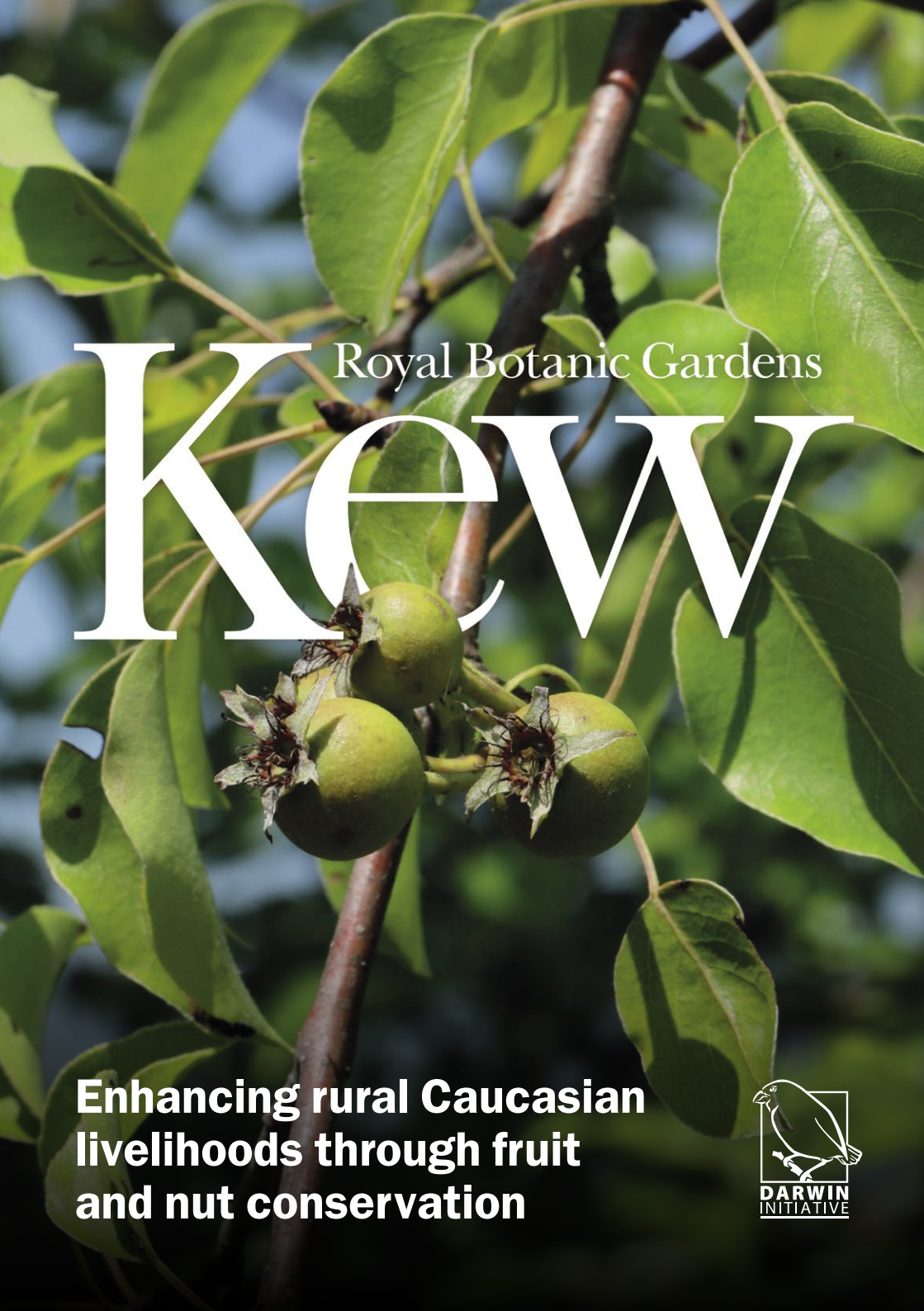


Enhancing rural Caucasian livelihoods through fruit and nut conservation

DARWIN INITIATIVE

Contents

An Armenian collector collecting wild pears.

Introduction

As the world's population is set to hit the 10 billion mark by 2050, there will be increasing pressure on an already fragile environment to produce sufficient food and maintain livelihoods. Additionally, humanity is facing a double burden of malnutrition, with hunger at one end and obesity at the other. Addressing these challenges will need a combination of strategies to ensure sustainable production of safe and nutritious foods, while also protecting biodiversity and the ecosystem services nature provides.

Species of plants that are typically harvested (or foraged) from wild populations are often known as neglected and underutilised species (NUS). They are generally overlooked by agricultural researchers, plant breeders and policy makers alike, despite increasing evidence showing their potential to improve the livelihoods of local people and communities. Additionally, many of these species – along with the traditional knowledge regarding their harvesting sites, use and processing techniques – are being lost at an alarming rate, threatening not only local biodiversity, but cultural diversity as well.

The South Caucasus is truly a unique place, both botanically and culturally. The region holds over 6,500 plant species and an unusually high number of endemics (plants not found anywhere else in the world). It also boasts a high concentration of wild relatives of modern crop varieties, including fruits, berries and nuts. These wild relatives are valuable as they provide a direct livelihood and nutrition to local communities, and potentially hold key genetic traits to help adapt modern domesticated crops to future environments. In Georgia and Armenia, fruits and nuts are strongly linked to the economy and people's culture. Unfortunately, the habitats that these species are found in are rapidly being threatened by anthropogenic activities (logging and pollution), while some wild harvested species are at risk from unsustainable harvesting.

Thanks to funding from the Darwin Initiative, the National Botanical Garden of Georgia, the Institute of Botany in Georgia, Nature Heritage NGO in Armenia, and the Royal Botanic Gardens, Kew (RBG Kew), we were able to embark on a three-year project to engage rural communities and create awareness of wild harvested fruit and nut species, alleviate harvesting pressures through training, and halt extinction through *in situ* and *ex situ* conservation activities.

Here, we report the project's achievements and its contribution towards the following Sustainable Development Goals.

Conserving wild harvested fruit and nut species

Wild harvested fruit and nut species play an important role in the rural lives of communities in the South Caucasus. Successful conservation of these wild harvested plants requires a multi-pronged approach, to ensure their long-term protection while also continuing to support local community needs.

ENGAGEMENT

Close engagement with local communities is key to ensure conservation action remains sustainable and impactful.

Awareness:
Create an engagement campaign on the value of plant conservation.

Targeting:
Work with communities to identify important species and their uses, taking into account women and children.

Alleviation:
Work with communities to develop fruit and nut plots to alleviate overharvesting.

53% of participants said they harvest from wild populations

Wild roses came top of the most harvested produce

59% of collectors identified fruit and nut species as 'very important'

TRAINING

Training ensures relevant skills and knowledge are shared and instilled into the next generation.

Biodiversity and sustainability:
Nature Heritage NGO and the National Botanical Garden of Georgia led training in biodiversity value and sustainable harvesting to their target communities.

Red-listing:
RBG Kew led IUCN Red List training for conservationists and students from Georgia and Armenia.

Research techniques:
Students from Georgia and Armenia travelled to RBG Kew to learn DNA extraction and analysis.

140 people trained by the project

'I had the opportunity to communicate with amazing specialists in this field, and learn important laboratory skills. also during this time I was able to significantly improve my understanding of the language.'

Razmik Papikyan

IN SITU CONSERVATION

In situ conservation is the conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings. The first step is the identification of threats and prioritisation of species via National and Global IUCN Red Lists.

Red List assessments involve a combination of literature research, herbarium studies and field work to gather sufficient evidence to assess their target species against the IUCN categories and criteria.

20 fruit and nut species assessed

EX SITU CONSERVATION

Ex situ conservation is the conservation of biological diversity outside of natural habitats. For plants, this is largely done in seed banks.

Seed collection:
Seeds of fruit and nut species need to be collected at the optimum time. Extensive research is done before going into the field to find the best area and time to collect.

Seed banks:
Seeds are cleaned, dried and frozen to ensure they stay alive for decades in seed banks.

Duplication:
Collections are split and one set is sent to the Millennium Seed Bank for added security.

119

unique fruit and nut species in *ex situ* collections

RESEARCH

Scientific research is key to our understanding and conservation of wild harvested edible species. The following is a selection of research work done under the project.

What is it?
Some species are really difficult to identify, which makes them harder to conserve. Molecular techniques have been used to resolve the taxonomy of endemic roses and blackthorn as part of this project.

How is it useful?
In Armenia, MSc student Razmik identified the antibacterial and antioxidant properties of endemic roses.

5

species of rose in Armenia, including two endemics, have potentially useful medicinal properties

2

MSc students trained and completed their studies

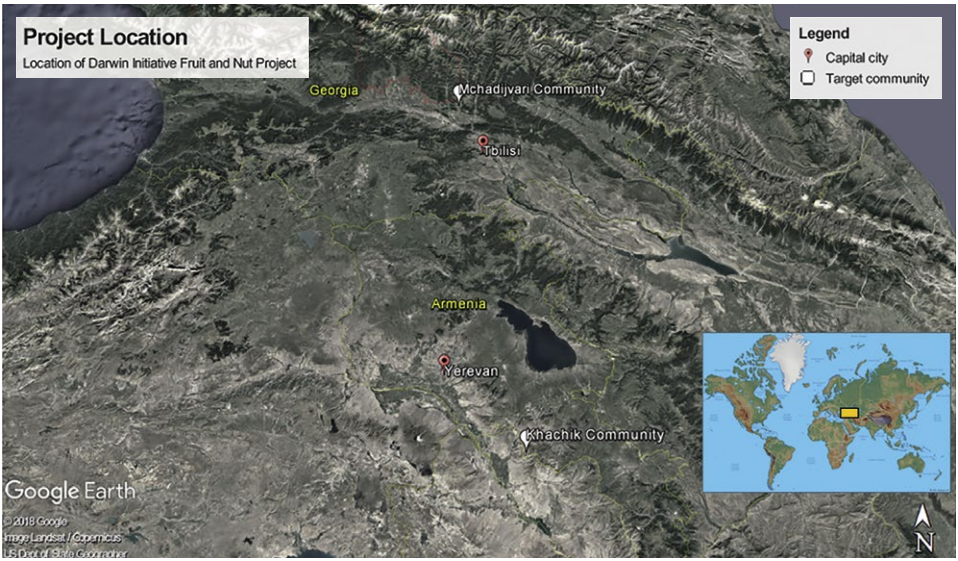
Wild harvested fruit
being sun dried.

Study location

The Caucasus region is recognised as being one of the world's 36 'biodiversity hotspots' and 35 'priority places' according to Conservation International and the WWF. It is home to over 6,500 plant species, of which around 25% are found nowhere else in the world, making the Caucasus the region with the highest level of endemism within the temperate zone of the Northern Hemisphere.

Around 2,000 plant species found within the region have a direct economic value and are used by local communities for various purposes, from food and medicines to fuel and dyes. Of these, over 15% are wild-growing fruit and nut species. In 1991, heavy economic recession and high unemployment rates in the South Caucasus (the Transcaucasus) forced rural families into poverty and a heavy dependence on ecosystem services. In Georgia, approximately 1,200 plant species are used medicinally and in Armenia, fruits and nuts make up 52% of frequently collected forest products.

The project aims to safeguard the ecologically and economically important fruit and nut species in Georgia and Armenia, which would safeguard rural livelihoods and conserve these valuable genetic resources. In Georgia, we engaged with the Mchadijvari community to the north of the capital city, Tbilisi, and in Armenia, the Khachik community to the south of the capital city, Yerevan. Formal permission to conduct the project within the target communities was sought from the municipality leaders and further discussions with heads and teachers from the local schools.



Community engagement

During the first year of the project, teams from Nature Heritage NGO and the National Botanical Garden of Georgia, in collaboration with respected social scientists, conducted a survey to identify initial levels of fruit and nut harvesting within the two communities and to engage with communities about the project. This was accomplished in three main ways.

Community surveys

A community survey was conducted to quantify the percentage of the population that collected wild harvested produce, including the species collected, time of collection and their uses. Additional information regarding individual knowledge about biodiversity conservation was also captured. We found that over 50% of the target communities still harvest fruit and nuts from wild populations. Although reliance on these wild harvested produce as their main income was not significant, we received 154 responses claiming that key fruit and nut species are ‘very important’ to the community for their diet, medicine and/or culture.

A social scientist conducting a baseline survey and community assessment in the Georgian Mchadijvari community.

Project leaflets

Within the first year of the project, over 650 information leaflets were handed out to both communities. These were written in the Armenian and Georgian languages and explained the project's main objectives. Before the end of the project, teams in Armenia and Georgia returned to their respective communities to distribute country-specific project booklets. These booklets serve as an overview of project activities and contain practical advice on sustainable harvesting and cultivation of community plots. They also include the community-led conservation action plans.

School quiz

Teams in Armenia and Georgia worked alongside local schools in the target communities to engage with younger generations. Around 55 children took part in the talks that were carried out at their schools. In Armenia, a quiz was conducted for individual pupils, which found over 80% of the pupils showed an understanding of the value of biodiversity, while over 70% could identify the function of a seed bank. In Georgia, the quiz was conducted as a team exercise. All teams were familiar with the Red List and its function in conservation.

Armenian project leaflets


Tsira Mikatadze-Pantsulaia distributing project leaflets to a Mchadijvari community member.


Engagement with a local school in the Khachik community.

Berberis vulgaris

Important plant genera: Profiles

Through surveys and questionnaires, community members in both the Khachik and Mchadijvari communities were asked which wild harvested species were most important to them. Their responses were analysed and led to the compilation of the following profiles. Each profile provides a general description, details of local species collected by communities, their local names and uses.

Each profile is accompanied by a 'Seed Jar' and a 'Red List' icon. The 'Seed Jar' details the number of seed collections held within the Millennium Seed Bank Partnership from Armenia and Georgia for each genus, and the number of taxa represented within these collections (species, subspecies, variety and accepted hybrids). Each 'Red List' icon details the category (e.g. VU) and number of taxa featured in the IUCN Red List of Threatened Species. See page 33 of this booklet to learn more about the IUCN Red List.

BERBERIS

Description

Thorny shrub associated with forests, forest margins and scrub thickets.

Leaves: rounded/obovate.

Flowers: racemose inflorescences, yellow.

Fruits: elongated red, occasionally pink and yellow berries.

Collecting time

Flowers and fruits collected from May to October.

Main species collected by communities

Berberis vulgaris L.

Local names

Armenia: Ծորենի (*tsoreni*), բարբարիս (*barbaris*), կծոխուր (*ktsokhur*)

Georgia: კოწახური (*kocaxuri*), ჩვეულებრივი კოწახური (*chveulebrivi kocaxuri*)

Uses

Bark (dye), fruits (culinary).

CORNUS

Description

Shrub or small tree associated with forest undergrowth and scrub.

Leaves: opposite, simple, entire.

Flowers: small, yellow.

Fruits: olive-shaped, red or yellow fruits.

Collecting time

Fruits collected from August to September.

Main species collected by communities

Cornus mas L., *Cornus mas* var. *flava* (unusual yellow fruits, in cultivation only [Mchadijvari])

Local names

Armenia: Հոն (*hon*)

Georgia: შინდი (*šindi*)

Uses

Leaves, fruits, bark, roots (medicinal), fruits (culinary), wood (construction, utensils), bark (barrel cleaner), bark, branches, leaves (dying and tanning of leather), entire plant (horticulture).

Cornus mas

CORYLUS

Description

A monoecious tree or shrub native to the temperate Northern Hemisphere, broad-leaved forests.

Leaves: simple.

Flowers: in single-sex catkins.

Fruits: nuts in clusters, large, roundish-ovoid, enclosed by a leafy involucre formed from three connate bracteoles.

Collecting time

Nuts are collected from June to November.

Main species collected by communities

Corylus avellana L., *C. colurna* L. (very rare in Armenia)

Local names

Armenia: *Corylus*: Պնդուկ (*pnduk*), տխիլ (*tkhil*); *Corylus avellana*: տխլենի սովորական (*tkhleni sovorakan*); *Corylus colurna*: արջատխլենի (*arjatkhleni*)

Georgia: *Corylus*: თხილი (*t'khili*); *Corylus avellana*: ჩვეულებრივი თხილი (*chveluebrivi t'khili*); *Corylus colurna*: დათვისთხილა (*dat'vist'khila*)

Uses

Nuts (food and livestock feed), wood (local handicraft), fruits, bark, leaves, roots and oil (medicinal).

Corylus colchica

CRATAEGUS

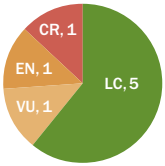
Description

Shrub or small tree associated with forest margins, open slopes and shrublands.

Leaves: mostly alternate, pinnately lobed or toothed.

Flowers: small, white, rarely pink (cultivars), in inflorescences.

Fruits: red, orange or black pulpy fruits.



Collecting time

Flowers collected from May to June, fruits from June to October.

Main species collected by communities

Crataegus orientalis Pall. ex M.Bieb., *C. x kyrtostyla* Fingerh., *C. pentagyna* Waldst. & Kit. ex Willd., *C. pontica* K.Koch

Local names

Armenia: *Crataegus*: Սզնի (*szni*), ալոճ (*alotsch*), սինձ (*sindz*); *C. orientalis*: Եմիշան (*yemishan*)

Georgia: *Crataegus*: კუნელი (*kuneli*); *C.* x *kyrtostyla*: წითელი კუნელი (*citeli kuneli*); *C. pentagyna*: შავი კუნელი (*šavi kuneli*); *C. orientalis*: კნაპა (*knapa*); *C. pontica*: ყამბრო (*qambro*)

Uses

Fruits, leaves, flowers (medicinal), fruits, flowers (culinary), wood (local handicraft), entire plant (ornamental).

Crataegus orientalis

JUGLANS

Description

A monoecious tree found growing on riversides and in mixed woods or scrub.

Leaves: pinnately compound leaves.

Flowers: thick, hanging catkins.

Fruits: green, fleshy, round, containing characteristic nut.

Collecting time

Leaves and flowers collected from April to May, fruits from August to September.

Main species collected by communities

Juglans regia L. (only native species), *Juglans nigra* L., *Juglans mandshurica* Maxim. (Georgia only)

Local names

Armenia: Պոպոք (*popoq*)

Georgia: ჩვეულებრივი კაკლის ხე (*chveulebrivi kaklis xe*)

Uses

Fruits (culinary), leaves, fruits, catkins (medicinal), timber (construction, utensils), fruits, male flowers (dye), entire plant (horticulture).

Juglans regia

MALUS

Description

Medium-sized tree found growing in mixed broad-leaved woodland and riversides.

Leaves: alternate, serrate, petiolate.

Flowers: white or pink held in racemes.

Fruits: round, yellow/green fruits, pulp without stone cells.

1 taxa
26 collections

DD, 1

Collecting time

Fruits collected from August to October.

Main species collected by communities

M. orientalis Uglitzk. (only native species), *M. domestica* (Suckow) Borkh. widely cultivated and occasionally naturalised.

Local names

Armenia: *Malus*: Վայրի խնձորենի (*vayri khndzoreni* – wild apple tree)

Georgia: *Malus*: მაჟალო (*mažalo*)

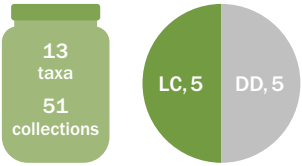
Uses

Fruits (medicinal and culinary), leaves (surrogate for tea), bark (source of dyes), wood (carpentry, turning, carving).

Malus orientalis

PRUNUS

(including syn. *Cerasus*, *Laurocerasus*)



Description

Shrub or small tree, sometimes spiny, associated with forests, shrub thickets and riversides.

Leaves: alternate, entire or incised.

Flowers: single, clustered or in rows along inflorescences.

Fruits: red-purple, yellow, fleshy or dry with large stone.

Collecting time

Fruits collected June to September.

Main species collected by communities

Prunus spinosa L., *Cerasus incana* (Pall.) Spach (syn. of *P. incana* (Pall.) Batsch), *P. divaricata* Ledeb. (syn. of *P. cerasifera* Ehrh.), *Laurocerasus officinalis* (syn. of *P. laurocerasus* L.)

Local names

Armenia: *Prunus*: Շլոր (*shlor*); *Cerasus*: Հավալոլոկ (*havalolok*), Բալենի (*baleni*)

Georgia: *Prunus*: ტყემალი (*tqemali*); *P. spinosa*: კვრინჩხი (*kvrinčxi*); *L. officinalis*: წყავი (*cqavi*)

Uses

Leaves, fruits (medicinal), fruits (culinary), wood (local handicraft), seeds (insecticides).

Prunus divaricata

PYRUS

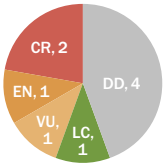
Description

Shrub to tall tree found in forests, shrubland and as individuals on open ground.

Leaves: alternate, petiolate.

Flowers: clustered in inflorescence, petals white to pinkish.

Fruits: fleshy, round or pear-shaped.



Collecting time

Fruits collected from June to October.

Main species collected by communities

Pyrus megrica Gladkova, *P. salicifolia* Pall., *P. caucasica* Fed. (subsp. of *P. communis* (Fed.) Browicz), *P. balansae* Decne. (syn. of *P. communis* L.)

Local names

Armenia: *Pyrus*: Վայրի տանձենի (vayri tandzenih – wild pear tree), քռոսիկ (*qrosik*); *P. caucasica*: Պանդա (*panda*), ձմեռային տանձ (*dzmerayin tandz* – winter pear)

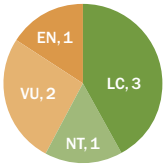
Georgia: *Pyrus*: პანტა (*panta*); *P. caucasica*: კავკასიური პანტა (*kavkasiuri panta*); *Pyrus balansae*: ბალანზას პანტა (*balanzas panta*)

Uses

Fruits (medicinal), fruits (food and drink), wood (construction, utensils).

Pyrus caucasica

ROSA



Description

Shrub with prickly stem associated with forest margins/ clearings, grassland, disturbed and open ground.

Leaves: pinnate.

Flowers: solitary or in corymbs with white, pink, red, purple or yellow petals.

Fruits: round/ovoid, fleshy, red, black or orange.

Collecting time

Flowers collected from May to July, fruits from July to November.

Main species collected by communities

R. hemisphaerica Herrm., *R. pimpinellifolia* L. (syn. of *R. spinosissima* L.), *R. canina* L., *R. iberica* Steven ex M.Bieb.

Local names

Armenia: *Rosa*: Մասրենիր (*masreni*), վարդ (vard-rose); *R. hemisphaerica*: Ղրնգյոզ (*ghrngyoz*); *R. pimpinelifolia*: Սև մասուր (*sev masur* – black rosehip)

Georgia: *Rosa/Rosa canina*: ასკილი (*askili*); *Rosa iberica*: ქართული ვარდი (*k'art'uli vardi*)

Uses

Leaves, fruits (medicinal), fruits (culinary), wood (local handicraft), seeds (insecticides).

Rosa canina

RUBUS

Description

Shrub or scrambler, occasionally perennial herb found in forest margins, open places, shrubbery and riversides.

Leaves: borne on first-year stems, complex or simple.

Fruits: composite made up of many single-seeded fleshy drupes.

Collecting time

Flowers collected from May to July, fruits from July to October.

Main species collected by communities

R. idaeus L. (raspberry), *R. fruticosus agg*. L., *R. saxatilis* L.

Local names

Armenia: *Rubus*: Մոշենի (*mosheni*); *R. idaeus*: Ազնվամորի (*aznvamori*), մոռ (*mor*)

Georgia: *Rubus*: მაყვალი (*maqvali*); *R. fruticosus*: მაყვალი (*maqvali*); *R. idaeus*: ჟოლო (žolo); *R. saxatilis*: კლდის ხახამა (*kldis xaxama*)

Uses

Roots, leaves, flowers, fruits (medicinal), leaves, flowers, flower buds, shoots, fruits (culinary), timber (construction, utensils), leaves, flowers, fruits (dye).

Rubus kacheticus

Project partners meeting with a fruit and nut collector from the Khachik community.

Community conservation action

In trying to conserve wild fruit and nut species and enhance the livelihoods of two rural communities, effective engagement with those communities is essential. One of the first actions taken was to establish local steering committees with members of the Khachik and Mchadijvari communities, which was achieved during the first year of the project. Both steering committees have played a leading role in engaging and empowering their respective communities throughout the project lifetime.

Each steering committee appointed one Biodiversity Champion, who has acted as an essential mediator between community members and project staff and helped turn project objectives into community action.

Engagement with both communities has been a two-way process. Project partners delivered theoretical training and practical workshops, and facilitated dialogue throughout the community, while community members have contributed a wealth of knowledge about local fruit and nut species, their uses and perceived threats. Taken together, these activities have led to the development of local community fruit and nut plots and community conservation action plans. The following sections highlight the experiences of both the Khachik and Mchadijvari communities.

Knowledge exchange workshop with Georgian community members.

A Nature Heritage NGO botanist talking to community members about fruit species and the collection of voucher specimens for identification.

Khachik community members planting and caring for saplings at the fruit and nut community plot.

ARMENIA

Awareness-raising and training

In the first year of the project, staff visited the local primary school in the Khachik community, where they taught children the importance of biodiversity to people and planet. The younger generation in the community still engage in collecting from the wild. Project staff introduced children to key concepts in conservation and seed banking.

The project partners then evaluated learning through a 'pop quiz'. The training was well received by the children, with 25 out of 30 able to confidently answer conservation-related questions and some even offering to volunteer on the project. On top of engaging Khachik's youth, project partners also trained adults in sustainable harvesting techniques. This was mainly done through practical field experience, demonstrating conservation standards for collecting from wild populations.

Demonstration plot and fruit and nut cultivation

Together with the steering committee, project partners identified a suitable area to establish a plot that could be used to grow locally important fruit and nut species, as well as being accessible to members of the community. The Biodiversity Champion organised a practical training session for interested community members and project partners taught them how to plant and care for fruit and nut trees and shrubs planted within the plot. Community members were especially appreciative to receive expertise that they could also use on their own private gardens: for example, the importance of mulching. The plot has been successfully established with *Rosa hemisphaerica*, *Crataegus orientalis*, *Crataegus armena*, *Pyrus sosnovskyi* and *Berberis vulgaris*.

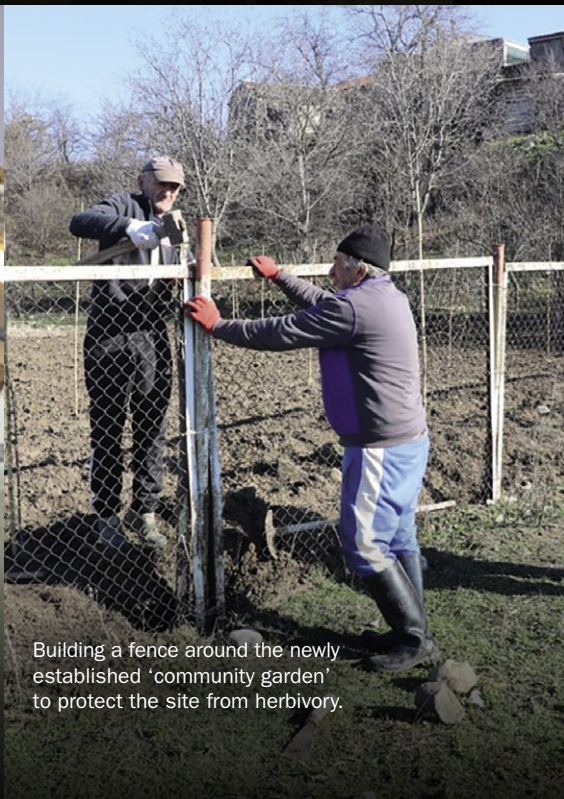
There is an appetite within the community to maintain the plot. A survey conducted less than a year after the plot was established showed over 60% of members who knew about the plot said they would care for it into the future. Additionally, 75% of those who were not initially familiar with the plot said they would also like to contribute after being told about and/or after visiting it. The plot, and the community's enthusiasm to sustain it, will contribute towards alleviating overharvesting of wild populations.

Empowerment

The project has created an invaluable link between the Khachik community and conservation groups, , as well as a platform for the community to express concerns and become empowered to conserve their own biodiversity. Over 60 individuals from the community have contributed their ideas towards a community-led conservation action plan, including measures to protect plant health within wild populations. They also raised concerns around threats to their local biodiversity, for example overharvesting rosehips from commercial collectors. By empowering the community, local conservation groups such as Nature Heritage NGO can be more effective allies, and together enable the conservation of biodiversity alongside supporting local livelihoods. Project partners will continue to support the community to share project learning with neighbouring communities, enhancing the project's impact to conserve biodiversity while enhancing livelihoods in Armenia.

A project partner showing propagation techniques to the local community.

A Mchadijvari school group visiting NBGG and learning about seed banking.



Building a fence around the newly established ‘community garden’ to protect the site from herbivory.

GEORGIA

Awareness-raising and training

In Georgia, awareness-raising involved both the adult and youth members of the community. Together with a social scientist, project staff taught children from a local Mchadijvari school about practical plant conservation and seed banking. They evaluated learning through a 'pop quiz' and all the teams managed to confidently answer questions around the importance of conservation. Children and teachers were later invited to visit the National Botanical Garden of Georgia in Tbilisi to learn more about these topics.

Project partners targeted the adult population with training in sustainable harvesting techniques and propagation methods. The workshops also involved local community members taking the lead on some sessions. For example, local collector Temur led a training session involving the identification of 30 species of value for their community. Project partners taught participants the importance of herbarium specimens, recording data and sustainable collecting.

Demonstration plot

Together with the steering committee, project partners identified an accessible location for the fruit and nut demonstration plot and chose the species that should be planted. The community expressed their interest in cultivating nationally threatened species within their plots with one participant requesting threatened species whose fruits and nuts could generate income. In response, a plot was established with species featured in the Red List of Georgia, which will highlight their conservation value and use to the community. The plot has been well received by members of the community, with the biology teacher from the local school exclaiming:

'*We [teachers] really like this demonstration plot. The students have always learnt about important species in Georgia in the classroom, and now they can come out here and see them*.'

The community wanted to go further and decided to create a 'community garden' together with project partners on the school grounds. Twenty-four species were selected, and an irrigation system established to protect against drought. This will further enhance local livelihoods and alleviate overharvesting pressures on wild communities.

Empowerment

The establishment of the community garden is testament to the community's desire to take action that will ensure fruit and nut plant use can be sustained into the future. The idea was driven by the steering committee and the director of the local school, and supported by the project and the local project partners. Community members have continued to contribute ideas for conserving important wild harvested produce, including the suggestion of a point of contact within the community for fruit and/or nut produce, to provide advice and additional subsistence to the people, and hold community gatherings to showcase the products produced and illustrate their importance.

A bag of rosehips collected from a variety of species by local collectors.

The seed's journey

Conventional seed banking is becoming an increasingly important tool for plant conservation and directly contributes to *in situ* conservation action. Banking fruit and nut species in this way ensures that genetic material of economically valuable species is conserved for future generations.

TARGETING

Before going into the field, teams collate valuable information such as locality and flowering/fruiting times from herbarium specimens and past literature. Teams also ensure relevant permits are sought.

COLLECTING

Teams use the Millennium Seed Bank's International Standard to ensure high quality seeds are collected without compromising populations. Seeds/fruit, herbarium specimens and data are collected during every field mission.

CLEANING

At the seed bank, seeds are extracted from wet fruits/pods, cleaned and separated from empty seeds and debris. Teams perform cut tests to identify the overall quality of each seed collection.

DRYING

Cleaned seeds are dried to ~15% equilibrium relative humidity using either silica gel, an incubator drier or a built-in dry room.

FREEZING

After the seeds are sufficiently dried, the collection is sealed in appropriate containers and frozen at -20 degrees Celsius. This will allow seeds to be kept alive for decades.

Seed banks

First applied to crop species, the practicability of seed banks relied on the ability of most species' seeds to survive air-drying (dessication-tolerant).* In recent years, the development of seed banks capable of storing wild species, instigated through the Millennium Seed Bank Partnership (MSBP), has allowed many countries, including those within the Caucasus, to conserve their unique flora.

Through the project, this unique seed bank network has ensured the conservation and accessibility of 119 species of fruit and/or nut species of the South Caucasus.

Millennium Seed Bank

Managed by the RBG Kew, and situated in the grounds of Wakehurst in West Sussex, England, the Millennium Seed Bank is the largest wild species seed bank in the world. It has the capacity to hold up to 75% of the world's desiccation-tolerant seed-bearing plants. As of January 2021, the MSB currently holds around 96,399 collections of 39,707 species from 190 countries and territories. Most of its collections are duplicates from members of the global partnership, the MSBP, serving as a safe location in case the original collection is destroyed or used up. Both Armenia and Georgia are part of the MSBP and have duplicated their collections here for over ten years.

NBGG National Seed Bank and Institute of Botany

The National Seed Bank of Georgia, established in 2001 (then named the Caucasus Regional Seed Bank), is located and managed by the National Botanical Garden of Georgia (NBGG). In 2010, NBGG National Seed Bank joined the International Partnership Phase of the MSBP and as of 2020 has conserved 1,851 species. Work of *ex situ* conservation, including this project, is done in collaboration with the Institute of Botany of Ilia State University with active involvement of the National Herbarium of Georgia (TBI).

RBG Kew's Millennium Seed Bank, West Sussex, UK.

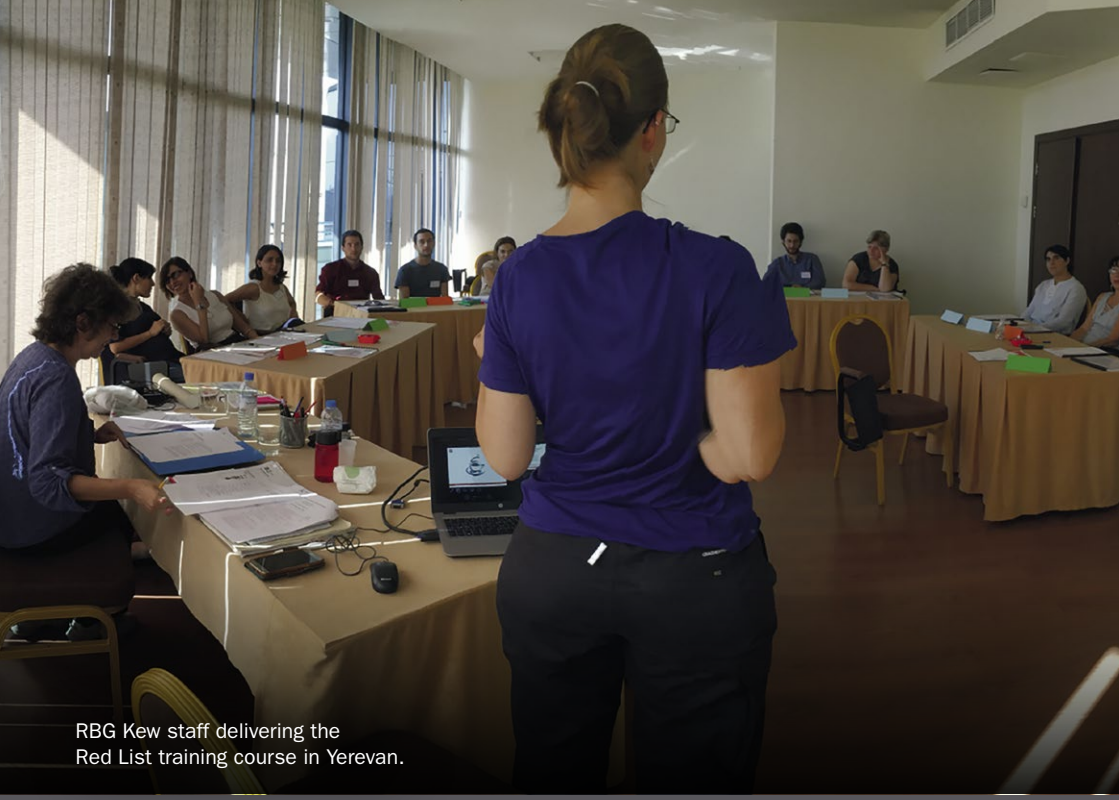
TBI is the oldest herbarium in the Caucasus and holds one of the largest and most valuable collections in the former Soviet Union. Its unique collection contains up to one million herbarium vouchers, including 1,900 type specimens.

Seed Bank of Armenian Flora

The Seed Bank of Armenian Flora (SBAF) was established in 2011 as the national seed bank for wild species in Armenia. It is managed by the Institute of Botany, Academy of Science of the Republic of Armenia. It joined the MSBP in 2011 to help deliver its mission to conserve the unique and endangered flora of Armenia. As of February 2021, around 870 native Armenian species have been conserved at the SBAF and 727 collections duplicated to the MSB for safe storage.

*** What about those that cannot be banked?**

Recent studies have shown that most plants (~90%) are able to be dried and frozen (desiccation-tolerant or orthodox). However, the rest are unable to withstand these conventional processes. Species such as oaks and chestnuts come under this category, which is why *in situ* conservation is key, alongside the storage of their germplasm in cryopreservation units, such as those available at the Millennium Seed Bank.



RBG Kew staff delivering the
Red List training course in Yerevan.

The IUCN Red List Threat Categories.

Reference: ™ IUCN Red List of Threatened Species is a trademark of IUCN.

NOT EVALUATED	DATA DEFICIENT	LEAST CONCERN	NEAR THREATENED	VULNERABLE	ENDANGERED	CRITICALLY ENDANGERED	EXTINCT IN THE WILD	EXTINCT
NE	DD	LC	NT	VU	EN	CR	EW	EX

Threatened species

Developed by the International Union for Conservation of Nature (IUCN) in 1964, the IUCN Red List of Threatened Species has become a comprehensive source of information on the global conservation status of animal, fungi and plant species.

It can be a powerful tool to inform and initiate conservation action for biodiversity and changes in policy. The IUCN Red List Categories and Criteria is a global system for classifying species at high risk of global extinction. It divides species into nine categories: Not Evaluated (NE), Data Deficient (DD), Least Concern (LC), Near Threatened (NT), Vulnerable (VU), Endangered (EN), Critically Endangered (CR), Extinct in the Wild (EW) and Extinct (EX) (iucnredlist.org). 'Data Deficient' includes species where inadequate information exists to make an assessment and does not mean a species is not threatened.

Although the global list exists, we must also acknowledge regional and national red lists, which are extremely valuable sources of information for conservationists, researchers and governments. RBG Kew works closely with the IUCN to aid in global plant conservation, specifically through assessing species using the IUCN Red List Categories and Criteria, as well as conducting training programmes to enable other researchers and conservationists to do the same. As part of the project, staff at RBG Kew conducted a training event in Yerevan for 15 participants. As a result, approximately 20 species are currently being assessed for the global Red List, contributing towards their conservation into the future.

'*One of the best things about this workshop was the advice from Catia [Plant Assessment Unit, Kew], that we should not be afraid of making [mistakes], that this is the way of learning. I would like for Catia to say that in every training session, so that people won't be afraid to learn.*'

Extract from anonymous participant course feedback form.

Armenian and Georgian students/researchers with their Red Listing Training Certificates.

FIVE THREATENED SPECIES OF CONCERN IN ARMENIA

1 **Species:** *Crataegus orientalis* Pall. ex M.Bieb.

Distribution: Common but not widespread.

Use and threats: Fruits edible, targeted by collectors. Overharvesting is common. Urban expansion threatens arid forest habitat leading to reduced species range.

Current conservation: Three seed collections banked and made available for use*; occurs in many Protected Areas including Dilijan National Park and Shikahogh reserve. Not included in the Red Data Book of Armenia (LC Globally).

Action needed: If urban, agricultural and touristic expansion continues, this species will become increasing threatened. Increased community engagement and training needed.

2 **Species:** *Rosa hemisphaerica* Herrm.

Distribution: Found in Yerevan, Darelegis and Meghri floristic regions. Populations very small.

Use and threats: Fruits tasty, few seeds. Threatened by often unintentional overharvesting and climate change. Low seed number per fruit further reduces chance of reproduction by seed.

Current conservation: Three seed collections banked and made available for use*; occurs in Areviq National Park with one population and in Arpa Protected Landscape, a community-managed protected area. Not included in the Red Data Book of Armenia (NT Globally).

Action needed: Controls on overharvesting, species reintroduction, and increased awareness among collectors.

3 **Species:** *Prunus microcarpa* C.A.Mey. (syn. of *Cerasus microcarpa* (C.A.Mey.) Boiss.)

Distribution: Very restricted area of distribution, only Zangezur and Meghri floristic regions.

Use and threats: Edible fruits, but not very popular for harvesting. Threatened by climate change and susceptible to pests which reduce seed viability.

Current conservation: One seed collection banked and made available for use*; found in Shikahogh State Reserve and Areviq National Park. Not included in the Red Data Book of Armenia (DD Globally).

Action needed: Investigate impact of harvesting, monitor populations to understand current state and research pests and possible protection.

4 **Species:** *Rubus cartalinicus* Juz.

Distribution: Severely fragmented distribution, found in Ijevan and Meghri floristic regions.

Use and threats: Fruits harvested and sold by locals. Threatened by often unintentional overharvesting of *Rubus* species.

Current conservation: No Armenian collections banked *ex situ*; small population grows within Areviq National Park. Not included in the Red Data Book of Armenia (EN Globally).

Action needed: Population studies needed to inform conservation, investigation into intensity of harvesting and impact of trade, and increased *ex situ* conservation of seeds and genetic material.

5 Species: *Pyrus megrica* Gladkova

Distribution: Limited distribution; found in Darelegis and Meghri floristic regions.

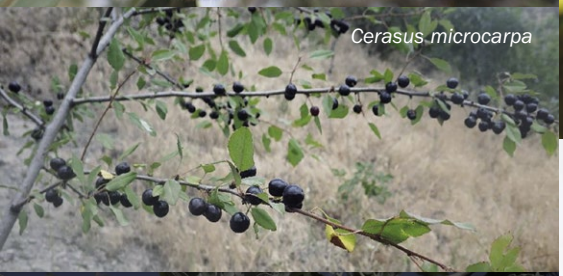
Use and threats: Fruits harvested for making compote and alcoholic drink. Potentially overharvested by locals targeting other *Pyrus* species in the area.

Current conservation: No Armenian collections banked *ex situ*; found in Areviq National Park and one population within Arpa Protected Landscape, a community-managed protected area. Not included in the Red Data Book of Armenia (no Global Assessment).

Action needed: Population studies needed to inform conservation, investigation into intensity of harvesting and impact of trade, and increased *ex situ* conservation of seeds and genetic material.

* use of collections dependent upon seed number and consent from partner institution in Armenia.


Crataegus orientalis


Cerasus microcarpa


Pyrus megrica


Rosa hemisphaerica


Rubus carthalinicus

FIVE THREATENED SPECIES OF CONCERN IN GEORGIA

1 **Species:** *Staphylea colchica* Steven

Distribution: Fragmented distribution; populations are low in abundance.

Use and threats: Flowering shoots with buds are eaten and used to produce pickles. Over-collecting of these parts reducing plants' ability to reproduce by seed.

Current conservation: Three seed collections banked and made available for use*; unlikely to occur in any Protected Area within Georgia. Georgian Red List species (NE Globally).

Action needed: Taxonomic studies needed to validate species status, research on threats, and controls on harvesting.

2 **Species:** *Corylus iberica* (unresolved)

Distribution: Fragmented distribution; populations are low in abundance.

Use and threats: Fruits are used for food; valuable timber is used in construction. Small populations are likely affected by over-collecting fruits and cutting trees for timber.

Current conservation: Six seed collections (syn. of *C. colchica*) banked and made available for use*; occurs in three Protected Areas: Algeti National Park, Borjomi-Kharagauli National Park and Lagodekhi Nature Reserve. Not included in Georgian Red List (VU Globally).

Action needed: Taxonomic studies to improve understanding and ensure effective conservation practice, increase capacity within Georgia to bank desiccation-sensitive seeds.

3 **Species:** *Crataegus pontica* K.Koch

Distribution: Fragmented distribution.

Use and threats: Fruits are edible; fruits and flowers have medicinal properties primarily for treating cardiac diseases. Small populations are likely affected by collecting fruits and flowers.

Current conservation: One seed collection banked and made available for use*; species unlikely to occur in any Protected Area. Georgian Red List species (LC Globally).

Action needed: Research on threats, reintroduction trials, increase representation in *ex situ* collections.

4 **Species:** *Prunus microcarpa* C.A.Mey.

Distribution: Represented by a very low number of populations composed of few specimens.

Use and threats: Fruits are edible. Small populations are likely affected by collecting fruits and flowers.

Current conservation: Four seed collections banked and made available for use*; reintroduction programme at Davit Gareji Monastery Complex to conserve *in situ*. Georgian Red List species (DD Globally).

Action needed: Continuation of reintroduction programme, increased dissemination work, increased representation in *ex situ* collections.

5 **Species:** *Juglans regia* L.

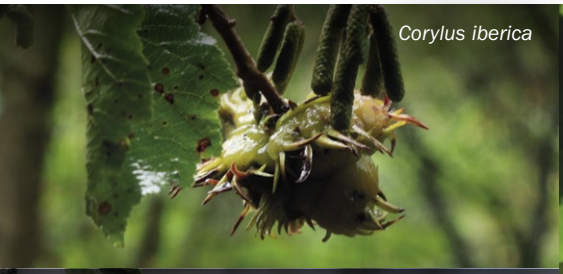
Distribution: Fragmented distribution; populations are low in abundance.

Use and threats: Fruits are used for food; valuable timber is used in construction and to make utensils. Likely affected by collecting fruits and cutting for timber.

Current conservation: One small seed collection banked; occurs in Borjomi-Kharagauli National Park, Mtirala National Park, Kintrishi State Nature Reserve and Lagodekhi Nature Reserve. Georgian Red List species (LC Globally).

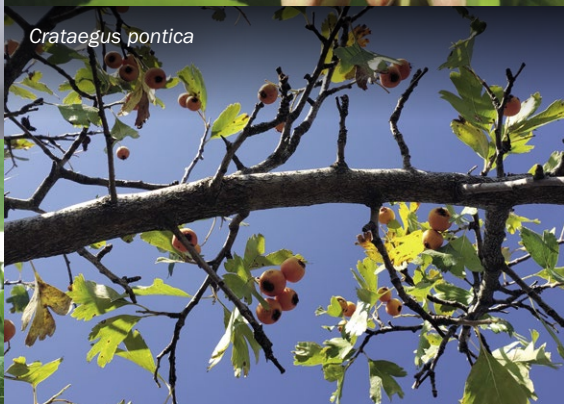
Action needed: Research on threats, more effective control of illegal logging, taxonomic study of infraspecific variability and greater representation in *ex situ* seed collections.

* use of collections dependent upon seed number and consent from partner institution in Georgia.

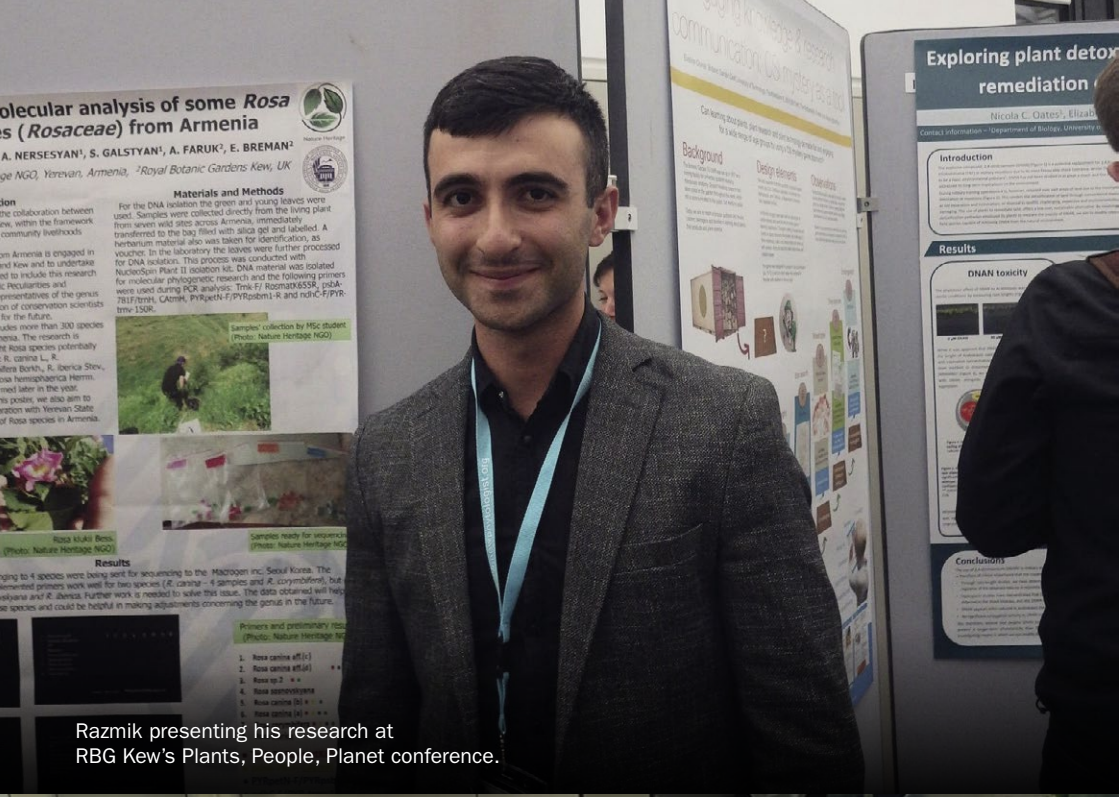

Corylus iberica


Staphylea colchica


Prunus microcarpa


Crataegus pontica


Juglans regia



Razmik presenting his research at RBG Kew's Plants, People, Planet conference.

Ana during her two-week residential training course at RBG Kew's Jodrell Laboratory.

Research

Successful conservation action and effective policy change is underpinned by empirical evidence gathered through robust scientific research. Therefore, enhancing the capacity of nations to conduct research is key in ensuring sustainable conservation efforts. A key part of the project was to do just this by supporting two MSc students in Georgia and Armenia.

Razmik Papikyan

Razmik started as an MSc student with the project, co-supervised by the Yerevan State University and Nature Heritage NGO. He chose to study the native roses found in Armenia, focusing on resolving their taxonomy using traditional and molecular techniques, as well as identifying potential pharmacological properties (antioxidant, antibacterial and antifungal). In 2019 he travelled to the Jodrell Laboratory at RBG Kew to receive practical training on molecular analysis techniques, which enabled him to build a phylogenetic tree of *Rosa* in Armenia. Since starting his course, he has presented his research at two international conferences and is now in the final stages of preparing two papers for publication.

'*The laboratory studies were very useful for developing [Razmik's] practical skills*.'

Razmik's MSc supervisor

Ana Kvlividze

Ana started as an MSc student with the project, supervised by Ilia State University of Georgia, and worked closely with the National Botanical Garden of Georgia throughout the project. Her chosen study species is *Prunus spinosa*. Her preliminary focus was to study the different forms within the *P. spinosa* complex found across Georgia using morphometric and molecular analysis. Like Razmik, Ana also travelled to RBG Kew for training in 2020. Through her work, she has successfully developed a trait database for *P. spinosa* and preliminary analysis has revealed that one of the forms she was studying has a close resemblance to a newly described taxa found in Ukraine. Her findings will have significant implications for its conservation status and can be used to aid in its protection.

'*I got familiar with commonly used laboratory methods…[for] the molecular study of* Prunus spinosa*, which is one of the major parts of my Master's thesis. It was also interesting to meet local scientists and discuss some of the molecular techniques of [their] laboratory*.'

Ana Kvlividze

Key messages

Plants play an essential role in our lives. Unfortunately, we currently only utilise around 2% of the potential edible plants within our current food systems.

In Georgia and Armenia, fruits and nuts are strongly linked to the economy and people's culture. Many wild foraged edible species of fruits and nuts, along with people's traditional knowledge, are being lost at an alarming rate, requiring conservation action.

We found over 50% of community members still harvest from wild populations, including children, showing the importance of ensuring they were also part of conservation efforts.

Taxa that are regularly harvested included species from the genera *Rosa*, *Crataegus*, *Juglans*, *Cornus*, *Prunus*, *Berberis*, *Malus*, *Pyrus*, *Rubus* and *Corylus*. Half of the genera had species which were within the IUCN threatened categories.

The project had a series of community-led conservation actions, including the establishment of local community groups, who oversaw the development of fruit and nut plots.

Increasing cultivation, research and red-listing capacity through knowledge transfer ensured long-term conservation within the region.

Ex situ conservation through seed banking provides added reassurance against species extinction for approximately 119 species from the project. Seed collections are also made accessible for research and restoration.

Acknowledgements

This project was made possible thanks to funding from the Darwin Initiative. The Darwin Initiative is a UK government grants scheme that helps to protect biodiversity and the natural environment through locally based projects worldwide. We would also like to acknowledge the work of our local Biodiversity Champions, Leila Mighdiseli (Georgia) and Bela Arakelyan (Armenia), alongside the social scientists, STREAM (Georgia), Emma Hakobyan and Llanna Harutyunyan (Armenia), Marina Kuchukhidze and Nona Kereselidze (Georgia), who were instrumental in ensuring the success of community engagement activities. To the community members who have welcomed us into their schools, their homes and their hearts, we are forever grateful. Finally, to the students and volunteers who have kindly given their time and energy to the project, your contribution and enthusiasm enabled the project to flourish.

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MILLENNIUM SEED BANK PARTNERSHIP

NATIONAL BOTANICAL GARDEN OF GEORGIA

Who are we?

The following are core teams:

RBG Kew:

The overall management and coordination of the project is led by Dr Aisyah Faruk (Conservation Partnership Coordinator) and Ian Willey (Country Project Officer), based at the Millennium Seed Bank. For more information on our projects and expertise, please visit our institutional pages **kew.org/science/our-science/people/aisyah-faruk** and **kew.org/science/our-science/people/ian-willey**.

Georgia:

In Georgia, the project is run by two partner institutions: the National Botanical Garden of Georgia (NBGG) and the Institute of Botany, Ilia University (IoB). The team in NBGG was led by Mr Tamaz Darchidze, Dr Tsira Mikatadze-Pantsulaia and Dr Tinatin Barblishvili. The team in IoB was led by Dr Shalva Sikharulidze and Dr David Kikodze.

Armenia:

In Armenia, the project is run by Nature Heritage NGO, led by Dr Anush Nersesyan and Mrs Astghik Papikyan.

Pyrus salicifolia found in Georgia.

Rosa pimpinellifolia

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