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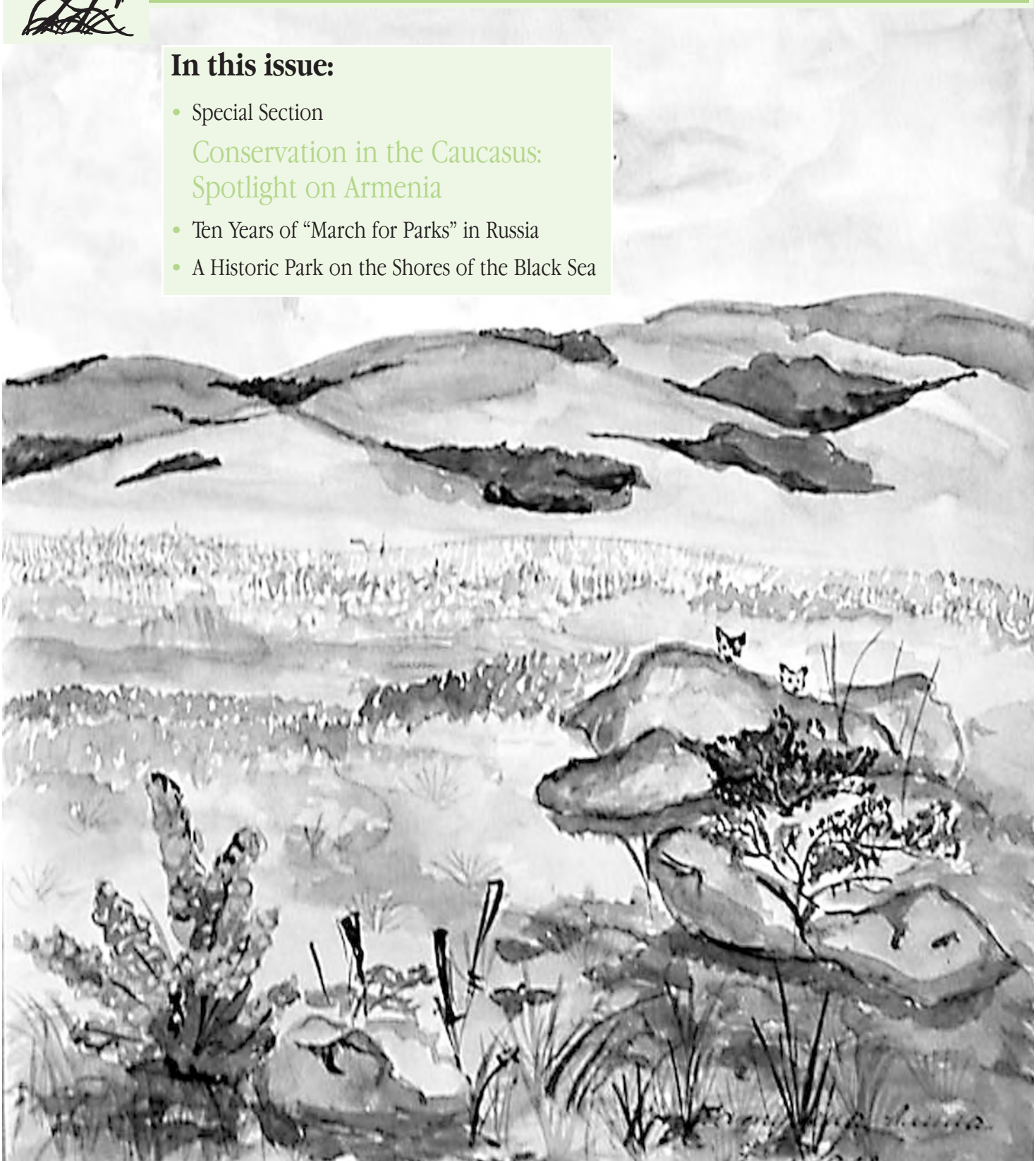
In this issue:



PROMOTING BIODIVERSITY CONSERVATION IN RUSSIA AND THROUGHOUT NORTHERN EURASIA

Conservation in the Caucasus: Spotlight on Armenia

By Way of an Introduction

Conservationists around the world widely recognize the Caucasus region as one of the Earth's most biologically diverse. Boasting high species richness and levels of endemism, among other exceptional characteristics, this mountainous region between the Black and Caspian Seas is globally important for biodiversity conservation. In the upcoming section of this thirty-ninth issue of *Russian Conservation News*, we spotlight one of the countries at the heart of this special region: Armenia.

The following pages of the journal offer a rounded conservation profile of the country, including descriptions of its varied landscapes and rich biodiversity. Although the present Armenian state is no larger than Russia's Lake Baikal, its landscapes are remarkably diverse, including semi-desert, juniper sparse forest, broadleaf forest, mountain steppe, and sub-alpine meadow habitats. These habitats harbor many rare species, such as the Persian leopard, which stealthily prowls Armenia's southern regions. In this section, you will read about the research work of two dedicated Armenian scientists to research and protect this extremely rare and elusive cat. We also offer an article on work conducted under the Birds of Armenia Project to investigate the majestic raptors circling the skies above the forests on Armenia's highest peak, Mt. Aragats.

The upcoming pages also present some of the pressing conservation challenges facing the country. You will read about Armenia's beloved and beleaguered Lake Sevan, and the long-lasting mark that unsustainable nature use policies during the Soviet era have left on this vast alpine lake. We also report on the deforestation threat, which emerged most noticeably after the dissolution of the Soviet Union, when acute economic and energy crises plagued the newly independent Republic of Armenia.

A view from Armenia's highest peak, Mt. Aragats. *Photo by C. Santore.*

In our coverage of Armenia, we will also share with you a number of heartening conservation success stories, such as the reforestation and poverty reduction work of the Armenia Tree Project and a victorious campaign by Armenian and international activists to reroute a highway planned to cross one of the country's protected nature areas.

This reporting is part of our continuing commitment to cover conservation-related issues in the Caucasus region. It was made possible by the Critical Ecosystem Partnership Fund. For more information about this funding partnership between Conservation International (CI), the Global Environment Facility (GEF), the Government of Japan, the MacArthur Foundation, and the World Bank, please see: *http://www.cepf.net.*

Landscapes and Biodiversity in Armenia: An Overview

By ***Gohar Oganezova***

Armenia is an ancient land, and although its name appeared on maps belonging to the Egyptian pharaohs, many people in the modern world are unfamiliar with the nation's whereabouts. Armenia's territory has decreased significantly since antiquity and now just ten percent of its historic lands fall within the borders of the contemporary Republic of Armenia. Situated on approximately 30,000 square kilometers in the southwestern Transcaucasus region, Armenia is a small spot on the globe, but one well worth knowing.

Armenia is not only the smallest of the three republics in the southern Caucasus region (the others being Georgia and Azerbaijan), but it is also the most mountainous. It occupies the northern part of the Armenian Plateau and is located almost entirely at elevations of at least 500 meters above sea level. The highest point in the republic is Mt. Aragats (4,095 meters above sea level). The region's largest alpine lake, Lake Sevan, is located in Armenia. Also found here are the sources of numerous rivers in the Kura-Araks watershed, which encompasses 200,000 square kilometers in Armenia, Azerbaijan, Georgia, and parts of Turkey and Iran.

The country harbors a surprising wealth of flora and fauna. In Armenia, 5,455 plant species[1] are registered, of which 3,015 species are flowering plants. Diverse vegetation communities are also characteristic for the republic. Steppe, meadow, mountain forests, different types of open woodlands, alpine and sub-alpine communities, swamps, semi-deserts, and islands of desert are among the many communities that comprise Armenia's surprising mosaic of vegetation cover.

Map by M. Dubinin.

This diversity can be attributed to the country's complex mountain relief. Armenia's mountains have varied origins. Some appeared as a result of tectonic shifts and others from the activity of numerous volcanoes. The country's mountain chains run north-south and east-west and differ from one another in their moisture regimes. Some, such as the Murguz Chain in northeastern Armenia, have abundant springs and streams and receive much precipitation. Others, such as Mt. Arailer, in the central part of the country, are almost completely devoid of springs and receive very little precipitation.

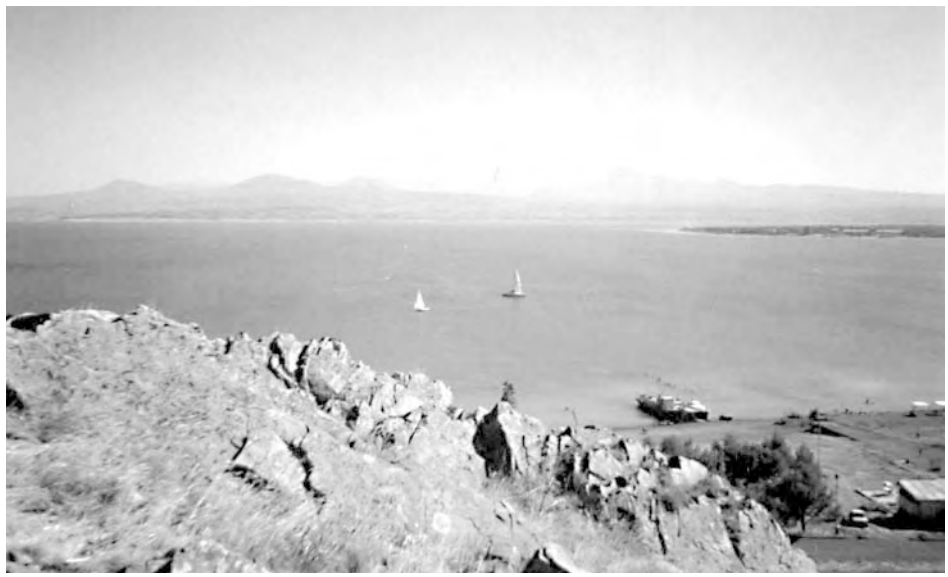
It is also here in Armenia that two different floristic complexes meet: the moisture-loving Caucasian mesophytic floristic complex and the Armenian-Iranian floristic complex, which is adapted to arid climates. The country is also regarded as one of the world's ancient cradles of agrobiodiversity. Numerous local, and for that reason

The Ararat Valley at dusk. Mt. Ararat is a 5,165-meter-tall snow-capped dormant volcanic cone located in northeastern Turkey. The peak, which was part of Armenian territory until 1915 when it fell to the Turks, remains a national symbol of Armenia. *Photo by K. Avanyan.*

especially precious, types of apricots, peaches, apples, pears, walnuts, grains, and other cultivated plants are concentrated here. Diverse populations of these crop plants' wild relatives are also encountered here and they comprise an important part of the republic's ecosystems.

Armenia's mountainous terrain and its various vegetation communities create habitat for a diverse group of animal species. Birds occupy a special place among local fauna and avifauna here is extremely rich. Located along the global flyway, Armenia is an intersection, where Asian and European bird species approach and co-exist with one another. In total, 349 bird species are registered in the republic. The Dalmatian pelican (*Pelecanus crispus*) and marbled teal (*Marmaronetta angustirostris*) are listed in both the Red Data Book of Armenia and on the World Conservation Union (IUCN) Red List of Threatened Species, while other bird species encountered in Armenia such as the ferruginous duck (*Aythya nytoca*), lesser kestrel (*Falco naumanni*), and corn crake (*Crex crex*) are included on the IUCN Red List only. Richer still is the country's insect fauna, which is represented by more than 14,900 species.

Reptiles and mammals are far fewer, 52 and 83 species, respectively. Of the reptiles, many are endemic, including the white-bellied lizard (*Lacerta unisexualis*), the Armenian lizard (*L. armeniaca*), and Darevsky's viper (*Vipera darevskii*). Threatened reptiles include the Caucasian rat snake (*Elaphe hohenackeri*); the lidless skink (*Ablepharus cernovi*); and the Armenian viper (*Vipera raddei*) and racerunner (*Eremias arguta transcaucasica*), both of which are also endemics. Among Armenia's 83 mammals, six endemic species or subspecies are registered: the northern mole vole (*Ellobius lutescens*), Vigradov's jird (*Meriones vinogradovi*), the jeroboa (*Allactaga williamsi*), the Caucasian birch mouse (*Sicista caucasica*), the Armenian mouflon (*Ovis ammon gmelin*), and a sub-species of Natterer's bat (*Myotis nattereri araxenus*). Endangered mammals, listed both in Armenia's Red Data Book and the Red Data Book of the former Soviet Union, include the Mediterranean horseshoe bat (*Rhinolophus euryale*), Mehely's horseshoe bat (*R. mehelyi*), the bezoar goat (*Capra aegagrus aegagrus*), and the Armenian mouflon.



Lake Sevan. *Photo by G. Oganezova.*

Yet, much of Armenia's outstanding biodiversity is under significant threat. The reasons for this are similar to the causes behind biodiversity loss in other parts of the world. Simply, global climate change and human activities are negatively affecting the natural environment. In Armenia, anthropogenic impacts such as intensive agricultural and livestock development and urban and industrial development, are exacerbated by the country's relatively high population density (400-500 people per square kilometer), as well as by the paucity of arable land (just 18% of the total land area), much of which is also threatened by desertification. Nearly 80% of Armenia's land is characterized by some degree of degradation.

For Armenia, the last fifteen years have been very difficult. Socio-economic and political crises have been abundant and this has only increased human pressures on the environment. In Armenia, the use of all natural resources, including biological resources, has been uncontrolled to the point of being catastrophic. The country's forest ecosystems have suffered in particular, as illegal logging has reached disastrous levels. Specialists predict that if the current rate of logging persists, Armenia will be stripped of its forests in a matter of several decades. And with the forests, so too would disappear many of the country's animal species.

Lake Sevan, which is both Armenia's largest lake and the largest supply of freshwater in the region, also faces a very serious threat. Since the 1930s, when the waters of this oligotrophic lake were first used to support the country's industrial, agricultural, and energy sectors, the lake's level has plunged by almost twenty meters. As a result, its temperature regime has changed. As the water mass began to warm, algal blooms occurred, meaning that algae in the lake increased dramatically and became visible to the eye. The Sevan trout (*Salmo ishkan*), an endemic fish species that had previously been represented by four subspecies, diminished drastically, while two sub-species of less valuable whitefish (*Coregonus lavaretus*) that were introduced to the lake in the 1920s, thrived.

In recent years, though, use of the lake's water has been scaled back; now it is used for irrigation only. In addition, a tunnel that diverts water to the lake from the nearby Arpa River was repaired and again put into use. These interventions have not only stopped the decrease in the level of the lake, but also succeeded in increasing it by

A typical mountain forest landscape in northern Armenia. *Photo by G. Oganezova.*

two meters. This positive development has buoyed hopes that the lake's natural balance might be restored and that Sevan, Armenia's great jewel, will be saved.

The Armenian government is making efforts to improve the ecological situation in the country. Most of the state's plans are related to obligations under various international conventions, including the United Nations (UN) Conventions to Combat Desertification, on Climate Change, and on Biological Diversity, and the Council of Europe's European Landscape Convention. At present, a national strategy for the sustainable management of forest resources is being developed. The strategy proposes many new approaches. Among other innovations, it envisions forest certification and the partial transfer of forest ownership, such as by leasing forest resources or transferring ownership of forests to nearby villages.

In addition, the Armenian government approved a national strategy and action plan to develop the country's specially protected areas. According to this program, the number of specially protected areas will increase almost two-fold; that is, the percentage of the country's territory under various protection regimes will grow from ten to nearly twenty percent. The implementation of this program may unify Armenia's specially protected areas within one network, which would be connected by migration corridors. The prospects of uniting Armenia's protected areas network with a regional network of protected areas, which is only just now being planned, are also very real.

Despite these positive steps, most of the ecological problems in Armenia still remain unresolved. Many of the issues are not actively being addressed—plans to resolve them exist only on paper—while some issues are not even being reviewed right now.

Armenia is going through a challenging period in its long history. The country is making a serious effort to build a civilized and democratic state, but for now, real results are still a long way off. Corruption and shortcomings in management on all levels of government are thwarting progress. The republic's non-governmental organizations often collaborate with governmental bodies, participate in various programs, and initiate activities to resolve ecological problems. But, to a large extent, these organizations' activities remain ineffective. The country's NGOs are not always in step with one another and seldom collaborate. In addition, most of the public, which is still largely impoverished, is not involved in the environmental movement.

But hope is not lost. We remain firm in our belief that Armenia will be incorporated into global processes, and that the country will long occupy a place on the map of the world, not just as an intersection of flyways, but also ecotourism routes. Come, visit us in Armenia. Come to our mountains. This ancient land has endured many misfortunes and hardships and should withstand these latest challenges.

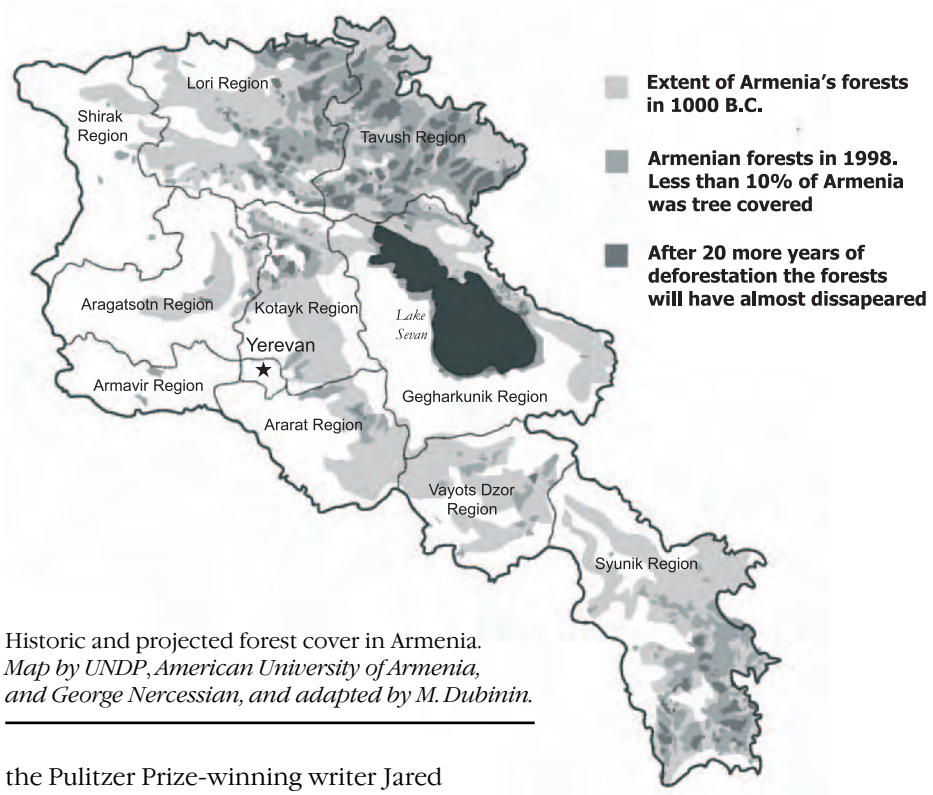
***Gohar Oganezova**, a doctor of biological science, is Vice President of the Armenian Botanical Society and the Head Specialist of the Institute of Botany, within the National Academy of Sciences of the Republic of Armenia.*

[1] All numeric data were taken from "The National Action Plan to Combat Desertification in Armenia" (Armenia 2000) and "Desertification in Armenia and Measures to Combat it" (G.G. Oganezova, "Conference on Desertification," Caucasus Regional Environmental Center, Tbilisi, 2002).

Armenia Tree Project Beginning to Fight Deforestation Threat

*By **Jeff Masarjian** and **Jason Sobigian***

At the turn of the twentieth century, an estimated twenty-five percent of Armenia was covered by trees. According to a Ministry of Nature Protection report on biodiversity, forests now cover approximately just ten percent of the land surface of Armenia, while others have reported forest cover at only eight percent. Because of the low level of forest cover, the World Bank has estimated that eighty percent of Armenia is at risk of becoming desert. At the current rate of deforestation, all of Armenia's forests may be gone in as little as twenty years, leading to irreversible environmental damage and loss of a critical component of Armenia's infrastructure.



Historic and projected forest cover in Armenia. *Map by UNDP, American University of Armenia, and George Nercessian, and adapted by M. Dubinin.*

The loss of forests in Armenia, brought about by a lack of alternate fuel sources, legal and illegal cutting and export of wood, and improper management of this renewable resource, is having a dramatic impact on the environment. A primary cause of deforestation is poverty and unemployment. Without other sources of income, people inevitably turn to unsustainable harvesting of forest resources. In urban centers such as Yerevan, residents desperate for fuel cut between 2–3 million trees during the energy shortages of the early 1990s, often leaving only the stumps remaining. These barren lots were once protective hillsides circling urban areas as a vital barrier to pollution and dust, and once beautiful parks were turned into ecological graveyards devoid of greenery.

Forests perform important environmental and socioeconomic functions, but when they disappear, inevitable and long-term consequences result, such as increased erosion, flooding, and landslides, drying of the local climate and loss of water supply, reduction of topsoil fertility causing lower crop yields, loss of plant and animal biodiversity, and severe air pollution. As the Pulitzer Prize-winning writer Jared Diamond has noted in his recent book, "Collapse: How Societies Choose to Fail or Succeed," deforestation, soil erosion, and water management problems all result in less food for populations. Such problems have also been exacerbated throughout history by droughts, which have been partly caused by humans through deforestation, notes Diamond.

To help address this crisis, Armenian-American philanthropist Carolyn Mugar founded Armenia Tree Project (ATP) in 1994. During the winter of 1992 while visiting Armenia, Ms. Mugar saw that families desperate to heat their homes were burning their own furniture, and massive numbers of trees were being cut for fuel. In order to research and develop a plan for an organization that would work towards preventing further deforestation in Armenia, she hired a local staff in Armenia, and ATP's efforts were officially launched with a tree-planting at the Nork Senior Center in Yerevan in 1994. In the US, a small staff was hired to do fundraising and public relations with the national and international community.

Over the course of eight years, thousands of trees were planted in communities throughout the country as part of the Sponsor-A-Tree program funded by thousands of individual Diasporan donors, two state-of-the-art nurseries were opened in Karin and Khachpar (in the Aragatsotn Region), several forest rejuvenation programs were implemented in the Tsitsernakaberd Genocide Memorial Park (in the Yerevan Region) and elsewhere, and a database of Diasporan donors was created.

ATP has expanded over the past several years, and as a result, the organization has revisited its methodology to ensure that programs and objectives work hand in hand toward accomplishing the interrelated goals of tree planting, poverty reduction, and environmental education and advocacy.

Since 2001, ATP has begun to redirect its goals towards more aggressive, all-encompassing reforestation efforts, aimed at rehabilitating devastated rural and urban areas and providing

Armenian citizens with the resources as well as incentive for redeveloping their immediate environment. Specifically, programs have been launched in Aygut (in the Gegharkounik Region) in the vicinity of Lake Sevan and in Vanadzor, the third largest city in Armenia, located in the Lori region. Since 1994, over 600,000 trees have been planted and restored, and hundreds of jobs have been created for Armenians in seasonal tree-regeneration programs. For the coming year, ATP has been searching for ways to expand its output and begin planting trees at an even larger scale to combat the threat of deforestation in Armenia. In addition to the 50,000-60,000 trees outplanted each year from the organization's traditional nurseries in Aygut, ATP has 200,000 seedlings growing for reforestation purposes, and at its current nursery site in Vanadzor there are more than 300,000 trees growing.

ATP's tree planting strategy has three components. The first is production of trees on an increasingly larger scale at the state-of-the-art nurseries at Karin and Khachpar, at the reforestation nursery in Vanadzor, and in backyard reforestation nurseries in the rural Getik River Valley. Second is planting these trees in partnership with residents of urban and rural communities at public sites, rural backyards, and areas targeted for mountainous reforestation. And third is coppicing, whereby the unproductive shoots that sprout from a stump are trimmed by teams of workers in order to grow a new, vital tree with an intact root system. ATP's targets for 2005 have been to extend community tree planting activities to local villages where backyards and common areas will receive new trees, rejuvenate public areas including the Botanical Gardens and Komitas Park (both in the Yerevan Region), and to reforest a large tract of land in Aygut.

As highlighted by international foresters such as Nobel Peace Prize winner Wangari Maathai of the Green Belt Movement in Kenya, poverty is one of the great enemies of forests. Historically, people with no other viable source of income or energy have destroyed the forests that were their lifelines, due to non-sustainable harvesting. Therefore, successful reforestation must be combined with locally based poverty reduction efforts in order to protect existing resources and investments in the future. In both urban and rural settings, poverty reduction and community development activities reduce the pressure on remaining forests.

After assessing the severity of tree cutting and how it affected the vitality and sustainability of citizens in rural, impoverished areas, ATP laid out a strategy to reforest the Getik River Valley, an area located just north of Lake Sevan. ATP initiated a pilot project that was designed to reforest degraded lands while generating income through micro-enterprise development in villages inhabited by Armenian refugees relocated from Azerbaijan. In 2004, ATP taught 17 families in the village of Aygut techniques for growing tree seedlings in backyard nursery plots.

With ATP's technical support these micro-enterprises produced 20,000 seedlings, and ATP paid participants for each seedling transplanted into the forest. This year, ATP has expanded this project to include 200 families who will be growing 200,000 seedlings. The development of these "micro-enterprise" nurseries not only provides for larger scale reforestation efforts, but also significantly increases each participant's annual income.

While ATP's primary focus is reforestation, it has also encouraged the involvement of other agencies in providing a broad range of services to the Getik River Valley. Organizations including Heifer International, Project Harmony, World Vision, Armenian Eye Care Project, UNDP, USDA-MAP, and Weyerhaeuser Family Foundation are all involved in new projects. The ultimate goal is to revitalize the socioeconomic and ecological conditions of the thirteen villages throughout the Getik River Valley.

ATP is also developing environmental education as a core program area in order to prepare the nation's youth for becoming the next generation of environmental stewards. By actively engaging youth in a process to better under-

The efforts of the Armenia Tree Project helped transform the Khor Virap Monastery in the Ararat Valley. *Photo courtesy of Armenia Tree Project.*

Members of the environmental youth club established by Armenia Tree Project (ATP) working in the school fruit orchard in the village of Aygut. *Photo by G. Lachinian.*

stand and appreciate the value of a healthy and sustainable environment, ATP seeks to protect the trees planted today from future exploitation.

ATP has developed an environmental curriculum called "Plant an Idea, Plant a Tree." ATP staff and Peace Corps volunteers are field-testing the environmental curriculum on students of all levels at the Ohanian Center, at the ATP nursery in Karin nursery, and in villages. They are presenting the various lessons to students and providing ATP feedback on the quality of information provided and its effectiveness. The eventual goal is to present the curriculum to the Ministry of Education for implementation in schools throughout Armenia, but it is still in an early stage and we anticipate it will be some time before that is done. In addition, all of the reforestation work in rural villages has a key educational component focusing on youth. An Environmental Education Center at the Karin nursery is a state-of-the-art facility in which students from secondary schools and colleges, as well as professionals in the field, attend trainings and seminars on trees and the environment.

Advocating for the development of a sustainable forest policy in Armenia and environmental laws that provide for natural resource protection is most effectively accomplished with a coalition of like-minded individuals and groups, and ATP has been a proponent of working in collaboration with partners to promote an environmental ethic at all levels of society.

Just this year, ATP worked with others to advocate for an alternative to a proposed roadway through the middle of the Shikahogh Nature Reserve in the southern part of the country. In May when the construction project became known to the public, ATP founder Carolyn Mugar sent a letter to the President and other high ranking officials urging them to hold public hearings and choose an alternate route. ATP staff traveled to the site on fact-finding missions with scientific experts and journalists, and Ms. Mugar traveled from the U.S. on such a visit in June. The ATP outreach office issued several press releases and action alerts via email to constituents about the endangered reserve, and commissioned a documentary film on the Shikahogh Reserve, funded in partnership with Armenian Forests NGO and World Wildlife Fund. The coalition of individuals and representatives of more than forty local and international NGOs and scientific organizations is cautiously optimistic that a decision to bypass Shikahogh will be implemented. During a June 17 public forum at the American University of Armenia, the Minister of Transportation announced that the government is choosing a new route that bypasses the reserve, and the Prime Minister appointed a commission to study the issue.

In its first 10 years of operation in Armenia, ATP has developed a significant range of knowledge and experiences. As it builds on successes and failures by moving toward large-scale reforestation efforts, ATP has begun the process of appealing to international agencies and organizations for larger sources of funding. In addition, ATP has begun to focus its attention on some of the challenges of reforestation in Armenia. These include the need to work in cooperation with Armenian governmental agencies and local communities for securing access to land for reforestation, finding adequate supplies of local seed sources since most of the healthy trees in the country have already been harvested, and meeting the organization's stringent site selection criteria. Sites are chosen based on a number of factors, including access to adequate water, protection from livestock grazing, and adequate protection measures against fire and especially poaching and cutting.

After operating in Armenia for over a decade now, it has become apparent that the constraints on reforestation are not merely financial. ATP is dedicated to working with communities, organizations, governments, and individuals toward the goal of assisting the Armenian people in using trees to improve their standard of living and protect the environment, guided by the need to promote self-sufficiency, aid those with the fewest resources first, and conserve the indigenous ecosystem.

Jeff Masarjian *is Executive Director and* ***Jason Sobigian*** *is Deputy Director of Armenia Tree Project. For additional information about the program and the problem of deforestation in Armenia, visit the Web site www.armeniatree.org.*

Lake Sevan: Lessons in Nature Use

By ***Rafael Hovhannisyan, Zhanna Mkrtchyan, Robert Hovhannisyan****, and* ***Varduhi Grigoryan***

Among the former Soviet states, the Republic of Armenia is one of the most arid. The vast majority of the hundred or so lakes and reservoirs dotting the countryside are small, generally occupying no more than a few dozen hectares and averaging less than 10 meters in depth. Lake Sevan, in the northeastern part of Armenia, is an exception. This vast alpine lake, located in the Caucasus Mountains at an elevation of 1,916 meters above sea level, holds 58.5 cubic kilometers of water and its surface area spans nearly 1,250 square kilometers. Lake Sevan is not only the largest freshwater body in Armenia, but also in the entire Caucasus Region.

The energy of Lake Sevan's waters have brought power to many cities and villages in Armenia and helped drive industrialization of the country. The lake also brought life to the sultry deserts of the Ararat Valley by enabling the development of agricultural activities. Resorts built along the shores of this picturesque lake have accommodated tourists from around the world. Lake Sevan has always been and will always be exceptionally important for Armenia's economy. For this reason the protection and sustainable use of its waters is a task of utmost national importance.

Lake Sevan has long attracted the interest and attention of researchers and planners hoping find an effective means to utilize the lake's water and fish resources. Theoretical work toward this end dates as far back as the mid-1800s, when the prospects of using the lake's water to irrigate land on the left bank of the Radzan River were first explored. The drive to develop Lake Sevan's water resources intensified during the first three decades of the twentieth century, after researchers had determined that under natural conditions, twenty times more water evaporated from the lake than flowed into the Radzan River, the lake's only outlet. They further concluded that lowering the level of Lake Sevan and decreasing its surface area would reduce the loss of water through evaporation, thus making more water available for release and use.

Map by M. Dubinin.

This conclusion served as the foundation of a project, developed in 1931, to decrease the lake's water level by fifty meters over fifty years, or by 1,025 million cubic meters annually—650 million cubic meters for hydropower and 375 million cubic meters for irrigation. According to the plan, the natural outflow of water from the lake through the Radzan River would increase by fourteen times. These water releases were initiated both to irrigate the Ararat Plain and outlying suburban regions (totaling 130,000 hectares in area), as well as to produce hydropower at the Sevan-Razdan "power cascade," a group of hydropower stations constructed on the Razdan River. At the same time, it was expected that the land exposed as the lake's level decreased could be used to sow crops.

Work to lower the water level of the lake according to this plan began in 1933. Within twenty-five years, the water level of the lake had already fallen by almost fourteen meters and it became clear that the plan to decrease the lake's water level by fifty meters needed to be re-examined. Reasons for this were manifold. Calculations suggested that freshwater sources in Armenia that could be used to expand the country's supply of drinking, agricultural, and industrial water would be exhausted by the end of the twentieth century. Given this, Lake Sevan would remain Armenia's only guaranteed source of water. Also, the decrease in water up to that point has exposed close to 200 square kilometers of silty and sandy-silty soil on the lake's shore; however, these areas proved unsuitable for agricultural use and are now affected by intensive erosion processes. In addition, it was determined that Lake Sevan did not produce adequate energy to support the long-term development of the Armenian economy. New hydro-electric and atomic energy stations were built in Armenia and this created alternative opportunities to generate energy without causing such significant damage to nature.

Lake Sevan. *Photo by C. Santore.*

Considering the aforementioned developments, the initial project to use the lake's waters was re-examined and planners decided to take steps to preserve the water in Lake Sevan closer to its natural level. In order to stabilize and subsequently increase the lake's water level, planners decided in 1961 to divert part of the flow (250

Changes in Lake Sevan during the Course of its Drainage

Parameter	Unit of Measure	1930-1935	1978-1982	1985-1990	1995-1999	2001-2003
Deviation from the natural level of the lake	Meters	0.0	-18.8	-17.6	-19.8	-20.2
Height above sea level	Meters	1,915.6	1,896.8	1,898.0	1,895.8	1,895.4
Surface area	Kilometers	1,416	1,249	1,259	1,246	1,242
Maximum depth	Meters	98.6	79.8	81.0	78.8	78.4
Volume of water	Kilometers	58.5	35.3	37.4	34.0	33.4
Water transparency	Meters	14.3	3.0	5.6	2.1	3.0
Bacteria-plankton	10^6 cells/milliliter	0.4	1.80	0.78	2.1	3.6
Phytoplankton Biomass	Grams/meter^3	0.32	3.5	2.1	5.2	6.4
Primary Production	kilojoules/ meter^2/year	4,180	28,600	14,630	29,260	N/A
Macrophytes	Tons 10^3/year	900.0	8.05	37.3	12.0	42.0
Zooplankton	Grams/meter^3	0.45	1.80	0.64	0.70	0.73
Fish	tons/year	1000	3070	2200	800	560

million cubic meters per year) of the Arpa River, which flows from the Vadrenis Mountain Massif, into Lake Sevan through 48-kilometer-long tunnel. Construction on the Arpa-Sevan tunnel began in 1962 and continued for almost twenty years. All this time, the level of the lake continued to fall, and by 1980, the decrease had reached 18.5 meters, the lake's surface area had decreased by 12.2%, and its volume by 42.2%.

The Arpa-Sevan tunnel was put into use in 1982. The lake's water level began to stabilize shortly thereafter and subsequently increased by ninety centimeters. To further increase the rise in the lake's level, planners devised another tunnel project, the 21.6 kilometer-long Vorotan-Arpa tunnel. This second tunnel was planned to transfer 165 million cubic meters of water a year from the Vorotan River to the Kechut Reservoir and from there through the Arpa-Sevan tunnel to Lake Sevan. Construction and repair work of the Vorotan-Arpa tunnel continues to this day.

Although the net inflow of water into Lake Sevan was positive throughout much of the 1980s, high releases again took place during the years 1990-1995, when the country experienced an energy crisis, and the water level of the lake decreased again, this time by two meters. Although the net inflow of water reversed again after 1995, Lake Sevan remains extremely unstable to this day.

And what effects have seventy years of human tinkering had on the lake and its ecosystem? The lake lost more than 10% of its surface area and more than 40% of its volume. The lake's cold, benthic layer of water also disappeared. This zone, located immediately above the bottom of the lake, had the lake's highest concentration and content of oxygen. The cold water also isolated a diffusion of organic material that had accumulated on the upper layers of the bottom of the lake over centuries; it further regulated the biogeochemical cycling of matter. Due to these changes, the average annual temperature of the lake's water increased by almost two degrees Celsius, while its thermal capacity (the accumulation of the sun's energy) decreased nearly 1.5 times, thus leading to frequent freezing. In addition, the lake's horizontal and vertical water current intensified and this increased by several times the quantity of suspended and dissolved organic matter in the lake, which had previously been isolated in the benthic cold water zone.

These phenomena, in turn, negatively impacted the lake's ecosystem in four general aspects. The increase by more than five times of suspended and dissolved organic matter decreased the transparency of the lake's water, which affected photochemical and biological processes in the lake. The oxidation of benthic organic matter, which entered into the lake's biochemical cycle, caused the oxygen concentration in the lake to decrease by more than 50%, while it neared zero in the benthic layers. In addition, the concentration of nutrients derived from human activities, particularly nitrogen, increased by thirty times, and this stimulated massive growth and reproduction of algae. Finally, the diffusion, sedimentation, and sediment burial processes of various organic materials were destroyed, as was the redox process in the benthic zone. All of these changes caused significant biological reorganization in the trophic chains of the lake's ecosystem.

For instance, due to the increase in the quantity of nitrogen in the lake, as well as the significant loss in the biomass of higher aquatic vegetation (from 900,000 tons to 8,000 tons), the biomass of single-celled algae increased almost twenty-fold. This, in turn, affected species and communities of aquatic bacteria, multi-celled invertebrates, and fish.

Many of Lake Sevan's fish communities were also profoundly affected by

A peninsula extends out into Lake Sevan. Once just a chain of small islands, the peninsula formed after the lake's water level decreased. *Photo courtesy of WWF.*

the loss of spawning habitat—many littoral zone breeding grounds dried up as the lake's level fell—as well as by unregulated fishing. Two lake-spawning sub-species of the Sevan trout (*Salmo ischchan*), an endemic, and the only salmonid in Lake Sevan, died out. The trout's two river-spawning subspecies hover on the verge of extinction, as does the Gokcha barbel (*Barbus goktschaicus*). In addition, the population of the Sevan khramulya (*Varicorhinus capoeta sevangi*) continues to decrease.

Numerous other species of flora and fauna have declined or altogether disappeared due to the decreased water level of the lake and its associated consequences. For waterfowl, Lake Sevan serves as an important inland breeding area, as well as a resting and wintering site during migration. However, because of the artificial water-level decrease and the drainage of close to 10,000 hectares of swamp land, the number of bird species inhabiting the lakeshore area has sharply fallen.

It is important to note that Lake Sevan's current ecological situation was caused not only by anthropogenic restructuring of the lake's hydrological processes, but also by the intensification of industrial, agricultural, and other economic activities in the lake's catchment area. Biogenic elements, pollutants, and nutrients (primarily nitrogen and phosphorous) from fertilizers have entered into the lake's ecosystem. In addition, intensive logging and the construction of numerous roads and recreational areas increased erosion in the lake's catchment area.

Delicate flowers adorn the shores of Armenia's largest lake. *Photo courtesy of WWF.*

Armenia's nature conservation and scientific communities, as well as its governmental structures, have been working to save the lake. Work is being carried out to increase the water level of Lake Sevan and to stop eutrophication. Agricultural activity in the catchment basin of Lake Sevan is being regulated and work to decrease anthropogenic nitrogen and phosphorous loading into the lake from its catchment basin is being carried out. In addition, work to improve the sanitary-toxicological status of Lake Sevan and its shore area is being implemented. Hydrological scientific research work also continues.

In 2001, the National Meeting of the Republic of Armenia adopted the "Law on Sevan;" this piece of legislation aims to help improve the ecosystem of Lake Sevan, the natural landscapes of its catchment area, and the watersheds of nearby rivers. The law established criteria for using Lake Sevan's natural resources and allowable limits of change in its water quality. Nevertheless, there are still many unresolved problems and the situation in the Sevan Basin remains very alarming.

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Sevan National Park

Sevan National Park, the only national park in Armenia, was established in 1978 to protect Lake Sevan and surrounding areas. Including its buffer zones, the park protects 150,100 hectares, 24,800 hectares of which are on dry land. The park falls within the jurisdiction of Armenia's Ministry of Nature Protection and is managed as a research center that monitors the lake's ecosystems and undertakes various conservation measures, including the regulation of use and tourism, the protection of historical and cultural monuments, and licensed fishing. The park has a system of zoning which includes a core (reserve) zone, a recreation zone, and a zone for economic use. Protection efforts are focused mainly on rare and endemic species of the lake and surrounding habitats.

Compiled with materials from the Ministry of Nature Protection of Armenia, available online at *http://enrin.grida.no/biodiv/biodiv/national/armenia/proarea/snpv.htm*.

A Victory for Shikahogh Reserve

By ***Inga Zarafian***

"Scorching land:" this how the name of the unique strict nature reserve in southern Armenia, Shikahogh Reserve, translates from Armenian. The reserve's geographic location has given rise to the uncommon diversity of its flora and fauna. Mountain ridges shield three sides of the reserve from the penetration of cold, harsh winds, while one side is open to the caress of warm, moist air masses from the Caspian Sea. In Shikahogh, landscapes change abruptly, with near-virgin oak forests suddenly giving way to peaceful alpine meadows. More than 1,100 plant species grow in the reserve, among which there is a multitude of endemics and rare species. Animals listed in the International Red Data Book, such as the Armenian mufflon (*Ovis ammon gmelin*) and the bezoar goat (*Capra aegagrus aegagrus*), are encountered here. The Persian leopard (*Panthera pardus saxicolor*), which has begun to resettle in the region, has also been observed here in recent years.

The pristine nature, which the reserve has protected since 1958, remains largely untouched by man. Not even the widespread logging of Armenian forests, which was precipitated by the country's energy crisis in 1992-1996, affected Shikahogh. Loggers were unable to access the Mtnadzor Forest Massif, which covers over one third of the reserve, due to the absence of roads leading to it. In the last year, however, plans to construct a highway between Armenia and Iran brought road construction perilously close to the reserve's borders, threatening Shikahogh's intact forests and the rich flora and fauna communities that inhabit them.

Shikahogh Reserve. *Map by M. Dubinin.*

In late November 2004, the Ministry of Transportation and Communication of the Republic of Armenia approved a project to construct the Kapan-Meghri highway connecting Armenia with its neighbor to the south, Iran. According to this initial project, a seventeen-kilometer-long stretch of road was planned to run through Shikahogh Reserve. A tender among construction companies was hastily carried out. Although many necessary documents, including results from an environmental impact assessment, which may have detailed anticipated impacts and damages, were not submitted, a winner of the tender was named: the "Transproject" Company.

The efforts of Armenian and international activists saved the near virgin forests blanketing Shikahogh Reserve from a destructive plan to route a highway through the protected area. *Photo courtesy of WWF.*

The "Transproject" Company quickly set to work. The firm transported construction equipment and workers to the middle of the proposed road, just ten meters from the nature reserve's border. Here, they were met by ecologists who arrived on the scene to inform them that their actions were illegal, and in violation of several international conventions as well as Armenian legislation, including the law "On Specially Protected Nature Areas." The surprised construction workers defensively assured representatives of the regional State Nature Conservation Inspectorate that they were properly licensed and had official permission. The groups reached an impasse and the situation became more acute by the hour. Bulldozers and tractors were stopped just short of the nature reserve's territory. The situation required immediate and decisive action.

Non-governmental organizations in Armenia took up the cause and launched a campaign to save Shikahogh. Dr. Karen Manvelyan, the Director of the Worldwide Fund for Nature (WWF) Caucasus Programme Office in Armenia, appealed to the Union of Armenian Ecological NGOs with the suggestion that a working group to protect the reserve be established. Thus, on May 3, 2005, "SOS Shikahogh," a coalition of concerned individuals and representatives from more than forty local and international NGOs and scientific organizations, was formed.

Working jointly, the members of this grassroots coalition played a critical role in raising awareness about the threat to Shikahogh. In early May, the Armenian representative of the Caucasus office of WWF appealed to international organizations including the United Nations Development Programme (UNDP), United Nations Environment Programme (UNEP), and the Organization on Security and Cooperation in Europe (OSCE) with the request to come forward in support of the reserve. At the same time, the Union of Armenian Ecological NGOs appealed to high-ranking Armenian officials, including the country's President, Prime Minister, Speaker of Parliament, and General Prosecutor, with the demand that the illegal construction be stopped.

Members of the coalition also organized events designed to attract broad public attention to the matter. On May 27, for instance, environmental NGOs organized a protest at the Ministry of Transport and Communication, while on June 17, the "SOS" Group staged a public hearing about the highway construction, which was held at the American University of Armenia.

Another important facet of the work of the "SOS Shikahogh" group was in gathering and disseminating information from the front line. Independent experts from the coalition traveled to the site of road construction near the reserve on June 1 to evaluate the situation and assess presumed future damages, in the event that construction were to continue into the reserve's territory. The independent experts estimated that the cost of the damage to the reserve could reach as high as twelve million dollars. About a week and a half later, another delegation of independent experts and representatives of NGOs and the media traveled to the Syuink region, where the reserve is located, to further investigate the situation on the ground. The NGO "Armenian Forests" subsequently organized a press conference on the results of the trip to Shikahogh.

The endangered Armenian mufflon (*Ovis ammon gmelin*)inhabits rough, rocky, mountainous terrain in Skikahogh Reserve. *Photo by H. Ghazaryan.*

Advocacy for the Shikahogh Reserve came not just from within Armenia. The Armenian Diaspora joined the effort as well. On May 25, the Armenian Assembly of America addressed an open letter about the necessity of protecting Shikahogh to the President of the Armenian Republic, Robert Kocharian. On June 14, the organization Armenia Tree Project issued an action alert asking Diaspora Armenians to communicate their concerns to President Kocharian via an electronic letter forwarded to Armenian Ambassador to the U.S. Tatoul Markarian. More than 700 people participated in this campaign.

The international conservation community also expressed its concern about the threat to Shikahogh. For instance, the acting director of the Critical Ecosystem Partnership Fund (CEPF) Dan Martin and the CEPF Grant Manager for the Caucasus Hotspot Christopher Holtz traveled to Armenia and discussed the issue during a meeting with the Minister of Nature Protection of the Republic of Armenia, Vardan Aivazyan, as well as at a press conference.

Shikahogh Reserve protects important habitat for another endangered species, the bezoar goat *(Capra aegargrus aegargrus). Photo by H. Ghazaryan.*

Finally, after almost two months of intensive campaigning by Armenian and international NGOs and other concerned activists, the government of the Armenian Republic adopted the decision on June 29, 2005, to construct the road around, rather than through, the nature reserve. All those who fought to save Shikahogh wonder if this decision is indeed a victory, or merely a temporary respite. True, the construction workers relocated their equipment to another part of the road. True, they have not yet violated the nature reserve. But Armenian NGOs are already familiar with the workings of those who are motivated more by short-term profit than by concern for the future of the environment. For this reason, the members of "SOS Shikahogh" continue to closely monitor the situation.

Inga Zarafian *is the President of the Armenian NGO, Ecolur. Ecolur is widely known in Armenia for its environmental activities. The organization is establishing a journalists' network for distributing information about conservation-related issues in the country.*

Researching Forest Raptors on Armenia's Highest Peak

By ***Haik Harutunyan, Maro Kochinyan,*** *and* ***Karen Agababyan***

At 4,090 meters above sea level, Mt. Aragats is Armenia's tallest mountain massif. It is located in the central part of the republic, in Aragatsotn Region, where it is isolated from the rest of the country's mountain ranges. For this reason, the small forest massif that covers the mountain's southern macro-slope is isolated from the rest of Armenia's forests; the nearest forest on Mt. Ara is located ten kilometers away. The forest on Mt. Aragats, like other forests in central Armenia, is residual. It is located at an elevation of 2,000-2,200 meters above sea level and occupies an area of about five square kilometers. Although the forest is predominantly comprised of small Caucasian oak trees *(Quercus macranthera)*, other deciduous trees such as wild plum, wild pear, maple, ash, and artificially planted pine trees are occasionally encountered. Sub-alpine steppe with elements of alpine meadows are situated above the forest, while agricultural areas – primarily grain fields – occupy the land below it.

Despite the relatively small size and isolation of the Aragats forest, as well as the diminutive height of its trees, all diurnal raptor species inhabiting Armenia's forests can be found here. During the spring and summer of 2005, a group of staff from the American University of Armenia's Birds of Armenia Project, which included the authors of this article, conducted a series of six expeditions to research the population and species structure of raptors inhabiting the forests of Mt. Aragats.

In their work, the researchers employed two methods. They conducted observations from fixed points to identify raptors' nesting territories and then also searched for the nests. As a result of their work, the researchers fixed the inhabitation of the following species: honey buzzard *(Pernis apivorus)*; black kite *(Milvus migrans)*; short-toed eagle *(Circaetus gallicus)*, which is listed in the Red Book of the Armenian Soviet Socialist Republic of 1987; buzzard *(Buteo buteo);* lesser spotted eagle *(Aquila pomarina);* booted eagle *(Hieraaetus pennatus);* sparrow hawk *(Accipiter nisus);* and northern goshawk *(Accipiter gentiles)*.

Mt. Aragats. *Map by M. Dubinin.*

The researchers found nests belonging to the short-toed eagle, lesser spotted eagle, and buzzard. Based on observations of the birds' behavior during the nesting period, the researchers also surmise that nesting and general ranges for the remaining raptor species occur here. Various types of mating flights, food displays, directed flights with food during the nestling period, and territorial defense reactions suggested nest presence. Researchers did not observe the Eurasian hobby *(Falco subbuteo)* and it is possible that the species is absent from nesting-sites in this forest.

The researchers conducted their observations from three points along the road, from where they could survey the Aragats forest massif in its entirety. From these observation points, the agricultural areas below

Spotlight on the Birds of Armenia Project

The Birds of Armenia Project works to research and protect birds and their biotopes in Armenia. The project was established under the auspices of the American University of Armenia in 1993, upon the initiative of Sarkis Akopian, an American industrialist. The project's first major products were: "A Field Guide to Birds of Armenia," available in both English (M. S. Adamian and D. Klem, Jr., 1997.) and Armenian (M. S. Adamian and D. Klem, Jr., 2000) languages; and the "Handbook of the Birds of Armenia (M. S. Adamian and D. Klem, Jr., 1999). Beginning in 2001, the Birds of Armenia Project expanded its environmental education activities. Starting in 2004, the project began a two-year-long trial course to identify birds in nature. Fifteen students with various specialties and backgrounds participated in the course the first year and in 2005, the course expanded by 70 people. In addition, project specialists are beginning research on the influence of pesticides and heavy metals on indicator species of wetland birds and birds of prey. Working together with nature conservation NGOs and state institutions, the project hopes to preserve Armenia's unique avifauna.

Buzzard *(Buteo buteo)* nestling. *Photo by H. Harutunyan.*

could also be surveyed. Hunting of most of the raptor species – with the exception of sparrow hawk, northern goshawk, and honey buzzard – was observed in these areas numerous times.

Researchers noted several factors of disturbance affecting the raptors inhabiting Mt. Aragats. Their habitat's close proximity to Yerevan, as well as its proximity to road systems, makes this territory an attractive destination for Sunday picnickers. As many as seven to ten groups, each with five to twenty people, may come here on any given Sunday. They leave their litter behind. No one cleans up the territory, so the garbage—plastic bags, bottles, tin cans, foil—just accumulates. The resultant contamination of soil and water is particularly detrimental to birds of prey. They are end links in the food chain and harmful substances accumulate in their bodies and adversely affect their reproductive potential.

In addition, some of the people who visit Mt. Aragats bring with them firearms. Although these people primarily shoot at empty bottles (which is also unpleasant, given the amount of broken glass that remains afterwards) who can guarantee that they are able to resist the temptation of shooting a raptor flying overhead?

Based on their investigation, the researchers see the primary importance of the Mt. Aragats forest to be the high concentration of raptors it supports on a relatively small territory. The raptors here are also often and easily observed. Finally, the forest is regularly visited by people from outlying villages and cities, who are the primary factors of disturbance affecting the raptors. These conditions make the area an ideal point for observing nesting raptors and for carrying out ecological education among the local population. Using raptors as a focal point of ecological education, it would be possible to educate people visiting the Mt. Aragats forest about principles of conduct in nature. In the future, it might also be possible to implement joint activities with the public to clean the territory and protect the birds.

In conclusion, the authors would like to express their gratitude to the Birds of Armenia Project for providing financial support for research work; to A. Asatryan, from the Institute of Botany, National Academy of Sciences of the Republic of Armenia, for consultation; as well as a group of dedicated project volunteers, who actively participated in the investigations. Among them, the authors would like to note: Anna and Arpine Yeghiyan, Siranush Tumanyan, Vilena Bejanyana, Gor Rustamyan, Grigor Janoyan, Levona Rukhkyan, and Ruben Maliyan.

The nest of a lesser spotted eagle *(Aquila pomarina)*, found by researchers in the Mt. Aragats forest. *Photo by K. Agababyan.*

Haik Harutunyan *and* ***Maro Kochinyan*** *are students at Yerevan State University.* ***Karen Agababyan*** *is a Senior Scientist at the American University of Armenia.*

The small forest massif covering the southern macro-slope of Mt. Aragats provides habitat to representatives of all diurnal raptor species found in Armenia. *Photo by H. Harutunyan.*

Changes in the Diversity of Waterbird Species in Select Important Bird Areas in Armenia

By ***Nshan Margarian, Mamikon Ghasabyan,*** *and* ***Luba Balyan***

Under the patronage of BirdLife International, the Armenian Society for the Protection of Birds (ASPB), a local NGO that is working with BirdLife on Armenia's Important Bird Area Program, has worked to designate 18 Important Bird Areas (IBAs) in Armenia for basic monitoring. This monitoring is intended to provide information on the state of the sites and the pressures affecting them. Overall, Armenia's Important Bird Area Program aims to identify and protect a network of sites critical for the long term viability of globally threatened bird species across the range of those species for which the site-based approach is appropriate.

Breeding colonies of the Armenian gull *(Larus armenicus)* are threatened by unsustainable tourism activity in the region of Lake Sevan. © *V. Ananian.*

Of the IBAs designated in Armenia, five encompass wetland sites. Among Armenia's wetland IBAs, three are located in the Ararat Valley and the Sevan Basin: Lake Sevan, the Metsamor River System, and the Armash Fish Farming Ponds.

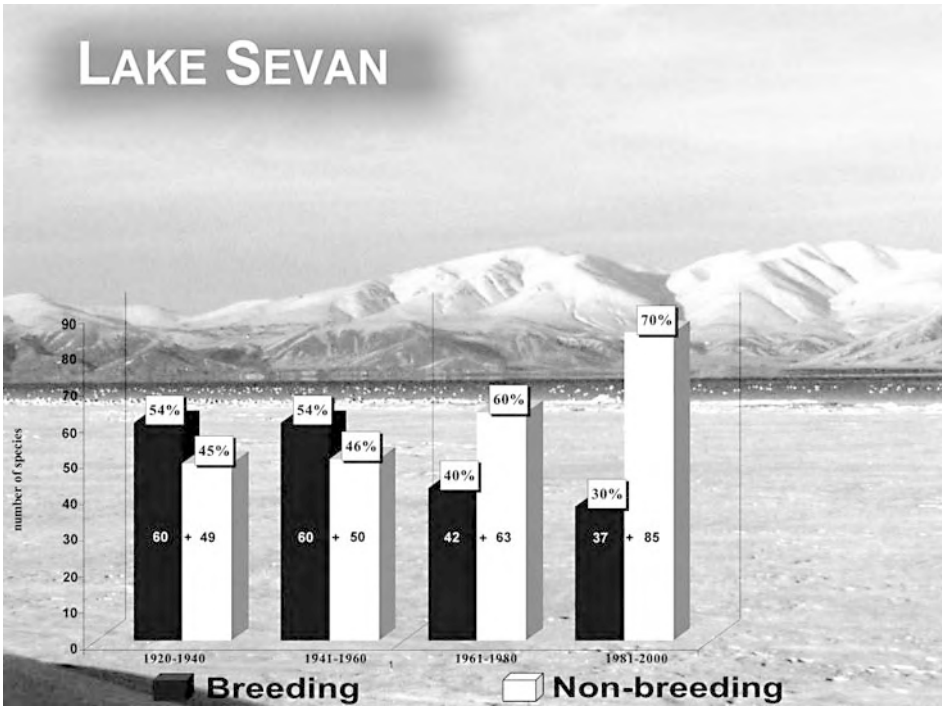
Historically, Lake Sevan, the largest inland freshwater body in the Transcaucasian region, and adjacent Lake Gilli at the southeastern corner of Lake Sevan comprised the primary aquatic habitats for a vast number of breeding and non-breeding waterbird populations. Extensive studies conducted by the researcher Dal in the 1940s suggested that the associated wetlands offered ample food resources and aquatic plants that provided excellent forage sites for both breeders and migrant birds. They determined the overall distribution of waterfowl in the lake basin and established that the overwhelming majority of waterfowl at Sevan concentrated around the former Lake Gilli.

For most of the twentieth century, the Masrik River fed Lake Gilli and associated bogs and marshes. In 1960, however, the government decided to divert the Masrik River and drain Lake Gilli to enhance agriculture in the region. As a result, Lake Gilli disappeared completely and no longer exists as such. Currently, the area is primarily used for low-productive agriculture that brings little profit to local farmers.

Despite its protected status, Lake Sevan has also historically been exposed to various types of human disturbance. Foremost among them is the dramatic twenty-meter decline in its water level. Unauthorized activities including illegal fishing, logging, uncontrolled grazing, and rapid residential expansion are also affecting the lake's ecosystem. Poaching is rampant. The illegal fish catch has even been estimated to surpass the official one. Yet, what most endangers the remaining waterfowl resources is motorized boating, which is a real scourge on the lake. One fishing lodge alone harbors up to fifteen motorized boats that cruise the lake twice daily. This factor of disturbance is present year round and is extremely detrimental to birds such as the white-headed duck *(Oxyura leucocephala)*, ruddy shelduck *(Tadorna ferruginea)*, common goldeneye *(Bucephala clangula)*, and tundra swan *(Cygnus columbianus)* during their wintering and migration periods. Tourism is primarily unsustainable and is practiced in the most environmentally sensitive areas, which poses a great risk to a large breeding colony of the Armenian gull *(Larus armenicus)* during the breeding season.

Armenia: A Hotspot for Avian Diversity

Positioned at the junction of the Western and Eastern Palearctic biogeographic zones, Armenia allows for the exchange of species from the Far North and those from the Far South. Hence, the country's geographical position makes it globally important for establishing links in habitat chains, as well as for the preservation of avian diversity. Thanks to the high diversity of habitats at varying elevations, 352 bird species classified into 18 orders have been observed within this relatively small geographic region, which totals just 29,793 square kilometers in area.



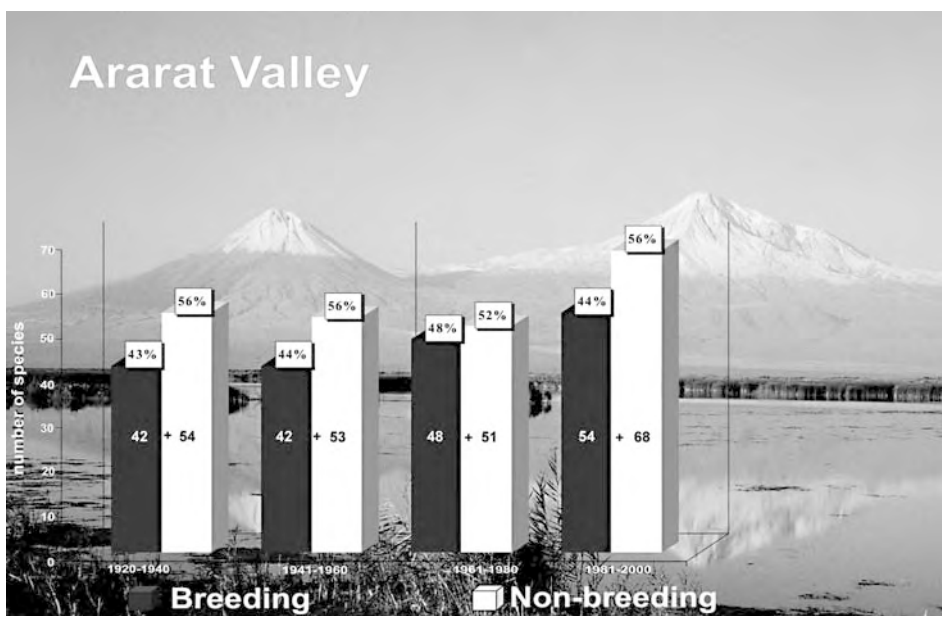
Change in the diversity of waterbird species in the region of Lake Sevan over time. *Graphic provided by the Armenian Society for the Protection of Birds.*

The unsustainable use of Lake Sevan and the drainage of adjacent Lake Gilli and its surrounding wetlands destroyed habitat required for breeding and non-breeding populations of waterbirds such as the great cormorant *(Phalacrocorax carbo)*, red-necked grebe *(Podiceps grisegena)* and caused the contraction of waterfowl resources in the lake basin. Between the periods 1941-1960 and 1981-2000, breeders in Lake Sevan declined from 60 to 37 species, while non-breeders increased from 49 to 85 species.

At the time that Lake Gilli, a life-giving nursery area for breeding waterfowl, was drained in the 1960s, a series of commercial fish farming ponds were constructed in the arid lands of the Ararat Valley in southwestern Armenia. These ponds attracted and now accommodate most of the breeding and non-breeding waterbirds that once occupied Lake Gilli. In other words, they brought about a redistribution of Armenia's waterfowl populations and completely altered the overall pattern of waterfowl distribution in the country. Between the periods 1941-1960 and 1981-2000, breeders in the Ararat Valley increased from 42 to 54 species, while non-breeders rose from 54 to 68 species.

In addition to the large fisheries in the Ararat Valley, an especially important area is the extensive Metsamor River and its adjacent wetlands, which is a natural riverine system that has existed since time immemorial. Winding through the Ararat Valley, the river extends for approximately 20 kilometers and originates with standing and slow-flowing waters. But even this unique matrix of natural wetland patches has begun to lose its avian value due to rapid urban expansion, which has gained momentum over the past decade. Lands adjacent to the Metsamor River are used for agriculture and commercial fish production. They are being converted to small private fish ponds ranging, on average, between 100 and 500 square meters and larger, while wetland drainage and channel excavation is irreversibly altering riparian ecosystems and leading to habitat loss. The Metsamor River System also plays a key role as a waterfowl habitat, wintering, and stopover site for wetland and water-dependent birds such as the common pochard *(Aythya ferina)*, red-crested pochard *(Netta rufina)*, common snipe *(Gallinago gallinago)*, pygmy cormorant *(Phalacrocorax pygmaeus)*, whiskered tern *(Chlidonias hybridus)*, cattle egret *(Bubulcus ibis)* and little crake *(Porzana parva)*, especially now that Lake Sevan and the area of the former Lake Gilli area offer little refuge to birds.

The creation in the 1970s of artificial water impoundments in the Ararat Valley helped to restore waterfowl and other bird species that had disappeared from the Lake Sevan Basin. The sole refuge for breeding avifauna



Change in the diversity of waterbird species in the Ararat Valley over time. *Graphic provided by the Armenian Society for the Protection of Birds.*

Staff members of the Armenian Society for the Protection of Birds conduct an extensive waterbird census of the Lake Sevan Important Bird Area. © *V. Ananian.*

appears to be the Armash fish farm, which was created in 1975 in the arid lands of the Ararat Valley in southwestern Armenia. The farm used to be the largest supplier of commercial fish during the Soviet Era and is still the largest active fishery in the entire Transcaucasus Region. The fishery's 29 ponds, each of which ranges from between 11 and 95 hectares in size, occupy a total of 1,514 hectares. They offer unique habitat for breeding and migratory birds, especially now that the surrounding wetland ecosystem of Lake Gilli no longer exists.

Ornithologist V. Ananian maintains that Armash is currently known to harbor up to 220 species of birds, which comprises over 62% of the total number of bird species in Armenia. Included among these are the breeding white-tailed lapwing *(Chettusia leucura)*, Eurasian spoonbill *(Platalea leucorodia)*, gull-billed tern *(Sterna nilotica)*, slender-billed gull *(Larus genei)*, and blue-cheeked bee-eater *(Merops persicus)*, as well as two species, the marbled teal *(Marmaronetta angustirostris)* and white-headed duck *(Oxyura leucocephala)*, which are listed on the IUCN Red List as threatened species.

Positioned on one of the valley's major flyways, these man-made ponds and wetland patches act as a large transit and stopover point for migratory waterfowl. They also serve as one of their key wintering habitats in Armenia. However, these man-made water impoundments were established with the sole purpose of supplying commercial fish and did not envisage the conservation of birds and their habitat. Although the fish ponds contributed to the strengthened formation of avian fauna in the country, birds are not protected on them by law.

Today, the Armash Fish Farm is a private joint-stock company with intensive commercial fish production, which impedes any effective activities to support the conservation of waterbirds and associated habitats. Breeding waterfowl populations are exposed to the increased degradation of their habitat and to illegal bird kills by poachers and fishery owners who shoot fish-eating birds such as pelicans, cormorants, egrets and herons, which they see as "potential enemies" to their business.

ASPB has committed to a program to develop the IBA Caretaker Network in the Caucasus; this program is an integral part of the IBA conservation program. It aims to establish an effective network of local people who are able to promote, carry out and/or contribute to the conservation and monitoring of bird species, and to promote the direct involvement of civil society in the conservation of sites important for birds. An established site-based approach in the Lake Sevan Basin ensured the full year-round monitoring of birds, as well as monitoring of the state of these sites and the pressures affecting them. This helps provide early warning about changes and signals the need to take conservation actions to remove common threats.

In view of the rapid urban expansion and intensive agriculture development in the Metsamor River System, public advocacy actions will be taken to interpret the importance of habitat changes and land-use impacts affecting different species of birds. As important and comprehensive is the educational component of this conservation program, which aims to promote knowledge of the birds, encourage their protection, and establish a long overdue conservation ethic using traditional educational tools, personal encounters and communication, and the mass media. For the Armash Fish Farm, where birds and the threats affecting them are fully and comprehensively monitored, our approach will be to develop a long-term conservation strategy through the involvement of the private sector and associated hunters who utilize the farm's natural resources. We aim to develop a long-term management plan for the fishery, which will include sustainable farming practices tailored to bird conservation needs and to provide for future tourism development opportunities as an alternative source of income.

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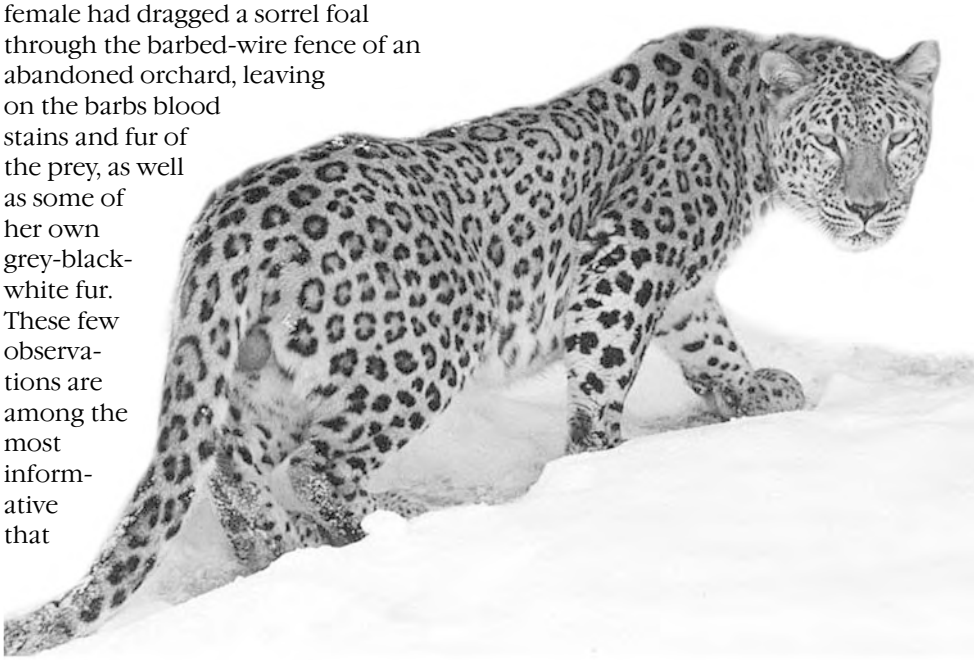
Research and Conservation of the Persian Leopard in Armenia

By ***Igor Khorozyan*** *and* ***Alexander Malkhasyan***

It was a dreary and misty day in late January, like all other days during this month in the rocky mountains of southern Armenia. We hiked over the wind-swept trails along the southern slopes, where the snow melts quickly and wild animals move around more easily. Suddenly, we came across a set of large, round clawless footprints and other similar, but smaller ones, which comprised clear tracks stretching along the trail in both directions. Scrapes, which were dug into the ground to attract a mate, were numerous. We made similar finds over the course of the next several days, and later again in early February and early March. From these signs, we deduced that a large male and slender female of the species were moving around to meet each other. From their fresh scats, it appeared that they had been feeding on wild boar *(Sus scrofa)* and Indian crested porcupine *(Hystrix indica)*. Following the tracks and scrapes, we reconstructed a fuller picture: in one place, the male had scratched the bark of a Christ's thorn *(Paliurus spina-christi)* and left some of its fur on the barbs. In another, a female had dragged a sorrel foal through the barbed-wire fence of an abandoned orchard, leaving on the barbs blood stains and fur of the prey, as well as some of her own grey-black-white fur. These few observations are among the most informative that we might hope to glean about the notoriously elusive and rare Persian leopard *(Panthera pardus saxicolor)*.

The current range of the leopard in southwestern and southern Armenia. *Map provided by I. Khorozyan and S. Asmaryan and adapted by M. Dubinin.*

Since prehistoric times, the leopard's beauty, strength, and grace have evoked a mixture of admiration for and fear of its stealthy, nocturnal, and cryptic life. African tribes gave this big cat such vivid epithets as: "Gentle hunter, whose tail plays on the ground while he crushes a skull;" "Beautiful death, who dons a spotted robe when he goes to his victim;" and "Playful killer, whose loving embrace splits the antelope's heart." Scientists claim that the hypnotizing effect that leopard spots have on humans is genetically programmed, similar in this way to the panic and stupor that snakes excite in monkeys. It is not surprising that leopard skin mantles, amulets made of the beast's teeth and claws, and medicines made from its bones are so very popular among indigenous peoples that live side by side with this predator.



A male Persian leopard *(Panthera pardus saxicolor)* in theYerevan Zoo. *Photo by A. Malkhasyan.*

The Persian leopard is the only large felid species still surviving in southwestern and southern Armenia, albeit in meager numbers. Here, the large cat inhabits sparse juniper forests, arid and mountain grasslands, sub-alpine, and alpine meadows, while it avoids semi-desert, nival (abounding with snow), and harsh nival environments. Its current range extends from the Khosrov Reserve southwards to the Arax River on the state border with Iran. As late as the mid-1970s, the leopard also inhabited northern Armenia. The northern boundary of its current range stretches along the Azat River and along the Geghama and Vardenis Mountain Ridges.

According to rough estimates, no more than ten to fifteen leopards, of which five to eight are adults, currently live in Armenia. The most stable group of the population is located in the southern part of the country, on the Zangezour, Bargushat and Meghri Ridges, from where they are able to move to and from Azerbaijan's Naxcivan Republic and northwestern Iran. The Zangezour Ridge and its branches serve as linkages between this group and the other group in

Khosrov Reserve and the Vayots Dzor Province.

The primary threats that have brought the leopard to the brink of extinction in Armenia are disturbance, poaching, and habitat destruction. More specifically, this entails livestock grazing, edible plant and mushroom gathering, destruction of wildlife by firearms and traps, and dry grasses and conifer fires during the hot summer. All these factors pose a great risk to the leopard and the species upon which it preys, the bezoar goat *(Capra aegagrus)*, wild boar, roe deer *(Capreolus capreolus)*, Indian crested porcupine, and European hare *(Lepus europaeus)*.

Concerned over the fate of the leopard in Armenia, we began researching the species in 1999-2000 by studying its diet, feeding competition, and distribution. We have since incorporated new research methods, including GIS mapping, camera photo-trapping, scat counts and use of lures. We initially began our work in Khosrov Reseve, and subsequently expanded our study areas to include other important "hotspots" of the cat's range such as Mt. Gbndasar/Noravank Canyon, Meghri Region, Vayots Dzor Province, and the Sisian Region. We published a number of scientific papers, monographs, and conference proceedings, which are mainly in English. Three years ago, we established a website, *www.persianleopard.com*, which we regularly update.

Fresh leopard tracks found on Meghri Ridge. *Photo by A. Malkhasyan.*

Thanks to financial support provided by international foundations and zoos, our efforts continue and ensure the quite stable status of the leopard in Armenia. However, this situation is very fragile and can worsen at anytime if even just one leopard is lost to poaching or another human factor.

Leopard habitat in Khosrov Reserve. *Photo by A. Malkhasyan.*

For example, recently in 2005, we faced a real threat of losing the leopard and other biodiversity in southern Armenia because of the national Ministry of Transportation's plans to build a road, the Kapan-Meghri Highway, right through the Shikahogh Reserve, which protects habitat important to the leopard and its prey. To avert the danger, all available resources were mobilized to promote cooperation between the Ministry of Nature Protection, environmental NGOs, and mass media. As this road is essential for Armenia, the coalition did not press for the complete cancellation of the project, but instead insisted that planners implement a second, less damaging option, which would affect the reserve to a lesser extent. This option would lengthen the road by seven kilometers (from thirty-five to forty-two kilometers) and increase costs, but would significantly shorten the segment of road passing through the reserve (from 16.6 to 0.5 kilometers) and reduce the numbers of trees and saplings to be cut (from 19,085 to 681 and from 117,000 to 4,178, respectively). In June 2005, policymakers officially adopted the more reserve-friendly option.

Our ongoing research project aims to identify and describe Priority Leopard Conservation Areas (PLECAs), which leopards currently and constantly inhabit, and which, therefore, require priority conservation actions. This project is necessary because we must know where the leopard presently inhabits in order to direct financial, human, and technical resources specifically there. The first candidates for PLECA status are the central and eastern parts of Khosrov Reserve in southwestern Armenia and the Shvanidzor-Nuvadi area in the extreme southern part of the country. The search for other PLECAs is underway. In this work, we combine field research, lab techniques and GIS mapping. Once we have identified PLECAs, we will divide them into priority regions, where focused protection measures will be implemented. It is still premature to specify which measures, such as the creation of protected areas or strengthened infrastructure, may be realized and when; this will be determined on a case-by-case basis.

Leopard conservation activities have been underway in Armenia since 2002 and include technical support, raising awareness among local people and the border guards, and the operation of anti-poaching squads and population monitoring. These efforts must be intensified and expanded in their scale.

Armenian citizens should be proud that such a wonderful and rare animal as the leopard still lives in their country. Hopefully, people are gradually coming to understand that a leopard seen for a few seconds in the shadows of the wilderness looks far better than any leopard skin rug or moth-eaten stuffed specimen in a museum.

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