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# Landscape-ecological Excursion Field Guide

## Based on an Azerbaijani-German student excursion to Northeastern Azerbaijan in 2015

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# Landscape-ecological Excursion Field Guide

Based on an Azerbaijani-German student excursion to

Northeastern Azerbaijan

from August 24 to September 6, 2015

June 2017

**Cover pictures** (clockwise): Cultural landscapes at Mt. Shahdagh (J. Etzold); Steppe Eagle (D. Eichhorn); Rendzina soil above the village Jek (J. Etzold); *Dianthus caucaseus* and *Gentiana septemfida* from foot of Mt. Shahdagh (J. Etzold); in centre: Boy riding his donkey near to the village Khinalig (J. Etzold)

**Landscape-ecological Excursion Field Guide**

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# Abbreviations

| | |
|---|---|
| AOS | Azerbaijan Ornithological Society |
| approx. | approximately |
| BSU | Baku State University |
| CNF | Caucasus Nature Fund |
| dt | deciton |
| ECP | Ecoregion Conservation Plan for the Caucasus |
| GDP | Gross Domestic Product |
| GIZ | Deutsche Gesellschaft für internationale Zusammenarbeit GmbH |
| ha | hectare |
| IBA | Important Bird Area |
| IBiS | Integrated Biodiversity Management, South Caucasus (Programme of GIZ) |
| IUCN | International Union for Nature Conservation |
| m a.g.l. | metres above ground level |
| m a.s.l. | metres above sea level |
| MENR | Ministry of Ecology and Natural Resources of Azerbaijan Republic |
| NABU | Deutscher Naturschutzbund e.V. (German Association for Nature Conservation) |
| NP | National Park |
| SMBP | Sustainable Management of Biodiversity Programme (GIZ) |
| UNESCO | United Nations Educational, Scientific and Cultural Organisation |
| WWF | World Wide Fund for Nature |

# Transliteration

Transliteration of Azerbaijani terms follows the Romanisation tables after Allworth (1971)[1] and transliteration of Russian terms follows the Romanisation tables according to the standard by BGN/PCGN 1947[2].

# Taxonomic synonyms

Plant species taxonomy in this book follows the reference list of the former Soviet Union (Czerepanov 1995[3]), which was checked against www.emplantbase.org, partly also against www.theplantlist.org. Bird species names follow Avibase 2016.[4]

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[1] Allworth, E. (1971): Nationalities of the Soviet East. Publications and Writing Systems. New York. Available at http://transliteration.eki.ee/. Accessed: March 2016.

[2] United States Board on Geographic Names and the Permanent Committee on Geographical Names for British Official Use. Available at http://transliteration.eki.ee/. Accessed: March 2016.

[3] Czerepanov, S.K. (1995): Vascular Plants of Russia and adjacent states (The former USSR).Cambridge University Press.

# I. Preface

**Caucasus Biodiversity hotspot**. Azerbaijan is situated in the Caucasus, a region that has been listed as one of the 34 global biodiversity hotspots recognized by Conservation International (Zazanashvili et al. 2013) or even as one of the world's 25 biodiversity hotspots (Myers et al. 2000).

Criteria for listing the Caucasus as a global biodiversity hotspot include the high number (1,600) and percentage (25%) of endemic plant species among its flora of in total around 6,300 species as well as the high level of threat to these species and habitats that host them (Myers et al. 2000). Among the countries in the Caucasian region, Azerbaijan is particularly rich in plant and animal species. It hosts approx. 4,200 plant species, approx. 660 vertebrate species, and approx. 14,000 insect species (Schmidt & Uppenbrink 2009), many of which are red listed (Baghirov & Aliyev 2013).

**Conservation effort in Azerbaijan**. Aware of the threats to its unique biodiversity since 2003 the government of Azerbaijan has established a nine National Parks, and brought more than 10 % of the country under conservation (IUCN 2014, MENR 2015). At the same time, much of the countries' biodiversity occurs outside protected areas, where it is affected by ongoing changes in land use and the effects of progressive climate change. Conserving this biodiversity inside and outside protected areas requires among others human capacity in conservation biology and the management of the habitats and landscapes that host this biodiversity. The Deutsche Gesellschaft für internationale Zusammenarbeit GmbH (GIZ) and the Michael Succow Foundation identified weak capacity in this area as a major limitation to improved biodiversity conservation To strengthen these capacities in the Baku State University, the Michael Succow Foundation was assigned with the task to develop curricula and training materials for a two-year field training programme for young lecturers and students of the Faculty of Biology and the Faculty of Ecology and Soil Science. Several trainings on the determination and monitoring of wintering water birds, songbirds, diurnal butterflies and vascular plants were conducted between 2012 and 2014. Prior to these trainings, experts of the Michael Succow Foundation and the University of Greifswald had been working in various research projects in Azerbaijan since the year 2000. More than 25 students of this university submitted their theses based on own research in this country. Many of these works are published and partly summarized in Schmidt et al. (2008) and Schmidt & Uppenbrink (2009).

**Need for capacity building and the international student excursion**. The ability to recognize and name species and understanding their habitat requirements and landscape-ecological setting is a crucial skill required by experts working in biodiversity conservation. While indoor training may help, this knowledge is primarily gained outdoors – on excursions, during field trips and

[4] Avibase (2016): Bird Checklists of the World; Azerbaidjan. Available at http://avibase.bsc-eoc.org/checklist.jsp?lang=EN&p2=1&list=clements&synlang=AZ&region=AZ&version=text&lifelist=&highlight=0. Accessed: March 2016.

investigations in the countryside. This report describes an excursion on the landscape ecology of Azerbaijan that took place in August and September of 2015. The excursion was supported by the German International Cooperation programme on Sustainable Management of Biodiversity (GIZ SMBP, South Caucasus) and led by teachers and experts from Baku State University (BSU), the University of Greifswald and the Michael Succow Foundation. Participants were students from both universities in the fields of ecology and soil science, who worked in teams to explore the species and landscapes from the lowland semi-deserts and lowland forests to mountain forests and up to the alpine grasslands in north-eastern Azerbaijan.

**Purpose of the book**. The results presented in this book are meant to provide guidance to those wishing to organize future landscape-ecological excursions in the respective areas. With the help of maps and GPS coordinates, this guidebook offers an opportunity to undertake self-organised excursions by providing detailed scientific information on vegetation, soil and land use along the excursion route of the international student excursion in 2015. With this, the field guide aims at facilitating future excursions and scientific work at BSU and other potentially interested people and organizations. It could for example also be used for education and training of experts and teachers.

**Structure of the book**. The field guide is divided into three chapters that follow:

Chapter II provides an introduction to the environment and biodiversity of Azerbaijan to allow the reader a proper understanding of the landscape-ecological setting of the biodiversity and nature conservation in the country. The chapter is based on literature review and seminars organized for the German students prior to the excursion, and was further enriched and revised by the experts who edited this book. First, the chapter offers four sections that describe the climate, the land use, the major landscapes and the bird life in Azerbaijan. This is followed by a section that describes nature conservation and the protected area system in the country. The next section then describes the geology and the geomorphology of the Greater Caucasus region, which was the focus area of the excursion. The chapter is concluded with two sections that describe the vegetation zonation of the Greater Caucasus and the vegetation of the the semi-deserts and steppes at its foothills and in the lowlands.

Chapter III provides an introduction of methods that could be applied to describe vegetation, soils, land use and birds during future landscape-ecological excursions. The chapter also describes the methods that were used during the excursion which formed the basis for the results presented in Chapter IV. It also describes the materials, which were used during the excursion and which may be considered for use during future field excurions.

Chapter IV summarizes the results of the excursion. It describes the landscapes for specific sites along each of the transects that were visited. The descriptions of geomorphology, soils, vegetation and birds observed as well as tables and maps will enable the reader to reconstruct the excursion and replicate visits to the respective excursion points. The site descriptions were prepared by tandems of German and Azerbaijani students and subsequently revised by the experts who edited this book. More specifically, the chapter guides the reader through landscapes in the coastal forest of Samur-Yalama across cultural landscapes with forests, fruit orchards and hay meadows in the foothills and lower mountains around Guba and Altiaghaj to high-mountain grasslands in the Greater Caucasus, as found in Khinalig or Laza. It also includes a description of

the lowlands and semi-desert landscapes around Beshbarmag, the lowlands of Samur-Dävächi and the Shirvan plain.

**Acknowledgements**. This excursion guide builds on prior cooperation of both universities with the Succow Foundation, supporting the education at BSU through the development of a curriculum and training materials for a two-year field training programme for young lecturers and students from the Faculty of Biology and the Faculty of Ecology and Soil Science (supported by GIZ). The excursion as well as this field guide was funded by the GIZ IBiS (Integrated Biodiversity Management, South Caucasus) and SMBP programmes. Special thanks for support during the whole process go to Dr. Oliver Kögler and Alexandra Joseph, to Rugiya Aliyeva for administrative support and to Kamil Aghayev and Natiq Ismailov for the organisational and logistic support during the excursion (all GIZ staff at that time). In addition, BSU kindly supported the excursion with the provision of accommodations during a large part of the excursion. We also thank the lecturers Elman Isgandar, Hasan Babayev and Abdin Abbasov of the BSU who accompanied the group and supported the excursion. As well, we thank Hendrik Herlyn for improving the English manuscript and Shahin Isayev for checking the spelling of the Azerbaijani bird names. Additional thanks go to Jan de Leeuw who kindly helped improving some chapters in the process of finalising this book.

Enjoy exploring!

The editors

## References

Baghirov, H. S., Aliyev, J.A. (eds.) (2013): Red Book of the Republic of Azerbaijan–Rare and Endangered Plant and Mushroom Species, Second Edition, Baku, AZ. 677p.

IUCN (2014): IUCN welcomes the Republic of Azerbaijan as new State Member. http://www.iucn.org/news_homepage/all_news_by_region/news_from_usa/?14867/IUCN-welcomes-the-Republic-of-Azerbaijan-as-new-State-Member. Accessed: August 2015.

MENR (2015): Ministry of Ecology and Natural Resources Republic of Azerbaijan. http://eco.gov.az/en (and subsequent links). Accessed: August 2015.

Myers, N., Mittermeier, R.A., Mittermeier, C.G., da Fonseca, G.A.B. & Kent, J. (2000): Biodiversity hotspots for conservation priorities. Nature 403: 853–858.

Schmidt S., Gauger, K., Agayeva, N. (2008): Birdwatching in Azerbaijan – a guide to nature and landscape. Michael Succow Foundation, Greifswald, DE. 224p.

Schmidt, S. & Uppenbrink, M. (eds.) (2009): Potential analysis for further nature conservation in Azerbaijan. Michael Succow Foundation, Geozon Science Media, Greifswald, DE. 164 p.

Williams, L., Zazanashvili, N., Sanadiradze, G., Kandaurov, A. (eds.) (2006): An Ecoregional Conservation Plan for the Caucasus. 2nd edition. WWF Caucasus Programme Office, Tbilisi, GE. 220p.

Zazanashvili, N., Garforth, M., Jungius, H., Gamkrelidz, T. (eds.) (2013): Ecoregion Conservation Plan for the Caucasus. 2012 revised and updated edition. WWF Caucasus Programme Office, Tbilisi, GE. 64p.

# II. Introduction: Understanding landscape ecology in Azerbaijan

This chapter provides an introduction to the environment and biodiversity of Azerbaijan to allow the reader a proper understanding of the landscape-ecological in the country. The chapter is based on literature review and seminars organized by the German students prior to the excursion, and was further enriched and revised by the experts who edited this book. First, the chapter offers four sections that describe the climate, the land use, the major landscapes and the bird life in Azerbaijan. This is followed by a section that describes nature conservation and the proptected area system in the country. The next section then describes the geology and the geomorphology of the Greater Caucasus region, which was the focus area of the excursion. The chapter is concluded with two sections that describe the vegetation zonation of the greater Caucasus and the vegetion of the the semi-deserts and steppes in the lowlands.

## 2.1. Climate of Azerbaijan (by Leonie Elisabeth Nikrandt)

### 2.1.1. Introduction

One unique characteristic of Azerbaijan is the wide variety of climatic conditions in a relative small area. This diversity results from the geographical location, different landscape features, influence of the Caspian Sea and the circulation of air masses (Heydar Aliyev Foundation 2016). The presence and interaction of these various factors enable the formation of nine different types of climate (Hasanov 2014, see Chapter 2.1.2.).

The geographical position for Azerbaijan is given with 38–41° northern latitude and 44–50° eastern longitude (Hasanov 2014). All in all, around 284 days of sunshine are generally registered (Altmann et al. 2012).

"*The sun is bright during 2,200–2,500 hours a year at the altitude of over 3,000 metres. The total annual radiation equals to 28–132 kilocalories per 1 sq. cm. It declines towards the mountains (down to 120–124 kcal-cm², at a height of 500–600 metres above sea level), then gradually increases and reaches 140–150 kcal-cm² at a height above 3,000 metres of Major and Minor Caucasus*" (Heydar Aliyev Foundation 2016).

Azerbaijan belongs to the subtropical zone, shows a mean annual temperature of 13.1 C° and a mean summer temperature of 26 °C (ibid.). Most of the country (60 %) is mountainous, while 18 % of the land lies below sea level (Hasanov 2014).

The Greater Caucasus, as one of the major mountain ranges, serves as an important influencing factor for the climate. It is located in the north of Azerbaijan and stretches from west to east across the country. Cold air masses from the north are diverted to the east and west. As a consequence, the originally cold air masses are heated up. This process occurs predominantly due to the contact with the Black and Caspian Seas. Finally, moderate air masses reach the interior land area of Azerbaijan (Hasanov 2014; Zazanashvili et al. 2000).

Two other important relief features are the Lesser Caucasus and the Talish Mountains in the south. Acting as obstacles, they both lead to a more moderate climate. In fact, they protect against the invasion of dry, warm, tropical air masses from the south (Hasanov 2014; Zazanashvili et al. 2000).

In addition, the Caspian Sea plays a leading role in converting air masses from central Asia into more moderate conditions. As a result, these eastern air masses are less cold in the winter and less dry and warm in the summer (ibid.). Besides sun radiation, relief and the presence of large water bodies, a wide range of air masses affects the climate. These are (apart from local movements of air):

- Kara and Scandinavian Arctic anticyclones
- Azores, Siberian and Central Asian anticyclones
- Southern cyclones, which originate from the Mediterranean Sea
- Tropical air masses (ibid.).

According to Altmann et al. (2012), the general aspects of Azerbaijan's climate contain an interior with semi-desert/desert climate, while the coastal region is warm and windy throughout the entire year. In the mountains, an arctic-alpine climate prevails. Azerbaijan usually shows low amounts of precipitation.

Fig. 1 illustrates the distribution of average rainfall. Significant are the lower amounts in the lowlands and the increasing rates at higher altitudes.

Fig. 2 illustrates the large temperature differences present in Azerbaijan. Again, a difference between the lowland and mountainous regions is clearly visible.

Average climate data for the country are given in Tab. 1.

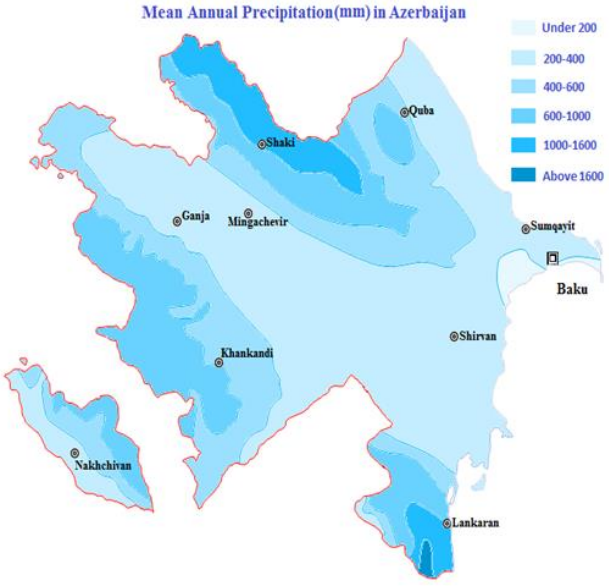


**Fig. 1:** Annual mean precipitation (mm) in Azerbaijan. Source: Kagan (2014)

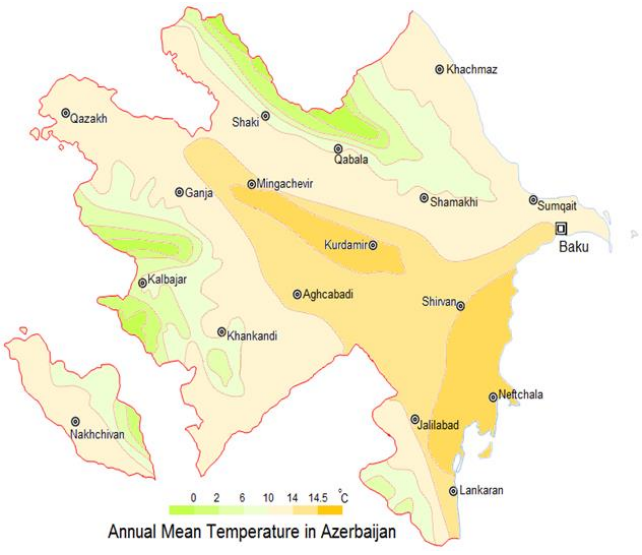


**Fig. 2:** Annual mean temperature (°C) in Azerbaijan. Source: Kagan (2014)

**Tab. 1:** Climate data for Azerbaijan (Source: Ipicture 2016)

| | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| min. temp. | -1 | -1 | 3 | 7 | 13 | 16 | 19 | 19 | 15 | 10 | 5 | 1 | °C |
| max. temp. | 7 | 8 | 13 | 17 | 25 | 28 | 31 | 30 | 26 | 19 | 14 | 10 | °C |
| humidity | 70 | 69 | 69 | 65 | 56 | 51 | 50 | 50 | 58 | 66 | 71 | 76 | % |
| rain days | 8 | 6 | 8 | 11 | 11 | 11 | 6 | 6 | 7 | 8 | 6 | 7 | /month |

## 2.1.2. Nine different types of climate

As already mentioned, many authors divide the area of Azerbaijan into nine different climatic regions (Burmester 2005). The description below follows Hasanov (2014).

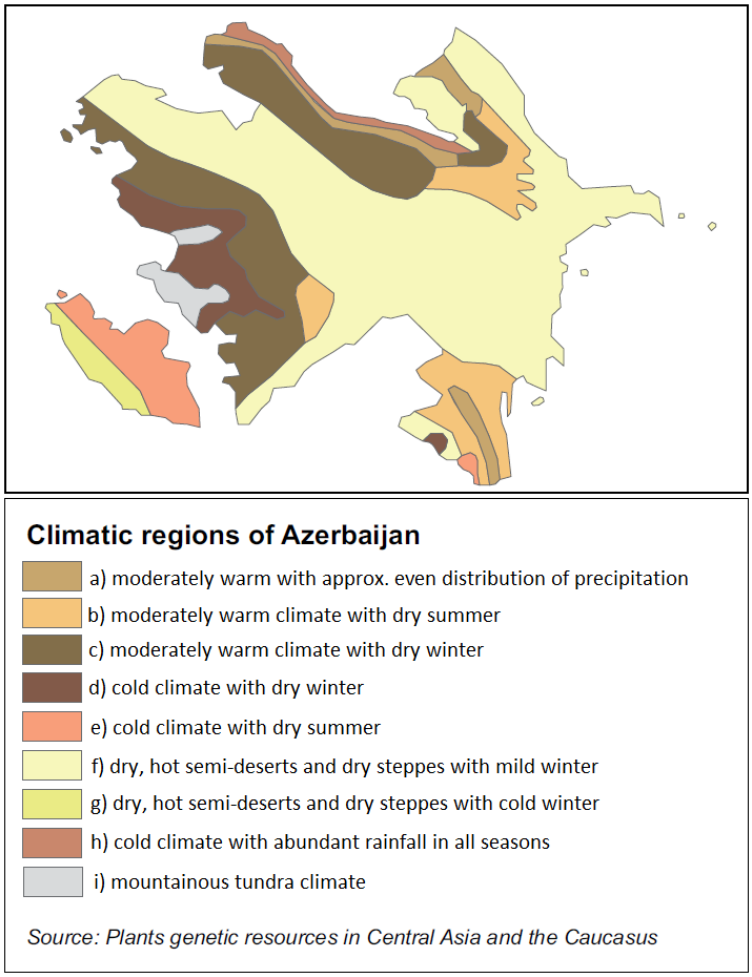


**Fig. 3:** Climatic regions in Azerbaijan (Source: Schmidt & Uppenbrink (2009), referring to Embassy of the Republic of Azerbaijan (2009), original not available)

a) *Climate of semi-deserts and dry steppes with mild winter and dry, warm summer:*

This type of climate is characterised by a precipitation of 400 mm/yr., a mean temperature of > 10 °C/yr.; the hottest month has a mean temperature varying between 26 and 27 °C, whereas the coldest month shows mean temperatures between 2 and 4 °C. This type covers about 50 % of Azerbaijan; for instance, the Samur-Dävächi lowlands and Gobustan belong to this first type.

b) *Climate of semi-deserts and dry steppes with cold winter and dry, warm summer:*

The average annual precipitation is noticeably lower (200–400 mm) than in type a), as is the mean annual temperature (10–14 °C). However, the mean temperature of the hottest month is the same as in the above-mentioned climate type (26–27 °C). In contrast, the mean temperature of the coldest month is different at -5 to -4 °C. The climate of semi-deserts and dry steppes with cold winters and dry, warm summers is found along the river Araz.

c) *Moderately warm climate with dry winter:*

This type is characterised by a mean temperature of 0–3 °C (in terms of defining the coldest month), 20–24 °C (in relation to the hottest month), and an average precipitation of 400–600 mm/yr. With this amount of rainfall, it exceeds the precipitation of type a) and b). The mean annual temperature barely exceeds the 10°C margin (10–12 °C). The moderately warm with dry winters is encountered in parts of the Greater Caucasus, but also in parts of the Lesser Caucasus.

d) *Moderately warm climate with dry summer:*

This climate is defined by rather high amounts of rainfall (up to 1000–1,600 mm per year) and consequently gives rise to the maximum amount of precipitation in Azerbaijan. The mean temperature of the coldest month is not only above, but also below freezing (-3 to +3 °C) and the mean temperature of the hottest month exceeds the 20 °C margin (20–25 °C). This climate type is found in the Talish Mountains, for example.

e) *Moderately warm climate with approximately even distribution of precipitation*:

This type is found in the Greater Caucasus (southern and north-eastern slopes) and also in the Talish Mountains (centre). The mean annual precipitation is also high (600–1,000 mm). The mean temperature of the hottest month lies between 15 and 20 °C, and the mean of the coldest month between -6 and -0.3 °C. With 6–10 °C, the mean annual temperature never rises above the 10 °C margin.

f) *Cold climate with dry summer:*

The mean annual precipitation from 300 to 600 mm is evidently lower than in type e). On the other hand, this climate type exceeds the mean temperature of the hottest month (15–25 °C) and the mean annual temperature (+6–10 °C) of the previously mentioned types. The cold climate with dry summers can frequently be found in Nakhchivan Autonomous Republic.

g) *Cold climate with dry winter*:

The average precipitation is 600–800 mm. The hottest month shows temperatures between 15 and 20 °C, the coldest month between -3 and 0 °C, and the mean annual temperature ranges from 6 to 10 °C. This cold climate with dry winters is encountered at an altitude of 1,000–2,700 m in the Greater Caucasus and 1,400–2,700 m in the Lesser Caucasus.

h) *Cold climate with abundant rainfall*:

This type of climate can only be found on the southern slope of the Greater Caucasus. Most

significant is the high mean annual precipitation, which lies between 900–1,600 mm. The temperature of the coldest month is relatively cold (-6 to -3 °C). The hottest month, in turn, does not show temperatures above 20 °C (15–20 °C). As a result, the mean temperature is relatively low (2–6 °C).

i) *Climate of the mountain tundra*:

This climate type is found in the Greater and Lesser Caucasus at altitudes above 3,000 m. The mean annual temperature from 0 up to 2 °C is an indication of the low mean temperature of the hottest month (5–10 °C) and also of the low mean temperature of the coldest month (-10 to -6 °C).

These nine different types of climate in Azerbaijan illustrate the high variation in temperature and precipitation conditions. This serves as one explanation for the high variability of ecosystems, the numerous plant and animal species and also the different land use patterns (see Chapter 2.2.).

### 2.1.3. Natural areas of Azerbaijan and their climatic conditions

Schmidt et al. (2008) divide Azerbaijan into the following regions with characteristic climatic conditions:

- Coastal region, which is arid to semi-arid and is characterised by precipitation amounts between 200–300 mm. One example is Baku, with a mean annual precipitation of 210 mm (see Fig. 5). Länkäran should be specially emphasised; it lies in the southernmost part of the coastal region and shows in average rainfall of more than 1,000 mm/yr (see Fig. 7).
- Central lowlands, with mostly arid to semi-arid parts. The altitudes are mainly between 27 and 80 m. The Shirvan plain with a precipitation of 300 mm/yr is one example of this region.
- Dry foothills, with semi-arid/dry-subtropical climate characterised by an annual precipitation that varies between 200–400 mm. For instance, Gobustan can be mentioned here, with only 250 mm/yr. One important factor in this area is the elevation.
- Greater Caucasus, with a permanent snow line above 3,900 m. The city of Guba is located in this area (mean annual precipitation of 525 mm and a mean temperature of 10.2 °C, see Fig. 7).
- Lesser Caucasus, with Gänjä at its edge as an example (see Fig. 5), which has warm summer temperatures averaging up to 25 °C and a mean annual precipitation around 300 mm.
- Talish Mountains, showing a decrease in precipitation with increasing distance to the Caspian Sea. The lower parts of Talish are subtropical, with high humidity and high amounts of rainfall (see Fig. 7 "Lenkoran").
- Nakhchivan, which is more continentally influenced, with weather somewhat similar to the lowlands.

## 2.1.4. Examples

The following map (Fig. 4) and climate graphs (Fig. 5, Fig. 7) were created by Mühr (2014) and give a visual impression whether, for instance, a lack of rainfall occurs or temperatures below freezing require specific adaptations by the flora and fauna. The abbreviations refer to the Köppen climate classification. In the upper left corner, the altitude of the location is given; in the upper right corner, the mean annual temperature and precipitation can be found. The left axis gives the precipitation in mm, while the right axis gives the temperature in °C. The lower axis represents the 12 months. The correct transliterations of the seven climate stations are given in the caption of each graph.

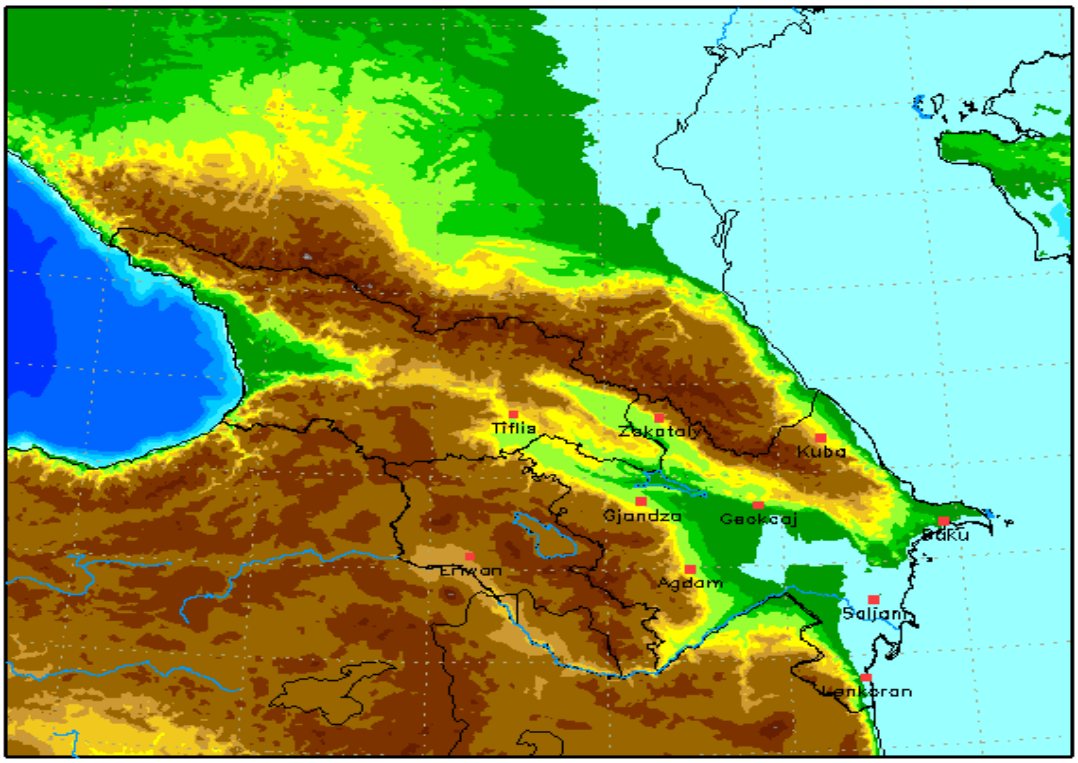


**Fig. 4:** Selection of climate stations in Azerbaijan (Source: Mühr 2014)

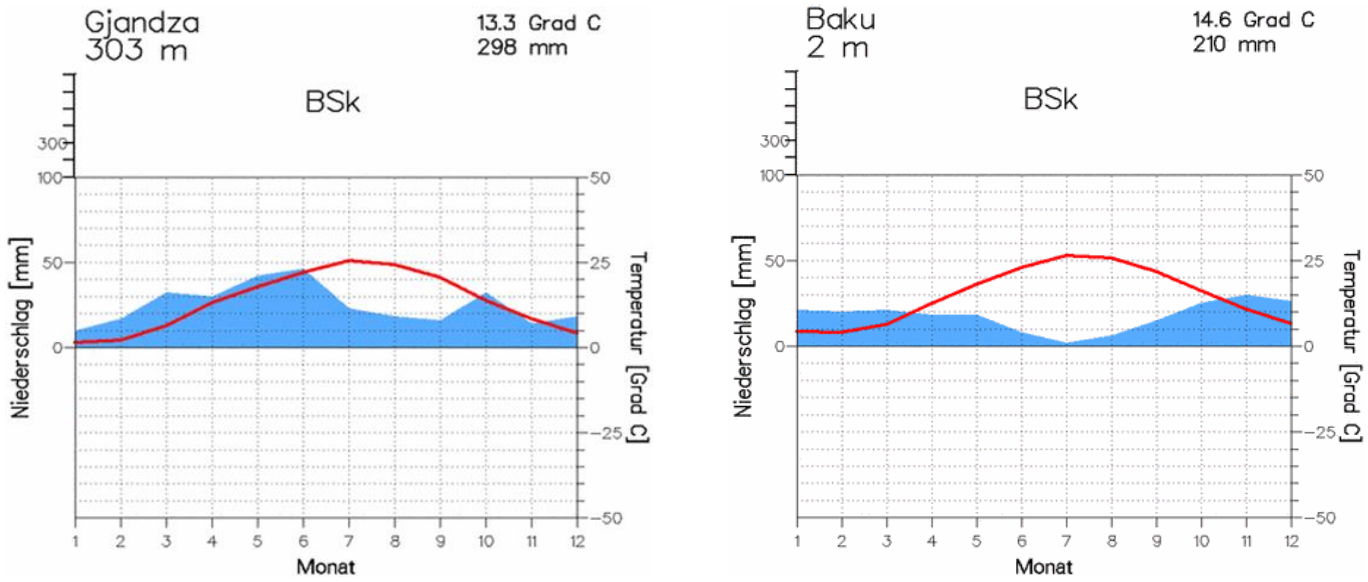


**Fig. 5:** Climate diagrams of Gänjä (left) and Baku (right), BSk belongs to the Semi-arid Mid-Latitudes. (Source: Mühr 2014)

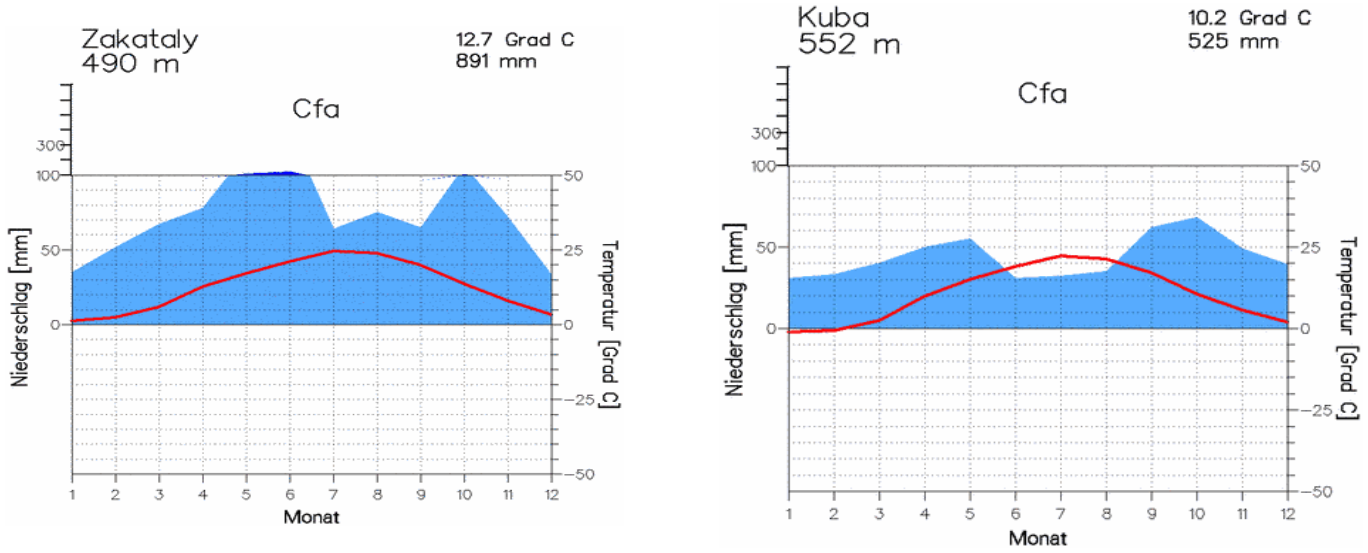


**Fig. 6**: Climate diagrams of Zagatala (top left), Guba (top right), (Source: Mühr 2014), (Cfa belongs to the Humid-Subtropical climate, Csa belongs to the Mediterranean climate)

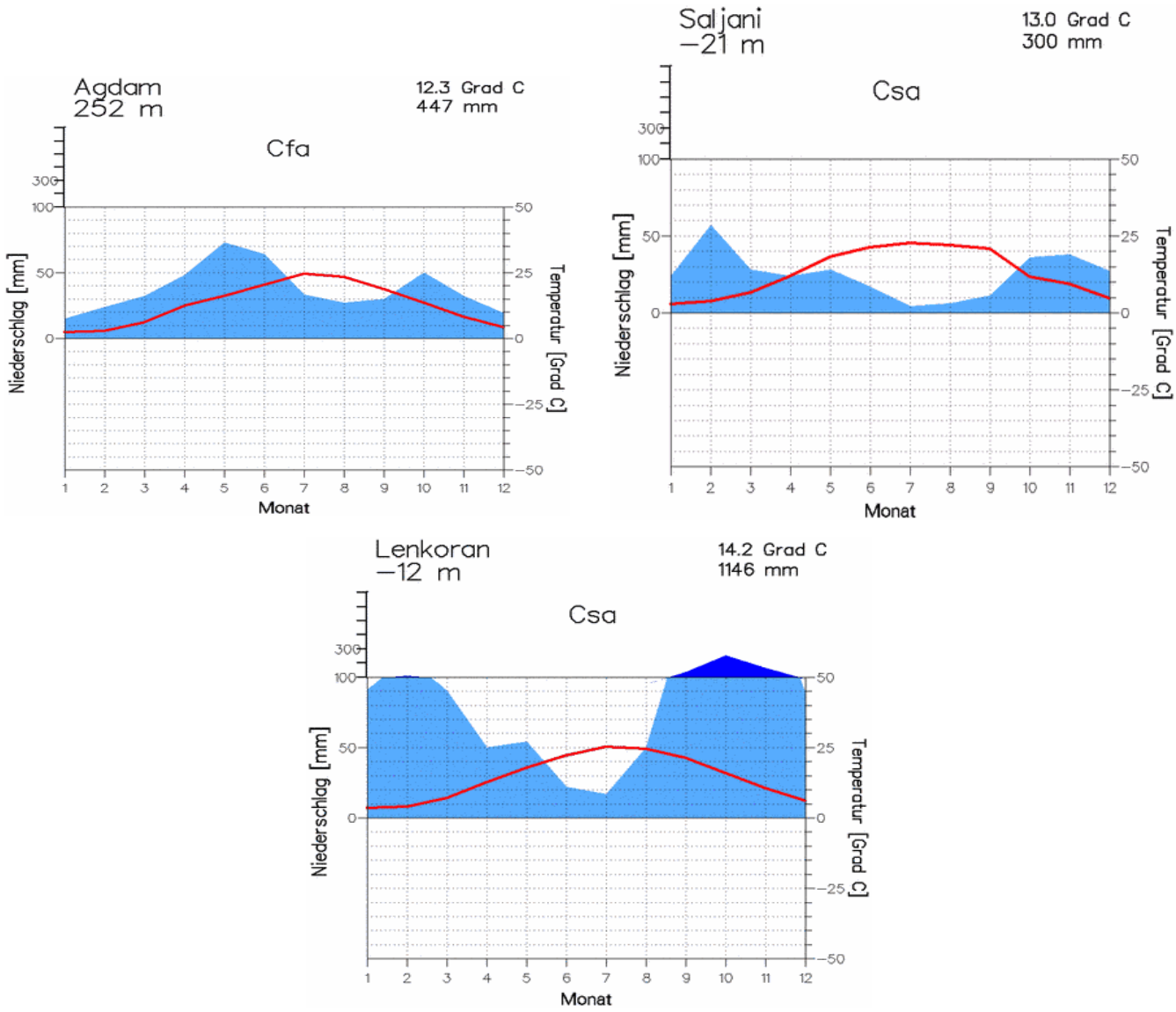


**Fig. 7:** Climate diagrams of, Agdam (top left) and Salyan (top right) and Lenkoran (bottom), (Source: Mühr 2014), (Cfa belongs to the Humid-Subtropical climate, Csa belongs to the Mediterranean climate)

## References


Altmann, G., Läzer, G., von Oppeln, P. (2012): Aserbaidschan. Second edition, Trescher Verlag, Berlin, DE. 229p.

Burmester, A. (2005): Socio-economic situation and land use conflicts in the Shirvan National Park Region, Azerbaijan. Diploma thesis, Institute of Botany, Greifswald University, DE. 153p.

Hasanov, M. (2014): Climate of Azerbaijan as natural treasure. In: My Azerbaijan. IRS (editor), No. 19/2014, 22–29.

Heydar Aliyev Foundation (2016): The climate-forming factors. http://www.azerbaijan.az/portal/Nature/Climate/climate_e.html. Accessed: February 2016.

Ipicture (2016): Wetter und Klima in Aserbaidschan. http://www.ipicture.de/daten/wetter_aserbaidschan.html. Ipicture – Die Welt im Bild. Accessed: February 2016.

Kagan, A. (2014): Climate of Azerbaijan. http://en.wikipedia.org/wiki/Climate_of_Azerbaijan#/media/File:Annual_Mean_Temperature_in_Azerbaijan.png and https://en.wikipedia.org/wiki/Climate_of_Azerbaijan#/media/File:Mean_annual _perseption_in_azerbaijan.png. Accessed: February 2016.

Mühr, B., (2014): Klimadiagramme weltweit: Aserbaidschan. http://www.klimadiagramme.de/Asien/aserbaidschan.html. Accessed: February 2016.

Schmidt, S., Gauger, K., Agayeva, N. (2008): Birdwatching in Azerbaijan – a guide to nature and landscape. Michael Succow Foundation, Greifswald, DE, 224p.

Zazanashvili, N., Gagnidze, R., Nakhutsrishvili, G. (2000): Main types of vegetation zonation on the mountains of the Caucasus. Proceedings IAVS Symposium, Opulus Press, Uppsala, SE: 214–217.

## 2.2. Land use in Azerbaijan (by Jasmine Kischkat)

### 2.2.1. Introduction

One of Azerbaijan's primary goals today is to remove the economy's dependence on oil and to assure the expansion of the economic development to rural areas. Agriculture, as the third biggest sector in Azerbaijani economy, employs nearly 40 % of the labour force (Heydar Aliyev Foundation 2016). Land use is mainly characterised by farming (with emphasis on irrigation farming) and semi-nomadic animal husbandry (Schmidt et al. 2008). A favourable climate allows two harvests per year in many regions, and the use of many pastures is possible throughout the year. 61 % of the agricultural production is provided by farming and 39 % by livestock breeding (Azerbaijans.com 2011a). The agricultural sector has shown remarkable growth rates during the past years: from 2003–2007, an average of 4.5 %, continuing in the following years (Azerbaijans.com 2011b). For 2009, a growth rate of 6.7 % is reported, as compared to 2008 (DAF 2016).

The distribution of the total land resources of Azerbaijan (around 86,600 km$^2$) is given in Tab. 2 below.

**Tab. 2:** Distribution of the total land resources of Azerbaijan, with focus on agriculture. (Source: Schmidt & Uppenbrink (2009), quoting Khanalibayli (2008), original not available).

| | | | | |
|---|---|---|---|---|
| **Total land resources** | | | **8,641,500 ha** | |
| Other land (not specified) | | 33.6 % | 2,900,200 ha | |
| Forest | | 14.0 % | 1,213,000 ha | |
| **Agricultural land** | | **52.4 %** | **4,528,300 ha** | |
| Consisting of | Arable land | 36.2 % | 1,641,000 ha | of which irrigated ~ 87 % (~1,433,000 ha) |
| | Permanent crops | 3.40 % | 155,500 ha | |
| | Pasture | 56.90 % | 2,576,500 ha | |
| | Hayfields | 2.40 % | 109,600 ha | |
| | Fallow land | 1 % | 45,700 ha | |
| Total agricultural land | | 100 % | 4,528,300 ha | |

The strong economic growth of Azerbaijan challenges many of its ecosystems. High-mountain grasslands, steppes and semi-deserts suffer from overgrazing, unregulated construction, contaminated soils and poaching of wildlife such as the last remaining Goitered Gazelles (Peper 2012).

### 2.2.2. Major crops

The agricultural production in Azerbaijan is diverse. The major crops cultivated are wheat, cotton, different vegetables, potatoes, wine and tobacco. In addition, barley, rye, oat, corn, millet, rice, legumes, fruits like berries, nuts, tea, olives and forage crops are also cultivated (DAF 2016). Other crops grown in Azerbaijan include sugar beets, sunflower seeds, saffron and henna plant (Azerbaijans.com 2011a).

Only 20 % of the national demand for grain is met locally; the rest is imported. The average productivity per hectare is 17 dt. Grain cultivation is divided into non-irrigated and irrigated farming. Non-irrigated (rain-fed) grain production is mostly done in the mountainous regions where sufficient precipitation occurs, while in the lowland (plain) regions grain production succeeds only with irrigation. Vegetables are grown in all areas, with a certain focus on the Länkäran region. Most potatoes are planted in the western region (mainly rain-fed) (Azerbaijans.com 2011a).

The very labour-intensive but highly profitable viticulture is mainly carried out on irrigated land (60 %) in lowland areas, while the other 40 % takes place in rain-fed foothill situations. There are over 250 cultivated grape varieties, mostly for wine production but also sold as table grapes, raisins or currants (Azerbaijans.com 2011a).

### 2.2.3. Animal husbandry

As mentioned above, animal husbandry is the other important land use sector in Azerbaijan. It encompasses, among others, primarily the rearing of cattle and sheep, which mostly serve for meat and milk production. In addition, poultry is bred, and silkworms are raised for silk production (DAF 2016), but bee-keeping is of regional importance as well (Azerbaijans.com 2011a).

Most of the livestock is grazed on pastures, which cover approximately 30 % of Azerbaijan's total land resources (see Tab. 2). The development of the numbers of the four most important grazing livestock species is shown in Fig. 7

Besides common cattle kept for meat and milk-meat production all over the country, in the south (Lerik-Yardimly) zebu-type cattle are raised as well. Buffaloes are most widespread in water-rich lowland regions. Sheep husbandry (including goats) is mainly dependent on grazing on summer- and winter pastures and hence on the natural forage base (Azerbaijans.com 2011a).

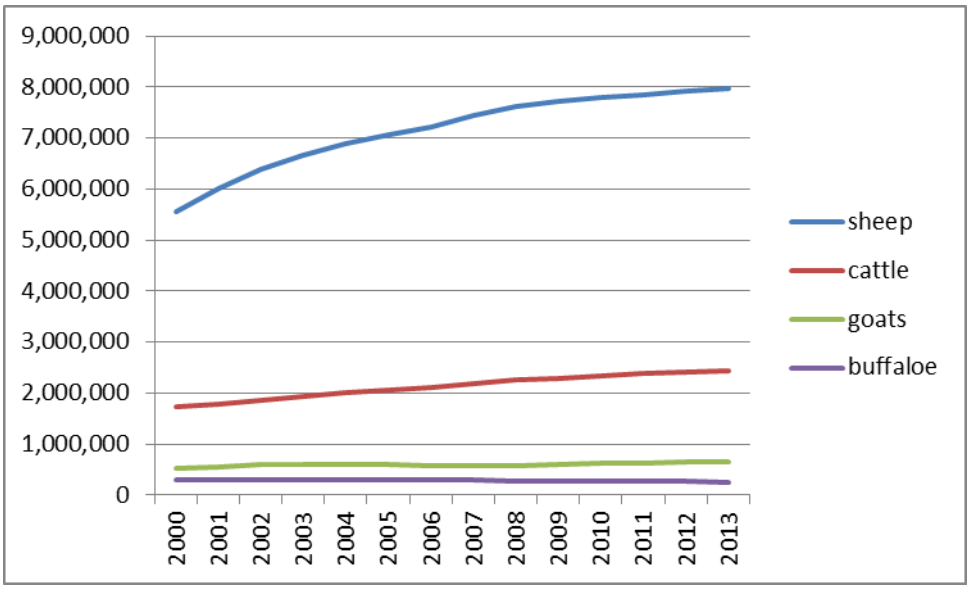


**Fig. 8:** Numbers of the most important grazing livestock species from 2000 to 2013 (Source: State Statistical Committee of the Republic of Azerbaijan 2015)

After spending October through May on winter pastures in semi-deserts and steppes below 700 m a.s.l., a large-scale migration to the summer pastures in the mountain regions located above 1,700 m a.s.l. takes place at the end of May (Neudert et al. 2015).

The mobile pastoralism can be traced back to the beginning of the modern time system (Schmidt et al. 2008). Under Tsarist and socialist influence, it was attempted several times to suppress the annual movement of herds of sheep. Furthermore, the introduction of irrigation agriculture for large-scale cotton production was radically reducing the winter pastures. After abandoning the practice of suppressing mobility, pastoralism was reorganised in collective herds, which again migrated regularly between summer and winter pastures (Neudert et al. 2015). In the early 1990s, the pasture area was again reduced significantly, since with the "territorial conflict over Nagorno Garabagh, the summer-pastures in the Lesser Caucasus are off-limits for many herds today, which increased the pressure on other regions in Azerbaijan" (Schmidt et al. 2008: p.38).

### 2.2.4. Land ownership

Since Azerbaijan gained its independence in 1991, the legislation regarding land tenure, land markets and land registers has thoroughly changed. Accordingly, this led to changes in the structures of land ownership and land use. Today, three forms of landownership exist:

- state ownership
- public (municipal) ownership
- private ownership

The *state ownership* includes land on which governmental authorities or military estates are located. Mineral or water resources and nature protection areas normally belong to the state and cannot be privatised. Land can only be purchased by Azerbaijani citizens; foreign persons or organisations can merely lease land. The *municipality* is a local self-governing institution. The

municipalities have their own property, budget and election bodies. The municipal land includes land for different purposes and reserve stock land (Schmidt & Uppenbrink 2009).

### 2.2.5. History of land tenure and land use

The Soviet collectivisation of the 1920s and the privatisation in the 1990s were the two major events in the 20th century that impacted the formation of the land use system in present-day Azerbaijan. The consequence of collectivisation was an extensive utilisation of almost all available land areas, accompanied by a vast increase of arable land. On top of that, privatisation led to increased pressure on remaining arable regions, caused by the abandonment of fallow land (Schmidt et al. 2008). The economy changed from a centralised to a market-oriented system, and Soviet *Kolkhoses* and *Sovkhoses* (collective and state agricultural farms) were distributed among farm workers and villagers (Neudert et al. 2015).

The "Law on land reform," issued in July 1996, set the basis for the first privatisation. In the course of this, employees of collective farms were given livestock and machinery resources. However, the pastures themselves were still controlled and administrated by collective farms. In the following years, a dramatic decline in pastoralism ensued, resulting in the herding of just a few animals per family on common pastures around their homes. For maintaining mobile pastoralism they would have required bigger herds that allow for sufficient revenues to cover the costs of migrations and winter pasture lease (Neudert et al. 2015).

The legal basis for the reorganisation of property rights is the "Land Code" (issued June 25, 1999). Starting in 2000, arable land and meadows were privatised; however, pasture resources continued to be controlled by the state, while newly established pastoral farms were given an opportunity to rent pastures from the state.

Along with the exploitation of oil reserves and the resulting increase of wealth in Azerbaijan, a rapid increase in prices set in. Thus, "[...] the price development for sheep and goat meat exceeded the growth rates of the price index for animal products" (Neudert et al. 2015, p. 661). Following the increase of meat consumption, the demand for meat started to exceed the supply and prices rose along with prices for other food products. In particular, high prices for lamb meat caused pastoral farmers to focus more on meat than on wool production, making sheep production highly profitable. This profitability of sheep farming led to a new peak of livestock numbers in Azerbaijan in 2008. In addition to this, rapid allocations of pasture resources in 2004 and 2006 already had indicated an increasing value of pastures. GDP growth, the aforementioned increase in livestock numbers and higher prices for such products add to this increased value (Neudert et al. 2015).

According to Schmidt & Uppenbrink (2009), the agricultural production is organised in about 2,650 municipal cooperatives, 1,200 collective farms, 150 farmers' cooperatives and 840,000 family farms. Since 1999, farmers are exempt from all taxes and a leasing system of land machines was introduced to support the existence of small farms. Since the breakdown of the Soviet Union, the share of the private sector in the agricultural production has been extremely high. Although privatisation and the resulting subsistence farming ensured the farmers' livelihood, unregulated and uncontrolled utilisation led to a deterioration of land use. "Despite

existing regulations, the present land use practices are dominated by an intensive utilisation and frequent overexploitation of the natural resources" (Schmidt et al. 2008: p. 38).

## References


Azerbaijans.com (2011a): Agricultural, Agrarian - industrial complex. http://www.azerbaijans.com/content_465_en.html. Accessed: March 2016.

Azerbaijans.com (2011b): Development of agriculture and food security. http://azerbaijans.com/content_1771_en.html. Accessed: March 2016.

DAF (2016): Aserbaidschan – Wirtschaft – Agrarsektor. http://www.aserbaidschan-aktuell.de/wirtschaft/agrarsektor/. Deutsch Aserbaidschanisches Forum e.V. Accessed: March 2016.

Heydar Aliyev Foundation (2016): Agriculture. http://www.azerbaijan.az/_Economy/_Agriculture/_agriculture_e.html. Accessed: March 2016.

Neudert, R., Ruehs, M., Beckmann, V. (2015): Implementation of pasture leasing rights for mobile pastoralists – a case study on institutional change during post-socialist reforms in Azerbaijan. International Journal of the Commons, 9 (2): 648–669.

Peper, J. (2012): Initiativen der Michael-Succow-Stiftung zum Schutz der Natur in Aserbaidschan. In: Steppenlebensräume Europas – Gefährdung, Erhaltungsmaßnahmen und Schutz. Tagungsband 2012, Ministerium für Landwirtschaft, Forsten, Umwelt und Naturschutz, Thüringen, DE: pp. 447–452.

Schmidt S., Gauger, K., Agayeva, N. (2008): Birdwatching in Azerbaijan – a guide to nature and landscape. Michael Succow Foundation, Greifswald, DE. 224 p.

Schmidt, S. & Uppenbrink, M. (eds.) (2009): Potential analysis for further nature conservation in Azerbaijan. Michael Succow Foundation, Geozon Science Media, Greifswald, DE. 164 p.

State Statistical Committee of the Republic of Azerbaijan (2015): Numbers of main livestock: http://www.stat.gov.az/source/agriculture/indexen.php. Accessed: August 2015.

# 2.3. Overview of the landscape types in Azerbaijan (by Lena Haeberlein)

## 2.3.1. Introduction

Azerbaijan is bordered by the Lesser Caucasus to the southwest, the Greater Caucasus to the northeast and the Caspian Sea to the east, including the Absheron peninsula where Baku is located.

The immense lowlands are covered by steppes, semi-deserts and wetlands in the river deltas, at lake shores and in part along the coastline, which is more than 850 km long (ADB 2014). Higher up, the dry foothills connect the mountain ranges with the interior land area. To the south near the Iranian border, the Talish Mountains with the Hyrcanian Forests rise up close to the Caspian Sea.

Nearly half of Azerbaijan's surface (86,600 km² in total) is covered by mountainous areas. Forest ecosystems in floodplains and on mountains constitute up to 11 % of the territory, and 55 % of the territory is used as pastureland or crop fields. Semi-deserts cover more than 30 % of the country's area in the Kura-Araz lowlands.

Due to different climatic influences (see Chapter 2.1.) and the huge variation in altitudes, the landscapes of Azerbaijan are very diverse. Five main landscape types can be distinguished (Walter 1974, Schmidt & Uppenbrink 2009; ADB 2014):

1. Forest ecosystems (floodplain and mountain forests)
2. High-mountain ecosystems (forests, sub-alpine and alpine grasslands)
3. Dry mountain shrubland ecosystems
4. Steppe and semi-deserts ecosystems
5. Wetlands and coastal ecosystems

## 2.3.2. Forest ecosystems

Approximately 11 % of Azerbaijan's land area is still covered by forests (ADB 2014). These can be found in both the Greater (49 %) and the Lesser Caucasus (34 %) as well as in the Talish Mountains (12 %) and in the Kura-Araz lowland (2.5 %) (Schmidt et al. 2008).

The forests of Azerbaijan can be divided into floodplain forests and mountain forests. They all have in common that they are mostly unofficially used for grazing, fuel wood and timber production, often resulting in a high risk of erosion (Gerasimov 2014).

### *Lowland forests*

Due to the low precipitation in the lowlands, the occurrence of forests here is almost exclusively restricted to floodplains. In former times, these forests were widely distributed, but due to their mostly fertile soils, they are used for agriculture or were lost because of river development (Peper 2006). Today, relevant remains can only be found in the Garayazi Strict Nature Reserve and the

Samur-Yalama region (mainly in the newly established National Park). They are dominated by White Poplar (*Populus alba*), Wingnut (*Pterocarya pterocarpa*) and Common Oak (*Quercus robur* subsp. *pedunculiflora*) (Schmidt et al. 2008).

### *Mountain forests*

These forests are found in the Greater and Lesser Caucasus and range from 500 to 2,500 m a.s.l. The most common tree species are Oriental Beech (*Fagus orientalis*), two hornbeam species (*Carpinus orientalis* and *Carpinus betulus*) and oaks. At the lower and mid elevations, the Georgian Oak (*Quercus petraea* subsp. *iberica*) is most common, and at the higher elevations up to the tree-line, the Persian Oak (Q*uercus macranthera*) dominates. Other important species at both high and lower elevations are the Caucasian Lime (*Tilia begoniifolia*), Sweet Chestnut (*Castanea sativa*), European Ash (*Fraxinus excelsior*) and Red-bud Maple (*Acer trautvetter*i). The vegetation changes with altitude, but also depends on the exposure. The southern slopes of the Greater Caucasus are dominated by oaks, maple, hornbeam and lime, whereas the northern slopes are characterised by beech and oak (Walter 1974; Schmidt et al. 2008).

### *Hyrcanian Forests in the Talish Mountains*

The Hyrcanian Forests close to the Iranian border and the Caspian Sea are a special type of subtropical forest. They are rich in relict species, since during the ice ages, favourable conditions continued to prevail in this region and tertiary species such as Irontree *(Parrotia persica)*, Caspian Locust (*Gleditsia caspia*), Caucasian Elder (*Alnus subcordata)* or Chestnut-leaved Oak (*Quercus castaneifolia*) could survive here. With a high number of endemics, these forests have a unique character (Scharnweber et al. 2007).

## 2.3.3. High-mountain ecosystems

The sub-alpine and alpine grasslands, which are located above the tree line in the Greater and Lesser Caucasus, are very rich in plant species (up to 70 different species on 10m²) (Schmidt et al. 2008). The boundary between them is often hard to define, depending on humidity and exposure, and ranges from 2,100 to 2,700 m a.s.l. (Walter 1974). Between 1,900 and 2,500 m a.s.l., plant species diversity is at its highest. These grasslands, which often contain many geophytes, are still mostly surrounded by sub-alpine shrublands, composed of birches, e.g., which form the treeline in many areas.

The alpine zone is characterised by grasslands, frequently in the form of short-growing alpine lawns (e.g., with *Carex tristis*) (Walter 1974; Schmidt et al. 2008).

## 2.3.4. Dry mountain shrubland ecosystems

These ecosystem types can be found between 600 and 1,000 m a.s.l., primarily in the eastern part of the Greater Caucasus and along the lower dry foothills. They are characterised by shrub-like forests with Pistachio (*Pistacia mutica*), Juniper (*Juniperus excelsa*), Jasmine (*Jasminum fruticans*) and

Almond (*Prunus fenzliana*). They occur together with steppe and semi-desert ecosystems, as these regions are affected by summer droughts and have a more continental climate. It is not known for certain whether these forests are of natural origin or the result of the long period of human influence (Schmidt & Uppenbrink 2009).

### *Juniperus forests south of Altiaghaj*

*Juniperus excelsa* and other juniper species grow on the slopes of the mountains in the Altiaghaj region between 830 and 1,300 m a.s.l. They form sparse forests and shrublands of xerophilous tree species such as *Crataegus orientalis*, *Lonicera iberica* and *Pyrus salicifolia*. Due to the high land use pressure (grazing, burning, fuel wood collection), these landscapes have the more steppe-like character of heath- or shrublands (Schmidt & Uppenbrink 2009).

## 2.3.5. Steppe and semi-deserts ecosystems

### *Steppe ecosystems*

As all across the former Soviet Union, steppe ecosystems also used to be widespread in Azerbaijan's lowlands, from the Caspian Sea to the dry foothills of the Greater Caucasus (between 500/600 m to 1,000 m a.s.l.) (Walter 1974). Today, most of the steppes have been transformed into crop fields, accounting for more than half of the country's total agricultural area. In many areas where irrigation is not possible, the use for grazing in winter has led to changes in the soil conditions and species composition, resulting in a semi-desert character.

Areas with a secondary steppe character can be found in places formerly occupied by woodlands (originally covered with semi-arid tree species such as *Pistacia mutica, Juniperus* species*, Celtis australis* subsp. *caucasica, Acer ibericum, Pyrus salicifolia*) that turned into steppes as a result of human use. Remaining patches of steppe are dominated by grasses such as Feather Grass (*Stipa* species), *Festuca* species, or Plains Blue-stem (*Bothriochloa* species) (Walter 1974; Schmidt et al. 2008; Peper 2012).

### *Semi-desert ecosystems*

Naturally, semi-deserts occur in Azerbaijan in the lowlands up to 400–600 m a.s.l. (Walter 1974). As mentioned above, semi-deserts are also a result of degradation of former steppes due to grazing. Those that are not grazed have been used for irrigation agriculture (cotton and wheat) for decades, having a lower productivity compared to steppes.

The main types are wormwood semi-deserts and saltwort semi-deserts. The wormwood type is dominated by *Artemisia fragrans*.

The saltwort type is characterised by various chenopodiaceous species (e.g., *Salsola dendroides, Salsola ericoides, Suaeda dendroides, Salicornia europaea*), often indicating a salinity gradient with their specific species compositions (Schmidt & Uppenbrink 2009, see also Chapter 2.8.).

*Mud volcanoes in the Gobustan region:* The many mud volcanoes found within steppe and semi-desert

ecosystems at the dry foothills of the Greater Caucasus, mainly in the Gobustan region (most within a circle of ~100 km from Baku, see also Chapters 2.8. and 4.3.1.), are of special interest.

### 2.3.6. Wetlands and Coastal ecosystems

The Caspian Sea, as a remnant of the historical ocean Tethys (see also Chapter 2.6.) is home to a flora and fauna with many ancient species, such as five sturgeon species (90 % of the world's population) and the Caspian Seal (*Pusa caspica*).

Due to the fluctuating sea level, the shoreline hosts highly dynamic wetland systems that are used by millions of migratory, wintering and nesting birds (see Chapters 2.4 and 2.5).

The plant communities in the wetlands are mainly dominated by widespread species such as Common Reed (*Phragmites australis*) or rushes (*Juncus* species). Many wetlands are places of salinization due to sinking water levels in the summer. Two lakes, Aghgöl and Sarisu, are the two most important wetlands in the interior lowlands, surrounded by extensive reed belts. Besides Gizilaghaj Bay, the two coastal wetlands described below are of particular importance (Schmidt et al., 2008).

#### *Samur-Dävächi lowlands*

The rare sand dune-lagoon complex is located in the north of Azerbaijan in a flat plain between the Caspian coast and the foothills of the Greater Caucasus. The complex (around 12 km long) behind the sandy beach consists of dunes and lagoons on clayey ground. The lagoons are irregularly flooded by sea water. Between the bare dunes, *Elaeagnus caspica, Tamarix ramosissima, Populus alba* and planted *Pinus brutia* occur, as well as reed vegetation, psammophytes and halophytes. 230 bird species have been recorded here, and the vast reed belts serve as an important nesting site for many species (Schmidt et al. 2008, Schmidt & Uppenbrink 2009).

#### *Kura river delta*

Originating in Turkey and traversing Georgia, the Kura reaches the central lowlands of Azerbaijan and finally forms a vast delta before flowing into the Caspian Sea. After the Volga River, the Kura is the second biggest contributing stream to the Caspian Sea.

The delta covers 19,000 ha with large reed belts and shallow seawater areas. It has three outlets, two of which are artificial. The entire delta is grazed extensively and serves as an important area for breeding and resting birds. 220 bird species have been recorded in these wetlands (Schmidt & Uppenbrink 2009).

# References

ADB (2014): Azerbaijan: Country Environment Note, Country Partnership Strategy: Azerbaijan 2014-2018. http://www.adb.org/sites/default/files/linked-documents/cps-aze-2014-2018-sd-04.pdf. Accessed: February 2016.

Gerasimov (2014): Analysis of the Voluntary Forest Certification Potential within Forestry Sector of Azerbaijan, ENIPI east FLAS Program. http://www.enpi-fleg.org/site/assets/files/1521/voluntary_forest_certification_report.pdf. Accessed: February 2016.

Peper, J. (2006): Wälder und ihre Degradationsstadien in der Kura-Niederung (West-Aserbaidschan) [Forests and their degradation stages in the Kura lowlands (western Azerbaijan)]. Diploma thesis, Institute of Botany, Greifswald University, DE (German). 114p.

Peper, J. (2012): Initiativen der Michael-Succow-Stiftung zum Schutz der Natur in Aserbaidschan. In: Steppenlebensräume Europas – Gefährdung, Erhaltungsmaßnahmen und Schutz. Tagungsband 2012, Ministerium für Landwirtschaft, Forsten, Umwelt und Naturschutz, Thüringen, DE: pp. 447–452.

Scharnweber, T., Rietschel, M., Manthey, M. (2007): Degradation stages of the Hyrcanian forests in southern Azerbaijan. Archiv für Naturschutz und Landesforschung, 46 (2): 133–156.

Schmidt, S., Gauger, K., Agayeva, N. (2008): Birdwatching in Azerbaijan – a guide to nature and landscape. Michael Succow Foundation, Greifswald, DE, 224p.

Schmidt, S., Uppenbrink, M. (eds.) (2009): Potential analysis for further nature conservation in Azerbaijan. Michael Succow Foundation, Geozon Science Media, Greifswald, DE. 164p.

Walter, H. (ed.) (1974): Die Vegetation Osteuropas, Nord- und Zentralasiens [The vegetation of Eastern Europe, Northern and Central Asia]. Gustav Fischer Verlag, Stuttgart, DE. 373p.

## 2.4. Birds of Azerbaijan (by Dina Valeeva)

### 2.4.1. Introduction

Considering its territory of only 86,600 km², Azerbaijan is particularly rich in birds (AOS 2016). By the early 2000s, 372 bird species had been recorded in Azerbaijan, including 107 resident species, 139 summer residents, 95 migrants and wintering species, 28 accidental visitors and 3 probably extirpated species. In addition, there were unconfirmed records of another 8 species. Bird species found in Azerbaijan belong to 17 orders and 58 families, which includes 220 species of non-passerines and 147 passerines (Patrikeev 2004). Other figures are given by AOS (2016) and Musaev et al. (2000): more than 40 % of all species are sedentary. A high percentage of sedentary species can be explained by the high diversity of attractive habitats and the mild climate. Nearly 27 % of bird species spend the winter here, while migrating birds only constitute a relatively small percentage (about 10 %).

With 144 species, water birds are particularly diverse. Less than 40 % of these water-dependent species nest on the territory of Azerbaijan; the remaining is wintering or recorded on migration. Their most important wintering and resting grounds are found along the southwestern coast of the Caspian Sea and in some of the wetlands in the Kura-Araz lowland (Musaev et al. 2000).

A vertical distribution of bird species numbers is apparent. The lowland-foothills region is richest in species, while the forested mountain areas hold fewer species. In the high mountains, bird diversity is the lowest, with more species recorded in the Lesser Caucasus compared to the Greater Caucasus.

Under zoogeographical aspects, the avifauna of Azerbaijan is heterogenic: Palearctic, European and Siberian species as well as endemics of the Mediterranean region occur. The Mediterranean aspect is prevalent (Musaev et al. 2000). This combination of avifaunal elements most likely arose during the Quaternary period. No birds are endemic to Azerbaijan only, but several species and subspecies endemic to the Caucasus and/or Talish Mountains occur in the country (Patrikeev 2004).

Currently, there is only a small number of local birdwatchers, and scientific studies more or less came to an end with the breakdown of the Soviet Union. It is very likely that more species will be added to the list, as more foreign birdwatchers visit the country. For example, even birds breeding in Azerbaijan, such as the Barn Owl, were overlooked before and were only recorded in 2006 (Schmidt et al. 2008, Kvartalnov et al. 2011). Some species have been newly rediscovered after a long period of no research or were recorded for the very first time, as shown by Schmidt et al. (2008), who mention that, in contrast to the figures given above, a total of 394 species of birds have been recorded on the territory of Azerbaijan since the 19th century. Many interesting ornithological issues remain to be studied in the future.

## 2.4.2. Ecosystem-complexes and species composition

Azerbaijan can be divided into five ecosystem complexes, which all contribute to this small country's large biodiversity: forest ecosystems, high-mountain ecosystems, dry mountain scrubland ecosystems, steppe and semi-desert ecosystems, wetland and coastal ecosystems (Schmidt et al. 2008, see also Chapter 2.3.). Following Musaev et al. (2000), the territory can also be divided into two zoogeographical regions: Caucasian and South-West Asian, and further, following Patrikeev (2004), into seven avifaunal regions: 1) Greater Caucasus, 2) Lesser Caucasus and Zangezur, 3) Nakhichevan Low Mountains, 4) Talish (South-East), 5) Central Low Mountains, 6) Central Lowland, 7) Caspian Coast.

The following description of the six ecosystem complexes follows Schmidt et al. (2008): Today, **forests** cover less than 12 % of the country. The distribution of forested areas is very uneven. Small remnants of Azerbaijani lowland coastal forests are located in the north near the Daghestan border. A high diversity of passerines can be found in this type of forest. Common Nightingale, Red-breasted Flycatcher, Great and Blue Tits and Eurasian Chaffinch are the most common species. Eurasian Blackbird, Golden Oriole, Green and Great Spotted Woodpeckers can also be found there. Eurasian Kestrel, Common Buzzard and Eurasian Hobby are the most common raptor species of the coastal forests. Riparian forests in the Central Lowlands are attractive for Imperial and Lesser Spotted Eagles, Black Kites, Sparrowhawks and Black Storks. Stock Doves, Eurasian Hoopoes and European Rollers can be found as well, along with many songbird species.

The forest belt of the Greater Caucasus offers suitable breeding habitat for additional raptor species such as Booted and Short-toed Snake-Eagles, European Honey-buzzards, etc.

The avifauna of the forested areas of the Lesser Caucasus is generally similar. The species composition of the lower Talish Mountains resembles that of any European broad-leaved forest. Many species known from the Greater and Lesser Caucasus occur here, too. Great Spotted and Green Woodpeckers are common from the foothills to the upper tree line, while Black Woodpeckers only occur in old and undisturbed beech and oak forests. These are also good sites for Stock Doves and Wood Pigeons, Tawny and Long-eared Owls. The most interesting among songbirds is the Sombre Tit.

The **high mountains** of the Greater and Lesser Caucasus can be divided into sub-alpine and alpine as well as sub-nival and nival regions. During trips into the mountains, the sky should regularly be scanned for raptors, among them Golden Eagle, Peregrine Falcon, Eurasian Kestrel, Eurasian Griffon and Lammergeier. The endemic Caucasian Black Grouse is restricted to birch and willow scrub with surrounding meadows between 1,800 to 2,500 m a.s.l. Caspian Snowcocks are quite widespread in the alpine zone. Hunting Alpine Swifts are common all over the mountains.

**Dry mountain scrubland** ecosystems are found at elevations around 600 to 1,000 m, predominantly in the eastern parts of the Greater Caucasus or at lower altitudes along the dry foothills. Eurasian Griffons and Egyptian Vultures find nesting sites in the cliffs, while Cinereous Vultures build their nests in old juniper trees. Typical songbirds of the arid woodlands are Rock Sparrow, Rock Nuthatch, Menetries's Warbler, Greater and Lesser Whitethroat.

Most of the originally widespread **steppe** ecosystems have nowadays been converted into cultivated land. Various types of wormwood steppe dominate around the Mingächevir Water Reservoir. The wide-open areas hold characteristic steppe and semi-desert species such as Isabelline Wheatear and Greater Short-toed Lark.

Similar to steppe regions, the **semi-deserts** also underwent dramatic changes. Today, semi-desert areas of manifold character can mostly be found in the lowlands throughout the entire country. The largest part of Azerbaijan's coastal zone is dominated by arid semi-desert. Crested Lark and Isabelline Wheatear are among the most characteristic inhabitants of this type of ecosystem. Other species occurring in such open, arid areas include Corn Bunting, Lesser Short-toed Lark and Hoopoe. Small numbers of Black-bellied Sandgrouse breed in the dry semi-deserts of the Shirvan Plain.

Azerbaijan shares the world's largest inland body of water, the Caspian Sea. The coastal regions are highly dynamic and offer important habitats for numerous nesting, wintering and migratory bird species. Along the shoreline, coastal **wetlands**, the Kura delta, islands and lowland forests provide a broad range of habitats. In the coastal region, mixed colonies of Pygmy Cormorants, Little and Cattle Egrets, Squacco Herons and Glossy Ibis can be observed. Spoonbills are rare; Greater Flamingos are irregular breeders at Gizilaghaj Bay. Wetlands in the country's interior are mainly influenced by the Kura and Araz Rivers. The most important water bodies are the lakes Aghgöl and Sarisu. Almost all lakes and marshes are inhabited by Whiskered and White-winged Terns. The large mixed colonies of herons, cormorants and terns can be very impressive. Many waders breed on wet ground around the lakes. Breeding ducks are Mallard, Garganey, Red-crested Pochard, Ferruginous Duck and Marbled Duck; other typical resident species in the wetlands of the Central Lowlands include Great Crested and Little Grebes and Purple Swamphens. The dominant raptor of these wetlands is the Eurasian Marsh-Harrier. Numerous small songbirds build their nests in the reeds.

The lakes and wetlands within the Central Lowlands play a key role for wintering populations of water birds from the large areas north of the Caspian Sea. Azerbaijan's lakes are probably the most important wintering sites for the White-headed Duck in the world. The shallow waters of Aghgöl, Sarisu and Mahmudchala attract Greater Flamingos.

### 2.4.3. Migrations

Every year, millions of birds leave their breeding grounds in Eurasia to reach their wintering grounds further south, e.g., in Africa, Arabia or India. The barrier function of mountains and open water causes a concentration of migrating birds; this is also true in Azerbaijan. One of the most frequented migration routes – the Eastern Caucasus/Caspian flyway (from Eastern Europe and Western Siberia to Middle East and East Africa) – crosses the country (Heiss & Gauger 2011). An estimated 10-20 million water birds alone cross Azerbaijan during migration, and 1-1.3 million water birds winter here, among them many globally threatened species (Gönner et al. 2011).

At least one place in Azerbaijan can be considered a hotspot for bird migration. Eighty kilometres north of Baku, the foothills of the Greater Caucasus and the Caspian Sea act as a bottleneck at Mount Beshbarmag (see Fig. 9), forcing migrating birds to pass through an only

three-kilometres-wide coastal plain (Heiss & Gauger 2011, Heiss 2013). Migrating birds may be encountered almost year-round, but the best times with the most noticeable passage are April/May and September/October (Schmidt et al. 2008). Passerine migration is mainly restricted to the coastal plain. Along the coastline, strong migratory movement of terns, gulls and ducks is noted, while raptor migration is rather weak and mainly restricted to the adjacent mountains. The entire region has a high value for international bird protection (Heiss & Gauger 2011, Heiss 2013).

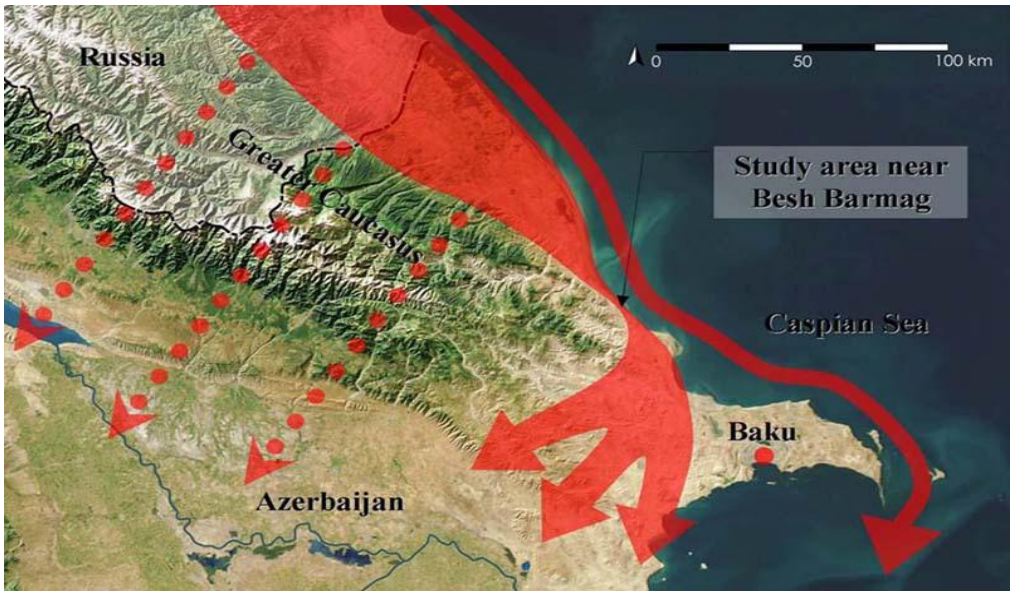


**Fig. 9:** The area at Mount Beshbarmag with important migration routes (red). The barrier function of the Greater Caucasus and the Caspian Sea leads to a concentration of migrating birds at this point. Dotted line = weak migration route through the Greater Caucasus, broad line = main migration route through the lowland, narrow line = coastal water bird migration route. (Source: Heiss & Gauger 2011)

## 2.4.4. Anthropogenic influences

The influence of different anthropogenic factors on the life and ecology of most birds was important during much of the formation of the current species composition. Some of these factors lead to a total or selective decrease in the numbers of birds and occasionally to the disappearance of one or more species. Other factors, however, have a positive effect on certain bird species (Musaev et al. 2000).

Many ecological problems are only now beginning to receive broader awareness or any political backing in Azerbaijan (Schmidt et al. 2008). Main threats for birds are the destruction of habitats (e.g., forest cutting, drainage of water reservoirs, urbanisation, disturbance by grazing, etc.), illegal hunting, oil production and transportation (especially in the Caspian Sea), or electric lines, etc. (AOS 2016).

Azerbaijan is one of the oldest oil-drilling countries in the world. As a result of more than 150 years of production, large areas throughout the coastal region are polluted. Oil-polluted soils are a serious problem, especially on the Absheron Peninsula and at sites where exploitation ceased, leaving behind an oil pond after the deconstruction of the drilling equipment. Attractive for birds

due to their water-like surface, especially at night, these artificial "lakes" act as traps for many wetland species. Oil pollution has also extended to the Caspian Sea. Several incidents resulted in the death of tens of thousands of waterfowl along the coast of the Absheron Peninsula and Alat archipelagos (Schmidt et al. 2008).

Poaching is a major threat to many bird species. The idea that Red Book species require protection from hunting has not yet gained public acceptance. Hunting is very popular in the country, and local men often sell bundles of freshly shot birds, both common and rare, along the roadsides. Most wetlands are regularly visited by hunters, and in many regions, the activities have even been commercialised with the selling of shot birds. Species of interest are mainly ducks, coots and geese. In semi-desert areas, Little Bustards *Tetrax tetrax* are a favoured target. With the emergence of incidences of avian flu, the poaching of birds temporarily decreased, as hunters were intimidated by possible consequences (Schmidt et al. 2008).

Man-made structures, in particular, are known to threaten the passage of migrating birds at such concentration points, and any risks incurred by migrating birds can be derived from their migration behaviour. Flight height above ground level (given in m a.g.l.) is clearly an important parameter in assessing the collision risk for the observed individuals. Since low-flying birds are confronted with the highest density of anthropogenic obstacles, the risk of collision increases with decreasing flight height. Thus a flight height between 0 and 50 m a.g.l. is regarded as an 'immediate risk' for migrants owing to existing hazards such as overhead power lines, buildings, traffic and hunting. From 51 to 200 m a.g.l., no immediate risk could be identified, but in the wake of infrastructural development such as wind farms or high buildings, this would lead to a 'possible future risk.' The flight heights above 200 m a.g.l. are regarded as risk-free, because no conceivable future constructions will exceed this height, and thus were characterised as being of 'no immediate or possible future risk.' The migrants' preference for low flight heights can be linked to their search for optimal wind conditions. At the Beshbarmag bottleneck, northerly winds dominated in both seasons, with a strong westerly component in autumn. Especially in the spring, these wind conditions lead to unfavourable head winds, whose detrimental effect on energy consumption the migrants offset by electing low flight heights. One of the main threats to individuals migrating below 50 m a.g.l. through the coastal plain is the dense network of overhead power lines supplying electricity to several villages and an oil production area. Power lines are known to entail collision hazards (Heiss 2015).

According to AOS (2016), power lines pose a threat to birds year-round. Raptors and many passerine birds perish mainly during roosting. Other birds with a quick and linear flight perish from colliding with electric lines, especially during strong winds or when fog occurs. The highest mortality rates occur during wintering and migration. A focussed search for birds killed by power lines could reveal information about unsafe power lines.

Wind turbines are large-sized obstacles, and direct collisions with rotors and wind turbine towers have been observed. The construction of wind energy plants, especially in the narrow coastal plain between the Greater Caucasus and the Caspian Sea, will seriously affect bird migration and might be a serious future threat to many bird species. It is difficult for migrants to avoid wind energy plants, due to the narrowness of this area. Along ridges of coastal foothills, which offer excellent wind conditions, the construction of wind energy plants would negatively affect raptor migration. Offshore wind farms along the coast of the Caspian Sea would also have a strong

impact on migrating birds, killing high numbers. Here, detailed studies should be conducted (Heiss & Gauger 2011, Heiss 2015).

The following anthropogenic influences on birds are described in Musaev et al. (2000). Deforestation in combination with extensive animal husbandry not only poses a threat to habitats and species, but it also leads to severe erosion. Clear-cutting and transformation of forests and scrublands into agricultural land lead to a significant decrease of bird population densities. However, changing the forests to orchards does not appear to have a dramatic influence on bird communities.

Pesticides used in agriculture can have indirect and direct effects on birds. Poisoned individuals usually have lower fertility rates and a lower activity when feeding the chicks and sometimes even abandon their nests. Birds may also be killed outright due to poisoning. Nevertheless, agricultural activities do not only have a negative impact. For some species, there can also be advantages. During the periods of seeding, sprouting and harvesting, huge flocks of birds, comprising one or several species, concentrate in the fields, following the ploughs and harvester machines and collecting the soil invertebrates that are being turned up during soil tillage (e.g., White Storks, raptors, many songbirds).

Associations with livestock can be frequently observed (e.g., Western Yellow Wagtails, Common Starlings, and Cattle Egrets). Birds catch the insects flushed by grazing herds, and also collect ectoparasites from the livestock's skin. Many bird species also gather at feeding sites for poultry, horses and other livestock. Many synanthropic bird species benefit from human food waste or grain losses during harvesting as food sources and from various buildings as nesting sites.

In conclusion, on the one hand, anthropogenic factors are dangerous for rare, ecologically specialised species or for large birds that are attractive as hunting targets. On the other hand, anthropogenic processes can bring benefits, mainly to small birds with a high ecological plasticity. Previous studies primarily revealed qualitative rather than quantitative changes in bird species composition in the country.

### 2.4.5. Bird conservation efforts and Important Bird Areas

Since birds are comparatively easy to observe, the use of a sound monitoring system not only allows the detection of particular population trends, but birds can also serve as bioindicators for the condition of the ecosystems they inhabit (Musaev et al. 2000, Gönner et al. 2011).

Setting up protected areas is the basic way for conserving ecosystems, including those important for birds (Musaev et al. 2000). In Azerbaijan, two Strict Nature Reserves (Gizilaghaj and Aghgöl) were founded especially for birds, with an emphasis on water birds, in particular, but other reserves with a lower protection status such as "Samukh preserve-hunting firm," the island Gil and other sites were established to protect birds. Great numbers of water birds occur on the lakes Sarisu (up to 500,000 individuals), Mahmudchala (up to 40,000), the Kura estuary (to 75,000), and along the Absheron-Gobustan sea shore (between the island of Pyrallahy and Cape Pirsagat; 200,000) (AOS 2016).

An effective protection of these wintering and breeding areas would ensure the conservation and integrity of the birds' diversity and their populations. Special emphasis should be placed on rare

species, e.g., those listed in the Red Book of Azerbaijan, but special measures such as the fight against poaching, and the conservation of nesting or roosting sites should be implemented as well, and at least a general attempt should be made to improve the environmental legislation and its implementation (Musaev et al. 2000).

To foster the protection of birds as well as their habitats, which also include other parts of the biodiversity for which many bird species serve as umbrella species, Birdlife International developed the concept of Important Bird Areas, described as follows in Birdlife (2016a): "The selection of Important Bird and Biodiversity Areas (IBAs) is achieved through the application of quantitative ornithological criteria, grounded in up-to-date knowledge of the sizes and trends of bird populations. The criteria ensure that the sites selected as IBAs have true significance for the international conservation of bird populations, and provide a common currency that all IBAs adhere to, thus creating consistency among, and enabling comparability between, sites at national, continental and global levels. It is crucial to understand why a site is important, and to do this it is necessary to examine its international significance in terms of the presence and abundance of species that occur there, year-round or seasonally."

Following Birdlife (2016b) for the *Europe* region, which Azerbaijan is part of, "20 IBA criteria have been developed for the selection of IBAs […]. These allow the identification of IBAs, based on a site's international importance for: a) Threatened bird species, b) Congregatory bird species, c) Assemblages of restricted-range bird species, d) Assemblages of biome-restricted bird species. Criteria have been developed such that, by applying different ('staggered') numerical thresholds, the international importance of a site for a species may be categorised at three distinct geographical levels: a) Global ('A' criteria), b) European ('B' criteria), c) [not applicable for Azerbaijan] European Union ('C' criteria)." For details, please see Birdlife (2016b).

According to these criteria, 53 IBAs were identified in Azerbaijan, covering a total of 833,242 ha (Birdlife 2016c, see here also for a list of all countries' IBAs), which amounts to approximately 9.5 % of the country's territory, and which represent most of the habitats in the country. However, it should be stressed that an IBA is "only" a priority site for conservation, which is therefore not automatically protected. It should be protected by special conservation instruments (national laws, international conventions; Birdlife 2016a); only a part of the 53 Azerbaijani IBAs currently hold the status of a protected area (see their categories in Chapter 2.5.).

The best available map depicting 52 of the today 53 Azerbaijani IBAs is shown as Fig. 10.

A non-governmental organisation engaged in bird assessment and conservation since 1986 is the Azerbaijan Ornithological Society (AOS, for details see their website at www.aos.az).

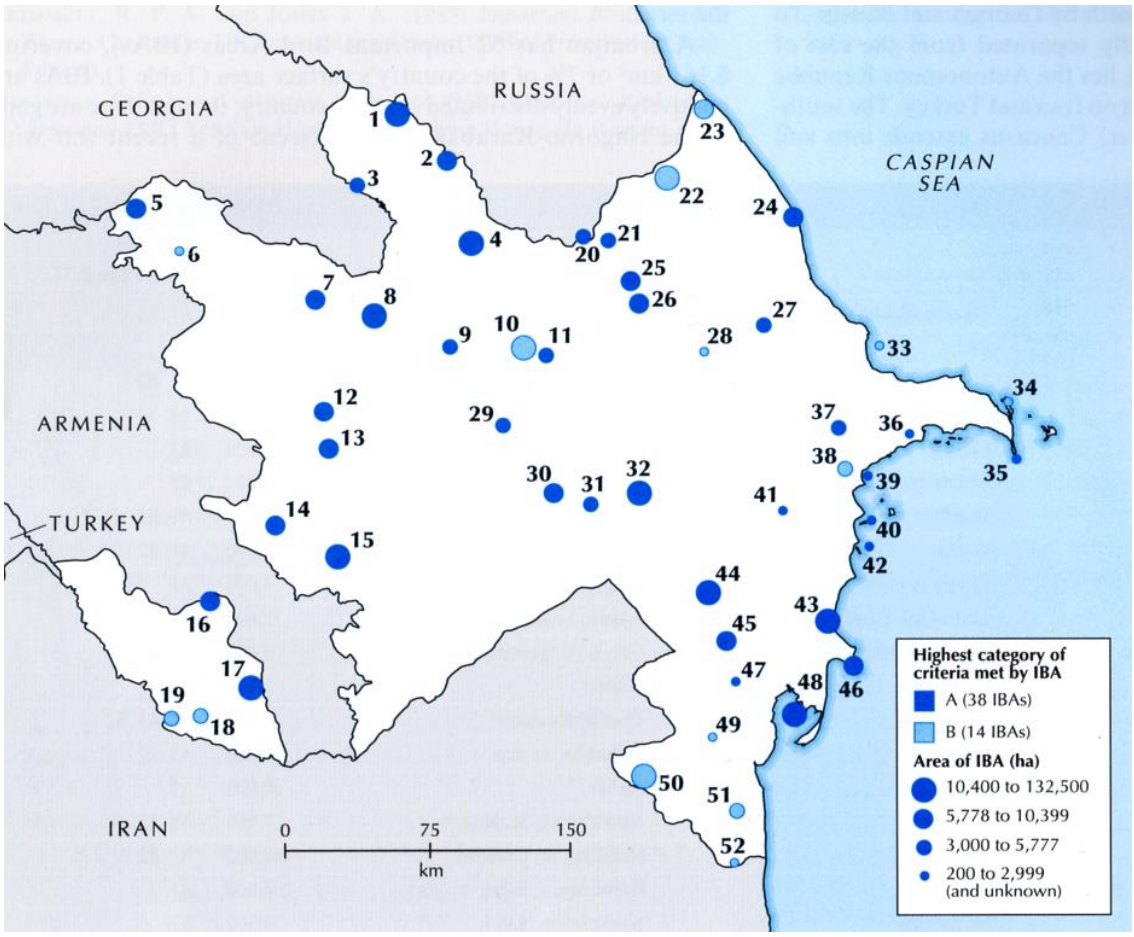


**Fig. 10:** Location, area and criteria category of Important Bird Areas in Azerbaijan. (Source: Heath et al. 2000)

## References

AOS (2016): Birds of Azerbaijan. http://www.aos.az/en/2013-01-10-09-21-19/bird-s-world-of-azerbaijan. Accessed: February 2016.

Birdlife (2016a): Why apply criteria. http://www.birdlife.org/datazone/info/ibacriteria. Accessed: March 2016.

Birdlife (2016b): European IBA categories and criteria. http://www.birdlife.org/datazone/info/ibacriteuro. Accessed: March 2016.

Birdlife (2016c): Country/Territory = Azerbaijan. http://www.birdlife.org/datazone/sitesearchresults.php?cty=15&fam=0&gen=0#. Accessed: March 2016.

Gönner, C., Isayev, S., Sultanov, E., Werner, S. (2011): Monitoring of Waterbirds in Azerbaijan. Manual, GIZ Working Paper – Sustainable Management of Biodiversity, South Caucasus. Baku, AZ. 34p. http://biodivers-southcaucasus.org/wp-content/uploads/2015/02/Waterbird-Monitoring-Manual.pdf (available in English and Azerbaijani).

Heath, M.F., Evans, M. I., Hoccom, D.G., Payne, A. J., Peet, N.B. (2000). Important Bird Areas in Europe: Priority Sites for Conservation Volume 2: Southern Europe. Cambridge, Birdlife International. 791p.

Heiss, M., Gauger, K. (2011): Coastal bird migration at the Caspian shore of the Azerbaijan Republic in October 2007. Podoces, 6(1): 59–71.

Heiss, M. (2013): The importance of Besh Barmag bottleneck (Azerbaijan) for Eurasian migrant birds. Acta Ornithologica 48 (2): 151–164.

Heiss, M. (2015): Migratory behaviour of bird species occurring in critical numbers at Besh Barmag bottleneck in Azerbaijan, Bird Conservation International (published online).

Kvartalnov, P.V., Poyarkov, N.D., Popovkina, A.B., Dementyev, M.N (2011): Barn Owl at the southeastern Azerbaijan. Berkut, 20 (1-2): 111-114.

Musaev, M.A., Gadzhiev, D.V., Rakhmatulina, I.K. (2000): Zhivotnyy mir Azerbaydzhana, tom. III, Pozvonochnye [Animals of Azerbaijan, vol. 3, Vertebrates]. Baku, Elm, AZ (Russ.). 656 p.

Patrikeev, M. (2004): The birds of Azerbaijan, Pensoft Publishers, Sophia, BG. 380p.

Schmidt S., Gauger, K., Agayeva, N. (2008): Birdwatching in Azerbaijan – a guide to nature and landscape. Michael Succow Foundation, Greifswald, DE. 224p.

# 2.5. Nature conservation and protected areas (by Esther Sophia Lutz)

## 2.5.1. Introduction

Azerbaijan has a high number of different ecosystems at every altitude and, because of its geographic location, contains species of European, Central Asian and Mediterranean origin. Due to many spatial climatic variations (see Chapter 2.1.), there is a high biodiversity in a relatively small area and many endangered species occur in Azerbaijan. *Conservation International* listed the country as part of one of the world's 25 hotspots of biodiversity and endangered ecosystems, namely the Caucasus ecoregion (Williams et al. 2006, MENR 2014), together with the tropical rain forests and Pacific islands, to name but a few.

This status imposes an important responsibility for the protection of nature upon Azerbaijan (Schmidt & Uppenbrink 2009).

Semi-deserts, wetlands, steppes, deciduous forests and alpine ecosystems are represented in Azerbaijan. Around 4,200 species of vascular plants, 107 mammals, 394 birds, 54 reptiles, 9 amphibians, around 100 fish species and approximately 14,000 insect species have been registered to date. An estimated 270 species of plants are endemic to Azerbaijan, and a much higher number of both animals and plants is unique to the Caucasus region (Schmidt & Uppenbrink 2009).

Unfortunately, Azerbaijan has experienced a continued loss of biodiversity. As in many countries, this is mainly caused by unsustainable land use such as logging, overgrazing, poaching, pollution and infrastructural development. Traditionally, the people of Azerbaijan have lived in close touch with nature, and even today, there is a general public awareness of the environment. But it appears that a strong agricultural sector, a high interest in hunting and fishing as well as recreational use of scenic landscapes often exceed a deep understanding of ecological coherences. Nature conservation is not 'self-evident' yet on a broad scale. For a country in transition, it is a challenge to manage both nature conservation and industrial development (Schmidt & Uppenbrink 2009).

## 2.5.2. Protected area system

In Azerbaijan, 9 National Parks (see Fig. 8, Tab. 1), 11 Strict Nature Reserves (former Zapovedniks) and 24 Sanctuaries (former Zakazniks) cover more than 10 % of the country's area (IUCN 2014a). Compared to Germany, Azerbaijan has a higher percentage of protected areas in the upper IUCN (International Union for Conservation of Nature) categories (see their specification below, here meant categories I-IV). In Germany, National Parks and Nature Reserves (and similar areas, including categories I-IV) together only make up around 4 % of the country´s terrestrial surface area (BFN 2016).

The different categories are defined by the *Law on Specially Protected Natural Areas and Objects* of 2000 and include areas of international, national and local concern. The categories, sorted by IUCN categories, are as follows (after IUCN 2014b, MENR 2015):

**Strict Nature Reserves (former Zapovedniks) (IUCN Category Ia)** are defined as protected areas with a high scientific, ecological and historical-cultural value. Nature is allowed to develop without any human interference and activities, and only persons with scientific or educational intentions are allowed to enter the reserve.

The IUCN defines **National Parks** in **Category II** as "large natural or near-natural areas set aside to protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally compatible spiritual, scientific, educational, recreational and visitor opportunities."

**Natural Monuments (IUCN Category III)** preserve single unique natural objects of special scientific or historical- cultural value.

**State Nature Sanctuaries (former Zakazniks)** are protected areas that belong either to **IUCN Category III**, *Natural Monument or Feature*, or **Category IV** *Habitat/Species Management Area*. The former protect specific natural monuments such as specific landforms or geological features like caves; the latter protect particular species or habitats and are managed in the best possible way to reach the protection goal.

**Protected Landscapes (IUCN Category V)** are areas where the interaction of people and nature has created a landscape with aesthetic, cultural and ecological value.

While National Parks and State Nature Reserves are connected with international and national interests, sanctuaries such as monuments or zoological parks are mainly of local importance (Schmidt & Uppenbrink 2009). Many National Parks developed from previous Strict Nature Reserves (Zapovednik) and became larger protected areas in the process (MENR 2015).

Although the different types of protected areas correspond to the IUCN categories, they are not yet internationally accepted. That would require additional restrictions and management (Schmidt & Uppenbrink 2009). Protected areas corresponding to the IUCN categories Ib and VI are completely missing in Azerbaijan.

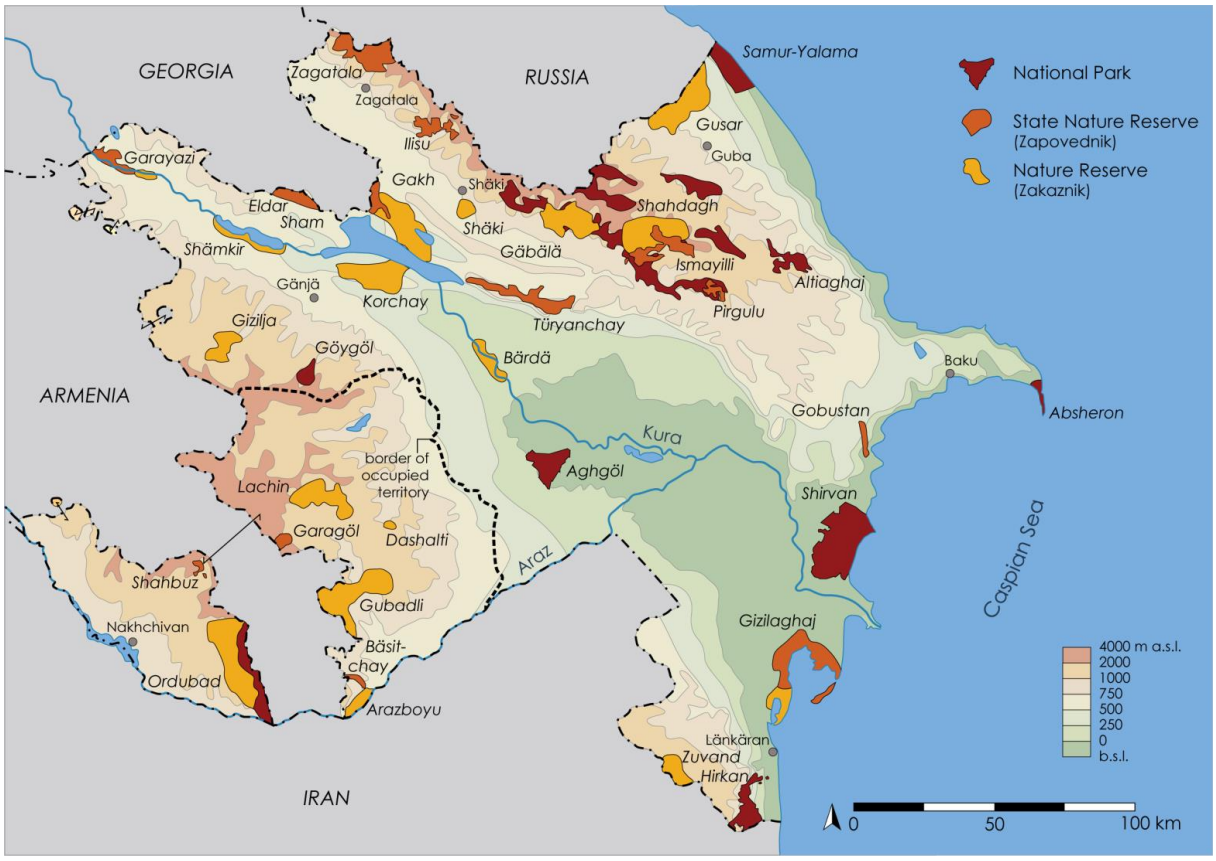


**Fig. 11:** Protected areas of Azerbaijan. (Source: Adopted and updated from Schmidt & Uppenbrink 2009, Map by S. Busse)

## 2.5.3. Protected Area development

Compared to other countries in the world, it took a long time for Azerbaijan to protect its unique nature on a large scale. While Lagodekhi National Park in Georgia was founded in 1912, Germany's Bavarian Forest National Park in 1970 or Sotchi National Park in Russia in 1983, Azerbaijan's first National Park was not founded until 2003. However, the country's first protected area was also one of the first in the entire region: Goy Göl State Nature Reserve in 1925, followed few years later (in 1929) by the Zagatala reserve (MENR 2015).

Following the creation of the *Ministry of Ecology and Natural Resources of Azerbaijan Republic* (MENR) in 2001, an elaborate National Park Programme was introduced. As mentioned above, in 2003 the first National Parks were created - Shirvan, Zangazur and Agghöl National Parks; the most recent National Park, Samur-Yalama, was established in 2012 (MENR 2015).

Fortunately, at this point in time, the main ecosystems and landscapes of Azerbaijan are already protected. However, for long-term nature conservation in Azerbaijan, international recognition and support such as certification by the UNESCO (World Heritage Sites, Biosphere Reserves) could be helpful. A law on *Biosphere Reserves* is currently lacking, but there have been negotiations in the past. The Zagatala region at the border to Georgia and the Gobustan region in the east, for example, are qualified to become Biosphere Reserves in the near future. But whether politicians are interested in developing the protected areas remains to be seen. Nature conservation continues to involve a permanent clash of interests (Schmidt & Uppenbrink 2009).

Currently, there are two UNESCO World Heritage sites in the country: the Old City of Baku and the Neolithic rock engravings of Gobustan. The Hirkan Forests in the south on the border with Iran have already been selected to become a UNESCO World Natural Heritage site. This area has a high potential for international recognition and support (Schmidt & Uppenbrink 2009).

**Tab. 3:** National Parks of Azerbaijan (Source: MENR 2008 and MENR 2015)

| | National Park (size) | Year established | Characteristics, habitats, wildlife |
|---|---|---|---|
| 1 | Zangazur National Park (42 797 ha) | 2003 | Mountainous forest and grassland, rich ornithofauna with, e.g., Lammergeier (*Gypaetus barbatus*), and rare mammals such as Leopard (*Panthera pardus ciscaucasica*), Mouflon (*Ovis orientalis gmelini*), Bezoar Ibex (*Capra aegagrus aegagrus*). Historical monument: *Gamigaya* (Ordubad mountains). |
| 2 | Shirvan National Park (54 373 ha) | 2003 | Semi-deserts and steppes, biggest wild population of Goitered Gazelle (*Gazella subgutturosa*) within the country and the wider region, >25,000 wintering Little Bustards (*Tetrax tetrax*) and other birds. |
| 3 | Aghgöl National Park (17 924 ha) | 2003 | Most famous steppe lake ecosystem in AZ, with a broad reed belt; Ramsar Site of international significance as a refuge for endangered bird species (e.g., Lesser White-fronted Goose (*Anser erythropus*), White-headed Duck (*Oxyura leucocephala*), Marbled Duck (*Marmaronetta angustirostris*). |
| 4 | Hirkan National Park (40 358 ha) | 2004 | Talish mountains with typical relict flora such as Irontree (*Parrotia persica*) or Chestnut-leaved Oak (*Quercus castaneifolia*); rare mammals such as Leopard (*Panthera pardus ciscaucasica*), Lynx (*Lynx lynx*), Wildcat (*Felis silvestris*). |
| 5 | Altiaghaj National Park (11 035 ha) | 2004 | State Nature Reserve in 1990 (Altiaghaj 4438 ha); mountainous oak and Oriental Beech (*Fagus orientalis*) forest, riverbed of Atachay; mammals include. Wolf (*Canis lupus*), Brown Bear (*Ursus arctos*). |
| 6 | Absheron National Park (783 ha) | 2005 | State Nature Reserve in 1969, semi-deserts, coastal habitats, wetlands, Caspian Seal (*Pusa caspica*), important stopover for thousands of migratory birds. |
| 7 | Shahdagh National Park (130 508 ha) | 2006 | Mountainous forests, high-mountain grasslands, birds include Golden Eagle (*Aquila chrysaetos*), Caucasian Black Grouse (*Tetrao mlokosiewiczi*), mammals, e.g., Daghestan Tur (*Capra cylindricornis*). |
| 8 | Göygöl National Park (12 755 ha) | 2008 | The first State Nature Reserve in AZ (1925), mountain forests (e.g., oaks, Oriental Beech), mountain grasslands; Göygöl and other lakes. |
| 9 | Samur-Yalama National Park (11.772 ha) | 2012 | Caspian coastal zone covered with lowland forest; mammals such as European Otter (*Lutra lutra*), Maral Deer (*Cervus elaphus maral*). |

### 2.5.4. Administration

The *Ministry of Ecology and Natural Resources* (MENR) is the central executive authority in Azerbaijan that controls and regulates all activities concerning ecology, environmental protection and the use of natural resources. Furthermore, it has the function of raising the national knowledge regarding environmental issues and providing information about nature conservation and sustainable land use. The Ministry was established in May of 2001 under President Heydar Aliyev. Since then, Huseyngulu Baghirov has led the Ministry, along with three deputy ministers. The ministry contains several divisions, e.g., for ecology and nature protection policy, for international cooperation and for science and monitoring (MENR 2015).

### 2.5.5. International nature conservation commitments

Several bilateral agreements and memorandums are in place between Azerbaijan and foreign countries regarding cooperation in the field of environmental protection; for example, with Turkey, Georgia, Iran, Moldova, Ukraine and Germany (MENR 2015). To enhance the international collaboration on the conservation of biodiversity, Azerbaijan joined the UN Convention of Biodiversity in 2000. The Kyoto Protocol was ratified in 2004 (Schmidt & Uppenbrink 2009, MENR 2015). As a country with a high desertification risk, Azerbaijan signed the United Nations Convention to Combat Desertification (UNCCD) in 1998, as did 193 other countries to date (Schmidt & Uppenbrink 2009; UNCCD 2015).

### 2.5.6. International support

Acknowledging the Caucasus ecoregion's high international importance regarding biodiversity, there are several international programmes and initiatives that aided in assisting and financing nature conservation activities, especially in the three South Caucasus states. Not only because Azerbaijan is a member of the *European Neighbourhood Policy* (ENP, since 2004), the German government offers support through its *Caucasus Initiative*. This initiative aims to contribute to the economic, social and political development of the southern Caucasus countries by at least establishing a firm transboundary protected area network. As an example, in 2009, Azerbaijan and the technical cooperation organisation of the Federal Republic of Germany (GTZ, now GIZ) manifested their cooperation in the field of sustainable use of natural resources. Even earlier, German agencies were already contributing to a process which in 2006 led to the publication of the *Ecoregional Conservation Plan* (ECP) in cooperation with the WWF, experts from universities, governments and NGOs of all Caucasus states. "*The purpose of the Ecoregion Conservation Plan is to create a roadmap for conserving the rich biodiversity of the Caucasus Ecoregion. Conservation groups working in the region will benefit from the ECP in order to better plan their activities, avoid duplication of efforts, and ensure long-term support for conservation programmes. The ECP outlines a vision and long-term goals for biodiversity conservation in the Caucasus Ecoregion, which will be achieved through implementation of a concrete set of short- and medium-term actions*" (Williams et al. 2006). For example, the establishment of the Samur-Yalama National Park is based on the plan's advice (Schmidt &

Uppenbrink 2009). An update of the ECP was published in 2013 (Zazanashvili et al. 2013), continuing to back nature conservation efforts in Azerbaijan.

The United Nations Educational, Scientific and Cultural Organisation (UNESCO), United Nations Development Program (UNDP), the Michael Succow Foundation, NABU, WWF and the Caucasus Nature Fund (CNF), along with several banks and many other unnamed NGOs, have been active in Azerbaijan for many years. The Michael Succow Foundation, in cooperation with the MENR, started a comprehensive study about the ecological importance of the Hirkan Forest and its potential for restoration and provided many additional suggestions for further nature conservation development in Azerbaijan. The NABU, for example, conducted several workshops in order to train local stakeholders in terms of environmental protection and tourism, whereas the CNF and international banks such as the World Bank provide financial support for several projects (Schmidt & Uppenbrink 2009).

### 2.5.7. National activities

In accordance with the *United Nation Convention on Biological Diversity,* in 2006, Azerbaijan declared the *National Strategy and Action Plan on Conservation and Sustainable Use of Biodiversity*. It contains goals regarding the protection of natural resources and sustainable development in the country.

National organisations for nature conservation or environmental education are few, but the existing ones are active. For example, the *Azerbaijan Ornithology Society* (AOS) promotes comprehensive information about birds, their protection and observation sites (also for international tourists), but is also engages in monitoring of birds throughout the country. The *Naturefriends* (naturefriends.az) organise several activities for young people in order to raise awareness of nature and to point out opportunities for sustainable life. In the same way, *IDEA* (international NGO, idea.int) brings people together through scientific seminars with environmental experts and clean-up actions in Baku City.

# References

BfN (2016): Bundesamt für Naturschutz, Gebietsschutz/ Großschutzgebiete. https://www.bfn.de/0308_gebietsschutz.html (and subsequent links). Accessed: February 2016.

IUCN (2014a): IUCN welcomes the Republic of Azerbaijan as new State Member. http://www.iucn.org/news_homepage/all_news_by_region/news_from_usa/?14867/IUCN-welcomes-the-Republic-of-Azerbaijan-as-new-State-Member. Accessed: August 2015.

IUCN (2014b): IUCN Protected Areas Categories System. https://www.iucn.org/about/work/programmes/gpap_home/gpap_quality/gpap_pacategories/. Accessed: February 2016.

MENR (2008): Protected areas of Azerbaijan. Ministry of Ecology and Natural Resources, Baku, AZ.

MENR (2014): Legends of Nature: Protected Areas of the Southern Caucasus. Ministry of Ecology and Natural Resources, Baku, AZ.

MENR (2015): Ministry of Ecology and Natural Resources Republic of Azerbaijan. http://eco.gov.az/en (and subsequent links). Accessed: August 2015.

Schmidt, S., Uppenbrink, M. (eds.) (2009): Potential analysis for further nature conservation in Azerbaijan. Michael Succow Foundation, Geozon Science Media, Greifswald, DE. 164p.

Williams, L., Zazanashvili, N., Sanadiradze, G., Kandaurov, A. (eds.) (2006): An Ecoregional Conservation Plan for the Caucasus. 2nd edition. WWF Caucasus Programme Office, Tbilisi, GE. 220p.

UNCCD (2016): http://www.unccd.int/en/regional-access/Pages/countries.aspx?place=17. Accessed: February 2016.

Zazanashvili, N., Garforth, M., Jungius, H., Gamkrelidz, T. (eds.) (2013): Ecoregion Conservation Plan for the Caucasus. 2012 revised and updated edition. WWF Caucasus Programme Office, Tbilisi, GE. 64p.

## 2.6. Geology and geomorphology of the Greater Caucasus (by Danny Eichhorn)

### 2.6.1. Location and extension

The Caucasus is a complex mountain area with strong geographical contrasts. It is composed of two main mountain systems: The Greater Caucasus in the north and the Lesser Caucasus in the south. Both mountain systems are separated by the Rioni-Lowland to the west and the Kura-Lowland to the east (Fig. 12).

The Greater Caucasus forms the major mountain range of the Caucasus Mountains, extending nearly 1,200 km from the coastal region of the Black Sea in the northwest to the Caspian Sea in the southeast. Traditionally, the Greater Caucasus is separated into three main parts: The Western Caucasus, reaching from the Black Sea to Mount Elbrus in Russia, followed by the Central Caucasus, which extends from Mount Elbrus to Mount Kazbek in Georgia, and the Eastern Caucasus, which ranges from Mount Kazbek to the Caspian Sea in Azerbaijan.

In the centre, the mountains show a typical alpine relief, with summits reaching elevations of more than 5,000 m a.s.l. The highest elevation is located in the western part, with Mount Elbrus reaching an altitude of 5,642 m a.s.l. The central parts of this mountain range are currently still the most glaciated and form a tectonically active area. The northern slope of the Greater Caucasus is predominated by cross valleys, whereas the southern slope is characterised by steeply inclined mountain sides (Paffengolz 1963).


**Fig. 12:** Physical map of the Caucasus, showing the Greater Caucasus to the north and the Lesser Caucasus to the south. Between both mountain systems, the lowlands of Rioni are located to the west and Kura to the east. (Source: Kurtabadze & WWF-Caucasus 2005).

## 2.6.2. Geological evolution

The geological evolution of the Caucasus region is largely determined by its position between the still converging Eurasian and African-Arabian continental plates. As a result of the African-Arabian and Eurasian plate collision, former basins were inverted to form fold-and-thrust belts in the Greater and Lesser Caucasus. The mountain-forming process began when the African-Arabian plate moved in a northward direction toward the Eurasian plate. In the process, the former Tethys Sea was closed. Secondly, the Eurasian plate moved in a southward direction against the Arabian plate (Adamia et al. 2011). This process caused the highest pressure in this area. As a result, rocks deposited from the Jurassic to the Miocene were folded and uplifted to form the Caucasus Mountains as a part of the Alpide mountain belt (Fig. 13).

This mountain-forming process, the so-called Alpidian orogeny, dates back to the time from the late Cretaceous to the Miocene and encompasses a period of approximately 100 million years. The strongest uplift took place in the Miocene, about 20 million years ago. During the Alpine orogeny, other mountain systems such as the Pyrenees, the Alps, the Carpathians and the Himalayas were formed.

Recent geodynamic processes are mainly caused by the still converging Eurasian and African-Arabian plates. The rate of convergence is an estimated 20–30 mm/year. The northward motion

of the Arabian plate causes tectonic activities. As a result, we can find evidence of intensive eruptions of Neogene to Quaternary volcanoes in the main range of the Greater Caucasus, e. g., Mount Elbrus, Mount Keli and Mount Kazbegi (Paffengolz 1963).

Within the region, sedimentary, magmatic and metamorphic complexes developed from the upper Proterozoic (from 2.5 billion years ago) to the Phanerozoic (541 million years ago – present). Their formation occurred in various palaeogeographic and geodynamic environments, e.g., oceanic basins, intercontinental areas as well as active and passive continental margins. Palaeozoic (541–252 million years ago) sedimentary cover is represented by various facies of terrigenous, carbonate and volcanogenic deposits in almost all tectonic units of the Caucasus. The oldest sediments date back to the Precambrian (4.6 billion years ago – 541 million years ago) and are represented in rock formations such as gneiss, mica, quartzite, marble and many more complex compositions. A complex network of faults determines the divisibility of the region into a number of separate terrains, based on their geological nature, genesis and dimensions (Adamia et al. 2011).

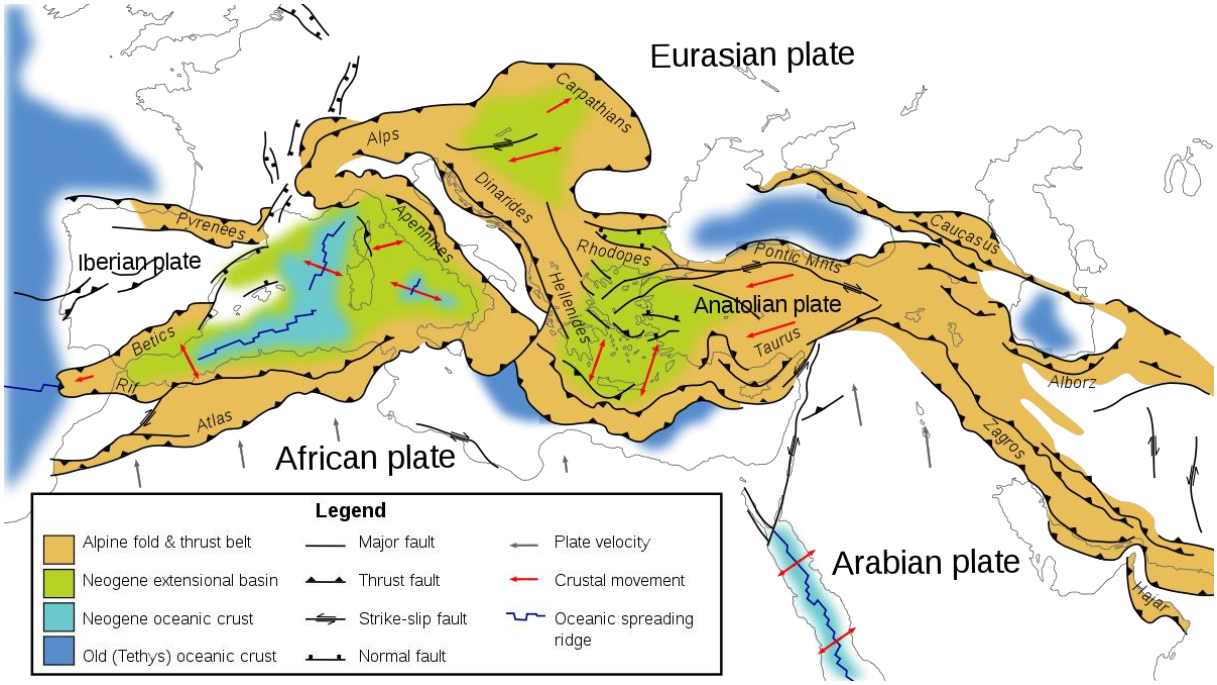


**Fig. 13:** Tectonic structures of the western Alpide mountain belt. Note the movement of the African-Arabian plate and the Eurasian plate. Both continental plates are moving toward each other, forming the Alpide mountain belt; a process that began in the late Cretaceous and still continues to date. (Source: Woudloper 2009).

## 2.6.3. Geomorphological characteristics

Regarding geomorphology aspects, it is important to have knowledge about the relation between the reliefs and tectonic structures, because they are responsible for the geomorphological characteristics of the Caucasus. Like the Alps, the Caucasus is a fold mountain range with primary relief zones of different ages. The centre of this mountain range forms a crystalline core, which is composed of metamorphic-palaeozoic rocks such as gneiss, shale and amphibolites.

In the Greater Caucasus, we can highlight three different geomorphological zones (Paffengolz 1963).

*Zone 1: The glacial high-mountain relief*

This zone is strongly modified through erosion processes such as wind and precipitation. It covers the central part of the main ridge of the Greater Caucasus and is mainly composed of Jurassic shale-sandstone series.

*Zone 2: Low-mountain relief*

The second zone covers the lower mountains with tertiary structures. The landscape presents bed-ridges alternating with folded ridges, forming a shale-sandstone zone. These structures can mostly be found on the northern and southern slopes of the Greater Caucasus.

*Zone 3: Volcanic relief profile*

The volcanic relief of Alpidic age is separated as a third zone of the Greater Caucasus. This type of landscape is composed of formations resulting from extensive volcanic activity with a slow lava outflow, e.g., Mount Elbrus and Mount Kazbek. Quaternary vulcanites such as quartz-andesites are the dominant rock formations in this area.

The recent surface shape of the Caucasus had been moulded by glacial and postglacial processes during the Quaternary (2.6 million years ago – present). Therefore, remnants of the last glacial periods can be found at altitudes of more than 2,000 m a.s.l. These remnants can occur in form of U-shaped valleys, harsh ridges, cirques as well as circus stairways. In addition to those forms, we can also find sedimentary deposits such as end moraines, border moraines, morainic damming and sand from melting water (Succow in Klotz 1989).

Within the territory of Azerbaijan, the highest peak is Mount Bazardüzü (4,466 m a.s.l.), and the second highest Mount Shahdagh (4,243 m.a.s.l.). The rivers from the southern macroslope of the Greater Caucasus are flowing toward the Kura lowland. From the northern macroslope of this mountain range, numerous rivers flow directly toward the Caspian Sea or merge into the system of the Samur River (Franz 1973).

## References


Adamia, S., Zakariadze, G., Chkhotua, T., Sadradze, N., Tsereteli, N., Chabukiani, A. Gventsadze, A. (2011): Geology of the Caucasus: A Review. Turkish J. Earth Sci., Vol. 20: 489–544.

Franz, H.-J. (1973): Physische Geographie der Sowjetunion [Physical geography of the Soviet Union] (pp. 206–226 on the Caucasus). VEB Hermann Haack, Geographisch-Kartographische Anstalt, Gotha/Leipzig, DD. 535p.

Kurtabadze, M. & WWF-Caucasus (2005): The Caucasus ecoregion, topographic map. http://www.grida.no/graphicslib/detail/the-caucasus-ecoregion-topographic-map_c390. Accessed: April 2016.

Paffengolz, K. (1963): Geologischer Abriss des Kaukasus [Geological outline of the Caucasus]. Akademie-Verlag, Berlin, DD (German). 351p. (Translation of original Russian title 'Geologicheskiy ocherk Kavkaza').

Succow, M. (1989): Der große Kaukasus [The Caucasus]; in: Klotz, G. (ed.) (1989): Hochgebirge der Erde und ihre Pflanzen- und Tierwelt [High mountains of the earth and their flora and fauna], Urania-Verlag, Berlin, DD (German): pp. 171–183.

Woudloper (2009): Tectonic map Mediterranean EN. https://commons.wikimedia.org/wiki/File:Tectonic_map_ Mediterranean_ EN.svg#/media/File:Tectonic_map_Mediterranean_EN.svg (licensed under CC BY-SA 1.0 via Wikimedia Commons). Accessed: February 2016.

# 2.7. Vegetation zonation of the Greater Caucasus in Azerbaijan (by Verena Kaiser)

The part of the Greater Caucasus that lies within the territory of Azerbaijan belongs to the Eastern Greater Caucasus, an area that extends from Mount Kazbek in Georgia towards the east all the way to the Caspian Sea. This chapter describes the altitudinal zonation of the mountain ecosystem of the Greater Caucasus from the forests in the montane belt to the alpine zone.

## 2.7.1. Forests

The forest types found in the Caucasus are diverse; however, the composition of the individual forest types is often less varied, with most formations being dominated by only a few tree species. In contrast, the undergrowth in most of the forest formations is often rich in species. Precipitation, humidity and temperature are the main factors determining the lower boundary of the forest belt. Since precipitation and temperature vary widely, the lower limit of montane forests cannot be found at the exact same elevation throughout the altitudinal belt. In addition, human influence leads to a forest distribution that differs from the natural occurrence.

An example of an anthropogenically triggered vegetation formation is the sparse semi-arid woodlands, a zonal type of vegetation in eastern Transcaucasia. This woodland formation is also called *Shiblyak* and can be compared to the *Phrygana* vegetation of Mediterranean ecosystems. Subject to human use, the *Shiblyak* formation represents a degradation state of oak or juniper forests (Schmidt & Uppenbrink 2009). According to the zonation overview of Succow 1989 (see Fig. 14) these woodlands occur around 500 m a.s.l. in the Eastern Greater Caucasus. Common woody species found in these woodlands include *Pistacia mutica* (Anacardiaceae), *Pyrus salicifolia* (Rosaceae) and *Celtis australis* subsp. *caucasica* (Ulmaceae). In the shrub layer, one can find – among others – species such as pomegranate *Punica granatum* (Lythraceae), *Rhamnus pallasii* (Rhamnaceae), Jerusalem Thorn *Paliurus spina-christi* (Rhamnaceae), *Spiraea crenata,* the Smoke Tree *Cotinus coggygria* (Anacardiaceae) and *Berberis orientalis* (Berberidaceae). A common species in the herb layer is *Bothriochloa ischaemum* (Poaceae) (Succow 1989).

Oak forest types – some degraded, others still intact – can be found widely throughout the Caucasus. Dolukhanov (1966) lists 18 oak species, 14 of which are considered to be endemic to the region. However, Schmidt (2004) states that the number of endemics assumed by many authors is too high. Also, Schmidt (2004) only lists eight oak species (including several subspecies). The most widespread is the Georgian Oak *Quercus petraea* subsp. *iberica* (Fagaceae), which is treated as a separate species (*Quercus iberica)* by some Caucasian authors (Schmidt 2004). As this species requires low soil salinity and good drainage, it usually grows on slopes. In the eastern part of the Greater Caucasus, the Georgian Oak occurs at its widest extent between 500–1,100 m a.s.l. (Gulisashvili et al., 1975; Succow, 1989).

Although it represents the most common type of hardwood forest found in the Caucasian mountains and contains the highest timber reserves, the Oriental Beech (*Fagus orientalis)* forest is not as frequently encountered in the Eastern Greater Caucasus as in the western or central parts. Being able to better persist in the more continental and drier climates, birch takes over here, but

*Q. petraea* subsp. *iberica* also intermingles with *Fagus orientalis*, forming a Beech-Oak forest between 1,100–2,100 m a.s.l. on the southern slopes of the Greater Caucasus (Succow 1989). On the northern slopes, Hornbeam (*Carpinus betulus*, Betulaceae) and Persian Oak (*Quercus macranthera*) grow, along with *Fagus orientalis,* only between 1,100–1,600 m a.s.l. (Gulishashvili et al.1975).

On the southern macroslope of the eastern part of the sub-alpine zone between 2,200 m a.s.l. and 2,600 m a.s.l., *Quercus macranthera* forms the montane Persian Oak Forest at the tree line. The herb layer of these forests is described as highly diverse, with plant species such as *Scabiosa caucasica* (Dipsacaceae), *Campanula latifolia* (Campanulaceae), *Aconitum orientale* and *A. nasutum* (both Ranunculaceae), to name but a few (Succow 1989).

Primarily on steep rocky slopes between 1,600–2,100 m a.s.l. with poorly developed soils, birch species such as *Betula pendula var. pendula* and *Betula litwinowii* (both Betulaceae), which may be forest-forming, can also be found in these sites, especially on the northern macroslope of the Eastern Greater Caucasus (Gulishashvili et al. 1975).

### 2.7.2. Sub-alpine zone

Sub-alpine grasslands and woodlands occur between 2,200 and 2,400 m a.s.l. on the northern slope of the Eastern Greater Caucasus. Characterised by a short vegetation period of only 3 to 4 months, the forests gradually give way to grassland steppes or mountain steppes of the sub-alpine zone (Gulisashvili et al. 1975). On the southern slopes, roughly between 2,500 and 2,800 m a.s.l., sub-alpine steppes and grasslands occur, according to Succow (1989); however, other authors assign this zone to elevations between 1,900–2,500 m a.s.l. (Zazanashvili, 2000) or between 1,800–2,400 m a.s.l. (Prilipko, 1954).

Walter (1974) distinguishes four formations of sub-alpine ecosystems in the Greater Caucasus. The above-mentioned species *Fagus sylvatica* and *Betula litwinowii* may not reach a great height, and based on this growth form, the formation is called *Krummholz* formation. However, different tree species may also grow in a park-like setting (*Quercus macranthera, Betula pendula var. pendula*, *Salix* species. (Salicaceae)*, Sorbus* spec. (Rosaceae) and even *Fagus orientalis*). The shrub layer of the *Krummholz* formation consists of various woody shrubs such as *Ribes alpinum, R. biebersteinii* (both Grossulariaceae)*, Philadelphus* coronaries (Hydrangeaceae) and S*ambucus nigra* (Caprifoliaceae).

Another formation listed by Walter (1974) are thick stands of tall forbs, containing, for example, *Polygonatum verticillatum* (Convallariaceae), *Veratrum lobelianum* (Melanthiaceae), *Aruncus dioicus* (Rosaceae) and *Selinum alatum* (Apiaceae). In addition, Etzold (2005) describes a tall herb community occurring on moist sites in depressions or in the foothills, especially on north-facing slopes. This consists of species such as *Aconitum orientale, Galega orientalis* and *Delphinium* cf. *flexuosum,* among others.

Another wood-free formation can be encountered; characterised by grasses such as *Brachypodium pinnatum* (Poaceae) and *Calamagrostis arundinacea* (Poaceae), this formation can be found up to 3,000 m a.s.l.

Marking the smooth transition to the alpine zone, the fourth formation named by Walter (1974) are the sub-alpine mountain steppes, typically dominated by *Festuca woronowii* (Poaceae) and other tussock grasses. These grasslands can often be found in the eastern part of the southern macroslope of the Greater Caucasus (Gulishashvili et al. 1975). The grasses may be accompanied by *Ranunculus breyninus* (Ranunculaceae)*, Campanula collina* (Campanulaceae) and *Trifolium ambiguum* (Fabaceae), among others.

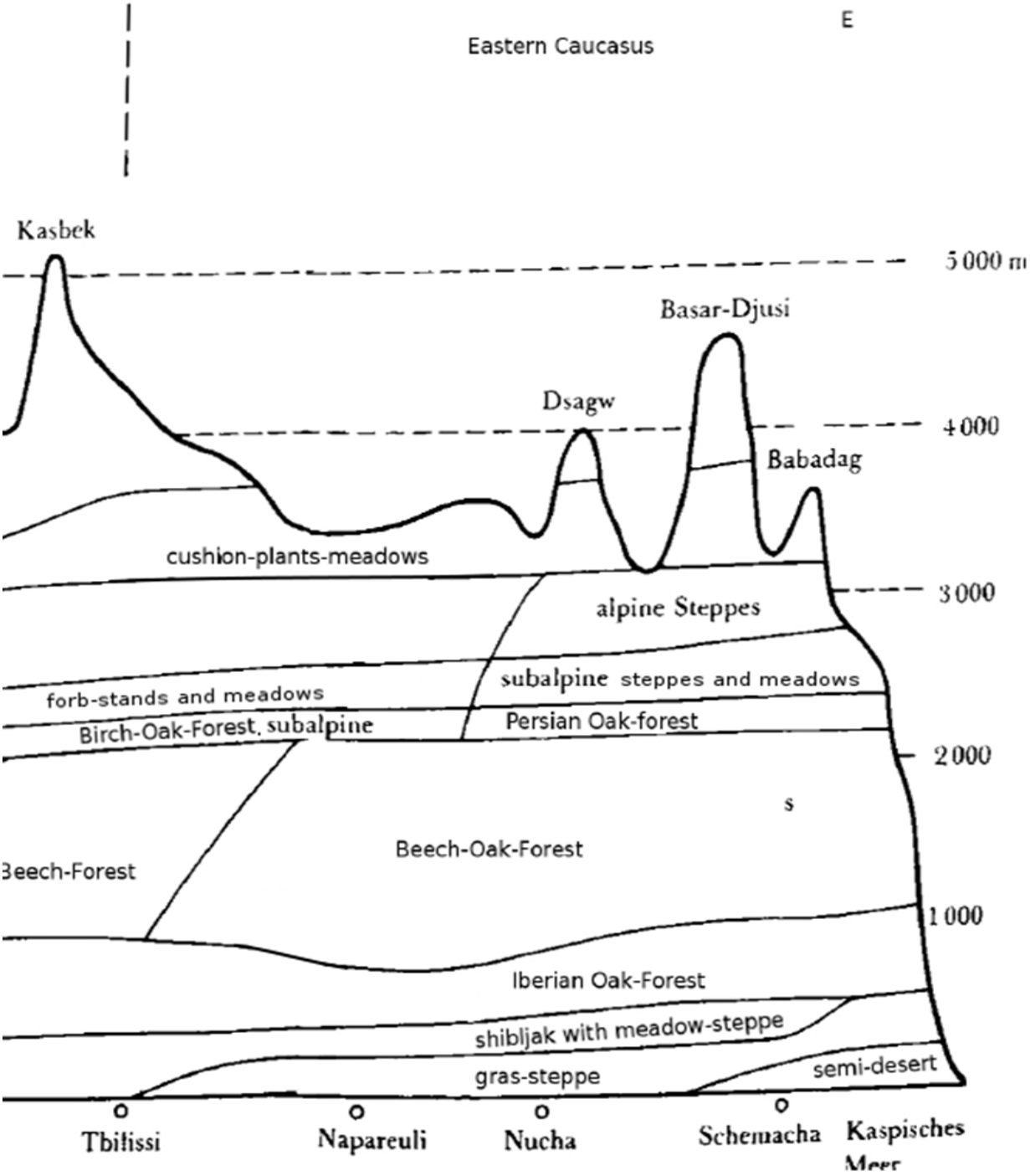


**Fig. 14:** Vegetation zonation of the southern macroslope of the Eastern Greater Caucasus. (Source: Modified after Succow in Klotz 1989, p. 178/179)

## 2.7.3. Alpine zone

According to Succow (1989), alpine grasslands develop at approx. 2,800 m a.s.l. in the eastern part of the Greater Caucasus and sometimes do not transition into the sub-nival zone until they

reach elevations of 4,000 m a.s.l. On the northern macroslope, the alpine zone starts around 2,400 m a.s.l., extending up to the snow line at 3,900 m a.s.l.

In this zone, low summer temperatures (no frost-free period) and the short vegetation period as well as strong winds, poorly developed soils and extensive areas of rocks and scree affect plant growth. Although there may be relatively high amounts of precipitation, the shallow soils cannot retain enough water to keep the plants from experiencing droughts at times, and the herb-rich vegetation often only reaches 10–20 cm in height. In late summer, fires can occur on alpine meadows (Walter 1974).

Because of geomorphological and climatic differences in the mountains, the alpine belt has a very complex structure, causing different types of alpine formations. Four main types of alpine vegetation in the Caucasus were distinguished by Gulisashvili et al. (1975):

Alpine mats, grasslands characterised by many herbaceous species and with only a subordinate role of sedges, occur in depressions with well-developed soil cover, sufficient moisture and good drainage. Typical representatives of this formation are *Taraxacum stevenii* (Asteraceae) and species of the genera *Alchemilla, Potentilla* (both Rosaceae), *Primula* (Primulaceae), *Geranium* (Geraniaceae) and *Campanula*.

According to Gulisashvili (et al. 1975), so-called impoverished alpine grassland communities on nutrient-poor soils suffer from frequently occurring physiological droughts and are usually dominated by single species such as *Nardus stricta* (Poaceae), *Kobresia persica* or *Kobresia macrolepis* (both Cyperaceae). The latter two occupy large areas between 2,400–2,300 m a.s.l. on flat plateaus or gentle slopes, whereas *Nardus stricta* grows in topographic depressions with poor drainage. The Mountain Everlasting *Antennaria dioica* (Asteraceae) may be found on these sites as well (Succow 1989).

Alpine grasslands, the main zonal type, are also dominated by grasses and sedges. A common species is *Carex tristis* (Cyperaceae), growing very densely and making it difficult for other species to establish themselves. However, smaller variations of the sub-alpine species as well as *Colpodium versicolor, C. caucasicum, Briza marcowiczi* (all three Poaceae) can also be found in this formation (Gulisashvili et al. 1975; Walter 1974).

The vegetation of rocky habitats and open alpine communities is very diverse, with succulents and cushion plants such as *Androsace villosa* (Primulaceae), *Minuartia imbricata* (Caryophyllaceae), *Saxifraga* species (Saxifragaceae), *Draba bryoides* (Brassicaceae) and *Jurinea moschus* subsp. *pinnatisecta* (Asteraceae). Especially on sites with limestone, the ecosystem is extremely rich in species of the genera *Draba* (Brassicaceae), *Gypsophila, Arenaria* (both Caryophyllaceae), *Saxifraga* (Saxifragaceae) and many endemics of other genera as well (Succow 1989).

## References


Dolukhanov, A.G. (1966): Regularities of geographical diversity of vegetation and upper timberline in the Transcaucasian mountains. Probl Bot. 8: 196–207.

Etzold, J. (2005): Analyses of vegetation and human impacts in the habitat of the Caucasian Black Grouse *Tetrao mlokosiewiczi* in the Greater Caucasus/Azerbaijan. Archives of Nature Conservation and Landscape Research 44 (4): 7–36.

Gulisashvili, V. Z., Mahatadze, L. B., Prilipko, L.I. (1975): Rastitel'nost' Kavkaza [Vegetation of the Caucasus]. Nauka Publishing House, Moskva, SU (Russ.). 227p.

Prilipko, L. I. (1954): Lesnaja rastitel'nost' Azerbaydzhana [Forest vegetation of Azerbaijan], Izdatel'stvo Akademii Nauk Azerbaydzhanskoj SSR, Baku, SU (Russ.). 488p.

Schmidt, P. A. (2004): Oaks and oak forests in Caucasia. In: International Oaks – Proceedings of the Fourth International Oak Conference Fall 2003, Winchester, UK: pp. 111–123.

Schmidt, S., Uppenbrink, M. (eds.) (2009): Potential analysis for further nature conservation in Azerbaijan. Michael Succow Foundation, Geozon Science Media, Greifswald, DE. 164p.

Succow, M. (1989): Der große Kaukasus [The Caucasus]; in: Klotz, G. (Hrsg.) (1989): Hochgebirge der Erde und ihre Pflanzen- und Tierwelt [High mountains of the earth and their flora and fauna], Urania-Verlag, Berlin, DD (German): pp. 171–183.

Walter, H. (ed.) (1974): Die Vegetation Osteuropas, Nord- und Zentralasiens [The vegetation of Eastern Europe, Northern and Central Asia]. Gustav Fischer Verlag, Stuttgart, DE (German). 373p.

Zazanashvili, N., Gagnidze, R., Nakhutsrishvili, G. (2000): Main types of vegetation zonation on the mountains of the Caucasus, Proceedings IAVS Symposium, Opulus Press, Uppsala, SE: 214–217.

# 2.8. Vegetation of semi-deserts and steppes (by Paul-August Schult)

## 2.8.1. Introduction

The diverse landscapes of Azerbaijan include steppe and semi-desert ecosystems. Both ecosystems are favoured by the subtropical climate with dry, hot summers and mild winters in the lowlands and along the foothills of the Greater Caucasus.

Today, very few steppe areas with natural vegetation cover remain, since most have been converted to cropland due to their highly productive soils. Steppe ecosystems in Azerbaijan are traditional winter pastures. The increasing livestock numbers have led to an increase in grazing intensity. Due to this, most steppe ecosystems have taken on a semi-desert character. What remains are mainly small secondary steppe-like patches as a result of overgrazing in woodland and shrub ecosystems.

The vegetation of semi-deserts in Azerbaijan – like the steppe vegetation – has been altered by human influence. Especially in the Kura-Araz lowland, cotton cultivation has taken the place of large parts of the natural semi-desert vegetation. Furthermore, overgrazing and irrigation changed the composition of the plant communities. Nevertheless, many different types of semi-desert vegetation can still be found there. The two main types of semi-desert vegetation are wormwood (*Artemisia* species) semi-desert and saltwort (*Salsola* species) semi-desert. These two types can be further divided into subtypes, depending on soil salinity. Wormwood semi-deserts as well as saltwort semi-deserts are characterised by a high number of ephemeral plant species that can complete their life cycle in the spring within a short period of about four weeks (Schmidt et al. 2008).

## 2.8.2. Steppes

Dominating genera in different steppe types are feather grasses (*Stipa* species), fescues (*Festuca* species) and blue stems (*Bothriochloa* species). Shrub-like vegetation is composed of species such as Jerusalem Thorn (*Paliurus spina-christi*) and wild relatives of various fruit trees. The natural vegetation of steppe ecosystems is under high pressure due to human influence. Traditionally used as winter pastures, they suffer today under the increasing livestock numbers (Schmidt & Uppenbrink 2009). According to Tagieva (2012), overgrazing – especially year-round grazing – in the Ajinohur-Jeyranchöl foothills in western Azerbaijan has led to the degradation of grass steppes. Impacted by the heavy grazing pressure, it is transforming into wormwood-grass steppe, which is dominated by *Artemisia* species. With further pressure, these sites develop into a wormwood semi-desert and finally change to a wormwood-ephemer and wormwood-saltwort semi-deserts. The wormwood-ephemer semi-desert is dominated by *Poa bulbosa* and *Artemisia arenaria*. The wormwood-saltwort semi-desert hosts salt-tolerant species such as *Salsola dendroides* and *Salsola ericoides*.

Due to their highly productive soils, former steppe ecosystems have a share of about 60 % in Azerbaijan's cultivated area. They are used for cultivating cotton, grain, wine, vegetables and fruit trees and are altered by irrigation and fertilizing (Schmidt et al. 2008).

### 2.8.3. Semi-deserts

As mentioned above, semi-desert ecosystems in Azerbaijan underwent similar changes as the steppes. In areas not used for the cultivation of cotton, one can distinguish between wormwood semi-desert dominated by *Artemisia fragrans* and saltwort semi-desert that hosts various chenopodiaceous species such as *Salsola dendroides, Salsola ericoides, Suaeda dendroides* or *Salicornia europaea*. In addition, the vegetation composition changes along a gradient in soil salinity (Schmidt et al. 2008).

The wormwood semi-desert dominated by *Artemisia fragrans* hosts a variety of ephemeral species. These plants with a short life cycle can make up to 70 % of the entire vegetation cover. Some species occurring here are *Poa bulbosa, Medicago minima* and *Catabrosella humilis*. Additional lichens such as *Collema granulatum* and *Squamarina muralis* can be found on the soil surface. The cyanobacterium *Nostoc commune* impacts the ground of non-saline light and dark Chestnut soils (Walter 1974).

Due to the occurrence of precipitation primarily in the spring and autumn, the flowering of most species takes place at that time of the year. Many therophytes bloom in the spring and are followed by *Iris iberica* subsp. *elegantissima* and *Eryngium billardierei* in May and June. After a summer dormancy, *Artemisia fragrans* flowers in autumn.

With increasing altitude, the wormwood semi-desert becomes more steppe-like, due to the occurrence of grasses. *Stipa tirsa*, *Agropyrum caespitosum* and *Koeleria macrantha* can be found. Due to the occurrence of *Artemisia* species together with *Capparis spinosa*, a very special type of wormwood semi-desert is formed in the Mughan Steppe and Mil Steppe (Walter 1974).

Saltwort semi-desert vegetation grows on more saline soils than wormwood semi-desert vegetation. It hosts – besides various chenopodiaceous species – many ephemeral therophytes such as *Agropyrum triticeum, Agropyrum orientale, Phleum paniculatum, Hordeum murinum* subsp. *leporinum* and *Bromus japonicus*. These grasses grow in the spring, with shallow root systems at the non-saline soil surface (Walter 1974). Chenopodiaceous species found here are *Salsola ericoides, Salsola dendroides, Salicornia europaea* and *Suaeda dendroides* (Schmidt et al. 2008). Depending on the soil salinity, a gradient in vegetation pattern can be observed. On slightly saline soils, *Salsola dendroides* occurs. Soils that have a higher salinity – e. g., around mud volcanoes – are occupied by *Suaeda microphylla* and *Salsola gemmascens* (Schmidt et al. 2008). On highly saline soils, *Salsola ericoides* grows together with *Sphenopus divaricatus* and *Psylliostachys spicata*. At the edge of wet saltpans, the salinity gradient is again visible in the vegetation pattern: *Halocnemum strobilaceum* grows on highly saline soils, followed by *Halostachys belangeriana* and *Kalidium caspicum* (Walter 1974).

The vegetation in general is often very patchily patterned, due to higher areas that are overgrown by *Artemisia* species and lower – more saline and wet – depressions with halophytic vegetation. Larger brackish depressions of different salinities are called "Tchaly" and host a typically hydrophilic vegetation. Depending on salinity and wetness, species such as *Prosopis farcta,*

*Glycyrrhiza glabra, Limonium meyeri* and *Aeluropus lagopoides* subsp. *repens* can be encountered (Walter 1974).

### 2.8.4. Dry foothills of Gobustan (after Schmidt & Uppenbrink 2009, Peper 2010)

Gobustan is located in Eastern Azerbaijan between the shore of the Caspian Sea and the south-easternmost escarpments of the Greater Caucasus. It starts in the western vicinity of Baku and extends to the banks of Pirsaat River. It is characterised by many riverbeds and gullies, which carve deeply into the loamy soil but are only filled with water after rain events. Gobustan has a semi-arid climate with dry, hot summers and mild winters. The mean annual precipitation is about 250 mm near the Caspian shore and increases with altitude to around 460 mm. Main precipitation is recorded in spring and autumn. Mean annual temperatures range from 13 to 15 °C (depending on altitude) with mean temperatures in July of about 26 °C and in January of about 0–3 °C.

An impressive feature of Gobustan is the occurrence of mud volcanoes, which release a mixture of gas, water and mud from depths down to 4,000 m. They form mounds ranging in height from 1 to 500 m.

The grey-brown soils in the lower parts of Gobustan are generally salty and are covered by crusts of gypsum and salt. At 150 m a.s.l., they change to raw or brown soils and Solonchaks. Chestnut soils can be found in the western parts of Gobustan at higher altitudes. Besides semi-shrubs such as wormwood or saltwort, the vegetation of Gobustan is formed mostly by therophytes and geophytes, which develop from October to May due to the occurrence of precipitation. Salt-resisting annual chenopodiaceous species that do not tolerate frost germinate in spring and die in autumn.

The saltwort semi-desert vegetation changes with rising altitude to wormwood semi-desert and steppe. The saltwort semi-desert occurs at lower altitudes below 150 m a.s.l. and on salty soils around mud volcanoes. It is characterised by *Kalidium caspicum, Halocnemum strobilaceum, Suaeda microphylla* and several salt-tolerating annuals. Within this vegetation, patches of wormwood semi-desert can be found. Dominated by *Artemisia fragrans, Salsola gemmascens and Plantago ovata,* it is characterised by salt-resistant species such as *Reaumuria hypericoides, Parapholis incurva* and *Psylliostachys spicata.*

A different type of wormwood semi-desert is distributed at altitudes between 175 and 560 m a.s.l. It is characterised by *Adonis aestivalis, Alyssum* species *and Trachynia distachya,* without the occurrence of any salt-indicating ephemerals.

Wormwood steppe is dominated by *Artemisia fragrans* and has higher species richness in perennial plants than wormwood semi-desert. Between 150 and 600 m a.s.l., a type formed by many ephemerals such as *Clypeola jonthlaspi* and *Bupleurum tenuissimum* can be found on sites that are inaccessible to grazing livestock. Above 600 and up to 760 m a.s.l. and at lower altitudes in western Gobustan, a different type of wormwood steppe is distributed. It is characterised by *Vinca herbacea, Bongardia chrysogonum, Vicia narbonensis* and *Nepeta racemosa.*

On the slopes of Mount Gijäki, grass steppe is distributed from 760 m a.s.l. to the top at 1,047 m a.s.l. It hosts single shrubs of *Pyrus salicifolia* and *Crataegus* spec. as well as herbs such as *Achillea micrantha, Salvia aethiopis* and *Rumex thyrsiflorus*. Some woodlands dominated by *Prunus cerasifera* and *Crataegus* spec. can be found on the northern slopes of Mount Gijäki. They harbour taller herbs such as *Arum elongatum, Asperula tinctoria* and *Urtica dioica.*

Other vegetation types are formed around stables and in river valleys. Due to high eutrophic and disturbed conditions close to buildings used for livestock, a thistle community is formed, and during the summer, chenopodiaceous ephemerals develop. Groundwater-fed vegetation of salt-adapted shrubs, for example tamarisks (*Tamarix ramosissima, T. tetragyna), Lycium ruthenicum* and *Nitraria sibirica*, develops at the banks of rivers and forms a Tugai shrubland. After flooding, many different annuals germinate between the shrubs.

### 2.8.5. Shirvan National Park

Shirvan National Park is located on the shore of the Caspian Sea southeast of the Gobustan foothills. It encompasses the eastern part of the Shirvan steppe that extends from the south-bending Kura River westward to the Caspian Sea. The climate there is also characterised by dry, hot summers and mild winters. The annual mean precipitation is about 286 mm, mainly falling in spring and autumn. The main soils occurring in the park are Serosems and Solonchaks.

The vegetation of Shirvan National Park has characteristics of semi-desert and dry steppe. Wormwood semi-desert dominated by *Artemisia fragrans* can be found on alkaline Serosems, as well as Saltwort semi-desert dominated by *Salsola* species. The largest area of Shirvan National Park is covered by halophytic dwarf shrub vegetation, dominated by *Halocnemum strobilaceum* and *Kalidium caspicum* and mixed with salt-tolerating ephemerals such as *Spergularia marina, Petrosimonia brachiata* and *Sphenopus divaricatus*. *Salicornia europaea* and *Puccinellia gigantea* can be found as initial vegetation on wet and highly saline soils as well as *Petrosimonia brachiata* associated with *Tetradiclis tenella*. On less saline soils, vegetation dominated by *Artemisia fragrans* and *Halocnemum strobilaceum* develops.

In the southern parts of Shirvan National Park, steppe vegetation dominated by *Artemisia szovitsiana* and *Halocnemum strobilaceum* is distributed on sands that cover loam and clay. Wormwood steppe associated with *Linaria simplex* is distributed only in the western part of Shirvan National Park.

On the slopes of Mount Zayachya close to the Caspian shore, vegetation dominated by *Stipa caspica* associated with *Allium rubellum* or *Salsola gemmascens* can be found. Along the Caspian shore, a belt of psammophytic vegetation is distributed. It is formed by species such as *Lactuca tatarica, Salicornia europaea, Phragmites australis* and *Cakile maritima*, augmented by *Convolvulus persicus* and *Argusia sibirica.*

Patches of vegetation dominated by *Halostachys belangeriana* associated with *Salsola dendroides* and *Hordeum leporinum* are scattered throughout the entire Shirvan National Park and harbour many ephemerals and grasses (this whole section following Schmidt 2005).

# References

Peper, J. 2010. Semi-desert vegetation of the Greater Caucasus foothills in Azerbaijan: effects of site conditions and livestock grazing. Inaugural dissertation, University of Greifswald, DE. 112p.

Schmidt, S. (2005): Vegetation cluster and coil types of Shirvan National Park, Azerbaijan – a landscape ecological approach. Diploma thesis, Institute of Botany, Greifswald University.

Schmidt, S., Gauger, K., Agayeva, N. (2008): Birdwatching in Azerbaijan – a guide to nature and landscape. Michael Succow Foundation, Greifswald, DE. 224p.

Schmidt, S., Uppenbrink, M. (eds.) (2009): Potential analysis for further nature conservation in Azerbaijan. Michael Succow Foundation, Geozon Science Media, Greifswald, DE. 164p.

Tagieva, E. N. (2012): Degradation of the vegetation cover as exemplified by the arid foothill areas of the Greater Caucasus within Azerbaijan. Geography and Natural Resources, Vol. 33 (1): 146–150.

Walter, H. (ed.) (1974): Die Vegetation Osteuropas, Nord- und Zentralasiens [The vegetation of Eastern Europe, Northern and Central Asia]. Gustav Fischer Verlag, Stuttgart, DE (German). 373p.

# III. Methods for landscape-ecological excursions

This chapter provides an introduction of methods that could be applied to describe vegetation, soils, land use and birds during future landscape-ecological excursions and field investigations. This introduction is based on the "Handbook on Methods for Field Courses" prepared in 2013 by Til Dieterich and Narmina Sadigova for the Department of Bio-Ecology at Baku State University Azerbaijan. The compilation presented here is brief and provides only basic guidance for landscape-ecological excursions and field investigations. Readers without relevant experience are advised to consult further literature as recommended in the respective sections.

The chapter also describes the methods that were used during the excursion which formed the basis for the results presented in Chapter IV. It also describes the materials, which were used during the excursion and which may be considered for use during future field excursions and investigations focusing on soil, vegetation, land use and birds. The choice of methods as well as the extent of their application needs to be decided individually according to duration of excursion and number of participants. In the case of the presented excursion, for example, due to a lack of time, extensive vegetation and soil assessments could not be done for every site.

## 3.1. Vegetation

### 3.1.1. Identification of plant species

Azerbaijan is home to approximately 4,200 vascular plant species. They can be identified with the Flora of the Caucasus (Grossgeym 1939–1967) and Azerbaijan (Karyagin 1950–1961). The identification books are relatively old and it is necessary to double-check for synonyms and new taxonomic developments in up-to-date databases on the internet, e.g. www.plantlist.org, emplantbase.org, Flora europaea (http://rbg-web2.rbge.org.uk/FE/fe.html), etc. In addition, illustrated guides such as Shetekauri & Jacoby (2009) are good sources for narrowing down the search to the genus level in most cases, but they are usually not sufficient for species identification. In order to conduct ecological observations effectively, the observer needs to know the most common species of the country, which includes about 1/4 of the overall species found in Azerbaijan.

For species identification in the laboratory, it is necessary to collect plants and prepare them for a herbarium. Important here is to note the location, habitat and GPS coordinates for each specimen. The collected plants must then be labelled, which is shown Tab. 4. Species that are rare should only be photographed. For example, members of the Orchidaceae and Liliaceae families are naturally rare and should only to be collected if there is a special scientific interest in them. Other rare species are listed in the Red Book of Plants for Azerbaijan from 2013 (see Baghirov & Aliyev 2013), in which 140 plant species are listed.

**Tab. 4:** Label for Herbarium (Leg. = legit = name of the collector, Det. = determinavit = name of person who identified the species)

| | |
|---|---|
| No. | |
| Family | |
| Species (+ author) | |
| Date of collection | ____.____.20____ |
| GPS | N E |
| Locality | |
| Habitat | |
| Leg. | |
| Det. | |

### 3.1.2. Syntaxonomic work and geobotany

In order to conduct plant surveys in an ecological context, it is necessary to categorize different plant formations. Their spatial extension can be shown on a vegetation map, which, in turn, helps to understand and manage our environment. There are many different ways to classify plant formations. Here, we concentrate on those that are relevant for Azerbaijan, both based on historical surveys and current geobotanical trends in the region's scientific community.

In the post-Soviet era, two major systems have been applied primarily. These are the dominant species system (physiognomic system) (compare Rabotnov 1992) and the classical floristic system of phytosociology (after Braun-Blanquet 1964). In addition, formation of ecological-floristic species groups can be applied if work is done on a regional level and there is enough ecological information on the species involved (Succow & Joosten 2001). In general, scientists in the post-Soviet era in the past years have also been moving toward the classical floristic system, but in order to allow a comparison with scientific works of Soviet origin, we have to understand the variety of classification systems and the limitations of transferring vegetation descriptions from one system to the other.

Mueller-Dombois & Ellenberg (1974) and Kent (2011) can serve as standards on methodology for vegetation ecological work, including descriptions on data analysis. Modern approaches for data storage and analysis are provided by Hennekens & Schaminee (2001) and Tichy (2002), e.g.

For assessing vegetation in plots, we recommend to use a consistent data sheet such as the sheet used during the excursion (see "Data sheet template – vegetation assessment" in Annex 1.1.).

## *Plot size*

Depending on the average size of individual plants, different habitat types require different plot sizes in order to include a representative set of species in an observation, while at the same time keeping observation efforts at a reasonable level. Based on long-term experience in phytosociology, there are recommended ranges of plot sizes for different habitat types that are commonly used (Tab. 5).

**Tab. 5:** Recommendations for plot sizes typically used in vegetation observations in different vegetation types (Mueller-Dombois & Ellenberg 1974).

| Vegetation type | Typical plot size in $m^2$ |
|---|---|
| Forest | 200-500 |
| Herb layer in forest | 50-200 |
| Dry meadow | 50-100 |
| Hay meadow | 10-25 |
| Dwarf shrub heath | 10-25 |
| Fertilized pasture | 5-10 |
| Arable land associations | 25-100 |
| Moss associations | 1-4 |
| Lichen associations | 0.1-1 |

## *Phytosociology – the classical floristic system (Braun-Blanquet 1964)*

Since the 1920s, the classical floristic classification system of phytosociology has been developed in Central Europe; its smallest unit is the association. The classification follows a strictly hierarchic system and is based on the presence of diagnostic species (character and differential species). An example is given here:

**Class:** Festuco-Brometea Br.-Bl. et Tx. in Br.-Bl. 1949

The class comprises grasslands and steppes of infertile calcareous or sandy soils, often drought-prone, in temperate and sub-boreal regions.

**Order:** Brometalia erecti Br.Bl. 1936

Suboceanic, more or less arid swards

**Alliance:** Bromion erecti Koch 1926

Swards of less arid soils in hemi-oceanic parts of Europe

**Association:** Onobrychido viciifoliae-Brometum T. Müller 1966

Semi-dry meadows on calcareous soil

The observation plots are selected in a homogenous part of the vegetation stand, with plot size chosen according to the habitat type, as described above. The scale used during the excursion to estimate the cover of every species recorded is given in Tab. 6. The figures offer a balance between the accuracy needed for syntaxonomic classification and avoiding an impression of false accuracies.

**Tab. 6:** Extended Braun-Blanquet Scale (Braun-Blanquet 1964, Dierschke 1994).

| Symbol | Description |
|---|---|
| r | rare, usually only one individual plant specimen |
| + | 2 – 5 individuals, cover < 5% |
| 1 | 6 – 50 individuals, cover < 5% |
| 2m | >50 individuals, < 5% cover |
| 2a | unlimited numbers, 5 – 15% cover |
| 2b | unlimited numbers, 15 – 25% cover |
| 3 | unlimited numbers, 25 – 50% cover |
| 4 | unlimited numbers, 50 – 75% cover |
| 5 | unlimited numbers, 75 – 100% cover |

Another scale frequently used is the **Londo scale** (Londo 1975, 1984). It has the advantage of being more detailed in ranges of higher cover than the Braun-Blanquet scale.

**Tab. 7:** Londo scale

| Zacharias/ Londo (1996) | % | Comments |
|---|---|---|
| r | <1 | 1 Ind. |
| + | <1 | 2-5 Ind. |
| 0.1 | <1 | 6-50 Ind. |
| 0.1m | <1 | >50 Ind. |
| 0.2 | 1--3 | |
| 0.2m | 1--3 | >50 Ind. |
| 0.4 | 3--5 | |
| 0.4m | 3--5 | >50 Ind. |
| 1 | 5--15 | |

| Zacharias/ Londo (1996) | % | Comments |
|---|---|---|
| 2 | 15-25 | |
| 3 | 25-35 | |
| 4 | 35-45 | |
| 5 | 45-55 | |
| 6 | 55-65 | |
| 7 | 65-75 | |
| 8 | 75-85 | |
| 9 | 85-95 | |
| 10 | 95-100 | |

## *Life cycle stages*

In addition, the stage of the life cycle of the different plant species can be noted. The classification suggested here is given in Tab. 8.

**Tab. 8:** Table showing phenological parameters. In one observation plot, an individual species can occur in several phenological stages.

| No. | Life Cycle Description |
|---|---|
| 1. | Seedling |
| 2. | New Sprout |
| 3. | Rootrunners without flowers |
| 4. | Buds |
| 5. | Flowering |
| 6. | Fruiting |
| 7. | Fruiting-Flowering |
| 8. | Fruits fallen off |
| 9. | New sprouts after fruits have fallen off |
| 10. | Dying off root runners |
| 11. | Dead plant |

## *Vegetation form concept (Greifswald school)*

In addition to the strictly hierarchic classical floristic concept, scientists around Succow and Joosten (2001) developed a concept where not only floristic parameters are used to characterize vegetation types, but also site conditions under which the vegetation types occur. To distinguish between vegetation units, called vegetation forms, socio-ecological species groups are used. The basic data collection is the same as described for Braun-Blanquet (see above). Nevertheless, during the table work no observations are sorted out and the socio-ecological species groups are formed by taking into account preferences for light, temperature, continentality (geographic region), nutrients, soil moisture, pH and salinity of the plant species (Ellenberg 1992). The main idea is that vegetation can best be described by identifying indicator groups of species, which show specific environmental conditions where the vegetation form can grow, e.g., soil moisture, etc. Important here is that the ecological amplitude of the species has already been investigated. For Azerbaijan, many questions still remain unanswered in this field. Since the vegetation form concept can only be used regionally and is not hierarchical, it is possible for a scientist to determine the amplitude for all species in the observation area within a few vegetation periods. As the method also requires soil investigations in parallel with the vegetation investigation, the results of this type of research are much more application-oriented and can be directly used in developing landscape and natural resource management strategies. In addition, since no observation plots are omitted, the ambiguity in the generation of vegetation maps can be minimized in comparison to the Braun-Blanquet method (Succow & Joosten 2001).

The vegetation forms are named by taking the names of one or two characteristic plant species in combination with a term describing the physiognomy or land-use form of the area (e.g., *Utricularia vulgaris-Cladium mariscus* marsh community).

### 3.1.3. Landscape-ecological assessment with focus on plants and soil

#### *Vegetation Transects*

The assessing of transects is a very time-consuming method. This is useful in cases where the borders between associations are not clear and time restrictions can be compensated for with a higher number of investigators, e.g., on a practical student exercise. There are different methods for exploring the frequency of species, but they are all very time-intensive. We therefore do not discuss them here and recommend using the Braun-Blanquet or Londo scale in a small area along the transect (30x30, 50x50, 100x100 cm). This will generally deliver suitable results with an acceptable time effort (Mühlenberg, 1989). A simplified example of such transect is given in Fig. 15 below. We can observe the presence or absence of different species and in turn will be able to better understand the borders between different plant associations and the ecological factors connected with their spatial occurrence.

#### *Soil transects and landscape-ecological catena*

Soil transects are used analogous to vegetation transects to investigate typical spatial relationships of soil types along a uniform slope. Due to erosion processes, soil is washed downhill over time. Consequently, this leads to different soil types and hence different ecological conditions for plant growth. In the landscape-ecological observations, we select the observation sites with the help of the vegetation cover, since soil and plants are interrelated. A string of observation points is set up along a slope, with a starting point on the top and an end point at the slope bottom. The distances between the observation points depend on the magnitude of the different vegetation/soil belts along the slope. This method allows developing a relatively fast understanding of landscape patterns and processes including soil and vegetation. As soil investigations are much more time-consuming, vegetation observations can be made in a number of other localities as well, for example to document larger transition zones. In return, conclusions on erosion and succession processes can be drawn and a deeper understanding of the landscape can be generated. This, in turn, allows making management recommendations. Nevertheless, it must be considered that a single transect only constitutes a sample of the overall landscape and does not give the full spatial information on the situation that a thematic map on soil or vegetation would offer. To take things one step further, we can combine the information from repeated transects and create an abstraction of the most typical spatial relationships in a landscape-ecological catena (see Fig. 15).

With the results of the excursion only vegetation transects could be created (see chapter 4.1. and 4.2.) as for full catenas the soil data collected during the excursion was insufficient.

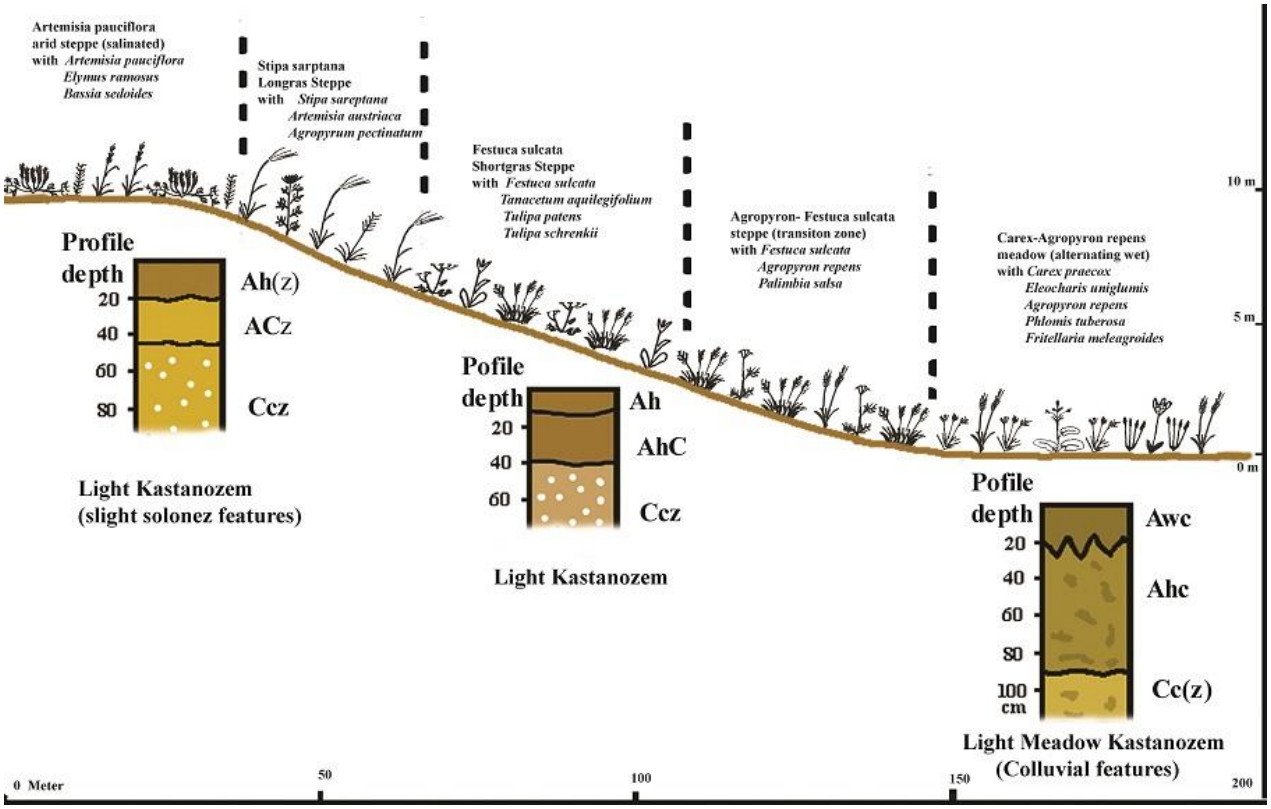


**Fig. 15:** Landscape-ecological catena in the rolling hill country of Central Kazakhstan with natural steppe and meadow vegetation (Dieterich 2000).

## 3.1.4. Field Equipment Vegetation

- Herbarium press
- Digital photo with GPS
- GPS and compass
- Magnifying glass 10x
- Measuring tape, sticks and a rope for marking transects and observation plots
- Copies of "Data sheet template – vegetation assessment" (see in Annex 1.1.)

## 3.1.4. Literature on vegetation (cited and further recommended)


Aleksandrova, V. D. (1969): Klassifikatsiya rastitel'nosti. Obzor printsipov klassifikatsii i klassifikatsionnykh sistem v razlichnykh geobotanicheskikh shkolakh [Vegetation classification. Overview of the principles of classification and classification systems in different geobotanic schools]. Nauka, Leningrad, SU (Russ.). 275p.

Baghirov, H. S., Aliyev, J.A. (eds.) (2013): Red Book of the Republic of Azerbaijan–Rare and Endangered Plant and Mushroom Species, Second Edition, Baku, AZ. 677p.

Braun-Blanquet J. (1972): Plant Sociology: the study of plant communities, Hafner Publishing Company, Michigan, US. 439p.

Braun-Blanquet, J. (1964): Pflanzensoziologie: Grundzüge der Vegetationskunde [Plant Sociology: Basics of vegetation science]. 3rd edition. Springer, Berlin, Wien, New York (German). 865p.

Czerepanov, S.K. (1995): Vascular Plants of Russia and adjacent states (The former USSR). Cambridge University Press, UK. 532p.

Dierschke H. (1994): Pflanzensoziologie. Grundlagen und Methoden [Plant Sociology: Basics and methods]. Ulmer Verlag, Stuttgart, DE (German). 683p.

Dieterich, T. (2000): Landschaftsökologische Untersuchungen an Ackerbrachen im künftigen Biosphärenreservat „Tengis See" in Zentralkasachstan [Landscape ecological investigations on fallow fields in the perspective Biosphere Reserve „Tengiz Lake" in Central Kazakhstan]. Diploma Work at Institute for Landscape Ecology and Botany, University of Greifswald, DE (German). 141p.

Ellenberg H., Weber, H. E., Düll R., Wirth V., Werner, W., Paulißen, D. (1992): Zeigerwerte der Pflanzen in Mitteleuropa. 3., erweit. Aufl. [Indicator values of plants in Central Europe. 3rd, extended edition]. Scripta Geobotanica 18, Goltze, Göttingen, DE (German). 258p.

Grossgeym, A. A. (1939–1967) Flora Kavkaza T. I – VII [Flora of the Caucasus Vol. I – VII]. Izdatel'stvo Asfan, Baku, SU (Russ.).

Hennekens, S. M., Schaminee, J. H. J. (2001): TURBOVEG, a comprehensive data base management system for vegetation data. Journal of Vegetation Science 12: 589–591.

Karyagin, I.I. (1950–1961): Flora Azerbaydzhana T. I – VIII [Flora of Azerbaijan Vol. I – VIII]. Izdatel'stvo Akademii Nauk Azerbaydzhanskoy SSR, Baku, SU (Russ.).

Kent, M. (2011): Vegetation Description and Data Analysis: A Practical Approach, 2nd Edition. Wiley, Chichester, West Sussex, UK. 428 p.

Londo, G. (1975): Dezimalskala für die vegetationskundliche Aufnahme von Dauerquadraten. - In: Tüxen, R. (Hrsg.): Sukzessionsforschung, Ber. Int. Sympos. IVV Rinteln (1973): 613–617. –German.

Londo, G. (1984): The decimal scale for relevés of permanent quadrats. - In: Knapp, R. (Hrsg.): Sampling methods and taxon analysis in vegetation science. Handb. Veg. Sci. 4: 45–49. Den Haag, NL.

Mueller-Dombois & Ellenberg, H (1974): Aims and methods of vegetation ecology. Wiley, New York, London, Sydney, Toronto. 547p.

Mühlenberg, M. (1989): Freilandökologie [Outdoor ecology]. 2nd Edition, Quelle & Meyer, Heidelberg, DE (German). 430p.

Peper, J. (2010): Semi-desert vegetation of the Greater Caucasus foothills in Azerbaijan: Effects of site conditions and livestock grazing, Dissertation at University of Greifwald, DE. 112p.

Rabotnov, T. A. (1992): Fitotsenologiya: uchebnoe posobie dlya vuzov [Phytosociology: textbook for high universities]. Izd-vo MGU, Moskva, RU (Russ.). 352p.

Rabotnov, T. A. (1995): Istoriya fitotsenologii: uchebnoe posobie [History phytocoenology: Textbook], Argus, Moskva, RU (Russ.). 158p.

Shetekauri, S., Jacoby, M. (2009): Mountain flowers & trees of the Caucasus. Buneba print, Tbilisi, GE. 315p.

Strasburger, E., Sitte, P., Weiler, E., Kadereit, J.W., Bresinsky A., Körner, C. (2002): Lehrbuch der Botanik für Hochschulen. 35. Auflage [Textbook of botany for universities. 35th edition]. Spektrum Akademischer Verlag, Heidelberg, DE (German). 1123p.

Succow, M., Joosten, H. (eds.) (2001): Landschaftsökologische Moorkunde, 2. Auflage [Landscape ecology of mires, 2nd edition]. Schweizerbart`sche Verlagsbuchhandlung, Stuttgart, DE (German). 622p.

Tichy, L. (2002): JUICE, software for vegetation classification. Journal of Vegetation Science, 13(3): 451–353.

Traxler, A. (1997): Handbuch des vegetationsökologischen Monitorings – Methoden, Praxis, angewandte Projekte [Handbook of ecological monitoring for vegetation – methods, practice, applied projects], Umweltbundesamt Austria, Wien, AT (German). 391p.
(Internet: http://www.umweltbundesamt.at/fileadmin/site/publikationen/M089A.pdf).

Zacharias, D. (1996): Vegetationskundliche Dauerbeobachtung; Konzepte und Beispiele aus der Praxis Niedersachsens [Vegetationecological permanant plot observation – concepts and examples from the praxis in Lower Saxony]. In: Umweltbundesamt Österreich (ed.): Tagungsmappe zum "Seminar on Monitoring for Nature". Umweltbundesamt Austria, Wien, AT (German). 47–55
(Internet: http://www.umweltbundesamt.at/fileadmin/site/publikationen/CP022.pdf).

## 3.2. Soils

For landscape-ecological investigations, the soil layer, which is relevant for the vegetation cover, needs to be investigated. Historical soil genesis processes as well as anthropogenically induced erosion processes can be observed in soil profiles. Basics of soil science are available, e.g., in Ganzhara (2001) and Rosanov (2004). The international state of the art classification of soils can be derived from the IUSS Working Group WRB (2006, 2015). Its 'Guidelines for soil description' (FAO 2006) provide an easily accessible manual, describing all necessary steps for soil assessment, including the equipment needed. Babaev et al. (2006) published a modern Azerbaijani soil classification, which can be used as the basis for future field work.

In the field, it is important to investigate and record the colour, texture, humidity, structure, density, pore space, roots, character of borders between horizons and depth in a soil profile. In addition, parameters such as visibility of salt, limestone, gypsum, roots, and influence of water (gley) are noted for the whole profile, along with general parameters regarding the location and date of the observed profile (see "Data sheet template – soil assessment" in Annex 1.2.). It is also important to note the depth of the samples taken in each horizon. One can take samples at the centre of each horizon or a mixed probe taken along the horizon in an even manner (example given in Fig. 16).

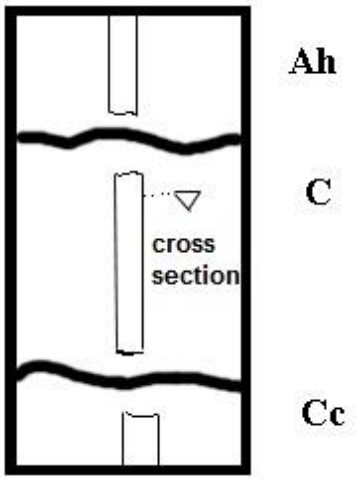


**Fig. 16:** Sampling along the soil profile. Only the transition zones between the horizons are omitted (Dieterich 2000).

In general, it is sufficient to dig about one metre deep, and even less if the C horizon starts earlier. The root density indicates the relevance of the soil depth for the vegetation, which is the major objective in the soil investigations. It is important to limit the amount of work required.

As described above, the soil transect approach is used to get an overview of the situation in a certain area (see description above).

They are not described here and can be derived from the given literature, e.g. Ganzhara (2002). In general, the C/N ratio, pH, content of calcium carbonate and absolute as well as organic carbon are of high ecological interest.

## 3.2.1. Equipment Soil

- Spade
- Measuring tape
- Digital photo with GPS
- GPS and compass
- Plate for soil profile number
- 10% HCl
- Munsell Colour Charts
- Copies of "Data sheet template – soil assessment" (see in Annex 1.2.)

## 3.2.2. Literature on soil assessment (cited and further recommended)


Babaev, M. P., Dzhafarova, C. M., Gasanov, V. G. (2006): Modern Azerbaijani soil classification system. Eurasian Soil Science 39 (11): 1176–1182 (Original Russian text: Babaev, M. P., Dzhafarova, C. M., Gasanov, V. G. (2006) published in Pochvovedenie 11: 1307–1314).

Dieterich, T. (2000): Landschaftsökologische Untersuchungen an Ackerbrachen im künftigen Biosphärenreservat „Tengis See" in Zentralkasachstan [Landscape ecological investigations on fallow fields in the perspective Biosphere Reserve „Tengiz Lake" in Central Kazakhstan]. Diploma Work at Institute for Landscape Ecology and Botany, University of Greifswald, DE (German). 141p.

FAO (2006): Guidelines for soil description, 4th edition. FAO, Rome, IT. 145p. Available: http://www.fao.org/3/a-a0541e.pdf

Ganzhara, N. F. (2001): Pochvovedenie [Soil Science]. Agrokonsalt, Moskva, RU (Russ.). 392p.

Ganzhara, N. F., Borisov, B. A., Baybekov, R. F. (2002): Praktikum po pochvovedeniyu [Practicals on soil science]. Agrokonsalt, Moskva, RU (Russ.). 279p.

IUSS Working Group WRB (2006): World Reference Base for Soil Resources 2006. A framework for international classification, correlation and communication, 2nd edition. World Soil Resources Reports No. 103, FAO, Rome, IT. 145p. Available: http://www.fao.org/3/a-a0510e.pdf (also in Russian or Turkish: http://www.fao.org/publications/search/en/?sel=ZmRyX2Nfc2VyaWVzOiJodHRwOi8vYWltcy5mYW8ub3JnL2Fvcy9zZXJpZXMvY185ODQi).

IUSS Working Group WRB (2015): World Reference Base for Soil Resources 2014, update 2015. International soil classification system for naming soils and creating legends for soil maps. World Soil Resources Reports No. 106. FAO, Rome, IT. 203p. Available: http://www.fao.org/3/a-i3794e.pdf (this latest update so far only available in English).

Rosanov, B. G. (2004): Morfologiya pochv [Soil morphology]. Izd-vo Akademiicheskiy proekt, Moskva, RU (Russ.). 432p.

## 3.3. Land Use

Landscapes combine different functions. Apart from ecological functions (e.g. habitat for species, water regulation), the capacity of natural processes as well as the provision of material and services for the fulfilment of human needs is important. These functions comprise the socio-economic functions of the landscape (Steinhardt et al. 2005). To derive information on the adopted land use in a given area, not only mere observation but also contact to land users is necessary. Even simple questions about the population, household or livestock numbers of a certain area or information on the specific land use type and the time-frame in which this use is applied can be helpful in identifying aspects of the current land use. These aspects, together with other assessed landscape-ecological parameters, can then help to draw a clearer picture of the current state of an ecosystem.

To assess basic characteristics of land use at the stops and sites of the excursion, a sheet for land use assessment, which includes observations and questions for small interviews, is attached (see "Data sheet template – land use assessment" in Annex 1.3.).

Natural resources form an important basis for the livelihood of people in Azerbaijan. Especially the summer pastures in the mountains are an important resource for livestock farming. At the same time, mountain meadows represent an outstanding value for biodiversity. Overgrazing and other forms of unsustainable land use are common problems. Erosion, in particular, is a big threat to livestock farming as well as to nature conservation. Management and policy decisions for sustainable pasture use should be based on thorough knowledge about the ecological capacity as well as on the current state of the summer pastures (Etzold & Neudert 2013). As a "guidance for a comprehensive and objective monitoring of pasture conditions" (p.1), and to provide "management recommendations for a sustainable pasture use […] of pastures in the future" (p.1), Etzold & Neudert (2013) developed a Monitoring Manual for summer pastures in the Greater Caucasus in Azerbaijan. It can be downloaded from the source given in the references of this section. In a simple cooking-recipe style, each step for assessing the socio-economic background of the pasture use and ecological condition of a particular pasture is laid out and can easily be followed. The method has already been widely tested during many training runs in Azerbaijan and successfully implemented in application projects by UNDP. For more details, see the data sheet in Annex 2.4.

### 3.3.1. Literature Land Use

Etzold, J., Neudert, R. (2013): Monitoring Manual for Summer Pastures in the Greater Caucasus in Azerbaijan. GIZ Working Paper – Sustainable Management of Biodiversity, South Caucasus. Baku, AZ. 60p. Available (also in Azerbaijani) at: http://biodivers-southcaucasus.org/wp-content/uploads/2015/02/Monitoring-manual-for-summer-pastures-in-the-Greater-Caucasus-in-Azerbaijan_EN.pdf.

Steinhardt, U., Blumenstein, O., Barsch, H. (2005): Lehrbuch der Landschaftsökologie. Elsevier Spektrum Akad.Verlag, Heidelberg, DE (German). 294p.

## 3.4. Birds

Among all animal groups, birds are the easiest and most rewarding subjects for an ecological study and further monitoring programme, due to their visibility and recognisability. Many of them act as umbrella species, representing entire ecosystems, and many are so attractive that they are considered flag-ship species, while others bear strong cultural values.

### 3.4.1. Identification of Birds

In Azerbaijan, 372 bird species are listed, with 13 classified as endangered (Musaev et al. 2000, see also Chapter 2.4.1.). Although this represents only a moderate number of species, a large amount of field training is required to identify birds throughout the year. Since many birds change their plumage in winter, young animals may show a different plumage than adults, and the plumage of males frequently differs from that of females, it is necessary to learn a number of forms in order to arrive at the correct identification. Fortunately, there are two accessible identification guides covering the whole variety of species in Azerbaijan (Svensson et al. 2010 and Flint et al. 1968). In addition, there is a variety of possibilities to learn bird songs, which can help to identify the species. Some bird observers combine a listening device with an identification book, since both can be taken into the field. Singer (2011) published such a book for German songbirds, which is quite suitable for use with birds in Azerbaijan, as well.

### 3.4.2. Monitoring of Birds

There are several counting methods used for the monitoring of breeding bird communities (see Bibby et al. 2000). Outside of the breeding season, it is not feasible to apply these methods. Since the excursion took place in late summer, none of these methods were applied. Instead, bird species observed at every excursion point were recorded in a simple list. Nevertheless, even such lists can provide valuable information, as many bird species characteristically occur together with others and represent a specific bird community typical for certain habitats.

### 3.4.3. Equipment Birds

- Binoculars 10x magnification
- Scope 20x-60x magnification
- Hand counting devices (for large flocks)
- Identification Guide (Svensson et al. 2010)
- Counting form

## 3.4.4. Literature Birds

Bibby, C. J., Burgess, N. D., David, A. H., Musoe, S. (2000): Bird Census Techniques. Academic Press, London, New York, Tokyo. 302p.

Flint, V., Byëme, R., Kostin, Yu., Kuznetsov, A. (1968): Ptitsy SSSR [Birds of the USSR]. Izd-vo Mysl, Moskva, SU (Russ.). 637p.

Gönner, C., Isayev, S., Sultanov, E., Werner, S. (2011): Monitoring of Waterbirds in Azerbaijan. Manual, GIZ Working Paper – Sustainable Management of Biodiversity, South Caucasus. Baku, AZ. 34p. http://biodivers-southcaucasus.org/wp-content/uploads/2015/02/Waterbird-Monitoring-Manual.pdf (available in English and Azerbaijani).

Musaev, M.A., Gadzhiev, D.V., Rakhmatulina, I.K. (2000): Zhivotnyy mir Azerbaydzhana, tom. III, Pozvonochnye [Animals of Azerbaijan, vol. 3, Vertebrates]. Baku, Elm, AZ (Russ.). 656 p.

Singer D. (2011): Was fliegt denn da? [What is flying there?]. Franckh Kosmos Verlag, Stuttgart, DE (German). 399p. (including Ting device for bird songs).

Svensson, L., Mullarney, K., Zetterstrom, D., Grant, P. J. (2010): Collins Bird Guide: The Most Complete Guide to the Birds of Britain and Europe. 2nd edition. Harper Collins, London, UK. 448p.

# IV. Excursion results

**Introduction**. This chapter describes the results of the excursion. It describes the landscapes for specific sites along each of the transects that were visited. The descriptions of geomorphology, soils, vegetation and birds observed as well as tables and maps will enable the reader to reconstruct the excursion and replicate visits to the respective excursion points. The site descriptions were prepared by tandems of German and Azerbaijani students and subsequently revised by the experts who edited this book.

More specifically, the chapter guides the reader through landscapes in the coastal forest of Samur-Yalama across cultural landscapes with forests, fruit orchards and hay meadows in the foothills and lower mountains around Guba and Altiaghaj to high-mountain grasslands in the Greater Caucasus, as found in Khinalig or Laza. It also includes a description of the the lowlands and semi-desert landscapes around Beshbarmag, the lowlands of Samur-Dävächi and the Shirvan plain.

**The excursion**. The results presented in this chapter were collected during an excursion that took place from the end of August until the beginning of September 2015. Ten students from Baku State University and ten students from the University of Greifswald participated and were led by teachers and experts from both universities and the Michael Succow Foundation (see Photo 1). The overview map (see Fig. 17) depicts the excursion's route. Detailed maps are inserted in the respective sections below. The route was chosen to be representative for the country, touching most of the ecosystem and landscape types of Azerbaijan. The route can be divided into three parts, which are reflected in the Chapters 4.1., 4.2. and 4.3.

The overall greenest part of the route is located in the very north of the country. It is presented in Chapter 4.1., with a transect stretching from the very specific lowland forests on the shore of the Caspian Sea in the Samur-Yalama region across cultural landscapes with fruit orchards and hay meadows and various forests in the foothills and lower mountains around Guba to high-mountain grasslands in the Greater Caucasus, e.g., near Laza or Khinalig. The climate of the second transect (Chapter 4.2.) is generally more arid than along the previous route. This transect extends from coastal ecosystems across semi-deserts and steppes in the foothills below Khizi and various broad-leaved forest types up to montane grasslands around and above Altiaghaj. Lowland semi-desert vegetation in the Shirvan plain and on Absheron is presented in Chapter 4.3.

**Photo 1:** Participants of the excursion in 2015 from Greifswald University and Baku State University (S. Hirschelmann)

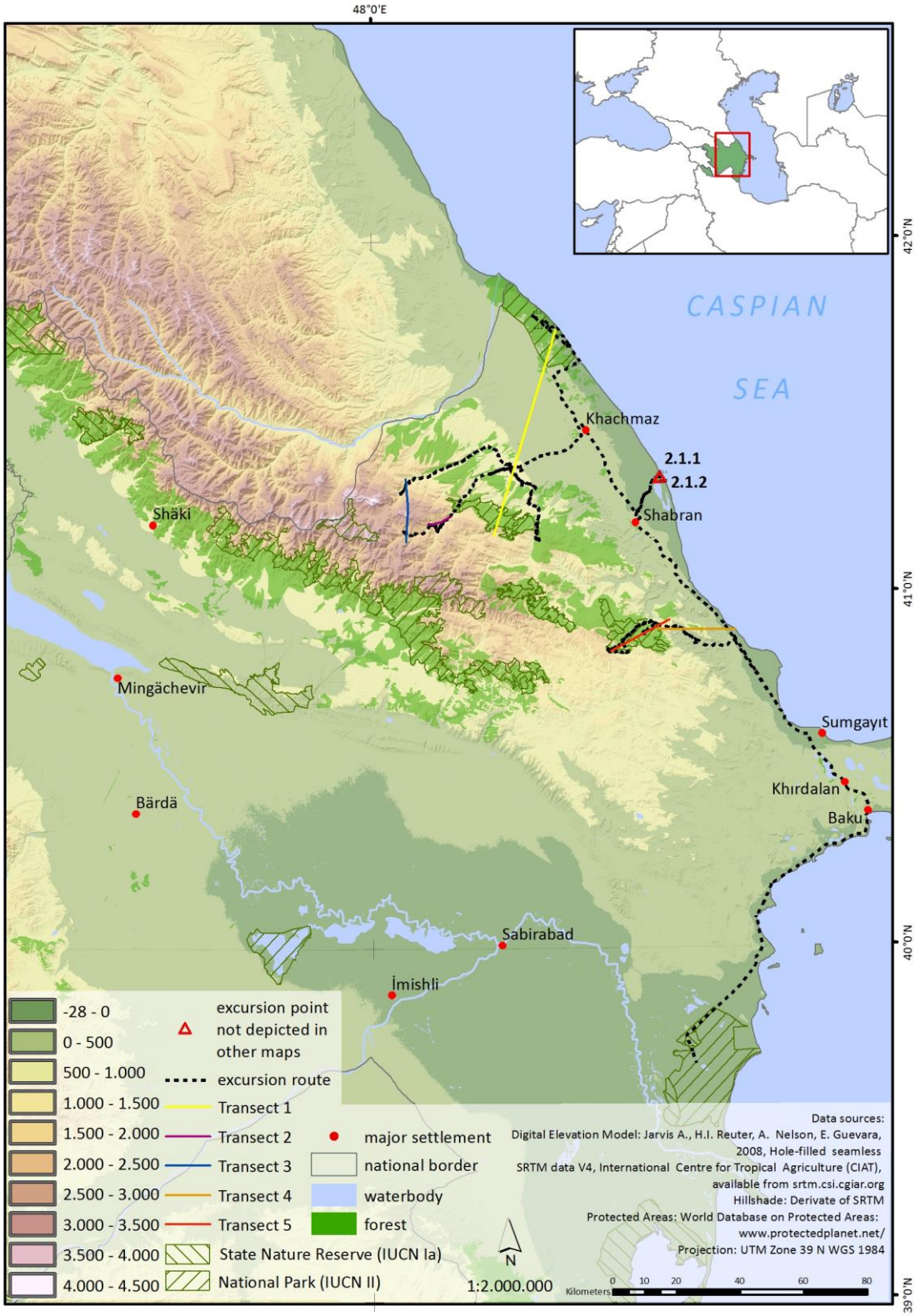


**Fig. 17:** Overview of excursion route and points (Map: Jens Wunderlich)

## 4.1. Transect Samur-Yalama – Guba – Khinalig

A detailed map covering this transect is shown in Fig. 18. In order to cover the altitudinal sequence of ecosystems from the Caspian Sea to the nival zone, which at the same time corresponded to the observations of the excursion route, three separate schematic cross-cut sections were created along three transects. The positions of these three transects are shown in Fig. 18.

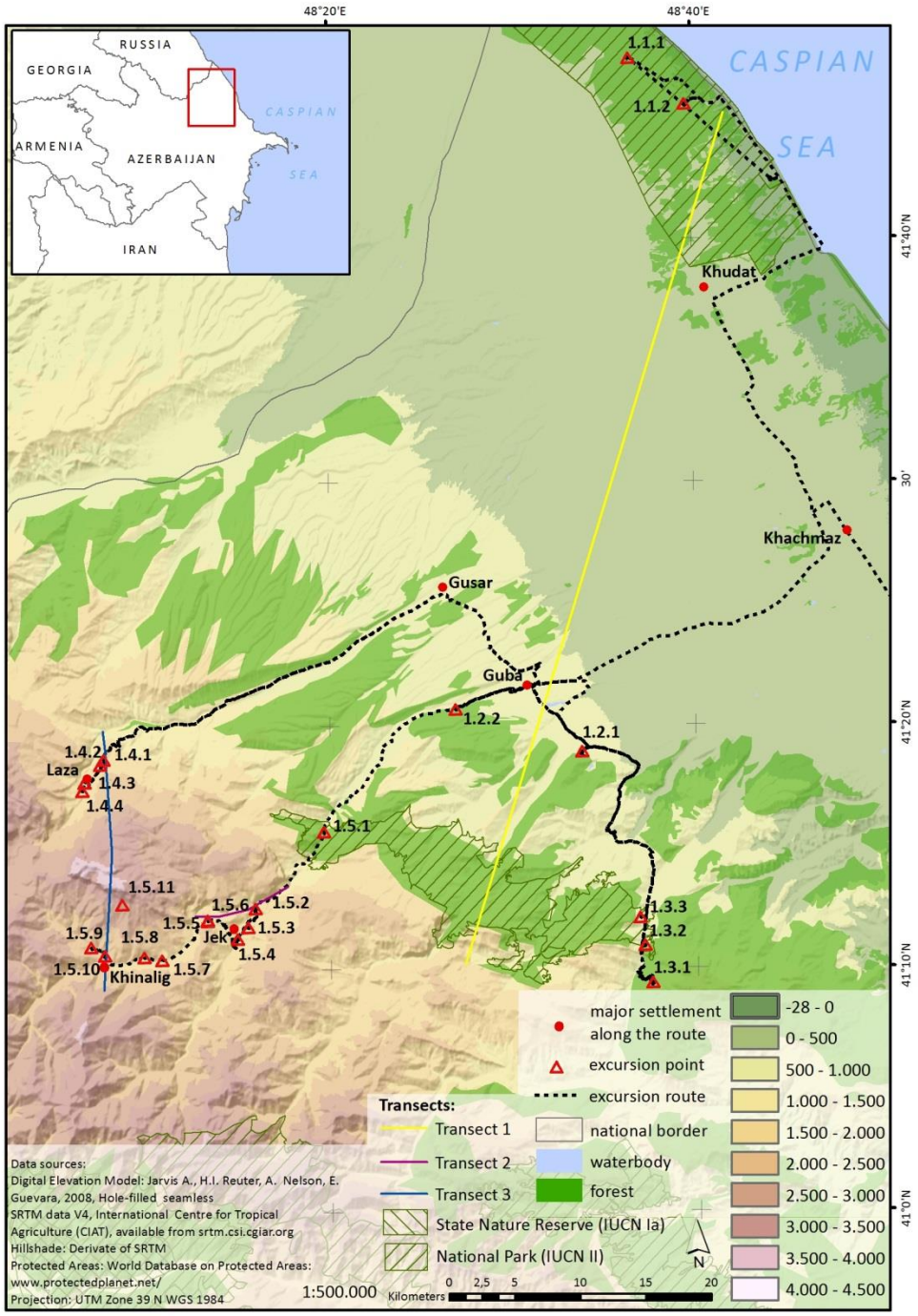


**Fig. 18:** Overview map of excursion route, points and transects in northern Azerbaijan (Note: forest cover depicts only larger continuous forest patches) (Map: Jens Wunderlich)

The first cross-cut section in Fig. depicts the altitudinal gradient over a distance of 70 km from the Caspian Sea in the Samur-Yalama region in the northeast to the middle forest belt until around 1500 m a.s.l. southwest of the town of Guba.

This cross-cut section (Transect 1 in 19.1) starts with the very specific broad-leaved forests on the Caspian shore in Samur-Yalama NP, which are described in detail in Chapter 4.1.1. The peculiarity here is that, based on the climate, only semi-deserts would be expected to occur. The availability of ample water from a dense river system and abundant ground water supply enables these forests to grow here. These forests were once more extensive and have been replaced today by shrub vegetation, meadows and other agricultural land forms. Moving uphill, we reach flat, rolling hills, which were once covered by treeless steppes, but today have been converted to arable land, intermixed with large, irrigated apple and other fruit plantations. On the first foothills, so-called Shiblyak vegetation, a semi-open thorny bushland of *Paliurus spina-christi* and Juniper species, replaces the semi-arid oak forests that once grew here (see Chapters 2.7.1. and 4.2.2.). Closed forests can again be found above 500 m.a.s.l. around the town of Guba. Their strongholds are slopes with northern exposure, as the conditions there are more favourable for forest growth. In general, evapotranspiration on cooler northern slopes is lower, compared to warmer southern slopes, i.e., there is better availability of water for plants on northern than on southern slopes. Consequently, on southern slopes, once disturbed, the conditions for forest recovery are worse and the forests are subsequently replaced by bushland or grasslands and other forms of cultural landscapes (see Chapters 4.1.2. and 4.1.3.).

Fig. shows the second cross-cut section, which stretches along a transect of only around 8 km between the famous Cloudcatcher Canyon at around 1,500 m a.s.l. and the surroundings of the village of Jek at approx. 1,900 m a.s.l. The excursion points 1.5.1-6 represent different habitats and are described in detail in Chapter 4.1.5.

In the deep-cut Cloudcatcher Canyon, sufficient humidity is responsible for partly still dense forest stands on the hardly accessible steep slopes. Forest cover presumably also occurred at higher altitudes in the past, as demonstrated by a few forest patches on northern slopes. Centuries of wood cutting and grazing reduced the forests, which were replaced by rather mesophytic grasslands on northern slopes and xerophytic vegetation on the southern slopes. At many sites of the latter, thorny bushlands with prickly and aromatic Juniperus and thorn cushions gained dominance due to their defence mechanisms against grazing animals.

The third cross-cut section (see Fig. 19.3) runs from Laza village at the foot of Mt. Gizilgaya's northern slope over its summit to the southern slope and the much drier interior montane valley of the Gudiyalchay River with the village of Khinalig. Along a comparably short distance of less than 20 km, the vegetation indicates a strong climatic gradient. While on the northern slope with more than 1,000 mm annual precipitation, birch krummholz and mesophytic meadows occur, xerophytic vegetation prevails on the southern slope, with thorn cushions occurring in the lower part. In this interior montane valley, the annual precipitation adds up to only 550 mm. However, on its northern slopes, mesophytic grasslands can again be recorded.

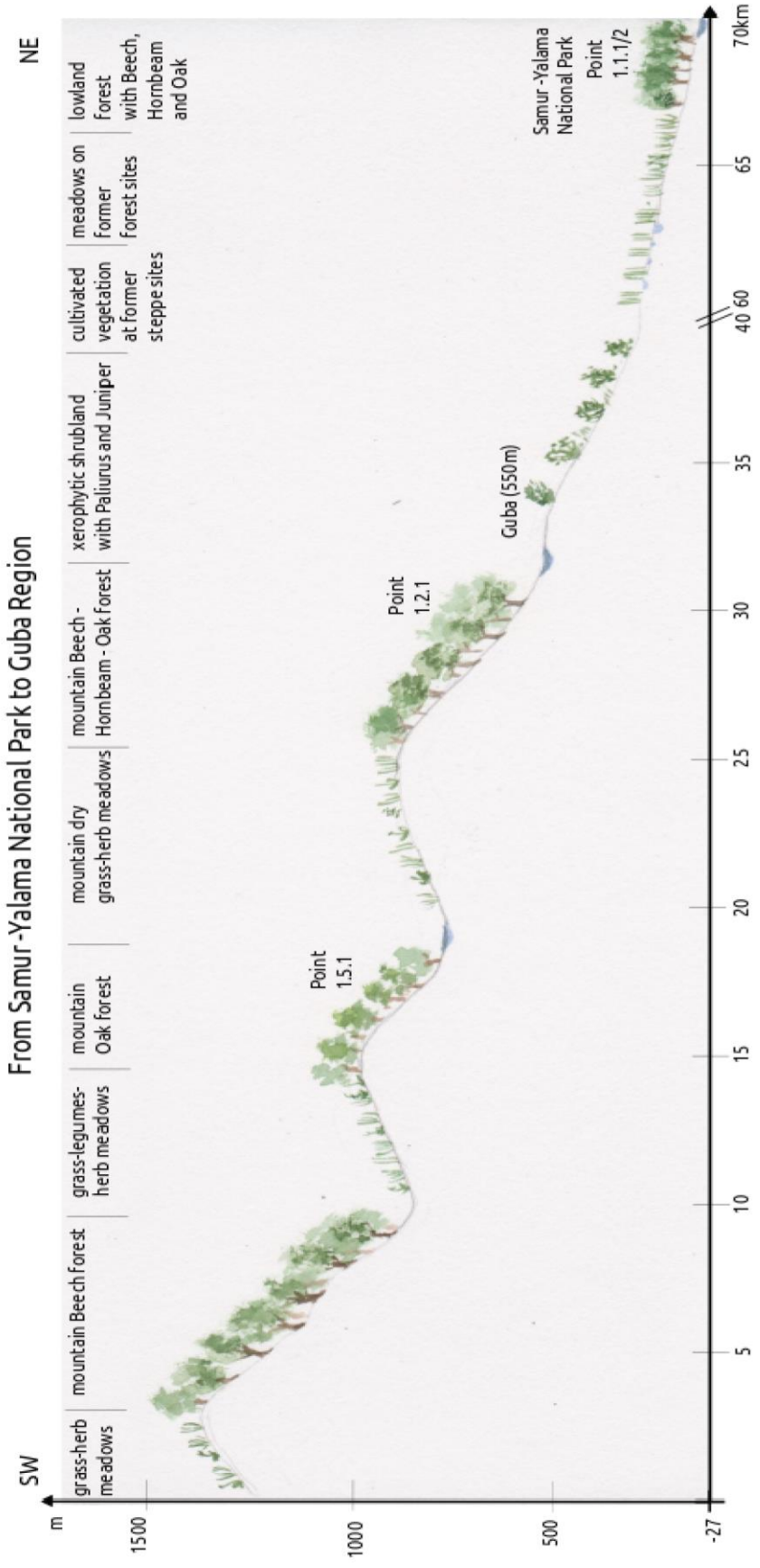


**Fig. 19.1:** Landscape transect showing a section with the main landscape types from Samur-Yalama NP to Guba Region (drawing: Lena Haeberlein)

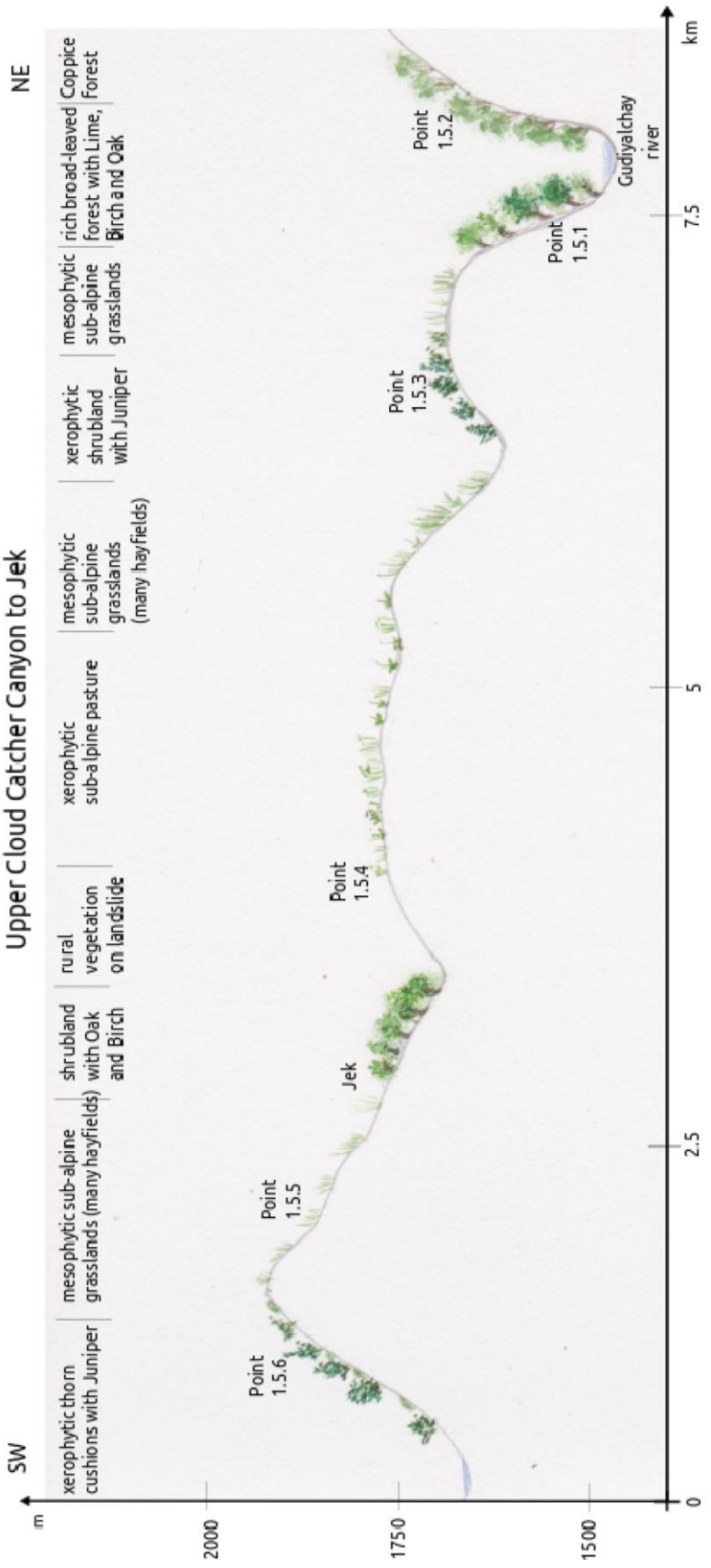


**Fig. 19.2:** Landscape transect showing a section with the main landscape types from Upper Cloudcatcher Canyon to Jek (drawing: Lena Haeberlein)

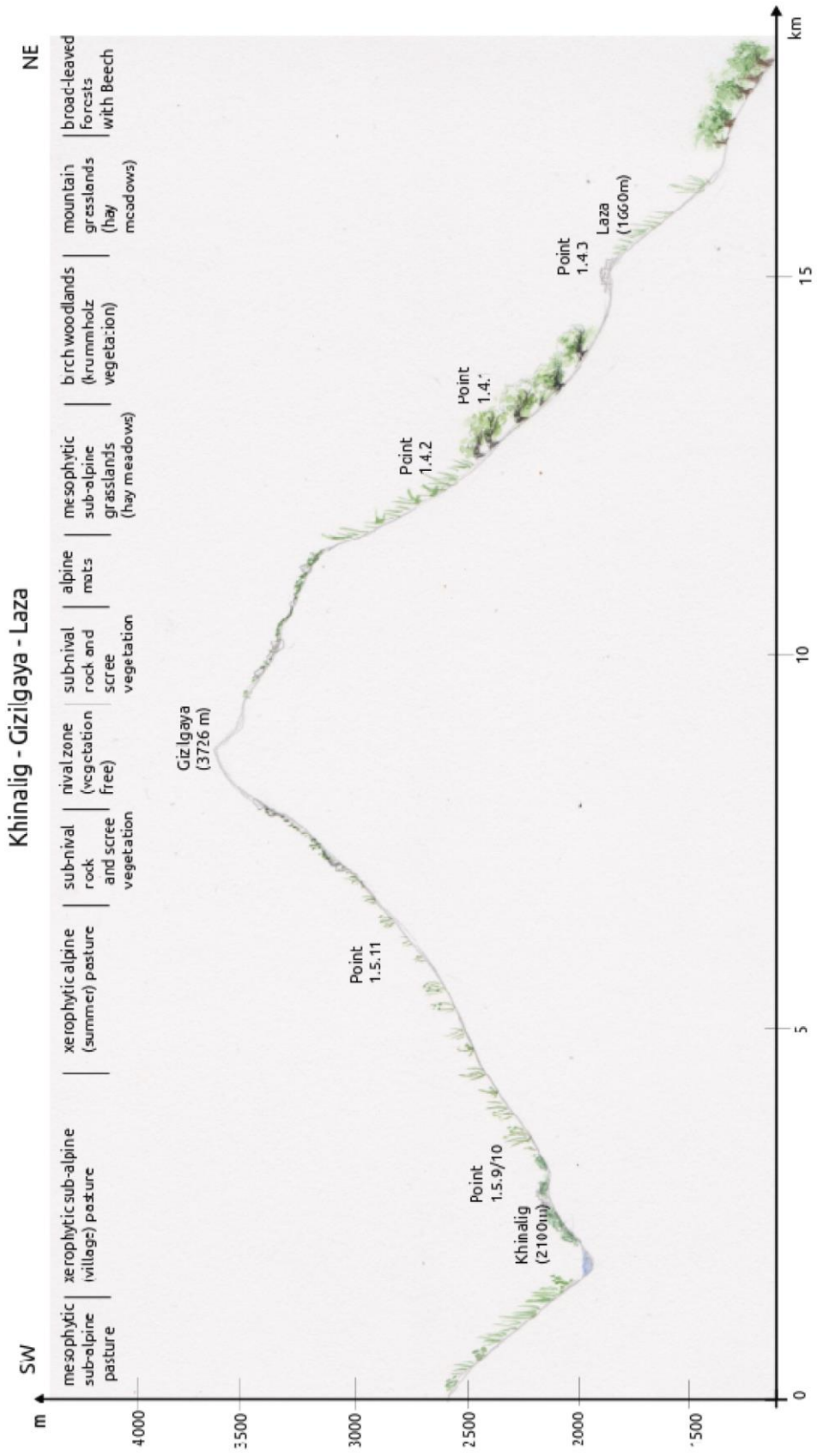


**Fig. 19.3:** Landscape transect showing a section with the main landscape types from Khinaliq to Gizilgaya to Laza (drawing: Lena Haeberlein)

## 4.1.1. Broad-leaved Forests in Samur-Yalama National Park

**Day of protocol: 01.09.2015**

**Names of students: Mesud Abdullayev; Danny Eichhorn**

Number of excursion points: 2

Number of vegetation plots: 3

Number of soil profiles: 1

Number of land use assessments: 0

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### *General characteristics of the landscape*

Samur-Yalama National Park has a size of 12,000 ha and is located in the north-eastern corner of Azerbaijan. The northern boundary of the National Park (NP) is the state border to Russia. The western boundary is formed by a railroad and in the east the park reaches the coastline of the Caspian Sea.

The park was established in 2012 and co-funded with Azerbaijani-German cooperation through the German KfW development bank.

The main conservation goal of the National Park is the protection of the last remaining coastal forests in Azerbaijan – the so-called Khudat lowland forest ecosystem. Since its establishment as a National Park, the forest area has been free of human utilisation such as logging for firewood. Therefore, those parts of the forest that have been used in the past are now developing through a natural succession. The core zone is located in the northern area and is characterised by dense forests dominated by Hornbeam (*Carpinus betulus*). The White Poplar (*Populus alba*) and Alder (*Alnus glutinosa*) are of importance especially in areas with high groundwater level. In its southern parts, the forest becomes sparser and is dominated by oak species (mainly *Quercus robur* subsp. *pedunculiflora*). Several liana species (e.g., *Smilax excelsa*, *Clematis vitalba* or *Hedera pastuchowii*) give many of these forests a peculiar appearance.

The climate of the Samur-Yalama region is characterised by distinct dry seasons with an annual precipitation of 250 mm. In combination with annual temperatures of more than 13 °C, this amount of rainfall alone cannot support dense temperate forests, but the expected biome would be classified as semi-desert. Thus, an additional water supply is necessary, which is provided from the northern slope of the Greater Caucasus and is transported to the Caspian coast both above- and belowground via a system of riverbeds. The additional water supply, in combination with highly productive soils, is the main reason for the great diversity of plant species in the park, which amounts to nearly 450 native species.

Within the area of the National Park, the villages of Nabran, Tel, Ashagioba, and part of the village of Yalama are included. The surroundings of the villages are dominated by open areas, which are mainly used as pastures and crop fields. Along the coastline, some fishing economy is also present, as well as tourism business. The two most important months for tourist activities are July and August.

**Photo 2:** Brook with accompanying *Alnus glutinosa* in the core zone of Samur-Yalama NP, while away from water bodies *Carpinus betulus* is dominating (J. Etzold).

## *Excursion point 1.1.1: Forest in the core zone*

**a. Location** N 41°47'28.1" E 48°36'39.0" 17 m a.s.l.

**Brief description of landscape features** (landscape genesis and formation processes, dominant vegetation, soil features, land use, etc.)

Samur-Yalama National Park, core zone: The area belongs to a former floodplain and is located not far from the shore of the Caspian Sea (here approx. 3 km). The upper soil substrate is a loess layer with a depth of one to several metres (dominated by silt), which lies on top of different layers of gravel. The older gravel layers are the result of millennia of mountain erosion and have been deposited as a result of water erosion from the Caucasus to the Caspian Sea via numerous rivers since the rise of the Caucasus during the Tertiary. The relatively thin loess layer on top of the gravel is much younger and the result of aeolian processes during the last glacial period between 100,000 and 15,000 years ago (late Pleistocene). Loess in general develops as the result of long-distance transport of dust by strong winds and subsequent deposition. The dust originates from the surface and the open, bare foreland of large glaciers and is transported over hundreds of kilometres. The typical layering of loess covering tertiary gravel deposits can best be observed at fossil cliffs located directly at the coast of the Caspian Sea (see Photo 3).

**Photo 3:** Cliff near the Caspian Sea showing the main texture of the region's soils: Aeolian sediments (loess) located on top of fluviatile sediments (gravel and sand) (J. Etzold).

The loess soil has a very strong water-holding capacity. Water remains for a long time in the soil; therefore, the area is very fertile. The vegetation cover in the surroundings of the two plots within the forest (see vegetation assessment 5 and 6 in Annex 2.1.) can be characterised as natural. It shows a homogeneous herb layer and the dominant tree species is *Carpinus betulus*. By contrast on the forest edge (see vegetation assessment 7 in Annex 2.1.), the species diversity is significantly higher, with e.g. many liana and herbaceous species taking advantage of the better light conditions.

Before the establishment of the National Park, the area was used for livestock grazing, logging and firewood collection. Today, the forest area is strictly protected and devoid of any human use.

### b. Additional information on other topics during that stop

Information provided by the NP staff:

The NP was established on November 5, 2012. The very productive soil and climate enable fast natural tree recovery; therefore, no artificial tree planting activities are necessary to support forest regeneration.

In the future, it is intended to build a visitor centre to inform the people about the goals and tasks of the National Park. Furthermore, the construction of pathways and tracks is planned, which will be advertised with useful maps and guidelines.

### c. List of bird species observed

Most of the birds observed during that stop are typical forest dwellers, apart from Ortolan Bunting and Eurasian Hobby which occur in semi-open habitats with single groups of trees or bushes.

| Latin Name | English Name | Azerbaijani Name |
|---|---|---|
| *Buteo buteo* | Common Buzzard | Adi sar |
| *Columba palumbus* | Common Wood-Pigeon | Iri meşə göyərçini |
| *Cyanistes caeruleus* | Eurasian Blue Tit | Adi arıquşu |
| *Dendrocopos major* | Great Spotted Woodpecker | Iri ağacdələn |
| *Emberiza hortulana* | Ortolan Bunting | Bağ vələmirquşu |
| *Falco subbuteo* | Eurasian Hobby | Adi qarağöz qızılquş |
| *Ficedula parva* | Red-breasted Flycatcher | Xırda milçəkqapan |
| *Fringilla coelebs* | Common Chaffinch | Meşə sərçəsi |
| *Parus major* | Great Tit | İri arıquş |
| *Periparus ater* | Coal Tit | Qara arıquşu |
| *Sitta europaea* | Eurasian Nuthatch | Adi sitta |
| *Sylvia borin* | Garden Warbler | Bağ silvi |
| *Troglodytes troglodytes* | Eurasian Wren | Adi bilibitdan |

**d. List of plant species**

See vegetation Assessment sheet in Annex 2.1.

**e. Description of soil profile**

At relevé 5 a soil profile was dug. The texture was a uniform loess layer of more than 1 m (see genesis above). Only in the uppermost 20 cm soil organic matter is visible.

See soil assessment sheets in Annex 2.1.

## *Excursion point 1.1.2: Used forest near the village Tel*

**a. Location:** N 41°45'33.41" E 48°39'41.25" 7 m a.s.l.

**b. Brief description of landscape features** (landscape genesis and formation processes, dominant vegetation, soil features, land use, etc.)

Samur-Yalama National Park is located in the vicinity of the village of Tel. The area belongs to the National Park but is located outside of the core zone. The forest is dominated by *Carpinus betulus* and *Quercus robur* subsp. *pedunculiflora* and very rich in species (not assessed in detail, see list of the important species under e.). In the outer forest parts, we found evidence of grazing, mostly the excreta of sheep. They often feed on the seeds of the oaks. The occurrence of many thorny hawthorn (*Crataegus* spec.) shrubs and poisonous species of Euphorbiacaea served as additional clues for grazing activities. The outer parts of this forest are dominated by *Paliurus* shrubs and annual grasses.

### c. Additional information on other topics during that stop

The area of the village of Tel is characterised by agricultural use. The importance of tourism is low. The same situation can be asserted for the village of Yalama. Only for the village of Nabran, which is located directly on the coast of the Caspian Sea, the amount of tourist activity increases during the summer months of July and August?

### d. List of bird species observed

No new species could be found in the forest area.

The set of bird species observed while driving in the area represent mainly that of semi-open habitats, as found in the cultural landscape in between of the denser forest patches: arable fields and pastures, intermixed with groups of trees or bushes, or Shiblyak-like bushlands.

| Latin Name | English Name | Azerbaijani Name |
|---|---|---|
| *Carduelis cannabina* | Eurasian Linnet | Dan sərçəsi |
| *Carduelis carduelis* | European Goldfinch | Əlvanburun susüpürən |
| *Circus aeruginosus* | Eurasian Marsh-Harrier | Göl qağayısı |
| *Coracias garrulus* | European Roller | Adi göycəqarğa |
| *Corvus cornix* | Hooded Crow | Böyük qarabatdaq |
| *Delichon urbicum* | Common House-Martin | Kətanquşu |
| *Falco tinnunculus* | Eurasian Kestrel | Adi muymulu |
| *Galerida cristata* | Crested Lark | Çay sternası |
| *Garrulus glandarius* subsp. *atricapillus* | Eurasian Jay | Kiçik qağayı |
| *Hieraaetus pennatus* | Booted Eagle | Cırtdan qartal |
| *Hirundo rustica* | Barn Swallow | Cırtdan qartal |
| *Lanius collurio* | Red-backed Shrike | Adi alacəhrə |
| *Merops apiaster* | European Bee-eater | Kəkili torağayı |
| *Motacilla alba* | White Wagtail | Ağ çaydaçapanı |
| *Oenanthe oenanthe* | Northern Wheatear | Boz qarğa |
| *Passer domesticus* | House Sparrow | Çaxraxçıl |
| *Pastor roseus* | Rosy Starling | Ala sığırçını |
| *Phoenicurus ochruros* | Black Redstart | Gümüşü qağayı |
| *Pica pica* | Eurasian Magpie | Sağsağan |
| *Picus viridis* | Green Woodpecker | Kiçik ağ vağ |
| *Streptopelia turtur* | European Turtle-Dove | Kənd qaraquşu |
| *Sturnus vulgaris* | European Starling | Adi sığırçın |

Species observed during the lunch break on the coastline:

| Latin Name | English Name | Azerbaijani Name |
|---|---|---|
| *Ardea cinerea* | Grey Heron | Qaraca odquyruq |
| *Chroicocephalus ridibundus* | Black-headed Gull | Qurqur |
| *Egretta garzetta* | Little Egret | Şəhər qaranquşu |
| *Hydrocoloeus minutus* | Little Gull | Yaşıl ağacdələn |
| *Larus cachinnans* | Caspian Gull | Sağsağan |
| *Phalacrocorax carbo* | Great Cormorant | Qamışlıq belibağlısı |
| *Plegadis falcinellus* | Glossy Ibis | Zığzığ |
| *Sterna hirundo* | Common Tern | Qaranaz |
| *Thalasseus sandvicensis* | Sandwich Tern | Qızılı qızlarquşu |

## e. List of plant species

| Bush and tree species | |
|---|---|
| *Acer laetum* C.A.Mey. | *Crataegus* spec. L. |
| *Carpinus betulus* L. | *Cydonia oblonga* Mill. |
| *Cornus mas* L. | *Quercus robur* subsp. *pedunculiflora* |
| *Crataegus germanica* (L.) Kuntze | *Sambucus ebulus* L. |
| **Herbaceous species** | |
| *Drymochloa sylvatica* (Pollich) Holub | *Orobanche* spec. L. |
| *Euphorbia nicaeensis* All. subsp. *nicaeensis* | |

## 4.1.2. Oak and beech forests around Guba

**Day of protocol: 26.08.15**

**Names of students: Gunay Behremzade, Abdin Abbasov, Jasmine Kischkat**

Number of excursion points: 2

Number of vegetation plots: 4

Number of soil profiles: 2

Number of land use assessments: 0

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### *General characteristics of the landscape*

The region around the two district centres Guba and Gusar is characterised by a large plain sloping down from the Greater Caucasus northeast to the Caspian Sea. It is formed by Pleistocene alluvial deposits, which have been deeply cut by rivers such as the Gudiyalchay and the Gusarchay. The climate is temperate, with a precipitation of 550 mm/year and a mean temperature of around 10 °C (see Fig. 7 climate diagram of Guba). While flatter areas are widely used for agriculture (cropping, fruit orchards) and as pastures, forests are still found on the steeper, and especially the northern slopes (see Fig. 19.1 and explanations in introduction of Chapter 4.1.).

### *Excursion point 1.2.1: Forest near the village Nügedi*

**a. Location** N 41°18'46.20" E 48°33'47.55" 680 m a.s.l.

**Brief description of landscape features (**landscape genesis and formation processes, dominant vegetation, soil features, land use, etc.)

The north-eastern slope directly behind the field station of Baku State University in the village of Nügedi near Guba is covered with a dense coppice forest, growing on average less than 10 m high, dominated by Oriental Beech, Hornbeam and Georgian Oak, but with a diversity of other woody species. *Fagus orientalis* is the most competitive among the tree species and is able to shade out *Carpinus betulus* and *Quercus petraea* subsp. *iberica*.

The advantage of a coppice forest for the nearby villages is the continuous availability of good fire wood and construction material for new houses. Due to area's connection to the natural gas supply in the recent past, the pressure on the forest has decreased and it is even possible to find bigger trees, which would have been cut down in the times prior to the availability of gas.

In the past, the landscape was heavily affected by illegal logging and road construction to carry the timber out of the forest, which locally was the cause for massive soil erosion. A dense vegetation cover is needed to avoid erosion and with above mentioned development these problems might decrease.

The northern foot of the slope is dominated by a cultural landscape with meadows and orchards, but also pastures. Where overgrazing occurs, erosion processes can be the consequence.

**b. List of bird species observed**

The few species recorded during that stay are mostly forest representatives.

| Latin Name | English Name | Azerbaijani Name |
|---|---|---|
| *Buteo* spec. | Buzzard spec. | Əsl sar |
| *Corvus corax* | Common Raven | Quzğun |
| *Garrulus glandarius* subsp. *atricapillus* | Eurasian Jay | Zığzığ |
| *Periparus ater* | Coal Tit | Qara arıquşu |
| *Turdus merula* | Eurasian Blackbird | Qara qaratoyuğu |

**c. List of plant species**

See filled-out vegetation assessments 1 and 2 in Annex 2.2.

**d. Description of soil profile**

The soil was determined as luvisol, with the parent material being a clayey alluvial deposit; it is characterised by physical vertical transfer of clay (termed lessivage) from the Ae (or Et, eluvial) to the Bt (illuvial) horizon by vertically draining soil water (http://classification.soilweb.ca/luvisol/).

For details, see filled-out soil assessment sheet in Annex 2.2.

## *Excursion point 1.2.2: Forests near the village of Gächräsh*

**a. Location** N 41°20'42.49" E 48°26'53.56" 770 m a.s.l.

**Brief description of landscape features** (landscape genesis and formation processes, dominant vegetation, soil features, land use, etc.)

In contrast to the coppice forest near the BSU field station in Nügedi (point 1.2.1), this north-western slope is covered by a high-growing forest. It is located along the road from Guba to Khinalig, close to the village of Gächräsh (see Photo 4). The dominant tree species are the same as in Nügedi: *Carpinus betulus*, *Fagus orientalis* and *Quercus petraea* subsp. *iberica*; however, a few other tree species are intermixed.

**Photo 4:** Dominating *Carpinus betulus* with intermixed *Fagus orientalis* in the forest of Gächräsh. An irrigation channel is cutting through this north-western slope (S. Hirschelmann).

The higher growth is facilitated by fewer disturbances through cutting in the last decades, compared to the Nügedi forest. However, the high proportion of *Carpinus betulus*, many of them with multiple trunks, hints at former coppicing. Species such as *Fagus* and *Quercus* were also extracted at the same time, but in contrast to *Carpinus* they are less capable to make new growth from the stump or roots if cut down. Additionally, *Fagus* and *Quercus* are the preferred timber species. Consequently, *Carpinus* could become dominant.

In general, the diversity of plant species in this older and more shaded forest is lower, compared to the heavily disturbed and therefore more open coppice forest in Nügedi (compare with vegetation assessments in Annex 2.2.).

The tree species composition significantly changes on a nearby eastern slope. Due to higher radiation, *Fagus* gives way to a higher incidence of *Quercus* and other trees such as *Sorbus* species and *Fraxinus excelsior*. The diversity in the herb layer is also higher, compared to the shaded north-western slope.

**b. Additional information on other topics during that stop**

Along the road in the forest, there are many restaurants and other recreation areas, which are especially crowded during the summer months. Therefore, the forest ecosystems have been heavily altered.

### c. List of bird species observed

While the two species of finches (Linnet and Greenfinch) are rather typical for forest-edges and semi-open landscapes, the other bird species observed are characteristic representatives of high-grown forests.

| Latin Name | English Name | Azerbaijani Name |
|---|---|---|
| *Carduelis cannabina* | Eurasian Linnet | Kətanquşu |
| *Certhia familiaris* | Eurasian Treecreeper | Adi süzər |
| *Chloris chloris* | European Greenfinch | Meşə kanareykası |
| *Dendrocopus major* | Great Spotted Woodpecker | Iri ağacdələn |
| *Erithacus rubecula* | European Robin | Şəfəq bülbülü |
| *Oriolus oriolus* | Eurasian Golden Oriole | Sarıköynək |
| *Sitta europea* | Eurasian Nuthatch | Adi sitta |

### d. List of plant species

Two vegetation assessment sheets were filled out (see vegetation assessments 3 and 4 in Annex 2.2.).

### e. Description of soil profile

The soil can be described as Brown Soil (Cambisol) with Ah/Bv/C horizons, which are typical for such deciduous forests. The high content of pebbles confirms the parent material as alluvial deposits (for details, see the soil Assessment sheet in Annex 2.2.).

## 4.1.3. Cultural Landscapes with fruit orchards in the Tängäalti region

**Day of protocol: 27.08.2015**

**Names of students: Carl Barnick, Rəmal Dadasov**

Number of excursion points: 3

Number of vegetation plots: 2

Number of soil profiles: 1

Number of land use assessments: 1

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### *General characteristics of the landscape*

The region around the villages of Tängäalti and Afurja in the Guba district is situated along the foothills of the Greater Caucasus. The landscape is characterised by middle-belt mountain broad-leaved forests of oaks with Cornel (*Cornus mas*), e.g., intermixed with secondary bushlands (e.g., with hawthorn), grasslands and fruit orchards (e.g., plum, apple, walnut) besides small-scale agriculture around the villages. Climatically the region might feature similar values as Guba (see Chapter 4.1.2.). Many of the rivers have cut deeply into the limestone bedrock, forming spectacular canyons with cliffs up to 600 m high. These canyons, including a waterfall near Afurja, attract many tourists. The resident population is not very dense. Locally, livestock grazing causes erosion. The fauna is said to be very rich, with many amphibian, reptile, bird and mammal species.

**Photo 5:** Cultural landscape around the village Afurja with orchards, degraded forest patches and pastures (J. Etzold)

## *Excursion point 1.3.1: Afurja waterfall*

**a. Location** N 41°09'24.3" E 48°37'32.0" 1,100 m a.s.l.

**b. Brief description of landscape features** (landscape genesis and formation processes, dominant vegetation, soil features, land use, etc.)

The Afurja waterfall near Afurja village shows cascades with a height of 60 m and has been included in the list of natural monuments (see Photo 6). The surrounding area consists of small villages, pastures, (coppice) forests on the steeper parts, riparian forests in the river valleys and Shiblyak as a degradation formation of the forest on the dryer parts and waysides (see Photo 5).

Along the path to the waterfall, there are species-rich margins with thermophilous species such as *Dictamnus albus, Cotinus coggygria* and *Teucrium polium.*

**Photo 6:** Path to Afurja waterfall with a rich woody and herbaceous species composition (V. Kaiser)

**c. List of plant species**

| Bush and tree species | |
|---|---|
| *Berberis vulgaris* spec. L. | *Ligustrum vulgare* L. |
| *Carpinus betulus* L. | *Lonicera xylosteum* L. |
| *Cornus mas* L. | *Malus sylvestris* subsp. *orientalis* (Uglitzk.) Browicz |
| *Cornus sanguinea* subsp. *australis* (C. A. Mey.) Jáv. | *Prunus cerasifera* Ehrh. |
| *Cotoneaster racemiflorus* (Desf.) K. Koch | *Quercus petraea* subsp. *iberica* (Steven ex M. Bieb.) Krassiln. |
| *Crataegus germanica* (L.) Kuntze | *Rhamnus cathartica* L. |
| *Cotinus coggygria* Scop. | *Rosa* spec. *L.* |
| *Crataegus monogyna* Jacq. | *Rubus* spec. *L.* |
| *Euonymus verrucosa* Scop. | *Ulmus minor* Mill. |
| *Juglans regia* L. | *Viburnum lantana* L. |
| **Herbaceous species** | |
| *Allium* spec. L. | *Origanum* spec. L. |
| *Artemisia* spec. L. | *Parietaria judaica* L. |
| *Briza minor* L. | *Scorzonera* spec. L. |
| *Campanula lezgina* (Lipsky) Kolak. & Serdyuk. | *Scutellaria orientalis* L. |
| *Carex* spec. L. | *Taraxacum* spec. F. H. Wigg. |
| *Dictamnus albus* L. | *Teucrium polium* L. |
| *Dorycnium pentaphyllum* subsp. *herbaceum* (Vill.) Bonnier & Layens | *Thesium* spec. L. |
| *Echinops* spec. L. | *Xanthium spinosum* L. |
| *Euphorbia* spec. L. | |

**d. Description of soil profile**

No detailed assessment. Due to the rocky surroundings near the waterfall, soils are shallow with a high skeleton content.

## *Excursion point 1.3.2: Semi-natural riparian floodplain close to Tängäalti Canyon*

**a. Location** N 41°11'24.7" E 48°37'09.4" 717 m a.s.l.

**b. Brief description of landscape features** (landscape genesis and formation processes, dominant vegetation, soil features, land use, etc.)

Untouched riparian floodplains are rare in Azerbaijan. Due to favourable conditions for land use (e.g., constant water supply throughout the year), most of the floodplains have been used for hundreds or even thousands of years. As a consequence, only a few floodplains with natural

vegetation and natural dynamics remain and are therefore highly endangered. Only few riparian floodplains are protected in Azerbaijan (e.g., Garayazi, Turyanchay), including a very small number in the mountains within larger protected areas (e.g. Shahdagh National Park).

Anthropogenic pressure on riparian floodplains includes deforestation for agricultural and building purposes as well as gravel extraction for road construction, straightening of rivers, often as a "flood control" measure, or damming for power generation and water extraction for irrigation. All of these impacts inhibit natural dynamics; consequently, many species adapted to riparian floodplains are endangered.

In terms of natural fluvial dynamics, the floodplain of the Välvälächay close to Tängäalti Canyon (between the villages of Tängäalti and Afurja) is still in relatively good condition. There are still remnants of the riparian forest with typical tree species such as *Alnus incana, Populus alba, P. nigra* and *Eleagnus rhamnoides* (see Photo 7). Many of the characteristic floodplain species are relatively drought-resistant due to irregular water provision and are therefore often used as robust trees for roadside plantations.

Nevertheless, the floodplain is relatively small and highly threatened by human activities. Although not of high importance for the floodplain dynamics, the huge amount of garbage in the river and on the riverbanks further impacts the ecosystem's integrity.

**Photo 7:** In the floodplain of Välvälächay close to Tängäalti Canyon still riparian forest with typical tree species such as *Populus* species and *Eleagnus rhamnoides* are found (S. Hirschelmann).

**c. List of plant species**

| Bush and tree species | |
|---|---|
| *Alnus incana* (L.) Moench | *Populus nigra* L. |
| *Clematis orientalis* L. | *Pyracantha coccinea* M. Roem. |
| *Eleagnus rhamnoides* L. | *Salix* spec. L. |
| *Populus alba* L. | |
| **Herbaceous species** | |
| *Artemisia absinthium* L | |

**d. Description of soil profile**

No detailed assessment. Typical for a floodplain, the soil texture is dominated by loamy sands with a high content of river pebbles.

## *Excursion point 1.3.3: Meadows with scattered fruit trees near Tängäalti*

**a. Location** N 41°12'07.3" E 48°36'53.4" 758 m a.s.l.

**b. Brief description of landscape features** (landscape genesis and formation processes, dominant vegetation, soil features, land use, etc.)

Many meadows in the Guba region are not only used as pastures or for making hay, but also to grow fruit trees. They often represent a kind of boundary between natural woodlands in the higher parts and the villages, agricultural fields and meadows in the lower parts of the mountains.

The meadow near Tängäalti is a very typical example for this. It is a huge meadow, located on the eastern slope of the mountains, with scattered fruit trees that were planted by the villagers. The higher you climb up the mountains (and the farther you get from the village), the more natural the vegetation becomes, i.e., the forests grow denser and fewer fruit trees and mowed meadows are found (see Photo 8).

**Photo 8:** Mowed hay meadow with intermixed fruit trees and transition to natural vegetation in the background; due to texture (loamy silt) and livestock impact high risk of erosion (S. Hirschelmann).

The meadow is mowed in July for hay and grazed in late summer and autumn.

As observed also at previous visits, due to the moderate use intensity on the grasslands (mowing with subsequent grazing) and the mosaic of open areas and forest, the landscape features a very high species richness of plants as well as birds, insects and other organisms. One contributing factor for the high biodiversity might be as well the calcareous soils, which regularly support high species numbers (compare also with excursion points 1.4.4 and 1.5.2).

Due to the fact that many people are moving to the cities (e.g., Baku), abandonment of the traditionally used meadows is a big threat to this species-rich ecosystem.

### c. List of plant species

Two vegetation assessment sheets were filled out, one on a flatter slope with more open grassland, another in a steeper bushland part (see vegetation assessments 8 and 9 in Annex 2.3.).

### d. Description of soil profile

For details, see attached soil assessment sheet (Annex 2.3.).

Extremely calcareous Rendzina soil (in the FAO classification, this type belongs to the Leptosols) with a maximum Ai horizon of 5 cm and a Cc horizon underneath. There is hardly any humus accumulation, due to ongoing erosion of the topsoil. Erosion of the topsoil is taking place due to

the high silt content of the soil (texture of loamy silt, see Photo 9). The undulating micro-relief is a result of landslides and erosion; grazing impact/trampling of livestock leads to partially exposed soil, and consequently to erosion and landslides.

**Photo 9:** Soil profile of Rendzina with Ai horizon of only 5 cm (J. Etzold)

### e. Comments and additions

The land use assessment sheet was filled out during an interview with local farmers (see Annex 2.3.). The whole area is used by different families. They pay some kind of lease fee for it. They are not allowed to cut trees anymore and they use the fruits of the trees (mainly apples) for their own consumption.

### f. Bird list for all excursion points of that day

| Latin Name | English Name | Azerbaijani Name |
|---|---|---|
| *Accipiter gentilis* | Northern Goshawk | Tetraçalan |
| *Aegithalos caudatus* | Long-tailed Tit | Uzunquyruq arıquşu |
| *Aegypius monachus* | Cinereous Vulture | Qara kərkəsi |
| *Alcedo atthis* | Common Kingfisher | Adi balıqçıl |
| *Anthus trivialis* | Tree Pipit | Meşə antı |
| *Buteo buteo* | Common Buzzard | Adi sar |
| *Buteo rufinus* | Long-legged Buzzard | Çöl sarı |
| *Carpodacus erythrinus* | Common Rosefinch | Adi mərciməkquşu |
| *Delichon urbicum* | Common House-Martin | Şəhər qaranquşu |
| *Erithacus rubecula* | European Robin | Şəfəq bülbülü |
| *Falco peregrinus* | Peregrine Falcon | Şahin |
| *Falco subbuteo* | Eurasian Hobby | Adi qarağöz qızılquş |

| | | |
|---|---|---|
| *Ficedula parva* | Red-breasted Flycatcher | Xırda milçəkqapan |
| *Fringilla coelebs* | Common Chaffinch | Meşə sərçəsi |
| *Gyps fulvus* | Eurasian Griffon | Ağbaş kərkəs |
| *Hieraaetus pennatus* | Booted Eagle | Cırtdan qartal |
| *Hirundo rustica* | Barn Swallow | Kənd qaraquşu |
| *Merops apiaster* | European Bee-eater | Qızılı qızlarquşu |
| *Motacilla cinerea* | Grey Wagtail | Dağ çaydaçapanı |
| *Pernis apivorus* | European Honey-buzzard | Adi arıyeyən |
| *Phoenicurus phoenicurus* | Common Redstart | Adi odquyruq |
| *Phylloscopus collybita* | Common Chiffchaff | Kölgəlik yarpaqgüdən |
| *Phylloscopus nitidus* | Green Warbler | Sarıqarın yarpaqgüdən |
| *Phylloscopus trochilus* | Willow Warbler | Bahar yarpaqgüdəni |
| *Pica pica* | Eurasian Magpie | Sağsağan |
| *Sylvia communis* | Greater Whitethroat | Boz silvi |
| *Tachymarptis melba* | Alpine Swift | Ağqarın uzunqanad |

## 4.1.4. Sub-alpine grasslands and birch forests (Laza region)

**Day of protocol: 28.08.2015**

**Names of students: Elvin Maharramov & Benjamin Gnep**

Number of excursion points: 4

Number of vegetation plots: 0

Number of soil profiles: 1

Number of land use assessments: 0

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### *General characteristics of the landscape*

On the way to the region, there are stunning views of Mt. Shahdagh, at 4,244 m a.s.l. the second highest mountain in the country, and its eastern neighbour Gizilgaya (3,726 m a.s.l.). Characteristic for these two mountain massifs are steep white cliffs of Upper Jurassic limestone with softly undulating slopes in between (see Photo 12).

Due to moist air masses rising up from the Caspian Sea, the northern slopes receive a comparably high amount of precipitation (around 1,000 mm/year). This results in grasslands that are still green in the late summer months and particularly good condition for forest growth. However, due to a long land use history in this region, true high-grown forests cannot be found above approx. 1,600 m a.s.l. Under natural conditions, the entire area, at least below 2,100 m a.s.l., would be covered by forest. These forests were replaced by sub-alpine grasslands and, on steep northern slopes, by Krummholz-type low-growing forests, which are dominated by birch (mainly *Betula litwinowii*). They can be found here up to 2,500 m a.s.l.; above that elevation, natural alpine grasslands occur (Etzold 2005, Etzold et al. 2015).

### *Excursion point 1.4.1: View of new ski resort above Kuzun village*

**a. Location** N 41°18'43.01" E 48° 7'37.56" 1,750 m a.s.l.

**b. Brief description of landscape features** (landscape genesis and formation processes, dominant vegetation, soil features, land use etc.)

The impact of grazing can be seen everywhere, and the slopes are covered by a dense network of parallel lines (cattle tracks/terracettes) perpendicular to the slope line. The remaining forest fragments, which are dominated by *Betula litwinowii*, are restricted to the very steep northern slopes that are hard to access for grazing animals or for hay harvest. Most of the area is used as pasture, but some of the flatter areas on the slopes also support traditional hay meadows (see Photo 12). These extensively managed meadows are beneficial for conservation in terms of species richness and host many different species of plants. However, the land use is changing,

and a newly built large ski complex dominates the view. Its impact on the landscape is very obvious and frustrating to the observer. Most surrounding slopes are used for downhill skiing, and lifts and snow guns are visible everywhere. For this a lake with an unique terrestrialisation mire (Thiele et al. 2008) was transformed to a water reservoir.

### c. Additional information on other topics

When the new ski resort was built, promises were made that the local community would benefit from the new infrastructure and be employed during the construction process. However, the work was mainly done by external workers, and it appears that the locals hardly profit from the complex.

The Caucasian Black Grouse, an endemic species of the Caucasus, is a typical bird of the Krummholz forest (mainly *Betula litwinowii*), but it is usually very difficult to observe (see Photo 10). During the winter, birch buds form the grouse's main diet. The males display in groups in the spring and often use the same traditional display ground (lek), which is typically located on a southern slope. The species partly benefits from the land use, because it prefers borderline structures along the edges of the birch forest. However, it is also very sensitive to disturbances by humans or shepherd dogs, and the increasing pressure by tourists around the ski complex may push it into more remote areas. There is only limited knowledge regarding its range and total population size in the Caucasus (Etzold 2005).

**Photo 10:** The Caucasian Black Grouse (*Tetrao mlokosiewiczi*) is endemic for the mountain ranges between the Black and the Caspian Sea. It still occurs in birch krummholz around Laza village (J. Etzold).

**Photo 11:** The Eurasian Griffon (*Gyps fulvus*) needs undisturbed steep cliffs for breeding (usually in colonies), like found around the massifs of Gizilgaya and Shahdagh. However they roam over large distances in search for their diet: carcasses (D. Eichhorn).

**d. List of bird species observed**

Apart from the European Bee-Eaters, which can be observed during migration time almost everywhere in the country, the other species are typically found in high-mountains – at least during that time of the year.

| Latin Name | English Name | Azerbaijani Name |
|---|---|---|
| *Anthus spinoletta* | Water Pipit | Dağ antı |
| *Carduelis flavirostris* | Twite | Dağ kətaquşu |
| *Gyps fulvus* (see Photo 11) | Eurasian Griffon | Ağbaş kərkəs |
| *Merops apiaster* | European Bee-eater | Qızılı qızlarquşu |
| *Oenanthe oenanthe* | Northern Wheatear | Çaxraxçıl |
| *Serinus pusillus* | Fire-fronted Serin | Dağ vüroku |

## *Excursion point 1.4.2: Slope between ski resort and Laza village*

**a. Location** N 41°18'29.81" E 48° 7'28.01" 1,700 m a.s.l.

**b. Brief description of landscape features**

Along our route near the pass leading to Laza, we stopped at a slope next to the road where we examined the vegetation of a birch forest (*Betula litwinowii*, Krummholz-like appearance; compare with the birch patches on Photo 12) and the sub-alpine meadow around it. The slope is very steep and thus less impacted by grazing. Where it flattens out, we found taller herbs that benefit from the improved supply with nutrients and water, which arrives from above and slows down on the flatter part of the slope. The meadow is very species-rich (see the species list below).

In order to estimate the age of the forest, a branch of a representative birch was cut to count the annual rings. The coppice-like appearance with heights around 3–4 m and the estimated age of 15–20 years indicate that, until recently (especially in the 1990s), this birch forest was still used for firewood collection, although this is not allowed within the National Park and in general.

### c. Bird species observed

A big flock of Common Rosefinches (*Carpodacus erythrinus*) was foraging in the birch forest. This species is an abundant breeding bird of the area. In the winter, it migrates to Southeast Asia, unlike the majority of other migratory passerine birds wintering in south-west Asia or Africa.

### d. List of plant species found in the meadow and the birch forest

| Bush and tree species | |
|---|---|
| *Betula litwinowii* Doluch. | *Sorbus aucuparia* L. subsp. *aucuparia* |
| *Salix caprea* L. | |
| **Herbaceous species** | |
| *Anemonastrum fasciculatum* (L.) Holub. | *Gentianella amarella* (L.) Börner |
| *Astrantia trifida* Hoffm. | *Inula orientalis* Lam. |
| *Asyneuma campanuloides* (Sims) Bornm. | *Leontodon hispidus* L. |
| *Brachypodium pinnatum* (L.) P. Beauv. | *Linum hypericifolium Salisb.* |
| *Bupleurum falcatum* subsp. *polyphyllum* (Ledeb.) H. Wolff | *Lotus* spec. L. |
| *Calamagrostis arundinacea* (L.) Roth | *Medicago glomerata* Balb. |
| *Carex humilis* Leyss. | *Onobrychis petraea* (Willd.) Fisch. |
| *Centaurea phrygia* subsp. *salicifolia* (Willd.) Mikheev | *Pastinaca armena* Fisch. & C. A. Mey. |
| *Cephalaria gigantea* (Ledeb.) Bobr. | *Phleum* spec. L. |
| *Cirsium macrocephalum* C. A. Mey. | *Pimpinella rhodantha* Boiss. |
| *Cirsium obvallatum* (M. Bieb.) Fisch. | *Primula veris* subsp. *macrocalyx* (Bunge) Lüdi |
| *Cruciata glabra* (L.) Ehrend. | *Ranunculus caucasicus* M. Bieb. |
| *Delphinium arcuatum* N. Busch | *Rhinanthus angustifolius* subsp. *grandiflorus* (Wallr.) D. A. Webb |
| *Dianthus caucaseus* Sims | *Rubus saxatilis* L. |
| *Euphrasia* spec. L. | *Salvia glutinosa* L. |
| *Festuca woronowii* Hack. | *Scabiosa bipinnata* C. Koch |
| *Filipendula vulgaris* Moench | *Scabiosa caucasica* Bieb. |
| *Fritillaria collina* Adam | *Stachys macrantha* (K. Koch) Stearn |
| *Galega orientalis* Lam. | *Tanacetum coccineum* (Willd.) Grierson |
| *Galium boreale* L. | *Valeriana tiliifolia* Troitzk. |

**Photo 12:** Laza village at the foot of the Shahdagh massif. Note the limestone cliffs with softly inclined slopes in between, the remnants of *Betula litwinowii* Krummholz on steep northern slopes as preferred habitat of the endemic Caucasian Black Grouse and different grasslands (pastures and hay meadows, J. Etzold).

## *Excursion point 1.4.3: Laza village*

**a. Location** N 41°17'46.25" E 48° 6'36.10" 1,660 m a.s.l.

**b. Brief information on the village**

Laza is a Lezgian village, and most inhabitants belong to this ethnic minority, which encompasses about 800,000 people. They live in two separate groups in the Russian Republic of Daghestan and in northern Azerbaijan in roughly equal proportions.

In the village, the excrements of sheep and cows are collected and dried to be used as fuel in the winter. Around many houses, the "shit briquettes" are built up as walls. In addition, birch wood from the remaining forests is also used for heating. From the perspective of nature conservation, it would therefore be beneficial to also supply the remote villages with natural gas to decrease the pressure on the forests. This has been promised by the government for several years already, but the promise has yet to be fulfilled. Typically, the ovens that are used in the houses are not very efficient and use much more fuel than modern heating devices.

In their gardens and in small fields near the village, the inhabitants grow mainly potatoes, cabbage and other vegetables. Even fruit trees such as apples are grown in the gardens. Bee-keeping is another important source of income, as the flower-rich meadows in the surrounding provide good conditions. Hay meadows are primarily found at a maximum distance of 1 km from the

village, especially on better accessible, less steeply inclined slopes and where livestock can more easily be kept out.

**c. List of bird species observed**

The species observed in the village are only in part exclusively restricted to high mountains (Golden Eagle, Common Rosefinch, Ring Ouzel, originally also Black Redstart). The other species are either ubiquitous (White Wagtail) or found mainly in the montane belt (+/- forest zone).

| Latin Name | English Name | Azerbaijani Name |
|---|---|---|
| *Aquila chrysaetos* | Golden Eagle | Bərqud |
| *Carduelis cannabina* | Eurasian Linnet | Kətanquşu |
| *Carpodacus erythrinus* | Common Rosefinch | Adi mərciməkquşu |
| *Jynx torquilla* | Eurasian Wryneck | Adi burunboyuq |
| *Motacilla alba* | White Wagtail | Ağ çaydaçapanı |
| *Phoenicurus ochruros* | Black Redstart | Qaraca odquyruq |
| *Turdus philomelos* | Song Thrush | Oxuyan qaratoyuq |
| *Turdus torquatus* | Ring Ouezel | Ağdöş qaratoyuq |
| *Turdus viscivorus* | Mistle Thrush | Çil qaratoyuq |

## *Excursion point 1.4.4: At Gusar River near the border station*

**a. Location** N 41°17'25.94" E 48° 6'29.20" 1,650 m a.s.l.

**b. Brief description of landscape features**

The water of Gusar River looked relatively "dirty" (brown-grey), since it carries a lot of sediments. This is caused by unnaturally high erosion further upstream, where grazing pressure is very high and the bedrock is dominated by slate, which is more prone to erosion. Around the village, both pastures (with partly strong signs of erosion) and hay meadows are found, where erosion is not prominent. Near the river and at the bottom of slopes, many taller herbs can be encountered (tall herb communities), since they benefit from a better water and nutrient supply there (Etzold et al. 2015).

**c. Additional information on other topics during that stop**

On the upper part of the hill, a military station controls the border zone between Russia and Azerbaijan along a strip about 10 km wide. Due to various security concerns, the area is intensively controlled, which is an obstacle to touristic activities such as hiking within the National Park. In part, this may be beneficial for conservation, since the border area is hard to access, but it is nevertheless used for grazing, as well.

Next to the river, individual large rocks that are inaccessible for grazing animals provide the last remaining habitat for plant species that are sensitive to grazing. On top of the rocks, the species composition is very different from that on the ground next to them and offers an insight into the natural species composition that would be found in areas without grazing pressure.

Hay meadows in the surroundings could not be accessed. They are particularly species-rich compared to most pastures, especially those with heavy grazing pressure and signs of degradation such as erosion. Up to 85 plant species per 100 m² were recorded in 2007 on hay meadows with limestone bedrock near Laza (per. comm. J. Etzold).

**Photo 13:** The silhouette of Lammergeiers (*Gypaetus barbatus*, here an immature individual) is unique: a long wedge-shaped tail and long rather narrow wings. Unlike other vultures they even feed on the last remnants of a carcass: bones (D. Eichhorn).

### d. List of bird species observed

During the breeding season these species are found only in high-mountain landscapes.

| Latin Name | English Name | Azerbaijani Name |
|---|---|---|
| *Gypaetus barbatus* (see Photo 13) | Lammergeier | Toğlugütürən |
| *Oenanthe oenanthe* | Northern Wheatear | Çaxraxçıl |
| *Tichodroma muraria* | Wallcreeper | Qırmızıqanaq tixodrom |

## e. List of plant species found in a wide area around the river

| Bush and tree species | |
|---|---|
| *Betula litwinowii* Doluch. | *Rosa* spec. L. |
| *Cotoneaster melanocarpus* (Bunge) Loudon | *Salix caprea* L. |
| *Myricaria germanica* (L.) Desv. | *Sorbus aucuparia* L. subsp. *aucuparia* |
| **Herbaceous species** | |
| *Aconitum nasutum* Fisch. Ex Reichenb. | *Inula aspera* Poir. |
| *Aconitum orientale* Mill. | *Leontodon hispidus* L. |
| *Artemisia chamaemelifolia* Vill. | *Lilium monadelphum* M. Bieb. |
| *Campanula rapunculoides* L. | *Lotus corniculatus L.* |
| *Centaurea phrygia* subsp. *salicifolia* (Willd.) Mikheev | *Medicago glomerata* Balb. |
| *Cephalaria gigantea* (Ledeb.) Bobr. | *Melilotus officinalis* (L.) Lam. |
| *Dianthus caucaseus* Sims | *Mentha* spec. L. |
| *Epilobium* spec. L. | *Origanum vulgare* L. |
| *Filipendula ulmaria* (L.) Maxim. | *Rhynchocorys elephas* (L.) Griseb. |
| *Galium anfractum* Somm. & Levier | *Salvia verticillata* L. |
| *Galium valantioides* M. Bieb. | *Stachys macrantha* (K. Koch) Stearn |
| *Gentianella amarella* (L.) Börner | *Thalictrum foetidum* L. |
| *Geranium ruprechtii* (Woronow) Grossh. | *Thalictrum minus* L. |
| *Geranium sanguineum* L. | *Trifolium pratense* L. |
| *Geranium* spec. L. | *Tussilago farfara* L. |

## f. Description of soil profile

In the soil profile, a Rendzina soil with an A and a C horizon was visible (in the FAO classification, this type belongs to the Leptosols). The upper dark layer is formed by humus with some sand. The humus layer is 15 – 20 cm strong, which is due to the cool and wet conditions at the site that slow down the decomposition of organic material. In the second layer C, the concentration of calcium carbonate is much higher compared to the A horizon (shown by the strong reaction with chloride acid), since the calcium carbonate in the upper layer has been washed out by rainfall.

This soil type is characteristic in the wider area with Upper Jurassic limestone bedrock, whereas on sites with slate bedrock, similarly shallow A/C soils are found (Ranker soils). However, these soils are usually free of calcium carbonate and less deeply developed, due to the softer bedrock and higher natural proneness to erosion.

## References

Etzold, J., Münzner, F., Manthey, M. (2015): Sub-alpine and alpine grassland communities in the northeastern Greater Caucasus of Azerbaijan. Applied Vegetation Science 19 (2): 316–335.

Etzold, J. (2005): Analyses of vegetation and human impacts in the habitat of the Caucasian Black Grouse *Tetrao mlokosiewiczi* in the Greater Caucasus/Azerbaijan. Archives of Nature Conservation and Landscape Research, 44(4): 7–36.

Thiele, A., Schlöffel, M., Etzold, J., Peper, J., & Succow, M. (2008): Mires and Peatlands of Azerbaijan. Peatlands International, 2/2008: 44–49.

## 4.1.5. The way to Khinalig – from forests in the Cloudcatcher Canyon to sub-alpine and alpine grasslands

**Days of protocol: 29. – 31.08.2015**

**Names of students: Afag Rizayeva, Leonie Elizabeth Nikrandt (29.08.2015)**
**Pervin Azizli, Esther Lutz (30.08.2015)**
**Sanam Allahverdiyeva, Verena Kaiser (31.08.2015)**

Number of excursion points: 11

Number of vegetation plots: 0

Number of soil profiles: 3

Number of land use assessments: 1

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### *General characteristics of the landscape*

During these three days, our route led from Guba up the Gudiyalchay River to Khinalig, at an altitude of approx. 2,200 m a.s.l. one of the highest settled villages in Azerbaijan, and back again. The road called *Khinalig yolu* crosses cultural landscapes with gardens, grasslands and forests in the montane zone, follows the river through the deeply cut Cloudcatcher Canyon with its steep cliffs and forested slopes, reaches the present timberline shortly behind the canyon (stops on August 29th and 31st 2015 at the excursion points 1.5.1–3) and continues through almost treeless sub-alpine grasslands to Khinalig (stops on August 29th and 31st 2015 at the excursion points 1.5.4–10), passing the villages of Jek, Galay Khudat and Bostankesh, a small mountain pass and the wide river bed of the Gudiyalchay. On August 30th, a hike led up towards Mount Gizilgaya (3,726 m a.s.l.) to the higher alpine belt (excursion point 1.5.11).

While the dominating bedrock formation of Cloudcatcher Canyon up to the mountain pass above Jek village is hard whitish Upper Jurassic limestone, the remaining way to Khinalig is characterised by comparably soft, dark grey Middle Jurassic slates, which also form the highest peaks in the south (e.g., Khinalig Dagh at 3,713 m a.s.l.). Only the highest parts of the Qizilgaya massif in the north are once again made up of the same limestone mentioned before.

The Gudiyalchay valley above Cloudcatcher Canyon is an interior montane valley with comparably dry conditions (around 550 mm mean annual precipitation, measured at the two climate stations Griz and Bostankesh). Moist air masses rising up from the Caspian Sea are impeded in their further movement by the northern mountain chain (Qizilgaya and Shahdagh massifs). Here, they condensate and form clouds, and high amounts of precipitation are recorded on the northern slopes (e.g., around 1,000 mm mean annual precipitation in Laza, see Chapter 4.1.4.). Similar effects hold true for air masses approaching from southern directions, where high mountains (e.g., Babadagh, Khinalig Dagh, Tufandagh) also hold them back. Therefore, precipitation in the sheltered Gudiyalchay valley is noticeably lower, which is reflected by a very different appearance of the vegetation: forests are almost absent or restricted to small remnants

on steep, less disturbed northern slopes. Xerophytic vegetation dominated by Juniper stands or thorn cushion plants, e.g., is widespread on southern slopes, especially in the sub-alpine belt. Northern slopes as well as southern slopes at higher altitudes are dominated by a few tussock-forming grass species.

Besides small-scale agriculture, land use is dominated by livestock farming. On the one hand, transhumant herds are kept on leased summer pastures, being led to winter pastures in the lowlands, while on the other hand, sedentary livestock is kept in the villages year-round and grazed on common pastures in the vicinity of the villages. For the latter hay is cut on often specially protected meadows.

## *Excursion point 1.5.1: Lower Cloudcatcher Canyon*

**a. Location** N 41°15'42.55" E 48°19'38.67" 980 m a.s.l.

**b. Brief description of landscape features** (landscape genesis and formation processes, dominant vegetation, soil features, land use)

Over thousands of years, the Gudiyalchay River has cut deeply through the limestone bedrock and created a stunning, partly very narrow gorge, the so-called Cloudcatcher Canyon. The name Cloudcatcher Canyon is derived from the process of capturing clouds originating from the Caspian Sea (see above). The high amount of moisture in this canyon enables the growth of specific plant communities.

During the time of our visit, the Gudiyalchay River showed a brownish colour, which originates from soil erosion in its catchment area, aggravated by unsustainable grazing.

**c. Additional information on other topics during that stop**

As the Cloudcatcher Canyon is a tourist attraction due to its spectacular scenery, and since temperatures are pleasant in the summer months, a couple of roadside restaurants and resorts were opened in its surroundings.

**d. List of plant species**

Due to limited possibilities for making stops directly inside the canyon, no detailed plant assessment was conducted. Manifold plant species can be found directly on the rocks and the steep slopes.

Among several tree species, *Tilia begoniifolia* Stev. and the rare *Taxus baccata* L. were noted.

On rocks, *Campanula lezgina* (Alexeenko ex Lipsky) Kolak & Serdjukova, which was described from this region (see Photo 15), and the small fern *Asplenium trichomanes* L. were recorded.

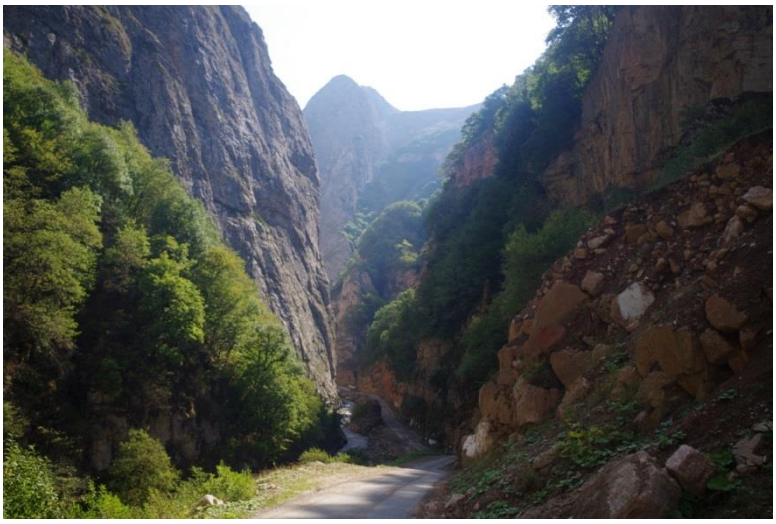

**Photo 14:** Upper exit of the narrow part of the Cloudcatcher Canyon with forests rich in *Tilia begoniifolia* on its steep slopes (J. Etzold)

**Photo 15:** The endemic bellflower *Campanula lezgina* is mostly found in rock crevices (J. Etzold)

## *Excursion point 1.5.2: Upper Cloudcatcher Canyon with rich oak forest*

**a. Location** N 41°12'34.03" E 48°15'53.95" 1,540 m a.s.l.

**b. Brief description of landscape features** (landscape genesis and formation processes, dominant vegetation, soil features, land use, etc.)

At its upper margin, the limestone cliffs of Cloudcatcher Canyon widen and it is possible to stop next to a roadside restaurant. From here, the forking of the canyon is apparent, which is caused by the confluence of the Gudiyalchay and its tributary, the Aghchay. On both sides of the valley, bushy trees grow in cracks of various sizes in the rocks (see Photo 16). The cracks result from the weathering of the limestone bedrock, which is partly caused by the process of freezing and thawing during the colder months. This effect is intensified with increasing temperature

fluctuations. Trees and other plants find partly favourable conditions in such cracks, especially where more nutrient-providing humus is accumulated and water is available.

Nevertheless, the rocky conditions hinder the development of deeper soils that offer good growth conditions and allow for high-growing forests, which could climatically still occur here. Rather, the forests have the appearance of low-growing and partly open coppice forests, although on many of the steeper slopes, trees may never have been cut by man. Only on sites with easier access, traces of wood cutting (presumably for fire wood collection) can be found.

However, these forests are extremely rich in tree, shrub and herb species (see e.): the relatively warm and well-lit conditions, combined with the limestone in the soil and a sufficient amount of moisture, are perfect for a species-rich vegetation composition. Wherever these features are present, the most species-rich forests in the temperate zone occur. As observed, such open forests are also very rich in insect species such as butterflies or ants, among others.

**Photo 16:** View down the river Aghchay into the Cloudcatcher Canyon from south. Note the steep limestone cliffs and forest remnants on the steeper slopes (J. Etzold).

### c. Additional information on other topics during that stop

Old stone walls and terraces on the opposite slopes are indications of previous hay making and crop farming.

A note regarding *Populus tremula* found in the open forest: this site is situated near the limit of its southernmost distribution; usually, the species is found in more northerly latitudes. As a boreal tree, it is adapted to cold winters and requires a sufficient water supply. Therefore, at its southern distribution boundary, it is mainly found in montane forests where the aforementioned conditions occur.

### d. List of bird species observed

Most of the species observed typically breed in steep cliffs like here in the Cloudcatcher Canyon.

| Latin Name | English Name | Azerbaijani Name |
|---|---|---|
| *Aegypius monachus* | Cinereous Vulture | Qara kərkəsi |
| *Aquila chrysaetos* | Golden Eagle | Bərqud |
| *Delichon urbicum* | Common House-Martin | Şəhər qaranquşu |
| *Gypaetus barbatus* | Lammergeier | Toğlugütürən |
| *Gyps fulvus* | Eurasian Griffon | Ağbaş kərkəs |
| *Ptyonoprogne rupestris* | Eurasian Crag Martin | Qaya (Dağ) qaraquşu |

### e. List of plant species

| Bush and tree species | |
|---|---|
| *Berberis vulgaris* L. | *Quercus* spec. L. |
| *Betula* spec. L. | *Rhamnus cathartica* L. |
| *Euonymus verrucosa* Scop. | *Ribes* spec. L. |
| *Juniperus communis* subsp. *nana* Syme | *Rosa* spec. L. |
| *Juniperus excelsa* subsp. *polycarpos* (K. Koch) Takht. | *Sorbus* spec. L. |
| *Lonicera* spec. L. | *Spiraea hypericifolia* L. |
| *Populus tremula* L. | *Tilia begoniifolia* Stev. |
| *Quercus macranthera* Fisch. & C. A. Mey. ex Hohen. | *Viburnum lantana* L. |
| *Quercus petraea* subsp. *iberica* (Steven ex M. Bieb.) Krassiln. | |
| **Herbaceous species** | |
| *Alchemilla sericata* Rchb. | *Peucedanum ruthenicum* M. Bieb. |
| *Alchemilla* spec. L. | *Pimpinella* L. |
| *Allium* spec. L. | *Primula veris* subsp. *macrocalyx* (Bunge) Lüdi |
| *Briza media* L. | *Salvia* spec. L. |
| *Bupleurum* spec. L. | *Scabiosa bipinnata* C. Koch |
| *Campanula sibirica* L. | *Sedum maximum* (L.) Hoffm. |
| *Carpinus betulus* L. | *Sedum obtusifolium* C. A. Mey. |
| *Echium rubrum* Forssk. | *Sedum* spec. L. |
| *Erigeron* spec. L. | *Sempervivum* spec. L. |
| *Galium valantioides* M. Bieb. | *Seseli transcaucasicum* (Schischk.) Pimenov & Sdobnina |
| *Geranium robertianum* L. | *Taraxacum* spec. F. H. Wigg. |
| *Helianthemum tomentosum* (Scop.) S.F. Gray | *Thalictrum foetidum* L. |
| *Lathyrus* spec. L. | *Thymus* spec. L. |
| *Medicago* spec. L. | *Veronica* spec. L. |

## *Excursion point 1.5.3: Juniper bushland*

**a. Location** N 41°11'46.71" E 48°15'30.79" 1,685 m a.s.l.

**b. Brief description of landscape features** (landscape genesis and formation processes, dominant vegetation, soil features, land use, etc.)

Above the canyon, the landscape continues to be characterised by limestone, but a much softer variant, causing more visible erosion. We stopped in a bend of the road where it crosses a small valley running from ESE to WNW. Here, a strong contrast between the southern slope and the northern slope of the valley was obvious. The more humid northern slopes show a relatively closed vegetation cover with a fresh green colour and include many species common in grasslands of the higher sub-alpine zone.

On the southern slope, more open soil is visible (especially in terracettes/livestock tracks) and the vegetation differs markedly from that on the northern slope, featuring more thorny and hairy species that are better adapted to the lack of available water here. Of special interest are the thorn cushion species *Onobrychis cornuta* and the high abundance of Juniper bushes.

Other bush species are mainly restricted to the bottom of the small valley (see Photo 17).

**c. Additional information on other topics during that stop**

A question discussed: Why are tall growing shrubs (in our case mainly Juniper) restricted to the bottom of the small valley?

Different reasons were mentioned, including:

a) More moisture is found on these sites, as water is temporarily flowing in the riverbed.

b) The temporary water flow carries nutrients and enables increased microbe activity.

c) The steep slopes on either sides of the riverbed have protective features against wind, offering shelter against high transpiration pressure as well as against severe frosts.

In general, the favourable growth conditions at the bottom of the valley allow for higher growth rates and also regeneration after disturbances.

Another interesting observation: At the time we stopped at the site, no water was flowing down the riverbed. However, it was apparent how high up the edges the last flood had reached by the presence of such plants as *Taraxacum* spec. and *Achillea setacea* (as well as others not named here). These species are adapted to disturbances caused by floods. In this case, they were growing at a height of around 1.5 m from the valley bottom, so the flood can be presumed to have been that high.

**Photo 17:** Small valley with bushland of two different *Juniperus* species and *Berberis vulgaris*, e.g. (V. Kaiser).

When you look on the northern slope above this valley you might discover periglacial hexagonal polygons (see Photo 25), which are explained in more detail under excursion point 1.5.6.

### d. List of bird species observed

Besides the before mentioned bird species typical for steep cliffs, Common Redstart or Eurasian Blackcap depend on tree or bush cover.

| Latin Name | English Name | Azerbaijani Name |
|---|---|---|
| *Aquila chrysaetos* | Golden Eagle | Bərqud |
| *Columba livia* | Rock Pigeon | Çöl göyərçini |
| *Phoenicurus ochruros* | Black Redstart | Qaraca odquyruq |
| *Phoenicurus phoenicurus* | Common Redstart | Adi odquyruq |
| *Ptyonoprogne rupestris* | Eurasian Crag Martin | Qaya (Dağ) qaraquşu |
| *Pyrrhocorax pyrrhocorax* | Red-billed Chough | Qırmızıdimdik qarğa |
| *Sylvia atricapilla* | Eurasian Blackcap | Qarabaş silvi |

## e. List of plant species

| Bush and tree species | |
|---|---|
| *Acer platanoides* L. | *Juniperus excelsa* subsp. *polycarpos* (K. Koch) Takht. |
| *Berberis vulgaris* L. | *Juniperus communis* subsp. *nana* Syme |
| *Betula litwinowii* Doluch. | *Onobrychis cornuta* (L.) Desv. |
| *Betula raddeana* Trautv. | *Quercus macranthera* Fisch. & C. A. Mey. ex Hohen. |
| *Cotoneaster* spec. Medik. | *Rosa* spec. L. |
| *Daphne glomerata* Lam. | *Salix caprea* L. |
| *Daphne* spec. L. | *Spiraea hypericifolia L.* |
| *Euonymus* spec. L. | *Viburnum lantana* L. |
| **Herbaceous species** | |
| *Achillea setacea* Waldst. & Kit. | *Fragaria viridis* Weston |
| *Alchemilla sericata* Rchb. | *Fritillaria collina* Adam |
| *Alchemilla* spec. L. | *Galega orientalis* Lam. |
| *Allium kunthianum* Vved. | *Galium boreale* L. |
| *Arenaria serpyllifolia* L. | *Gentianella amarella* (L.) Börner |
| *Artemisia* spec. L. | *Hordeum brevisubulatum* subsp. *violaceum* (Boiss. & Hohen.) Tzvelev |
| *Astragalus sanguinolentus* M. Bieb. | *Inula orientalis* Lam. |
| *Astrantia trifida* Hoffm. | *Filipendula vulgaris* Moench |
| *Asyneuma campanuloides* (Sims) Bornm. | *Leontodon hispidus* L. |
| *Brachypodium pinnatum* (L.) P. Beauv. | *Matricaria* spec. L. |
| *Bupleurum falcatum* subsp. *polyphyllum* (Ledeb.) H. Wolff | *Medicago glomerata* Balb. |
| *Bupleurum* spec. L. | *Medicago lupulina* L. |
| *Calamagrostis arundinacea* (L.) Roth | *Medicago* spec. L. |
| *Campanula collina* Sims | *Onosma* spec. L. |
| *Carex humilis* Leyss. | *Pastinaca armena* Fisch. & C. A. Mey. |
| *Centaurea phrygia* subsp. *salicifolia* (Willd.) Mikheev | *Plantago media* L. |
| *Cephalaria velutina* Bobr. | *Potentilla reptans* L. |
| *Cirsium macrocephalum* C. A. Mey. | *Ranunculus* spec. L. |
| *Cirsium obvallatum* (M. Bieb.) Fisch. | *Scorzonera* spec. L. |
| *Cruciata glabra* (L.) Ehrend. | *Sempervivum* spec. L. |
| *Cruciata laevipes* Opiz | *Sesleria phleoides* Roem. & Schult. |
| *Dianthus caucaseus* Sims | *Stachys macrantha* (K. Koch) Stearn |
| *Erigeron* spec. L. | *Taraxacum* spec. F. H. Wigg. |
| *Euphorbia* spec. L. | *Thymus caucasicus* Willd. Ex Ronn. |
| *Euphrasia* spec. L. | *Thymus* spec. L. |
| *Festuca woronowii* Hack. | *Urtica dioica* L. |

## *Excursion point 1.5.4: Large landslide opposite of village Jek*

**a. Location** N 41°11'18.15" E 48°14'55.72" 1,640 m a.s.l.

**b. Brief description of landscape features** (landscape genesis and formation processes, dominant vegetation, soil features, land use)

The surrounding mountains consist of three different types of bedrock: hard limestone, rather soft black slates and a white soft stone (resembling chalk). At some points, especially where the bedrock is soft, landslides are visible, which regularly bury the road. Such a landslide can be seen here at this site (see Photo 18). Low vegetation cover indicates the unstable soil conditions, as permanent vegetation can hardly establish. In general, assessing the presence of hard versus soft bedrock offers important information for evaluating the risk of erosion.

**Photo 18:** A huge landslide opposite of the village Jek (S. Hirschelmann).

On the opposite slope around the village of Jek, very sharp lines are visible. These are fences (or dry walls, in part) that separate hay meadows from village pastures to protect the hay to be harvested (see Photo 19). On common pastures in the vicinity of the villages, grazing pressure is particularly high. Compared to hay meadows inside the fence, the grazed vegetation outside is much lower and the erosion much heavier.

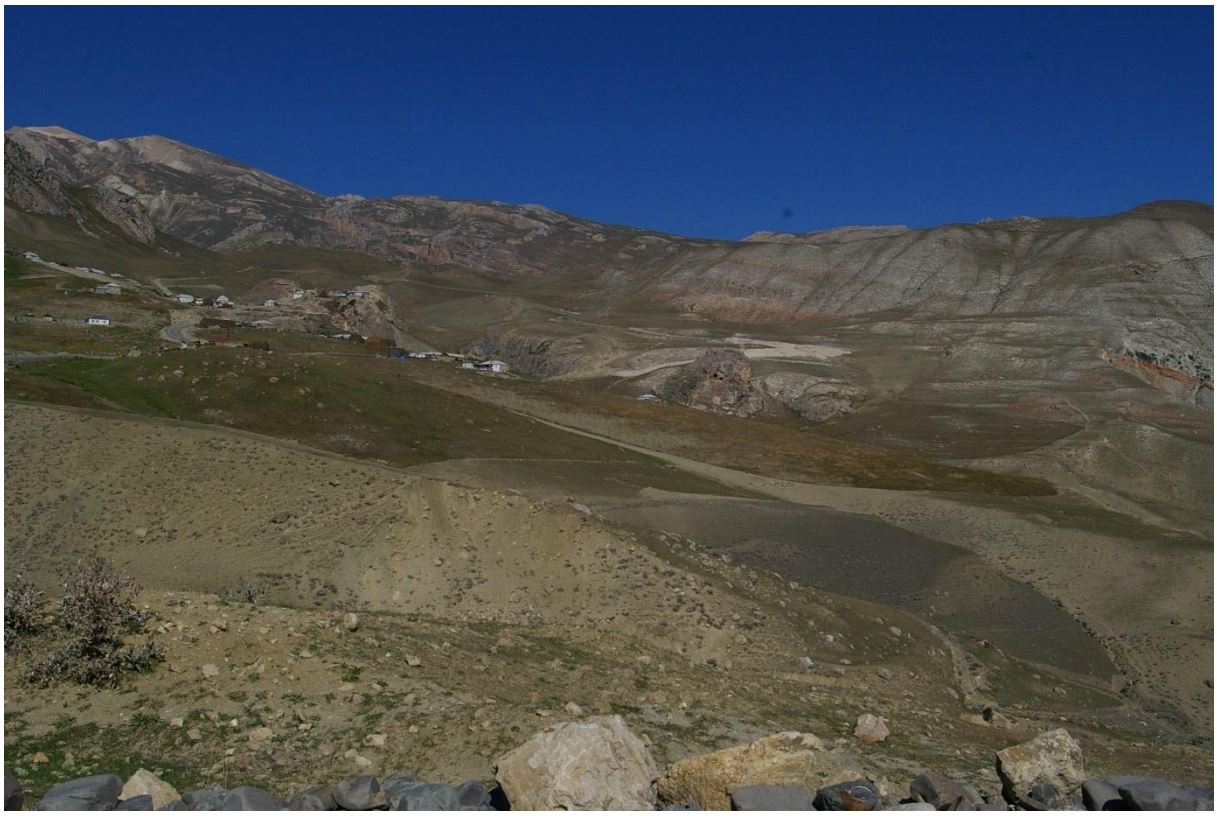

**Photo 19:** Fences, visible as sharp lines, separate hay meadows from overgrazed pastures of the village Jek (J. Etzold).

From here, only one small remnant patch of oak forest is visible above Jek village. This serves as a reminder that this altitude still falls within the forest zone. Only very few trees are left, due to a long history of grazing and wood cutting. Consequently, almost no wood is left as fuel for heating and cooking for the village population. Alternatively, dried livestock excrements, visible as walls of briquettes next to the houses, are used as fuel.

### c. Additional information on other topics during that stop

In former times, due to the difficult accessibility, living in these mountain villages was very hard. Only since the 1960s, telephone lines have been installed and an initial dirt road was built, although this was not accessible in the winter. In Soviet times, agriculture was organised in collective farms, allowing each family to own only very few heads of livestock and to produce only a few of their own agricultural products.

Since privatisation in the 1990s, a certain percentage of hay meadows was allocated to each resident family (approximately one hectare per family member). Since then, more livestock is being kept, leading in part to very heavy overstocking and overgrazing of the village pastures. Besides traces of erosion, this overgrazing is often evidenced by the presence of so-called grazing indicator species: Some plants, such as the sturdy thistle *Cirsium argilosum* with its silvery-hairy leaves, feature thorns as a protection against grazing animals (see Photo 20). Other protective adaptations include hairs or chemicals, which give the plants an unpleasant taste. Under heavy

grazing pressure, they have an advantage compared to "tasty" plants, allowing them to increase their cover.

Additional livelihood observation: young boys were seen selling dried herbs (e.g., caraway, thyme) and knitted socks on the roadside. This provides additional income to their families.

**Photo 20:** The sturdy thistle *Cirsium argilosum* with its silvery-hairy leaves is the dominant species on the landslide with mostly open soil (L. E. Nikrandt)

**Photo 21:** Only one Egyptian Vulture (*Neophron percnopterus*) was observed during the whole excursion. This globally threatened species cannot be confused with other birds due to its unique plumage pattern and silhouette (D. Eichhorn).

### d. List of bird species observed

The Tawny Pipit is usually found on slopes with abundant bare soil – like on this landslide – from to colline to the sub-alpine zone. The other two species observed occur over the same range, however nest in cliffs.

| Latin Name | English Name | Azerbaijani Name |
|---|---|---|
| *Anthus campestris* | Tawny Pipit | Tarla (Çöl) antı |
| *Neophron percnopterus* (see Photo 21) | Egyptian Vulture | Leşyeyən qartal |
| *Pyrrhocorax pyrrhocorax* | Red-billed Chough | Qırmızıdimdik qarğa |

### e. List of plant species

As dominant species on this landslide only the thistle *Cirsium argilosum* Kharadze was noted. Besides the above mentioned defence functions against grazing animals the cover with these silvery hairs help to decrease transpiration pressure.

### f. Description of soil profile

Due to heavy erosion activity at this landslide site, almost no humus can be seen in the topsoil, as the soil had no time to develop.

## *Excursion point 1.5.5: Mountain pass above Jek village, northern slope*

**a. Location** N 41°12'3.65" 48°13'17.63" 1,970 m a.s.l.

**b. Brief description of landscape features** (landscape genesis and formation processes, dominant vegetation, soil features, land use)

The small pass above Jek village is situated on hard limestone bedrock. Due to this hardness, susceptibility to erosion is not very high here. In general, the terrain on this limestone is rather gentle, interrupted by steep cliffs. In contrast, facing south, the mountain slopes with soft, dark slates are generally much steeper, interrupted by large patches of partly naturally occurring erosion.

Back on the pass, the northern slopes were, and in part still are, used as hay meadows and feature a close vegetation cover, while the southern slopes are mainly used as village pastures, showing more open soil (see point 1.5.6).

The meadow on the northern slope is very rich in species (the most important are mentioned under e). Striking is the high proportion of legumes (Fabaceae), which have an advantage over other species due to their ability to fix nitrogen from the air with the help of their microbial symbionts (e.g., *Rhizobium*, *Frankia*) located at their roots.

The dominant grass species here are *Festuca ovina* and *Carex humilis*. These grasses, in particular, are responsible for the very dense root system, which stabilises the soil to a significant degree.

**c. Additional information on other topics during that stop**

Another village – Griz – is located to the NW on the opposite side of the river high above the canyon (see Photo 24). Only recently, it's very difficult accessibility was improved by the construction of a new dirt road. It remains to be seen whether this can stop the abandonment of further houses: While in the 1960s, around 100 were still inhabited, 5 years ago there were only around 20 houses left. Griz and its neighbouring villages (Jek, Älik and two others) share a unique language.

The sedentary livestock farming on the villages' common pastures is similarly organised in all villages: Families who own fewer than 50 sheep and goats are allowed to use the common pastures nearby. In this case, the families often unite their own small flocks of sheep and goats in one or several herds every morning, which are then herded in a rotating regime by one representative of each family in a row.

If a family owns a larger number of livestock, they are requested to lease their particular pasture from the municipality. However, in some villages the municipalities' ability to lease out the pasture land under their control led to the leasing out of large parts of the village pastures to "foreign" transhumant livestock keepers, which caused a scarcity of pasture resources for the resident population. Therefore, the most degraded pastures are often found in the vicinity of the villages.

In contrast to the village livestock herded by the families themselves, the transhumant livestock on the leased summer pastures are usually herded by professional shepherds. For migration in

early summer and early autumn, defined migration roads have to be used: one can be seen south of here, beginning in the Gudiyalchay valley and passing another mountain pass to the east near Älik village. It is not allowed to use the motor road over the mountain pass at this excursion point.

**Photo 22:** *Stipa* spec. with its characteristic feather-like awns and other typical species of such northern slopes, from a vegetation plot in June 2007, only around 200 m away from excursion point 1.5.5 (J. Etzold)

Notes on some important plant species observed at this site:

*Stipa capillata* has a characteristic long awn with hairs attached, a typical feature of feather grasses (see Photo 22). With the help of these long "feathers," the seeds are dispersed through the air (this widespread seed dispersal strategy is called anemochory). When falling to the ground, and especially in conjunction with moist conditions, the sharp seed tip helps to drill the seed effectively into the soil and facilitates germination. With this feature, *Stipa* seeds are sometimes dangerous to livestock when they drill into their skin and cause inflammation. In addition, with their sharp hairy leaves, these feather grasses are not attractive as food plants.

*Festuca ovina,* with its fine green-bluish leaves, grows in small tussocks, which create a favourable microclimate (see Photo 35).

The greenish-yellow *Carex humilis* grows in dense flat tussocks. They can become very old, growing from the inside outward. As the older inner parts die over time, characteristic rings are formed (see Photo 23).

**Photo 23:** Characteristic ring-like tussocks of the small Cyperaceae *Carex humilis*, which is an important species on the pastures. Note also its distinct greenish-yellow colour (L. E. Nikrandt).

On this site, *Trifolium trichocephalum*, *Oxytropis owerinii* and *Alchemilla sericata* are examples of species that developed a dense hair cover. On the one hand, this adaptation helps to lower transpiration pressure. On the other hand, hairy leaves are not very attractive to grazing animals and are therefore useful to avoid being eaten by animals.

### d. List of bird species observed

While Peregrine and Northern Wheatear mainly breed in high mountains, the Eurasian Hobby depends on trees, where it breeds mostly in old crow nests.

| Latin Name | English Name | Azerbaijani Name |
|---|---|---|
| *Falco peregrinus* | Peregrine Falcon | Şahin |
| *Falco subbuteo* | Eurasian Hobby | Adi qarağöz qızılquş |
| *Oenanthe oenanthe* | Northern Wheatear | Çaxraxçıl |

## e. List of plant species

| Herbaceous species | |
|---|---|
| *Alchemilla sericata* Rchb. | *Oxytropis owerinii* Bunge |
| *Carex humilis* Leyss. | *Plantago atrata* Hoppe |
| *Festuca ovina* L. | *Salvia verticillata* L. |
| *Medicago glomerata* Balb. | *Stipa capillata* L. |
| *Onobrychis petraea* (Willd.) Fisch. | *Trifolium trichocephalum* M. Bieb. |

## f. Description of soil profile

At a road cut along the pass road, we observed another Rendzina soil (in the FAO classification, this type belongs to the Leptosols). Compared to the one at excursion point 1.4.4 on August 28th near Laza (see Chapter 4.1.4.), the top soil is dryer and less dark here, i.e., the humus content is lower. Similar to the Rendzina near Laza, the soil texture mostly consists of silt with a low clay content. This can be assessed in the field with a finger test in which the substrate feels like flour, is hardly sticky and contains only few sand particles.

Three horizons with gradual borders can be distinguished (see Fig. 20).

Ah dense root felt, humus rich (darkest of all horizons), low content of $CaCO_3$ (weak reaction with chloride acid)

AhC lighter, with rocks and with some humus content

C without humus, with rocks, high content of $CaCO_3$ (strong reaction with chloride acid)

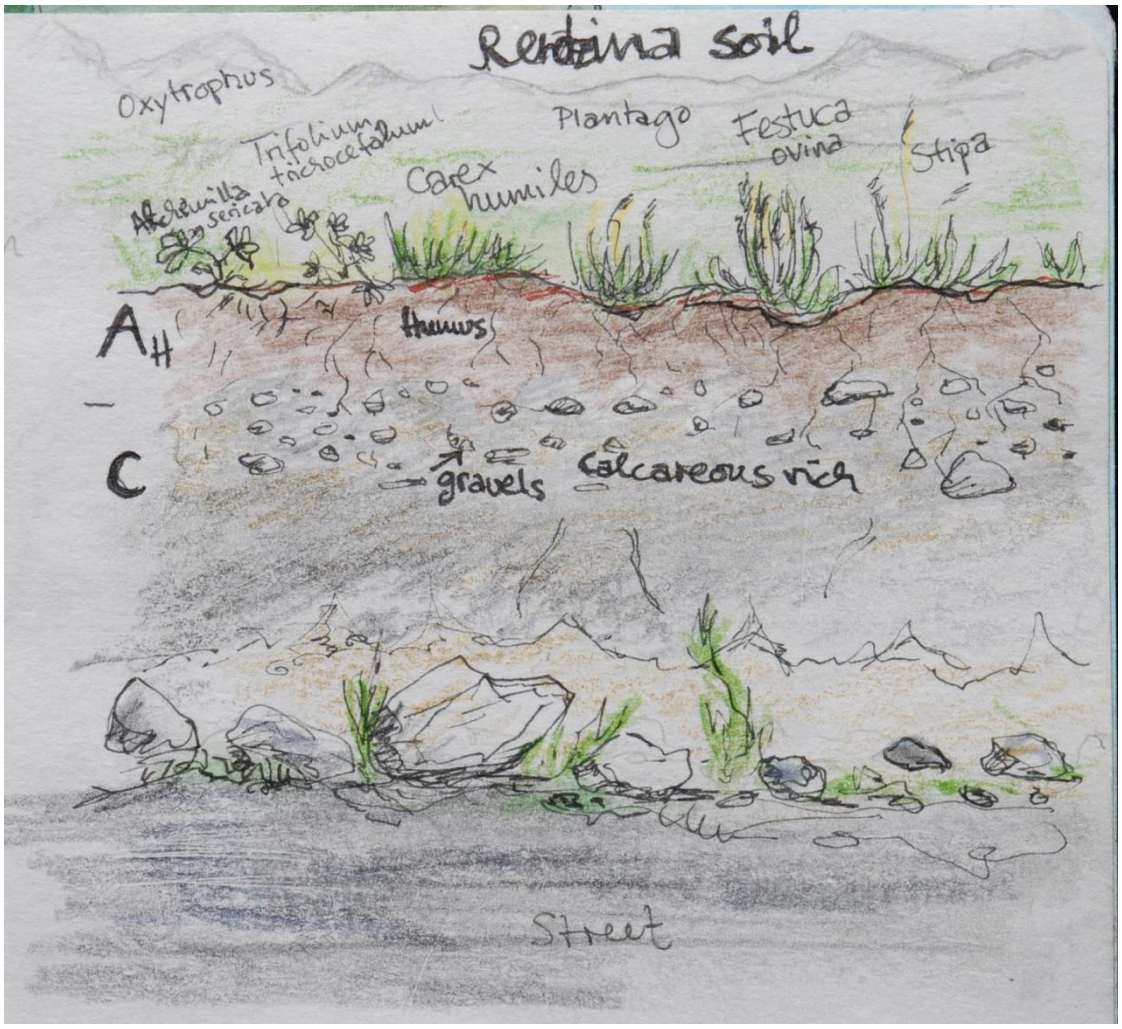


**Fig. 20:** Field sketch of soil profile with a typical Rendzina sequence at excursion point 1.5.5 (correct spelling of the plant species in the plant list under e.) (Drawing: L. Haeberlein).

## *Excursion point 1.5.6: Mountain pass above Jek village, southern slope*

**a. Location** N 41°12'6.17" E 48°13'18.25" 1,980 m a.s.l.

**b. Brief description of landscape features** (landscape genesis and formation processes, dominant vegetation, soil features, land use)

This excursion point is located only around 100 m north of point 1.5.5 on a southern slope. Here, vegetation cover is less dense, and more stones, bare soil and traces of erosion are visible.

From the ridge on top of the slope, remnants of forests and bushland (mainly *Betula raddeana* and *Quercus macranthera*) are again visible on the northern slope below the descent to the canyon of Gudiyalchay (see Photo 24).

**Photo 24:** From the ridge above excursion point 1.5.6 the contrasting vegetation on southern (right) and northern (left) slopes is visible. On the northern slope remnants of oak and birch bush-like forest are visible. In the background you see the small village Griz perched above the steep cliffs of the Cloudcatcher Canyon (Dina Valeeva).

### c. Additional information on other topics during that stop

Terraces (man-made microrelief) seen from here indicate the former cultivation of cereals, even up to altitudes of around 2,500 m a.s.l., which shows that the climate is still convenient for this type of agriculture (see terraces also on Photo 28). It was stopped during Soviet times (in the 1960s), when importing cereals or flour became common.

Especially on northern slopes, another interesting feature of a naturally formed microrelief can be observed. As a typical periglacial landform, hexagonal polygons with a diameter of around 2 m were formed in the past by processes called cryoturbation, caused by repeated freezing and thawing of the soils (see Photo 25). In this process, finer and coarser soil materials are sorted, forming regular patterns (Hendl & Liedtke 1997).

**Photo 25:** Hexagonal polygon pattern on a northern slope opposite of the village Jek, formed by periglacial cryoturbation processes (J. Etzold).

A rare observation was possible on the same slope of this excursion point: *Vipera ursinii* (or following the hint of T. Kirschey according to Uetz & Hallermann (2016) most likely the recently split *Vipera shemakhensis* Tuniyev, Orlov, Tuniyev & Kidov, 2013), a small snake of around 40 cm length with a short tail and triangular head typical for this genus and a characteristic zig-zag pattern on the back. It is listed in the Red Book of Azerbaijan (see Photo 26).

**Photo 26:** The small snake *Vipera shemakhensis* with the characteristic triangular head and the zig-zag pattern on the back (J. Etzold).

Striking was the presence of two grasshopper species (presumably of the genus *Oedipoda*), each exclusively occurring on one of either slopes of these excursion points 1.5.6 and 1.5.5. The species with red wings occurred only on the northern slope (1.5.5), while the other one with blue wings was recorded only on the southern slope (1.5.6).

### d. Bird species observed

Several Eurasian Griffons (*Gyps fulvus*) were seen circling over the canyon and also sitting in the cliffs. It seems likely that there is a small breeding colony of this impressive bird species.

### e. List of plant species

| Bush and tree species | |
|---|---|
| *Betula raddeana* Trautv. | *Juniperus excelsa* subsp. *polycarpos* (K. Koch) Takht. |
| *Cotoneaster melanocarpus* (Bunge) Loudon | *Quercus macranthera* Fisch. & C. A. Mey. ex Hohen. |
| *Ephedra equisetina* Bunge | *Rhamnus depressa* Grubov |
| *Juniperus communis* subsp. *nana* Syme | |

| Herbaceous species | |
|---|---|
| *Artemisia* spec. L. | *Pedicularis condensata* M. Bieb. |
| *Campanula sarmatica* Ker Gawl. | *Potentilla* spec. L. |
| *Carex humilis* Leyss. | *Rostraria cristata* (L.) Tzvelev |
| *Carex* spec. L. | *Sedum* spec. L. |
| *Echium rubrum* Forssk. | *Thymus* spec. L. |
| *Festuca ovina* L. | |

### f. Description of soil profile

The soil is very shallow here, which hints at a high erosion rate. Due to a high skeleton content, it was only possible to dig to a depth of approx. 20 cm (see Photo 27).

The Ah horizon with its darker colour (humus content) was very thin (around 5 cm). Below, the C horizon held a much higher content of skeleton. The soil can be also classified as a Rendzina.

**Photo 27:** Shallow Rendzina at the soil profile of excursion point 1.5.6 (A. Rizayeva)

**References**

Hendl, M., Liedtke, H. (eds.) (1997): Lehrbuch der Allgemeinen Physischen Geographie. 3. überarbeitete und erweiterte Auflage, Perthes, Gotha, DE. 866p.

Uetz, P., Hallermann, J. (2016): Vipera shemakhensis (TUNIYEV, ORLOV, TUNIYEV & KIDOV, 2013). http://reptile-database.reptarium.cz/species?genus=Vipera&species=shemakhensis. Accessed: April 2016.

## *Excursion point 1.5.7: Village Bostankesh*

**a. Location** N 41°10'28.12" E 48°10'47.71" 1,900 m a.s.l.

**b. Brief description of landscape features** (landscape genesis and formation processes, dominant vegetation, soil features, land use)

Bostankesh is a sub-village of Khinalig, positioned in a small tributary valley of the Gudiyalchay. It was founded as the location of a Soviet time collective farm. The third village belonging to Khinalig municipality is Galay Khudat. We passed it a few kilometres earlier; it is located high on the slopes at the foot of the Gizilgaya massif.

Bostankesh is located in the zone of Middle Jurassic slates, with a black-grey colour and high erodibility due to their softness. While all of the slopes on the opposite side of Gudiyalchay with their highest peaks Khinalig Dagh (3,713 m a.s.l) and Tufandagh (4,191 m a.s.l) belong to this zone, a transition zone occurs above Bostankesh: White limestone rocks that tumbled down from the Upper Jurassic limestone lie on top of the black slates, causing an intermediate risk of erosion due to their hardness, compared to the pure black slates.

The villages' homesteads are built next to small potato and cabbage fields surrounded by hay meadows, which are partly fenced in and receive water through small irrigation channels in order to increase the productivity on these rather dry southern slopes. The sharp contrast between the heavily grazed, rocky pastures outside the fences and the green meadows inside is striking. As mentioned before, hay meadows and other small pieces of land (such as potato fields) were allocated to the families in the 1990s, according to the number of family members.

**c. Additional information on other topics during that stop**

Above the village, the climate station of Khinalig is found (climate data mentioned before).

On the opposite side of the Gudiyalchay, an extensive area with hay meadows is located on a flat lower river terrace (see Photo 28). It is used by villagers from Khinalig as well as Bostankesh. While the harvesting on the hay meadows that are located on more or less steep slopes is usually only possible with a scythe, hay can be harvested here with the aid of tractors. Apparently, during Soviet times, impeding stones were systematically collected and piled up to form clearance cairns. In addition, a regular system of irrigation channels was built to allow for better harvest yields.

Furthermore it can be seen from here that in the past large terraces were created higher up on these northern slopes to create better conditions for growing cereals (flatter inclinations allow for better water availability to plants, easier tilling, etc.; see **Photo 28**). As mentioned before, this form of land use was given up in the 1960s. Today, these terraces with northern exposure are again covered by mesophytic grasslands and are either used as productive hay meadows, or pastures.

**Photo 28:** Opposite of the village Bostankesh on the flat lower river terrace a large hay meadow is located. Visible in the right part of the picture are also clearance cairns (stone heaps) and irrigation channels. Terraces formerly used for growing cereals are today as well partly used as hay meadows. Note the bedrock of these slopes: black-grey Middle Jurassic slates, which easily erode due to their softness (J. Etzold).

### d. List of bird species observed

The birds found here are rather ubiquitous and found over a wide altitudinal range.

| Latin Name | English Name | Azerbaijani Name |
|---|---|---|
| *Lanius collurio* | Red-backed Shrike | Adi alacəhrə |
| *Passer domesticus* | House Sparrow | Dan sərçəsi |
| *Passer hispaniolensis* | Spanish Sparrow | Qaradöş sərçəsi |
| *Petronia petronia* | Rock Petronia | Qaya sərçəsi |
| *Upupa epops* | Eurasian Hoopoe | Adi hop-hop |

**e. List of plant species**

| Bush and tree species | |
|---|---|
| *Populus nigra* L. subsp. *nigra* | *Elaeagnus rhamnoides* (L.) A.Nelson |

## *Excursion point 1.5.8: Steep black slate slope between Bostankesh and Khinalig*

**a. Location** N 41°10'34.04" E 48° 9'50.49" 1,965 m a.s.l.

**b. Brief description of landscape features** (landscape genesis and formation processes, dominant vegetation, soil features, land use)

On the road to Khinalig that cuts through the steep slope above the river here, the high natural erodibility of the black-greyish Middle Jurassic slates becomes obvious (see Photo 29). The road requires regular clean-up and repair after rock falls and landslides. Part of this dynamic can be regarded as natural erosion.

When picking up a piece of this black slate, many thin and easily breakable layers can be seen. Slate is made up of clay material (very small grain size, no carbonates contained) that was deposited as sediments in deep sea areas of an ocean.

**Photo 29:** Many thin and easily breakable layers of the Middle Jurassic slates are responsible for their high natural erodibility. Here at the road between Bostankesh and Khinalig, note also the dominant thorn cushions of the genus *Astracantha*, which help stabilising these southern slopes with their deep roots (S. Hirschelmann).

All plant species growing here are adapted to life on mobile screes, i.e., they can tolerate to be covered by stones from time to time, finding their way back to the surface with fresh tillers (e.g. *Nepeta* spec in Photo 30). Under these high dynamics, no soil formation and humus accumulation is possible, which means that plants do not have many nutrients at their disposal.

Thorn cushions of the genus *Astracantha* are dominant here (see Photo 29). With their deep roots and a growth form as very dense bushes with hairy branches (decreased transpiration pressure), they are well adapted to the harsh, comparably dry conditions on these southerly exposed, eroded slopes. As a member of the Fabaceae family, they are also capable to fix nitrogen from the air with the help of symbionts (see excursion point 1.5.5 for details). Despite their infamous reputation among shepherds as a negative element in their pastures (low palatability due to dense thorns), on many steep sites thorn cushions are of high importance for slope stabilisation.

Additional plant species typical of these scree communities are mentioned below. Interestingly, several springs can be found on this southern slope. In these moister sites, a few bushes grow, mainly Seabuckthorn (*Elaeagnus rhamnoides*), and even Common Reed (*Phragmites australis*), a typical wetland species, can be found.

### c. Additional information on other topics during that stop

From here, it is possible to get a closer look at the large hay meadow in the floodplain mentioned before.

A dead individual of the Green Toad (*Bufo viridis*) was found on the road. It is one of the last amphibian species recorded at such altitudes. It mainly breeds in small pools and oxbow lakes in the riverbed.

### d. List of bird species observed

Both species are restricted to the high-mountain zone.

| Latin Name | English Name | Azerbaijani Name |
|---|---|---|
| *Eremophila alpestris* | Horned Lark | Buynuzlu torağay |
| *Gypaetus barbatus* | Lammergeier | Toğlugütürən |

### e. List of plant species

| Bush and tree species | |
|---|---|
| *Elaeagnus rhamnoides* (L.) A. Nelson | *Astracantha aurea* (Willd.) Podlech |
| **Herbaceous species** | |
| *Heracleum grandiflorum* M. Bieb. | *Phragmites australis* (Cav.) Steud. |
| *Malabaila sulcata* Boiss. | *Rumex acetosa L.* |
| *Nepeta* spec. L. | *Salvia beckeri* Trautv. |
| *Onosma armeniaca* Klokov | *Salvia* spec. L. |

**Photo 30:** This *Nepeta* spec. is adapted to life on mobile screes; besides coping with regular covering by rubble, the harsh conditions on a southern slope are endured by silvery hairs reducing transpiration pressure, while aromatic oils help to reduce browsing pressure by livestock (J. Etzold).

## *Excursion point 1.5.9: Entrance of Shahdagh National Park in Khinalig*

**a. Location** N 41°10'59.76" E 48° 6'55.84" 2,095 m a.s.l.

**b. Brief description of landscape features** (landscape genesis and formation processes, dominant vegetation, soil features, land use)

The entrance to Shahdagh National Park is a big gate, located at the western end of Khinalig village.

**c. Additional information on other topics during that stop**

A ranger gave us a report regarding the basic data of Shahdagh National Park. Initially encompassing 115,000 ha, it was founded in 2006 by presidential decree to protect high-mountain animals and the high-mountain landscapes. Two existing strict nature reserves protecting mainly forests formed the basis of the National Park (NP); further forests as well as sub-alpine, alpine, sub-nival and nival areas were added later. Today, the NP covers 143,000 ha and is one of the largest NPs in the Greater Caucasus. Tourism routes were designed and an entrance regime was established. One huge benefit of the National Park is the restriction of house construction for recreational purposes.

The participants of the excursion discussed problems in the protected areas of the country. The comparably low salaries paid to rangers and other staff present a partial obstacle to their full commitment, as they often still need to work in other jobs. Equipment provided to the staff is regarded as inadequate. Consequently, monitoring duties are in part fulfilled only insufficiently.

**d. List of bird species observed:**

All three raptors flying over breed in cliffs, mainly in the high-mountain zone.

| Latin Name | English Name | Azerbaijani Name |
|---|---|---|
| *Falco tinnunculus* | Eurasian Kestrel | Adi muymulu |
| *Gypaetus barbatus* | Lammergeier | Toğlugütürən |
| *Gyps fulvus* | Eurasian Griffon | Ağbaş kərkəs |

## *Excursion point 1.5.10: Khinalig village (stroll around village and museum)*

**a. Location** N 41°10'39.13" E 48° 7'40.97" 2,160 m a.s.l.

### b. Brief information on the village

The following information is based on the knowledge of local specialists and partly questionable information compiled from two websites (Jabbarov 2015, Wikipedia 2015).

Khinalig is located at altitudes between around 2,000–2,200 m a.s.l. in the higher reaches of the Gudiyalchay and at the foot of Mount Gizilgaya, with its centre well protected on a steep mountain spur like a fortress town (see Photo 31). Besides the village of Galay Khudat, which belongs to the same municipality, it is Azerbaijan's highest village.

The village is situated in a harsh mountain climate, with a mean temperature of 4.6 °C (winter and summer temperatures ranging between -20 °C to 20 °C) and a mean annual precipitation of 572 mm (data from climate station in sub-village Bostankesh (Etzold et al. 2015)).

Today, Khinalig has a population of about 2,000 people (down from around 6,000, since many villagers resettled in lowlands) and 230 families, belonging to their own ethnic group. The village is famous for its language, peculiar customs and traditions.

Due to its location, scenery and relative isolation, Khinalig is considered one of Azerbaijan's premiere destinations for hikers and adventure travellers.

**Photo 31:** The upper part of the village Khinalig, well protected by steep slopes on a mountain spur. It is surrounded by hay meadows (like in the valley in the foreground) and village pastures, partly located on terraces of former arable land. Note the black slate mountains of the Khinaligdagh (left) and Tufandagh (right) massifs with their in parts natural erosion (J. Etzold).

### c. Additional information on other topics during that stop

Khinalig has preserved its architectural style. The flat roof of one house serves as a small courtyard for another built at a higher level, giving the central village on a steep hill the appearance of terraces. The houses are made of cobblestone, with very thick walls reaching 2.5 m at the base and 1.5 m on the top. The houses are about 200 years old, and there are many ruins of older buildings in the village. Tiny gardens are established inside the courtyards or in the ruins (for impressions see Photo 31 and Photo 32).

It is claimed that Khinalig is one of the oldest continuously inhabited places in the world, with a history reaching back over 5,000 years.

The inhabitants of Khinalig speak an original language understood nowhere else, which belongs to the Northeast Caucasian language family. However, most of them speak Azerbaijani as well.

The population's main occupation is livestock breeding. In the summer, livestock is either brought to nearby village pastures or the real summer pastures at higher altitudes. In the winter, due to low temperatures and lack of fodder on the alpine and sub-alpine pastures, livestock is kept in stables and fed with locally produced hay or is brought to winter pastures in the lowlands.

In 1968, the first road to Khinalig was built. However, only in 2006 the old gravel road was replaced by an asphalt road, facilitating access to the village.

In 2001, under the guidance of village elders, the Khinalig historical and ethnographic museum was established. In the museum, archaeological and ethnographic materials as well as rugs and carpets, pottery and copper plates, a variety of home and household items, stone inscriptions and many other objects are kept and displayed to the visitors. A villager who gave a lot of information about Khinalig told about a milk-pipeline made of clay, which was used in former times to transport milk from the pastures above the village to the settlement. Thus, the milk could be processed much faster compared to the long transportation by foot or by horse.

Furthermore, according to the villager, the people of Khinalig had already undergone several religious changes, e.g., during the last two millennia from Zoroastrism over Christianity to Sunni Islam today. The village mosque is said to have been built 1,300 years ago. Stone-carvings can be found on the walls, written in a pre-Albanian alphabet, which cannot be deciphered.

**Photo 32:** A typical Khinalig house, with its courtyard being the flat roof of a house at a lower level. Dried briquettes of livestock dung are used as fuel. In the background Gizilgaya massif, to where the excursion on August 30th took place (J. Etzold).

### d. List of bird species observed

See comment at the previous point 1.5.9 under d.

| Latin Name | English Name | Azerbaijani Name |
|---|---|---|
| *Falco tinnunculus* | Eurasian Kestrel | Adi muymulu |
| *Gypaetus barbatus* | Lammergeier | Toğlugütürən |
| *Gyps fulvus* | Eurasian Griffon | Ağbaş kərkəs |

Additional mammals observed: *Capra cylindricornis* – East Caucasian Tur (four individuals seen in early morning from the village) on the slopes of Khinalig Dagh.

### References

Jabbarov, X. (2015): Xinaliq. http://xinaliq.com/index.html. Accessed: October 2015.

Wikipedia (2015): Khinalug. https://en.wikipedia.org/wiki/Khinalug. Accessed: October 2015.

Etzold, J., Münzner, F., Manthey, M. (2015): Sub-alpine and alpine grassland communities in the northeastern Greater Caucasus of Azerbaijan. Applied Vegetation Science 19 (2): 316–335.

## *Excursion point 1.5.11: High-alpine belt at foot of Mount Gizilgaya*

**a. Location** N 41°12'45.55" E 48°8'37.18" 2,990 m a.s.l.

**b. Brief description of landscape features** (landscape genesis and formation processes, dominant vegetation, soil features, land use, etc.)

The excursion led from the village of Khinalig uphill to the foot of the Upper Jurassic limestone cliffs of Mount Gizilgaya (3,726 m a.s.l., see Photo 32 and Photo 33). Driving by truck through the sub-alpine belt to an altitude of around 2,700 m, a transhumant summer camp was reached. From there, an uphill hike led to the higher alpine belt at around 3,000 m a.s.l. With the highest point climbed by part of the group, at 3,160 m a.s.l. we may have reached the lower sub-nival belt.

Much of the alpine zone consists of grasslands, partly with sedge heaths typical of the arcto-alpine zone. As the closed vegetation cover becomes patchy and is replaced by stones, rocks and open soil, we enter the transition from the upper alpine to the sub-nival belt. The sub-nival zone is the highest zone where vegetation still exists. This area is shaped by frequent frosts that restrict extensive plant colonisation. Only a few highly adapted plant species can cope with these harsh climatic conditions. Vegetation is distributed in patches, since it is restricted to only the most favourable locations that are protected from the strong winds that often characterise this area. As a climatic adaption at this altitude, many plant species grow in rosettes flat on the ground or in dense cushions in order to lower transpiration pressure and to achieve more favourable temperatures through decreased wind-chill. Mosses and lichens (a symbiosis between fungi and algae, see on rock at Photo 38) form the last vegetative cover to be recorded with increasing elevation before the nival zone begins, which is devoid of any vegetation.

**Photo 33:** Group during field work at around 2800 m a.s.l. at the foot of the Upper Jurassic limestone cliffs of Mt. Gizilgaya. Note heavy signs of erosions caused by high grazing pressure (M. Manthey).

### c. Additional information on other topics during that stop

The alpine grasslands are mostly used as summer pastures by transhumant herders and the village livestock. Many signs in the vegetation cover indicate a high grazing pressure. Besides natural "bare soil" areas (e.g., steep rocky areas, especially with black soft slates as bedrock, as seen on the opposite slopes to the south at Mount Khinalig), in many parts erosion is caused by livestock activities. When the vegetation cover becomes thin and sparse due to high grazing and trampling pressure, the resulting open soils are a starting point for erosion, which can lead to entire landslides (see Photo 33). Furthermore, frost bursting and cracks due to drying and subsequent rewetting of soils are natural processes, which also can be aggravated by livestock-induced erosion.

Excessive livestock trampling can result in terracettes (see Chapter 4.1.4., excursion point 1.4.1 b), which can be initial sites for erosion, especially on steep slopes. Livestock is kept during the night in camps, as seen in the summer camp at 2,730 m a.s.l (see Photo 34). Here, vegetation has almost disappeared due to the resting livestock and high trampling frequency. The livestock's excrements lead to a high nutrient input, that, along with the trampling pressure, only a few specific plant species are able to withstand. Examples are *Taraxacum* spec. or *Capsella bursa-pastoris*, forming nitrophilous camp site lawns (as for other vegetation ecological details in this chapter, see Etzold et al. 2015).

**Photo 34:** Summer camp above Khinalig (in the background) at 2,730 m a.s.l., which is almost free of vegetation due to the trampling of resting livestock. Only few adapted planted species occur here, forming nitrophilous camp site lawns (S. Hirschelmann).

**Photo 35:** Grazing sheep flock on a summer pasture above Khinalig. Visible in the foreground are two typical dominant species: the thorn cushion plant *Astracantha aurea* and the small bluish-green tussocks of *Festuca ovina* (Esther Lutz).

The dominant vegetation is composed of the grazing-resistant thorn cushion species *Astracantha aurea* (in the lower part, decreasing in size with increasing altitude before disappearing at around 2,800 m a.s.l.), and grass species such as *Festuca woronowii, Festuca ovina* and *Carex humilis* (see Photo 35). Without grazing, *Festuca woronowii* would be the tallest grass species (around 20–30 cm). This species forms tussocks (with a high content of dead biomass) and is only eaten by sheep and cattle when grazing pressure increases, resulting in less palatable alternatives.

An example of adaptation to grazing pressure is *Astragalus sanguinolentus*, which, as a leguminous species, is attractive to livestock. However, it grows in very low carpets flat on the ground, which are almost out of reach of the livestock's mouths. The same adaptation is shown by many species that grow with their leaves in rosettes close to the ground, e.g., *Campanula tridentata* or *Primula algida*.

Besides many different moss and lichen species, numerous cushion plants can be found in crevices on rocks and stones, such as *Draba* and *Saxifraga* species. In order to keep the transpiration as low as possible, most of these species display a short and branched habit, forming dense cushions. Furthermore, many species have hairy or succulent leaves, which constitutes yet another adaptation for managing an existence under the extreme conditions with little soil and water available.

Using the questionnaire for assessing pasture management of summer pastures (based on Etzold & Neudert 2013), an interview was conducted with the shepherd in the summer camp visited. An extract is found in Annex 2.4.

**Photo 36:** The foot of Mt. Gizilgaya is one of the very few places in Azerbaijan where the Güldenstädt´s Redstart (*Phoenicurus erythrogastrus*) can be rather reliably observed. While in the breeding season it is restricted to the high-alpine and sub-nival zone, in winter it is also found in the valleys of mountain rivers (D. Eichhorn).

### d. List of bird species observed

Almost all birds found during this hike are restricted to the high-mountain zone.

| Latin Name | English Name | Azerbaijani Name |
|---|---|---|
| *Anthus spinoletta* | Water Pipit | Dağ antı |
| *Carduelis cannabina* | Eurasian Linnet | Kətanquşu |
| *Carduelis flavirostris* | Twite | Dağ kətaquşu |
| *Eremophila alpestris* | Horned Lark | Buynuzlu torağay |
| *Falco tinnunculus* | Eurasian Kestrel | Adi muymulu |
| *Gypaetus barbatus* | Lammergeier | Toğlugütürən |
| *Gyps fulvus* | Eurasian Griffon | Ağbaş kərkəs |
| *Monticola saxatilis* | Rufous-tailed Rock Trush | Qaya qaratoyuğu |
| *Montifringilla nivalis* | White-winged Snowfinch | Alp vüroku |
| *Oenanthe oenanthe* | Northern Wheatear | Çaxraxçıl |
| *Phoenicurus erythrogastrus* (Photo 36) | Güldenstädt´s Redstart | Qırmızıqarın odquyruq |
| *Phoenicurus ochruros* | Black Redstart | Qaraca odquyruq |
| *Prunella collaris* | Alpine Accentor | Alp çərənçisi |
| *Pyrrhocorax graculus* | Alpine Chough | Sarı dimdik |
| *Pyrrhocorax pyrrhocorax* | Red-billed Chough | Qırmızıdimdik qarğa |

**Photo 37:** The small Gentianaceae *Lomatogonium carinthiacum* occurs on sites with moist soil conditions (D. Valeeva)

**Photo 38:** Typical for extreme site conditions on rocks: cushion plants (here *Draba incompta*) and many different lichens (Pervin Azizli).

## e. List of plant species

The plant species were recorded between approx. 2,750 and 3,000 m a.s.l. Apart from the semi-shrub and thorn cushion *Astracantha aurea,* all other plant species are herbaceous. Per definition, bushes and trees do not occur in the alpine zone. The species were sorted according to site conditions.

| | |
|---|---|
| In areas with high disturbance, such as camp sites | |
| *Capsella bursa-pastoris* (L.) Medik. | *Taraxacum* spec. F. H. Wigg. |
| *Polygonum aviculare L.* | |
| On moist sites such as little peatlands in depressions | |
| *Campanula tridentata* Schreb. | *Hordeum brevisubulatum* subsp. *violaceum* (Boiss. & Hohen.) Tzvelev |
| *Carex* spec. L. | *Lomatogonium carinthiacum* (Wulfen) Rchb. |
| *Gentianella umbellata* (M. Bieb.) Holub | *Primula algida* Adams |
| On soils with moderate conditions | |
| *Alchemilla caucasica* Buser | *Festuca woronowii* Hack. |
| *Astracantha aurea* (Willd.) Podlech | *Kobresia humilis* (Trautv.) Serg. |
| *Bupleurum polyphyllum* Ledeb. | *Myosotis alpestris* F. W. Schmidt |
| *Campanula stevenii* M. Bieb. | *Ochlopoa supina* (Schrad.) H. Scholz & Valdés |
| *Catabrosella variegata* (Boiss.) Tzvelev | *Potentilla inclinata* Vill. |
| *Cyanus cheiranthifolius* (Willd.) Soják | *Trifolium ambiguum* M. Bieb. |
| *Festuca ovina* L. | *Thymus caucasicus* Willd. Ex Ronn. |
| On rocks/ shallow and stony soils | |
| *Androsace koso-poljanskii* Ovcz. | *Minuartia* spec. L. |
| *Asperula alpina* Bieb. | *Oxytropis albana* Steven |
| *Astragalus sanguinolentus* M. Bieb. | *Plantago atrata* Hoppe |
| *Chamaesciadium acaule* (M. Bieb.) Boiss. | *Saxifraga juniperifolia* Adams |
| *Cystopteris fragilis* (L.) Bernh. | *Saxifraga moschata* Wulfen |
| *Draba incompta* Stev. | *Veronica petraea* (M. Bieb.) Steven |

## f. Description of soil profile

On a small erosion cliff in a small depression at approx. 3000 m a.s.l, one soil profile could be assessed. High precipitation on the mountainous slopes and bedrock close to the surface lead to soil-forming processes, which can result in Gley soil. Subsurface water flow caused the development of a Gley soil with rusty-reddish spots above and greyish Gley spots below 35 cm soil depth. The humus-rich Ah horizon layer measured approx. 20 cm, indicating that decomposition is at a medium rate (see Photo 39 and soil assessment sheet in Annex 2.4.).

**Photo 39:** Profile of a Gley soil at approx. 3000 m.a.s.l. with its characteristic rusty-reddish spots above and greyish Gley spots below 35 cm soil depth (J. Etzold).

## References

Etzold, J., Neudert, R. (2013): Monitoring Manual for Summer Pastures in the Greater Caucasus in Azerbaijan. GIZ Working Paper – Sustainable Management of Biodiversity, South Caucasus. Baku, AZ. 60p. Available (also in Azerbaijani) at: http://biodivers-southcaucasus.org/wp-content/uploads/2015/02/Monitoring-manual-for-summer-pastures-in-the-Greater-Caucasus-in-Azerbaijan_EN.pdf.

Etzold, J., Münzner, F., Manthey, M. (2015): Sub-alpine and alpine grassland communities in the north-eastern Greater Caucasus of Azerbaijan. Applied Vegetation Science 19 (2): 316–335.

## 4.2. Transect Dävächi lowlands – Beshbarmag – Khizi – Altiaghaj

This transcet is shown in the detailed map in Fig. 21. The altitudinal sequence of ecosystems from the Caspian Sea to the sub-alpine zone above Altiaghaj is depicted in the two separate schematic cross-cut sections 4 and 5 along the transects shown in the map.

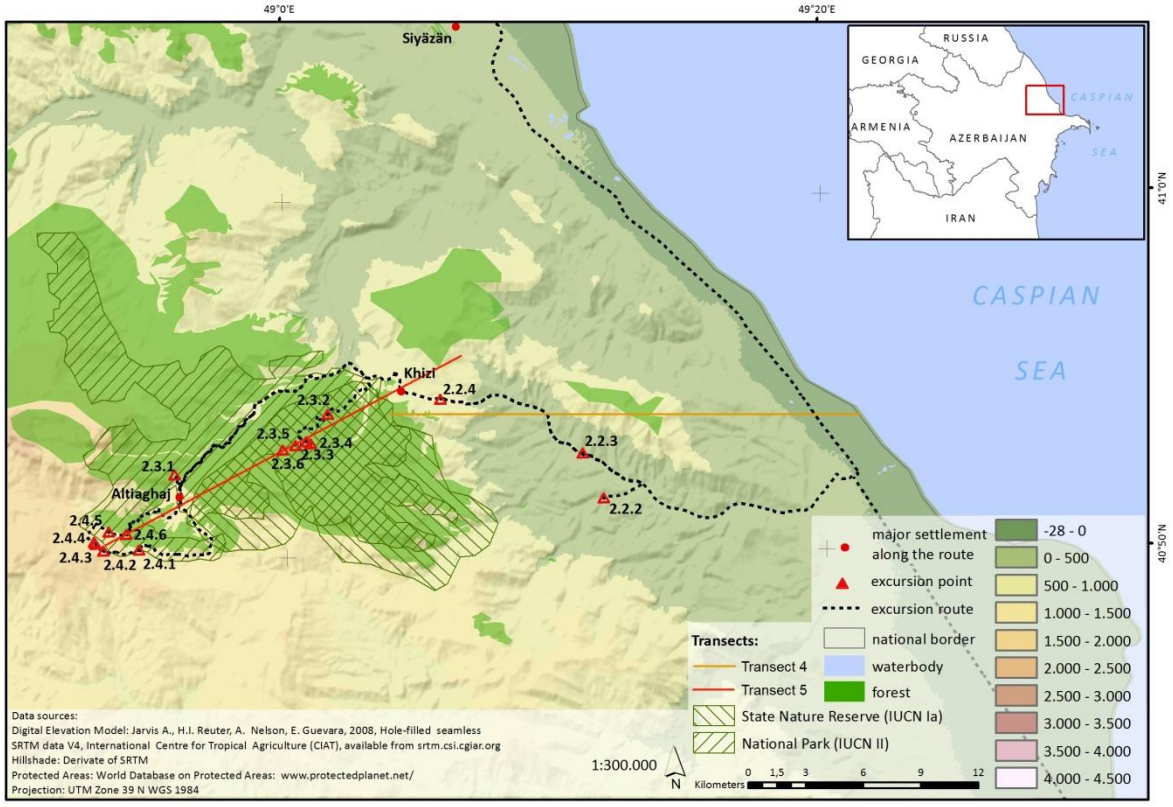


**Fig. 21:** Map showing a part of the excursion route from Altiaghaj to Dävächi (Note: forest cover depicts only larger continuous forest patches) (Map: Jens Wunderlich)

Cross-cut section 4 shown in Fig. 22 starts at the shore of the Caspian Sea and rises over a distance of approx. 25 km until it reaches the oak forest zone around the district centre Khizi. The sand dunes and lagoons visited by the excursion and described in detail in Chapter 4.2.1 are actually located further north. However, these ecosystems are also represented in the narrow lowland strip between Mt. Beshbarmag and the Caspian Sea, albeit to a much smaller extent. The subsequent zone of halophytic semi-desert in the plain and in the foothills has partly been replaced by irrigated arable land. Of special interest are the partly barren, colourful slopes of the so-called Candy Cane Mountains, which are presented in Chapter 4.2.2. under excursion point 2.2.3. On the lower mountains, wormwood and grass steppe vegetation can be observed. Presumably more widespread along the rivers in the past, only small remnants of riparian woodlands still occur today. Among these, the last known stand of *Populus euphratica* in Azerbaijan is described in Chapter 4.2.2., excursion point 2.2.2.

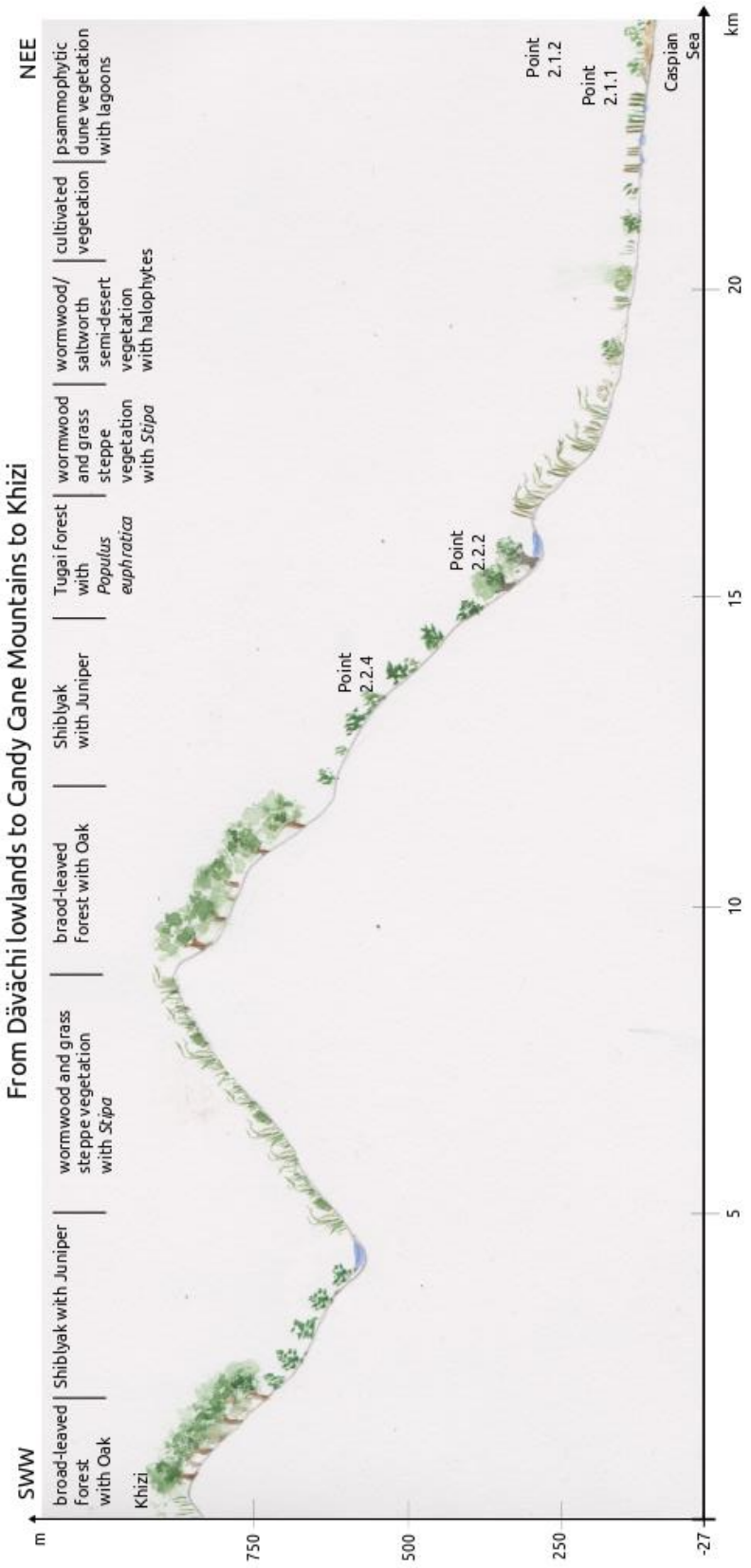


**Fig. 22:** Landscape transect showing a section with the main landscape types from Dävächi lowlands to Candy Cane Mountains to Khizi (drawing: Lena Haeberlein)

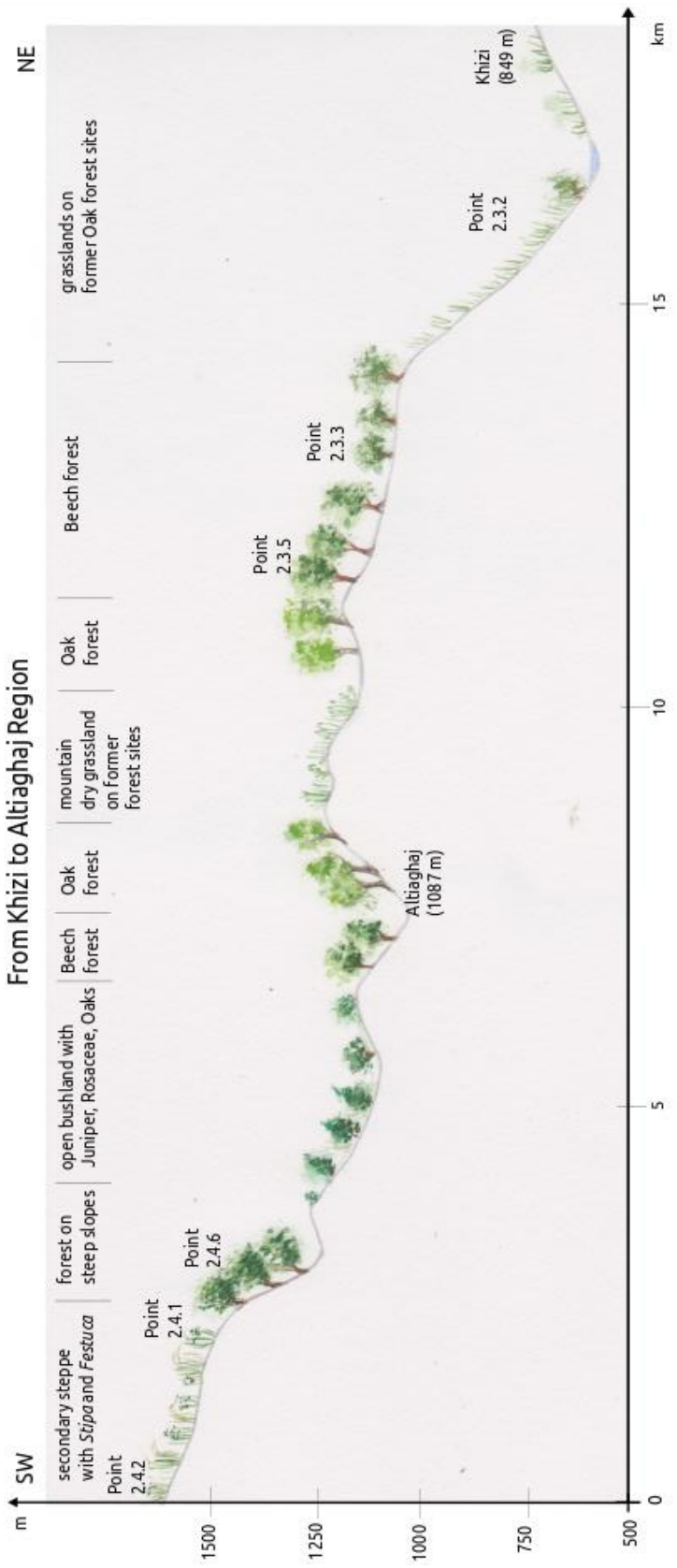


**Fig. 23:** Landscape transect showing a section with the main landscape types from Khizi to Altiaghaj region (drawing: Lena Haeberlein)

Primarily thorny Shiblyak bushland usually represents a degradation stage of xerophytic oak forests (see Chapter 4.2.2., excursion point 2.2.4.), due to centuries of grazing and wood cutting. Closed stands of these oak forests can still be found today above 500 m a.s.l., at this elevation predominantly only on northern slopes, while on southern slopes again wormwood and grass steppe vegetation prevails.

The sequence is continued in cross-cut section 5 (see Fig. 23), extending over approx. 20 km from an elevation of 700 m near Khizi to around 1,500 m above Altiaghaj. The most striking feature here is that oak forests are the predominant forest type on southern slopes (or rather not-northern slopes, see Chapter 4.2.3., excursion point 2.3.2), while at these cooler elevations, Oriental Beech encounters optimal growth conditions on northern slopes, where it is dominant (see Chapter 4.2.3., excursion points 2.3.3/5). Particularly on the southern slopes, but generally on all easily accessibly slopes, centuries of disturbance have caused the replacement of forests with various types of grass- and bushland. Today, forests are frequently restricted to the steeper slopes (see Chapter 4.2.4., excursions point 2.4.6). At the highest elevation covered by this cross-cut section, secondary steppes on previously forested sites were recorded (see Chapter 4.2.4., excursions points 2.4.1./2.).

## 4.2.1. Shifting dunes in the Samur-Dävächi lowlands

**Day of protocol: 02.09.2015**

**Names of students: Lena Haeberlein and Fidan Aghayarli**

Number of excursion points: 2

Number of vegetation plots: 0

Number of soil profiles: 0

Number of land use assessments: 0

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### *General characteristics of the landscape*

The shifting dune complex of the Samur Dävächi lowlands covers an area of about 10,000 ha (Prilipko 1970) and is approximately 12 km long, consisting of single segments that lie parallel to the beach. A beach lagoon is separated from the beach by a flat sandy mound. The beach lagoon itself is 300–400 m wide and contains shallow water on clayey ground (see Photo 40). Its depth decreases towards the dunes. The beach lagoon is presumably subject to irregular flooding by seawater. Behind the beach lagoon towards the dunes, a gravel dike of 3 m height interrupts the natural sequences of the complex. The core of the complex consists of two dune ridges up to 10 m high. Active sand transport leads to the development of steep slopes on the lee side (see

Photo 41). Sandy hummocks of approximately 1 m in height make up the dune valleys, leading to an undulating relief. An inner lagoon that can be found roughly 1 km inland covers a varying area between 6,000–7,000 ha, depending on the water supply. Ditches through the surrounding salinized fallows and meadows feed the inner lagoon with drainage water, but the river Dävächichay also complements the water supply in the ditches. To the south, the inner lagoon drains toward the sea through an outlet. Overall, the sea level fluctuations of the Caspian Sea directly influence the water regime of the complex (Tegetmeyer et al. 2007, Schmidt & Uppenbrink 2009).

**Photo 40:** In the Samur-Dävächi lowlands a sequence from the Caspian Sea over lagoons (here with wide reed belt) to shifting dune ridges and dune valleys can be observed (S. Hirschelmann).

**Photo 41:** While the eastward-facing slopes of the sand dunes are mobile (in background) due to the steadily blowing wind from the Caspian Sea, the western slopes are stabilized by vegetation (in forefront). At the feet of the dunes and in the valleys, with good water provision bushes and trees like *Tamarix ramosissima* or even *Populus alba* grow (J. Etzold).

## *Excursion points 2.1.1 and 2.1.2: Dune valleys and dune ridges*

**a. Location**

Excursion point 2.1.1: Dune valley (wet)

N 41°20'04.81" E 049°04'56.61" -28 m a.s.l.

Excursion points 2.1.2: Top of dune

N 41°19'52.14" E 049°04'51.85" -25 m a.s.l.

**b. Brief description of landscape features** (landscape genesis and formation processes, dominant vegetation, soil features, land use etc.)

The dune valleys are covered with marsh plants and *Tamarix* and *Elaeagnus* bushes. The tops of the dunes are covered with psammophyte vegetation adapted to the mobile sands. The dune system developed parallel to the coast due to fluctuating sea levels. Currently, the sea level is 3–4 m lower than it was about 100 years ago. The steadily blowing wind from the Caspian Sea transports the sand, which leads to the formation of dunes. Due to high infiltration rate of rain water in the sandy substrate and the vicinity to the Caspian Sea, the groundwater level is very high. Salt water is heavier than rainwater, thus salinization in the dune valleys is relatively low. This is because salt is washed out and the rainwater forms a layer of fresh water floating on top of the salty ground water layers.

The land is grazed by cattle, and there is a small fish farm with artificial ponds. In the lagoons significant numbers of water birds are shot. The area has no protection status and (illegal) sand mining takes place. The area is recommended as a protected area by international specialists (Schmidt & Uppenbrink 2009). To date, no steps have been undertaken to realise this.

**Photo 42:** The Blue-cheeked Bee-eater (*Merops persicus*) is a colourful inhabitant of the semi-deserts in Azerbaijan. For nesting it digs holes in the ground (D. Eichhorn).

**Photo 43:** The Caspian Turtle (*Mauremys caspica*) with its characteristic stripes on the neck is widespread in fresh- and brackish water habitats in the lowlands (D. Valeeva).

## c. List of bird species

### Associated to wetlands

| Latin Name | English Name | Azerbaijani Name |
|---|---|---|
| *Ardea cinerea* | Grey Heron | Boz vağ |
| *Ardea purpurea* | Purple Heron | Kürən vağ |
| *Bubulcus ibis* | Cattle Egret | Misir vağı |
| *Chlidonias leucopterus* | White-winged Tern | Ağqanad sterna |
| *Ciconia nigra* | Black Stork | Qara leylək |
| *Circus aeruginosus* | Eurasian Marsh-Harrier | Qamışlıq belibağlısı |
| *Egretta garzetta* | Little Egret | Kiçik ağ vağ |
| *Gallinago gallinago* | Common Snipe | Bekas |
| *Gelochelidon nilotica* | Gull-billed Tern | Qağayıburun sterna |
| *Haliaeetus albicilla* | White-tailed Eagle | Ağquyruq dəniz qartalı |
| *Ixobrychus minutus* | Little Bittern | Kiçik danquşu |
| *Tringa glareola* | Wood Sandpiper | Boz trinqa |
| *Tringa ochropus* | Green Sandpiper | Qara trinqa |

### In the dunes and bushlands

| Latin Name | English Name | Azerbaijani Name |
|---|---|---|
| *Circus pygargus* | Montagu's Harrier | Çəmən belibağlısı |
| *Cuculus canorus* | Common Cuckoo | Ququ quşu |
| *Falco naumanni* | Lesser Kestrel | Çöl muymulu |
| *Falco subbuteo* | Eurasian Hobby | Adi qarağöz qızılquş |
| *Hippolais pallida* | Eastern Olivaceous Warbler | İri zəvzək |
| *Hirundo rustica* | Barn Swallow | Kənd qaraquşu |
| *Lanius collurio* | Red-backed Shrike | Adi alacəhrə |
| *Lanius minor* | Lesser Grey Shrike | Qaraalın alacəhrə |
| *Lanius senator* | Woodchat Shrike | Qırmızıbaş alacəhrə |
| *Merops apiaster* | European Bee-eater | Qızılı qızlarquşu |
| *Merops persicus* (see Photo 42) | Blue-cheeked Bee-eater | Yaşıl qızlarquşu |
| *Muscicapa striata* | Spotted Flycatcher | Boz milçəkqapan |
| *Pastor roseus* | Rosy Starling | Ala sığırçını |
| *Pica pica* | Eurasian Magpie | Sağsağan |
| *Riparia riparia* | Bank Swallow | Sahil qaranquşu |
| *Sylvia communis* | Greater Whitethroat | Boz silvi |
| *Sylvia curruca* | Lesser Whitethroat | Çərənçi silvi |

**Photo 44:** Dune valley with brown-greenish *Juncus acutus* tussocks and lilac *Limonium meyeri*. Lower sand dunes are often stabilized by *Elaeagnus angustifolia* bushes (S. Hirschelmann).

**Photo 45:** Large fields of mobile sand are found on the windward eastern dune slopes. Psammophytic species like the silvery-leaved Caspian endemic *Convolvulus persicus* or *Alhagi maurorum* grow here (D. Valeeva).

## d. List of plant species

### Plant species recorded in the dune valleys (see Photo 44)

| Bush and tree species | |
|---|---|
| *Clematis orientalis* L. | *Tamarix ramosissima* Ledeb. |
| *Rubus* spec. | |
| **Herbaceous species** | |
| *Agropyron arenarium* Opiz ex Bercht. | *Lotus tenuis* Waldst. & Kit. |
| *Agrostis stolonifera* L. | *Lythrum salicaria* L. |
| *Arundo donax* L. | *Medicago sativa* L. |
| *Asparagus verticillatus* L. | *Saccharum ravennae* (L.) Murray |
| *Calamagrostis* spec. | *Samolus valerandi* L. |
| *Cynanchum acutum* L. | *Scirpoides holoschoenus* (L.) Soják |
| *Ecballium elaterium* (L.) A.Rich. | *Setaria* spec. |
| *Epilobium hirsutum* L. | *Typha angustifolia* L. |
| *Juncus acutus* L. | *Xanthium spinosum* L. |
| *Limonium meyeri* (Boiss.) Kuntze | *Xanthium strumarium* L. |

### Plant species recorded on the dunes (see Photo 45)

| Bush and tree species | |
|---|---|
| *Elaeagnus angustifolia* L. | |
| **Herbaceous species and semi-shrubs** | |
| *Agriophyllum* cf. *squarrosum* (L.) Moq. | *Eryngium* spec. |
| *Alhagi maurorum* Medik. | *Melilotus* spec. |
| *Artemisia arenaria* DC. | *Nitraria* cf. *komarovii* Iljin & Lava |
| *Artemisia* spec. | *Salsola kali* L. |
| *Astragalus* spec. | *Suaeda microphylla* Pall. |
| *Convolvulus persicus* L. | *Zygophyllum fabago* L. |
| *Echinops* cf. *sphaerocephalus* L. | |

Plant species of intermediate sites:

| Herbaceous species and semi-shrubs | |
|---|---|
| *Cephalaria transylvanica* (L.) Schrad. ex Roem. & Schult. | *Plantago arenaria* Waldst. & Kit. |
| *Glycyrrhiza glabra* L. | |

## e. Description of soil profile

Soils were not assessed in detail, as the landscape is of comparably young origin without much time for soil formation. Sandy soils are dominating, especially in the two-kilometre-wide strip along the coast the dune ridges are limited to. In contrast, the plain surroundings are made up of fine sediments, with salt-influenced Gleysols and Solonchaks predominating (Mamedaliev 1963).

## Reference


Mamedaliev, J. G. (1963). Atlas Azerbaydzhanskoy SSR [Atlas of the Azerbaijan SSR]. Gosudarstvennyy Geologicheskyy Komitet, Baku, Moskva, SU (Russ.). 214p.

Prilipko, L. I. 1970. Rastitel'nyy pokrov Azerbaydzhana [Vegetation cover of Azerbaijan]. Elm, Baku, SU (russ.). 170p.

Schmidt, S., Uppenbrink, M. (eds.) (2009): Potential analysis for further nature conservation in Azerbaijan. Michael Succow Foundation, Geozon Science Media, Greifswald, DE. 164p.

Tegetmeyer, C., Peper, J., Etzold, J., & Schmidt, S. (2007): Conservation value of the shifting sand dune complex and lagoons in the Samur Divichi Lowlands (Northern Azerbaijan). Archives of Nature Conservation and Landscape Research, 46(2), 79–92.

## 4.2.2. The way to Altiaghaj – from semi-deserts and steppes over Tugai forests and Shiblyak towards the broad-leaved forest zone

**Day of protocol: 05.09.2015**

**Names of students: Rufat Hashimli and Paul August Schult**

Number of excursion points: 3

Number of vegetation plots: 0

Number of soil profiles: 0

Number of land use assessments: 0

### *General characteristics of the landscape*

The easternmost foothills of the Greater Caucasus are characterised by a hot and summer-dry climate. Rainfall occurs mainly from autumn to spring. Soils are prone to salinization. In the dry and hot summer months, due to capillary action, salts are transported by evaporating water to the upper soil layers, especially in flatter areas at lower elevations. Many halophytes mixed with ephemeral species occur due to the saline soils. With increasing altitude, halophytic vegetation becomes less dominant. Some woody plants such as *Tamarix species* and wild pomegranate *Punica granatum* grow close to river banks in the valleys where water flows only temporarily in part, but is present as ground water throughout the year. In former times, the Euphrate Poplar *Populus euphratica* might have been more widespread in such valleys, but apart from only very few sites, it is now widely extirpated.

At middle elevations, xerophytic forest made up of oak and wild fruit tree species grows naturally on dry slopes, as well. A bushland-like, so-called Shiblyak vegetation dominated by *Paliurus spina-christi* is common as a degradation stage due to the cutting of the forest trees and grazing by livestock. Steppe and semi-desert plants take over where the trees and shrubs were cut. High grazing pressure favours erosion, leading to a generally sparse vegetation cover. Only in higher areas with a cooler climate and more available water do closed forests persist until today.

The lowland areas and dry foothills are traditionally used as winter pastures for the herds of sheep and goats that are brought from the mountains of the Greater Caucasus in autumn and stay until spring.

## *Excursion point 2.2.2: Remnants of Populus euphratica Tugai forest at Disavarchay*

**a. Location** N 40°51'33.98" E 49°11'46.17" 223 m a.s.l.

**b. Brief description of landscape features** (landscape genesis and formation processes, dominant vegetation, soil features, land use, etc.)

The main road to Altiaghaj runs through the easternmost foothills of the Greater Caucasus south of Beshbarmag Mountain along the river Tughchay. Leaving the valley to the left at a sign indicating the way to Dizavar village, we enter the valley of the tributary Disavarchay. After approx. 2 km, a stand of Euphrate Poplar *Populus euphratica* is found (see Photo 46). It is situated within the remnants of a riparian forest dominated by *Tamarix species* and surrounded by chenopodiaceous and ephemeral semi-desert vegetation.
The stand is a natural monument, since it is the biggest confirmed natural site with *Populus euphratica* in Azerbaijan (Peper et al. 2010). For this purpose, it is in parts fenced to prevent livestock from grazing. Information signs have been installed to inform visitors.

**Photo 46:** The biggest stand of exclusively male clones *Populus euphratica* on both sides of Disavarchay (S. Hirschelmann).

**Photo 47:** As visible here, *Populus euphratica* has two different age-dependent leaf shapes: young specimens and long shoots form lanceolate leaves; short shoots of old trees have roundish leaves (J. Etzold).

### c. Additional information on other topics during that stop

*Populus euphratica* is adapted to sites with a dry climate in river valleys. It needs dynamic river beds with a seasonal flooding for sexual reproduction. The seeds only germinate when they fall in early summer on wet and bare soils, which are created after floods as open sandbanks. Vegetative reproduction by means of root suckers is very common. Special adaptations to the ecological conditions are fast and deep growth of the seedling roots, hard and leather-like leaves and an age-dependent leaf shape. Young specimens and long shoots form lanceolate leaves; short shoots of old trees have roundish leaves like *Populus tremula* (see Photo 47). In between these two leaf types, several intermediate forms exist. Cutting is a big problem for *Populus euphratica* since the trees have no wound healing mechanism and the tree sap just flows out.

*Populus euphratica* is one of the rarest tree species within the Caucasus region. Very isolated stands exist in Azerbaijan, Georgia and Armenia, but just a few of them are confirmed to be still in existence. These are only remnants, surviving by asexual reproduction.

At Disavarchay, about 211 single trees are left, but they do not represent 211 genetically different individuals. Just 4 different clones where identified by means of genetic analysis. Sexing of these trees resulted in 1 female and 3 male clones. At the excursion site, only male clones are present. The female clone is about 4 km away from the males at the river Tughchay, of which the Disavarchay is a tributary. The oldest tree is about 60 years old, but its clone is probably much older, since its individuals are distributed along a stretch of 350 m.

The mere presence of only a few clones indicates that the conditions for sexual reproduction, which requires flooding at the time of seeding (see above), were not given for a very long time.

However, with improved protection, this now unique forest stand may still persist for a long time (Peper et al. 2010).

**d. List of bird species observed**

In the noon heat outside of the breeding season, only few bird species were recorded. Only the Pied Wheatear can be regarded as a typical representative of such a hilly landscape under semi-desert conditions.

| Latin Name | English Name | Azerbaijani Name |
|---|---|---|
| *Carduelis carduelis* | European Goldfinch | Payız bülbülü |
| *Coturnix coturnix* | Common Quail | Bildirçin |
| *Oenanthe pleschanka* | Pied Wheatear | Keçəl çaxraxçıl |

**e. List of plant species**

| Bush and tree species | |
|---|---|
| *Berberis vulgaris* L. | *Rhamnus pallasii* Fisch. & C.A. Mey. |
| *Elaeagnus* spec. L. | *Tamarix ramosissima* Ledeb. |
| *Paliurus spina-christi* Mill. | *Ulmus* spec. L. |
| *Populus euphratica* Olivier | |
| **Herbaceous species and semi-shrubs** | |
| *Kalidium caspicum* (L.) Ung.-Sternb | *Salsola verrucosa* M. Bieb. |
| *Lycium ruthenicum* Murray | |

**References**

Peper, J., Schönfeld, M., Fehrenz, S. (2010): Die Verbreitung der Euphrat-Pappel (*Populus euphratica* Olivier) in Kaukasien [The distribution of *Populus euphratica* Olivier in the Caucasus], Mitt. Deutsch. Dendrol. Ges. (MDDG) 95: 77–86 (in German).

## *Excursion point 2.2.3: Candy Cane Mountains and surrounding semi-deserts*

**a. Location** N 40°52'51.03" E 49°11'1.14" 234 m a.s.l.

**b. Brief description of landscape features** (landscape genesis and formation processes, dominant vegetation, soil features, land use, etc.)

Back on the main road along Tughchay, the mountains become more and more colourful. Their soft slate originates from sediments of the Thetys Ocean during the Cretaceous period and is approximately 65 million years old. The name "Candy Cane Mountains" derives from the colouration of the sediments (see Photo 48). Many different layers with either reddish or greyish colouration were formed during the process of sedimentation. Depending on the water's oxygen

condition during their formation, they became either reddish or greyish. Under aerobic conditions, the iron compounds oxidised to $Fe_2O_3$ and the sediments became red. Anaerobic conditions resulted in the oxidation of the iron compounds to FeO and the sediments turned grey. Later, the horizontal layers were folded and twisted during the formation of the Greater Caucasus. Ongoing erosion cuts into the slopes, thus allowing an insight into these colourful sediments with their candy-like appearance. Due to high temperatures in summer, groundwater is moving upward in the soil capillaries, transporting salt to the surface. Therefore, many halophytic plant species are found on such sites. For agricultural use of such sites, a high amount of freshwater is needed to water the plants and especially to wash out the salt deep enough in order to grow crops or vegetables. Along Tughchay, additional remnants of riparian forests dominated by *Tamarix* species can be found.

**Photo 48:** Whitish and reddish colours of the folded and twisted marl stone gave name to the so-called "Candy Cane Mountains" (J. Etzold).

**Photo 49:** Belemnite fossils, remains of cephalopods that lived in the Tethys Ocean, can be found everywhere on the slopes of the "Candy Cane Mountains" (D. Valeeva).

### c. Additional information on other topics during that stop

A special feature of the Candy Cane Mountains are numerous belemnite fossils (order Belemnitida), which can be found everywhere on the slopes and which collect especially in the gullies. They are the remains of cephalopods that lived in the Tethys Ocean. Their rostrums were filled with silicates during the process of sedimentation, forming these fossils (see Photo 49).

### List of bird species observed

As for excursion point 2.2.2, the heat of the afternoon outside of the breeding season was the reason for few bird observations. The Corn Bunting is widespread in cultural landscapes in the semi-desert to the montane belt.

| Latin Name | English Name | Azerbaijani Name |
|---|---|---|
| *Emberiza calandra* | Corn Bunting | Tarla vələmirquşu |

### d. List of plant species

| Herbaceous species and semi-shrubs | |
|---|---|
| *Artemisia lerchiana* Stechm. | *Hordeum* spec. L. |
| *Climacoptera crassa* (M. Bieb.) Botsch. | *Limonium meyeri* (Boiss.) Kuntze |
| *Capparis spinosa* L. | *Salsola dendroides* Pall. |
| *Eremopyrum* spec. (Ledeb.) Jaub. & Spach | *Suaeda microphylla* Pall. |

## *Excursion point 2.2.4: Shiblyak*

**a. Location** N 40°54'25.63" E 49°05'46.99" 630 m a.s.l.

**b. Brief description of landscape features** (landscape genesis and formation processes, dominant vegetation, soil features, land use, etc.)

After leaving Tughchay valley, the road quickly reaches extensive patches of bushland on the slopes. These are stands of so-called Shiblyak vegetation, a shrubby tree community often growing on dry slopes. Its vegetation is a degradation stage of xerophytic forests dominated by oaks. At this excursion site, it is of artificial origin, planted approximately 50 years ago to prevent erosion. This vegetation is highly susceptible to fire. In the natural state it is dominated by *Paliurus spina-christi* (see Photo 50). This species is a good nurse plant due to its toxicity and thorns. It protects other plants from the heavy grazing by livestock that is common in this type of habitat. Steppe and semi-desert vegetation dominated by ephemeral grasses and herbs occurs between the trees and shrubs. At the time of the excursion, this vegetation was already dried up. At the excursion site, relatively few *Paliurus spina-christi* was found due to the planting of *Cotinus coggyreria* and other shrub and tree species.

**Photo 50**: Jerusalem Thorn (*Paliurus spina-christi*) is the dominating species in so-called Shiblyak vegetation, which is mostly a degradation stage on former sites of semi-arid oak forests. The species is resistant against browsing due to its thorns and chemical content (J. Etzold).

## c. List of plant species

| Bush and tree species | |
|---|---|
| *Astracantha* spec. Podlech | *Prunus cerasifera* Ehrh. |
| *Cotinus coggygria* Scop. | *Pyrus salicifolia* Pall. |
| *Cotoneaster* spec. Medik. | *Quercus petraea* subsp. *iberica (Steven ex M. Bieb.) Krassiln.* |
| *Crataegus* spec. L. | *Rhamnus pallasii* Fisch. & C.A. Mey. |
| *Lonicera* spec. L. | *Rosa* spec. L. |
| *Paliurus spina-christi* Mill. | |
| Herbaceous species and semi-shrubs were not noted | |

## 4.2.3. Oak and beech forests in Altiaghaj National Park

**Day of protocol: 03.09.2015**

**Names of students: Gunay Behremzade, Abdin Abbasov, Jasmine Kischkat**

Number of excursion points: 6

Number of vegetation plots: 2

Number of soil profiles: 2

Number of land use assessments: 0

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### *General characteristics of the landscape*

Based on the regional diversity of landscapes, the eastern Greater Caucasus in Azerbaijan can be divided into three characteristic regions: 1) the southern slope of the mountain ridge with dense forests and towns such as Shamakhi, Shäki and Zagatala; 2) the forested northern slope, which rises in the hinterlands of Guba and Gusar and 3) the more arid eastward sloping mountains around Altiaghaj National Park.

Altiaghaj National Park was established in August 2004. The National Park is located in the Khizi and Siyäzän regions. It was created on an area of 11,035 ha on the basis of the already existing Altiaghaj Strict Nature Reserve and adjacent state-owned forest lands. The landscape is dominated by montane oak and beech forests as well as forest steppe vegetation. The main tree species are *Quercus petraea* subsp. *iberica*, *Carpinus betulus, Fagus orientalis, Fraxinus excelsior* and *Betula* species. Shrub species include representatives of the genera *Crataegus*, *Rosa* and *Rubus*. Most of the forests visited (see excursion points 2.3.1–2.3.5) now belong to the National Park and are therefore protected from wood cutting. Among the soil types especially Brown Soils are characteristic for the forest areas (Äsädov et al. 2008).

The climate can be described as moderately warm with dry summers and winters.

The biggest river in the National Park is Atachay, which originates at 1,870 m a.s.l. near Dübrar Mountain and flows into the Caspian Sea.

Typical mammal species of the National Park include Roe Deer (*Capreolus capreolus*), Brown Bear (*Ursus arctos*), Wild Boar (*Sus scrofa*), Lynx (*Lynx lynx*), Racoon (*Procyon lotor*), Red Fox (*Vulpes vulpes*), Wolf (*Canis lupus*), European Hare (*Lepus europaeus*) and Caucasian Squirrel (*Sciurus anomalus*). Typical birds are Common Nightingale, Golden Oriole, Pied Wheatear, Ortolan Bunting as well as pheasants, partridges, thrushes, finches, European Nightjar and nearly every raptor species known in Azerbaijan (information partly retrieved from MENR 2015).

## References

Äsädov, K. S., Mämmädov, F. M., Sadikhov, S. Ä. (2008): Böyük Gafgazin shimal-särg hissäsinin dendroflorasi vä meshäläri [Dendroflora of the northeastern part of the Greater Caucasus and the forests]. Baku, AZ (Azerb.). 248p.

MENR (2015): Ministry of Ecology and Natural Resources, Azerbaijan. Altiaghaj National Park. http://eco.gov.az/en/624-altiagac-milli-parki. Accessed: October 2015.

**Photo 51:** *Quercus petraea* subsp. *iberica* dominates in rather low-growing forests like here on this southwestern slope (J. Etzold).

## *Excursion point 2.3.1: Forest behind the BSU Field Station*

**a. Location** N 40°52'24.35" E 48°55'52.21" 1,078 m a.s.l.

**b. Brief description of landscape features** (landscape genesis and formation processes, dominant vegetation, soil features, land use, etc.)

This forest on a north-eastern slope is very rich both in tree as well as in herbaceous species (for details, see vegetation assessment sheet in Annex 2.5.). The dominating tree is *Carpinus betulus,* with sub-dominant *Quercus petraea* subsp. *iberica*, *Fagus orientalis* and *Fraxinus excelsior*. Although recent signs of cutting are absent, this species composition and the appearance (small diameter of trunks = low age) hint at former intensive coppicing. In addition, a frequent cattle grazing occurs.

**c. List of bird species observed**

The species listed are representative for the entire day and in general for the species set occurring in the forests of the region. At the other excursion points, no additional species were noted.

| Latin Name | English Name | Azerbaijani Name |
|---|---|---|
| *Accipiter nisus* | Eurasian Sparrowhawk | Bildirçinçalan |
| *Ficedula parva* | Red-breasted Flycatcher | Xırda milçəkqapan |
| *Fringilla coelebs* | Common Chaffinch | Meşə sərçəsi |
| *Garrulus glandarius* subsp. *atricapillus* | Eurasian Jay | Zığzığ |
| *Periparus ater* | Coal Tit | Qara arıquşu |
| *Phylloscopus trochilus* | Willow Warbler | Bahar yarpaqgüdəni |
| *Sitta europea* | Eurasian Nuthatch | Adi sitta |

**d. List of plant species**

See filled-out vegetation assessment sheet 10 in Annex 2.5.

**e. Description of soil profile**

A soil type typical for many forest sites was recorded: Brown Earth (Cambisol after FAO classification) with the sequence of horizons Ah/Bv/C.

For details, see filled-out soil assessment sheet in Annex 2.5.

## *Excursion point 2.3.2: Oak forest on west-north-western slope*

**a. Location** N 40°54'2.76" E 49°01'35.49" 827 m a.s.l.

**b. Brief description of landscape features** (landscape genesis and formation processes, dominant vegetation, soil features, land use)

The oak-dominated forest on this west-north-western slope was formerly used as coppice forest, with a canopy that was further opened up by livestock grazing. Since the Altiaghaj forests are generally part of the closest extensive forest area in the vicinity of Baku, around 120 years ago they were intensively cut to produce charcoal for the increasing demand for fuel in the expanding city, and especially for charcoal-powered cargo ships exporting oil products.

The dominating tree species is *Quercus petraea* subsp. *iberica* with sub-dominant *Carpinus betulus* and *Fraxinus excelsior*. Site conditions appear to be too dry for the growth of *Fagus orientalis*.

Few recent signs of cutting were detected, as the forest now belongs to the National Park. The relatively small diameter of the trunks indicates a low age of the forest stand. However, unfavourable soil conditions (see below) might also be responsible for a comparably low growth rate.

### c. List of plant species

See filled-out vegetation assessment sheet 11 in Annex 2.5.

### d. Description of soil profile

The Rendzina soil with the horizon sequence Ah/C was difficult to dig in, as the texture was a heavy loam that was also very dry. These soil conditions might be responsible for the apparently rather poor tree growth performance.

For details, see filled-out soil assessment sheet in Annex 2.5.

**Photo 52:** Soil profile with dense heavy loam, which seems to cause unfavourable conditions for forest growth (M. Manthey).

**Photo 53:** *Fagus orientalis* becomes dominant on slopes with northern exposure, like here at excursion point 2.3.3 (S. Hirschelmann).

## *Excursion point 2.3.3: Beech forest on north-north-western slope*

**a. Location** N 40°53'17.39" E 49° 0'46.09" 1,183 m a.s.l.

**b. Brief description of landscape features** (landscape genesis and formation processes, dominant vegetation, soil features, land use)

During this very short stop, the following observation was made: in comparison to point 2.3.2, the trees are higher here, which can either be explained by a higher age of the trees (i.e., less cutting in the past) or more likely by the fact that the conditions for forest growth are more favourable here. Due to the more northern exposure, more moisture is available to the vegetation. These site conditions allow *Fagus orientalis* to become the dominating tree species (see Photo 53).

**c. List of plant species**

| Bush and tree species | |
|---|---|
| *Acer laetum* C. A. Mey. | *Fraxinus excelsior* L. |
| *Fagus orientalis* Lipsky | |
| **Herbaceous species** | |
| *Bromopsis ramosa* (Huds.) Holub | *Galium odoratum* (L.) Scop. |
| *Drymochloa drymeja* (Mert. & W. D. J. Koch) Holub | *Geranium* spec. L. |

**d. Description of soil profile**

A natural soil profile could be observed at the basis of a fallen beech trunk:

Under an Ah horizon, the B horizon with a brown colour can be detected over the stony C horizon, which is very rich in carbonates and darker. The sequence can be interpreted as a former Rendzina, which became an initial Cambisol (Brown Earth) where carbonates are washed out from the B horizon.

## *Excursion point 2.3.4: Forest glade due to road-side erosion*

**a. Location** N 40°53'13.64" E 49° 0'56.20" 1,223 m a.s.l.

**b. Brief description of landscape features** (landscape genesis and formation processes, dominant vegetation, soil features, land use, etc.)

On the downhill side of the road, a landslide opened due to disturbances connected with road construction 3 or 4 years ago (see Photo 54). There are many huge stones in the bedrock, which contributed to the erosion process. The first succession step is already taking place, with pioneer species such as *Sambucus nigra, Sambucus ebulus, Populus alba, Salix* cf. *caprea, Acer laetum, Prunus avium* and *Ulmus* spec. These pioneers are capable of germinating on raw soils with plenty of direct light. The surrounding forest is dominated by *Fagus orientalis* with accompanying *Carpinus betulus* or *Acer hyrcanum*. *Fagus orientalis* normally does not germinate in the sun, as it requires the shade of other trees. After a succession of several decades, the current forest glade might become a *Fagus* forest again.

**Photo 54:** Watching from the destroyed *Fagus orientalis* forest in north-eastern direction down to the hazy Caspian Sea (Mt. Beshbarmag as small hill on the horizon). Due to drier and hotter conditions, the dense forests are gradually dissolving to bushland and finally steppe vegetation (see Fig. 22 and Fig. 23) (J. Etzold).

## *Excursion point 2.3.5: Beech forest*

**a. Location** N 40°53'10.95" E 49° 0'22.62" 1,246 m a.s.l.

**b. Brief description of landscape features** (landscape genesis and formation processes, dominant vegetation, soil features, land use, etc.)

This beech-dominated forest on a north-eastern slope opening towards Beshbarmag and the Caspian Sea was formerly used as coppice forest, with a canopy that was further opened up by livestock grazing.

During our stop, we pointed out several individuals of the conifer *Taxus baccata*, which is a typical understory tree of beech forests in Europe. Since in medieval times, the wood of *Taxus* was particularly valued for bow production (as weapons), Great Britain experienced a shortage of *Taxus baccata* and foreign visitors had to pay an entry tax in the form of *Taxus* wood.

**c. Additional information on other topics during that stop**

A particularly interesting plant species recorded in this beech forest is the overall brownish orchid *Neottia nidus-avis*. The colour is due to the almost complete lack of chlorophyll, i.e., the species is non-photosynthetic and lives entirely parasitic, depending on the nutrients and carbohydrates provided by its host. The host is a fungus species (i.e., the orchid is myco-heterotrophic), which itself lives in symbiosis with a tree species, in this case mostly beech. Therefore, the orchid ultimately depends on the metabolites of the tree species, provided through the fungus mycelium (epiparasitism) (Düll and Kutzelnigg 2011 in Wikipedia 2016).

**d. List of plant species**

| Bush and tree species | |
|---|---|
| *Acer laetum* C.A.Mey. | *Carpinus betulus* L. |
| *Fagus orientalis* Lipsky | *Taxus baccata* L. |
| *Quercus petraea* subsp. *iberica* (Steven ex M. Bieb.) Krassiln. | |
| **Herbaceous species** | |
| *Hordelymus europaeus* (L.) Harz | *Sanicula europaea* L. |
| *Neottia nidus-avis* (L.) Rich. | |

### References

Düll, R., Kutzelnigg, H. (2011): Taschenlexikon der Pflanzen Deutschlands und angrenzender Länder. Die häufigsten mitteleuropäischen Arten im Porträt (7. korrigierte und erweiterte Auflage). Quelle & Meyer, Wiebelsheim, pp. 529–530.

In: Wikipedia (2016): https://de.wikipedia.org/wiki/Vogel-Nestwurz. Accessed: April 2016.

## *Excursion point 2.3.6: Village Yarimja-Ghizil Ghazma*

**a. Location** N 40°53'3.57" E 48°59'54.04" 1,276 m a.s.l.

**b. Brief description of landscape features** (landscape genesis and formation processes, dominant vegetation, soil features, land use, etc.)

The village of Yarimja-Ghizil Ghazma is surrounded by the protected forests of the Altiaghaj National Park and is located on a plateau characterised by grass- and bushlands. It is dominated by vacation houses and long walls enclosing these compounds. Until the recent construction of a massive asphalt road for improved access to the area, living permanently in this village appeared not to have been attractive, due to its former isolation. This is indicated by fallows and shrub encroachment, suggesting that previous agricultural use had been given up.

The road construction for the sake of infrastructure development for private vacation homes through the core zone of the National Park indicates a subordinate role of nature conservation interests.

## 4.2.4. Open montane zone above Altiaghaj

**Day of protocol: 4.09.2015**

**Names of students: Dina Valeeva, Lalə Qaradağli, Musfiq Bahaddinov**

Number of excursion points: 6

Number of vegetation plots: 0

Number of soil profiles: 0

Number of land use assessments: 0

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### *General characteristics of the landscape*

The area visited during that day is not part of the National Park. Driving up along the road from Altiaghaj in a south-westerly direction toward the village of Chisty Kl'utch, the landscape becomes more open with a mosaic of bushland, grasslands and some rather rocky areas, which are all used as pastures for sheep, cattle and donkeys (see Photo 55). Chestnut, Light Chestnut, Brown Soils and other types are found in this area (Äsädov et al. 2008). Closed forest remnants are almost exclusively restricted to steeper northern slopes, since after decades or centuries of tree cutting and livestock grazing, large parts of the original forests stands were altered to bush- and grasslands. However, with decreasing land use intensity due to the migration of many residents to larger cities, forests might return to some areas. Nonetheless, the anthropogenic impact is still higher close to the settlements than it is in the more remote parts.

Besides oak species and junipers, the most common tree and bush species in this open bushland landscape are wild fruit trees from the family Rosaceae, such as pears, apples, plums and hawthorns (see e.g. Photo 57).

The diverse avifauna recorded during this day indicates a multitude of different habitats and thus a generally high biodiversity.

**References**

Äsädov, K. S., Mämmädov, F. M., Sadikhov, S. Ä. (2008): Böyük Gafgazin shimal-särg hissäsinin dendroflorasi vä meshäläri [Dendroflora of the northeastern part of the Greater Caucasus and the forests]. Baku, AZ (Azerb.). 248p.

**Photo 55:** View to north-east from the semi-open landscape with steppe-like grasslands and species-rich bushlands (note e.g. silvery *Pyrus salicifolia* trees and flat juniper bushes) over the forests of Altiaghaj NP down to Caspian Sea (in haze in the background, S. Hirschelmann).

## *Excursion point 2.4.1: Way from Altaghaj towards Chisty Kl'utch*

**a. Location** N 40°50'18.42" E 48°54'30.92" 1,477 m a.s.l.

**b. Brief description of landscape features** (landscape genesis and formation processes, dominant vegetation, soil features, land use, etc.)

While walking along the Chisty Kl'utch (Чистый Ключ) road, we passed a wide variety of habitats, including crop fields, hay fields, pastures and bushland.
During the stop at this site, on a flat north-western slope initial conclusions on the surrounding landscape were drawn.
Striking is the multitude of tree and bush species, as shown by the list below. Some of the trees such as *Acer laetum*, *Carpinus betulus* and *Quercus petraea* subsp. *iberica*/ *Qu. macranthera* are typical representatives of the forests that are now restricted to less accessible areas, e.g., steep slopes. The presence of these species indicates that forests would naturally cover the entire area and only gave way to this cultural landscape after centuries or even millennia of human use.
In addition, the presence of *Brachypodium sylvaticum* (Poaceae) also indicates the potential for forest growth here.

It could not be clarified which of the two *Quercus* species in fact occurs at this site. While the first is one of the forest-forming tree species in the entire forest belt below, the second species is typical for the timber line in the whole region, reaching elevations of 2,400 m on the southern macroslope and often growing in open park-like forest stands. It is not known how far down this species occurs.

Many wild representatives of fruit trees such as pear, apple or plum, were recorded. Many of these are typical for semi-open forests and bushlands on southern slopes. The annual rings visible in the crosscut of a pear indicated an age of around 100 years.

Among the bush species that are typically found in such landscapes used by grazing livestock, many are "equipped" with thorns (e.g., *Crataegus* spec., *Berberis vulgaris*, *Rosa* spec.) or prickly needles (junipers). With this adaptation, they are better able to withstand the grazing impact of livestock.

Among herbaceous species, as well, many representatives bear the characteristic adaptations, which make them less palatable for grazing livestock. There are particularly thorny or hardy, prickly species like *Carlina vulgaris*, *Cirsium* spec. and *Inula aspera*, species featuring a dense hair cover such as *Stachys byzantina*, or species stuffed with chemical substances unpleasant for livestock like *Nepeta* spec., *Origanum vulgare* or *Thymus* spec. The latter often have a pleasant, aromatic smell for humans, making them popular for medicinal or alimentary use.

**c. Additional information on other topics during that stop**

Chisty Kl'utch village only recently became permanently inhabited; in former times, it used to be a mere summer village for former Russian settlers. These so-called Molokans also live in other villages in Azerbaijan, which usually bear Russian names.

The timberline at nearby Mount Dübrar (at 2,205 m a.s.l. the highest mountain of the region, which is isolated from similar altitudes further west) used to be the habitat of the Caucasian Black Grouse *Tetrao mlokosiewiczi* (see Photo 10), as recorded approx. 100 years ago. Today, this species is extinct here and occurs only further west.

**Photo 56:** The globally threatened Steppe Eagle (*Aquila nipalensis*) is migrating in considerable numbers through Azerbaijan, especially over the lower mountains along the Caspian Coast (see also Heiss 2013) (D. Eichhorn).

### d. List of bird species observed

On the day of our visit, migration of various raptor species was noted, with several individuals of buzzards and eagles passing by. Most songbirds noticed at this and the next excursion points are typical for this kind of semi-open landscape with intermixed bush- and grasslands.

| Latin Name | English Name | Azerbaijani Name |
|---|---|---|
| *Aquila nipalensis* (see Photo 56) | Steppe Eagle | Çöl qartalı |
| *Buteo buteo* | Common Buzzard | Adi sar |
| *Falco subbuteo* | Eurasian Hobby | Adi qarağöz qızılquş |
| *Hieraaetus pennatus* | Booted Eagle | Cırtdan qartal |
| *Merops apiaster* | European Bee-eater | Qızılı qızlarquşu |
| *Motacilla alba* | White Wagtail | Ağ çaydaçapanı |
| *Saxicola rubetra* | Whinchat | Çəmən çəkçəkisi |
| *Saxicola torquatus* | European Stonechat | Qarabaş çəkçəkisi |
| *Sylvia communis* | Greater Whitethroat | Boz silvi |
| *Sylvia curruca* | Lesser Whitethroat | Çərənçi silvi |

## e. List of plant species

| Bush and tree species | |
|---|---|
| *Acer laetum* C.A.Mey. | *Prunus spinosa* L. |
| *Berberis vulgaris* L. | *Pyrus communis* subsp. *caucasica* (Fed.) Browicz |
| *Carpinus* spec. L. | *Pyrus georgica* Kuth. |
| *Crataegus germanica* (L.) Kuntze | *Pyrus salicifolia* Pall. |
| *Crataegus* spec. L. | *Quercus petraea* subsp. *iberica* (Steven ex M. Bieb.) Krassiln./ *Quercus macranthera* Fisch. & C. A. Mey. ex Hohen. |
| *Juniperus communis* subsp. *nana* Syme | *Rhamnus cathartica* L. |
| *Lonicera* spec. *L.* | *Rosa* spec. L. |
| *Malus sylvestris* subsp. *orientalis* (Uglitzk.) Browicz | *Sorbus armeniaca* Hedl. |
| *Prunus cerasifera* Ehrh. | *Viburnum lantana* L. |
| **Herbaceous species** | |
| *Agrimonia eupatoria* L. | *Inula aspera* Poir. |
| *Brachypodium sylvaticum* (Huds.) P. Beauv. | *Nepeta* spec. L. |
| *Briza media* L. | *Origanum vulgare* L. |
| *Carex humilis* Leyss. | *Plantago* spec. L. |
| *Carlina vulgaris* L. | *Primula veris* subsp. *macrocalyx* (Bunge) Lüdi |
| *Cirsium* spec. Mill. | *Stachys byzantina* K. Koch |
| *Dactylis glomerata* L. | *Thymus* spec. L. |
| *Festuca* spec. L. | |

**Photo 57:** The Wild Apple (*Malus sylvestris* subsp. *orientalis*) is one of the many wild fruit trees from the Rosaceae occurring in this semi-open landscape (S. Hirschelmann).

**References**

Heiss, M. (2013): The importance of Besh Barmag bottleneck (Azerbaijan) for Eurasian migrant birds. Acta Ornithologica 48 (2): 151–164.

## *Excursion point 2.4.2: Plateau*

**a. Location** N 40°50'17.12" E 48°53'11.69" 1,630 m a.s.l.

**b. Brief description of landscape features** (landscape genesis and formation processes, dominant vegetation, soil features, land use, etc.)

The highest point of this excursion day was reached on a kind of plateau, forming the ridge of the southern macroslope.

This excursion point is located on an eastern slope with an inclination of around 10 degrees. Clearly separated lines with a different vegetation composition indicate the former use of parts of this area as crop fields. Today, natural vegetation develops again on these fallows.

Although climatically forests could still persist on this site as well (most likely oak-dominated forests), a secondary steppe dominated by characteristic species such as Poaceae grasses of the genera *Stipa* and *Festuca* has developed on this site.

There are several possible reasons why a return to forested land seems difficult to achieve.

- Obviously, the wind exposure on this plateau is high, indicated by Juniper and other bushes, which show a comparably flat growth form. In contrast, on the steeper northern margins, trees can grow higher, as conditions there are more favourable for high growth.
- Possible fires in the past may have hindered the return of woody species, whereas the aforementioned dominant grass species can withstand intensive fires much better.
- Grazing impact is visible on many of the bushes on the plateau. Only few individuals grow out of the livestock's reach. In addition, the presence of many bushes and also herbaceous species with the above-mentioned adaptations against grazing pressure (thorns, hairs, chemical substances) indicates the impact of livestock on shaping this landscape.

**c. Additional information on other topics during that stop**

Grasshoppers (order Orthoptera) such as *Calliptamus italicus* recorded here are typical and numerous inhabitants of such steppe habitats.

**d. List of plant species**

| Bush and tree species | |
|---|---|
| *Berberis vulgaris* L. | *Prunus cerasifera* Ehrh. |
| *Juniperus communis* subsp. *nana* Syme | *Pyrus communis* subsp. *caucasica* (Fed.) Browicz |
| *Juniperus excelsa* subsp. *polycarpos* (K. Koch) Takht. | *Pyrus georgica* Kuth. |
| *Juniperus* spec. L. | *Rosa* spec. L. |
| *Ligustrum vulgare* L. | *Sorbus armeniaca* Hedl. |
| **Herbaceous species** | |
| *Achillea setacea* Waldst. & Kit. | *Inula aspera* Poir. |
| *Agrimonia eupatoria* L. | *Koeleria macrantha* (Ledeb.) Schult. |
| *Alyssum alyssoides* (L.) L. | *Lotus corniculatus L.* |
| *Astracantha* spec. Podlech | *Nepeta* spec. L. |
| *Brachypodium sylvaticum* (Huds.) P. Beauv. | *Origanum vulgare* L. |
| *Briza minor* L. | *Oxytropis* spec. DC. |
| *Carex humilis* Leyss. | *Pedicularis* spec. L. |
| *Carlina vulgaris* L. | *Plantago* spec. L. |
| *Dianthus fragrans* Adams | *Potentilla argentea* L. |
| *Dianthus* spec. L. | *Potentilla humifusa* Willd. |
| *Erigeron* spec. L. | *Primula veris* subsp. *macrocalyx* (Bunge) Lüdi |
| *Festuca ovina* L. | *Sanguisorba minor* Scop. |
| *Festuca stricta* subsp. *trachyphylla* (Hack.) Pils | *Stachys byzantina* K. Koch |
| *Filipendula vulgaris* Moench | *Stipa* cf. *lessingiana* Trin. & Rupr. |
| *Galium anfractum* | *Teucrium* spec. L. |
| *Gentiana septemfida* Pall. | *Trifolium* spec. L. |
| *Helianthemum* spec. Hill | *Ziziphora puschkinii* Adam |

## *Excursion point 2.4.3: Way down from plateau*

**a. Location** N 40°50'29.01" E 48°52'53.78" 1,616 m a.s.l.

**b. Brief description of landscape features** (landscape genesis and formation processes, dominant vegetation, soil features, land use, etc.)

Leaving the plateau in a northern direction, higher growing trees and even remnants of closed forest stands become more common once again.

Among herbaceous species, as well, more favourable conditions become obvious, as indicated by higher growing species such as tall forbs, e.g., *Dipsacus* spec. or *Phlomis tuberosa*.

**c. List of bird species observed**

Red-breasted Flycatchers are common breeders in montane forests in Azerbaijan. However, the high number of individuals recorded during that day in this semi-open landscape hints on accumulations during migration.

| Latin Name | English Name | Azerbaijani Name |
|---|---|---|
| Ficedula parva | Red-breasted Flycatcher | Xırda milçəkqapan |

**d. List of plant species**

| Bush and tree species | |
|---|---|
| *Acer campestre* L. | *Crataegus* spec. L. |
| *Acer laetum* C.A.Mey. | *Prunus cerasifera* Ehrh. |
| **Herbaceous species** | |
| *Calamagrostis* spec. Adans. | *Plantago major* L. |
| *Campanula* spec. L. | *Pulmonaria* spec. L. |
| *Dipsacus* spec. L. | *Rumex* spec. L. |
| *Phlomis tuberosa* L. | *Scabiosa* spec. L. |

## *Excursion point 2.4.4: Small swamp*

**a. Location** N 40°50'32.75" E 48°52'51.51" 1,601 m a.sl.

**b. Brief description of landscape features** (landscape genesis and formation processes, dominant vegetation, soil features, land use, etc.)

Many small wetlands such as little lakes, swamps or even peatlands are embedded in this undulating landscape, where obvious aquiclude bedrock or soil layers are responsibly for local water retention. Most of the tall-growing herbaceous species mentioned below are typical for these moist or wet soil conditions. The tree and bush species listed are not particularly confined to such sites.

**c. List of bird species observed**

Besides the Rock Bunting, which is a bird of open landscapes with single bushes, the other species are typical forest representatives.

| Latin Name | English Name | Azerbaijani Name |
|---|---|---|
| *Emberiza cia* | Rock Bunting | Daş vələmirquşu |
| *Fringilla coelebs* | Common Chaffinch | Meşə sərçəsi |
| *Garrulus glandarius* subsp. *atricapillus* | Eurasian Jay | Zığzığ |
| *Turdus merula* | Eurasian Blackbird | Qara qaratoyuğu |

**d. List of plant species**

| Bush and tree species neighbouring the swamp | |
|---|---|
| *Lonicera* spec. L. | *Malus sylvestris* subsp. *orientalis* (Uglitzk.) Browicz |
| *Betula pendula* Roth *var. pendula* | *Sorbus torminalis* (L.) Crantz |
| **Herbaceous species** | |
| *Agrostis stolonifera* L. | *Juncus effusus* L. |
| *Calamagrostis epigejos* (L.) Roth | *Lythrum salicaria* L. |
| *Epilobium hirsutum* L. | *Mentha longifolia* (L.) L. |

**Photo 58:** A specific set of wetland plant species like tall *Carex* spec. hint on a peatland embedded in this semi-open landscape. Like here or at excursion point 2.4.4 water is retained in small depressions due to particularly dense bedrock or soil layers (J. Etzold).

## *Excursion point 2.4.5: Small peatland*

**a. Location** N 40°50'49.28" E 48°53'24.05" 1,494 m a.s.l.

**b. Brief description of landscape features** (landscape genesis and formation processes, dominant vegetation, soil features, land use, etc.)

A small probable peatland was discovered, embedded in the mosaic of forests, bushland and grassland patches like other wetlands (see previous point 2.4.4). The plant species listed below indicate the wet soil conditions and lead to the assumption that the site is indeed a peatland (see Photo 58). However, for verification it would be necessary to dig or drill into the soil. If a layer of at least 30 cm of peat (partially decayed organic matter) is detected, the term peatland applies.

**c. Additional information on other topics during that stop**

A European Tree Frog *Hyla arborea* was found in the wetland.

**d. List of plant species**

| Herbaceous species | |
|---|---|
| *Carex* spec. L. | *Lythrum salicaria* L. |
| *Equisetum palustre* L. | *Mentha longifolia* (L.) L. |
| *Epilobium* spec. L. | *Parnassia palustris* L. |
| *Gentiana* spec. L. | *Polygonatum odoratum* (Mill.) Druce |
| *Hordelymus europaeus* (L.) Harz | *Sanicula europaea* L. |
| *Inula helenium* L. | |

**Photo 59:** Forest on a steep northern slope dominated by Oak. The reason for the comparably low growth height could be unfavourable soil conditions (J. Etzold).

## *Excursion point 2.4.6: Oak forest above resort*

**a. Location** N 40°50'44.57" E 48°54'3.05" 1,410 m a.s.l.

**b. Brief description of landscape features** (landscape genesis and formation processes, dominant vegetation, soil features, land use, etc.)

The route back to Altiaghaj led downhill through this steep forest dominated by oaks. Most likely it involves the forest-forming oak *Quercus petraea* subsp. *iberica* here (see discussion under excursion point 2.4.1). Despite the northern exposure, for *Fagus orientalis* the conditions seem not to be suitable. Possible explanations could be unfavourable soil conditions (compare with excursion point 2.3.2), which however were not studied here. They could also explain why the growth height of the trees is comparably low (see Photo 59).
Tracks and dung of cattle indicate that these steeper forests are also used as livestock pastures. The partly rather open canopy allows many herbaceous species to grow, which obviously is attractive to grazing cattle.

### c. Additional information on other topics during that stop

Mammals:

- *Ursus arctos* (tracks)
- *Felis sylvestris* (dead)
- *Sus scrofa* (dead)

### d. List of plant species

| Bush and tree species | |
|---|---|
| *Acer campestre* L. | *Pyrus communis* subsp. *caucasica* (Fed.) Browicz |
| *Acer hyrcanum* Fisch. C.A. Mey. | *Quercus petraea* subsp. *iberica* (Steven ex M. Bieb.) Krassiln./ *Quercus macranthera* Fisch. & C. A. Mey. ex Hohen. |
| *Acer laetum* C.A.Mey. | *Rubus* L. |
| *Carpinus betulus L.* | *Sorbus torminalis* (L.) Crantz |
| *Lonicera* spec. L. | *Pyrus communis* subsp. *caucasica* (Fed.) Browicz |
| **Herbaceous species** | |
| *Galium odoratum* (L.) Scop. | *Primula* spec.L. |
| *Hordeum* spec.L. | *Stellaria holostea* L. |

**List of bird species observed during that day (for all points together)**

| Latin Name | English Name | Azerbaijani Name |
|---|---|---|
| *Accipiter nisus* | Eurasian Sparrowhawk | Bildirçinçalan |
| *Aegitalos caudatus* | Long-tailed Tit | Uzunquyruq arıquşu |
| *Alauda arvensis* | Sky Lark | Tarla torağayı |
| *Anthus campestris* | Tawny Pipit | Tarla (Çöl) antı |
| *Aquila nipalensis* | Steppe Eagle | Çöl qartalı |
| *Buteo buteo* | Common Buzzard | Adi sar |
| *Buteo buteo vulpinus* | Common (Steppe) Buzzard | Adi sar |
| *Circaetus gallicus* | Short-toed Snake-Eagle | Adi ilanyeyən |
| *Columba palumbus* | Common Wood-Pigeon | Iri meşə göyərçini |
| *Delichon urbicum* | Common House-Martin | Şəhər qaranquşu |
| *Emberiza calandra* | Corn Bunting | Tarla vələmirquşu |
| *Emberiza cia* | Rock Bunting | Daş vələmirquşu |
| *Falco subbuteo* | Eurasian Hobby | Adi qarağöz qızılquş |
| *Ficedula parva* | Red-breasted Flycatcher | Xırda milçəkqapan |
| *Fringilla coelebs* | Common Chaffinch | Meşə sərçəsi |
| *Garrulus glandarius* subsp. *atricapillus* | Eurasian Jay | Zığzığ |
| *Gyps fulvus* | Eurasian Griffon | Ağbaş kərkəs |
| *Hieraaetus pennatus* | Booted Eagle | Cırtdan qartal |
| *Hirundo rustica* | Barn Swallow | Kənd qaraquşu |
| *Lanius collurio* | Red-backed Shrike | Adi alacəhrə |
| *Lanius minor* | Lesser Grey Shrike | Qaraalın alacəhrə |
| *Lullula arborea* | Wood Lark | Meşə torağayı |
| *Merops apiaster* | European Bee-eater | Qızılı qızlarquşu |
| *Motacilla alba* | White Wagtail | Ağ çaydaçapanı |
| *Motacilla cinerea* | Grey Wagtail | Dağ çaydaçapanı |
| *Motacilla flava* | Western Yellow Wagtail | Sarı çaydaçapanı |
| *Muscicapa striata* | Spotted Flycatcher | Boz milçəkqapan |
| *Oenanthe oenanthe* | Northern Wheatear | Çaxraxçıl |
| *Parus major* | Great Tit | İri arıquş |
| *Pernis apivorus* | European Honey-buzzard | Adi arıyeyən |

| | | |
|---|---|---|
| *Phoenicurus phoenicurus* | Common Redstart | Adi odquyruq |
| *Saxicola rubetra* | Whinchat | Çəmən çəkçəkisi |
| *Saxicola torquatus* | European Stonechat | Qarabaş çəkçəkisi |
| *Sylvia borin* | Garden Warbler | Bağ silvi |
| *Sylvia communis* | Greater Whitethroat | Boz silvi |
| *Sylvia curruca* | Lesser Whitethroat | Çərənçi silvi |
| *Turdus merula* | Eurasian Blackbird | Qara qaratoyuğu |

## 4.3. Further excursion points in and the wider vicinity of Baku

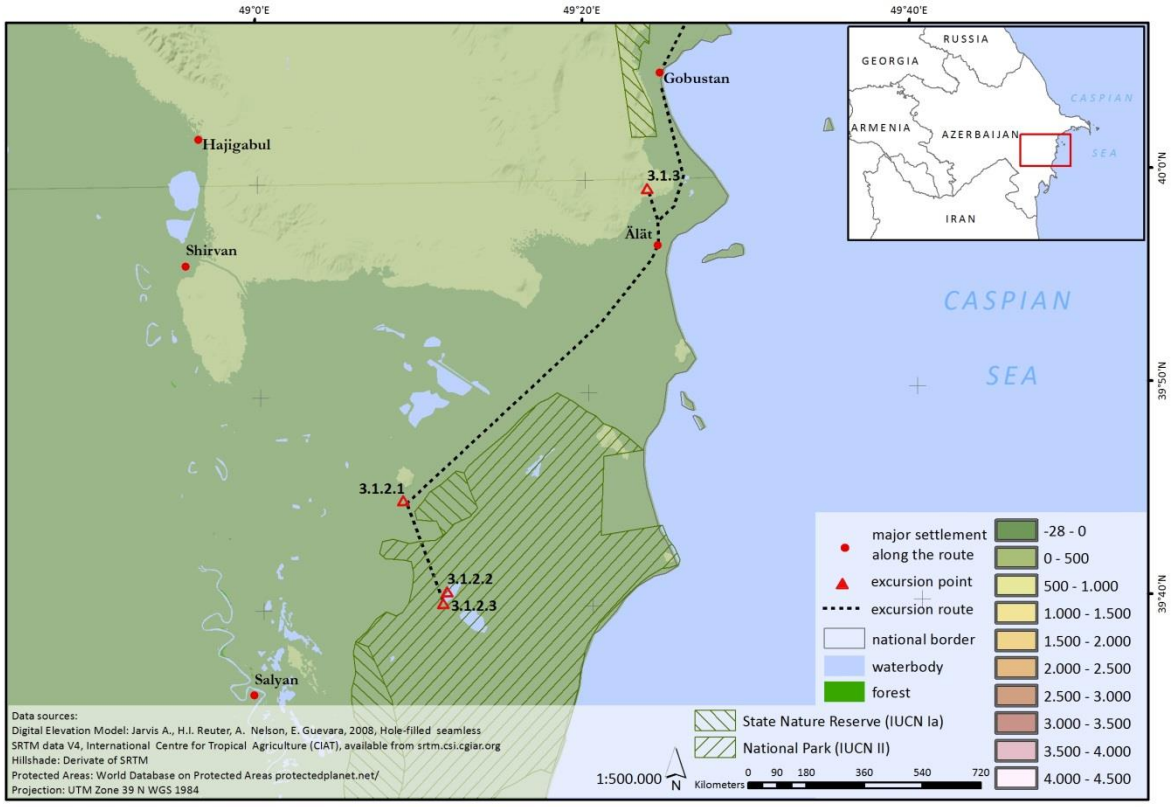


**Fig. 24:** Overview map of route and points in southern part of excursion around Shirvan NP and Gobustan Mud Volcanoes (Map: Jens Wunderlich).

### 4.3.1. Shirvan National Park and mud volcanoes near Älät

**Day of protocol: 06.09.2015**
**Names of students: Rufat Hashimli and Paul August Schult**
Number of excursion points: 4
Number of vegetation plots: 0
Number of soil profiles: 0
Number of land use assessments: 0

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#### *General characteristics of the landscape*

Shirvan: Down in the Kura-Araz lowland, wormwood semi-desert, dominated mainly by *Artemisia lerchiana* and other wormwood species, is widespread (Peper 2010). In the spring,

flowering ephemeral species and therophytes offer a pleasant sight. The *Artemisia* species flower in autumn, when it starts to rain again. On soils with higher salinity, the wormwood semi-desert is replaced by saltwort semi-desert. In areas with a very high salinity, bare soil devoid of any vegetation cover and with crusts of salt can be found (Schmidt et al. 2008). In the area of Gobustan, the landscape is characterised by gullies and dry riverbeds that carve deeply into the loamy soils. They only carry water shortly after heavy rain. Many of the higher hills originate from active or former mud volcanoes and are somewhat conical in shape. Mud volcanoes occur with the release of gas and mineral water, mixed with mud and sometimes traces of oil, from great depths. With the majority of mud volcanoes recorded in Azerbaijan located in Gobustan, it is a hotspot for this type of volcanic activity (Schmidt et al. 2008).

The lowland areas and dry foothills are traditionally used as winter pastures for the livestock that is kept on the pastures of the Greater Caucasus during the summer.

Large parts of the natural steppe and semi-desert ecosystems have been destroyed or altered by human activities. They are either irrigated and used for agricultural production, or they suffer under high grazing pressure (Schmidt et al. 2008). Additional problems are the pollution that derives from the oil industry and illegal hunting. In earlier times, these areas where home to thousands of Goitered Gazelles (*Gazella subgutturosa,* see Photo 60). Nowadays, the gazelles can be found in larger numbers only in the protected areas of Shirvan National Park and Korchay Nature Reserve (Schmidt & Pietzsch 2007).

Regarding the available literature, it has to be stressed that among all points visited during the whole excursion in 2015 the density of information on Shirvan NP is highest. This is especially highlighted by the extensive lists of plant and bird species recorded in the NP (based on Müller 2010), which as a valuable resource for potential field work we therefore decided to attach in Annex 3 and 4.

**Photo 60:** A female (right) and a young male Goitered Gazelle (*Gazella subgutturosa*) in the midst of semi-desert vegetation: blue-greenish semi-shrubs (Chenopodiaceae) and brown annual grasses (Poaceae) (D. Eichhorn).

## *Excursion points in Shirvan National Park*

**a. Locations**

- Entrance of the park, Point 3.1.2.1:
  N 39°45'7.12" E 49°8'35.66" -26 m a.s.l.
- Birdwatching hide at "Flamingo Lake," Point 3.1.2.2:
  N 39°40'47.2" E 49°11'10.59" -30 m a.s.l.
- Lake house, Point 3.1.2.3:
  N 39°40'14.66" E 49°10'56.40" -28 m a.s.l.

**b. Brief description of landscape features** (landscape genesis and formation processes, dominant vegetation, soil features, land use, etc.)

Shirvan National Park is situated in the eastern part of the Shirvan steppe, south of the Gobustan area, and encompasses 54,373 ha. It is bordered by the Caspian Sea in the east and the Kura River to the south. The substrate was formed by terrestrial and marine sediments. Soil processes are dominated by salinization and high evaporation. The major vegetation is formed by steppe and semi-desert plants. Large parts are covered by *Artemisia* semi-desert. Depressions with higher salinity are dominated by halophytes. The *Artemisia* semi-desert was traditionally used as winter pasture, but since the establishment of the National Park in 2003, no grazing is allowed to take place in the area. The main objective of the Shirvan National Park is to protect the Goitered Gazelle (*Gazella subgutturosa*) and several species of waterfowl as well as the characteristic vegetation of the Shirvan steppe (Schmidt 2005).
In the centre of the National Park area, an artificial lake – called the "Flamingo Lake" – is located. Its banks and more than half of its surface are covered with dense reed belts. As its name implies, it often hosts the Greater Flamingo (*Phoenicopterus roseus*, see Photo 61) and many other species of waterfowl. The water flows into the lake through a channel system that was constructed during Soviet times for agricultural irrigation. Nowadays, the water is pumped through the channels only for nature conservation purposes (Müller 2010).

**Photo 61:** The lake in the Shirvan NP is named after the Greater Flamingo (*Phoenicopterus roseus*), which is regularly resting here. With their curved bills these birds filter arthropods (mainly crustaceans) from the shallow waters (D. Eichhorn).

### c. Additional information on other topics during that stop

At the beginning of the 19th century, the Goitered Gazelle was an abundant species in the Shirvan Steppe. Due to hunting, habitat loss and the grazing competition with livestock, it became nearly extinct in Azerbaijan. Only 130-200 individuals where left in the 1960s. The extinction of this last population was prevented by the establishment of the Bändovan Zakaznik in 1961 and the Shirvan Zapovednik in 1969. Due to this protection, the population slowly recovered and increased up to 2,000-3,000 individuals in 2006 (Schmidt & Pietzsch 2007). Since 2011, about 150 gazelles have been caught in the Shirvan National Park and released in other areas of Azerbaijan. North and south of the Mingächevir Reservoir, this appears to have been somewhat successful.

**Photo 62:** A characteristic bird of semi-deserts is the Isabelline Wheatear (*Oenanthe isabellina*). The species builds its nest in rodent holes and is often seen perched on semi-shrubs typical for semi-deserts, like here *Kalidium caspicum* (D. Eichhorn).

## d. List of bird species observed

In the wetlands:

| Latin Name | English Name | Azerbaijani Name |
|---|---|---|
| *Anas clypeata* | Northern Shoveler | Enliburun ördək |
| *Anas crecca* | Green-winged Teal | Fitçi cüre |
| *Ardea alba* | Great Egret | Böyük ağ vağ |
| *Ardea cinerea* | Grey Heron | Boz vağ |
| *Ardea purpurea* | Purple Heron | Kürən vağ |
| *Calidris minuta* | Little Stint | Sərçəvari qumluq cüllütü |
| *Calidris temminckii* | Temminck's Stint | Ağquyruq qumluq cüllütü |
| *Charadrius hiaticula* | Common Ringed Plover | Yaxalı cüllüt |
| *Egretta garzetta* | Little Egret | Kiçik ağ vağ |
| *Emberiza schoeniclus* | Reed Bunting | Qamışlıq vələmirquşu |
| *Fulica atra* | Eurasian Coot | Qaşqaldaq |
| *Panurus biarmicus* | Bearded Reedling | Bığlı arıquşu |
| *Phalacrocorax carbo* | Great Cormorant | Böyük qarabatdaq |
| *Phalaropus lobatus* | Red-necked Phalarope | Dəyirmidimdik üzər |
| *Phoenicopterus roseus* (see Photo 61) | Greater Flamingo | Qızılqaz |
| *Porphyrio porphyrio* | Purple Swamphen | Soltan toyuğu |
| *Porzana porzana* | Spotted Crake | Adi porzan |
| *Remiz pendulinus* | Eurasian Penduline-Tit | Pəsnək arıquşu |
| *Tringa erythropus* | Spotted Redshank | Şeqol |
| *Tringa stagnatilis* | Marsh Sandpiper | Çay cüllütü |
| *Tringa totanus* | Common Redshank | Otluq cüllütü |

In the semi-desert and bushlands:

| Latin Name | English Name | Azerbaijani Name |
|---|---|---|
| *Coracias garrulus* | European Roller | Adi göycəqarğa |
| *Falco naumanni* | Lesser Kestrel | Çöl muymulu |
| *Francolinus francolinus* | Black Francolin | Turaç |
| *Lanius minor* | Lesser Grey Shrike | Qaraalın alacəhrə |
| *Merops apiaster* | European Bee-eater | Qızılı qızlarquşu |
| *Merops persicus* | Blue-cheeked Bee-eater | Yaşıl qızlarquşu |
| *Motacilla flava* | Western Yellow Wagtail | Sarı çaydaçapanı |
| *Muscicapa striata* | Spotted Flycatcher | Boz milçəkqapan |
| *Oenanthe isabellina* (see Photo 62) | Isabelline Wheatear | Oynaq çaxraxçıl |
| *Pica pica* | Eurasian Magpie | Sağsağan |
| *Sylvia borin* | Garden Warbler | Bağ silvi |
| *Sylvia communis* | Greater Whitethroat | Boz silvi |
| *Upupa epops* | Eurasian Hoopoe | Adi hop-hop |

A list of all bird species recorded in Shirvan NP after Müller (2010) is given in Annex 3.

**e.** A list of all plant species recorded in Shirvan NP (following Müller 2010) is given in Annex 4.

## References


Czerepanov, S.K. (1995): Vascular Plants of Russia and adjacent states (The former USSR). Cambridge University Press, UK. 532p.

Müller H. (2010): Management Plan of the Shirvan National Plan, unpublished, 118 p. with annexes

Peper, J., Pietzsch, D.; Manthey, M. (2010): Semi-arid rangeland vegetation of the Greater Caucasus foothills in Azerbaijan and its driving environmental conditions, Phytocoenologia, Issue 40, Book 2-3, p. 73–90.

Schmidt S. (2005): Vegetation Cluster and Soil Types of Shirvan National Park, Azerbaijan – a Landscape Ecological Approach, Diploma work, Greifswald University, DE. 157p. with annexes

Schmidt, S., Gauger, K., Agayeva, N. (2008): Birdwatching in Azerbaijan – a guide to nature and landscape. Michael Succow Foundation, Greifswald, DE. 224p.

Schmidt S., Pietzsch D. (2007): Contributions to the number of a *Gazella subgutturosa subgutturosa* population in Shirvan National Park, Azerbaijan, Archiv für Naturschutz und Landschaftsforschung, Issue 2, June 2007, p. 71–77.

**Photo 63:** The Spur-thighed or Greek tortoise (*Testudo graeca*) is still common in many parts of Azerbaijan, occurring from the Caspian Sea to semi-open landscapes in the montane belt. Due to still very famous although illegal pet trade and habitat fragmentation, the species is listed by IUCN as Vulnerable (D. Eichhorn).

**Photo 64:** A field of active mud volcanoes near Älät (D. Valeeva).

## *Excursion point 3.1.3: Mud volcanoes near Älät*

**a. Location** N 39°59'33.30" E 49°23'47.77" 33 m a.s.l.

**b. Brief description of landscape features** (landscape genesis and formation processes, dominant vegetation, soil features, land use etc.)

An extensive and very impressive field of dozens of smaller and larger mud volcanoes (see Photo 64), the Firuz Craters, is situated on a plateau inland above the small coastal town Älät (Elliott 2010). As mentioned in previous chapters, with their mostly conical mounds ranging in height from 1 to 500 m and partly bubbling pools, mud volcanoes are typical landscape features in the coastal plain and the foothill zone of Eastern Azerbaijan. Around 60 % of the world's mud volcanoes are found in Azerbaijan, which is linked to tectonic activity and the rich oil and natural gas deposits here. These "cold" volcanoes release a mixture of gas, water, mud, and occasionally also rocks and oil from great depths. From time to time, in some of the larger mud volcanoes release even dangerous eruptions, containing massive amounts of mud and gas that can cause damage to nearby infrastructure and lead to long-burning columns of fire (Schmidt et al. 2008). Reflecting Azerbaijan's global responsibility for this geological peculiarity, since 2007, a part of Azerbaijan's mud volcanoes is protected in a special State Nature Reserve (MENR 2016).

The soils around mud volcanoes are mostly saline, which allows only a few halophytic plant species to grow here. Typical representatives are *Suaeda microphylla*, *Salsola gemmascens, Kalidium caspicum, Halocnemum strobilaceum* and several salt-tolerating annuals (Schmidt & Uppenbrink 2009, Peper 2010).

### References


Elliott, M. (2010): Azerbaijan (with Excursions to Georgia). Trailblazer Publications; 4th edition, Surrey, UK. 366p.

MENR (2016): Ministry of Ecology and Natural Resources Republic of Azerbaijan. Mud volcanoes SNR. http://eco.gov.az/en/554-baki-ve-abseron-yarimadasinin-palciq-vulkanlari-qrupu-dovlet-tebiet-qorugu. Accessed: May 2016.

Peper, J. 2010. Semi-desert vegetation of the Greater Caucasus foothills in Azerbaijan: effects of site conditions and livestock grazing. Inaugural dissertation, University of Greifswald, DE. 112p.

Schmidt, S., Gauger, K., Agayeva, N. (2008): Birdwatching in Azerbaijan – a guide to nature and landscape. Michael Succow Foundation, Greifswald, DE. 224p.

Schmidt, S., Uppenbrink, M. (eds.) (2009): Potential analysis for further nature conservation in Azerbaijan. Michael Succow Foundation, Geozon Science Media, Greifswald, DE. 164p.

## 4.3.2. Urban Vegetation in the City of Baku

**Names of authors: T.P. Dieterich, G.R. Saryeva, N.A. Sadykova**

Number of excursion points: 3

Number of vegetation plots: 0

Number of soil profiles: 0

Number of land use assessments: 0

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### *General characteristics of the landscape*

The potential natural vegetation cover of Baku City is that of an *Artemisia* and *Chenopodiaceae* semi-desert. In the shaded rocky areas, shrub vegetation could be found as well, with *Punica granatum*, *Ficus carica*, *Ephedra distachya*, *Vitis vinifera* and other drought-resistant species.

Only wild plants and introduced plants that regenerate within the city's territory are considered part of the urban flora. Introduced plants that show no tendency to regenerate by themselves are not considered part of the natural urban flora.

During our investigations, we were able to observe 190 species. Only an extract is shown in the plant lists below. Since the TV Tower area was used as a reference for near-natural vegetation of the surroundings of Baku City, we could find species here that are not considered part of the urban flora, but rather remnants of the semi-deserts once covering the area of the city. Some of these are even listed in the Red Data Book of Azerbaijan (Baghirov & Aliyev 2013), e.g., *Iris acutiloba* and *Dianthus schemachensis*. Overall, 17 species have been introduced in Baku, and these neophyte plants are all members of the urban flora, 8 of which were introduced in historic times (Archeophytes) and 9 in more recent times (Neophytes). Archeophytes are species that were introduced before the discovery of America in 1492. Neophytes are considered to have been introduced in more recent times (Wittig 2008). Neophytes are believed to be extremely closely bound to urban habitats (urbanophile), which could be confirmed for Baku. Examples are the *Amaranthus* and *Oxalis* species.

The Flora Absheron (Karyagin 1952) lists 729 plant species. Studies from Europe show that about half of the indigenous species can be expected to be present in the city (Wittig 2008). Thus, a total number of 300 to 400 plant species can be expected for the whole area of Baku.

Further investigation is necessary in order to gain a full picture of the city's flora. Generally, it must be said that the greenery of Baku should take into account more indigenous species, which are well adapted to the dry and hot climate. Thus, shrubs such as *Punica granatum*, *Pyrus salicifolia*, *Calligonum bakuense* (see Photo 65) and *Nitraria schoberi* are part of the indigenous flora of the Absheron peninsula. *Nitraria schoberi* is even capable of tolerating high salt contents. As for the

lawns, *Festuca* and *Poa* species are used throughout the city. The drought-resistant species *Cynodon dactylon* is part of the urban flora and is used for lawns in other parts of the world. Large water resources could be saved by replacing the current species with the native and well adapted *Cynodon dactylon*.

The three excursion points were visited in the first half of the year 2015, but not during the student excursion in August and September 2015. Therefore, these three points are not shown on the maps above, as they only depict the route of the excursion.

**Photo 65:** *Calligonum bakuense* (fruiting), a psammophyte species well adapted to the dry climate on sandy parts of the Absheron peninsula (T. Dieterich)

## *Excursion point 3.2.1: Central City Railway station*

**a. Location** N 40°22'58.24" E 049°51'29.95" -16 m a.s.l.

**b. Brief description of landscape features** (landscape genesis and formation processes, dominant vegetation, soil features, land use etc.)

In cities, special focus should always be placed on the areas around the train station, as these areas are considered the gateway for new species of urban flora (Sukopp & Wittig 1998). Due to the use of the train stations for cargo, about 55 to 70 % of the urban flora can usually be found at railway stations (Wittig 2008). With limited time resources, it is thus best to start botanical work at the railway station of a city. Unfortunately for our work, the central part of the railway station in Baku was reconstructed in 2015. However, the sidings and the cargo areas have not been worked on and offer plenty of room for plant growth. Some characteristic psammophytic species of the Absheron peninsula could be found here, i.e., *Salsola kali*, *Limonium meyeri*, *Chondrilla juncea*

and others. Less frequent were species typical for clay substrates, such as *Alhagi maurorum*, *Scorzonera biebersteinii* and others.

On the sidings and cargo tracks, typical flora elements of the Baku urban flora are present: *Polygonum aviculare*, *Sisymbrium irio*, *Cynodon dactylon*, *Hordeum murinum*, *Sonchus oleraceus, Lactuca serriola*, *Oxalis corniculata*, *Tribulus terrestris*, *Convolvulus arvensis*, *Stellaria media*, *Plantago lanceolata* and others. In addition, most of the neophyte species can be found here, i.e., *Ailanthus altissima* (very frequent, see Photo 66) and species from the Americas such as *Amaranthus deflexus*, *A. hybridus, A. blitoides*, *A. retroflexus*, *A. spinosus* and *Erigeron canadensis*. Neophyte vegetation is concentrated at railway stations, channels and botanical gardens (Sukopp 2004).

### c. List of plant species

| Bush and tree species | |
|---|---|
| *Ailanthus altissima* (Mill.) Swingle | |
| **Herbaceous and semi-shrub species** | |
| *Alhagi maurorum* Medik. | *Hordeum murinum* L. |
| *Amaranthus blitoides* S. Watson | *Lactuca serriola* L. |
| *Amaranthus deflexus* L. | *Limonium meyeri* (Boiss.) Kuntze |
| *Amaranthus hybridus* L. | *Medicago sativa* L. |
| *Amaranthus retroflexus* L. | *Oxalis corniculata* L. |
| *Amaranthus spinosus* L. | *Oxalis dillenii* Jacq. |
| *Anisantha sterilis* (L.) Nevski | *Plantago lanceolate* L. |
| *Centaurea diffusa* Lam. | *Poa annua* L. |
| *Chenopodium album* L. | *Polygonum aviculare* L. |
| *Chondrilla juncea* L. | *Salsola kali* L. |
| *Convolvulus arvensis* L. | *Scorzonera biebersteinii* Lipsch. |
| *Crepis sonchifolia* (M. Bieb.) C.A. Mey. | *Sonchus oleraceus* (L.) L. |
| *Cynodon dactylon* (L.*) Pers.* | *Stellaria media* (L.) Cirillio |
| *Echinochloa crus-galli* (L.) P.Beauv. | *Sisymbrium irio* L. |
| *Erigeron canadensis* L. | *Tragopogon graminifolius* D.C. |
| *Hirschfeldia incana* (L.) Lagr.-Foss. | *Tribulus terrestris* L. |

**Photo 66:** *Ailanthus altissima* spreading on the tracks at the Baku railway station (T. Dieterich)

## *Excursion point 3.2.2: Baku Maiden Tower*

**a. Location** N 40°21'58.60" E 049°50'13.88" -18 m a.s.l.

**b. Brief description of landscape features** (landscape genesis and formation processes, dominant vegetation, soil features, land use etc.)

This area is in a part of the city that has been inhabited the longest, and in its surroundings, cobble stones are used for road construction. This supports the growth of characteristic vegetation in the gaps between the cobble stones. Many synanthropic plant species can be found here. As of 2015, the perimeter of the area had not been excessively paved with concrete and asphalt. This allows a typical ruderal urban flora to grow between the cobble stones and alongside the roads. Typical species are ephemeral plants such as *Sagina procumbens*, *Sagina apetala*, *Polycarpon tetraphyllum, Spergularia rubra* and others. In addition, a number of neophyte species are present, such as *Amaranthus* species, *Erigeron candadensis*, *Ailanthus altissima*, *Oxalis corniculata* and others.

### c. List of plant species

| Bush and tree species | |
|---|---|
| *Ailanthus altissima (Mill.) Swingle* | *Morus alba* L. |
| *Ficus carica* L. | |
| **Herbaceous species** | |
| *Cynodon dactylon* (L.) Pers. | *Polycarpon tetraphyllum* (L.) L. |
| *Conyza canadensis* (L.) Cronquist | *Polygonum aviculare* L. |
| *Erigeron candadensis* L. | *Sagina apetala* Ard. |
| *Limonium meyeri (Boiss.) Kuntze* | *Sagina procumbens* L. |
| *Melilotus officinalis* (L.) Pall. | *Sisymbrium irio* L. |
| *Oxalis corniculata* L. | *Sonchus oleraceus* (L.) L. |
| *Plantago lanceolata* L. | *Spergularia rubra* (L.) J. Presl & C. Presl |
| *Poa annua* L. | *Tribulus terrestris* L. |

## *Excursion point 3.2.3: Baku TV Tower*

### a. Location N 40°20'42.19" E 049°49'51.92" 87 m a.s.l.

### b. Brief description of landscape features

The TV tower area is not urbanised due to very steep slopes, which make the area prone to earthquake damage. This makes it a perfect area to observe semi-natural desert vegetation within the city's borders. Currently, the area is planted with *Pinus brutia var. eldarica* and other species better adapted to the harsh desert environment, e.g., *Nerium oleander*, *Cupressus sempervirens*, *Thuja occidentalis,* etc. An irrigation system has been installed in order to water the trees and shrubs.

The vegetation is an ephemeral *Artemisia fragrans* semi-desert association. This association is typical for the Absheron peninsula. Here, some rare Red Data Book species (Baghirov & Aliyev 2013) of this habitat can still be found in low densities, e.g., *Iris acutiloba*. They give an indication of the relatively high integrity of the semi-desert ecosystem, as these species did not adapt to growing in urbanised areas.

Thus, the Baku TV tower area can well serve as an area to compare semi-natural vegetation with urban vegetation without leaving the city itself. The area is easily accessible by public transport as well as on foot.

## c. List of plant species

| Bush and tree species | |
|---|---|
| *Cupressus sempervirens* L. | *Pinus brutia* Ten. |
| *Nerium oleander* L. | *Thuja occidentalis* L. |
| **Herbaceous and semi-shrub species** | |
| *Alhagi pseudoalhagi (*M. Bieb.) Desv. ex B. Keller & Shap. | *Hordeum murinum* L. |
| *Artemisia arenaria* D.C | *Iris acutiloba* C. A. Mey. |
| *Artemisia fragrans* Willd. | *Lactuca serriola* L. |
| *Aegilops triuncialis* L. | *Lolium perenne* L. |
| *Allium* spec. | *Malcolmia africana* (L.) R.Br. |
| *Artemisia fragrans* Willd. | *Medicago arabica (L.)* Huds. |
| *Avena fatua* L. | *Onobrychis vaginalis* C.A.Mey. |
| *Catapodium rigidum* (L.) C. E. Hubb. | *Orobanche artemisiae-campestris* Gaudin. |
| *Cirsium arvense* (L.) Scop. | *Poa bulbosa* L. |
| *Erodium cicutarium (*L.) L'Hér. | *Rostraria cristata (*L.) Tzvelev |
| *Filago pyramidata* L. | *Salsola kali* L. |
| *Hirschfeldia incana* (L.) Lagr.-Foss. | *Suaeda cf.microphylla* Pall. |

## References


Baghirov, H. S., Aliyev, J.A. (eds.) (2013): Red Book of the Republic of Azerbaijan–Rare and Endangered Plant and Mushroom Species, Second Edition, Baku, AZ. 677p.

Karyagin, I. I. (1952): Flora Apsherona [Flora of Absheron], Izdatel'stvo Akademii Nauk Azerbaydzhanskoy SSR, Baku, SU (Russ.). 439p.

Sukopp, H. (2004): Human-caused impact on preserved vegetation, Landscape and Urban planning 68: 347–355.

Sukopp, H., Wittig, R. (eds.) (1998): Stadtökologie. Ein Fachbuch für Studium und Praxis. 2. überarbeitete Auflage. Gustav Fischer Verlag, Stuttgart, Jena, Lübeck, Ulm, DE. 474p.

Wittig, R. (2008): Siedlungsvegetation [Vegetation of Settlements], Ulmer, Stuttgart (Hohenheim) DE. 252p.

# Annexes

# Annex 1: Data sheet templates

## Annex 1.1.: Data sheet template - Vegetation assessment

| **No.** | | | **Date:** | | | | |
|---|---|---|---|---|---|---|---|
| **Authors:** | | | | | | | |
| **N** | | | **E** | | | | |
| **Elevation:** | | | **Inclination:** | | **Exposition:** | | |
| layer | moss/lichen | herbs | dwarf shrubs | shrubs | trees | bare soil | rocks |
| **Height** [cm] | | | | | | | |
| **Cover** [%] | | | | | | | |
| **Cover total:** | | | **Habitat:** | | | | |
| **Cover-Scale used:** □ Braun-Blanquet □ Londo **Plotsize:** _____X m | | | | | | | |

**Species List**

| No. | Species | Phenophase | Layer | Cover according to scale |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |
| 6 | | | | |
| 7 | | | | |
| 8 | | | | |
| 9 | | | | |
| 10 | | | | |

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| 11 | | | | |
| 12 | | | | |
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| 14 | | | | |
| 15 | | | | |
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| 17 | | | | |
| 18 | | | | |
| 19 | | | | |
| 20 | | | | |
| 21 | | | | |
| 22 | | | | |
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| 24 | | | | |
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| 26 | | | | |
| 27 | | | | |
| 28 | | | | |
| 29 | | | | |
| 30 | | | | |
| 31 | | | | |
| 32 | | | | |
| 33 | | | | |
| 34 | | | | |
| **Comments:** | | | | |

## Annex 1.2.: Data sheet template – soil assessment

<table>
<tr><th colspan="8">General observations on soil profile</th></tr>
<tr><td>Observation Point №</td><td colspan="7"></td></tr>
<tr><td>Profile №</td><td colspan="7"></td></tr>
<tr><td>Authors:</td><td colspan="7"></td></tr>
<tr><td>Date:</td><td colspan="7"></td></tr>
<tr><td>GPS:</td><td colspan="7">N E</td></tr>
<tr><td>Status of the soil surface (salination, moisture, clumpy, fracturing, stony and other features)</td><td colspan="7"></td></tr>
<tr><td>General relief</td><td colspan="7"></td></tr>
<tr><td>Meso-relief, exposition [°] and steepness of slope [% or °]</td><td colspan="7"></td></tr>
<tr><td>Bedrock and soil forming underground</td><td colspan="7"></td></tr>
<tr><td rowspan="2">Depth of profile in cm</td><td colspan="2">Boiling at depth of cm (10% HCL)</td><td colspan="2">Accumulation of Ca, $CO_2$</td><td colspan="2">Gypsum</td></tr>
<tr><td>weak</td><td>strong</td><td>depth [cm], form</td><td>amount</td><td>depth[cm], form</td><td>Amount</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Easy soluble salts</td><td>Rusty spots depth [cm], form</td><td>Gley spots depth [cm], form</td><td>Depth of ground water, cm</td><td colspan="2">Inclusions</td></tr>
<tr><td>depth [cm], form</td><td>amount</td><td></td><td></td><td></td><td>depth [cm], form</td><td>amount</td></tr>
<tr><td>Land use characteristic</td><td colspan="7"></td></tr>
<tr><td colspan="8">a) field name of soil</td></tr>
<tr><td colspan="8">b) final name of soil</td></tr>
<tr><td colspan="8"></td></tr>
</table>

| **Observation along the different genetic horizons of the profile**<br>(Indication, depth, thickness of the genetic horizons) | | | | | | |
|---|---|---|---|---|---|---|
| **Horizons** | | | | | | |
| **Properties and indications of horizons** | | | | | | |
| 1. Colour (Munsell Number) | | | | | | |
| 1. soil texture:<br>clay-1, heavy loam-2, medium loam-3, light loam-4, sandy loam-5, sand-6 | | | | | | |
| 2. humidity:<br>wet-1, slightly wet-2, damp-3, moist-4, slightly moist-5, fresh-6, dry-7 | | | | | | |
| 3. structure:<br>cloddy-1, prismatic-2, columnar-3, nutty-4, stony-5, grained-6, dusty-7 | | | | | | |
| 4. density<br>very dense-1, dense-2, packed-3, weakly packed-4, rather loose-5, loose-6 | | | | | | |
| 5. boiling of HCL 10% | | | | | | |
| 6. pore space:<br>few-1, medium-2, a lot-3 | | | | | | |
| 7. roots:<br>none-1, few-2, medium-3, a lot-4 | | | | | | |
| 8. character of border between horizons:<br>gradual-1, clear-2, very clear-3, sharp-4 | | | | | | |
| 9. depths where probes have been taken | | | | | | |
| **Soil type (FAO)** | | | | | | |
| **Water regime type** | | | | | | |
| **Hydromorphic features** | | | | | | |
| **Vegetation type** | | | | | | |
| **Use type** | | | | | | |
| Comments: | | | | | | |

## Annex 1.3.: Data sheet template – land use assessment

<table>
<tr><td colspan="2">Date:</td><td colspan="2">Author:</td></tr>
<tr><td colspan="4">Place:</td></tr>
<tr><td colspan="4">Interview partners:</td></tr>
<tr><td colspan="4">Related to vegetation assessment No:</td></tr>
<tr><td colspan="4">OBSERVATION</td></tr>
<tr><td>Distance to nearest settlement</td><td colspan="2"></td><td>☐ permanent<br>☐ temporary</td></tr>
<tr><td rowspan="4">Which land use activities can you observe around the excursion site? (please tick)</td><td rowspan="2">☐ Livestock farming (livestock, tracks, dung, grazing traces visible)</td><td colspan="2">Which livestock?<br>_____<br>Which type is most abundant?<br>_____</td></tr>
<tr><td>☐ Field agriculture</td><td colspan="2">Which plants are cultivated?<br>_____</td></tr>
<tr><td colspan="3">☐ Wood use</td></tr>
<tr><td colspan="3">☐ Other:<br>_____<br>_____</td></tr>
<tr><td colspan="4">QUESTIONS</td></tr>
<tr><td>How big is this settlement?</td><td colspan="2">Population number: _____</td><td>Household number: _____</td></tr>
<tr><td>How did these population numbers change in the last 10 and 5 years? (positive/negative trend, increase/decrease)</td><td colspan="2"></td><td></td></tr>
<tr><td>What are the main land use activities of the people in this settlement?</td><td>☐ Livestock farming (livestock, tracks, dung, grazing traces visible)</td><td colspan="2">Which livestock do people hold?<br>_____<br>_____</td></tr>
</table>

| | | |
|---|---|---|
| | | Which type is most abundant? _____ |
| | ☐ Field agriculture | Which plants are cultivated? _____ _____ |
| | ☐ Wood use, for: _____ | |
| | ☐ Other: _____ _____ | |
| Age of land use activities: Since when do the people undertake these land use activities? | Livestock farming | |
| | Field agriculture | |
| | Wood use | |
| | Other: | |

| | | | | | |
|---|---|---|---|---|---|
| Who is the owner of the land that is chosen for the excursion point and site assessment? (please tick) | ☐ Not clear | ☐ Protected Area | ☐ private | ☐ government | ☐ Other: |
| Comments: | | | | | |

# Annex 2: Results of excursion

## Annex 2.1.: Broad-leaved Forests in Samur-Yalama National Park (Chapter 4.1.1.), 01.09.16

### *Excursion Point 1.1.1: Forest in the core zone*

3 Vegetation assessments, 1 soil assessment

| | | | |
|---|---|---|---|
| **Number** | 5 | | |
| **Date (year/month/day)** | 2015/09/01 | | |
| **Authors** | Mesud, Paul, Ben, Verena, Danny, Michael | | |
| **Altitude [m]** | 17 | | |
| **Aspect [°]** | - | | |
| **Slope [°]** | 1-2° | | |
| **Coordinates N** | 41°47'27.9" | **Coordinates E** | 048°36'37.3" |
| **Cover** | | | |
| tree layer (t) [%] | shrub layer (s) [%] | herb layer (h) [%] | litter layer [%] |
| 60 | 10 | 50 | 90 |
| **Height** | | | |
| (highest) trees [m] | (highest) shrubs [m] | Aver. height (high) herbs [cm] | |
| 30 | 3 | 25 | |
| **Mosses identified (y/n)** | N | | |
| **Lichens identified (y/n)** | N | | |
| **Habitat** | Inner forest | | |

| **Species** | **Cover** | **Phenophase** | **Layer** |
|---|---|---|---|
| *Carpinus betulus* | 3 | 6 | t |
| *Euphorbia nicaeensis* subsp. *nicaeensis* | 3 | 8 | h |
| *Quercus robur* | 3 | 6 | t |
| *Hedera pastuchowii* | 1b | 3 | s* |
| *Crataegus germanica* | 1a | 3 | s |
| *Carex sylvatica* | 1a | 8 | h |
| *Drymochloa drymeja* | 1a | 8 | h |
| *Geum urbanum* | 1a | 6 | h |
| *Acer campestre* | + | 1 | h |
| *Agrostis* spec. | + | 8 | h |
| *Brachypodium* spec. | + | 8 | h |
| *Cephalanthera longifolia* | + | 8 | h |
| *Crataegus* spec. | + | 3 | s |
| *Euonymus europaea* | + | 3 | s |
| *Fraxinus excelsior* | + | 1 | h |
| *Galium odoratum* | + | 3 | h |
| *Poa* spec. | + | 8 | h |
| *Prunus avium* | + | 3 | h |
| *Prunus cerasifera* | + | 3 | s |
| s* = liana (woody species) | | | |

| | | | | |
|---|---|---|---|---|
| **Number** | 6 | | | |
| **Date (year/month/day)** | 2015/09/01 | | | |
| **Authors** | Jonathan, Ramal, Kalle, Sophie, Fidan, Dina, Leonie | | | |
| **Altitude [m]** | 17 | | | |
| **Aspect [°]** | - | | | |
| **Slope [°]** | 0 | | | |
| **Coordinates N** | 41°47'28.1" | **Coordinates E** | 048°36'39.0" | |
| **Cover** total: 95% | | | | |
| tree layer (t) [%] | shrub layer (s) [%] | herb layer (h) [%] | litter layer [%] | moss layer [%] |
| 70 | 30 | 65 | 25 | 1 |
| **Height** | | | | |
| (highest) trees [m] | (highest) shrubs [m] | Aver. height (high) herbs [cm] | | |
| 25 | 1.8 | - | | |
| **Mosses identified (y/n)** | N | | | |
| **Lichens identified (y/n)** | N | | | |
| **Habitat** | Inner forest | | | |

| **Species** | **Cover** | **Phenophase** | **Layer** |
|---|---|---|---|
| *Euphorbia nicaeensis* subsp. *nicaeensis* | 3 | - | h |
| *Carpinus betulus* | 2b | - | t |
| *Fraxinus excelsior* | 2b | - | t |
| *Alnus glutinosa* | 2a | - | t |
| *Carex sylvatica* | 1b | - | h |
| *Crataegus germanica* | 1b | - | s |
| *Fraxinus excelsior* | 1b | - | h |
| *Hedera pastuchowii* | 1b | - | s* |
| *Lonicera* spec. | 1b | - | h |
| *Prunus cerasifera* | 1b | - | s |
| *Rubus* spec. | 1b | - | h |
| *Acer campestre* | 1a | - | s |
| *Crataegus* spec. | 1a | - | s |
| *Geum urbanum* | 1a | - | h |
| *Smilax excelsa* | 1a | - | s* |
| *Acer campestre* | + | - | h |
| *Carpinus betulus* | + | - | h |
| *Crataegus* spec. | + | - | h |
| *Drymochloa drymeja* | + | - | h |
| *Equisetum arvense* | + | - | h |
| *Equisetum telmateia* | + | - | h |
| s* = liana (woody species) | | | |

| | | | | |
|---|---|---|---|---|
| **Number** | 7 | | | |
| **Date (year/month/day)** | 2015/09/01 | | | |
| **Authors** | Til, Esther, Gunay, Abdin, Pervin, Musfig | | | |
| **Altitude [m]** | 17 | | | |
| **Aspect [°]** | - | | | |
| **Slope [°]** | 0 | | | |
| **Coordinates N** | 41°47'28.6 | **Coordinates E** | 048°36'41.8 | |
| **Cover** | | | | |
| tree layer (s) [%] | shrub layer (s) [%] | herb layer () [%] | litter layer [%] | bare rock [%] |
| 12 | 3 | 4 | 92 | 1 |
| **Height** | | | | |
| (highest) trees [m] | (highest) shrubs [cm] | Aver. height (high) herbs [cm] | | |
| 25 | 65 | 35 | | |
| **Mosses identified (y/n)** | N | | | |
| **Lichens identified (y/n)** | N | | | |
| **Habitat** | Forest edge | | | |

| **Species** | **Cover*** | **Phenophase** | **Layer** |
|---|---|---|---|
| *Rubus* spec. | 3 | - | s |
| *Vitis sylvestris* | 2b | - | s* |
| *Prunus cerasifera* | 2a | - | t |
| *Carpinus betulus* | 1b | - | t |
| *Acer campestre* | 1b | - | t |
| *Fraxinus excelsior* | 1b | - | t |
| *Quercus robur* subsp. *pedunculiflora* | 1b | - | t |
| *Clematis vitalba* | + | - | s* |
| *Sambucus ebulus* | + | - | s |
| *Smilax excelsa* | + | - | s* |
| *Agrimonia procera* | na | - | h |
| *Alcea rosea* | na | - | h |
| *Brachypodium sylvaticum* | na | - | h |
| *Bromus hordeaceus* | na | - | h |
| *Bupleurum* spec. | na | - | h |
| *Calystegia silvatica* | na | - | h |
| *Calystegia* spec. | na | - | h |
| *Carex* spec. | na | - | h |
| *Carthamus lanatus* | na | - | h |
| *Cichorium intybus* | na | - | h |
| *Cirsium* spec. | na | - | h |
| *Crataegus germanica* | na | - | s |
| *Crataegus monogyna* | na | - | s |
| *Cydonia oblonga* | na | - | t |
| *Equisetum telmateia* | na | - | h |
| *Eryngium caucasicum* | na | - | h |
| *Euphorbia nicaeensis* subsp. *nicaeensis* | na | - | h |
| *Euphorbia* spec. | na | - | h |
| *Galium* spec. | na | - | h |
| *Gleditsia triacanthos* | na | - | t |
| *Hedera pastuchowii* | na | - | s* |
| *Humulus lupulus* | na | - | h |
| *Inula salicina* | na | - | h |
| *Lotus corniculatus* | na | - | h |

| | | | |
|---|---|---|---|
| *Malus pumila* | na | - | t |
| *Morus nigra* | na | - | t |
| *Origanum vulgare* | na | - | h |
| *Orobanche* spec. | na | - | h |
| *Pheum pratense* | na | - | h |
| *Plantago lanceolata* | na | - | h |
| *Prunus avium* | na | - | h |
| *Rubia tinctorum* | na | - | h |
| *Securigera varia* | na | - | h |
| *Trifolium fragiferum* | na | - | h |
| *Ulmus minor* | na | - | t |
| *Verbena officinalis* | na | - | h |
| *Viola* spec. | na | - | h |
| *Xanthium* spec. | na | - | h |
| * na = cover not assessed | | | |
| s* = liana (woody species) | | | |

| General observations on soil profile | | | | |
|---|---|---|---|---|
| **Observation Point №** | Vegetation assessment 5 | | | |
| Authors: | Mesud Abdullayev; Danny Eichhorn | | | |
| Date: | 01.09.2015 | | | |
| Region: | Samur-Yalama National Park | | | |
| Location: | Inner Forest | | | |
| GPS: | N | 41°47'27.9" | E | 048°36'37.3" |
| Status of the soil surface (salination, moisture, clumpy, fracturing, stony and other features) | fracturing | | | |
| General relief | flood plain | | | |
| Meso-relief, exposition [°] and steepness of slope [% or °] | 1-2° | | | |
| Bedrock and soil forming underground | stony | | | |
| Boiling (10% HCL) | yes | | | |
| Accumulation of Ca, $CO_2$ | At depth of 100 cm | | | |
| Depth of ground water | 300 cm | | | |
| Land use characteristics | National Park, forest, out of human use, some grazing indicators in the edge zones | | | |
| Name of soil: Silt | | | | |
| a) field name | | | | |
| b) final name | Exact name not clear | | | |

| **Observation along the different genetic horizons of the profile** | | |
|---|---|---|
| | **Horizons** | |
| **Properties and indications of horizons** | A | C |
| 1. Colour (Munsell Number) | | |
| 2. soil texture:<br>clay-1, heavy loam-2, medium loam-3, light loam-4, sandy loam-5, sand-6 | - | 5 |
| 3. humidity:<br>wet-1, slightly wet-2, damp-3, moist-4, slightly moist-5, fresh-6, dry-7 | 6 | 7 |
| 4. structure:<br>cloddy-1, prismatic-2, columnar-3, nutty-4, stony-5, grained-6, dusty-7 | - | 6 |

| | | |
|---|---|---|
| 5. density:<br>very dense 1, dense-2, packed-3, weakly packed-4, rather loose-5, loose-6 | 2 | - |
| 6. boiling of HCL 10% | no | yes |
| 7. pore space:<br>few-1, medium-2, a lot-3 | 1 | 2 |
| 8. roots:<br>none-1, few-2, medium-3, a lot-4 | 3 | 2 |
| 10. character of border between horizons:<br>gradual-1, clear 2, very clear-3, sharp-4 | 1 | |
| 11. depths where probes have been taken | 112 | |
| Soil type (FAO) | silty soil | |
| Water regime type | | |
| Hydromorphic features | no GW-level to see | |
| Vegetation type | Forest | |
| Use type | National Park | |
| Comments: No oxygen signs visible; no groundwater level visible; carbonate test positive → not washed out → hint for semi-arid-climate; organic material ~ 20 cm | | |

# Annex 2.2.: Oak and beech forests Guba (Chapter 4.1.2.), 26.08.15

## *Excursion point 1.2.1: Forest near the village Nügedi*

2 vegetation assessments, 1 soil profile

| | | | | |
|---|---|---|---|---|
| **Number** | 1 | | | |
| **Date (year/month/day)** | 2015/08/26 | | | |
| **Authors** | Jasmine, Gunay, Paul, Ben, Danny, Esther, Kalle, Pervin, Abdin, Ramal, Mesud | | | |
| **Altitude [m]** | 627 | | | |
| **Aspect** | SSW | | | |
| **Slope [°]** | 39 | | | |
| **Coordinates N** | 41°18'48" | **Coordinates E** | 048°33'47" | |
| **Cover** total: 80% | | | | |
| tree layer (t) [%] | shrub layer (s) [%] | herb layer (h) [%] | moss layer [%] | bare rock [%] |
| 80 | 10 | 20 | 1 | 70 |
| **Height** | | | | |
| (highest) trees [m] | (highest) shrubs [m] | Aver. height (high) herbs [cm] | | |
| 8 | 3 | 20 | | |
| **Mosses identified (y/n)** | N | | | |
| **Lichens identified (y/n)** | N | | | |
| **Habitat** | Forest slope | | | |

| **Species** | **Cover*** | **Phenophase** | **Layer** |
|---|---|---|---|
| *Carpinus betulus* | 3 | 6 | t |
| *Fagus orientalis* | 3 | 6 | t |
| *Drymochloa drymeja* | 2a | 7 | h |
| *Acer laetum* | 1a | 3 | s |
| *Euonymus latifolia* | 1a | 3 | s |
| *Quercus petraea* subsp. *iberica* | 1a | 3 | s |
| *Crataegus germanica* | + | 3 | s |
| *Lonicera caprifolium* | + | 3 | s |
| *Polystichum aculeatum* | + | 3 | h |
| *Primula acaulis* | + | 3 | h |
| *Rubus* spec. | + | 3 | s |
| *Vicia crocea* | + | 3 | s |
| *Viola* spec. | + | 3 | h |
| *Calystegia silvatica* | a | - | - |
| *Carex* spec. | a | - | - |
| *Crataegus* spec. | a | - | - |
| *Geum urbanum* | a | - | - |
| *Hypericum* spec. | a | - | - |
| *Lapsana communis* subsp. *intermedia* | a | - | - |
| *Ligustrum vulgare* | a | - | - |
| *Melica uniflora* | a | - | - |
| *Prunella vulgaris* | a | - | - |
| *Pyrus communis* subsp. *caucasica* | a | - | - |
| *Sanicula europaea* | a | - | - |
| *Sorbus torminalis* | a | - | - |
| *Tilia begoniifolia* | a | - | - |
| * a = accompanying outside of plot | | | |

| | | | | |
|---|---|---|---|---|
| **Number** | 2 | | | |
| **Date (year/month/day)** | 2015/08/26 | | | |
| **Authors** | Til, Verena, and others. | | | |
| **Altitude [m]** | 673 | | | |
| **Aspect** | SW | | | |
| **Slope [°]** | 18 | | | |
| **Coordinates N** | 41°18'46.2" | **Coordinates E** | 048°33'47.6" | |
| **Cover** total: 75% | | | | |
| tree layer (t) [%] | shrub layer (s) [%] | herb layer (h) [%] | moss layer [%] | bare rock [%] |
| 50 | 50 | 6 | 2 | 1 |
| **Height** | | | | |
| (highest) trees [m] | (highest) shrubs [m] | Aver. height (high) herbs [cm] | | |
| 15 | 5 | 45 | | |
| **Mosses identified (y/n)** | N | | | |
| **Lichens identified (y/n)** | N | | | |
| **Habitat** | - | | | |

| **Species** | **Cover** | **Phenophase** | **Layer** |
|---|---|---|---|
| *Carpinus betulus* | 3 | 6 | t |
| *Fagus orientalis* | 3 | 3 | s |
| *Corylus avellana* | 2b | 6 | s |
| *Crataegus germanica* | 2b | 6 | s |
| *Carpinus betulus* | 2a | 3 | s |
| *Dryopteris filix-mas* | 1b | 6 | h |
| *Galium odoratum* | 1a | 7 | h |
| *Rubus* spec. | 1a | 8 | h |
| *Acer laetum* | + | 3 | s |
| *Carpinus betulus* | + | 3 | sl |
| *Corylus avellana* | + | 3 | h |
| *Euonymus latifolia* | + | 3 | h |
| *Euonymus latifolia* | + | 3 | s |
| *Geranium robertianum* | + | 7 | h |
| *Polystichum aculeatum* | + | 6 | h |
| *Prunus cerasifera* | + | 3 | s |
| *Rubus* spec. | + | 8 | s |
| *Tilia begoniifolia* | + | 3 | h |
| *Viola* spec. | + | 8 | h |

| General observations on soil profile | | | | |
|---|---|---|---|---|
| **Observation Point №** | Vegetation Assessment 1 | | | |
| Authors: | Gunay, Abdin, Jasmine | | | |
| Date: | 26.08.2015 | | | |
| Region: | Guba | | | |
| Location: | Slope behind Nügedi Field Station of Baku State University | | | |
| GPS: | N | 41°18'48" | E | 048°33'47" |
| Status of the soil surface (salination, moisture, clumpy, fracturing, stony and other features) | Clumpy | | | |
| General relief | Northeastern exposition, flat | | | |
| Land use characteristic | Grazing and firewood cutting | | | |

| **Observation along the different genetic horizons of the profile** | | | | | |
|---|---|---|---|---|---|
| | **Horizons** | | | | |
| **Properties and indications of horizons** | L | Of | Ah | Et | Bt |
| 1. Colour (Munsell Number) | - | - | - | - | |
| 2. soil texture: clay-1, heavy loam-2, medium loam-3, light loam-4, sandy loam-5, sand-6 | - | - | silty loam | loam | heavy loam |
| 3. humidity: wet-1, slightly wet-2, damp-3, moist-4, slightly moist-5, fresh-6, dry-7 | 7 | - | - | - | - |
| 4. structure: cloddy-1, prismatic-2, columnar-3, nutty-4, stony-5, grained-6, dusty-7 | - | prismatic-columnar | | | |
| 5. density: very dense 1, dense-2, packed-3, weakly packed-4, rather loose-5, loose-6 | - | - | 3 | 2 | 2 |
| 6. boiling of HCL 10% | - | - | - | - | - |
| 7. pore space: few-1, medium-2, a lot-3 | - | 4 | 3 | 3 | - |
| 8. roots: none-1, few-2, medium-3, a lot-4 | - | - | - | - | - |
| 10. character of border between horizons: gradual-1, clear 2, very clear-3, sharp-4 | - | - | - | - | - |
| 11. depths where probes have been taken | - | - | - | - | - |
| Soil type (FAO) | Luvisol | | | | |

| | |
|---|---|
| Water regime type | - |
| Hydromorphic features | - |
| Vegetation type | Carpinus betulus coppice forest |
| Use type | Coppice forest, grazing and fire wood logging |
| Comments: Of = 0-2cm, Ah = 2-10cm, Et = 10-50, Bt >50 | |

## *Excursion point 1.2.2: Forests near the village of Gächräsh*

2 vegetation assessments, 1 soil profile

| | | | | |
|---|---|---|---|---|
| **Number** | 3 | | | |
| **Date (year/month/day)** | 2015/08/26 | | | |
| **Authors** | Gunay,Paul, Ben, Danny, Esther, Kalle, Pervin, Mesud, Abdin, Jonathan, Elvin | | | |
| **Altitude [m]** | 748 | | | |
| **Aspect [°]** | 337 | | | |
| **Slope [°]** | 38 | | | |
| **Coordinates N** | 41°20'44 | **Coordinates E** | 048°26'56" | |
| **Cover** total: 75% | | | | |
| tree layer (t) [%] | shrub layer (s) [%] | herb layer (h) [%] | moss layer [%] | litter layer [%] |
| 55 | 25 | 50 | 3 | 50 |
| **Height** | | | | |
| (highest) trees [m] | (highest) shrubs [cm] | Aver. height (high) herbs [cm] | | |
| 20 | 55 | 25 | | |
| **Mosses identified (y/n)** | N | | | |
| **Lichens identified (y/n)** | N | | | |
| **Habitat** | - | | | |

| **Species** | **Cover** | **Phenophase** | **Layer** |
|---|---|---|---|
| *Carpinus betulus* | 3 | 6 | t |
| *Drymochloa drymeja* | 3 | 6, 8 | h |
| *Fagus orientalis* | 3 | 3, 6 | t |
| *Euonymus latifolia* | 1b | 6, 8 | s |
| *Quercus petraea* subsp. *iberica* | 1b | 3, 6 | t |
| *Acer laetum* | + | 3 | h |
| *Asplenium adiantum-nigrum* | + | - | h |
| *Carex montana* | + | - | h |
| *Dryopteris filix-mas* | + | - | h |
| *Fraxinus excelsior* | + | 1 | h |
| *Orchidaceae* spec. | + | - | h |
| *Polystichum aculeatum* | + | - | h |
| *Vicia crocea* | + | 8 | h |
| *Viola* spec. | + | - | h |

| | | | | | |
|---|---|---|---|---|---|
| **Number** | 4 | | | | |
| **Date (year/month/day)** | 2015/08/26 | | | | |
| **Authors** | Til, Kamil, Lale, Dina, Sanam, Lena, Sophie, Verena, Fidan | | | | |
| **Altitude [m]** | 740 | | | | |
| **Aspect [°]** | 337 | | | | |
| **Slope [°]** | 38 | | | | |
| **Coordinates N** | 41°20'42.5" | | **Coordinates E** | 048°26'53.6" | |
| **Cover** total: 70% | | | | | |
| tree layer (t) [%] | shrub layer (s) [%] | herb layer (h) [%] | moss layer [%] | bare rock [%] | |
| 55 | 18 | 35 | 5 | - | |
| **Height** | | | | | |
| (highest) trees [m] | (highest) shrubs [cm] | Aver. height (high) herbs [cm] | | | |
| 20 | 31 | 30 | | | |
| **Mosses identified (y/n)** | N | | | | |
| **Lichens identified (y/n)** | N | | | | |
| **Habitat** | - | | | | |

| **Species** | **Cover *** | **Phenophase** | **Layer** |
|---|---|---|---|
| *Carpinus betulus* | 3 | 6 | t |
| *Drymochloa drymeja* | 3 | 3, 8 | h |
| *Fagus orientalis* | 3 | 6 | t |
| *Fagus orientalis* | 1b | 3 | s |
| *Dryopteris filix-mas* | 1a | 3 | h |
| *Euonymus latifolia* | 1a | 3 | s |
| *Acer laetum* | + | 3 | h |
| *Asplenium adiantum-nigrum* | + | 6 | h |
| *Carex remota* | + | 3 | h |
| *Carpinus betulus* | + | 3 | h |
| *Euonymus latifolia* | + | 3 | h |
| *Fagus orientalis* | + | 3 | h |
| *Fraxinus excelsior* | + | 3 | h |
| *Fraxinus excelsior* | + | 3 | s |
| *Galium odoratum* | + | 3 | h |
| *Polygonatum* spec. | + | 3 | h |
| *Polystichum aculeatum* | + | 3 | h |
| *Rubus* spec. | + | 3 | h |
| *Viola* spec. | + | 3 | h |
| *Asplenium trichomanes* | a | | |
| *Calystegia* spec. | a | | |
| *Crataegus germanica* | a | | |
| *Crataegus* spec. | a | | |
| *Euonymus verrucosa* | a | | |
| *Fragaria vesca* | a | | |
| *Hypopitys hypophegea* | a | | |
| *Lathyrus vernus* | a | | |
| *Prunus cerasifera* | a | | |
| *Sorbus torminalis* | a | | |

* a = accompanying outside of plot

| General observations on soil profile | | | | |
|---|---|---|---|---|
| **Observation Point №** | Vegetation Assessment 3 and 4 | | | |
| Authors: | Gunay, Abdin, Jasmine | | | |
| Date: | 26.08.2015 | | | |
| Region: | Guba | | | |
| Location: | Road to Khinalig, close to village Gächräsh | | | |
| GPS: | N | 41°20'42.5" | E | 048°26'53.6" |
| Status of the soil surface (salination, moisture, clumpy, fracturing, stony and other features) | stony, moist | | | |
| General relief | 38° steepness, NNW, convex | | | |
| Bedrock and soil forming underground | Alluvial terrace | | | |
| Land use characteristic (uniformity - complexity) incl. % of different forms | no current use, perhaps coppice 60 years ago and perhaps illegal fire wood logging | | | |
| Name of soil | Brown Soil (Cambisol) | | | |

| **Observation along the different genetic horizons of the profile** | | | | |
|---|---|---|---|---|
| | **Horizons** | | | |
| **Properties and indications of horizons** | L | Of | Ah | Bv |
| 1. Colour (Munsell Number) | - | - | - | - |
| 2. soil texture: clay-1, heavy loam-2, medium loam-3, light loam-4, sandy loam-5, sand-6 | - | - | 5 | 3 |
| 3. humidity: wet-1, slightly wet-2, damp-3, moist-4, slightly moist-5, fresh-6, dry-7 | - | - | 5 | 5 |
| 4. structure: cloddy-1, prismatic-2, columnar-3, nutty-4, stony-5, grained-6, dusty-7 | - | - | 5 | 5 |
| 5. density: very dense 1, dense-2, packed-3, weakly packed-4, rather loose-5, loose-6 | - | - | 3 | 3 |
| 6. boiling of HCL 10% | - | - | - | - |
| 7. pore space: few-1, medium-2, a lot-3 | - | - | - | - |

| | | | | |
|---|---|---|---|---|
| 8. roots:<br>none-1, few-2, medium-3, a lot-4 | 4 | 4 | 4 | 4 |
| 10. character of border between horizons:<br>gradual-1, clear 2, very clear-3, sharp-4 | - | 2 | 2 | - |
| 11. depths where probes have been taken | - | - | - | - |
| Soil type (FAO) | Cambisol | | | |
| Water regime type | - | | | |
| Hydromorphic features | - | | | |
| Vegetation type | Beech-hornbeam forest | | | |
| Use type | Former coppice | | | |
| Comments: High pebble content (Alluvial deposits) | | | | |

# Annex 2.3.: Cultural Landscapes with fruit orchards in the Tängäalti region (Chapter 4.1.3.), 27.08.15

## *Excursion point 1.3.3: Meadows with scattered fruit trees near Tängäalti*

2 vegetation assessments, 1 soil assessment, 1 land use assessment

| | | | | | |
|---|---|---|---|---|---|
| **Number** | 8 | | | | |
| **Date (year/month/day)** | 2015/08/27 | | | | |
| **Authors** | Til and students | | | | |
| **Altitude [m]** | 776 | | | | |
| **Aspect [°]** | 80 | | | | |
| **Slope [°]** | 30 | | | | |
| **Coordinates N** | 41°12'09.0" | **Coordinates E** | 048°36'488 | | |
| **Cover** | | | | | |
| tree layer (t) [%] | shrub layer (s) [%] | herb layer [%] | moss layer [%] | litter layer [%] | bare soil [%] |
| 75 | 15 | 80 | 2 | 92 | 1 |
| **Height** | | | | | |
| (highest) trees [m] | (highest) shrubs [m] | Aver. height (high) herbs [cm] | | | |
| 7 | 2.5 | 15 | | | |
| **Mosses identified (y/n)** | N | | | | |
| **Lichens identified (y/n)** | N | | | | |
| **Habitat** | - | | | | |

| **Species** | **Cover** | **Phenophase** | **Layer** |
|---|---|---|---|
| *Carpinus betulus* | 4 | 6 | t |
| *Fagus orientalis* | 2b | 3 | t |
| *Drymochloa drymeja* | 2a | 3 | h |
| *Craniospermum mongolicum* | 1b | 3 | s |
| *Fagus orientalis* | 1b | 3 | s |
| *Quercus petraea* subsp. *iberica* | 1b | 3 | t |
| *Cornus mas* | 1a | 3 | s |
| *Acer laetum* | + | 3 | s |
| *Acer laetum* | + | 3 | t |
| *Carex* spec. | + | 3 | h |
| *Carpinus betulus* | + | 3 | s |
| *Cornus mas* | + | 3 | t |
| *Crataegus germanica* | + | 3 | s |
| *Euonymus latifolia* | + | 3 | s |
| *Fragaria vesca* | + | 3 | h |
| *Fraxinus excelsior* | + | 3 | s |
| *Ligustrum vulgare* | + | 3 | s |
| *Lonicera caprifolium* | + | 3 | s |
| *Primula* spec. | + | 3 | h |
| *Prunus cerasifera* | + | 3 | s |
| *Quercus petraea* subsp. *iberica* | + | 3 | h |
| *Sorbus torminalis* | + | 3 | s |
| *Sorbus torminalis* | + | 3 | t |
| *Vicia crocea* | + | 3 | h |
| *Viola* spec. | + | 3 | h |

| | | | |
|---|---|---|---|
| **Number** | 9 | | |
| **Date (year/month/day)** | 2015/08/27 | | |
| **Authors** | Carl, Jonathan, Dina, Ramal | | |
| **Altitude [m]** | 758 | | |
| **Aspect [°]** | 84 | | |
| **Slope [°]** | 35 | | |
| **Coordinates N** | 41°12'07.3" | **Coordinates E** | 048°36'53.4" |

| **Cover:** total: 75% | | | | | |
|---|---|---|---|---|---|
| tree layer (t) [%] | shrub layer (s) [%] | herb layer (h) [%] | moss layer [%] | litter layer [%] | bare soil [%] |
| 10 | - | 40 | 30 | 15 | - |

| **Height** | | |
|---|---|---|
| (highest) trees [m] | (highest) shrubs [m] | Aver. height (high) herbs [cm] |
| 7 | - | 3 |

| | |
|---|---|
| **Mosses identified (y/n)** | N |
| **Lichens identified (y/n)** | N |
| **Habitat** | - |

| **Species** | **Cover** | **Phenophase** | **Layer** |
|---|---|---|---|
| *Carex* spec. | 2a | - | h |
| *Malus pumila* | 2a | - | t |
| *Aegilops cylindrica* | 1b | - | h |
| *Festuca rubra* | 1b | - | h |
| *Plantago lanceolata* | 1b | - | h |
| *Agrimonia eupatoria* | 1a | - | h |
| *Leontodon hispidus* | 1a | - | h |
| *Potentilla* spec. | 1a | - | h |
| *Achillea millefolium* | + | - | h |
| *Dactylis glomerata* | + | - | h |
| *Fragaria* spec. | + | - | h |
| *Geranium* spec. | + | - | h |
| *Laser trilobum* | + | - | h |
| *Linum* spec. | + | - | h |
| *Lotus corniculatus* | + | - | h |
| *Medicago minima* | + | - | h |
| *Pilosella officinarum* | + | - | h |
| *Plantago media* | + | - | h |
| *Prunella vulgaris* | + | - | h |
| *Sanguisorba minor* | + | - | h |
| *Scorzonera* spec. | + | - | h |
| *Securigera varia* | + | - | h |
| *Sonchus* spec. | + | - | h |
| *Taraxacum* spec. | + | - | h |
| *Trifolium* spec. | + | - | h |
| *Viola* spec. | + | - | h |
| *Thuidium philibertii* | v | - | h |

| General observations on soil profile | | | | |
|---|---|---|---|---|
| **Observation Point №** | Vegetation Assessment 9 | | | |
| Authors: | Sebastian Schmidt, Rufat | | | |
| Date: | 27.08.2015 | | | |
| Region: | Tängäalti - Guba | | | |
| Location: | - | | | |
| GPS: | N | 41°12'07.3" | E | 048°36'53.4" |
| General relief | slope | | | |
| Boiling (10% HCL) | Strong in Ai and Cc | | | |
| Name of soil | | | | |
| a) field name | Rendzina | | | |
| b) final name | Rendzina | | | |

| **Observation along the different genetic horizons of the profile** | | |
|---|---|---|
| | **Horizons** | |
| **Properties and indications of horizons** | Ai | Cc |
| depth | 5 cm | beneath |
| 1. Colour (Munsell Number) | - | - |
| 2. soil texture: clay-1, heavy loam-2, medium loam-3, light loam-4, sandy loam-5, sand-6 | loamy silt | loamy silt |
| 3. humidity: wet-1, slightly wet-2, damp-3, moist-4, slightly moist-5, fresh-6, dry-7 | 5 | 6-7 |
| 4. structure: cloddy-1, prismatic-2, columnar-3, nutty-4, stony-5, grained-6, dusty-7 | - | - |
| 5. density: very dense 1, dense-2, packed-3, weakly packed-4, rather loose-5, loose-6 | - | - |
| 6. boiling of HCL 10% | yes | yes |
| 7. pore space: few-1, medium-2, a lot-3 | - | - |
| 8. roots: none-1, few-2, medium-3, a lot-4 | 3 | 2 |
| 10. character of border between horizons: gradual-1, clear 2, very clear-3, sharp-4 | 1 | - |

| | | |
|---|---|---|
| 11. depths where probes have been taken | - | - |
| Soil type (FAO) | Leptosol | |
| Water regime type | - | |
| Hydromorphic features | - | |
| Vegetation type | Calcareous grassland | |
| Use type | hay meadow, pasture, fruit trees | |
| Comments:<br>Extremely calcareous soil. Erosion of topsoil is taking place due to high silt content of the soil. Micro-relief is a result of landslides and erosion (grazing impact/trampling of cattle leads to open soil parts, as a consequence to erosion and landslides).<br>There is hardly any humus accumulation, due to ongoing erosion of the topsoil. | | |

| **OBSERVATION** | | |
|---|---|---|
| Distance to nearest settlement(s) | Meadow next to the village, distance from plot: 200 m | ☒ permanent<br>☐ temporary |
| Which land use activities can you observe around the excursion site? (please tick) | ☒ Livestock farming (livestock, tracks, dung, grazing traces visible) | Which livestock?<br>cow, donkey, horse, chicken<br>Which type is most abundant?<br>Cows |
| | ☐ Field agriculture | Which plants are cultivated? |
| | ☒ Wood use: coppice forest in upper part of slope | |
| | ☒ Other: Hay meadow, fruit and nut trees | |
| **QUESTIONS** | | |
| How old is this settlement? | 200 years | |
| How big is this settlement/the nearest settlement? area: 250 ha | Population number: 800 people | Household number: 250 |
| How did these population numbers change in the last 10/20 years? (numbers and/or positive/negative trend) | Positive trend, increase of around 200 people | - |

<table>
<tr><td rowspan="4">What are the main land use activities of the people on the meadow (of the plot)?</td><td>☒ Livestock farming (livestock, tracks, dung, grazing traces visible)</td><td colspan="3">Which livestock do people hold?<br>Cows, sheep, donkeys, horses, chicken (everything except pigs)<br><br>Which type is most abundant?<br>cows</td></tr>
<tr><td>☐ Field agriculture</td><td colspan="3">Which plants are cultivated?<br>_____</td></tr>
<tr><td colspan="4">☒ Wood use, for: firewood for household, but only dead wood is collected</td></tr>
<tr><td colspan="4">☒ Other:<br>Fruit and nut harvesting, planting of nut trees (everything else is growing wildly, fruit trees are ennobled/Improved (veredeln), especially pear)</td></tr>
<tr><td>What do you think, which land use activity is the most important one for you in the future?</td><td colspan="4">Livestock farming, especially cattle<br>If the harvest is bad they rely on milk and meat<br>They want to invest into cattle</td></tr>
<tr><td>Who is the owner of the land that is chosen for the excursion point and site assessment? (please tick)</td><td>☒ Not clear</td><td>☐ Protected Area</td><td>☐ private</td><td>☐ government</td><td>☐ Other:</td></tr>
<tr><td colspan="5">Comments/Notes:<br>- The meadow/fruit orchard is divided into parts, different people use it, government distributes the land to the people, size of area is calculated according to number of family members<br>- These parts of the land are owned by the people, not rented, but tax is paid per year<br>- He owns 1 ha and 8 sot<br>- No fences are needed, every family knows its area and where they are allowed to harvest<br>- Only fruit trees within their own area can be harvested<br>- the grass is cut in June, livestock comes for grazing in July, his cows graze on the pasture for the whole year<br>- Nuts and fruits are used in the house, if yield is good it is sold on the market (walnut, Crataegus)<br>- Compot (fruit drink) is made from the fruits, it is not sold<br>- Fruits, especially pears are also dried and sometimes sold<br>- In Soviet times many springs were on the hill, but since the 1980s they dried, only few left<br>- Yield of hay decreased (in former times they were harvesting a KAMAS full, now only half of such a truck)<br>- Ministry of Ecology is not allowing to cut trees in the forest of this hill, some people have permissions to collect dead wood, government is checking, there are special places to cut wood close to the settlement, e.g. at the river<br>- No grass was sown on the meadow</td></tr>
</table>

# Annex 2.4.: The way to Khinalig – from forests in the Cloudcatcher Canyon to sub-alpine and alpine grasslands (Chapter 4.1.5.), 30.08.15

## *Excursion point 1.5.11: High-alpine belt at foot of Mount Gizilgaya*

1 soil assessment, 1 land use assessment

| **General observations on soil profile** | | | | | | |
|---|---|---|---|---|---|---|
| **Observation Point №** | | no vegetation assessment | | | | |
| Authors: | Pervin Azizli, Esther Lutz | | | | | |
| Date: | 30.08.2015 | | | | | |
| Region: | Khinalig, Qizilqaya Mountain | | | | | |
| Location: | 3000 m a.s.l. | | | | | |
| GPS: | N | 41°12'45.55" | E | 48°8'37.18" | | |
| Status of the soil surface (salination, moisture, clumpy, fracturing, stony and other features) | | no stones | | | | |
| General relief | slope | | | | | |
| Meso-relief, exposition [°] and steepness of slope [% or °] | | southern slope | | | | |
| Micro-relief | | small depression on the slope | | | | |
| Inclination [°] | | 20° | | | | |
| Bedrock and soil forming underground | | slate and limestone | | | | |
| Depth of profile in cm | Boiling at depth of cm (10% HCL) | | Accumulation of Ca, $CO_2$ | | Gypsum | |
| - | - | | - | | - | |
| Easy soluble salts | | Rusty spots depth [cm], form | Gley spots depth [cm], form | Depth of ground water, cm | Inclusions and neoformations | |
| depth [cm], form | amount | | | | depth [cm], form | amount |
| 56 | - | 20 | 35 | 0 | - | - |
| Land use characteristic (uniformity - complexity) incl. % of different forms | alpine meadow, high grazing pressure, erosion is going on (e.g. water erosion) | | | | | |
| Name of soil: Gley | | | | | | |

| Observation along the different genetic horizons of the profile | | | |
|---|---|---|---|
| | Horizons | | |
| **Properties and indications of horizons** | Ah | G | O |
| 1. Colour (Munsell Number) | rusty reddish | - | - |
| 2. soil texture:<br>clay-1, heavy loam-2, medium loam-3, light loam-4, sandy loam-5, sand-6 | 1 | - | - |
| 3. humidity:<br>wet-1, slightly wet-2, damp-3, moist-4, slightly moist-5, fresh-6, dry-7 | 2 | - | - |
| 4. structure:<br>cloddy-1, prismatic-2, columnar-3, nutty-4, stony-5, grained-6, dusty-7 | 7 | - | - |
| 5. density:<br>very dense 1, dense-2, packed-3, weakly packed-4, rather loose-5, loose-6 | 2 | - | - |
| 6. boiling of HCL 10% | no | - | - |
| 7. pore space:<br>few-1, medium-2, a lot-3 | 1 | - | - |
| 8. roots:<br>none-1, few-2, medium-3, a lot-4 | 3 | - | - |
| 10. character of border between horizons:<br>gradual-1, clear 2, very clear-3, sharp-4 | 2 | - | - |
| 11. depths where probes have been taken | - | - | - |
| Soil type (FAO) | Gley | | |
| Water regime type | - | | |
| Hydromorphic features | - | | |
| Vegetation type | alpine grassland | | |
| Use type | pasture | | |
| Comments: contains Fe2O3, FeO; silty soil - result of water erosion; iron reduced | | | |

**Questionnaire for assessing pasture management of summer pastures (extract)**[5]

– **Basic data of summer pasture**

Name of pasture: Kara arkhach/ Sari bulag

Interview partner: N. (he is a shepherd, not the owner of the whole herd); for approx. 25 years he comes to this summer pasture, arriving earliest in the middle of May, departing latest on the fifth of October. Usually he stays for around three months on the camp-site. Normally his arrival is between the fifth and tenth of June and he departs between the end of September and October when the school starts.

– **Where is the livestock kept on this pasture stay in winter?**

On a winter pasture in the Shirvan region near the village Pirsaat near Hajigabul

– **Which intermediate pastures are used between summer and winter pasture?**

There are some intermediate pastures (near Shamakhi); he needs approx. four weeks (150 km) to move from summer to winter pastures through the Greater Caucasus down to Gobustan (Hajigabul)

– **Who is responsible for herding on this summer pasture?**

There are five different persons which take care. One is the owner (D.) of the majority of the herd and pays the salary to every shepherd. He is in charge with all management tasks but has no presence on the summer pasture for working. Three of the four working shepherds have also sheep in the herd. Four shepherds are responsible for herding tasks during the time. Every three days they change the shepherd in charge. The owners have to pay for medical care by themselves, but pay no lease fees and have no more management costs.
The four shepherds are furthermore responsible for the daily organisation of herding, whereas the number of livestock on the summer pasture and the time and organisation of seasonal migration are governed by the "chief-shepherd".

– **Who else stays here on the summer pasture?**

The whole farmers´families.

– **Which milk products are produced and sold from the summer pasture?**

Butter, cream, yoghurt, cheese and some meat. The majority of cheese is sold in Baku, Guba and Khinalig, the milk is mainly for their own needs.

[5] Etzold, J., Neudert, R. (2013): Monitoring Manual for Summer Pastures in the Greater Caucasus in Azerbaijan. GIZ Working Paper – Sustainable Management of Biodiversity, South Caucasus. Baku, AZ. 60p. Available (also in Azerbaijani) at: http://biodivers-southcaucasus.org/wp-content/uploads/2015/02/Monitoring-manual-for-summer-pastures-in-the-Greater-Caucasus-in-Azerbaijan_EN.pdf.

– **Which number of livestock is sold during the year on markets?**

It depends on the increase of animal amount and the more animals the more can be sold. Approx. 200 animals (mainly lambs born on the winter pastures) in Guba and regions around before June and 300 animals in summer in Baku and Guba.

– **According to the lease contract how many hectares do you use?**

Total: 180 ha; fertile land: 150 ha

– **How much livestock is kept on the summer pasture?**

Sheep: 1400; goats: 200; cattle: ~ 40 (1 cow = 6 sheep units, i.e. 40 cows = 240 sheep units)

(Good to know: Cattle is not allowed on the summer pasture because they cause much more damage than sheep and goats. When the cattle is on the pastures during spring and winter time it becomes very problematic because than the soil is wet and prone to damage. Furthermore on summer pasture it is officially allowed to keep a maximum of 8 sheep units per hectare, in reality it is mostly beyond).

– **How did the number of livestock develop in the last years?**

It became more.

– **How many adult dogs do you keep on your summer pasture?**

Eight adult dogs are on the summer pasture and only sometimes along with the shepherd during herding. During the day the dogs go further than 200 m from the camp. The shepherds feeds to the dogs barley and meat and sometimes bread.
(These questions are of biodiversity concern like if the Caucasian Black Grouse could be affected by herding dogs)

– **How do you appraise the condition of this pasture compared to neighbouring pastures?**

In the south are better conditions than in the north because of rocks.

– **Did the condition of this pasture change during the last 10 years?**

The condition is getting worse and worse because of lesser grass.

– **Is the pasture area enough for the livestock kept here?**

It is effectively not enough.

– **What measures do you use to improve the condition of this pasture?**

Nothing.

– **When you keep too much livestock on a pasture?**

a) ...what happens to the livestock?
They become thin, lose weight, sick (e.g. eat poisoning plants)

b) ...what happens to the pasture?
Slides are natural but less grass leads to high pressure on soil.

# Annex 2.5.: Oak and beech forests in Altiaghaj National Park (Chapter 4.3.2.3), 03.09.15

## *Excursion point 2.3.1: Forest behind the BSU Field Station*

1 vegetation assessment, 1 soil assessment

| | | | | | |
|---|---|---|---|---|---|
| **Number** | 10 | | | | |
| **Date (year/month/day)** | 2015/09/03 | | | | |
| **Authors** | Gunay, Abdin, Jasmine | | | | |
| **Altitude [m]** | 1078 | | | | |
| **Aspect [°]** | Northeast | | | | |
| **Slope [°]** | 30 | | | | |
| **Coordinates N** | 40°52'24.35" | **Coordinates E** | 48°55'52.21" | | |
| **Cover: 70 %** | | | | | |
| tree layer (t) [%] | shrub layer (s) [%] | herb layer (h) [%] | moss layer [%] | litter layer [%] | bare soil [%] |
| 70 | 1 | 12 | 1 | - | 15 |
| **Height** | | | | | |
| (highest) trees [m] | (highest) shrubs [m] | Aver. height (high) herbs [cm] | | | |
| 15 | 0.8 | 20 | | | |
| **Mosses identified (y/n)** | N | | | | |
| **Lichens identified (y/n)** | N | | | | |
| **Habitat** | - | | | | |

| **Species** | **Cover *** | **Phenophase** | **Layer** |
|---|---|---|---|
| *Carpinus betulus* | 3 | 6 | t |
| *Primula acaulis* | 3 | 3 | h |
| *Quercus petraea* subsp. *iberica* | 2b | 6 | t |
| *Fagus orientalis* | 2a | 3 | t |
| *Fraxinus excelsior* | 2a | 0 | t |
| *Quercus macranthera* | 2a | 6 | t |
| *Acer campestre* | 1b | 3 | t |
| *Carex* spec. | 1a | 3 | h |
| *Poa nemoralis* | 1a | 6 | h |
| *Ajuga pyramidalis* | + | 3 | h |
| *Alliaria petiolata* | + | 3 | h |
| *Brachypodium sylvaticum* | + | 3 | h |
| *Campanula* spec. | + | 6 | h |
| *Cephalanthera rubra* | + | 6 | h |
| *Chaerophyllum temulum* | + | 6 | h |
| *Clinopodium vulgare* | + | 6 | h |
| *Galium odoratum* | + | 3 | h |
| *Geum urbanum* | + | 6 | h |
| *Klasea quinquefolia* | + | 3 | h |
| *Lapsana communis* | + | 6 | h |
| *Lonicera* spec. | + | 3 | h |
| *Stellaria holostea* | + | 3 | h |
| *Veronica* spec. | + | 3 | h |
| *Viola* spec. | + | 3 | h |
| *Acer hyrcanum* | a | - | - |
| *Acer laetum* | a | - | - |

| | | | |
|---|---|---|---|
| *Cornus* spec. | a | - | - |
| *Crataegus germanica* | a | - | - |
| *Crataegus* spec. | a | - | - |
| *Euonymus verrucosa* | a | - | - |
| *Juniperus communis* | a | - | - |
| *Ligustrum vulgare* | a | - | - |
| *Pyrus communis* subsp. *caucasica* | a | - | - |
| *Salix caprea* | a | - | - |
| *Sorbus torminalis* | a | - | - |
| *Viburnum lantana* | a | - | - |
| * a = accompanying outside of plot | | | |

| General observations on soil profile | | | | |
|---|---|---|---|---|
| **Observation Point №** | vegetation assessment 10 | | | |
| Authors: | Gunay, Abdin, Jasmine | | | |
| Date: | 03.09.2015 | | | |
| Region: | Altiaghaj NP | | | |
| Location: | Behind the BSU Field Station | | | |
| GPS: | N | 40°52'24.35" | E | 48°55'52.21" |
| Status of the soil surface (salination, moisture, clumpy, fracturing, stony and other features) | Leaves, litter | | | |
| General relief | Northern slope | | | |
| Meso-relief, exposition [°] and steepness of slope [% or °] | Northeast<br>30° | | | |
| Micro-relief | Concave | | | |
| Inclination [°] | 30 | | | |
| Bedrock and soil forming underground | Shales (deep sea sediments of clay and silt) | | | |
| Name of soil: Brown Soil | | | | |

| **Observation along the different genetic horizons of the profile** | | | | | |
|---|---|---|---|---|---|
| | **Horizons** | | | | |
| **Properties and indications of horizons** | L | Of | Oh | Ah | Bv |
| 1. Colour (Munsell Number) | - | - | - | - | - |
| 2. soil texture:<br>clay-1, heavy loam-2, medium loam-3, light loam-4, sandy loam-5, sand-6 | - | - | - | clay-silt | |
| 3. humidity:<br>wet-1, slightly wet-2, damp-3, moist-4, slightly moist-5, fresh-6, dry-7 | 7 | - | - | 7 | |
| 4. structure:<br>cloddy-1, prismatic-2, columnar-3, nutty-4, stony-5, grained-6, dusty-7 | - | - | - | Clumps of 0.2-2 cm | |
| 5. density:<br>very dense 1, dense-2, packed-3, weakly packed-4, rather loose-5, loose-6 | - | - | - | - | - |
| 6. boiling of HCL 10% | - | - | - | no | a little bit |
| 7. pore space:<br>few-1, medium-2, a lot-3 | - | - | - | 2 | 2 |
| 8. roots:<br>none-1, few-2, medium-3, a lot-4 | - | - | - | 4 | 3 |

| | | | | | |
|---|---|---|---|---|---|
| 10. character of border between horizons:<br>gradual-1, clear 2, very clear-3, sharp-4 | - | - | - | 1 | 1 |
| 11. depths where probes have been taken | - | - | - | - | - |
| Soil type (FAO) | Cambisol | | | | |
| Water regime type | - | | | | |
| Hydromorphic features | - | | | | |
| Vegetation type | Carpinus-Oak forest, mixed broad-leaved forest | | | | |
| Use type | no wood cutting use, medium intensive grazing, historical coppice forest | | | | |
| Comments:<br>Top soil does not have much carbonate. Many leaves around, fungi take over decomposition of organic material. High amount of acid, which comes especially from oak leaves, which are difficult to decompose. | | | | | |

## *Excursion point 2.3.2: Oak forest on west-northwestern slope*

1 vegetation assessment, 1 soil assessment

| | | | | | |
|---|---|---|---|---|---|
| **Number** | 11 | | | | |
| **Date (year/month/day)** | 2015/09/03 | | | | |
| **Authors** | Gunay, Abdin, Jasmine | | | | |
| **Altitude [m]** | 827 | | | | |
| **Aspect [°]** | 292 | | | | |
| **Slope [°]** | 18 | | | | |
| **Coordinates N** | 40°54'2.76" | **Coordinates E** | 49°01'35.49" | | |
| **Cover: 70 %** | | | | | |
| tree layer (t) [%] | shrub layer (s) [%] | herb layer (h) [%] | moss layer [%] | litter layer [%] | bare soil [%] |
| 70 | 10 | 15 | 1 | - | 1 |
| **Height** | | | | | |
| (highest) trees [m] | (highest) shrubs [m] | Aver. height (high) herbs [cm] | | | |
| 12 | 3 | - | | | |
| **Mosses identified (y/n)** | N | | | | |
| **Lichens identified (y/n)** | N | | | | |
| **Habitat** | - | | | | |

| **Species** | **Cover** | **Phenophase** | **Layer** |
|---|---|---|---|
| *Quercus petraea* subsp. *iberica* | 3 | - | t |
| *Carpinus orientalis* | 2b | - | t |
| *Drymochloa drymeja* | 2a | - | h |
| *Fraxinus excelsior* | 2a | - | t |
| *Acer campestre* | 1b | - | t |
| *Cornus sanguinea* subsp. *australis* | 1b | - | s |
| *Acer laetum* | 1a | - | h |
| *Fraxinus excelsior* | 1a | - | h |
| *Alliaria petiolata* | 1a | - | h |
| *Aegonychon purpureocaeruleum* | + | - | h |
| *Bupleurum* spec. | + | - | h |
| *Euonymus latifolia* | + | - | s |
| *Galium odoratum* | + | - | h |
| *Klasea quinquefolia* | + | - | h |
| *Lapsana communis* subsp. *intermedia* | + | - | h |
| *Ligustrum vulgare* | + | - | s |
| *Lonicera* spec. | + | - | s |
| *Piptatherum virescens* | + | - | h |
| *Primula acaulis* | + | - | h |
| *Pyrus* spec. | + | - | s |
| *Quercus petraea* subsp. *iberica* | + | - | h |
| *Stachys* spec. | + | - | - |
| *Stellaria holostea* | + | - | h |
| *Ulmus minor* | + | - | s |
| *Viola* spec. | + | - | h |

| General observations on soil profile | | | | | |
|---|---|---|---|---|---|
| **Observation Point №** | vegetation assessment 11 | | | | |
| Authors: | Gunay, Abdin, Jasmine | | | | |
| Date: | 03.09.2015 | | | | |
| Region: | Altiaghaj | | | | |
| Location: | Broad-leaved forest along asphalt road to Yarimja-Ghizil Ghazma | | | | |
| GPS: | N | 40°54'2.76" | E | 49°01'35.49" | |
| Status of the soil surface (salination, moisture, clumpy, fracturing, stony and other features) | Leaves‘ cover | | | | |
| General relief | Northwestern slope | | | | |
| Meso-relief, exposition [°] and steepness of slope [% or °] | 292°<br>18° | | | | |
| Name of soil: Rendzina | | | | | |
| **Observation along the different genetic horizons of the profile** | | | | | |
| | **Horizons** | | | | |
| **Properties and indications of horizons** | L | Of | Ah | Co | |
| 1. Colour (Munsell Number) | - | - | - | - | |
| 2. soil texture:<br>clay-1, heavy loam-2, medium loam-3, light loam-4, sandy loam-5, sand-6 | clumpsy | - | 2 | 2 | |
| 3. humidity:<br>wet-1, slightly wet-2, damp-3, moist-4, slightly moist-5, fresh-6, dry-7 | - | - | 7 | 7 | |
| 4. structure:<br>cloddy-1, prismatic-2, columnar-3, nutty-4, stony -5, grained-6, dusty-7 | - | - | clumps | clumps | |
| 5. density:<br>very dense 1, dense-2, packed-3, weakly packed-4, rather loose-5, loose-6 | - | - | dense and getting denser in the lower part | | |
| 6. boiling of HCL 10% | - | - | no | yes | |
| 7. pore space:<br>few-1, medium-2, a lot-3 | - | - | - | - | |
| 8. roots:<br>none-1, few-2, medium-3, a lot-4 | - | - | 2 | 1 | |
| 10. character of border between horizons:<br>gradual-1, clear 2, very clear-3, sharp-4 | - | - | 1 | 1 | |
| 11. depths where probes have been taken | - | - | - | - | |
| Soil type (FAO) | Leptosol | | | | |
| Vegetation type | Oak forest | | | | |
| Use type | moderate grazing, fire wood logging in former times | | | | |
| Comments: Calcium washed down, no rocks in profile | | | | | |

# Annex 3: List of bird species in Shirvan National Park (Chapter 4.3.1.)

**Tab. 9:** List of bird species observed during the excursion (marked with *) and generally recorded from the area (adopted from Müller 2010).

| Scientific name | English name | Azerbaijani name | Presence | Number |
|---|---|---|---|---|
| *Acrocephalus arundinaceus* L. 1758 | Great Reed Warbler | Qaratoyuğabənzər qamışcıl | breeding | few |
| *Acrocephalus palustris* Bechst. 1798 | Marsh Warbler | Kolluq qamışcılı | breeding | few |
| *Acrocephalus schoenobaenus* L. 1758 | Segde Warbler | Gizlin qamışcıl | resident | few |
| *Actitis hypoleucos* L. 1758 | Common Sandpiper | Adi sahildəyişən | wintering-migratory | rare |
| *Aegypius monachus* L. 1758 | Cinereous Vulture | Qara kərkəs | feeding | rare |
| *Alauda arvensis* L. 1758 | Eurasian Skylark | Tarla torağayı | wintering-migratory | common |
| *Alcedo atthis* L. 1758 | Common Kingfisher | Balıqçıl zərricə | breeding | few |
| *Anas acuta* L. 1758 * | Northern Pintal | Bizquyruq ördək | wintering | few |
| *Anas clypeata* L. 1758 * | Northern Shoveler | Enlidimdik ördək | wintering-migratory | common |
| *Anas crecca* L. 1758 * | Green-winged Teal | Fitçi-cürə | breeding | common |
| *Anas penolope* L. 1758 | Eurasian Wigeon | Marek (fiyu ördək) | wintering-migratory | few |
| *Anas strepera* L. 1758 | Gadwall | Boz ördək | wintering-migratory | few |
| *Anthropoides virgo* L. 1758 | Demoiselle Crane | Gözəl durna | migratory | few |
| *Anthus campestris* L. 1758 | Tawny Pipit | Tarla(antı)haçaqanadı | breeding-migratory | common |
| *Anthus cervinus* Pall. 1811 | Red-throated Pipit | Qırmızıdöş haçaqanad | migratory | common |
| *Anthus pratensis* L. 1758 | Meadow Pipit | Çəmənlik haçaqanadı | wintering-migratory | common |
| *Anthus spinoletta* L. 1758 | Water Pipit | Dağ haçaqanadı | wintering-migratory | few |
| *Anthus trivialis* L. 1758 | Tree Pipit | Meşə haçaqanadı | migratory | common |
| *Apus apus* L. 1758 | Common Swift | Qara uzunqanad | migratory | common |

| Scientific name | English name | Azerbaijani name | Presence | Number |
|---|---|---|---|---|
| *Aquila clanga* Pall. 1811 | Greater Spotted Eagle | Böyük qartalça | wintering-migratory | rare |
| *Aquila heliaca* Sav. 1809 | Imperial Eagle | İmperator (məzar) qartalı | feeding | rare |
| *Aquila nipalensis* Temm. 1828 | Steppe Eagle | Bozqır (çöl) qartalı | migratory | rare |
| *Aquila pomarina* Brehm 1831 | Lesser Spotted Eagle | Kiçik qartal | migratory | rare |
| *Ardea alba* L. 1758 * | Great Egret | İri ağ vağ | feeding | few |
| *Ardea cinerea* L. 1758 * | Grey Heron | Boz vağ | feeding | common |
| *Ardea purpurea* L. 1766 * | Purple Heron | Kürən vağ | migratory | few |
| *Asio flammeus* Pont. 1763 | Short-eared Owl | Bataqlıq bayquşu | accidental | few |
| *Asio otus* L. 1758 | Long-eared Owl | Qulaqlı bayquş | wintering | few |
| *Athene noctua* Scop. 1769 | Little Owl | Dam bayquşu | feeding | few |
| *Aythya ferina* L. 1758 | Common Pochard | Qırmızıbaş dalğıc | wintering-migratory | big flocks on Caspian Sea |
| *Aythya fuligula* L. 1758 | Tufted Duck | Kəkilli qaraördək | wintering-migratory | big flocks on Caspian Sea |
| *Aythya marila* Lin. 1761 | Greater Scaup | Dəniz qara ördəyi | wintering-migratory | small flocks on Caspian |
| *Aythya nyroca* Guld. 1770 | Ferruginous Duck | Ağgöz qaraördək | wintering and breeding | few |
| *Bucephala clangula* L. 1758 | Common Goldeneye | Güləyən ördək | wintering-migratory | few |
| *Buteo rufinus* Gretz. 1827 | Long-legged Buzzard | Bozqır (çöl) sarı | migratory | rare |
| *Buteo buteo vulpinus* Glog. 1833 | Common (Steppe) Buzzard | Adi sar | migratory | rare |
| *Calandrella brachydactyla* Gm. 1789 | Greater Short-toed Lark | Kiçik torağay | breeding | common |
| *Calandrella rufescens* Vieil. 1820 | Lesser Short-toed Lark | Boz turağayça | breeding | few number |
| *Calidris canutus* L. 1758 | Red Knot | İslandiya qum cüllütü | accidental | rare |
| *Calidris ferruginea* Pont. 1763 | Curlew Sandpiper | Qırmızıdöş qum cüllütü | migratory | common |

| Scientific name | English name | Azerbaijani name | Presence | Number |
|---|---|---|---|---|
| *Calidris melanotos* Vieil. 1819 | Pectoral Sandpiper | Du-du qum cüllütü | accidental | rare |
| *Calidris minuta* Leis. 1812 * | Little Stint | Sərçəvari qum cüllütü | wintering-migratory | common |
| *Calidris temminckii* Leis. 1812 * | Temminck's Stint | Ağquyruq qum cüllütü | migratory | common |
| *Carduelis carduelis* L. 1758 | European Goldfinch | Adi payızbülbülü | migratory | few |
| *Carduelis chloris bilkevischi* Jarud 1911 | European Greenfinch | Adi yaşılca | breeding | common |
| *Carduelis spinus* Lin. 1758 | Eurasian Siskin | Yalançı bülbül | migratory | few |
| *Cettia cetti* Temm. 1820 | Cetti's Warbler | Bülbülü enliquyruq | breeding | common |
| *Charadrius alexandrinus* L. 1758 | Kentish Plover | Dəniz bozcası | resident | common |
| *Charadrius asiaticus* Pall. 1773 | Caspian Plover | Xəzər bozcası | migratory | rare |
| *Charadrius dubius* Scop. 1786 | Little Ringed Plover | Kiçik bozca | migratory | common |
| *Charadrius hiaticula* L. 1758 * | Ringed Plover | Yaxalıqlı bozca | wintering-migratory | few |
| *Charadrius leschenaultia* Less. 1826 | Greater Sand-Plover | Yoğundimdik bozca | breeding | common |
| *Chettusia gregarius* Pall. 1771 | Sociable Lapwing | Çığırğan çökükburun | migratory | few |
| *Chettusia leucurus* Lich. 1823 | White-tailed Lapwing | Ağquyruq çökükburun | breeding | few, 10-20 ind. |
| *Chlidonias hybridus* Pall. 1811 | Whiskered Tern | Ağyanaq sterna | migratory | common |
| *Chlidonias leucopterus* Temm. 1815 | White-winged Tern | Ağqanad sterna | migratory | common |
| *Chlidonias niger* L. 1758 | Black Tern | Qara sterna | migratory | common |
| *Cicus pygargus* L. 1758 | Montague´s Harrier | Çəmən belibağlısı | migratory | rare |
| *Circaetus gallicus* Gm. 1788 | Short-toed Snake-Eagle | İlanyeyən | migratory | rare |
| *Circus aeruginosus* L. 1758 | Eurasian Marsh-Harrier | Bataqlıq belibağlısı | resident | few |
| *Circus macrourus* Gm. 1771 | Pallid Harrier | Bozqır (çöl) | wintering-migratory | rare |

| Scientific name | English name | Azerbaijani name | Presence | Number |
|---|---|---|---|---|
| | | belibağlısı | | |
| *Columba livia* Gm. 1789 | Rock Pigeon | Çöl göyərçini | feeding | common |
| *Coracias garullus* L. 1758 * | European Roller | Adi göycəqarğa | migratory | few |
| *Corvus cornix* L. 1758 | Hooded Crow | Boz qarğa | resident | common |
| *Corvus corone* L. 1758 | Carrion Crow | Qara qarğa | feeding | common |
| *Corvus frugilegus* L. 1758 | Rook | Zağca qarğa | wintering-migratory | common |
| *Cuculus canorus* L. 1758 | Common Cuckoo | Adi qu-qu quşu | breeding | few |
| *Cyanistes caeruleus L. 1758* | Eurasian Blue Tit | Abı arıquşu | breeding | few |
| *Delichon urbica* L. 1758 | Common House-Martin | Adi şəhər qaranquşu | migratory | common |
| *Dendrocopos syriacus* Hem. 1833 | Syrian Woodpecker | Suriya ağacdələni | breeding | rare |
| *Egretta garzetta* L. 1766 * | Little Egret | Kiçik ağ vağ | migratory | few |
| *Emberiza calandra* L. 1758 | Corn Bunting | Tarla vələmirquşu | breeding | common |
| *Emberiza citrinella* L. 1758 | Yellowhammer | Adi vələmirquşu | wintering-migratory | few |
| *Emberiza hortulana* L. 1758 | Ortolan Bunting | Bağ vələmirquşu | resident-migratory | few |
| *Emberiza melanocephala* Scop. 1769 | Black-headed Bunting | Qarabaş vələmirquşu | breeding | common |
| *Emberiza schoeniclus* L. 1758 * | Reed Bunting | Qamışlıq vələmirquşu | resident-migratory | common |
| *Eremophila alpestris* L. 1758 | Horned Lark | Buynuzlu torağay | wintering-migratory | rare |
| *Falco cherrug* Gray. 1834 | Saker Falcon | Ütəlgi qızılquş | migratory | rare |
| *Falco columbarius* L. 1758 | Merlin | Ördəktutan qızılquş | migratory | rare |
| *Falco naumanni* L. 1758 * | Lesser Kestrel | Bozqır (çöl) muymulu | breeding | few |
| *Falco peregrinus harteri* But. 1907 | Peregrine Falcon | Şahin (adi qızılquş) | migratory | rare |
| *Falco tinnunculus* L. 1758 | Eurasian Kestrel | Adi muymul | resident | common |
| *Falco vespertinus* L. 1766 | Red-footed Falcon | Gərgiçək qızılquş | migratory | very rare |
| *Ficedula semitorquata* Hamayer | Semi-collared | Ağboyun alaca | breeding | rare |

| Scientific name | English name | Azerbaijani name | Presence | Number |
|---|---|---|---|---|
| 1885 | Flycatcher | | | |
| *Ficedula albicollis* Temm. 1815 | Collared Flycatcher | Ağboyun alaca | migratory | rare |
| *Ficedula hypoleuca* Pall. 1764 | Pied Flycatcher | Milçəkqapan alaca | migratory | few |
| *Ficedula parva* Bechst. 1794 | Red-breasted Flycatcher | Kiçik alaca | breeding | common |
| *Francolinus francolinus* L. 1766 * | Black Francolin | Adi turac | resident | common |
| *Fringilla coelebs* L. 1758 | Common Chaffinch | Meşə sərçəsi | wintering-migratory | common |
| *Fulica atra* L. 1758 * | Eurasian Coot | Adi qaşqaldaq | Resident, wintering | breeding few, wintering common |
| *Galerida cristata* L. 1758 | Crested Lark | Adi kəkilli torağay | resident | common |
| *Glareola nordmanni* Nord. 1842 | Black-winged Pratincole | Bozqır haçaquyruğu | migratory | occasional |
| *Grus grus* L. 1758 | Common Crane | Boz durna | migratory | common |
| *Grus leucogeranus* Pall. 1773 | Siberian Crane | Ağ durna | migratory | Very rare, 3-4 birds in population |
| *Gypaetus barbatus* L. 1758 | Lammergeier | Saqqallı qartal | feeding | rare |
| *Gyps fulvus* Habl. 1783 | Eurasian Griffon | Ağbaş kərkəs | feeding | rare |
| *Haematopus ostralegus* L. 1758 | Eurasian Oystercatcher | Saxsağan alacüllüt | migratory | few |
| *Haliaeetus albicilla* L. 1758 | White-tailed Eagle | Ağquyruq dəniz qartalı | resident | 1 pair |
| *Himantopus himantopus* L. 1758 | Black-winged Stilt | Adi caydaq cüllüt | breeding | rare |
| *Hippolais caligata* Licht. 1817 | Booted Warbler | Kiçik zəvzək | breeding | few |
| *Hippolais pallida elaeica* Linder. 1843 | Eastern Olivaceous Warbler | İri zəvzək | breeding | common |
| *Hirundo rustica* L. 1758 | Barn Swallow | Adi kənd qaranquşu | migratory | common |
| *Junx torquila* L. 1758 | Eurasian Wryneck | Adi buruqboyun | breeding | few |
| *Lanius collurio* L. 1758 | Red-backed Shrike | Adi alaçöhrə | resident | common |
| *Lanius excubitor* L. 1758 | Northern Shrike | Boz alaçöhrə | wintering-migratory | common |

| Scientific name | English name | Azerbaijani name | Presence | Number |
|---|---|---|---|---|
| *Lanius minor* Gm. 1788 * | Lesser Grey Shrike | Qaralın alaçöhrə | breeding | common |
| *Lanius meridionalis pallidirostris* Cas.1852 | Southern (Steppe) Grey Shrike | Boz alaçöhrə | accidental | rare |
| *Lanius senator* L. 1758 | Woodchat Shrike | Qırmızıbaş alaçöhrə | breeding | few |
| *Larus armenicus* But. 1934 | Armenian Gull | Gümüşü qağayı | resident and migratory | common |
| *Larus cachinnans* Pall. 1811 | Caspian Gull | Qəh-qəhi qağayı | migratory | few |
| *Larus canus* L. 1758 | Mew Gull | Boz qağayı | wintering-migratory | common |
| *Larus genei* Breme 1840 | Slender-billed Gull | Göyərçə qağayı | migratory | few |
| *Larus melanocephalus* Temm. 1820 | Mediterranean Gull | Qarabaş qağayı | migratory | common |
| *Larus minitus* Pall. 1776 | Little Gull | Kiçik qağayı | wintering-migratory | common |
| *Larus ridibundus* L. 1766 | Black-headed Gull | Göl qağayısı | migratory | common |
| *Limicola falcinellus* Pont. 1763 | Broad-billed Sandpiper | Qara lil cüllütü | migratory | common |
| *Limosa lapponica* L. 1758 | Bar-tailed Godwit | Kiçik oxcüllüt | accidental | rare |
| *Limosa limosa* L. 1758 | Black-tailed Godwit | Böyük oxcüllüt | wintering-migratory | few |
| *Locustella melanopogon* Temm. 1820 | Moustached Warbler | Qamışcıl nazikdimdik | breeding | common |
| *Lymnocryptes minimus* Brun. 1764 | Jack Snipe | Tüklü cüllüt (qarşnep) | migratory | rare |
| *Melanocorypha bimaculata* Menetr. 1832 | Bimaculated Lark | İkixallı bozqır turağayı | wintering-migratory | rare |
| *Melanocorypha calandra* L. 1766 | Calandra Lark | Bozqır (çöl) torağayı | wintering-migratory | common |
| *Melanocorypha leucoptera* Pall. 1811 | White-winged Lark | Ağqanad bozqır turağayı | wintering-migratory | few |
| *Melanocorypha yeltoniensis* Fors 1768 | Black Lark | Qara bozqırturağayı | wintering-migratory | rare |
| *Mergus albellus* L. 1758 | Smew | Nazik pazdimdik | wintering-migratory | very rare, 2-5 ind. |
| *Mergus merganser* L. 1758 | Common Merganser | Böyük pazdimdik | wintering-migratory | very rare, 2-5 |

| Scientific name | English name | Azerbaijani name | Presence | Number |
|---|---|---|---|---|
| | | | | ind. |
| *Merops apiaster* L. 1758 * | European Bee-eater | Qızılı qızlarquşu | migratory | common |
| *Merops persicus* L. 1758 * | Blue-cheeked Bee-eater | Yaşıl qızlarquşu | migratory | common |
| *Milvus milvus* L. 1758 | Red Kite | Qırmızı çalağan | rare | rare |
| *Motacilla alba* L. 1758 | White Wagtail | Ağ titrəkquyruq | resident and migratory | common |
| *Motacilla cinerea* Tunst. 1771 | Grey Wagtail | Dağ titrəkquyruğu | migratory | few |
| *Motacilla citreola* Pall. 1776 | Citrine Wagtail | Sarıbaş titrəkquyruq | migratory | few |
| *Motacilla flava* L. 1758 | Western Yellow Wagtail | Sarı titrəkquyruq | migratory | common |
| *Muscicapa striata* Pall. 1764 * | Spotted Flycatcher | Boz milçəkqapan | breeding | common |
| *Neophron percnopterus* L. 1758 | Egyptian Vulture | Leşcil ağqartal | feeding | rare |
| *Netta rufina* Pall. 1773 | Red-crested Pochard | Qırmızıburun dalğıc | wintering-migratory | small flocks on Caspian |
| *Numenius phaeopus* L. 1758 | Whimbrel | Ortaboy əyridimdik | migratory | few |
| *Numenius tenuirostris* Vieil. 1817 | Slender-billed Curlew | Kiçik əyridimdik (kronşnep) | accidental | rare |
| *Oenanthe deserti* Temm. 1825 | Desert Wheatear | Səhra çaxraqcılı | accidental | rare |
| *Oenanthe finschii* Heug. 1869 | Finch's Wheatear | Qaraboyun çaxraqcıl | breeding | few |
| *Oenanthe hispanica* L. 1758 | Black-eared Wheatear | Ala çaxraqcıl | breeding | common |
| *Oenanthe isabellina* Temm. 1829 * | Isabelline Wheatear | Oynaq çaxraxçıl | migratory | few |
| *Oenanthe oenanthe* L. 1758 | Northern Wheatear | Adi çaxraqcıl | resident-migratory | common |
| *Oenanthe pleschanka* Lep. 1770 | Pied Wheatear | Keçəl çaxraqcıl | breeding | few |
| *Oriolis oriolis* L. 1758 | Eurasian Golden Oriole | Adi sarıköynək | migratory | few |
| *Otis tarda* L. 1758 | Great Bustard | Dovdaq | accidental | rare |
| *Oxyura leucocephala* Scop. 1769 | White-headed Duck | Adi göydimdik ördək | wintering-migratory | few |

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|---|---|---|---|---|
| *Pandion haliaetus* L. 1758 | Osprey | Balıqcıl qaraquş | migratory | rare |
| *Panurus biarmicus* L. 1758 | Bearded Reedling | Bığlı arıquşu | breeding | few |
| *Parus major* L. 1758 | Great Tit | Böyük arıquşu | breeding | common |
| *Passer domesticus* L. 1758 | House Sparrow | Dam sərçəsi | resident | common |
| *Passer montanus* L. 1758 | Eurasian Tree Sparrow | Çöl sərçəsi | resident | common |
| *Pastor roseus L. 1758* | Rosy Starling | Adi ala sığırçın | migratory | common |
| *Pernis apivorus* L. 1758 | European Honey-buzzard | Adi arıyeyən | migratory | rare |
| *Phalacrocorax carbo* L. 1758 * | Great Cormorant | Böyük qarabatdaq | breeding | common |
| *Phalaropus lobatus* L. 1758 | Red-necked Phalarope | Dəyirmiburun üzərcə | migratory | few |
| *Philomachus pugnax* L. 1758 | Ruff | Döyüşkən cüllüt | migratory | few |
| *Phoenicopterus roseus* Pall. 1811 * | Greater Flamingo | Adi qızılqaz | migratory | common |
| *Phoenicurus ochruros* Gm. 1774 | Black Redstart | Qaraca odquyruq | breeding | few |
| *Phoenicurus phoenicurus* L. 1758 | Common Redstart | Adi odquyruq | migratory and breeding | common |
| *Phylloscopus collybita* Vieil. 1817 | Common Chiffchaff | Kölgəlikyarpaqgüdəni | breeding | common |
| *Phylloscopus sindianus lorenzii* Lorenz 1887 | Mountain (Caucasian) Chiffchaff | Qafqaz yarpaqgüdəni | breeding | rare |
| *Phylloscopus nitidus* Blyth. 1843 | Green Warbler | Sarıqarın yarpaqgüdən | breeding | few |
| *Phylloscopus sibilatrix* Bechst. 1793 | Wood Warbler | Cır-cır yarpaqgüdən | migratory | rare |
| *Phylloscopus trochilus* L. 1758 | Willow Warbler | Bahar yarpaqgüdəni | migratory | common |
| *Pica pica* L. 1758 * | Eurasian Magpie | Sağsağan | resident | common |
| *Pluvialis apricaria* L. 1758 | Eurasian Golden-Plover | Qızılı qonurqanad | wintering-migratory | few |
| *Porphyrio porphyrio* L. 1758 | Purple Swamphen | Adi soltanquş | resident | common |
| *Porzana porzana* L. 1766 * | Spotted Crake | Adi (təqibçi) | resident | few |

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|---|---|---|---|---|
| | | porzan | | |
| *Porzana pusilla* Pall. 1776 | Baillon´s Crake | Cörtdan (təqibçi) porzan | migratory | few |
| *Prunella modularis* L. 1758 | Dunnock | Meşə çərənçisi | migratory | few |
| *Pterocles alchata* L. 1766 | Pin-tailed Sandgrouse | Ağqarın bağrıqara | accidental | rare |
| *Pterocles orientalis* L. 1758 | Black-bellied Sandgrouse | Qaraqarın bağrıqara | accidental | rare |
| *Remiz pendulinus* L. 1758 * | Eurasian Penduline-Tit | Pəsnək arıquşu | breeding | common |
| *Riparia riparia* L. 1758 | Bank Swallow | Adi sahilqaranquşu | migratory | common |
| *Saxicola ruberta* L. 1758 | Winchat | Çəmənlik çəkməkəsi | breeding | few |
| *Saxicola maurus* Pall.1773 | Siberian Stonechat | Qarabaş | migratory | few |
| *Saxicola torquata rubicola* L. 1766 | European Stonechat | Qarabaş çəkməkə | wintering-migratory | few |
| *Sterna albifrons* Pall. 1764 | Little Tern | Kiçik sterna | migratory | common |
| *Sterna caspia* Pall. 1770 | Caspian Tern | Xəzər sternası | migratory | common |
| *Sterna hirundo* L. 1758 | Common Tern | Çay sternası | migratory | common |
| *Sterna nilotica* Gm. 1789 | Gull-billed Tern | Qırmızıayaq qağayıburun | breeding and migratory | few |
| *Sterna sandvicensis* Lat. 1787 | Sandwich Tern | Alaburun sterna | breeding and migratory | common |
| *Streptopelia turtur* L. 1758 | European Turtle-Dove | Adi qur-qur | feeding | common |
| *Sturnus vulgaris* L. 1758 | European Starling | Qara sığırçın | migratory | common |
| *Sylvia atricapilla* L. 1758 | Eurasian Blackcap | Qarabaş pöhrəcil | breeding | common |
| *Sylvia borin* Bood. 1783 * | Garden Warbler | Bağ pöhrəcili | migratory | common |
| *Sylvia communis* Lath. 1787 * | Greater Whitethroat | Boz pöhrəcil | breeding | few |
| *Sylvia curruca* L. 1758 | Lesser Whitethroat | Çərənçi pöhrəcil | breeding | common |
| *Sylvia hortensis* Getz. 1826 | Eastern Orphean Warbler | Oxuyan pöhrəcil | breeding | few |
| *Sylvia mystacea* Menetr. 1832 | Menetries's Warbler | Ağbığ pöhrəcil | breeding | common |

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|---|---|---|---|---|
| *Sylvia nana* Hemp. 1833 | Asian Desert Warbler | Səhra pöhrəcili | migratory | rare |
| *Sylvia nisoria* Bechst. 1795 | Barred Warbler | Qırğıyaoxşar pıhrəcil | breeding | few |
| *Syrrhaptes paradoxus* Pall. 1773 | Pallas's Sandgrouse | Büldürük | accidental | rare |
| *Tetrax tetrax* L. 1758 | Little Bustard | Adi bəzgək | wintering-migratory | Common, 1,000-10,000 |
| *Tringa erythropys* Pall. 1764 * | Spotted Redshank | Bülbülü ilbizcüllüt | migratory | common |
| *Tringa glareola* L. 1758 | Wood Sandpiper | Fifi (fiyu) ilbizcüllüt | migratory | few |
| *Tringa nebularia* Ginn. 1776 | Common Greenshank | Böyük ilbizcüllüt | migratory | common |
| *Tringa ochropus* L. 1758 | Green Sandpiper | Qara ilbizcüllüt | wintering-migratory | common |
| *Tringa stagnatilis* Bechst. 1803 * | Marsh Sandpiper | Çay ilbizcüllütü | migratory | few |
| *Tringa totanus* L. 1758 * | Common Redshank | Otluq ilbizcüllütü | wintering-migratory | common |
| *Turdus iliacus* L. 1766 | Redwing | Ağqaş qaratoyuq | wintering-migratory | few |
| *Turdus merula* L. 1758 | Eurasian Blackbird | Qara qaratoyuq | resident-migratory | common |
| *Turdus philomelos* Brehm 1831 | Song Thrush | Oxuyan qaratoyuq | wintering-migratory | few |
| *Turdus pilaris* L. 1758 | Fieldfare | Xallı qaratoyuq | wintering-migratory | few |
| *Upupa epops* L. 1758 * | Eurasian Hoopoe | Şanapipik | breeding | few |
| *Vanellus vanellus* L. 1758 | Northern Lapwing | Çibis | migratory | common |
| *Xenus cinereus* Guld. 1774 | Terek Sandpiper | Boz səsyamsılayan | migratory | few |

# Annex 4: List of plant species in Shirvan National park (Chapter 4.3.1.)

**Tab. 10:** List of 151 plant species according to Müller (2010), corrected nomenclature following emplantbase.org and Czerepanov (1995)

| | | |
|---|---|---|
| *Aegilops cylindrical* Host | *Calamagrostis epigeios* (L.) Roth | *Filago pyramidata* L. |
| *Aelurops littoralis* (Gouan) Parl. | *Calendula arvensis* (Vaill.) L. | *Frankenia hirsuta* L. |
| *Aeluropus lagopoides* subsp. *repens* (Desf.) Tzvelev | *Calligonum bakuense* Litv. | *Frankenia pulverulenta* L. |
| *Agrostis capillaris* L. | *Camphorosma monspeliaca* subsp. *lessingii* (Litv.) Aellen | *Gagea reticulata* (Pall.) Schult. & Schult. f. |
| *Alhagi maurorum* Medik. | *Capparis sicula* subsp. *herbacea* (Willd.) Inocencio & al. | *Galium humifusum* Bieb. |
| *Allium rotundum* L. | *Capsella bursa-pastoris* (L.) Medik. | *Galium tenuissimum* Bieb. |
| *Alopecurus myosuroides* Huds. | *Cardaria draba* (L.) Desv. | *Geranium dissectum* L. |
| *Alyssum turkestanicum* Regel et Schmal. | *Carduus pycnocephalus* subsp. *albidus* (M. Bieb.) Kazmi | *Geranium molle* L. |
| *Anabasis aphylla* L. | *Carduus seminudus* Bieb. | *Glycyrrhiza glabra* L. |
| *Anisantha rubens* (L.) Nevski | *Carthamus lanatus* L. | *Gnaphalium luteo-album* L. |
| *Anthemis altissima* L. | *Centaurea iberica* Trev. et Spreng. | *Halanthium pilosum* (Pall.) Volkens |
| *Argusia sibirica* (L.) Dandy | *Ceratocarpus arenarius* L. | *Halocnemum strobilaceum* (Pall.) Bieb. |
| *Artemisia campestris* subsp. *inodora* Nyman | *Chenopodium album* L. | *Halostachys belangeriana* (Moq.) Botsch. |
| *Artemisia fragrans* Willd. | *Cichorium intybus* L. | *Helianthemum salicifolium* (L.) Mill. |
| *Artemisia scoparia* Waldst. et Kit. | *Cirsium arvense* (L.) Scop. | *Herniaria hirsuta* L. |
| *Artemisia spicigera* C. Koch. | *Cirsium ciliatum* subsp. *szovitsii* (K. Koch) Petr. | *Hordeum bulbosum* L. |
| *Artemisia szowitziana* (Bess.) Grossh. | *Climacoptera crassa* (Bien.) Botsch. | *Hordeum geniculatum* All. |
| *Arundo donax* L. | *Convolvulus arvensis* L. | *Hordeum murinum* subsp. *leporinum* (Link) Arcang. |
| *Astragalus hyrcanus* Pall. | *Convolvulus persicus* L. | *Juncus acutus* L. |
| *Astragalus stevenianus* D. C. | *Cynodon dactylon* (L.) Pers. | *Juncus littoralis* C. A. Mey. |
| *Atraphaxis spinosa* L. | *Datura stramonium* L. | *Kalidium capsicum* (L.) Ung. - Sternb. |
| *Avena barbata* subsp. *wiestii* (Steud.) Mansf. | *Calligonum bakuense* Litv. | *Koelpinia linearis* Pall. |
| *Avena clauda* Durieu | *Ephedra distachya* L. | *Krascheninnikovia ceratoides* (L.) Gueldenst. |
| *Avena eriantha* Durieu | *Eragrostis pilosa* (L.) Beauv. | *Lagoseris glaucescens* (C. Koch.) Sosn. |
| *Bassia prostrata* (L.) Beck | *Eremopyrum orientale* (L.) Jaub. et Spach | *Leopoldia caucasica* (Criseb.) Losinsk. |
| *Beta vulgaris* subsp. *maritima* (L.) Arcang. | *Eremopyrum triticeum* (Caerth.) Nevski | *Lepidium ruderale* L. |
| *Brassica rapa* (L.) L. | *Erigeron bonariensis* L. | *Limonium caspicum* (Willd.) Gams. |
| *Bromus japonicus* Thunb. | *Erodium cicutarium* (L.) L'Her. | *Limonium meyeri* (Boiss.) O.Kuntze |

| | | |
|---|---|---|
| *Lolium rigidum* Caudin. | *Psylliostachys spicata* (Willd.) Nevcki | *Trachynia distachya* (L.) Link |
| *Lycium ruthenicum* Murr. | *Puccinellia gigantea* (Crosch.) Crosch. | *Tragopogon graminifolius* DC. |
| *Malvalthaea transcaucasica* (Sosn.) Jljin | *Rhaponticum* repens (L.) Hidalgo | *Trifolium angustifolium* L. |
| *Medicago caucasica* Vass. | *Rostraria glabriflora* (Trautv.) Czer. | *Trifolium fragiferum* L. |
| *Medicago minima* (L.) Bartalini | *Salicornia europaea* L. | *Trifolium tumens* Stev. |
| *Melilotus indicus* (L.) All. | *Salsola dendroides* Pall. | *Tripleurospermum inodorum* (L.) Sch. Bip. |
| *Melilotus officinalis* (L.) Pall. | *Salsola ericoides* Bied. | *Tripleurospermum parviflorum* (Willd.) Pobed. |
| *Melilotus polonicus* (L.) Pall. | *Salsola gemmascens* Pall. | *Typha angustifolia* L. |
| *Minuartia hamata* (Hausskn.) Mattf. | *Salsola soda* L. | *Urtica urens*.L. |
| *Nitraria schoberi* L. | *Salsola tragus* L. subsp. tragus | *Valerianella uncinata* (Bieb.) Dufr. |
| *Noaea mucronata* (Frssk.) Asch. et Schw. | *Sclerochloa dura* (L.) Beav. | *Veronica polita* Fries |
| *Onosma dichroantha* Boiss. | *Senecio leucanthemifolius* subsp. *vernalis* (Waldst. & Kit.) Greuter | *Vicia monantha* Retz. subsp. *Monantha.* |
| *Orobanche purpurea* Jacq. | *Sonchus arvensis* L. | *Vulpia ciliata* Dumort |
| *Oxybasis rubra (L.)* S. Fuentes & al. | *Sonchus oleraceus* L. | *Vulpia myuros* (L.) C. C. Gmel. |
| *Paliurus spina-christi* Mill. | *Spergularia marina* (L.) Griseb. | *Xanthium strumarium* L. |
| *Papaver ocellatum* Woronow | *Spergularia rubra* (L.) C. Press | |
| *Parapholis incurva* (L.) C. E. Hubb. | *Sphenopus divaricatus* (Gouan) Rechen. | |
| *Persicaria lapathifolia* (L.) S.F. Gray | *Stellaria media* (L.) Vill. | |
| *Petrosimonia brachiata* (Pall.) Bunge | *Stuckenia pectinata* (L.) Börner | |
| *Phalaris minor* Rets. | *Suaeda acuminata* (C. A. Mey.) Moq. | |
| *Phragmites australis* (Cav.) Trin. et Steu. | *Suaeda dendroides* (C. A. Mey) Moq. | |
| *Plantago arenaria* Waldst. & Kit. | *Suaeda microphylla* Pall. | |
| *Plantago coronopus* L. | *Tamarix hohenackeri Bunge* | |
| *Plantago lanceolata* L. | *Tamarix ramosissima* Lebed. | |
| *Poa bulbosa* L. | *Taraxacum desertorum* Schischk. | |
| *Podospermum laciniatum* (L.) DC. | *Tetradiclis tenella* (Ehrenb.) Litv. | |
| *Polypogon maritimus* Willd. | *Torilis nodosa* (L.) Gaerth. | |

# Annex 5: Index of birds, locations, and plants mentioned in the field guide

***Birds***

***Locations***

***Plants***



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