EXPEDITION REPORT

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Authors:

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Biosphere Expeditions

Abstract

This study was part of an expedition to the Tien Shan Mountains (Kyrgyz Ala-Too range), run by Biosphere Expeditions and NABU from 8 June to 8 August 2015 with the aim of surveying for snow leopard (*Uncia uncia*) and its prey species. Using a cell methodology adopted by Biosphere Expeditions for volunteer expeditions, 56 cells of 2x2 km were surveyed and 22 interviews with local people were conducted. Twenty butterfly species not previously known to occur in the area were also recorded. Previous expeditions indicated that snow leopard was present in the survey area. In 2015 prolonged and continuous snow cover considerably raised the efficacy of the research, resulting in the discovery of fresh signs of snow leopard presence and confirming the importance of the study area as a habitat for the predator. The surveys also showed that the area's habitat is sufficiently varied and capable of sustaining a healthy prey base for the snow leopard and other carnivores such as the wolf. Potential prey species are Siberian ibex, marmot and snowcock; in 2015 there was no trace of argali. Enough location data on Siberian ibex enabled its distribution to be modelled against climatic and topographic variables. Poaching, overgrazing and other disturbances are serious issues that must be addressed in order to avoid habitat impoverishment and with it the loss of the snow leopard. On the other hand, local people are overwhelmingly in favour of snow leopard presence and receptive to creating economic incentives based on intact nature and snow leopard presence. To that end, Biosphere Expeditions and NABU will continue with the annual research expeditions to the area, seeking to conduct further surveys and involving local people in this, as well as the search for economic benefits and incentives to maintaining habitat health and with it snow leopard presence.

Резюме

Төмөндөгү изилдөө Тянь-Шань (Кыргыз Ала-Тоо) тоолорунда өткөрүлгөн экспедициянын бир бөлүгү болуп эсептелет. Бул экспедиция Биосфералык экспедиция жана NABU тарабынан 2015-жылы 8-июндан 8-августка чейин өткөрүлүп, максаты ак-илбирстин жашаган чөйрөсүн жана тоют базасына баа берүү болуп эсептелген. Биосфералык экспедиция уюму тарабынан иштелип чыккан координаттык торчо методун картага колдонуп, волонтёрлор менен бирге илимий практикалык жүзүндө 56 полигон (аянты 2x2 км) изилденип жана 22 жергиликтүү жашоочулардан сурамжылоо жүргүзүлгөн. Мурда бул региондо аныкталбаган күндүзгү учкан көпөлөктөрдүн 20 түрү тизмеге кирген. Жергиликтүү калкка жүргүзүлгөн сурамжылоонун негизинде малга кол салуу фактылары билинип, тегеректе ак илбирстин жашаганы аныкталган. 2015 - жылы жааган кардын үстүнө ак илбирстин издери түшүп, ак илбирстин ошол жерге келип кеткени дагы бир аныкталган. Ошонун негизинде региондун бул жаныбарга маанилүү экени белгиленген. Изилдөөлөрдүн негизинде аныкталган область биологиялык жактан ар түрдүү экени жана анын тоют базасы болуп эсептелген тоо теке, суур, улардын бар экени аныкталган; бул жылы аркар кулжа байкалган жок. Бирок ошол жерде тоо текенин жүргөн фактылары жетиштүү аныкталып,климат жана топографиянын байланышынын негизинде модельдин түзүлүшүнө өбөлгө түзүлөт. Браконьерчилик, өсүмдүктөрдүн үстүнкү катмарынын бузулушу жана башкалар чоң көйгөй жаратып, ак илбирстин жоголуп кетишине жана ал жашаган ареалынын бузулуп кетишине өбөлгө түзөт. Жергиликтүү калктын бул жаныбарга болгон мамилеси позитивдүү. Ошондуктан, Биосфералык экспедиция жана NABU уюму бул изилдөөлөрдү улантып, жапайы жаныбарлардын санын аныктоо максатында иш алып барат; жергиликтүү калк менен бирге ак илбирсти экономикалык факторду эске алуу менен аны сактап калуунун жолдору изделип келет.

Резюме

Настоящее исследование является частью экспедиции в горах Тянь-Шаня (Кыргыз Ала-Тоо), организованного Биосферной экспедицией совместно с НАБУ с 8 июня по 8 августа 2015 года, с целью определения наличия снежного барса и оценки его потенциальной кормовой базы. Применив методику координатной сетки на карте, разработанной Биосферной экспедицией для проведения научно-практического исследования совместно с волонтерами, было исследовано 56 полигонов (размером 2x2 км) и был проведен опрос у 22 местных жителей. Получен также список 20 видов дневных бабочек, не ранее отмеченных в данном регионе. Опросы местного населения и факты нападения на скот подтвердили присутствие снежных барсов в окрестностях. В 2015 г. снежный покров способствовал тому, что удалось обнаружить свежие следы пребывания снежного барса. Таким образом, получено подтверждение значимость региона для обитания этого хищника. Исследования показали, что изученная область является биоразнообразной и в наличии имеется кормовая база снежного барса (горные козлы, сурки, улары); аргали в этом году не отмечены. Имеющиеся наблюдения по горному козлу позволили с учетом ряда факторов окружающей среды промоделировать его распространение в регионе; интересно, что предсказанные моделью наиболее благоприятные для вида территории близко сопали с теми, где были обнаружены следы барса. Браконьерство, уничтожение растительного покрова и другие нарушения являются серьезной проблемой, способствуют локальному вымиранию снежного барса и ухудшают среду его обитания. С другой стороны, отношение местного населения к этой кошке положительное. В связи с этим, Биосферная экспедиция и NABU продолжат исследования с целью определения численности диких животных; совместно с населением будут осуществлен поиск путей сохранения снежного барса как вида с учетом экономических факторов.

Zusammenfassung

Diese Studie war Teil einer Expedition in das Tien-Shan-Gebirge Kirgisiens (Ala-Too Bergkette), durchgeführt von Biosphere Expeditions und dem NABU vom 8. Juni bis 8. August 2015 mit dem Ziel ein Gutachten über den Schneeleoparden (*Uncia uncia*) und dessen Beutetiere zu erstellen. Als Basis diente eine von Biosphere Expeditions angepasste Zellenmethodik, bei der 56 Zellen von 2 x 2 km Größe untersucht und 22 Interviews mit der einheimischen Bevölkerung durchgefuehrt wurden. Außerdem wurde eine Liste von 20 in der Region vorkommenden Schmetterlingarten erstellt. Daten, die in vorangegangenen Expeditionen gesammelt wurden, gaben Hinweise darauf, dass der Schneeleopard im Studiengebiet vorkommt. Die im Jahr 2015 lange vorhandene geschlossene Schneedecke erhöhte die Spurenfindungs-Effektivität der Forschungsarbeit beträchtlich: Frische Schneeleoparden Spuren wurden gefunden und damit bestätigt, dass es sich beim Studiengebiet um ein wichtiges Habitat des Schneeleoparden handelt. Die Forschungen zeigten auch, dass das Habitat im Studiengebiet variabel genug ist und alle Voraussetzungen für eine gesunde Beutetierpopulation, sowie andere Karnivoren, wie z.B. den Wolf erfüllt. Potenzielle Beutetiere sind der sibirische Steinbock, das Murmeltier und die Schneehenne. 2015 wurden keine Spuren vom Bergschaf gefunden. Andererseits gab es genug Steinbock-Positionsdaten, um Verbreitungsmodelle der Art in Relation zu Klima und Topographie entwickeln zu können. Weiters sind Wilderei, Überweidung und andere negative Einflüsse ernstzunehmende Störfaktoren, die es im Auge zu behalten gilt, um eine Verödung des Lebensraumes und das damit einhergehende Verschwinden des Schneeleoparden zu verhindern. Andererseits ist die Akzeptanz des Schneeleoparden bei der einheimischen Bevölkerung hoch und die Menschen sind sehr empfänglich dafür, ökonomische Massnahmen zu kreieren und umzusetzen, die auf beidem basieren: Einer intakten Natur und dem Schneeleopard in freier Wildbahn. Biosphere Expeditions und der NABU werden die alljährlichen Expeditionen ins Studiengebiet weiterführen, mit dem Ziel noch mehr Daten zu sammeln, die lokale Bevölkerung einzubeziehen und nach wirtschaftlichem Nutzen sowie Massnahmen zu suchen, die einen intakten Lebensraum und damit einhergehend das Vorkommen von Schneeleoparden sichern.

Contents

Please note: Each expedition report is written as a stand-alone document that can be read without having to refer back to previous reports. As such, much of this and other sections, which remain valid and relevant, are a repetition from previous reports, copied here to provide the reader with an uninterrupted flow of argument and rationale.

1. Expedition Review

M. Hammer (editor)
Biosphere Expeditions

1.1. Background

Biosphere Expeditions runs wildlife conservation research expeditions to all corners of the Earth. Our projects are not tours, photographic safaris or excursions, but genuine research expeditions placing ordinary people with no research experience alongside scientists who are at the forefront of conservation work. Our expeditions are open to all and there are no special skills (biological or otherwise) required to join. Our expedition team members are people from all walks of life, of all ages, looking for an adventure with a conscience and a sense of purpose. More information about Biosphere Expeditions and its research expeditions can be found at www.biosphere-expeditions.org.

This project report deals with an expedition to the Tien Shan mountains of Kyrgyzstan (Kyrgyz Ala-Too Range) that ran from 8 June to 8 August 2015 with the aim of surveying snow leopards as well as their prey species such as argali (a mountain sheep) and the Central Asian ibex. The expedition also surveyed other animals such as marmots, birds and small mammals, and worked with the local anti-poaching patrol "группы барс" (snow leopard group "Grupa Bars") and other local people on capacity-building and incentive creation projects.

Little is known about the status and distribution of the globally endangered snow leopard in the area and its interaction with prey animals such as the Tien Shan argali and Central Asian ibex, and its reliance on smaller prey such as marmots, ground squirrels and game birds. Biosphere Expeditions will provide vital data on these issues, which can then be used in the formulation of management and protection plans. The expedition also worked with locals in an effort to build capacity, educate and involve local people in snow leopard conservation and generate income through responsible tourism activities.

1.2. Research area

Kyrgyzstan is a country located in Central Asia and often referred to as the "Switzerland of Central Asia". Landlocked and mountainous, Kyrgyzstan is bordered by Kazakhstan to the north, Uzbekistan to the west, Tajikistan to the southwest and China to the east. Its capital and largest city is Bishkek. Kyrgyzstan is further from the sea than any other country and all its rivers flow into closed drainage systems, which do not reach the sea. The mountainous region of the Tien Shan covers over 80% of the country, with the remainder made up of valleys and basins. The highest peak is Jengish Chokusu (Pik Pobedy) at 7,439 m and more than half the country is above 2,500 metres. Steppe and alpine vegetation dominate the landscape; glaciers and permanent snow cover over 3% of the country's total area. The climate in Kyrgyzstan is continental with a small amount of rainfall.

The Kyrgyz Ala-Too (Кыргыз Ала-Тоосу, also Kyrgyz Alatau, Kyrgyz Range) is a large range in the northern Tien Shan mountains. The range is situated just south of the capital city of Bishkek and the views from the city itself are stunning and form a backdrop that is unique in the world. The Kyrgyz Ala-Too Range stretches for a total length of 454 km from the west end of Issyk-Kul to the town of Taraz in Kazakhstan. It runs in an east-west direction, separating into the Chuy, Kochkor, Suusamyr and Talas valleys. The western part of Kyrgyz Ala-Too serves as a natural border between Kyrgyzstan and Kazakhstan. The range's highest mountain is Alamyudyun Peak at 4,855 m.

Figure 1.2a. Map and flag of Kyrgyzstan with study site.

An overview of Biosphere Expeditions' research sites, assembly points, base camp and office locations is at Google Maps.

The mountains are divided by several river valleys and there is a great variety of landscape. There are hollows with semi-desert landscapes, alpine peaks, narrow river canyons and broad valleys, highland tundra and deep natural limestone gorges, open steppes, permanent snow and glaciers and tracts of forest, as well as a multitude of lakes, wild rivers and waterfalls. Forests of larch, cedar, spruce and pine (but very few deciduous trees) cover more than a half of the mountain territory.

Many threatened animal and plant species, a great number of them endemic, are present in the area with a recent count showing at least 70 mammal, 376 bird, 44 fish and over 3,000 insect species.

The Kyrgyz people are descendants of several different nomadic Turkish ethnic groups in Central Asia and were first mentioned in writing in 201 BC. Kyrgyzstan is one of the active members of the Turkic Council and the TÜRKSOY community. Kyrgyzstan's history is one of Turkish and Mongol, and more recently Soviet and Russian domination. Independence from the Soviet Union was declared on 31 August 1991 and Kyrgyzstan became, and has stayed, a unitary parliamentary republic.

1.3. Dates

The project ran over a period of two months divided into four 12-day slots, each composed of a team of international research assistants, scientists and an expedition leader. Slot dates were:

8 - 20 June | 22 June - 4 July || 13 - 25 July | 27 July - 8 August 2015

Team members could join for multiple slots (within the periods specified).

1.4. Local conditions & support

Expedition base

The expedition team worked from a mobile base camp, set up in various valleys on the southern side of Kyrgyz Ala-Too (see Fig 2.2.3b). Base camp consisted of an assortment of dome, mess and kitchen, as well as shower tents and a yurt (see Fig. 1.4a). All meals were prepared by the expedition cook; breakfast and dinner were provided at base and a lunch pack was supplied for each day spent in the field.

Figure 1.4a. Base camp with kitchen and mess tunnel tents, a yurt and dome tents for participants. Shower and toilet tents are outside the frame. There is also an expedition lorry for transporting base camp and the expedition 4x4 vehicles.

Weather

The local climate is temperate continental with short, hot summers (during which the expedition took place) and prolonged, cold winters. Winter temperatures range from -9°C to -45°C, summer temperatures from +11°C to +35°C during the day. Base camp was in the mountains at an altitude of 2,700 m (groups 1 & 2 in June) and 2,900m (groups 3 & 4 in July-August) and as such the weather was very variable. In June the temperatures dropped to almost zero degrees at night, in July/August it was mostly sunny and hot. Wind and rain showers occurred frequently in June, but only occasionally in July/August.

Field communications

The expedition had a satellite phone for emergency communications. There were also hand-held radios for groups working close together. There was generally no mobile phone network. The expedition leader posted a diary with multimedia content on Wordpress and excerpts of this were mirrored on Biosphere Expeditions' social media sites such as Facebook and Google+.

Transport & vehicles

Team members made their own way to Bishkek. From there onwards and back to Bishkek all transport was provided for the expedition team. A variety of 4x4 vehicles were rented from Almaz Alzhambaev of www.carforrent.kg. Local partner NABU also provided a 4x4 vehicle and a lorry (see Figure 1.4a). Horses were rented from local people as necessary.

Medical support and incidences

The expedition leaders were trained first aiders and the expedition carried a comprehensive medical kit. Further medical support was provided by the Public Foundation "Rescue in the mountains of Kyrgyzstan", small district hospitals in the town of Suusamyr (about 40 km from camp 1) and Kochkor (about 40 km from camp 2), a large hospital in Kara-Balta and large public hospitals and private clinics in Bishkek (about 140 km and 200 km from camp respectively). Safety and emergency procedures were in place and invoked once for a case of acute abdominal pain, which was cleared without any ill effects for the patient by a visit to Bishkek.

All team members were required to carry adequate travel insurance covering emergency medical evacuation and repatriation.

1.5. Expedition scientist

Volodymyr Tytar was born in 1951 and his Master's Degree in Biology is from Kiev State University. At that time he first experienced the Tien Shan mountains and wrote a term paper on the ecology of the brown bear. He then pursued a career as an invertebrate zoologist before shifting towards large mammals and management planning for nature conservation. Apart from in Kyrgyzstan, he has worked with Biosphere Expeditions on wolves, vipers and jerboas on the Ukraine Black Sea coast, and on snow leopards in the nearby Altai mountains, and has been involved in surveying and conservation measures all his professional life.

1.6. Expedition leaders

Malika Fettak (groups 1 – 3) is half Algerian, but was born and educated in Germany. She majored in Marketing & Communications and worked for more than a decade in both the creative department, but also in PR & marketing of a publishing company. Her love of nature, travelling and the outdoors (and taking part in a couple of Biosphere expeditions) showed her that a change of direction was in order. Joining Biosphere Expeditions in 2008, she runs the German-speaking operations and the German office and leads expeditions all over the world whenever she can. She has travelled extensively, is multilingual, a qualified off-road driver, diver, outdoor first aider, and a keen sportswoman.

Rossella Meloni (group 4) was born in Italy and has lived and worked in the UK for 12 years before experiencing life further afield by living in Muscat (Sultanate of Oman) and Seoul (South Korea). Rossella studied languages in Italy and gained a BSc in Computing and Information Systems from the University of Portsmouth. Since her first cautious breath underwater, well over a decade ago, she has become increasingly interested in the beauty and welfare of the underwater world. Her love for the marine environment and the outdoors encouraged her to join her first marine expedition in 2006 spending six weeks in a remote coastal village in Madagascar and later to continue training as PADI Open Water Diving Instructor. Her passion for diving and nature has led her to volunteer in remote areas of the world and eventually to lead expeditions with Biosphere Expeditions. When she is not busy tinkering with technology, leading expeditions, volunteering or supporting environmental causes, she can be found exploring the outdoors and pursuing new adventures. She is also a City & Guilds trained photographer, a RYA competent crew, a keen kite surfer and a qualified Emergency First Response trainer.

1.7. Expedition team

The expedition team was recruited by Biosphere Expeditions and consisted of a mixture of all ages, nationalities and backgrounds. They were (in alphabetical order and with country of residence):

8 – 20 June 2015

Theresa Bosque (UK), Carolyn Catt (New Zealand), Charlie Catt (New Zealand), Robert Christensen (USA), Sue Hughes (USA), Torsten John (Germany). Also Kathy Gill (Strategy Adviser, Biosphere Expeditions).

22 June – 4 July 2015

Carolyn Catt (New Zealand), Charlie Catt (New Zealand), Amadeus DeKastle (placement, Kyrgyzstan), Azim Duischeev (placement, Kyrgyzstan), Neus Gallés (Germany), Susan King (UK), Yvonne Raap (Switzerland), Ben Rees (UK), John Soos (Canada), Peter Sporrer (Germany), Rahat Yusubalieva (placement, Kyrgyzstan).

13 – 25 July 2015

Nurzhan Alymkanova (placement, Kyrgyzstan), Nick Benfell (New Zealand), Azim Duischeev (placement, Kyrgyzstan), Michael Kasch (Germany), Ceire McGinley (UK), Andre Meine (Germany), Vincent Schaller (Sweden), Barbara Schirmer (Germany), Suzie Schnell (USA), Duncan Sharp (UK), Siv Siem (Norway), Peter Sporrer (Germany), Anke Ulke (Germany), Ellen Westbrook (USA).

27 July – 8 August 2015

Sandra Frey (Germany), Tobias Binder (press, Germany), Daniela Gunz (Switzerland), Dirk Kunischewski (Switzerland), Christine Leung (China), Matthias Paul (Germany), Phil Pearce (UK), Henrik Roigaard (Switzerland), Vincent Schaller (Sweden), Michael Seipel (Germany), Rainer Springhorn (Germany), Susanne Tappe (press, Germany), Ellen Westbrook (USA).

Also our expedition cook throughout the expedition, Emma Alimbekova, and, on a rotational basis, members of NABU's anti-poaching patrol 'Grupa Bars': Zholdosch Akunovv (who has sadly since passed away), Kurmanbek Duischeev, Schailoo Tesektschiev, Aman Talgartbek Uulu), all from Kyrgyzstan.

1.8. Acknowledgements

We are grateful to the expedition participants, who not only dedicated their spare time to helping but also, through their expedition contributions, funded the research. Thank you also to our partner organisation, the Naturschutzbund (NABU = nature protection alliance), in particular the Grupa Bars (see section 1.7. for their names), as well as Tolkunbek Asykulov and NABU's Bishkek office staff, Boris Tichomirow, Hanna Pfüller and Britta Hennig. A big thank you also to Almaz Alzhambaev of www.carforrent.kg, who has helped us very much over and above the call of duty. Thank you also for John Soos for kindly revising our community questionnaire. Emma Alimbekova, was an amazing cook and the heart and soul of the expedition. Biosphere Expeditions would also like to thank members of the Friends of Biosphere Expeditions and donors for their support.

1.9. Further information & enquiries

More background information on Biosphere Expeditions in general and on this expedition in particular including pictures, diary excerpts and a copy of this report can be found on the Biosphere Expeditions website www.biosphere-expeditions.org.

Enquires should be addressed to Biosphere Expeditions at the address given on the website.

1.10. Expedition budget

Each team member paid towards expedition costs a contribution of £1,860 per person per 12-day slot. The contribution covered accommodation and meals, supervision and induction, special research equipment and all transport from and to the team assembly point. It did not cover excess luggage charges, travel insurance, personal expenses such as telephone bills, souvenirs etc., or visa and other travel expenses to and from the assembly point (e.g. international flights). Details on how this contribution was spent are given below.

Income	£
Expedition contributions	49,106
Expenditure	
Expedition base includes all food & services	5,255
Transport includes hire cars, fuel, taxis in Kyrgyzstan	9,890
Equipment and hardware includes research materials & gear etc. purchased internationally & locally	3,911
Staff includes local and Biosphere Expeditions staff salaries and travel expenses	8,586
Administration includes miscellaneous fees & sundries	1,272
Team recruitment Tien Shan as estimated % of annual PR costs for Biosphere Expeditions	4,186
Income – Expenditure	**16,006**
Total percentage spent directly on project	**67%**

2. Monitoring snow leopards and other species on the south side of the Kyrgyz Ala-Too mountain range in the Tien Shan mountains of Kyrgyzstan

Volodymyr Tytar
I.I Schmalhausen Institute of Zoology of the National Academy of Sciences of Ukraine

2.1. Introduction

2.1.1. Background on the snow leopard

The snow leopard (*Uncia uncia*) is a member of the *Felidae* subfamily *Pantherinae* and on the basis of morphology, behaviour and genetics, it is placed alone in its own genus (Johnson et al. 2006). Snow leopards are found in 12 countries across Central Asia (China, Bhutan, Nepal, India, Pakistan, Afghanistan, Tajikistan, Uzbekistan, Kyrgyzstan, Kazakhstan, Russia and Mongolia). China contains as much as 60% of the snow leopard's potential habitat.

Figure 2.1.1a. Part of the snow leopard's range (brown) and range countries. Expedition study site in black ellipse.

Inaccessible and difficult terrain, along with the secretive nature of this rare cat, helps account for the fact that large parts of its range have yet to be surveyed. Between 4,500 and 7,350 snow leopards are thought to occur within a total potential habitat area of 1,835,000 km^2. Snow leopards are generally solitary and mating usually occurs between late January and mid-March, with one to five cubs being born after a gestation period of 93 to 110 days, generally in June or July. Snow leopards are closely associated with the alpine and subalpine ecological zones, preferring broken, rocky terrain with vegetation that is dominated by shrubs or grasses.

The home range of five snow leopards in prime habitat in Nepal ranged from 12 to 39 km^2, with substantial overlap between individuals and sexes. In Mongolia, where food resources may be scarcer, home ranges of both males and females exceeded 400 km^2 (McCarthy et al. 2005) Snow leopards are opportunistic predators capable of killing prey up to three times their own weight. They will also take small prey such as marmot or chukar partridge. In general, their most commonly taken prey consists of wild sheep and goats (including blue sheep, Asian ibex, markhor and argali). Adult snow leopards kill a large prey animal every 10–15 days, and remain on the kill for an average of three to four days, and sometimes up to a week. Predation on livestock can be significant, which often results in retribution killing by herders.

Snow leopards are listed as Endangered on the IUCN Red List. Currently the species does not meet the standards of Critically Endangered, but populations are projected to decline by 50% or more over the next three generations due to potential levels of exploitation (trade in pelts/bones and conflict with livestock), and due to declining suitable habitat, extent of occurrence, and finally quality of habitat (prey depletion). They appear in Appendix I of both CITES and the Convention on Conservation of Migratory Species of Wild Animals (CMS). Snow leopards are protected nationally over most of their range. However, in some countries the relevant legislation may not always be very effective (Snow Leopard Working Secretariat 20013).

2.1.2. The snow leopard in Kyrgyzstan

Kyrgyzstan was once home to the species' second largest population in the world. In the 1970s and 1980s, the trapping and export of wild animals was officially organised by the Soviet national zoo authority. Kyrgyzstan supplied approximately 40 snow leopards annually, which the central office in Moscow sold to zoos worldwide for USD 50 per animal. With the end of the Soviet Union, many official wildlife trappers were put out of work. Today, because of the high prices snow leopard parts earn on the black market, snow leopards have been poached heavily since Kyrgyzstan gained independence from the Soviet Union in 1991.

In Kyrgyzstan (representing around 4% of the snow leopard home range, Table 2.1.2a), numbers declined from an estimated 600–700 individuals in the late 1980s (Koshkarev 1989) to 150–200 individuals by 2000 (Koshkarev & Vyrypaev 2000), putting the species at high risk of extinction in the country.

Table 2.1.2a. Potential habitat area (in square kilometres) for the snow leopard across its range in Central Asia (after Hunter & Jackson 1997).

Country	Total potential habitat (estimated occupied habitat)	Good	Fair	Percent protected
All Countries	3,024,728	549,706	2,475,022	6.0
Kyrgyzstan	126,162 (105,000)	32,783	93,379	1.1

Across the snow leopard’s range, gaining a more accurate picture of snow leopard distribution and identifying “hotspots” is a critical conservation need. Over most of the range, it is uncertain where the species occurs. This emphasises the need for snow leopard surveys and distribution mapping, the results of which will help identify areas for conservation.

Secondly, there is a need for a better understanding of prey species distributions and populations. As with snow leopards themselves, the distribution and abundance of the cat's prey is poorly documented over much of the range. Baseline population estimates should be gained for this purpose. This will allow long-term trend monitoring to begin.

Thirdly, an important issue is the evaluation of the attitudes and lifestyles of local communities who share the snow leopard's habitat.

Recently these needs have been incorporated into a new international effort to save the snow leopard and conserve high-mountain ecosystems (the Global Snow Leopard & Ecosystem Protection Program, GSLEP, www.globalsnowleopard.org/documents-grid/), which corresponds to the commitments of the Bishkek Declaration adopted by 12 snow leopard home range countries at the Global Snow Leopard Forum in 2013. Under GSLEP, portfolios of national activities have been designed and are expected to be implemented with the support from international and national partners.

On this expedition our main partner was the German conservation organisation NABU (NABU = Naturschutzbund = nature protection alliance). Founded in 1899, NABU is one of the oldest and largest environment associations in Germany. The association encompasses more than 450,000 members and sponsors, who commit themselves to the conservation of threatened habitats, flora and fauna, to climate protection and to energy policy. In Kyrgyzstan, NABU, in cooperation with the Kyrgyz government, is implementing a programme to conserve the snow leopard through a twin approach of research and the prevention of illegal hunting and trade of the endangered species (see http://nabu.kg/wp/).

2.1.3. Background on Kyrgyzstan

Terrain

The terrain of Kyrgyzstan is dominated by the Tien Shan and Pamir mountain systems, which together occupy about 65% of the country. The Alay Range portion of the Tien Shan system dominates the south-western crescent of the country, and, to the east, the main Tien Shan Range runs along the boundary between southern Kyrgyzstan and China before extending farther east into China's Xinjiang Uygur Autonomous Region. Kyrgyzstan's average elevation is 2,750 m, ranging from 394 m in the Fergana Valley near Osh to 7,439 m at Peak Jengish Chokusu. Almost 90% of the country lies more than 1,500 m above sea level.

The mountains of Kyrgyzstan are geologically young, so that the physical terrain is marked by sharply uplifted peaks separated by deep valleys. There is also considerable glaciation. Kyrgyzstan's 6,500 distinct glaciers are estimated to hold about 650 km^3 of water. Because the high peaks function as moisture catchers, Kyrgyzstan is relatively well-watered by the streams that descend from them.

Climate

The country's climate is influenced chiefly by the mountains, Kyrgyzstan's position near the middle of the Eurasian landmass, and the absence of any body of water large enough to influence weather patterns. Those factors create a distinctly continental climate that has significant local variations. Although the mountains tend to collect clouds and block sunlight (reducing some narrow valleys at certain times of year to no more than three or four hours of sunlight per day), the country is generally sunny, receiving as much as 2,900 hours of sunlight per year in some areas. The same conditions also affect temperatures, which can vary significantly from place to place. In January the warmest average temperature (−4°C) occurs around the southern city of Osh, and around lake Ysyk-Köl. The latter, which has a volume of 1.7 km^3, does not freeze in winter. Indeed, its name means "hot lake" in Kyrgyz. The coldest temperatures are in mountain valleys. There, readings can fall to −30°C or lower; the record is −53.6°C. The average temperature for July similarly varies from 27°C in the Fergana Valley, where the record high is 44°C, to a low of −10°C on the highest mountain peaks. Precipitation varies from 2,000 mm per year in the mountains above the Fergana Valley to less than 100 mm per year on the west bank of lake Ysyk-Köl.

Environmental issues

Kyrgyzstan has been spared many of the enormous environmental problems faced by its Central Asian neighbours, primarily because its designated roles in the Soviet system involved neither heavy industry nor large-scale cotton production. Also, the economic downturn of the early 1990s reduced some of the more serious effects of industrial and agricultural policy. Nevertheless, Kyrgyzstan has serious environmental problems because of inefficient use and pollution of water resources, land degradation, and improper agricultural practices.

Global climate change, ozone layer depletion, desertification and biodiversity loss are among global environmental issues presently on the agenda in Kyrgyzstan.

Global Climate Change: Kyrgyzstan acknowledged the problem of global climate change and in 2003 ratified the Kyoto Protocol to the United Nations Framework Convention on Climate Change. It is estimated that the energy sector of the country is responsible for emissions of approximately two-thirds of the total carbon dioxide, and in absolute terms this amount is likely to grow, even though there is also an increase in the share of renewable energy such as hydropower. Related to the global climate change in Kyrgyzstan is the problem of deglaciation. The area occupied by glaciers has decreased by 20% lately and there are concerns that glaciers in the country could disappear by 2100.

Biodiversity loss: In terms of biological diversity, Kyrgyzstan holds a prominent place worldwide. It possesses around 1% of all known species, while its area makes up only 0.13% of the world's land mass. According to the National Biodiversity Strategy and Action Plan, the threats to biodiversity are related to anthropogenic activity and include habitat loss and alteration, fragmentation of natural communities due to overuse, overharvesting, direct mortality, introduction of non-native species, environmental pollution and climate

Degradation of mountain ecosystems: Kyrgyzstan is a mountainous country with 90% of its area located at altitudes above 1,500 m. Large-scale technological pressure on fragile mountain ecosystems by mining and infrastructure projects, and the agricultural sector, served to disturb the natural balance and accelerate a number of natural hazards.

Land management: The most important problems in land use are soil erosion and salinisation in improperly irrigated farmland. An estimated 60% of Kyrgyzstan's land is affected by topsoil loss, and 6% by salinisation, both problems with more serious long-term than short-term effects. In 1994 the size of livestock herds averaged twice the carrying capacity of pasturage land, continuing the serious overgrazing problem and consequent soil erosion that began when the herds were at their peak in the late 1980s. Uncertain land tenure and overall financial insecurity have caused many private farmers to concentrate their capital in the traditional form - livestock - thus subjecting new land to the overgrazing problem.

The Tien Shan mountains

The Tien Shan mountains are the largest mountain range in Asia, in surface area, with a length of 2,800 km and a maximum width of 800 km, and with a total of 40 peaks over 6,000 m. They stretch across several countries and much of the system lies in the territory of Kyrgyzstan. Extending from the Chatkal Range just east of Tashkent to Urumchi (beyond which they rise again as the Bogdo Ola Range), the Tien Shan mountains are usually described as being divided into northern, western, eastern, central and inner ranges and most of them exhibit typical “alpine” features.

It is the central portion, south-east of lake Ysyk-Köl, which contains the very high mountain peaks such as Khan Tengri and Peak Pobeda, closely grouped together along ridges that stretch east to west. The area surrounding the Enilchek Glacier has two peaks over 7,000 m (Pobeda and Khan Tengri), 23 higher than 6,000 m, and 80 more peaks between 5,000 and 6,000 m. The range is made up of sedimentary, metamorphic and igneous rocks.

Kyrgyz Ala-Too

The Kyrgyz Ala-Too (Kyrgyz: Кыргыз Ала-Тоосу, also Kyrgyz Alatau, Kyrgyz Range) is a large range in the north Tien Shan (Figs 2.1.3a and 2.2.2a). It stretches for a total length of 454 km from the west end of lake Ysyk-Köl to the town of Taraz in Kazakhstan. It runs in an east–west direction, separating Chuy Valley from Kochkor Valley, Suusamyr Valley and Talas Valley. The Talas Ala-Too Range adjoins the Kyrgyz Ala-Too near the Töö Ashuu Pass. The western part of Kyrgyz Ala-Too serves as a natural border between Kyrgyzstan and Kazakhstan.

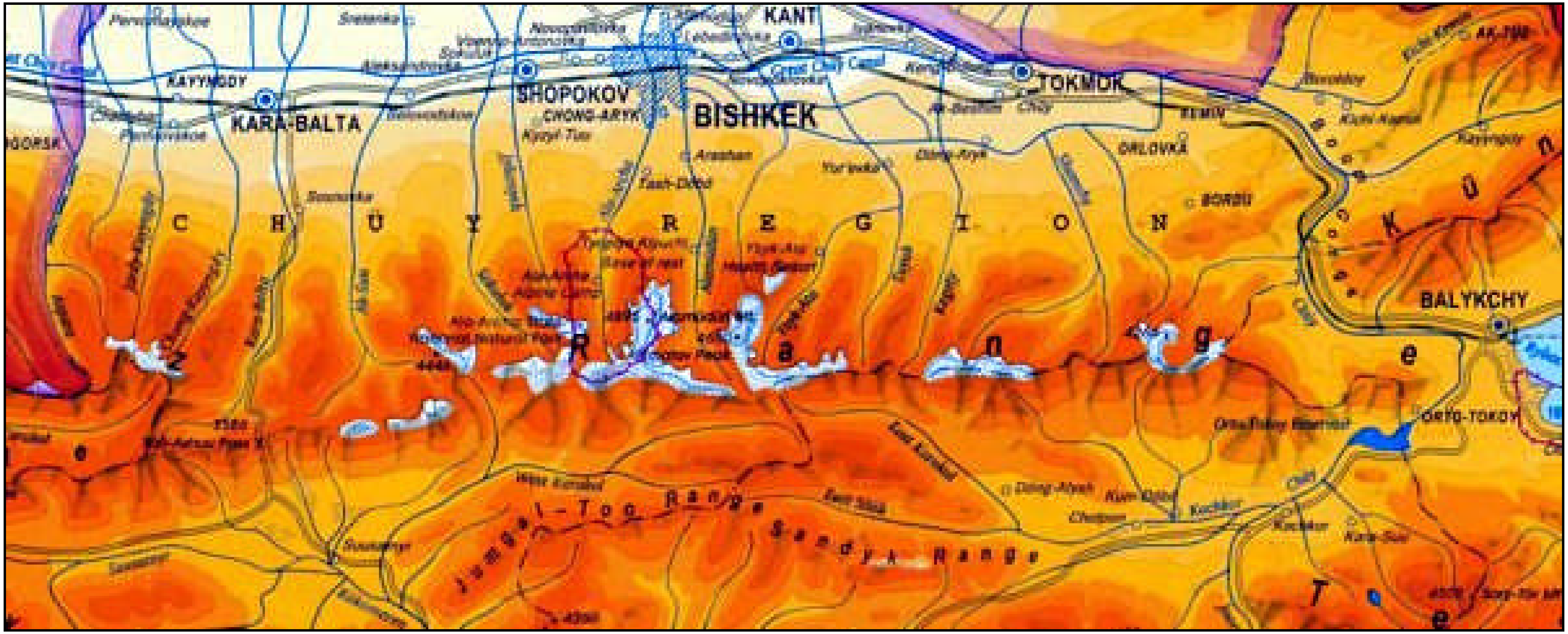


Figure 2.1.3a. The Kyrgyz Ala-Too Range to the south of Bishkek, the capital of Kyrgyzstan. Also see Figure 2.2.2a.

2.2. Materials and methods

2.2.1. Kyrgyz Ala-Too study site

By a joint decision of NABU and Biosphere Expeditions the Kyrgyz Ala-Too mountain range was chosen for snow leopard inventory and habitat research for several reasons including:

(1) The area in recent times has been poorly surveyed for snow leopard; previous research (Koshkarev 1989, see Table 2.2.1a) of the area has suggested the suitability of the area for sustaining snow leopards, however more evidence is needed before coming to a final conclusion.

Table 2.2.1a. Numbers, density and area occupied by the snow leopard in various parts of the Tien Shan (excerpt from Koshkarev 1989). Ala-Archa is within the Kyrgyz Ala-Too Range.

Range, river catchment area	Number of individuals	Average density (individuals / 100 km^2)	Occupied area (in km^2)
Aksu	12-14	2.51	517.5
Sokoluk	6-8	3.25	215.6
Ala-Archa	7-9	2.40	333.5
Issyk-Ata	5-6	3.25	169.0

(2) A map study suggested that the area may be an important corridor for snow leopard dispersal between the Talas Ala-Too Range (western Tien Shan) and ranges located in the Ysyk-Köl basin. According to a draft design of an ecological network for Kyrgyzstan, led by E.M. Shukurov, “it supports habitats and migration routes of many wild animals (the snow leopard, black vulture, bearded vulture, hawk-type raptors, lynx, wild boar, Siberian ibex, Himalayan snowcock) as well as juniper and spruce forests that need protection.”

(3) The habitat is high in biodiversity, supporting a range of prey species and other carnivores.

(4) The area lacks proper protection and is threatened by a growing economic interest; as quoted in the draft design above, “geographically, the zone is located in the Chuisk Oblast, which is the most populous province nationwide (over 1.5 million people). The proximity to the capital city of Bishkek makes the zone more vulnerable, because of heavy recreation pressure from city dwellers visiting the nearest national park, mountaineer camps, *zakaznik* (sanctuary) reserves, ski resorts, thermal springs etc. The anthropogenic impact on natural ecosystems is especially pronounced in summer, as domestic cattle (over 100,000 heads of cattle, over 250,000 of sheep and goats) are put to pasture on the Kyrgyz Ala-Too. The commonest violations of land use are unsystematic cattle grazing, illegal hunting and forest felling.” However, there is a potential here for establishing protected areas (several proposals have been made in the quoted draft) that could favour wildlife and benefit local residents.

2.2.2. Research area & timing of survey

Surveys concentrated on the south side of Kyrgyz Ala-Too, away from the main cities on the northern slopes. Suusamyr Valley was the expedition's main access route into the southern valleys. Suusamyr Valley is a high steppe plateau (2,200 m) that, although only some 160 km from Bishkek, is also one of the more remote and rarely visited regions of Kyrgyzstan, which was one of the reasons for selecting this option. The valley's population of about 6,000 is mainly Kyrgyz. In Soviet times the valley was one of the major sheep breeding areas in the country. Up to four million sheep a year were driven over the mountain passes in spring to graze on the grasses of the steppe. Today, in the summer, people still live in yurts (traditional round tent structures) and graze sheep and horses. The valley's main settlement, the village of Suusamyr, is also the one that gives the valley its name. The village lies at the eastern edge of the plain, about 15 km east of the main Bishkek–Osh road. From here, there is a route following the course of the West Karakol River at the southern foot of the Kyrgyz Ala-Too and up to the Karakol Pass (3,452 m) and leading further to Kochkor (Fig. 2.2.2a). The surroundings are practically deserted – there are virtually no settlements in the valley. In summer, people occupy the jailoos (high-mountain pastures) right up to the Karakol Pass itself – grazing horses, cattle and sheep.

For reasons of safety, accessibility and convenience, base camps were located close to the Suusamyr–Kochkor road. Base camp was moveable and moved once during the expedition in order to cover the largest area possible (see Fig. 2.2.2a). From base camp, mostly one-day surveys, but also some two-day/one-night surveys were conducted to various portions of the Kyrgyz Ala-Too Range and to Jumgal Too Range located on the opposite side of the West Karakol River.

Camp 1 (10 June – 3 July 2015) was set up in the Tuyuk-Ala-Archa Valley (N 42.351806^o, E 74.543806^o, elevation 2,705 m). Camp 2 (15 July – 7 August 2015) was relocated to a spot on the side of the West Karakol River (N 42.359639^o, E 74.695861^o, elevation 2,919 m). This site was surrounded by running water: on one side by the river itself and on the other by a shallow stream, hence the location's name of "Aral", meaning "island" in the Turkic languages. Camp locations are shown in Figure 2.2.3b.

Snow leopard surveys are best undertaken when weather permits travel within the proposed survey area, when animals are most actively marking and when signs are most long-lived. These conditions rarely coincide, so trade-offs have to be made between logistical factors and biological ones. Logistics and team recruitment factors by and large determined the survey period for this study. On the one hand, summer is a difficult time to find snow leopard signs: marking activity is low, human disturbance is high and livestock grazing can soon obliterate signs. Suitability of tracking substrate is also poor (tracking is much easier in snow). Weather conditions also tend to be unpredictable and contribute to sign erosion and eradication; rain erodes signs very rapidly. On the other hand, recruiting for a summer expedition is much more realistic, logistics are not nearly as prohibitive as in winter and, most importantly for this study, human presence can be a valuable source of information, especially in the absence of other baseline data.

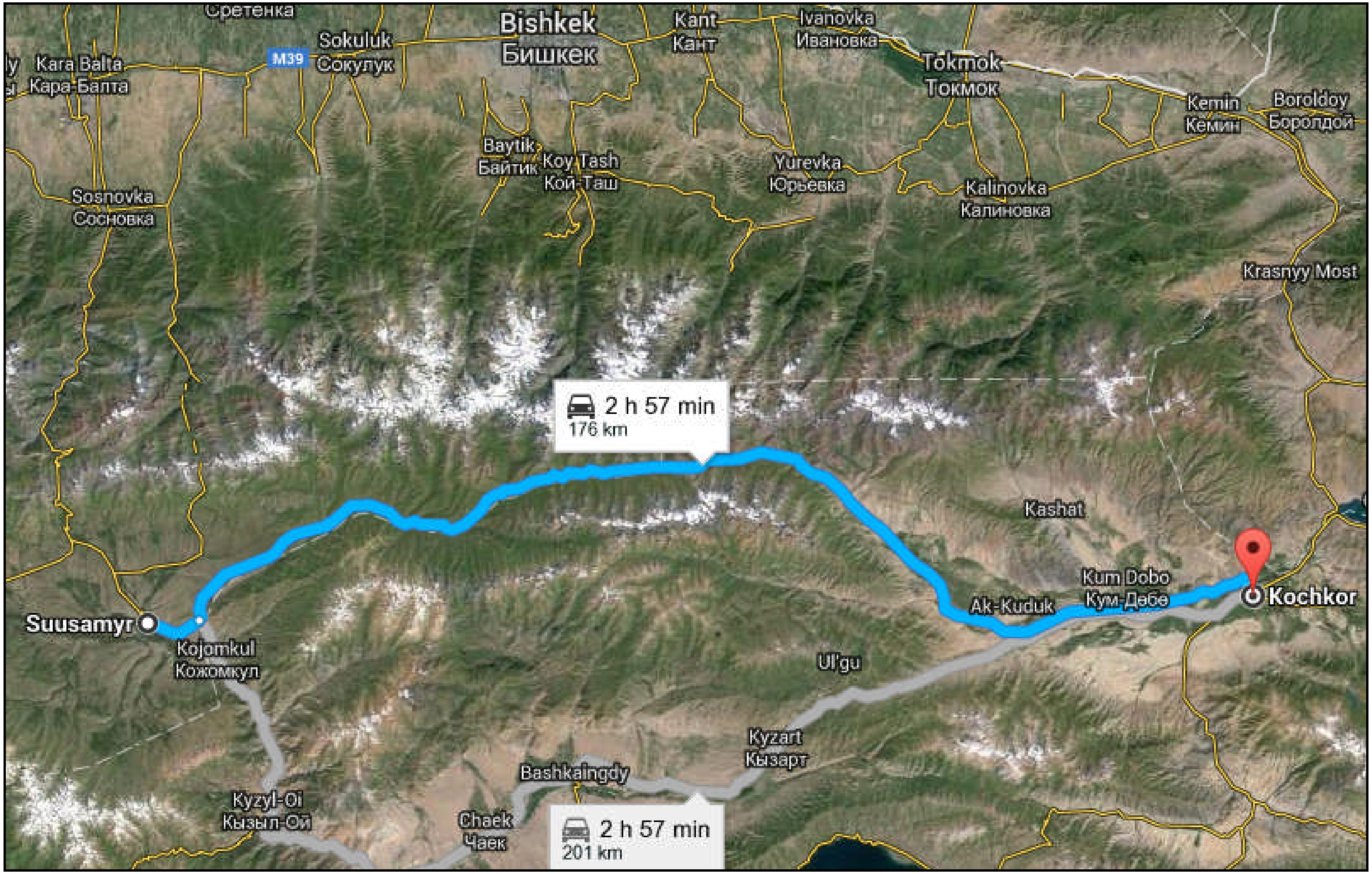


Figure 2.2.2a. Kyrgyz Ala-Too and road from the villages of Suusamyr to Kochkor (along Suusamyr valley) on the range's southern side (from Google Maps).

2.2.3. Methods

Survey routes followed river valleys and landform edges wherever possible. Research focused on areas considered the most important habitat for snow leopard and prey, and with the lowest levels of human disturbance. Distant survey sites were accessed by car. Ground surveys were conducted on foot.

Snow leopard presence can be detected by signs, i.e. pugmarks (tracks), scrapes, faeces (scat), urination and scent spray on rocks. These signs tend to be left in relatively predictable places. For example, scrapes tend to be left at the base of cliffs, beside large boulders, on knolls and promontories, at bends in trails, or along other well-defined landform edges (Koshkarev 1984, Schaller et al. 1987, Jackson & Ahlborn 1988, Mallon 1988). These factors are important when deciding where to survey.

Surveying the prey base is another essential component of a snow leopard presence/absence survey. Argali (*Ovis ammon*) and ibex (*Capra sibirica*) are considered the main prey species in the area. In general, their range closely parallels that of the snow leopard.

Prey species were surveyed by recording signs and by direct observation. Prey signs included tracks, faeces, hair/wool and carcasses/bones. Prey species were divided into "primary" (ibex and argali) and "secondary" (roe deer *Capreolus capreolus*, marmot *Marmota caudata*, pika *Ochotona* spp., hare *Lepus capensis tolai*, wild boar *Sus scrofa* and game birds, in line with Lyngdoh et al.'s (2014) prey preference study). The same search sites were used for snow leopard and for prey.

The study site encompassed an area of 122 x 38 km within the Kyrgyz Ala-Too Range (see Figs 2.2.3a and b), with additional surveys conducted in the Jumgal Too Range. The area was divided into 2 x 2 km cells and surveying followed the methodology manual developed for volunteer expeditions by Mazzolli & Hammer (2013).

GIS and mapping

The main reference maps used were Soviet military topographic maps created between 1950 and 1980 at a scale of 1:100 000 and 1:200 000. A GIF image of the area was imported and georeferenced into the GIS freeware program TrackMaker (www.gpstm.com) (Fig. 2.2.3a). A grid of 2 x 2 km coded cells, of which a fraction was actually surveyed, covering the study area was uploaded into the expedition's GPS units (Garmin eTrex 20 and 30) to aid navigation and data collection. Grid data was in Universal Transverse Mercator projection, covering zone 43T and datum WGS 84.

Using GIS freeware programs DIVA-GIS 7.5 (www.diva-gis.org/) and QGIS 2.6.1 (www.qgis.org), grid cells were polygonised, their centroids were found and hexagon buffers were created around them. These shapefiles were then used in the subsequent analysis of collected data.

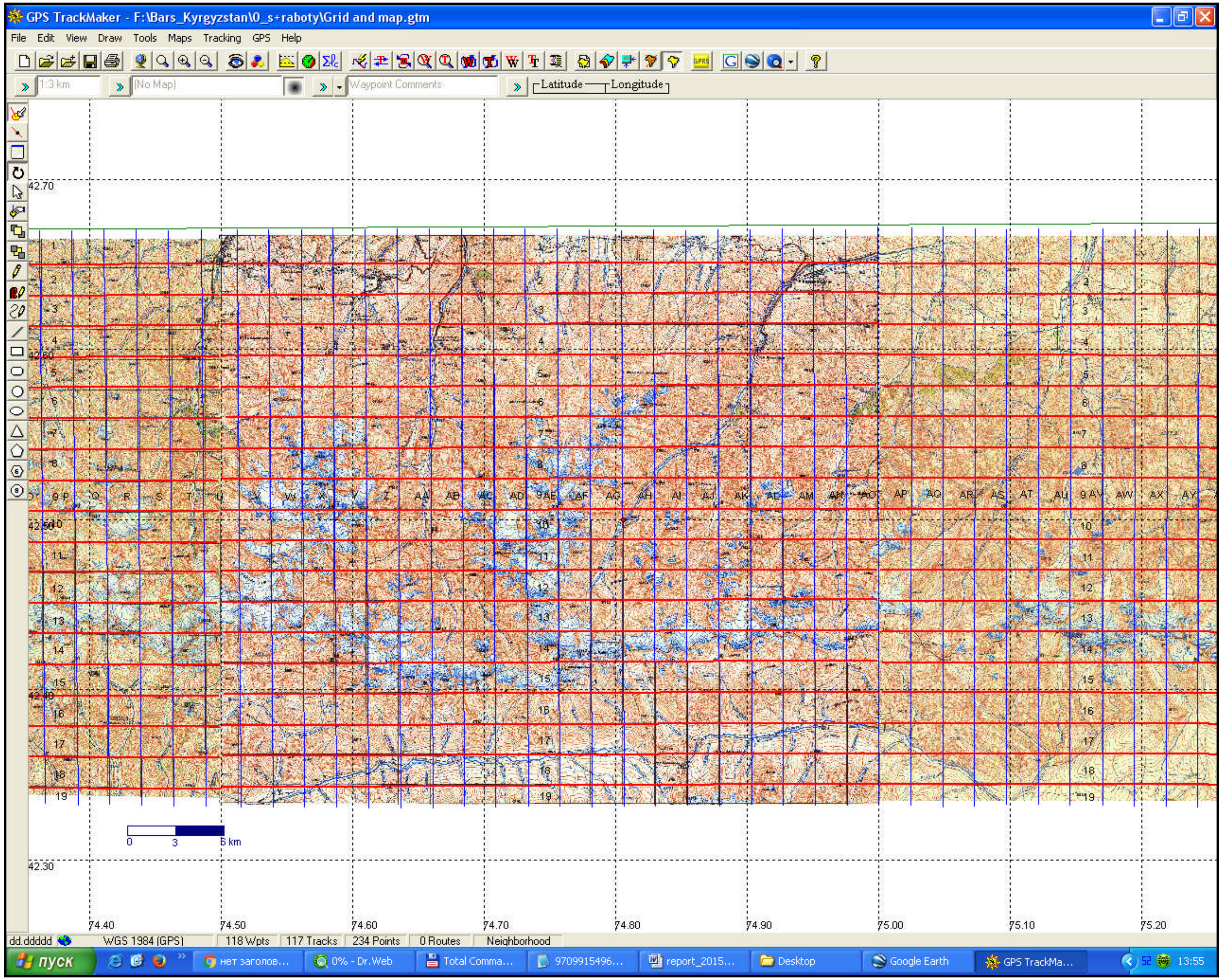


Figure 2.2.3a. Screenshot of the map and grid of 2 x 2 km cells covering the study area (viewed in the GIS freeware program TrackMaker).

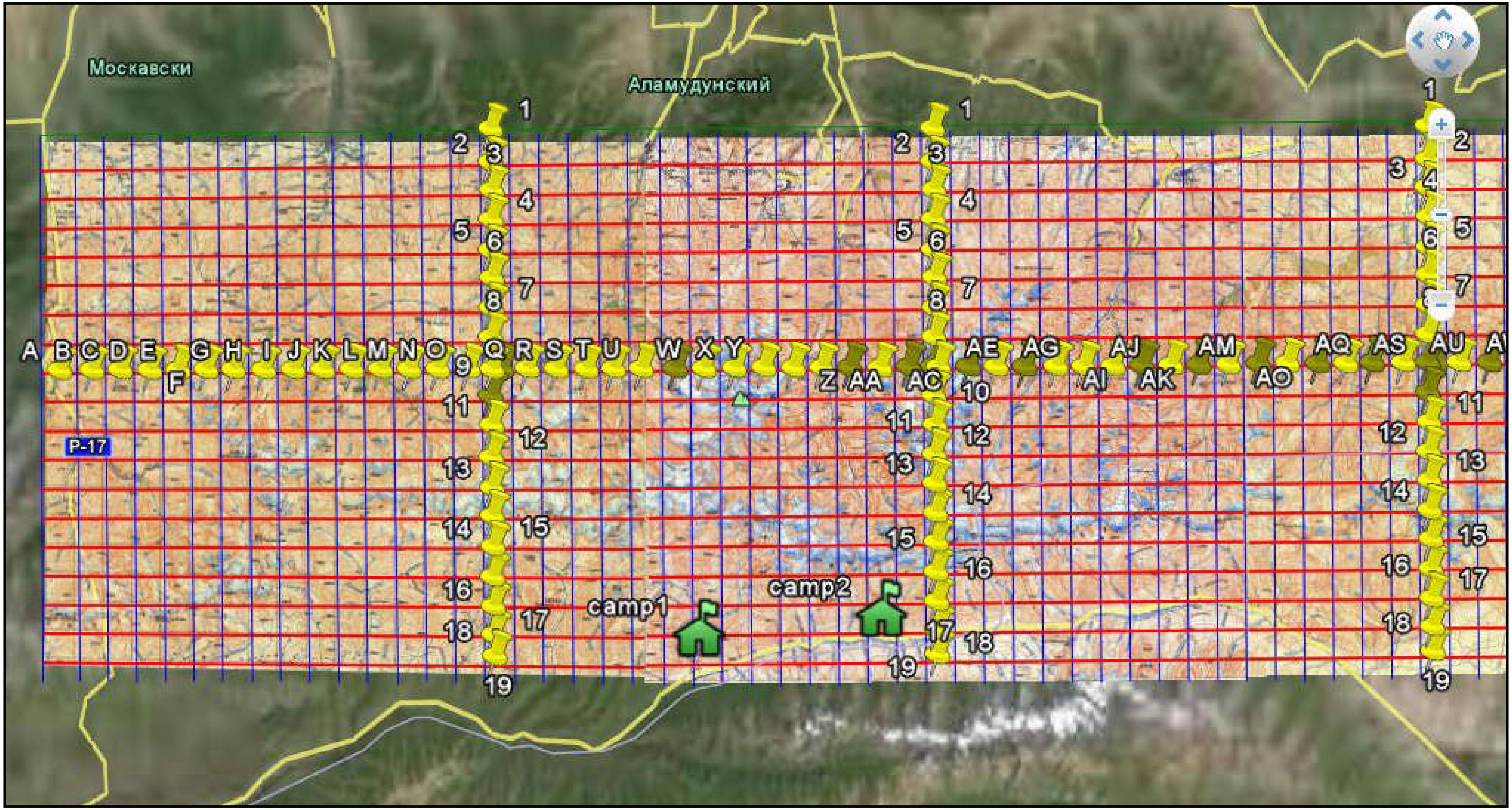


Figure 2.2.3b. Fragment of the map and grid of 2 x 2 km cells (depicted in Figure 2.2.3a above), shown as a Google Earth file (*.kml).
Grid lines (tracks) – red, waypoints – yellow pins, base camps – green icons.

2.2.4. Training of expedition participants

In this study, data collection was performed by volunteers with no previous knowledge of wildlife research and conservation, except that which was given during the initial stages of the expedition. Training included an introduction to snow leopard conservation issues, the role of NABU and Biosphere Expeditions in the snow leopard survey and the methods of recording presence of species using GPS and datasheets. For these purposes various handouts were produced, including an 18 page illustrated Expedition Field Guide.

Before participants were split into small groups to perform their various research tasks, an introductory survey on the first day was performed as part of the training process. During this survey, tracks and scats of known species were shown.

To reduce identification errors, participants were instructed to bring scats to base camp whenever they were unable to identify the species. They were also briefed on how to take photos of tracks for identification later at base. The large surveying team recruited by Biosphere Expeditions helped to cover a substantial geographical area in a short time, meaning that chances of finding snow leopard and other wildlife sign were maximised by having many people fully engaged in looking for vestiges.

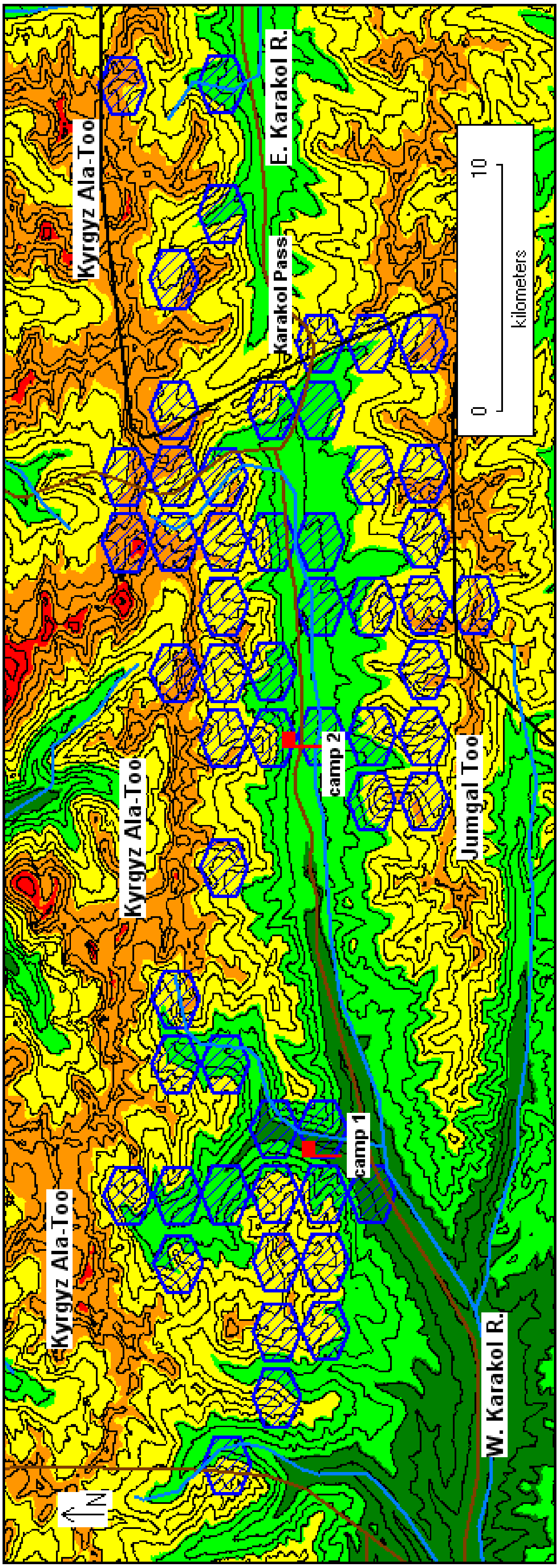
2.2.5. Sampling

Fifty-six cells 2 x 2 km in size over a 20 x 58 km area located in the southern Kyrgyz Ala-Too Range (Fig. 2.2.5a) were surveyed for snow leopard and sympatric medium and large-sized mammals and game birds during an 8-week period in June-August 2015. Some cells were resampled a number of times. Individual survey teams ranged from four to eight volunteers. Following the presence/absence method of occupancy (MacKenzie et al. 2002) and the field manual developed by Mazzolli & Hammer (2013), the presence of prey species and large carnivores was recorded using the general location given by a cell code. Once a species or its signs were found in a given cell, it was scored as containing the species.

In cases of snow leopard sign GPS records were taken at the spot. Locations of Siberian ibex sightings were also recorded using a GPS receiver when feasible and with the aid of a physical map and a SILVA compass. This was done to record more precisely their location for modeling purposes, rather than just recording the cell code alone.

There is a need to cover large areas so that the survey can better represent the snow leopard and potential prey populations. Furthermore, it is recommended that rare species should be surveyed in more locations less intensively than few locations intensively (MacKenzie, Royle 2005). For this reason, teams usually covered two or more 2 x 2 km cells during the daily surveys.

Nineteen digital Bushnell camera traps were set throughout the study area. The cameras were installed in areas which the field team perceived as good spots to produce photos of the snow leopard and species associated with snow leopard habitat. Other species, including birds, mammals, one amphibian species and butterflies, were recorded whenever possible.



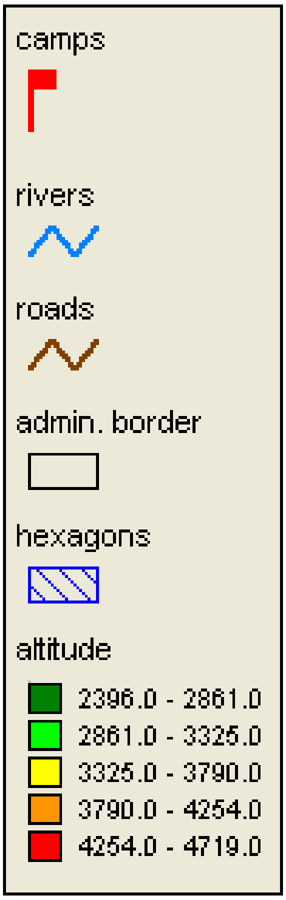


Figure 2.2.5a. The 2 x 2 km cells sampled and found to contain data in the planned research area (for convenience of computer processing in GIS the "square" cells are represented by hexagons, which share the same centroids, i.e. "average" position of all the points in the shape). The administrative border is between the Chuy and Naryn oblasts of Kyrgyzstan. Legend is the same for the maps below.

2.2.6. Species records and modelling for Siberian ibex

We gathered 75 records of Siberian ibex in the study area according to direct sightings and camera trap results obtained over two consecutive years (the expeditions in 2014 and 2015). This was enough to produce a predictive model of the ibex distribution. The extracted points were georeferenced using *OziExplorer* v.3.95.4m. All the coordinates were expressed in decimal degree and converted to a point vector file for modelling the distribution of the species. Only spatially unique ones, corresponding to a single environmental grid cell (resolution of 30 arc seconds, ~ 1km) were used.

Environmental & bioclimatic data

To relate the occurrence records of ibex with abiotic conditions, we downloaded 19 bioclimatic variables for the current climate at a 30 arc second resolution and WGS84 projection (Hijmans et al. 2005). These variables represent annual trends (e.g. mean annual temperature, annual precipitation), seasonality (e.g. annual range in temperature and precipitation) and extreme or limiting environmental factors (e.g. temperature of the coldest and warmest month, and precipitation of the wet and dry quarters).

Temperature has long been recognised as an important environmental factor in ecosystems in regard to its pivotal role over biological (development, growth and reproduction), chemical and physical properties. Precipitation regimes and variation of precipitation events have broad effects on ecosystem productivity, habitat structure and ultimately on species distribution.

For the study region of the Kyrgyz Ala-Too, scientific data on a range of environmental resources (other than bioclimatic) are limited, which hinders sustainable management and nature conservation.

The need for updated information has long been recognised and stimulated the use of earth data using remote sensing techniques, which has become a universal and familiar instrument for assessing natural resources (Philipson & Lindell 2003). Information from low-altitude satellite sensors and remote sensing offers an optimal path for understanding pattern and process related to rangeland condition in the area. The multi-temporal and multi-spectral data acquired by various satellite sensors are used to identify, map and monitor rangelands, and to derive specific environmental variables.

We used a Landsat 8 satellite image (path 151/row 31) taken on 7 August 2014 (Fig. 2.2.6a), freely acquired from the U.S. Geological Survey georeferenced GeoTIFF files at a 30 m resolution via https://libra.developmentseed.org/. This image encompassing the study area was selected because of the minimum cloud coverage (0.16%).

Candidate predictor variables were extracted from the Landsat image. Although raw Landsat bands can convey habitat information (e.g. open water is easily differentiated from vegetation in infrared bands), derived variables can be better predictors than raw ones (Wintle et al. 2005).

The variables found in the published results as most suitable to predict the ecological niche dominance within the landscape include tasselled cap transformation, Enhanced Vegetation Index (EVI), and Land Surface Temperature (LST).

EVI is a standardised vegetation index, which allows us to generate an image showing the relative biomass.

Landsat 8 thermal bands, i.e. band 10 and band 11, were used to calculate the brightness temperature over the study area. This gives an assessment of the ground temperature, which may be hotter than the ambient air temperature.

Tasselled cap transformations, originally developed to understand changes in agricultural lands, generate three orthogonal bands from the six-band Landsat composite (Huang et al. 2002). The three generated bands represent measurements of brightness (band 1, dominated by surface soils), greenness (band 2, dominated by vegetation) and wetness (band 3, includes interactions of soil, vegetation and moisture patterns) (Kauth & Thomas 1976).

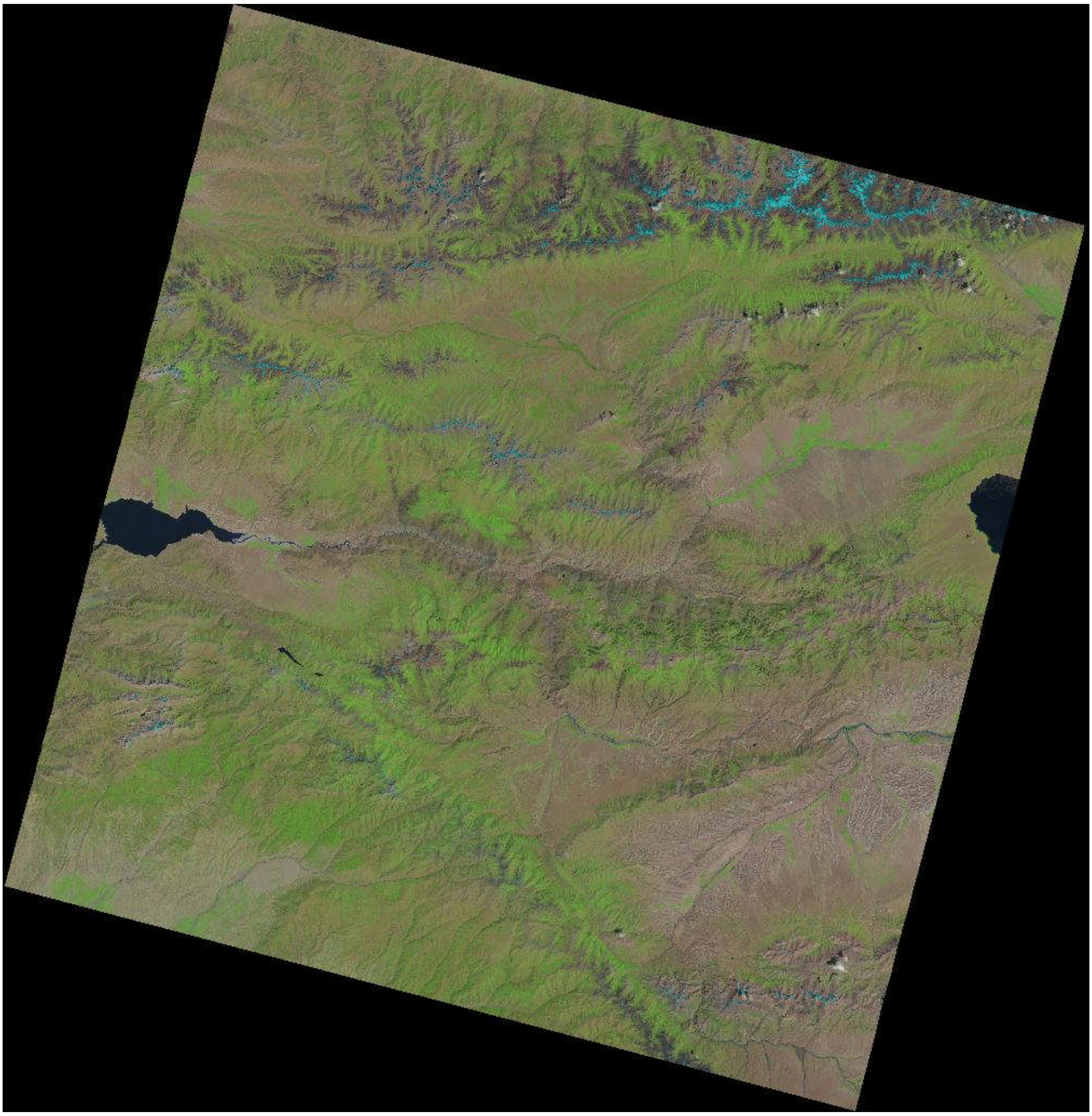


Figure 2.2.6a. Landsat 8 image LC81510312014219LGN00.

A digital elevation model (DEM) was used as input for capturing topographic variables. The DEM was aggregated from the 30 seconds (~30 m) NASA Shuttle Radar Topography Mission (SRTM) DEM. The following terrain features were extracted: slope, aspect and terrain ruggedness. Slope is the steepness or the degree of incline of a surface. Aspect is the orientation of slope, measured clockwise in degrees from 0 to 360, where 0 is north-facing, 90 is east-facing, 180 is south-facing, and 270 is west-facing. The topographic ruggedness index (TRI) was developed to express the amount of elevation difference between adjacent cells of a DEM. These were selected because terrain roughness and slope generally create a template of risk, in which herbivores have to trade off between resource acquisition (e.g. foraging in high quality habitats, finding mates) and predator avoidance (Schweiger et al. 2015). Ibex are very good climbers that find protection from predators and the possibility to overview large areas in predominantly rocky terrain with steep slopes.

The resolution or grain of Landsat images (30 x 30 m) and the DEM is finer than the accuracy by which we can record ibex presence in the field; for this reason all the considered environmental layers have been rescaled to a 30 arc second resolution (~ 1 km).

The System for Automated Geoscientific Analyses (SAGA) GIS software (v. 2.2.7) has been used for the preliminary data processing and extracting (clipping) images for the study area. SAGA is a Free Open Source Software (FOSS). SAGA's analytical and operational capabilities cover geostatistics, terrain analysis, image processing, georeferencing and various tools for vector and raster data manipulation (Conrad 2006). Final results were processed and visualised in DIVA-GIS 7.5 (http://www.diva-gis.org/) and QGIS 2.6 (http://www.qgis.org/), free computer programs for mapping and geographic data analysis.

Statistical modelling

Factor analysis in Statistica 8 Portable was used to examine the contributions and the main patterns of inter-correlation among the potential environmental controls. Principal component (PC) was used as the extraction method. By rotating the factors a factor solution was found that is equal to that obtained in the initial extraction, but which has the simplest interpretation, and for this purpose the Varimax normalised type of rotation was applied. Usually a solution that explains 75–80% of the variance is considered sufficient.

Maxent distribution model

We used the freely available Maxent software, version 3.3.3k, which generates an estimate of probability of presence of the species that varies from 0 to 1, with 0 being the lowest and 1 the highest probability. The default settings of Maxent were used in this study. We ran models with 25 bootstrap replicates. Model performance was assessed using the average AUC (area under the receiver operating curve) score to compare model performance. AUC values >0.9 are considered to have "very good", >0.8 "good" and >0.7 "useful" discrimination abilities (Swets 1988).

The logistic output format was used, because it is easily interpretable with logistic suitability values ranging from 0 (lowest suitability) to 1 (highest suitability).

The logistic probabilities provide a relative indication of the likelihood of occurrence of the species, but they do not define predicted occurrence in the binary, presence/absence manner typically required by managers. Better interpretation is made in most cases by defining thresholds of habitat suitability. Therefore, we applied three thresholds to the logistic output of each model to produce a three-category model, restricting the predicted probability of occurrence to values >0.4, >0.5 and >0.6. Final versions of maps were considered to benefit by generalising raster outputs: 2x2 neighbourhood filtering implemented in DIVA-GIS was applied for this purpose.

2.2.7. Outreach activities

Involvement of the local communities through interviews and talks was an important part of the expedition. Time was spent with local people in their villages, settlements and surrounding areas, in order to gather local knowledge about the area and record snow leopard sightings, to investigate the level of human/wildlife conflict and to learn about local attitudes to wildlife and natural resources. Participants recorded data gathered during interviews. The NABU staff together with local volunteers provided invaluable help in communicating with local people.

2.2.8. Petroglyphs – rock art

Petroglyphs are one of the earliest expressions of abstract thinking and are considered a hallmark of humanity. Beyond their value as an aesthetic expression, petroglyphs provide a rich body of information on several different dimensions. They may shed light on the dynamic histories of human populations, the patterns of their migrations and their interactions. Petroglyphs have also been used in studies of climate change and the changing inventories of species (Lenssen-Erz & Heyd 2015).

A large number of petroglyphs (pictures drawn or etched onto stones) were found in the field. These petroglyphs left on rocks can provide evidence of the way of life and the environment of times gone by when there was no system of writing. Kyrgyzstan boasts a very large number of petroglyphs and recent mapping of sites showed that petroglyphs are found all over the country. It may be that some of the locations found during the expedition were previously unknown.

2.3. Results

2.3.1. Snow leopard presence/absence survey

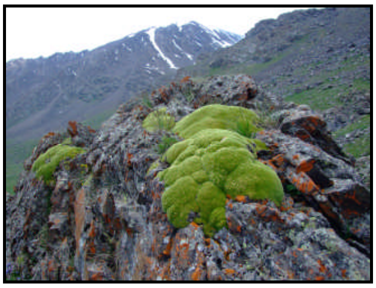
Over an eight-week period from June to August 2015 snow leopard presence/absence surveys were carried out in 56 2 x 2 km cells (Fig. 2.2.5a). The search effort took from 5 to 10 hours per cell. Elevations ranged from 1,998 m to 3,396 m. The dominant landscape surveyed in the areas consisted of narrow valleys and broken terrain. Other landforms included grass plateaus, ridges, rockfalls, moraines and glacial lake areas.

In terms of the Global Land Cover 2000 Project (GLC 2000), a harmonised land cover database over the whole globe, seven land cover categories can be distinguished in the study area (Fig. 2.3.1a), amongst which areas of “herbaceous cover, closed-open”, “bare” areas and areas covered with “snow and ice” are prevailing, occupying 59%, 14% and 21% of the area covered in the survey respectively.

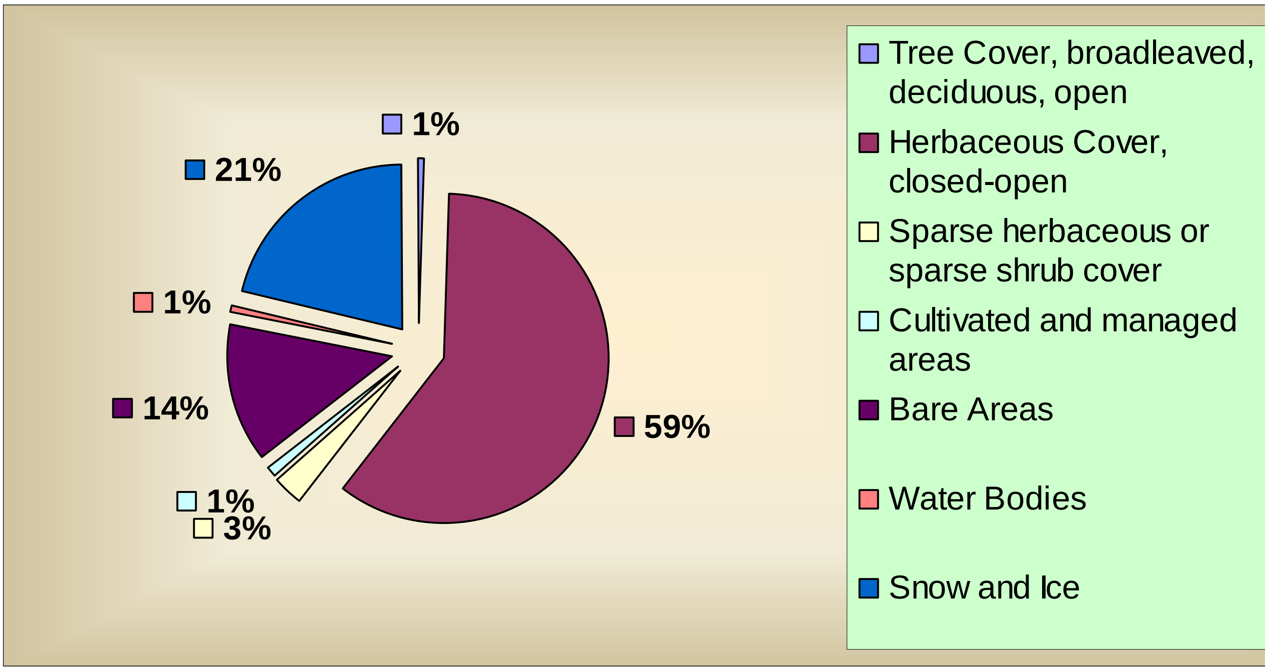
GLC 2000 makes use of the VEGA 2000 dataset: a dataset of 14 months of pre-processed daily global data acquired by the VEGETATION instrument on board the SPOT 4 satellite (Fritz et al. 2003).

Tree cover, broadleaved, deciduous, open

Herbaceous cover, closed-open



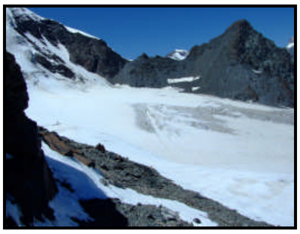
Sparse herbaceous or sparse shrub cover



Cultivated and managed areas

Bare Areas

Water Bodies



Snow and ice

Figure 2.3.1a. Types of GLC 2000 land cover categories found in the study area and their percentages.

Tracks (pugmarks)

These are more easily found in sandy rather than gravelly places, but sandy or muddy areas were only present at lower elevations, away from preferred snow leopard terrain. Snow patches left over from the winter and fresh snow cover were specifically examined for tracks. Table 2.3.1a and Fig. 2.3.1b detail the three sets of tracks found by the expedition in 2015.

Table 2.3.1a. Snow leopard tracks found by the 2015 expedition.

Date	Location	GPS location	Elevation (m)	Cell	Notes
16 June	Karakol Pass	N 42.355167^o E 74.839944^o	3,405	AI18	Tracks of one animal crossing in a SE direction in snow
15 July	Upper reaches of Kashka-Tor Valley	N 42.305222^o E 74.746806^o	3,564	AE20*	Tracks of one animal in muddy soil
16 July	Upper reaches of Issyk-Ata Valley	N 42.419389^o E 74.780139^o	3,846	AF14	Track of one animal in snow

*Interestingly, in 2014 in the neighbouring cell of AF20 a foal had been presumably attacked by a snow leopard and mutilated, but escaped death. Up to now this is a second indication of snow leopard presence in that particular area.

Scrapes

These can be found in sandy sites (short-lived) and gravel (longer-lived). Unfortunately, suitable substrates were not present in most of the survey area favoured by snow leopard, where the majority of substrate was vegetation-covered or broken terrain. Potential suitable substrate was subject to livestock grazing. Rainfall and occasional snowfall throughout much of the survey period also reduced the possibility of finding scrapes.

No scrapes of possible snow leopard origin were encountered.

Faeces

Faeces can be long-lived in areas with little rainfall and minimal insect activity – the survey area was subject to high rainfall and intense insect activity. Grasshoppers and ground beetles, for instance, were found at all but the highest elevations and are voracious consumers of faecal matter. Faeces can be deposited solitarily or with other scats of varying ages. Faeces are most often found in association with scrapes.

No sign of faeces was recorded.

Urination

Urine can be deposited on scrape piles and is commonly deposited along regular paths or trails.

No definite signs of urination were found during the survey period. Lack of trails and difficulty in finding scrapes were a contributing factor.

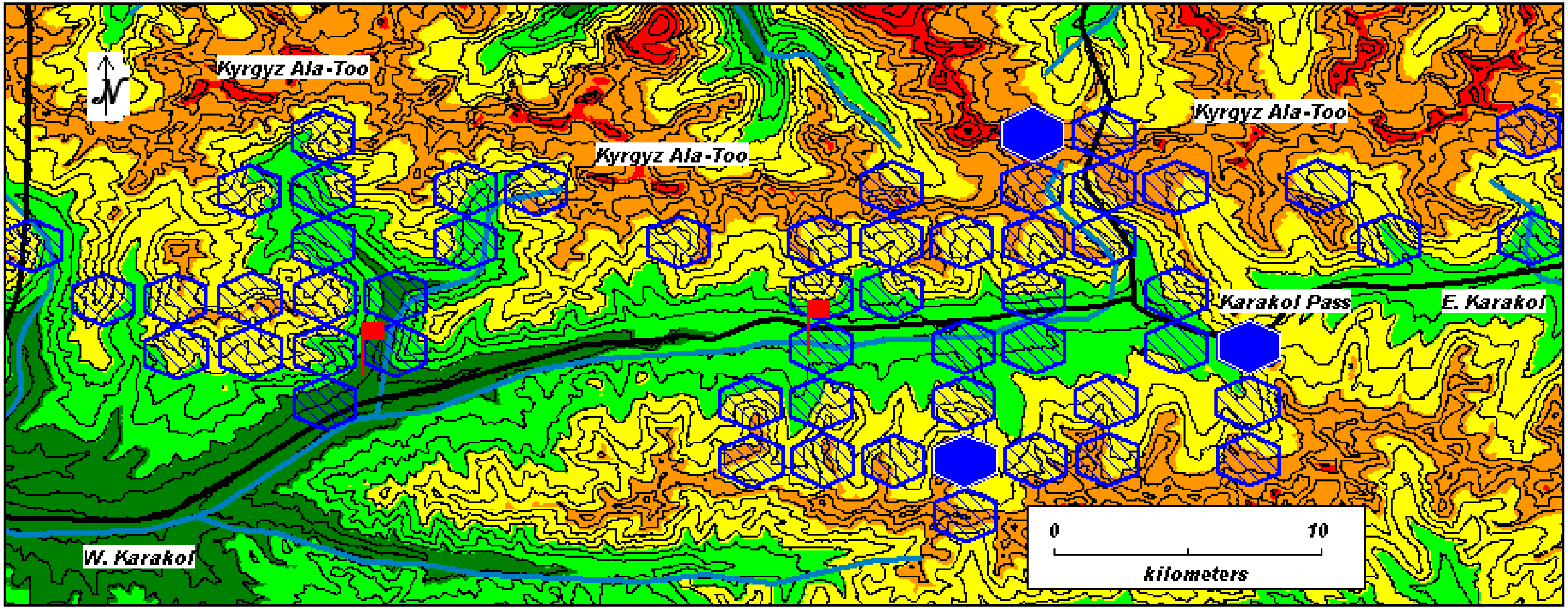


Figure 2.3.1b. Location of cells (shaded blue) in which snow leopard tracks were found by the 2015 expedition.

Scent spray

Snow leopards spray-mark the faces of upright or overhanging boulders and the base of cliffs. Some sites are periodically revisited and re-sprayed (mainly along trails). The majority of spray sites will have one or more scrapes within a distance of a few metres.

No scent spray was found during the survey.

2.3.2. Threats to snow leopard presence

In the course of the presence/absence survey, an account was taken of human-induced factors considered to threaten snow leopard presence in the area. Grazing activities turn out to be the most common and are widespread. In the early season most of the grazing is confined to foothills and mouths of valleys facing the West Karakol. However, later on in the summer (with the depletion of the grass stands), herds move up the valleys and reach altitudes where they become a disturbing factor to snow leopards and/or they prey.

In some ways the negative impact of human presence on prey availability (i.e. Siberian ibex) can be evidenced by the obviously inverse relationship between the numbers of interviewed villageres (INT), as a proxy of human presence, and direct sightings (OBS) of ibex, reflecting (with certain amendments) their numbers and abundance in the field (Fig. 2.3.2a).

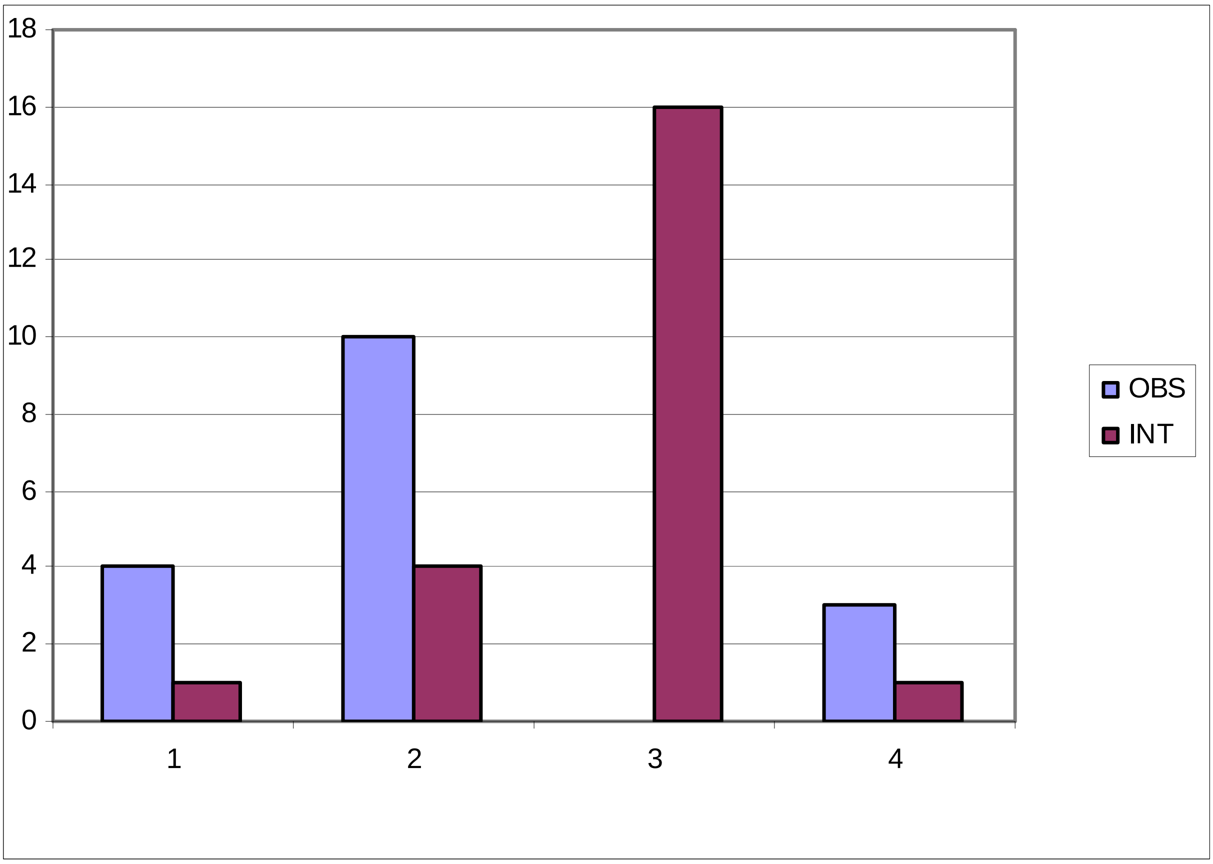


Figure 2.3.2a. Numbers of direct sightings (OBS) of Siberian ibex and interviews conducted (INT) in expedition groups 1, 2, 3 and 4.

In general, the grazing pressure in the area has considerably reduced from the former communist regime. Many areas suitable for grazing have been abandoned by herders as they are no longer subsidised by the government. Today these areas are considered to be “empty”, but judging by the abundance of ruderal weeds (i.e, species typically dominating disturbed areas such as Bishop's weed *Aegopodium podagraria*, lady's mantle *Alchemilla vulgaris* etc.), much of the ecosystem in the area is yet far from full recovery.

Occasional horse droppings and car tracks found at higher altitudes indicate sporadic human presence over most of the area. Other signs of human presence and disturbance included bullet cases, hides, campfires and various items of rubbish left behind by visitors.

2.3.3. Prey base survey

Signs of prey species during presence/absence surveys were found to be fairly abundant and widespread in a variety of terrains for some species (Fig. 2.3.3a). Most records were of Siberian ibex (39%), whereas argali (12%) is less abundant in the study area with only indirect signs of its presence. Marmots are common at lower elevations (28%), whereas indications of snowcock presence (13%) appear at higher altitudes (these are mainly droppings left over from the winter season).

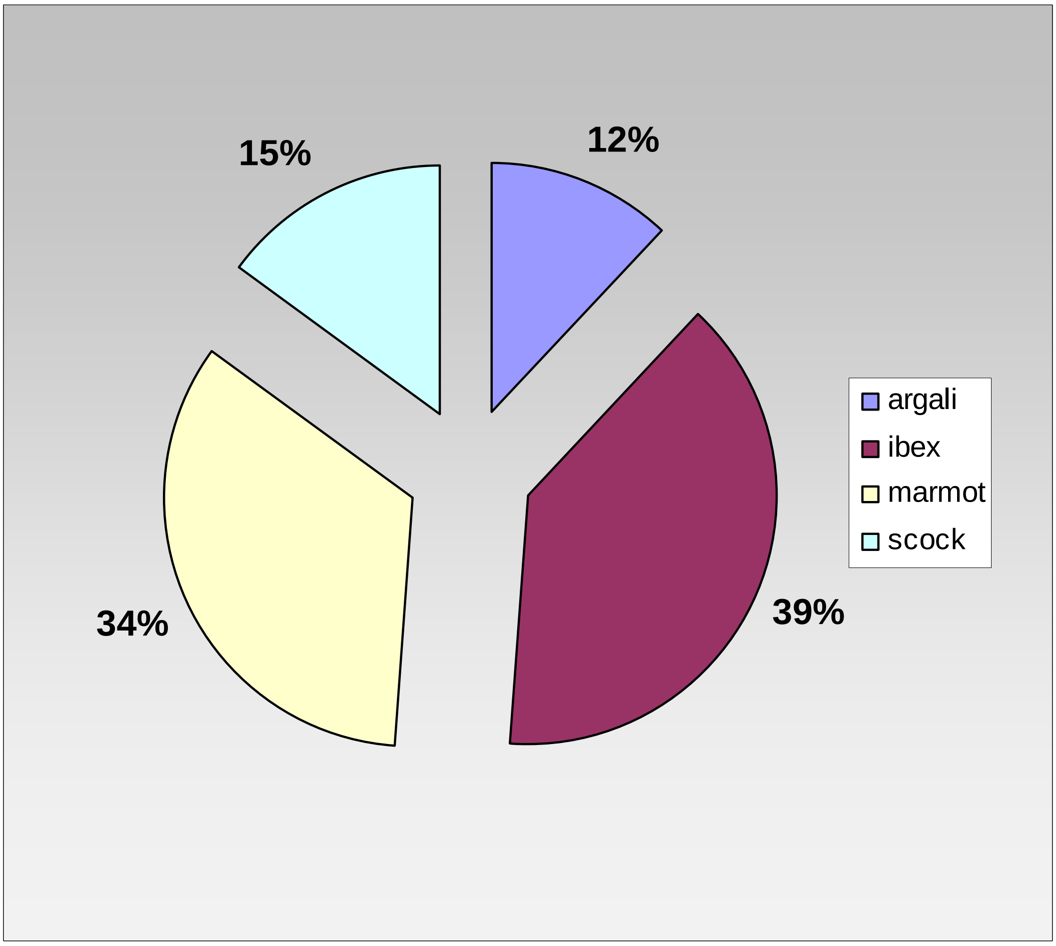


Figure 2.3.3a. Signs of prey species found in the presence/absence surveys (in % of records) during the expedition.

The maps below display the cells in which species with substantial quantitative information were found.

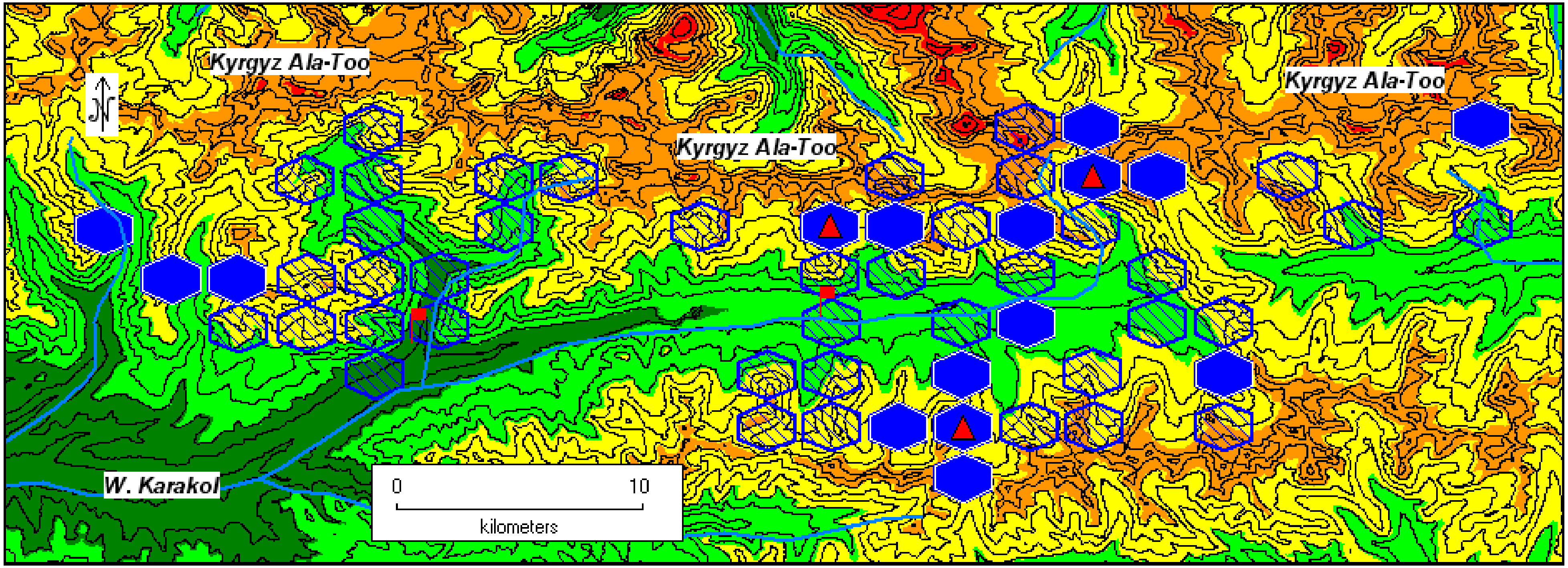


Figure 2.3.3b. Map showing the distribution of Siberian ibex. Recording methods are direct observation (n=21) and camera traps (n=8). In a number of cells independent records were made two to three times. Red triangles indicate cells where camera traps were placed and successfully took pictures of ibex.

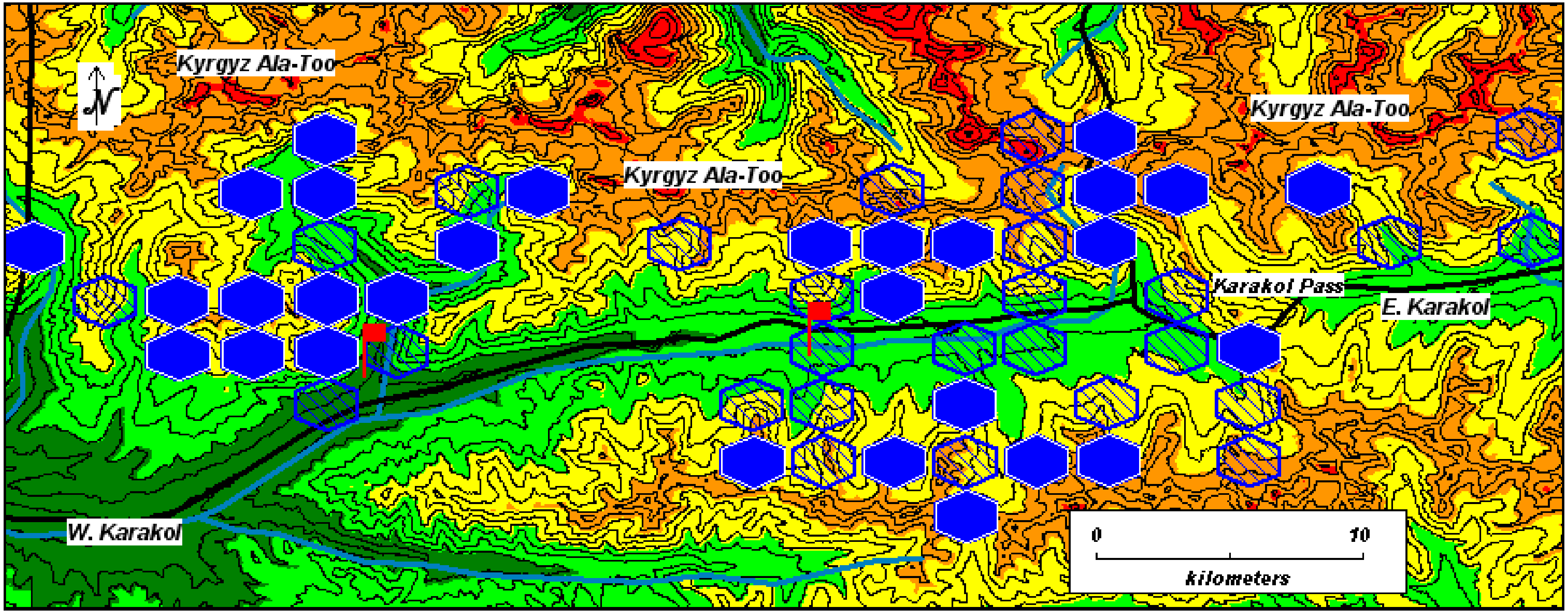


Figure 2.3.3c. Map showing the distribution of ibex (recording methods: track, scat and other, n=51). Note that some cells yielded a number of independent records.

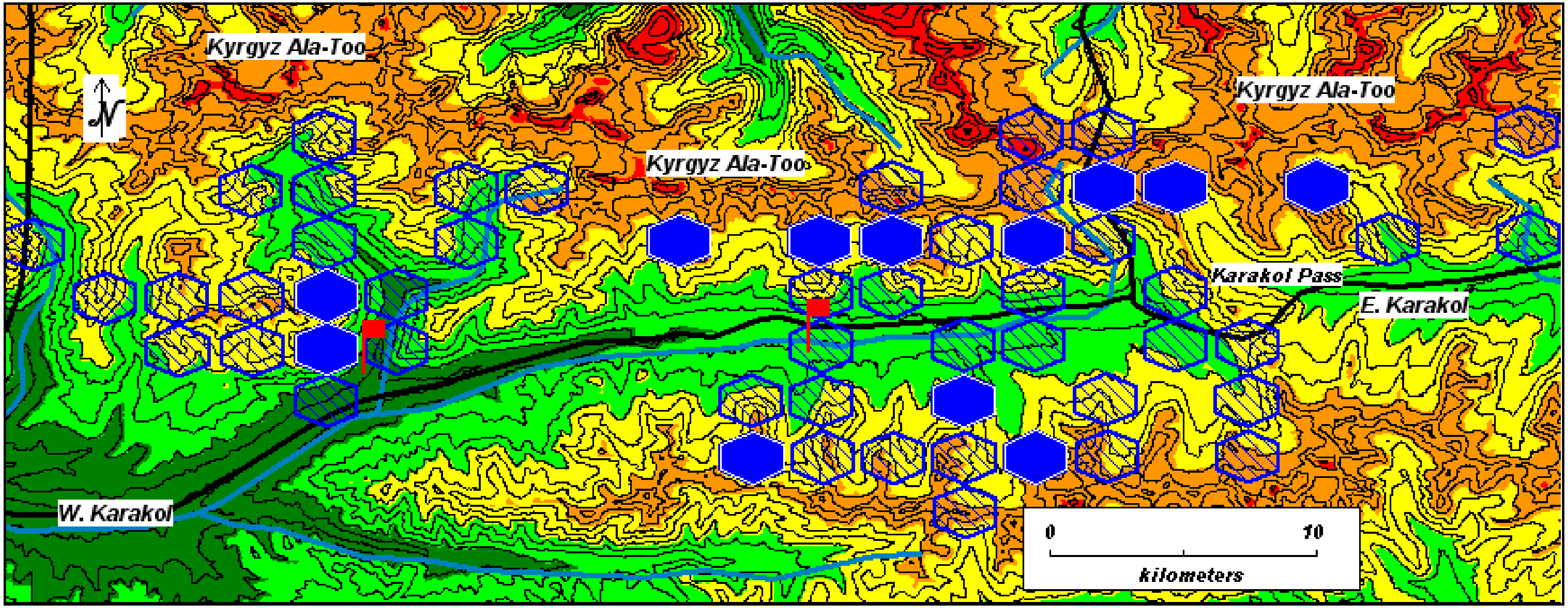


Figure 2.3.3d. Map showing the distribution of argali (recording methods: scat and other, n=15).
Note that some cells yielded a number of independent records.

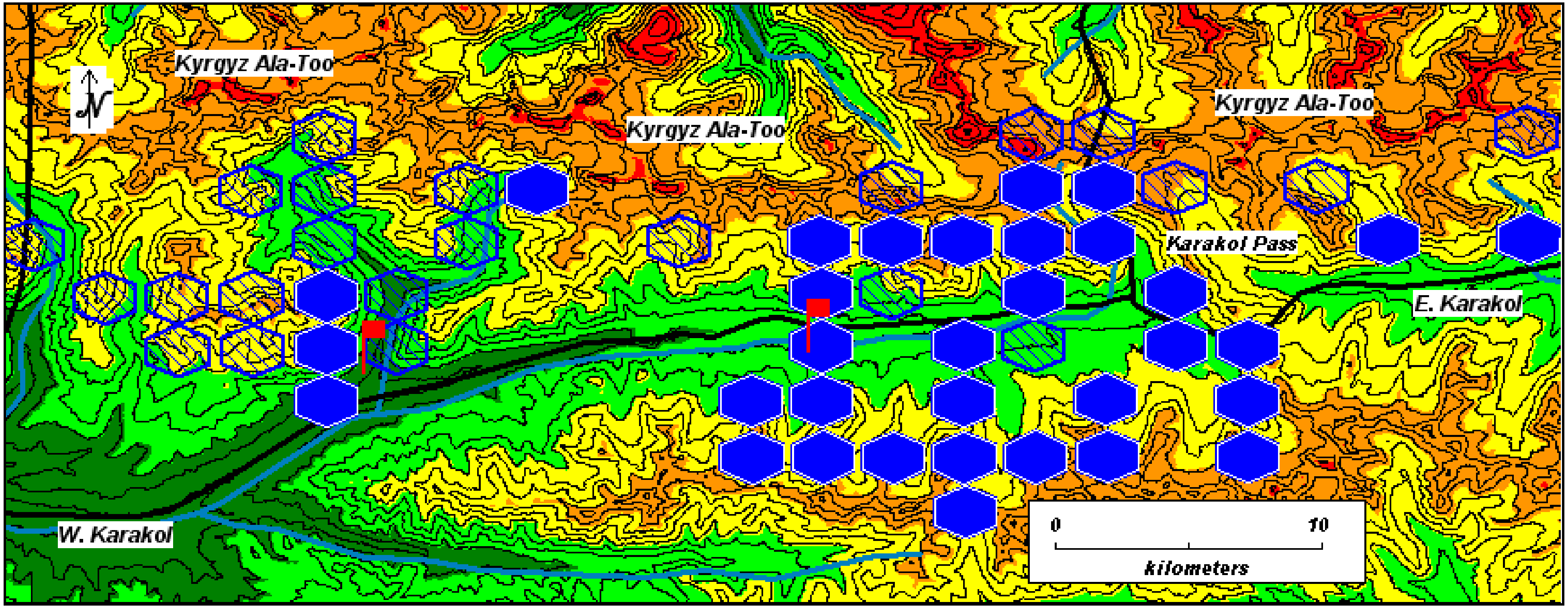


Figure 2.3.3e. Map showing the distribution of marmot (recording methods: all, n=63).
Note that some cells yielded a number of independent records.

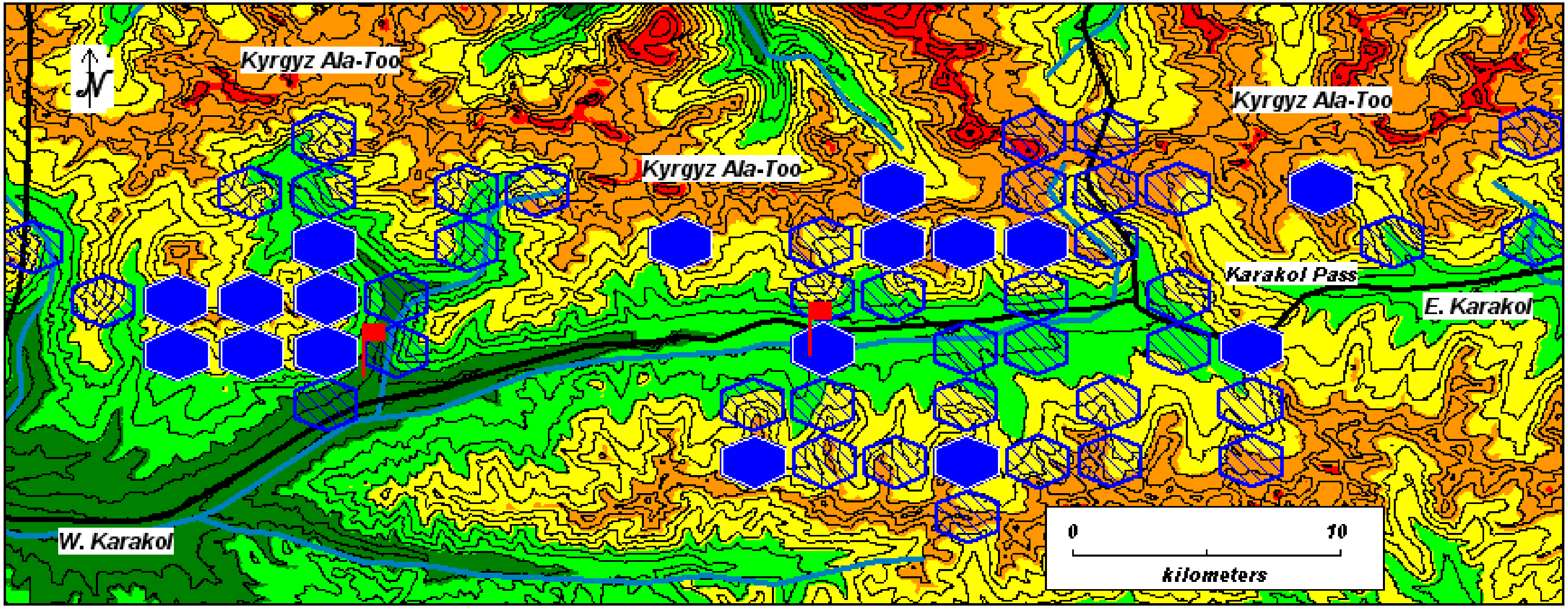


Figure 2.3.3f. Map showing the distribution of the snow cock (recording methods: scat and other, n=26). Note that some cells yielded a number of independent records.

2.3.4. Siberian ibex distribution modeling

Principal component (PC) analysis provided a comprehensive way to analyse the niche of Siberian ibex in the study area. In order to capture various aspects of ibex ecology and environmental requirements of the species, we considered separately three categories of predictor variables: bioclimatic, variables extracted from the Landsat image and terrain features. Precipitation was much higher in the western side of the study area (Fig. 2.3.4a).

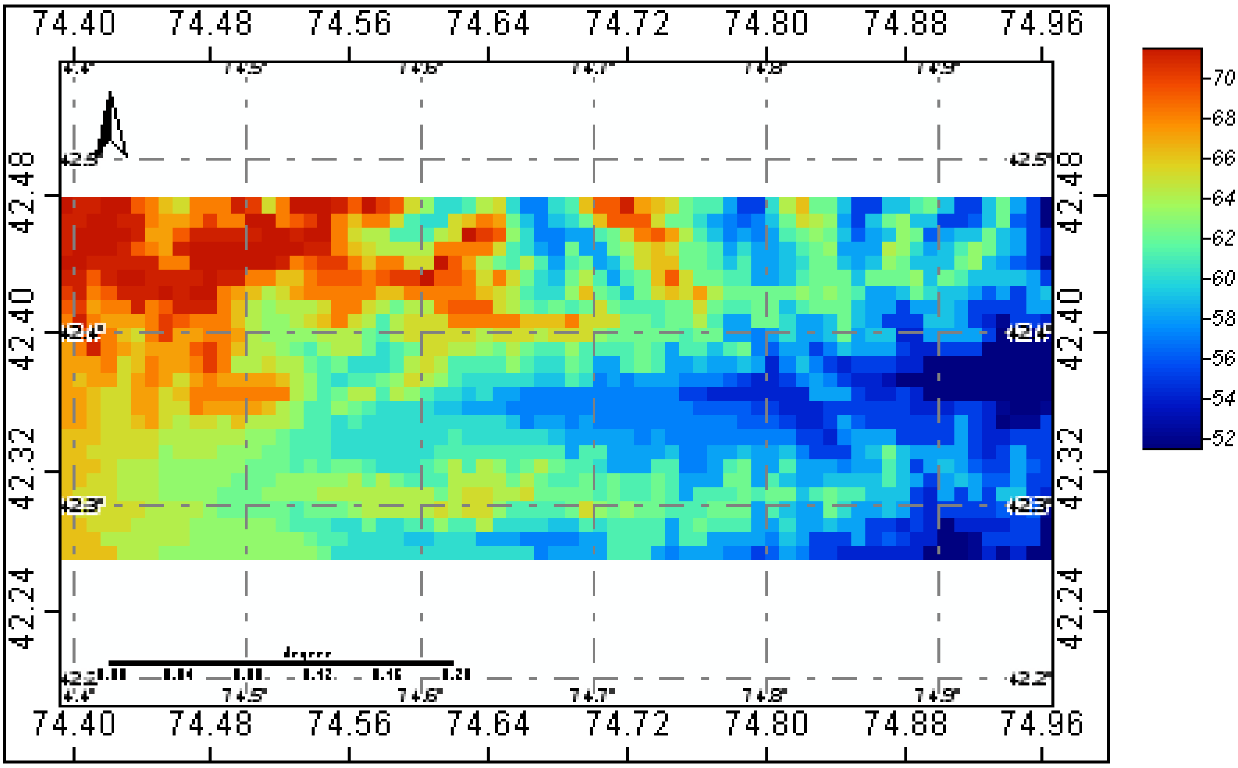


Figure 2.3.4a. Precipitation (in mm) of Coldest Quarter (*bio19*).
Note the big difference between the western and eastern sides of the study area.

In the first case three PCs accounted for close to 94% of the variance in the data set covering all the bioclimatic variables extracted from the occurrence points within the range of ibex in the study area. The first component (PC1) explained around 53% of the total variance and is strongly associated with most of the temperature-related variables; *bio1* (Annual Mean Temperature) can be considered a suitable proxy for this component. In the same way *bio19* (Precipitation of Coldest Quarter, Fig. 2.3.4a) (PC2, ~35% of the total variance) and *bio8* (Mean Temperature of Wettest Quarter) can be selected for modelling purposes.

For variables extracted from the Landsat image the first two PCs accounted for around 80% of the variance in this particular data set. The first component explained around 55% of the total variance and is associated with two highly correlated variables, namely the Enhanced Vegetation Index (EVI) (2.3.4b) and Greenness; arbitrarily the former is taken as a proxy for PC1. PC2 is associated with both inversely correlated Wetness and Average Brightness Temperature reflecting ground temperature; once again, arbitrarily Wetness is selected as the proxy variable.

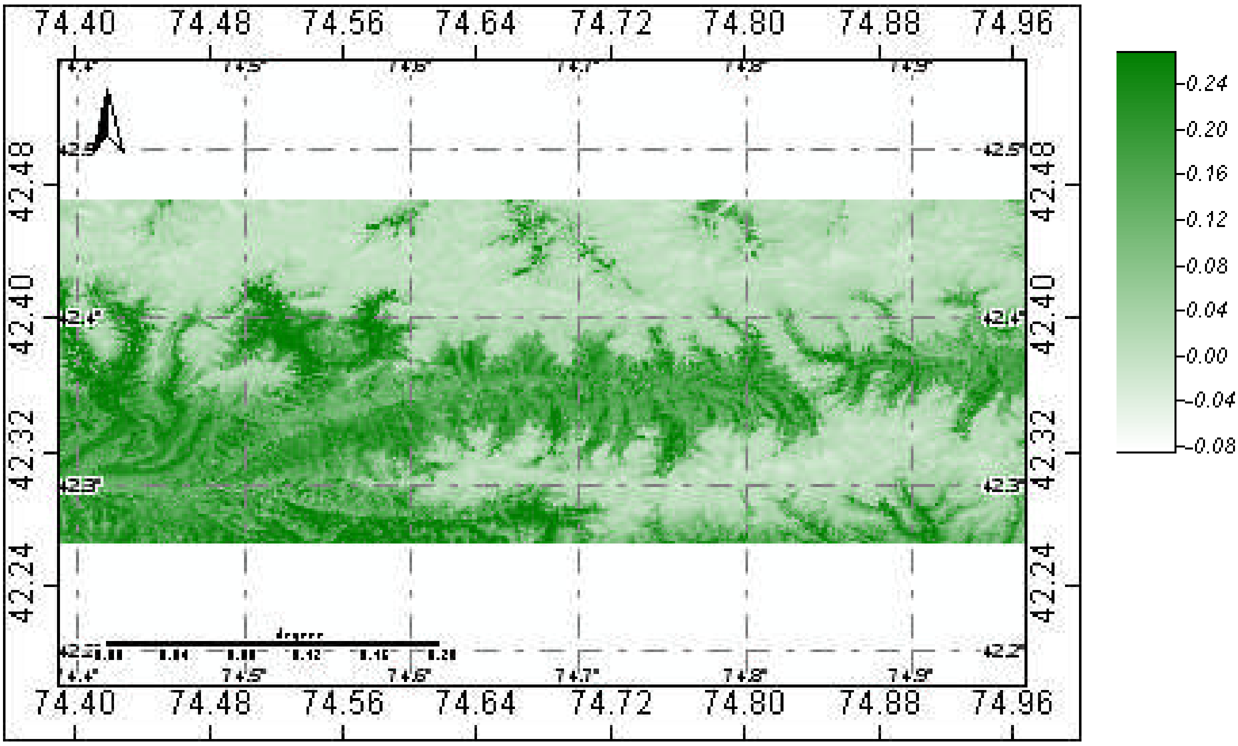


Figure 2.3.4b. Enhanced Vegetation Index (EVI). Bare soils are between 0 and 0.1, and vegetation over 0.1; values <0.5 characterise sparse vegetation. Increase in the positive EVI value means greener vegetation.

The same logic applied to the terrain features singles out Slope (2.3.4c) (highly correlated with the Terrain Ruggedness Index) and Aspect (2.3.4d).

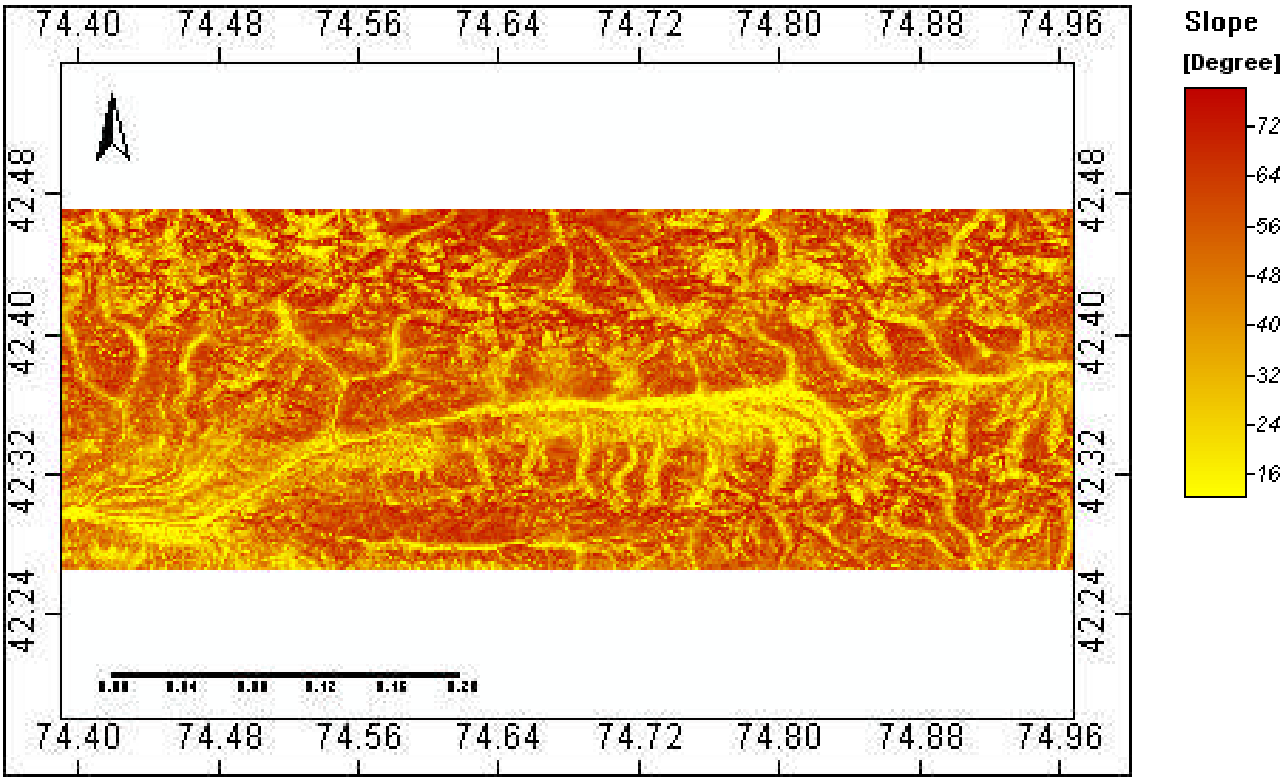


Figure 2.3.4c. Slope.

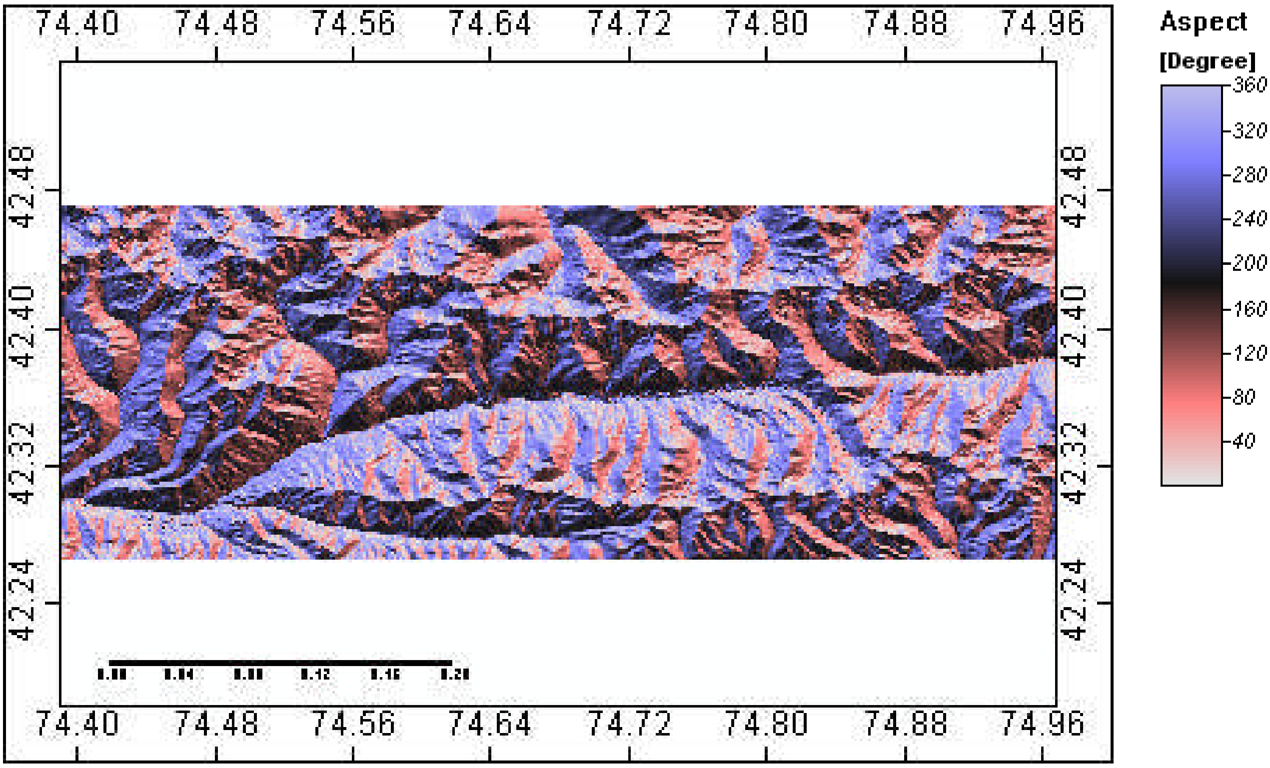


Figure 2.3.4d. Aspect.

From the 25 model runs, the average AUC was 0.884, with little variation in area under curve (AUC) between runs (SD=0.016), which indicates "good" discrimination abilities (Swets 1988). As the AUC test compares predicted contribution with the raw point data from the field surveys, a value of 0.884 is a good fit of model to reality. The averaged output from these 25 model runs is shown in Figs 2.3.4e–g., depicting areas of predicted probability of Siberian ibex occurrence at >0.4, >0.5 and >0.6, respectively.

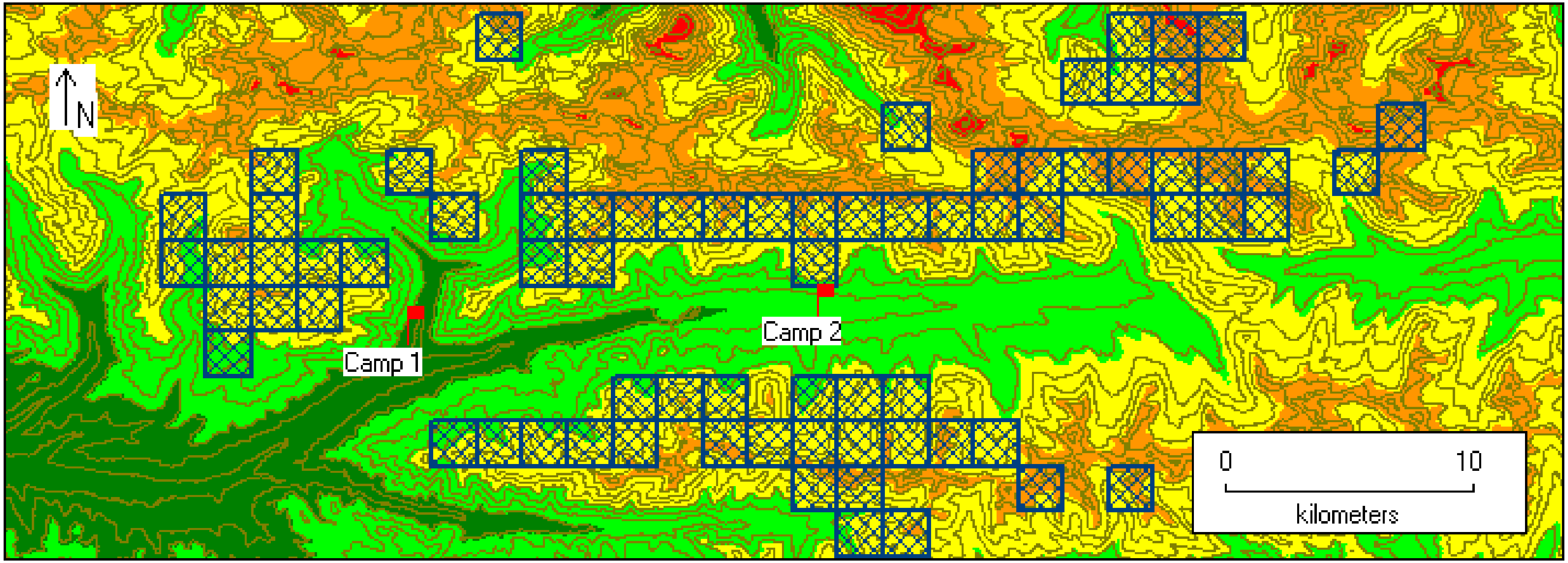


Figure 2.3.4e. Areas of predicted probability of Siberian ibex occurrence >0.4.

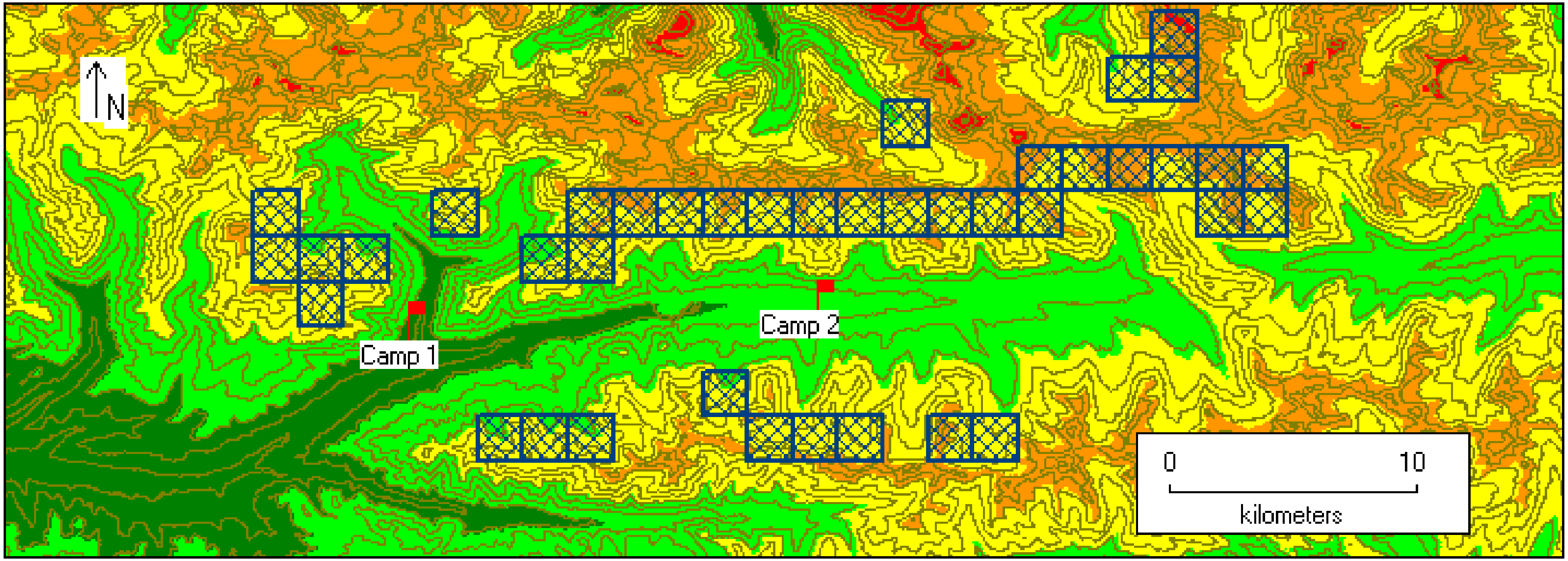


Figure 2.3.4f. Areas of predicted probability of Siberian ibex occurrence >0.5.

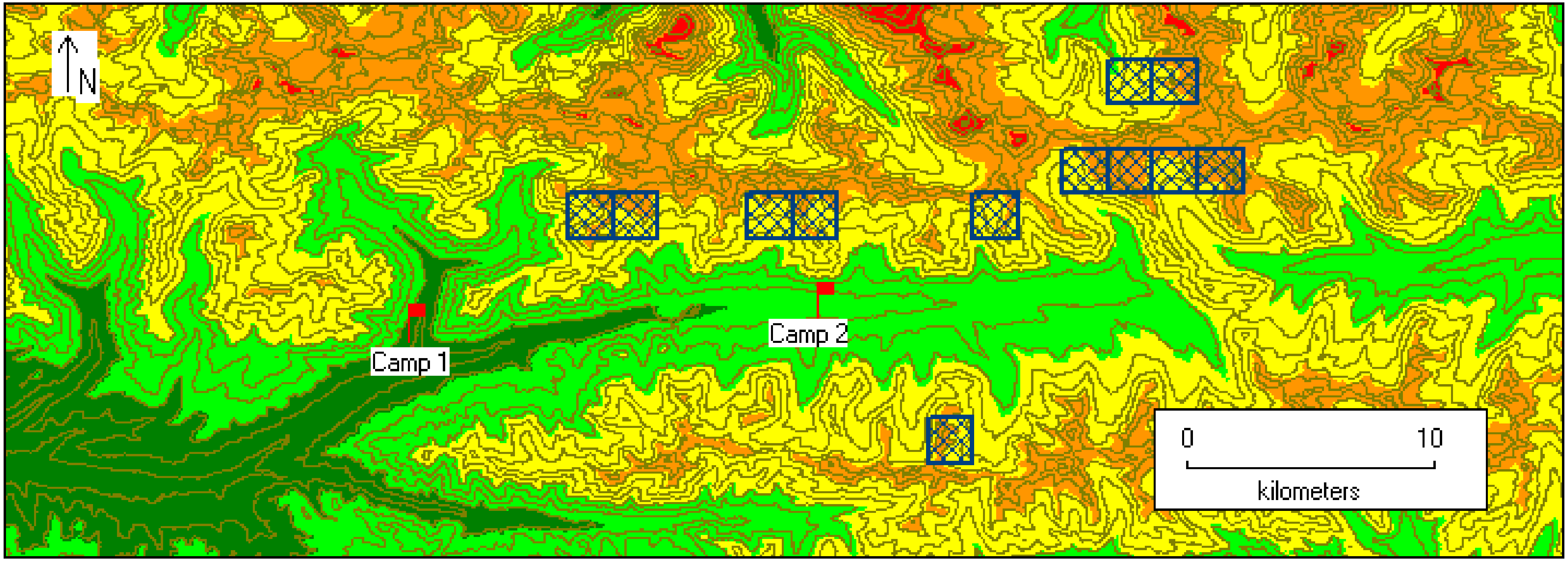


Figure 2.3.4g. Areas of predicted probability of Siberian ibex occurrence >0.6.

2.3.5. Additional surveys

Evidence of other carnivores sharing snow leopard habitat was also recorded. These included the wolf (*Canis lupus*) and the red fox (*Vulpes vulpes*). Wolf signs were found in a variety of places ranging from lowlands to mountain passes (Fig. 2.3.5a). Wolf is the major predator currently preying on domestic livestock in the area. Villagers were found to be deeply concerned about livestock losses to wolf depredation. This combined with the perception that wolves are an increasing threat to the economic well-being of villagers contributed to the government policy of paying a substantial bounty for killing wolves (Hazell 2001). The Kyrgyz government spends up to 1 million Kyrgyzstani soms (approx. £ 12,000) annually in support of eradication measures. These measures (mass raids on wolves, shooting, etc.) pose a threat to the snow leopard and/or the primary prey species. Besides this, there is a high potential for conflicts between these two predators, especially when the diversity of profitable, large prey is low (Jumabay-Uulu et al. 2013, Wang et al. 2014).

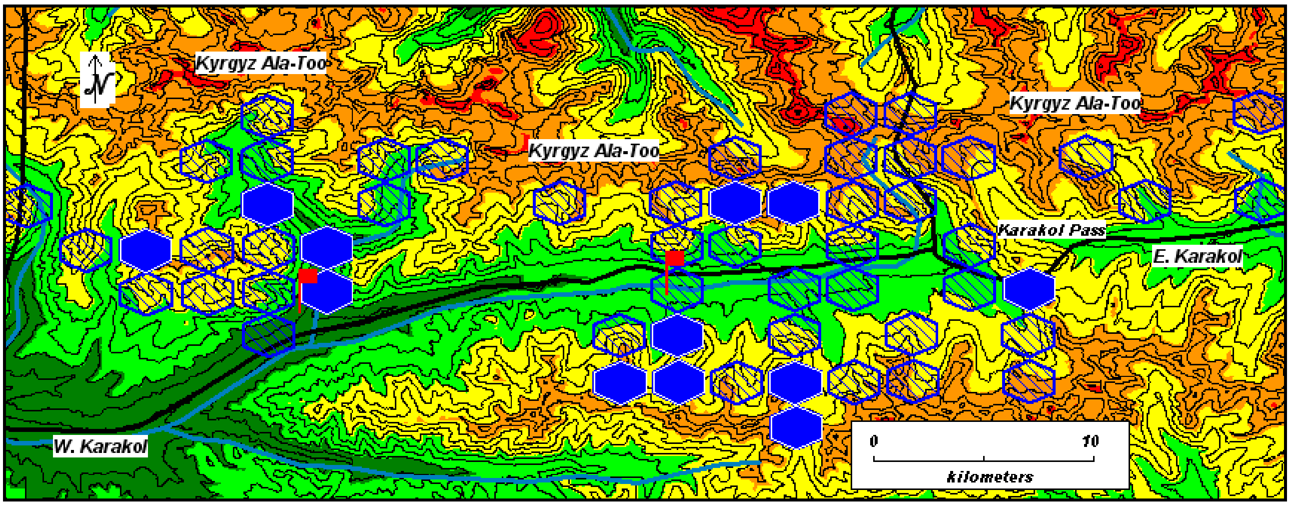


Figure 2.3.5a. Distribution of the wolf (recording methods: scat and other, n=17).

Capturing images of the target species, camera-trap studies, commonly record numerous additional species, although much of this extraneous data has been historically marginalised and rarely published. It may, however, provide important information about the biodiversity in the region, differences between areas, efficacy of protected areas, and documentation of species thought to be locally extinct (McCarthy et al. 2010). In 2014 this particularly concerned argali, which before the expedition was thought not to be present in the study area (as evidenced from talks of the NABU Grupa Bars with suspected poachers), but which was photographed by the 2014 expedition. However, no camera trap photos of argali were recorded by the 2015 expedition, meaning the local population could be in steep decline.

Birds are convenient indicators of biodiversity, at least at larger scales, and as monitors of environmental change (Furness & Greenwood 1993). One reason is that birds have long been popular with naturalists, amateur and professional, and consequently their taxonomy and distributions are better known than for any other comparable group of animals. However, only a few keen birdwatchers were part of the team this year. Nevertheless, the joint efforts of the teams came up with a list of 46 bird species (Appendix I).

Other noteworthy mammal and amphibian species

The manul (*Otocolobus manul*), also called the Pallas's cat, is a small wild cat with a broad but fragmented distribution in the grasslands and montane steppes of Central Asia. It is negatively affected by habitat degradation, prey base decline and hunting, and has therefore been classified as Near Threatened by the IUCN since 2002 (Ross et al. 2005). One track presumably made by a manul was recorded 18 July in cell AE16 (in Dzhor-Bulak Valley, formerly known to participants as "no name valley") at an altitude of 3,653 m. The species is also listed in the Red Data Book of Kyrgyzstan (Status: VI category, Near Threatened, NT).

Lynx (*Lynx lynx*) is not supposed to be found within the study region; however, one scat found on 30 June in cell AI19 could belong to this species. Lynx is listed in the Red Data Book of Kyrgyzstan (VI category, Near Threatened, NT).

Beech marten (*Martes foina*) was repeatedly recorded between the 28 June and the 17 July by a camera trap set in Chon-Chikan (N 42.391278^{o}, E 74.692278^{o}). This species is listed in the Red Data Book of Kyrgyzstan (VII category, Lower Risk/least concern - LR/lc).

Pewzow's toad (*Bufo pewzowi*) (Fig. 2.3.5b) has special scientific significance due to its polyploid speciation, in which the entire genome is duplicated. This is a rare phenomenon in animals in general (Borkin et al. 1986). Polyploid species occur in fewer than 5% of the world's amphibian species. Records made by the expedition were adult specimens and tadpoles in cell W17, 10 June at approx. 2,700 m; and juvenile toads and crushed adults on a road nearby camp 2, cell AC18, 22 July at approx 2,910 m.

Figure 2.3.5b. Pewzow's toad (*Bufo pewzowi*) as photographed by the expedition.

2.3.6. Outreach activities and interviews

Twenty-two interviews were conducted with the local community. These activities reached 17 adult herders (14 men and three women, aged between 18 and 73) and five children of school age (9–15 years old). In most cases livestock was a mix of sheep, cows and horses, fewer goats (10 cases) and some poultry (8 cases).

Statements best describing feelings towards snow leopards were overwhelmingly in favour of the animal: "Strongly Like" and "Like" summed up 17 of the responses, while only five were "Indifferent". Interviewees declared that they liked the snow leopard because "*this is our proud*", "*beautiful and rare animal*", "*beauty created by God*", "*part of Nature*", "*King of the Mountains*", "*dreaming to see it*".

We found no "Dislike" attitude concerning the snow leopard. Despite a few "Indifferent" responses, 19 interviewees consider the presence of the animal in their area as "a good thing".

The response to the question "Have you ever seen a snow leopard?" was in most cases negative. In addition, some interviewees say they don't even know anyone who has seen a snow leopard. Usually older people respond positively; however, most of these records date as far back as the 1960s to 1990s. More recently (within the last three years), snow leopard tracks have been found in the snow (not clear where) and repeated sightings were made of the snow leopard itself in an area far away from our region of interest (Söök Mountain Pass).

The question "How many snow leopards do you think live in the region?" seems to be confusing: eight people could not give any kind of estimate at all (saying "*hard to answer*"). Other estimates ranged from zero up to ten, but most stated one or two animals, sometimes maybe up to six.

Almost everybody (20 out of 22) answered that they were aware of the protected status of the snow leopard, and most know that the species is listed in the Red Data Book of Kyrgyzstan. One herder, who was not very sure on the protected status of the snow leopard, knew that "*the President has raised initiatives to protect the snow leopard*", thereby referring to the Global Snow Leopard & Ecosystem Protection Program (GSLEP).

A community assessment of the impact of snow leopards on wildlife and of human/predator relations (Table 2.3.6a) shows that most interviewees find snow leopards have no considerable or only a weak impact on large game (argali, ibex etc.). There is a belief that snow leopards "*eat the sick and old animals, so this is a natural cleaning process*".

In a few cases the common and widespread myth in Central Asia was repeated that snow leopards feed exclusively on the blood of their prey: "*only drinks the blood, doesn't eat meat*". According to Andrews (2002), this myth probably originated because of the puncture marks created when the leopard suffocates its prey, but it has great symbolism. The blood of anything is its life force. In many societies there existed the belief that what one ate, one became. An animal that only took the blood and not the flesh may indicate great discrimination so that only the powers and life force of the prey are assumed and not its weakness (symbolised by the flesh).

More interviewees (even most of them) consider snow leopards have no impact on small game (for instance, marmots). This is because they believe that small game is not a part of the diet of the predator.

Table 2.3.6a. Community assessment of the impact of snow leopards on wildlife and of human/predator relations. Figures given are numbers of respondents.

Statement	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Snow leopards have a considerable impact on large game (argali, ibex etc.)	8	4	2	3	1
Snow leopards have a considerable impact on small game (marmots etc.)	11	2	3	1	1
Snow leopards reduce populations of argali and ibex to unacceptable levels	13	4	1	0	0
Snow leopard attacks on humans are more frequent in regions where snow leopards live in close proximity to humans	10	2	1	5	1
In regions where snow leopards live in close proximity to livestock, they feed primarily on domestic animals	9	4	3	5	0
We already have enough snow leopards in the region	7	2	6	3	0

Most interviewees agree that snow leopards cannot reduce populations of argali and ibex to unacceptable levels, because "*snow leopards just kill for food, maybe once every two weeks*", meaning their demand is low. Some blamed hunters for reducing ibex numbers, thus causing the decline of the snow leopard population ("*the snow leopard is leaving the area*"). Wolves are blamed as well: "*snow leopards kill one animal, whereas wolves kill many at a time*".

About one third of the interviewees believed snow leopards can attack humans; however, nobody has been a witness of such an attack. Most of these have been stories told by somebody else.

Livestock depredation by the snow leopard does not appear to be a major issue, because there "*are too few*" and attacks can take place "*only when the animal is very hungry*" or "*when they can't find other food*". Instead, as in the previous year, there were many complaints concerning wolves: "*wolves attack livestock, but not snow leopards*".

The majority of interviewees found it a "good thing" if snow leopards attracted more tourists to the region, because this could create more job opportunities. Many would be ready to sell local products (meat, cheese, kumis, felt carpets etc.) and/or develop tourist-based businesses.

2.3.7. Petroglyphs – rock art

In addition to the biological surveys, participants compiled an extensive database, consisting of 178 georeferenced records, of rock art in the study area, grouped into clusters (Fig. 2.3.7a). The largest cluster occupies the upper reaches of the West Karakol River and its tributaries, particularly within the Sary-Köl area, which we have named the “Sary-Köl Petroglyph Site”. Other such sites are: “Cholok-Tor”, “Kashka-Tor”, “Kara-Tor” and “Dunguruma”.

Rock drawings here appear to have been made in two ancient artistic styles. The first technique was silhouette or shadow, typical of many ancient pictures. Blows were made with a metallic or stone instrument to take out the entire surface of the rock nearly 2 mm deep inside the silhouette. Some pictures were beaten by blunt tools, which removed only a thin sunburnt rock layer (called varnish), and this is typical of later periods. Another technique used tools with sharp edges and frequent blows, producing a deep line engraved in the rock.

The total number of registered rock art sites in Kyrgyzstan is still unclear, as reports by specialists show different figures. The State Register of Historical and Cultural Sites of Kyrgyzstan (2002) includes 23 locations that have status of national significance; in addition, some are on the List of Sites of Local Importance (Abdykanova, 2014).

The majority of the petroglyphs represent ibexes. The depiction of ibexes in the ancient arts may involve a variety of meanings, of which the most common concerns prowess, which is seen as a symbol of masculinity, power, abundance, fertility and long life (Karimi 2007). Other drawings represent human and animal figures, including hunting scenes. Some of these figures depict, for instance, red deer – a species rarely met today in the study area. Nevertheless, their prolific representation in rock art suggests that the deer was once a common species.

Canids are recognisable by fairly short legs, short, upright pointed ears and long tails, but are difficult to identify with accuracy. Straight tails might be indicative of dogs or wolves. Carnivores identified by a long thin tail curled at the tip could be snow leopards (Fig. 2.3.7b).

Contrary to the majority of rock art themes, one example clearly stands out amongst others by depicting Chinese characters (Fig. 2.3.7c).

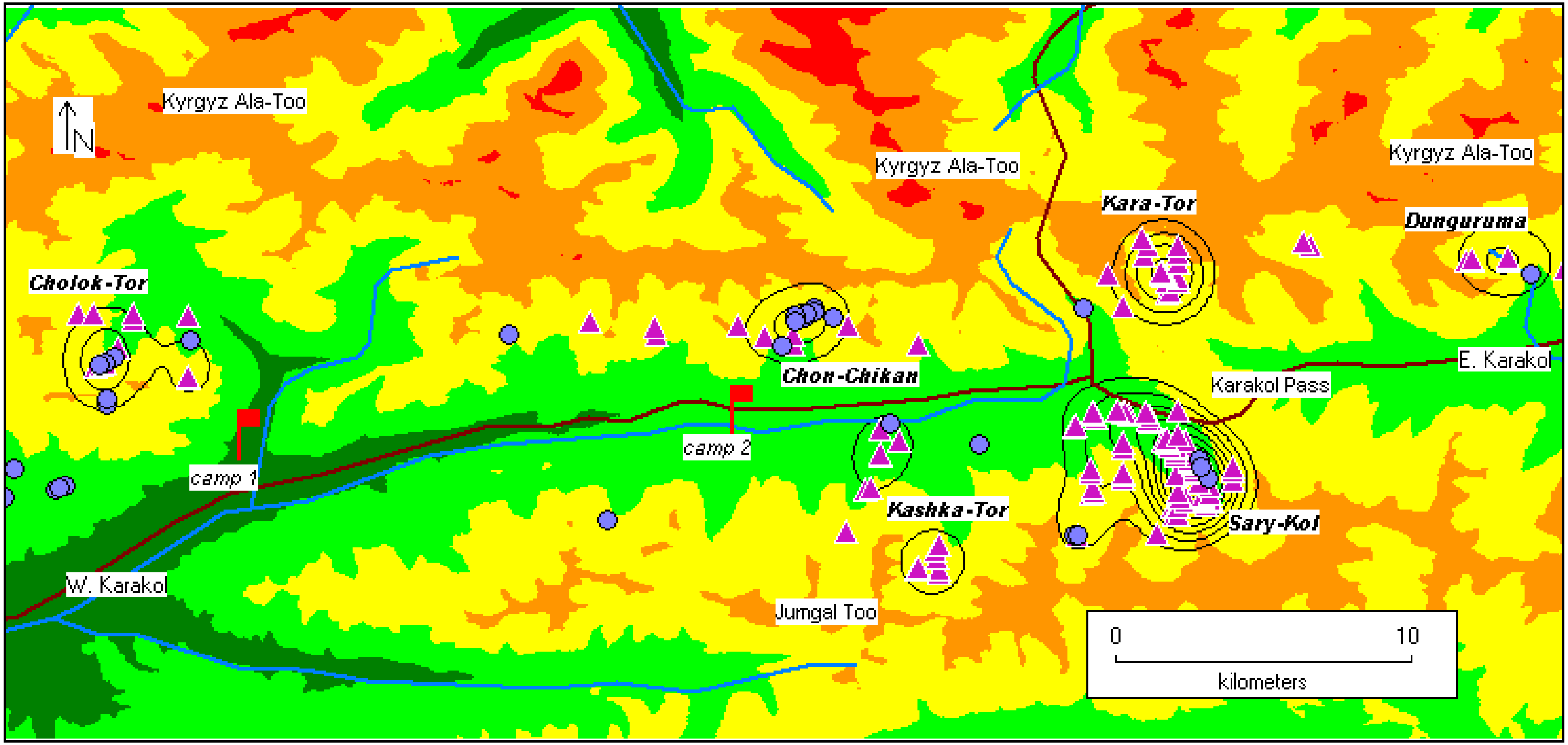


Figure 2.3.7a. Petroglyph sites in the study area: distribution (triangles – 2014, circles – 2015 data) and their joint density (contours derived from a kernel density map produced in *SAGA GIS* 2.2.7).

Figure 2.3.7b. Creatures with long thin tails curled at the tip are perhaps snow leopards.

Figure 2.3.7c. Inscription depicting Chinese characters ("Peace under the sky").

2.4. Discussion and conclusions

Understanding the factors influencing Siberian ibex in the study region

Siberian ibex occurs across the mountains of Pakistan, China, India, Afghanistan, Kyrgyzstan, Kazakhstan, Uzbekistan, Mongolia, Russia and Tajikistan (Shackleton 1997), mainly occupying rocky mountainous regions, both open meadows and cliffs, and coming down to low elevations during winter. The species does not enter densely forested areas and in summer on hot days seeks shaded areas under rocks or plants, remaining in steep escape terrain. The diet of ibex consists mainly of grass and sedges, flowers, twigs and moss. It is crepuscular in feeding, foraging mostly in the early morning hours as well as in the evening. They come down from their steep habitats during late afternoon and evening to the alpine meadows below to feed. During the summer, ibexes need to drink water every other day and therefore seek regions where there is a dependable water source. Ibex live in small groups (6–30 animals) varying considerably in size, and rarely in herds of >100 animals (Fedosenko & Blank 2001). In the study area groups rarely exceed 20 individuals. Since wild sheep (argali) seem to occur in the study site in very low numbers, snow leopards in the area are likely depend on ibex as a primary food source.

The presence of a species depends upon the specific environmental conditions that enable it to survive and reproduce (Marzluff & Ewing 2001). Understanding the factors influencing its existence is a basic requirement for the assessment of the species distribution and devising efficient species conservation strategies (Wein 2002). This knowledge helps to focus efforts on protecting the prey species snow leopards rely on the most.

Unfortunately wild prey animals are poached for meat and sport hunting, decreasing population sizes. In order to protect these animals, there is a need to create conservation programmes and designate areas that address the issues of overgrazing and poaching.

Among the various tools used in conservation planning to protect biodiversity, species distribution models (SDMs), also known as climate envelope models, habitat suitability models and ecological niche models, provide a way to identify the potential habitat of a species in an ecoregion. Applications of such models have increased exponentially (for an overview see Research Fronts 2014). SDMs are based on the concept of the "ecological niche" (Hutchinson 1957), which can be defined as the sum of the environmental factors that a species needs for its survival and reproduction. When applied to species, all SDMs are based on the assumption of niche conservatism (Wiens & Graham 2005) and rarely consider biotic interactions (Guisan & Thuiller 2005, Elith & Leathwick, 2009). Moreover, these techniques are based on observed occurrence or abundance data and therefore estimate the realised niche or the potential niche (i.e. the realised niche assessed from a reduced number of ecological dimensions). Many niche models are based purely on climate variables, because these data are readily available, covering large spatial scales. SDMs predict the potential distribution of a species by interpolating identified relationships between presence/absence or presence-only data of a species on the one hand and environmental predictors on the other, across an area of interest. From the array of various applications available, Maxent (Phillips et al. 2006) stands out because it has been found to perform best among many different modelling methods (Elith et al. 2006) and may remain effective despite small sample sizes. Maxent is a maximum entropy based machine learning program that estimates the probability distribution for a species' occurrence based on environmental constraints (Phillips et al. 2006). It requires only species presence data (not absence) and environmental variable (continuous or categorical) layers for the study area. Spatial (habitat) and temporal (seasons) variables define the ecological niche of a certain species within a given environment.

On both expeditions over the two past years, there have been no direct observations of ibex in valleys; the lowest altitude at which a number of ibex were discovered was 3044 m. This was at the tip of the moraine Sary-Kol and occurred at a time (in 2015) when there were no herders around, because the Karakol Pass was blocked by snow. On the whole, direct observations of ibex have been made within the range of 3,044 to 4,159 m (average around 3,600 m). In the winter time these figures will be different, but we are modelling the summer distribution of the species. Of course, there is a theoretical probability that ibex may be found in valleys, but this probability is below the figure of 0.4. Using this fairly low threshold, the model shows (Figure 2.3.4e) that areas with probabilities of ibex occurrence exceeding 0.4 are almost entirely in high mountain terrain.

In terms of nature conservation planning and setting snow leopard research priorities, areas of predicted probability of Siberian ibex occurrence >0.6 (i.e. 60%) are the areas of greatest interest. The results of modelling show that these areas include heads and surrounding ridges of the streams Ayu-Ter and Kuyke-Bulak, ridges in between and surrounding Chon-Chikan and Chaartash streams, upper parts and surrounding ridges of the Choloktor stream, as well as an area in between the upper reaches of Issyk-Ata, neighbouring Kara-Tor stream. In the south, modelling indicates ridges around the Kashka-Tor stream as a priority area.

In line with the cell methodology used in the expedition surveys, these areas are more or less encompassed by the following cells: Y15, Y16, Z16, AB16, AC16, AE16, AF16, AE20, AG15, AH15, AI15, as well as AH13 and AI13, which can be accessed only from the northern side of the Kyrgyz Ala-Too Range. Excluding cells AH13 and AI13, these comprise a fairly small portion of the cells covered by the expedition (14% in 2014, and 20% in 2015). Interestingly, the upper reaches of Issyk-Ata and Kashka-Tor are exactly the places where snow leopard pugmarks were recorded this year.

Conclusions

On an expedition such as this, covering a large area of remote, rough and broken terrain, it is difficult to find signs of snow leopard and its primary prey species, especially during the absence of prolonged, continuous snow cover. Ungulates and carnivores favour higher ground and are more dispersed during the summer season and snow leopard signs are harder to find.

Evidence from local people, and an attack on a foal in 2014, indicated that snow leopard was present in the surveyed area and confirmed the importance of the study area as a habitat for snow leopard. Prolonged and continuous snow cover in 2015 considerably raised the efficacy of the research, resulting in the discovery of fresh signs of snow leopard presence.

Evidence from local people indicated that snow leopard was present in the surveyed area and confirmed the importance of the study area as a habitat for snow leopard. However, no independent confirmation of snow leopard presence was found by the extensive sign surveys or through camera-trapping.

The expedition has also shown that the habitat in the study area (and beyond) is sufficiently varied and capable of sustaining a healthy prey base for the snow leopard. The developing relationship between the predator and prey species could be very fragile, so any decline (as confirmed this year, a special concern are argali) in the prey species may drive the snow leopard out of the area. Indeed, poaching (both in the past and today) and growing disturbance may be the main factors for driving animals out of the site, a notion perceived as well by local stakeholders.

Overgrazing by livestock is a significant problem, particularly at lower altitudes. Higher places are affected too, particularly in the later summer season. As a priority recognised by NABU staff, improved anti-poaching control together with a temporary ban on hunting could have an immediate impact on halting the decline of prey species and, by inference, snow leopards.

Further research is needed to confirm snow leopard presence and monitor snow leopard and prey population trends in the survey area. Presence/absence surveys will need to be repeated in the coming years, using camera traps from the very beginning of the survey. Finding a trail and/or relic scrape(s) is a high priority. If either of these can be found, remote camera-trapping would be enhanced as a survey tool. These efforts can be guided by modelling exercises as above, showing places where basic requirements for Siberian ibex, upon which snow leopards rely the most, are met to a significant degree.

With the collapse of the Soviet Union much of the area under study was abandoned by nomadic herders and henceforth a slow recovery of wildlife has occurred, though the vegetation still bears the traces of human disturbance. However, the current growth of the population in the country and increased development may nullify this positive trend and drive the snow leopard out of the area.

Under these circumstances, there is an urgent need for research (population & life history parameters, threats), site protection and management.

Liaising with local people, who by and large have positive attitudes towards snow leopard presence in the area, will continue to play a key part in the research. Continued dialogue with herders is important, not only to find out what has happened in between expedition periods, but also to involve them more fully in the research (for instance, maintenance of the camera traps) and explore possibilities of benefiting the local community. The friendly attitude towards the snow leopard expressed by the majority of local people could be the key to the success of such initiatives.

Recommendations for the 2016 expedition:

- Concentrate surveys on high probability Siberian ibex areas as derived by modelling. This means concentrating on cells Y15, Y16, Z16, AB16, AC16, AE16, AF16, AE20, AG15, AH15, AI15, as well as perhaps AH13 and AI13, but these cells can only be accessed from the northern side of the Kyrgyz Ala-Too Range (an option for the gap between slot 1 and 2, if an appropriate team of NABU staff and volunteers can be arranged).

- In addition to using the cell methodology adopted by Biosphere Expeditions for volunteer expeditions, expedition participants and the scientist should take into account any kind of point data (first and foremost of primary prey species, Siberian ibex and argali, especially sightings) for modeling, research design and planning purposes.

- Implement the revised version of the questionnaire (kindly reviewed by John Soos in 2015, see appendix II) for gathering local knowledge about the area and recording snow leopard presence and attitudes towards the species.

- Continue to build relationships with herders and establish who amongst them is willing and able to help with year-round camera trap studies. Establish equipment and remuneration needs required for this.

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3. Butterflies of the Suusamyr Valley, Kyrgyzstan (Lepidoptera, Diurna)

Amadeus DeKastle
Plateau Perspectives

3.1. Introduction

Although the Suusamyr Valley (Fig 3.1a) is only 7–8 hours away by car from Bishkek, the capital city of Kyrgyzstan, this region is very poorly studied in regard to its ecology. Information on butterfly distributions in this region is lacking in most currently available resources. As a result, the data presented here provide new information that enhances our understanding of the distribution of many of these butterflies.

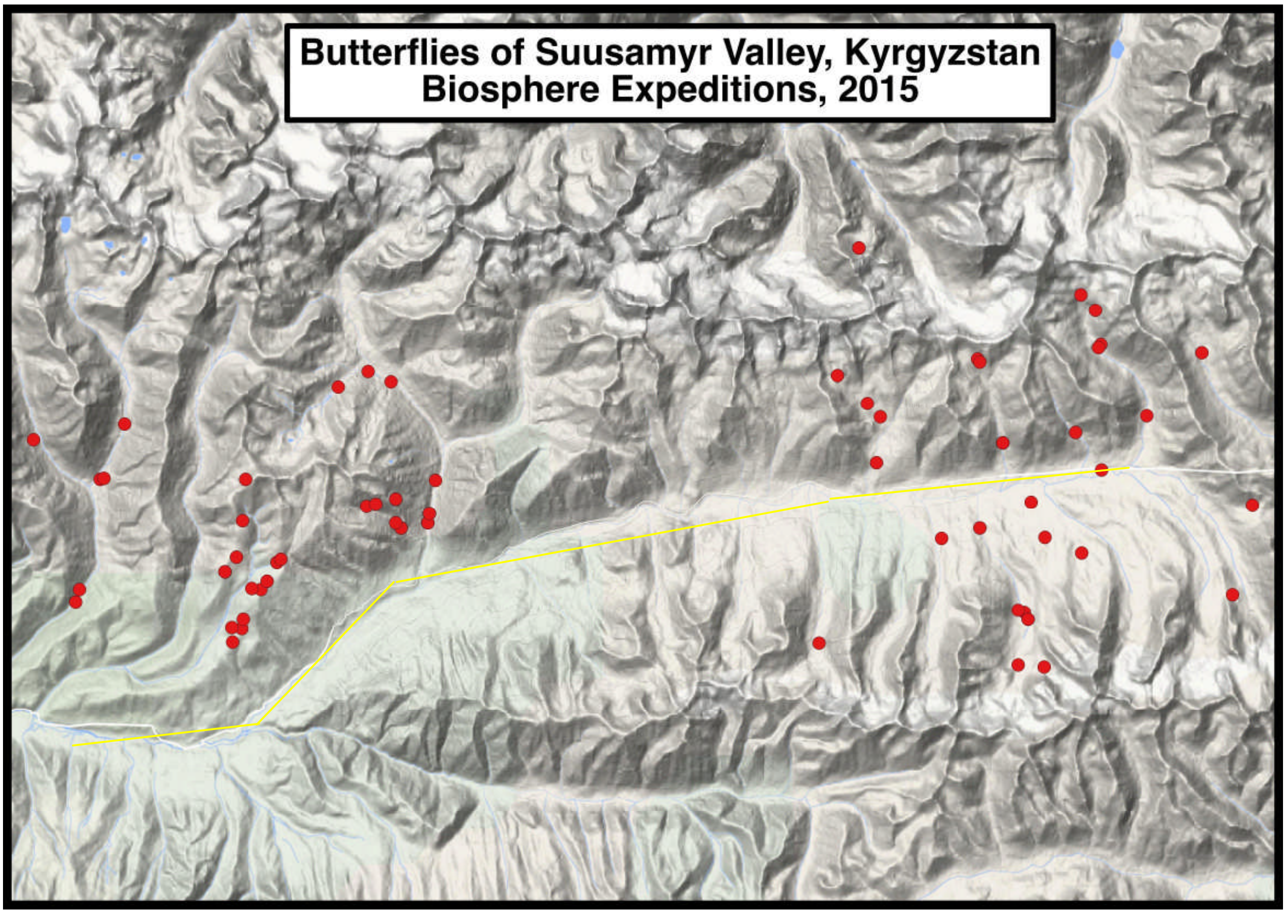


Figure 3.1a. Suusamyr Valley (yellow) area studied, including data points for each butterfly observation.

3.2. Materials and methods

Data were collected during the Biosphere Expeditions project during the summer of 2015 in July and August. Citizen scientists from around the world were present during four 12-day trips over which the expedition took place. Although the main duties of the expedition were not related to butterfly identification and distribution mapping, efforts were made by many participants to catalogue the butterflies seen.

This was done by taking an image of the butterfly, and writing down the image file name (determined by the camera) and GPS coordinates taken at the time of the sighting onto a spreadsheet provided. Identification verification was later done on the basis of these images, thereby providing the raw data for distribution maps. As this was only the first summer that this aspect of the expedition was implemented, the numbers are quite low. However, we expect future surveys to provide much more data, especially with the future implementation of the “Butterflies of Kyrgyzstan” smartphone application being produced by the author (available in 2016).

3.3. Results

In all, 20 species were identified with 77 individual sightings. All of these species provide location data new to science.

Table 3.3a. Butterflies of the Suusamyr Valley, Kyrgyzstan, Biosphere Expeditions, July – August 2015.

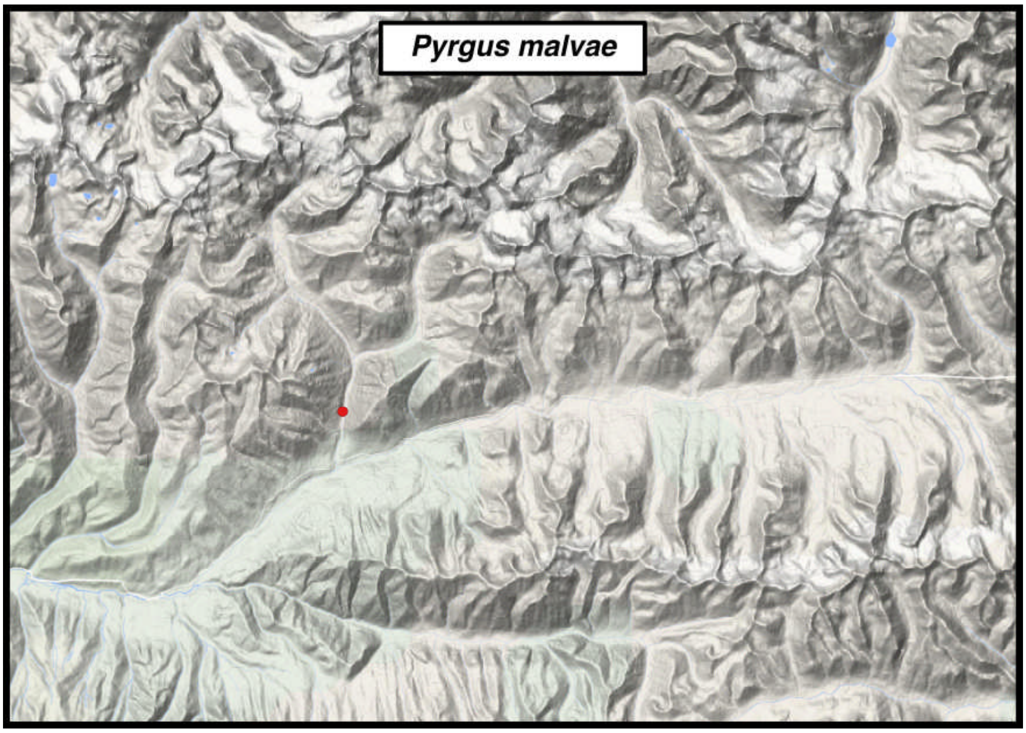
Family	Scientific Name	Common English Name
Hesperiidae	*Pyrgus malvae*	Grizzled skipper
Lycaenidae	*Cupido buddhista*	Buddhist blue
Nymphalidae	*Aglais urticae*	Small tortoiseshell
	Boloria generator	No Common Name (NCN)
	Clossiana erubescens	NCN
	Issoria lathonia	Queen of Spain fritillary
	Melitaea solona	NCN
Papilionidae	*Papilio machaon*	Old World swallowtail
	Parnassius delphius	Banded apollo
	Parnassius mnemosyne	Clouded apollo
	Parnassius tianschanicus	Large-keeled apollo
Pieridae	*Colias erate*	Pale clouded yellow
	Pieris bryoniae	Dark-veined white
	Pieris napi	Green-veined white
	Pontia callidice	Lofty Bath white
	Pontia daplidice	Bath white
Satyridae	*Coenonympha caeca*	NCN
	Coenonympha sunbecca	NCN
	Erebia mopsos	NCN
	Erebia sokolovi	NCN

Species profiles

Species profiles include photographs, natural history and distribution maps for each species observed during the expedition. Note that all photographs and maps are the property of the owner (unless otherwise noted) and only permitted for use outside this report with proper permission.

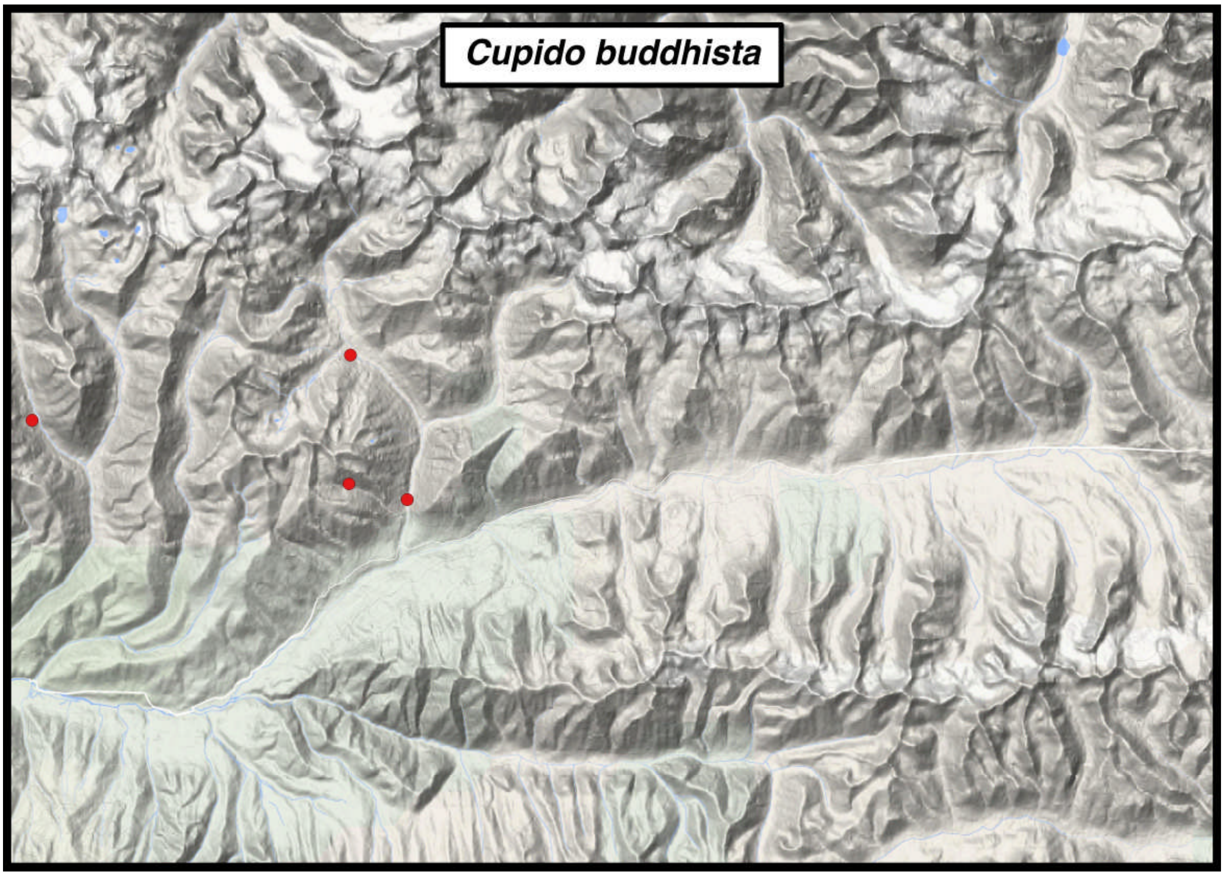
Pyrgus malvae - Grizzled skipper

Flight time	May to early July	Elevation (m)	1,000 – 3,000
Habitat	Forest clearings, mountainous meadows, steppes		
Food plants	*Potentilla* spp. (cinquefoil) and *Rosa* spp. (wild rose)		
Life cycle	Eggs laid singly on host plant. Species overwinters as an egg. Likely univoltine.		



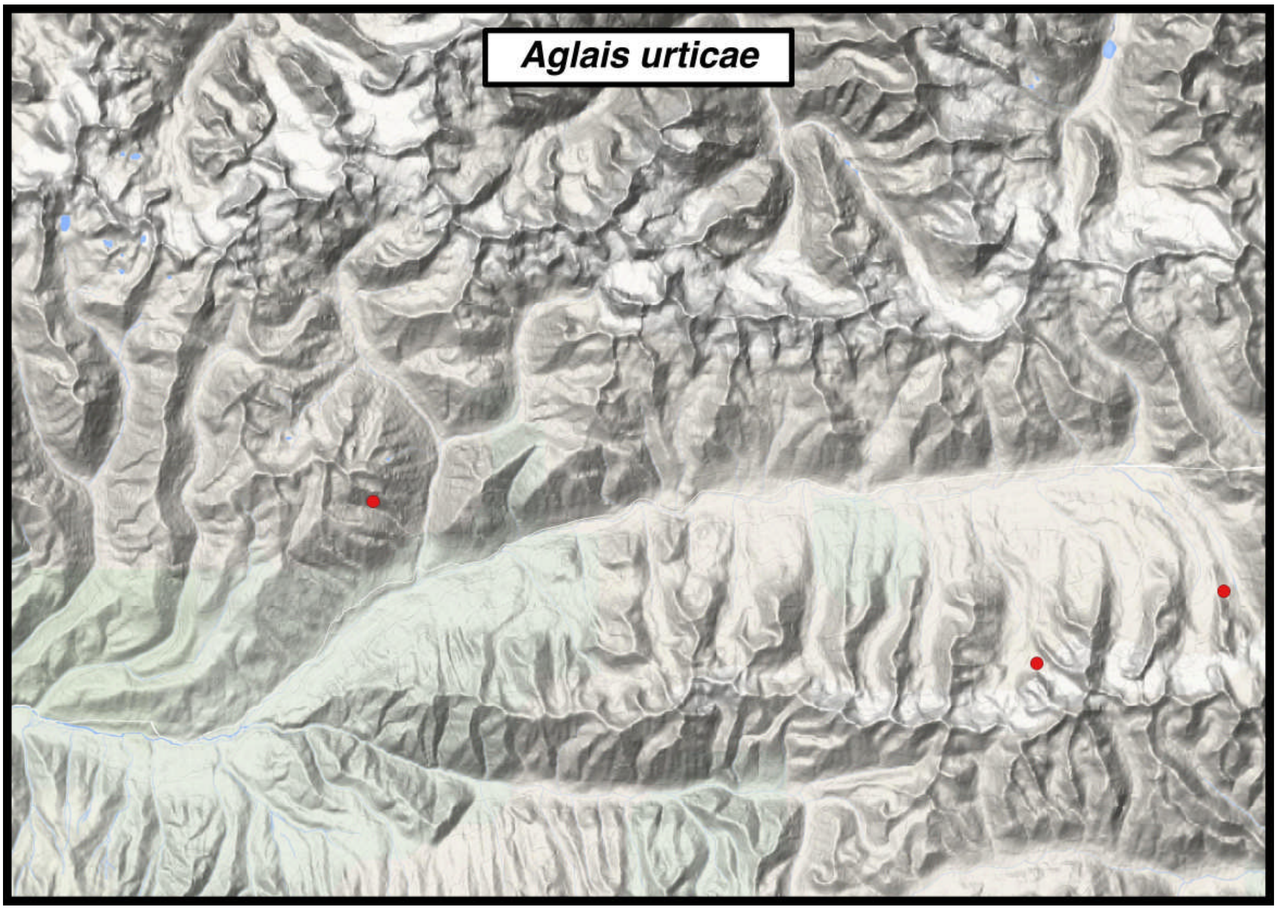
Cupido buddhista - Buddhist blue

Flight time	June to September	Elevation (m)	2,300 – 3,400
Habitat	Alpine biomes with many herbaceous plants		
Food plants	*Oxytropis* spp. (locoweed)		
Life cycle	Unknown		



Aglais urticae - Small tortoiseshell

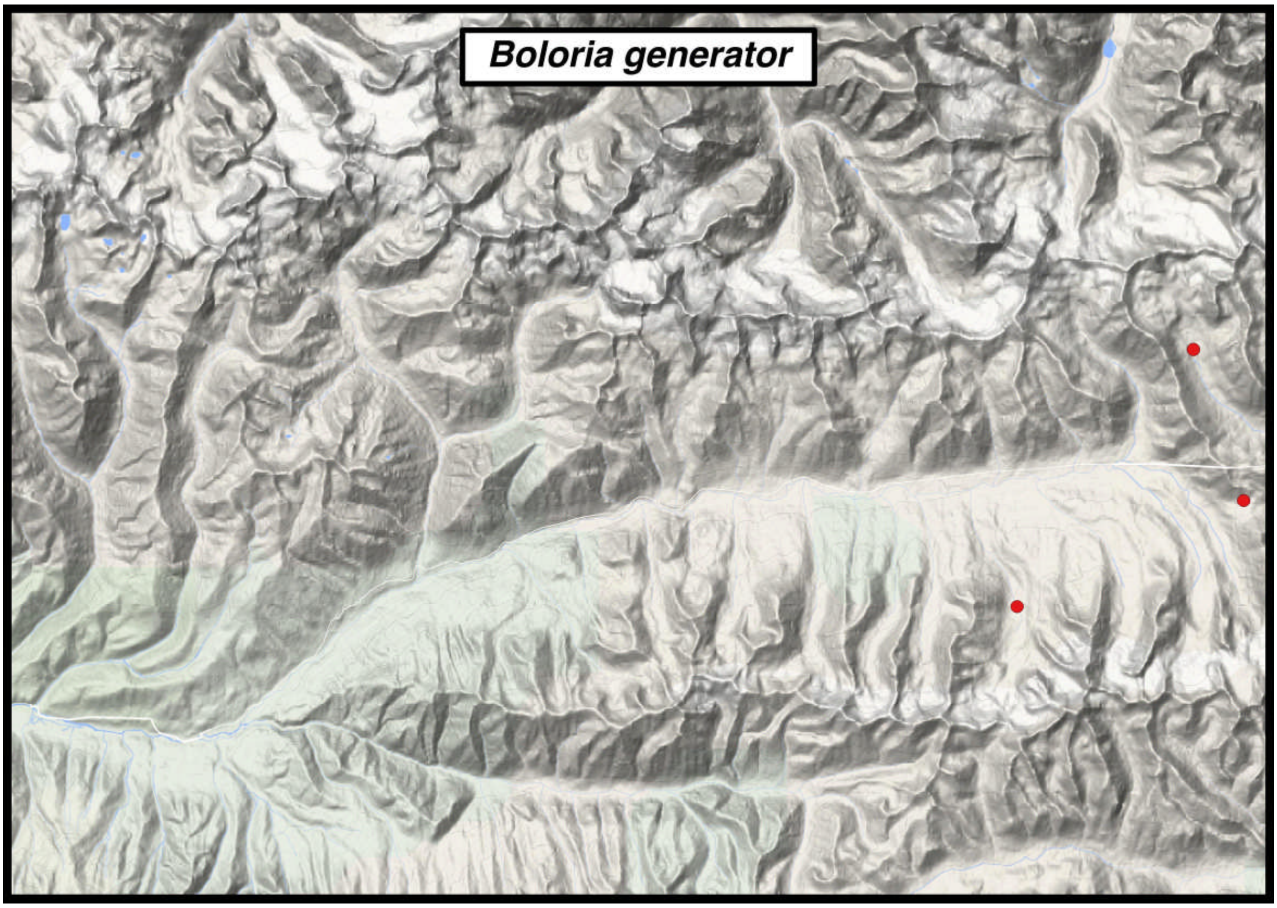
Flight time	April to September	Elevation (m)	3,000 – 4,000
Habitat	Open areas and mountain gorges with a high density of the host plant		
Food plants	*Urtica* spp. (stinging nettle)		
Life cycle	Adults overwinter in a state of hibernation begun around October. They emerge during early spring.		



Boloria generator

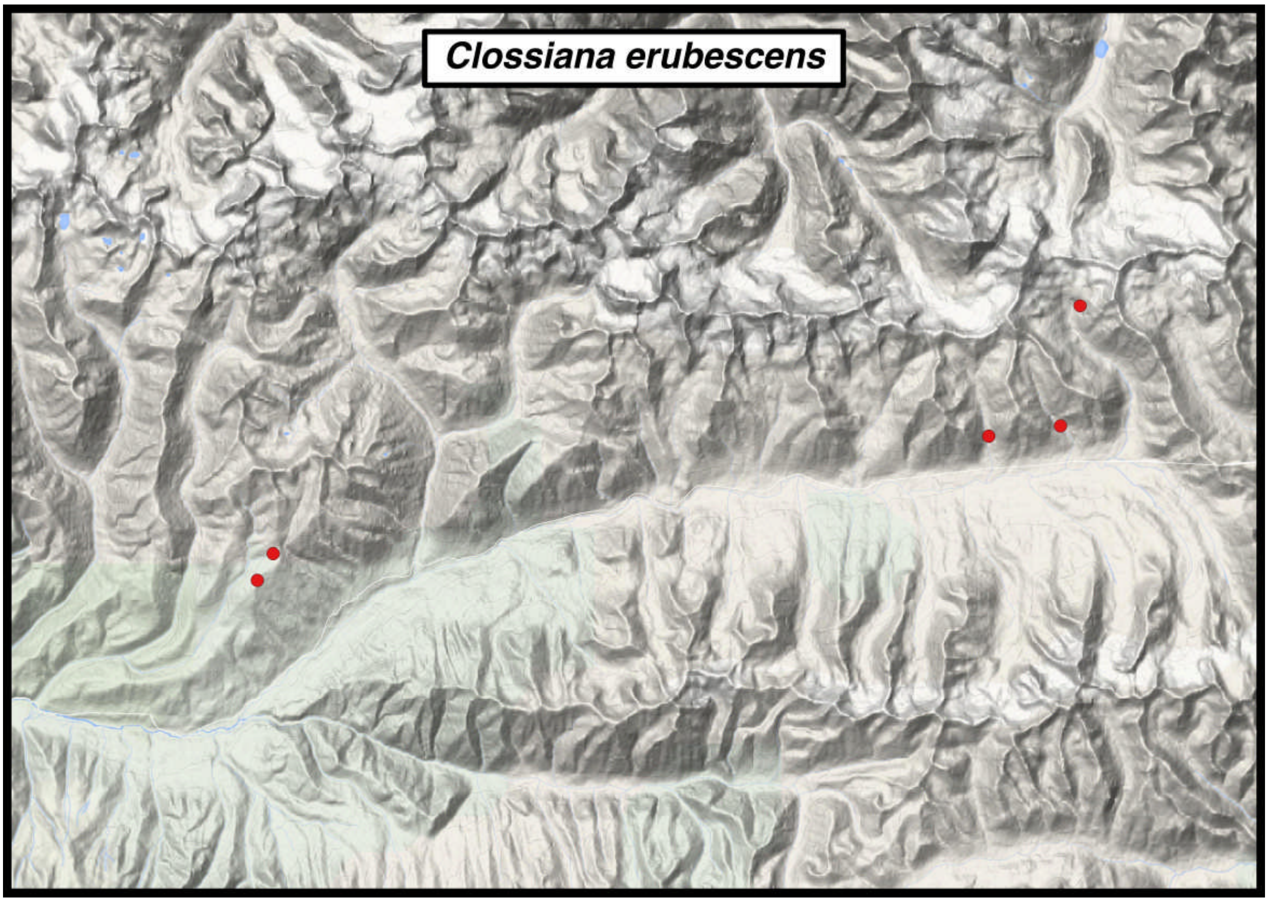
Flight time	July to September	Elevation (m)	2,500 – 4,500
Habitat	Moist mountain meadows and stream banks		
Food plants	*Polygonum alpinum* (Alpine knotweed)		
Life cycle	Unknown		

Photo courtesy of Barbara Schirmer



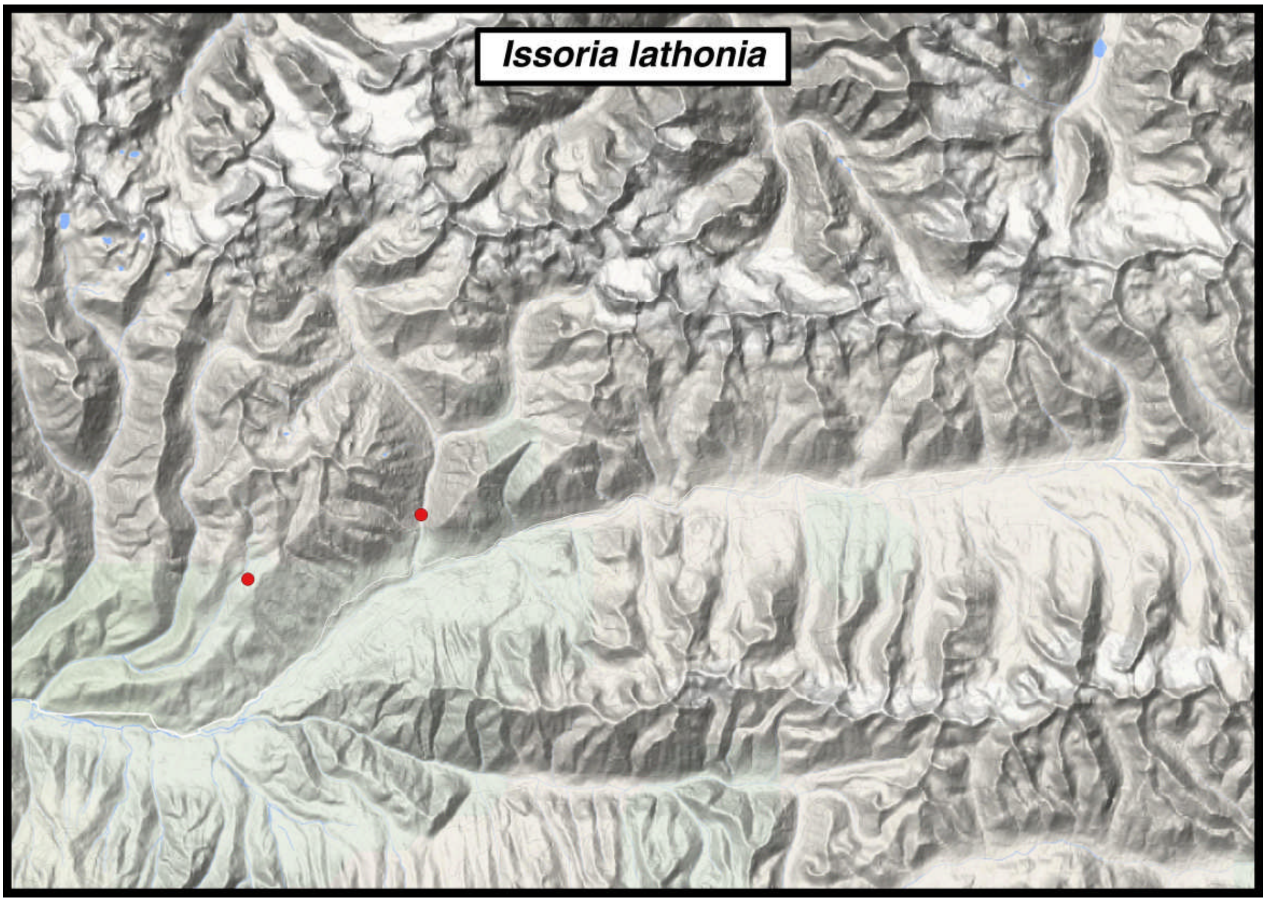
Clossiana erubescens

Flight time	June to August	Elevation (m)	2,000 – 3,600
Habitat	Mountain meadows and stream valleys		
Food plants	Violaceae (violets and pansies)		
Life cycle	Unknown		



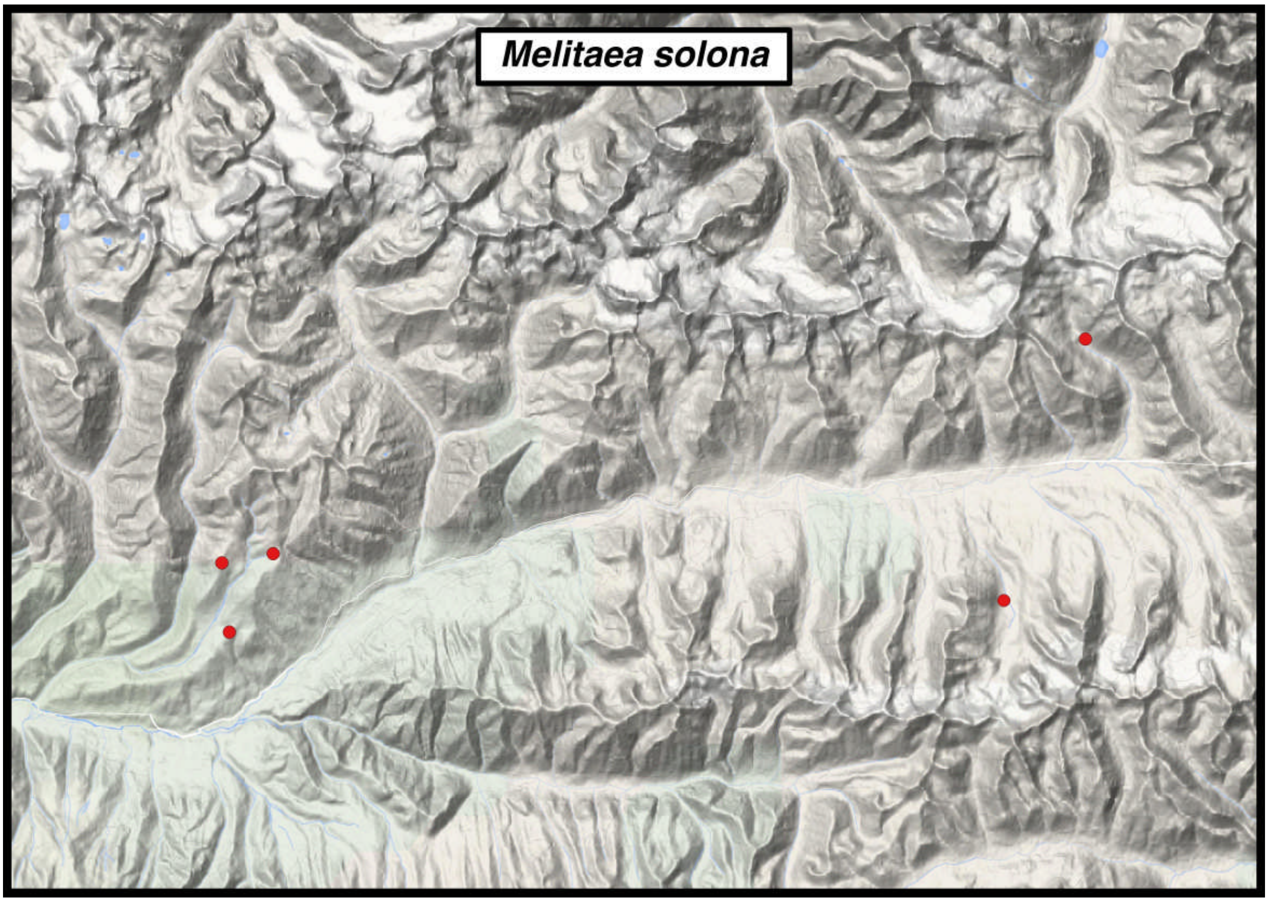
Issoria lathonia — Queen of Spain fritillary

Flight time	April to October	Elevation (m)	up to 3,500
Habitat	Low elevation plains up to subalpine biomes		
Food plants	Violaceae (violets and pansies)		
Life cycle	Species can overwinter as a larva or pupa. Bivoltine or multivoltine.		



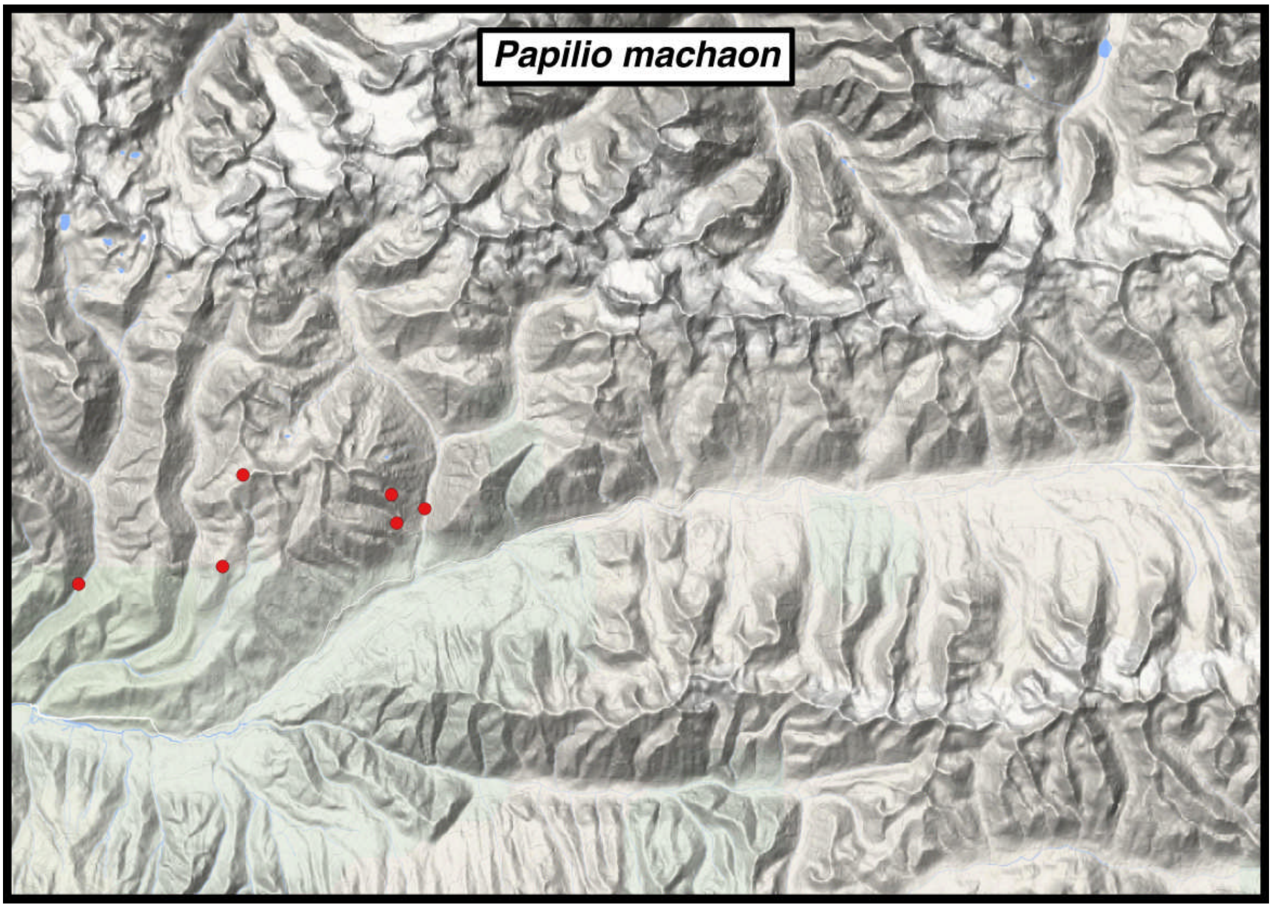
Melitaea solona

Flight time	June to July	Elevation (m)	2,700 – 4,000
Habitat	Humid alpine meadows		
Food plants	*Pedicularis* spp. (lousewort)		
Life cycle	Unknown		



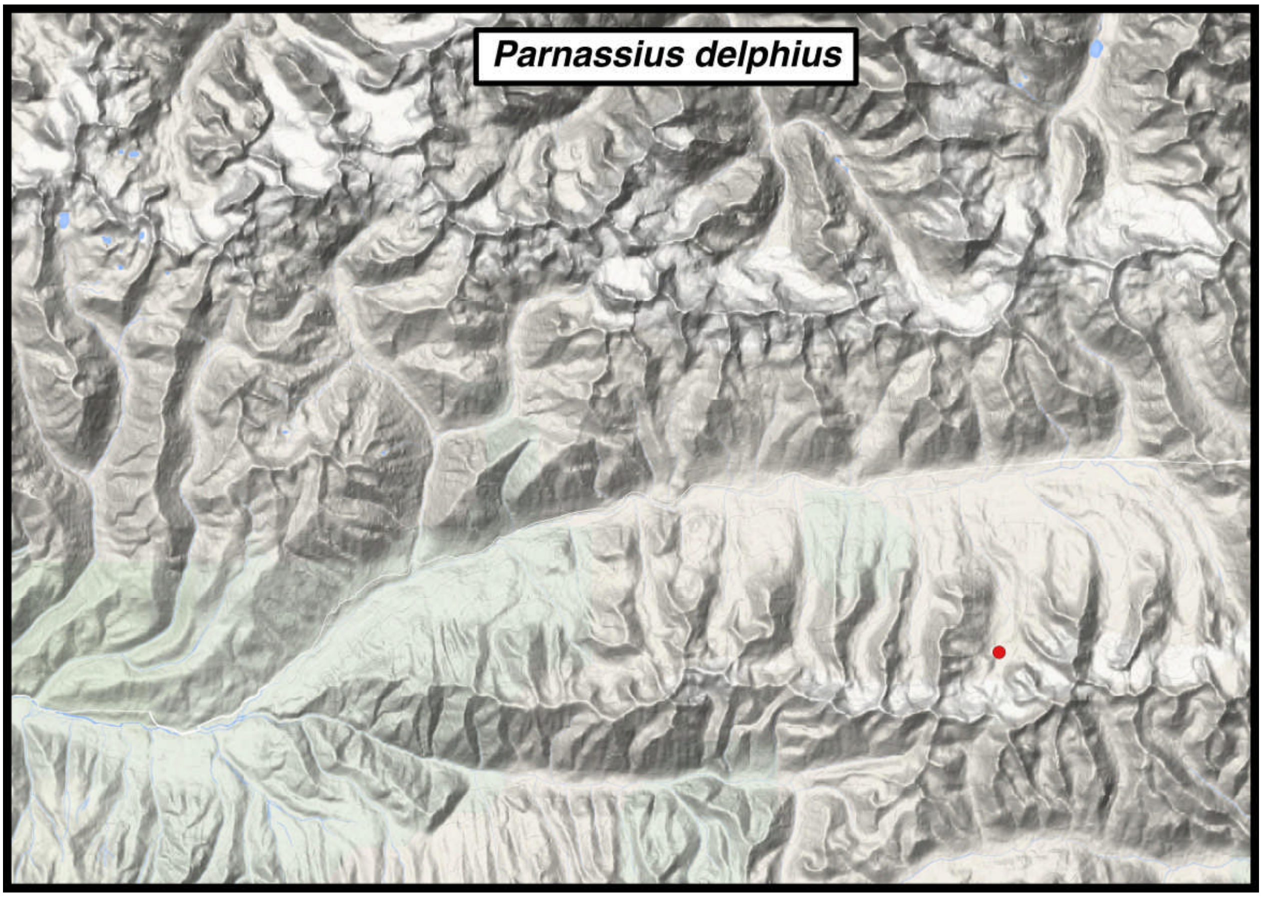
Papilio machaon - Old World swallowtail

Flight time	April to November	Elevation (m)	Unknown
Habitat	Found in virtually any ecosystem from lowlands to high mountains		
Food plants	*Prangos* spp., *Artemisia* spp. (wormwood), *Haplophylum* spp., *Ferula* spp.		
Life cycle	Eggs laid singly on host plant. Overwinters as a pupa. Pupal diapause up to three years before adult emergence. Uni- or bivoltine depending on location.		



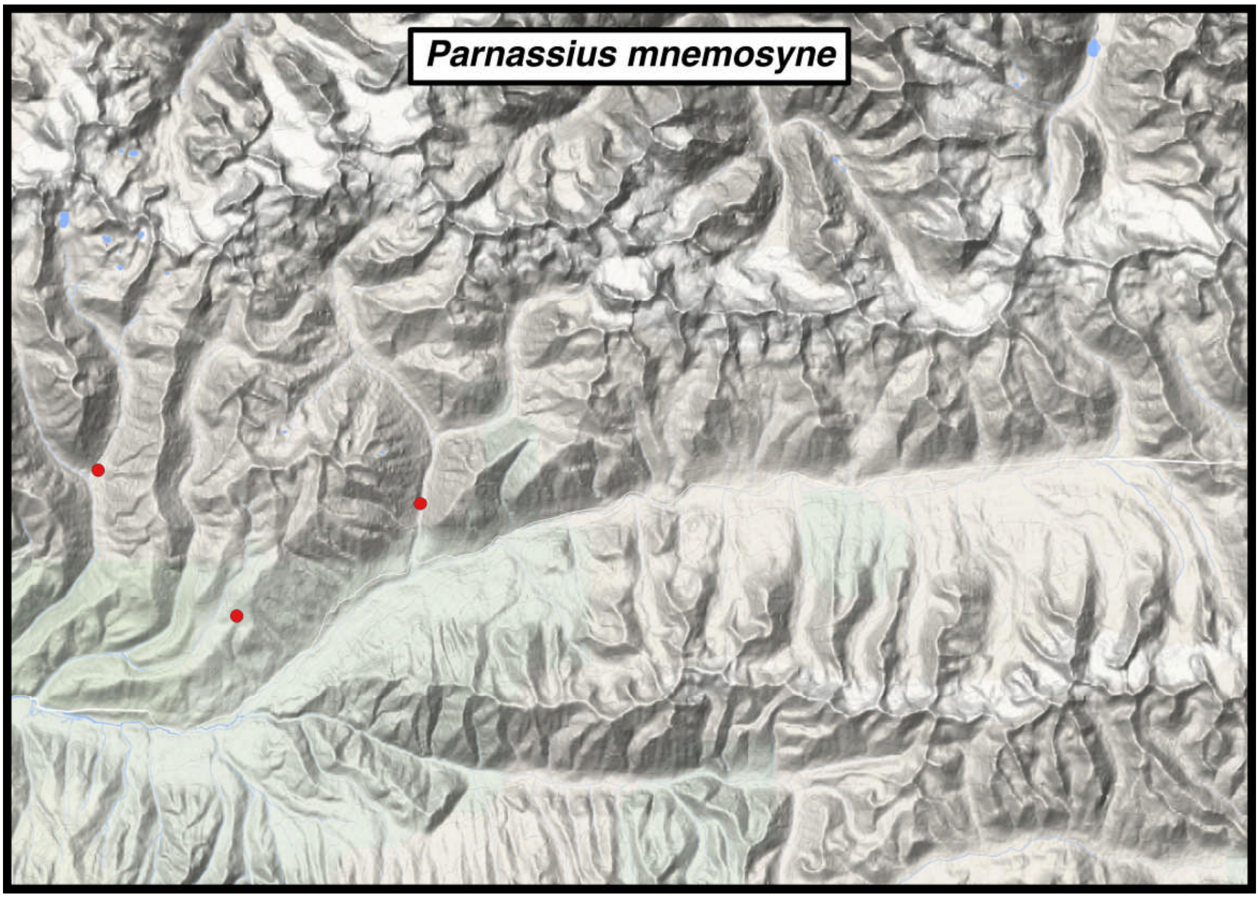
Parnassius delphius - Banded apollo

Flight time	June to July	Elevation (m)	3,000 – 4,000
Habitat	Western facing rocky slopes, scree fields and mountain meadows		
Food plants	*Cysticorydalis fedtschenkoana*, *Corydalis tenella* (discreet corydalis), *Corydalis gortschakovi*		
Life cycle	Follows a two-year life cycle. Initially overwinters as an egg hatching in spring. Larvae feed for one year then overwinter as pupae the second winter.		



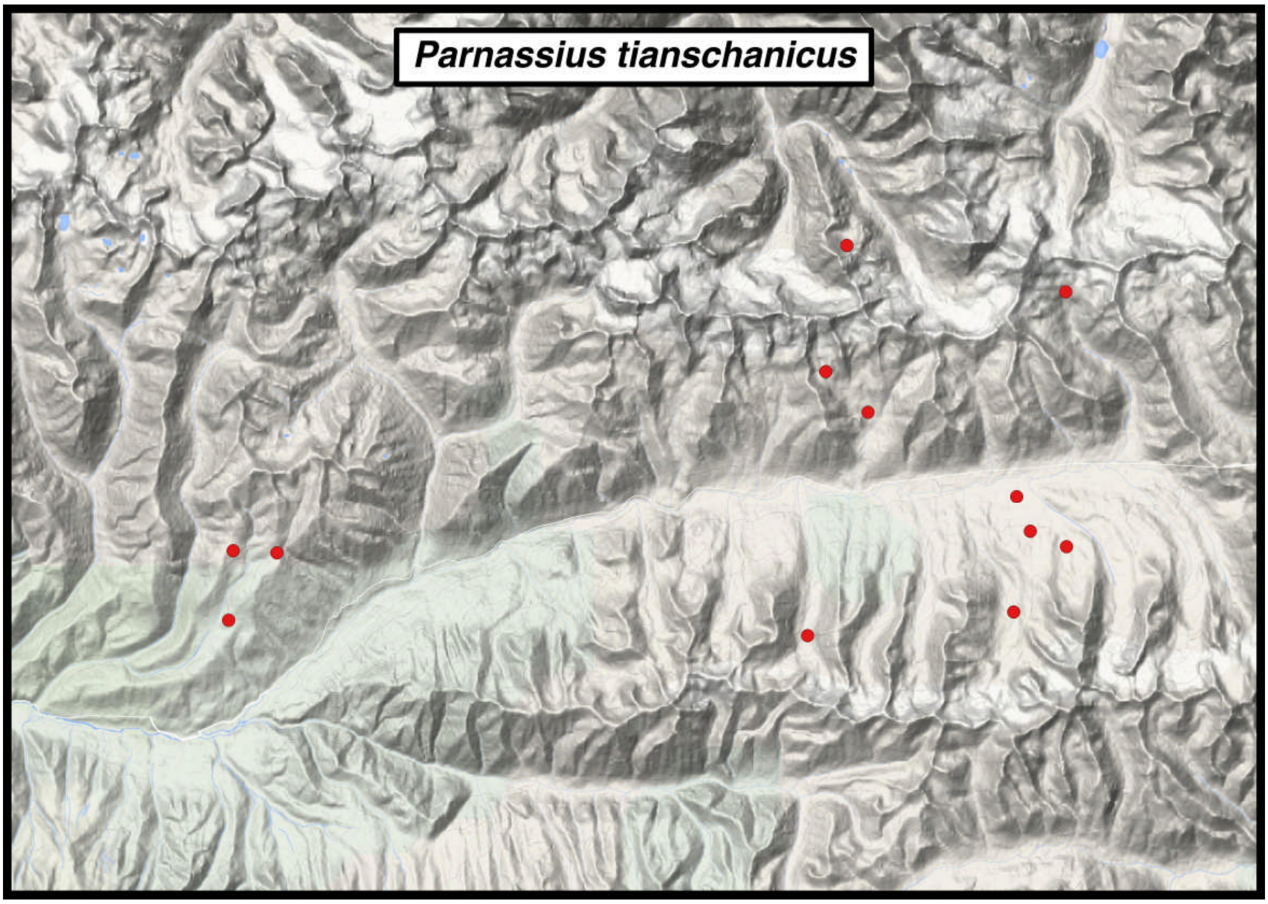
Parnassius mnemosyne — Clouded apollo

Flight time	May to July	Elevation (m)	1,300 – 3,000
Habitat	Grassy stepped slopes as well as mountain valleys and river terraces		
Food plants	*Corydalis ledebouriana* and *Corydalis glaucescens*		
Life cycle	Overwinters as an egg		



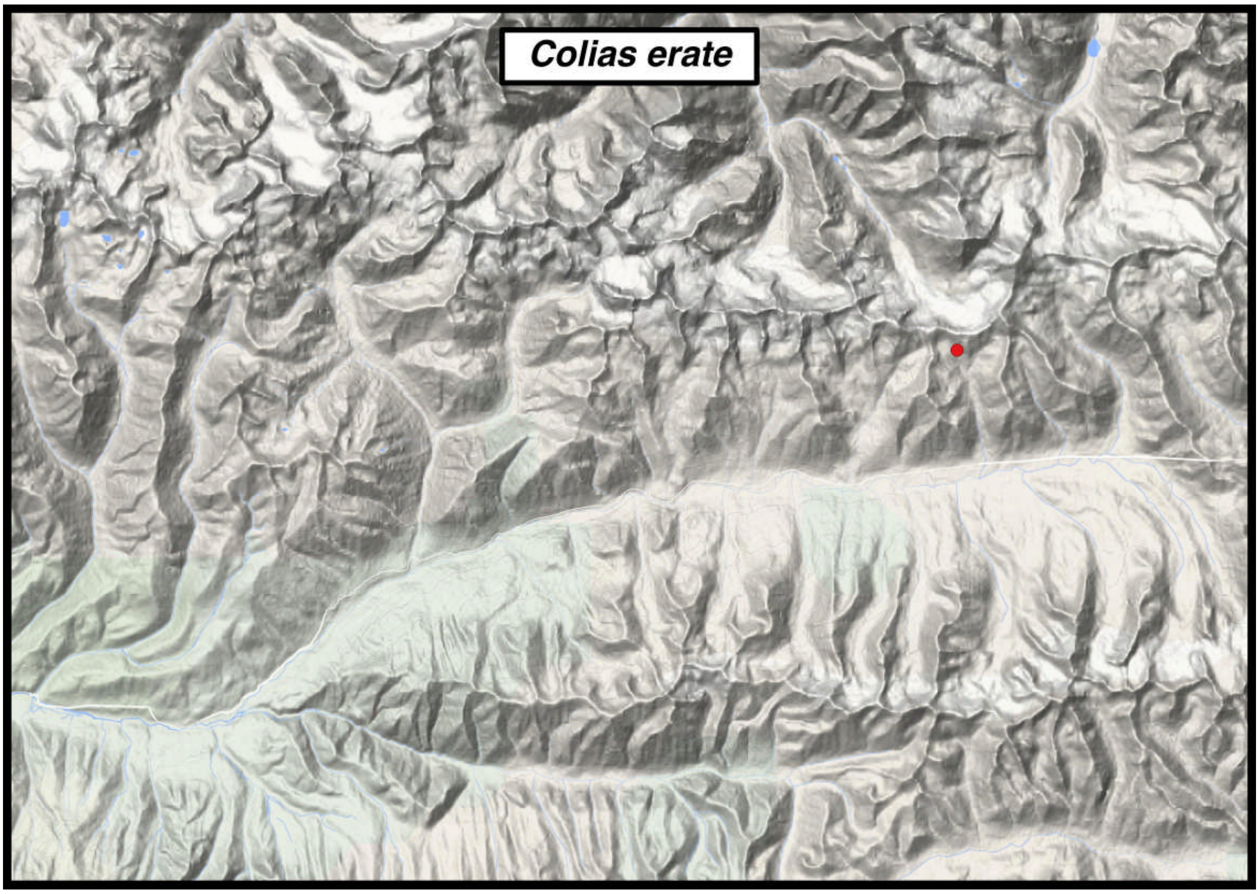
Parnassius tianschanicus — Large-keeled apollo

Flight time	May to September	Elevation (m)	1,700 – 3,500
Habitat	East- and south-facing rocky slopes in subalpine and alpine areas		
Food plants	*Rhodiola* spp., *Sedum ewersii* (stonecrop), *Sedum hybridum*		
Life cycle	Overwinters as a larva		



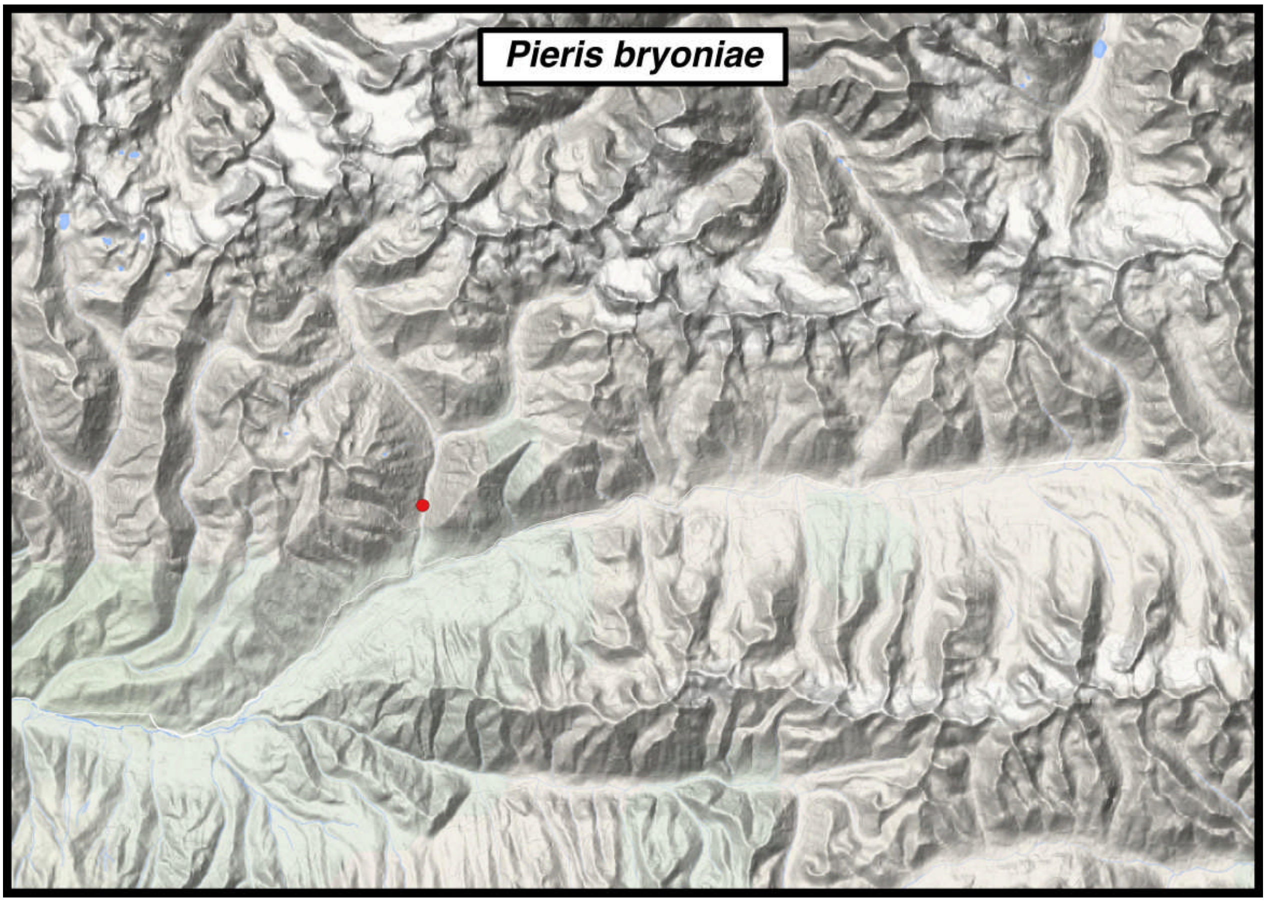
Colias erate - Pale clouded yellow

Flight time	April to October	Elevation (m)	up to 3,300
Habitat	Steppes, fields and mountain meadows		
Food plants	*Onobrychis* spp. (sainfoin), *Medicago* spp. (burclover), *Trifolium* spp. (clover), *Trigonella* spp. (fenugreek), *Alhagi* spp. (camelthorn)		
Life cycle	Bivoltine. Overwinters as either a pupa or larva.		



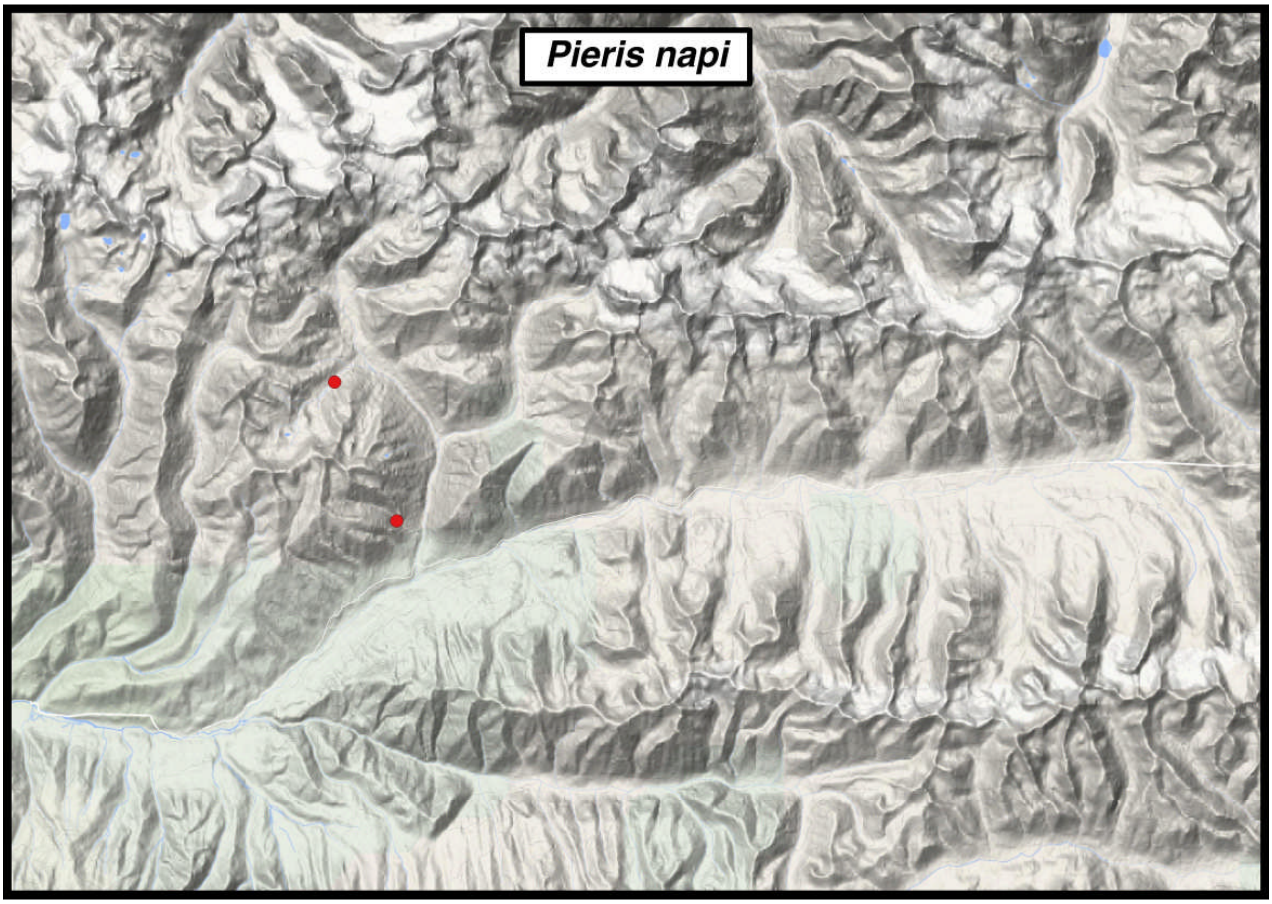
Pieris bryoniae - Dark-veined white

Flight time	June to July	Elevation (m)	up to 2,700
Habitat	Damp foothills and meadows		
Food plants	*Thlaspi* spp. (pennycress)		
Life cycle	Overwinters as a pupa		

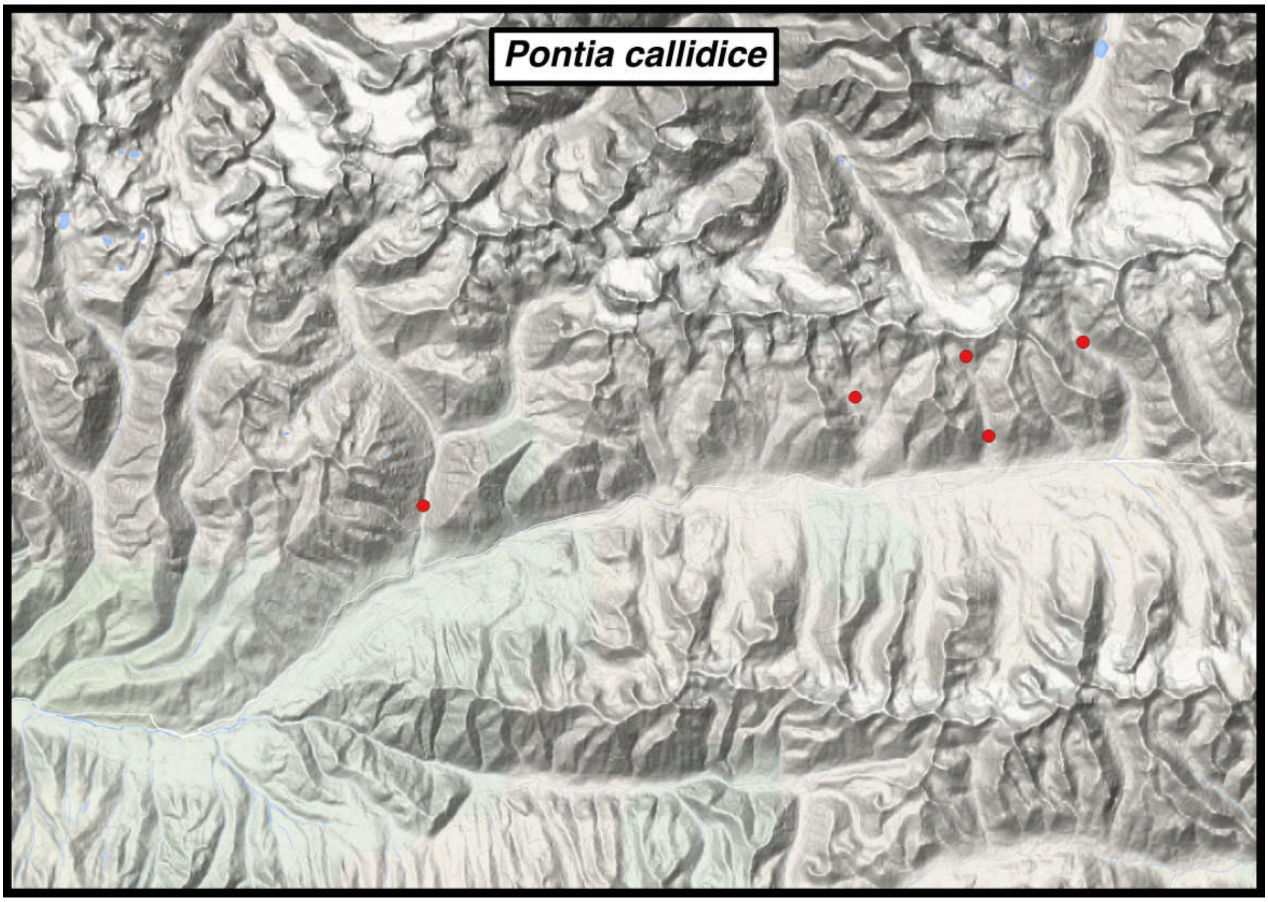
Pieris napi — Green-veined white

Flight time	April to September	Elevation (m)	up to 3,000
Habitat	Meadows and river valleys		
Food plants	*Brassica* spp. (cabbage), *Cardamine* spp. (bittercress), *Alyssum* spp., *Arabis* spp. (rockcress), *Barbarea* spp. (winter cress), *Descurainia* spp. (tansymustard), *Erysimum* spp. (wallflower), *Sisymbrium* spp. (rocket), *Thlaspi* spp. (pennycress), *Draba* spp. (whitlow-grass), *Lepidium* spp. (peppercress), *Reseda lutea* (wild mignonette).		
Life cycle	Bivoltine or multivoltine depending on the altitude. Eggs are laid singly. Overwinters as a pupa.		



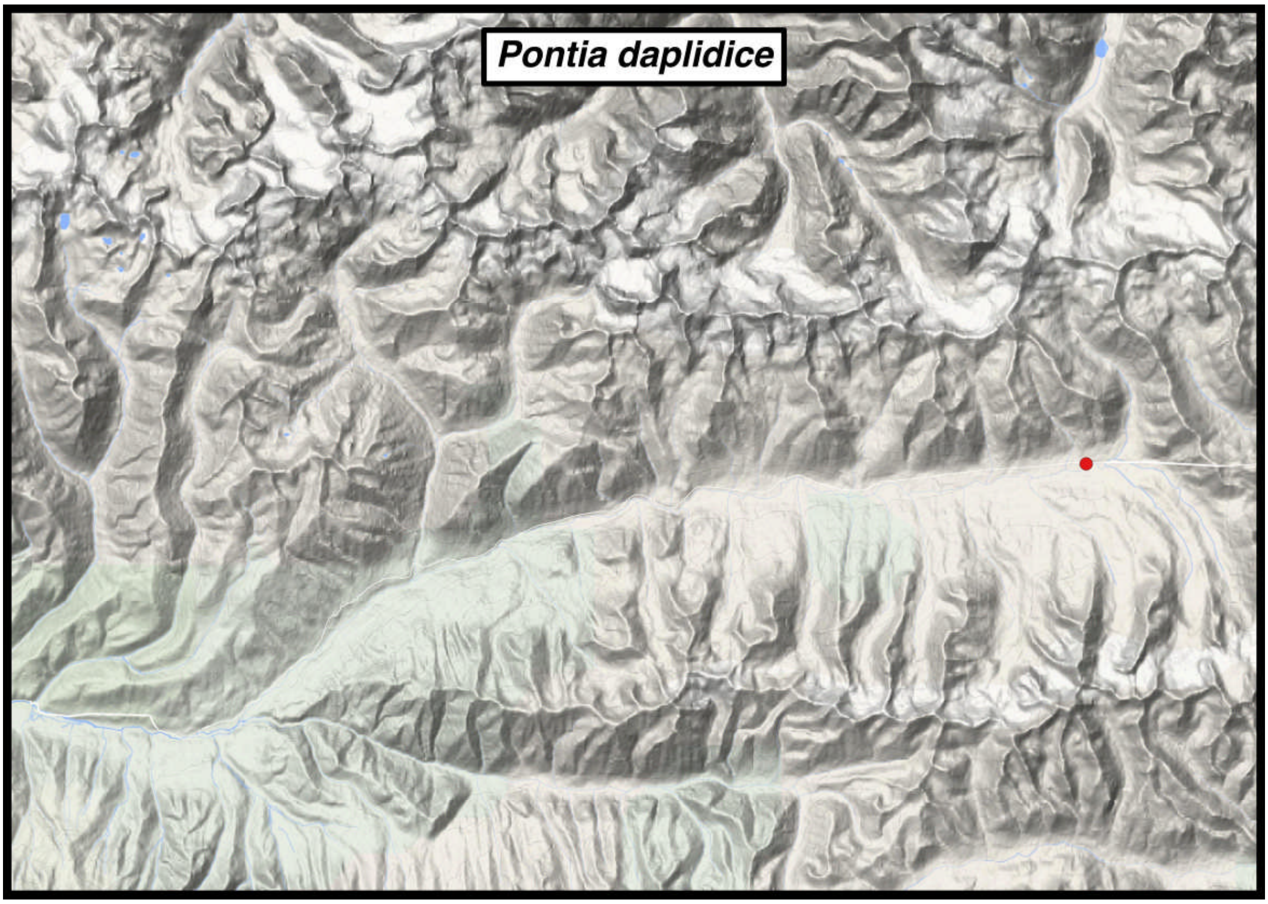
Pontia callidice - Lofty Bath white

Flight time	May to September	Elevation (m)	2,000 – 4,500
Habitat	South facing river valleys and steppe slopes		
Food plants	*Brassica* spp. (cabbage), *Alyssum* spp., *Arabis* spp. (rockcress), *Barbarea* spp. (winter cress), *Descurainia* spp. (tansymustard), *Erysimum* spp. (wallflower), *Sisymbrium* spp. (rocket), *Thlaspi* spp. (pennycress), *Draba* spp. (whitlow-grass), *Lepidium* spp. (peppercress), *Reseda lutea* (wild mignonette), *Orostachys* spp. (Chinese hat)		
Life cycle	Bivoltine. Second generation hibernates as a pupa.		



Pontia daplidice - Bath white

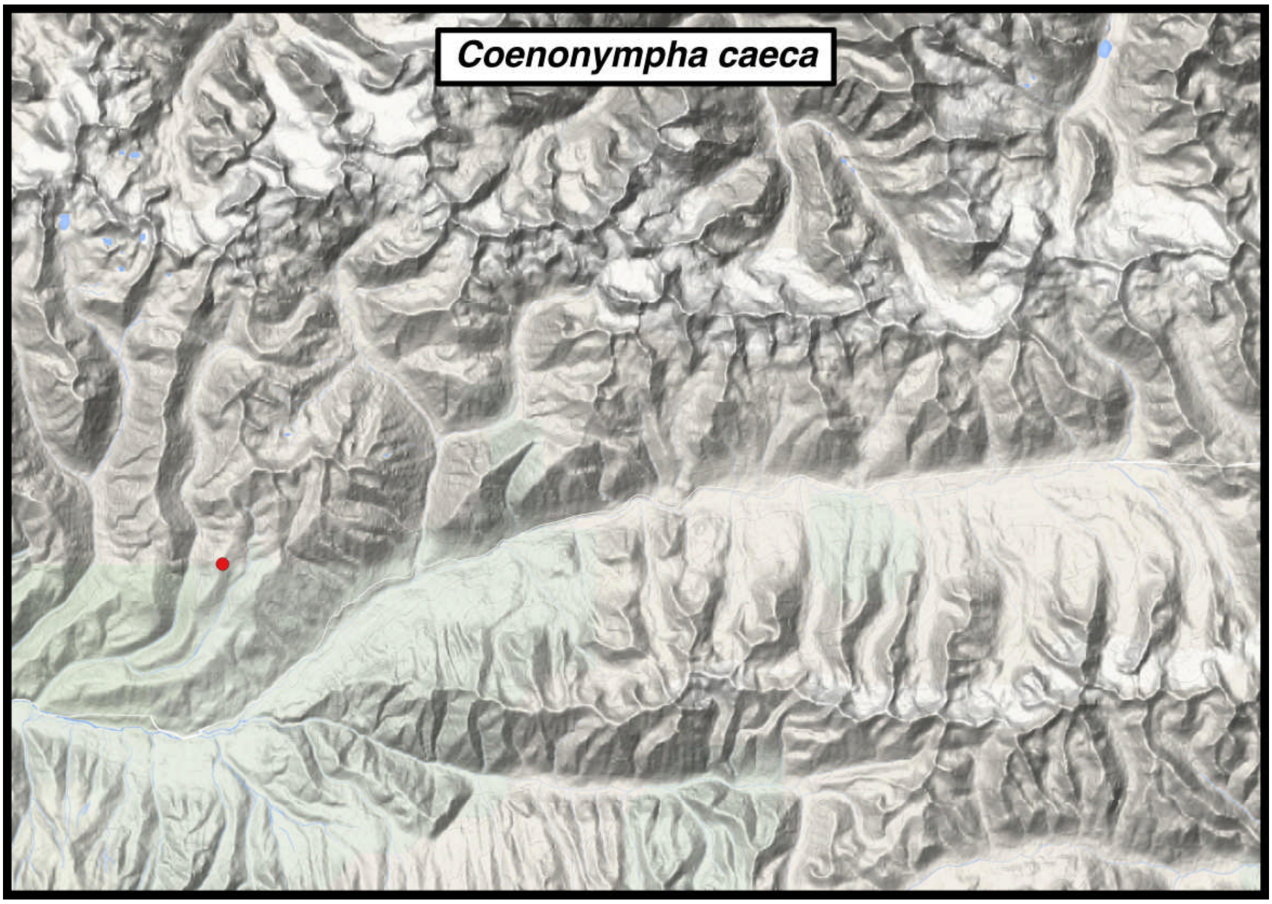
Flight time	April to October	Elevation (m)	500 – 4,000
Habitat	Deserts, steppes, river valleys		
Food plants	*Alyssum* spp., *Arabis* spp. (rockcress), *Berteroa* spp. (hoary alison), *Erysimum* spp. (wallflower), *Sisymbrium* spp. (rocket), *Thlaspi* spp. (pennycress), *Reseda lutea* (wild mignonette), *Vicia* spp. (vetch), *Lathyrus* spp. (sweet pea), *Pisum* spp. (pea), *Trifolium* spp. (clover).		
Life cycle	Multivoltine. Overwintering generation does so as a pupa.		



Coenonympha caeca

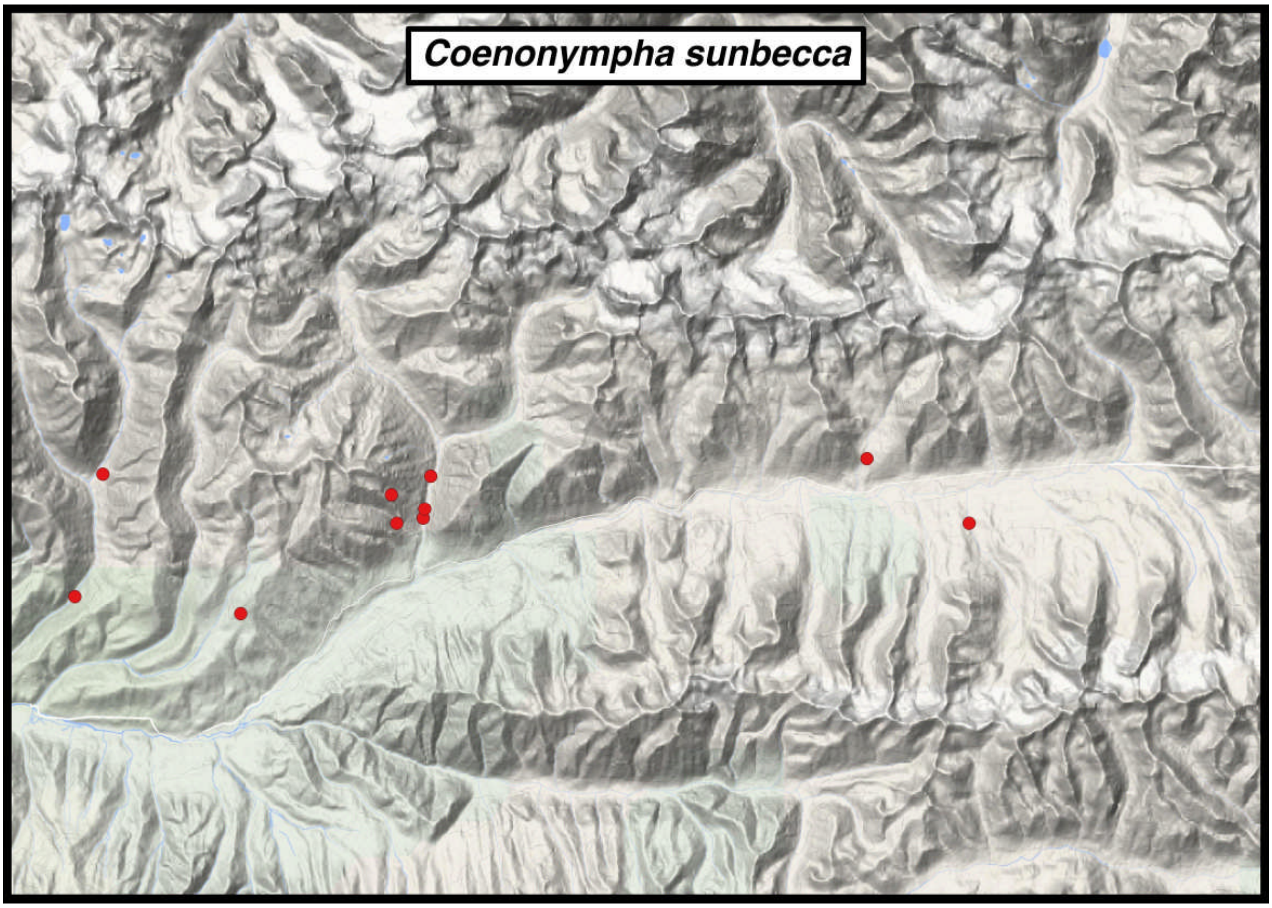
Flight time	June to July	Elevation (m)	2,000 – 3,500
Habitat	Alpine meadows, stream banks, and stoney slopes that face eastward		
Food plants	*Carex* spp. (sedge)		
Life cycle	Unknown		

Photo courtesy of Rahat Yusubalieva



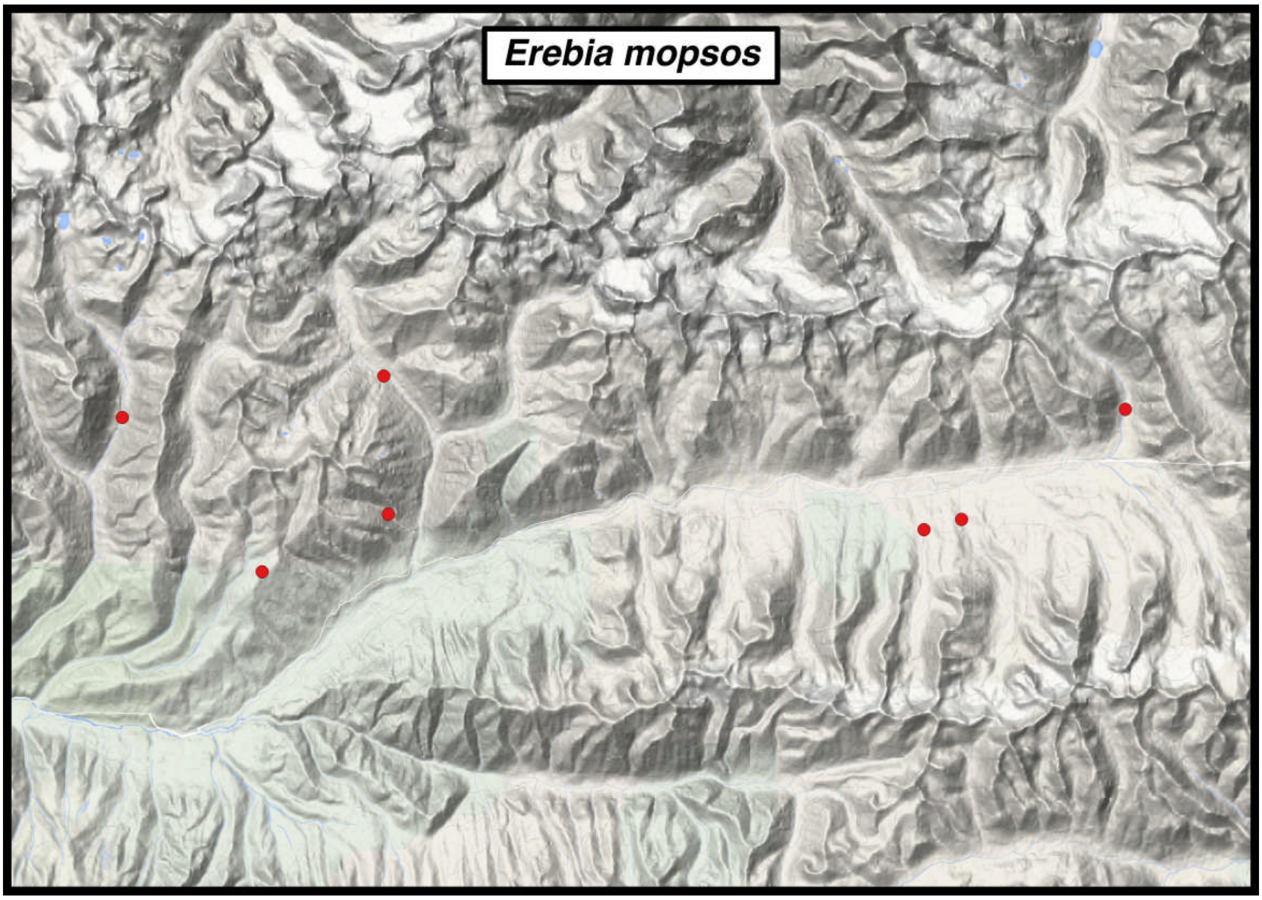
Clossiana erubescens

Flight time	June to August	Elevation (m)	1,500 – 3,400
Habitat	Sloped meadows and stream banks		
Food plants	Poaceae (grasses)		
Life cycle	Unknown		



Erebia mopsos

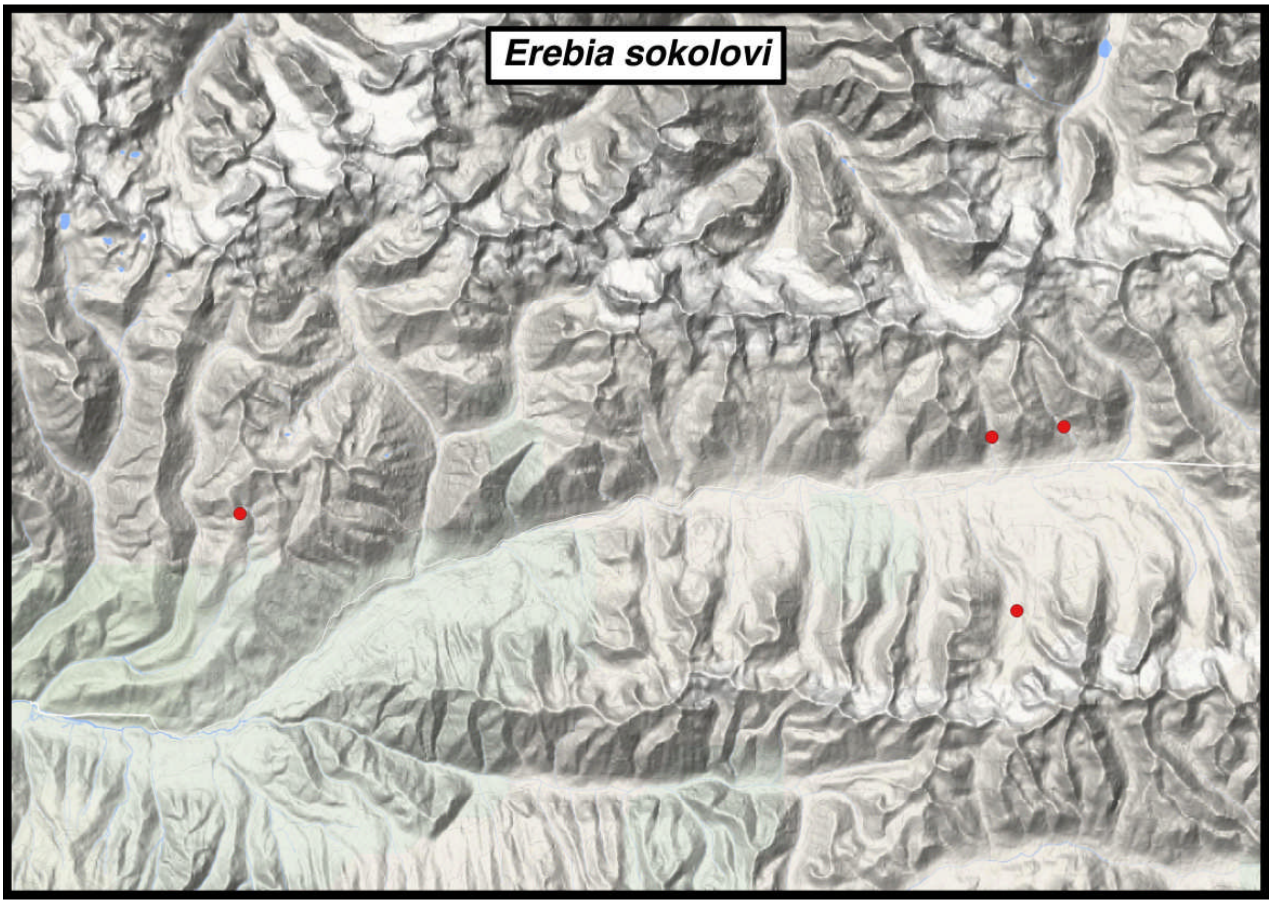
Flight time	June to July	Elevation (m)	2,800 – 3,500
Habitat	Meadow slopes in subalpine and alpine areas		
Food plants	*Festuca* spp. (fescue)		
Life cycle	Unknown		



Erebia sokolovi

Flight time	July to August	Elevation (m)	3,000 – 3,600
Habitat	Meadow slopes in subalpine and alpine areas		
Food plants	Poaceae (grasses)		
Life cycle	Unknown		

Photo courtesy of Peter Sporrer



3.4. Discussion and conclusions

It is important to remember that the Suusamyr region of Kyrgyzstan, although relatively close geographically to the capitol, Bishkek, has been very poorly studied in terms of entomological diversity. As such, this study appears to be the first real effort to catalogue butterfly species found there.

Of the 20 species found by the expedition, 13 were also found on the northern side of the Alatoo mountain range, in Ala Archa National Park, during the summer of 2015. This suggests that seven of the 20 species are not found on the northern side, although more collection is needed from both sides to confirm this. These seven species are *Pyrgus malvae, Cupido buddhista, Boloria generator, Parnassius delphius, Parnassius tianschanicus, Coenonympha caeca,* and *Erebia sokolovi.*

Recommendations for 2016:

- The 2016 expedition should use the smartphone app “Butterflies of Kyrgyzstan”, a citizen science app that will allow expedition participants to collect data upon sighting butterflies. This will speed up both the data collection and the data input processes. It will also allow for better verification of each species observation. The app is being developed by the author.

- A clearer understanding by expedition participants of the sub-project of collecting information on the observations of butterflies will increase the number of sightings and thereby should also increase the number of species observed. As such the author will conduct training of participants and staff during the first expedition group, to be taken over by expedition staff for subsequent groups when the author will not be present on the expedition.

3.5. Resources

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Appendix I: List of bird species recorded during the 2015 expedition.

Latin name	**English name**	**Русское название**
Acanthis cannabina	Linnet	Коноплянка
Actitis hypoleucos	Common sandpiper	Перевозчик
Anthus spinoletta	Water pipit	Горный конек
Anthus trivialis	Tree pipit	Лесной конёк
Aquila chrysaetos	Golden eagle	Беркут
Aquila heliaca	Imperial eagle	Могильник
Asio flammea	Short-eared owl	Болотная сова
Buteo buteo	Common buzzard	Обыкновенный канюк
Buteo rufinus	Long-legged buzzard	Курганник
Calliope pectoralis	Himalayan rubythroat	Черногрудая красношейка
Carduelis carduelis	Goldfinch	Черноголовый щегол
Carpodacus erythrinus	Common rosefinch	Обыкновенная чечевица
Cinclus cinclus	Dipper	Белобрюхая оляпка
Corvus corax	Raven	Ворон
Corvus corone	Carrion crow	Черная ворона
Cuculus canorus	Common cuckoo	Обыкновенная кукушка
Delichon urbicum	Northern house martin	Городская ласточка
Emberiza buchanani	Grey-necked bunting	Каменная овсянка
Eremophila alpestris	Horned lark	Рогатый жаворонок
Falco cherrug	Saker falcon	Балобан
Falco peregrinus	Peregrine falcon	Сапсан
Falco subbuteo	Hobby	Чеглок
Gypaetus barbatus	Bearded vulture	Бородач
Gyps himalayensis	Himalayan griffon	Кумай
Ibidorhyncha struthersii	Ibisbill	Серпоклюв
Leucosticte brandti	Brandt’s rosefinch	Жемчужный вьюрок
Locustella naevia	Grasshopper warbler	Обыкновенный сверчок
Melanocorypha calandra	Calandra lark	Степной жаворонок
Milvus migrans	Black kite	Черный коршун
Monticola saxatilis	Rock thrush	Пестрый каменный дрозд
Motacilla cinerea	Grey wagtail	Горная трясогу́зка
Motacilla citreola	Citrine wagtail	Желтоголовая трясогузка
Motacilla flava	Yellow wagtail	Жёлтая трясогу́зка
Oenanthe oenanthe	Wheatear	Каменка обыкновенная
Phoenicurus erythrogaster	Guldenstadt’s redstart	Краснобрюхая горихвостка
Phoenicurus erythronotus	Eversmann's redstart	Красноспинная горихвостка
Phylloscopus humei	Hume's leaf warbler	Пеночка тусклая
Pica pica	Magpie	Сорока
Prunella collaris	Alpine accentor	Альпийская завирушка
Pyrrhocorax graculus	Alpine chough	Альпийская галка
Saxicola torquata	Stonechat	Черноголовый чекан
Sylvia communis	Common whitethroat	Серая славка
Tadorna tadorna	Shelduck	Пеганка
Tetraogallus himalayensis	Himalayan snowcock	Гималайский улар
Tichodroma muraria	Wall creeper	Стенолаз
Tringa ochropus	Green sandpiper	Черныш

Appendix II: Revised community questionnaire.

FIELD DATA SHEET: INTERVIEW

You will be visiting local people to find out about their knowledge, beliefs and attitudes about snow leopards. This is also an opportunity to obtain information about their observations of wildlife. Snow leopard conservation is, to a significant degree, dependent on the understanding that people have about the snow leopard and of their relationship to the animal. This interview is an opportunity to gain a better understanding of the interactions between snow leopards and the Kyrgyz people.

Interviews are to be conducted in an informal, conversational style. In order to establish rapport and help create a relaxed atmosphere, begin by introducing yourself and state that you are interested in learning about what local people think and feel about snow leopards in this area. Emphasize that there are no right or wrong answers, and that you are simply interested in hearing about their ideas and experiences with snow leopards.

Prior to the interview, ask if there are any questions. Once their questions are answered, start the process with, "Is it alright for us to proceed?"Explain that you will be referring to this questionnaire as we go along in order to make sure that everyone is asked the same questions.

INTERVIEW CONDUCTED BY:	**DATE OF INTERVIEW:**
PERSONAL INFORMATION ABOUT THE INTERVIEWEE	
NAME: ________________________________	AGE:__________
GENDER: male ❒ female ❒	
PLACE OF RESIDENCE:___________________________	PLACE OF BIRTH:_________________
OCCUPATION: _________________________________	
If you work with livestock, what kind of animals and how many? ("many" is optional).	
SHEEP ❒_____ GOATS ❒_____ COWS ❒_____ HORSES ❒_____ POULTRY ❒	

INFORMATION ABOUT SNOW LEOPARDS
I would like to ask you some questions about snow leopards.
1. Have you ever seen a snow leopard, or signs of a snow leopard?
❒ **YES,** Seen a snow leopard (ASK QUESTION 2a)
❒ **YES**, Seen signs of a snow leopard (ASK QUESTION 2b)
❒ **NO**, Never seen a snow leopard or signs of a snow leopard
❒ **YES**, Do you know a person that has seen a snow leopard or signs of a snow leopard
❒ **NO**, Do you know a person that has seen a snow leopard or signs of a snow leopard

2a. If you saw a snow leopard, can you tell me about that please. a. When did you see it? b. Where did you see it? c. What was it doing? d. How do you feel about having seen a snow leopard? ❐ **Excited** ❐ **Not excited**
2b. If you saw signs of a snow leopard, such as tracks in the snow for example (but not an actual snow leopard) - a. What did you see? b. When did you see this? c. Where did you see this? d. How do you feel about having seen signs of a snow leopard? ❐ **Excited** ❐ **Not excited**
3. The presence of snow leopards has a ❐ beneficial or ❐ detrimental impact on this area? **(In your view, are they ❐ good or ❐ bad for the country?)** Can you tell me a little more about the impact that snow leopards have on Kyrgyzstan?
4. Can you tell me how you feel about snow leopards in general? Do you like, dislike or feel neutral about snow leopards? ❐ LIKE ❐ DISLIKE ❐ NEITHER

5. Do snow leopards attack people? ❒ **YES** ❒ **NO** ❒ **DON'T KNOW**

If YES: What makes snow leopard attacks on people?

If snow leopards attack people, are these attacks are more frequent in places where snow leopards live near people? ❒ YES ❒ NO ❒ DON'T KNOW

6. How many snow leopards are there in Kyrgyzstan? ___________
❒ DON'T KNOW

7. Are snow leopards protected in Kyrgyzstan? ❒ **YES** ❒ **NO** ❒ **DON'T KNOW**

In your opinion, should snow leopards be legally protected in Kyrgyzstan? ❒ YES ❒ NO
❒ DON'T KNOW

Can you tell me more about that?

THE EFFECT OF SNOW LEOPARDS ON OTHER ANIMALS

8. Do snow leopards reduce the number of large game animals such as ibex or argali sheep in this area?
❒ **YES** ❒ **NO** ❒ **DON'T KNOW**

IF YES: How do snow leopards reduce the numbers of large animals?

IF NO: Why do you think snow leopards do not reduce the number of large animals?

9. Do snow leopards reduce the number of small animals such as marmots and snowcock in the area? ❒ **YES** ❒ **NO** ❒ **DON'T KNOW** **IF YES:** Hoe do snow leopards reduce the number of small animals? **IF NO:** Why do you think that snow leopards do not reduce the numbers of small animals?
9. In areas where snow leopards live near livestock, do they feed on domestic animals? ❒ **YES** ❒ **NO** ❒ **DON'T KNOW** **IF YES:** Can you tell me more about that.

SNOW LEOPARDS AND TOURISM
10. If snow leopards attracted more tourists to this region, would this be a good thing or a bad thing? ❒ A good thing ❒ A bad thing ❒ I don't have an opinion about snow leopards and tourism What are your thoughts about how snow leopards might influence tourism?
ADDITIONAL COMMENTS 11. Before we end our meeting, I wonder if you have anything else that you might want to tell me about snow leopards that we didn't discuss so far?
Thank you very much for taking the time to explain your thoughts and feelings about snow leopards. Your answers to these questions will be useful in helping us understand how people and snow leopards can harmoniously coexist in this country.

Appendix III: Expedition diary and reports

A multimedia expedition diary is available on https://biosphereexpeditions.wordpress.com/category/expedition-blogs/tien-shan-2015/

All expedition reports, including this and previous expedition reports, are available on www.biosphere-expeditions.org/reports.