and many of these are high mountain and xeric mountain forms, as well as those growing on rocks and scree. In addition to many young endemics in the region, there are distinct relict species. The following genera have many endemic species in the Caucasus: *Saxifraga*, *Draba*, *Delphinium*, *Astragalus*, *Rosa*, *Pyrus*, *Onobrychis*, *Scutellaria*, *Campanula*, *Symphyandra*, *Pyrethrum*, *Primula*, *Heracleum*, *Jurinea*, *Psephellus*, and *Cirsium* (Dolukhanov 1966).

In all, the Caucasus has an estimated 152 mammal species, including 147 terrestrial and 5 aquatic; of these, 32 are endemic to the hotspot (Zazanashvili et al. 1999). As with other young mountain regions, the Caucasus has many newly evolved species, but also quite a few relict species as well such as the unusual long-clawed mole-vole (*Prometheomys shapochinskovi*), the only representative of an endemic genus, and species in the genera *Mesocricetus*, *Apodemus* and *Sicista*. The later genus is represented by four endemic species of birch mice (*S. caucasica*, *S. kluchorica*, *S. kazbegica*, and *S. armenica*, EN) (Zazanashvili et al. 2004).

Bird diversity is only moderate compared to the other hotspots, with around 380 species, and endemism is low, with only two endemics - Caucasian black grouse (*Tetrao mlokosiewiczzi*) and Caucasian snowcock (*Tetraogallus caucasicus*). Nonetheless, the Caucasus is very important for migratory species, with two major migration routes passing through the region: the east coast of the Black Sea and the west coast of the Caspian Sea. Every summer and autumn, millions of birds fly over the Caucasus isthmus en route to their winter homes. Globally threatened waterbird species in the region include the marbled duck (*Marmaronetta angustirostris*), lesser white-fronted goose (*Anser erythropus*), and white-headed duck (*Oxyura leucocephala*).

Reptiles are represented by 87 species, of which 21 are endemic. The genera *Lacerta* and *Darevskia* from the family Lacertidae exhibit particular diversity: of the 60 known species in the world, 28 species occur in the Caucasus, and 15 are endemic. Amphibian diversity is relatively low, with 17 species, but four of them are endemic. The endemic Caucasian salamander (*Mertensiella caucasica*, VU), sole representative of the genus is a graceful and colourful animal, and the best example of an amphibian flagship species in the region (Zazanashvili et al. 2004).

The Caucasus has around 130 species of fish, only 12 of which are endemic. Among the many interesting features of this fish assemblage are the three lamprey species: *Caspyomyzon wagneri*, *Eudontomyzon mariae*, and *Lamperta lanceolata*. Lampreys are ancient, jawless, scaleless fishes that date back 280 million years and have the highest number of chromosomes of all vertebrates (164-174) (Hardisty 1986). Sturgeons are another ancient group of fishes well represented in the hotspot with seven species, including the famous Beluga sturgeon (*Huso huso*), which is considered the largest freshwater fish (Frimodt 1995). Populations of all sturgeon species have been reduced through overharvesting, including poaching, primarily for high-value (black) caviar, while other threats include water pollution and damming that restricts anadromous migrations in the few remaining spawning rivers (mainly the Kura flowing into the Caspian and Rioni into the Black Sea).

The invertebrates, especially insects, are diverse and in the uplands, one can observe spectacular examples of the varied insect life, including an endemic butterfly *Parnassius nordmani* and the Rosalia longicorn beetle (*Rosalia alpina*, VU). Some endemic insects are found in the foothills, including Caucasian zerinthia (*Allancastra caucasica*).

Threats

Biodiversity of the Caucasus is being lost at an alarming rate. On average, nearly half of the land in the hotspot has been transformed by human activities. The plains, foothills and subalpine belts have been the most heavily impacted. Native floodplain ecosystems remain on only 5-6% of their original area. Most natural old-growth forests have been fragmented and divided mostly by areas of commercial forests, as well as agricultural and developed lands. For the Caucasus as a whole, about a quarter of the region remains in reasonable condition, while around 10-12% of the original ecosystems, including forests and high mountains, can be considered pristine. Numbers of large carnivores (such as leopard, hyena, lynx), as well as large herbivores (bezoar goat, turs - endemic wild goats of the Greater Caucasus, mouflon, chamois, Caucasian red deer, roe deer, wild boar) have fallen dramatically in the past century.

The major threats to biodiversity in the region are legal and illegal logging (mostly for fuel wood and the timber trade), overgrazing, poaching, overfishing and illegal wildlife trade, infrastructure development, and pollution of rivers and wetlands. These threats lead to habitat degradation, decline of species populations and disruption of ecological processes - all contributing to overall loss of biodiversity. Global climate change has become a big new challenge for the region, the best evidence for which is rapid melting and retreat of glaciers during recent decades, raising the timberline and activating desertification processes

in dry areas. The consequences include increasing frequency of catastrophic floods and decreasing area of high-mountain and dry grassland ecosystems, which in the medium-term can significantly affect the sustainability of structural patterns of bio-assemblages and will bring additional disparity to ecosystem processes.

The root causes of the direct threats to biodiversity can be broadly grouped into three categories: socioeconomic, political and institutional. Poverty is perhaps the most significant of the socioeconomic root causes, leading to poaching, fuel wood consumption, illegal logging, overgrazing and other threats. Poverty forces people to depend on natural resources and use them unsustainably to meet their basic needs. The lack of public awareness and public involvement in nature conservation is another reason people are more likely to participate in poaching, over-fishing and other violations. Economically, the public has little incentive to conserve firewood, water, or other resources. Poor land use planning results in overgrazing, pollution of waterways and inefficient infrastructure development.

Political root causes of biodiversity degradation stem from gaps and contradictions in legislation and the lack of a clear delineation of jurisdiction for enforcement agencies. Political and civil conflicts hinder cooperation on nature conservation and military conflicts often result in increased forest fires, logging, poaching and pollution. The lack of trans-boundary cooperation between countries hinders control of over-fishing, illegal trade of timber and wildlife and pollution of waterways.

Institutional root causes include limited coordination among institutions and lack of communication that sometimes result in duplication of efforts and misunderstandings. Insufficient knowledge of conservation issues among some key stakeholders hinders environmental protection efforts (CEPF 2003).

Priority Species

Globally Threatened Species

During the CEPF Ecosystem profiling process, 51 targets - globally threatened species - were identified, including 50 vertebrate and one plant species. Later the list was revised: some species, which are less characteristic of natural ecosystems of the Caucasus have been removed. Table 1 includes 46 globally threatened species as of IUCN 2003^c. Population status of most of these species has been surveyed within the CEPF five priority corridors (large conservation landscapes), such as Greater Caucasus, West and East Lesser Caucasus, the Caspian coastal and marine, and Talysh-Alborz (CEPF 2003). Corresponding action plans have been produced, some measures for planning and/or strengthening key protected areas have been implemented as well.

As results show, current status of globally threatened large herbivores such as Gmelin's (Armenian) mouflon (*Ovis orientalis gmelini*) and bezoar goat (*Capra aegagrus*) still calls for urgent conservation actions: surveys in Armenia (East Lesser Caucasus) have revealed the occurrence of around 1,500 bezoars and just 200 mouflons (Khorozyan et al. 2009); estimated numbers of mouflon in the bordering part of Azerbaijan (Nakhchyvan autonomous region) are about 250-300, while the total number of wild goats is around 1,000 individuals (Talibov et al. 2009). The existence of small populations of bezoar goat has been reported from West Lesser Caucasus corridor (Diker et al. 2009). Very small population of this animal survive in Georgia (eastern part of Greater Caucasus) and a relatively healthy population survives

^c Since 2003 status of many species included in Table 1 were revised. Most species were downlisted: according to IUCN 2009, six of seven bat species (except *Rhinolophus euryale*) listed in Table 1 are not considered as globally threatened (CR, EN, VU), as well as European otter (*Lutra lutra*), Daghestan tur (*Capra cylindricornis*), corncrake (*Crex crex*), and amphibians - Caucasian toad (*Bufo verrucosissimus*) and Caucasian parsley frog (*Pelodytes caucasicus*). At the same time four species were uplisted: Caspian seal (*Pusa caspica*, EN), sociable lapwing (*Vanellus gregarius*, CR), red-breasted goose (*Branta ruficollis*, EN) and Wagner's viper (*Vipera wagneri*, CR).

in bordering Daghestan/Russian Federation with estimated 2,000 individuals (Akhmedov et al. 2009).

Within the framework of CEPF investments for improvement of protection and conservation of wider range of habitats of these species, technical support was provided to Khosrov and Shikahogh Nature Reserves, and three more protected areas (Gnishik, Arevik and Zangezur) have been planned in Armenia^d. These investments were followed by a project funded by the Norwegian Government, targeting among other actions, further development of these protected areas (Zazanashvili et al. 2009). Grants have also been issued for development of a bezoar goat reintroduction program in Borjomi-Kharagauli National Park (Georgia).

The Caucasus has a number of important flagship species. Large mammal flagships include the East Caucasian or Daghestan tur (*Capra cylindricornis*) and the West Caucasian tur (*Capra caucasica*), two members of goat family endemic to this hotspot. They are found in the eastern and western portions of the Greater Caucasus Range, dwelling mainly in the high mountains and sometimes descending into the rocky gorges of the forest belt. The population trend for both species is still negative and also calls for urgent strengthening of protection activities. Surveys show populations of Daghestan tur (*Capra cylindricornis*) are relatively healthy with the best stock in Daghestan: on the Azerbaijan part of the southern macro-slope of the Greater Caucasus 5,300 individuals have been registered (Guliyev et al. 2009). It seems that approximately the same number of this species survive in the Georgian section of the eastern Greater Caucasus and 18,000^e in Daghestan. Status of West Caucasian tur (*C. caucasica*) is more problematic (Kopaliani and Gurielidze 2009; Magomedov and Yarovenko 2009).

Actually all CEPF funds granted for development of the protected areas system in Russian part of the Caucasus, including econet planning and so called “Green Corridor” project (Zazanashvili et al. 2009), as well as planning the Khevsureti National Park in Georgia can be considered as important step for creation of networks of protected areas and protection of turs in the Greater Caucasus. Technical support has been provided to Zakatala Nature Reserve - one of the key protected areas for conservation of endemic goat species in Azerbaijan.

As for other mammal species, the situation of local endemic Dahli’s jird (*Meriones dahli*) is alarming, as it seems to be extinct due to land conversion to agriculture, overgrazing, sand extraction and some other threats (Sahakyan et al. 2009).

Through CEPF investments, caretaker networks for strengthening protection of globally threatened bird species in the region have been established and are active at 29 sites/Important Bird Areas within priority corridors of South Caucasus countries (Armenia, Azerbaijan, Georgia and Turkey) and 29 sites in the Russian part of the Caucasus; in addition, a number of sites outside priority corridors have also been protected by caretaker networks (Gallo-Orsi et al. 2009, Lyubimova et al. 2009).

Conservation recommendations for two endemic, threatened species of vipers (*Vipera kaznakovi*, *V. dinniki*) have been developed and partly implemented. The critical condition of micro-populations of *Vipera kaznakovi* is reported from all key sites. The status of *Vipera dinniki* is markedly better. However, negative pressure of human impact on the natural-historical range of both species is reported too (Tuniyev and Tuniyev 2009). Recommendations for redlisting of reptiles and amphibians have been worked out (Agasyan 2009; Ananjeva et al. 2009). In addition to measures taken for conservation of endemic vipers in the western part of the region, key habitats of one more endemic species, Armenian viper (*Vipera raddei*), recommended for inclusion in IUCN Red List as VU) has been integrated in the recently established Arpi Lake National Park in Armenia.

^d Recently Arevik National Park and Zangezur Sanctuary were officially declared by the Government of Armenia.

^e This must be reason for downlisting of this species as NT (IUCN 2009).

The best known amphibian species is the Caucasian salamander (*Mertensiella caucasica*), which is a local endemic found only in the West Lesser Caucasus of Georgia and Turkey. A cross-boundary study of the status and taxonomic variation has been carried out and recommendations for improving protection developed. Two taxonomically distinct populations are identified: eastern and western. The study shows that if the continuing decline in habitat quality is considered, global status of the eastern taxon should be Endangered - EN B2ab(iii) and of the western taxon - VU B2ab(iii) (Tarkhnishvili and Kaya 2009). Technical support provided to Borjomi-Kharagauli National Park, as well as establishing the buffer zone of Mtirala National Park (Natural Landscape Territory of Mtirala and Machakhela) will significantly contribute to conservation of both taxa of Caucasian salamander.

Table 1. Globally threatened species of the Caucasus (IUCN Red List 2003)¹

	Scientific name	Common name	IUCN status, 2003			Distribution by country / CEPF investments					
			VU	EN	CR	Arm.	Az.	Geo.	Iran	Rus.	Tur.
	Mammals		12	3	1	11	11	10	10	12	9
1	<i>Barbastella barbastellus</i>	Western barbastelle	•			•	•	•		•	•
2	<i>Myotis emarginatus</i>	Geoffroy's bat	•			•	•	•	•	•	•
3	<i>Myotis schaubi</i>	Schaub's bat		•		•			•		
4	<i>Myotis bechsteini</i>	Bechstein's bat	•				•	•	•	•	•
5	<i>Rhinolophus euryale</i>	Mediterranean horseshoe bat	•			•	•	•	•	•	•
6	<i>Rhinolophus hipposideros</i>	Lesser horseshoe bat	•			•	•	•	•	•	•
7	<i>Rhinolophus mehelyi</i>	Mehely's horseshoe bat	•			•	•	•	•	•	•
8	<i>Lutra lutra</i>	Common otter	•			•	•	•	•	•	•
9	<i>Pusa caspica</i>	Caspian seal	•				•		•	•	
10	<i>Capra aegagrus</i>	Wild (bezoar) goat	•			•	•	•	•	•	•
11	<i>Capra caucasica</i>	West Caucasian tur		•				•		•	
12	<i>Capra cylindricornis</i>	East Caucasian tur	•				•	•		•	
13	<i>Ovis [orientalis] gmelini</i>	Gmelin's mouflon	•			•	•		•		•
14	<i>Sicista armenica</i>	Armenian birch mouse			•	•					
15	<i>Spalax giganteus</i>	Giant mole rat	•							•	
16	<i>Meriones dahli</i>	Dahl's jird		•		•					
	Birds		9	1	1	4	8	3	11	11	10
17	<i>Aquila heliaca</i>	Imperial eagle	•			•	•	•	•	•	•
18	<i>Aquila clanga</i>	Greater spotted eagle	•				•	•	•	•	•
19	<i>Falco naumanni</i>	Lesser kestrel	•			•	•	•	•	•	•
20	<i>Vanellus gregarius</i>	Sociable lapwing	•			•	•	•	•	•	•
21	<i>Crex crex</i>	Corncrake	•			•	•	•	•	•	•
22	<i>Grus leucogeranus</i>	Siberian crane			•		•		•	•	
23	<i>Otis tarda</i>	Great bustard	•						•	•	•
24	<i>Marmaronetta angustirostris</i>	Marbled duck	•			•	•		•	•	•
25	<i>Anser erythropus</i>	Lesser white-fronted goose	•				•		•	•	•
26	<i>Branta ruficollis</i>	Red-breasted goose	•				•		•	•	•
27	<i>Oxyura leucocephala</i>	White-headed duck		•		•	•	•	•	•	•
	Reptiles		3	3	2	4	4	6	1	4	6
28	<i>Testudo graeca</i>	Spur-thighed tortoise	•			•	•	•	•	•	•
29	<i>Natrix megalcephala</i>	Large-headed water snake	•				•	•		•	•

	Scientific name	Common name	IUCN status, 2003			Distribution by country / CEPF investments					
			VU	EN	CR	Arm.	Az.	Geo.	Iran	Rus.	Tur.
30	<i>Vipera darevskii</i>	Darevsky's viper			•	•		•			
31	<i>Vipera kaznakovi</i>	Caucasian viper		•		•	•	•		•	•
32	<i>Vipera dinniki</i>	Dinnik's viper	•				•	•		•	
33	<i>Vipera pontica</i>	Pontic viper			•						•
34	<i>Vipera wagneri</i>	Wagner's viper		•							•
35	<i>Darevskia clarkorum</i>	Clarks' Lizard		•		•		•			•
	Amphibians		3			0	2	3	0	2	3
36	<i>Mertensiella caucasica</i>	Caucasian salamander	•					•			•
37	<i>Bufo verrucosissimus</i>	Caucasian toad	•				•	•		•	•
38	<i>Pelodytes caucasicus</i>	Caucasian parsley frog	•				•	•		•	•
	Fish		1	5	1	0	6	6	5	6	4
39	<i>Acipenser gueldenstaedtii</i>	Russian sturgeon		•			•	•		•	
40	<i>Acipenser persicus</i>	Persian sturgeon		•			•	•	•	•	•
41	<i>Acipenser nudiventris</i>	Bastard sturgeon		•			•	•	•	•	•
42	<i>Acipenser ruthenus</i>	Sterlet	•				•		•	•	
43	<i>Acipenser stellatus</i>	Star sturgeon		•			•	•	•	•	•
44	<i>Acipenser sturio</i>	Baltic (Atlantic) sturgeon			•			•			
45	<i>Huso huso</i>	Beluga sturgeon		•			•	•	•	•	•
	Plants		1			1					
46	<i>Sambucus tigranii</i>	Tigran's elder	•			•					

Note: ¹Dots indicate existence of the species: red colour dots - addressed by CEPF investments; and black colour dots - not addressed by CEPF

The status of six species of sturgeon has been identified in the Georgian part of the Black Sea. By 2007, the total number of sturgeons in Georgia went down to its historical minimum of 10,000, meaning that from 1907 up to the present, the number of sturgeons has declined by at least 37 times. Implementation of policy and field protection measures, including conservation of the last spawning grounds is urgently required. Good news is that two juvenile individuals of the rarest species, Atlantic sturgeon (*Acipenser sturio*, CR) have been caught in the Black Sea near the Rioni river mouth, which proves that a small population of this species still inhabits the Rioni basin and coastal waters of the eastern part of the Black Sea (Guchmanidze 2009). WWF conducts feasibility studies for identifying perspective thematic and geographic areas for intervention, on the basis of which, relevant programme for protection of these overused, threatened species will be designed and implemented.

Caucasian plant species are obviously underrepresented in the IUCN Red List: only one species is listed as VU and some others with lower categories. To fill that gap, the status of endemic species of the Caucasus has been assessed by scientists from all countries of the region and relevant recommendations have been developed (Schatz et al. 2009).

ECP Priority Species

Along with endemic tur species, bezoar goat, mouflon, Imperial eagle, marbled duck, Caucasian salamander and all seven sturgeon species, ECP identifies some other priority species for the Caucasus, of which the leopard (*Panthera pardus saxicolor* = *P. p. ciscaucasica*) is perhaps the best known and the most celebrated in poems, rhythms, and song. At the beginning of the century it was widespread

throughout the Caucasus, but is now restricted to inaccessible portions of the eastern Greater Caucasus and Iori-Ajinour uplands, the Talysh-Alborz Mountains, south Armenia, bordering Nakhchivan/Azerbaijan and north-western Iranian uplands, and probably remote corners of northeastern Turkey. The leopard has always evoked mixed emotions of fear, hatred, and respect among local people; it has declined because of habitat destruction and development, poaching, and loss of prey species like wild boar (*Sus scrofa*), bezoar goat, red deer (*Cervus elaphus maral*), turs and chamois (*Rupicapra rupicapra*). It also attacks domestic stock on occasion, and this does not endear it to local communities. Unfortunately, it is still on the verge of extinction in the Caucasus (estimated total number of individuals does not exceed 60) and it is considered an Endangered subspecies (Breitenmoser et al. 2007). Since 2000, WWF has been implementing a long-term conservation program for leopard and its prey species in the Caucasus: this comprises permanent field monitoring in key areas and support for improving protection in key reserves and national parks and establishing new protected areas. Two years ago a Regional Strategy for Leopard Conservation was developed with participation of experts, representatives of relevant governmental organisations and NGOs; based on this document National Action Plans are under preparation. This process will definitely contribute to further strengthening of joint effort for the survival of this main flagship species of the Caucasus.

Of the other large carnivores in the region, striped hyena (*Hyaena hyaena*) is critically threatened. Camera-trap monitoring in some parts of the Caucasus organized by WWF shows that lynx (*Lynx lynx*) populations are healthier. Brown bear (*Ursus arctos*), wolf (*Canis lupus*) and jackal (*Canis aureus*) populations are widespread.

Of large herbivores, populations of Caucasian red deer dramatically plummeted during the 1990s – a totally unstable period after the collapse of USSR; e.g. in the Borjomi reserve number of individuals decreased from 800 in the 1980s to 37 in 1999. Fortunately, populations of red deer have recently begun to increase due to improvement in management of key protected areas of the region. Shirvan reserve in Azerbaijan is the only protected area in the region with a large population of goitered gazelle (*Gazella subgutturosa*) and serves as a reservoir for restoring the historic range of this beautiful species.

Acknowledgments

Thanks to CEPF investments today we know much more about the status of globally threatened species in the region than five years ago, and we have scientifically-based, comprehensive guidelines for improvement of their protection.

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Executive Summary

The distribution and status of bezoar goat in the Eastern Caucasus was assessed through field surveys and compared with previous data. Factors impacting on the population were assessed, a public awareness campaign was initiated and recommendations for conservation of the species were developed. The total population size was estimated at 2,000. Poaching is the main threat to bezoar goats in the study area.

Scope and Objectives of the Work

The bezoar goat *Capra aegagrus* (Erxleben, 1777) is one of the rarest ungulate species in the eastern Caucasus. Most of its range is located in Daghestan and bordering regions of Chechnya and Georgia. The bezoar goat is listed in Category 2 of the Red Data Book of the Russian Federation (species with declining population in the northern outskirts of the range) and Category 1 of the Red Data Book of Daghestan (critically endangered species with extremely limited range).

No details of the total population size in the Greater Caucasus are available, but a decline in numbers and range is obvious and is mainly due to increasing human impact. If this trend persists, the Bezoar goat may disappear from the Greater Caucasus in the coming decades and drastic conservation measures are necessary to save the species. According to Sokolov (1959), the subspecies *Capra aegagrus aegagrus* (Erxl) occurs in the Caucasus, Asia Minor, southwest Asia, and Iran.

The ultimate aim is to ensure conservation and, possibly, growth of the bezoar goat population within its historical range in the Greater Caucasus. The objectives of this project were to investigate the current status of bezoar goats in the Eastern Caucasus and to initiate a public awareness campaign among local communities to promote conservation of the bezoar goat and nature in general.

Methodology

Field visits were organized to different parts of the range and the data collected were used to evaluate population size, preferred habitats, structural organization, behavior and other aspects of its ecology. The work was conducted in different parts of the range in the Eastern Caucasus, both in optimal areas (inaccessible to people) and unsuitable areas (subject to man's impact). The public awareness campaign involved meetings with local communities within bezoar goat range and distribution of information leaflets explaining the importance of protection and conservation of the species. Measures for Bezoar goat conservation within its present range and a strategy for increasing its numbers and restoring its historical range have been developed. We used the Student's t-test to compare differences in the distribution by altitude of separate age/sex groups of bezoar goat and East Caucasian tur *Capra cylindricornis*.

Results

Distribution and Population

In the Caucasus, Bezoar goats are distributed in the eastern part of the Greater Caucasus and in the

Lesser Caucasus (Georgia, Armenia, and Azerbaijan) (Vereshchagin 1959; Dormidontov and Blokhin 1977). There is little data on numbers and density in different parts of the range available from literature. In 1970s, in Azerbaijan, the population was estimated at 2,300 individuals (Kuliev 1981). Up to 450 animals are estimated in Armenia at present (Weinberg 1999). The global population apparently does not exceed 50,000 animals (Red Data Book of the Russian Federation 2001).

The largest part of the range of the Bezoar goat in the Greater Caucasus was historically in Daghestan. At the beginning of the 21st century, the Bezoar goat was found in the Andi, Gunib, Samur and Kazikumukh districts in the Eastern Caucasus (Dinnik 1910; Vereshchagin 1959). Currently, it is found only in the former Andi and Gunib districts. They inhabit the gorges of the Andi and Avar Koisu tributaries; the Andi and Bogos ridges and western branches of the Nukatl ridge. The population in Chechnya in the 1970s was estimated at 450-600 individuals (Tochiev 1975) and 250 (Ravkin 1975), while at the end of 1970s it amounted to 350-360 individuals with average population density of 7-8 individuals/1000 ha (Bakhtiev 1989). In Georgia, by the end of 1980s, the Bezoar goat population did not exceed 300 animals (Arabuli 1989). No up-to-date data on bezoar goat numbers in these regions are available.

Over the past century, Bezoar goat range in Daghestan has shrunk by 1.7 times to 2,400 km² (Fig. 1). Average population density is 4.6 ± 2.3 individuals/km² but animals are concentrated in smaller areas and this fact should be considered while estimating total numbers. Sites where the goats were found made up to 12%-30% of the total range. Therefore, we estimate that the average population density in the whole of bezoar goat range in Daghestan was 1.02 ± 0.19 individuals/km², which gives an estimated population of 2,000 bezoar goats.

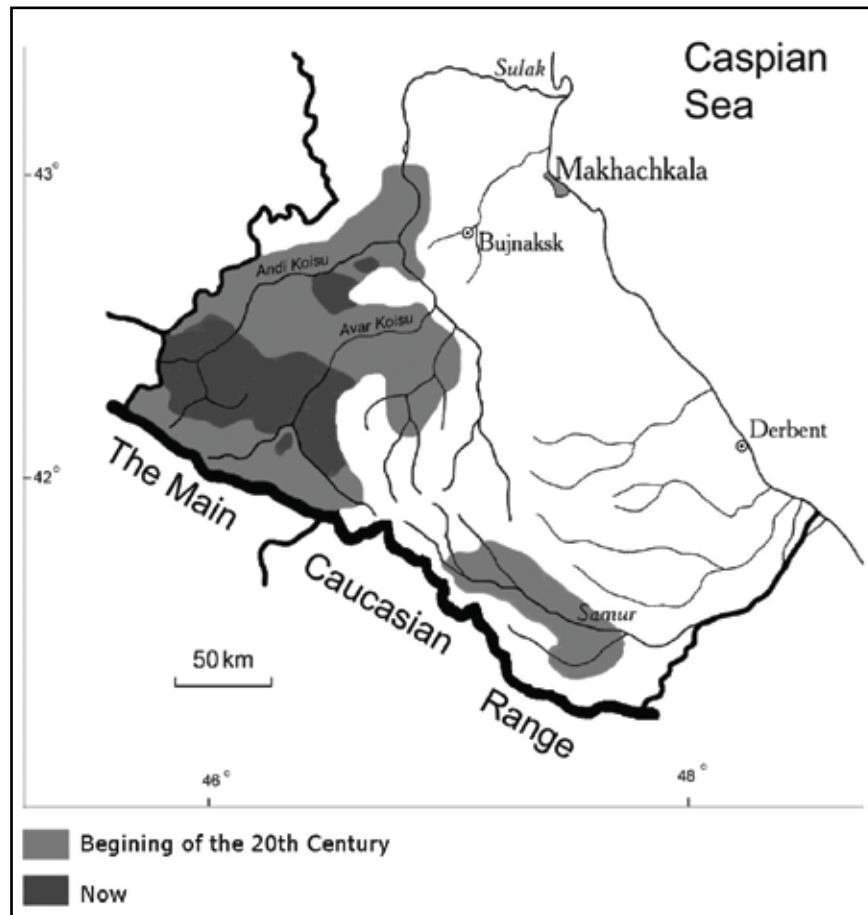


Fig. 1. Bezoar goat range in Daghestan at the beginning of the 20th century and in 2009

Biology, Behavior and Habitat

Most bezoar goat females give birth to two kids. Female bezoar goats reach sexual maturity after 1 year of age, which means that they have higher reproductive potential than other ungulate species of the Caucasus (Fig.2). They can live close to people if not hunted or poached. Bezoar goats inhabit mountain slopes with rocky outcrops, covered with a mix of shrubs and trees. Their distribution greatly depends on accessibility of forage in winter, when they mainly feed on shrubs and trees as snow cover is quite deep (Fig. 3).



Fig. 2. One-year-old male and female bezoar goats / © E. Akhmedov

Bezoar goats in Daghestan live in small isolated groups of 7-25 animals, whose vulnerability to poaching, predators and diseases can be aggravated by deterioration of the environment. Creation of additional anthropogenic barriers (logging, construction of roads, communications, water reservoirs, etc) also has an adverse affect on goat populations. Within its range in the Eastern Caucasus, the Bezoar goat inhabits the lower and middle parts of the slopes that people use most intensively for agricultural purposes (livestock grazing and hay making). In winter the goats sometimes descend to villages and feed on haystacks prepared by local farmers for their cattle. This makes them easily accessible to poachers.

Bezoar goats may live close to human settlements and roads (in the middle and lower slopes), so are accustomed to seeing people and vehicles and normally are not afraid of them, which can make them more vulnerable to poachers.

Socioeconomic Factors

Until recently, the main aspects of socioeconomic development in the region that influenced the bezoar goat population, directly or indirectly, were extremely negative in nature. These are: (1) High unemployment among the local population. Many local residents lost their jobs after the dissolution of kolkhozes (collective farms) and sovkhoses (state farms), where most of the local population had been employed. They had to earn their living by logging and sale of wood, making the area less suitable for bezoar goats. (2) Due to the unstable situation in the region (Bezoar goat range in Daghestan lies on the borders with Chechnya and Georgia) local residents possess large numbers of weapons, which they often use for hunting and poaching. (3) Concentration of a large number of frontier posts in the region, as border guards also hunt for the animals on occasion.



Fig. 3. Typical habitat of bezoar goat in Eastern Greater Caucasus / © V. Lukarevskiy

However, socioeconomic trends sometimes have a positive influence: (1) unemployment in mountain areas has led to migration of a majority of able-bodied jobseekers to urban areas in Daghestan and other regions of Russia; this resulted in reduction of the number of people in the mountain areas of Daghestan; (2) the dissolution of the kolkhozes and sovkhozes (Soviet collective farms) led to a decline in small cattle numbers, which has had a positive effect on the Bezoar goat's forage reserves; (3) the concentration of frontier posts in this region to some extent prevents local residents from openly carrying unlicensed weapons.

Threats

Poaching and Hunting

Hunting of this species continues in Daghestan, although on a smaller scale than in the 1990s. It is noteworthy that people responsible for observance of the law - officers of regional militia departments and even employees of environmental organizations and local gamekeepers hunt bezoar goats. Therefore, along with discussions with these people, we gave a high priority to advocating bezoar goat conservation among local communities. Before our project, many local residents were unaware that the bezoar goat is one of the rarest species in the Caucasus fauna.

Poaching is the main cause of comparatively high mortality of adult male goats. While female goats are mainly confined to forests both in summer and winter, male goats migrate higher to the subalpine zone in summer, where they are more accessible to poachers on the open slopes. During the rut, usually lasting from November through January in the Eastern Caucasus, male goats migrate in search of females, and many of them are killed by poachers. Thus, adult males are the most vulnerable age/sex group in the population in the Eastern Caucasus. In the second half of winter, when mountain streams freeze, the goats descend to the bottom of gorges, where they are hunted by predators and poachers.

Habitat Destruction and Degradation

As stated above, unemployment led to intensive logging and sale of wood in the region in the 1990s. In the Eastern Caucasus, the Bezoar goat is mostly confined to forested mountain areas of Western Daghestan, and logging has certainly led to deterioration in habitat quality. The situation has now changed, as unemployment forced many local residents to move from their villages to urban areas in search of work. As a result, the number of people in bezoar goat habitats has been gradually declining. Although logging still continues, its rate has decreased by several times, so it should not be regarded as a factor leading to population decline.

Lack of Forage

As mentioned above, the project covered the northern parts of bezoar goat species range. Like other populations inhabiting the outlying districts of the range, bezoar goat populations in the Eastern Caucasus are vulnerable to climatic factors. Forage deficit can appear at the end of winter – the most critical period for all ungulates - when forage accessibility and movement of animals are limited by thick snow.

Competition with Livestock

Prior to the collapse of the USSR, these areas were used for grazing by domestic sheep and goats belonging to local and distant kolkhozes and sovkhozes. At present, the situation has changed in favor of the bezoar goats as the number of livestock grazing in their habitats has declined dramatically since the dissolution

of the Soviet Union. Therefore competition with livestock is not a serious cause of forage shortage.

Competition with Wild Ungulates

Daghestan tur *Capra cylindricornis* occurs in the same area as bezoar goats but the two species usually occupy different elevations. The smallest difference in elevation was found between male bezoar goats and female turs in summer, when male bezoar goats move through the forest to the subalpine zone. Interspecific competition does not appear to be a significant factor as there is ample forage. It would be more appropriate to say that the weakening of competition in summer results in partial overlap of ecological niches of the Bezoar goat and the tur in the context of their distribution by altitude.

Differences in distribution show more clearly in winter, when male and female bezoar goats descend to the forest zone. Although tur also descend to lower elevations, they mainly remain above the forest. Thus, in the period of forage shortage and limited pasture reserves, differences in the distribution of tur and Bezoar goat by altitude are much more distinct than in summer. Therefore, there is almost no competition for forage between these two mountain ungulate species.

Conservation

Favorable Factors for Bezoar Goat Conservation

There are some districts in the Eastern Caucasus that are completely inaccessible to humans due to the terrain. Though few in number, these areas provide refuges and contribute to the survival of bezoar goats. Population density in these areas is regulated by intraspecific mechanisms. If bezoar goat numbers increase, some individual will migrate to neighboring areas where they are often killed by poachers.

In addition to the existence of areas completely inaccessible to people, favorable factors for bezoar goat conservation include: (1) High reproductive potential. (2) Ability to dwell in the immediate proximity of inhabited localities.

Improvement of the Protected Area Network

It is necessary to strengthen Bezoar goat conservation measures throughout its range in the Caucasus, beginning with the central parts of the range which act as refuges. Although the goat is formally protected in Kosob-Keleb, Bezhtin and Tlyarin game reserves in Daghestan, no effective conservation actions are being implemented, which necessitates the establishment of a protected area on the basis of the Kosob-Keleb and Bezhtin game reserves.

Scientific Research

At present, Bezoar goat range has a fragmented character. This may increase the chances of inbreeding, leading to a reduction in population viability. It is important to conduct scientific research to ensure that bezoar goat conservation in the Eastern Caucasus, like all environmental activities, is based on sound knowledge of its biology. This includes continuous monitoring of population size and status.

Awareness Raising

Popularization of the bezoar goat conservation measures was one of the main aims of our project. Public opinion has a special value in the Caucasus so it is essential to change attitudes of local communities towards poachers. We made some progress in this context and intensive efforts should be continued.

During meetings with biology teachers and young naturalists, they recommended that we should include information on bezoar goat conservation in work plans of young naturalists' groups.

International Cooperation

The bezoar goat is one of the ancestors of domestic goats and so has a special genetic value. Cooperation between Russia and Georgia, as well as cooperation with international environmental organizations, is needed to ensure conservation of its entire range, and the WWF/CEPF project is making an invaluable contribution to this.

All this, alongside the awareness campaign that we launched to promote bezoar goat conservation (and which we plan to continue in the future), gives reason to hope that the goat will survive in the Caucasus and that its population size and range will grow.

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Executive Summary

In this study, we aimed to investigate the distribution and the populations of bezoar goat in the Kaçkar Mountains of north-east Turkey. Fifty-two fieldwork days were spent in the area, investigating the habitat and status of bezoar goats and factors affecting their populations. In the first stage, in July 2008, possible bezoar goat habitats were surveyed, and information was gathered from local hunters within the Kaçkar Mountains. In January 2009, the field work was carried out in the Barhal Valley of Yusufeli, Artvin and Sırakonaklar and Aksu Valley in İspir, Erzurum. Bezoar goat herds were detected and observed by camera and binoculars for 2 to 6 days. We observed the herds that were close to each other with extra care to avoid double-counting. Predators were identified and their impact on bezoar goats was also investigated.

The Barhal Valley contains good habitat within the Kaçkar Mountains, probably due to the presence of semi-forested areas surrounded by steep rocky cliffs. In other habitats, bezoar goats are extinct or nearly extinct because of heavy poaching pressure and construction of hydroelectric power plants. In the Barhal Valley, because of hunting tourism and poaching, we observed very few adult males and young. Overall, we observed 64 individuals in Barhal Valley and detected 7 in Sırakonaklar Valley.

Methods

We first identified habitats of bezoar goats by gathering information from local hunters and the Provincial Directorate of Environment and Forestry. Field surveys covering 52 days were conducted in these areas (12 days in July 2008, 30 days in January 2009, and 10 days in June 2009). Camps were established in the field and observations made using 16x50 binoculars and 40x optical zoom cameras. Direct observations, tracks, droppings and bedding places were recorded on transects through the region. Sites identified during the first study period were checked again in January 2009. Due to the severe winter conditions and snowfall, bezoar goats were observed at 1,000-1,400 m in steep, rocky valleys. Bezoar goat movements and numbers were recorded from fixed points for a few days to avoid over-counting. In three locations where we did not observe any bezoar goats we followed their tracks for a considerable distance in an attempt to estimate the number of individuals.

Status

Distribution and Habitat

Bezoar goat (*Capra aegagrus*) occurs in Turkey, Georgia, Russia (Daghestan), Armenia, Azerbaijan, Iran, Iraq, Turkmenistan, Afghanistan and Pakistan. In Turkey, the bezoar goat is found in the Taurus Mountains, from Datça peninsula along the Mediterranean coast to the Iranian border and in the eastern and north-eastern Anatolian mountains which have suitable habitats up to 4,000 m altitude (Gündoğdu 2006). Bezoar goats live in mountainous, rocky, sparsely forested lands (Fig. 1). Because of poaching,

loss of habitat, growth of settlements, over-grazing, and construction of road and hydro-electric power plants, bezoar goat numbers are declining and in many areas, populations are already extinct. Bezoar Goat is listed as “Vulnerable” (VU A2cd) on the IUCN Red List.

Kaçkar Mountains

The Kaçkar Mountains are located in northeast Turkey, within the borders of Erzurum, Artvin and Rize provinces and run parallel to the Black Sea coast. The highest point is 3,932 m. The north side of the Kaçkar Mountains rises rapidly from the Black Sea and has a humid climate because of abundant



Fig. 1. A view of Kaçkar mountains bezoar goat habitats / © H. Diker

annual rainfall. There are dense forests and alpine meadows, while fast-flowing rivers form deep, rocky valleys, surrounded by dense forest and vegetation. The southern side of the Kaçkar Mountains has a low annual rainfall, but springs fed from the north side combine and form fast flowing rivers. These steep, rocky and sparsely forested valleys and cliffs create suitable habitat for bezoar goats.

Other ungulates occurring in the Kaçkar Mountains are chamois (*Rupicapra rupicapra*), wild boar (*Sus scrofa*), and roe deer (*Capreolus capreolus*). Roe deer live on the north side of the Kaçkar Mountains and bezoar goats live on the south. Chamois live above 1,800 m and in winter

they descend to the higher forests. Wild boars are distributed from sea-level up to the alpine meadows. Large and medium mammal predators are: Brown bear (*Ursus arctos*), wolf (*Canis lupus*), lynx (*Lynx lynx*), leopard (*Panthera pardus*), golden jackal (*Canis aureus*), red fox (*Vulpes vulpes*), European badger (*Meles meles*), stone marten (*Martes foina*), pine marten (*Martes martes*), and otter (*Lutra lutra*).

The north side of the Black Sea Region from the sea shore to the Kaçkar mountains has a mild climate with abundant rainfall and high numbers of cloudy days, creating dense forests dominated by beech (*Fagus*), hornbeam (*Carpinus*), alder (*Alnus*), yew (*Taxus*), chestnut (*Castanea*), lime (*Tilia*), fir (*Abies*) and spruce (*Picea*) trees. The south side of Kaçkar has a dry climate. Dry forests of oak (*Quercus*) and juniper (*Juniperus*) trees rarely create sparse communities up to 1,200 m altitude. Above 1,200 m, spruce and Scots pine (*Pinus sylvestris*) trees create dense forests.

Study Area

The Barhal River valley which combines with the streams coming from Kaçkar, Altıparmak and Marsis Mountains contains perfect bezoar goat habitat between Sarıgöl and Yaylalar villages, where the herds prefer steep rocky hills covered with tall grasses and oak forests. Bezoar goats are the rarest and most threatened species of large herbivore in the region.

Results

We observed a total of 64 bezoar goats in Barhal Valley: 20 females, 8 males and 5 young between Barhal and Demirdöven villages, and 19 females, 7 males and 5 young between Sarıgöl and Barhal village (Fig. 2). Villagers reported two further herds, which we we did not see, on rocky slopes near Barhal and Sarıgöl. The

most optimistic estimate is that 100-120 bezoar goats live in suitable habitats of the Barhal Valley.

Local people in the Barhal area said that numbers of young had declined in recent years. We observed 39 adult females and 10 young. Bezoar goats usually give birth to 2, rarely 1 young each year (Weinberg 2001). The low number of young detected suggests that bezoar goat numbers may decline rapidly in the future and the species may face extinction in the Barhal Valley. Only 8 of 15 males seen were over the age of 6 years, as identified by their horns. One of these old males was killed by hunters while we were in the field. The remaining males in the herds were young individuals aged 2-5 years.



Fig. 2. Bezoar Goats from Barhal Valley / © H. Diker

Between Sarıgöl and Yaylalar villages, a steep rocky section of the Barhal Valley, about 30 kms long, forms good habitat for bezoar goats. Within this area there are a few small villages. Although the population in these villages is low in winter, many people move up to the mountains in summer and bezoar goat habitats are surrounded by small settlements with a highly-concentrated population. In this habitat it is difficult to control poaching and some bezoar goats are killed each year.

The National Parks, Game and Wildlife Directorate regulates hunting tourism by issuing annual quotas for bezoar goat and chamois. In recent years the number of bezoar goats and chamois in the Barhal Valley is decreasing because of poaching and hunting tourism. For the hunting season from 1 August 2009 to 31 March 2010, the hunting quota in the Kaçkar Mountains is 5 bezoar goats in Yusufeli and 3 in İspir. Quotas in previous years were much higher (Anonymous 2009). Dr Şağdan Başkaya from Karadeniz Technical University and Casim Cihan from Artvin National Parks, Game and Wildlife Directorate issued a report in 2000 specifying that chamois numbers are too low in Yusufeli district to support hunting tourism (Başkaya 2000).

Hunting guides and local people say that predators such as lynx and wolves are increasing in number every year. We were unable to find any evidence to confirm this. Large predators in the region are wolf, lynx and common leopard. The status of leopard in Kaçkar has not been investigated. The only recent record is a pelt of a leopard that was shot by poachers in 2001 near the Coruh Valley. According to local information, a small number of lynx live in Kaçkar. We recorded no tracks or scats of lynx during our fieldwork. Wolves often attack domestic livestock on the south side of Kaçkar in summer. We have identified two wolf packs, involving 5-7 individuals, between Sarıgöl and Demirdöven. We collected and analyzed more than 50 wolf scats during field work in January 2009. Only two samples contained bezoar goat hair, while 8 samples contained wild boar hair and one contained brown hare hair. The other samples contained fruit remains, especially dates (*Diospyros lotus*), called *karahurma* in Yusufeli. We also observed these fruit remains in jackal scats.

During fieldwork, two groups of bezoar goat containing 15 females, 3 males, and 2 young were tracked for 3 weeks near Demirdöven village, where two wolf packs share the same territory. The same number of goats were present at the end of the 3 weeks at the same sites, although the wolf packs were active every night. It appears difficult for wolves to hunt bezoar goats, because of the steep terrain, and they prefer to prey on wild boar. Trophy hunters and poachers sometimes take only the skin and the trophy and leave the rest of the animal. Thus the bezoar goat hair found in the wolf scats may have come from

an old male left by hunters.

We carried out fieldwork in Sirakonaklar Valley, on the southern side of the Kaçkar which is good habitat for bezoar goats. We found fresh tracks of a bezoar goat herd in the snow, 3 km below Sirakonaklar village. Tracks indicated that the herd contained 7 individuals with 2 males, but unfortunately we did not observe any bezoar goats there. In another field trip in Aksu Valley, where bezoar goats were seen in the previous years, according to local hunters, we did not observe any bezoar goats. We assume that one reason for that could be construction of a hydroelectric power plant with disturbance from many heavy trucks. In addition, use of explosives during construction is also very common and causes disturbance to not only the bezoar goat but all wildlife species in the area.

Outside the Kaçkar Mountains, bezoar goats live in rocky parts of the Coruh Valley and its tributaries from Artvin to Uzundere. National Parks - Hunting and Wildlife Directorate of Artvin carried out inventory counts in Coruh River Wildlife Conservation Area (CVWCA) in October 2008 (Table 1). According to this information, 439 adults and 459 young, a total of 898, were observed in an area of 235 km². Annual quotas for hunting tourism are based on these inventory counts. However the Barhal Valley contains a different habitat and an independent group of bezoar goats.

Table 1. CVWCA Inventory Counts October 2008

Area (ha)	Observation points	Number of bezoar goats observed				
		Male	Female	Young	Undefined sex	Total
23500	95	94	337	459	8	898

Threats

Both legal hunters and poachers select older males with long horns. Poachers rarely shoot females and young. All the hunters say that they only shoot older males so they do not damage the populations. However, because of the pressure on older males, 2-3 year old males often mate with the females and their fecundity is so low that only one or no young is born. The herd we observed in the Barhal Valley had 3 males aged 3, 4 and 7 years old. When the 3 and 4-year old males entered the female group, they were suddenly repelled by the adult females. But the females did not show any negative reaction when the 7 year old approached, and mated with him. Intense hunting pressure on male bezoar goats in the Barhal Valley is weakening the population.

Because of continuous pressure of hunting, intensive settlements and roads around the habitat and the difficulty in controlling poaching, bezoar goats may be facing extinction within a few years in the Barhal Valley, the most suitable and important habitat (Fig. 3).

In the Coruh Valley, bezoar goat numbers are also declining every year due to poaching. In the last few years, construction of hydroelectric power plants, new settlements and roads have resulted in loss of habitat and fragmentation of bezoar goat populations. Construction often involves working under intense lights at nights and use of high explosives that has further negative effects on bezoar goats. Moreover, temporary camps for construction workers force the herds out of their natural territories, putting them in a very dangerous situation as they become more visible to poachers.

The “Yusufeli Dam and Hydro Electric Power Plant Project Environmental Impact Assessment (EIA) Report” says that dam construction will result in some populations losing their habitats. Measures are said to be taken to address these problems (Ministry of Energy and Natural Resources of Turkey 2006), but poaching continues to increase, according to construction workers, especially near Narlık located

along the Coruh River. Villagers and local hunters in Coruh Valley reported that bezoar goats cross the river by the bridges especially late at night. According to the EIA report, the dams will prevent contact between the populations, though the Çoruh River is said to be a natural barrier.

Conservation

To protect bezoar goats and to increase their populations, Wildlife Development Areas were established by General Directorate of Nature Protection and National Parks, including the Çoruh Valley Wildlife Development Area, established on 23,200 ha of bezoar goat habitat. Hunting quotas for bezoar goats are issued each year for hunting tourism to prevent poaching, to control the bezoar goat populations, to earn revenue, and to contribute to the village management, pension management and guiding activities. The aim is to encourage the villagers to take an active role in the protection of wildlife. In practice, it seems that hunting tourism does not benefit bezoar goat



Fig. 3. The habitat of bezoar goats are in conflict with villages land-use / © H. Diker

populations. In addition, other than some foreign hunting companies and a few local operators, local people do not receive any revenue from trophy hunting. This causes local people to react against these activities and as a result, poaching is increasing especially in higher plateaus of the Kaçkar Mountains used for transhumance in summer, due to the difficulty in controlling it by state rangers.

A conservation plan involving local people must be established for the Barhal Valley, one of the most suitable habitats for bezoar goats in the Kaçkar Mountains. Hunting tourism activities must be terminated urgently. Sites where poaching occurs must be strictly controlled with the help of local people.

Acknowledgements

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Conservation Strategy for Armenian Mouflon (*Ovis [orientalis] gmelini* Blyth)^a and Bezoar Goat (*Capra aegagrus Erxleben*) in Armenia

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Executive Summary

The main objectives of this study were: (1) to describe the current distribution and status of the Armenian mouflon and bezoar goat in Armenia; and (2) To develop a national action plan for their conservation, including short-term (to 2009) and medium-term (to 2012) targets and long-term (to 2015) objectives.

During field studies carried out in 2006-2007 we surveyed almost all areas of southern Armenia where, according to the literature and local records, mouflon and bezoar goat occur: southern slopes of the Geghama Ridge (Kakavaberd and Khosrov districts of Khosrov Reserve), Aiotsdzor Ridge (Noravank, Kaput and Khndzorut), southern slopes of the Vardenis Ridge and Syunik Highland (Eghegis Valley, Her Her and Jermuk), Zangezur and Bargushat ridges and southern part of the Meghri Ridge (vicinities of Nuvadi [Ernadzor] village). We also used data collected in January 2004. For administrative reasons we failed to survey the Urts Ridge, one of the key areas for bezoar goats and the only area where a resident mouflon population exists.

During the surveys, spot and route counts recorded 153 mouflons and about 500 bezoar goats (1,124 individuals were counted, many of them repeatedly). As a result, we estimate that bezoar goat numbers in Armenia exceed 1,000 (and likely 1,500) individuals and mouflon abundance is hardly over 200 animals (Fig. 1 and 2).

Status of Armenian Mouflon

Mouflon and bezoar goat belong to the Western Asian faunistic complex and the mouflon has penetrated the least far into the Caucasus isthmus. Only a small portion of mouflon range extends to the north of the Arax River and the stronghold of the species is located in Iran (Ziaie 1997). Since the late 19th century, mouflons have disappeared in Iraq (Shackleton 1997) and most of Turkey (Kence and Tarhan 1997). Surprisingly, the South Caucasus fringe of the range has changed the least since historical times: mouflons occur in the same Zangezur, Aiotsdzor and Urts ridges as a century ago (Dinnik 1910; Sarkisov 1944; Dal 1944, 1948, 1953, 1954; Yavruyan 1969, 1975; Airumyan and Gasparyan 1976).

In the first half of the 20th century, mouflons regularly migrated across the Arax River to Iran to avoid harsh winters. Migrating groups reportedly numbered up to hundreds of individuals (Sarkisov 1944). Thus, the South Caucasian population was dependent on replenishment by animals from Iran. In the 1950s, the Soviet-Iranian state border was fortified and the Arax riverside became saturated with settlements, infrastructure and other facilities. So, an apparent reduction in population size was aggravated by termination of transboundary migrations, isolating the South Caucasus population from the main population in Iran.

^a Editorial note: in IUCN Red List 2009.2 (see at <http://www.redlist.org/apps/redlist/details/15739/0#sectionTaxonomy>) scientific name of this mouflon's subspecies is referred as *Ovis orientalis gmelinii*; common names for particular subspecies are not listed: in the texts for Range Description and Conservation Actions the subspecies is named as Armenian sheep and Armenian mouflon. For this book keeping the names used by authors has been decided.

Information on mouflon abundance and population densities in the late 19th – early 20th centuries is lacking. Only some contradictory records on winter herds are available (Dinnik 1910; Sarkisov 1944). Dal (1948) estimated mouflon densities in some small areas of the Aiotsdzor Ridge which cannot be extrapolated over larger scales. Publications on mouflon numbers began to appear only in the late 1970s, giving total numbers of 350-400 individuals for both Armenia and Nakhichevan (Yavruyan 1975; Airumyan and Gasparyan 1976).

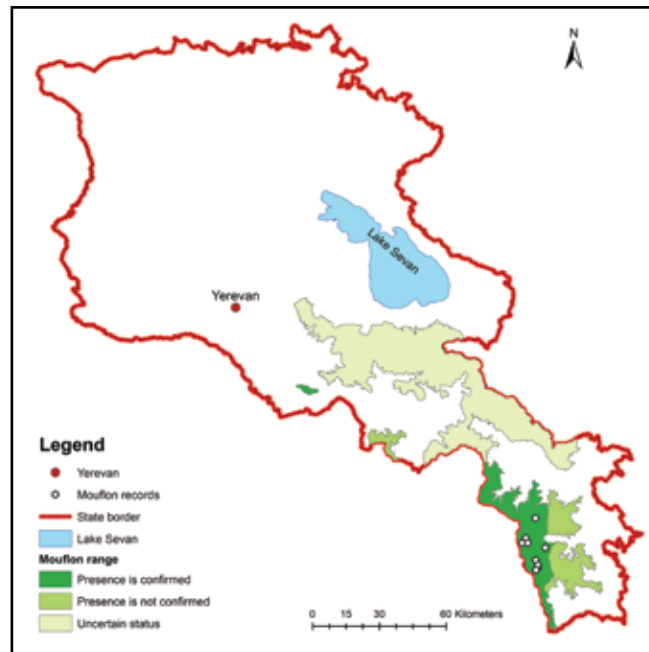


Fig 1. Armenian mouflon (top right), typical habitat (top left) and distribution (below) in Armenia /Photos © WWF, A. Malkhasyan

We found mouflons only on the southern Zangezur Ridge (from the junction with the Bargushat Ridge to the Meghri Ridge), mostly in the Gyard Valley and the adjoining part of the Bargushat Ridge. There is some information on summer occurrence of a limited number of mouflons on the northern slopes of the junction of the Zangezur and Bargushat ridges above Dastakert town and Soflu village. Local people report occasional sightings of mouflons on the Aiotsdzor Ridge where Dal (1948) noted the mouflon as a common and even crop-destroying species. We recorded, in different seasons and possibly without double counts, 153 mouflons, including 87 males of different age groups and only 66 females with yearlings and lambs. Population density was estimated at 0.76 individuals/km². Even considering possible underestimation, the maximum number of mouflons on the Armenian sides of Zangezur and Bargushat would hardly exceed 200. This number is realistic for the snow-free period, because from late autumn to

spring, mouflons are seen less frequently and sightings contain fewer males (Fig. 1 and 2).

Dominance of male groups over female groups in summer (Table 1) allows one to surmise that some adult males migrate during this season from Nakhichevan to Armenia. It is more difficult to age mouflons than goats and to distinguish adult and yearling females, and also to discriminate between yearling females and lambs in the autumn-spring period. That is why our records are insufficient to calculate the sex ratios and indices of yearlings and juveniles. Records of female groups were rare (4 cases) and only one of them was in the snowy period when male herds were much smaller than female herds.

Table 1. Size of mouflon herds on the eastern slope of the Zangezur Ridge

Herd type	Seasons			Average
	Winter and early Spring (Jan-Mar)	Summer (Jun-Aug)	Autumn (Oct)	
Male	9.5 (2) ¹	6.2 (12)	12.7 (3)	7.7 (17)
Female	33 (1)	24 (1)	19.5 (2)	23.8 (4)
Average	17.3 (3)	7.5 (13)	13.2 (5)	10.8 (21)

Note: ¹The values in brackets represent the number of herds

The principal traits of mouflon biology are linked with life in open subalpine and mountain grassland environments. These habitats are relatively more accessible than the rocky outcrops and screes preferred by bezoar goats and can be used for livestock grazing and crop fields. Relatively high fertility allows mouflons to recover quite quickly from population losses. Like all small Eurasian sheep, mouflons usually deliver twins (Sarkisov 1944; Schaller 1977). Some authors (e.g., Dinnik 1910; Sarkisov 1944) emphasized the prudence and vigilance of mouflons compared to goats, a feature common for all inhabitants of open environments. Mobility and low site fidelity enable mouflons to flee successfully from a dangerous area and re-settle safe areas where they were previously wiped out or ousted by humans. For example, in the 1990s small flocks of mouflons were recorded during harsh winters on isolated hills to the east of Yerevan where they were never detected before.

The principal negative factors affecting mouflon population viability and individual fitness are: (1) openness and accessibility of habitats and, to a lesser degree, (2) reduced vigilance during the rutting period. Three positive factors allow mouflons to withstand unfavorable conditions: (1) quite high fertility; (2) prudence; and (3) mobility.

Status of Bezoar Goat

Abundance and distribution of the bezoar goat continued to decline during the 20th century over the entire range, including the Greater Caucasus (Dinnik 1910; Weinberg 1999; Magomedov et al. 2001). The distribution of this species in Armenia has not experienced a significant change, apart from the disappearance of goats from the Pambak Ridge and Mt. Aragats (Dal 1954; Gasparyan 1974). It is virtually impossible to track the dynamics of goat numbers over the years, as even Dal (1951, 1954) did not provide such data. The Urts Ridge is the only place in Armenia where goat censuses have been conducted by means of a single methodology. There, aerial surveys from helicopters were chosen as the best technique of counting goats, even though they would detect only 10-15% of the population. The most comprehensive description of status, ecology and distribution of the bezoar goat in Armenia is provided by Gasparyan (1974) who estimated the total population size at 400-500 individuals (Table 2).

Table 2. Age composition of the bezoar goat population in Armenia

Month(s) and year	Area	Age classes			Indices	
		Adult ♀	Yearlings	Juveniles	Juveniles/♀	Yearlings/♀
Jan, 2004	Noravank	8	3	6	0.75	0.38
	Nuvadi	19	10	12	0.63	0.53
	Khosrov	6	1	6	1.0	0.16
Total		33	14	24	0.73	0.42
Jun-Jul 2007	Zangezur	17	13	21	1.24	0.76

We conducted bezoar goat surveys across pre-selected sites. Censuses of ungulates in mountainous and close habitats are hardly feasible due to the low detection probability of animals (Weinberg 1999). Use of the software program PRESENCE 2.0 has shown that estimated detection probability of bezoar goats to the north of Nuvadi (Ernadzor) village is 59% (Khorozyan et al. 2008).

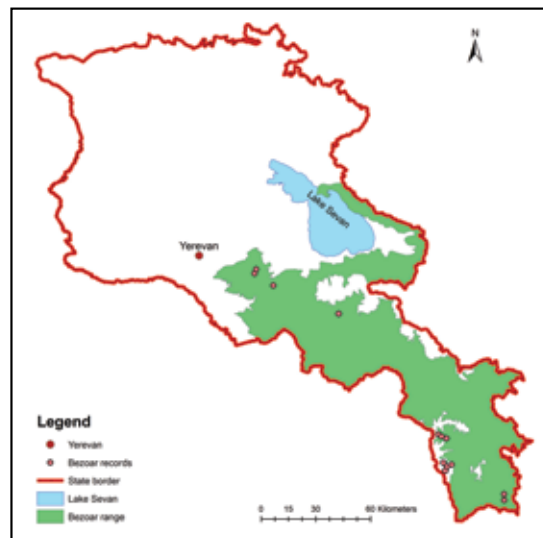


Fig. 2. Bezoar goats (top right), typical habitat (top left) and distribution (below) in Armenia / Photos © WWF, A. Malkhasyan

We counted about 500 goats (Table 3) and in almost all areas, excluding the Zangezur Ridge, females outnumbered males. Therefore, as not all males were included in the census, the total number of goats

must be much higher. In December 2006, 130 goats, including at least 12 adult males, were detected on the Meghri Ridge to the north of Nuvadi. Adult males have seldom been detected in this area beyond the rutting season, but the group of 26 adult males was found twice in summer in Shikahogh Reserve where, most likely, goats migrated from Nuvadi.

The situation on the Zangezur and Bargushat ridges is completely different. In May 2006 we did not observe any females with kids, and in June-July 2007 males, including adults, totally outnumbered females. Here we found more males than anywhere else. It should be noted that beyond the rutting season (November-December) adult males (> 6 years old) and females (> 2 years) live in separate groups, sometimes even in different habitats (e.g., Weinberg 1999, 2007). However, in November 2006 several mixed groups dominated by females with juveniles were recorded in the vicinities of Ajubaj village (headwaters of Geghi Valley). As a result, in summer, females in Zangezur are underestimated and the dominance of males over females can be explained also by immigration of males from the opposite slope in Nakhichevan. The western slope of Zangezur in Nakhichevan differs from the Armenian slope by aridity, limited number of water sources and high abundance of grazing livestock which might drive the male bezoar goats to Armenia.

Table 3. Abundance of bezoar goats in Armenia¹

Years	Periods	Areas					Total
		Zangezur and Bargushat (without Kirs, Darmanadzor and Bohakar)	Arpa River basin (Aiotdzor Ridge and canyons of Eghegis, Her-Her and Jermuk)	Khosrov Reserve (Kakavaberd, Khosrov, Khachadzor)	Urts Ridge	Others (including Meghri Ridge)	
1939 ²	Summer				118		
1950 ³	Apr. – May.				124		
1961-1965 ⁴	Summer	≥100	80	40	90	≈ 100	347
2004-2007 ⁵	May		74 (2/28/44)	59 (2/7/27) ⁶		40 (0/17/12) ⁷	
	Jun. – Jul.	180 (71/129/17) ¹					
	Nov. – Dec.	70 ⁸				130 ⁷	
	Jan.		20 (0/3/8) ⁹	31 (7/15/7) ¹⁰		45 (0/4/19) ⁷	
Total		>200	>74	>90		>130	≈500
Size, km ²		300	70	50		50	
Density per km ²		0.7	1.1	1.8		2.6	

Note: ¹Numbers between parenthesis mean males > 6 years old/males 2-5 years old/adult females, respectively; ² Dal (1951); ³ Dal (1951); ⁴ Gasparyan (1974); ⁵Our study; ⁶ Only Kakavaberd; ⁷ Nuvadi; ⁸ Only Ajubaj; ⁹ Only Noravank; and ¹⁰ Only Khosrov.

Our surveys show higher numbers of bezoar goats in Armenia than previously assessed, due to

underestimation in earlier studies. Considering underestimation and the missed areas presumably inhabited by goats (Sevan Ridge, most of the Meghri Ridge, parts of the Bargushat and Aiotdzor ridges, Arpa River canyon and Urts Ridge), we can estimate the bezoar goat population size in Armenia at over 1,000 and even up to 1,500 individuals, including males on the Zangezur and Aiotdzor ridges that undertake seasonal transboundary migrations between Armenia and Nakhichevan.

Bezoar goat density is highest in the Nuvadi area and in Khosrov Reserve (Table 3), but even there it is slightly lower than in similar habitats in Daghestan in the mid-1990s (Weinberg 1999). Our estimates are also lower than in the Urts Ridge (Dal 1951), but this author calculated densities only for small areas where goats were actually detected and not for all suitable habitats.

The species range in Armenia is patchy, especially in its central part where local populations in the Aiotdzor and Vardenis ridges and in the Syunik Highland are connected by the Arpa River canyon. In some places (headwaters of the Artavan and Kaput on the northern slopes of Aiotdzor) bezoar goats are rare despite available rocky areas and water sources.

Goat ecology is entirely dependent on adaptability to rocky habitats. Living on cliffs, goats feel safe and do not escape rapidly. Movement routes of goats are conservative and readily used by poachers, which makes these ungulates increasingly vulnerable to hunting pressure. Bezoar goats, especially males, lose vigilance during the rutting season.

The bezoar goat has four features that increase population viability and individual fitness: (1) high fertility; (2) secretiveness; (3) mobility; and (4) fidelity to hardly-accessible rocky areas. Female goats usually deliver twins. Bezoar goats in Armenia are fecund: the juvenile/female ratio exceeds 1 and the yearling/female ratio is 0.76 (Table 2). Such birth and kid survival rates are comparable with those in Daghestan (Weinberg 1999) and exceed those in Pakistan (Schaller 1977; Edge and Olson-Edge 1990) and Turkmenistan (Korshunov 1995), enabling this ungulate to withstand intense human pressure.

The secretiveness of bezoar goats allows them to survive in rocky woodlands and scrub near settlements and human infrastructure. They are also capable of crossing quite long distances through open habitats and dwell on isolated rocky “islands” (e.g., in small cliffs and canyons around the Jafar Canyon in the Noravank area). Fidelity to rocky outcrops makes goat range highly fragmented, but also protects animals from human pressure as these habitats have not been used for settlements and agricultural purposes (except for limited livestock grazing). This is why goats usually fare much better than mouflons in sympatric areas. If not disturbed by people or shepherds’ dogs, goats easily tolerate human presence. For instance, goats living in safe zones are not worried by noise of traffic and perceive roads and vehicles as familiar elements of the landscape.

Conservation Strategy

There is a combination of positive and negative factors underlying the essential conservation efforts to be undertaken in order to save the bezoar goat and the mouflon from extinction in Armenia.

The positive factors are the following: (1) reduction in the rural population, mostly caused by armed conflict (results of population census 2003); (2) reduction in livestock numbers, especially of sheep, and, hence, of people and shepherds’ dogs in goat and mouflon habitats; (3) recovery of natural vegetation in mountain grasslands formerly used as pastures.

The negative factors are: (1) intensification of mining (copper, molybdenum, uranium); (2) rapid development of infrastructure (roads, gas pipelines) which destroys habitats and simplifies access to pristine lands; (3) high numbers of refugees who have to exploit natural resources to survive; (4) availability of firearms; and (5) high numbers of border guards at the Armenian-Azerbaijani (Nakhichevan) state border.

Conservation actions directed towards protecting bezoar goats and mouflons in Armenia can be divided into captive breeding, strengthened protection in the wild, improvement of natural conditions, enforcement of environmental impact assessment of main economic activities and raising public awareness.

Both mouflons and bezoar goats have been kept at the Yerevan Zoo, but most of them are hybrids (especially between wild mouflons and domestic sheep) meaningless for captive breeding and reintroduction. Reintroduction is not a priority issue for replenishment of these ungulates in the wild, as mouflon range in Armenia has not changed in the past 100 years and Mt. Aragats is easily accessible and thus useless for reintroduction of bezoar goats.

The Armenian mouflon is listed in the 2008 IUCN Red List of Threatened Species as “Vulnerable” (A2cde; IUCN 2008) and in the Red Data Book of Armenia (1987) as “Endangered”. Until very recent times, the only protected area for mouflons was the Urts Ridge within Khosrov Reserve, but in 2006 it was taken into private ownership. This is the best known mouflon area in Armenia due to its proximity to Yerevan. This factor reduces the value of Urts for mouflon protection. The ridge has been surrounded by towns, villages, a cement factory and a gold smelter. The size of Urts (20 km by 8 km) is enough to secure the safe existence of the resident mouflon population, but only if poaching and disturbance are completely stopped. At this moment, the only protected area just visited by mouflons is Bohakar Sanctuary in the southern part of the Zangezur Ridge. The Zangezur and Aiotdzor ridges are potentially much more important for mouflon conservation in Armenia than the Urts Ridge.

The bezoar goat is globally “Vulnerable” (A2cde; IUCN 2008) and “rare, tending to reduction in range and abundance” in the Red Data Book of Armenia (1987). This ungulate has been protected in Khosrov and Shikahogh reserves, Sevan National Park and Bohakar, Goris, Eghegnadzor, Her-Her, Jermuk Forest, Plane Tree Grove and Sev Lich sanctuaries. The sanctuaries are too small and are deprived of financial and technical resources, so the priority in bezoar goat conservation should be the above-mentioned reserves and national park.

Beginning in the year 2002, the projects supported by World Wide Fund for Nature (WWF) and Critical Ecosystem Partnership Fund (CEPF) provided technical assistance to Khosrov and Shikahogh reserves. It is still insufficient and there is an urgent need to promote implementation of the following activities: (1) strengthen anti-poaching squads to curb illegal hunting and habitat destruction; (2) raise public awareness and train personnel of protected areas; and (3) stimulate economic development of local communities. Sevan National Park is involved in the project on natural resource use and poverty reduction supported by Global Environment Facility (GEF) and The World Bank. Joint efforts of WWF, CEPF and Ministry of Nature Protection of Armenia have led to the establishment of Arevik National Park (Meghri and Zangezur ridges) and Zangezur Sanctuary (Zangezur Ridge) in 2009, and the establishment of Gnishik Sanctuary (Aiotdzor Ridge) is planned.

Apart from measures against poaching and habitat destruction, the principal conservation actions should include: (1) preservation and restoration of good quality grasslands, sparse forest stands and water sources in the most arid areas (e.g., Urts Ridge); (2) enforcement of legislative and preventive measures to control mining and infrastructure development; (3) raising the levels of public awareness about these species and other wildlife, especially among local people.

Conservation cannot be successful without scientific research and biodiversity monitoring. Monitoring is an essential tool to determine population status and trends in space and time, therefore it is vitally important to develop monitoring techniques, identify the areas to be monitored and train appropriate personnel. Scientific research should focus on sex/age structure, birth and survival rates (especially among yearlings and juveniles), spatial distribution and movement patterns (especially transboundary migrations in the Zangezur and Aiotdzor ridges) of goat and mouflon populations.

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Conservation Strategy of the Asiatic Mouflon (*Ovis [orientalis] gmelini* Blyth)^a and the Bezoar Goat (*Capra aegagrus* Erxleben) in Azerbaijan

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Executive Summary

The main objectives of this study were: (1) to describe the current distribution and status of the Asiatic mouflon and the bezoar goat in Azerbaijan; and (2) to develop a national conservation action plan. During field studies carried out in 2006-2007, we surveyed most of Nakhchyvan Autonomous Republic where, according to the literature and local records, mouflon and the bezoar goat occur: Arpachai River basin around the reservoir, Garagush Massif, Kuku Massif, a large part of Zangezyr Range south of Kapujykh mountain, the area between the Alinjachai and Gilyanchai Rivers, including Darydagh mountain, and also Kyapaz massif in mainland Azerbaijan, a spur of Murovdag Range. During spot and route counts 252 mouflon (49 aged and sexed) and 365 bezoar goats (112 aged and sexed) were encountered, some of them repeatedly. Estimated numbers of mouflon in Nakhchyvan are ca. 250-300, while the number of bezoar goats may reach 1,000.

Status of Asiatic Mouflon

Only a small northern outskirts of mouflon range extends to the north of the Araz River and the stronghold of the species is located in Iran (Ziaie 1997). The South Caucasus fringe of the range has changed the least in historical times: mouflons occur in the same Zangezur, Aiaz Ranges and some lowlands of Nakhchyvan as a century ago (Dinnik 1910).

In the first half of the 20th century, mouflon regularly migrated across the Araz River into Iran to avoid harsh winters (Vereshchagin 1959). The small Trans-Caucasian population was dependent on the Iranian population. In the 1950s, the Soviet-Iranian state border was fortified and the Araz River valley was gradually filled with settlements, infrastructure and other facilities. A reduction in mouflon population size was accompanied by the cessation of transboundary migrations, isolating the South Caucasus population from the main one in Iran. Small numbers of mouflon still migrate reportedly in spring and autumn via Darydagh to Negramdagh Plateau crossing the main Nakhchyvan highway running along the Araz River valley on the way, but do not cross the river itself. This may be regarded as a relict of the former mass migrations to Iran.

Unfortunately there are almost no data on numbers or density of mouflon in Nakhchyvan. Dinnik (1910) described winter groups of up to 10-12 animals and approximate annual harvest in the 1930s was estimated at 200 animals (Vereshchagin 1947), but by the end of the 1940s, mouflons were already regarded as rare in the Nakhchyvan lowlands but still sufficiently abundant on Zangezur Range (Vereshchagin 1959). At the beginning of the 1970s, total numbers in Nakhchyvan were estimated at 1,000-1,200 (Aleperov et al. 1976; Talibov 1999) while a census in 1990-93 produced a figure of 1,185 mouflon, 620 of which

^a Editorial note: in IUCN Red List 2009.2 (see at <http://www.redlist.org/apps/redlist/details/15739/0#sectionTaxonomy>) scientific name of this mouflon's subspecies is referred as *Ovis orientalis gmelinii*; common names for particular subspecies are not listed: Asiatic mouflon as common name cannot be found in the IUCN Red List webpage; but for this book keeping the names used by authors has been decided.

occurred on Zangezur range. These figures are hardly realistic. In the 1990s, mouflon disappeared from lowlands of Sharur district in western Nakhchyvan, and were met only sporadically in Shakhbuz district (Kuliev 2000b).

We found mouflon in the vicinity of Ardychdagh Mnt. (Sharur district), on the Garagush Mnt. (Kengerli district), in the area between Alinjachai and Gilyanchai Rivers (Julfa district), and on the Zangezur Range in the headwaters of the Paragachai River and above Nasirvaz village (Ordubad district). We found no mouflon at the southern end of Zangezur Range (Ketam, Genza and Hyus-Nyus Valleys) and on Kuku mountain. (Shakhbuz district). (Talibov et al. 2007) indicate overall absence of mouflon in Shakhbuz district (upper half of Nakhchyvanchai river basin) though 3 animals were seen a couple of years ago near Badamly mineral springs in the east of the district. Summing up all the data, there are 2 main local mouflon populations in Nakhchyvan: 1) eastern – in the central Zangezur Range approximately between Eshak-Maidany Pass in the north and upper reaches of Mazdanychai River in the south, and between Alinjachai and Gilyanchai Rivers, including surroundings of Ilandagh and Darydagh Mnts. and also Negramdagh Plateau (approx. 650 km²); 2) western – on the spurs of Daralayaz Range, Garagush mountain) and around Arpachai Reservoir (approx. 400 km²). These areas include human settlements and agricultural land, so the actual area of mouflon habitat is in reality smaller (Fig. 1).

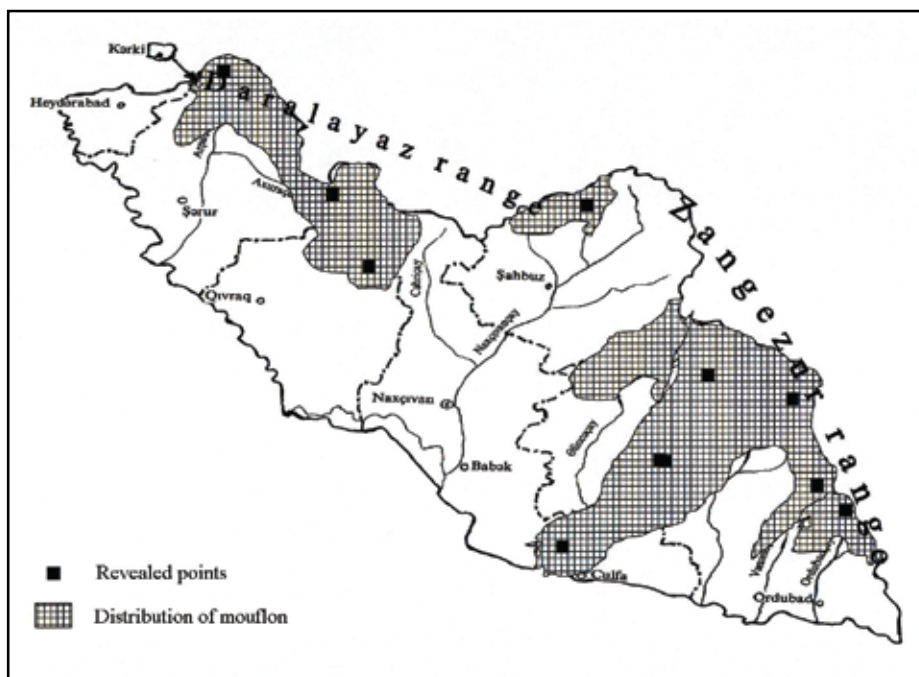


Fig. 1. Distribution of Asiatic mouflon in Nakhchyvan

Distribution of mouflon in Azerbaijan is shown in Fig. 1. Their spread to new areas is connected to an increase in fine-horned livestock in Nakhchyvan. The gradual movement of flocks upwards compels mouflon to leave the middle slopes and move to the high mountains.

Mouflon are essentially lowland, warmth-loving animals, but also inhabit typical highland landscapes of Zangezur Range. In summer, they mostly move to higher elevations but some animals, not just females with young, but also adult males, remain in the lowlands. As a result of the research in 2008, new zones of mouflon distribution were revealed. Age and sex structure of the mouflon populations observed is shown in Table 1.

Table 1. Age and sex structure of mouflon populations

Month, year	Site	Age and sex classes					Indices		
		Adult males ≥ 6 yrs	Young males 2-5 yrs	♀	Yearlings	Juveniles	♂/♀	Juveniles/♀	Yearling/♀
June, 2006	Zangezur, Nasirvaz		1	5		3 ¹			
Nov. – Dec., 2007	Shurut, Darydagh, Garagush	7	3	5	4	11	0.67	0.73	0.27
Aug. 2008	Soyughdagh, Gecheldagh	3	4	6	2	2			

Note: ¹ One twins

According to our data, which are mathematically insufficient, the juvenile/female index was just 0.73, the yearling/female index being 0.27 during the rut (Table 1). For a species in which twinning is common, these figures are low, particularly the yearling index, indicating low survival rates. Yearlings also made up just 10% of all animals encountered during the rut, which is a low natural increase. The adult sex ratio (0.67) reflects high anthropogenic pressure.

Status of Bezoar Goat

Distribution and numbers of bezoar goats decreased almost everywhere during most of the 20th century (Weinberg et al. 1997). Distribution in Azerbaijan suffered less, except for their disappearance from Talysh. Now, the bezoar goat's main range is in Nakhchyvan where it inhabits practically all suitable habitats, though in variable densities (Fig. 2). These roughly correspond to the precipitousness of the terrain. The most favorable conditions exist in the southernmost part of Zangezur Range where mouflon seldom, if ever, occur. The situation on Daralayaz Range is much worse; we did not find goats, or even signs of their presence, on Kuku mountain, previously well-known for the abundance of goats. Nor did we see goats on Ilyandagh mountain in summer or winter. The total area of bezoar goat habitats in Nakhchyvan is approximately 1,300 km², most of which is encompassed by Ordubad National Park.

In mainland Azerbaijan, the bezoar goat occurs on Kyapaz mountain (Fig. 3). This is a limestone spur of the Murovdagh Range. The total area of bezoar goat habitat on Kyapaz is 2-3 km² and cannot support an independent population. We saw 8 goats there which are wholly dependent on the main Murovdagh population. In 1947, the occurrence of the bezoar goat was reported at the headwaters of Gerdymanchai River (Ismaily district), on the Greater Caucasus (Vereshchagin 1947). That would be the only population on the southern slope of the Greater Caucasus and separated by some 200 km from the nearest population in Daghestan. That information was later repeated in many publications (e.g. Sokolov 1959; Heptner et al. 1961), but a survey conducted in 2002 revealed that the report was erroneous. Only East Caucasian tur (*Capra cylindricornis*) and chamois (*Rupicapra rupicapra*) occur there, and the bezoar goat is unknown to local people.

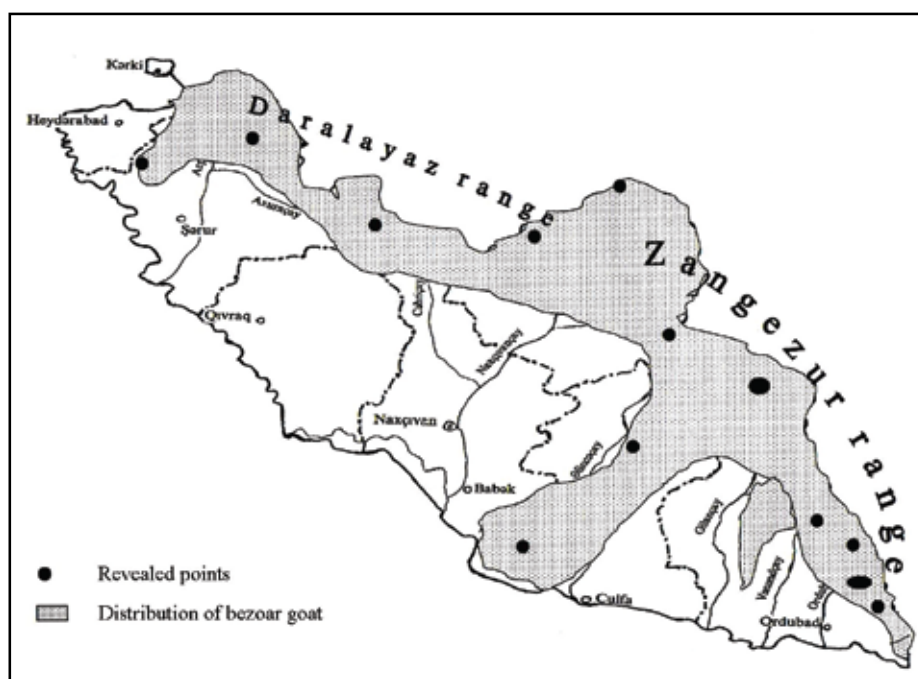


Fig. 2. Distribution of bezoar goat in Nakhchivan

There are no published data on bezoar goat numbers in Azerbaijan before the 1970s. Vereshchagin (1947) estimated the annual harvest at 300 animals in the 1930-40s. In summers of 1972-74, 1,194 animals were counted in Nakhchivan (a density of 15 animals/1,000 ha), 740 of which were on Zangezur Range (Kuliev 1981). Later, the Nakhchivan population was estimated even higher: 1,800-2,000 animals (Aleksperov et al. 1976) and total numbers for Azerbaijan at 2,350 (Kuliev 1981). However, by the mid-1990s, estimates were only 1,500-2,000 (Kuliev 1997). We estimate total numbers in Nakhchivan at 1,000 in the cold season, since part of the population, in particular males, migrates in summer (as do mouflon), to the western, more humid slopes of the range. There are two main bezoar goat populations in Nakhchivan: the Zangezur population, and another in Daralayaz Range and Arpachai Reservoir. There are next to no animals in the central part of the autonomous republic, in the Nakhchivan River basin.



Fig. 3. Kyapaz mountain (Habitat of the bezoar goat) / © E. Askerov

Bezoar goats are more sedentary than mouflon and seldom perform noticeable seasonal migrations. In Ketam Valley, goats have been encountered in the same places both in summer and winter. However, male groups can be met in arid and hot midlands and in cold alpine highlands during the same months.

Age and sex structure of bezoar goat populations is shown in Table 2. Twinning is common in the Lesser Caucasus (Kuliev 2000a), and high juvenile and yearling indices (Table 2) substantiate this for Nakhchivan. These data, though mathematically insufficient, roughly correspond to those for Daghestan (Veinberg 1999) and exceed those for Pakistan (Schaller 1977; Edge and Olson-Edge 1990) and Turkmenistan (Korshunov 1995).

Table 2. Age and sex structure of the bezoar goat

Month, year	Site	Age and sex classes					Indices		
		Adult males ≥ 6 yrs	Young males 2-5 yrs	♀	Yearlings	Juveniles	♂/♀	Juveniles/♀	Yearlings/♀
Nov., 2001	Zangezur, Ketam		2	2		2			
Nov. – Dec. 2006	Zangezur, Ketam, Ganze, Nyus-Nyus	2	7	20	9	15			
Total during the rut		2	9	22	9	17	0.5	0.77	0.41
Jun. – Jul. 2007	Zangezur	8	16	9	3	9	2.8	1.0	0.33
Jun. 2007	Kyapaz		2	3		3	0.67	1.0	

Main Threats and Current Conservation Actions

Almost all bezoar goat and mouflon populations in Azerbaijan are transboundary and more or less concentrate near the state borders with Armenia (especially in summer) which run along Zangezur and Daralayaz Ranges. These borders are guarded by considerable numbers of military personnel who are the main poachers. Mouflon hunting has been banned since the 1930s in Azerbaijan, to no obvious positive result, because of insufficient enforcement.

However, the main negative anthropogenic factor in Nakhchyvan is not poaching but loss and degradation of habitats caused by livestock grazing. Numbers of livestock have grown from 475,000 in 2004 to 602,000 in 2005-2007. All the territory of the autonomous republic is subject to uncontrolled grazing, except the most precipitous areas. This mainly affects mouflon whose habitat is mostly being overgrazed. According to our observations and local informants, the gradual ascent of livestock herds drives mouflon out of the middle slopes in June when they still contain green grass and water and forces them up to higher slopes. But livestock reach the highlands too. We suppose that competition with livestock forces mouflon to migrate over the Zangezur Range to Armenia where highland pastures remain unused at the moment. Lowlands and midland areas of Nakhchyvan are so overgrazed that only *Artemisia* remains in winter. In the arid climate, overgrazing leads to desertification. Competition for space and the disturbance factor is more crucial than direct competition for food. The Nakhchyvan slope of Zangezur range faces southwest, while the foothills face south. Together with the semiarid climate and low winter precipitation, the eastern midland and lowland part of Nakhchyvan appears to be an ideal wintering area for mouflon, in comparison with the opposite slope, but year-round, uncontrolled grazing eliminates these advantages. Another essential factor is tree and shrub-cutting. Only small remnants of forest and shrub vegetation remain in Nakhchyvan, which serve as an important source of shelter and part of the food base.

Both Asiatic mouflon and the bezoar goat are listed as “Vulnerable” in the IUCN Red List of Threatened Species (IUCN 2008) and in the Red Data Book of Nakhchyvan AR. Both species are protected in Ordubad NP, the territory of which has been recently extended to cover the area between Alinjachai and Gilyanchai Rivers inhabited by bezoar goat and mouflon. The bezoar goat is also protected in Geigel Nature Reserve, including Kyapaz Mountain but not Murovdagh Range. However, both protected

areas cannot effectively protect the bezoar goat and mouflon as they do not forbid livestock pasturing.

Recommended Strategies and/or Actions

Conservation strategies for Asiatic mouflon and bezoar goat in Nakhchyvan should focus on two main issues: 1) restriction and regulation of livestock grazing pasturing in areas that currently harbor both species, mouflon in particular; 2) minimization of poaching. These two aims could be partly achieved by: 1) reducing of livestock numbers by introduction of alternative agricultural activities traditional for Azeris, such as bee-keeping, horticulture and fish-farming, which have good prospects in Nakhchyvan; 2) raising public awareness about bezoar goat and mouflon among local people, but most of all military personnel and children.

Establishing new protected territories should be regarded as a secondary measure. However, the area around Arpachai Reservoir and the Garagush Massif may be considered as a potential future sanctuary, especially since the surroundings of the reservoir have to be protected *per se* and cannot be used as pastureland.

Conservation needs current data on numbers, densities and population structure of both species, especially since the last research on the bezoar goat was in the 1970s and on mouflon even earlier, and the last census data are far from reliable. Thus, monitoring of both species is essential, concentrating on: a) annual counts, preferably in winter; b) collection of data on sex and age structure in summer, after the lambing period, and in autumn–winter, during the rut. These data will enable time and scale of seasonal transboundary migrations to be estimated. International cooperation is essential, but understandably hampered at the moment by the political conflict.

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Executive Summary

The main objectives of this study were to: 1) assess the current status of Daghestan or East Caucasian tur in Azerbaijan; 2) estimate current threats; and 3) propose a long-term conservation strategy. We surveyed most areas of the Greater Caucasus within Azerbaijan: Zakatala Nature Reserve and its surroundings, Ilisu NR and Kakh Sanctuary, headwaters of Aligchai River (Oguz District), Damiraparanchai River and Vandamchai River (Gabala District), and Gudiyalchai River (Guba District, north-slope). Tur counts were made over practically the whole southern slope of the Greater Caucasus in Azerbaijan, except Sheki. We also used 2002 data from the headwaters of Girdymanchai River (Babadagh Massif). A total of 5,301 tur were counted on the south slope of Azerbaijan Greater Caucasus, of which 1,046 were aged and sexed.

Status

The distribution of Daghestan tur has not changed substantially compared to the recent past. There may have been some retreat from the middle slopes: Dinnik (1910) notes that tur occurred on the Main Range east of Babadagh - where it is now absent – but only in winter after livestock left the area. The southern slope of the Greater Caucasus in Azerbaijan is quite steep and narrow so the range here hardly exceeds 10 km in width and it was unlikely to be much wider in historic times. The range could have contracted in the easternmost part of the north-slope (Shakhdagh and Gyzylgaya massifs, and Mykhtoken Range) where it is much wider and reaches 25 km north to south.

Tur numbers decreased almost everywhere during most of the 20th century, except for short period of recovery in the 1940s-1980s (Weinberg et al. 1997), but exact data on the first half of the century do not exist. Both Dinnik (1910) and Vereschagin (1947) regarded the easternmost massifs of Shakhdagh, Bazarduzu and Babadagh as the richest in tur, and thought that numbers decreased westwards. However, after Zakatala Reserve in western Azerbaijan was founded in 1929-30, tur numbers rose and reached 4,000 by the mid-1940s with densities up to 14/km² (Vereshchagin 1947). About 2,000 tur were harvested annually in Azerbaijan at the time (Vereshchagin 1947). There has been a more or less steady decline since then with a highly unreliable leap in 1993 (Table 1). Our counts produced a total of 5,301 tur, excluding the north slope where some 1,000 more may occur. Thus, there could be about 6,000 Daghestan tur in Azerbaijan altogether. It should be noted that these data characterize the summer daytime population which is probably larger than that during the night and in winter (see below). Since we are dealing with a transboundary population, fluctuations in numbers or changes in anthropogenic pressure in Daghestan will most certainly cause corresponding changes in Azerbaijan.

Table 1. Tur numbers and population density

Sites	Area (Km ²)	Years					
		1940-1945 ¹	1958-1959 ²	1960 ³	1970-1975 ⁴	1993 ⁵	2006 ⁶
Zakatala National Reserve (ZNR)	105 ⁷	$\frac{4000^8}{14,0^9}$	$\frac{2000}{19,0}$	$\frac{3000}{NA^{10}}$	$\frac{2800}{12,1}$	— ¹¹	$\frac{2404}{NA}$
Belokana Vally (Outside ZNR)	—	—	—	—	—	—	$\frac{470}{NA}$
Kakh Sanctuary	—	—	—	—	—	—	$\frac{387}{NA}$
Between ZNR and Kakh Sanctuary	—	—	—	—	—	—	$\frac{199}{NA}$
Oguz District	—	—	—	—	—	—	$\frac{1091}{NA}$
Gabala District (Vandam Valley)	—	—	—	—	—	—	$\frac{109}{NA}$
Between Gabala and Ismailly (inclusively)	—	—	—	—	—	—	$\frac{750}{NA}$
North slope (Gudiyalchai Valley)	—	—	—	—	—	—	—
Total	1827 ¹²	—	—	$\frac{8000}{NA}$	$\frac{6000}{NA}$	$\frac{13700}{7,5}$	$\frac{5301}{NA}$

Notes: ¹(Vereshchagin 1947); ²(Popkova and Popkov 1965); ³Aliev 1961 (cited in Syroyechkovsky and Rogacheva 1975); ⁴(Kuliev 1981); ⁵(Kuliev 2000); ⁶(This article); ⁷The area of the subalpine and alpine zones (the census area for tur) shrank naturally in Zakatala Reserve because of forest regeneration, from 125 km² in 1953 to 67 km² in 1986 (Gasnov 1990a). It may be even smaller now; ⁸Numerators are equal to number of individuals; ⁹Denominators are equal to density; ¹⁰NA = Density information not available; ¹¹— = Information not available at all; and ¹² Value includes 1000 individuals on the south slope.

On the south slope in Azerbaijan, tur inhabit elevations from 800 to at least 3,500 m occurring also in broadleaved forests where it usually absent on the northern slope (Vereshchagin 1938; Veinberg 1984; Magomedov et al. 2001). In the mid-20th century, during particularly snowy winters, tur were even observed in the foothills at 500 m. There are some essentially forest populations that include adult males, e. g. in Ilisu Reserve.

In Djar area of Zakatala NR, females with young favor forest while males occur almost exclusively above the timberline (Table 2) which was not the case in other areas. It should be noted that data for Ak-Kemal are not really useful since animals concentrated near artificial salt-licks. Daily migrations of tur over the ridge of the Main Range to Daghestan (Russia) and back were observed in Djar and Ilisu in particular.

Table 2. Zonal distribution of Daghestan tur in Azerbaijan on the south slope of the Greater Caucasus^{1 and 2}

Sites	Type of Animal	Altitudinal Zones		Season of Measurement	
		Sub-alpine and Alpine	Forest	Summer	Winter
Ak-Kemal (Zakatala National Reserve)	Adult males	$\frac{40^3}{100^4}$	—	X	
	Young males	$\frac{29}{87,9}$	$\frac{4}{12,1}$	X	
	Females with young	$\frac{62}{87,3}$	$\frac{9}{12,7}$	X	
Djar (Zakatala National Reserve)	Adult males	$\frac{89}{100}$	—	X	
	Young males	$\frac{86}{97,7}$	$\frac{2}{2,3}$	X	
	Females with young	$\frac{23}{40,4}$	$\frac{34}{59,6}$	X	
Murovdag (Zakatala National Reserve)	Adult males	$\frac{31}{91,2}$	$\frac{3}{8,8}$		X
	Young males	$\frac{18}{81,8}$	$\frac{4}{18,2}$		X
	Females with young	$\frac{119}{88,8}$	$\frac{15}{11,2}$		X
Ilisu (Kakh Sanctuary)	Adult males	$\frac{32}{86,5}$	$\frac{5}{15,5}$	X	
	Young males	$\frac{55}{91,7}$	$\frac{5}{8,3}$	X	
	Females with young	$\frac{206}{88,0}$	$\frac{28}{12,0}$	X	

Note: ¹All the animals observed in Babadagh in summer 2002 and Gabala District in winter 2006 occurred above the timberline; ²Difference in zonal distribution between males and females with young in Djar is statistically significant according to chi-square test; ³Numerators are equal to number of individuals; and ⁴Denominators are equal to proportions, presented in percentages.

In the 1970s, juveniles comprised 20.5% of the population and the juvenile/female ratio (juvenile index) was 0.87 (Kuliev 1981). Our research showed a much lower juvenile index (Table 3). Data on Ak-Kemal are considered unreliable, as females may visit salt-licks leaving their newborns behind, and indeed the index for Ak-Kemal was abnormally low compared to that for other sites and even for females from Ak-Kemal observed at some distance from the salt-lick (Table 3). On the whole, the juvenile index is lower than that for Daghestan (Magomedov et al. 2001) and North Ossetia in the 1970-80s, but close to the current index in North Ossetia (Veinberg 2002). The situation seemed better in an unprotected area in Gabala. Wardens suggested that a low juvenile index in Zakatala NR and Kakh Sanctuary could be due to the harsh previous winter.

Table 3. Age and sex structure of Daghestan tur populations

Sites	Age and Sex Classes					Indices		
	Adult ♂ ≥ 7 yrs	Young ♂ 2-6 yrs	♀	Yearling	Juvenile	♂/♀	Juvenile /♀	Yearling /♀
Belokanchai, Ak-Kemal (Zakatala) ¹	40	32	51 (15) ²	13	14 (10)	1.41	0.27 (0.67)	0.25
Katekhchai, Djar (Zakatala) ¹	89	88	33	5	19	536	0.58	0.15
Kuchmukchai, Sarybash (Ilisu) ¹	37	60	130	48	76	0.75	0.58	0.37
Girdymanchai, Babadagh ³	—	2	25	9	13	0.08	0.52	0.36
Gudiyalchai ⁴	—	1	2 8 ⁵	—	2	0.5	1.0	—
Katekhchai, Murovdagh (Zakatala) ⁶	35	19	88	17	38	0.61	0.43	0.19
Vandamchai and Demiraparanchai (Gabala) ⁶	8	12	45	15	29	0.44	0.64	0.33

Note: ¹Observations conducted in July, 2006; ²Values in brackets for Ak-Kemal are at some distance from the salt-lick; ³Observations conducted in August 2002; ⁴Observations conducted in September, 2007; ⁵Unidentified; and ⁶Observations conducted in November and December, 2006

The proportion of yearlings, which characterizes natural population increase, can be calculated only in the rutting season, and again it is insignificantly higher for Gabala than Zakatala NR, 13.8 % and 8.6 % respectively, though both are close to figures in North Ossetia (Weinberg 2002). However, the sex ratio which can characterize the population only during the rut, is insignificantly lower in Gabala, which is typical for unprotected areas, as males, especially adults, are the primary target of hunters. Data on Zakatala NR (Table 3) suggest that at least some of the males present in summer in winter, presumably migrating to the north slope with much less winter precipitation and lower depth of snow (Mekhtiev 1965; Himmelreich 1967; Gasanov 1990a, b; Gadjieva and Solovyev 1996).

Thus, summer counts cannot provide adequate information on number and structure of tur populations, not only because of peculiarities of altitudinal distribution but also because of daily and seasonal migrations over the Main Range, which is also a state border. The tur population in Azerbaijan from its border with Georgia to Bazarduzu Mountain is trans-boundary, except for the easternmost part of the population, from Bazarduzu to Babadagh, which dwells completely within Azerbaijan (Fig. 1).

The main biological and behavioral disadvantages of Daghestan tur compared to bezoar goat are: 1) low reproductive rate, because twinning is extremely rare and 2) lower secretiveness, as tur do not hide and are considerably easier to spot even in the forest. Bezoar goats keep a “low profile” under anthropogenic pressure, and can survive near villages and roads, while tur just leave the area, as they are less flexible. The only advantage in tur biology is an ability to dwell in highland rocky habitats seldom claimed by people for land-use.



Fig. 1 Bazarduzu mountain population of tur / © V. Lukarevskiy

Poaching is one of the main threats to tur in Azerbaijan, as everywhere else (Weinberg et al. 1997). Unlike in the Lesser Caucasus, tur hunting is an essential part of the local tradition in the Greater Caucasus though it is no longer a substantial or an important source of meat. According to local information, tur poaching is often carried out by officials, or on their orders, or with their knowledge.

Competition with livestock, especially sheep, is the second negative anthropogenic factor. Contemporary numbers of livestock pastured in the highlands of Greater Caucasus are obviously lower

than during the Soviet period, but are rising slowly. Practically all the montane grasslands are grazed, except protected areas and the most precipitous places. Competition with livestock may be an additional stimulus for tur to migrate to the north slope which has much more complex topography and where the area of montane grasslands is several times larger. In fact, livestock from South Caucasus have always been driven to summer pastures on the north-slope. Now, most shepherds in Azerbaijan are deprived of this opportunity. However, overgrazing in the Greater Caucasus is incomparably lower than in Nakhchivan, therefore the main negative impact of livestock grazing on tur is not competition for food resources, but disturbance and competition for space and habitat. Lack or poor quality of forage may be more significant for tur on wintering areas already heavily grazed by livestock in summer and autumn.

Nevertheless, in certain conditions, tur tolerate neighboring sheep flocks. This was observed in Kakh Sanctuary where tur lay down and grazed some 500 m from sheep. According to wardens, a similar situation exists on Murovdagh Range of Zakatala NR, where livestock grazing is allowed. Such a situation might be partly explained by the fact that tur feed mostly behind the ridge on Russian territory, while in Azerbaijan they mostly rest during the day and feed less, mainly on inaccessible cliffs. It also should be noted that it is not only allowed to pasture livestock in certain places within Zakatala NR, but also to drive livestock through the reserve to the pastures on the north-slope. Ruderal vegetation, old livestock paths and shepherd camping sites are quite noticeable in the subalpine and alpine meadows of Zakatala NR where livestock pasturing was forbidden decades ago.

Long-term data from the second half of the 20th century, as well as ours, indicate a decrease of tur numbers and densities in the eastern end of the Greater Caucasus, in areas of intense and uncontrolled grazing, e.g. in Gudiyalchai River headwaters (Guba District) where just 13 animals were observed in 15 km² (0.9/ km²) (Table 4). According to census data, there were no tur in areas of mass grazing in Oguz District. It is telling that on the Babadagh Massif, which is considered sacred and therefore much less pastured, tur density is considerably higher than in other unprotected places of the easternmost part of the range (Table 4).

There are several economic and political factors connected with the disintegration of the USSR and war with Armenia which affect nature conservation in Azerbaijan: 1) a great number of refugees; 2) inevitable slackening of law enforcement due to war and refugees; 3) large number of illegal military firearms in private possession; 4) establishment of a state border between Azerbaijan and Russia. The

latter brought a considerable number of border guards into tur habitat. It is known that many mountain ungulate populations in the USSR survived mainly behind border fences, but during establishment of the border, poaching by border guards is almost inevitable. However, all these factors are gradually diminishing.

Table 4. Tur population density in control areas in Azerbaijan

Site	Month	Parameters		
		Observed Animals	Area (Km ²)	Density (Tur/Km ²)
Ak-Kemal (Zakatala National Reserve)	July	150	10	15.0
Djar (Zakatala National Reserve)	July	234	25	9.4
Murovdag (Zakatala National Reserve)	November	197	25	7.9
Kakh Sanctuary	July	351	40	8.8
Vandam	December	109	50	2.2
Babadagh, Girdymanchai	August	49	10	4.9
Gudiyalchai	September	13	15	0.9

Daghestan tur status is quite satisfactory in Azerbaijan. Population densities in protected areas seem optimal. There is an opportunity for growth in the eastern part of the range (Gabala, Gussar, Guba and maybe Ismaily Districts). Areas of tur habitat are about 1,200 km² there and, at an overall density of 4/km², could harbour some 4,500 tur. Daghestan tur is listed as “Near Threatened” (IUCN 2008) but remains a desirable and legal trophy in Azerbaijan and Russia. In Azerbaijan, it is protected in Zakatala NR, Kakh and Ismaily Sanctuaries, but sanctuaries do not protect tur habitat.

Conservation Strategy

Considering that Daghestan tur populations in western Azerbaijan are transboundary, protecting the easternmost part of the range that occurs wholly within Azerbaijan should be the priority. Thus, (1) the establishment and effective functioning of the newly founded Shakhdag National Park should be a priority issue. It should be zoned, areas of total protection delineated and legal grazing capacity worked out. (2) Successful tur conservation in western Azerbaijan cannot be achieved without international cooperation with Russia, which has no nature reserves in highland Daghestan. (3) Local people need highland pastures, but some way has to be found to stop livestock grazing in the middle of the comparatively small (238 km²) Zakatala NR and driving stock through the reserve. Protection of habitat by itself is as vital for tur, since overgrazing is not heavy and grassland deterioration is not evident.

Sustainable Use

Sustainable use is an integral part of tur protection. Currently, all legal hunting is state-controlled, and local communities gain little or no profit from trophy hunting. With national tur hunting traditions and legal foreign trophy hunting, local people must also have a legal opportunity to hunt; otherwise their

attitude to foreign trophy hunting that can bring outside money for tur conservation will be strictly negative and will lead to poaching.

Ecological tourism is another part of sustainable use. It is relatively easy to show tur and other large mammals to tourists in Zakatala Reserve or Kakh Sanctuary. Foreign ecotourism could help protected areas to earn their own income. Local ecotourism will hardly bring any income in the near future.

Monitoring and Scientific Research

Monitoring and Scientific Research of tur in Azerbaijan is necessary, as the last full-scale research on tur biology was carried out in the 1970s (Kuliev 1981). These actions have to concentrate upon: 1) annual counts on protected areas and selected plots outside them; 2) collecting data on age and sex structure of the population in summer, after the lambing period, and during the rut. The data obtained will show population trends and inform on the character and scale of seasonal transboundary migrations, which in turn will enable coordination of international conservation efforts and work out a really rational scheme of sustainable use of transboundary tur population. It is also necessary to raise awareness of local people about tur and other wildlife, especially among schoolchildren, since it is very difficult to change attitudes of adults.

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Executive Summary

In the remote past, turs (*Capra cylindricornis* and *C. caucasica*) were widespread in Georgia. Both species numbers have decreased dramatically due to human pressure over the course of several centuries and they are now included on the Red List of Georgia. The Georgian Law on Wildlife prohibits hunting of turs, but illegal hunting and habitat degradation are still the main threats to tur populations. The objectives of the project were to assess current status and trends of East Caucasian tur *Capra cylindricornis* and West Caucasian tur *C. caucasica* populations, conduct a Population Viability Analysis (PVA), evaluate threats, and develop an Action Plan for conservation. A more detailed version of the status report and conservation action plan is available (NACRES 2006).

Methods

Tur populations were estimated on field surveys using transect counts, with density calculated according to the method of Hoglund, Nilsson and Stalfelt (cited in Caughley 1977) and adaptive cluster sampling (Thompson et al. 1998). For tur PVA, we used stochastic population simulation software VORTEX 9.61, which is based on the Monte Carlo model. Population simulation was implemented on four sub-populations of East Caucasian tur and one population of West Caucasian tur. All simulation models were based on the same parameters. Variable parameters were only: initial size of the population, biological capacity, and mortality rate. In the initial model, mortality rate was set at 25% which was the total of natural mortality rate plus the number of individuals affected by poaching. The data were extrapolated over the entire area. We also took into account the minimal links between sub-populations. Threats were recorded on a field form according to the major threat types in the IUCN Threats Classification Scheme (Version 3.0). Hunting was further assessed through a questionnaire survey of hunters.

Status

Global Status of Turs

West Caucasian tur *Capra caucasica* and East Caucasian tur *Capra cylindricornis* are endemic to the western and eastern Caucasus respectively, with a small hybridization zone (Fig. 1). Their taxonomy is still unclear; *C. caucasica* has sometimes been considered a subspecies of *C. ibex*, while other authors regard both turs as a single species. They are listed and assessed separately on the IUCN Red List.

West Caucasian tur is distributed only in the western part of the Caucasus in Georgia and Russia. Its range extends for about 250 km from Mount Chugushi (44°N, 40°E) to the source of the river Baksani (43°N, 43°E) (Satunin 1920, Radde 1899). Its current Red List status is Endangered (EN A2ad) (Weinberg 2008a).

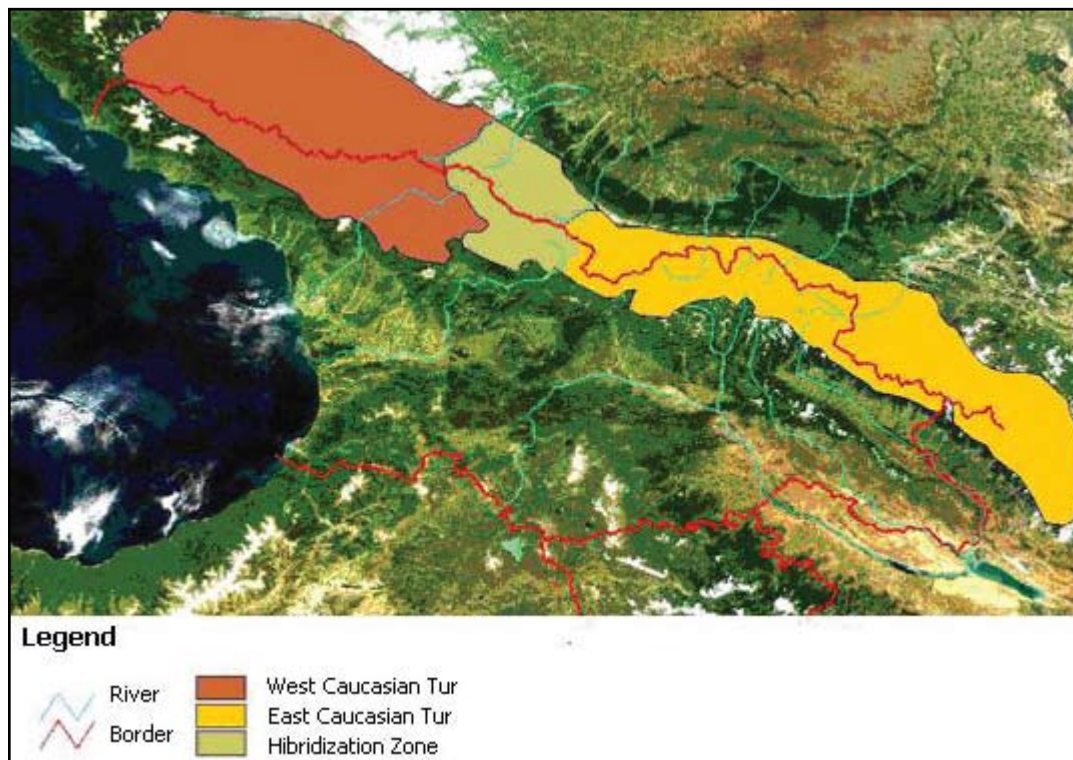


Fig. 1. Distribution of *Capra caucasica* and *Capra cylindricornis* in the Caucasus and presumed hybridization zone

East Caucasian tur range extends for ca. 500 km in the eastern Caucasus and is distributed in Azerbaijan, Georgia, and Russia (Kabardino-Balkaria, North Ossetia-Alania, Ingushetia, Chechnya, Dagestan) (Satunin 1920; Radde 1899). Its current Red List status is Near Threatened (NT) (Weinberg 2008b). The supposed hybridization zone is located between the Baksani and Digora rivers.

Distribution in Georgia

East Caucasian tur *Capra cylindricornis* occurs in Lagodekhi, Tusheti, Pshavi, Khevsureti, and Khevi (Stepantsminda outskirts). West Caucasian tur *Capra caucasica* is found in Svaneti, probably also in Racha (near its border with Svaneti) and Abkhazia (Ritsa reserve). The zone of hybridization on Georgian territory is located between the sources of the Enguri and the Rioni Rivers. In the remote past, turs were widespread in Georgia not only in the Greater Caucasus, but also the Lesser Caucasus, as shown by bones found in human settlements of the Palaeolithic period (Kokhodze 1991).

Population Trends

By the end of the 20th century, the number of East Caucasian turs in Georgia did not exceed 2,800 individuals. The number of West Caucasian tur was 2,500 individuals. The strong decline in the population started in the second half of the 19th century and was due to the accumulation of firearms among the population of Georgia and an increase in the number of shepherds and visiting hunters. A further sharp decline began in the 1990s, when due to difficult economic conditions and excessive accumulation of firearms, all wild animals, including tur, were subject to high poaching pressure.

Assessment of Sub-populations

East Caucasian Tur - *Capra cylindricornis*

Lagodekhi Reserve. At present approximately 240 turs inhabit Lagodekhi Forest Reserve within 54 km² of habitat; density is 4.4 individuals/km². In the 1930s, there were about 300 turs in Lagodekhi. In the 1950s their number increased, probably due to the extending of reserve protection to Lagodekhi ravine in 1929. In the 1960s there were herds of 200-300 turs and the total number in Lagodekhi Reserve reached 5,000 individuals. In the 1980s, the number of turs was about 1,200 (Sokolov and Siroechkovskii 1990). In the 1990s, due to excessive poaching (ordinary hunting and shooting from helicopters), the number of turs in Lagodekhi reserve again declined.

Tusheti Forest Reserve and National Park. At present approximately 680 turs inhabit Tusheti reserve and national park. Tur habitat covers about 300 km² representing a density of 2.26 individuals/km² (Fig. 2).

Khevi (Stepantsminda, Kazbegi Outskirts). At present approximately 3,000 turs inhabit Khevi. There are regular migrations to adjacent ridges. Sex ratio is approximately 1 male to 15-20 females.

Khevsureti. Turs inhabiting Khevsureti constitute a part of Khevi-Khevsureti sub-population. Approximately 1,000 turs are found in Khevsureti. There are regular movements to the adjacent ranges

towards Chechnya and Ingushetya and the Arguni ravine. Sex ratio is approximately 1 male to 20 females. The most favorable habitats for tur are in Terghi and Tanie ravines, near Shuatskhvari, Sasadzagle and Shavtskali. Old turs of the largest size are found in Arkhoti near Sasadzagle and Shavtskali.



Fig. 2. Habitat of East Caucasian tur / © N. Kopaliani

East Caucasian turs were found in Racha. By the end of the 1990s, small numbers of tur remained on the border between Racha and Svaneti. This area was not visited during the field surveys and the present status of West Caucasian tur and their numbers in this area are unknown.

Population Viability Analysis (PVA)

This was carried out for four subpopulations of *C. cylindricornis* (Lagodekhi, Tusheti, Khevsureti, and Khevi) and one subpopulation of *C. caucasica* (Svaneti) (Table 1).

West Caucasian Tur - *Capra caucasica*

Svaneti. According to NACRES (1996), approximately 2,500 West Caucasian tur were found in Georgia in the 1990s. At present, approximately 1,000 live in Svaneti. Average herd size is 15 individuals.

Racha. In the past, West Caucasian tur and possibly hybrids of West Caucasian and

Table 1. Results of Population Viability Analysis (PVA)

Species	Site	Parameters		
		Initial size of population	Capacity	Mortality (%)
<i>Capra cylindricornis</i>	Lagodekhi	250	2,000	25
	Tusheti	700	3,000	25
	Khevsureti	1,000	3,000	25
	Khevi	3,000	5,000	25
<i>Capra caucasica</i>	Svaneti	1,000	3,000	25

1,000 simulations for 200 years were implemented for each of the five subpopulations, with the initial size of the subpopulation based on the results of survey data and mortality rate estimated at 25%. In each case, subpopulations became extinct at least once. This corresponds to 0.0 for the success of the population and 1.0 for the probability of extinction. Therefore, given the existing mortality rate of 25%, all sub-populations of tur are subject to extinction within 50 years on average (Fig. 3).

The simulations were then re-run with mortality reduced to 15% to represent a reduction in poaching pressure, but with natural mortality remaining the same, and the other parameters unchanged. In this case, all subpopulations remained stable and viable.

Conservation Status in Georgia

On the Red List of Georgia, *Capra caucasica* is classified as Critically Endangered (CR), according to criteria A1d+2cde. *Capra cylindricornis* is classified as Vulnerable (VU) according to criteria A1d+2de, C1.

Threats

The two most important threats for tur populations in Georgia are hunting and grazing. There are two major types of hunting: for economic purposes and for sport.

The highlanders of Georgia suffer severe economic hardships. The lack of a transportation system, or its poor functioning, restricts the access of the local population to towns where they can sell agricultural products. Thus, any source of income becomes very important. Local hunters obtain turs for meat, which is either used by their families for food or sold as a delicacy. Horns and skins are also sold. Drinking vessels made of tur horns are popular in Georgia and elsewhere. Local hunters also act as guides to visiting hunters. Nevertheless, tur-hunting cannot be considered a regular source of food or income.

Tur-hunting is part of the cultural life in Svaneti, Tusheti, and Khevsureti. Due to the difficulty in hunting in inaccessible rocky places and in obtaining trophies, hunting is considered a matter of valor and hunters are deeply respected. Hunting is also linked to numerous rituals and customs. Horns are sacrificed to divinities and churches to gain a blessing. In former times there were certain restrictions and prohibitions. For example, it was prohibited to kill more than three turs at a time and after the hunter had killed 100 animals, his weapons were considered sinful and had to be buried. As guns were expensive, hunters tried not to exceed this limit. At present these customs are almost completely neglected.

A second important threat that affects the tur habitat and its quality is excessive grazing by livestock.

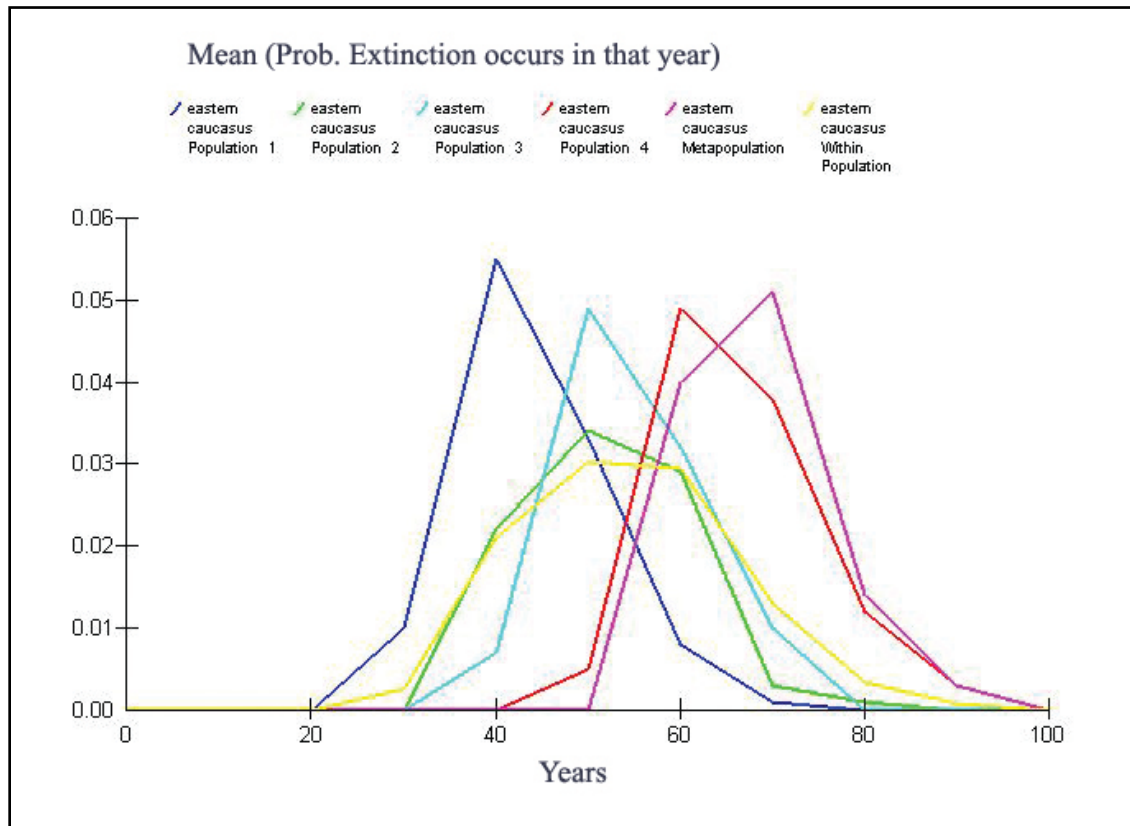


Fig. 3. Probability of extinction (mean)OX stands for years, OY – probability of extinction

Grazing leads to a significant decrease in the biomass of alpine and sub-alpine pastures. It can also lead to sources of erosion, which in turn cause landslides and avalanches, which kill many turs. Different diseases are spread, infecting both livestock and turs. This form of threat is very significant for Lagodekhi, Tusheti, and Khevi subpopulations.

Other threats include tourism which affects the population to a lesser extent but is an additional disturbance factor. A potential threat to the Khevi subpopulation is the Georgian military road, which was built in 1811-1863. This road crosses the Greater Caucasus Chain and divides this subpopulation of tur. The Vladikavkaz-Tbilisi gas pipeline also caused damage when it was constructed in the 1980s when all ecological norms were neglected. These brought about terrible consequences along the entire Khevi region. Strong - in many places irreversible - erosive processes developed (Abdaladze et al. 1998), which in turn affected the population of tur.

Natural limiting factors include severe winters and avalanches. The severity and extent of each threat is represented in Tables 2 and 3.

Table 2. Range of threats affecting *Capra cylindricornis*

Type of threat	Intensity (Strength of the threat)			Extent (Territorial layout of threats)		
	Strong	Medium	Comparatively weak	Affects 1/2 or > of the habitat	Affects 1/2 or < of the habitat	Affects only a small portion of habitat
Hunting						
Grazing						
Tourism						

Table 3. Range of threats affecting *Capra caucasica*

Type of threat	Intensity (Strength of the threat)			Extent (Territorial layout of threats)		
	Strong	Medium	Comparatively weak	Affects 1/2 or > of the habitat	Affects 1/2 or < of the habitat	Affects only a small portion of habitat
Hunting						
Grazing						
Tourism						

Conservation measures taken

- Turs are listed in the Red Book of Georgia
- The Georgian Law on Wildlife prohibits hunting of turs
- Turs have been added to Georgia National Biodiversity Strategy and Action Plan

Main Recommended Actions

1. *Conservation of Tur habitat by Creating new National Parks and Supporting Existing National Parks (Fig. 4)*
 - 1.1. Create a national park in Khevsureti, focusing on Tur protection.
 - 1.2. Expand and optimize Kazbegi National Park (Stepantsminda outskirts) and prepare a management plan based on international standards.
 - 1.3. Create National Parks in the Central Caucasus (Svaneti and Racha).
2. *Supporting the Improvement of Tur Habitat*
 - 2.1. Identify sites where domestic animal pastures and tur habitat overlap; determine optimal capacity to avoid overgrazing.
3. *Preservation and Management of Migration Corridors between Tur Sub-populations and Protected Areas*
 - 3.1. Identify corridors and stepping stones and plan their system.

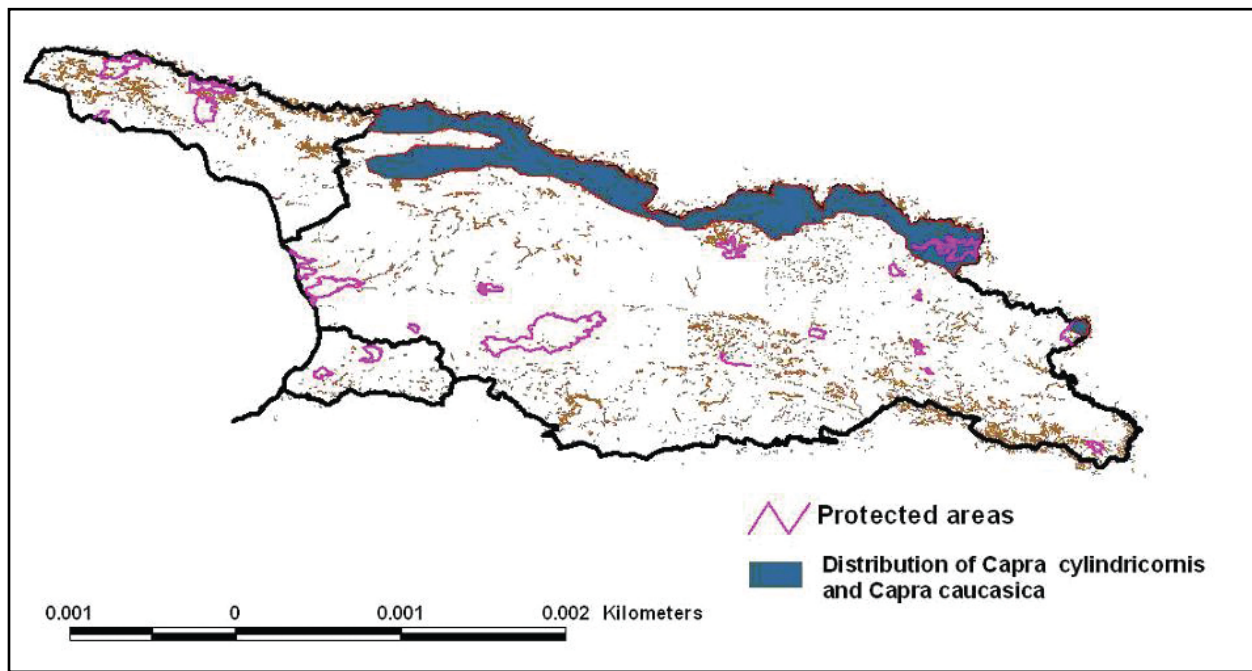


Fig. 4. The habitat of East Caucasian tur in Georgia (4000 km²) and protected areas (only cover 500 km² of tur habitat)

3.2. Develop the legislative basis for the functioning of migration corridors.

4. *Reduction of Poaching Pressure by Involving the Local Population in Conservation Activities and their Economic Stimulation*

4.1. Establish community-based trophy hunting or hunting farms by local communities.

4.2. Develop the concept of traditional hunting.

4.3. Develop the legislative basis for the creation of community based hunting farms.

4.4. Develop methods and principles of establishing quotas on a scientific basis.

4.5. Establish joint control by State organizations and NGOs of the principles of defining and regulating quotas.

5. *Preservation of the Normal Physical Condition of the Population*

5.1. Prevent diseases transmitted by domestic animals (especially sheep) to tur populations by enhancing veterinary control.

5.2. Create database and studbook for captive individuals.

6. *Monitoring of Populations of Both Species of Tur*

6.1. Select the existing methods (techniques of recording) and adapt to local conditions.

6.2. Conduct field research on each sub-population using selected methodology.

6.3. Research causes of mortality in all sub-populations, among adult and young individuals.

6.4. Carry out Habitat Suitability Analysis and identify 'key areas'.

Acknowledgements

We thank Critical Ecosystems Partnership Fund (CEPF) for financial support and WWF for thorough cooperation

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Executive Summary

The status and current distribution of Daghestan or East Caucasian Tur (Fig. 1) in Daghestan was assessed through field surveys, the main population nuclei identified, population density and sex/age-composition assessed, and conservation measures recommended.

The aim was to identify populations of Daghestan tur (*Capra cylindricornis*) in the mountain ecosystems of the Eastern Caucasus and develop conservation measures for the entire historical range. This required the following:

- Evaluation of population density.
- Assessment of the current status of separate populations.
- Analysis of range structure and migration routes.
- Identification of key factors influencing population density.
- Identification of key areas (optimal habitats) and ecological corridors.
- Development of general concepts of protection and conservation of local tur populations in the Eastern Caucasus.

Methodology

Animals were counted with the help of telescopes (30-60 x) and binoculars (20 x 60; 10 x 50). To evaluate tur population density, we selected 1,500-5,000 ha plots in different parts of the range that were most typical. Animals were counted in the plots over 3-5 days depending on the area (100-250 ha) and configuration. The size of each plot and the entire study area were measured using 1:50,000 and 1:100,000 scale topographic maps. An allowance was made for the measurement of the actual slope surface area (Zotov et al. 1987). Density of animals was calculated for each plot and the results extrapolated to the all the identical habitat within the study area.



Fig. 1. Mixed herd of Daghestan tur / © M-R Magomedov & Yu. A. Yarovenko

Tur distribution was recorded in relation to slope aspect, with the focus on southern and northern slopes, their productivity, areas of rock outcrops and screes, and areas of cattle grazing. Sex/age composition of Daghestan tur was assessed using four groups: young animals under 1 year; juveniles of both sexes from 1 to 3 years and males younger than 5 years; mature adult males over 5 years; and mature adult females over 3 years. We paid special attention to counting animals, in order to obtain reliable data on tur population density in different areas.

Status

East Caucasian Tur

The Daghestan or East Caucasian tur *Capra cylindricornis* (Blyth, 1840) is endemic to the Greater Caucasus. Its distribution is limited to the main Caucasus range, Lateral range and Skalystiy range. Most of the population occurs in Daghestan. Although its distribution is confined to mountain areas, until recently it was the most numerous wild ungulate species in this region. Numbers have decreased dramatically in some areas mostly due to anthropogenic factors, such as the lack of functioning protected areas; unfavorable economic and financial status of local communities (who possess a great number of rifled weapons); the lack of public support for conservation measures; concentration of border troops in nature reserves or along main seasonal migration routes of the Daghestan tur (Pavlinov et al. 2002)

Distribution in the Eastern Caucasus

The historical distribution in the Eastern Caucasus (Dinnik 1910) was much wider than the modern one (Fig. 2). This situation is typical for many other ungulates in Daghestan. It is now impossible to restore parts of the historical range, due to intensive anthropogenic pressure (sheep breeding, and poaching).

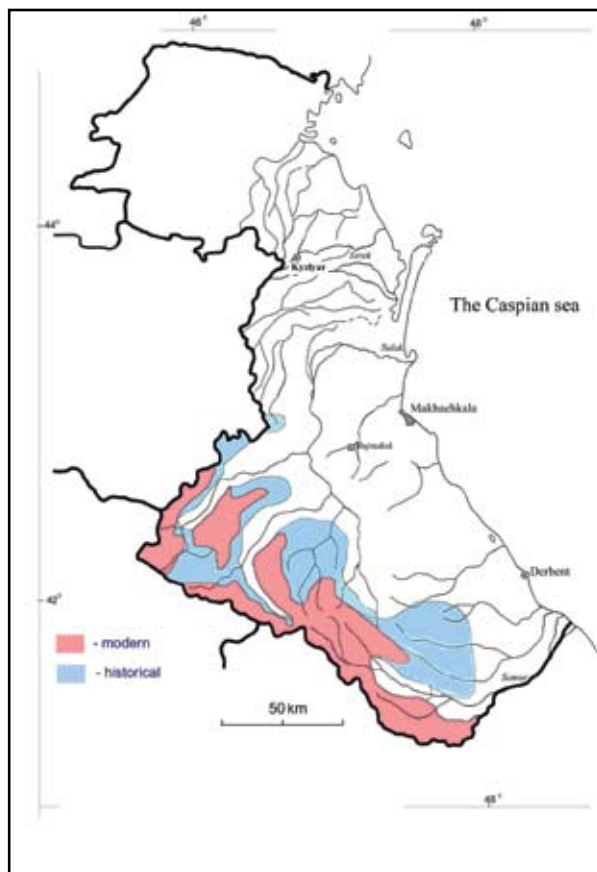


Fig. 2. Modern and historical ranges of East Caucasian tur in Daghestan

There are more than 8 large mountain ranges in Daghestan stretching for more than 40 km. Their numerous lateral branches (average length 15-20 km) are rather rocky and meet all parameters required for stable high numbers of tur (Ayunts 1980). There are currently four large population groups with high density in Daghestan (Fig. 3).

The densest population is in the central part of the mountains between the peaks of Guton, Nukatl, Dyultydag and Alakhundag and in the southern part between the peaks Bazardyuzi, Shalbuzdag, Charyndag, Malkamud and Deavgai. The population inhabiting the Snegovoy ridge is isolated from the population nucleus, which affects its density. A fourth population with high density inhabits the Bogos ridge (Fig. 3).

Winter is a very important time for survival of Daghestan tur. Large rocky massifs and steep slopes cannot serve as refuges because of their inaccessibility in this time of year. However, even small rock outcrops can provide safe shelter from predators. Pasture forage reserves acquire great importance in winter. The size of winter pastures is the most important factor influencing population well-being and density (Zelikhanov 1967; Weinberg 1984; Kotov 1968; Magomedov and Akhmedov 1994).

Population

According to our data, the total number of animals including young reaches 18,000 individuals in summer, which shows that the largest population nuclei of tur are concentrated in the abovementioned areas of

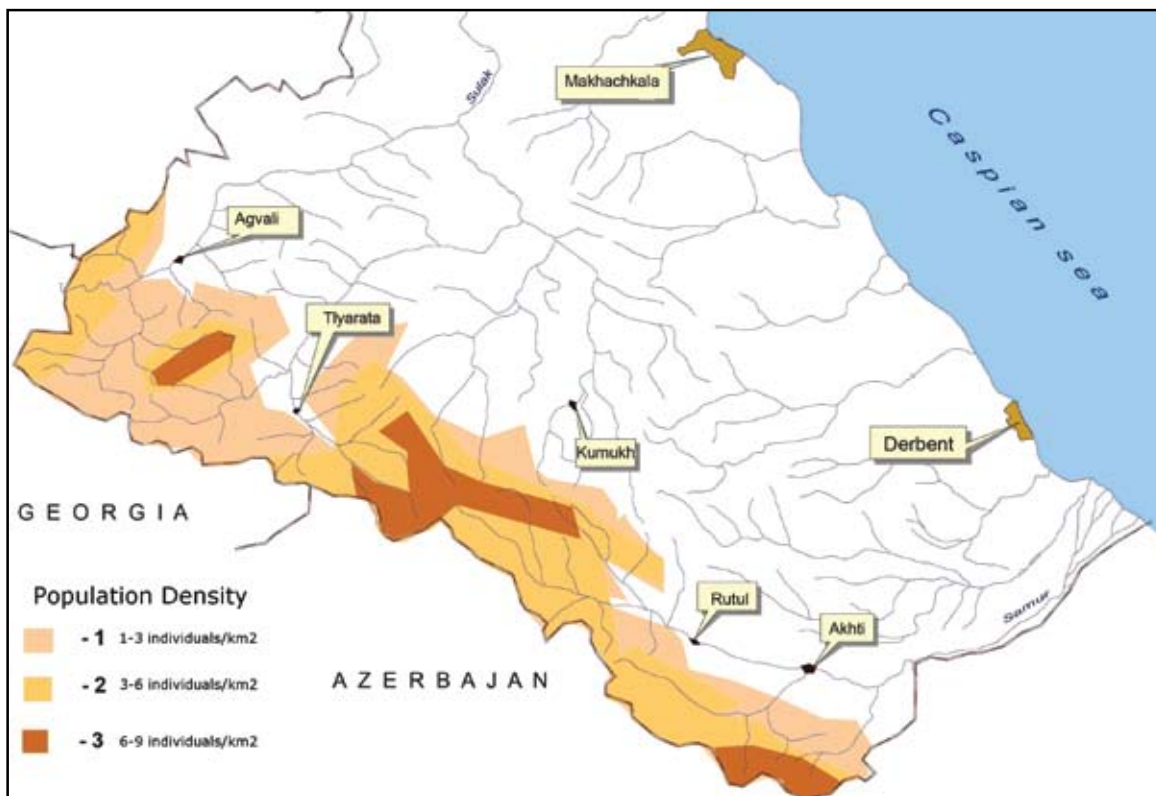


Fig. 3. Range boundaries and population density of the tur in Daghestan

Daghestan. Two main conditions necessary for the existence of turs are:

- Protective conditions (rocky, steep slopes, length of main ridges).
- Forage conditions (productivity and accessibility of winter pastures).

Age and sex composition are also important for functioning of tur populations. Knowledge of the structure of local populations enables the correct assessment of their status and appropriate management for sport and trophy hunting. Composition of tur age/sex groups varies in different parts of Daghestan (Table 1). On average, adult females make up $36.87 \pm 1.9\%$, adult males – $23.57 \pm 5.2\%$, young – $22.27 \pm 1.9\%$ and immature young animals aged 1-3 years – $17.8 \pm 1.4\%$ (Magomedov and Akhmedov 1994).

Tur population density differs significantly in various regions of Daghestan, ranging from 1.8 to 7.3/100 ha (Fig. 3). Average population density is 5.1/100 ha. Populations with the highest density inhabit the branches of large massifs of the Main Caucasus range and the Lateral range longer than 7-10 km and with elevations above 4,000 m (Magomedov and Akhmedov 1994).

Seasonal distribution of turs and the habitat conditions required in the Eastern Caucasus can be briefly described as follows:

- Complex of protective conditions (rockiness and steepness of slopes, length of main ridges).
- Complex of forage conditions (productivity and accessibility of winter pastures) which determines population density and number of turs.

Table 1. Age/Sex structure of tur populations in mountain massifs and administrative districts of Daghestan

Daghestan		Percentage of Age/Sex Groups			
Areas/Mountains	Administrative Districts	Adult Males	Adult Females	Under-yearling	Young
Bazar-Dyuzi	Dokuzparin	40.6	31.1	18.0	10.3
Bazyki (Khnov)	Akhtyn	11.0	43.0	30.0	16.0
Deavgai	Rutul	—	44.4	28.2	27.4
Alakhundag	Kulin-Agul	—	43.5	31.9	24.6
Dyultydag	Lak	43.6	26.7	15.6	14.1
Dartsa	Charodin	20.5	36.2	21.4	21.9
Nukatl	Charodin	34.7	32.8	16.5	16.0
Guton	Tlyaratin	30.9	36.6	17.4	15.2
Bogoss	Tsumadin	27.9	36.5	20.8	14.8

Active daily migration of males in summer and no migration by females have several causes, among which activity of predators (brown bear *Ursus arctos*, lynx *Lynx lynx*, wolf *Canis lupus*, leopard *Panthera pardus* and golden eagle *Aquila chrysaetos*) is probably of decisive importance. Wolves hunt turs throughout the year, causing the most significant damage to their populations. Wolves, bears, eagles, lynxes and even sheepdogs prey on turs during the breeding period (Filonov and Kaletskaya 1985; Kudatkin 1982). Females with yearlings are most vulnerable to predators, which causes them to stay in steep and rocky habitats (Akhmedov and Magomedov 1996).

Main factors influencing use of areas by different age/sex groups are:

- Distribution of rock massifs and forage plants,
- Temperature conditions,
- Activity of predators, and
- Encroachment by humans and domestic animals.

Conservation

To conserve the existing population and aid possible restoration of the historical range of the Daghestan tur in the Eastern Caucasus, we recommend the following measures:

- Allow only limited trophy hunting within selected population nuclei (marked with the deepest color on Fig. 3) and allocate one part of the profits for tur conservation activities and another part to local communities
- Establish protected areas within the given distribution (Fig. 3)
- Place strict controls on tur hunting licenses and hunting areas
- Limit the number of sheepdogs in the mountains to 2 dogs per 1000 head of sheep
- Give the Border Defense Service responsibility for controlling tur hunting in their areas of

- responsibility, as was done for protection of bio-resources of the Caspian Sea region
- Gain agreement and support of local administrations and the Ministry of Internal Affairs for conservation actions and prevention of poaching
 - Encourage the work of local elders' councils, advocating among local communities against human interference in natural processes
 - Organize public outreach campaigns to explain the importance of turs for the ecosystems of the Eastern Caucasus
 - Prohibit the use of night observation sights, small-caliber and non-hunting cartridges while hunting turs
 - Hold capacity-building training for employees of environmental organizations
 - Supply gamekeepers and inspectors with necessary equipment
 - Organize awareness campaigns for schoolchildren in mountain regions
 - Make a documentary series increasing the popularity of the tur - a natural component of mountain landscapes

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Executive Summary

The project was implemented by Georgian Centre for the Conservation of Wildlife (GCCW). The goal of our study was to model the habitats of West Caucasian tur (*Capra caucasica*), East Caucasian tur (*C. cylindricornis*), bezoar goat (*C. aegagrus*) and mouflon (*Ovis orientalis*) in the Caucasus Hotspot, and promote these models in order to enable more effective conservation management strategies to be implemented. Presence and absence data for the species were evaluated. Habitat variables related to climate, terrain, land cover, inter-specific competition and human disturbance were used to construct predictive models of habitats by employing a geographic information system (GIS) and logistic regression.

The project was implemented by the Georgian Center for the Conservation of Wildlife (GCCW) Habitat modeling (i.e. quantitative assessment of habitat requirements) helps define important habitat variables and areas best suited to conservation efforts. To our knowledge no quantitative grid-based analyses of habitat requirements of these study species have been performed in the Caucasus Ecoregion.

The models developed can be applied to the Caucasus to (a) predict species occurrence, (b) identify areas where previously unknown sites might be located, (c) highlight areas where the species may occur in the future if populations grow due to conservation activities, and plan corridors for broader scale conservation. Our models will define the areas best suited to major conservation efforts, and which variables – included in the best-fit habitat models – are manageable. The project will help develop strategies and action plans. Differences in datasets between the study species resulted in temporal and spatial models per sex for turs, temporal and spatial models for bezoar, and only spatial model for mouflon.

Methods

Study Area and Sampling

In 2006-07 we collected presence/absence locations of turs (*Capra cylindricornis*, *C. caucasica*), bezoar (*Capra aegagrus*) and mouflon (*Ovis orientalis*) in Armenia and Georgia using a Garmin Etrex 12 Channel GPS unit. We sampled ~6000 km of ridgelines, trails and roadsides by car, on foot and horseback. Data were mapped using ArcView v.3.3 GIS software (ESRI Inc., Redlands, CA). Presence points were based on signs (footprints, feces, spoor, and kills), sightings, and records of poached animals (Fig. 1). To avoid repeated sampling of habitat variables (Table 1), we used presence points that were >130 m from neighboring points. We obtained a total of 1,000 presence points for each species.

We obtained absence points from areas with similar habitats. First, we used ranges of the habitat variables measured at all 1,000 presence points for each study species to identify areas similar to those of their presence. Then we generated 1,000 random points within those identified areas where our surveys and data revealed no signs of the presence of the study species. Colleagues from Russia and Azerbaijan kindly provided all available data.

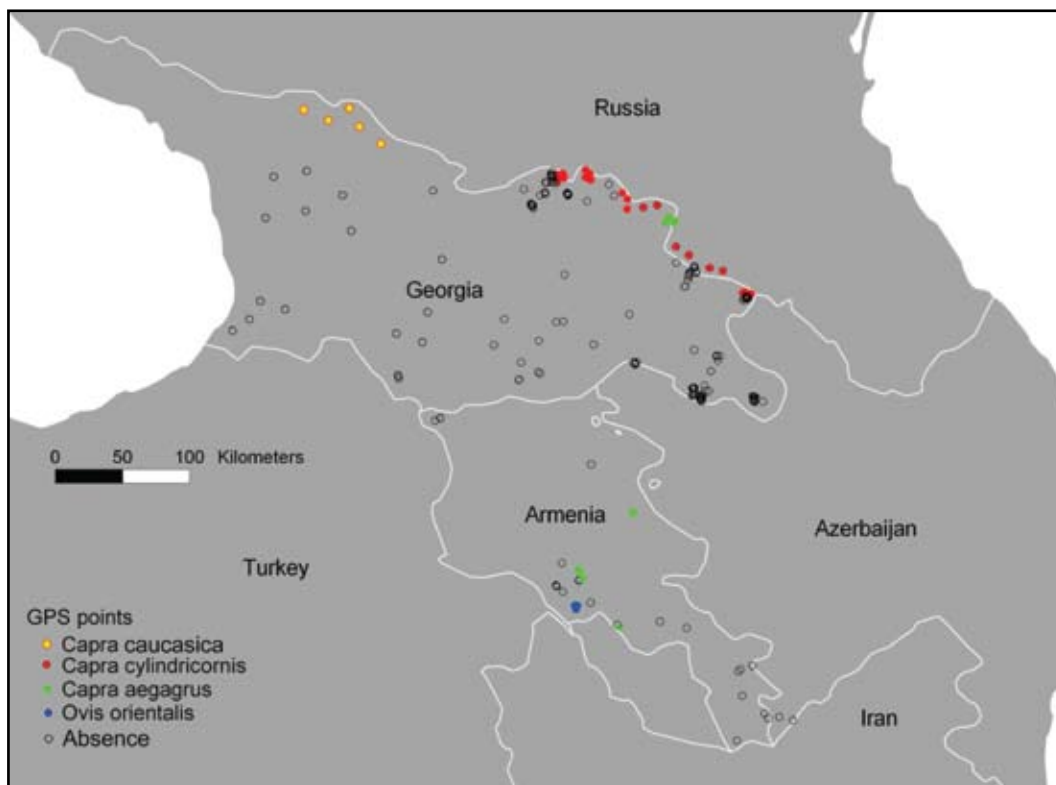


Fig. 1. Distribution of presence/absence points collected during the 2006-07 fieldwork

Habitat Characteristics

We considered habitat variables related to climate, terrain, land cover and human disturbance (Table 1). We extracted terrain, anthropogenic and land cover data from downloaded free online digitalized data and managed them using ArcView v.3.3 GIS software. The variables used were based on species-habitat associations documented in the literature and with regard to their availability.

Terrain data were measured from the Shuttle Radar Topography Mission (SRTM) elevation data in the UTM projection at a resolution of 90-m pixels. These data were also used to calculate potential annual direct incident radiation (mj/cm²yr) from the equation developed by McCune & Keon 2002. We indexed climate by an equation $[(0.0075 * \text{Elevation}) + \text{Latitude}]$. Higher values of the index correspond to harsher climate. Vegetation cover was measured from 1,000-m NDVI time series maps and snow cover from status maps, both provided by the VEGETATION Program (SpotImage/VITO, <http://www.vgt.vito.be>). Tree cover was taken from 500-m MODIS Tree Cover Continuous Field (Hansen et al. 2003). VEGETATION and MODIS data were re-projected into a UTM projection using ArcView GIS Grid and Theme Projector v. 2 (Jenness 2004) and resampled to a 90-m pixel size.

We identified cliffs where turs and bezoar took cover when disturbed, by surveying areas for (a) slope derived from SRTM and (b) normalized difference vegetation index (NDVI) derived from Landsat ETM images.

To identify urban areas, we acquired human populated points accurate to a scale of 1:50,000 (GIS-Lab Ltd, Tbilisi, Georgia), and then derived urban polygons at each of these points. We identified urban polygons as compact networks of intersecting straight lines extracted from Landsat imagery. As surrogates for human disturbance and development we derived Euclidian and least-cost distances from urban polygons (Table 1). The computation of least-cost distances was based on the ArcView module Spatial Analyst

and incorporated information provide more realistic terrain-adjusted distances regarding the movement of humans than straight-line Euclidian distances that are often used in present-day modeling. We also checked to see if the presence of one species could be a reason for the absence of the other species by considering presence/absence of each species as a variable.

Table 1. Variables considered in modelling habitats for turs, bezoar and mouflon

Variable	Description
ELEV	Elevation above sea level (m)
A	Aspect
SLOPE	Steepness (°) of terrain
SLOPE1	Mean slope within a 500-m radius, averaged from a 90-m slope grid
SLOPE2	Mean slope within a 5-km radius, averaged from a 90-m slope grid
SLOPE3	Mean slope within a 10-km radius, averaged from a 90-m slope grid
SLOPE4	Mean slope within a 15-km radius, averaged from a 90-m slope grid
SNOW	Days of snow cover per year maximized from 2001-05 time -series.
CLMT	Climatic index (°) = (0.0075 * Elevation) + Latitude
SUN	Potential annual direct incident radiation (mj/cm ² yr)
NDVI _L	NDVI calculated from Landsat ETM.
VI _{sum}	Sum of vegetation index (VI) values per year averaged from 2001-05 time-series: where VI=(NDVI+0.1)/0.004 and NDVI is positive.
VI _{max}	Maximum value of VI over a year averaged from 2001-05 time-series: where VI=(NDVI+0.1)/0.004
TREE	Percent tree canopy cover (%)
DST1	Straight-line Euclidean distance (m) from urban areas
DST2	Cost distance (m) from urban areas traveled on a friction grid of 1/cosine of SLOPE (i.e. actual length of the least cost path).
DST3	Cost distance (m) from urban areas traveled on a friction grid of tangent of SLOPE (i.e. sum of differences in elevation along the least cost path).

Model Development and Validation

For habitat modeling based on species presence/absence points, we used binomial logistic regression, LR (Hosmer and Lemeshow 1989; Menard 2002). Model predictive accuracy was validated using a test presence/absence dataset based on Kappa statistic (Fielding and Bell 1997). Model development was performed using SPSS v.11 for Windows.

Models were validated, and the best model selected, on independent datasets generated via the model multiplication approach (Gavashelishvili and Lukarevskiy 2008) and supplemented thanks to various experts (V. Lukarevskiy, Yu. Iarovenko, M. Ghasabian, K. Aghababian, E. Askerov, and M. Nosrati). We applied the best-fit models to the entire Caucasus Ecoregion to generate predictive distribution maps. The resultant probability maps were converted into presence/absence maps using a classification cut-off value that equally balanced sensitivity and specificity in the best-fit models.

Cliffs suitable for the cover of turs and bezoar met the following requirement: SLOPE $\geq 30^{\circ}$ and NDVI_L $< 0/+0.05$ (depending on Landsat ETM scene). So, in calculating the probability of suitable cliffs (P_{cliff}), we assigned a value of 1 to areas that met the above requirement and a value of 0 if otherwise. To calculate final probability models, we multiplied P_{cliff} by all habitat models of turs and bezoar, which were based on other variables. All models developed for turs, bezoar and mouflon had a cutoff value of ~ 0.5 that balanced specificity and sensitivity.

Results

Habitat Models for Turs

For turs we derived three models: the presence probability of females and males in winter (October-April); females in summer, and males in summer (May-September). Tur models suggest a quadratic, bell-shaped relationship with climate severity. In winter, male and female turs share the same habitat that varies between 1395-3605 m at a latitude of 42.2° , and has aspects of 90° - 270° . In the summer both sexes move to higher elevations: females to 1795-4005 m, and males to 2519-4083 m. In addition, the probability of tur presence increases with terrain-adjusted distance from urban areas. Finally, there is a significant preference for south-facing slopes in winter with a probability value of >0.5 at aspects of 90° - 270° but no preference as to aspect in summer. The interpretation of these models onto maps is demonstrated in Figs. 2, 3, 4.

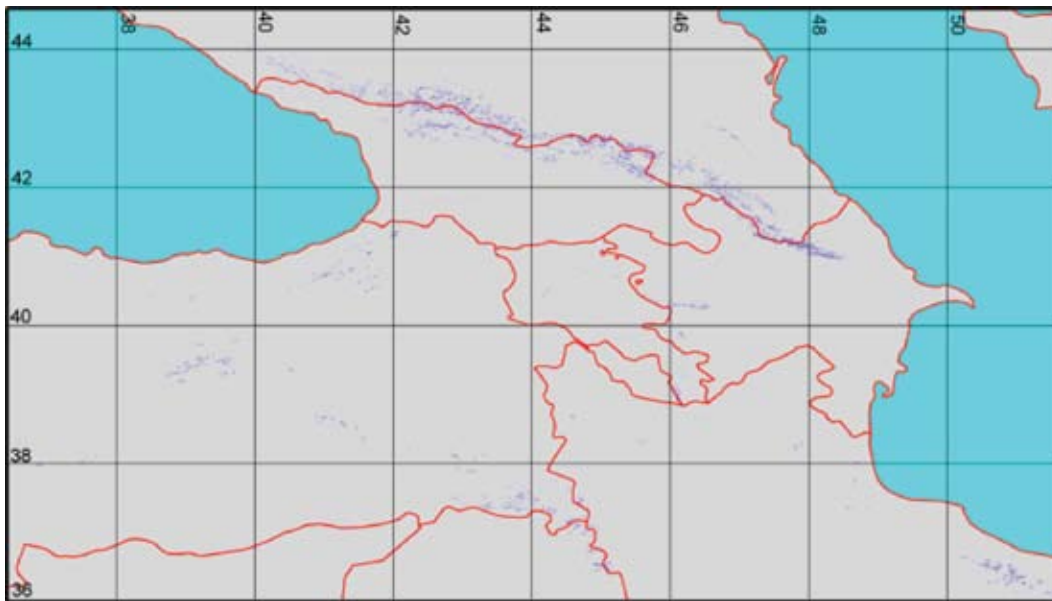


Fig. 2. Predicted distribution of female and male turs in the winter (October-April) in Caucasus Ecoregion

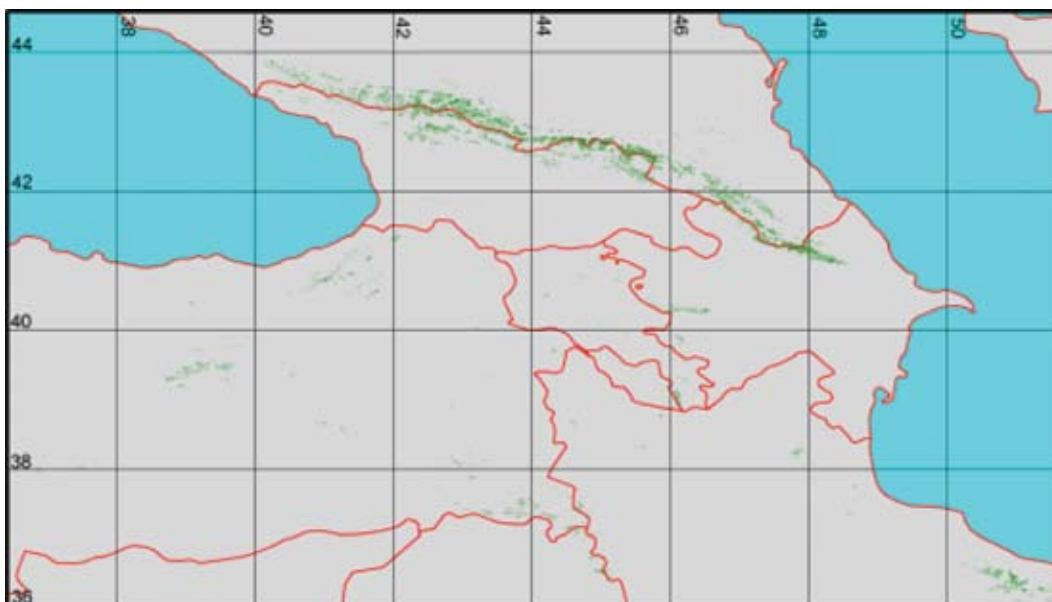


Fig. 3. Predicted distribution of female turs in the summer (May-September) in Caucasus Ecoregion

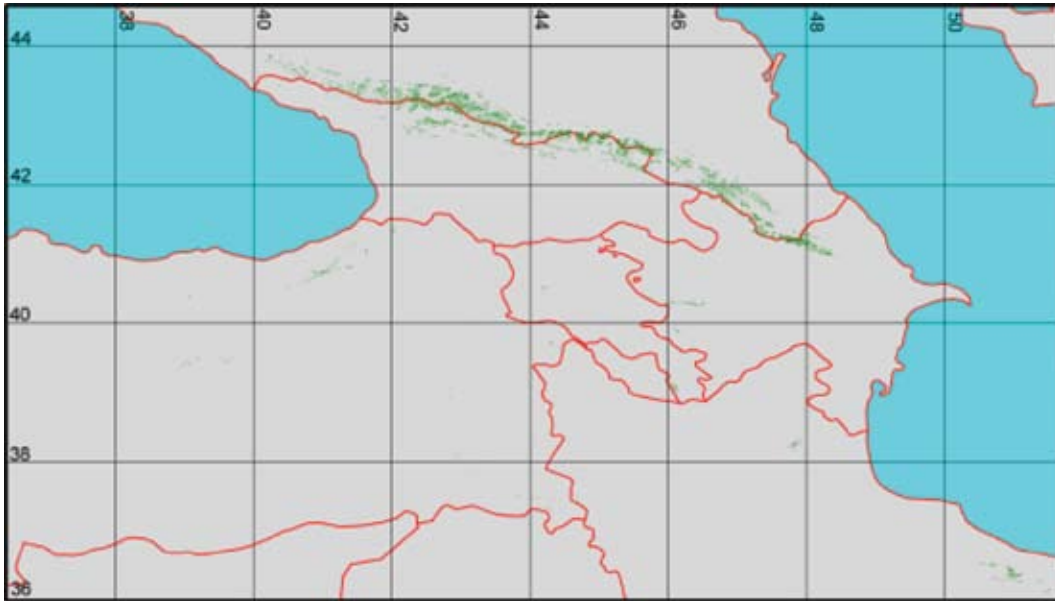


Fig. 4. Predicted distribution of male turs in the summer (May-September) in Caucasus Ecoregion

Habitat Models for Bezoar

For bezoar we derived two models: presence probability in winter (October-April) and in the summer (May-September). Our analysis suggested that bezoar did not occur wherever turs occurred. This model suggests a negative linear relationship with climate severity and a positive linear relationship with annual vegetation index and terrain-adjusted distance from urban areas. There is a significant preference for south-facing slopes in the winter. In winter bezoar occurs in habitat that varies between 0-3605 m and shows a significant preference for aspects of 90° - 270° . In summer the species moves to higher elevations, reaching 4084 m. The species shows no preference for aspect in summer. These models are demonstrated in Figs. 5, 6.



Fig. 5. Predicted distribution of bezoar in the winter (October-April)



Fig. 6. Predicted distribution of bezoar in the summer (May-September)

Habitat Model for Mouflon

For mouflon we derived one model regardless of season and sex. Mouflon favor areas difficult to access from urban areas throughout the year. In addition the species occurs in areas with annual vegetation productivity of 1600-3000, snow cover of 0-100 days per year, tree cover of 0-10%, and ruggedness of > 50 . The interpretation of this model onto a map is demonstrated in Fig. 7. The model shows a positive, linear relationship with terrain ruggedness and terrain-adjusted distances from urban areas.

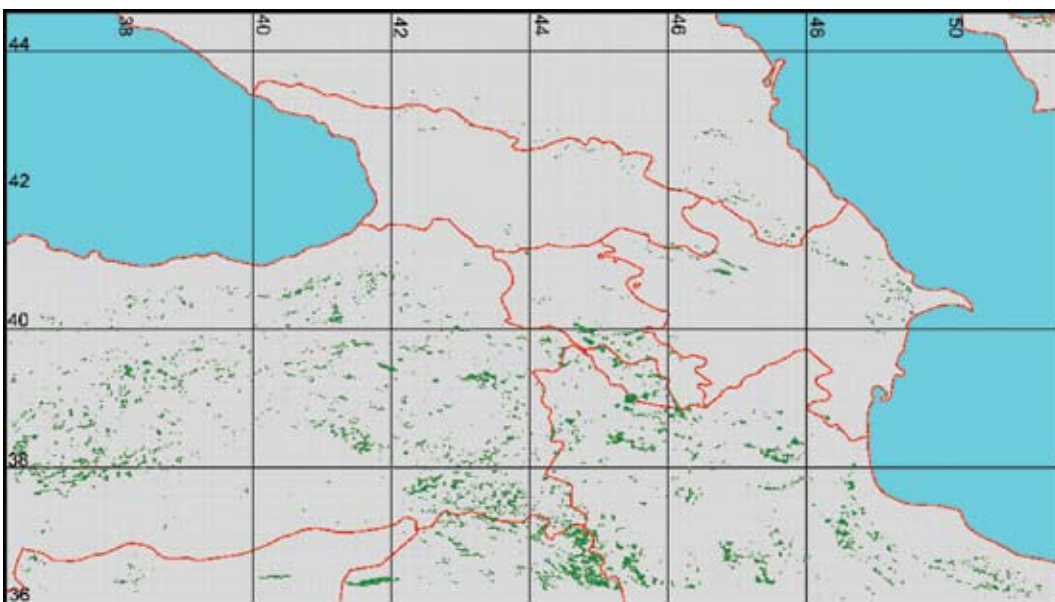


Fig. 7. Predicted distribution of mouflon in Caucasus Ecoregion

To our knowledge this is the first attempt to model the habitats of these four species over an area this large. According to existing accounts (Ekvtimishvili 1952; Heptner et al. 1961; Kuliev 1981; V. Lukarevskiy, Yu. Iarovenko, M. Ghasabian, K. Aghababian, E. Askerov and M. Nosrati, pers. comm.) and local hunters, bezoar males also occupy higher elevations in summer than females. However, our models failed to indicate that because data used for modeling originally were linked to season regardless of sex.

The tur and bezoar models are generally consistent with existing information (Vereshchagin 1938; Ekvtimishvili 1952; Naniyev 1958; Heptner et al. 1961; Chlaidze 1967; Zalikhanov 1967; Kotov 1968; Abdurakhmanov 1973; Kuliev 1981; Veinberg 1984; Aiunts and Kolomyts 1986; Akhmedov and Magomedov 1996; Shackleton 1997; Yarovenko 1997; Eriashvili 2000; Magomedov et al. 2001; Weinberg 2002; Gavashelishvili 2004). Both species show strong correlation with steep slopes and the sum of differences in elevation along the least-cost path from urban areas. This may be because the terrain-adjusted distances between an urban area and a certain point account for not only straight-line distances but also efforts humans have to make to move through a rugged terrain in order to reach the point. This explains the higher sensitivity of our model to the sum of differences in elevation along the least-cost path from urban areas because this variable better reflects the expansion of human disturbance. The models predict the presence of turs and bezoar in areas where they do not occur (e.g. turs outside the Greater Caucasus). The absence of the species does not necessarily mean that the models erroneously suggest the suitability of these areas. It could be that the species may not have colonized these areas because of their remoteness from source populations, or may have occurred there but have gone extinct or the areas are too small and far apart to support viable populations. The latter point is supported by the summer distribution of male turs (Fig. 4) that might be a limiting factor for the species total distribution.

Our bezoar models suggest that bezoar does not occur wherever turs occur. It appears that, barring human persecution, turs are the reason for the absence of bezoar in much of the Greater Caucasus, perhaps due to antagonism and competition over resources.

Our mouflon model suggests the species occurs in arid areas excluding barren deserts and preference for slightly rugged terrain. Mouflon also respond positively to the actual length of the least cost path from urban areas. This is consistent with their escape strategy. For mouflon to survive, a large, undisturbed, relatively flat area matters more than small areas of rugged inaccessible landscape. This makes mouflon more vulnerable than turs and bezoar because human encroachment primarily affects relatively flat landscapes. To make matters worse, in arid areas humans mainly colonize water sources that are very important to the survival of mouflon. The mouflon model predicts the presence of mouflon in areas where they definitely do not occur (e.g. in the Greater Caucasus, southern Georgia or the transboundary areas of Azerbaijan and Georgia). Mouflon may have occurred there but gone extinct or these areas are too small and far apart to support viable populations without strict protective measures.

Conclusions

The models we constructed provide a tool for more effective identification of potential populations of the study species and their habitats in the Caucasus Ecoregion as well as for conservation and the management of these species. The models predict the likely distribution of the study species and, when based on knowledge of the territoriality of resident animals, may enable estimation of population sizes. Because census of these species is difficult over vast and rugged areas, our models should allow detection and population estimations to be more efficient. Another practical use of the model will be to predict connectivity between different populations and facilitate corridor planning for conservation purposes. The identification of corridors will contribute to the species management to ensure their long-term survival throughout the Caucasus Ecoregion.

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Executive Summary

The main objectives of this project were to (1) clarify taxonomic status of Caucasian tur and (2) propose a taxonomically-based conservation strategy for tur - the dominant ungulate species of the Greater Caucasus. To achieve this we examined morphological characteristics of tur. Initially only the Central Caucasus population was suggested for research, as it was supposedly the key population, but in the early stages of the work it became clear that animals from along the length of the Caucasus needed to be studied. Collections of Zoological Institute (St-Petersburg), Zoological Museum of the Moscow University, Institute for Ecology of Mountain Areas (Nal'chik), Zoological Institute of Azerbaijan (Baku), Zakatala (Azerbaijan), North Ossetian, Kabardin-Balkarian, and Caucasus Nature Reserves, and also materials in private possession were examined. Field observations were carried out in Azerbaijan, North Ossetia, Kabardin-Balkaria, and Karachai-Circassia. Old observations made the Caucasus Reserve dating back to 1970s, and material collected in Dagestan in the 1990s was also been used.

We studied geographic variation in features used in traditional morphology, but quantitatively wherever possible: shape of horn sheaths and cores, horn divergence angle, shape of coronal suture, position of the highest spot of forehead compared to the bases of horn cores in males, size and shape of beard in males, leg striping pattern, and difference in winter coloration in adult males and females. The following age and sex classes were distinguished: adult males (> 6 yrs), young males (2-5 yrs), females, yearlings of both sexes, and juveniles. The listed features are essentially very different. Some can be measured, if not very precisely (shape of horns), others can be regarded as discrete or alternative (the shape of striping pattern on legs), the rest are difficult to estimate at all (e.g. difference in winter coloration).

Our data revealed clinal geographic variation for most traits analyzed. The clines are more or less alike, and mostly display a steep and/or undulating part in the area from Teberda to Bezengi, with two sloping parts to the west and, particularly, to the east. The characteristics of the cline suggest not a primary clinal variation due to gradual geographic changes in climate etc., but a secondary cline caused by contact between two taxa and a process of parapatric hybridization, encompassing the adjoining parts of both populations (Mayr 1963). If so, there were initially two rather close taxa of tur separated by some sort of geographic barrier in the Central Caucasus that vanished later on, and the two taxa came into contact. "West-Caucasian tur" and "East-Caucasian tur" here refer to morphotypes, not taxa, unless specifically stated.

The material is very different, both in essence and amount. If data proved close for neighboring valleys but were clearly insufficient, they were amalgamated, and sometimes in different ways for different traits, depending on the occurrence and amount of the data.

Results

Shape of Curvature and Twist in Adult-male Horns

This has always been the main feature in classifying *Capra*. A series of horns from across the Caucasus

reveals a process of scimitar-shaped horn sheath curved roughly along a single plane gradually developing a 3-dimensional spiraling twist when moving eastwards (Fig. 1). However, the spiral is not regular and does not usually complete a full curl, even in animals from the easternmost Caucasus. Because of their irregular shape, horns of East-Caucasian tur are often called perverted, since they display weak homonym twist near the base, replaced by heteronym twist in the remaining part of the horn.

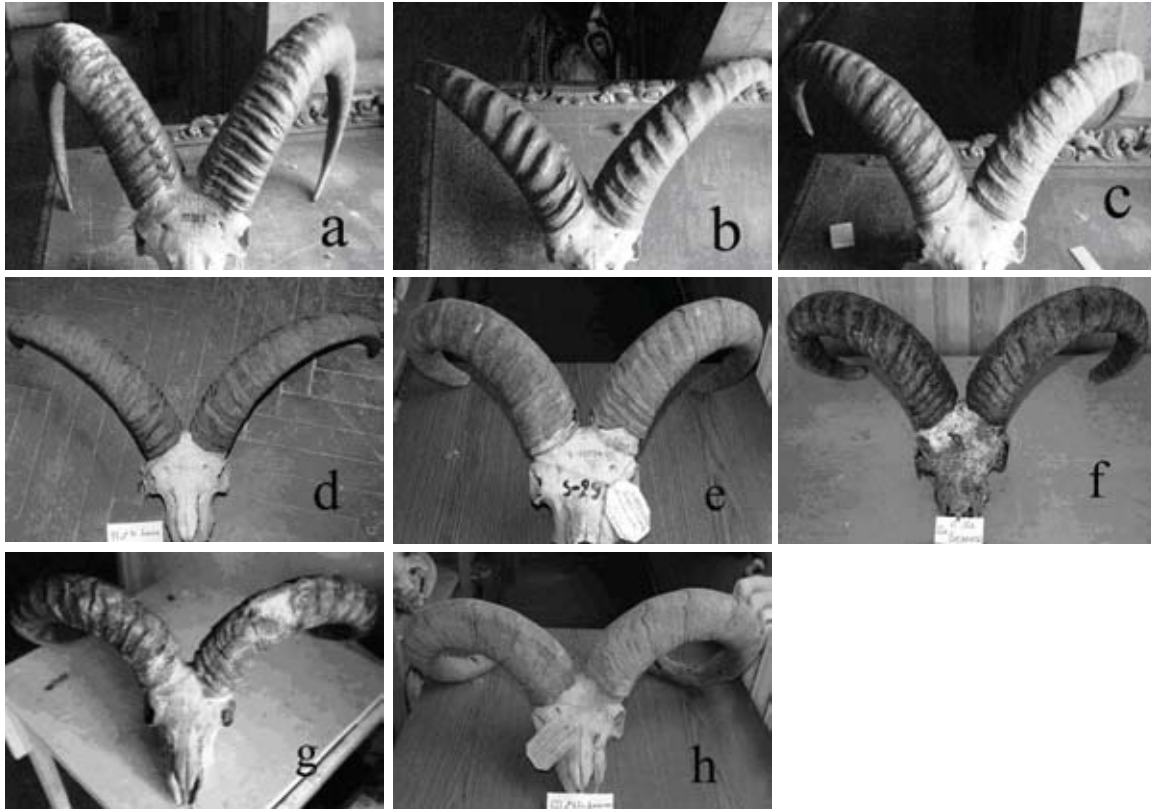


Fig. 1. Horns of Caucasian tur (a – Caucasus Reserve; b – Teberda; c – Malka; d – Baksan; e – Chegem; f – Bezengi; g – North Ossetia; h – Daghestan)

Nevertheless, horn sheaths of adult tur males from North Ossetia, Daghestan and Azerbaijan may be described as conical spirals, though the cones differ. The changing shape of the spiral and its irregularity prevents calculation of mathematical characteristics of the spiraling shape of horn sheath, unlike spiraling shells of mollusks (Thompson 1992). Therefore, we modified the method of Aiunts and Kolomyts (1986). Deviation of the sheath from a 2-dimensional plane is measured by height of the second annulus because the first annulus, especially in spiraling horns, is usually broomed or broken off. All these measurements cannot be very precise, so measurements were made with an accuracy of up to 5 mm. Despite the opinion of Tsalkin (1955), horn cores of East-Caucasian tur males do not perform a noticeable spiraling twist and hence proved useless for studying geographic variation

Index of spiraling in male horn sheaths is characterized by deviation from a plane (H/L ratio) that correlates with age, but within the given age group of a local population doesn't correlate with length of the horn. In the Caucasus Reserve, the index does not change with age and therefore the younger age group is not shown at all. In Bezengi, North Ossetia, Daghestan, Lagodekhi and Zakatala, indices of neighboring age groups overlap within each region, but the means for these age groups differ noticeably, often significantly. In Teberda, Kuban', Malka, and Baksan, from 5-years on, positive correlation with age doesn't show at all, though horns of younger 3-4-year-olds look absolutely scimitar-shaped, and do not suggest that they will acquire a spiraling twist with age. The scimitar curvature of the part of the horn

sheath curved in a single plane also changes. Indices of spiraling twist and curvature do not depend upon size of horn within the given age group and site, even if the horn is abnormally small.

Dynamics of geographic variation of twist and curvature do not coincide and show some sort of break. In the case of spiraling, moving eastwards, the sheath rises and winds around the cone, but this dynamic is not continuous. In the region from Teberda to Chegem, twisting fluctuates, then jumps in Bezengi and farther on to the east grows slowly. It changes clinally, while the dynamics of curvature are very different, being minimal, though fluctuating, in the Central Caucasus, but growing both to the east and west.

In terms of number of the curls of the spiral, horns from Balkaria form $\frac{2}{3}$ of a curl at most, horns from North Ossetia almost $\frac{3}{4}$ of a curl, and only horns of old males from Daghestan, East Georgia and Azerbaijan may display a full curl, and only when preserving the first annulus, that being a very rare event.

Twist of Female Horns

This was more difficult to measure because of the smaller size. In animals older than 4-5 years, the first annulus is rarely intact. Precision was up to 2 mm. Female horn sheaths are laterally flattened and acquire a frontal-inner keel from 4-5 years on, so the axis of sheath cross-section may be easily estimated in all annuli. Thus, the angle of twisting can be measured to 5^0 precision. The upper cross-section was taken from the base of the first annulus.

Tur females have usually been regarded as morphologically uniformly similar and taxonomically insignificant (e.g. Dinnik 1909; Sokolov 1959; Veinberg 1993). However, this research revealed certain morphological variation in female horns along the Caucasus. Spiraling twist in female horns becomes noticeable only in specimens with abnormally twisted horn sheaths, looking like miniature male East-Caucasian horns. Spiraling twist is noticeable even in some specimens from the westernmost Caucasus and grows eastwards. The angle of twist displays similar dynamics, but all differences are mathematically insignificant. Unlike males, the index of curvature is almost similar in all studied populations. Thus, sexual dimorphism of tur horns is expressed not so much in presence or absence, as in the degree of the spiraling twist.

Shape of Core Cross-section

Only a preliminary analysis of this trait is proposed here. It was taken from adult males, 1 cm above the core base, by means of a plastic wire. West-Caucasian tur are close to ibexes (*C. nubiana* and *C. sibirica*) on this feature. In tur from North Ossetia, the base of the triangle becomes longer than the sides. Unfortunately, the data obtained do not enable us to present any geographic variation in this trait.

Divergence Angle of Horns

This could be correctly measured only as angles between the planes along which the basal parts of horns grow, because horns of West-Caucasian tur grow upwards and backwards, while horns of East-Caucasian tur grow upwards and sideways. Measurements of horizontal projections of horn sheath would be more adequate, but unfortunately this idea came too late. We measured the divergence angle in males between the basal 10 cm of inner-frontal keel of the sheaths (Sokolov 1959); this was easier to do on the photos taken more or less perpendicularly to the surface of the forehead, while in females the angle was measured between lines drawn through tips of cores and their mid-bases. The precision in both cases was up to 5^0 . The angle in animals from the westernmost Caucasus and animals from North Ossetia and areas eastwards of it differ, but not so much as expected by the external appearance of the horns and their

position on the skull. There is a dynamic, though mostly mathematically insignificant. On the whole, dynamics in males and females are alike.

Highest Point of Forehead

In skulls from the Caucasus Reserve this is situated noticeably in front of the line connecting the centres of the cores. In animals from Teberda, Kuban', Malka and Baksan it is situated just in front of the middle, while in animals from Bezengi and all regions eastwards it may be pushed even behind the middle line. In fact, only adult males from the westernmost Caucasus noticeably differ by this trait from the other populations. In all populations, the highest forehead point in young males is closer to the core midline than in adult males. If estimated in points, this trait would gain 2 in the Caucasus Reserve, and 1 in all the rest of the range.

Coronal Suture

We compared only the shape of the angle, which can be observed in all age and sex groups, except in old males with fused sutures or in insufficiently cleaned specimens. Some of the material in collections is represented not by complete skulls but only foreheads with horns, or sometimes even just horn sheaths, so the amount of data on this trait is considerably smaller than on curvature and twist of sheaths. The western type of coronal suture occurs in adult males at the East Caucasus too, while eastern type of suture may occur in central or west Caucasus. In young males and females, types are randomly distributed, as individual variability. There is also an intermediate type of suture. A fourth type, formed by 4 arcs and 3 peaks, occurs in all age and sex groups, but best displayed in females and young males, more often in the Central and West Caucasus. Therefore, shape of coronal suture is not a discrete feature, is hardly measurable, and is very subjective. The dynamics are unclear and subjectivity prevents use of this trait for taxonomic purposes.

Size and Shape of Beard:

Quantitative characteristics are rather difficult to obtain because it is unclear how to measure the beard: the longest hairs, middle hairs, etc. It is also almost impossible to measure the beard on collection specimens. The only effective method is to compare photos of live animals, where the overall size of the beard can be scaled to the size of the head. Beards molt late and are evident until June. They show variation, basically four main types:

- a) Eastern type: monotonously colored, broad, pointed forward, about 8-10 cm long; if pressed to the chin, doesn't extend beyond it. Occurs westwards of the Baksan Valley.
- b) In Baksan and, probably, in Malka, the beard is short but narrow, as a rule, and pointed down not forwards.
- c) In Teberda, the beard is longer - about 12-15 cm, and is tapered and hanging.
- d) In the Caucasus Reserve, same shape as in Teberda, but even longer, up to 17-18 cm, but with peculiar coloration –the frontal part dark and contrasting with the light remaining part.

All over the Eastern Caucasus, the shape and size of beard in adult males is about the same, while westwards of Bezengi it gets narrower and longer, and finally obtains dichromatic coloration. Beard in the Caucasus Reserve can be estimated at 4 points, in Teberda 3 points, in Malka and Baksan 2 points, and from Bezengi eastwards 1 point. Beards of the same shape and coloration often occur in winter coat of females in the West Caucasus, unlike the rest of the range, where beards in females are exceptionally rare.

Striping Pattern on Legs

This is easily seen in most seasons and in collection specimens. Many authors describe head color in detail, but mention only briefly that tur display dark striping along the front surface of the legs, without detailing the actual pattern (e.g. Dinnik 1909; Tsalkin 1955). Judging by collections and photos, females, young males, yearlings and juveniles in the Caucasus Reserve have a branching pattern of striping in winter and summer coats (Fig. 2a), but adult males have a darkened pattern (Fig. 2b). This is shown in the famous specimen S-494400 of Moscow Zoological Museum, considered an example of *dinniki* morphotype (Tsalkin 1955), and also demonstrated by V. Kotov's photos. In Teberda, the branching type is displayed by females, yearlings and juveniles, while young males display both types, and adult males possess only darkened pattern.

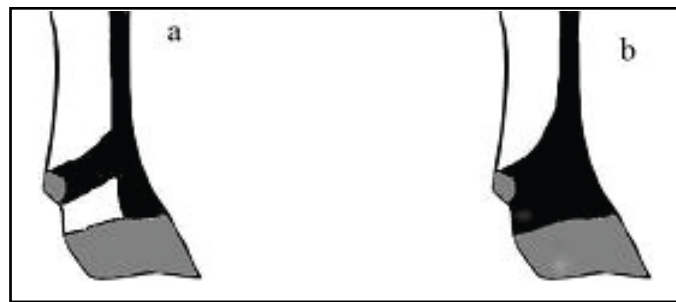


Fig. 2. Pattern of stripes on tur legs (a – branching pattern, b – darkened)

In Baksan, branching occurs only in summer and only in yearlings, juveniles and some females. No males were observed there in summer. In Bezengi, only a darkened pattern was observed, and in North Ossetia, where most observations were made, the branching pattern is very rare, occurring only in juveniles in summer pelage. Eastwards, only the darkened pattern is observed. Thus, from Baksan eastwards, branching pattern disappears. Estimates would be: 4 points in Caucasus Reserve, 3 in Teberda, 2 in Baksan, 1 in Bezengi and eastwards.

Winter Coloration

Unlike the beard, winter color does not remain long after the end of the rutting season (end of November – mid-January) and fades quickly, particularly in adult males. In North Ossetia, adult males are much darker than females during the rut, while in March they do not differ from females in intensity of coloration. Intensity of winter coloration of adult males is a very indefinite trait. The only way to characterize it is by comparison with females. Eastwards of Mt. Elbrus, males from 3-4-years age are already so uniformly dark that the striping pattern on the legs becomes inconspicuous (Fig. 3). Thus, males at long distances, even if their horns are not visible, are easily recognizable from females.

There are darker and lighter specimens among males, but they are always much darker than females. In the forest zone of Azerbaijan, very dark males were observed, with coal-black, glossy coat. Such coloration has never been noted in North Ossetia or Kabardin-Balkaria. In Baksan, even at the beginning of March adult males were conspicuously darker than females. In Teberda, in mid-January when the rut was not yet over, adult males were darker than females but not as contrastingly dark as in the Central and Eastern Caucasus. Unfortunately, we have no data of our own on winter coloration in the Caucasus Reserve, but judging by V. Kotov's rare photo showing males with lifted tails courting females, adult males in the Caucasus Reserve did not differ in intensity of coloration from females. Also judging by another of V.



Fig. 3. Adult tur males in Bezengi in November, snowing / © P. Weinberg

Kotov's photos, leg striping pattern is visible in male winter coloration, unlike in males from Bezengi. Adult male winter coloration really darkens eastwards, but not enough as to differentiate West- and East-Caucasian males by this trait alone, and absence of our own winter observations from Caucasus Reserve does not allow definite conclusions.

Conclusions

Almost all the examined traits display clinal east-west variation. In cases when data are insufficient (2 areas for male horn core cross-sections) or material enables only 2 geographic groups to be distinguished, these groups invariably are: 1) the animals from the westernmost Caucasus

(Caucasus Reserve) and 2) all the rest eastwards, starting from Teberda. In cases of clinal variation, there are usually sloping parts of the cline to the west and east (longer one) from the central Caucasus, while in the area from Teberda or Malka to Chegem, a steep part of the cline occurs, often with considerable fluctuations. The only trait displaying different geographic variation is the curvature index in adult male horn sheaths, with maximum in the central Caucasus and declines to the west and east.

Thus, our results correspond to those obtained earlier for spiraling twist in male horn sheaths (Aiunts and Kolomyts 1986) and to some other traits only treated quantitatively (Tembotov 1974). We also demonstrate the occurrence of similar clinal variation in tur females. Despite the occurrence of noticeable individual variation within local populations around Mt. Elbrus, they cannot be treated as mixed, consisting of western and eastern morphotypes in definite proportions changing from west to east (Nasimovich 1950).

Existence of clinal geographic variation in several traits, with a steep and fluctuating section in the middle of the cline, is hardly consistent with lumping Caucasian tur into one species with 3 subspecies, the middle one occurring exactly within the area of 'jump' and fluctuations in the cline (Sokolov 1959; Tembotov 1974). Multiple and correlated clinal variation in a large and actively moving ungulate within such a limited range (770 km long and up to 80 km wide) can hardly be explained by geographical dynamics of environmental factors, especially when it is unlikely there are any parallels in the Caucasus. The shape of the cline is also very distinctive (short western and long eastern sloping parts with a steep and fluctuating centre), suggesting secondary contact and hybridization (Mayr 1968).

Since there is only one steep part of the cline, contact of just 2 primary taxa may have occurred, initially separated by a geographic barrier in the Central Caucasus (Weinberg 2006). The most likely barrier would be a mighty glaciation centre which fluctuated during the Pleistocene in the area including Mts. Elbrus in the west and Kazbek in the east (Fig. 4), and partly still in existence (Gerasimov and Markov 1939; Kotlyakov and Krenke 1980; Milanovsky 1966; Shcherbakova 1973), and situated where the steep and fluctuating part of the cline occurs. This glaciation centre could periodically separate the all-Caucasus tur

population into two and create conditions for evolution of two taxa: East-Caucasian and West-Caucasian turs. This fluctuating barrier can also explain hybridization between the two initial taxa because it was not constant and periods of isolation were probably insufficiently long. Populations were in contact periodically (as now), hybridized but could not evolve mechanisms of effective reproductive isolation for shaping into “good” species. Such a situation has no parallels within *Capra* (as far as we know) and is valuable for fundamental biology, and also for biodiversity.

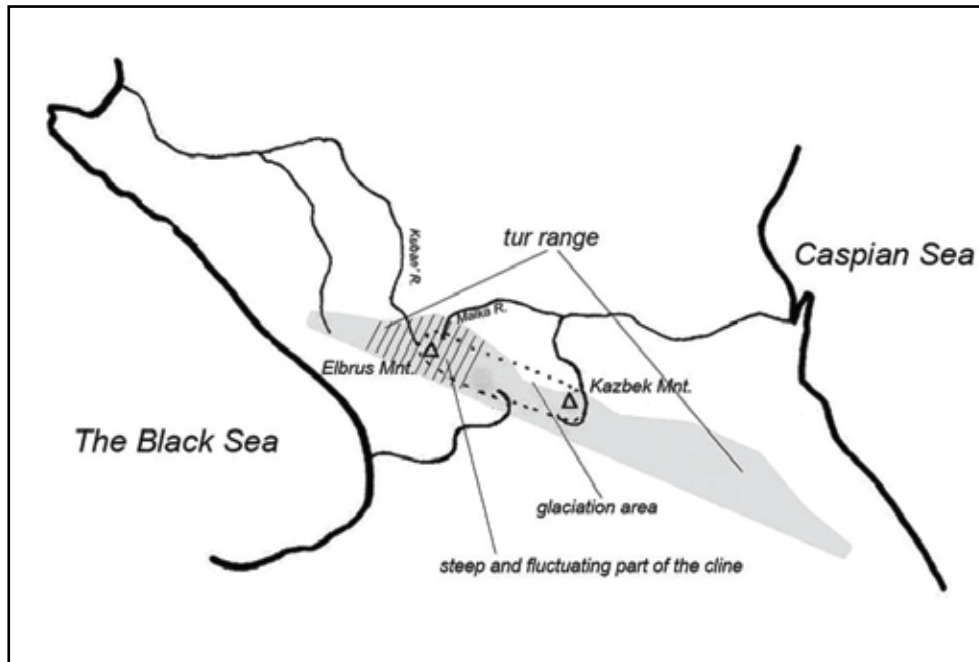


Fig. 4. Scheme of tur range and centre of glaciation in the Greater Caucasus

If one considers West- and East-Caucasian tur as separate species, even if not quite “good”, then one must accept the names *Capra severtzovi* Menzb., and *Capra cylindricornis* Blyth, since *Capra caucasica* Guld. et Pall. belongs to a hybrid population occurring in the steep and fluctuating part of the cline east of Mt Elbrus (Fig. 4). Unfortunately, gene sequencing cannot yet determine recent hybridization (Manceau et al. 1999; Pidancier et al. 2006; Zvychainaya 2008). However, it would be unrealistic to attempt to resolve tur taxonomy without genetic corroboration.

Recommendations

1. Conduct further morphological research on existing material (on divergence angle in females and males, and shape of cross-section of male horn cores) and add data on regions not covered by our research (Arkhyz, Chechnya or Tushetia, and Shakhdag), and also study the collection of the Caucasus Museum (Tbilisi).
2. Continue genetic research to establish methods to distinguish recent hybridization.

Considering all the shortcomings, the suggested taxonomic scheme is realistic and can serve as the basis for a tur conservation strategy. If the aim is to preserve the clinal geographic variation of tur, then all the populations along the whole of its range would have to be protected, but mainly those in the central and western parts, as the range and numbers are bigger in the east while the cline is very sloping. Protection of small separate local populations might result in fragmentation of the integral range of tur

and possibly in gradual loss of clinal variation. The results here indicate that West-Caucasian tur as a “pure” morphotype and initial taxon (no matter what ranking) exists only in the westernmost Greater Caucasus. Tur in Teberda already differ from those in the Caucasus NR. Numbers of this West-Caucasian morphotype would hardly exceed those in the Caucasus NR, meaning that they are now significantly below 5,000 (Romashin 2001).

The existing network of protected areas is potentially adequate for protection of tur in the west and central Caucasus (Caucasus Reserve, Teberda Reserves, Prielbrus’ye NP, Kabardin-Balkarian Reserve, Alania NP, North Ossetian and Erzi Reserves in Russia, Kazbek Reserve in Georgia), as shown by high former numbers of tur in Caucasus and Teberda Reserves, and sufficient numbers in Kabardin-Balkaria. Teberda Reserve with its Arkhyz branch is also quite sufficient. However, in Karachai-Circassia, Kabardin-Balkaria and western North Ossetia, federal protected areas occur exclusively on the Watershed and Side Ranges, thus omitting surviving tur populations on the Rocky Range exactly within the supposed hybridization zone. The network is also insufficient in the eastern Caucasus, where Russia has no federal protected area within tur range. Only Azerbaijan and Georgia have nature reserves there, but the main distribution of tur occurs on the northern, Russian slope, in Daghestan.

Meanwhile a new phase of land-use in the highlands is beginning, with construction of large and small hydropower stations, development of infrastructure and recreational industry, and possible restoration of sheep- and cattle-herding. On the whole, as experience in the Alps shows, *Capra* can coexist with recreational and limited industrial land-use, when supported by a carefully designed programme of mountain use, that considers wildlife conservation, but not alongside unregulated and spontaneous projects, without benefit of ecological expertise. Formation of new federal high-ranking protected areas may not always be necessary, if it is possible to protect animals and their habitats within areas of conventional land-use, e.g. livestock pasturelands.

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Executive Summary

The main aim of the CEPF/WWF project ‘Help Save the Otter’ was to assess the current status of Eurasian otter in Azerbaijan and recommend measures for the conservation and restoration of the species. The study covered all Azerbaijan except Nakhchivan. Field work was carried out from 2005 through 2007. In total, 215 otter sites were surveyed. Total numbers were estimated at 108 animals. This represents a sharp population decline from the previous estimate of 1,500. Results of the study were presented in the form of reports and presentations at workshops and conferences at regional, national and international level.

Scope and Objectives of the Work

Eurasian Otter *Lutra lutra* has a widespread distribution in Eurasia. It is a CEPF priority species due to its status in the region. It is listed in the IUCN Red List as Near Threatened (IUCN 2008), and is included in Appendix I of CITES and the Red Data Book of the former USSR. At present the otter is an endangered species in Azerbaijan, though it was not included in the Red Data Book of Azerbaijan (1989). The central part of the range of this rare and poorly studied geographical form - the subspecies *Lutra lutra meridionalis* Ognev - is located in Azerbaijan.

Large numbers of otters used to inhabit the Caucasus at the beginning of the last century, but the population was already declining by the mid-1950s. Gajiev (2000) estimated no more than 1,500 animals in Azerbaijan. In recent decades there have been several observations of otters in remote areas. In Zakatala Reserve, the Eurasian otter was recorded in the tributary of the Karehchay river (Pichigel section) in August 1957, and in the upper reaches of the Tsilbanchay river (Verketel section) in July 1963 (Gajiev et al. 1985; Sokolov and Syroechkovsky 1990). According to Litvinov (1998), a male, a female and a yearling were trapped in Kyzylagach Reserve 1976, and individual animals were occasionally seen in Lesser Kyzylagach Bay and at the mouth of the canal in Greater Kyzylagach Bay. The range is almost unchanged, but numbers are now close to critical and the Eurasian otter is close to extinction in Azerbaijan.

The main goal of the project ‘Help Save the Otter’ was to analyze and evaluate the current status of Eurasian otter in Azerbaijan and prospects for conservation and restoration of the species. The specific objectives were:

1. To study Eurasian otter distribution and biology
2. To make an inventory of the species in transboundary, protected and other areas
3. To identify causes of the decline
4. To review and summarise available scientific information

Methods

Field work was carried out in different seasons across the Republic of Azerbaijan, except Nakhichevan, during 2005-2007. The project covered all natural corridors in the country, including Hirkan (Lenkoran

lowland), Caspian (Samur-Yalama), and Greater Caucasus (Zakatala, Balakany). The project covered large, small and high-mountain rivers, bays, lagoons (limans) and lakes, i.e. all types of water body with suitable habitat. Surveys covered 42 rivers of the Lenkoran, Zakatala, Ismaily, Juba-Khachmass regions, and Lesser Kyzylagach Bay, Divichinsky lagoon and Khanbulak reservoir. In total, 215 otter sites were studied. At each site a long strip of bank, ranging from 500-8000 m, was surveyed.

Information was collected through visual observations, field signs, footprint measurements, and social surveys. Estimation of numbers and distribution was based on the approach proposed by Ilushkin (2004) with some slight modifications, and included:

- Inventory of water bodies and potential otter locations using hydrological data, books, large-scale maps and data obtained during field visits. The inventory included the length of rivers that could be used by otters. The results were used to produce schematic maps showing locations where otter signs were found or where the animal was seen by hunters or local residents, as well as approximate data on population density.
- Field inventory on routes covering otter habitats (banks of rivers, lakes, lagoons).
- Based on field survey data, an average density was calculated per 10 km of each river and then extrapolated to all water bodies in the area inhabited by the otter.

Location of field signs, droppings, seasonal dens and breeding dens was recorded. In addition to observations and description of habitats, the air and water temperature were measured. Animal signs, dens and typical habitats were photographed. Data on the fish fauna were also collected. Plaster casts were made of tracks of otters and other animals found on river banks. Data were also collected on the human impact on otter habitats.

Results

Distribution

Our research and observations show that the Eurasian otter is primarily found in the south, northeast and northwest of Azerbaijan (Fig. 1). The otter was found on 18 watercourses, including the rivers Tangerut, Dilmyadi, Novushtarud, Bolady, Vilyash, Lenkaranchay, Gumbashi and Vasharud in the Lenkaran Natural Area; the rivers Samur, Gusarchay, Tairjal, Geperchay of the Kuba-Khachmass zone; the Alazan, Agrichay, Belokanchay, Mazymchay and Katekhchay rivers of the Sheki-Zakatala zone, and the mouth of the Kura. No survey was carried out in the southwest as this zone is occupied. However, the Eurasian otter may potentially occur along the Akera River and its tributaries.

Population

In general, otter numbers are very low. On average, there are 42 animals in the northwest of the country, 12 in the north, 7 in the central part, and 47 in the south. In total, we estimated that 108 otters occur in Azerbaijan (Table 1). According to local people and hunters, the total number of otters is somewhat over 200. In 2000, the estimated number of otters was 1500 (Gadjiev 2000). This decline confirms that the Eurasian otter should be included in the Red Data Book of Azerbaijan.

Otter population density in all areas is also very low, on average 0.2-0.5 individuals/10 km of bank line. On some sections of the rivers Tangerut, Samur, Alazan, and Kura tributaries, the maximum density of 0.8-1.1 animals/10 km was observed. A similar situation was observed in Lesser Kyzylagach Bay (38°57' - 39°18'N; 48°46' - 49°12'E), on some sections of the Divichinskiy lagoon (41°16' -41°19'N; 49°03' -49°07'E; 24.9-26), where the population density was 0.7-1.3 animals.



Fig. 1. Current distribution of the otter in Azerbaijan (Red – sites recorded during field surveys; and Blue – distribution)

The results show that the Lenkoran natural area is the most favorable for the otter, with its rather mild climate, a wide network of rivers of different size, rich in fish, and not freezing in winter. In Talysh, the otter was mainly found in small, difficult-to-access mountain rivers: the Dilmyadi (38°27'N; 48°39'E; 594m asl), Navushtarud (38°17'N.; 48°19'E; 614m), Tangerut (38°30'N; 48°39'E; 873m). In each river, no more than one family was found, consisting of 3-4 animals, occasionally only one individual.

We believe that the small number of otters is due to insufficient prey, as other conditions meet the necessary habitat requirements. Movement of otters from one river to another was also observed. The length of such movements ranged from 2 to 4 km. On small mountain rivers, such as the Dilmyadi and the Tangerut, signs of the same otter were observed along a distance of 7 km.

Table 1. Eurasian otter habitats and numbers in Azerbaijan

Region	Watercourses (rivers, lakes, lagoons)	Otter numbers		Length of bank surveyed (km)
		Our data	Data from local population	
Kuba-Khachmass	Samur	12	28 - 30	25
	Tairjal	2	6 - 10	8
	Gusarchay	1	8 - 12	15
	Geperchay	1	4 - 8	6
	Divichinsky lagoon	26	34 - 45	—

Region	Watercourses (rivers, lakes, lagoons)	Otter numbers		Length of bank surveyed (km)
		Our data	Data from local population	
Lenkoran Natural Area	Lenkaranchay	8	15 - 20	20
	Vilyashchay	6	—	8
	Kumbashichay	5	10	12
	Bolady	3	15	10
	Tangerut	6	12	18
	Dilmyadi	3	8	8
	Novushtarut	1	4	6
	Smaller Kyzylagach Bay	15	40 - 50	—
Sheki-Zakatala	Agrichay	8	15 - 20	12
	Karachay	2	10	10
	Belokanchay	1	8	7
Kura mouth	Kura mouth	7	25	10
Gabalin	Turianchay	1	—	15
Total	18	108	219	

Habitats and Ecology

Large water bodies, such as Small Kyzylagach Bay, Divichinsky lagoon, with lots of fish, wetland birds, and other potential prey such as amphibians, shellfish, and rodents, and where sites may be protected by tamarisk and bulrush, provide suitable habitat for the otter. In such sites we observed a unique interaction between hunters and the otter, when wounded game became an easy prey for the animal. Poaching poses a threat to otters.

Six otter dens were found and 4 of them were examined thoroughly. They turned out to be temporary or foraging dens and were situated in rock crevices, had one entrance and were quite large: 35-45 cm high, 60-80 cm deep and 50-60 cm wide. Some contained bedding of dry grass and moss. The other two dens were impossible to reach.

Analysis of 24 droppings collected during the survey showed varied prey composition (fish, frogs, birds, shellfish, small mammals) and also seasonal changes. Depending on the area, otters fed on fish of the families Caprinidae, Salmonidae, Gasterosteidae and Pereidae. By biomass, freshwater fish of the family Caprinidae prevailed, including barbel (*Barbus*), khramulya (*Varicorhinus*), bystranka (*Alburnoides*), bitterling (*Rhodeus*), and species of the family Salmonidae. In addition, the spring and summer diet includes frogs, nestlings of wetland birds and ducks, water shrews (*Sorex araneus*), water



Fig. 2. Otter habitats in Hirkan National Park / © E.Askerov

voles (*Arvicola terrestris*), larvae of trichopterans and ephemerals, freshwater crayfish and shellfish.

The otter's main habitat requirements are water bodies with clean, clear water, sufficient prey, ice-free areas, and safe dens. Otter numbers and spatial distribution depend largely on the available prey base. These may be fast-flowing rivers with pools, backwaters, areas with dense vegetation and banks that are difficult to access, or lakes and lagoons with sufficient prey and places of shelter. Main habitats of the otter include rivers in the middle mountain belt, rarely visited by people and rich in fish. An important aspect of the habitat is presence of forests on riverbanks and debris in the river channel (Fig. 2) alternating sand bars and steep rocky banks offering the necessary minimum protection. Typically, they avoid large rivers and prefer tributaries and medium-sized and small mountain rivers.

Threats

Threats to the species were identified and a list of remedial measures to improve of the status of the otter in Azerbaijan were developed (Table 2).

Table 2. Remedial measures to improve the status of the Eurasian otter in Azerbaijan

Threats	Measures
Habitat change	<ol style="list-style-type: none"> 1. Prohibit cutting of trees and bushes on banks of rivers, lakes and lagoons inhabited by otter; 2. Strengthen control over use of water supplies for irrigation; 3. Prevent pollution of rivers 4. Create favorable conditions for conservation of the gene-pool of the main otter populations 5. Monitor otter habitats regularly and take necessary measures to eliminate negative impacts and causes; 6. Identify new places favorable for otters and reintroduction.
Decrease in fish resources	<ol style="list-style-type: none"> 1. Control fisheries; 2. Categorically prohibit stunning of fish in water bodies inhabited by otters; 3. Offer credit to local residents for alternative livelihoods to hunting and poaching: (such as bee-keeping, gardening, re-forestation, quail-farming, etc); 4. Identify water bodies (rivers, lakes, lagoons) where fishing is allowed; 5. Develop and support modern technologies of fish breeding and increasing fish stocks;
Poaching	<ol style="list-style-type: none"> 1. Conduct awareness raising and educational work among the local population to increase their responsibility for illegal hunting and fishing; 2. Enhance anti-poaching activities; 3. Increase existing fines for illegal hunting; 4. Regulate behavior of people in the area of otter conservation; 5. Improve socio-economic status of people in areas inhabited by otters; 6. List additional measures for otter conservation, identify the existing potential; 7. Stimulate otter conservation at the local and regional levels; 8. Raise environmental awareness of the population: educational, awareness-raising activities to underline the uniqueness of nature and its residents.
Disturbed water regime	<ol style="list-style-type: none"> 1. Maintain adequate hydrological regime in rivers; 2. Strictly control the use of water from rivers inhabited by otters for irrigation of agricultural lands.
Catastrophically low number of the otter in the country	<ol style="list-style-type: none"> 1. Promote idea of nature protection and the need to conserve the Eurasian otter. 2. Increase the responsibility of local authorities for uncontrolled fishing and hunting; 3. Train the State Reserve and PA staff in biology, ecology, and habits of otters 4. Monitor numbers annually and assess identified otter habitats; 5. Conduct scientific research to study the population, spatial structure, seasonal and irregular migration of otter; 6. Restore the extinct local populations; 7. Recommend the inclusion of the Caucasus river otter (<i>Lutra lutra meridionalis</i>) in the Red Data Book of Azerbaijan.

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Executive Summary

The Caucasus is home to 35 species of bats (Rakhmatulina 1996; Benda and Tsytsulina 2000). Most of the previous bat studies were limited to individual countries, and those that covered a part of the Caucasus or the region in general, addressed only separate species or pooled general information. No evaluation of threatened bats according to IUCN Red List criteria has been ever done in the Caucasus, nor has any full list of threatened bat species been developed for the entire ecoregion. Current status of most known large colonies of threatened bat species remained unstudied; there was no inventory of key habitats. Lack of international coordination affected the effectiveness of the conservation of species that changed their winter and summer roosts between different countries.

An international program was developed to comprehensively address conservation of threatened bats of the Caucasus. The project aimed to:

1. Identify key habitats for each threatened species in protected areas and wildlife corridors of the Caucasus.
2. Develop a basis for their conservation status.
3. Make regional assessments of species status according to IUCN criteria.

The study was the first attempt to conduct joint research simultaneously in most of the Caucasus. As a result, current bat status has been evaluated both Caucasus-wide, and in all four countries of the region. In many places a decline in bat numbers has been identified, primarily in the number of rare and legally protected species.

Methodology

Studies were carried out in the North Caucasus (Russia) and South Caucasus (Azerbaijan, Armenia, Georgia). Bats were studied using ultrasound bat detectors, in roosts, visually, captured with nets or by hand. Ultrasound recordings were transcribed using BATSOUND software. Bat numbers were evaluated visually. Larger colonies that were hard to count were photographed and population size calculated from photographs.

The team made over 90 field visits and observed 239 sites: 33 in Azerbaijan, 49 in Armenia, 67 in Georgia and 90 in Russia. Out of the 35 bat species existing in the Caucasus, 19 species were registered in Azerbaijan, 17 - in Armenia, 23 - in Georgia and 22 - in Russia. The project focused on 14 species (see Table 1), which consisted of seven priority CEPF species selected from the IUCN Red List as of 2004; six species protected by the legislation of the participating countries, and one species (*Myotis dasycneme*) after it was first found in the Caucasus (Gazaryan 2004).

Table 1. National, regional and global status of Caucasus Chiroptera by IUCN categories

Name of Species	Armenia	Azerbaijan	Georgia	Russia	Caucasus	IUCN
<i>Rhinolophus ferrumequinum</i>	NT	NT	VU	EN	VU	
<i>Rhinolophus hipposideros</i>	VU	VU	LC	NT	NT	
<i>Rhinolophus euryale</i>	EN	EN	VU	CR	EN	VU A2c
<i>Rhinolophus mehelyi</i>	CR	CR	CR	CR	CR	VU A2c
<i>Myotis blythii</i>	VU	LC	LC	NT	NT	
<i>Myotis bechsteinii</i>	NE	DD	NE	DD	DD	VU A2c
<i>Myotis dasycneme</i>				NE	NE	VU A2c
<i>Myotis emarginatus</i>	VU	VU	EN	EN	EN	VU A2c
<i>Myotis schaubi</i>	DD				DD	EN B1+2c,C2a,D
<i>Nyctalus lasiopterus</i>			DD	DD	DD	
<i>Barbastella barbastellus</i>	DD	NT	VU	VU	VU	VU A2c
<i>Barbastella leucomelas</i>	NT	DD		DD	DD	
<i>Miniopterus schreibersii</i>	EN	VU	VU	EN	EN	
<i>Tadarida teniotis</i>	DD	DD	NE	DD	DD	
Total Target Species	12	11	11	13	14	
Species protected by the State	6	3	4	7	-	
Endangered species	5	5	6	6	6	

Note: NT = Near Threatened, VU = Vulnerable, EN = Endangered, CR = Critically Endangered, LC = Least Concern, NE = Not Evaluated, and DD = Data Deficient

The team investigated all known caves and assessed the current status of bat populations. We found new bat colonies, including some that are critical for rare and protected species conservation, and identified forests important for protecting complexes of bat species. For each species, key habitats were identified and a database developed and posted on the internet at <http://www.campester.org>. The project initiated establishment of several Protected Areas (PAs) and prepared proposals for the establishment of several PAs in each country of the region. The team evaluated the status of vulnerable species and their habitats in the Caucasus and in each country.

Status

Regional Red List Status

The 14 target species were re-assessed for the entire region and for individual countries, according to IUCN criteria for regional red-listing (IUCN 2003) (Table 1).

National Status

Armenia

In many caves, a decline in bat numbers was primarily due to increased recreational and other anthropogenic pressure. A sharp decline was identified in *Myotis blythii*, and that species is now proposed for listing in the Red Data Book of Armenia. In some areas construction work carried out to develop existing mining

and metal plants is accompanied by felling of old and hollow trees, e.g. in Kapan, Kajaran, Tehut and Vanadzor, which sharply reduced the number of bats there. However, the number of *Pipistrellus* has increased significantly. Accumulations of *Pipistrellus* including several thousand bats were identified near villages of Chimani (Vedi district), Areni-Elpin (Ehegnadzor district) and Tandzik (Armavir district), both in the reproduction period and in winter. The bats live in attics, concrete roof slabs, ruins, and abandoned buildings.

Azerbaijan

A cave at Maraly in Shahbuz district, Nakhichevan Autonomous Republic that was formerly inhabited by *Rhinolophus blasii*, *R. mehelyi* and *R. ferrumequinum*, *Myotis blythii* and *Miniopterus schreibersii* (Rakhmatulina 2005) is now being used for livestock and is no longer used by bats. An attic in Isty-Su village in Lenkoran province was refurbished without advice from bat specialists. This resulted in disappearance of a large nursery colony of about 1,000 adult females of the globally endangered *M. emarginatus*. Increased recreational pressure on Sirab cave, Babek district, Nakhichevan AR, that used to contain about 220-230 *R. ferrumequinum* and 70-80 *R. mehelyi* in winter, reduced the number of the former species to about 120 bats and resulted in the disappearance of the globally endangered *R. mehelyi*. An increase in the number of *Myotis blythii* and *Miniopterus schreibersii* was identified in the Nakhichevan AR, which could be due to the fact that a large area lies in Ordubad National Park.

Georgia

Declines are observed only in the western and central parts of the Iori plateau (David Gareji cave systems etc). Data from western Georgia are deficient. Only fragmentary data are available from speleologists, karst specialists and archaeologists, which show that some places were colonized by many bats before archeological digging started in caves or tourists started to visit the areas. Increased anthropogenic pressure reduced bat numbers or resulted in bat loss. Decline in the number of bats in the BTC project zone stopped after construction works were completed and in some places they are recovering. The number of species increased somewhat near lake Cherepanovskoe and the village of Tsikhisjvari during last years, but it still has not reached the status of 2004-2005.

Bats have also returned to the David Gareji Monastery, yet one cannot consider it a growth in number, as the bat colony there is a part of a bigger colony that split in 2002 because of partial collapse of a roost in the Tetri Senakebi caves. In general, no significant growth in the number of bats has been recorded in Georgia.

Russia

Anthropogenic pressure is as strong as in other countries. Increasing recreational pressure resulted in the reduction and even loss of bats in many caves. A cave of Hajokh (Adygea) was colonized by *M. blythii* until the mid-1980s, with over 500 individuals sharing the cave with other bat species. There are no longer any bats in the cave because many tourists visit the place every day. Colonies living in caves of the Sochi National Park are the most vulnerable because of intense use of natural sites, including caves, for recreation. In particular, a colony of bent-winged bats that used to live in Vorontsovskaya Cave is no longer there. Bats abandoned the Tahira and Tigrovaya caves, and almost no longer use the caves of Navalishenskaya and Akhshtyrskaya. Many roosts in caves located on the northern slopes of the Greater Caucasus are also endangered. Large and easily accessible caves are used as tourist attractions and for sports. In Daghestan, a critical factor is direct extermination of bats in caves because of the superstitious

attitude of the local population. Such extermination, carried out by locals, resulted in the disappearance of bats from the Bat Cave near the village of Urma earlier colonized by the Greater Horseshoe Bat, Lesser Mouse-eared Bat and probably also Mehely's Horseshoe Bat.

No Greater Noctule bats were found in the North Caucasus but two other species of the genus *Nyctalus* were captured. In several, bat detectors recorded ultrasounds resembling those typical of *N. lasiopterus*. No specific negative factors were identified that could significantly reduce the number of Giant Noctule. Probably the most important factor for *N. lasiopterus*, as well as for other bats living in forests, is mass felling of trees that causes habitat and roost loss.

There are also some positive changes. *M. blythii* is the only bat species in caves of the Russian Caucasus with no concerns over its status. Numbers of *M. blythii* have increased and they occupy new caves. A winter colony of 2,300 Lesser Mouse-eared Bats was found in the Shuby-Nykhasskaya cave (North Ossetian State Reserve), the biggest colony found in the cave since 1981. The biggest accumulation of *M. blythii* in Russia and one of the biggest in the Caucasus (about 2,500 bats) is in Karabudakhkent Cave in Daghestan. Large nursery colonies of *M. blythii* were also found in Nalchik and the Samorodnaya Cave in Karachai-Cherkessia. Falling numbers and declining diversity of bat species and even local extinctions have also been recorded in habitats in the North Caucasus (grottos and building in the villages of Sarmakovo and Verkhniy Kurkuzhin, Vorontsovskaya Cave, etc).

New Findings

Rhinolophus blasii was found in Georgia for the first time (first published here). *R. euryale* was found in Russia for the first time since the 1960s (Gazaryan & Ivanitskiy 2005), and a new location was identified on the northern slope of the Greater Caucasus. Data suggest that numbers and species diversity are very sensitive to climate change resulting in thermophilic species moving north. Thus, big winter colonies of *R. ferrumequinum* have been found in the caves of Dedova Yama, Ared, Popov, Gunkin and in a gallery near Derbentsky village. Two bats of this species were found in caves of Daghestan. New findings suggest a wider spread of the species than earlier believed.

New bat colonies have also been found: four locations including caves of the Sleeping Beauty and Nozma with big colonies of *M. schreibersii*, a grotto on Mount Gebeus with a winter colony of *M. emarginatus*, Babaylovskaya cave with a winter colony of *M. blythii*; nine locations in Georgia, including Machakhela gorge at the confluence of the rivers Machakhela and Skurdidi with high species diversity, a grotto in the Sagorela Gorge (Lamparedzebis tskali), a tributary of the Chakvistavi River (*R. ferrumequinum*, *M. schreibersii*), surroundings of the villages of Nunisi, Moliti and Zvare with high species diversity, the Adjameti Nature Reserve with diverse bat species, cave of Tsutskhvati VII (a mixed colony of *R. hipposideros*, *R. euryale*, *M. blythii*, *Miniopterus schreibersii* and the biggest ever colony found of *R. euryale* consisting of about 300 bats), canyon on the Sharaula River (high species diversity, colony of *R. euryale*), the Okhvameshkari caves (high species diversity, colony of *R. euryale*), Dashbash canyon (high species diversity), the Khevsuretis Aragvi gorge (*B. barbastellus*, *M. blythii*, high species diversity); seven locations in Azerbaijan, in Nakhichevan AR: the Imamzade cave, surroundings of the village of Turkesh, galleries in the Kotamchay valley, surroundings of the villages of Kaliaki and Dyrnys, Paragchay valley, Yarasa Yuvasy cave in Bilav. In the Greater Caucasus, locations are the surroundings of Gabiz-Darya village, the town of Sheki and its surroundings; two locations in Armenia are the Aygut grotto (*R. ferrumequinum*) and the Artsavan cave in the Garni-Gehard fault (*R. ferrumequinum*, *M. blythii*).

The studies confirmed that Caucasus bat populations mainly had a transboundary character. This consideration suggested existence of the *R. blasii*, *Eptesicus bottae*, *B. leucomelas* and *T. teniotis* in Georgia (Bukhnikashvili & Kandaurov 2002). In 2006, *R. blasii* was found in western Georgia. Bat

detectors also showed the existence of *T. teniotis* in Borjomi district of Georgia, yet the animals were not captured; *M. dasycneme* was found in the North Caucasus (Gazaryan 2004). This suggests that new species can also be found in the Caucasus in general as well as in separate countries of the region.

There have also been some new findings in known locations:

In Armenia, the first wintering roost of *M. blythii* was found in the cave of Karmir; *Plecotus auritus* was found in the Ulashik gorge; *Barbastella leucomelas* – in the David Bek cave; *Myotis hajastanicus* was found in grottos of Tsapatah; *Pipistrellus nathusii* was identified at a scientific station of Yerevan State University on the Blandchay River; *R. hipposideros* was found in the smaller cave of the Noravank Caves; *Pipistrellus pygmaeus* was identified in the Chimani siphon and on the roof of a secondary school in village Chimani.

A quite large population of *R. ferrumequinum*, *M. blythii* and *Barbastella leucomelas* was found in several galleries on the right bank of Debet River (Alaverdi district), where their wintering roosts were also found.

In Azerbaijan, *R. ferrumequinum*, *Myotis blythii*, *M. emarginatus*, *Miniopterus schreibersii* were found in Nakhichevan city for the first time; *M. blythii*, *M. schreibersii* in the cave of Dashgala; *R. ferrumequinum*, *R. hipposideros*, *R. mehelyi*, *M. blythii*, *M. schreibersii* were found in the Yarasa Yuvasy cave and its surroundings; *R. hipposideros* were found in a church near the villages of Bunut and Hazrya and the surroundings of Sheki.

In Georgia, three roosts of *R. blasii* were found in the Taroklde, Kumistavi (Tskaltubo II) and Gogolati caves; *R. hipposideros*, *M. blythii*, *Nyctalus noctula*, *N. lasiopterus*, *Nyctalus leisleri* and *M. schreibersii* were found in the surroundings of Chakvistavi; *M. blythii*, *M. nattereri*, *Eptesicus serotinus*, *E. nilssonii*, *Pipistrellus pipistrellus* were identified on the Green Cape; *R. euryale*, *M. blythii*, *M. nattereri*, *Eptesicus serotinus*, *Pipistrellus pipistrellus* were found in the Okhvameshkari caves; *R. euryale*, *N. noctula*, *P. pipistrellus*, *M. schreibersii* were found together with *R. blasii* in the neighboring caves of Kumistavi and Ghliana; *R. ferrumequinum*, *M. blythii* – in the Tsilto IV cave.

In Russia, first records included *B. barbastellus* in the Shubi-Nykhass cave; *M. nattereri* in Babaylovskaya cave, *M. nattereri* in the Kamennie Sarai caves; *R. euryale* in Bolshaya Fanagoriskaya cave; *M. blythii* and *R. ferrumequinum* in the Samorodnaya cave, and *R. ferrumequinum* in a cave on mount Jalgan.

During the project it was noted that some bats of *B. barbastellus* in Western Georgia and western part of the North Caucasus had white spots. Additional information is necessary to understand the origin of the spots, whether they are a sign of partial albinism or a feature typical for *B. barbastellus* in the western Caucasus.

Key Habitats

Key habitats were identified for each country:

Armenia:

Karmir Blur cave (*R. mehelyi*); Magala cave (*R. euryale*, *R. mehelyi*, high species diversity); Banali and Chaykend caves (*R. euryale*); grottos on the northern bank of Lake Sevan (high species diversity, *M. bechsteinii*); a cave in Khndzoresk and church ruins (*R. mehelyi*); Hustup-Katar cave labyrinth (*R. euryale*).

Azerbaijan

Galleries near Kayaki (*R. mehelyi*); a church in Jalud (*M. emarginatus*); Yarasa Yuvasy cave in Paragchay

and Girmanchay valleys (big colony of *M. blythii* and *M. schreibersii*) (Fig. 1); a forest near Yamala (diverse species and *B. barbastellus*); the villages of Borchaly, Biliasar, Siov, Dilmadi and Rangerud in Talysh (*B. barbastellus*); Bozdag ridge near Mingechaur reservoir (*M. emarginatus*).



Fig. 1. Yarasa Yuvasy Cave, Azerbaijan / © I. Rakhmatulina

Georgia

The surroundings of Nunisi, Moliti and Zvare (13 species including *B. barbastellus*, *M. emarginatus*); Sachinkia cave (*R. euryale*); Tsutskhvati VII cave (*R. hipposideros*, *R. euryale*), *M. blythii*, *M. schreibersii*); Gogolati cave and its surroundings (*R. euryale*, *M. emarginatus*, *B. barbastellus*); Kheta, Okhvameshkari caves I, II and III (*R. euryale* and *R. ferrumequinum*); Abanoeti (*R. euryale* and *R. hipposideros* in an abandoned house); Sakishore and Kidobana caves (big colony of *M. schreibersii*, *M. emarginatus*); the river Chivchivi and surroundings of Samshvilde (16 species including *M.*

emarginatus and *B. barbastellus*); Dashbash canyon (Fig. 2) (high species diversity and *M. emarginatus*); river Aragvi, galleries and forests in the surroundings of Barisakho (*B. barbastellus*, *M. emarginatus*); galleries and forests in Lagodekhi Nature Reserve (*B. barbastellus*); Natlismtsemeli cave complex, artificial cave no. 19 (the biggest known colony of *M. blythii* in Eastern Georgia including 350-400 bats); Tetri Senakebi cave complex, artificial caves no. 3 and no. 5 (high species diversity and a mixed colony of *R. ferrumequinum* and *M. emarginatus* of 600-700 bats); a watch tower in the David Gareji cave complex (*R. ferrumequinum*, *M. emarginatus* including 300-400 bats a part of the previous colony that split after partial collapse of cave no. 5 in Tetri Senakebi in 2002).

Russia

Krasnodar Area: the cave of Chertova Nora (Devil's Hole) Matsesta, and floodplain of the Agura River (high number of protected species, small colony of *R. euryale*); Fanagoriyskaya, Bolshaya Fanagoriyskaya cave (*R. euryale*, *M. bechsteinii*, *M. emarginatus*); Chernigovskoyem cave of Canyon and Chernogorie karst massif (8 species and a colony of *B. barbastellus*); Memzay, cave Arde (*M. emarginatus*); Guamka, Guam Gorge (*B. barbastellus*); Maliy Utrish near Anapa (*M. bechsteinii* roosting in a cellar of an abandoned building); Derbentsky (8 species, including *B. barbastellus*); Belaya Rechka, caves of Uyanotup, river floodplain (9 species including *B. barbastellus*); the Skirda Ridge, Babaylovskaya and Sleeping Beauty caves (10 species, including *B. barbastellus*, big colonies of *M. blythii* and *M. schreibersii*); Shubi-Nykhass caves, forest in the basin of Ardon (the biggest colony *M. blythii*, also *B. barbastellus* in the surroundings); mount Gebeus, forest and the floodplain of the river Teshebs (*M. bechsteinii*, *M. emarginatus*); Tabasarank district, Karabudakhkent Cave (*M. blythii*, *R. mehelyi*).

Conservation

Protected Areas

As a result of these studies, Noravank Gorge Sanctuary was established in Armenia, where 16 grottos and caves are located; the entrances to the Mozrov and Archeri caves were closed.

In 2005-2006, the project group in Georgia (members of NGO “Campester”) participated in the development of Management Plan for Protected Areas in Central Caucasus (in the frame of the Georgian Protected Areas Project financed by World Bank). Under the aegis of this project the group proposed to include three caves (Gogoleti, Sakishore and Kidobana), as the key bats habitats, in the Protected Areas System of the Central Caucasus (planned Racha-Lechkhumi National Park). These caves are situated in karst massifs where up to 200 caves are located; the area is covered by forest and is characterized by high diversity of bats. Our recommendations were taken into consideration during the establishment of new protected area - Imereti Caves PA (which includes 11 caves).



Fig. 2. Dashbash Canyon, Georgia / © A. Bukhnikashvili

So far only one protected area for bat protection has been established in the North Caucasus, in the Canyon Cave site of nature. In cooperation with WWF-Russia, recommendations have been prepared for the RF Ministry of Education for a perspective Protected Area Plan. In collaboration with the staff of the Caucasus Nature Reserve, Maykop branch of the All-Russian Society for the Protection of Nature (VOOP), and the North Caucasus Ecological Watch (NGO), a report was prepared justifying the establishment of a natural park in the Apsheron district of Krasnodar District, and an initial zoning plan for the park. According to the zoning of the Sochi National Park, environmental organizations prepared bat protection proposals for the commission of the Federal Service for the Supervision of Natural Resource Usage (“Rosprirodnadzor”). The proposals include implementation of federal target programs with minimum damage to bat biodiversity. The team of experts invited to develop the federal PA scheme proposed establishment of bat protection PAs in the following areas: 1. Galleries near Derbentsky. 2. Bolshaya Fanagoriyskaya Cave. 3. Chernogorie Caves. 4. Ared Cave. 5. Ambitsugov’s Cave. 6. Caves on mount Ekvetsopko. 7. Gunkin gully caves. 8. Svetlaya Balka Gully caves. 9. Chernorechenskaya Cave. 10. Caves near Besleneevskaya. 11. Dedova Yama cave. 12. Zubashenko’s Cave. 13. Masliaev’s Cave. 14. Caves of the Black Sea Ridge, 15. Kucheriavaya Balka Gully caves. 16. Caves on Mount Sadovaya. 17. Caves of the Bigger and Smaller Shaitan-Tomak. 18. The Jentu karst massif. 19. Uyanotup caves, 20. Karabudakhkent cave.

Action Plans

The studies resulted in the establishment of one regional (Kandaurov 2008 (Ed.)) and three national Bat Conservation Action Plans in Azerbaijan, Armenia and Georgia (Rakhmatulina 2008; Yavruyan et al. 2008; Bukhnikashvili et al. 2008, respectively), as well as an Action Plan for Bat Conservation in the Russian Caucasus (Gazaryan 2008) that identified threats, objectives for a 20-year perspective, and

actions to address the objectives.

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Executive Summary

The objective of the survey was to identify the current range and numbers of the Giant Blind Mole Rat *Spalax giganteus* in the North Caucasus and to propose a program for restoration of its distribution and numbers. Mapping colonies helped to identify the larger populations, to establish the spread and current boundaries of the range, and to establish key factors that caused reduced numbers and fragmented range in the 1980s-1990s. Studies on the ecology of *Spalax giganteus*, including underground communication systems, 24-hour activity, foraging and digging, showed that the colonization process is the critical mechanism enhancing population stability. Our research was conducted within the entire range of *Spalax giganteus* in the North Caucasus in 2005-2007.

Historical status was reviewed from the published literature. Study areas were located throughout the range of *S. giganteus* in Eastern Ciscaucasia^a. Current population size was evaluated on the basis of colony mapping and presence of new mounds, and then reassessed per hectare (Puzachenko and Vlasov 1993) (Fig. 1). In addition, 8 monitoring sites were established in the optimum range (N 43°21'603" E 47°05'941") in conditions with different grazing schemes where grazing has an impact on population dynamics. The protection status was assessed using the approach suggested by Puzachenko (1999). A long-term program and a set of measures have been developed to restore the number of *S. giganteus* in Eastern Ciscaucasia.



Fig. 1. Mapping process for identifying new mounds /© K. Omarov

Status

Spalax giganteus, first described by Nering in 1897 in the surroundings of Makhachkala, Russia, is found only in the North Caucasus and is the only species of Caucasus rodent included in the Red Data Book of the Russian Federation. It is the largest species of the family Spalacidae. Its body length reaches 350 mm; weight of adults ranges between 834g and 1,017 g in males and 636-800 g in females.

S. giganteus inhabits sandy and clay semi-deserts of north-east Ciscaucasia, near the Caspian coast (Red Data Book of the RF 2001; Omarov et al. 2007). It prefers sands covered with reeds and bushes, steppe-

like hilly sands with bushes, crop-herb steppes and *Artemisia*-herb steppes, but they usually avoid very humid or very dry areas with scarce vegetation (Pavlov et al. 1963; Gitinomagomedov and Spasskaya 1980; Spasskaya and Gitinomagomedov 1980; Spasskaya 1982; Omarov et al. 2007) (Fig. 2). The giant

^a Ciscaucasia = northern part of North Caucasus (Russia), mostly plains and foothills.

mole rat can also occupy anthropogenic landscapes: edges of rice fields, areas along road embankments, vegetable gardens, etc, though in most cases human activities (tilling, irrigation, overgrazing, etc) have a negative impact on status and numbers.

S. giganteus occurs in two areas in Ciscaucasia. The first is bounded by the Makhachkala-Gudermess railway up to Naurskaya station (Chechnya) in the south; the north-west boundary lies near the Tersko-Kumsk canal as far as the village of Achikulak (Stavropol Area). The north-east boundary runs from south of Bryansk Spit (Daghestan) through the villages of Talovka, Chubutla and Arslanbek, and the northern boundary runs through the Tersk-Bazhigansk-Achikulak sands to the village of Achikulak. The second is a small area in southern Kalmykia, near the Ulan-Holl railway station (Ognev 1947; Vereshchagin 1959; Pavlov et al. 1963; Prokofiev 1969; Topachevsky 1969; RSFSR Red Data Book 1983; Gineev et al. 1988; Pishvanov and Prilutskaya 1988; Puzachenko 1993; RF Red Data Book 2001; Omarov et al. 2007). In Daghestan, populations are distributed from the northernmost boundary to Makhachkala in the south and are found mainly in the lowlands, in fragmented areas, frequently at the edges of sandy massifs.

Since the mid-1970s, numbers of *S. giganteus* have been declining at a high rate. In 1963 the average density was 4-6 animals/1000 ha, and the total number in Ciscaucasia reached 20,000-25,000 animals (Pavlov et al. 1963). In the 1980s, average density fell to 0.2-0.3 animals/1000



Fig. 2. Typical habitat of the Giant Blind Mole Rat / © K. Omarov

ha, which was critical for the species. According to some estimates, total numbers in Daghestan, where most of the population is located, fell to 1.0-1.2 thousand animals during that period (Spasskaya and Gitinomagomedov 1980; Spasskaya 1982). According to some authors, these were underestimates. According to figures extrapolated from aerial surveys, the number of *S. giganteus* in Daghestan was about 10,000 (Gineev et al. 1988). One of the most negative consequences of the fall in numbers is range fragmentation. Virgin lands, field edges, scarce bushes and reeds became reserves where *S. giganteus* survived.

The fall in numbers and range fragmentation were caused by strong anthropogenic pressure that affected the entire range up to the end of the 1980s. Farming, irrigation, use of pesticides and flooding reduced the area of habitat. The southern boundary of the range contracted sharply to Kizliar. In habitats with the least human pressure, numbers reached their upper limit despite the overall downward trend. Unfortunately, no data on population fluctuations in the 1990s are available. Also during the 1990s, the entire complex of human impacts, primarily overgrazing, decreased in the north-west Precaspian zone, which influenced the current status of *S. giganteus*.

Females give birth at the end of April, and the young usually leave the nest at the age of 35-40 days. The offspring survival rate is quite high. The highest digging activity is recorded in spring, when they produce 70% of the total annual number of mounds. By the end of the growing season, digging activity is minimized.

Mapping of colonies during 2005-2007 allowed us to identify current range boundaries, to estimate the total population of *S. giganteus*, and to indicate areas of relative population density (Fig. 3). Field surveys

showed current positive population dynamics, compared to the fragmented range of the late 1980s. Fragments of the range have merged and extended farther to the south, up to the northern boundary of Makhachkala. The highest density was recorded in the Tarum, Kizlar, Hasavyurt and Kizilyurt regions of Daghestan (Fig. 3). We associate this positive trend with the considerable decrease in anthropogenic pressure during the 1990s, in particular, lower levels of livestock grazing and ploughing, to which *S. giganteus* is especially sensitive. This is further confirmed by inventories of *Spalax* populations carried out in 2005-2007 in the optimum range around the village of Samilah, Kizilyurt district, in an area called 'white forest' (N 43°21'603" E 47°05'941") (Fig. 1).

Two plots of equal area (15 ha each) were marked out, with equal initial density of *S. giganteus* calculated according to new mounds. At the same time, one plot was ungrazed. Two years later the number of new mounds on that site increased from 18 to 47.

Studies were also made on the system of underground tunnels, 24-hour activity, foraging, reproduction, digging activity and population-forming of *S. giganteus*. These studies formed the basis for assessing the prospects for restoring the range and numbers in the North Caucasus. *S. giganteus* lives only underground. It constructs a complex system of underground passageways with foraging and nest chambers, with a total length reaching 400 cm and above. Foraging passageways are located at depths of 15-50 cm and are extensive, whereas nest chambers are located 65-80 cm below the surface. Year-round digging activity is typical for *S. giganteus*, which pushes up 30-50 cm-high mounds of earth on the surface. The density of mounds depends on the density of the population and the season. As a rule, the 24-hour activity has a two-phase character, being more intense at night. *Spalax giganteus* forages primarily on vegetation, gnawing plant roots, and eating green matter and seeds. They store up to 2 kg of food (roots) in each 'storage' chamber.

Factors contributing to the vulnerability of *S. giganteus* include its low reproductive potential and conservatism of the intra-population structure, which allows only compensation for natural mortality (Puzachenko 1999). *S. giganteus* gives birth to one litter a year, early in spring. The percentage of reproducing females does not exceed 60%. Female mole rates reach sexual maturity in the second year of their life. On average, a litter does not include more than 3 embryos.

Population surveys showed good potential for restoring the range of *S. giganteus* in the North Caucasus. The colonization process is the most important mechanism for ensuring sustainability of a *S. giganteus* population. Our studies showed the potential for artificial colonization of the species, which would allow its numbers to be restored at a higher rate. In Northern Daghestan, some areas have been identified that are suitable for new colonies of *S. giganteus* in areas where the animal used to be common in the past.

Conservation Recommendations

A Restoration Program for *S. giganteus* has been developed and includes the following sections:

- I *Evaluation of the Status, Numbers and Range in all the North Caucasus*
- II. *Studies of Ecology under Situations of High and Low Anthropogenic Pressure*
- III. *Economic Development of the Region Affecting Conservation of the Species*
 - a) Land treatment
 - b) Land improvement
 - c) Overgrazing
- IV. *Threats*
 - a) Anthropogenic factors
 - b) Aridification of the climate

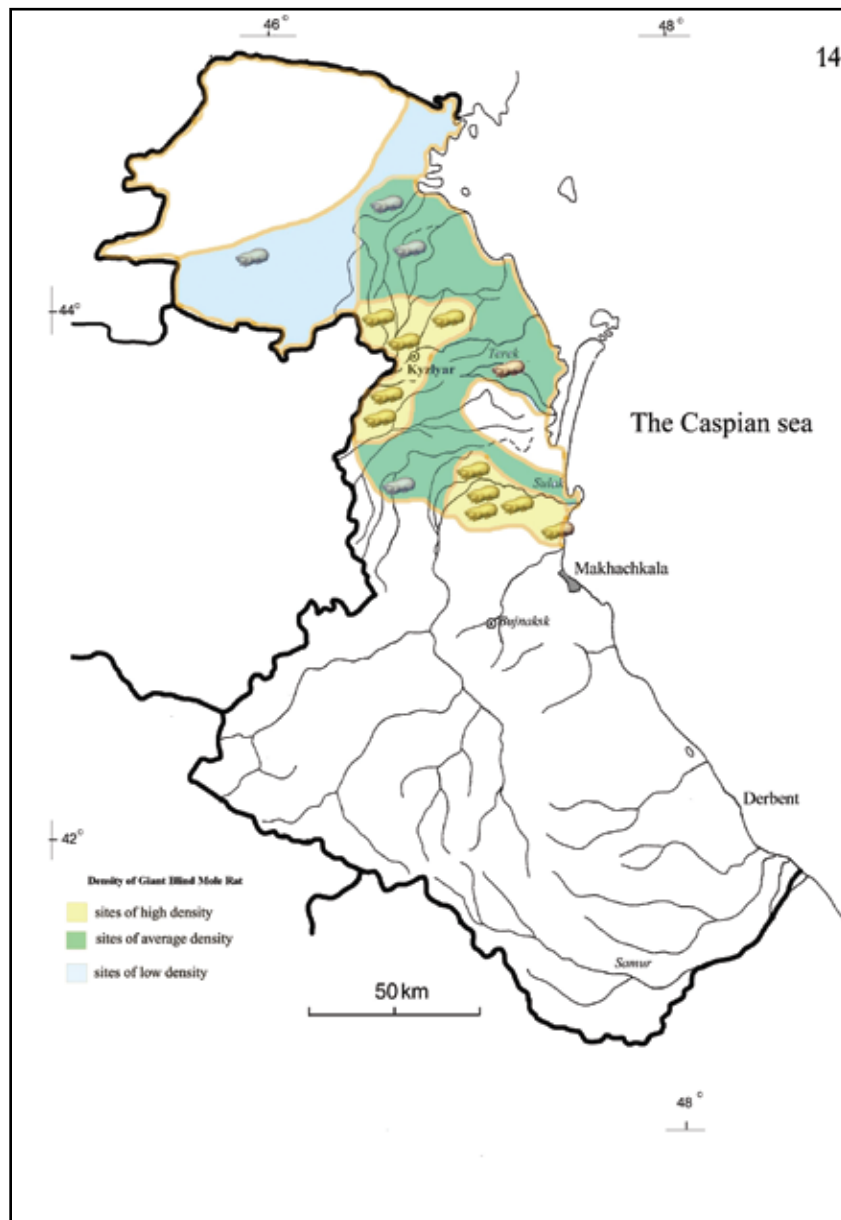


Fig. 3. Density of the Giant Blind Mole Rat

- c) Habitat deterioration
- d) Decreased forage

V. Conservation Measures

- a) Reduce anthropogenic pressure in the largest concentration zones
- b) Establish protected areas around large colonies
- c) Carry out long-term monitoring

VI. Restoration of the *S. giganteus* Population within its Range

- a) Reintroduction

Furthermore, we propose updating the status of the species on the IUCN Red List as *S. giganteus* is no longer endangered and positive population size dynamics have been observed. At the same time, the situation should be monitored on an ongoing basis until the range and numbers are fully restored.

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Executive Summary

The project “Estimation of the Current Status of the Dahl's Jird Population and Development of Recommendations for the Species Conservation” aimed to clarify the current status of Dahl's jird, changes in range and numbers, and major threats by comparing results of field research with collection specimens, reports and the literature. The project was carried out in 2006-2007. Known habitats of Dahl's jird were investigated on field surveys. No Dahl's jird populations were found. Its status is critically endangered and it is possible that it is extinct.

Status

Until recently, Dahl's jird *Meriones dahli* was regarded as a subspecies of southern jird *M. meridianus*. It is now shown to be a separate species with distinct features (Pavlinov and Rossolimo 1998). Its independence has been confirmed by hybridological analysis (Dyatlov and Avanian 1987) and analysis of karyotypes of different subspecies of *M. meridianus* (Korobitsina and Kartavtseva 1984, 1986, 1988).

Dahl's jird is one of the globally threatened species occurring in the Caucasus. It is listed as Endangered in the IUCN Red List (IUCN 2009) though research shows that in fact it met the criteria for Critically Endangered as early as 1980.

Distribution

Dahl's jird is endemic to the Ararat Plain. It is a psammophilic (sand-dwelling) species with a narrow ecological range and suitable habitat is found in rather small patches. These patches have been shrinking since the start of land development in the Ararat Plain and are continuing to shrink. By the 1960s, Dahl's jird distribution already covered less than 300 ha. Its range was divided into several isolated patches, separated by several dozen kilometers. According to the literature, Dahl's jird inhabited relict sands near the villages of Goravan, Shidlu, Pokr Vedi, Ranchpar, Markar and Sadarak (border village in Nakhichevan Autonomous Republic, Azerbaijan). The two largest areas of occurrence, Goravan and Sadarak, are situated close to the southwestern foothills of the Urts and Velidag ridges respectively. The other four areas are on the banks of the Aras river. These areas do not exceed several hectares and are separated from each other by floodplain habitats that are unsuitable for the jird. During spring floods, the areas become partially submerged, their size decreases and the configuration changes (Adamyan 1976).

Population

In the mid-1980s, the total estimate for the global population was 500-6,000. The last summary data on Dahl's jird were published in 1976. Later information consists of sporadic records, but also indicates a constant decline in numbers. In the 1990s, the population estimate was 500-1,000. Until recently, no precise information has been available on the limits of its range, its occurrence in certain areas that they

had inhabited earlier, on population numbers and trends, as well as on major threats.

Results

We focused our attention on sandy areas where Dahl's jird is typically found. In Armenia, the majority of these habitats are in the Ararat Plain. They consist of alluvial deposits formed by river sediments or, more often, by Pliocene lacustrine sediments, overlaid by deposits brought down by temporary mountain flows. The small size and isolation of the sandy areas from each other dictate the mosaic and fragmentary distribution pattern of Dahl's jird. Vegetation is closely connected with semi-desert *Achillea* species and represents the final stage of its development in the most pronounced sandy areas.

The most important area for Dahl's jird, is located close to Goravan. This is a classic *Calligonum* desert but much of the *Calligonum polygonoides* that dominates the hilly sands was cut down at the beginning of the 1990s. Vegetation cover is only 5-10% and is characterized by mosaic distribution and varying species composition (a majority of local plants are not found in other habitats). There are small shrubs of *Calligonum polygonoides*, a typical xerophyte. The current status of the species in the area that we have investigated is satisfactory as we observed fruiting plants and seed regeneration. The local vegetation also includes the following plants: *Achillea tenuifolia*, *Euphorbia marschalliana*, *Astragalus paradoxus*, *Oligochaeta divaricata*, *Salsola tamamschianae*, *Celsia suvoroviana*, *Heliotropium ellipticum*, *Nepeta micrantha*, *Scorzonera gorovanica*, *Ziziphora tenuior*, *Anisantha tectorum*, *Aphanopleura trachysperma*. There are also two plant species endemic to the South Caucasus and Armenia (*Scorzonera gorovanica*, *Astragalus holophyllus*) and a series of extremely rare, endangered species included in the Red Data Book of Armenia (*Sameraria glastifolia*, *Gypsophila virgata*, *Salsola tamamschjanae*, *Astragalus eriopodus*, *Astragalus paradoxus*, *Rhinopetalum gibbosum*, *Calligonum polygonoides*, *Aphanopleura trachysperma*, *Astragalus massalskyi*).

The Goravan Sands consist of 6 sections, separated by rain channels 15-150 m wide, often inhabited by Vinogradov's jird *Meriones vinogradovi* (Fig. 1). Each section has certain distinctive features. One section was formerly covered with mulberry (*Morus*) trees that have disappeared. There are silverberry (*Eleagnus*) shrubs growing along the borders of this area. It is covered by 20-120 m layer of blown sands overlying a 15-20 m layer of cemented sand, which in its turn overlays at least 2 m of poorly cemented sand, incorporating diatomite. There is almost no sand in the second section, which is composed of dry clay soils. There is a hill measuring 150-200 m in diameter in the southeast part of this area. The third section is covered with a 30-60 cm layer of blown sands with rock outcrops. The fourth section is covered with stabilized sands, while the fifth and sixth sections are completely covered with unstabilized sands with 2-m high hills. The sixth section borders on the Urts ridge and its branches. The rocky habitats adjacent to the sands are inhabited by Vinogradov's jird and Persian jird *M. persicus*, while the clay habitats are inhabited by Tristram's jird *M. tristrami*. Although jird habitats in Armenia are of the same type and all Dahl's jird colonies are confined to sands, mainly poorly fixed hilly sands at elevations ranging between 600 and 1,200 m, the foothill and bank habitats differ to a certain extent in their soil composition and vegetation communities.

The second group of districts investigated are sandy areas near the Aras river and in the Ararat Plain. The main difference between these areas and the Goravan sands is the absence of *Calligonum*, while the key features of the vegetation (5-10% cover, and mosaic distribution) and flora are similar to the first area. The typical xerophyte, *Achillea tenuifolia*, is the dominant species, which also includes *Taeniatherum crinitum*, *Lepidium vesicarium*, *Kochia rostrate*, *Noaea mucronata*, *Haplophyllum villosum*, *Euphorbia marschalliana*, *Cymbocarpus anethoides*, *Tribulus terrestris* and other plants. No rare plant species were found in these areas during our research. Tristram's jird is common in saltwort (*Salsola*) semi-desert

bordering these areas.

The third group of sites is situated in the Azat catchment and is covered with semi-desert vegetation associated with volcanic sands. Local vegetation mainly has features typical for sand deserts and cover is a little more extensive, up to 15-20%, especially in spring and early summer. The vegetation is composed of shrubs: *Zygophyllum atriplicoides*, *Rhamnus pallasii*, *Spiraea crenata*, *Rosa spinosissima*, and herbs: *Astragalus paradoxus*, *Matthiola odoratissima*, *Allium materculae*, *Stipa capillata*, *Tanacetum chiliophyllum*, *Taeniatherum crinitum*, *Anisantha tectorum*, *Capparis spinosa* and others. Several plant species rare for Armenia, are found in this area: *Zygophyllum atriplicoides*, *Amberboa moschata*, *Spinacia tetrandra* and others. Rocky habitats around the sands are inhabited by the Persian jird.

The fourth group of sites investigated is located in the western part of the Ararat Plain near Talin. These are stony semi-desert areas with typical *takyr* habitats. The dominant species is *Artemisia fragrans*; local vegetation also includes *Ceratocarpus arenarius*, *Koelpinia linearis*, *Kochia prostrata*, *Xeranthemum squarrosum*, *Tanacetum chiliophyllum*, *Jurinea pulchella* and others.

We also investigated abandoned sand pits. Although sand excavation has ceased, there are no typical sands or vegetation in these sites and soils are covered with weeds and ephemeral plants typical of Armenian semi-deserts, such as *Taeniatherum crinitum*, *Anisantha tectorum* and *Tanacetum chiliophyllum*, as well as the dominant species of sagebrush semi-desert such as *Artemisia fragrans*, *Capparis spinosa*, and *Kochia prostrata*.



Fig. 1. Goravan sands with *Calligonum polygonoides* / © M. Kalashian

Unfortunately, no Dahl's jird populations were found during our research over two field seasons. We believe it is too early to reach the conclusion that Dahl's jird is extinct, although certain unpredictable and adverse factors that hampered our field research have undoubtedly affected jird populations as well.

Our first field expeditions in 2006 showed that the Goravan sands had been colonized by large populations of Tristram's and Vinogradov's jirds. The process started in summer 2005 at the latest, while by summer 2006, the Persian jird appeared in Goravan, where it had not been found before. This made it very difficult to identify Dahl's jird burrows, as it is impossible to distinguish them visually from burrows of young jirds of larger species. No information on colonization of sandy areas by non-psammophilic jirds is available in the literature. According to the Centre for the Prevention of Extremely Dangerous Infections that has been monitoring this district since 1969, this is the largest-scale expansion ever recorded there. This expansion could undoubtedly be the reason for the critical state, or even disappearance, of Dahl's jird in this area. The presence in Goravan of the third species, Persian jird, that is the most aggressive when in sympatry with other species, further aggravates the critical situation of Dahl's jird. This expansion of other jird species has been caused by a number of factors of which anthropogenic pressure and first signs of global climate change are the most important.

Thus, small/medium-size populations of Vinogradov's jird and even smaller populations of Persian and Tristram's jirds that had been typical for the entire Armenian range, including the Goravan sands since 1991, increased in size very rapidly during the historically hot and dry years 1997-2006 that were most

favorable for jirds. Populations of the three jird species reached their maximum size in the most favorable habitats and remained high with slight fluctuations and two peaks in 2001 and 2005. At the time of the first, and highest peak of 2001, several habitats suitable for Vinogradov's jird remained unoccupied. This enabled the population to stay within its typical habitats. Yet, by the time of the second peak in 2005, there were no unoccupied areas left, which caused the population to expand into the sands that are not a typical habitat for this species. This factor has had a similar influence on Persian and Tristram's jirds. However, their population peaks were lower, as these species are non-colonial and their expansion into the sands was caused by destruction of their virgin habitats by people who converted stony and clay semi-deserts and foothills into gardens and farmlands, as well as by a growth in their numbers. The process became more intensive with the advent of big private landowners at the end of the 1990s. A decline in population size in the sands (no doubt suboptimal sites for these species), which we observed in summer-autumn 2006, and possibly wintering conditions, caused the migrants to vacate the largest part of the sands by the end of spring 2007. By autumn 2007, all main colonies of non-psammophilic jirds in the Goravan sands were abandoned, but, unfortunately, no colonies of Dahl's jird were found there either.

The unusual climatic conditions of winter 2006 and spring 2007 also negatively affected our research. Early snowfall and thick snow cover that remained until April, as well as extremely low temperatures in the Ararat Plain in the first ten days of November and historical minimum temperature (-38°C) in December, hampered the field work scheduled for this period which was designed for a snowless and moderately cold winter.

Considering the 20th century literature on changes in the size and configuration of the floodplain sands depending on spring flood levels, we suggest that long-term flooding of the Aras riverside, floodplain and even flood-free areas is an even more negative factor than expansion of other species. High water levels in the Ararat Plain caused by rapid melting of unusually large snowfall and abundant precipitation in spring left no escape routes for small animals inhabiting the sands. Besides, the long-term impoundment of these areas due to the high level of ground water impeded burrowing and other activities, including the reproductive cycle. The same factors caused a large landslide and mudflow close to Goravan, which fortunately did not affect the sandy massif, but made a majority of areas in the Aras basin that we planned to investigate inaccessible until the middle/end of May and in some districts even until the middle of June. This forced us to reduce the scale of our research.

Finally, human impact has certainly contributed greatly to the critical state of Dahl's jird. In Goravan, anthropogenic activities included livestock grazing and almost total cutting of the tree-like *Calligonum* shrubs for firewood in the early 1990s. The latter has probably had an even stronger impact on Dahl's jird, as *Calligonum* seeds make up 70-80% of winter forage reserves and survival of the population in winter is hardly possible without these shrubs.

Uncontrolled sand extraction in sand-rich districts, which are most favorable for the jird, also had a negative impact. Another negative factor is the work in a quarry higher in the mountains. Roads leading to the quarry pass through the blown sands - the best jird habitats - while intensive movement of heavy trucks causes strong vibration of soil, which may damage or destroy jird burrows.

It was established during the expedition to the Aras sands in 2007 that almost all sandy areas on the river banks within the range described in the literature of the 1960s-1970s have been damaged by floods and sand excavation, which completely exhausted sand reserves in some areas. We saw 30 and more trucks waiting in line near the sand pits. According to the drivers, some of them make several trips a day. It is impossible to judge whether Dahl's jird used to occur in these areas and the majority of other sites that we investigated and that had not been described before, as floods and uncontrolled human activity could have erased the very signs of former presence of any jird species in this region. Some sandy areas that we

identified using geological maps, or that we were recommended to investigate, proved to be a recently exposed layer. i.e. had remained at the depth of several meters from the surface until recently, but were exposed by industrial sand recovery and consequently had a very poor flora and fauna.

Based on the above factors, it is impossible to rule out the actual loss of the Dahl's jird in this region. However, the barriers and obstacles that we encountered while trying to find the population in the sandy areas of the Ararat Plain give reason to hope that a more detailed and long-term investigation would result in the discovery in the Goravan area of several individuals or a small population that had migrated to a sandy area that we failed to investigate and now returned to its main territory. However, we believe that the possibility of Dahl's jird populations surviving in the sands on the river banks is extremely low.

Recommendations

We consider it necessary to classify Dahl's jird as Critically Endangered (CR). If the disappearance of its populations in Armenia is confirmed by additional research that we plan to conduct in the next field season and following seasons, we will try to find an opportunity to investigate the sandy areas on the right bank of the Aras and the Aralyh sandy massif in Turkey, which, according to recent data (Krystufek and Vohralik 2005), is inhabited by midday jird *M. meridianus*. Turkish zoologists consider this to be *M. dahli* (Yigit et al. 1998). Pavlinov *et al.* also made a similar suggestion in 1990, and included the neighboring regions of Iran in the range of the species as well. We have serious doubts regarding this theory, as *Meriones meridianus* → *M. dahli* evolution could hardly have occurred equally in areas covering several hundreds of thousands of hectares, even if we presume that all concomitant conditions coincided, which is also very doubtful. However, we believe that this theory should be investigated.

We also consider it necessary and advisable to invite a group of researchers from Moscow Zoo to participate in this work. In October 2006, we conducted a joint expedition to Goravan, which however yielded no results. In 2005-2006 the Moscow Zoo researchers assessed the opportunities for creating a captive population of Dahl's jird for future reintroduction. The work was undertaken with a grant from the European Association of Zoos and Aquaria (EAZA). Since creating a captive breeding population of Dahl's jird for reintroduction is urgent, and is our main recommendation under the project, we would need the expertise of the Moscow Zoo specialists.

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Executive Summary

The project aimed to create a coordinated ‘IBA caretaker’ network consisting of people living at or near 31 sites (20 in Azerbaijan, 5 in Armenia, 5 in Georgia, 1 in Turkey). The sites are Important Bird Areas (IBAs), identified by BirdLife International for one or more globally threatened bird species within the Caucasus ecoregion priority corridors.

IBA Caretakers are local people or groups who are able to promote, carry out and/or contribute to conservation and monitoring of globally threatened bird species and the conservation of each site. Development of IBA Caretaker Networks is an integral part of the IBA conservation program. The IBA Caretaker approach is a relatively flexible conservation tool and has proved to be very effective in a variety of political situations. Each network consists of a national coordinator, based at the HQ of the national NGO that BirdLife works with, and local caretakers living at or near each site. The CEPF project offered the opportunity to implement this scheme in the region.

The project was carried out between June 2005 and June 2008 by BirdLife International and four local partners: Armenian Society for the Protection of Birds (ASPB); Azerbaijan Ornithological Society (AOS); Georgian Center for the Conservation of Wildlife (GCCW); Doğa Derneği (Turkey) (DD). A full version of the Final Project Report is available from http://www.cepf.net/Documents/Final_Birdlife_IBACaucasus.pdf

The long-term Project Goal was: to achieve improved conditions at 31 sites for globally threatened species. The Project Purpose: To create an effective network of local people that promotes the conservation of sites identified in priority corridors for globally threatened bird species.

The capacity of national NGOs to identify and react to threats has increased dramatically through the establishment of the caretaker network.

Methods

A wide range of techniques was used to identify potential caretakers, from informal talks and presentations featuring the IBA program and other conservation issues, and activities including documentary films, contests in village schools, quizzes etc. Training sessions on IBA monitoring, grant writing, fundraising, and environmental legislation were delivered to local caretakers. All caretakers received training in baseline IBA surveys and were involved in other field work (mid-winter counts and/or field survey) and educational activities, particularly in schools.

^a Compiled by editors according to Final Project Completion Report (see link above).

Results

IBA Caretakers

A network of local people at site level across priority corridors was established and trained. The capacity created at national level also allowed national organizations to engage local communities at other sites not directly covered by this project. National IBA Caretakers were established at 29/31 sites (93.5%) (Table 1):

Table 1. Sites covered by the IBA Caretaker project

Corridor	Country	Site Outcome Name	IBA Name
West Lesser Caucasus	Georgia ¹	Meskheta	Meskheta Erusheti
		Trialeti Range	Trialeti Ridge
		Batumi	Batumi
		Kolkheti	Kolkheti
	Turkey ²	North-eastern Black Sea Mountains	North-eastern Black Sea Mountains
East Lesser Caucasus	Armenia ³	Dsegh-Haghartsin-Pambak Chain and Dilijan NP	Dsegh
			Haghartsin
			Pambak
	Lake Sevan	Sevan	
	Djermuk	Djermuk	
	Gorike	Gorike	
	Noravank	Noravank	
Greater Caucasus	Georgia ¹	Lagodekhi	Lagodekhi
	Azerbaijan ⁴	Ismaily	Ismaily
		Babadag Mountain	Babadag Mountain
		Shakhdag Mountain (1)	Shakhdag Mountain
Caspian	Azerbaijan ⁴	Samur Delta	Samur Delta
		Akzibir Lake	Akzibir Lake
		Kargabazar and Gush-Gaya Mountains	Kargabazar and Gush-Gaya Mountains
		Krasnoye Lake and Absheron Waterbodies	Red Lake and Absheron Waterbodies
		Alat Bay-Baku Archipelago (1-9)	Alat Bay
		Shirvan NR / Shorgel Lakes	Shorgel lake
		Kura Delta	Kura Delta
		Gyzyl-Agach Bay	Gyzyl-Agach Bay
		Mahmud-Chala Lake	Mahmud-Chala Lake
		Hadjikabul Lake	Hadjikabul Lake

Note: ¹Georgia 5/5 sites (+2 IBAs not in priority corridors); ²Turkey 1/1 (4 local caretaker groups); ³Armenia 4/5 (+1 IBA not in a priority corridor); and ⁴Azerbaijan 19/20 sites (+13 IBAs not CEPF priority sites or outside priority corridors).

All caretakers are members of the local community and received training on biodiversity conservation and monitoring. They are constantly in contact with the national coordinators and among themselves through national newsletters, telephone and email, and meet regularly.

Although the Eastern Black Sea Mountains site in Turkey covers a mountain range that represents an ecological unit, its size (1.7 million ha) and the limited network of roads and transportation made it very difficult to establish a well integrated network of caretakers. Communities on the two sides of the mountains are separated for several months during winter and the habitats are quite different. Also the road system is limited along the east-west axis. While reviewing the Key Biodiversity Areas for Turkey, DD split the site into 7 sub-sites. DD has established IBA caretakers in 4 sub-sites and identified contact persons in all 7 sub-sites and most of the towns. However, despite the good work of the existing caretakers, DD feels that they do not represent a functional network within the area: they all report to the Ankara HQ but do not interact among themselves, as hoped. DD is implementing other projects in the region and will continue work to improve the effectiveness of the network.

An updated Georgian IBA inventory has been produced, based on field work carried out by GCCW and IBA caretakers. A similar inventory is being finalized for Armenia and is scheduled for Azerbaijan in 2009.

The IBA monitoring scheme was implemented at all priority sites and data incorporated into the BirdLife World Bird Data Base and shared with local authorities and Wetlands International.

Species Action

Regional Species Action Plans (SAPs) were developed for globally threatened species: Imperial Eagle *Aquila heliaca* (Fig. 1) and Lesser Kestrel *Falco naumanni* (Fig. 2). A single action plan covered Dalmatian Pelican *Pelecanus crispus*, Lesser White-fronted Goose *Anser erythropus*, Red-breasted Goose *Branta ruficollis*, Marbled Duck *Marmaronetta angustirostris* and White-headed Duck *Oxyura leucocephala*.

Priority actions identified by the SAPs have been implemented through small grants and through additional work funded by successful fundraising efforts of national partners. Twenty-four Site Action Plans have been developed for priority sites plus 9 for sites outside the priority corridors:

Azerbaijan - 13 Site Action Plans (+ 7 sites outside priority corridors)

Armenia - 4 Site Action Plans

Georgia - 3 Site Action Plans (+ 2 sites outside priority corridors)

Turkey - 4 sub-Site Action Plans

Surveys improved our knowledge of the presence and population size of target bird species. The Azerbaijan national population of Imperial Eagle has proven to be far bigger than the 20-25 pairs estimated and may possibly be over 100 pairs.

Where the presence of target species could not be confirmed, the actions address other globally threatened species (Wild Goat *Capra aegagrus* in Turkey and bats in Noravank, Armenia) or flagship species (Caucasian Grouse *Tetrao mlokosiewiczzi* and Caucasian Snowcock *Tetraogallus caucasicus*) whose protection would benefit other globally threatened species



Fig. 1. *Aquila heliaca* / ©Z. Javakhishvili

that share the same habitat and threats.

One site in Azerbaijan (Krasnoye Lake) was largely destroyed in summer 2007. 40% of it was filled and a large shopping center was built. AOS had lobbied since 2006 for its protection and supplied scientific evidence on the importance of the site to the Ministry of Ecology and Natural Resources (MENR). Apparently as a result of the intervention of the MENR, part of the lake was spared and AOS is monitoring the situation carefully. Nevertheless this negative experience provided AOS with the



Fig. 2. *Falco naumanni* / © M. Ghasabyan, ASPB

opportunity to raise the issue with the media and the international community. A media event was organized on site and was attended by the German Ambassador, as well as a number of newspapers. On the positive side, the development also filled in two large water bodies which were highly polluted by oil and that most probably represented a deadly trap for migrating waterbirds. The Ministry stopped the work and 60% of the lake is still in place. As the work around the lake continued, ongoing monitoring by AOS registered a strong decline in wintering birds.

The main threat in the Eastern Black Sea Mountains is the planned destruction of the Çoruh River by a number of large dams which will transform the local ecology and economy and will require the re-location of several villages and many thousands of people. Local caretakers and SSGs were also involved in this issue and the damage that the dams will cause was

discussed during public awareness raising activities. DD has joined a growing international campaign and actively lobbied national government and international organizations against this project.

Public Awareness

One of the main threats identified during the planning phase of the project was the lack of knowledge among local communities, hunters, and local authorities of the conservation status of the target bird species and the importance of their country and site for them.

To address this problem, a range of public awareness materials were produced. Four posters were prepared by the project team. Each national partner developed one poster and all posters were produced in four national versions. The posters promoted the conservation of (1) Imperial Eagle, (2) Lesser Kestrel, (3) Wetlands and threatened waterbirds, (4) Threatened and endemic birds of the Caucasus. Each partner developed other public awareness tools such as calendars (Armenia and Azerbaijan), IBA leaflets and billboards (Armenia), IBA Newsletters. Public meetings were organized in all sites in order to engage local people and raise awareness.

Capacity Building

The capacity of national NGOs to deliver conservation has increased and all national organizations have improved their status within the BirdLife network. National NGO capacity to fundraise improved significantly and all national partners are now able to maintain the staff and the level of activities they were able to develop through this project.

The four national NGOs have also increased their capacity to address threats affecting globally threatened species by working at the appropriate level (local, national). They improved their technical skills in

conservation planning, fundraising, public awareness and communication as well as on working with local people.

The project offered the opportunity to national NGOs and their local caretakers to establish networks which allow the members to use and exchange experience, national and international recognition of their activities and provide them the feeling of belonging to a group of people doing the same work in different part of the country and even in different part of world.

Small Grants Program

This allowed implementation of direct conservation actions and enabled several caretakers to plan, fund-raise for, implement, and report conservation actions. Managing the small grants helped national NGOs to improve their skills in project assessment and evaluation. In total, 16 small grants were awarded: 4 in Armenia, 6 in Azerbaijan, 3 in Georgia and 3 in Turkey (for more detailed information see link provided in Executive Summary section).

Additional Funding

A further c. \$245,000 were raised from a range of different donors for work directly related to the CEPF project, in particular for the implementation of Species Action Plans and Site Action Plans or for further awareness raising activities.

Acknowledgements

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Scope and Objectives

The project consisted of two phases: April 1st, 2006 – June 31st, 2007 and February 1st, 2008 – January 31st, 2009. It was implemented by the Russian Bird Conservation Union and Wetlands International-Russian Program

The aims of the project were to:

1. Enhance the network of Important Bird Area (IBA) caretakers in the North Caucasus.
2. Extend the network to all 29 IBAs in priority corridors (Greater Caucasus Corridor and Caspian Corridor).
3. Develop 10-year action plans for all priority IBAs and Ramsar sites.
4. Develop conservation action plans for priority species (Fig. 1).



Fig. 1. Pelicans (Pelicanus crispus) in Khanskoe Lake / © R. Mnatsekanov

Results

IBA Caretakers

A network of IBA caretakers was established in the North Caucasus region. 80 IBAs (72% of all IBAs) and 4 additional sites are covered by 86 caretakers and 7 caretaker groups. In priority corridors, all 29 IBAs are secured by 42 caretakers and 3 caretaker groups. Caretakers enhanced their capacity and gained new skills during training and site action projects.

Fifty caretakers, regional coordinators and local people took part in the training for the local. A manual for IBA caretakers was produced and combined with Guidelines on legal tools for IBA caretakers with co-funding

of 2000 USD from the Dutch Ministry of Agriculture.

Special diplomas were designed and presented to the most active caretakers. Caretakers and caretaker groups also received materials on IBAs conservation, binoculars, guides and stickers.

IBA Review

Information on all IBAs in the North Caucasus region was reviewed and revised. 43 new IBAs were identified and their details entered into the World Bird Data Base. The boundaries of 70% of IBAs were refined and amended where necessary to improve their conservation purpose. Boundaries of all IBAs were digitized and stored in GIS format.

Datasheets for all 111 North Caucasus IBAs added to National IBA Database in RBCU coordination

center. A Review of all 111 IBAs in the North Caucasus region was published and distributed to the Ministry of Nature Resources of Daghestan, Ministry of Nature Resources of North Ossetia Republic, Daghestan Hunters' Society, state reserves and national parks, universities and others.

The 32 Caucasus IBAs of top conservation importance were proposed to the Russian Government by RBCU for inclusion in the new National List of prospective Specially Protected Areas.

Detailed action plans were developed for 29 IBAs in the priority corridors. These were published as a book that also contained the geographical, ornithological and economical characteristics of each IBA, analysis of threats and recommendation for conservation.

Species Action Plans

New data on priority bird species were collected. Action plans for 14 priority species were produced and published in a bilingual book "*Action plans for conservation of globally threatened birds in Caucasus eco-region*". The book was distributed to decision making agencies, ecological NGOs, and regional IBA coordinators and caretakers.

Site-based Actions

Seven site projects were carried out in 2006-2007 involving more than 100 volunteers:

- Excursions to 13 IBAs with children, school teachers and students.
- Exhibitions in 18 schools with posters and other information on priority bird species and IBA protection.
- Training for IBA caretakers and local people on bird identification and IBA protection.
- Poaching inspections on 11 IBAs by hunting inspectors and caretakers.
- Repair of irrigation systems on Temirgoiskie lakes IBAs.
- Organization of 2 new children ecological hobby groups on the base of IBAs.
- Six training sessions on IBAs and bird protection for teachers.
- Four trainings for hunters, game managers and National Reserves wardens.
- Ecological education activities based on IBAs in schools in Daghestan (conferences, lectures, competitions, festivals).
- Leaflets and posters about IBAs and threatened birds of Daghestan and Great Caucasus were printed.

RBCU was involved in action at two threatened IBAs.

Publicity

Information on the results of site action projects was been published on the RBCU (<http://www.rbcu.ru/programs>) and in 3 regional newspapers. Reports on local conservation action and IBA monitoring field projects were published in the RBCU IBA Bulletin which was circulated to 220 addresses - IBA coordinators, caretakers and decision making agencies.

Information about the project, IBA protection and IBA caretakers groups was published in newspapers in Daghestan Republic and Stavropol krai, and proceedings of Daghestan Geographical Society. Documentary films devoted to IBAs were produced and shown on Makhachkala TV. Monograph devoted IBAs, bird conservation and ecological education was published in Makhachkala (Daghestan).

Books and brochures published within the framework of the project:

- Bukreev, S. A., Dzhampirzoev, G. S. (Eds.). 2009. *Key ornithological areas of international importance in the Caucasus*. Moscow: RBCU. (In Russian)

- Bukreev, S. A., Dzhamirzoev, G. S. (Eds.). 2008. *Action plans for conservation of globally threatened birds in Caucasus eco-region*. Moscow, Makhachkala: RBCU. (In Russian and English)
- Bukreev, S. A., Dzhamirzoev, G. S. (Eds.). 2008. *Recommendation for conservation IBAs in Caucasus region*. Moscow, Makhachkala: RBCU. (In Russian)
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Executive Summary

The project aim was to develop a structured database to update the Red Data Book of Armenia on amphibians and reptiles. The project had the following objectives:

1. To update the Red Data Book of Armenia for reptiles and amphibians by including the latest data and applying recent taxonomic revisions;
2. To bring the Red Data Book of Armenia in conformity with the IUCN Red List;
3. To determine status of species on the IUCN Red List and to verify their existence in Armenia;
4. To prepare proposals for including species found in Armenia in the IUCN Red List;
5. To determine the ranges of rare and threatened species to provide a scientific basis for development of the PA system;
6. To study distribution, zoning, habitats and the ecology of selected species;
7. To analyze economic activities and human impact on their habitats; and
8. To identify areas to be designated as protected areas (PA).

The eastern part of South Caucasus, in particular Armenia, is one of the most interesting regions of the Caucasus region in a herpetological sense. The geographical location of Armenia, range of elevations, complex mountain terrain, diversity of soils and climatic conditions result in a vertical sequence of 9 altitudinal zones, from dry subtropical to nival. The consequence is a wide diversity of flora (over 3,500 higher plant species) and fauna (over 530 vertebrate species) (Baloyan, Shashikyan 1999), as well as a large number of endemic forms and restricted-range species. Out of 100 amphibian and reptile species occurring in the Caucasus, 59 have been found in Armenia (7 amphibians and 52 reptiles). The fauna is also notable for the presence of species of different origin, inhabiting the periphery of their ranges or isolated from their main ranges.

Many restricted-range and narrowly adapted species, endemic to certain landscape zones, have become critically endangered. The distribution of national reserves, changes in administrative borders, transfer of land to village communities and its privatization have been in progress in Armenia over the last few years. Given all this, it is essential to identify rare and endangered species and include their typical habitats in the protected areas system.

Methodology

Field observations were conducted throughout the field season (March-October) during 2006-2008. We also used results of long-term observations (since 1975) and all data available in the literature. We analyzed collection materials in Armenia (Zoology Institute, National Academy of Sciences of the Republic of Armenia), as well as those in the Zoology Institute of the Russian Academy of Sciences and the Caucasus Reserve in Sochi.

Species were selected for study through analysis of the available data (including the previous edition of the Red Data Book of Armenia, 1987; Red Data Book of the USSR, 1984; IUCN Red List, 2001, and

others) and consultation with specialists from Armenia and foreign institutions (Institute of Zoology of the Russian Academy of Sciences, St. Petersburg, Russian Federation; Caucasian Reserve, Russian Federation; Saint Louis Zoo and Fresno Zoo, USA; Toronto Royal Museum, Canada, and others). A total of 28 species (4 amphibians and 24 reptiles) were studied.

The project covered the entire territory of Armenia. Observations were made in Khosrov and Shikakhokh Reserves, in several sanctuaries and some herpetologically interesting areas. We selected study areas based on the latest records of different species and analysis of uninvestigated areas. We selected plots along our route and made morning, day or evening excursions depending on season, weather and temperature. Expedition members followed different routes but remained in contact with each other. As a rule, study areas were most typical of, or likely to be inhabited by, certain species according to habitat, altitude, etc. For each animal found, we recorded location, habitat, size, sex and physiological state, then released it at the site of capture. Coordinates and altitudes were recorded using GPS and marked on the maps.

We conducted phonological observations, and studied habitats to assess whether they were suitable for reptiles and amphibians. Standard methods were used (Andrushko 1936; Kaletskaya 1952; Korotkov 1980) with certain modifications conditioned by area-specific relief. To evaluate some ecological issues, animals were put in terrariums. Feeding trends were also studied using non-lethal methods, such as palpation and stimulation of regurgitation (Verzhuiskiy and Zhuravlev 1977).

Standard cartographic methods were applied to determine borders and measure size of habitats, using GIS and AutoCAD, topographic maps, landscape and cadastre maps. Status was evaluated using the IUCN Red List criteria. All data obtained were included in a computer database.

Status

We obtained comprehensive information on the status of the amphibian and reptile fauna of Armenia. We identified new sites inhabited by more than 12 species. We analyzed species composition in protected areas (PAs) and proposed PAs. We identified certain features of ecology, habitats, and phenology of most species. The list of rare and endangered species was updated. The Red Data Book of Armenia currently includes 1 species of batrachofauna and 11 herpetofauna species. We recommend the inclusion of 21 species (2 amphibians and 19 reptiles). These species have been described in separate articles, including range maps. One species (Darevsky's viper *Vipera darevskii*) is described in full and the other 20 are summarized below.

Amphibia

***Ommatotriton ophryticus* (Berthold, 1846) - Northern banded newt**

Status. Local relict populations are found in northern Armenia. Included in the Red Data Books of the former USSR, Russia and Georgia, as well as Annex II of the Bern Convention. Recommended for inclusion in the Red Data Book of Armenia as CR B2ab (iii,v).

***Pelobates syriacus* (Boettger, 1889) - Eastern spadefoot toad**

Status. Rare, narrow-range, declining. Included in the Red Data Books of the former USSR, Armenia and Azerbaijan and the Bern Convention. Classified as LC by IUCN and listed as VU B2ab(ii,iii) for Armenia.

Reptilia

***Testudo graeca* (Linnaeus, 1758) - Spur-thighed tortoise**

Status. Classified as VU A1cd by IUCN. Listed on CITES and Annex II of the Bern Convention, and in the Red Data Books of the former USSR and Armenia. Recommended for inclusion in the Red Data Book of Armenia as VU A2cd, B1a+2ab

***Phrynocephalus horvathi* (Mehely, 1894) - Sunwatcher toadheaded agama**

Status. Earlier regarded as a subspecies of *P. helioscopus*. Extremely rare, threatened species. Included in the Red Data Book of the former USSR. Recommended for inclusion in the IUCN Red List and the Red Data Book of Armenia as CR B2 ab(i,ii,iii).

***Ablepharus chernovi* (Darevsky, 1953) - Chernov's Skink**

Status. Extremely rare, threatened species. Included in the Red Data Books of the former USSR and Armenia. Recommended for inclusion in the IUCN Red List as CR A2ac.

***Trachylepis septemtaeniata* (Reuss, 1834) - A skink species**

Status. Classified as DD on the IUCN Red List. Included in the Red Book of Armenia as NT.

***Eumeces schneideri* (Daudin, 1802) - Long-legged skink**

Status. Included in the Red Data Book of Armenia. Classified as LC on the IUCN Red List. Recommended for inclusion in the Red Data Book of Armenia as NT.

***Eremias arguta transcaucasica* (Darevsky, 1953) - Transcaucasian steppe racerunner**

Status. Extremely rare, threatened species. Included in the Red Data Book of Armenia as a species isolated from the main range, with the subspecies endemic to Armenia. Recommended for inclusion in the IUCN Red List and the Red Data Book of Armenia as CR B2ab(ii,iii).

***Eremias pleskei* (Bedriaga, 1907) - Pleske's Racerunner**

Status. Narrow-range and declining. Recommended for inclusion in the IUCN Red List and the Red Data Book of Armenia as CR B2ab(ii,iii).

***Parvilacerta parva* (Boulenger, 1887) - Dwarf lizard**

Status. Extremely rare, threatened species. Included in the Red Data Books of the former USSR and Armenia, as well as the Bern Convention. Recommended for inclusion in the IUCN Red List and the Red Data Book of Armenia as CR A2ac.

***Darevskia praticola* (Eversmann, 1834) - Meadow lizard**

Status. NT on the IUCN Red List. Recommended for inclusion in the Red Data Book of Armenia as VU B1ab(iii)+2a.

***Darevskia dahli* (Darevsky, 1957) - Dahl's rock lizard**

Status. NT on IUCN Red List. Recommended for inclusion in Red Data Book of Armenia as EN B1a+2a.

***Darevskia rostombekovi* (Darevsky, 1957) - Rostombekov's rock lizard**

Status. EN B1ab(i,iii) on the IUCN Red List. Recommended for inclusion in the Red Data Book of Armenia as EN B2ab(ii,iii).

***Darevskia unisexualis* (Darevsky, 1966) - White-bellied lizard**

Status. Classified as NT on the IUCN Red List. Recommended for inclusion in the Red Data Book of Armenia as NT.

***Zamenis hohenackeri* (Strauch, 1873) - Transcaucasian rat snake**

Status. Included in the Red Data Books of the former USSR and Armenia. Recommended for inclusion in the Red Data Book of Armenia as NT.

***Pseudocyclophis persicus* (Anderson, 1872) - Dark-headed dwarf racer**

Status. Rare, narrow-range species. Recommended for inclusion in the Red Data Book of Armenia as Critically Endangered - CR B2ab(i,ii,iii).

***Rhynchocalamus melanocephalus satunini* (Nikolsky, 1899) - Satunin's black-headed rhynchocalamus**

Status. One of the rarest and least-studied snakes in the South Caucasus. Only 19 individuals have been recorded, including 17 in Armenia and Nakhichevan (Azerbaijan). Included in the Red Data Books of the former USSR and Armenia. Recommended for inclusion in the IUCN Red List and the Red Data Book of Armenia as VU B2ab(i,iii).

***Telescopus fallax* (Fleschmann, 1831) - European tiger snake**

Status. Classified as LC by the IUCN Red List. Included in the Red Data Book of Armenia. Recommended for inclusion in the Red Data Book of Armenia as NT.

***Vipera (Pelias) eriwanensis* (Reuss, 1933) - Armenian mountain steppe viper**

Status. Endemic to Armenian upland. The population has been dramatically declining in number during the recent years. Classified as Vulnerable B1ab(iii,v), on the IUCN Red List. Recommended for inclusion in the Red Data Book of Armenia in the same category VU B1ab (iii,v).



Fig. 1. Darevsky's viper / © A. Agasyan

***Vipera (Montivipera) raddei* (Boettger, 1890) - Caucasus viper or Raddei's viper**

Status. Endemic to the Armenian uplands. The population has been dramatically declining in recent years. Included in the Red Data Books of the former USSR and Armenia. Recommended for inclusion in the IUCN Red List and the Red Data Book of Armenia as VU B2b(ii,iii).

***Vipera (Pelias) darevskii* (Vedmederja, Orlov et Tuniyev, 1986) - Darevsky's viper**

Status. Narrow-range species, classified as Critically Endangered (CR C2b) on the IUCN Red List; after submission of our proposal to IUCN, the status has been confirmed using the additional criteria B1ab(ii,iii)+2ab(ii,iii); date of assessment: 12/14/2008

(IUCN 2009). Recommended for inclusion in the Red Data Book of Armenia in the same category Critically Endangered B1ab(ii,iii)+2ab(ii,iii).

Distribution. The southwest part of the Javakheti ridge in Armenia, extending to the border with Georgia (mount Achkasar, Ashots district, altitude: 2,350-3,000 m above sea level) (Fig. 1 and 2).

Habitat. Screes and rock outcrops in the subalpine zone. Seven isolated sites inhabited by the species have been identified. The availability of temporary and permanent shelters, such as moraines and large flat stones, is essential, as the vipers remain under 0.5-2 m thick stones throughout all seasons, including winter.

Population. Density in typical biotopes ranged from 10-12 individuals/ha in different years. The population size at the station above Saragyukh was 7-8 individuals/0.5 ha in the middle of June. A total of 19 snakes were captured, tagged and released here. By extrapolating data on known suitable habitats, the number of vipers in each population is 150-300, while the total population size is 1,200-1,500 individuals. By comparing data obtained in different years, starting from the 1980s, one can deduce that the population in typical habitats is relatively stable.

Reproduction. The mating period starts in early or mid-May. Females give birth to 5-8 young from the middle of September.



Fig. 2. Distribution of Darevsky's viper

Captivity. None are currently kept in captivity and the species does not reproduce in captivity.

Threats. Destruction of typical habitats, uncontrolled grazing and illegal capture.

Conservation actions taken. A Program on Development of Conservation Actions for Darevsky's Viper was launched in 2004. Conservation actions, ecological awareness raising measures, and identification of potential future PAs have been implemented under this program.

Conservation actions needed. The species should be included in the Red Data Book of Armenia, while its typical biotopes should be incorporated into the Arpi Lich National Park to be established in the Shirak marz.

Main Recommended Strategies and Actions

We recommend updating the Red Data Book of Armenia by including 21 amphibian and reptile species under the Law of the Republic of Armenia on Penalty for Violating Environmental Legislation and Inflicting Damage to Flora and Fauna. This will considerably toughen the penalty provisions for capturing and killing of these animals.

We recommend that specific parts of the ranges of certain species should be included in protected areas; these data are already being taken into consideration while mapping proposed sanctuaries under the government's medium-term program. This will also result in the size of fines for illegal capture of these animals being multiplied by five, as envisaged by the Law of the Republic of Armenia on Protected Areas.

To prevent trade in rare species, it is necessary to toughen controls at domestic and international markets, including through the engagement of CITES, to which Armenian acceded in 2008.

Agricultural land-use, first of all grazing and hay making, is one of the main threats to a majority of species. There is a need to develop farming regulations that ensure conservation of rare species.

Conservation activities should be based on cooperation between environmental organizations, law-enforcement agencies, local authorities and communities, which implies increased awareness of all stakeholders.

Ex-situ conservation of amphibians and reptiles is an important conservation trend. The existing methods of captive breeding several species enable captive further reintroduction if appropriate and if adequate funding is available.

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Executive Summary

The main objectives of the project “Reassessment of the IUCN Red List for amphibians and reptiles of the Caucasus in accordance with IUCN categories and criteria” were i) to collect data in all countries of the Caucasus ecoregion; ii) to identify the conservation status of all species based on the IUCN Red List Categories and Criteria: version 3.1 and the Guidelines for Application of IUCN Red List Criteria at Regional Levels; iii) to identify the most threatened species, and to highlight where the most threatened species are located. The project aimed to further transboundary cooperation as a key component of the long-term program of preservation of biodiversity of the Caucasus at the level of herpetofaunal complexes and especially rare and endangered species. The conservation status of all amphibian and reptile species occurring within the Caucasus Ecoregion was comprehensively assessed during the Global Reptile and Amphibian Assessment in Antalya, 22 – 26 September 2008. As a result, 35 species were classified as Critically Endangered (CR), Extinct Endangered (EN), Vulnerable (VU), Near Threatened (NT), and Data Deficient (DD).

Scope of the Work

Data on the Caucasus amphibians (17 species: 5 species of Caudata and 12 species of Anura) and reptiles (about 90 species: ca. 50 lizard species and 43 snake species, depending on taxonomic point of view) were collected and a gallery of images and distribution maps was compiled. Special attention was paid to Caucasus endemics and species having a Caucasus-Iran-Central Asia distribution. Data on status of each taxon in the past, present and expected future and proposals for conservation status from regional experts were also gathered.

Methodology

The conservation status of all amphibian and reptile species within the Caucasus Ecoregion was discussed during the Global Reptile and Amphibian Assessment in Antalya, 22-26 September 2008. The following points were considered in accordance with Guidelines for Application of IUCN Red List Criteria at Regional Levels (IUCN 2003). 1) species assessed at the regional level; 2) contact with other populations; 3) documentation and publication of regional Red Lists.

The project involved the following steps:

- a) Data were gathered in all countries of the Caucasian ecoregion on species, their distribution, limiting factors, populations, habitat and ecology, life history, breeding strategy, threats and conservation measures, using the most recent data and summarizing monographs (Darevsky 1967; Muskhelishvili 1970; Bannikov et al. 1977; Alekperov 1978; Darevsky and Orlov 1988; Anderson 1999; Kuzmin 1999; Tarkhnishvili and Gokhelashvili 1999; Ananjeva et al. 1997, 1998, 2006; Orlov et al. 2002; Szcerebak 1974, 1993, 2003; Tuniyev et al. 2009, in press).
- b) The status of each taxon in the recent past, the present and in the near future was assessed and presented to IUCN as a part of the supporting documentation. The assessment and confirmation

of status was carried out together with IUCN experts using the software “RAMAS® Red List”, version 2.0 and Guidelines for Application of IUCN Red List Criteria at Regional Levels (IUCN 2003).

- c) All information collected was reviewed, along with the conservation status of each species and its habitat, to develop priorities for conservation. Forms with information on distribution, limiting factors, populations, habitat and ecology, life history, breeding strategy, category of threat and conservation measures were completed, and a photo gallery and distribution maps in ArcView program were compiled.
- d) Species reviews and all recommendations on Red List reassessment of amphibians and reptiles of the Caucasus were submitted to the Species Survival Commission (SSC) of IUCN.

Assessment Results

As a result of the assessment, 35 species were classified as Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), or Data Deficient (DD) (Table 1). Of these, 21 taxa are classified in a threatened category (Critically Endangered, Endangered or Vulnerable).

Table 1. Reassessment of the IUCN Red List for amphibians and reptiles of the Caucasus

Species	Category	Criteria	Rationale
<i>Bufo verrucosissimus</i>	NT		Listed as Near Threatened because although it has a wide distribution and a presumed large population, it is likely to be declining rapidly in some areas due to loss of habitat and more recently to increased predation by the invasive raccoon <i>Procyon lotor</i> (introduced in 1970-1980). The rate of decline is probably not sufficient (30%) to qualify for Vulnerable. If action is not taken to prevent the further spread of the raccoon, <i>Bufo verrucosissimus</i> may soon qualify for Vulnerable.
<i>Pelodytes caucasicus</i>	NT		Considered Near Threatened due to population declines resulting from the invasive predatory species <i>Procyon lotor</i> which has recently become considerably more abundant. Additional declines result from habitat destruction (clearing of forests and leaf litter). Current rates of decline are not yet sufficient to qualify for a threatened category.
<i>Mertensiella caucasica</i>	VU	B2ab(ii,iii)	Listed as Vulnerable because its Area of Occupancy is less than 2,000 km ² , its distribution is severely fragmented and it is confined to small streams free of fish; there is also a continuing decline in the extent and quality of its habitat in Turkey and Georgia. The species is undergoing a rapid reduction across its range so it may also qualify for Vulnerable under A3c upon further investigation.
<i>Ommatotriton ophryticus</i>	NT		This species is listed as Near Threatened globally because of the rapid declines in Caucasus populations due to predation from invasive raccoons and collection for the pet trade. In Turkey, populations are declining particularly in the eastern part of its range. Overall, declines are not occurring fast enough to qualify as threatened. Turkey: LC: Least Concern because of its wide range and large population. Dam projects in eastern Turkey represent a significant future threat.
<i>Zamenis persicus</i>	DD		Listed as Data Deficient in view of the absence of recent information on its extent of occurrence, status and ecological requirements.
<i>Natrix megalcephala</i>	VU	A4ce	Considered to be Vulnerable due to a population decline estimated to be >30% in the past 10 years due to the proliferation of the invasive <i>Procyon lotor</i> which both feeds on the species and its prey (predator and competitor). Additional population reductions are occurring due to habitat destruction for development and human activities along the Black Sea coast. Reductions are predicted to increase and the species needs to be monitored in future.

Species	Category	Criteria	Rationale
<i>Montivipera raddei</i>	NT		Listed as Near Threatened because it has experienced significant and continuing declines as a result of habitat loss and overexploitation, but less than 30% over the past three generations (18 years). Turkey: VU (A2d): Listed as Vulnerable in Turkey because its population has declined at >30% over the past three generations (18 years). These declines are caused by exploitation for the pet trade.
<i>Montivipera wagneri</i>	CR	A2a+4c	Listed as Critically Endangered based on a population decline of more than 80% over the past 3 generations (18 years) due to exploitation and collection for the international pet trade. Planned dam construction would cause the loss of over 80% of the known habitat for this restricted range species.
<i>Pelias barani</i>	NT		Listed as Near Threatened because this species is in significant decline (but at a rate of less than 30% over ten years) because of over-harvesting for the international pet trade, making the species close to qualifying for Vulnerable. Development of its habitat and persecution are also major threats. Monitoring and protection efforts are necessary to prevent this species from becoming threatened.
<i>Pelias darevskii</i>	CR	B1ab(ii,iii)+ 2ab(ii,iii)	Listed as Critically Endangered because its Area of Occupancy is probably less than 10 km ² , its distribution is severely fragmented, and the extent of its habitat is declining due to effects of overgrazing around rock scree habitat.
<i>Pelias dinniki</i>	VU	B1ab(iii,v)	Listed as Vulnerable because its Extent of Occurrence is less than 20,000 km ² , its distribution is severely fragmented, and there is continuing decline due to persecution, over-collecting and overgrazing of its habitat.
<i>Pelias ebneri</i>	VU	B2ab(iii)	Listed as Vulnerable because its Area of Occupancy is possibly less than 2,000 km ² , its distribution is severely fragmented, and there is continuing decline in the extent and quality of its alpine meadow habitat.
<i>Pelias eriwanensis</i>	VU	B1ab(iii,v)	Listed as Vulnerable because its Extent of Occurrence is less than 20,000 km ² , its distribution is severely fragmented, and there is continuing decline in the extent and quality of its mountain steppe habitat due to overgrazing and agricultural conversion.
<i>Pelias kaznakovi</i>	EN	B2ab(ii,iii,v)	Listed as Endangered because its Area of Occupancy (confined to appropriate habitat within the range) is less than 500 km ² , its distribution is severely fragmented, and there is continuing decline due to over-collecting for the pet trade and in the extent and quality of its habitat. In addition, future development projects (tourism, urban development and dams) will likely cause further declines so the species should be monitored. It is thus likely that a 50% decline will occur in the next 10 years if estimated rates of decline continue.
<i>Pelias lotievi</i>	NT		Listed as Near Threatened because its Extent of Occurrence is probably not much greater than 20,000 km ² , and the extent and quality of its habitat are probably declining, thus making the species close to qualifying for Vulnerable.
<i>Pelias magnifica</i>	EN	B1ab(ii,iii,v); C2a(i)	Listed as Endangered because its Extent of Occurrence is less than 5,000 km ² , all individuals are in fewer than 5 locations, and there is continuing decline in the extent of occurrence, habitat quality and number of mature individuals. In addition there are less than 2,500 mature individuals in the population, with each subpopulation containing less than 250 individuals.

Species	Category	Criteria	Rationale
<i>Pelias orlovi</i>	CR	B1ab(i,v); C2a(i)	Listed as Critically Endangered because its Extent of Occurrence is less than 100 km ² , its distribution is severely fragmented, and there is continuing decline in the extent of occurrence and number of mature individuals due to over-collecting for the pet trade. In addition it is estimated that less than 250 mature individuals remain with little connectivity between subpopulations (each with less than 50 individuals).
<i>Pelias pontica</i>	CR	B1ab(i,iii,v); C1	Listed as Critically Endangered because its Extent of Occurrence is less than 100 km ² , its distribution is severely fragmented, and there is continuing decline in the extent of occurrence and number of mature individuals due to over-collecting for the pet trade. In addition it is estimated that less than 250 mature individuals remain with little connectivity between subpopulations (each with less than 50 individuals). There is a strong need for designation of protected areas as the species will likely become extinct in the near future.
<i>Pelias renardi</i>	VU	A1c+2c	This species is listed as Vulnerable because it has experienced habitat loss of over 30% over the past 3 generations (18 years). Habitat loss and fragmentation is continuing throughout its range.
<i>Vipera transcaucasiana</i>	NT		Listed as Near Threatened because this species is probably in significant decline (but at a rate of less than 30% over ten years) because of over-collecting for the pet trade and destruction of rocky habitats, thus making the species close to qualifying for Vulnerable.
<i>Phrynocephalus hortvathi</i>	CR	A2c	This species is listed as Critically Endangered because of a loss of more than 80% of its habitat over the past 3 generations (12 years) due to land conversion for agriculture and urbanization. In addition, its range is highly fragmented and the population is small and declining.
<i>Phrynocephalus persicus</i>	VU	A2c	Listed as Vulnerable because it has experienced a more than 30% habitat decline over the past 10 years. With low population densities, this habitat loss has led to significant fragmentation.
<i>Darevskia alpina</i>	VU	B1ab(i,iii,v)	Listed as Vulnerable because its Extent of Occurrence is less than 20,000 km ² , it is known from fewer than 10 locations, and there is continuing decline in the quality of habitat due to land conversion and climate change and the number of mature individuals is declining.
<i>Darevskia bendimahiensis</i>	EN	B1ab(ii)	Listed as Endangered because its Extent of Occurrence is less than 5,000 km ² , all individuals are in fewer than 5 locations, and there is a continuing decline in the extent and quality of its habitat.
<i>Draevskia clarcorum</i>	EN	B1ab(i,iii)	Listed as Endangered because its Extent of Occurrence is less than 5,000 km ² , all individuals are in fewer than 5 locations, and there is continuing decline in the extent and quality of habitat due to overgrazing.
<i>Darevskia dahli</i>	NT		Listed as Near Threatened because, although it is relatively abundant within its small range, its Extent of Occurrence is less than 5,000 km ² , and the extent and quality of its habitat are probably declining, thus making the species close to qualifying for Vulnerable. Competition with sympatric species is resulting in depressed populations for this parthenogenic species.
<i>Darevskia derjugini</i>	NT		Listed as Near Threatened because it is probably in significant decline (but at a rate of less than 30% over 10 years) because of widespread habitat loss and fragmentation of remaining populations through much of its range, thus making the species close to qualifying for Vulnerable.

Species	Category	Criteria	Rationale
<i>Darevskia dryada</i>	CR	B2ab(iii,v)	Listed as Critically Endangered because its Area of Occupancy is probably less than 10 km ² , all individuals are in a single sub-population, and the extent of its forest habitat has been severely reduced and continues to decline.
<i>Darevskia mixta</i>	NT		Listed as Near Threatened because although the species appears not to be in decline fast enough to qualify for a threatened category, its Extent of Occurrence is less than 5,000 km ² , thus making the species close to qualifying for Vulnerable.
<i>Darevskia praticola</i>	NT		Listed as Near Threatened because it is probably in significant decline (but at a rate of less than 30% over ten years) because of widespread habitat loss through much of its range, most especially in western populations, thus making the species close to qualifying for Vulnerable.
<i>Darevskia rostombekovi</i>	EN	B1ab(i,iii)	Listed as Endangered because its Extent of Occurrence is less than 5,000 km ² , all individuals are in fewer than 5 locations, and there is continuing decline in the extent and quality of its habitat.
<i>Darevskia uzzelli</i>	CR	B1ab(iii)+ 2ab(iii)	Listed as Critically Endangered because the Extent of Occurrence is less than 100 km ² , and its Area of Occupancy is less than 10 km ² , all individuals are in a single location, and there is continuing decline in the extent and quality of its habitat due to overgrazing and wood collection.
<i>Eremias pleskei</i>	CR	A2c	Listed as Critically Endangered because of a drastic population decline, estimated to be more than 80% over the last 10 years due to the loss of its very restricted habitat, an observed decline in distribution due to habitat loss (sandy enclaves) and anecdotal information on remaining populations.
<i>Iranolacerta brandti</i>	DD		There is a lack of information regarding threats to this species as well as its biology, ecology and geography. More research is therefore needed before a more accurate assessment can be made.
<i>Trachylepis septemtaeniatus</i>	DD		Listed as Data Deficient in view of continuing uncertainty as to its extent of occurrence in relation to <i>T. auratus</i> . This species complex needs to be fully reviewed, before the distributional ranges can be determined.

We have some comments on individual species. For example *Darevskia praticola* is recorded as NT, as a species with at least a 30% population decline and continuing habitat destruction (especially in western populations) so a possible change of category to VU could be considered. In the Caucasus it is not only widespread, but a species with a progressively increasing distribution and population. It is one of a few synanthropic species able to live in big cities (Krasnodar, Novorossiysk, Tuapse, and Sochi). We believe that the status of this species is unreasonably overrated and that it should be considered as Least Concern (LC).

An opposite example is presented by *Triturus karelinii*, considered globally Least Concern. In fact this species is the rarest among all Caucasian newts. Its range and number continue to decrease; it is also very rare in Crimea and there are now few localities from Iran. Therefore the category of this species should be no lower than NT. Lastly, a number of species considered Least Concern (LC) at global level are rare in the Caucasus or decreasing in number, as is reflected in regional Red Data books.

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Executive Summary

The project, “Determination of the Conservation Status and Conservation of the Mediterranean Tortoise (*Testudo graeca*) in Georgia”, was implemented in 2006-2007 and resulted in development of “Action Plan for Conservation of the Mediterranean Tortoise (*Testudo graeca*) in Georgia”.

Until recently, only the subspecies *T. g. iberica* was recorded in Georgia. During field work on this project two new subspecies were found: *T. g. nikolskii* in Western Georgia and *T. g. armeniaca* in Southern Georgia.

Status

Taxonomy

It was believed until recently that *Testudo graeca iberica* was the only subspecies of the Mediterranean tortoise, inhabiting the Caucasus. However, three new subspecies have been described based on morphology: *T. graeca nikolskii* – Western Caucasus, *T. g. armeniaca* – Armenia, Nakhichevan and Turkey, and *T. g. pallasii* – Dagestan. These subspecies inhabit isolated ranges. Data on results of DNA tests of these subspecies are so far scanty, but complying with the stated above (Semenova et al. 2004). The recent tortoise subspecies of the Caucasus have been recognized internationally (Bickham et al. 2007; Fritz and Havas 2007; Ananyeva et al. 2004). It is noteworthy that the tortoise from Armenia (*T. g. armeniaca*) is so peculiar owing to its extremely flat shell that some herpetologists have mistakenly referred it to the *Agrionemys* genus.

Distribution

Until 2006, it was considered by all herpetologists in the region that only one subspecies, *T. g. iberica*, was found in Georgia (Chkhikvadze 1995; Chkhikvadze and Bakradze, 1991, 1996). However, in the course of this project, a population of *T. g. nikolskii* was found in Western Georgia and a population of *T. g. armeniaca* was discovered in Southern Georgia. It probably also occurs in mountain districts of Ajara above the treeline (Fig. 1).

The ranges of the three recently published subspecies (*T. g. nikolskii*, *T. g. armeniaca*, *T. g. pallasii*) are described in Mazanaeva 2001, Chkhikvadze and Bakradze 1991, 2002, Danilov and Milto 2004, Danilov et al. 2004. One subspecies, *T. g. armeniaca*, occurs in the regions of Turkey bordering Georgia. Two subspecies, *T. g. iberica* and *T. g. armeniaca*, are also found in Azerbaijan and Armenia.

^a Editorial note: common name of *Testudo graeca* according to IUCN Red List 2009.2 is spur-thighed tortoise (see at <http://www.redlist.org/apps/redlist/search>)

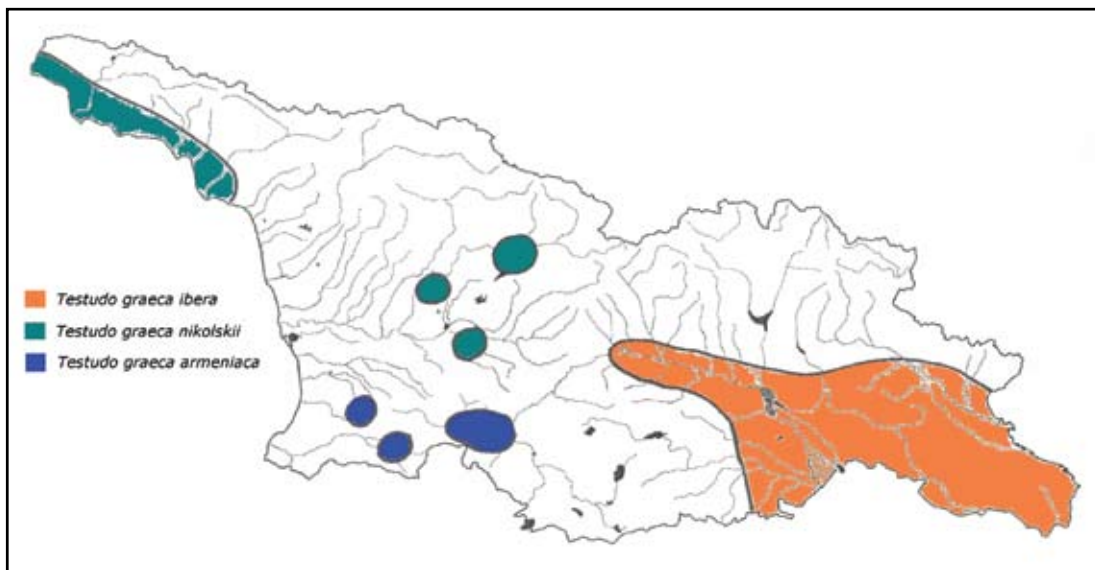


Fig. 1. Distribution of the *Testudo graeca* sub-species

***Testudo graeca ibera* (Pallas, 1814) (Fig. 2)**

Range. South-east Europe (east of the Balkan States up to the Danube) and south-west Asia (Asia Minor and South Caucasus to Iran).



Fig. 2. Female and male of *Testudo graeca ibera* / © A. Bukhnikashvili

***Testudo graeca nikolskii* (Chkhikvadze et Tuniev, 1986) (Fig. 3)**

Range. Western Caucasus: Krasnodar Region, Taman Peninsula, from Anapa, Novorossiysk, Sochi, Tuapse and further to the south to the Pitsunda Reserve (Tuniev 1987, 1995; Ananyeva et al. 2004; Red Data Book of the Russian Federation 2001). Western Georgia (Kharagauli, Ambrolauri and Tskaltubo districts).

***Testudo graeca armeniaca* (Chkhikvadze et Bakradze, 1991) (Fig. 4)**

Range. Armenia: Found only in the upper part of the Aras Valley, to the south-east of the Zengezur “gates” (Chkhikvadze and Bakradze 1991; Ananyeva et al. 2004). Azerbaijan: probably occurs in Nakhichevan. Turkey: areas adjacent to the Aras and probably western provinces of Turkey (verbal report of Turkish colleagues). Georgia: environs of Uraveli Village, Akhaltsikhe district and bordering areas of Adigeni district.

***Testudo graeca pallasii* (Chkhikvadze et Bakradze, 2002).**

Range. North-east Caucasus, Dagestan: environs of the village of Gilyary-Dag (Chkhikvadze and Bakradze 2002). The subspecies occurs almost throughout Dagestan (Mazanaeva 2001; Ananyeva et al. 2004; Danilov et al. 2004; Semenova et al. 2004).

Biology

The tortoises are active only at daytime. In spring they appear very early, usually in late February – early March. Starting from the middle of March they are found in large numbers, while in late April – early May they have the peak of mating period.

The tortoises have many natural enemies. Large tortoises are normally attacked only by hyenas, whose



Fig. 3. Male of *Testudo graeca nikolskii*, South Georgia, Kharagauli Region / © A. Bukhnikashvili

jaws are strong enough to crack their hard shells (Vekua et al. 1980). Young tortoises are attacked more frequently. During the incubation period and the first 3-4 years they have very weak shells and can be killed even by sparrows. Tortoise eggs are destroyed and eaten by small predators, rodents or birds (magpies, crows and others). Some reptiles, for instance *Vipera lebetina* also eat young tortoises.

Threats

Human activities have a dramatic impact on tortoise populations. The main groups impacting tortoise populations are tourists and persons engaged in illicit animal trafficking (Didmanidze et al. 2002). Removal of a single individual (as a pet or souvenir for tourists) damages the entire population. The viability of tortoise populations is determined by the number of adults and younger individuals that have developed strong shells. The presence of this age group in a population is the main condition for reproduction and its continued existence.



Fig. 4. Adult male of *Testudo graeca armeniaca*, Meghri, Armenia / © A. Bukhnikashvili

Human land-use frequently results in destruction and degradation of habitats through felling of trees and bushes, use of chemicals in agricultural areas and water and air pollution with toxic wastes and industrial and transport emissions causing environmental pollution in general. Expansion of agricultural land at the expense of natural landscapes causes natural habitats of tortoises to shrink. Tortoises die during steppe fires that also destroy grass and bushes, their forage reserve. Climatic changes affect reproductive performance of the species (death rates grow, birth rates fall).

Tortoise Conservation in Georgia

International status of the Mediterranean tortoise – VU a1cd. Status of the Mediterranean tortoise in Georgia – VU. Following analysis of the data collected, the following IUCN categories for subspecies are proposed:

Testudo graeca ibera – LR,

Testudo graeca nikolskii – CR/EN,
Testudo graeca armeniaca – VU.

T. g. nikolskii requires special conservation measures in Georgia. *T. g. armeniaca* is less threatened, as it occurs in sparsely populated and hard-to-reach areas in Southern Georgia. *T. g. iberica* has the widest range in the Caucasus and a comparatively stable status. It inhabits almost all plains and foothills in the eastern part of the South Caucasus: Eastern Georgia, almost the entire territory of Azerbaijan and north-west regions of Armenia.

Officially, Mediterranean tortoise conservation in Georgia meets all international laws. In reality, conservation of this species and its subspecies is at a very low level, and the situation has become markedly worse lately. Live tortoises are often seen for sale in Tbilisi markets. (See Didmanidze et al. (2002) for more detailed description of conservation of herpetofauna of Georgia).

For the conservation and reproduction of tortoises in Georgia, there is an urgent need to establish small protected areas (micro-sanctuaries) and special enclosures in key habitats for egg incubation and breeding of young tortoises, including within reserves and other protected areas. Professional biologists and nature lovers should become actively involved in tortoise conservation.

Ranges of the two subspecies discovered in Georgia after 2005 (*T. g. nikolskii* and *T. g. armeniaca*) have not yet been studied fully and more detailed research is needed.

Action Plan for Tortoise Conservation in Georgia

Population Status and Distribution

A more detailed inventory of tortoise populations in Georgia is needed. The information obtained in 2006-07 (also in 2005), proving the occurrence of the three subspecies of the Mediterranean tortoise

in Georgia, underscores the urgency of this problem. Mediterranean tortoise population status and range in Georgia has been more or less precisely studied only in Eastern Georgia. It requires continuous monitoring in Western and Southern Georgia.

Boundaries of key habitats of these subspecies are more or less known, but more intensive and long-term field research is necessary to specify them (Fig. 1 and 5).

Guidelines for monitoring the Mediterranean tortoise should be developed along with capacity building of monitoring specialists.

Creation of a unified Mediterranean tortoise database would contribute greatly.

This requires agreement and commitment

of herpetologists from range states, and at least some funding. Once the database has been created, periodical reports on status of separate populations in different regions can be issued.



Fig. 5. Typical habitat for *Testudo graeca iberica* (Eastern Georgia) /
© A. Bukhnikashvili

Education and Public Awareness

During field research we informed local communities on the need for conservation of tortoises and nature in general but such meetings are not sufficient. Special booklets with illustrations (flowers, rare plants, birds, fishes, amphibians, reptiles and mammals) should be published and used for raising awareness of adults and children about the importance of wildlife conservation. This kind of “imprinting” of conservation ideas in children is a very important aspect of education. It is noteworthy that the secondary school curriculum in Georgia includes the “Mother Nature” course (co-authored by Arnold Gegechkori).

A popular science booklet, brochure or atlas should be published. An excellent atlas of the contemporary herpetofauna of Georgia was published relatively recently (Muskhelishvili 1994). However, only a small number of copies were issued. The planned booklets should be of good quality, highly informative and available at a low price in order to be affordable to all interested persons.

It is also necessary to prepare for publication a popular scientific booklet for students and schoolchildren. It would be effective to advocate for Mediterranean tortoise conservation and to condemn facts of vandalism against this species through mass media.

Protected Areas

Explain to local staff the importance and methods of tortoise conservation and take into account the special conservation measures relevant to tortoises while developing PA management plans.

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Executive Summary

The project “Practical Activities for Conservation of *Testudo graeca* in Russia” was carried out in the Russian part of the Caucasus from July 2006 to the end of 2007 (18 months). The project aimed at the conservation of intra-specific diversity of Mediterranean tortoise (*Testudo graeca*) in the Russian part of its range. The project area covered the Caucasus section of the Black Sea coast from Anapa to Sokhumi and Daghestan. Objectives involved evaluation of numbers and distribution of the Mediterranean tortoise and public outreach campaigns among local communities to ensure tortoise conservation within its range in Russia.

Methods

The main study area was Krasnodar District, in Anapa-Sokhumi section and in the coastal lowlands and foothills of Daghestan. We used all available literature and data obtained during field research in 1994-2006. All sites where tortoises were found were mapped using GPS. We used different methods to estimate population size: transects in larger areas where the tortoises did not form accumulations, and the mosaic method in sites where the tortoises live in compact groups. Tagging and re-capturing of individuals were used for regular monitoring (Scherbak 1989). We also recorded causes of mortality, injuries, diseases, habitat damage and ecological factors (habitat type, climate, natural enemies, parasites). At regularly monitored sites we observed activity, feeding, reproduction, hibernation and migration, and also estimated age and sex composition of populations to evaluate their vitality and reproductive potential. All data were included in an electronic database. The project team cooperated with local communities and environmental organizations to gain more information about tortoises and people's attitude towards them. We developed several recommendations for conservation of the Mediterranean tortoise in Russia. Factors influencing *T. g. nikolskii* and *T. g. pallasi* differ to a certain extent, which requires different approaches to their conservation.

Status

Global Status

The range of the Mediterranean tortoise (*Testudo graeca* Linnaeus, 1758) includes North Africa, southern Europe, southwest Asia and the Caucasus (Bannikov et al. 1977; Ananyeva et al. 2004). It is included in the IUCN Red List as Vulnerable (VU), in Annex 2 of CITES and Annex II of the Bern Convention (Prisyazhnyuk et al. 2004) and Red Data Books of the former USSR (1984), the Russian Federation (2001), Krasnodarsky Krai/Region (1994), Republic of Daghestan (1998) and Chechen Republic (2007). The USSR Red Data Book lists it in Category I: its western form is endangered, while the number of the

^a Editorial note: common name of *Testudo graeca* according to IUCN Red List 2009.2 is spur-thighed tortoise (see at <http://www.redlist.org/apps/redlist/search>)

eastern form is rapidly decreasing. The Red Data Book of the Russian Federation refers *Testudo graeca* to Category I, i.e. ‘species steadily declining in number, with some populations being on the verge of extinction’.

Status in the Caucasus

The Mediterranean tortoise is found in Russia, Armenia, Georgia, Azerbaijan, Turkey, and Iran. It is one of the 51 priority species of the Caucasus ecoregion. It is found within five priority corridors: Caspian, Greater Caucasus, western Lesser Caucasus, Ior-Mincheaur, and Hirkan. In Russia, the tortoise is found in the Republic of Daghestan (Fig. 1) and on the Black Sea coast in Krasnodar district (Fig. 2). The subspecies *Testudo graeca nikolski* inhabits the western part of the Caucasus (Chkhikvadze and Tuniyev 1986), while *T. g. pallasii* inhabits the Eastern Caucasus (Chkhikvadze and Bakradze 2002).

Status in Krasnodar District is the most alarming. By the end of the 20th century, *T. g. nikolskii* range shrank dramatically and the population was divided into several isolated, declining populations (Red Data Book of the Russian Federation 2001). In some regions, for example on the Maliy Utrish Cape, the number of individuals remained stable for several years (1991-2001) (Leontjeva and Sidorchuk 2002).



Fig. 1. Distribution of Mediterranean Tortoise in the Republic of Daghestan

Until recently, there was insufficient data on *T. g. pallasii* population in Daghestan. There were formerly a great number of tortoises in the South Daghestan lowlands (up to 100 individuals/ km²) (Krasovskiy 1932; Bannikov 1951). Numbers later decreased to 1/ ha (Bannikov et al. 1977; Sosnovskiy 1987). In 1989, population density was 0.021 animals/ha (Kostina and Galinichenko 1998). Later research presented contradictory information on numbers, ranging from 0.012-0.015 individuals/ha (Spasskaya 1989) to 500-27,000 individuals/ha (Jamirzoev and Tertyshnikov 2000).

Latest research shows a mosaic distribution in coastal areas, with an average density of 0.33 individuals/ ha. In foothills, where the tortoise is distributed more uniformly, the population density is 0.13/ha (Mazanaeva

2001). Separate findings were reported from the north-east of the Chechen Republic (Anisimov 1989), but never actually corroborated. The northern boundary of *T. g. pallasii* range and population sizes of both subspecies remained undefined. This project helped to specify the geographic distribution of the Mediterranean tortoise within its range in Russia, to estimate population status in Krasnodar District and Daghestan, and to define limiting factors and develop conservation measures.

Testudo graeca nikolskii. The range covers the part of the northwest Caucasus close to the Black Sea with complex terrain, wide diversity of habitats, natural barriers, dissected relief, and diverse vegetation communities. Earlier, the range extended from Anapa to Pitsunda. In the 1990s, several individuals were found near the villages of Varvarovka (Eastern Dagomys River basin) and Kalinovie Ozero (the watershed between the Bolshaya Khosta and the Malaya Khosta). More than several hundred tortoises were observed in the River Ashe basin.

The map (Fig. 2) shows the latest data on *T. g. nikolskii* occurrence available from the literature and our studies, involving 29 sites. Two areas have the most favorable conditions. Both are associated with mountains parallel to the main ridge, the Navagir Ridge, Mounts Doob, Tkhachegochuk and Mikhailovka, and coastal mountains from the Pshada River to the Jubka. The ridge, dissected by creeks and gorges, widens close to the coast, creating favorable conditions for large populations of the tortoise. In the western part of the range, from Gelenjik to Anapa, the tortoise is found occasionally in non-agricultural areas. They are common in the area between the villages of Bolshie Khutora and Rayevskaya.



Fig. 2. Distribution of *T. g. nikolskii*

In July 2006, up to 15 adult animals were found every day in this hard-to-reach area on the watershed of the Navagir Ridge and the upper section of the Dyurso River. Small groups of tortoises were also observed close to Rayevskaya village, Sukko, Malyi Utrish and on the Mikhailovsky pass on slopes covered with forest-steppe vegetation. Hence, to date there are two zones inhabited by viable tortoise populations – the section between Anapa and Novorossiysk and the area to the south of Gelenjik. Besides this, separate individuals were found in the vicinity of Sochi.

Testudo graeca pallasii. In Daghestan, the range covers the plain close to the sea and the adjacent foothills, and extends to the territory of Azerbaijan. According to Beme (1928), Krasovsky (1932), Shubanov (1935), and Bannikov (1951), the northern boundary of the range is near the village of Manaskent, 30 km southeast of Makhachkala (Beme 1928; Bannikov 1951). Subsequent research shows that the tortoise was also found in the Tersk-Sulak lowland (Bannikov et al. 1977; Inozemtsev 1995; Leontyeva et al. 1998; Red Data Book of Daghestan, 1998). Summary reviews of herpetofauna of the former USSR and Russia never mentioned Chechnya as an area inhabited by Mediterranean tortoise. Yet regional reports (Afanasyev 1961; Tochiev 1980; Ryzhikov et al. 1991) said it was found in semi-deserts and steppes in the northeast of the republic. Anisimov (1989) saw the tortoise there several times in 1984-1987. In April 1990, it was found 5-7 km northwest of the village of Darbankhi (Fig. 2). Subsequent research suggests a viable population in the area of Bragun and Gudermes ridges (Red Data Book of the Chechen Republic 2007).

Based on our observations, the northern boundary of the range in the northeast Caucasus lies close to the Sarykum dunes, 15-20 km west of Makhachkala. This is wind-borne, sandy terrain at the foot of the Narattebe ridge, between the steppe and semi-deser. Further south, it is found in the foothills along the Caspian coast in the direction of the Sarykum-Narattebe ridge – Kukurtbash-Kanabur ridge. It was also found in dunes near Manaskent close to the sea; to the west, on foothill slopes extending from Karabudakhkent to Kakashur (Artkullar mountain, and south of Karabudakhkent, along the foothill ranges (from mounts Shakhre and Shelyabash to the Kolichi River and Sergokala and Myurego). Further south, it occurs sporadically along foothill ridges to Jalgan Mountain, Rubas valley and Novaya Maka and Magaramkent. The highest elevation where the tortoise can be found is 600 m.

In the lowlands, close to the sea, the tortoise was found around the villages of Zelenomorsk and Manaskent and to the south up to the mouth of the Kolichi River (northwest of Izberbash). There they inhabit the eastern edge of the first coastal terrace and dunes. They usually gather near hollows and erosion gullies. Further south, the tortoise was observed between Novokayakent and Mamedkala, Beliji and the River Samur mouth. A small group of animals was found on an 80-ha area of terraced slopes on the southeast side of the Rubas River floodplain, between Avadan and Aglobi.

Thus, in the eastern part of the range the tortoise inhabits two parallel zones, extending along the coastline from north to the south and involving foothills and coastal dunes, which touch near Makhachkala, Isberbash and Derbent (where the foothills are close to the sea). We could not find any corroboration of earlier records in northern Daghestan and northwest Chechnya.

Habitats

Mediterranean tortoise is a highly adaptive species with a wide range of habitats. *T. g. nikolskii* inhabits warm foothill slopes (200-400 m asl) covered with forest and steppe vegetation of Mediterranean type and shiblyak, and also steppes and meadows. *T. g. pallasi* is found in coastal sand dunes (Fig. 3), inland dunes (Sarykum dune), riparian forests, foothill slopes with exposed rocks covered with bushes and trees, foothill slopes and terraces covered with steppe plants and rushes, slopes covered with semi-desert plants and bushes, gentle slopes of foothills covered with shiblyak, small-trunked and flood-plain forests.



Fig. 3. Dunes near Papas lake, Daghestan / © L. Mazanaeva

Population Size and Density

In Krasnodar, large numbers of tortoise were earlier found between Novorossiysk and Adler, especially around Novorossiysk. They also occurred close to Verkhne-Bakanskaya, Tonnelskaya and near Gelenjik; were rather common near Sochi and Tuapse and abundant around Kabardinka (Nikolsky 1913). Now they have almost completely disappeared in the Tuapse-Gagra area. Holidaymakers used to catch and take away hundreds of animals every year. In 1985, population density in the

Anapa-Novorossiysk section was estimated at 5-8 individuals/km², and the total population was 25,000-30,000 (Inozemtsev and Pereshkolnik 1985). In 1991 the population density was 3-5/2 km², while the total number of tortoises did not exceed 10,000 (Plotnikov 1991). In Sochi National Park and in Anapa district

on the edge of agricultural land population density was 0.2/ha (Lukina and Sokolenko 1991), while in the Caucasus Reserve single tortoises were found in the Khosta Forest until 1982 (Tuniev 1999).

Population density in different biotopes in Daghestan ranges from 0.05 to 1.5/ha. Highest densities were recorded in coastal dunes close to Papas Lake (1.5/ha), the vicinity of Berikei village in Derbent district (0.75/ha), and between the mouths of the Rivers Maliy Samur and Samur (1/ha). There, tortoises inhabit coastal dunes and adjacent steppe. The density of the local group inhabiting the terraced slopes of the Rubas floodplain between Avdan and Aglobli is 2.3/ha. A lower population density of 0.01-0.3/ha is observed in forests and steppes. No tortoises have been found in Samur forest in recent years. Population density in the foothills is low. Highest density was recorded on Mount Shakhre (west of Gurbuki village) – 0.5/ha. Five years ago, single individuals were regularly found in Daghestan Reserve. At present no tortoises can be found there during a 2-hour trip. No tortoises have been found in recent years in the vicinity of Makhachkala (Tarki-Tau plateau, Kukurbash massif).

Factors Influencing Tortoise Numbers

Natural factors involve climate, disease, parasites and predators (foxes, wolves, jackals, dogs; gulls, birds of prey, crows; large whip snake and glass-snake). Young individuals are the most vulnerable, while the adults are well protected by their shells. Tortoise eggs, deposited in holes in the sand, are often eaten by gulls, crows, foxes, dogs, jackals and hedgehogs. Aridification in the eastern part of the range in recent years has caused droughts and drying of ponds and rivers in spring. In spring 2007, the tortoises could not find food after they woke from hibernation. Sea fog and breezes in coastal dunes make the problem less severe, but animals living in the foothills are in extreme conditions. Low air temperatures prevent the tortoise from spreading to the north.

Anthropogenic factors are the main cause of the reduction in numbers. These include damage to habitats and displacement or killing of tortoises. Lack of awareness of the importance of biodiversity conservation in the republic and poverty pushing people to uncontrolled use of natural resources are key factors. We recorded many examples of habitat degradation (sand excavation in dunes, deforestation, littering, grass burning, overgrazing, building and fencing, injury by people and domestic animals, crushing of tortoises by vehicles, falling into holes and canals, destruction of eggs, capture of individuals for sale). Tortoises can live in human landscapes (gardens, vineyards, melon plantations) if they are not fenced. Back in 1980, tortoises inhabited abandoned building lots, parks and vegetable gardens in Makhachkala. The present use of chemicals in vineyards and gardens is fatal for the animals.

Both in the western and eastern parts of the range, populations became split into small groups, which resulted in decline in numbers and eventual disappearance of entire populations. Over the past 10-20 years, the tortoise has vanished from the slopes of Tarki-Tau mountain in the Talgin Gorge, from the sea coast in the vicinity of Zelenomorsk, from coastal dunes near Izberbash Mountain, from Samur forest and the Tuapse-Gagra section. If this trend continues, these subspecies may very soon become extinct.

Practical Measures

We carried out an awareness campaign among local communities which involved meetings, interviews, on-ground training in tortoise habitats, television programs, visits to sand-pits and pastures, distribution of leaflets and posters, visits to pet-shops and markets. The campaign included schoolchildren, young people and adults (herders, builders, drivers, farmers). The campaign also involved visits of students and schoolchildren to tortoise habitats, demonstration of tortoises, moments in their life, and human impact. The local television channel 'Rubas' based in Derbent and covering southern Daghestan, aired programs

within the framework of the public outreach campaign. Together with television staff we visited illegal sand-pits in the coastal dunes. We sent official letters and inquiries to regional environmental agencies (Ministry of Natural Resources and Environment Protection and the Marine Inspection).

Recommendations

Factors influencing *T. g. nikolskii* and *T. g. pallasii* vary to a certain extent, so different approaches to their conservation are needed. The main limiting factors in the western part of the range are anthropogenic and are mainly due to recreational pressure. Therefore, the main focus should be on observation of conservation regimes (on reserves) and demarcation of protected areas outside reserves. An awareness campaign with the involvement of the mass media should be carried out for tourists and local communities.

In the eastern part of the range, natural factors, such as desertification and drying of ponds and rivers, are more important. So coastal dunes and broad-leaved forests are most suitable for the establishment of protected areas. Anthropogenic factors also have a strong influence because tortoise habitats lie within areas of large-scale building and farming. This requires amendments to local legislation, restricting the right to sell land inhabited by rare species.

It is also essential to create reserves on the coast where intensive development of recreational infrastructure is in progress. The best places are the Sarykum dunes (strengthening the conservation regime) and around Lake Papas (establishment of a protected area). It is also important to preserve tortoise populations and other rare species in non-agricultural areas in the foothills (dry slopes southwest of Derbent).

It is necessary to use the mass media to inform local communities about rare species, amendments to environmental legislation, fines for capturing rare animals and damaging their habitats (the fine for the Mediterranean tortoise being up to 15,000 rubles), to explain to local administrations the importance of financing environmental programs aimed at biodiversity conservation in their regions, and ensure involvement of local religious communities in conservation activities. It would be very effective and useful to make a series of documentaries about the nature and rare animals of the Caucasus, to create an information website and publish popular scientific magazines with good illustrations. It is necessary to create protected areas in places inhabited by viable populations with reproductive potential. These are: the hard-to-reach area on the watershed of the Navagir Ridge and the upper reaches of the Dyurso River, the environs of the Lake Papas in Daghestan (coastal dunes, Fig. 3), the River Rubas valley (dry foothill slopes), and Kolichi. Continuous monitoring of populations is also needed.

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Executive Summary

The Caucasus grey toad *Bufo verrucosissimus* and the Caucasus Parsley Frog *Pelodytes caucasicus* are endemic species of Caucasus amphibians with narrow distribution ranges (Fig. 1). At present the status of these species in Azerbaijan is assessed as Vulnerable (VU) because of the decline in numbers and limited distribution. However, there are insufficient data on the current status of *Pelodytes caucasicus* in Azerbaijan. Nor are there data available about the current status of these amphibian species in other parts of the Caucasus region. The Project was implemented by the NGO 'Center of Biological Diversity' in 2006. The key objective of the project was to improve protection of *Bufo verrucosissimus* and *Pelodytes caucasicus* in Azerbaijan by evaluating the current status of these amphibians distribution, number, habitats, and threats) and raising herpetological awareness of the local population.

The studies were conducted in the Talysh zone (Lenkoran, Astara, Masally, Yardymly areas) and southern slopes of the Greater Caucasus (Belakany-Ismaili zone). Data were obtained on habitats, range, population structure, and numbers of *B. verrucosissimus* and *P. caucasicus* in Azerbaijan. The distribution of *B. verrucosissimus* in Azerbaijan is wider than initially anticipated. *P. caucasicus* is very rare in the country and represented by a single population found in the Greater Caucasus close to the border with Georgia (Lagodekhi area in Zakatala Reserve). The research showed a decline in the numbers of *B. verrucosissimus* and *P. caucasicus* outside protected areas (PAs). Different factors affect conservation of amphibian species and a number of recommendations to improve their protection are proposed.



Fig. 1. Distribution of *Bufo verrucosissimus* and *Pelodytes caucasicus* in Azerbaijan

Methods

The study took place from April to August 2006 in Lenkoran natural area and the southern slopes of the Greater Caucasus in Azerbaijan. Population size and structure were evaluated by surveys along line transects (3 m wide and 100 m long) and circular plots (50-60 m diameter) in representative habitats of both species. The numbers of individuals per ha were extrapolated to the entire area. Observations were carried out by day and night. Habitat status was assessed by the presence of favorable conditions for conservation and by levels of negative anthropogenic impacts. Current status of the two species was evaluated by comparing field observation data to those available in the literature.

Status

Species of Interest

***Bufo verrucosissimus* - Caucasus Toad (Fig. 2)**

Taxonomy. The taxonomy of the *Bufo bufo* (complex is disputed. The entire complex, distributed from Europe to Japan, is regarded by some authors (e.g. Mertens and Wermuth 1960) as a species *Bufo bufo* (Linnaeus, 1758) and represented in the Caucasus by the subspecies *B. b. verrucosissimus* (Pallas, 1813). Comparison of external morphological characters has led other authors to conclude that *Bufo b. verrucosissimus* (Pall, 1813), is a separate species, represented by three separate subspecies in the Caucasus: *B. v. verrucosissimus* Pallas, 1813; *B. v. turowi* (Krasovcky, 1933), and *B. v. circassicus* (Orlova and Tuniev, 1989). In Azerbaijan, *Bufo verrucosissimus* is represented by the nominate form.

Distribution. *Bufo v. verrucosissimus* is found in the Caucasus and northwestern Iran. In Azerbaijan, its distribution is limited to the southwest (Lenkoran natural area) and northwest (Belokany-Zakatala) (Aleksperov 1978). There is also an assumption that the distribution on the southern slope of the Greater Caucasus is much wider (Ganiev and Nuriev 2000). Our studies showed that the range in the Lenkoran area and on southern slopes of the Greater Caucasus is not limited to areas referred to in the literature. In Lenkoran, it is found not only in the Lenkoran region (Hirkan forests and adjacent villages of Istisu, Hirkan, Paraken, Biurjali, Gaftoni) and Astarin region (villages of Pentser, Tengerud, Urjivan, Senjeredi), but also in some parts of Mesallin region (villages of Godman and Boyuk Kolatan) and Yadymlin region (village of Sengele). In Kyzyl-Agach Reserve (former Isle of Sarah), we found no specimens, though it was formerly recorded here (Aleksperov 1978). Its disappearance could be due to increase in the human population and urbanization of the area after construction of a dam turned the island into a peninsula. Our research showed that on the southern slopes of the Greater Caucasus, the primary range of *Bufo v. verrucosissimus* is in Belakany and Zakatala regions, with some small areas in Kakh, Shekin, Gabalin and Ismaily regions.

Habitats. The toad is found in forests, vegetable gardens, hay meadows, parks, and wide forest floodplains keeping to forest edges and grasslands. It is also found in inhabited areas, in yards and cellars. In the reproduction period, the toad uses still or slowly-flowing waters for spawning. It occurs in mountains up to 3,000m asl. The toad usually keeps to one habitat: forest litter, hollows under stones or tree roots, rodent burrows, fallen trees, rotten stumps, etc. The Caucasus toad is more sensitive to environmental pollution than other amphibians, especially to pollution of spawning sites. Therefore even slight levels of environmental pollution cause the toads to leave the site. On land, they prefer humid areas, rich in different species of invertebrates.

The area of natural habitat of Caucasus toad in Azerbaijan is about 90,000-95,000 ha (30,000-35,000 ha in the southern zone and 55,000-60,000 ha in the northern zone). About 30-40% of these habitats are located in PAs (Hirkan National Park in the south, Zakatala and Ilisu State Nature Reserves in the north).

The remaining habitats are outside PAs and frequently represent sporadically located and isolated small sites (Fig. 1).

Population Size and Structure. Large populations are rare in both northern and southern zones. In



Fig. 2. *Bufo verrucosissimus*, Zakatala State Reserve, 2006 / © T. Iskanderov

Burjali and Parakend (Lenkoran region) the density was 10-15 individuals/ha. The same density was observed in the Belokany-Zakatala zone. In Paraken (Lenkoran region) 20 Caucasus toads were found on 1 ha of a fishery area. In yards and gardens, the average number varied between 12 and 15/ha. In Hirkan forest and forests of Zakatala Reserve (800-1,000 m asl), the density was lower (on average 10-12 toads/ha). A higher number of toads (up to 20/ha) occurs in yards and gardens close to forests and in areas with ponds favorable for reproduction, with sufficient food and shelter (rocks, stones etc). In natural habitats (forest zones), individuals are spread over a wider area. Average number of toads in habitats exposed to strong human impact (grazing, tree felling, water pollution, etc.) is very low – about 3-5/ha and in some areas there are no toads. Comparison of data

from this survey and the literature (Aliiev and Nuriev 1995, 1997; Ganiev and Nuriev, 2000) shows that numbers have been declining in recent years and are 15-20 toads/ha versus 30-40 observed earlier. The reason is deterioration of habitats under anthropogenic influence.

Female toads make up about 41-42% of the total population, i.e. there are fewer females than males. This limits reproductive capacity and may prevent a sufficient increase in numbers. During field surveys, 73 toads were found in a population in the Lenkoran area, and 65 toads were found in the Astarin area. The number of females was 30 and 26 respectively. Toads aged 5-8 years, with body size of 8-12 cm made up 75-80% of the population. Younger toads (3-4 year old) are rarer – this is the age when the toads become mature, and their size is 6-7 cm. It is not shy and can be easily picked up by hand. Such behavior makes the toads an easy prey.

***Pelodytes caucasicus* (Boul., 1896) - Caucasus Parsley Frog**

Distribution. Endemic to the Caucasus. It occurs in northwest Azerbaijan, Georgia (southwest and South Ossetia), Russia (Krasnodar district) and probably in Turkey, close to the Georgian border. In Azerbaijan, *P. caucasicus* is found only in the Belokany part of Zakatala State Reserve in an area of no more than 10,000-15,000 ha. Its distribution is sporadic and populations are presumably isolated.

Habita. *Pelodytes caucasicus* is found in the broad-leaved forest and mixed forest zones up to 2,300m. The main habitat is shady banks of rivers, streams, springs, and lakes. It occurs in areas with high soil moisture content, rich in food (terrestrial and water invertebrates), natural shelters (forest litter, stones, fallen trees, etc) and also natural water bodies with clean, clear water.

In some sites along mountain rivers that are used for spawning, mudflows are frequent in spring and summer and pose a threat to larvae in the metamorphosis stage. For example, in July 2006 a mudflow in the Gumukh-Dere River, in Zakatala Reserve, carried away the whole clutch of Parsley Frogs that we had found in June.

Population Size and Structure. Population size, range and structure in Azerbaijan have not been studied in detail and the available data are not enough to enable an objective evaluation. The scientific part of the

study only identified some habitat fragments and some reproduction stages (spawning, tadpoles). In July-August 2006, only 11 Parsley Frogs/km were found along the bank of the Gumukh-Dere River (1,200m asl) not affected by the mudflow. On some sections we observed larval sacs and larvae. Longer-term observations are required to make a comprehensive evaluation of the *P. caucasicus* population.

Threats

Both species are threatened by natural and anthropogenic factors. Anthropogenic factors that pose a direct or indirect threat are the most dangerous.

Socio-economic trends

Socioeconomic reforms in the last decade have affected the character and scale of nature use in Azerbaijan, including habitats of *B. verrucosissimus* and *P. caucasicus*. A sharp decline in living standards in the transitional period, together with a lack of energy resources and emergence and development of local furniture-making industries, have resulted in intensive forest use, more frequent illegal felling and overgrazing in forests. A network of tourist facilities is under development, including recreational and resort zones and construction of facilities in forests.



Fig. 3. Polluted Watercourses, Gakh district, Azerbaijan
/ © T. Iskanderov

Habitat Loss and Deterioration

In some cases human activities create favorable habitats for the Caucasus toad. However such habitats (e.g. vegetable and fruit gardens) are artificial and may be only temporary. In most cases, anthropogenic impacts are negative. Natural habitats are frequently used for the development

of economy, infrastructure, or are destroyed by felling, grazing, water pollution, etc (Fig. 3). Loss of natural sites results in the splitting up of large areas into smaller and isolated fragments, which represents a serious threat.

Direct persecution

Negative attitudes are also a threat. People's ideas about amphibians are often based on myths and superstitions, so most people develop a negative attitude and even persecute them as useless or harmful animals. Some frogs are used for food especially in parts of Southeast Asia and Europe. Caucasus countries do not use frogs in the local cuisine, but it is possible that some cases of illegal capture may occur for sale; if this is confirmed, *P. caucasicus* should be listed under CITES.

Natural threats

Aspects of *B. verrucosissimus* behavior (peaceful attitude to enemies and reluctance to hide) and low percentage of females (41-42%) may limit reproductive capacity. *P. caucasicus* is highly sensitive to predators and is quick to hide. *B. verrucosissimus* readily occupies biotopes in populated areas such as fruit and vegetable gardens. *P. caucasicus* is found only in natural habitats.

Current Conservation Activities

- Both species are included in the National Red Data Books of Azerbaijan, Georgia and Russia as species declining in number and found within limited areas; and
- 30-40% of *B. verrucosissimus* range in Azerbaijan is in PAs (Hirkan National Park in the south, Zakatala and Ilisu State Reserves in the north). The whole range of *P. caucasicus* in Azerbaijan is in Zakatala State Reserve.

Neither PAs nor zoos and scientific institutions practice captive breeding of these species because of the lack of a tested method. At present, the Zoology Institute of the National Academy of Science continues scientific experiments for artificial breeding of *B. verrucosissimus*. In the PA system, *B. verrucosissimus* and *P. caucasicus* are not adequately protected: no work is being done to control the status of rare amphibian species, no measures have been taken to improve the species conservation; PA staff have little or no knowledge of amphibians.

Conservation

Strategy

Improve protection of rare amphibian species, the Caucasus toad and the Caucasus Parsley Frog and ensure conservation of the species in the region.

Recommendations

1. Monitor numbers and habitat status
2. Improve the resource use system in Caucasus toad and Caucasus Parsley Frog range
3. Re-introduce populations of the Caucasus toad and the Caucasus Parsley Frog
4. Improve the protected area network
5. Create sustainable captive populations of Caucasus toad and Caucasus Parsley Frog
6. Enhance international cooperation
7. Consider raising status of the Caucasus toad and the Caucasus Parsley Frog in the IUCN Red List to Vulnerable (VU), as they are endemic, with narrow ranges and declining
8. Conduct scientific research on both species in order to develop most efficient methods of protection and restoration
9. Raise awareness of the public and PA staff about conservation of Caucasus toad and Caucasus Parsley Frog and other rare amphibians

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Executive Summary

The objective of the project was to investigate the status of the Caucasian salamander (*Mertensiella caucasica* Waga, 1876), an endemic amphibian with a narrow range from Central Georgia to north-east Turkey. It is listed in the IUCN Red List as Vulnerable and in the Red List of Georgia (2005) in the same category. It is a priority species of the Critical Ecosystem Partnership Fund for the Caucasus and a focal species for the ecoregion (Williams et al. 2006).

Status

Taxonomy

The scientific name *M. caucasica* is still applied to all populations of Caucasian salamanders, but in fact there are two distinct (although cryptic) allopatric species, referred to here as *Mertensiella* sp. 1 and *Mertensiella* sp. 2. The two species have fully diagnostic mitochondrial haplotypes and nuclear DNA markers that indicate absence of gene flow between them since at least the Upper Miocene (Tarkhnishvili et al. 2000), although morphological differences are minute or absent. The two taxa also differ in their response to climate (Tarkhnishvili et al. 2009). The name *M. sp. 1* will be applied to the eastern population only, and the name *M. sp. 2* to the western population. Conservation should be planned separately for *M. sp. 1* and *M. sp. 2*, as and they should be assessed separately for the IUCN Red List.

Distribution

The range of the eastern taxon (*Mertensiella* sp. 1) is limited to the eastern Meskheta Range and western foothills of Trialeti Range in Georgia and largely lies within Borjomi-Kharagauli National Park. The original type locality of *M. caucasica* (Waga, 1870) is Zekari Pass in Meskheta Mountains, so if the two species are formally described, the existing name will be retained for this taxon. The western taxon (*M. sp. 2*) is distributed from Goderdzi Pass at the junction between Meskheta and Erusheti Mountains in Georgia, west to the Ordu area (Turnalık-Çambaşı) in Turkey (Tarkhnishvili et al. 2009). The known distributions and the potential ranges of both taxa, based on GIS-based analyses (Tarkhnishvili et al. 2009) are shown in Fig. 1 and Fig. 2.

Appearance, Habitats, and Life Cycle

M. sp. 1 and *M. sp. 2* are medium-sized salamanders, with a long, slender body. Total length (body + tail) of adults is 13-19 cm, with body length 6-8 cm. A short, horn-like protuberance on the upper side of the tail base differentiates males from females. The salamanders are found at elevations of 890 - c.1,900 m (*M. sp. 1*) and 67-2,340 m (*M. sp. 2*). They occur in a range of habitats, including mixed, broadleaved, and subalpine forests, and shrubs/grasslands above the timberline.

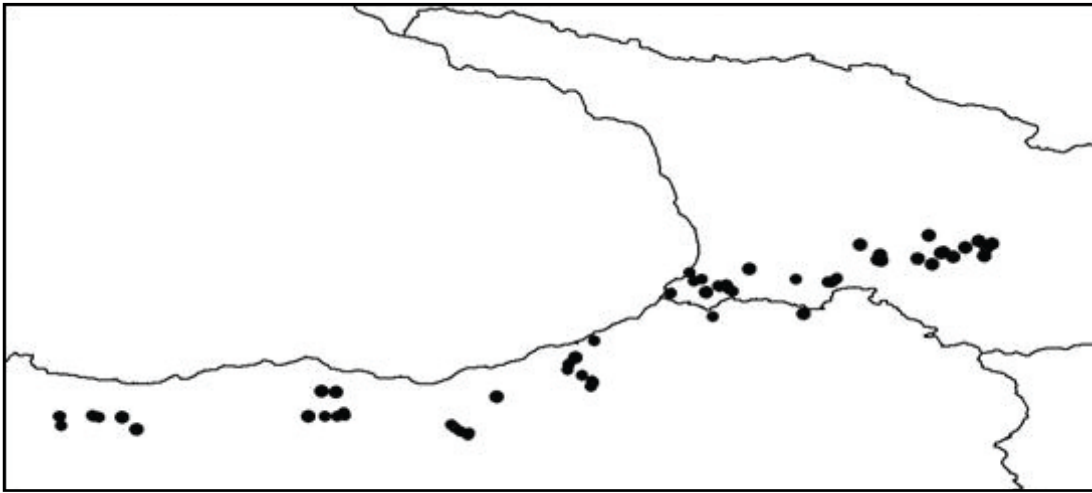


Fig. 1. Identified locations of *Mertensiella caucasica sensu lato* (Tarkhnishvili et al. 2009)

They live along small mountain streams with an uneven flow, usually with stony beds and shelters formed by stones or/and fallen logs. The water is neutral or moderately alkaline (pH 7-7.5), with high oxygen content and low levels of salts and chlorine (Sayim et al. in press). Eggs are laid in shelters, and sometimes in moist areas outside water. Adults and larvae are strictly nocturnal. The life cycle is prolonged: larvae spend 1-3 years in the water before metamorphosis, and metamorphosed animals need 10 or even more years before reaching reproductive size.

***Mertensiella* sp. 1.**

Population Status and Trend

Fifteen localities have been described so far (Tarkhnishvili et al. 2009; Fig. 1), but the estimated number of locations varies from a few dozens to 100-200. The extent of occurrence is c. 1,000 km² and predicted range is 1,782 km². The range is fragmented by mountains separating small river valleys. A long-term study at one locality estimated local population size at c. 1,000 adults (Tarkhnishvili and Serbinova 1993). If continuing decline in habitat quality is considered, global status should be Endangered (EN B2ab(iii)) based on extent of occurrence substantially < 5,000 km², range fragmented, and a continuing decline in habitat quality. Decline in area and quality of forests due to logging provide a solid indication that the

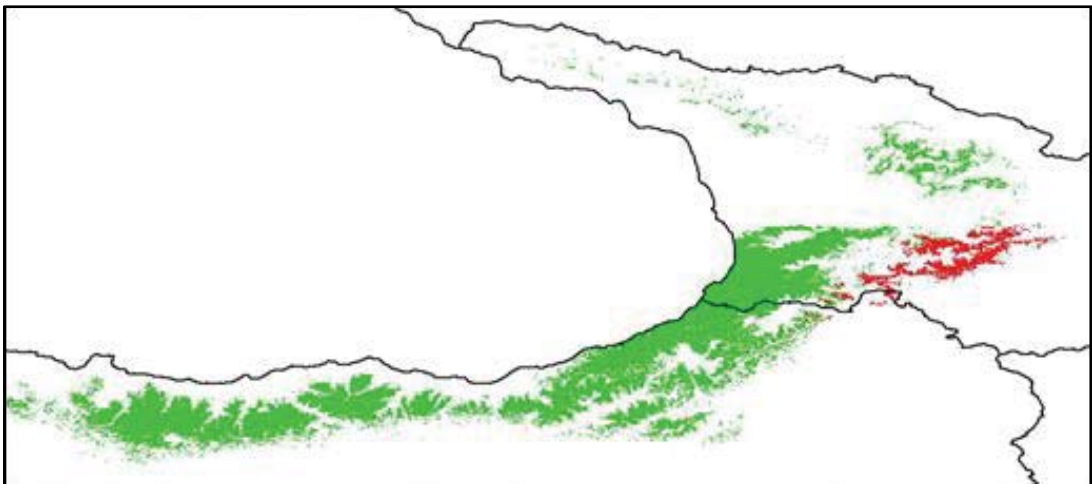


Fig. 2. Predicted range of *M. sp. 1* (red) and *M. sp. 2* (green) (Tarkhnishvili et al. 2009)

trend is negative. A single recorded case of population decline is Nedzvi Sanctuary (the easternmost locality), where a local population at Kekiya Brook was close to extinction by 2006.

Current Protection

Habitats are legally protected in Borjomi-Kharagauli National Park (approx. 76,000 ha) including

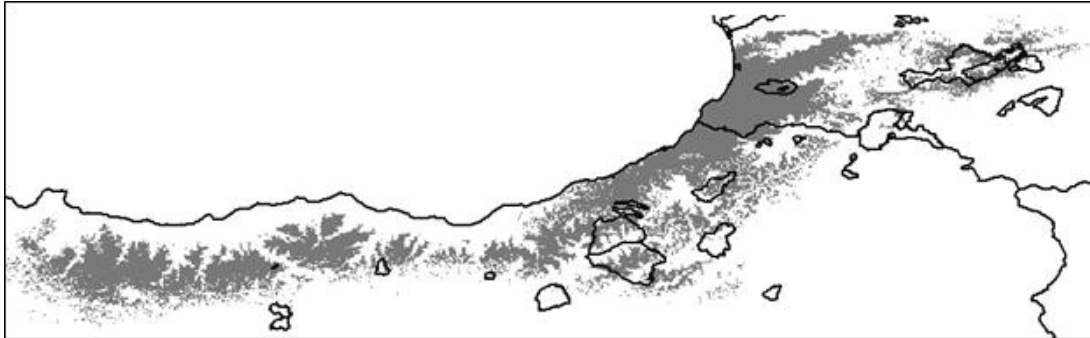


Fig. 3. Protected areas in Turkey and Georgia, in respect to the predicted ranges of *M. caucasica sensu lato*

Borjomi Strict Nature Reserve (18,000 ha) and Nedzvi Valley (11,200 ha). These mostly contain mixed and deciduous forests. The protected area covers 871.11 km² (87 % of the extent of occurrence) of the species (Fig. 3).

Out of 15 known locations of the salamander, 13 lie within the National Park (Table 1). No special conservation actions, beyond legal protection of potential habitats, are in place. A few small educational projects were recently carried out. Table 1 lists the number of known locations in protected areas of different IUCN categories and Fig. 3 shows protected areas in Georgia and Turkey within the range of *M. sp. 1* and *M. sp. 2*

Table 1. Number of known salamander locations within and outside protected areas

Region	Species	IUCN I	IUCN II	Other protected	Non-protected	Total	
Trialeti PCA, Georgia	<i>M. sp. 1</i>	4	9	0	2	15	
Ajara, Georgia	<i>M. sp. 2</i>	1	1	0	17	19	
Borçka-Şavşat area, Turkey		0	0	1	1	2	
Black Sea coast of Turkey		0	0	0	1	1	
Kaçkar area, Turkey		0	4	2	1	7	
Rize area, Turkey		0	0	4	2	7	
Trabzon-Sümela, Turkey		0	4	0	3	7	
Giresun area, Turkey		0	0	0	5	6	
Ordu area, Turkey		0	0	0	3	3	
Entire range			5	18	7	35	67

Threats

Illegal logging was substantially reduced after the creation of Borjomi-Kharagauli NP, but has not been completely eliminated. Even limited logging destroys salamander habitats when it occurs close to stream banks, or if logs are pulled along the stream beds. The consequences include degradation of vegetation; decrease in humidity of microhabitats; increase in water temperature as a result of increased illumination; direct damage to stream beds and shelters of larvae and adults. Critical areas for action are: (1) Nedzvi sanctuary, which has the only population on the eastern bank of the river Mtkvari, isolated from the rest of the range. (2) Abastumani, where only part of the mixed forests lies within the NP, and the rest of the valley suffers heavy destruction by logging.

Specific Actions for Conservation

Research and Monitoring

It is recommended that rangers are trained to identify and record on GPS new salamander locations and to identify larvae/breeding sites. Increasing the number of known locations to at least 50 will aid development of a more detailed spatial model of suitable habitat. Continued presence of salamanders at 15 known locations should be monitored at least every five years.

Legal Measures

Logging within at least 50 m of a streambed and pulling trees along the streambeds should be completely banned.

Public Awareness and Education

Action should include: information on the salamander available at commonly visited locations; increased awareness on the importance of the species as a part of unique regional biodiversity; a public campaign for several endemic Tertiary relict species, including *Darevskia mixta*, *Helix buchi*, *Mertensiella caucasica*, *Pelodytes causicus*, *Ruscus colchicus* and optionally some other animals and plants.

Recovery of Degraded Habitats and Re-stocking

The protection regime in Nedzvi Sanctuary should be substantially improved. If by 2011 two local populations from this area are extinct or remain depressed, translocation of salamanders from adjacent locations should be planned.

Long-term Targets for Conservation

1. All habitats of the salamander are effectively protected within the Borjomi-Kharagauli National Park.
2. Degradation of bank habitats completely stopped by 2015 and bank vegetation recovered by 2025.
3. No loss of monitored populations by 2025.
4. Local people are familiar with salamander habitats (relict species are among important targets of ecological tourism in the Borjomi-Kharagauli National Park).

***Mertensiella* sp. 2.**

Population Status and Trend

52 localities have been identified (Tarkhnishvili *et al.* 2009; Fig. 1). A broad estimate of the number of possible locations varies between several hundred and a few thousand. Predicted range of the species is about 19,895 km² but the anticipated area of occupancy is substantially smaller. Within the predicted distribution, there are several large fragments isolated by inappropriate habitat. If continuing decline in habitat quality is considered, global conservation status should be Vulnerable - VU B2ab(iii), based on extent of occurrence < 20,000 km², fragmented range, and continuing decline in habitat quality. No quantitative estimations of population trend or area of occupancy are available but a sharp decline in size and quality of forests in Georgia provide a strong indication that the trend is negative. Several small isolated populations, such as in Batumi Botanical Garden, appear particularly vulnerable.

Current Protection

Caucasian salamander habitats are legally protected in the following places:

Georgia

Kintrishi Reserve (13,893 ha); Mtirala National Park (15,806 ha).

Turkey

Şavşat-Balıkli & Maden (3,491 ha); Camili-Efeler Strict Nature Reserve (1,453 ha); Camili-Gorgit Strict Nature Reserve (490.5 ha); Borçka-Karagöl (386 ha); Çamburnu Natural Reserve (180 ha); Hatila Valley NP (17,138 ha); Çamlıhemşin-Kaçkar (4,142 ha); Kaçkar Mountains NP (51,550 ha); Uzungöl Lake (1,625 ha); Uzungöl Specially Protected Area (14,900 ha); Altındere Valley NP (4,800 ha); and Örumcek Forest Strict Nature Reserve (263 ha).

The total area of recorded or potential habitats that are protected is 1301.18 km² (6.5% of the extent of occurrence) - 296.99 km² in Georgia, and 1004.19 km² in Turkey. Only 17 out of 52 known locations of the species lie within protected areas. Table 1 lists the number of known locations in protected areas of different IUCN categories and Fig. 3 shows protected areas in Georgia and Turkey within the range of *M. sp. 1* and *M. sp. 2*

Not all PAs have adequate protection regimes. For instance, around Uzungöl Lake between Trabzon and Rize, Çamlıhemşin-Kaçkar and some other Turkish PAs are extensive tourist developments. Most PAs in Turkey are very small and fragmented, and cover only small parts of the range. Many important known or anticipated locations, such as Goderdzi Pass in Georgia, Batumi Botanical Garden, or the coastal mountains east of Rize in Turkey, remain unprotected.

Threats

Most of the predicted range lies in the mountain forest zone, although a substantial part (especially in Turkey) is located above the timberline. The most important factors concern habitat loss:

Degradation of Stream Beds and River Banks

This is the most important potential cause of local extinctions. However, destruction of terrestrial habitats may not always be followed by extinction of the salamander as abundant populations exist in treeless

areas below the timberline in Georgia and north-eastern Turkey: Goderdzi Pass (Georgia) the timberline is currently over 1,700 m; Çambaşı area (Turkey) – above c. 1,600 m; İmeriksa (Turkey) – above 1,700 m, i.e. 200-300 m below the timberline.

- Logging trees along the banks of streams causes degradation of riparian vegetation, in particular ostrich fern (*Matteuccia struthiopteris*), a decline in humidity, including in breeding sites, increases illumination and raises water temperature during the breeding period. Pulling logs along the streambed destroys shelters, including those of eggs and larvae. Logging is an especially important threat in the Georgian part of the range.
- Development of infrastructure often directly transforms streambeds into channels with smooth beds without shelters for larvae; more important in Turkish part of the range.

Destruction and Degradation of Terrestrial Habitats

This may result from: (a) overgrazing in subalpine habitats, especially in the Turkish part of the range, (b) logging in forest habitats (more important in Georgia), and (c) development of infrastructure, including urbanization. These also cause further range fragmentation.

Conservation Action

Effective long-term conservation of *M. sp. 2* should include: (1) improving the PA network; (2) enforcing protection in PAs; (3) reducing destruction of the salamander habitats outside PAs; (4) research; and (5) public awareness and education.

Improving the Protected Area Network

Current size and distribution of PAs in SW Georgia and NE Turkey is inadequate for effective conservation of *M. sp. 2*. PAs should form a single network linking suitable habitats. In Georgia, this applies to the northern slopes of Shavsheti Mountains and Charnali river valley. It is strongly recommended that a network of mini-reserves is developed along small rivers and streams entering the Chorokhi and Ajaristskali from the south. The isolated salamander habitat in Batumi Botanical Garden should be protected.

In Turkey, it is highly desirable to create a PA in the Karadeniz Mountains south of Giresun and Ordu. Most of the PAs in the mountains south-east of Rize are too small to ensure effective protection for Caucasian salamander and other relict species. It is desirable to create at least two additional national parks comparable in size with Kaçkar Mountains NP. Kaçkar Mountains NP should be substantially expanded to the west; Camili-Efeler and Camili-Gorgit strict nature reserves should be combined with Borçka-Karagöl protected area to form a national park that covers the entire mountain forest and subalpine areas along the left bank of the river Çoruh north of Borçka. Another PA is recommended in the mountains north of Shavshat, along the border with Georgia. Strict protection measures are only needed for areas within 100-200 m of mountain streams. The potential negative socio-economic effects of the creation of new PAs can be minimized if some economic activities are allowed.

Enforcing Protection in Protected Areas

In Georgia, measures include complete exclusion of illegal logging in PAs with special attention paid to bans on the pulling of logs along streambeds. In Turkey, special attention should be paid to popular tourist locations within PAs, such as Uzungöl Lake, Sümela, or Çamlıhemşin-Kaçkar. Most important is prohibition of construction work (including artificial stabilization of river and lake banks) where smaller streams enter the larger basins. Any building activities within salamander range should be preceded by

environmental impact assessment including. If the PA includes breeding sites, building activities should be displaced by at least several tens of meters.

Limiting Human Activities that Cause Habitat Loss outside Protected Areas

It is hardly possible to achieve protection of more than 50% of the existing area of occupancy of the salamander. However, strict regulation of human activities can and should be introduced throughout the entire predicted range of the species, including:

Cutting trees closer than 50 m to a river or stream should be strictly prohibited to maintain corridors where salamanders and other endemic species of fauna and flora can survive.

Special penalties should be introduced for pulling logs along river and stream beds

Artificial transformation of stream banks during infrastructure development in the vicinity of rivers and streams should be conducted only after identification of salamander habitats, and in case such habitats are present, the construction works should be displaced or limited by a short fragment (less than 10 m) of the stream banks.

These measures benefit not only biodiversity conservation but also maintain the aesthetic value of the landscape and existing water regime.

Research and Monitoring

52 known locations adequately represent the range of the species. Further refinement of the area of occupancy can be done through improving technical approaches (e.g. inclusion of more detailed maps for modeling the range) rather than by identifying new locations. Presence of the salamanders at 20-40 locations in Turkey and 10-20 locations in Georgia should be monitored at least every five years to assess trends. Introduction of a monitoring system is an important target to be achieved in the next few years. Also important is remote monitoring of the predicted range using satellite imagery: this helps to develop a retrospective view of landscape dynamics. This task should be done at least once per 10-year period. In order to improve knowledge on the spatial structure of salamander populations and identify potential genetically isolated populations, it is desirable to continue molecular genetic studies of *M. sp. 2*.



Fig. 4. *Caucasian Salamander I* © D. Tarkhnishvili

Public Awareness and Education

Although the salamander is a flagship species for the Western Lesser Caucasus, much needs to be done to popularize it as a representative of the local relict fauna. Public awareness varies in different parts of the range. In general, people are more familiar with the animal in the Turkish part of the range than in Georgia. Actions to increase public awareness should include:

- a) In Georgia – familiarize the local population with the species;

- b) Throughout the range – increase awareness of people and local authorities concerning the importance of the species as a part of unique regional biodiversity and a species included in the IUCN Red List.
- c) It is highly recommended to conduct public campaigns in Georgia and Turkey not only for the Caucasian salamander (Fig. 4), but jointly for several endemic relict species. For each region, the species complex should be selected individually. For instance, in Ajara (Georgia), Borçka area, west to Kaçkar mountains, the species complex could include Caucasian salamander, Caucasian mud-diver, Turkish Lizard, large snails of the group *Helix buchi*, and selected species of endemic plants such as *Rhododendron ungeri*. In Giresun-Ordu areas those could be *Mertensiella caucasica*, *Helix buchi*, *Pelodytes causicus*.

Conclusions

Caucasian salamanders are a part of the Tertiary relict species complex typical of the Western Lesser Caucasus. The Lesser Caucasus refugial landscapes are an important biodiversity heritage. *Mertensiella caucasica* sensu lato is possibly the species whose range covers these landscapes in the most representative way. Development of a set of measures to conserve the salamander will help to protect not just this single species group, but the entire relict community.

Acknowledgements

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Executive Summary

The project developed conservation recommendations for two endemic, threatened species of vipers (*Pelias [Vipera] kaznakovi*, *Pelias [Vipera] dinniki*) in the Caucasus. The critical condition of micro-populations of *Pelias kaznakovi* was noted in all sites investigated. The situation of *Pelias dinniki* was markedly more favorable. However, negative influences on both species were also marked, both natural-historical conditions and human activity. The main success of project was the inclusion of *Pelias dinniki*, on our recommendation, in the Red Data book of Krasnodarsky Krai/Region (where 2/3 of its population is concentrated). Also, for the first time, in the zoning of Sochi National Park, all places of occurrence of *Pelias kaznakovi* and *P. dinniki* were included in the specially protected areas.

Scope of the Work

The ancient polymorphic group of shield-headed vipers of «kaznakovi»-complex included 4 species until recently: *Pelias kaznakovi* (Nikolskiy, 1909), *P. dinniki* (Nikolskiy, 1913), *P. darevskii* (Vedmederja et al. 1986) and *P. pontica* (Billing et al. 1990). In 2001, two new species of *Pelias* were described: *P. orlovi* (Tuniyev and Ostrovskikh, 2001) and *P. magnifica* (Tuniyev and Ostrovskikh, 2001). Presumably *Pelias bārani* (Böhme et Joger, 1984) also belongs to this complex.

The aim of the project was to develop recommendations on conserving two endemic, threatened species of vipers (*Pelias kaznakovi*, *P. dinniki*) in the Caucasus, with a focus on the West Caucasian Biosphere Region. This was done on the basis of a rapid assessment of their current distribution and status, consultative discussions on the status of the species in key areas and on a transboundary conservation program.

Material was collected in alpine areas of the Greater Caucasus, particularly in Krasnodarsky Krai, Adygea (NW), Karachay-Cherkessia (NW), Kabardino-Balkaria (NW), Alania-North Ossetia (central part on N slope) and Daghestan (NE); in Abkhazia (SW), as well as in north-eastern Turkey (Mostly W Lesser Caucasus); also along the Black Sea coast in Russia, Georgia and Turkey. Earlier material collected in Chechnya, Ingushetia, Daghestan (NE Greater Caucasus), in Kura River catchment basin (Lagodekhi, SE Greater Caucasus and Borjomi, N Lesser Caucasus), Adjara (Batumi, Charnali, Gonio, Sarpi, W Lesser Caucasus), Poti (Kolkheti Lowlands) was also utilized, as well as material in collections (Zoological Institute Academy of Science of Russia, Zoological Museum of Moscow State University), and material kindly sent from Daghestan by E.S. Roitberg, and verbal reports from the late M.A. Bakradze on Lagodekhi.

Pelias dinniki (Nik., 1913) - Dinnik's viper

Status. Dinnik's viper (Fig. 1) is a declining species with some populations near to extinction. It is listed as Vulnerable (VU) in the IUCN Red List (Tuniyev et al. 2008a) and in the Red Data books of the Russian Federation (2001), Krasnodarsky Krai (2007), and Adygea Republic (2000).

Distribution and Habitats. Dinnik's viper is a subalpine species, occurring from the middle- to upper-alpine belts, up to 2200-2600 m asl. In Krasnodar Territory and Adigea Republic it was found along all middle-mountain and high-mountain zones of Kavkazsky State Biosphere Reserve, Sochi National Park and Sochi Federal Sanctuary. It inhabits pine forests, glades, subalpine and alpine meadows, overgrown talus slopes, and subalpine elfin-woods.

In Krasnodarsky Krai and Adygea Republic, Dinnik's viper was found in 68 localities. In the Karachay-



Fig. 1. *Pelias dinniki* - Dinnik's viper / © B. Tuniyev

Cherkessia republic it occurs in subalpine birch woods, pine forests, moraines, stony meadows and glades of the Imeretinka River, Mt. Zakan, Mt. Bolshaya Khatipara, Azgek canyon, Mukhu River, Abishir-Akhuba Ridge, and headwaters of the Kuban River. Unlike more brightly-colored populations from the Caucasus Reserve, Dinnik's viper from Teberdinsky Reserve is not so variable in color (grey and brown tones prevail), but they are still quite variable on the head and zigzag of the back.

From Kabardino-Balkaria and farther to the east, there are already isolated populations, which we investigated on Elbrus, in the

headwaters of the Fiagdon River (Alania-North Ossetia), Itumkalinskay Hollow of Chanty-Argun River (Chechnya), and Mt. Guton (Daghestan). The color of animals in these eastern populations is the most subdued of all: gray tones with darker zigzag, although some individuals can show a contrasting picture due to yellow edging of the zigzag.

The species is noted along practically all the highlands of western Georgia, the limestone mountains of Arabika, eastward to Svaneti and with an isolated population from Lagodekhi in eastern Georgia. Animals from Georgia are less brightly-colored than in Krasnodarsky Krai and Adygea Republic. They have brown-yellowish tones with a brown zigzag.

Population. Density varies, but numbers are declining practically everywhere. According to the Red Data book of the USSR (1984) there are 2-6/ha in the subalpine belt of the Greater Caucasus. In some places there are seasonal concentrations up to 30-40/ha. At present, the species reaches its highest density on stony talus slopes of the subalpine belt in the Caucasus Reserve. In the westernmost part of the area, in Sochi National Park (Khakudzh and Bekeshey mountains), Dinnik's viper is extremely rare and is more common on Mt. Achishkho and the Aibga Ridge. High concentrations are noted on Aishkha Ridge within Sochi Federal Sanctuary, where up to 46 vipers were counted during a daily excursion.

In Teberdinsky Reserve the species is common, in some places abundant; the highest density was observed on Mt. Bolshaya Khatipara (up to 30/ha). In Abkhazia density on the moraines of Kamenny Klad Ridge reaches 20/ha. In eastern Georgia, Kabardino-Balkaria, Alania-North Ossetia, Chechnya and Daghestan the species is extremely rare, and sporadically distributed in most mesic parts of the subalpine belt. It reaches a maximum density of 3/ha. Confirmed records from Ingushetia and Azerbaijan are not available at present, but the occurrence of Dinnik's viper in these districts is highly likely.

Ecology. In the high-mountain zones of the Greater Caucasus, heavy precipitation occurs and snow cover

remains for over half the year. A limited number of snake species can survive in such difficult conditions. *Pelias dinniki* is one of the obligate oreophylous species of the snake fauna of the Greater Caucasus.

Based on more than 30 years of observations both in the wild and in terrariums, young *Pelias dinniki* are born at the end of August - beginning of September. Later births are recorded in captivity: in the last ten days of September to the first ten days of November. In high-mountain zones, the first snow falls in mid-September and there is full snow cover from mid-October. Female vipers cannot give birth in this period and must hibernate while pregnant. New-born *P. dinniki* have been seen in the wild at the end of June - beginning of July. The ability of females to hibernate while pregnant is not a general characteristic but depends on locality, though this reproductive strategy is observed regularly.

Another interesting feature is the ability to give birth a year after mating, as observed by us in terrariums. The possible reproduction without males in high-mountain zones of the Greater Caucasus can reflect either parthenogenesis, or the protracted retention of viable sperm, or delayed development of the impregnated ovules. Without special histological analysis it is impossible to resolve this question. Remaining pregnant during hibernation and the possibility of giving birth without mating are unique aspects of the reproductive strategies of alpine snakes of the Caucasus, developed in the glacial period.

Threats. Outside protected areas, basic threats to western populations are recreational development and direct elimination of snakes and for eastern populations – grazing and direct elimination. In existing protected areas the basic threat is direct elimination and capture.

Protected Areas. NW Greater Caucasus: Sochi National Park – not less than 5,000 individuals (population is stable in the east and close to disappearance in the west of the Park); Kavkazsky State Biosphere Reserve – not less than 100,000 (stable); Sochi Federal



Fig. 2. *Pelias kaznakovi* - Caucasian viper / © B. Tuniyev

Sanctuary – not less than 5,000 (stable); Teberdinsky State Biosphere Reserve – not less than 30,000 (stable); «Priel’brus’e» National Park (NW Greater Caucasus), Kabardino-Balkarsky High-Mountain Reserve (NW Greater Caucasus), Lagodekhi Reserve (SE Greater Caucasus), Tlyaratinsky Federal Sanctuary (NE Greater Caucasus) – numerous but size of populations has not been determined. In Ritsa (SW Greater Caucasus) – no more than 1,000. The North-Ossetia Reserve (N slope of Central Greater Caucasus) has no more than 1,000. On the whole, numbers and population trend in protected areas are tending to decline.

Conservation Recommendations. The species is relatively safe in existing protected areas, but requires additional protection measures. In the Russian Federation it is necessary to create a new Federal Reserve in Itum-Kalinskaya Hollow of Chanty-Argun River in the Chechen Republic; to include within the Caucasus Reserve or Sochi National Park the south slope of Aishkha Ridge, from Sodovy Brook to the current border of the reserve. In Daghestan it is necessary to protect Guton Mountain and to create a State Reserve on the basis of Tlyaratinsky Sanctuary. International effort is needed to develop transboundary initiatives between appropriately located protected areas (Krokhmal and Tuniyev 2003).

***Pelias [Vipera] kaznakovi* (Nikolsky, 1909) - Caucasian viper**

Status. Caucasian viper (Fig. 2 and 3) is progressively disappearing across its range. Listed as Endangered (EN) in the IUCN Red List (Tuniyev et al. 2008b), Red Data books of Russian Federation (2001), Georgia (1982), Krasnodarsky Krai (2007), Adygea Republic (1999).

Distribution and Habitats. In Krasnodarsky Krai and Adygea Republic animals were found in 31 localities. It is present sporadically in Abkhazia (the vicinity of Gantiadi, Gagry, Bzyb Canyon, Pitsunda-Myusera Reserve, Bolshie Bebesyry Lake) and occurs in coastal Adjara (Poti, Batumi, Charnali Gorge). In Turkey it is found in the vicinity of Hopa – Kamili – Arkhavi.



Fig. 3 *Pelias kaznakovi* - Caucasian viper (melanistic specimen) / © B. Tuniyev

Population. In places where it was common at the beginning of the 20th century, it has now either disappeared or only non-viable micro-populations remain. Population density varies. In the vicinity of Tuapse, up to 3/100 m² were counted (Ostrovskikh 1991). On the Black Sea coast single specimens might be observed. The densest populations are found in Veselovsky and Aibginsky Forestry of Sochi National Park, where in a daily excursion it is possible to encounter 10 individuals. The total number in the Russian Federation does not exceed 2,000. The total number in Georgia scarcely exceeds 3,000. Numbers have not been estimated in the Turkish part of the range.

Threats. Basic threats are elimination of vipers, intensive capture by amateur herpetologists, transformation of their habitats, and recreational development of the Black Sea coast.

Protected Areas. NW Greater Caucasus: this species occurs in Kavkazsky State Biosphere Reserve, (threatened population, no more than 300 in total), Sochi National Park, (the core population in the Russian Federation with about 1,000 individuals); SW Greater Caucasus: Ritsa (threatened population, no more than 200 specimens in total) and Pitsunda-Myusera Reserve (coastal area; threatened population, no more than 100 specimens); W Lesser Caucasus: Kintrishi Reserve, (threatened population, number unknown), Turkish part: Camili Biosphere Reserve (threatened population, number unknown; Afsar & Afsar in press). Confirmation is needed of current occurrence in state parks of Altyndere, Karagel-Sahara, Hatila-Vadisi (W Lesser Caucasus, Turkey); Borjomi reserve (Bakradze 1969) and Borjomi-Kharagauli National Park (N Lesser Caucasus); Pskhu-Gumista and Kobuleti Reserves, Sataplia, Kolkheti and Mtirala National Parks (Colchic bio-geographic region, eastern part of the Black Sea catchment basin). On the whole, in most of its natural habitat, density of the species is substantially below natural density. Strengthening protection in existing protected areas is needed as well as educational work among employees and visitors to protected areas.

Conservation Recommendations. All areas with high density of Caucasian vipers in Sochi National Park are already in the specially protected area. Work has begun on including Loosky Forestry within

Sochi National Park. To conserve *P. kaznakovi* it is necessary to create reserves: Gagry - from Psou River and Sal'me on the north-west to the lower course of Bzyb River on the southeast, including the narrow canyons on the south slope of Gagrinsky Ridge (Tuniyev and Nilson 1995); to increase the area of Pskhu-Gumista Reserve, selecting cluster areas near Tsebel'da and Amtkel Lake; to increase the area of Kintrishi Reserve, in accordance with the recommendations of Memiadze (1976); to protect all forest parts of Kintrishi, Dekhvan, Chakhvistskali and Korolistskali gorges above 300-500 m and additionally to preserve 5 small areas in inland Adjara in the Adzharistskhali basin; to create the Reserve, including Charnali Gorge and Shavsheti Ridge.

International cooperation is needed to conserve this species, by designation of a «Colchic» Transboundary Biosphere Polygon/Territory, which could include all existing and planned protected areas within the eastern part of the Black Sea catchment basin.

Conclusions

Inclusion of *P. kaznakovi* and *P. dinniki* in the Red Data book of the Krasnodarsky Krai (2007) should be considered. Earlier, both species were included in the Red Data book of Russian Federation (2001) and Red Data book of Adygea Republic (2000). Thus, both species received legal and territorial protection at State and Regional level, at least, in the basic area covered by this project - West Caucasian Biosphere Region. A positive development is the start of a process to include Loosky Forestry within Sochi National Park to unite two cluster areas in a single protected area.

There are three forms of existing protection: legal, captive breeding, and territorial. Legal protection includes numerous acts, regulating or fully forbidding the killing or capture of one or another species. It should be underlined that *P. dinniki* was included in the Red Data books of different levels only in the new millennium, and the listing of *P. kaznakovi* in practically all international, national, and regional red lists and books over a long period has had little effect on reducing loss of natural habitat or population declines.

Captive breeding facilities to build up populations for subsequent reintroduction are practically absent for *P. kaznakovi* and *P. dinniki*, although some experience in terrariums has been accumulated. The most effective and reliable form of protection is territorial: nature reserves and other types of protected area. Nature monuments, as well as reservations, remain tourist destinations and are deprived of real protection, at least as applied to amphibians and reptiles. In national parks, with rare exceptions, scientifically-based zoning that takes into account the need to conserve vipers is absent.

The only existing reserve covering a large area is the Caucasus Reserve, but more than 66% of its territory is located on the north slope of the Greater Caucasus, and the southern part is occupied by middle-mountain and alpine landscapes, so that *P. kaznakovi* practically receives no protection. Reserves in Georgia and Turkey are extremely small in area, and the range of *P. kaznakovi* on their territory is extremely limited. To save both species of vipers, we consider a primary and urgent task to be improving the network of protected areas.

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Executive Summary

Data on current and historical status of sturgeons in Georgia were obtained by the project 'Research on Sturgeon Conservation Status in Georgia' implemented in 2006-2008. The study and monitoring of sturgeons in Georgia were suspended in 1991 due to political developments and resumed 16 years later within the framework of this project. The project covered: species composition, population size and structure, distribution, habitat status and harvesting, analysis of the decline, and threats. Sturgeon conservation status was determined and a guideline national conservation action plan was developed based on the project results.

According to our estimates, by 2007 the total number of sturgeons in Georgia declined to its historical minimum of 10,000, meaning that from 1907 to the present, the number of sturgeons has declined at least 37 times.

Status

All six species native to Georgia were found during the study so sturgeon species composition in the Georgian part of the Black Sea and the rivers falling into it maintains its historical diversity.

1. European sturgeon *Acipenser sturio* (Linnaeus, 1758) (Georgian: poronji, poreji);
2. Starry sturgeon *Acipenser stellatus* (Pallas, 1771) (Georgian: t'araghana, tskvrini);
3. Fringebarbel sturgeon *Acipenser nudiventris* (Lovetzky, 1828) (Georgian: jarghala);
4. Colchic sturgeon *Acipenser persicus colchicus* (Marti, 1940) (Georgian: zutkhi, tarti, dokhok'oni);
5. Danube-azov sturgeon *Acipenser güldenstädti tanaica* (Marti, 1940) (Georgian: zutkhi); and
6. Beluga sturgeon *Huso huso* (Linnaeus, 1758) (Georgian: svia).

A total of 281 individuals were examined during the study:

A. sturio: since 1991 there have been only three confirmed records. One was caught in 1999 near the mouth of the Rioni. One was seen at Batumi fish market on 20 August 2004. In November 2007, six juveniles were caught in the Black Sea, near the Rioni mouth. Four were released into the sea alive, while two were examined and identified as *A. sturio*.

A. nudiventris: 2 were caught.

A. güldenstädti tanaica: 7 were caught; apparently only a few of this species occur in Georgia.

A. stellatus: 37 individuals; minimum length – 20.05 cm, maximum length – 119 cm (weight – 9 kg). Individuals 30-70 cm long make up 78.33% of the population. Average length is 53.91 cm. Spawners make up 5.40% of the population.

H. huso: 87 individuals; minimum length – 22 cm, maximum length – 211 and 236 cm (weight – 62 and 88 kg); individuals 40-70 cm long make up 49.91% of the population. Average length is 74.71 cm. Spawners make up 6.09% of the population; females make up 40%, and males 60% of spawners.

A. persicus colchicus: 151 individuals; minimum length – 18 cm, maximum length – 151 cm and 158

cm (weight 31 and 29 kg). Individuals 30-70 cm log make up 69.5% of the population. Average length is 57.04 cm. Spawners make up 5.96% of the population; females make up 33.33%, and males 66.66% of spawners. No major differences in length and reproductive structure of sturgeon populations were found compared to the data of 1973-1989 (Burchuladze et al. 1973-1989). Figure 1 shows the percentage composition of sturgeon species in 2007.

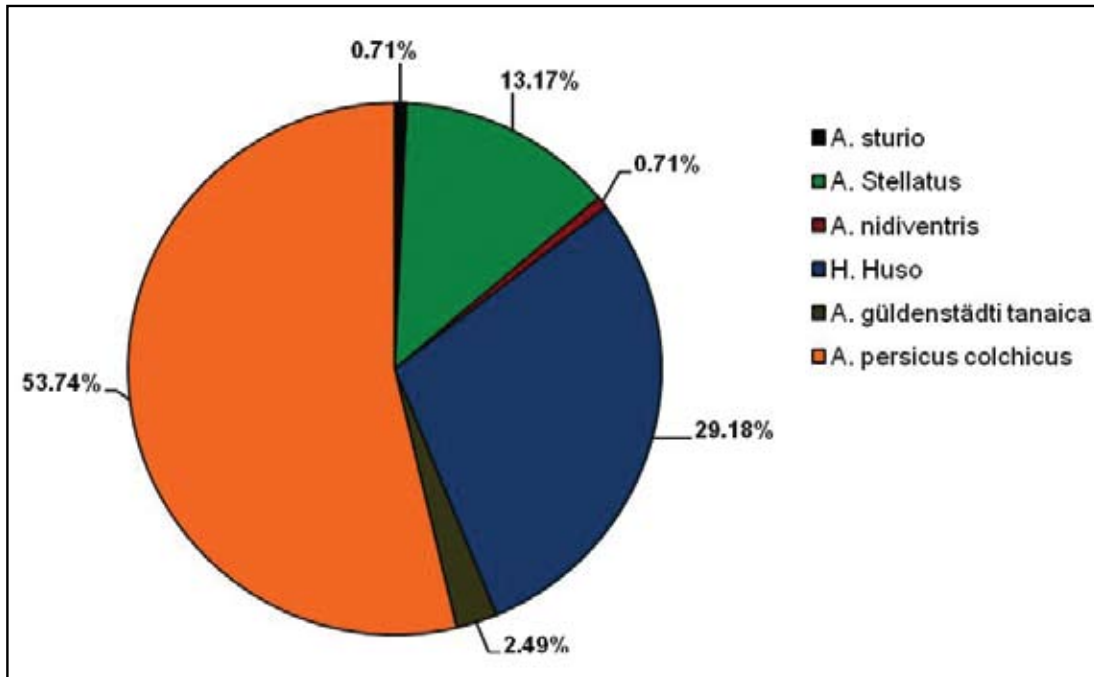


Fig. 1 Percentage parity of species in 2007

The percentage composition of sturgeon species in 2007 in relation to *A. persicus colchicus* was mostly similar to that of 1991, with *H. huso* and *A. stellatus* indices showing tendencies to increase and decline, respectively. All species except *A. sturio* fall within the minimum and maximum indices of 1973-1991. The *H. huso* index is only 0.3% lower than the maximum of 29.05% recorded in 1987.

A. güldenstädti tanaica was first referred to as a separate species in 1986. In 1987-1991 this fact was either disregarded or the species was still considered as *A. persicus colchicus*, or else it was not noticed because of its scarcity. The occurrence of the rarest species, *A. nidiventris*, in Georgia can be explained by the use of more diverse research methods in 2007. In 1973-1991, sturgeon numbers were studied primarily using bottom trawl surveys, but this time the focus was also on monitoring of traditional fishing, including poaching and illegal fish markets.

Sturgeon Numbers

We estimated the total number of sturgeons at 10,000. Research on sturgeon numbers and population structure started in Georgia in 1973 continued annually until 1991, when it was suspended because of political developments. There are no data available before 1973. An approximate number can be estimated using the correlation between captured sturgeons and the total stock. At the beginning of the 20th century, there were not less than 372,000 sturgeons in Georgia. By 1931 the number was 227,000; by 1936 – 168,000; by 1957 – 70,000 and by 1962 – less than 27,000 (Fig. 2). As a result of conservation action taken 1967-1975 (ban on sturgeon fishing in 1967, artificial propagation in 1974-1975) the number of sturgeons increased from 27,000 in 1973 to 78,000 in 1976 (Fig. 2). In 1976, another decline began

due to the termination of artificial propagation, and commercial anchovy fishing in areas of sturgeon concentrations that led to parallel fishing of sturgeon. By 1985, the number of sturgeons declined to the then historical minimum of 18,000.

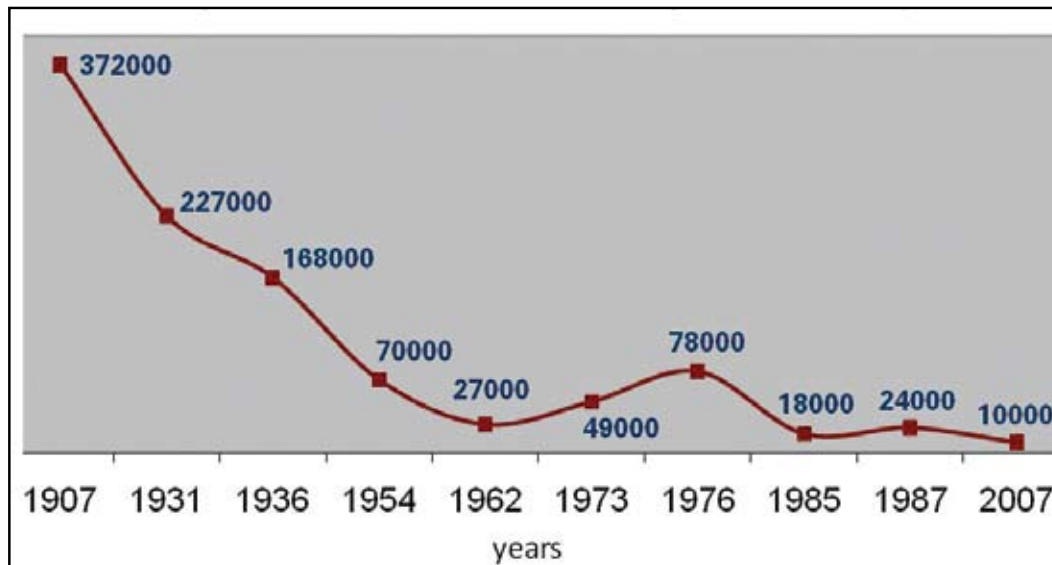


Fig. 2. General number of the sturgeons in 1907-2007 years

From 1985, numbers increased slightly, apparently as a result of the resumption of captive breeding and reached 24,000 by 1987 (30% growth). A new decline started from 1990. According to our estimates, by 2007 the total number of sturgeons in Georgia went down to its historical minimum of 10,000, a decline of at least 37 times from 1907 to the present. Since 1976, the number has declined by 7.8 times. The decline became slightly slower during the last 16 years. This is due to the economic collapse caused by the dissolution of the Soviet Union, drastic reduction in environmental pollution, recession in fish-breeding, termination of commercial anchovy fishing in the Georgian part of the Black Sea, and a sharp restriction in commercial fishing in the vicinity of the Abkhazian coast (two thirds of the Georgian Black Sea coastline) as a result of armed conflict. These events reduced pollution of sturgeon habitat and poaching.

The population of *A. sturio*, which was the most widely distributed species in Georgia, has declined catastrophically, from an estimated 4,300-4,400 in 1973-1974 to 400 in 1990-1991 (Burchuladze *et al.* 1973-1989; Komakhidze and Mazmanidi 1998). Presently, there are at most several dozen *A. sturio* in Georgia. The main cause of this critical situation is commercial fishing of anchovy in sturgeon concentration and feeding areas (Poti-Ochamchire), which leads to parallel fishing of the predator species - *H. huso* and *A. sturio*. While *H. huso* losses caused by commercial fishing were compensated by artificial propagation, no artificial propagation *A. sturio* has ever been practised.

Given the sturgeon percentage composition, percent of spawners and intervals between spawning, we deduce that the number of sturgeons annually spawning in the Rioni River is as follows: *A. nidiventris*, *A. sturio* and *A. güldenstädti tanaica* – several individuals, *A. stellatus* - 18-22, *H. huso* 35-44 and *A. persicus colchicus* - 64-80 (Table 1).

Table 1. Number (estimate) of sturgeons and spawners by species

Species	<i>A. strurio</i>	<i>A. nidiventris</i>	<i>A. stellatus</i>	<i>H. huso</i>	<i>A. persicus colchicus</i>	<i>A. guldenstadti tanaica</i>
Number	71	71	1317	2918	5374	249
Spawners	Separate individuals	Separate individuals	71	177	320	Separate individuals
Total Number	10,000					

Distribution

Two benchmarks, 1922 and 1957, were chosen to estimate the decline in sturgeon range. The decline started in 1923, so 1922 shows the range prior to that date. The range reduction reached a catastrophic level in 1958-1987.

Contemporary range size has been determined based on data from catches in 2002-2007. It shows the range status from the first benchmark through the following 40-45 years, including the period after the beginning of the catastrophic reduction. Gaps in data on sturgeon distribution in Georgia in 1922 and 1957 were bridged using data on ranges in 1964-2007.

In 1992, sturgeons were found in 16 rivers with a total length of sturgeon range approximately 540 km. By 1957 the number of spawning rivers was reduced to a quarter: Mtkvari, Alazani, Iori and Aragvi flooded, while the length of rivers shrank to 370 km (Arnold 1896; Barach 1939; Barach 1941; Verg 1916; Verg 1932; Verg 1948; Danilevskiy 1871; Kavraiskiy 1906; Kessler 1878; Svetovidov 1964). At present sturgeons are found only in six rivers: Rioni, Kodori, Chorokhi, Khobi, Bzypi and Enguri.

Sturgeons have the widest distribution in the Rioni and are very scarce in the Bzypi and especially in the Enguri. Only juvenile sturgeons enter the Enguri, moving only 4 km away from the mouth. In the Khobistskali River only three sturgeons were captured in the last 5 years, while before 2000, at least 10 sturgeons were caught annually in the Khobistskali mouth, in the sea close to the mouth and the lower reach of the river. The total length of the river section of sturgeon range in 2007 is 170 km.

The marine section of the range remained intact from 1922 to 1957, when its area was about 1,250 km² (continental shelf to the depth of 75 m). By 2007, the marine section area shrank a little to 1,080 km², although population density has declined drastically from 62.4 individuals per km² in 1976 to 8 individuals per km² in the Georgian part of the continental shelf (to a depth of 75 m).

Spawning Section of the Range

Sturgeon spawning grounds are situated in the rivers Rioni, Enguri and Tskhenistskali. The Rioni spawning ground formerly extended for about 57 km (from the 80th to the 137th kilometer from the mouth) from the Sajavakho-Samtredia railway bridge to Kutaisi (Burchuladze et al. 1973-1989; Marti 1939; Marti 1940; Tikhiy 1929). There is only one reference to the spawning area in the Rioni available from the literature (Burchuladze et al 1973-1989) that estimates it at 200 h (minimum depth 1 m, maximum flow rate – 1.5m/sec, stone soil, maximum diameter of stones – 5-6 cm).

The sturgeon spawning grounds in the Enguri extended for almost 35 km: starting near the railway bridge close to the Shamgona village (35 km from the month) and ending in the environs of the town of Jvari (70 km from the mouth) (Arnold 1890; Marti 1939, 1940; Tikhiy 1929).

There is only one general reference to sturgeon spawning grounds in the Tskhenistskali, Rioni's biggest tributary (Ninua 1976). Prior to regulation, the Tskhenistskali had the best conditions (water flow discharge, rate, depth and soil) for sturgeon spawning after the Rioni and Enguri. The spawning grounds in the Tskhenistskali extended for about 32 km. According to local fishermen, large sturgeons (1.5-3 m), including spawners, used to be caught in April-July before the regulation.

Today, the only spawning ground is in the Rioni, starting near the Ochopa stream mouth, about 4 km above the Sajavakho-Samtredia railway bridge, and ending near the Vartsikhe HPP's diversion canal. Only 9 km (16%) of Rioni's 57 km spawning ground remain today. The 44-km section of the spawning ground from Kutaisi to the Vartsikhe HPP's diversion canal and the 4-km section from Sajavakho-Samtredia railway bridge to the Ochopa stream mouth were destroyed by floods caused by regulation. The area has shrunk from 200 (51) to 30 ha or 15%. The 35 km spawning ground in the Enguri and 32 km section in the Tskhenistskali have been destroyed as a result of water flow regulation (Table 2).

Table 2. Length of sturgeon spawning areas in 1922 and 2007

Year	River		
	Rioni	Enguri	Ckhenistskali
1922	57	35	32
2007	9	0	0

The decline in sturgeon populations and shrinking of the range are due to habitat destruction, poaching and unsustainable fishing. Habitat destruction is mainly caused by construction of hydroelectric power plants, pollution of rivers and banks, operations of the Kulevi port. Other noteworthy causes are timber rafting and sand and gravel recovery in the spawning rivers.



Fig. 3 Current and historical distribution of sturgeons in Georgia

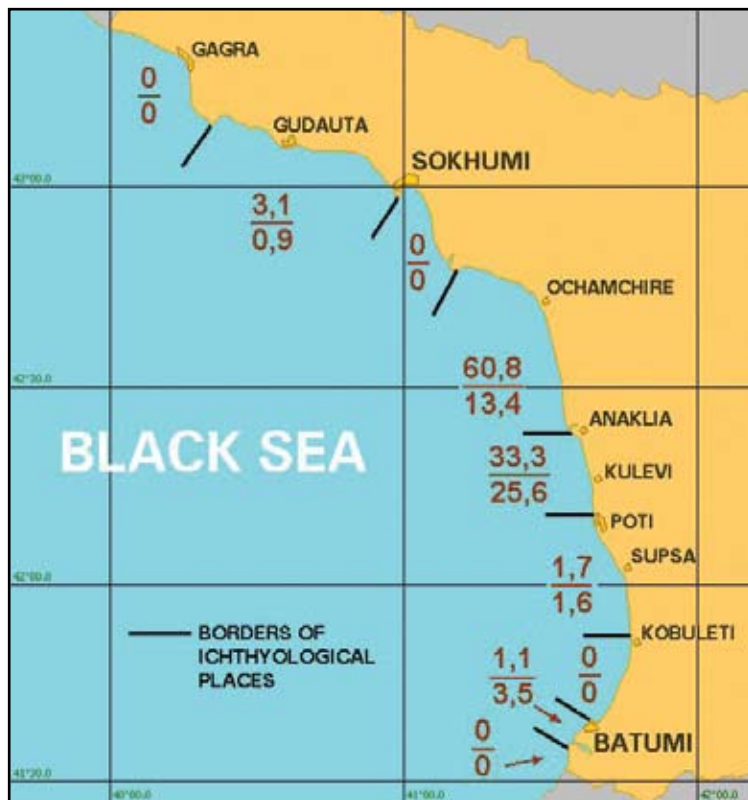


Fig. 4. Horizontal Distribution of Sturgeons near the Black Sea Coast¹

Note: ¹ Numerator = percent of the total number in the given section; and Denominator = number per km² of the given section

(Fig. 4). The vertical distribution of the total sturgeon population shows that the Poti – Kodori cape section is the main feeding area, while the Poti-Ochamchire section is the most densely populated part of the Poti – Kodori cape section.

National Conservation Status

National conservation status of each species was estimated based on our research, according to the IUCN Red List Categories and Criteria (IUCN 2001) and is shown in Table 3.

Table 3. Sturgeon National Conservation Status in Georgia

Species	Category	Criteria
<i>Acipenser sturio</i> (Linnaeus, 1758)	CR	A1acde+2d
<i>Acipenser nudiiventris</i> (Lovetzky, 1828)	CR	D
<i>Acipenser güldenstädti tanaica</i> (Marti, 1940)	CR	D
<i>Acipenser stellatus</i> (Pallas, 1771)	EN	A1acde+2d
<i>Huso huso</i> (Linnaeus, 1758)	EN	A1acde+2d
<i>Acipenser persicus colchicus</i> (Marti, 1940)	EN	A1acde+2d

Note: CR = Critically Endangered; and EN = Endangered

Vertical and Horizontal Distribution

Near the Black Sea coast, *H. huso* is found at depths of 5-57 m, mainly 10-55 m, while *A. stellatus* and *A. persicus colchicus* occur at 5-50 m, primarily 5-30 m. It is noteworthy that 94.1% of the total number of sturgeons inhabit coastal sections from Kodori cape the Anaklia cape and from Anaklia cape to Poti; 3.1% are found in the section from Bichvinta cape to Sokhumi cape, 1.1% inhabit the area from Batumi cape to Chorokhi mouth, while 1.7% are found in the Poti-Kobuleti section. No reports have been received in the Psou – Bichvinta cape section, Sokhumi cape – Kodori cape section, Kobuleti – Batumi cape section and the Chorokhi mouth – Sarpi section (Fig. 3).

On average, there are 8 individuals/km² in the Georgian part of the continental shelf (to a depth of 75 m); 16/km² in the spawning section from Poti to the Kodori cape, 3.5 in the Chorokhi mouth – Batumi cape section, 1.6 in the Kobuleti-Poti section and 0.9 in the Gudauta cape – Sokhumi cape section

Acknowledgements

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Summary

Information on the taxonomic status of the Persian Sturgeon is contradictory, with several authorities regarding it as sun-species of the Russian Sturgeon (*Acipenser gueldenstaedtii*) while others consider it to be a separate species (*Acipenser persicus* Borodin). The objective of this study was to use morphological and molecular genetic analyses of the same sample of fish to investigate the diversity of Russian sturgeon (*Acipenser gueldenstaedtii sensu* Berg, 1934), especially in relation to Persian sturgeon (*Acipenser persicus sensu* Borodin, 1897). Full results of the study have been published in the *Journal of Ichthyology* (Ruban et al. 2008) and only a brief summary is presented here.

Methodology

A sample of 58 specimens of the Russian sturgeon (*sensu* Berg, 1934) was collected in the southern part of the Caspian Sea in 2002. Of these, 21 had external characteristics conforming to those of Persian Sturgeon, as described by Borodin. Twenty-eight morphometric characters and six meristic characters were analysed using one dimensional and multivariate (Principal Components Analysis (PCA)) methods. Molecular genetic analysis was carried out on the same sample of fish based on cytochrome *b* polymorphism.

Results

Principal Components Analysis of the 28 morphometric characters demonstrated an absence of separate clusters. Frequency distributions of the six meristic characters also do not show any morphologically distinguishable forms. The results of the molecular genetic study also demonstrate the homogeneity of the sample. The combined results of the morphological and molecular genetic analyses of Russian Sturgeon *Acipenser gueldenstaedtii* (*sensu* Berg 1934) do not support the validity of the Persian Sturgeon as a separate species *Acipenser persicus*.

Acknowledgements

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Executive Summary

As part of the project ‘IUCN Red List Update of Arthropoda of the Hirkan Corridor and Introduction of the Species Population Monitoring in the Hirkan National Park’ (Fig. 1), we conducted an inventory of the arthropod fauna in the Hirkan corridor.

Field expeditions were conducted over 3 years, 2006-2008, to identify invertebrate species and to train staff of Hirkan National Park. A laboratory for insect population monitoring was established in the park. Habitats and representative landscapes that are refuges for rare endemic species were identified. The final inventory contained 330 species. Of these, 33 rare and endangered species of Arthropoda were identified and proposed for inclusion in the IUCN Red List.

A series of conservation measures were developed. These included production of a brochure on threatened species of Arthropoda and plants in the Hirkan Corridor; this was distributed to the customs, education facilities, libraries, and municipal agencies.

Scope of the Work

The Arthropoda are known to inhabit all ecosystems and play an important primary role in the establishment and existence of these systems and in seral processes, but the conservation system for Arthropoda is underdeveloped. The priorities are: endemic species with narrow ranges, relict species, representative species of large groups, and species that are widespread yet small in number, attracting attention by their bright colors, large sizes and unique shape. Unlike vertebrates, it is impossible to conserve Arthropoda species separately, so a comprehensive conservation system is necessary, including protection of habitats.

Talysh (an old historical name of the Hirkan corridor) has a particular importance in the mountain systems of the Caucasus region.

This importance is primarily due to mountain-forming processes that provided unique natural

conditions, with a subtropical climate inherited from the Tertiary period, and producing a unique flora and fauna containing with many endemic species. The high endemism of Hirkan (including areas of the Azerbaijan Talysh and Northern Iran up to the Alborz Range) has a dual nature. Firstly, there are several endemic species originating from the ancient Tertiary speciation phase (e.g. argan tree (*Argania spinosa*), Gleditsia, the silk tree (*Albizia julibrissin*), zelkova (*Zelkova*), etc. and associated insect species, such as Lepidoptera: (*Brahmaca christophi* St., *Argynnis alexandre* Men., *Melanargia hylata* Men.); Orthoptera: (*Izophya caspica* Sysh.); buprestids (*Dicerca fricitellum*, *Ancyloicheria solomoni* Men., capricorn beetle



Fig. 1. Forests in Hirkan National Park / © V. Lukarevskiy

–*Parandra caspia* Men.). Secondly, there are younger species originating from later changes in the local physical and geographic conditions and a new speciation phase: (Oriental persimmon *Diospyros lotus*, hazel *Corylus* etc.) and associated Lepidoptera (*Danais chrysippus* L.); bumblebees (*Bombus daghestanicus* Rad.); ants (*Aulocopone relictus* Arn., *Epitritus argiolus* Em.).

In addition, the presence of several climatic zones, such as humid subtropical up to 500 m, moderately cold mountain forest up to 1,300 m, and dry desert climate of treeless plateaus produces vegetation communities associated with several floristic provinces: the Aral-Caspian, Hirkan, and Iranian provinces (Aliev 2003; Guseinov 1998; Kuliev 1996; Samedov 1996; Effendi 1996).

The fact that Talysh never experienced the influence of glaciations was a critical prerequisite for the survival of Tertiary relic species, so that today Talysh represents a living natural museum, and its flora and fauna rank highest in the Caucasus for their species diversity. An example of typical lowland forest landscape with ‘aerial plants’ – lianas and epiphytes – survives only in Hirkan National Park. Yet even this area has been subject to great change in the last 50 years. Some scattered areas with remnants of natural and secondary forests can be found outside the national park boundaries. Emergence of such secondary and disturbed plant groups is solely due to anthropogenic factors. Separate groups of animals, first of all insects, are especially sensitive to habitat change. Agricultural habitats created in former forest areas resulted in the gradual disappearance of indigenous faunal complexes and their replacement by new ones with lower species diversity. Previously dominant forest elements have become relicts. Hence, the problem of sustainable resource use is closely linked to the problem of relict species conservation.

Forest felling and timber production (especially in the last 10-15 years) on land adjacent to Hirkan NP or within the park; felling of oak trees, hornbeams, maples, alders, chestnuts, etc. for furniture manufacture), active development of vegetable-growing and subtropical plantations, pollution of ponds and watercourses with pesticides and insecticides, uncontrolled grazing on unique alpine and subalpine grasslands resulted in habitat loss and reduced the number of many insect species.

The objectives of our study included compilation of an inventory of the arthropod fauna in the Hirkan corridor and identification of rare and endangered species and development and implementation of effective measures for gene-pool conservation.

Methodology

Field work was carried out in 2006-2008. Seasonal expeditions were conducted over the 3 years to identify invertebrate species as well as to train the staff of Hirkan National Park in collecting and storing entomological material and calculating insect numbers. A laboratory for insect population monitoring was established and equipped in the park.

The team also identified habitats and representative landscapes that are refuges for rare endemic species. These are humid subtropical forests with undergrowth, meadow vegetation on forest edges and coastal psammophilous (sand-dune) vegetation.

Results

Inventory

An inventory was compiled of under-studied Arthropod fauna in the Hirkan Corridor, with 336 Arthropod species found. These included:

- Order Hymenoptera – suborder – 30 species; superfamily Apoidea, - 120 species
- Order Hemiptera – 50 species;
- Order Lepidoptera – family Arctiidae - 29 species;

Order Arachnidae – 107 species.

Rare and Threatened Species

The following 33 rare and endangered Arthropod species have been identified and proposed for inclusion in the IUCN Red List:

Order Hemiptera

Family Pentatomidae – 3 species:

Andrallis spinidens (Fabricius, 1787)

Zicrana coerulea (Linnaeus, 1758)

Picromerus bidens (Linnaeus, 1758)

Family Reduviidae – 4 species:

Metapterus linearis (Costa, 1862)

Reduvius personatus (Linnaeus, 1758)

Collestodema fasciata (Kolfenati, 1875)

Ectomocoris quadrimaculatus (Serville, 1831)

Order Hymenoptera

Superfamily Apoidea

Andrenidae – 4 species:

Andrena semirubra (Morawitz, 1876)

Andrena orenburgensis (Schmeideknecht, 1882)

Andrena perviceps (Krichbauner, 1873)

Andrena viridescens (Viereck, 1916)

Anthophoridae – 1 species:

Anthophora meridionalis (Fedtschenko, 1875)

Colletidae – 1 species:

Colletes mlokoszewiczi (Rodoszkowski, 1891)

Megachilidae – 1 species:

Anthidium bartolomei (Rodoszkowski, 1882)

Family Halictidae – 5 species:

Nomioides turanicus (Morawitz, 1876)

Nomioides nigripes (Bluthgen, 1933)

Halictus cochlearitarsis (Dours, 1872)

Evyllaenus talyschense (Bluthgen, 1925)

Sphecodes albilabris (Kirby, 1802)

Suborder Symphyta:

Family Pamphilidae – 1 species

Pamphilius trigalrius (Konov, 1897)

Family Tenthredenidae – 1 species:

Ametastegia alabastris (Konov, 1902)

Order Lepidoptera

Family Arctiidae – 7 species:

Hyparia purpurata (Linnaeus, 1758)

Euglasia quadripunctaria (Poda, 1761)

Chelis dahurica (Boisduval, 1843)
Pelosia muscerda Hufnagel, 1766)
Pelosia obtusa (Herrich-Schäffer, 1799)
Sybina crotella (Linnaeus, 1758)
Sebina kuhlüeinii Hübner, 1803)

Order Araneae

Nemesiidae – 1 species:

Raveniola hyrcanica (Dunin, 1988)

Dysderidae – 2 species:

Dysdera concinna L. (Koch, 1878)

Harpactea hyrcanica (Dunin, 1991)

Theridiidae – 1 species:

Argyrodes hyrcanus (Logunov et Marusik, 1990)

Salticidae – 1 species:

Phintella castreisiana (Grube, 1861)

Conservation

The following prevention and conservation measures have been developed on the basis of the studies conducted:

1. General conservation activities.
2. Controls on illegal felling.
3. Sustainable use of pastures: control over livestock grazing and collection of herbs.
4. Conservation of refuges of rare species both in the Hirkan NP and adjacent lands.
5. Best and science-based practices in economic activities; control over pesticide use; application of biological methods of pest control.
6. Environmental awareness-raising through seminars, training, etc.
7. A brochure entitled ‘Rare and Endangered Arthropoda Species and plans of the Hirkan Corridor’ was published and distributed to the customs, education facilities, libraries, and municipal agencies.

Acknowledgements

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Executive Summary

The project aimed to create a database on rare and endangered species of invertebrates in Armenia for further updating of the Armenian Red Data Book. The project included:

1. Identification and listing of rare and endangered invertebrate species;
2. Clarification of ranges, both historical and contemporary;
3. Clarification of the population status of some model species, also species included in the IUCN Red List; and
4. Preparation of recommendations and respective documentation for including the Armenian species in the IUCN Red List and the Caucasus Red Data Book.

The project was implemented on the entire territory of Armenia, including most of the East Lesser Caucasus priority corridor (# 6), also part of the Southern Highlands corridor (#8) and the Javakheti corridor (#5) (CEPF 2003). Expert evaluations and analysis of literature were used as a basis for pre-listing rare species of Armenian invertebrates. A computer database was created that included all information available: published data, information obtained from interested specialists, data from collections, data on the listed species from previous field observations as well as from field expeditions carried out as part of this project. The database included a total of 586 species of Mollusca and Arthropoda. All the considered species were evaluated according to the IUCN Red List criteria (IUCN 2001) and recommendations were made for protection of individual species and groups of species.

Owing to its geography, Armenia has rich biodiversity for a country of the temperate zone. The area of Armenia is only 0.13% of the former USSR, but many large animal and plant taxa made up 40%, and sometimes over 50% of the respective flora and fauna taxa of the Soviet Union. On the other hand, the small area of the country and high population density (over 100/km²), high level of industrial development (including mining) and agriculture resulted in serious modification of local landscapes. That resulted in deterioration of habitats of most species, shrinking of their range and reduction in numbers. The situation was particularly threatening for the invertebrate fauna because of their rather limited mobility and strong 'attachment' to their communities. Yet traditionally the major focus of environmental agencies was almost wholly on vertebrate animals, primarily on so-called 'valuable' species. At the same time, 'individual protection' prevailed over 'territorial protection', that is, conservation of ecosystems in general was underestimated, though it could have helped to conserve invertebrates to some extent. No special measures for the conservation of invertebrates were made in Armenia, with a sole exception of the Ararat cochineal. The Red Data Book of Armenia (Red Data Book 1987) does not include any invertebrates.

The invertebrate fauna in Armenia includes up to 17,000 species (Baloyan, Shashikyan 1999). Many of them are associated with ecosystems that are under strong anthropogenic pressure. Particular consideration should be given to endemic species: according to the National Report, these are at least 300 endemic species in Armenia. Many endemics have a very limited range, which suggests that they should be listed under globally threatened categories (CR = Critically Endangered, EN = Endangered or VU = Vulnerable).

In view of the above, development of the Invertebrates Red Data Book of Armenia would be a key element for establishing legal and information frameworks for invertebrate conservation both at the level of individual species and as part of ecosystems, through the improved system of protected areas (PAs) in the country. The database created as part of the Project forms the basis for developing the Red Data Book, and the evaluation data may be taken into account for red-listing at a higher level, including the IUCN Red list (this is especially true for endemic species, for which regional evaluations coincide with global assessments).

Scope of the Work

The scope of the research included the invertebrate fauna of the Republic of Armenia. Types of Mollusca and Arthropoda were considered, including the classes Arachnida (belonging to two orders) and Insecta (representatives of seven orders). In Armenia, these groups include a total of over 6,000 species, i.e. somewhat more than one third of the local invertebrate fauna. About 600 species have been evaluated as rare. Unfortunately, no information could be obtained for many taxa, including large and environmentally important ones. For many such taxa, there are no published or available data and/or experts competent in both the systematics and status of the groups in Armenia. The studies embraced all landscape zones of the country.

Methodology

A number of factors were taken into consideration when pre-listing the species, namely, their limited range (including Armenian endemic species), apparent reduction in number, occurrence in especially vulnerable ecosystems. The preliminary list also included species from the IUCN Red List and Annex II to the Bern Convention. Consideration was also given to recommendations proposed by authors of previous updates (Akramovsky 1948; Avagyan 1975, 1984; Arakelyan 1984). A total of 650 species were selected. Collection data and literature were analyzed, primarily including reviews and revisions of the Armenian fauna listed in the bibliography, and numerous descriptions of new species, plus works at a larger geographic scale. Historical ranges of pre-listed species were evaluated with different confidence levels. Some species were excluded later because of lack of information and changes in taxonomic status, or species apparently mistakenly recorded for Armenia in international documents. To obtain contemporary information, field expeditions were carried out in all provinces of the Republic of Armenia, during which traditional entomological and malacological methods were used.

Data were entered into the electronic database under the following headings:

- Taxonomic status (including synonymies, if any)
- Range in Armenia
- General distribution ranges
- Ecosystems
- Biology
- Brief description of the adult stage
- Number and change trends (expert evaluation)
- Threats
- Existing conservation status

Distribution data were included in the database in GIS format using the program MapInfo. The data were used to evaluate the status of all species against the IUCN Red List criteria (IUCN 2001), primarily focusing on geographic aspects, as quantitative data are less applicable to invertebrates. Results of the

evaluation were included in the 'Proposed Status' column of the database. Conversion of the database columns allows drafting reports on individual species in different formats.

Results

The database includes a total of 586 species, including 30 species of mollusks (Mollusca), 1 arachnid (Arachnida) belonging to the order Aranei, and 547 species of insects (Insecta) representing seven orders: Odonata - 25 (Fig. 1), Orthoptera - 18 (Fig. 2), Homoptera – 85, Coleoptera - 303, Hymenoptera - 45, Lepidoptera - 48 (Fig. 3), and Diptera – 21.

The assessment suggests that at least two species can be classified as extinct: *Amphicoma eichleri* and *Glaphyrus calvaster* that used to inhabit the now totally devastated ecosystem near Echmiadzin and were last collected in 1930s. They were never found during many expeditions to the region in subsequent years. Two species of buprestids (*Capnodis excisa*, *Lampetis argentata*) are considered as Regionally Extinct in Armenia. In addition, 286 species are classified as CR, 132 as EN, 92 as VU, and 26 as Near Threatened (NT). Eight species redlisted by IUCN and included in Annex II of the Bern Convention have a quite favorable status in Armenia (e.g. black apollo (*Parnassius mnemosyne*) - Fig. 3, *Hyles hippophaes*, and the great capricorn (*Ceramnyx cerdo*), so they are listed as Least Concern (LC). Finally, 42 species are classified as Data Deficient (DD): these are primarily species from poorly studied groups, frequently of unclear ecological association and almost unavailable for collection, often known from single specimens.

Though not all species can be clearly assigned to this or that ecosystem type, some generalizations are possible. In the database, species of arid and semiarid ecosystems prevail (deserts and semideserts, phrygana, arid light forests etc). About 200 species are classified in this category. About 60 species



Fig. 1. *Onychogomphus flexuosus* / © M. Kalashian

are associated with steppes and 75 with meadow ecosystems (alpine and subalpine). About 100 rare species are found in forests of different types. About 55 species are residents of azonal communities.

Threats cannot always be identified, especially if potential. Yet one can suggest that contemporary or potential threats include primarily anthropogenic impacts leading to degradation or full deterioration of ecosystems, and these factors may be even more fatal for invertebrates than for vertebrates. For species on our list, the threats include grazing, agricultural land development, and construction of hydro-electric facilities. One of the most dangerous threats is increased



Fig. 2. *Bradiporus dilatatus* / © G. Karagyan

development of the mining industry. Another additional threat is the expected climate change that would entail change and fragmentation of ranges and would enhance negative impact of other factors.

Recommendations

Recommendations for conservation are given for most species included in the database. In most cases, the recommendations are similar, permitting some generalizations. As it follows from the above overview, impacts that entail some extent of ecosystem degradation are key threats for all species. Accordingly, conservation should first of all focus on conservation of the respective ecosystems, i.e. it should be territorial conservation. The main objectives of conservation are identification and effective operation



Fig. 3. *Parnassius mnemosyne* / © M. Kalashian

of protected areas (PAs). In Armenia, activities are carried out to establish new PAs as well as to enhance the efficiency of already existing ones, fortunately also taking into account data on invertebrates, including data from the Project database.

Certain consideration should be also given to sustainable use of natural resources outside the PA system, namely, standards and controls should be in place for controlling grazing, haymaking, forest and water use, pesticide use in view of the need to conserve rare animal and plant species. Strict limitations on mining are necessary in areas where rare and endangered species are concentrated, up to complete prohibition of mining activities in areas that are of particular

value for biodiversity conservation.

On the other hand, we believe that individual conservation approaches are not only ineffective but even detrimental for invertebrates, as limitations of scientific and even amateur capturing restrict opportunities for studying the insect fauna and for conserving them effectively.

At present, activities are going on to prepare the Red Data Book of Armenia for publication. Since the publication cannot include all the almost 600 species, species should be shortlisted for inclusion. We would recommend selecting species in a manner to embrace more systematic groups as well as different ecosystems. In addition, we believe it would be useful to include some species in the IUCN Red list, at least endemic species classified as highly vulnerable.

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Executive Summary

The project *Coordination and Development of Plant Red list Assessments for the Caucasus Biodiversity Hotspot* was implemented by IUCN in collaboration with Missouri Botanical Garden, USA, and botanists from six countries of the Caucasus (Armenia, Azerbaijan, Georgia, Russia, Turkey and Iran). The project aimed to provide a series of Red List training and validation workshops specifically tailored to the Caucasus region so that local botanists could use internationally accepted methods for plant conservation assessment and monitoring (IUCN Red List Categories and Criteria) and the Species Information Service Data Entry Module (SIS DEM) as tools for data management and analysis. The work has resulted in a comprehensive overview of the distribution and conservation status of the endemic plant species of the Caucasus region based on current knowledge.

The Caucasus Plant Red List Authority was established under the IUCN Species Survival Commission and the series of three Red List training and validation workshops successfully introduced participants to the IUCN Red List process during the first workshop, then reinforced proper practices and in some instances corrected mistaken concepts during the second workshop, and finally highlighted the use and relevance of assessments for conservation planning and the development of a regional Plant Conservation Strategy during the third workshop. Targets listed in the draft of the Plant Conservation Strategy for the Caucasus correspond to the targets of the Global Strategy for Plant Conservation. BGCI and the IUCN Caucasus office will be solicited for support of publication in 2010 of the Strategy, to be titled the “Caucasus Plant Conservation Initiative.”

Data collected for the species assessments resulted in a comprehensive list of Caucasus endemic plant taxa containing *ca.* 2,950 species/subspecies/varieties and Red List assessments of *ca.* 1,160 taxa were made with *ca.* 60% assessed as threatened, i.e., Critically Endangered, Endangered, or Vulnerable. The final product of the project “The Red List of Endemic Plants of the Caucasus Region” with the full list of endemic plant taxa of the region and species assessments is currently being finalized for issue in 2010 (Fig. 1).

Scope of the Work and Methodology

The Caucasus hotspot, historically interpreted as the isthmus between the Black and Caspian seas covers a total area of 580,000 km²; including Armenia, Azerbaijan and Georgia, the North Caucasus portion of the Russian Federation, northeastern Turkey and part of northwestern Iran (CEPF 2004). The flora of the Caucasus hotspot is extremely rich owing to geographical conditions and the ecological history of the region. According to preliminary assessments, the number of vascular plant species of the Caucasus was estimated to be *ca.* 6,300 and the approximate number of species endemic to the region *ca.* 1,600. However, the comprehensive list of the Caucasus endemic plant taxa (species/subspecies/varieties) developed



Fig. 1. *Galanthus platyphyllus* Traub et Moldenke (Caucasian endemic) / © D. Kikodze

within the framework of the project at present comprises *ca.* 2,950 taxa.

The list is still being processed, as distributions of certain species are revised according to available sources. Taxonomy and nomenclature of Caucasus endemic plant taxa follow mainly Czerepanov (1995) for Armenia, Azerbaijan, Georgia, Russian Federation (the North Caucasus); Davis (1967-88) for Turkey, and Rechinger (1963-2005) for Iran. Published volumes of the Caucasian flora conspectus (Takhtajan 2003-2008) were also used as important reference.

The Caucasus Plant Red List Authority was established within the framework of the project and comprises 40 members. It will ensure that all species within its jurisdiction are correctly evaluated against the IUCN Red List Categories (IUCN 2001) and following IUCN guidelines for their application (IUCN 2004). This process provides a peer review system ensuring that assessments include the necessary minimum documentation required and are made in as consultative manner as is possible, to ensure that the IUCN Red List is credible and scientifically accurate.

Botanists from each of the countries in the ecoregion, with technical support from IUCN and the Missouri Botanic Garden, are using existing expertise to incorporate the data into the Species Information Service, using the Data Entry Module. This will in turn ensure that all global plant assessments are suitably reviewed and made available for regional use and analysis.

Central to this project is that all work on endemic plant assessments will be included in the IUCN Red List of Threatened Species, which is guided by the IUCN Red List Programme. The Red List Programme identifies and documents those species most in need of conservation attention if global extinction rates are to be reduced and provides a global index of the state of degeneration of biodiversity. The role of the IUCN Red List in underpinning priority setting processes for single species remains of critical importance for species and habitat management. The IUCN Red List Programme and its companion information management system, the Species Information Service, provide fundamental baseline information on the status of biodiversity as it changes over time and ensures efficient management and integration of relevant data.

It is important to note that for many years, insufficient international cooperation between botanists from the states of the Caucasus region and consequent lack of data exchange resulted in a great number of taxonomic discrepancies as well as incomplete knowledge of the distribution of species. One of the major gaps in Red Listing in the Caucasus was for plants, as only one plant species was included in the Critical Ecosystem Partnership Fund (CEPF) Ecosystem profile. This project directly addressed one of the key strategic directions identified in the CEPF Ecosystem profile. By training botanists in plant conservation assessment techniques, the project also contributed to national, regional and global plant assessments (target 2, as identified in the Global Strategy for Plant Conservation adopted by the Convention on Biological Diversity in April 2002) as well as several other targets in this Strategy which

are dependent on plant conservation assessments. In particular, the result of this project, a conservation assessment of plants endemic to the Caucasus hotspot, supports target 2 of the CBD Global Strategy for Plant Conservation (to undertake plant conservation assessments at national, regional and global levels by 2010), as each country will now be able to include the global assessments in their own national assessment using IUCN Categories and Criteria.

Short-term Goals of the Project:

- 80% of all threatened plant species assessed in this project are included in documentation for land use and protection within 2 years of project completion.
- A process for identifying Important Plant Areas and contributing to the updating of Key Biodiversity Areas using information from this project is started before the end of this project.
- A regional plant conservation strategy for the Caucasus is produced by the Caucasus Plant Specialist Group within a year of project completion.

Assessment Results

The plant taxa initially suggested as endemic to the Caucasus Biodiversity Hotspot were thoroughly verified with respect to their distribution within the Hotspot borders by the project consultants, which resulted in a comprehensive list of the region's endemic taxa, containing up to 2,950 species, subspecies, and varieties, a significant increase over the 1,600 species estimated in the original proposal. Of these, 1,160 endemic taxa occurring in 1-3 countries of the Hotspot, i.e., all national endemics as well as those occurring in 2 or 3

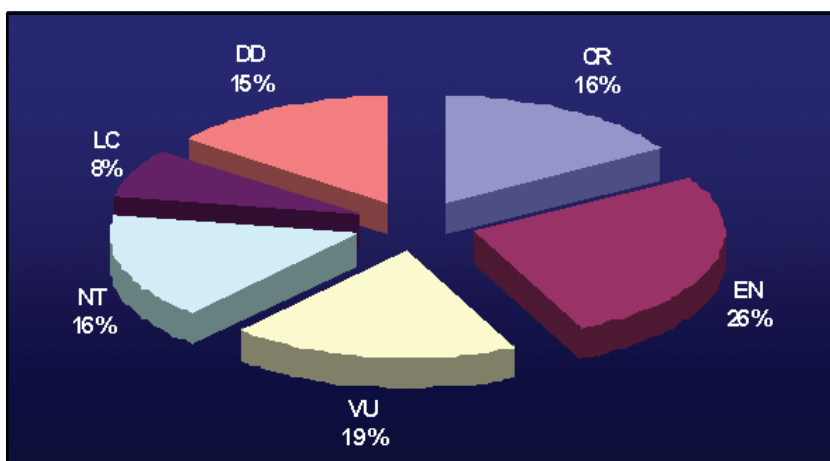


Fig. 2. Scheme of Red List assessments for ca. 1,160 of ca. 2,950 Caucasian endemic plant taxa (species/subspecies/varieties)

countries, and therefore those taxa most likely to fall into one of the threatened categories, were evaluated for their conservation status using the IUCN Red List Categories and Criteria. Figure 1 shows the breakdown of assessment categories for the 1,160 evaluated taxa, with 61% assessed as threatened, i.e., Critically Endangered, Endangered, or Vulnerable (Fig. 2).

Fifty priority national endemics were identified by each country of the Caucasus Biodiversity Hotspot to highlight plant conservation issues and imperatives. The final product of the project “The Red List of Endemic Plants of the Caucasus Region”, with the full list of endemic plant taxa of the region, the conservation assessments of 1,160 taxa, and top priorities for conservation action, to be issued in 2010, will be the first reference manual on the conservation status of Caucasian endemic plants, and will serve as an indispensable resource for the respective governmental and non-governmental organizations in each country upon which to undertake conservation planning to ensure the persistence and sustainable use of the region's endemic plant diversity.

After the project completion the Caucasus Plant RLA will continue its activities including further Red Listing of the Caucasus endemic plants to complete assessments of the remaining widespread (4-6 countries), probable Least Concern (LC) endemic taxa, and update national assessments using IUCN

Regional Guidelines (along with other activities included in the draft for the Plant Conservation Strategy for the Caucasus).

The final product of the project “The Red List of Endemic Plants of the Caucasus Region” with the full list of endemic plant taxa of the region and species assessments is currently being finalized for issue in 2010.

The process of identification of Important Plant Areas (IPAs) has already been started by the Armenian National Center prior to the end of the project and preliminary maps were presented by the consultants at the 3rd Regional Red List Workshop (24-29 May, 2009). Identification of IPAs will be started by the other national teams and project consultants in the coming months, to be completed by 2012, as called for in the draft of the Plant Conservation Strategy for the Caucasus developed at the 3rd Regional Caucasus Red List workshop, 24-29 May, Tbilisi, Georgia.

Targets listed in the draft of the Plant Conservation Strategy for the Caucasus correspond to the targets of the Global Strategy for Plant Conservation. BGCI and the IUCN Caucasus office will be solicited for support of publication in 2010 of the Strategy, to be titled the “Caucasus Plant Conservation Initiative.” The Strategy will be presented to all the relevant stakeholders in each of the Caucasian countries.

PLANT CONSERVATION STRATEGY FOR THE CAUCASUS (Draft)

(A) *Understanding and documenting plant diversity:* (a) Widely available database based of the Conspectus of the Flora of the Caucasus on Internet; (b) Digitization of the types of the Caucasus plants on-line; (c) New wave of exploration fieldwork for discovery/re-discovery of species; (d) Complete assessments of many widespread (4-6 countries) endemic taxa – probable LC; (e) Updated national assessments using IUCN Regional Guidelines; (f) Fieldwork to monitor the most threatened species to understand the nature and impact of threats using agreed standard methodology; (g) Digitization of slides of the Caucasus plants and creation of a virtual library/gallery of the Caucasus plants: www.caucasusplants.org

(B) *Conserving plant diversity:* (a) Identification of IPAs completed by 2012; (b) GAP analysis of threatened species with respect to presence in protected areas; (c) Regional and national inventories of alien invasive plants – research; (d) Symposium on invasive plants in the Caucasus region; (e) *Ex situ* cultivation of threatened plants and establishment of seed banks; (f) Ensure the conservation of crop wild relatives (s.l.) in the Caucasus region; (g) Maintenance of cultivars in local agricultural systems.

(C) *Using plant diversity sustainably:* (a) Review of Caucasus species in international trade; (b) CITES enforcement strengthened within region for trade of geophytes; (c) Ensure sustainable harvest of medicinal plants – research; (d) Native Caucasian plant species formerly used as food /food security through conservation of local knowledge; (e) Research in ethno-botany /traditional use of native plants for food and medicine, and aromatic plants.

(D) *Promoting education and awareness about plant diversity:* (a) Exchange of educational materials / success stories that promote plants conservation; (b) Engage stakeholders responsible for putting into practice; (c) Establish curricula in conservation biology at primary, secondary, university and graduate levels;

(E) *Building capacity for the conservation of plant diversity:* (a) Exchange of educational materials /success stories that promote plants conservation; (b) Engage stakeholders responsible for putting plant conservation into practice; (c) Establish curricula in conservation biology at primary, secondary, university and graduate levels; (d) Caucasus Plant SG expansion into a society for plant conservation including amateurs and non-professionals; (e) Greater interaction with IUCN regional office and national governments; (f) “Caucasus Plant Conservation Initiative” – seek support for regional strategy document from IUCN Caucasus office and BGCI.

Important lesson were learned during the project implementation:

The first important lesson learned at the very earliest stage of project implementation was the clear necessity for scientific cooperation among the countries of the region. The lack of such cooperation

historically has resulted in large gaps in the knowledge of species distributions within the region, as well as a great number of taxonomic discrepancies. Although species distributions were determined using all the sources available to the project consultants, a number of taxonomic questions that were not within the scope of this project are still to be resolved.

The second important lesson learned was that continuous consultations among the project participants (and now among the members of the Caucasus Plant Red List Authority) on specific questions related to the Red Listing process are essential for correct and consistent assessments.

The third lesson is that close contact with the IUCN Caucasus Office, WWF Caucasus Office, and governmental and non-governmental organizations dealing with nature protection in each country will be of paramount importance with respect to the future activities of the Caucasus Plant RLA in fulfillment of its mission to further the conservation of the plants of the Caucasus Region.

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Executive Summary

Talysh is a unique floristic region of the Caucasus whose floral composition differs from that of neighboring regions of Azerbaijan. The region contains many endemic species dating from the Tertiary Period and is notable in particular for the diversity of its tree species. Hirkan National Park (21,435 ha) was established to conserve the endemic flora. The aim of the project was to identify rare and endangered species in Hirkan NP. Vegetation communities were described and herbarium materials collected. Ten very rare species were identified, their distributions were mapped and their phenology described. Recommendations for future research and conservation were made.

Scope of the Work

Talysh in southeastern Azerbaijan is a unique floristic region (Gadjiev et al. 1979) bordering Iran in the west and the Caspian Sea in the east. The tree flora of Talysh has the highest diversity of species in the Caucasus, including many endemic species. Some of them are relicts of the Tertiary period, such as Persian ironwood (*Parrotia persica*), Persian pink siris (*Albizzia julibrissin*), chestnut-leaved oak (*Quercus castaneifolia*), Hirkan zelkova (*Zelkova hyrkana*), Oriental persimmon (*Diospyros lotus*), Hirkan butcher's broom (*Ruscus hyrkanus*), Alexandrian laurel (*Danae racemosa*), Hirkan box-tree (*Buxus hyrkana*), Caspian honey-locust (*Gleditsia caspica*), Hirkan fig tree (*Ficus carica*), Hirkan maple (*Acer hyrcana*) and other species. These species are included in the Red Data Book of Azerbaijan and many of them are cultivated in botanical gardens and arboreturns throughout the world.

Hirkan State Reserve (2,906 ha) was established in Talysh in 1936 for the conservation of relict and endemic species of the Tertiary period that are found in this region. On February 9, 2004, the State Reserve was transformed into Hirkan National Park (NP) with a total area of 21,435 ha.

Out of 1,200 plant species found in Hirkan NP, 96 are endemic. The aim of our research was to identify new, rare and endangered plant species in Hirkan NP that are in need of conservation.

Methods and Results

Research was conducted in 2006 in Hirkan NP and its environs. In the course of the research, we made several field trips during which we collected herbarium materials and made geobotanical descriptions of plant communities, including endangered species. Coordinates of each species were recorded using GPS. Species were identified using "The Flora of Azerbaijan", taking into account the nomenclatural changes proposed by Cherepanov (1995). We used the methods of Yaroshenko (1969) and Ramenskiy (1971). We gave morphological descriptions of rare species that we identified. We observed the growth and development of populations and drew up a table of phenological changes (Table 1).

Table 1. Phenology of selected rare species

Species	Appears	Flowering period	Fruiting	Start of Resting
<i>Allium lencoranicum</i>	05.05	10.07 – 25.07	25.07 – 15.08	25.08
<i>Muscari grossheimii</i>	25.02	05.04 – 05.05	25.04 – 05.06	10.06
<i>Epimedium pinnatum</i>	25.02	20.03 – 30.03	15.04 – 05.05	10.10
<i>Papaver chelidoniifolium</i>	15.04	10.05 – 25.05	25.05 – 20.06	30.06
<i>Alchimilla hyrcana</i>	05.04	05.06 – 30.06	25.06 – 25.07	15.08
<i>Securigera hyrcana</i>	10.03	15.06 – 05.06	10.70 – 25.07	15.11
<i>Alcea hyrcana</i>	20.04	10.60 – 15.09	15.70 – 25.09	20.11
<i>Peplis hyrcanica</i>	25.04	15.05 – 10.06	01.06 – 25.06	15.08
<i>Primula heterochroma</i>	01.02	25.02 – 05.05	01.05 – 20.05	15.09
<i>Scophularia hyrcana</i>	05.03	15.04 – 00.05	05.06 – 15.07	20.10

Priority Species (Fig. 1)

***Allium lencoranicum* (Misch.ex Grossh) - Lenkoran leek**

Status. Endemic to Hirkan, extremely rare. The species is found on rocky slopes and screes in the middle mountain belt. It occurs on the road towards Unuza in Hirkan NP. No special actions are being taken to conserve it. Coordinates: 38° 26.058'N; 48° 39.239'E. Elevation: 1,370 m.

Description. 1-2 cm thick ovate bulbs wrapped in brown sheaths; 16-40 (50) cm long stem; leaves rolled, almost thread-like, channeled; umbel semi-globular, 3-4 cm in diameter, branchy, loose, few-flowered; pedicels markedly unequal, 1.5 – 6 times longer than flowers, with bracts; perianth 5-6 mm, narrow, bell-shaped, pinkish-violet, rather pale; tepals oblong or linear-oblong, rounded and blunt or almost truncate, with purple veins, almost equal, external, cymbiform. Filaments a bit shorter than the perianth, 3 times shorter than the capsule. The capsule is shorter than the perianth. Flowering - July, fruiting –August.

***Muscari grossheimii* (A. Schchian) - Grossheim's grape hyacinth**

Status. Little-studied species with drastically shrinking range; special conservation actions are needed. The plant mostly grows separately, sometimes in groups. It is found in most humid areas in forests, on rocky slopes, in meadows and shrubs. It has a wide distribution, but can cover large areas on rocky slopes in favorable conditions. Habitats in the Hirkan National Park: the Palangasygun rocks (Coordinates: 38° 38.692' N; 48° 36.826'E. Elevation: 1,400 m; Bykhyabyalel rocks on the northern slope of the Ovala gorge. Coordinates: 38° 34.085' N; 48° 41.293'E. Elevation: 730 m. Growing among shrubs and herbs. No information on use for folk medicine or other purposes by local communities is available.

Description. Bulb small, 1-1.5 cm in diameter; oblong to ovate or ovate with brown to pinkish scales. Leaves, 3-4, narrowly linear, 1 mm wide below, 2-4 mm in the middle, and narrower in the inflorescence, grooved, shorter than the stem. Stem - 1, occasionally 2-3, 12-18 cm long. Terminal dense indeterminate cylindrical raceme to 2-3(4) cm. Sterile flowers are few, clavate, blue-purple. Pedicels of fertile flowers horizontal, mainly shorter, sometimes longer than flowers. Fertile flower perianths tubular to urceolate, 5(6) mm long and 3-4 mm wide, elongated at apex, cylindrical, blue-purple, with white orbicular to triangular, slightly deflected teeth and white edge underneath. Stamens positioned in 2 rows, with cylindrical fibers, widening to base, 2-3 times longer than globose anthers. Ovary indeterminate, 3-locular, subglobose, shortened at apex, of tapered style. Capsules 3-angled. Flowering - May, fruiting - June.

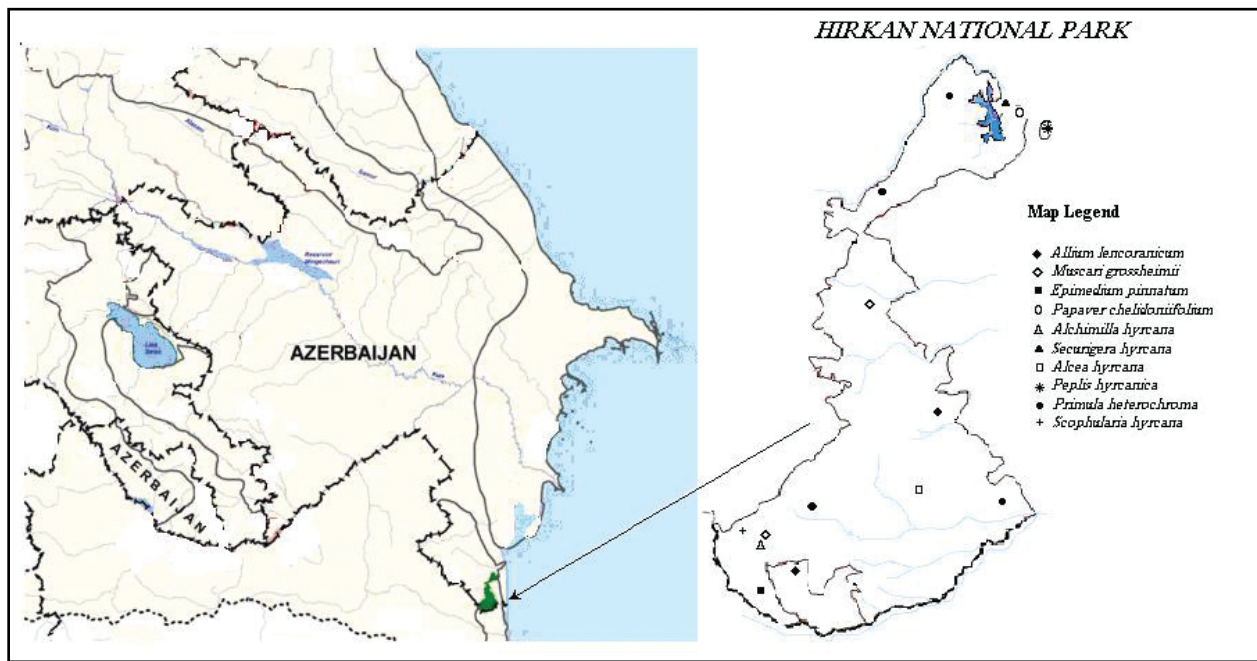


Fig. 1. Distribution of rare species

***Epimedium pinnatum* (Fisch) – Caucasian Barrenwort**

Status. Range shrinking. The plant is found in the middle mountain belt, in dense forests and rocky areas. It is widely distributed on Mount Almband. Separate plants occur on the Dilmadi-Siov road. The plant is used for ornamental purposes and also in folk medicine for treating general weakness and as a blood clotting agent. Coordinates: 38° 25.498" N; 48° 37.592" E. Elevation: 1,078 m.

Description. Perennial with firm cylindrical creeping rootstock. Stem 25-45 cm, glabrous. Leaves basal, odd-pinnatisect, 3-5-segmented or biternate, with long deciduous hairs; segments ovate, membranous to coriaceous with cartilaginous, serrate edges. Leaves deeply cordate at base, shortly acuminate at apex; flowering stem - 1 or 2, cylindrical, raceme terminal dense, indeterminate. Bracts 2, glabrous, oblong; flowers primrose; fruits capsular; petals and sepals ovate, come off easily. Flowering – March; fruiting – April to early May.

***Papaver chelidonifolium* (Boiss et Buhse) - Celandine poppy (Fig. 2)**

Status. Extremely rare endangered species. Found in lowlands up to the middle mountain belt, in shrubs and forest edges. Habitats within Hirkan NP: in the foothill belt close to Parakend village, on the Amolagal rocks. The species has not been found outside the National Park. Coordinates: 38° 38.498" N, 48° 47.529" E. Elevation: 182 m. No information on the use for folk medicine or other purposes by local communities is available.

Description. Annual; stem 35-37 cm, very slender, erect, sparsely hairy to glabrous, branched, angular. Leaves lyrate to pinnatifid, moderately broad, oval, entire, with incised sharp-toothed side segments and a larger apical segment, basal leaves with petioles, upper leaves sessile, membranous, tender. Pedicels slim, 20cm long. Buds ovate, up to 10 cm. Petals pale red, 15-20 mm, obovoid, with almost black spot at base. Capsule obovoid, glabrous, 5-7 mm, narrowing at base into very short stalk; disk membranous, slightly prominent with blunt-pointed slightly overlying teeth. Flowering - May, fruiting – June.

***Alchemilla hyrcana* (Bus.) Juz - Hirkan lady's-mantle**

Status. Rare endemic species. Habitat within Hirkan NP: the Palangasygun rocks (Cherepanov 1995). Coordinates: 38° 27.135'' N, 48° 36.826'' E. Elevation: 1,467 m. The plant is eaten by ungulates dwelling in the park and used in folk medicine for treatment of gastrointestinal diseases (Safarov and Farzaliev 2004).



Fig. 2. Celandine poppy (Papaver chelidonifolium) / © H. Safarov

Description. Perennial greenish-grey plant; stem 10-35 cm, sinuous, erect, hairy at base to glabrous; basal leaves medium-sized (1-4 cm long, 1.4-5 cm wide), flat, reniform, on long petioles, with 7-9 short arcuate or clypeate blades and 4-7 small semi-ovate blunt teeth on each side, hairy on both sides or almost glabrous from the top, between veins from below and in basal parts of veins. Stem leaves medium-sized. Inflorescence narrow, few-flowered, with branchlets growing at acute angles. Flowers in loose clusters, 1.5-3 mm long and wide. Carpophores roundish, glabrous; sepals shorter

than carpophores, external much smaller than internal; pedicles longer than carpophores, glabrous. Flowering – June, fruiting - July.

***Securigera hyrcana* (Prilipko) - Hirkan crown vetch**

Status. Extremely rare endemic perennial. The plant is rarely found in clearings and is eaten by herbivorous animals. Coordinates: 38° 38.984'' N; 48° 47.952'' E. Elevation: 128 m.

Description. Glabrous or hairy. Stems numerous, prostrate or erect; stipule 1-2 mm long; leaves odd-pinnate, with 9-11 leaflets; leaflets V-shaped or oblong-obovoid, with short and sharp apex, green from the top and blue-grey from below. Raceme has 7-9 flowers (sometimes 5 to 11) on 4-5 cm long stems; stems are twice as long as cups. Flower-cup bell-shaped, with sharp triangular teeth; corolla white or pale pink, purple at base. Pods spread apart, straight or slightly bowed, cylindrical, without strings or with weak strings. Seeds oblong or cylindrical, grayish-yellow, 3-3.5mm long and about 1mm wide. Flowering – June, fruiting – July (Farzaliev et al. 2007).

***Althaea hyrcana* (Grossh) - Hirkan hollyhock**

Status. Rare species, found in forests and among blackberry (*Rubus*) bushes. Coordinates: 38° 29.185'' N; 48° 41.329'' E. Elevation: 530 m. Medicinal and ornamental plant. Widely used in folk medicine: roots, leaf decoction and fruit tincture are expectorants. Decoction of the flowers is used to treat boils; flower and seed decoction is used to treat coughing and pneumonia (Safarov and Farzaliev 2004).

Description. Perennial herb, 35-85 cm long (occasionally 100cm) (Kozhina and Mamatov 1970) Stems simple or branchy, densely covered with long radial, racemose and stellar hairs. Petiolate leaves with tomentose petioles. Petioles of basal leaves are longer than petioles of upper leaves. Leaf blade is orbiculate, cordate, 5-7-lobed with unevenly serrate blunt lobes. Basal leaves larger and less lobed, upper ones more deeply-lobed. All leaves grayish velvet, creased from the top. Flowers isolated in leaf angles. Calyx with 7-8 triangular lobes almost equal to flower cup. Cup velvet, hairy; corolla pinkish-purple;

petals sinuate at apex, up to 40 mm long; fruits 15-20 mm wide, composed of 30-32 rounded to oval carpels; carpels grooved, hairy in the middle and from each side. Seeds brown, with very sparse short hairs. Flowering – June-September; fruiting – July and September.

***Peplis hyrcanica* (Sosn.) – Hirkan purslane**

Status. Rare, endangered species with a limited range. Habitat: Moscow Forest. Coordinates: 38° 39.005' N; 48° 49.103' E. Elevation: 10 m.

Description. Annual, 5-15 cm long; stem ascending, rarely upright, simple or branched, square, glabrous at base, with white hooked, papilliform hairs at apex. Leaves opposite, obovate to oblong-obovate, V-shape at base, rounded at apex, upper leaves with coarse papilliform hairs, rough at edge. Flowers isolated in leaf angles, with very short pedicels, bracts membranous, threadlike. Cup 2-3 mm long, cylindrical, bell-shaped, with triangle teeth almost 3-times shorter than tubule, cup appendages subulate, shorter than teeth. Stamens 6, style 1-2 mm long while fruiting. Capsule elliptic, slightly projecting from cup. Flowering – May, fruiting - June.

***Primula heterochroma* (Stapf) - Primrose**

Status. Species with decreasing range. Distributed throughout the National Park and in its environs (Farzaliev et al. 2007). Range has been shrinking rapidly in recent years due to many people removing the species to sell as an ornamental plant.

Description. Perennial rhizomatous plant; leaves oblong or ovate-oblong, 3-12 cm long, 4-5 cm wide. Leaf blade separated from narrowly-winged petiole, ovate-oval, 6-6.5 cm long, with serrulate edges, green and glabrous from top, tomentose with short, dense hairs from below. Pedicels reddish, 8-12 mm, with smooth hairy edges, divided into narrow spear-shaped teeth to the middle or deeper, not reaching the limb. Flowers 2.5-2.7 cm in diameter, with flat limb divided into bipartite obovoid lobes. Corolla many-colored, or white, or red, or purple, pink, yellow, etc. Capsule almost equal to corolla, seeds numerous, angular to globular or ovate, knobbed, pale black or dark brown, 1 mm long. Flowering – February to end of April, sometimes May, fruiting – May.

***Scophularia hyrcana* (Grossh.) - Hirkan figwort**

Status. Extremely rare, endangered, narrow-range endemic species. Distributed in lower and middle mountain belts, in forests, on rocks and in gorges. Coordinates: 38° 27.498' N; 48° 37.592' E. Elevation: 1,628 m.

Description. Perennial dark-green adenotrichous plant. Stems erect, tetraquetrous, adnate, 20-60 cm. Leaves broad, triangle-ovate, sharp, biserrate, slightly cordate at the base, almost glabrous from top, softly pubescent from below, basal leaves on petioles shorter than the blade, upper leaves almost sessile. Cymes with 2-5 flowers on 5-7cm long stems in apical pyramidal inflorescence. Capsule lobes oblate to ovate, blunt, herbaceous, pubescent. Corolla 6-7 mm long, sulphureous, urceolate, no staminodes present. Stamens with glandulose threads, projecting from corolla. Capsule 7-8 mm long, oblate-obovate, with V-shaped apex, glandulose. Flowering – April-May; Fruiting – June-July.

Recommendations

Hirkan NP has a rich diversity of plant species that have a specific Hirkan origin, i.e. have survived until the present day since the Tertiary period. There is an abundance of rare plant species in Hirkan that are

distinguished by their technical, ornamental and medicinal qualities and that have been used in folk medicine and modern medicine for a long time.

To ensure conservation and identification of new rare and endangered species in Hirkan NP and its environs, study of these species should continue to involve estimation of their development and distribution rates, collection of their genetic material and artificial cultivation in alternative conditions.

Some of the most valuable plant species found in Hirkan should be included in the IUCN Red List of rare plant species. Along with endemic and relict plants, there are species in Hirkan that are rare even for the local flora. Locations of these are shown in Fig 1. Research on these species should be continued.

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Executive Summary

The occurrence of 48 local endemic species belonging to 40 genera of 25 families was verified in the Georgian-Turkish transboundary zone within the West Lesser Caucasus Corridor. For each species, the main forms of habitat loss/degradation were determined and threats were determined according to extinction risk category and degree of responsibility of each country for global conservation. Out of these 48 species, 14 are considered to be Critically Endangered (CR), 17 Endangered (EN) and 17 VU (VU) (Table 1).

Ex situ and *in situ* conservation of species should envisage the following measures to reduce human impact and allow recovery of species:

- Developing a transboundary protected area network
- Giving protected areas status to selected habitats
- Reducing the impact caused by human activities, as well as toughening control measurements
- Planting gardens and green areas in populated areas
- Creating seed-stocks in botanic gardens, as well as regenerating and reintroducing species in their natural habitats
- Increasing local residents and visitors' awareness about biodiversity
- Setting-up information billboards on habitat approach roads

Scope of the Work

Within the Caucasus, the Colchic and Hyrcanian regions are distinguished by unique diversity of relic and endemic plant species, as a result of their status as refugia for meso- and thermophilous plant species during the Ice Age. The study area consists of two ethnographically associated parts of the south Colchic region of Georgia and Turkey, the bordering areas of the Autonomous Republic of Adjara, Georgia, and Artvin Vilayet (province), Turkey. The unique Colchic forests of Adjara are listed among 100 unprotected forests covered by WWF's European Forest Hotspots Campaign.

The governments of Georgia and Turkey and NGOs are taking steps to cooperate and improve coordination of nature conservation activities in the transboundary zone. These efforts are based on two documents: the Framework Agreement between the Republic of Georgia and Republic of Turkey on Friendship and Good Neighbourly Relations (07.30.92), and the Agreement between the Governments of Georgia and the Republic of Turkey on Cooperation in the Field of Environment Protection (07.14.97). These documents have laid a solid foundation for new transboundary environmental initiatives to develop recommendations for *in situ* and *ex situ* conservation.

Methods

Plant specimens were photographed and collected for herbarium processing on field excursions. Taxonomy is specified according to the nomenclature (Ketskhoveli et al. 1971-2005; Ketskhoveli 1964,

1969; Dmitrieva 1990a, b; Czerepanov 1995; Gagnidze 2005; Davis 1965-1982). Herbarium samples and digital pictures are kept at Batumi Botanical Garden (BAT). For indexing habitat types we followed Svanidze (2003). (See explanations for Table 1).

Red list category was assessed using the IUCN guidelines (IUCN 2006). Rarity was determined by estimating distribution and extent of subpopulations based on the number of 10x10 km UTM grid cells reflecting occupied habitat: 1-2 cells – **CR** (Critically Endangered); 3-9 – **EN** (Endangered); 10-49 – **VU** (Vulnerable). Degrees of responsibility of Georgia and Turkey for conservation of threatened subpopulations are **vh** – very high, **h** – high, **m** – medium, and **l** – low.

Results

Species Diversity

The first work on Adjara's flora, containing a list of 1,048 species and information on their status was by Grossgeim (1936). Further research increased the number to over 1,800 in 1990 (Dmitrieva 1956, 1959, 1990a, b). The flora of Turkey includes 2,991 endemic species, 35 of them endemic to Artvin administrative district (Davis 1965-1982; Güner et al. 2000; Anşin 1983; Eminağaoğlu & Anşin 2003, 2004; Özhatay et al. 2005, Eminağaoğlu et al. 2006, 2008). The flora of Adjara includes up to 180 endemic species (Ketskhoveri et al. 1971-2005; Gagnidze 2005; Manvelidze et al. 2008). Results verify the occurrence of 48 local endemic species belonging to 40 genera of 25 families in the Georgian-Turkish transboundary zone, including 22 species common to both regions (Table 1).

Table 1. Threatened endemic species in the Georgian-Turkish transboundary zone¹

Species	Family	IUCN (Vers. 6.2, 2006)	Habitat	
			Altitude (m)	Biotope
1. <i>Allium pseudostrictum</i> (<i>A.adzharicum</i>)	ALLIACEAE	CR	2450-2500	m; bs/B ₁
2. <i>Alyssum artvinense</i>	CRUCIFERAE	CR	250-750	fr ;bs; r; ; rsh/ A ₁
3. <i><u>Amaracus rotundifolius</u></i>	LABIATAE	VU	600-700	fr; r; bs/ A ₁ ; B ₁
4. <i>Angelica adzharica</i>	UMBELLIFERAE	CR	2000-2050	m ₂ fr;bs/ A ₁ ; B ₃
5. <i><u>Astragalus adzharicus</u></i>	FABACEAE	EN	270-750	fr;bs/ A ₁
6. <i>Astragalus doluchanovii</i>	FABACEAE	CR	2450	m; bs/ B ₁
7. <i><u>Astragalus sommieri</u></i>	FABACEAE	VU	650-1560	fsh ;bs/ A ₁ ; B ₁
8. <i><u>Betula medwediewii</u></i>	BETULACEAE	VU	1200-2400	Fsh/ B ₁
9. <i>Campanula betulifolia</i>	CAMPANULACEAE	VU	800-900	fsh; fr; r/ A ₁ , B ₁
10. <i>Campanula troegerae</i>	CAMPANULACEAE	CR	600-650	r/ A ₁
11. <i>Centaurea dmitriewiae</i>	ASTERACEAE	CR	700-800	bs; r/ A ₁
12. <i>Centaurea appendicigera</i>	ASTERACEAE	EN	2600-2800	r;bs/ A ₁
13. <i>Chesneya elegans</i>	FABACEAE	CR	650	fr;bs; fsh/ A ₁
14. <i>Convolvulus pseudoscammonia</i>	CONVOLVULACEAE	CR	550	fr;bs;r/ A ₁
15. <i><u>Cyclamen adzharicum</u></i>	PRIMULACEAE	VU	70-700	fm ;fsh ;fr;r/ A _{1,2} ; B ₁
16. <i>Dactylorhiza osmanica</i> var. <i>osmanica</i>	ORCHIDACEAE	VU	2450	fsh, sh/ A ₂
17. <i>Delphinium iris</i>	HELEBORACEAE	EN	2450	fsh; sh; bs/ B ₂
18. <i>Draba bruniifolia</i> ssp. <i>armeniaca</i>	CRUCIFERAE	VU	2700	m; bs/ B ₁

Species	Family	IUCN (Vers. 6.2, 2006)	Habitat	
			Altitude (m)	Biotope
19. <i>Epigaea gaultherioides</i>	ERICACEAE	VU	1200-1800	Fsh/ B ₃
20. <i>Erysimum contractum</i>	CRUCIFERAE	EN	150-200	fr; bs/ A ₁ ; B ₁
21. <i>Ficaria grandiflora</i> (F. <i>popovii</i>)	RANUNCULACEAE	VU	50-300	fm; m/ A ₁ ; B ₁
22. <i>Fritillaria armena</i>	LILIACEAE	EN	2450	fsh; sh/ B ₁
23. <i>Galanthus rizechensis</i>	AMARYLLIDACEAE	CR	2450	fsh; sh/ B ₁
24. <i>Galanthus krasnovii</i>	AMARYLLIDACEAE	CR	900-1200	f; fsh/ B ₁ ; B ₂
25. <i>Galium subuliferum</i>	RUBIACEAE	EN	200-250	r;bs/ A ₁ , B ₁
26. <i>Hypericum adzharicum</i>	HYPERICACEAE	EN	1100-1200	fr;fsh/ A ₁ , B ₁
27. <i>Genista suamica</i> (<i>G. adzharica</i>)	FABACEAE	CR	650-700	fr;bs/ A ₁ , B ₁
28. <i>Lilium ponticum</i>	LILIACEAE	VU	1000-1800	f; fsh/ B ₁ ; B ₂
29. <i>Linaria adzharica</i> (<i>L. sypirensis</i>)	SCROPHULARIACEAE	EN	200-300	bs; r; fr/ A ₁ ; B ₁
30. <i>Melampyrum alboffianum</i>	SCROPHULARIACEAE	CR	2350-2400	Bs/ B ₁
31. <i>Melampyrum arvense</i> var. <i>elatius</i>	SCROPHULARIACEAE	VU	1800	m;bs/ B ₁
32. <i>Muscari alexandrae</i>	HYACINTHACEAE	CR	50-100	fr;bs/ B ₂ ; B ₃
33. <i>Nonea pulla</i> subsp. <i>monticola</i>	BORAGINACEAE	EN	2000	m/ B ₁
34. <i>Orobanche armena</i>	OROBANCHACEAE	EN	2450	sh;bs/ B ₁
35. <i>Osmanthus decorus</i>	OLEACEAE	VU	300-1100	f; fr; bs/ B ₁
36. <i>Papaver lateritium</i>	PAPAVERACEAE	VU	2450	sh;bs/ B ₂
37. <i>Primula megasaefolia</i>	PRIMULACEAE	EN	100-1200	f;fm/ B ₁
38. <i>Psoralea acaulis</i> var. <i>adzharica</i>	FABACEAE	CR	600-700	fr;bs/ A ₁ ; B ₁
39. <i>Quercus dschorochensis</i>	FAGACEAE	VU	300-800	f/ A ₁ , B ₁
40. <i>Rhododendron smirnowii</i>	ERICACEAE	EN	1100-2000	fr,r/ B ₁
41. <i>Rhododendron ungerii</i>	ERICACEAE	VU	1100-2000	f; fsh/ B ₁ ; B ₂
42. <i>Rhodothamnus sessilifolius</i>	ERICACEAE	VU	2150	fr;bs/ B ₁
43. <i>Rhynchospora caucasica</i>	CYPERACEAE	EN	10	s/ C ₃
44. <i>Rubus adzharicus</i>	ROSACEAE	EN	25	fr; fsh/ B ₁
45. <i>Scutellaria pontica</i>	LABIATAE	VU	2400-2700	sh; bs/ B ₁
46. <i>Senecio integrifolius</i> ssp. <i>karsianus</i>	ASTERACEAE	EN	2450	m; bs/ B ₁
47. <i>Seseli foliosum</i>	APIACEAE	EN	400-500	r; bs/ B ₁
48. <i>Teucrium trapezunticum</i> (<i>T. chamaedrys</i> ssp. <i>trapezunticum</i>)	LABIATAE	EN	200-250	bs;r/ B ₁

Note: ¹The species occurring in the transboundary section of Georgia and Turkey of Adjara-Şavşat floristic region are shown in bold type.

²**Explanations:** **f** – forest; **sh** – shrubs; **wm** – wet meadow; **fm** – forest meadow; **r** – rock; **m** – meadow; **fsh** – forest shrubbery; **sc** – scree; **hv** – high herbaceous vegetation; **s** – swamp; **p** – still water; **sr** – moist rocks; **fr** – forest-covered rocks; **ss** – seashore; **sn** – sands; **al** – agricultural lands; **rd** – ruderal. **A-xerophilous (dry) biotope:** A₁ – steep slopes (21-35°) with primitive, shallow (≤15 cm), dry soil; A₂ – slanting slopes (11-20°) with thin (16-30 cm) and medium-thick (31-60 cm) dryish soils; and A₃ – flat slopes (≤10°) with medium-thick (31-60 cm) and thick (≥ 61 cm) dryish soils. **B-mesophilous (moderately wet) biotope:** B₁ – steep slopes (21-35°) medium-thick (31-60 cm) moderately wet soils; B₂ – slanting slopes (11-20°) with medium-thick (31-60 cm) and thick (≥ 61 cm) moderately wet soils; and B₃ – flat slopes (≤ 10°) with medium-thick (31-60 cm) and thick (≥ 61 cm) moderately wet soils. **C-meso-hygrophilous (wet) biotope:** C₁ – steep slopes (21-35°) with thin wet soil; C₂ – gentle slopes (11-20°) with medium-thick (31-60 cm) and thick (≥ 61 cm) wet soils; and C₃ – flat slopes (≤ 10°) with thick (≥ 61 cm) wet soils.

The IUCN criteria B2 (area of occupancy) and C (population size) and assessment of habitat stability were used to determine the conservation status and degree of responsibility of each country for global conservation of species endemic to the Georgian-Turkish transboundary zone (Adjara-Şavşat floristic region) (Table 1).

The local endemics *Galanthus krasnovii* and *Cyclamen adzharicum* (Fig. 1 and 2, respectively) are listed in CITES. Ten species are included in the Red Book of Georgia (1982): *Betula medwedewii*, *Epigaea gaultherioides*, *Rhododendron ungeronii*, *Rh. smirnovii*, *Quercus dschorochensis*, *Astragalus sommieri*, *Genista suamica*, *Osmanthus decorus*, *Primula megasaefolia*, and *Angelica adzharica*.

Currently, five species are included in the Red List of Georgia: *Betula medwedewii*, *Epigaea gaultherioides*, *Rhododendron ungeronii*, *Rhododendron smirnovii* (Vulnerable VU) and *Osmanthus decorus* (Endangered



Fig. 1. Artvin gorge of Çoruh River / © Z. Manvelidze and Ö. Eminağaoğlu

EN). Twenty-seven species are included in the Red Book of Turkey: *Galanthus krasnovii* (Critically Endangered - CR); *Campanula troegerae*; *Orobanche armena*; *Delphinium iris* (Endangered - EN); *Astragalus adzharicus*; *Astragalus sommieri*; *Chesneya elegans*; *Galanthus rizechensis*; *Epigaea gaultherioides*; *Lilium ponticum*; *Osmanthus decorus*; *Papaver lateritium*; *Primula megasaefolia*; *Rhododendron smirnovii*; *Rh. ungeronii*; *Rhodothamnus sessilifolius*; *Senecio integrifolius* subsp. *karsianus* (Vulnerable - VU); *Alyssum artvinense* (LR (cd)); *Campanula betulifolia*; *Convolvulus pseudoscammonia*; *Dactylorhiza osmanica* var. *osmanica*; *Draba bruniifolia* subsp. *armeniaca*; *Fritillaria armena*; *Nonea pulla* subsp. *monticola* (Least Concern – LC); *Centaurea appendicigera*;

Melampyrum arvense var. *elatius* (Near Threatened – NT); *Seseli foliosum* (Data Deficient- DD) (Ekim et al. 2000).

All 22 endemic species occurring in the transboundary section of Georgia and Turkey of Adjara floristic region (Table 1) should be included in the national Red Lists of Georgia and Turkey. Conservation of rare species - *Betula medwedewii*, *Rhododendron ungeronii*, *Astragalus doluchanovii*, *Melampyrum alboffianum* - will be considered in the Caucasus Red List.

Threats

The following main forms of habitat loss/degradation and threats were distinguished in the Adjara-Savsat floristic region:

- Clear cutting/logging including secondary forest material (brushwood, branches).
- Overgrazing.
- Ploughing and sowing on steep slopes.
- Over-collection of flowers, bulbs and parts of plants.
- Utilization of non-woody resources (berries, mushrooms, etc.).
- Hay making.
- Recreational pressure.
- Dam construction.

- Construction/widening of forest roads and highways.

Conservation

Ex situ and *in situ* conservation of species should envisage the following measures to reduce human impact and allow recovery of species:

- Develop a network of transboundary protected areas;
- Give the status of protected areas to selected habitats;
- Reduce human impact and toughen controls;
- Plant gardens and greenery in populated areas;
- Create seed-stocks in botanic gardens, regenerate and reintroduce species in their natural habitats;
- Increase awareness of local residents and visitors;
- Set up information boards on habitat approach roads;

There are many protected areas within the administrative borders of Artvin Vilaet coinciding or bordering with Adjara-Şavşat floristic region's boundaries, namely, Camili Biosphere Reserve, National Parks of Hatila Valley and Karagöl-Sahara, Strict Nature Reserve of Camili-Gorgit, Camili-Efeler and Çamburnu. Kintrishi reserve, Kintrishi protected area, Kobuleti reserve and Mtirala National park are located in Adjara Autonomous Republic occupying a total area of 30,137 ha or 15.7% of the area of Adjara's forests (19,3608 ha), and managed according to the Law of Georgia 'On the System of Protected areas' (1996) and *in situ* conservation requirements of species and habitats. There are also two protected areas underway: the support/buffer zone of the Mtirala National Park (multi-use area of 10,202 ha) and Machakhela (12,700 ha) (Fig. 3). Conservation of endemic species of the Adjara-Şavşat floristic region first requires Georgian-Turkish transboundary cooperation to protect and manage effectively those ecosystems of high conservation value.



Fig. 2. Adjaristskali River gorge / © Z. Manvelidze and Ö. Eminagaoglu

Cultivation of endemic species in botanic gardens and their reintroduction into natural habitats is the best way to conserve them. The Botanic Gardens Conservation International (BGCI) has certain commitments to the International Biodiversity Management Programme, reflected in the BGCI Strategy (International Agenda for Botanic gardens in Conservation 2002). It is logical to assume that the problem of *ex situ* conservation of endemic species of Adjara-Şavşat can be resolved through creation of collections of live plants and seed banks in botanic gardens, in conservation areas and in training and research centers in Georgia and Turkey.

The unique biological diversity and tourist and recreational opportunities in the transboundary area, nature protection-related tourism development should be considered as one of the main priorities. Machakhela gorge as well as Mtirala National Park and their support/buffer zones would act as ecological corridors and key protected areas in the south Colchic region, offering opportunities for transboundary cooperation.

The present conservation status of endemic species of the Adjara-Şavşat floristic region is unsatisfactory both in Georgia and Turkey. Actual conservation of habitats involves addressing a number of socio-

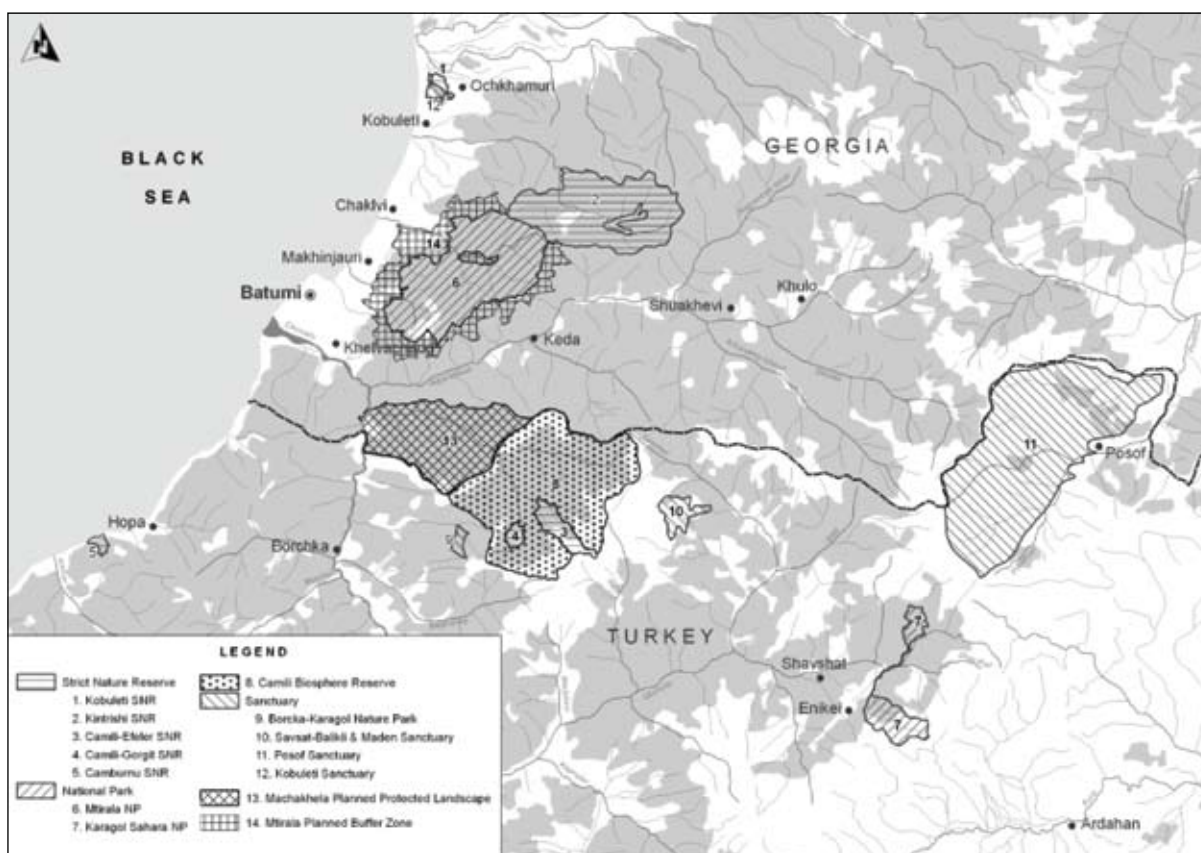


Fig. 3. Current and planned conservation territories of Adjara-Şavşat floristic region / © WWF, G. Beruchashvili

economic problems. Nevertheless, urgent measures should be taken to conserve many endemic species. Government agencies should be more actively involved in the process to enable solution of at least some problems in the near future. The assessments of rarity status of local endemic species of the Adjara-Şavşat floristic region and recommendations on endemic species protection and global conservation would be useful for Georgian-Turkish transboundary cooperation and coordination of efforts for protection and conservation of endemic species within the Lesser Caucasus Corridor.

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Executive Summary

Doga Dernegi (DD) successfully implemented a project between July 2006 and December 2008 in the Eastern Black Sea Mountains Key Biodiversity Area (KBA), called “Enhancing Conservation in the West Lesser Caucasus through Transboundary Cooperation and Establishing a Training Programme on KBA Conservation” in collaboration with Georgian Center for the Conservation of Wildlife (GCCW). The project is supported by the Critical Ecosystem Partnership Fund (CEPF). The aim of the project was to maintain the natural heritage of the Lesser Caucasus and support human societies in this corridor to live in a nature-friendly way in regard to the vulnerable and irreplaceable biodiversity of their region.

The Eastern Black Sea Mountains extend for about 250 km in north-east Turkey and include the Eastern Black Sea coastline. The western border of the region is marked by the Harsit Stream, the south-eastern by the Coruh River, and the eastern by the Karcal Mountains and the Georgian border.

The project promoted transboundary cooperation between Turkey and Georgia by carrying out joint initiatives on KBA work supporting conservation of the West Lesser Caucasus Corridor. The project implemented new strategies relevant to priority species and site outcomes; organized exchanges across project sites and key experts in biodiversity conservation; conducted international meetings of a working group focusing on transboundary cooperation.

Moreover, the project supported existing efforts to create new protected areas through delineation of KBAs. The project also developed and implemented a transboundary KBA strategy for Posof Forest and Akhaltsikhe Erusheti site. Development of this strategy engaged the expertise of relevant stakeholders including civil society, local authorities, businesses and other appropriate parties in the planning process.

This project enhanced transboundary nature conservation efforts as nature does not have borders. As a result of the project we aimed to double the skilled human capacity for conservation in the region, to show the governments of both countries that effective cooperation between the two countries is available, and to obtain all the information about KBAs in both countries.

Skilled human capacity for conservation was developed in the region by organizing two Nature School programs. Collaboration was carried out effectively by DD and GCCW between Turkey and Georgia (Çağlayan et al. 2007). The know-how on KBAs was shared between two project partners. The working group which was established in 2007 made visits to both sides, prepared a strategy on transboundary conservation and began to implement this for both countries.

Turkey’s biggest KBA was separated into 7 KBAs to facilitate effective conservation and Georgia initiated its first KBA work, delineating Erusheti Akhaltsikhe KBA. Turkey’s KBA inventory was published in English. The KBA conservation handbook was published for use by Nature School participants. The IUCN guidebook on KBA criteria was published in Turkish and Georgian.

Scope and Objectives of the Work

The West Lesser Caucasus Corridor extends across the borders of Turkey and Georgia, so transboundary cooperation is one of the key tactics for ensuring long-term biodiversity conservation in this corridor. The region is among DD's top priority Key Biodiversity Areas (KBA). KBAs are the remaining natural and semi-natural ecosystems that preserve vulnerable and irreplaceable populations of endangered species. DD has been working for the conservation of KBAs in Turkey for several years.

DD has been cooperating closely with its Georgian partner, the Georgian Center for the Conservation of Wildlife (GCCW; partnership under BirdLife International) for the conservation of the endemic Caucasian Grouse *Tetrao mlokosiewiczi* as a flagship species for the rich and threatened wildlife in the Lesser Caucasus. The aim of this collaboration is to determine a common vision and to share best practices in conservation. As a result of these efforts, there is a strong bond and working culture between DD and GCCW. Both organizations decided to further increase their cooperation, working on a KBA approach and transferring expertise from Turkey to Georgia. GCCW is aiming to introduce the KBA methodology in Georgia and producing its own KBA inventory in the near future. One of the pillars of the project addresses this aim: increasing the capacity in GCCW and carrying out pilot KBA work in the West Lesser Caucasus region.

DD identified 305 KBAs in Turkey based on the vulnerability and the irreplaceability of the species they shelter. Among these are at least 10 KBAs whose natural boundaries may cross Turkey's border.

The Eastern Black Sea Mountains is one of the 10 transboundary KBAs and the largest of all in Turkey. These mountains support a diverse variety of vegetation types. The climate of the Caucasus varies both vertically (according to elevation) and horizontally (by latitude and location). Species diversity and endemism are exceptionally high. This KBA holds many endemic and restricted-range plant, reptile and amphibian, butterfly, dragonfly and freshwater fish species as well as endangered birds and mammals. With all these characteristics, Eastern Black Sea Mountains is a unique KBA, not only for Turkey but also at the global level.

The project "Enhancing Conservation in the West Lesser Caucasus through Transboundary Cooperation and Establishing a Training Programme on KBA Conservation" aimed to maintain the natural heritage of the Lesser Caucasus and support human societies in this corridor to live in a nature-friendly way towards the vulnerable and irreplaceable biodiversity of their region.

The project ran in cooperation with Conservation International-Center for Applied Biodiversity Science (CABS) and Georgian Center for the Conservation of Wildlife to maintain necessary conditions for the conservation of Key Biodiversity Areas and the transboundary corridor between Turkey and Georgia.

The project had three main objectives:

1. To develop professional human capacity in nature conservation work in the region.
2. To develop an international working group in the region including representatives of local and central governmental bodies, academics, NGO representatives and participants of Nature School.
3. To improve scientific standards and baseline information to enhance the conservation of KBAs in the corridor.

Results

Developing Professional Human Capacity in Nature Conservation

Two different Nature School programs were implemented. The first Nature School was organized with

participation of 16 Turkish students from the Eastern Black Sea region in 2007. Three modules were completed successfully in Ardahan-Posof, Artvin-Yusufeli and Artvin-city center. In the process of implementation of the second Nature School, DD and GCCW cooperated in 2008 jointly with volunteers from Turkey and Georgia who wanted to gain skills and experience in nature conservation. Participants included 8 Georgian and 8 Turkish students. The first module of this program was organized in Georgia-Batumi, the second in Ardahan-Posof and the last module in Erzurum-Ispir. In total, 32 students participated in Nature School programs organized within the terms of the project. In addition, a KBA Conservation Handbook was produced for the Nature School graduates as a guideline for use in their conservation efforts.

Nature School

Nature School is a training program which aims to reach ambitious young people who will actively become involved in the problems facing nature and find participatory and appropriate solutions across borders, while developing transboundary dialogues. The training program is composed of 3 modules that include economic, social and environmental topics. The participants and trainers work as a team during the implementation of the training program along with games and interactive role plays, discussions and interpretations, field work and interactive assignments that provide a foundation for the participants to engage professionally in the field of nature conservation.

International Working Group

The first meeting of the international working group, which was also co-funded by the SEENET (South and East European Ecological Network) Project, was organized between 17 and 19 October in Posof, Ardahan, a town in Turkey close to a Georgian town called Akhaltsikhe. In total, 22 people from two countries, central and local nature conservation officers, academics, local governmental officers and non-governmental organization members participated in the meeting.

The meeting aimed to establish an international working group to analyze the existing situation in Posof (Turkey), Akhaltsikhe (Georgia) and to look for transboundary cooperation opportunities between two countries. During the three-day meeting, the biodiversity values of the region and nature conservation



Fig. 1. Posof Wildlife Reserve / © E. Çağlayan

legislation were shared with the other country experts and officers, and the conservation status of Posof Wildlife Reserve was investigated on a one day field visit (Fig. 1). Finally, a draft operational plan for the working group was prepared to form the basis for the next 2 meetings in 2008 to finalize the transboundary strategy. The international working group was established at the end of this first meeting to start the first real on-the-ground transboundary conservation work between Turkey and Georgia. The second meeting was held in Georgia-Tbilisi in 2008.

The first steps for transboundary cooperation initiatives were taken with the international working group. Governmental and non-governmental local and central representatives from both countries made contact for the first time during the project. Concrete outputs of this contact were seen even as the project was continuing. Georgia made an official application to Turkey to obtain gazelles for reintroduction to the south-east Georgian steppes. And representatives from the Turkish Ministry of Environment and Forestry made an oral request to Georgian officers to declare a transboundary protected area.

Posof Wildlife Reserve

This site is designated a Wildlife Development Area (WDA; 64,000 hectares) primarily to protect the population of Caucasian Grouse. The WDA holds important populations of species such as Caucasian Grouse *Tetrao mlokosiewiczii*, Caspian Snowcock *Tetraogallus caspicus*, Corncrake *Crex crex*, Brown Bear *Ursus arctos*, Lynx *Lynx lynx*, Wolf *Canis lupus* and Roe Deer *Capreolus capreolus*. It is also possible to see an impressive migration of birds of prey in spring and autumn in the region.

Wildlife and humans live side by side with little or no conflict. The area is in Ardahan, Posof where one of the two customs gates between Turkey and Georgia is located. The site lies along the border with Georgia.

DD and the national wildlife authority cooperated and organized a series of meetings and surveys at the site during the project. Management planning process for Posof Wildlife Reserve was completed after the last meeting with the participation of public at the end of November. The management plan for “Posof Wildlife Reserve” in Turkey was finalized (İsfendiyaroğlu et al. 2008) and approved and signed by the Turkish Ministry of Environment and Forestry. It is ready for implementation by official nature conservation authorities in Turkey.

Improving Scientific Standards and Baseline Information

Needs for KBA standards and trigger species in Turkey and Georgia were identified. A workshop was held with participation of species experts and DD and GCCW conservation officers. At the workshop, the Eastern Black Sea Mountains KBA was re-evaluated and separated into seven separate parts to facilitate conservation efforts (Fig. 2). All information and relevant data were compiled for each of the seven new



Fig. 2. Reassessment of the huge Eastern Black Sea Mountains KBA / © M. Ataol

KBAs. GCCW gathered all the previous data on species and habitats for the Western Caucasus. The KBA work was initiated in Georgia and the Western Caucasus region and was evaluated according to KBA standards. The method considered a KBA's irreplaceability, species-based vulnerability and site-based vulnerability to assign conservation priority levels. Erusheti KBA was delineated according to these criteria. This was the first KBA work carried out in Georgia. All the information on KBAs in the region was distributed through a web page which is available in English.

DD prepared the national KBAs inventory in 2006 and rapidly became a key national stakeholder in identifying the Turkish protected areas network. These sites are likely to be protected as part of the EU Natura 2000 network as well as under Turkish conservation laws. Among national KBAs, there are at least 10 that cross Turkey's boundaries. Therefore, DD's strategy clearly highlights the importance of conservation of transboundary corridors and thus cooperation with other countries. To achieve this, DD is willing to play a leading role in sharing its experience on KBA conservation with neighbouring countries. The complete inventory of Turkish KBAs has been published in English.

The IUCN book on KBA guidelines has been translated into Turkish and Georgian as a basis for application of the principles of KBA criteria and site delineation techniques to the Caucasus region.

Acknowledgements

The project was run in cooperation with the main project partners: GCCW and Conservation International - Center for Applied Biodiversity Science. In addition to project partners, DD worked with WWF-Caucasus on data sharing between the project and WWF-Caucasus for the delineation of new KBAs in the region. We thank GCCW and Turkish Ministry of Environment and Forestry for their admirable support on the project. Activities of the project were assisted by local contacts in Turkey and in Georgia. The participation of representatives of local villages and local and regional government was invaluable.

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Executive Summary

The West Lesser Caucasus region is represented by 14 administrative regions of Georgia (including five regions in Adjara). Georgia has mountain transboundary areas where there are particular concerns over socioeconomic and demographic issues, geo-ecological and political processes, unsustainable resource use, chaotic infrastructure development, and low public awareness of alternative energy sources and livelihoods. Protected area (PA) network planning should be based on systematic and comprehensive information on local socioeconomic, demographic and geo-ecological conditions, traditional use of natural resources, and encouragement of sustainable land-use. Transformation of natural landscapes in the region is mainly due to agriculture (livestock breeding, vegetable growing) and unsystematic forest use.

New protected areas are needed to enable self-restoration of the natural environment and regulation of geodynamic processes. This is especially true of the middle-mountain and forest landscapes that are a buffer zone between subalpine and low-mountain landscapes. To reduce the activity of geodynamic processes, protecting middle-mountain-forest landscapes is of great importance (especially in Adjara, Guria, and Imereti). Most of the region's landscape functions currently depend on socioeconomic needs and ignore environmental legislation, sustainability, and environmental purpose. Analysis of data collected allowed identification of two groups of new protected areas and corridors.

Scope and Objectives

The project was implemented by members of the Caucasus Ecohouse NGO and staff of Tbilisi State University. The objective of the project was to study and analyze socioeconomic, demographic and geo-ecological characteristics and the natural resource potential of the West Lesser Caucasus for the planning of new protected areas. Analysis of data collected allowed identification of new protected areas and corridors.

The West Lesser Caucasus region is an important link in the Caucasus PA network. Population density is high (120-130 people per km²) even in environmentally sensitive areas. High anthropogenic pressure has promoted active geodynamic processes. Landslides and erosion are also triggered by unsustainable forest use, overgrazing, unsustainable development of residential areas and transport infrastructure. The percentage of households with 2-3 family members is increasing in the region. On average, each household uses 12-15 m³ of wood for heating and cooking (an official permit for use of 7-8 m³ is issued in high mountain villages of Adjara). The situation is aggravated by proximity of the unforested regions of Akhaltsikhe, Aspindza, Akhalkalaki and populated areas that also need wood. Thus about 1 million m³ of wood on average are used annually in the region only for heating. Despite the so-called environmentally forced migration of the population to neighboring regions, the region remains the most environmentally sensitive area of Georgia.

The region is located in southwest Georgia and covers the westernmost part of the Lesser Caucasus, partly including the Adjara-Imereti, Shavsheti and Asrian Range and the Adjarian and Akhaltsikhe depressions.

It consists of 14 administrative regions of Georgia: Adigeni, Aspindza, Akhaltsikhe, Bagdadi, Vani, Kedi, Kobuleti, Lanchkhuti, Ozurgeti, Chokhatauri, Shaukhevi, Kharagauli, Khelvachauri, and Khulo, a total of 9,870 km², 14.2% of the area of Georgia. The southern boundary of the region coincides with the state border between Georgia and Turkey.

The region is characterized by different climate zones (humid-subtropical, temperate-humid, Mediterranean and transitional to dry subtropical) and different floristic and geographic zones. Coastal areas in the foothills contain humid subtropical forests with dense evergreen undergrowth, replaced by beech and coniferous forests and alpine meadows just several kilometers away, with the leeward slopes covered by oak (Georgian oak, Chorokhi oak) and oak-pine (Koch's pine) forests, with phryganoid vegetation in some areas. Annual precipitation at Mount Mtirala on the Adjara-Imereti Ridge is on average over 4000 mm, and in winter the depth of snow cover is 3-5 m. Farther into the area, the annual precipitation drops to 800-600 mm.

Vertical zoning is well developed, because of the elevation range (0-3000m above sea level) and complex orography as well as position relative to humid Black Sea air masses. Particular attention should be paid to relief factors that have a direct impact on landscape formation and function and on the environment. These include: orography, geology, neotectonics, and geodynamic processes.

The role of anthropogenic factors in forming landscapes is clear, especially in areas of historical economic activities. Human influence is so strong that almost half of the region's population is now faced with an environmental crisis. Uncontrolled human interference in the environment is reflected by:

- Irrational use of forest and land.
- Construction of roads and residential buildings on bearing parts of slopes.
- Large-scale development/use of steep slopes.
- Development of residential areas on geologically hazardous sites.
- Non-use of landscape planning principles.

The most difficult situation is found in Adjara where all types of geo-hazards develop near populated areas. Landslides and mudflows frequently coincide and strengthen each other. Landslides are historically most active in coastal mountain-hilly areas, though in recent years they have affected the basins of the rivers Chanistskali, Sairmistskali, Supsa, Adjaristskali and others, as a result of forest degradation and deforestation. Snow avalanches are an important factor in the Alpine forest zone (Meskheta, Shavsheti, and Arsiani Ridges) where they occur even on medium-steep slopes. Avalanches frequently affect populated areas, causing severe damage (Elizbarashvili et al. 2006).

Data from field surveys and analysis of air/satellite photos suggest the following geo-ecological zones with different levels of geodynamic processes in the region:

- Piedmont-hilly zone and low-mountain zone with active landslide processes.
- Middle-mountain relief with active erosion and denudation processes.
- High-mountain (alpine) relief with gravitational processes (snow avalanches, etc.).
- The Adjara depression with deep gorges and active geodynamic processes.

The region is characterized by high diversity of flora and fauna, which is conditioned by different factors: a) influence of the Black Sea and existence of orographic barriers; b) paleogeographic development of the area; c) proximity of different floristic regions, which has produced elements of Colchic, Caucasus, Boreal, Mediterranean, and West Asian flora as well as steppe and desert species on rocks (though limited); d) anthropogenic factors that have transformed vegetation cover in some areas.

A considerable part of the region is located in South Kolkhida, which was the best refugium in the glacial

era and has the richest diversity of relic species in the Caucasus. The relic and endemic species frequently even form vegetation communities. Despite strong anthropogenic transformation of the area, diverse and unique vegetation and landscapes still remain in some locations.

Methods

Methods used included analysis of literature, maps and statistics, field data, remote sensing, and GIS analysis (MapInfo Professional). Landscape maps of the Caucasus at 1:1,000,000 (Beruchashvili 1979) and 1:500,000 (Beruchashvili 1983) were used as the landscape basis. The current status of landscapes, natural and anthropogenic conflicts, natural potential and sustainability of areas were evaluated by space-time analysis and synthesis of natural territorial complexes (Methodology of Landscape-Geophysical Researches 1983) and landscape planning (Antipov et al. 2006).

Results

1. Socioeconomic, demographic and geo-ecological characteristics of the West Lesser Caucasus region were identified.
2. Aspects of the current natural landscape status were identified and the degree of their transformation and their socioeconomic functions evaluated.
3. Landscape functions of conservation, environment and resource reproduction were identified for planning PAs of different categories.
4. Functional zoning of the West Lesser Caucasus has been done and recommendations developed for new PA planning; results have been submitted to the Protected Areas Department of the Ministry of Environment Protection and Natural Resources (MEPNR) of Georgia.
5. A GIS database has been created including socioeconomic, demographic and geo-ecological data on West Lesser Caucasus (at 1:200,000).
6. Landscape and thematic maps at different scales have been generated.
7. Photographs were taken to illustrate the environmental conditions.
8. A new map has been generated showing recommended areas for planning new PAs and ecological corridors.

Main Landscapes and their Geo-ecological Characteristics

There are 2 classes, 7 types, 11 subtypes and 22 varieties of landscapes in the region (Fig. 1). The 7 types form the main landscape background. Fourteen of the landscapes also occur in Turkey, which makes establishment of a transboundary network of protected areas especially important.

Lowland and Piedmont-hilly Colchic Landscapes

Lowland and piedmont-hilly Colchic landscapes occur in the western part of the region. They form a narrow strip extending beyond the territory of Georgia, along the foothills of the Pontic Mountains, up to Trabzon in Turkey. These landscapes extend from sea level to 400-600m asl, and even to 800m in some regions (e.g. Upper Imereti). There are two key relief elements: the actual Kolkhida lowland and the piedmont-hilly surroundings. At present natural, almost intact complexes can be found only in protected areas (Kintrish Reserve, Mtirala National Park). In slightly transformed landscapes, polydominant forests prevail (chestnut, alder, maple, ash-tree, beech, oak, etc). Dense undergrowth is represented by rhododendrons (*Rhododendron smirnowii*, *Rh. ungeronii*, *Rh. ponticum*), cherry laurel (*Laurocerasus officinalis*), box-tree (*Buxus colchica*), ilex (*Ilex colchica*) and Butcher's broom (*Ruscus ponticus*). In

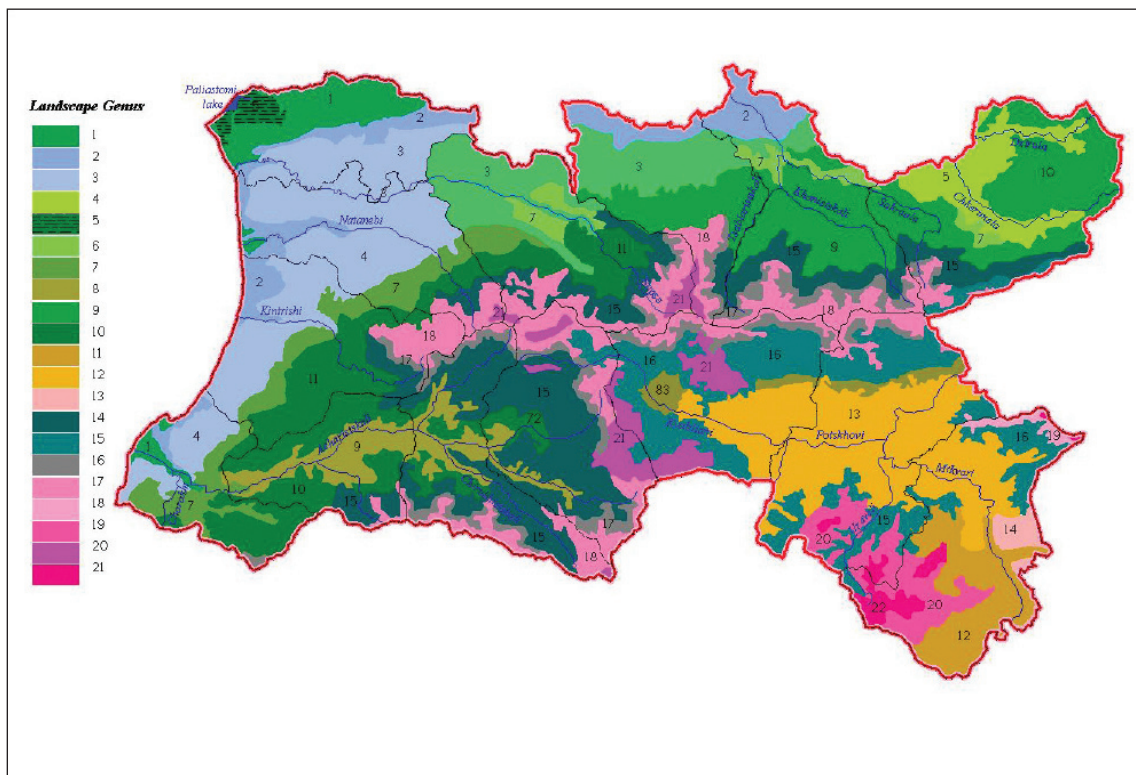


Fig. 1. Landscape map / © N. Beruchashvili 1979

coastal Adjara, there are Hemihylaea with all vegetation strata, except for the upper one, represented by evergreen plants. These complexes have the most subtropical character in the Caucasus. Colchic forests with mixed deciduous and evergreen undergrowth are associated with drier habitats, growing on yellow soils (zheltozem). The landscapes are significantly changed by human activities.

Low-mountain Forest Landscapes

Low-mountain forest landscapes form a rather narrow (5-10 km) strip around the Kolkhida foothills, widening to 10-20 km in Upper Imereti and Guria-Adjara. These also include mountains and depressions of Inner Adjara. They occur generally in the elevational range 300-800 m, reaching 900 m in the Adjaristskali basin.

Local relief and geology are very diverse. Landslides are widespread, inflicting huge damage to the local economy. The climate is transitional, from humid subtropical to temperate warm. Precipitation ranges within 1000-2500 mm, higher on slopes overlooking the sea (i.e. facing moisture-laden air masses) and lower in mountain depressions.

Semi-xeric oak forests growing on yellow-brown and brown forest soils prevail on steep southern slopes overlying limestone. Polydominant forests with evergreen undergrowth growing on brown forest soils prevail in shady gorges. In Inner Adjara, there are pine and oak trees with a lot of Mediterranean species. In mountain depressions, the landscapes are strongly transformed by human activities.

There are two sub-types: 1. *Low-mountain Colchic landscapes*, with temperate warm, humid climate, erosive-denudational relief and Colchic Hemihylaea (found in Turkey, on the Black Sea coast). There is severe anthropogenic transformation there, and the key socioeconomic functions are conservation and production of resources. 2. *Low-mountain Colchic landscapes*, with temperate warm, humid climate,

erosive-denudational relief and oak forests (Georgian oak, Chorokhi oak) and oak-pine forests, occasionally with phrygana. These landscapes occur in the Adjara depression and cover 400 km² (0.6% of the total area of Georgia). The altitude range is 300-700m. The degree of anthropogenic transformation is very high.

Middle-mountain Beech Forest Landscapes

Middle-mountain beech forest landscapes occur at 600–1,400 m on northern slopes of the western Lesser Caucasus, and the western part of the Shavsheti ridge. They also occur in Turkey, in the lower and middle reaches of the Chorokhi river. Sometimes these forests cut across the strip of middle-mountain beech and dark coniferous forests and make direct contact with subalpine forests and alpine landscapes, reaching 1,800 m.

Most of the middle mountain forest landscapes have medium-steep slopes. The climate is temperate and humid. Air temperature in January ranges from -0.6°C to -5.5°C , and in July from $+19^{\circ}\text{C}$ to $+16^{\circ}\text{C}$. Annual precipitation in middle mountains of coastal Adjara is 2,500-3,000 mm, but below 1,000 mm in deep and enclosed gorges. Beech and chestnut forests prevail, with evergreen undergrowth. There are ‘sheriani’, a dense, Colchic undergrowth that suppresses natural forest regeneration. Residential areas and gardens are found only in the bottoms of wider ravines. The anthropogenic impact is quite low. In Turkey the landscapes are medium-transformed, and significant areas are covered by walnut plantations.

Middle-mountain dark coniferous forests

Two sub-types of landscape represent middle-mountain dark coniferous forests. They occur in Western Georgia, on the southern slope of the Greater Caucasus and northern slopes of the Lesser Caucasus, and also in Russia (Northwest Caucasus) and Turkey (the basin of the Imerkhevi and lower reaches of the Chorokhi rivers). Altitudes are 1,000-2,000 m. The climate is temperate humid, coastal and weakly continental. The air temperature in January ranges within -3°C and -6°C , in July – between 14° - 16°C . Annual precipitation is sufficient throughout the landscapes, reaching 3000 mm in the mountains of Adjara and Guria. Snow cover remains from the end of October-November to April.

These forests occupy the second largest area after beech forests but their area has significantly declined and they are locally fragmented because of felling of trees in recent years. Regeneration of dark coniferous forests is also hampered by beech forests within them, as beech prevents the growth of young *Picea* and *Abies*. As a result, the dark-coniferous forests are replaced first by mixed beech and dark coniferous forests, and then by beech forests. Vegetation mass is on average 300-500 tons per ha, and in virgin forests it exceeds 500 tons per ha, the maximum in the Caucasus.

Using the landscapes for economic purposes could be a threat, as the impact (especially tree felling) on steep medium-steep slopes causes the risk of collapse and ecosystem degradation. Yet at present these processes are not too intense for two main reasons: firstly, the ecosystems remain in their natural intact condition, and secondly, demographic depopulation typical for this region would enable self-restoration of the ecosystems.

Subalpine Forest Landscapes

Subalpine forest landscapes occur in high-mountain areas, primarily in Western Georgia, on southern slopes of the Greater Caucasus and northern slopes of the Lesser Caucasus. Some fragments are also found in Eastern Georgia within the Trialeti Ridge. The landscapes extend over Imereti, Meskheta and Adjara. Their altitude ranges between 1,700 to 2,200 m. The relief is erosive-denudational with steep slopes. The climate is temperate cold and humid. The air temperature in January ranges within -5°C and

–7°C, and in July – between 12°C and 14°C. Annual precipitation reaches 2,000-2,500 mm. Main tree species in the forest are birch (*Betula litwinowii*, *B. medwedewii*, *B. megrelica*), pine (*Pinus sosnowskii*), oak (*Quercus macranthera*, in Kolkhida – *Q. pontica*), maple (*Acer trautvetteri*) and some others typical of alpine forests. These form specific groups of formations: light forests, crooked forests, and low forests, which result from adaptation to local extreme conditions of upper mountains. Forests alternate with meadows, in which tall grasses are most noteworthy. Human economic activity resulted in felling of a large area of the upper-mountain forests, so today secondary meadows occupy large areas, being used as grasslands and hayfields.

The main threat to these landscapes is loss of their conservation function in protecting areas at lower altitudes (mainly middle-mountain forests) from snow avalanches and mudflows. Therefore, establishment of protected areas in these landscapes is an important task.

Subalpine Landscapes

Subalpine landscapes occur in Western Georgia, on southern slopes of the Greater Caucasus and northern slopes of the Lesser Caucasus. These areas include Imereti, Meskheti, Guria and Adjara. In Turkey, they occur in the Marchkhala massif and subalpine zone of the Shavsheti Ridge. Their altitude ranges from 1,800–2,400 m. The landscapes are associated with high mountains, and rarely have a clear boundary as they are gradually replaced by Alpine landscapes. Denudational and paleoglacial relief types are typical. The climate is severe alpine. The air temperature in January drops to –8°C –10°C, and in July reaches +8°C +12°C. Annual precipitation ranges 1,500-2,000 mm. Snow cover stabilizes at the beginning of October and remains until early May. The areas have rich biodiversity with many endemic plants.

The landscapes are heavily modified by overgrazing and use as hayfields. Forest areas are frequently replaced by subalpine meadows. Some areas are inhabited seasonally, with several dozen households practicing traditional livestock rearing. Tree felling and overgrazing result in huge environmental changes - exposure of the land surface and weakening of conservation functions. Severe climate, frequent snow and rock avalanches, as well as economic activities interfere with self-restoration of the land. The key socioeconomic function of the landscapes is conservation and resource production.

Alpine Landscapes

Alpine landscapes are patchily distributed in the highest parts of the Lesser Caucasus and are associated with elevations of 2,600-3,100 m. They occur as narrow strips on crests and high slopes of the Adjara-Imereti, Shavsheti, and Arian ridges. The climate is severe alpine. The air temperature in January is –12°C –14°C, in July +5°C +7°C. The annual precipitation is 1,000-1,500 mm. Snow cover stabilizes late in September – early in October and remains until the end of May – beginning of June. Alpine meadows are the most widespread (*Festuca supina*, *Carex tristis*, *C. medwedewii*, *Alchimilla caucasica*, *Koeleria caucasica*, *Trifolium canensis*, *Scabiosa caucasica*, *Lotus causicus* etc). Caucasus rhododendron (*Rh. causicum*) is widespread on northern slopes. The key socioeconomic function is conservation and recreation.

Demographic Aspects

Two major stages can be identified in the human population dynamics of the region in the last two decades. Before 1994, the population was quite stable and in some cases there was even a population growth trend. The second (current) stage is characterized by an overall downward trend. Currently the human population is 635,500, 14.4% of the population of Georgia (Elizbarashvili and Meladze 2006).

There was a sharp decline in in Akhaltsikhe, Khulo, Shuakhevi, Ozurgeti, Chokhatauri and Adigeni regions, and in the town of Batumi. There have been unprecedented falls in the absolute number of births in several regions and a catastrophic decrease in birth rates, 2.5-6 times lower than in 1990, in Adigeni, Kharagauli, Vani and Khelvachauri. Total natality in the region decreased significantly.

The situation since 1996 does not allow for simple reproduction of the population. The natural growth coefficient there is currently 0.5-0.7‰, which shows a trend of demographic decline. The regions of Ozurgeti, Chokhatauri, Bagdadi, Vani, Kharagauli, Adigeni and Khelvachauri have had negative natural population growth rates for several years. The population of the region is rapidly approaching the demographic aging margin. The situation is most critical in the regions of Chokhatauri, Kharagauli, Vani, and Bagdadi where one fifth of the population aged 65 or older. The same regions also have high numbers of middle-aged people.

In 1989-2002, the absolute number of the population living in areas above 500 m fell by 11,181 people. In 2002, 18.9 % of the region's total population lived in those areas, 0.4 points lower than in 1989. A considerable population decrease is registered in the zones between 1000-1500m and above 1500 m, where the decrease was 10.2% in each. In the low-mountain zone (500-1000 m) the population declined by 5.6%.

Analysis of rural demography by altitude zones shows the following results: in the zone at 500-1000 m, there are 124 villages belonging to 10 regions, with about 7,1 % of the region's total population (2002). In 1989-2002, the population gradually decreased in those zones, except for the Adigeni and Akhaltsikhe regions. In the zone between 1000-1500 m asl, 11,1% of the region's total population lives in 161 villages of several regions of Adigeni, Akhaltsikhe, Khulo, Shuakhevi, Khelvachauri, Kharagauli, Kobuleti. In the zone above 1500 m asl., 20 villages belonging to four regions (Adigeni, Khulo, Shuakhevi and Akhaltsikhe) are located, with a total population of 4448.



Fig. 2. Land-use pattern in Kvabliani River valley / © N. Elizbarashvili

Thus, most villages located above 500 asl show a decrease in the population. Yet, the population number of the region's high-mountain areas is much higher than the 'territorial capacity'. In mountain areas of Adjara (Khulo, Shuakhevi, Keda), the recent decrease in the population has been due to environmental disasters which resulted in a part of the populating becoming 'ecomigrants'.

The zone that is most favorable and 'painless' for establishing protected areas, is above 1,500 m. The situation there offers preconditions for establishing national parks as well as ecological corridors. Yet consideration should be given to the fact that there are a lot of shepherds' summer camps in the area between subalpine forests and meadows, which shows a high level of traditional livestock breeding.

Socioeconomic Aspects

Most of the human population lives in villages and practice livestock breeding and cultivation. Areas most favorable for farming have high population density (120-130 people/km²). Landslides, mudflows

and erosion are also promoted by high anthropogenic pressure, uncontrolled forest felling, overgrazing, unsustainable use of farmlands, and transport infrastructure (Fig. 2). The highest numbers of cattle are found in Khulo (49,000), Ozurgeti (24,200), and Shuakhevi (38,500). The regions of Akhaltsikhe and Adigeni have lower densities of cattle.

Industrial production has grown sharply in recent years. On average, the timber industry contributes 20-25% of administrative budgets, reaching 35-40% in the Bagdadi and Chokhatauri regions. Forest use has greatly increased in Adigeni, with the share of timber production reaching 95% of the total production in the region.

Conclusion

Transformation of natural landscapes in the region is mainly due to agriculture (livestock breeding, vegetable growing) and unsystematic forest use. The type and extent of the transformation vary by altitudinal zone. Firstly, a high degree of transformation due to heavy anthropogenic pressure and agricultural activity is observed in mountainous-hilly, low-mountain, and middle-mountain Colchic landscapes. Secondly, in middle-mountain beech and dark coniferous forests the impact (forest use) is of low to medium degree and transformation is insignificant. Thirdly, subalpine and alpine landscapes have strong anthropogenic pressure (felling, overgrazing) and a medium-changed structure. New protected areas are needed to enable self-restoration of the natural environment and regulation of geodynamic processes, especially in the middle-mountain and forest landscapes that are a buffer zone between subalpine (the most unstable areas) and low-mountain landscapes (the most transformed).

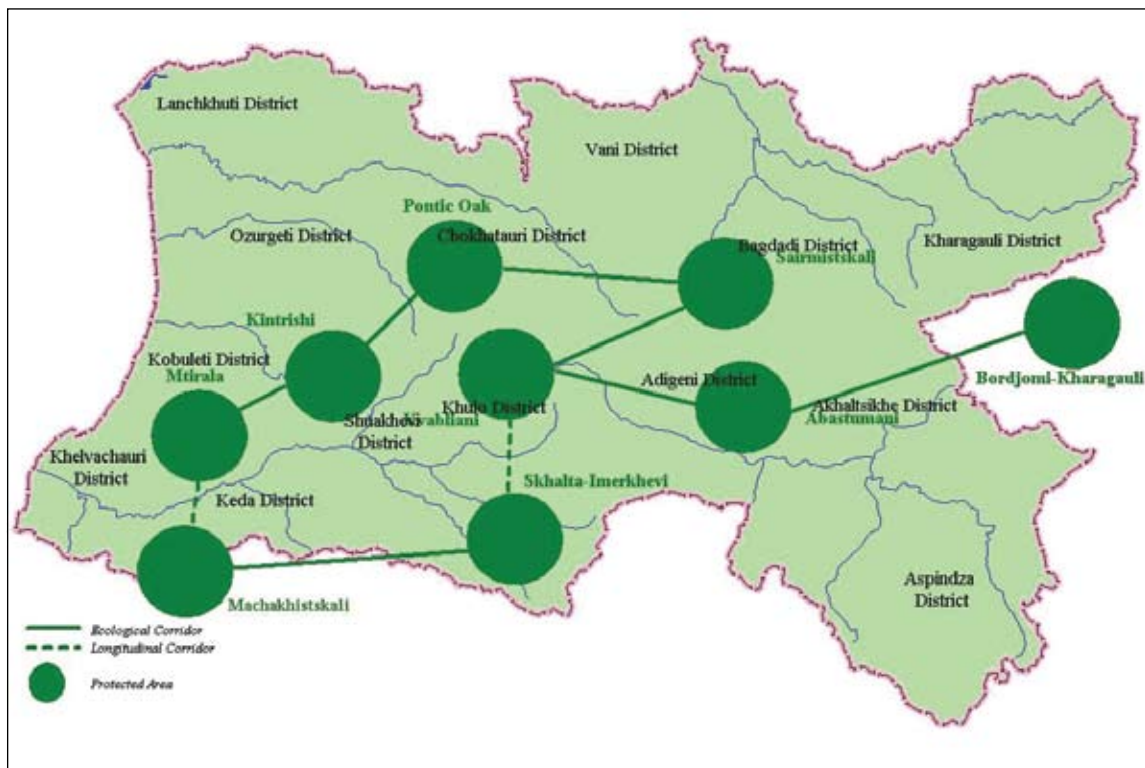


Fig. 3. Proposed protected area network

Proposed Protected Areas

In Bagdadi, Vani, Kharagauli, Chokhatauri, Adigeni, Khulo, and Shuakhevi, a new system of protected areas should be established and connected by ecological corridors. There are two potential groups of protected areas (Fig. 3):

- Meskheta - (Borjomi-Kharagauli – Abastumani – Kvabliani – Sairmistskali – Pontos Mukhis – Kintrishi – Mtilara).
- Arsiani-Shavsheti - (Zarzmi – Sakhlta-Imerkhevi, Machakhela).

The Arsiani-Shavsheti PAs and the Meskheta PAs could be then be connected by two ecological corridors:

- In Adjara along the meridian of the villages of Khertvisi and Maglakoni;
- In Meskheta along the meridian of the villages of Mokhi and Dartseli.

Acknowledgements

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Scope of Work and Objectives

The project was carried out between May 20th, 2005 and May 20th, 2006 by Wetlands International – Russia Program, in collaboration with the State Universities of Rostov, Karachai-Cherkess and Stavropol; the Maikop State Technological University; the Daghestansky, Rostovsky, Severo-Osetinsky and Kavkazsky Strict Nature Reserves (*zapovedniki*); the Krasnodar Krai Department of the Federal Supervisory Natural Resources Management Service, and the Russian Bird Conservation Union.

The Wetlands International–Russia Program has been supervising wetland inventory activities in Russia since 1997. To implement these activities, a national network of wetland experts has been established. The overall aim of the project was to provide an information base for nature resource management and decision-making and increase awareness of the importance of wetlands in the Caucasus by supporting the compilation and publication of an inventory of internationally and nationally important wetlands in the Russian Caucasus region.

Project objectives were to:

- Improve the conservation of wetlands in the Russian Caucasus region through the identification and compilation of a list of internationally and nationally important wetlands that need to be protected under the Ramsar Convention and national law on protected areas.
- Build human and institutional capacity in the region in support of wetland management and conservation on the basis of the existing Wetlands International network of Russian wetland experts.
- Increase awareness of wetland functions and values through publication of wetland inventory information and development of a standardized GIS-based data set on Caucasian wetlands.

The preparatory phase of the project reviewed information on Caucasian wetlands and identified high-altitude wetlands as poorly known, and some sites, especially on the Caspian coast, as being under extreme threat and so requiring urgent conservation measures. A total of 53 sites were identified for inclusion in the inventory. Nineteen local experts and consultants prepared detailed descriptions of these sites. The descriptions followed Ramsar Convention guidelines and were mainly derived from the literature and the project participants' own reports and material. Limited field studies were conducted at some sites (mainly in mountainous areas). The site descriptions also include data obtained under several other projects, including the Wetlands International–Russia's projects on *Promoting the International Waterbird Census in Russia in 2005*, funded by the Royal Netherlands Embassy in Russia, and on *Monitoring of Migratory Waterbirds in Russia and Neighbouring Countries*, funded by the Swiss Agency for Development and Cooperation. Information on the wetlands in Rostov Oblast was collected under the Wetlands International–Russia Program in 2004-2005, with support from the Dutch Ministry of Agriculture, Nature and Food Quality.

The main outputs of the project were a publication on important wetlands in the North Caucasus and a GIS-based data set.

Results

Site Inventory

The 53 selected wetland sites cover in total c. 11,245 km² in the North Caucasus (Caucasus region of the Russian Federation). Sites comprise lakes, floodplains, peatlands, marshes, coastal lagoons (*limans*) deltas and marine wetland complexes (Fig. 1). Sites are located in the 3 sub-regions of the North Caucasus: Western and Central Ciscaucasia (22 sites); Terek-Kuma Lowlands and Southern Caspian Shore of Daghestan (19 sites), and Caucasus Mountains (12 sites).

In Western and Central Ciscaucasia the most important wetlands are situated in the lower Kuban and Don river valleys which develop large deltas and 'plavni' marshes; in the floodplains of the Yeya, Beisug and Chelbas rivers entering the Sea of Azov; and brackish lagoons (*limans*) along the coast. In the Terek-Kuma Lowlands, most important sites consist of shallow bays and marine wetland complexes along the Caspian Sea and islands, and the Terek and Sulak deltas. In the Caucasus Mountains, several lakes and two relic mire complexes were identified as wetlands of national and international importance. The Manych, Azov and Caspian wetlands are important staging posts for huge numbers of birds on major migration flyways. The region harbors large breeding populations of waterbirds and the only wintering areas for waterbirds in Russia.



Fig. 1. Wetlands in Daghestan / © G. Dzhamirzoev

The inventory of important wetlands in the Caucasus was published in Russian as Volume 6 of the *Wetlands in Russia* series (Mishchenko 2006). This contained descriptions of the selected 53 sites, including maps and illustrations, information on threats and conservation activities, and chapters describing natural conditions, wetland types, functions and values, land use activities, major threats and conservation priorities.

A list of priority sites based on the wetland inventory will be submitted to the Ministry of Natural Resources of the Russian Federation for further designation of the sites under the Ramsar Convention on Wetlands.

Database

A Caucasus wetland database was compiled as part of the National Wetland Database developed under the Wetlands International – Russia Program and maps of wetland sites were digitized. Information on the project was also placed on the Wetlands International website (www.wetlands.org/Russia/Ru).

Acknowledgements

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Executive Summary

Protected areas (PAs) have played an important role in biodiversity, and particularly in globally threatened species conservation in the Caucasus. There are several different categories of PAs in the region: strict nature reserve (corresponding to IUCN category I), national park (mostly II), natural monument (III), sanctuary/wildlife reserve/wildlife refuge (mostly IV), nature park, protected landscape (V), and multiple use area (VI)^a. The first PA (strict nature reserve) in the region was created in the Lagodekhi gorge on the southeastern slopes of the Greater Caucasus Range in Georgia in 1912, which means just three years later than first national parks were established in Europe and earlier than “real” protected areas were created on the other continents excluding North America^b. In post-Soviet countries since the mid-1990s, protected area systems are successfully developing towards diversification of PA types and extension of the systems. For instance, during the current decade, the area of the PA system in Azerbaijan doubled, and the same speed of development is characteristic of Georgia’s system too. Two new National Parks (Arpi Lake and Arevik) and Zangezour Sanctuary were established recently in Armenia. In the Turkish part of the Caucasus during the last few years, two large national parks were established (Agri and Sarikamish), as well as Jamili Biosphere reserve on the border with Georgia.

Today, there are 41 strict nature reserves, 32 national parks, and around 166 sanctuaries, wildlife refuges and other types of protected areas (nature parks, protected landscapes, etc.) plus hundreds of natural monuments in the Caucasus Hotspot, covering around 10% of its area.

A great effort is still required to strengthen PA systems in the region: management practices and infrastructure of existing protected areas and adjacent land do not always ensure effective conservation of biodiversity. Buffer zones are virtually non-existent, so the consequences of resource use and human pressures outside reserves spill over the borders and impact protected ecosystems. Saving unique ecosystems and endangered species of the Caucasus Ecoregion still requires creation of new protected areas where gaps exist and linking of reserves by a network of corridors and stepping stones, and also improving management, financing, and government and public support for protected area activities.

CEPF Investments in Protected Areas System in the Caucasus

CEPF investments made it possible to address a considerable part of these gaps and weaknesses focusing on the areas that cover key habitats (site outcomes/key biodiversity areas) of globally threatened species (CEPF 2003; Table 1, Fig. 1). This also assists National Governments to meet their commitments vis-à-vis targets of CBD Programme of Work on Protected Areas (see Dudley et al. 2005), as well as objectives of National Biodiversity Strategies and Action Plans. In particular, the following works have been carried out.

^a On Protected Areas management categories see Dudley 2008.

^b On history of development of the World’s protected areas see Chape et al. 2008.

Table 1. Protected areas of the Caucasus covered by activities within CEPF investments

Protected Area	Activity	Country	CEPF Site	Globally Threatened Species according to IUCN 2003 and 2009
1. Absheron National Park	Improvement of infrastructure	Azerbaijan	# 57 Absheron sanctuary	2003, 2009: <i>Pusa caspica</i> , <i>Oxyura leucocephala</i> , <i>Anser erythropus</i>
2. Alania National Park	Capacity building/training	Russia	# 48 Alania NP	2003: <i>Capra cylindricornis</i>
3. Arevik National Park	Planning, basic equipment	Armenia	# 124 Meghri	2003, 2009: <i>Capra aegagrus</i> , <i>Ovis orientalis</i>
4. Arpi/Gnishik	Planning	Armenia	# 125 Noravank	2003, 2009: <i>Capra aegagrus</i> , <i>Ovis orientalis</i> , <i>Falco naumanni</i>
5. Borjomi-Kharagauli NP, Borjomi Strict Nature Reserve & Nedzvi Sanctuary	Improvement of infrastructure	Georgia	# 87, 88 Nedzvi Sanctuary, Borjomi-Kharagauli NP	2003, 2009: <i>Mertensiella caucasica</i> , <i>Vipera kaznakovi</i> ; 2003: <i>Myotis bechsteini</i> , <i>M. emarginatus</i> ; <i>M. bechsteini</i> ; <i>Barbastella barbastellus</i> , <i>Rhinolophus hipposideros</i> , <i>Pelodytes caucasicus</i> , <i>Bufo verrucosissimus</i>
6. Chernogorie Sanctuary	Development of management plan	Russia	# 38 Kavkazsky Biosphere Reserve	2003, 2009: <i>Capra caucasica</i> , <i>Testudo graeca</i> , <i>Natrix megalcephala</i> , <i>Vipera kaznakovi</i> , <i>V. dinniki</i> , <i>V. ursinii</i>
7. Erzi SNR	Extension planning, capacity building/training	Russia	#46 Erzi NR	2003: <i>Capra cylindricornis</i>
8. Kabardino-Balkarsky State (Strict) nature Reserve	Capacity building/training	Russia	# 42 Kabardino-Balkarsky NR	2003, 2009: <i>Capra caucasica</i> , <i>Vipera ursinii</i>
9. Kavkazsky Biosphere Reserve	Development of management plan, capacity building/training	Russia	# 38 Kavkazsky Biosphere Reserve	2003, 2009: <i>Capra caucasica</i> , <i>Testudo graeca</i> , <i>Natrix megalcephala</i> , <i>Vipera kaznakovi</i> , <i>V. dinniki</i> , <i>V. ursinii</i> ; 2003: <i>Barbastella barbastellus</i> , <i>Rhinolophus hipposideros</i> , <i>R. euryale</i> , <i>Myotis emarginatus</i> , <i>M. bechsteini</i> , <i>Lutra lutra</i> , <i>Crex crex</i> , <i>Pelodytes caucasicus</i> , <i>Bufo verrucosissimus</i>
10. Khevsureti	Planning	Georgia	# 30 Khevsureti	2003, 2009: <i>C. aegagrus</i> ; 2003: <i>Capra cylindricornis</i>
11. Khosrov State (Strict) Nature Reserve	Development of management plan and infrastructure, equipment, capacity building/training	Armenia	# 120 Khosrov NR	2003, 2009: <i>Capra aegagrus</i> , <i>Rhinolophus mehelyi</i> , <i>Testudo graeca</i> ; 2003: <i>Rhinolophus hipposideros</i> ;
12. Kolkheti National Park	Capacity building/training	Georgia	# 97 Kolkheti	2003, 2009: <i>Oxyura leucocephala</i> , <i>Anser erythropus</i> ; 2003: <i>Lutra lutra</i> , <i>Crex crex</i>
13. Machakhela	Planning, establishment	Georgia	#92 Chorokhi	2003, 2009: <i>Vipera kaznakovi</i> , <i>Mertensiella caucasica</i> , <i>Darevskia clarkorum</i> , 2003: <i>Barbastella barbastellus</i> , <i>Pelodytes caucasicus</i> , <i>Bufo verrucosissimus</i>

Protected Area	Activity	Country	CEPF Site	Globally Threatened Species according to IUCN 2003 and 2009
14. Mezmaysky Nature Park	Development of management guidelines for establishment	Russia	# 38 Kavkazsky Biosphere Reserve	See #6
15. Mtirala National park	Establishment of buffer zone	Georgia	# 94 Mtirala	2003, 2009: <i>Vipera kaznakovi</i> , <i>Mertensiella caucasica</i> , <i>Darevskia clarkorum</i> , 2003: <i>Barbastella barbastellus</i> , <i>Pelodytes causicus</i> , <i>Bufo verrucosissimus</i>
16. Posov Wildlife Reserve	Development of management plan	Turkey	# 83 Meskheta	2003, 2009: <i>Aquila heliaca</i> , <i>Falco naumanni</i> , <i>Vipera darevskii</i>
17. Prielbrusiye National Park	Capacity building/training	Russia	# 49 Prielbrusiye	2003: <i>Capra cylindricornis</i>
18. Sevan National Park	Capacity building/training	Armenia	# 118 Lake Sevan	2003, 2009: <i>Anser erythropus</i> ; 2003: <i>Lutra lutra</i>
19. Severo-Osetinsky State (Strict) nature Reserve	Capacity building/training	Russia	# 40 Severo-Osetinsky NR and Sanctuaries	2003, 2009: <i>Vipera dinniki</i> , <i>V. ursinii</i> ; 2003: <i>Capra cylindricornis</i>
20. Shikahogh (Strict) Nature Reserve	Development of management plan and infrastructure, equipment, capacity building/training	Armenia	# 124 Meghri	2003, 2009: <i>Capra aegagrus</i> , <i>Ovis orientalis</i>
21. Shirvan National Park	Improvement of tourism management	Azerbaijan	# 67 Shirvan NR / Shorgel Lakes	2003, 2009: <i>Marmaronetta angustirostris</i> , <i>Aquila heliaca</i> , <i>Falco naumanni</i> , <i>Testudo graeca</i>
22. Sochinsky National Park	Capacity building for tourism management	Russia	# 38 Sochinsky NP	2003, 2009: <i>Natrix megalcephala</i> , <i>Vipera dinniki</i> , <i>Vipera kaznakovi</i> ; 2003: <i>Rhinolophus hipposideros</i> , <i>R. euryale</i> , <i>Lutra lutra</i> , <i>Testudo graeca</i> ,
23. Teberdinsky Biosphere Reserve	Establishment of wildlife corridor/biosphere polygon	Russia	# 36 Teberdinsky NR	2003, 2009: <i>Capra caucasica</i> , <i>Aquila heliaca</i> , <i>Testudo graeca</i> , <i>Natrix megalcephala</i> , <i>Vipera dinniki</i> , <i>V. ursinii</i> ; 2003: <i>Barbastella barbastellus</i> , <i>Rhinolophus hipposideros</i> , <i>R. euryale</i> , <i>Myotis emarginatus</i> , <i>M. bechsteini</i> , <i>Lutra lutra</i> , <i>Pelodytes causicus</i> , <i>Bufo verrucosissimus</i>
24. Tlyaratinsky Federal Sanctuary	Enhancing the status	Russia	# 39 Tlyaratinsky Sanctuary	2003, 2009: <i>Capra aegagrus</i> , <i>Vipera dinniki</i> ; 2003: <i>Capra cylindricornis</i>
25. Zakatala(Strict) Nature Reserve	Development of management plan and Improvement of infrastructure	Azerbaijan	# 12 Zakatala NR	2003: <i>Capra cylindricornis</i> , <i>Barbastella barbastellus</i> , <i>Rhinolophus hipposideros</i> , <i>Myotis emarginatus</i> , <i>Pelodytes causicus</i> , <i>Bufo verrucosissimus</i>
26. Zangezur Sanctuary	Planning, basic equipment	Armenia	# 124 Meghri	2003, 2009: <i>Capra aegagrus</i> , <i>Ovis orientalis</i>

Armenia

Armenia launched its protected areas system in 1958 with creation of 3 State (strict) nature reserves (Khosrov, Dilijan and Shikahogh) and 6 State Sanctuaries (Juniper Open Woodlands of Sevan, Arjatkhlendi hazel-nut, Her-Her Open Woodlands, Jermuk, Gyulagarak Pine and Plane Grove). Today the country has 3 strict nature reserves (with a total area of 36,104 ha), 4 national parks (around 235,000 ha), 26 sanctuaries (109,000 ha) and 230 natural monuments (the list approved by the Government of Armenia in 2008). The protected areas cover in total about 360,000 ha or about 12,5% of the country's territory (including Lake Sevan as part of Sevan National Park, which is 4% of the territory of Armenia). Out of these approximately 75% correspond to IUCN I-II and 25% to IUCN IV. Nearly 65% of plant and animal species found in Armenia are represented within protected areas.

There are many gaps in the current PA system in Armenia. The existing PA system is not entirely representative of the full range of biodiversity and landscapes. Many important habitats of endangered species are not covered by any Protected Area. Another deficiency is that management practices of existing reserves do not always ensure effective conservation of biodiversity due to the lack of human and technical resources of the reserves as well as absence of well-designed management plans.

The existing Khosrov Forest and Shikahogh Reserves are located more than 300 km from each other and no protected area exists between them. Therefore they hardly contribute to migration of globally and nationally threatened species like Caucasian leopard, bezoar goat, Armenian mouflon, brown bear etc. Thus, establishment of new PAs and corridors linking them is urgently needed to promote conservation of threatened species. Management in the existing reserves also needs to be improved by increasing the qualifications of the reserve staff, providing technical resources and developing and implementing management plans.

Protected areas-related CEPF investments in Armenia were mainly focused on the solution of the existing gaps in the PA system including improving the management of existing reserves and creating new PAs in the south of Armenia (East Lesser Caucasus Corridor, Sites #: 120; 124; 125; see Ecosystem Profile for Caucasus Biodiversity Hotspot at <http://www.cepf.net/Documents/>). The total area covered by the projects was about 95,000 ha. The target protected areas are located in the 3 southern regions of Armenia: Ararat, Vayots Dzor and Syunik – critically important for survival of bezoar goat and Armenian mouflon.

The following projects were implemented by different grantees (NGOs) with support of WWF to achieve the main objective:

- Strengthening the Protection Regime of Khosrov Reserve (“Armenian Tourist Association” NGO)
- Strengthening the Protection Regime of Shikahogh Reserve (“Khustup” NGO)
- Feasibility Study on Establishment of Gnishik National Park (about 12,000 ha) (“Biodiversity and Landscape Conservation Union” NGO)
- Assistance to Establishment of New Protected Area Arevik (in Southern Armenia (Public Organization “Ecotourism Association” NGO)
- Assistance to Establishment of New Protected Area Zangezur in Southern Armenia (“Khustup” NGO)

Apart from the CEPF Ecosystem Profile, the following basic documents were taken into account while designing the above mentioned projects: The Programme of Work on Protected Areas (PoWPA) of the Convention on Biological Diversity (CBD) (see Dudley et al. 2005) ratified by the National Assembly of Armenia in 1993; The “Strategy for Development of Specially Protected Nature Areas and National

Action plan of Armenia” developed by the Ministry of Nature Protection (MoNP) and approved by the Government of Armenia in 2002; An Ecoregional Conservation Plan for the Caucasus (Williams et al. 2006). The following main results were obtained:

- Protection regime of Khosrov Forest Reserve and Shikahogh Reserve were strengthened through developing infrastructure and providing different equipment: management guidelines have been developed, off-road cars purchased, roadblocks and signs installed, etc.
- Draft Management Plan was developed for the planned Arpi/Gnishik National Park (NP), as well as drafts of other necessary documentation for its establishment.
- All necessary documents were developed for establishment of Arevik NP including draft management plan, maps with the park boundaries and zones, a draft Governmental decision on establishment of the park and a charter of the park. All documents have been submitted to the MoNP for coordination with the main stakeholders and finally for establishment of the NP.
- All necessary documents were developed for establishment of Zangezur sanctuary including draft management plan, maps with the boundaries, a draft Governmental decision on establishment of the sanctuary and a charter of the sanctuary. All documents have been submitted to the MoNP for coordination with the main stakeholders and finally for establishment of the sanctuary.

Zangezur Sanctuary (17,378 ha) and Arevik National Park (34, 401 ha) were recently (15.10.09) established by the Decrees of Government of Republic of Armenia significantly contributing development of PAs network in South Caucasus and protection of globally threatened species and subspecies, including Caucasus leopard.

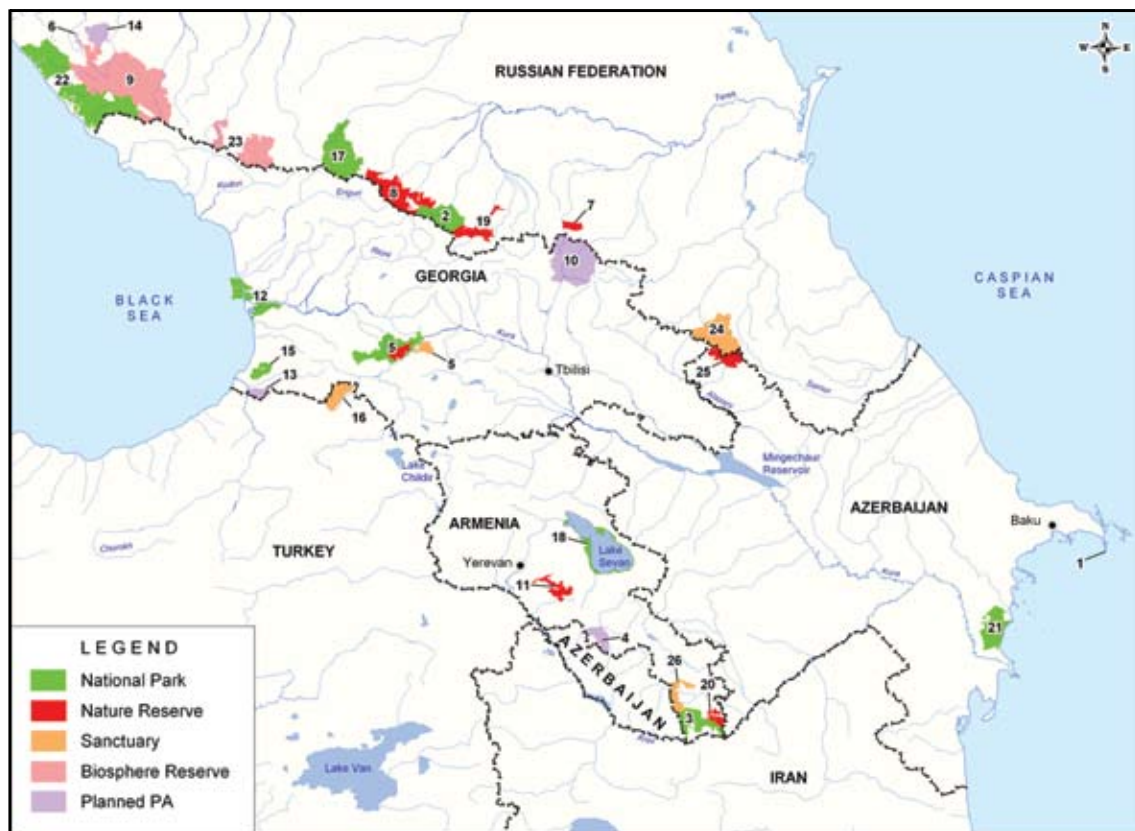


Fig. 1. Protected Areas addressed through CEPF investments in the Caucasus Hotspot

Azerbaijan

Azerbaijan's system of strictly protected nature reserves dates back to 1925, when the Gey-Gel Strict Nature Reserve was created in the Lesser Caucasus. Today, Azerbaijan has 14 strict nature reserves and 8 National Parks (IUCN I-II) covering approximately 488,000 ha or 5.63% of the country. Azerbaijan also has 24 wildlife refuges or sanctuaries (IUCN IV) with an area of 362,449 ha, protecting an additional 4.19% of the country. Other protected sites include geological and paleontological objects and endemic, valuable, and unique ecosystems, as well as more than 2,000 trees that are more than a century old, each of which are granted individual protection.

Thanks to the Ministry of Ecology and Natural Resources of Azerbaijan, the protected area system in Azerbaijan is rapidly extending; since early 2000 the total area of PAs doubled, and many new protected areas were created or expanded. The newly-created Ordubad National Park, recently established Shakhdag National Park and recently extended Zakatala Reserve play an important role in the conservation of globally threatened large herbivores, such as bezoar goat, mouflon and Daghestan tur. Another two new protected areas, Shirvan and Absheron National Parks, situated in the Caspian Sea coastal area, are of special importance for conservation of globally threatened bird species. In addition Shirvan National Park serves as the last "reservoir" of the Goitered gazelle population in the Caucasus, and Absheron National Park has special importance for conservation of the globally threatened Caspian seal (*Pusa caspica*). Despite great government effort, within the "fast growing" protected areas system of Azerbaijan some capacity and infrastructure still are lacking: within the scope of CEPF investments, mainly Zakatala reserve, Absheron and Shirvan National Parks have been targeted to improve infrastructure and some capacity. The total area of these reserves is about 100,000 ha.

Absheron National Park is not large, but as already mentioned is one of the key protected areas for survival of the Caspian seal. This is one of the smallest representatives of the Pinnipedia and is found exclusively in the brackish Caspian Sea. Many seals can still be observed in Absheron National Park and adjoining islands in spring and autumn. In spring, seals with young, newly-born on the ice of the northern Caspian, migrate to their main feeding and breeding grounds located farther south. In autumn, return migration is observed. Unfortunately, numbers of this species are dramatically declining: during the 20th century, the number fell by almost 5 times (Hadjiyev 2000). The negative population trend is the main reason for up-listing of this species to Endangered (EN) (IUCN 2009).

CEPF small grant investments for strengthening the protection regime of this Protected Area has been implemented by the NGO "Ecology and Conservation of Birds" and mostly covered activities for development of infrastructure and equipment: a motor-boat for patrolling and some other equipment was provided and an observation tower has been constructed. Some communication activities targeting the local population have been implemented as well.

Zakatala Reserve is one of the oldest in the Caucasus (established in 1929). It was recently expanded to 47,349 ha (almost doubling its area). This reserve, together with bordering Lagodekhi Protected Area (Georgia), plays a crucial role in protection of Daghestan tur on the south-eastern macro-slope of the Greater Caucasus. Here activities also have been mainly focused on infrastructure development and equipment: an off-road car and horses have been provided, ranger shelters constructed, etc. Training for rangers in monitoring of tur populations has been carried out as well. The project was implemented by the NGO "Center for Biodiversity"

Georgia

Georgia founded the first strict nature reserve in the Caucasus Ecoregion, Lagodekhi Strict Nature Reserve, in 1912. At the end of the 1990s (Soviet era) the Protected Area system in Georgia included 15

Strict Nature Reserves only, which covered 2.4% of country's territory. After the collapse of Soviet Union the system, with support of donors, such as GEF/World Bank, German Government, Government of Norway, and with technical assistance of WWF and some other international and national organizations, has been developing rapidly in both directions: extension and diversification. Today Georgia has 14 State (Strict) Nature Reserves (IUCN Category I), 8 National Parks (IUCN II), 14 Natural Monuments (IUCN III), 12 Sanctuaries (IUCN IV), 2 Protected Landscapes (IUCN V) and 5 Multiple Use Areas (IUCN VI) covering a total area of around 500,000 ha or 7.2% of the country's territory (3 times more than in the 1990s). However, Georgia's protected areas system still needs improvement and development. Some new protected areas, effectively functional buffer zones, as well as corridors between protected areas need to be established to allow animal migrations and certain threatened ecosystems need to be set aside.

Through the CEPF Investment, in the West Lesser Caucasus Corridor, the Natural-Landscape Territory of Mtirala and Machakhela was created with a combined area of 22,941 ha, including 18,835 ha of State forest land, through the development of a spatial planning document. This spatial planning document was approved and endorsed by the local governments and the next step is creation of two new protected areas under the Georgian Law on the Protected Area System: (i) a buffer zone for Mtirala National Park (10,202 hectares); and (ii) Machakhela Protected Landscape (12,739 hectares).

Since 2000, WWF has been developing the concept of establishing Georgia-Turkey cross- and transboundary cooperation for biodiversity conservation and sustainable resource use in the South Colchic region (Adjara Autonomous Republic of Georgia and bordering part of Turkey). From the Georgian side, apart from Mtirala National Park, Machakhela (Machakhel in Turkish) river valley is considered as the key area for development of transboundary activities. Machakhela is a relatively small transboundary river: the upper part is located in Turkey – protected as Jamili Biosphere Reserve (recently established within the framework of GEF/WB project) and middle and lower courses are located in Georgia. The valley is rich not only in biodiversity, but also from a historical-cultural viewpoint. After commencement of this CEPF-funded project on establishing the support/buffer zone to Mtirala National Park, local government authorities and representatives of Machakhela administration and some community leaders asked the project implementer to include the gorge in the project frame for future establishment of a transboundary Protected Area. This is how the project-frame was extended and the concept of Mtirala and Machakhela Natural-Landscape Territory was born. This particular two-stage approach of creation new protected areas is innovative for Georgia, minimizes conflicts with local people and considers their interests at the earliest convenience of the process.

The main objective of another important project implemented by the NGO “Sane” was creation of background for establishing new protected area in the eastern Greater Caucasus: management guidelines for establishment of Khevsureti National Park has been developed through consultation with local communities and in close cooperation with the Agency of Protected Areas at the Ministry of Environment and Natural Resources of Georgia. This document includes all necessary background information including PA zoning and drafts of legal acts for establishment of the National Park with total area of some 50,000 ha. The proposed Protected Area serves as a stepping stone or connecting unit between Tusheti and Kazbegi National Parks on the eastern Greater Caucasus – important sites for protection of bezoar goat and especially Daghestan tur.

Russia

The first strict nature reserve in the Russian (Northern) part of the Caucasus (Kavkazsky) was established in 1924. Today, Russia has 100 strict nature reserves, of which six are in the North Caucasus. Three of Russia's 35 national parks are located in the Caucasus Ecoregion. Together, strict nature reserves and

national parks cover 1,216,177 ha or 4.52% of the North Caucasus. Seventy-eight sanctuaries and nature parks add an additional 1.46 million ha (or 5.44%) to the area of protected lands in the North Caucasus. Hundreds of other sites with regional and local protected status are scattered throughout the North Caucasus. Yet despite the relatively high density of protected areas in the North Caucasus, the current network is insufficient to conserve a representative portion of the unique biodiversity of the Caucasus Ecoregion, much less save threatened ecosystems. Large gaps between the reserves do not allow animals to migrate naturally and without interference from humans. Scientists are calling for creation of a green corridor along the Greater Caucasus Range to link existing protected areas.

A corresponding project, “Creation of the System of Protected Areas of the North Caucasus (Green Corridor of the North Caucasus)” has been implemented by WWF-Russia within the framework of CEPF investments. The project envisaged creation of a biosphere polygon on Teberdinsky Reserve, expansion of the Erzi Reserve and establishment of a Tlyaratinsky cluster of the Daghestansky Reserve.

The Teberdinsky Reserve biosphere polygon would link the Teberdinsky and Arkhyzsky parts of Teberdinsky Reserve with Kavkazsky Reserve. This would enable protection of a wildlife migration corridor, first of all for large mammals, e.g. globally threatened Caucasian tur (*Capra caucasica*). The total area of the biosphere polygon is 29,070 ha. This increases the area of Teberdinsky Reserve to 114,134 ha and connects the Sochi National Park located in the Black Sea coastal area, with Kavkazsky and Teberdinsky reserves. All of these strengthen coordinated protection regimes of these protected areas and enable social and environmental monitoring, and implementation of sustainable nature management methods, which covers increasing sustainable tourism and corresponding job creation opportunities.

The need to create a reserve in the north-eastern Greater Caucasus, namely in the mountain part of Daghestan, boasting rich and original flora and fauna, has been raised many times in academic, public and political circles. In the 1980s, when the project on establishment of the Daghestansky State Nature Reserve was being developed, efforts were made to include the high-mountain Gutonsky area in the reserve. The plan failed, as some landowner organizations refused to cede their lands to the reserve. The Tlyaratinsky State Sanctuary (83,500 ha) of federal importance was established in 1996. As seen, the sanctuary has failed to meet biodiversity conservation requirements. Illegal logging, overgrazing and poaching have had a dramatic impact on the status of ecosystems and populations of separate species. In the course of implementation of the Green Corridor Project based on consultations with local authorities and communities, the optimal borders of the future Tlyaratinsky cluster of Daghestansky Reserve have been determined. The total area of the Tlyaratinsky section of the Daghestansky Reserve is 57,432 ha. Newly established section of Strict Nature Reserve will play important role in protection of globally threatened bezoar goat (*Capra aegagrus*), Daghestan tur (*Capra cylindricornis*), as well as many other regional priority species, including globally endangered subspecies of Caucasian leopard (*Panthera pardus ciscaucasica* = *P.p. saxicolor*) (see Breitenmoser et al. 2007). The Tlyaratinsky section of Daghestanskiy Reserve borders two important protected areas with the same category/protection regime and located on the southern macro-slope of the Greater Caucasus (Zakatala Reserve, Azerbaijan and Lagodekhi Reserve, Georgia); this will create favorable conditions for developing transboundary cooperation.

The Erzi State Nature Reserve is the newest among the North Caucasus reserves. The total area of the reserve (5,970 ha) was insufficient for conservation of biological and landscape diversity of the region’s mountain areas. This prompted the Government of the Republic of Ingushetia to start enlargement of the Erzi Reserve by joining bordering areas of high natural value. For historical reasons, no intensive economic activities took place in this area in the second half of the 20th century, which led to the low level of landscape disturbance. There are no populated areas, industrial enterprises, buildings or roads in the area to be added to Erzi Reserve. The reserve enlargement would help to keep the natural ecosystems in

the upper reaches of the Assa river basin intact and would provide conditions for restoration of a viable leopard population within its historical range in the Russian part of the Caucasus. It would also further stabilize the populations of the Daghestan tur and bezoar goat, which have declined dramatically over the last decade owing to poaching and deterioration of quality of habitats due to the ousting of wild ungulates by cattle to unsuitable rocky areas. This would also contribute greatly to the establishment of an optimal network of protected areas of different categories throughout the North Caucasus region.

Recently, according to the Decree of Cabinet of Ministers of Russian Federation, Erzi Reserve was expanded 6-times: total area of the reserve now amounts 35,292 ha, which should be considered as the first important step made toward “filling the gaps” existing in protected areas system in the Northern Caucasus, particularly on the north-eastern slope of the Greater Caucasus.

Turkey

Turkey founded its first national park in 1958. There are 35 strict nature reserves in Turkey – four are in the Turkish Caucasus (2,387 ha). There are 35 parks in the country’s national park system, six of which are in the Turkish Caucasus (188,134 ha). National parks and strict nature reserves protect 2.78% of the Turkish Caucasus. One Biosphere Reserve, three nature parks and ten sanctuaries (wildlife reserves) are also located in the Caucasus region, covering around 205,000 ha or 3% of the area. Altogether, in the Caucasus part of Turkey, nearly 395,000 ha (5.8% of Turkish Caucasus) are offered some form of protection. The Turkish Caucasus has a relatively high number of protected areas in comparison to the rest of Turkey. However, the northern part of the Turkish Caucasus is more thoroughly represented than the southern part.

The only project directly related to protected areas in Turkish Caucasus (particularly within West Lesser Caucasus) has been carried out to assess Protected Area Management Effectiveness. Relevant recommendations for improvement of PAs management have been elaborated and communicated to the responsible agencies.

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First, we would like to thank CEPF: Caucasian investments made possible implementation of considerable work of establishing new or strengthening existing protected areas (this article includes results of part of this work). Thanks to all implementing NGOs and their leaders and particularly “Ecotourism Association”, Leader Ms. Zhana Galyan; “Khustup”, Leader Mr. Vladik Martirosyan; “Biodiversity and Landscape Conservation Union”, Leader Mr. Jirair Vardanyan; “Armenian Touristic Association”, Leader Marine Hayrapetyan, “Ecology and Conservation of Birds”, Leader Mr. Ilyas Babayev, “Center for Biodiversity”, Leader Mr. Tavakkul Isgandarov, “Mta-Bari”, Leader Mr. Zurab Manvelidze; “Sane”, Coordinator Mr. Giorgi Arabuli, “Georgian Young Naturalist Society”, Coordinator Mr. Giorgi Sulamanidze, “Society of Green Artvin”, Leader Mr. Oguz Kurdoglu.

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