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EXPEDITION REPORT

Expedition dates: 26 June – 26 August 2017

Report published: June 2018

Mountain ghosts: protecting snow leopards and other animals of the Tien Shan mountains of Kyrgyzstan

(as well as studying butterflies as indicators of climate change)

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Abstract

This study was part of a continuing annual expedition to the Tien Shan Mountains (Kyrgyz Ala Too and Jumgal Too ranges), run by Biosphere Expeditions and NABU from June to August 2017, with the aim of surveying for snow leopard (*Panthera uncia*) and its prey species. Using a cell methodology developed for citizen scientist volunteer expeditions, 78 cells of 2x2 km were surveyed and 14 interviews with local people were conducted. 21 butterfly species were also recorded. Previous expeditions had indicated that snow leopard was present in the survey area and in 2017 the discovery of fresh signs of snow leopard presence (pugmarks) confirmed 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. Potential prey species in the are are Siberian ibex, marmot and snowcock; in 2017 there was no record of argali. Successful Maxent-directed field surveys identified wildlife areas promising for the development of a local network of protected areas. Poaching, overgrazing and other disturbances are serious issues that must be addressed in order to avoid habitat degradation and with it the loss of the snow leopard. Local people are in favour of snow leopard presence and receptive to the creation of economic incentives based on intact nature and snow leopard presence and in 2017 community members from the surrounding area were trained in camera trapping techniques in order to extend the study season through the winter. Biosphere Expeditions and NABU will continue with the annual research expeditions to the area, seeking to conduct further surveys and continuing to involve local people, as well as continuing to identify and develop economic benefits and incentives to maintaining habitat health, and with it snow leopard presence.

Резюме

Это исследование явилось частью продолжающейся ежегодной экспедиции в горы Тянь-Шаня (хребты Кыргыз Ала-Тоо и Джумгал-Тоо), проводимая Biosphere Expeditions и NABU (Кыргызстан) в июне-августе 2017 года с целью исследования снежного барса (Panthera uncia) и видов, составляющих его питание. Применив методику координатной сетки на карте, разработанной для проведения научно-практического исследования совместно с волонтерами, было исследовано 78 полигонов (размером 2x2 км) и был проведен опрос у 14 местных жителей. Также был зарегистрирован 21 вид дневных бабочек. Ранее отмечалось, что снежный барс обитает в районе исследований. В 2017 году обнаружение новых признаков присутствия снежного барса (отпечатки следов) подтвердило важность области исследования как место обитания для хищника. Исследования показали, что изученная область является биологически разнообразной и в наличии имеется кормовая база снежного барса (горные козлы, сурки, улары); аргали в этом году не отмечены. Успешные полевые исследования, направленные с помощью Maxent моделирования, позволили идентифицировать районы дикой природы, перспективные для развития локальной сети охраняемых территорий. 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, поэтому люди восприимчивы к созданию экономических стимулов, основанных на нетронутой природе и наличии снежного барса. В 2017 г. некоторые местные жители были обучены работе с фотоловушками, для продления сезона исследований еще на шесть месяцев. Biosphere Expeditions и NABU будут продолжать ежегодные исследовательские экспедиции в этот район. При этом будут проведены дальнейшие исследования и продолжено привлечение местных жителей. Также продолжится поиск стимулов для развития экономических выгод и поддержания здоровой среды обитания, а вместе с ним и снежного барса.

Корутунду

Бул изилдөө Биосфералык экспедиция менен НАБУнун Тянь-Шань (Кыргыз Ала-Тоо жана Жумгал Тоо) кыркаларына пландаган экспедициясынын бири болчу. 2017-жылдын июль жана август айында уюштурулган экспедициясынын максаты, илбирс жана анын тоют базасысынын аталган аймакта бар экендигин аныктоо болду. Ыктыярчылар менен илимий практикалык изилдөөнү өткөрүү үчүн атайын иштелип чыккан торчо карта методикасынын жардамы менен 78 полигон ((аймагы 2х2км) изилденип, жергиликтүү жашоочулар арасында 14 сурамжылоо өткөрүлдү. Мурда илбирс бул изилдөөнүүчү аймакты мекендейт деген малыматтар түшкөн. 2017-жылы илбирстин жаңы издеринин табылганы (таманынын издери) бул аймакты изилдөө маанилүү экенин түшүндүрдү. Изилдөөнүн негизинде, изилденген аймак биотүрдүүлүгү жагынан жогору, илбирстин тоют базасы болгон (эчки-теке, суур, улар) жетиштүү санда экени аныкталды. 2017-жылы архарлар жөнүндө эч кандай маалымат болгон эмес. Ийгиликтүү талаа изилдөөсүнун жүрүшүндө, максималдуу түрдө жапайы жаратылыштын аймагын идентификациялап анын келечектүү өнүгүүсүнө жана корголушуна аракеттер жасалды.Браконьерчиликтин өкүм сүргөнү жана өсүмдүктөрдүн жок болушу илбирстин санынын азайып жатышынын бирден-бир себептери болуп саналат. Бирок башка жагынан караганда жергиликтүү элдин бул жандыкка болгон мамилеси канааттандыраарлык экен. Ушул жактарын эске алып жергиликтүү элдерди фото капкан менен иштөөгө үйрөтүп, изилдөө иштеринин сезонун кышка чейин узартуу маанилүү болду. Биосфералык экспедиция менен НАБУнун мындан кийин да жыл сайын жергиликтүү жашоочуларды тартуу менен экономикалык факторлорду эске алып, жапайы жаныбарлардын санын аныктоо жана илбирсти сактап калуу максатында изилдөөлөрдү уланта бермекчи.

Zusammenfassung

Diese Studie war Teil einer Expedition in das Tien-Shan-Gebirge Kirgisiens (Ala-Too und Jumgal-Too Bergketten), durchgeführt von Biosphere Expeditions und dem NABU im Juli und August 2017 mit dem Ziel ein Gutachten über den Schneeleoparden (*Uncia uncia*) und dessen Beutetiere zu erstellen. Als Basis diente eine von Biosphere Expeditions entwickelte Zellenmethodik für Forschungsexpeditionen mit Bürgerwissenschaftlern, bei der 78 Zellen von 2x2 km Größe untersucht und 14 Interviews mit der einheimischen Bevölkerung durchgeführt wurden. Außerdem wurde eine Liste von 21 in der Region vorkommenden Schmetterlingsarten erstellt. Daten, die von vorangegangenen Expeditionen gesammelt wurden, gaben Hinweise darauf, dass der Schneeleopard im Studiengebiet vorkommt. Die Expedition 2017 fand frische Schneeleopardenspuren und bestätigt somit das Vorkommen der Art im Studiengebiet. Die Forschungen zeigten auch, dass das Habitat im Studiengebiet variabel genug ist und gute Voraussetzungen für eine gesunde Beutetierpopulation vorliegen. Potenzielle Beutetiere sind der sibirische Steinbock, das Murmeltier und die Schneehenne; 2017 wurden keine Anzeichen auf Argali-Bergschafe gefunden. Mithilfe von Felduntersuchungen, basierend auf Maxent-Verbreitungsmodellen vorangeganger Expeditionen, identifizierte die Expedition Gebiete für ein Netzwerk lokaler Schutzgebiete. Wilderei, Überweidung und andere negative Einflüsse bleiben ernstzunehmende Störfaktoren, die angegangen werden müssen, um eine Verödung des Lebensraumes und das damit einhergehende Verschwinden des Schneeleoparden zu verhindern. Die Akzeptanz des Schneeleoparden bei der einheimischen Bevölkerung ist 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. 2017 wurden auch Einheimische an Kamerafallen ausgebildet, um den Studienzeitraum auszudehnen und Menschen vor Ort weiter zu integrieren. 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 26 June to 26 August 2017 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, or about 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 provides vital data on these factors, 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 is 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 in the world 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 of 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 unlike any other 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 (wth study site) and flag of Kyrgyzstan.

An overview of Biosphere Expeditions' research sites, assembly points, base camp and office locations can be found 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 areas, alpine peaks, narrow river canyons and broad valleys, highland tundra and deep natural limestone gorges, open steppes, permanent snow and glaciers, 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 half of the mountain territory.

There are many threatened animal and plant species present in the area, a great number of them endemic, with a recent count showing at least 70 threatened mammal, 376 bird, 44 fish and 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, 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 three 12-day slots, each composed of a team of international research assistants, scientists and an expedition leader. Slot dates were:

26 June - 8 July | 10 - 22 July || 31 July - 12 August | 14 - 26 August 2017

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 2.2.3a). 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 (yellow) and mess (green) tunnel tents 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, with summer temperatures ranging from +11°C to +35°C during the day. Base camp was in the mountains at an altitude of 3,000 m and as such the weather was very variable. Wind and rain showers occurred infrequently and higher up could turn into snowfall. On 4 August a strong storm ripped through the camp about midday and destroyed both the mess tent and kitchen.

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 posted 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 when a pre-existing condition manifested itself in an unexpected spinal injury. The patient was evacuated to Bishkek and from there to Dubai.

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 obtained his Master's Degree in Biology 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. As well as 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 throughout his professional life.

1.6. Expedition leader

The expedition was led by Amadeus DeKastle, who has been living and working in Kyrgyzstan since 2009. Born in Germany and with a US passport, he holds a Masters degree in entomology from the University of Nebraska. He currently works with NGO Plateau Perspectives in environmental conservation with a number of citizen science research projects. He is also a part-time lecturer at the American University of Central Asia in the Environmental Management Department. In 2014 he found out about Biosphere Expeditions' work in Kyrgyzstan and signed up for a placement. After two years of volunteering with Biosphere Expeditions, he decided to jump in with both feet and joined the team in 2016.

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):

26 June - 8 July 2017: Adnan Ali (Kyrgyzstan)*, Regina Austermann (Germany), Matthias Graeub (Switzerland)**, Matthias Hammer (Germany)***, Lisa Hui (Australia), Shruti Kumar (India), Catherine McCosker (South Korea), Tessa Merrie (UK)***, Ulrich Pamler (Germany), Nitin Ramesh (India), Urmas Roostalu (UK), Jannis Schubert (Germany), Neil Seshadri (Japan), Nadia Trupcevic (Germany).

10 - 22 July 2017: Amy Cook (UK), Andrew Dean (UK), Maria Domingues (Portugal), Yryskeldi Emilbekov (Kyrgyzstan)*, Franziska Hefti (Switzerland), Martin Hefti (Switzerland), Amy Jordan (USA), Christoph Mareischen (Switzerland), Carol Montgomery (Dean) (UK), Brian Oram (UK), Christore Palitzsch (Germany), Sven Pelka (Germany), Christina Willi (Switzerland).

31 July - 12 August 2017: Susanne Ahlqvist (Norway), Claudia Bohnsack (Germany), Kate Cregoe (New Zealand), Thomas Exner (Austria), Cyril Feuerriegel (Germany), Anette Holmberg (Sweden), Janine Liddelow (Australia), Kenneth Magee (USA), Wolfgang Moschek (Germany), Michael Mueller (Germany), Emma Nargejev (Kyrgyzstan)*, Alina Reichardt (Germany)**, Jana Schweitzer (USA), Sarah Stephens (Australia).

14 - 26 August 2017: Nadia Asykulov (Kyrgyzstan)*, Tobias Babian (Germany), Sharon & Daniel Biancalana (UK), Joseph Colletti (USA), Caitlin Harding (UK), Jill Hill (USA), Abigail James (UK), Jennifer Jung-Bleicher (Germany), Beata-Clara Krambeck (Germany), Birgit Lorenz (Germany), Stephan Nerge (Germany), Asel Shailoobekova (Kyrgyzstan)*, Fabian von Poser (Germany)**, Lidia Waigner (Germany).

Also our expedition cook throughout the expedition, Gulia Subanova and, on a rotational basis, members of NABU's anti-poaching patrol Grupa Bars: Schailoobek Tezektschiev, Aman Talgartbek Uulu and Bekbolot Ozgorush Uulu, all from Kyrgyzstan.

*placement kindly supported by the Nando and Elsa Peretti Foundation
**press
***additional Biosphere Expeditions staff.

1.8. 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 environmental 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, and to climate protection and improving 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/).

1.9. 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 details), 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. Biosphere Expeditions would also like to thank members of the Friends of Biosphere Expeditions and all donors to a fundraising campaign for their support.

The expedition also gratefully acknowledges support from the Nando and Elsa Peretti Foundation.

1.10. 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.

1.11. Expedition budget

Each team member paid towards expedition costs a contribution of £1,890 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	76,731
Grant support	8,350
Expenditure	
Expedition base includes all food & services	9,411
Transport includes hire cars, fuel, taxis in Kyrgyzstan	11,781
Equipment and hardware includes research materials & gear etc. purchased internationally & locally	6,894
Staff includes local and Biosphere Expeditions staff salaries and travel expenses	13,451
Administration includes miscellaneous fees & sundries	3,054
Team recruitment Tien Shan as estimated % of annual PR costs for Biosphere Expeditions	6,733
Income – Expenditure	**25,407**
Total %age 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 Kygryzstan (2017)

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 (*Panthera uncia*) is a member of the cat family *Felidae*, subfamily *Pantherinae* (https://en.wikipedia.org/wiki/Snow_leopard). Snow leopards are found in twelve countries across Central Asia (Fig 2.1.1a). 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 (map © 2009 Snow Leopard Trust). Expedition study site in black ellipse.

Inaccessible and difficult terrain, along with the secretive nature of this rare cat, helps to 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 (McCarthy & Chapron 2003). Snow leopards are generally solitary creatures, 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 (Sunquist & Sunquist 2002).

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 (McCarthy & Chapron 2003).

The home range of five snow leopards in prime habitat in Nepal varied from 12 to 39 km^2, with substantial overlap between individuals and sexes (Jackson & Ahlbom 1988). In Mongolia, where food resources may be scarcer, home ranges of both males and females exceeded 400 km^2 (McCarthy & Chapron 2003). Snow leopards are opportunistic predators capable of killing prey up to three times their own weight (Mcdonald & Loveridge 2010). They will also take small prey such as marmot (*Marmota sp.*) or chukar partridge (*Alectoris sp.*). In general, their most commonly taken prey consists of wild sheep and goats (including blue sheep, Asian ibex, markhor and argali) (Lyngdoh et al. 2014). Adult snow leopards kill a large prey animal every 10-15 days, and remain on the kill for an average of three days, but sometimes up to a week (McCarthy 2000). Predation on livestock can be significant, which often results in retribution killing by herders (McCarthy & Chapron 2003).

In 2017 snow leopards were re-categorised, amongst much controversy still ongoing today, from Endangered to Vulnerable on the IUCN Red List (http://dx.doi.org/10.2305/IUCN.UK.2017-2.RLTS.T22732A50664030.en) because the global population is estimated to number more than 2,500, but fewer than 10,000 mature individuals, and there is an estimated and projected decline of at least 10% over three generations. Snow leopards also 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 although in some countries the relevant legislation may not always be very effective.

2.1.2. The snow leopard in Kyrgyzstan

Kyrgyzstan was once home to the species' second largest population in the world (Anon. 2013). 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 (Anon. 2013). 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 (Dexel 2002).

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. More recent population estimates are closer to 350-400 for the whole country (Davletbakov et al. 2016).

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 (McCarthy & Chapron 2003). This emphasises the need for snow leopard surveys and distribution mapping, the results of which will help to identify areas for conservation.

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

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

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 are poorly documented over much of the range. Baseline population estimates should be gained for this purpose and to assist with the initiation of long-term trend monitoring.

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

In 2013 these needs were 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 twelve snow leopard home range countries at the Global Snow Leopard Forum in Bishkek. Under GSLEP, portfolios of national activities have been designed and are expected to be implemented with the support from international and national partners (see www.globalsnowleopard.org/documents-grid/).

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 environmental 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, and to to climate protection and 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 and the Tien Shan, environmental issues

The Kyrgyz territory is almost entirely comprised of the ranges,valleys, and plateaus of the Tien Shan and Pamir-Alai ranges, with 94 % of the nation's territory being higher than 1,000 m in elevation, while 40 % of territory is above 3,000 m.

The Tien Shan mountains are amongst the largest mountain ranges in Asia in terms of 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. The geologic history of the Tien Shan is one of rapid uplift forming multiple, parallel ranges (Bullen et al. 2003). These geologic processes have led to the formation of a large number of long, roughly parallel valleys with wide altitudinal variation. One result of this geologic history has been the formation of numerous, closely spaced, and extremely varied microclimates. These microclimates in turn have led to the formation of a large number of remarkably diverse ecosystems. The combination of the Kyrgyz Republic's geographic positioning, numerous microclimates and variety of relict ecosystems, have endowed the country with remarkable species diversity.

Notable vertebrate species include the snow leopard (*Panthera uncia*), argali (*Ovis ammon*), Pallas's cat (*Felis manul*), and the Himalayan griffon (*Gyps himalyensis*).

Unfortunately, some of these species have been pushed to the brink of local extinction since the onset of the economic crisis of the 1990s, which hit rural areas particularly hard. Many Kyrgyz turned to hunting, including the widespread poaching of endangered species, which resulted in a severe reduction of wild animal populations. Poaching has had an alarming impact on protected species such as the snow leopard, which was formerly found throughout the country and in the mid-1980s had an estimated population of 1200–1400 animals (Koshkarev 1988). Mass impoverishment of rural populations led to a general breakdown of law enforcement measures concerning wildlife and protected areas, and by 1996 the estimated population of snow leopards had fallen by half to 650. In 2003, it was estimated that as few as 150 snow leopards remained in Kyrgyzstan (Vorobeev & van der Ven 2003).

Today Kyrgyzstan faces serious environmental problems. Among global environmental issues presently on the agenda are global climate change, ozone layer depletion, desertification, and biodiversity loss. 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, over-harvesting, direct mortality, introduction of non-native species, environmental pollution, and climate change. In Kyrgyzstan today, at least 10 % of the nation's vertebrate species are endangered. In this context loss of habitat and species diversity due to overgrazing remains a severe problem; overgrazing has resulted in erosion, proliferation of unpalatable plant species and an overall reduction in pasture productivity (Fitzherbert 2000). While these developments adversely affect domestic animals residing on mountain pastures, they also affect wild animals, particularly grazing animals, and lead to an overall reduction of wild plant species that are the preferred forage of both wild and domestic animals. In addition, uncertain land tenure and financial insecurity have caused many private farmers to concentrate their wealth in the traditional form - livestock - thus subjecting more land to the overgrazing problem in an apparent vicious cycle.

2.2. Materials and methods

2.2.1. Kyryz Ala-Too study site

The Kyrgyz Ala-Too (Kyrgyz: Кыргыз Ала-Тоосу, also Kyrgyz Alatau, Kyrgyz Range) is a large range in the northern Tien Shan (Fig. 2.1.1a). It stretches for a total length of 454 km from the west-end of Lake Issyk-Kul to the town of Taraz in Kazakhstan. It runs in an E-W direction, separating Chuy Valley from the valleys of Kochkor, Suusamyr and Talas.

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 of the area (Koshkarev 1989, see Table 2.2.1a) has suggested the suitability of the Kyrygz Ala-Too 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 Kyrygz Ala-Too range.

Range, river catchment area	Number of individuals	Average density (per 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 Issyk-Kul basin. According to a draft design of an ecological network for Kyrgyzstan led by prominent Kyrgyz biologist 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 Shukorov's draft design: "*geographically, the zone is located in the Chuy Oblast, which is the most populous province nationwide. 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 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 cattleand over 250,000 of sheep and goats) are put to pasture of the Kyrgyz Ala-Too*". Shukorov quotes the commonest violations of land use as: "*unsystematic cattle grazing, illegal hunting and forest felling*". However, there is potential here for establishing protected areas and several proposals have been made in Shukurov's draft that could favour wildlife and benefit local residents.

2.2.2. Research area and timing of survey

The chosen study area is located in the southern Kyryz Ala-Too, away from the main cities in the north. Surveys were centered around the Karakol Mountain Pass (3,452 m) and encompassed areas in the upper reaches of the West and East Karakol rivers. The expedition's main access route into the area was the Suusamyr plateau, 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. In Soviet times the area was one of the major sheep breeding regions in the country and 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 and graze their livestock here.

The main settlement, Suusamyr, lies about 15 km east of the main Bishkek-Osh road. From here, there is a dirt road following the river course of the West Karakol and heading towards the Karakol pass, before leading further to the town of Kochkor.

For reasons of safety, accessibility and convenience, the expedition base camp was located close to the Suusamyr-Kochkor road near to the middle of the planned study area (42.359535^{o}N, 74.737829^{o}E, 3,002 m). From this 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 the neighbouring Jumgal Too Range on the opposite side of the West Karakol river.

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, as 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.

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 and ground surveys were conducted on foot.

Snow leopard presence can be detected by sign, i.e. pugmarks (tracks), scrapes, faeces (scat), urination and rock scent spray. 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, Mallon 1988, Schaller et al. 1987, Jackson & Ahlborn 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 and their range closely parallels that of the snow leopard.

Prey species were surveyed by recording signs and by 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* sp.), hare (*Lepus capensis tolai*), wild boar (*Sus scrofa*) and game birds (in particular snowcock, *Tetraogallus himalayensis*). The same search sites were used for snow leopard and prey surveys.

The prospective study site encompasses an area of 122 x 38 km within the Kyrgyz Ala-Too Range, 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 1950-1980 at a scale of 1:100 000 and 1:200 000. A GIF image of the area was imported and geo-referenced into the GIS freeware program TrackMaker (www.gpstm.com). A grid of 2 x 2 km cells covering the study area, of which only a fraction was actually surveyed, 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 43 N and datum WGS 84 (Fig. 2.2.3a).

Using GIS freeware programs DIVA-GIS 7.5 (www.diva-gis.org/), QGIS 2.6.1 (www.qgis.org) and SAGA GIS (www.saga-gis.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.

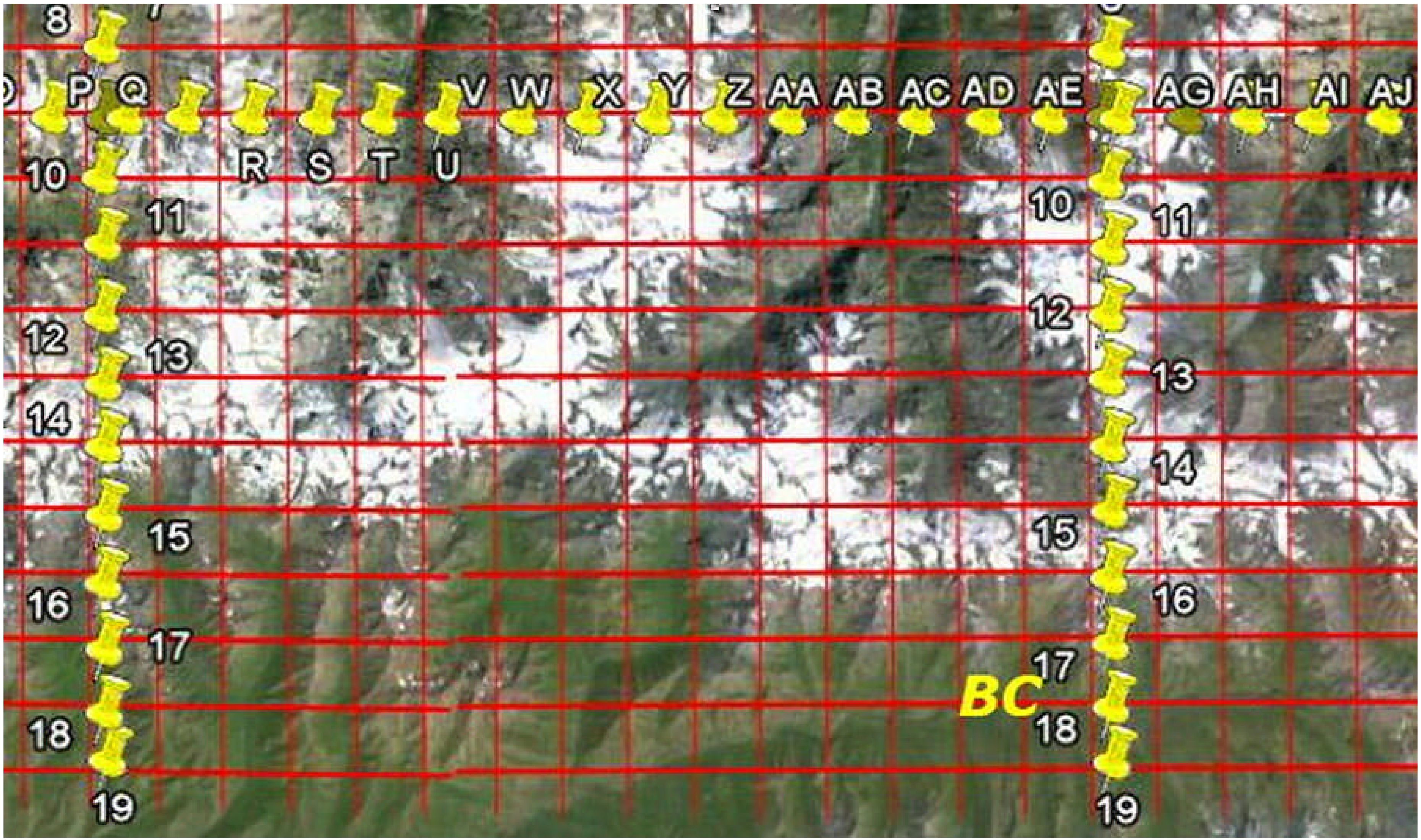


Figure 2.2.3a. Fragment of the map of the study area and grid of 2 x 2 km cells, shown as a Google Earth file (*.kml). Red = gridlines (tracks). Yellow pins = waypoints with cell codes, BC = base camp (located in cell AE18).

2.2.4. Training of citizen scientist expedition participants

In this study, data collection was performed by citizen scientsts with no previous knowledge of wildlife research and conservation, except that given during the initial stages of a short-duration 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 was performed on the first day 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 the chances of finding snow leopard and other wildlife sign were maximised by having many people fully engaged in looking for evidence.

2.2.5. Sampling

Following the presence/absence method in 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. Siberian ibex sightings were mapped where possible, using a GPS receiver, physical map and a SILVA compass in order to record more precisely their location, rather than just recording the given cell code alone.

It is important to cover large areas so that the survey can better represent the snow leopard and potential prey populations. 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. Two strategies were employed to install the cameras:

- one in which the field team identified a good spot to take photos of the snow leopard and species associated with snow leopard habitat;
- the other based on a species distribution modelling exercise performed on previously obtained visual records of the Siberian ibex, the main food source for the snow leopard.

In the first case, the selection of "good spots" was guided by field experience and intuition, whereas in the second it was presumed that areas of predicted probability of Siberian ibex occurrence >0.6 (i.e., 60%) represented areas of prime interest. The results of previous modelling carried out in the study area (Tytar et al. 2016 & 2017) 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 and neighbouring Kara-Tor streams. In the south, modelling indicates ridges surrounding the upper reaches of 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 covered by the following cells: Y15, Y16, Z16, AB16, AC16, AE16, AF16, AE20, AF20, AG15, AH15 and AI15.

For the first time live observations of ibex were accomplished (thanks to Sven Pelka from group 2 using his drone).

Other species, including birds, mammals (in particular wolves, *Canis lupus*) and butterflies etc., were recorded whenever possible.

2.2.6. Species records and distribution modelling

One major reason for snow leopard population decline is the reduction in the prey resource base. Siberian ibex are important for sustaining snow leopards (Lyngdoh et al. 2014). Understanding factors influencing the existence of the prey resource is a basic requirement for the assessment of the species' distribution and developing conservation strategies. This knowledge can help to focus efforts on protecting the prey species that snow leopards rely on the most, highlight conservation areas and address issues of overgrazing and poaching. However, the full distribution of a prey species, even within a limited range, often remains unknown, as field inventories cannot cover the entire landscape. Fortunately, recent advances in computing allow for comprehensive mapping of species habitat using an approach called species distribution modelling. In such a way even limited ground surveys can be combined with available environmental data, including some that is remotely sensed, to build predictive models, which in turn can be applied to broad areas of similar habitat. We used *Maxent* software (http://www.cs.princeton.edu/schapire/maxent) to generate an estimate of habitat suitability and to map the distribution of ibex and marmots in the study area. Input consisted of 103 georeferenced sightings and camera trap records of ibex collected in 2014-2017.

For the ibex data three categories of predictor variables were employed: bioclimatic, variables extracted from Landsat8 images, and terrain features.

The System for Automated Geoscientific Analyses (SAGA) GIS software (v. 2.2.7) was 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).

The Maxent computer software generates an estimate of habitat suitability of the species that varies from 0 to 1, with 0 being the lowest and 1 the highest suitability. The default settings of Maxent were used in this study and 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).

2.2.7. Outreach and capacity-building 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.

A new initiative to gather more data for more of the year was also started this summer, courtesy of a grant from the Nando and Elsa Peretti Foundation. One task of the expedition was to train community members from the surrounding area in camera trapping techniques in order to extend the study season through the winter months. Essentially, these community members will continue to monitor camera traps within the Kyrgyz Ala-Too between expeditions. This new incentive will be a great opportunity for local communities to learn more about their natural habitat and become more interested in many aspects of conservation. Results of the 2017/2018 community camera trapping season will be presented in the report of the 2018 expedition.

Herdspeople and their families were also involved in the expedition as paid guides, trackers, logistics, horse and food providers, and guest families for citizen scientists.

The NABU staff together with local volunteer placements 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 and the patterns of their migrations and interactions. Petroglyphs have 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 study site. 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.

An important theme in rock art research around the world is the acknowledgement of the role that the images play in the landscape. More recently, field surveys in Central Asia have begun to map out the distribution of rock art scenes and the archaeological sites, which have made possible the generation of archaeological landscapes which plot the features onto maps and topographic contour models (Rozwadowski & Lymer 2015). The concept of landscape is also important to ideas of cultural heritage and within the past few years rock art sites have started to be considered valuable tourist resources; they are termed "cultural landscapes", and are important to the respective Central Asian republic in which they reside.

2.3. Results

Seventy-eight cells 2 x 2 km in size over an area of approximately 20 x 40 km, located in the southern Kyrgyz Ala-Too and neighboring Jumgal Too ranges (Fig. 2.3.1a) were surveyed for snow leopard and sympatric medium and large-sized mammals and game birds. Surveys were conducted at an average altitude of 3,515±32 m. Around half of the cells were resampled two to four times. Records of animals of interest were made in 59 cells; in 54% these records were multiple (two to four). Individual survey teams ranged from four to eight citizen scientists and daily search efforts took from three and a half to ten hours, depending largely on weather conditions and difficulty of the terrain.

2.3.1. Snow leopard presence/absence survey

Snow leopard signs searched for during this study included: pugmarks (tracks), scrapes, faeces (scat), urination, rock scent spray and observations (including camera trapping). Finds are summarised Table 2.3.1a and Figure 2.3.1b.

Table 2.3.1a. Snow leopard signs found by the 2017 expedition (see also Fig. 2.3.1b).

Date	Location (area)	GPS location	Elevation (m)	Cell	Notes
30 June	Kashka Tor	N 42.31031° E 74.76950°	3591	AF20	Indistinct pugmarks in snow
5 July	Don Jalamysh	N 42.37108° E 74.47554°	3720	T17	Old pugmark found when setting camera trap
18 July	Kashka Tor	N 42.30800° E 74.74625°	3596	AE21	Pugmarks in soft soil
7 August	Chon Chikan	N 42.39303° E 74.71325°	3669	AD16	Pugmarks in clay soil
23 August	Chon Chikan	N 42.39453° E 74.71186°	3748	AD16	Pugmarks in clay soil
23 August	Chon Chikan	N 42.39400° E 74.71186°	3735	AD16	Pugmarks in clay soil
23 August	Chon Chikan	N 42.39381° E 74.71183°	3739	AD16	Pugmarks in clay soil

Figure 2.3.1a.

The 2 x 2 km cells sampled in the research area.

(base camp icon) = base camp.

Red triangles indicate cells where records were made of animals of interest.

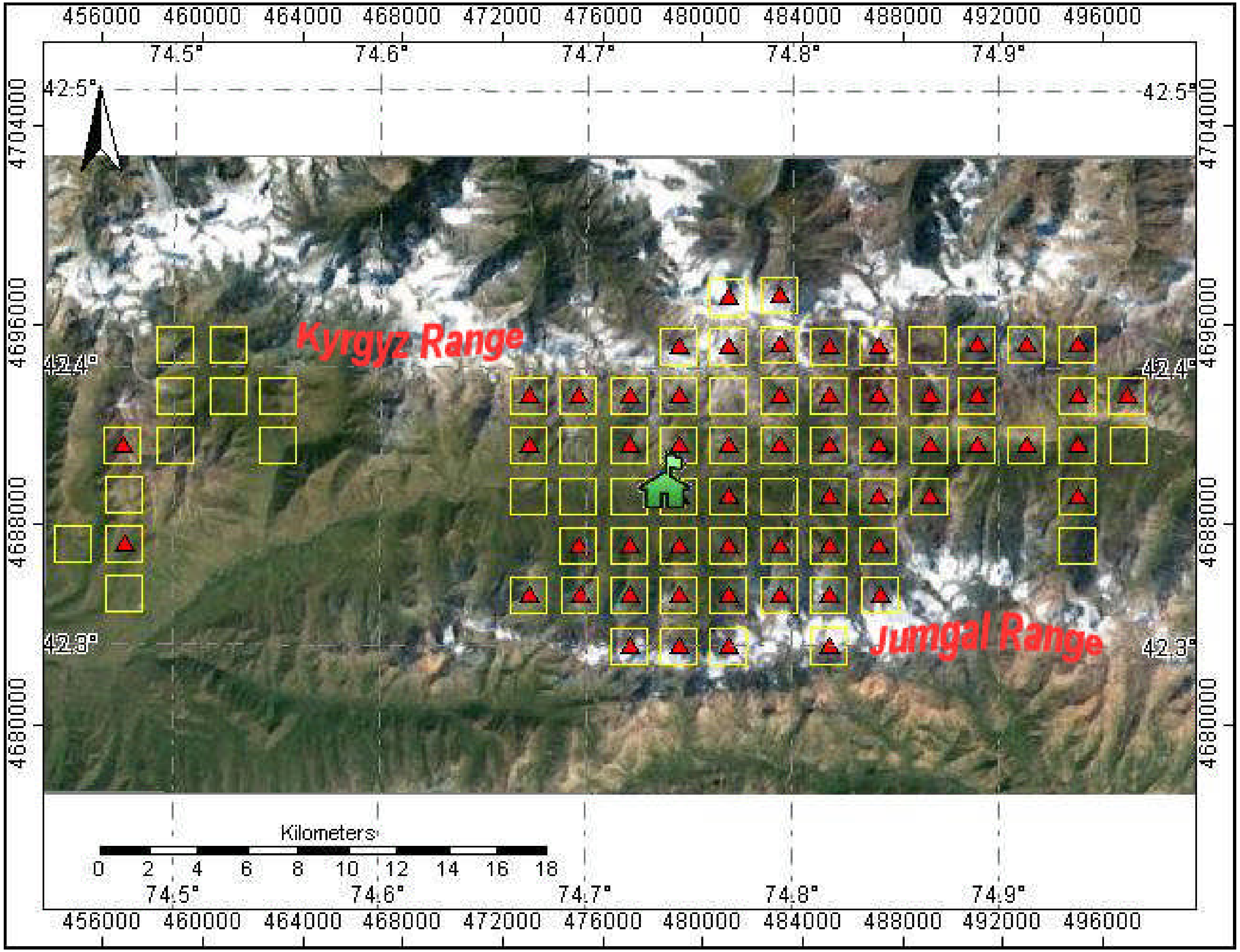
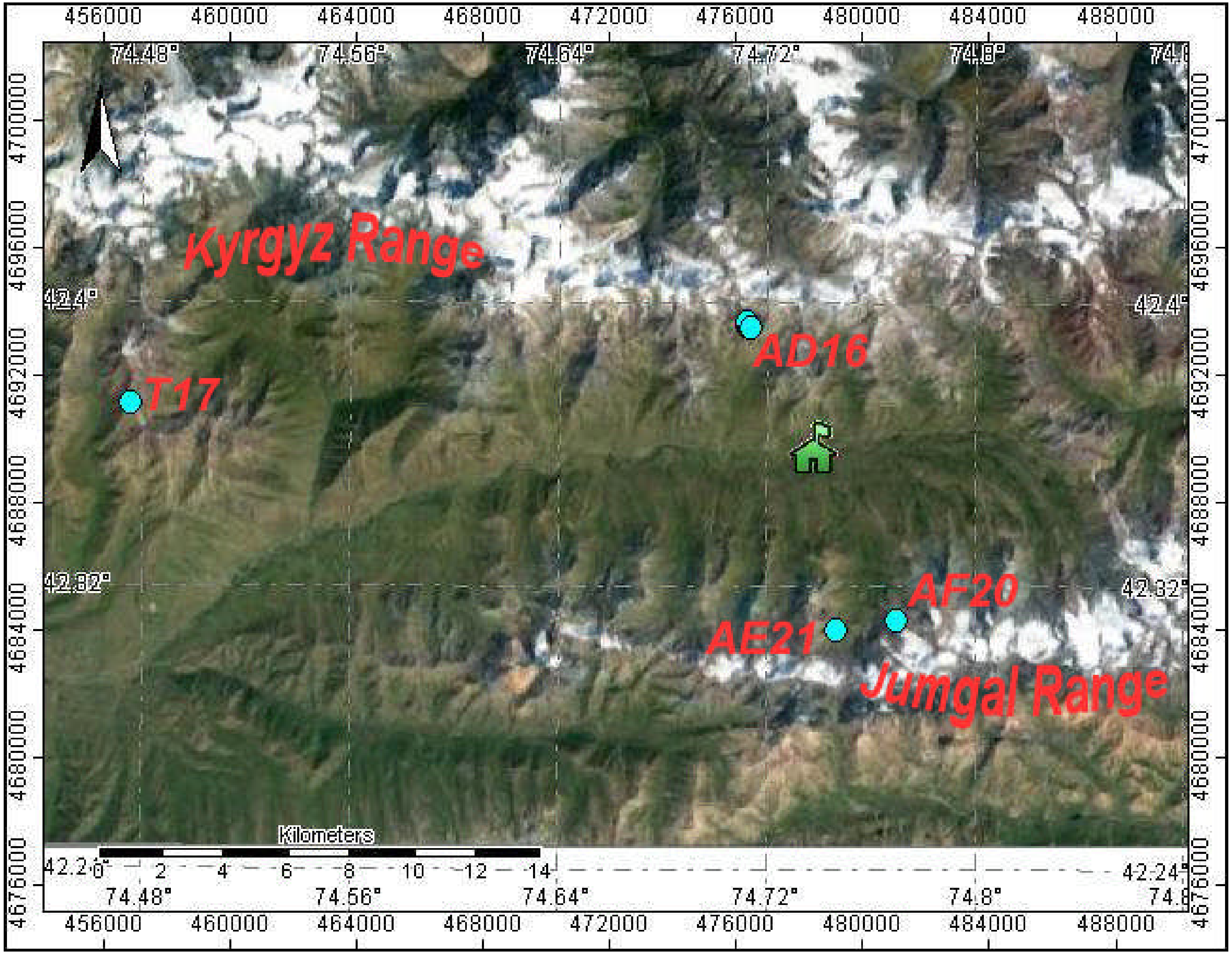


Figure 2.3.1b.

Location of cells (shaded cyan) in which snow leopard sign (pugmarks) were found by the 2017 expedition.

See also Table 2.3.1a for a list of findings.



Tracks (pugmarks)

These are more easily found in sand, mud or patches of fine gravel. They are usually present at lower elevations, away from preferred snow leopard terrain, but may be found alongside streams and/or melting snow and ice within the snow leopard's habitat. Snow patches left over from the winter and fresh snow cover were specifically examined for tracks. Out of the six pugmark records, six were discovered in soft soil or clay and one (rather doubtful one) was found in snow.

Scrapes

These can be found in sandy sites (short-lived) and fine gravel (longer-lived), both of which are rare in the study site, where the majority of substrate is broken, stony terrain. No scrapes were recorded this year.

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. 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. This year there was no sign of faeces.

Urination

Urine can be deposited on scrape piles and is commonly found along regular paths or trails. No definite signs of urination were identified during the survey period. Lack of trails and difficulty in finding scrapes were a contributing factor.

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 sprays were found during the surveys.

Observations (including camera trapping)

None were made during the expedition. It will be very interesting to see whether the community trapping efforts will yield any camera trap pictures.

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 areas within the larger river valleys, foothills and lower portions of the side valleys. Later on in the summer (with the depletion of the pastures in the lowlands), herders move their livestock up the valleys, reaching altitutdes where they become a disturbing factor to snow leopards and/or their prey.

Grazing pressure in the area has considerably reduced from the former communist era. 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 in the past two years the numbers of private herders moving in are increasing.

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. More trekkers crossing remote mountain areas have been recorded, too.

2.3.3. Prey base survey

Signs of some prey species during presence/absence surveys were found to be fairly abundant and widespread in a variety of terrains. Siberian ibex comprised 32% of these records. No argali was recorded. Marmots were common at lower elevations (62% of the total number of recordings), whereas indications of snowcock presence (6%) appeared at higher altitudes (these indications are mainly droppings left over from the winter season).

The maps below display the cells in which species with substantial quantitative information were found. For instance, there were 22 observations of ibex made in eleven cells, including one observation made by using a drone, and an additional eight observations in four cells made using the camera traps. Especially noteworthy are results for cell AC16 (upper reaches of Chon Chikan) where six separate observations of live ibex and three camera trap records (Figure 2.3.3a) of the same species were recorded. Interestingly, this is next to cell AD16, where snow leopard pugmarks were found. For the marmot there were 118 observations (based on all types of signs) made in 50 cells (Figure 2.3.3b) and eleven records of snowcock were made in seven cells (Figure 2.3.3c).

Figure 2.3.3a I

Siberian ibex signs logged by the expedition (cyan circles)

Recording methods are direct observation (n=22) and camera traps (n=8).

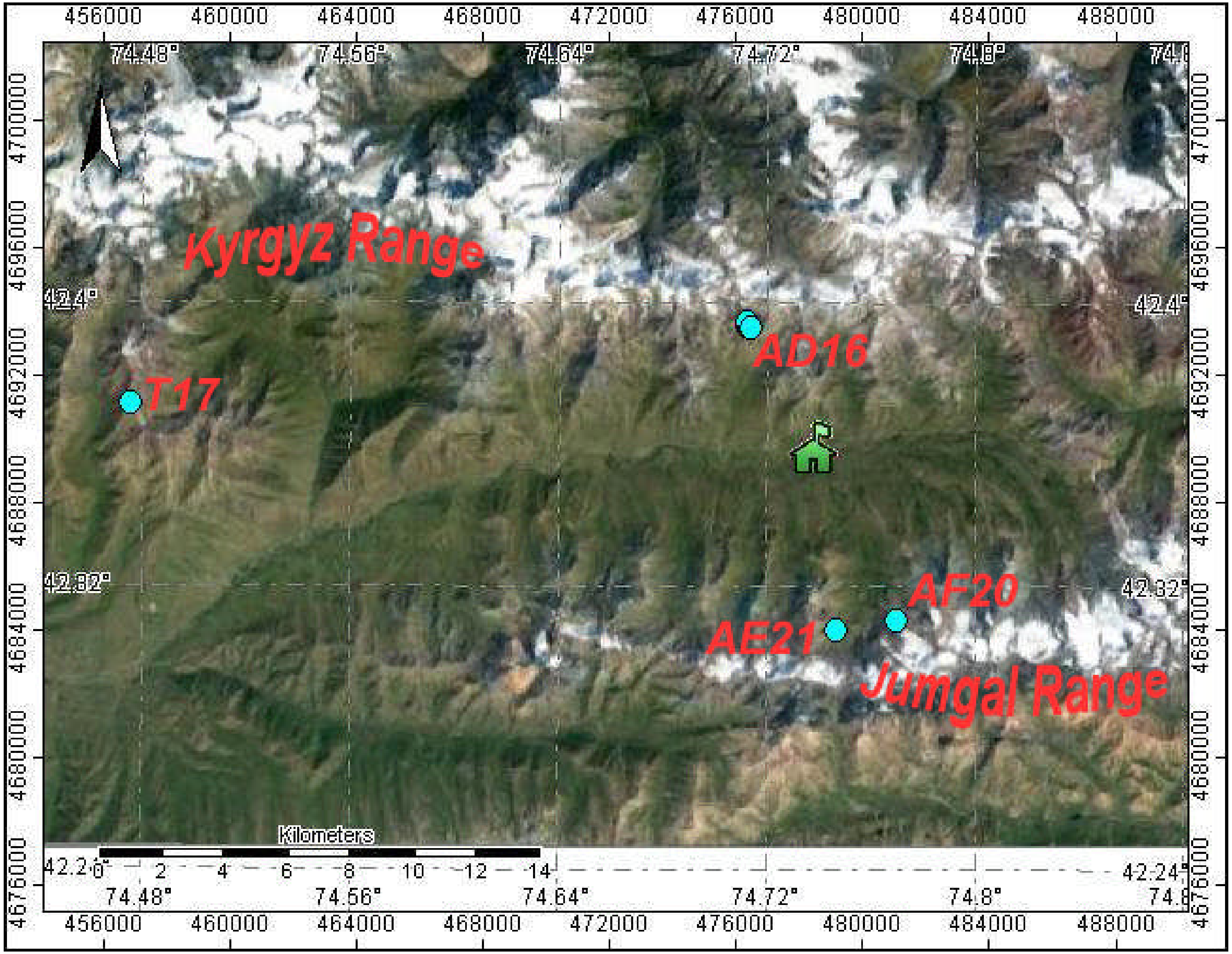


Figure 2.3.3a II

Siberian ibex signs recorded by the expedition, indicated by yellow aquares representing 2x2 km.

Red triangles indicate cells where camera traps were placed and successfully took pictures of ibex.

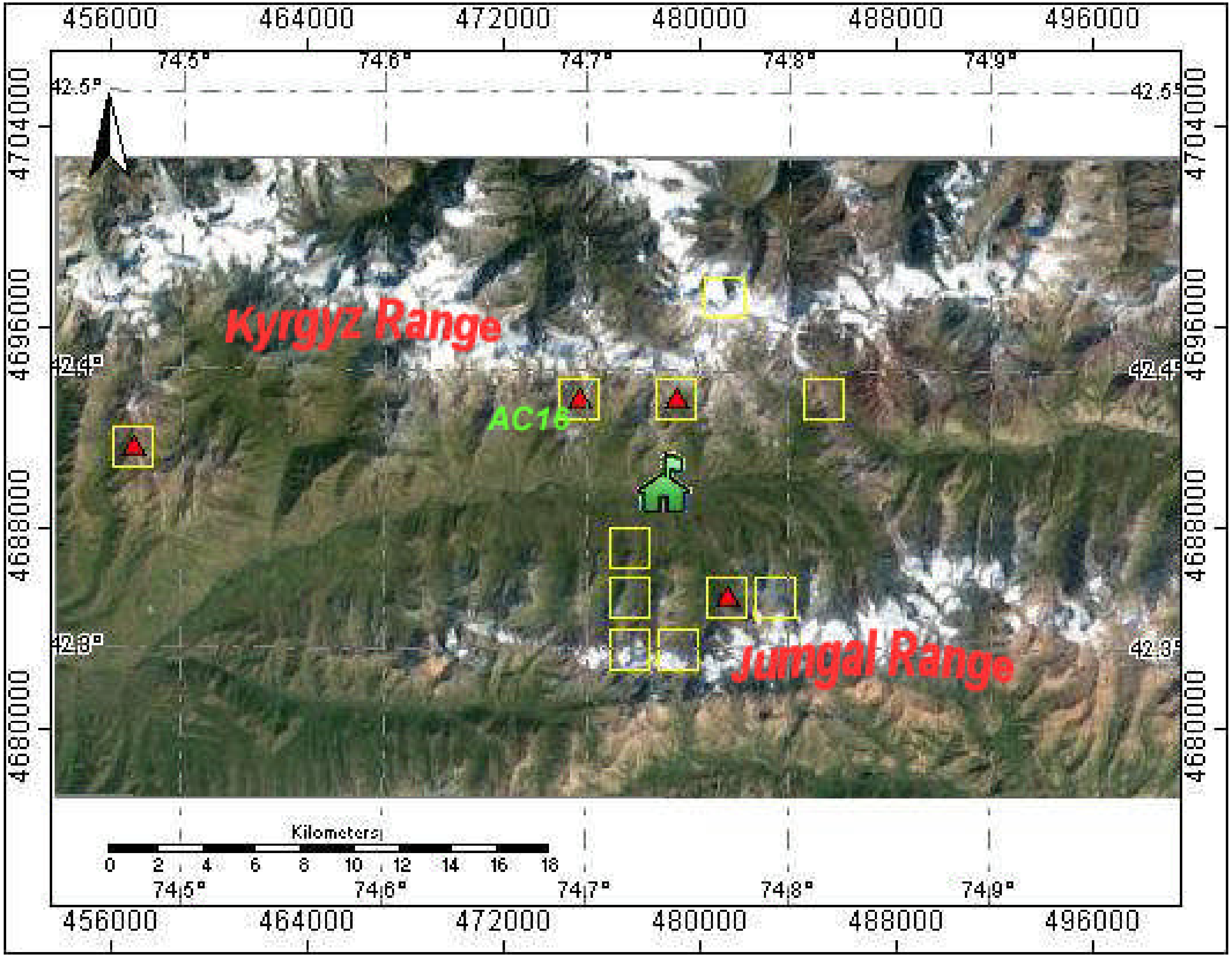


Figure 2.3.3b.

Marmot signs logged by the expedition.

Various recording methods, n=50.

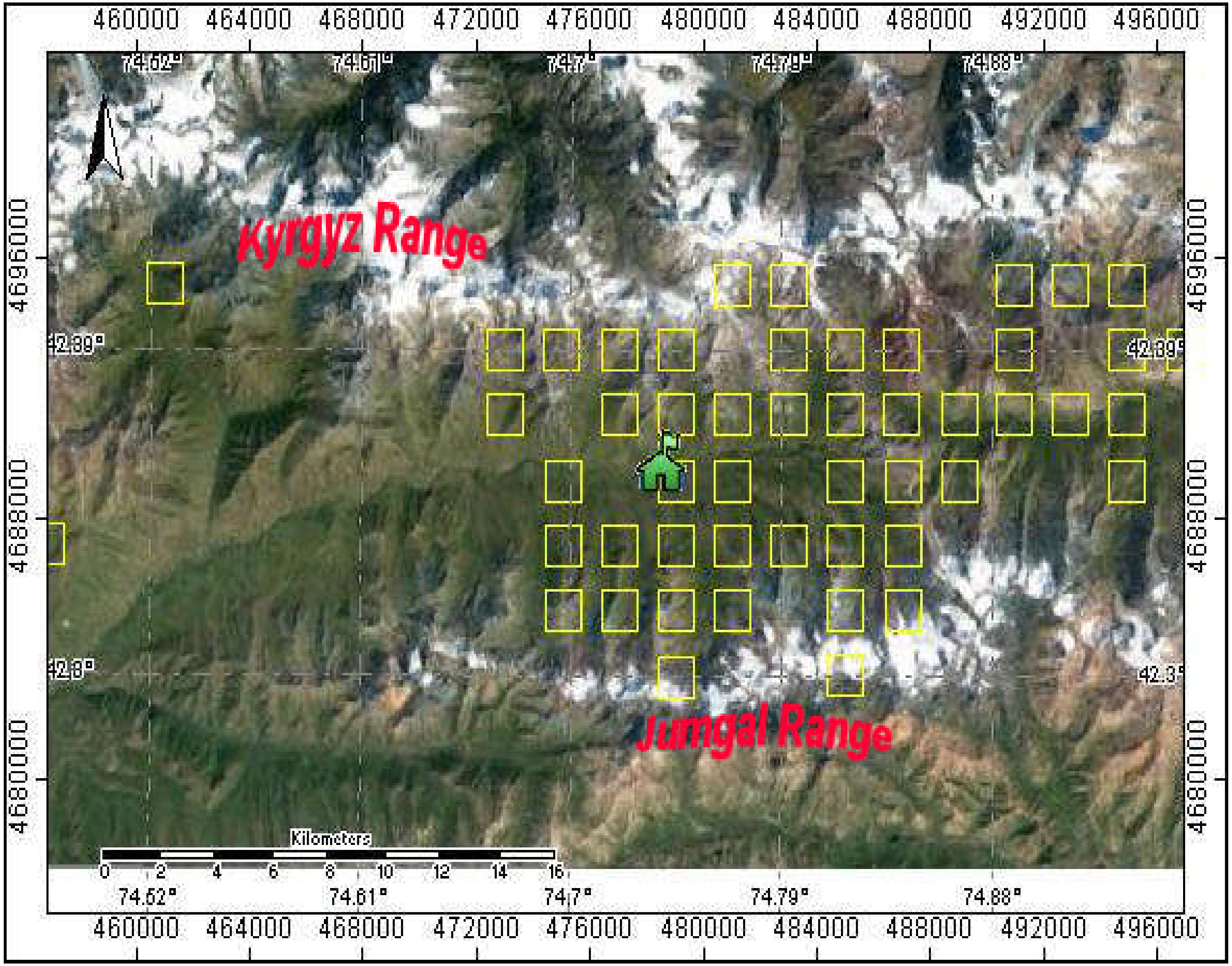
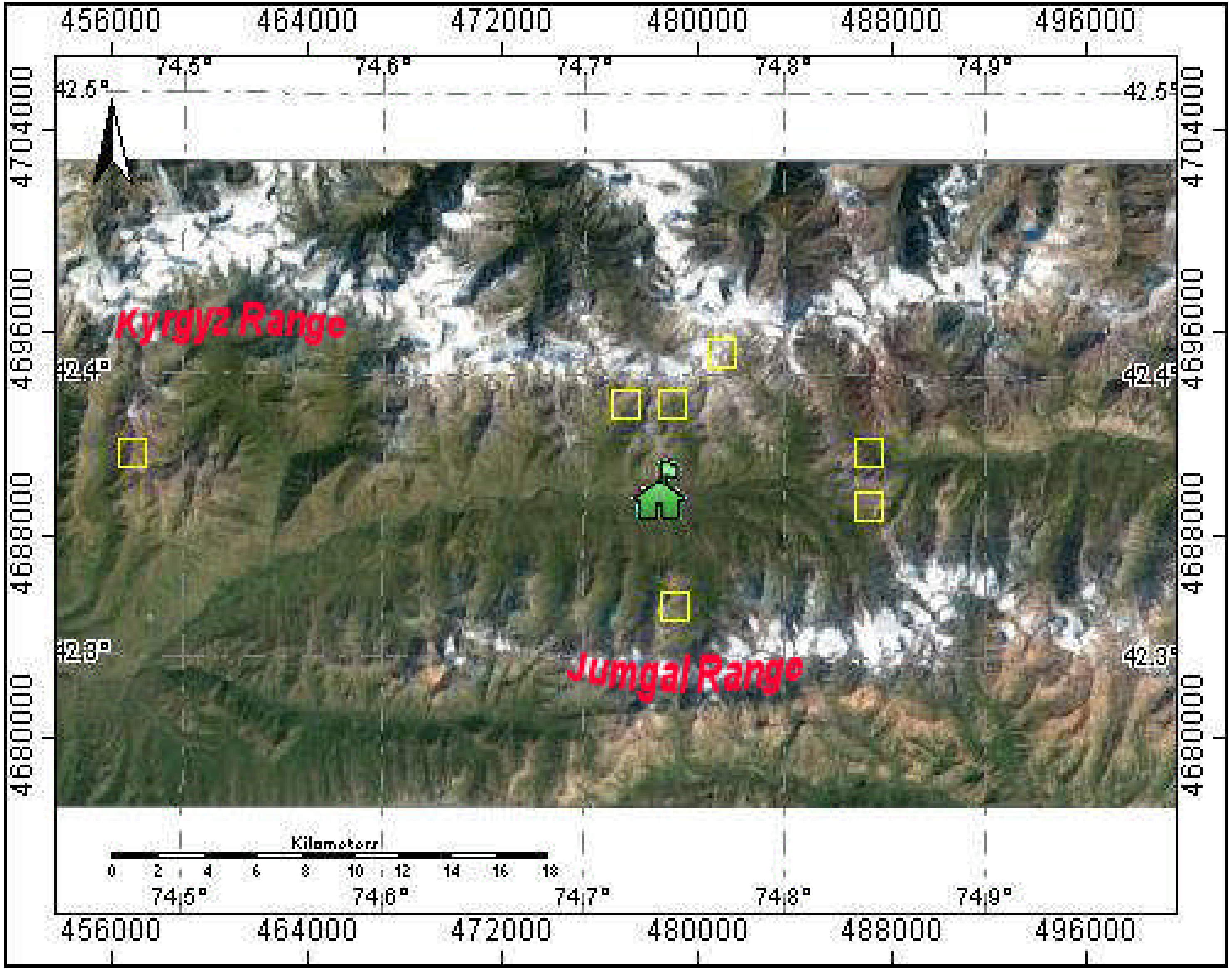


Figure 2.3.3c.

Snow cock signs logged by the expedition.

Various recording methods, n=11.



2.3.4. Distribution modelling

From the 25 model runs used to model the distribution of Siberian ibex in the study area, the average AUC was 0.884, with little variation (SD=0.016), meaning ‘good’ model performance. Areas of predicted habitat suitability exceeding 60% are likely to represent the greatest interest for conservation planning and for setting snow leopard research priorities (Appendix I).

These by and large include the upper reaches of Ala-Archa (area 1 on Fig. 2.3.4a), Kuyke Bulak (area 2), Chaartash (area 3), Chon Chikan (area 4), Jor Bulak (area 5), upper Choloktor (area 6) and upper Issyk Ata (area 7). All these are in the Kyrgyz Ala-Too range.

In the Jumgal range, modelling indicates the upper parts and ridges of Kashka Tor and neighbouring areas to be highly suitable for ibex (area 8). Together these areas could become components of a wider ecological corridor connecting the Ala Archa National Park and wildlife areas located further to the east beyond the Karakol Pass.

In terms of conservation, top priority may be given to the Chon Chikan area, the upper reaches of Issyk Ata and the Kashka Tor area, where there have been multiple records of snow leopard presence (in Fig. 2.3.4a these areas are outlined in red). In addition, the Chon Chikan area may have the opportunity to become an important cultural heritage site, because of the high concentration of rock art (petroglyphs) found in that area.

Figure 2.3.4a.

Areas of interest for conservation planning and setting snow leopard research priorities in the upper West Karakol.

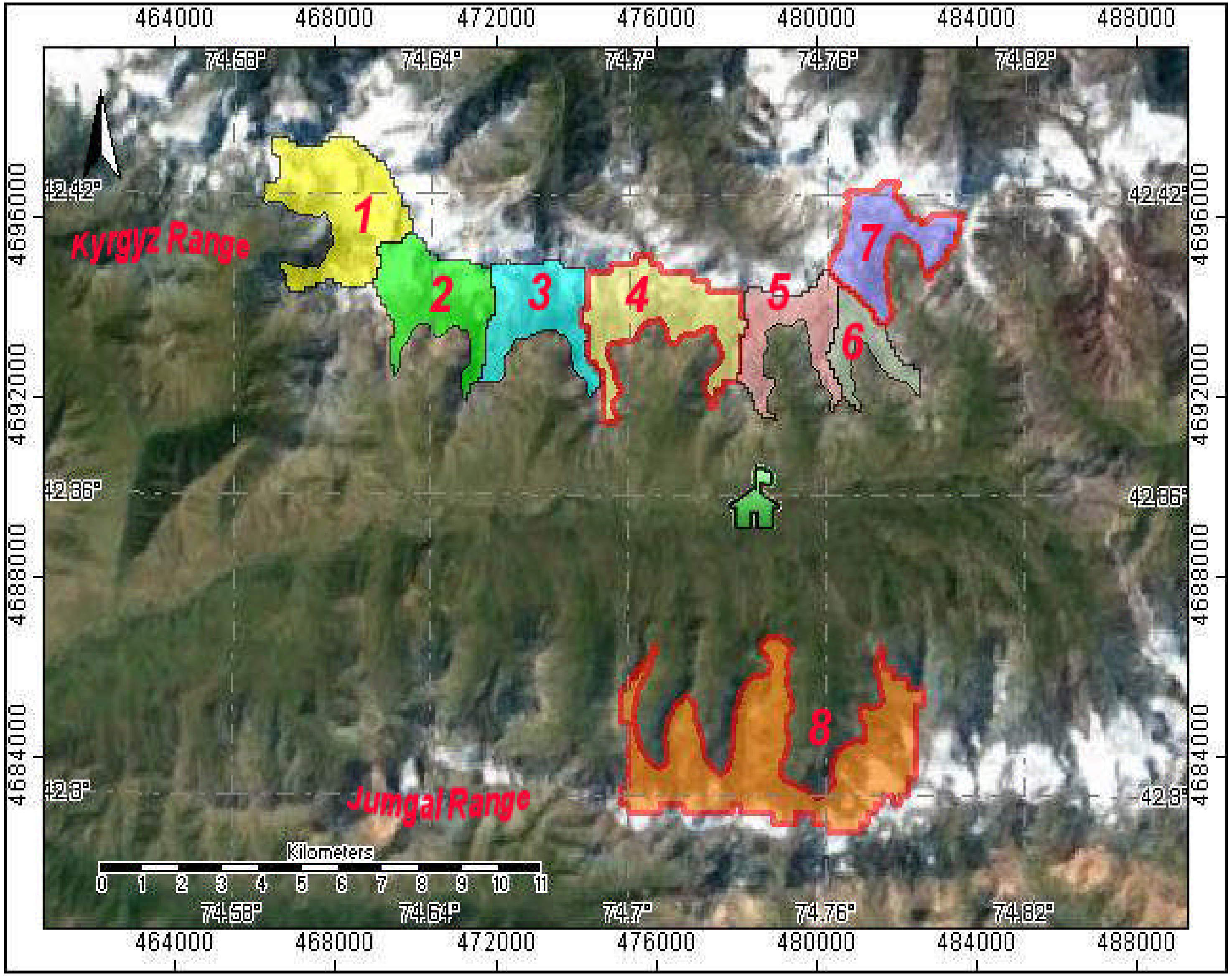
Kyrgyz Ala-Too range:

Upper reaches of Ala-Archa (1), Kuyke Bulak (2), Chaartash (3), Chon Chikan (4), Jor Bulak (5), upper Choloktor (6), upper Issyk Ata (7).

Jumgal range:

Upper parts and ridges of Kashka Tor and neighboring areas (8).

Top priority areas in both ranges where snow leopard signs have been founds are outlined in red.



2.3.5. Interviews and other outreach and capacity-building activities

Fourteen interviews were conducted in different households within the local community. These activities involved adult herders, all of which were men (aged between 30 and 68).

In most cases livestock was of a mix of sheep, goats, cows, horses and other domestic animals such as donkeys, some poultry and a number of dogs and cats. In all 14 households there were varying numbers of sheep (between 50 and 400) and horses (between five and 27), cows (up to 30) and goats (between 30 and 400).

The response to the question “Have you ever seen a snow leopard and/or sign of a snow leopard?” was 43% positive. Only one interviewee said he knows someone who has seen a snow leopard or sign of the animal. Together, these responses provide evidence for the presence yet rarity of the species in the area, possibly exacerbated by its elusive character, and the fact that herders rarely come into contact with the predator. Nevertheless, responses from local people indicate that snow leopard is present in the surveyed area and confirm its importance as a habitat for snow leopard.

When respondents were asked how they feel about the snow leopard, they 100% reported “liking” the animal (… “*our beauty*”…). When asked about the snow leopard’s impact on the area, 57% were in favour of the animal being present, whereas the rest were either in doubt or considered it to be detrimental by having in mind attacks on livestock. In terms of significance for the country, 100% responded that the species was beneficial. All but one of the interviewees knew that the snow leopard is under protection in Kyrgyzstan (the Red Data Book of Kyrgyzstan was often mentioned) and appreciated the legal protection of the species. From these results, it is clear that there is a solid basis in the area for developing nature conservation initiatives and extending community involvement.

Table 2.3.6a. Community assessment of the impact of snow leopards on wildlife and human/predator relations.

	Yes	No	Don't know
Do snow leopards reduce the number of large game animals such as ibex or argali?	5	8	0
Do snow leopards reduce the number of small animals such as marmots and snowcock in the area?	4	5	4
In areas where snow leopards live near livestock, do they feed on domestic animals?	7	7	0
Do snow leopards attack people?	0	13	1

In terms of community assessment of human/predator relations, half of the respondents said that snow leopards attack domestic animals when they live nearby (Table 2.3.6a), but at least three respondents stated that this happens rarely. The overall impression from the questioning is that livestock depredation by the snow leopard in the area does not appear to be a major issue, because “… there *are too few*…”, “… *snow leopards live at high altitudes…*”, “… *domestic animals rarely go to the elevation, where snow leopards are* …”, … it *happens when livestock is far away and left unattended by the herder* …”and “*the* *species can be considered beneficial to the area as long as it stays far up in the mountains*". As in previous years, much more blame for livestock depredation was put on wolves: "…*wolves attack livestock*…", which are considered by locals to be the most serious menace threatening their livelihoods.

Fewer than a half of the interviewees agreed that snow leopards can reduce populations of large game animals. However, it is not quite clear whether the respondents distinguish between "*reduce* populations" and "*feed* on populations". Those considering that snow leopards cannot reduce populations of large game animals argued that there are "… *still many ibex…*" or "… *there are enough snow leopards in the area for them to have a significant impact on ibex numbers* …". Interviewees agreeing that snow leopards can reduce populations of large game animals were far from considering the snow leopard a threat to populations of prey species, because "…*snow leopards just kill for food, not like wolves*…", meaning their demand is low. Besides this, there is a belief that snow leopards "… *take weak animals, act like sanitisers* …", "… *regulate numbers of prey…*", "… *keep the balance of nature…*", "*there is a balance between snow leopards and their prey*". Again locals consider wolves, as well as poachers, a bigger threat to large game animals in the area: "…*the real threat comes from wolves and illegal hunting*".

A belief widely held in Asia was repeated, i.e. that snow leopards feed exclusively on the blood of their prey: "… *only sucks blood of the victim…*" and "… *the meat of the victim is white, because the snow leopard has sucked out the blood…*". Only around a third of the respondents believe that snow leopards reduce populations of small animals (such as marmots and snowcock). Others believe that they are not a part of the diet of the predator. The reasons may be that "… *they live at different elevations*…" . A third respondent had no opinion on this issue.

None of the interviewees believed that snow leopards attack humans and none had been a witness of such an attack, although some had heard such stories told by somebody else, or considered that such attacks could happen if "*the snow leopard is threatened*".

100% of the interviewees considered it a *"good thing"* if snow leopards attracted more tourists to the region, because this could create more job opportunities and generate alternative means of income to the area. Many would be ready to sell local products (meat, cheese, kumis, felt carpets, etc.) and/or develop tourist-based businesses, emphasising the need to "… *employ local guides*…", "… *develop infrastructure …*", etc. However, there is also a fear amongst locals that business investments may lead to corruption and spark unfair competition with established travel companies.

In order to launch this summer's new initiative to gather data throughout more of the year (an additional six months), community members from a village in the surrounding area (Don Alysh) were trained in the use of camera traps and trapping techniques. For this purpose the community camera trappers joined the expedition in routine survey work and installed camera traps at various sites. Once this work was completed, they were given a total of twenty camera traps to install and maintain over the winter in a number of defined wildlife areas in the Kyrgyz Ala-Too before and after future expeditions. Results of these efforts, i.e. camera trap pictures and data, will be retrieved during the July/August expedition 2018 and reported on in the report of this expedition.

In addition, local people were involved in the expedition as paid guides and trackers, as logistics, horse and food providers, as well as to host the expedition team on its fortnightly day off as part of a relationship-building and cultural experience. Approximately 14 herdspeople and their families were involved in this way, deriving an alternative income and receiving experience and training in the provision of tourism-related activities.

2.3.6. 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*). Foxes are present throughout the area, whereas definite wolf signs were found only in five locations. Wolves are the major predators in the area, frequently causing losses to domestic livestock and for this reason they are universally disliked by herders.

Camera trap studies commonly record numerous species other than the main target species, but these additional data are rarely published. They may, however, provide important information about the biodiversity in the region and documentation of species thought to be locally extinct or absent (McCarthy et al. 2010). Besides Siberian ibex, the expedition's camera traps also recorded red foxes, badgers (*Meles meles*), stone marten (*Martes foina*, listed in the Red Data Book of Kyrgyzstan: VII category, Lower Risk/least concerned - LR/lc), marmots (*Marmota caudata*), a number of bird species (Himalayan snowcock, *Tetraogallus himalayensis*, commonly the Red-billed chough, *Pyrrhocorax pyrrhocorax*, Guldenstadt's redstart, *Phoenicurus erythrogaster*, and the Alpine accentor, *Prunella collaris*). An unexpected camera trap record was made of the Eurasian lynx (*Lynx lynx isabellinus*, Red Data Book of Kyrgyzstan: VI category, Nearly Threatened. NT) (Fig. 2.3.7a). The Eurasian lynx occurs in a wide variety of environmental and climatic conditions, but is primarily associated with forested areas, which have good ungulate populations and provide enough cover for hunting (Breitenmoser et al. 2015). Local people have consistently reported that lynx is absent from the area, although the species occurs sporadically throughout the Tibetan plateau and is found throughout the rocky hills and mountains of Central Asian (Nowell and Jackson 1996). According to the literature, lynx have been observed up to 5,500 m (Guggisberg 1975). Our record was made at an altitude of 3,454 m. This particular individual could have been attracted to the spot by the abundance of snowcock (numerous droppings were scattered nearby) and/or Siberian ibex (smaller females and offspring recorded by the camera trap in the same location are prey items for the lynx).

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 both amateur and professional, and with citizen scientists, and consequently their taxonomy and distribution are better known than for any other comparable group of animals. This year the expedition's bird list comprised 53 species (Appendix II). One dead specimen of a grebe (family *Podicipedidae*) was found in the upper reaches of Issyk Ata (above 3,600 m). This is the first time a grebe has been recorded in the study area, however no definite conclusion was reached on which particular species this was. Considering the altitude, it may have been a migratory black-necked grebe (*Podiceps nigricollis*); indeed birds of this species have been recorded elsewhere at high elevations during their seasonal migrations (Lama 2017). There are six listed in the Kyrgyz Red Data Book.

Figure 2.3.6a. Camera trap record of lynx: 31 July 2017, 04:24, 42.38928ºN, 74.55078ºE, altitude 3,545 m.

2.3.7. Petroglyphs – rock art

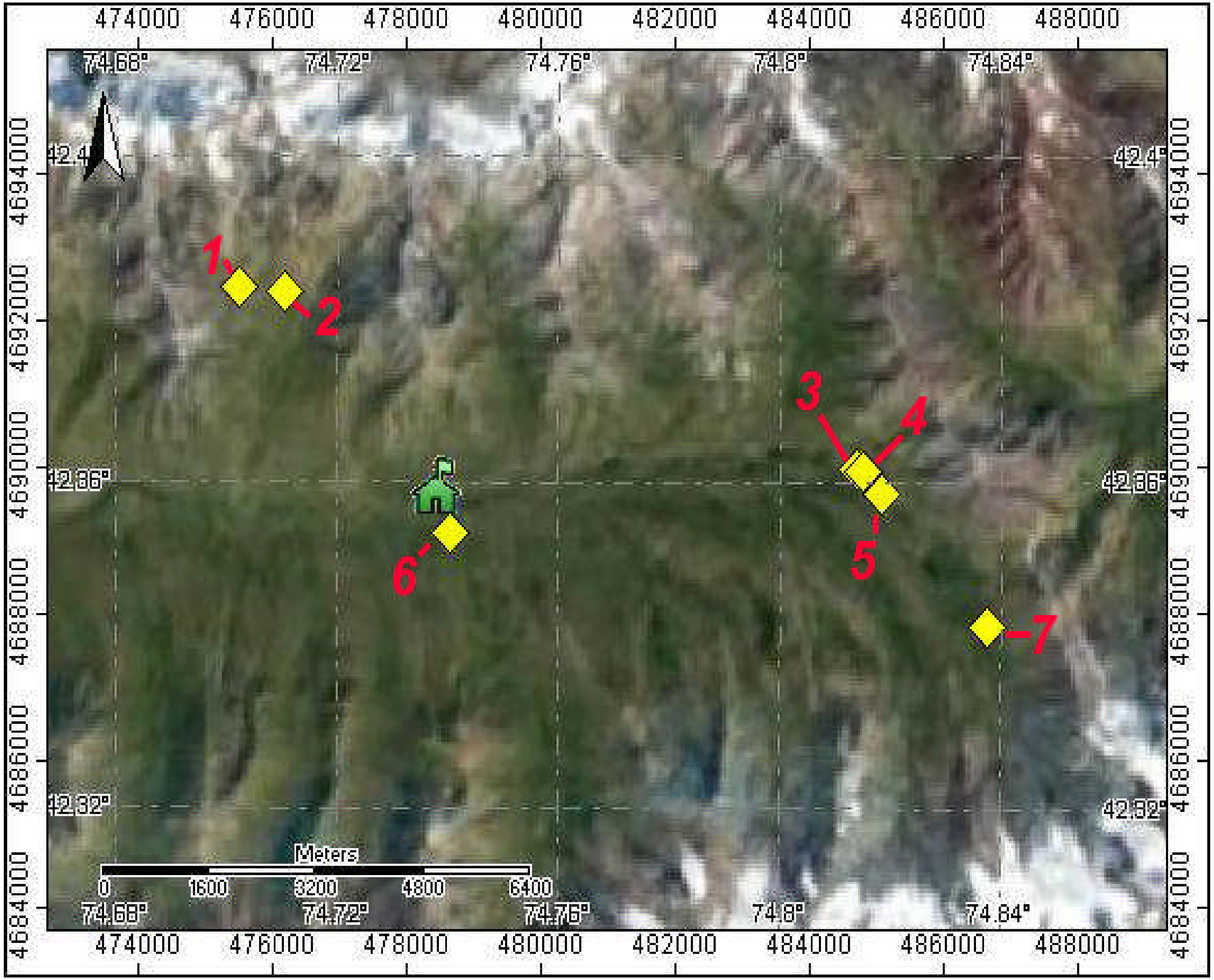
In addition to the biological surveys, the expedition continued to compile an extensive database consisting of over 200 georeferenced records, of rock art in the study area. Dozens of pieces of rock art were documented, particularly in the areas of Sary Kol and Chon Chikan.

Some of these pieces depict, for instance, red deer (*Cervus elaphus asiaticus*, Red Data Book of Kyrgyzstan: IV category, Endangered, EN C2a(i): R) – a species which has disappeared from the study area. Today the existing populations are located hundreds of kilometres away. Nevertheless, their prolific representation in rock art suggests that deer was once a common species. Fig. 2.3.8a shows the location of each petroglyph in the study area where red deer has been depicted. In total seven such petroglyphs were discovered by the expedition (Fig. 2.3.8b).

Figure 2.3.7a.

Locations of petroglyphs in the study area where red deer has been depicted.

See below for petroglyphs.



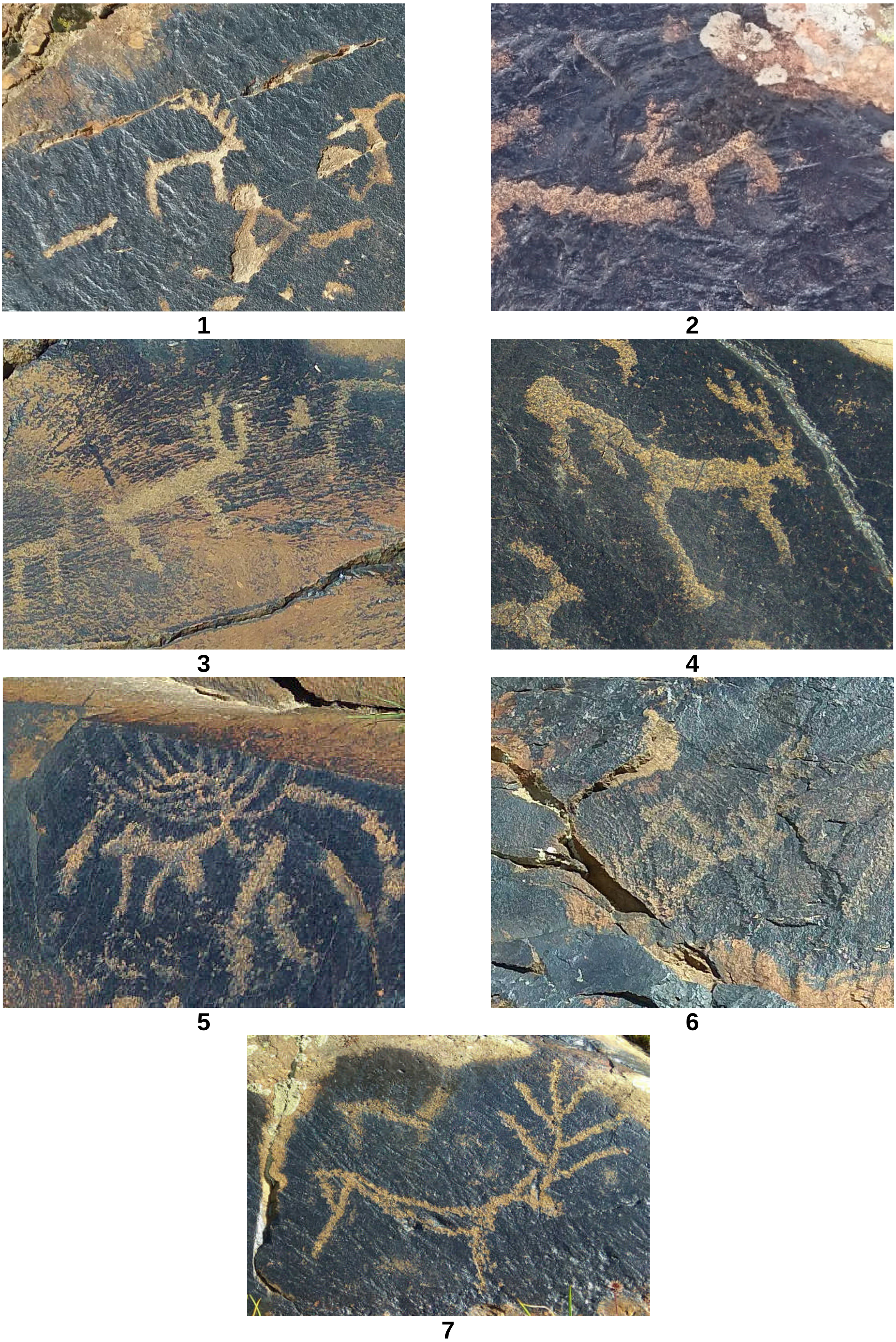


Figure 2.3.7b. Petroglyphs in the study area with red deer (numbers correspond to those in the map above).

2.4. Discussion and conclusions

Our modeling exercises based on the data gathered by the expeditions continue to yield interesting and useful heat maps of ibex distribution (Fig. 2.4a) to guide further research and conservation efforts.

Evidence from local people indicated that snow leopard is present in the area and confirmed the importance of the study area as a habitat for snow leopard. Subsequent sign surveys yielded confirmation of snow leopard presence by discovering pugmarks, seven in total during the 2017 expedition. However, there are as yet no records of the snow leopard through camera-trapping.

The expeditions have also shown that the habitat in the study area is capable of sustaining a healthy prey base for the snow leopard consisting of both primary (Siberian ibex) and secondary (marmots, Himalayan snowcock) prey species. However, relationships between the predator and prey species could be very fragile due to poaching and to growing disturbance from more herdsmen and their livestock moving into the area, and these could be core factors driving animals out of the site, a notion which was corroborated by the perceptions of local stakeholders. 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 monitor snow leopard presence and snow leopard prey population trends in the survey area. Presence/absence surveys will need to be repeated in the coming years, using camera traps throughout future expedition periods, as well as including community camera trapping results from outside expedition periods. Finding a trail and/or relic scrape(s) is a high priority as camera traps can be set in these locations, increasing the chances of determining conclusive snow leopard presence through capturing animal(s) on camera. Efforts to find signs on the ground can be guided by modelling exercises such as the ones presented in this report, showing places where basic requirements for Siberian ibex, upon which snow leopards rely on the most, are most likely to be met.

With the end of a subsidised socialist economy, a slow recovery of wildlife has occurred, but the current growth of the human population in the country, competition for pasture grounds and other developments may nullify this positive trend and drive the snow leopard out of the area. Under these circumstances, there is an urgent need for research (into population and life history parameters as well as threats), and for site protection and management, through to developing justifications for a local network of nature conservation areas.

Conservation planning to protect biodiversity can benefit from the results of the modelling: areas with predicted high habitat suitabilty for the Siberian ibex were primarily considered for this purpose. Live observations and successful camera trap recordings of ibex in these areas, together with records of snow leopard sign, have allowed us to discern wildlife areas that hold promise for developing a local network of protected areas.

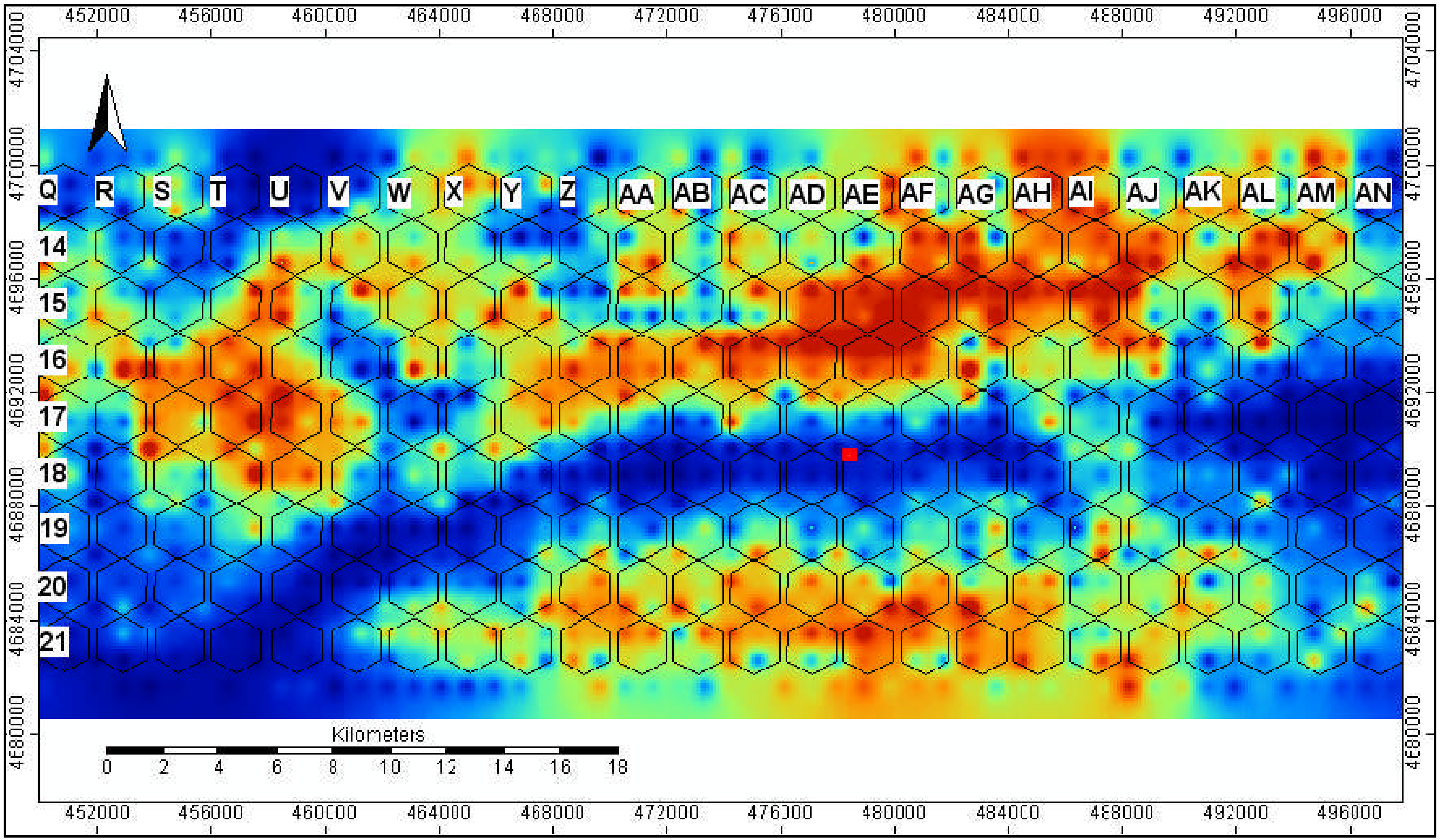


Figure 2.4a. Heat map for planning survey routes and camera trap locations; highest probability Siberian ibex areas are coloured in shades of red, lowest – in shades of blue; red square – Base Camp.

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, thereby building capacity and providing an alternative means of income, based on intact nature and/or snow leopard presence. For this purpose, community members from the surrounding area were trained in camera-trapping techniques in order to extend the study season year-round. Essentially, these community members will continue to monitor camera traps within the Kyrgyz Ala-Too range before and after future expeditions.

Community members were also involved as paid guides and trackers, logistics, horse and food providers, as well as to host the expedition team. This too provides alternative means of income and helps to build capacity and economic incentives based on intact nature and/or snow leopard presence. This, we believe, is a vital ingredient in local people accepting, progressing and embracing community-based conservation initiatives and areas. In addition, the positive attitude towards the snow leopard expressed by the majority of local people could be the key to the success of both research and community initiatives.

The presence of an abundance of rock art sites is another opportunity from which the local community can benefit, because these rock art sites present a valuable tourist resource for generating income.

Going forward, we will continue to evaluate and map the current status of snow leopard populations in the Kyrgyz Ala-Too range. The fifth expedition will take place between July and August 2018 and will continue to work in close co-operation with the Bishkek office of German conservation organisation NABU (Naturschutzbund = nature conservation alliance) and its “Gruppa Bars” (anti-poaching and snow leopard ranger group), as well as the newly created community monitoring group. Local people, community camera-trappers, student placements, as well as international citizen science volunteers from around the world will continue to join in the effort and, through their collective effort and funding, make it possible.

Recommendations for the 2018 expedition:

- Concentrate surveys on high probability Siberian ibex areas as guided by modelling and indicated on the corresponding map (Fig. 2.4a).

- As soon as snow depth allows access, install camera traps (in “hybrid” mode, meaning both photo and video shots will be taken) in places of high wildlife conservation interest: top priority areas in both the Kyrgyz and Jumgal ranges where snow leopard signs have been found – Chon Chikan, upper Issyk Ata, and upper Kashka Tor (Fig. 2.3.4a).

- Continue to explore remoter areas east of the Karakol mountain pass that might be promising for wildlife conservation (Donguruma etc.); set overnight camps for this purpose (one in each slot).

- Continue to build relationships with herders and interview people to gather local knowledge about the area and recordings of recent snow leopard presence. Working with NABU's Grupa Bars, local people should be identified and continued to be trained as community patrols to gather evidence of snow leopard presence when the expedition is not in situ.

- Build local capacity by building and training the next generation of snow leopard conservationists. Local students with an interest in nature and wildlife conservation should be selected, on a competitive basis, to take part in the 2018 research expedition. Successful candidates will have to write up reports and hold at least two talks – one to the public and one to their peer group – about the experience. They will also be required to write a public blog.

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3. Butterflies of the West and East Karakol River Valleys, Kyrgyzstan, 2017

(Lepidoptera, Diurna)

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Plateau Perspectives and American University of Central Asia

3.1 Introduction

Although the West Karakol River Valley is only seven to eight hours away by car from Bishkek, the capital city of Kyrgyzstan, this region is very poorly studied with regards to its ecology. Information on butterfly distributions in this region is lacking in most currently available resources. 2017 saw the continuation of data collection in this region started in summer 2015, when for the first time efforts were made to study the butterfly ecology in this region. As a result, the data presented within provides a lot of new information that enhances our understanding of the distribution of many of these butterflies. Elevation data have been used in association with the *Parnassius* genus to determine if there is a significant relationship between altitude and distribution, which could be used in the future to map possible altitudinal shifts with climate change in this genus, thus using them as an indicator for climate change.

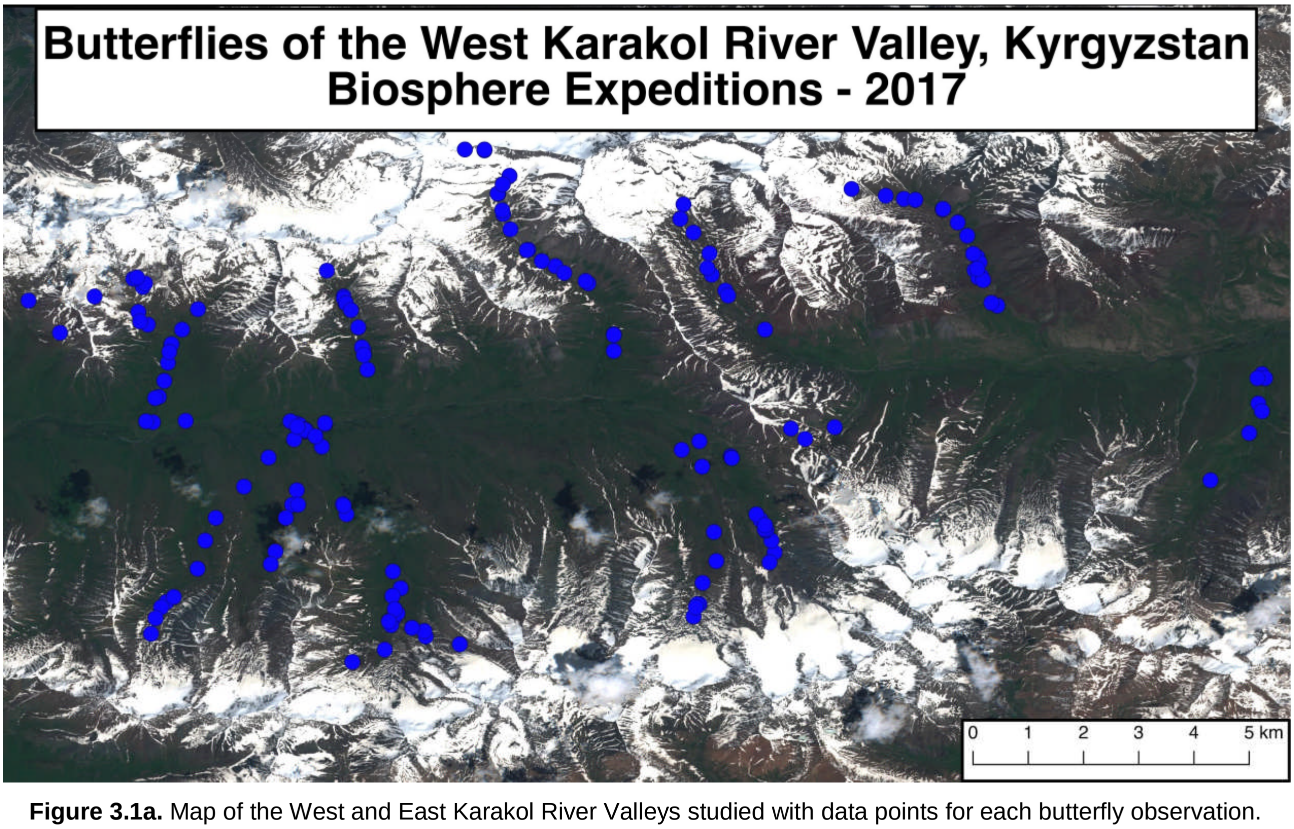


Figure 3.1a. Map of the West and East Karakol River Valleys studied with data points for each butterfly observation.

3.2. Materials and methods

Data were collected during the Biosphere Expeditions project during the summer of 2017 from June to August. Citizen scientists from around the world were present during four 12-day trips that the expedition was conducted over. Although the main duties of the expedition were not related to butterfly identification and distribution mapping, efforts were made by many citizen scientists on the expedition to catalogue the butterflies seen. This was accomplished using a smartphone app, Lapis Guides, that includes various citizen science enabled field guides. The app essentially functions as a field guide, but allows users to submit valuable location and image data. Data were collected along the same transects used by the snow leopard study, between approximately 2,800-4,050 m altitude.

3.3. Results

Table 3.3a. Butterflies of the West Karakol River Valley, Kyrgyzstan, June - August 2017.

Family	Scientific name	Common name
Hesperiidae	*Muschampia kuenlunus*	No common name (NCN)
Lycaenidae	*Cuppido buddhista*	Buddhist blue
Nymphalidae	*Aglais urticae*	Small tortoiseshell
	Argynnis aglaja	Dark green fritillary
	Boloria generator	NCN
	Issoria Lathonia	Queen of Spain fritillary
	Melitaea solona	NCN
Papillionidae	*Papilio machaon*	Old World swallowtail
	Parnassius delphius	Banded apollo
	Parnassius mnemosyne	Clouded apollo
	Parnassius tianschanicus	Large-keeled apollo
Pieridae	*Colias cocandica*	NCN
	Colias erate	Pale clouded yellow
	Colias thisoa	Menetries' clouded yellow
	Pieris napi	Green-veined white
	Pontia callidice	Lofty bath white
Satyridae	*Coenonympha caeca*	NCN
	Coenonympha sunbecca	NCN
	Erebia mopsos	NCN
	Erebia sokolovi	NCN
	Karanasa kirgisorum	NCN

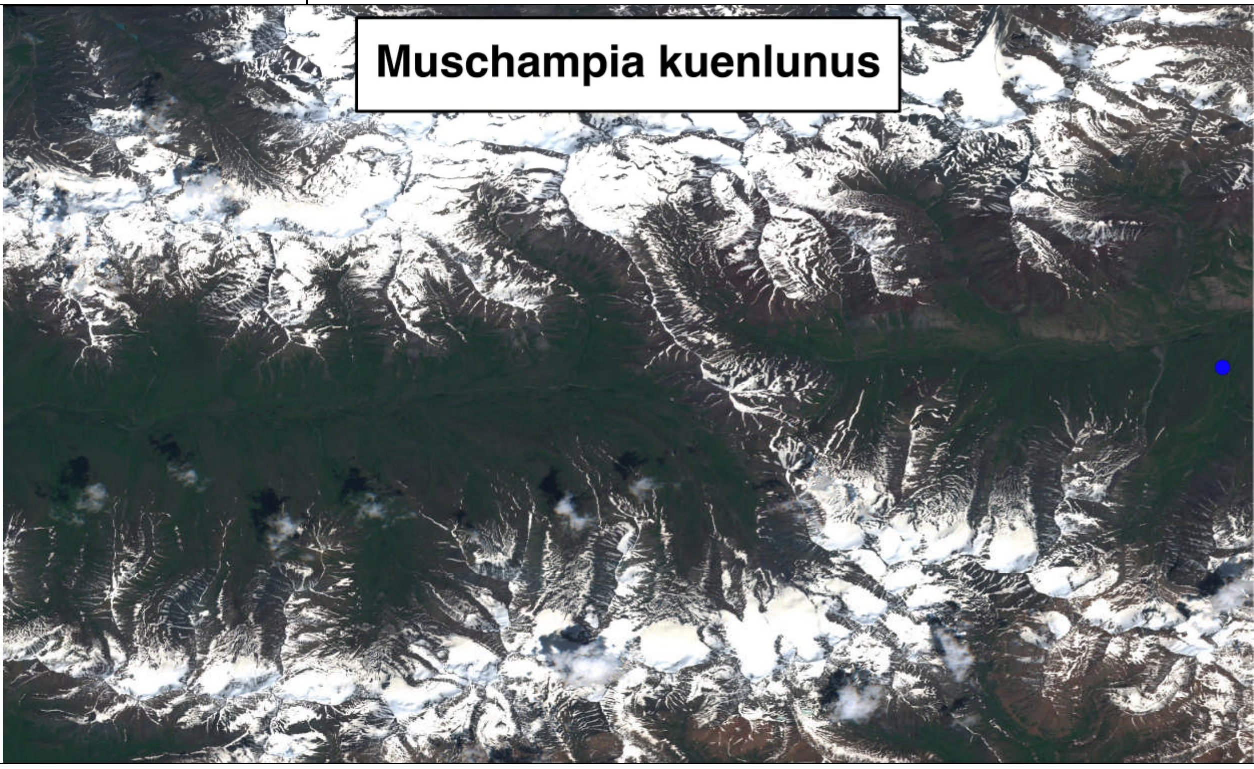
Over the course of the summer, 21 species were identified (Fig. 3.3a) with 163 individual sightings. Some of these species provide new location data that has not been published before. One species (*Colias cocandica)* however had only a single, doubtful sighting, while another single sighting of *Colias erate* was found dead on a glacier overlooking the northern side of the Kyrgyz Ala-Too range where there is a known population. It is most likely to have been blown up to this altitude and died there, rather than having lived there.

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 author (unless otherwise noted) and only permitted for use outside this report with the permission of the author.

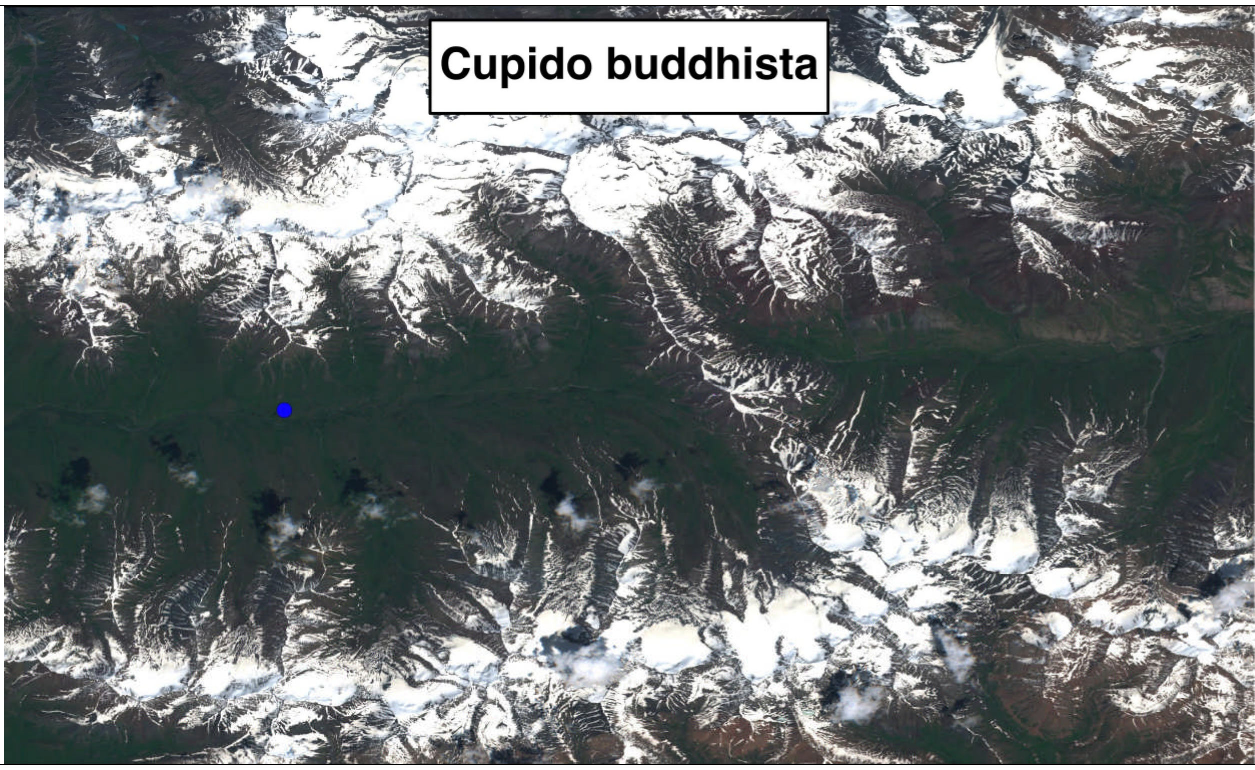
Hesperiidae

Muschampia kuenlunus			
Flight time	June to August	Elevation (m)	1,500-3,300
Habitat	Meadows and steppes		
Food plants	*N/A*		
Life cycle	Univoltine		



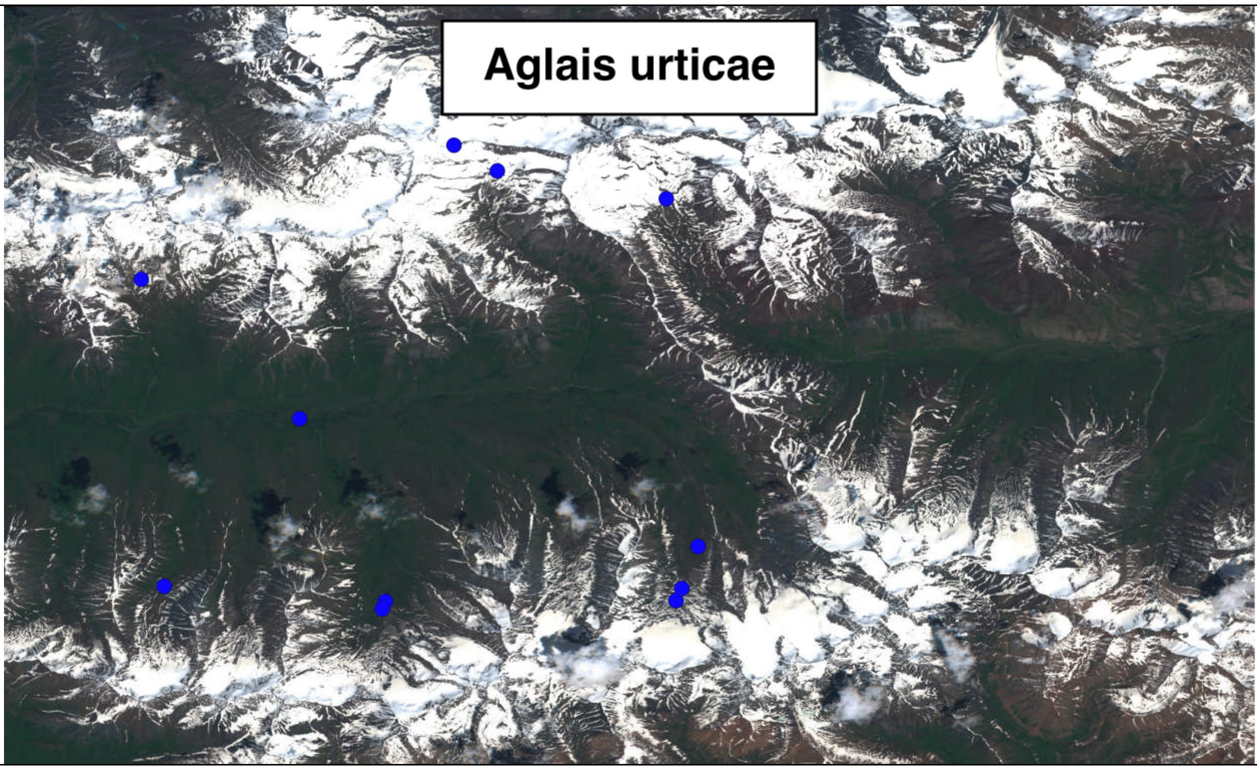
Lycaenidae

Cupido buddhista — Buddhist blue			
Flight time	June to September	Elevation (m)	2,300-3,400
Habitat	Alpine biomes with lots of herbaceous plants		
Food plants	*Oxytropis spp.* (locoweed)		
Life cycle	N/A		



Nymphalidae

Aglais urticae — Small tortoiseshell			
Flight time	April to September	Elevation (m)	up to 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		



Argynnis aglaja — Dark green fritillary			
Flight time	June to August	Elevation (m)	up to 4,200
Habitat	Meadow areas in mountainous and subalpine biomes		
Food plants	*Violaceae spp.*(violets) and *Polygonaceae spp.* (buckwheats)		
Life cycle	Species overwinters as a small larva		

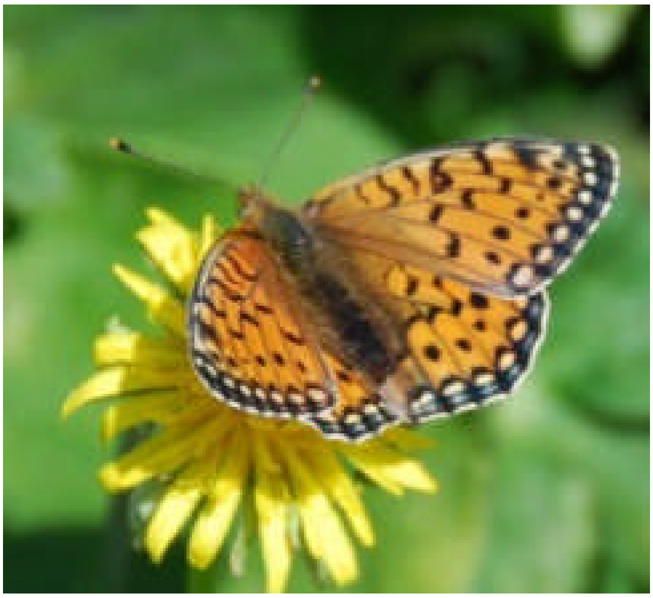
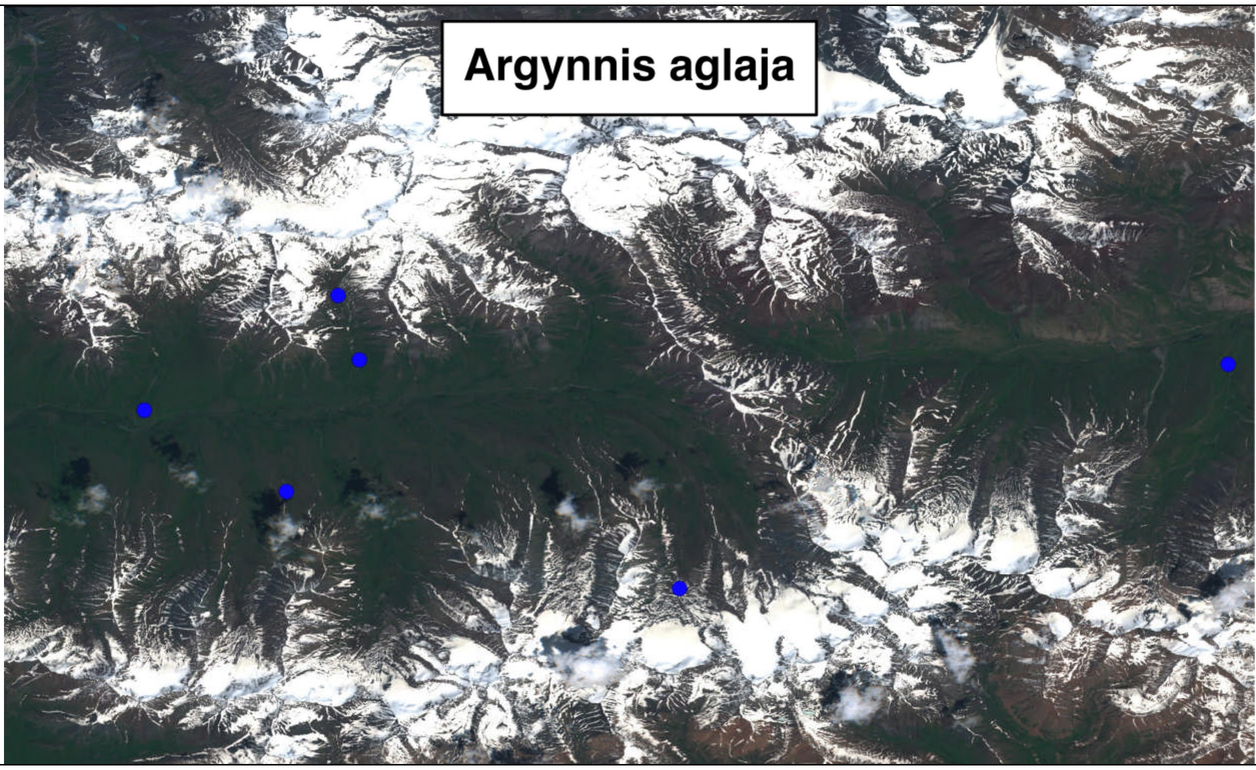
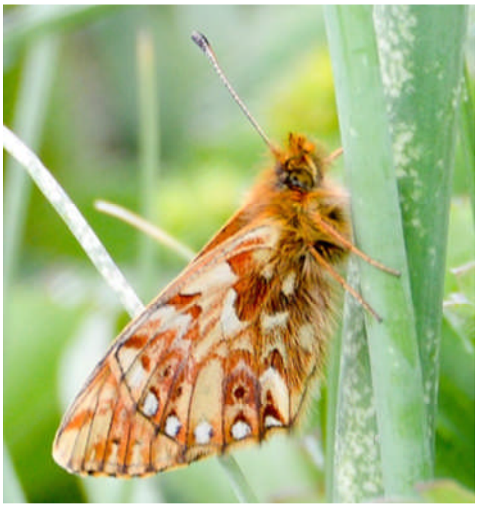
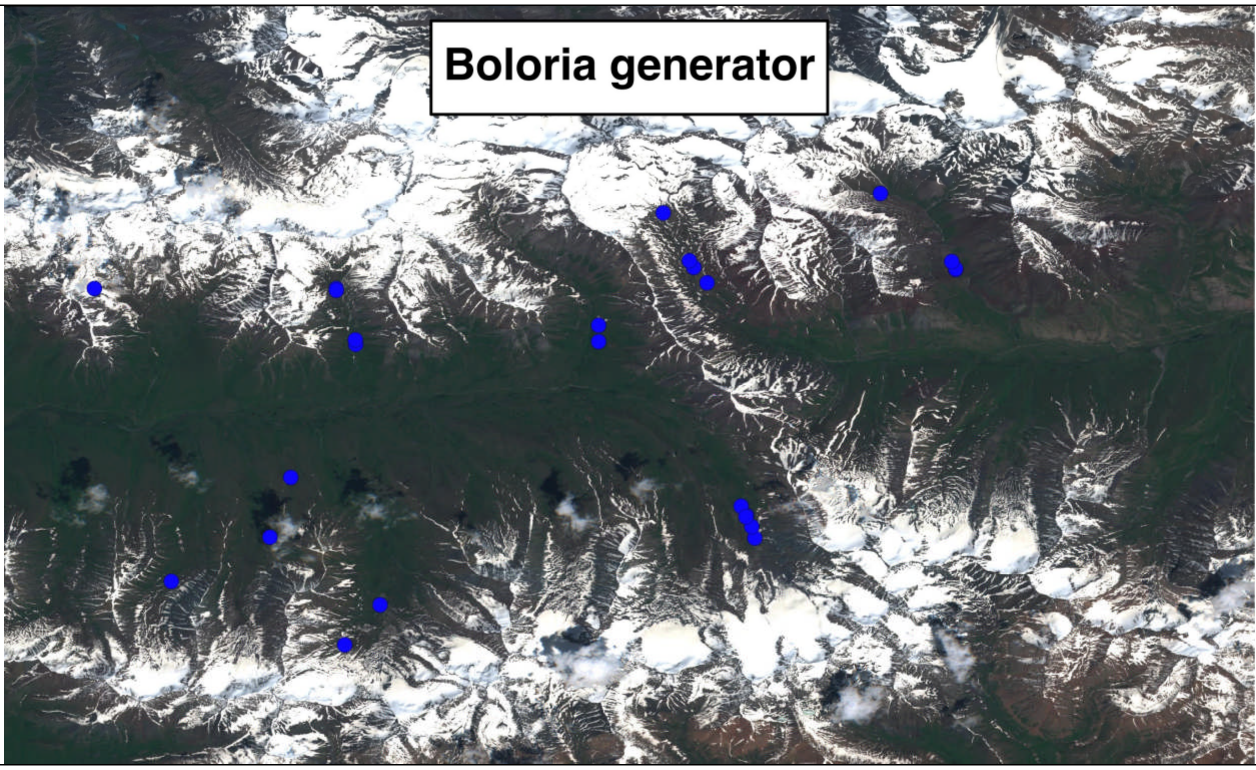


Photo courtesy of Koenraad Bracke - 2016

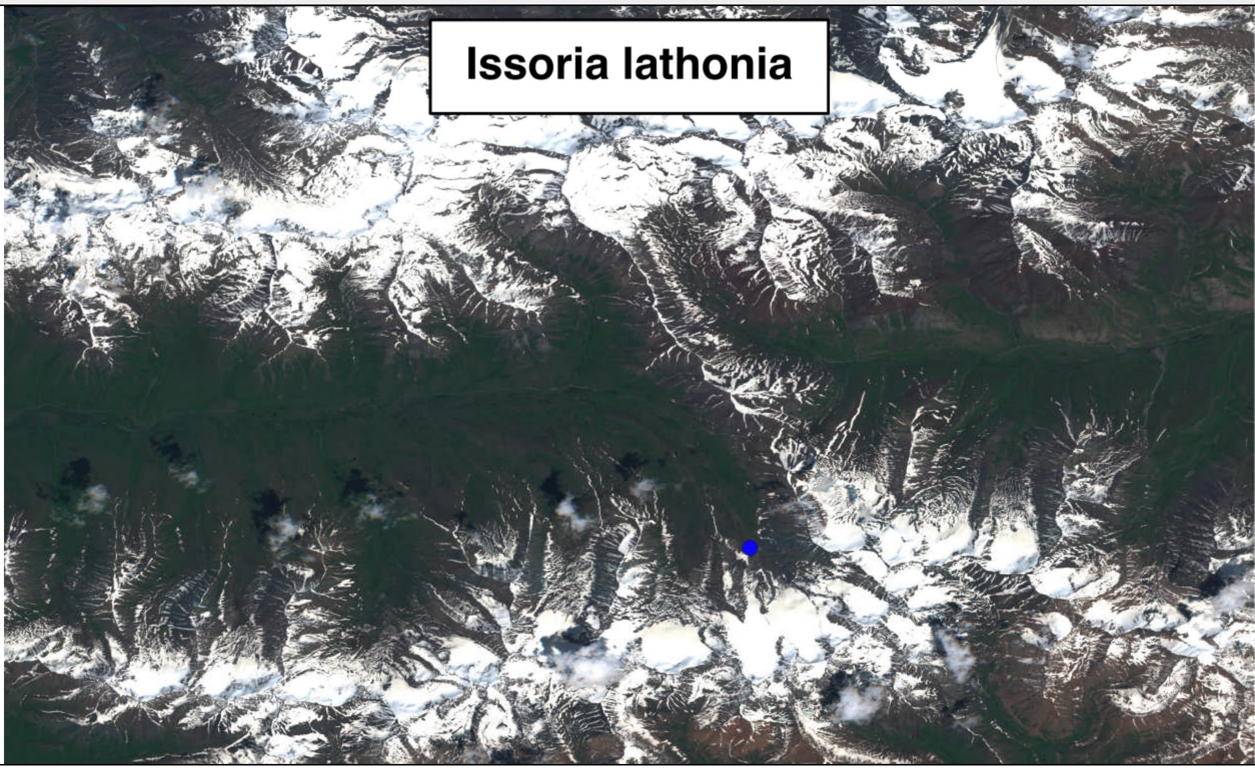


Boloria generator			
Flight time	July to September	Elevation (m)	2,500-4,500
Habitat	Moist mountain meadows and stream banks		
Food plants	*Polygonum alpinum* (Alpine knotweed)		
Life cycle	N/A		

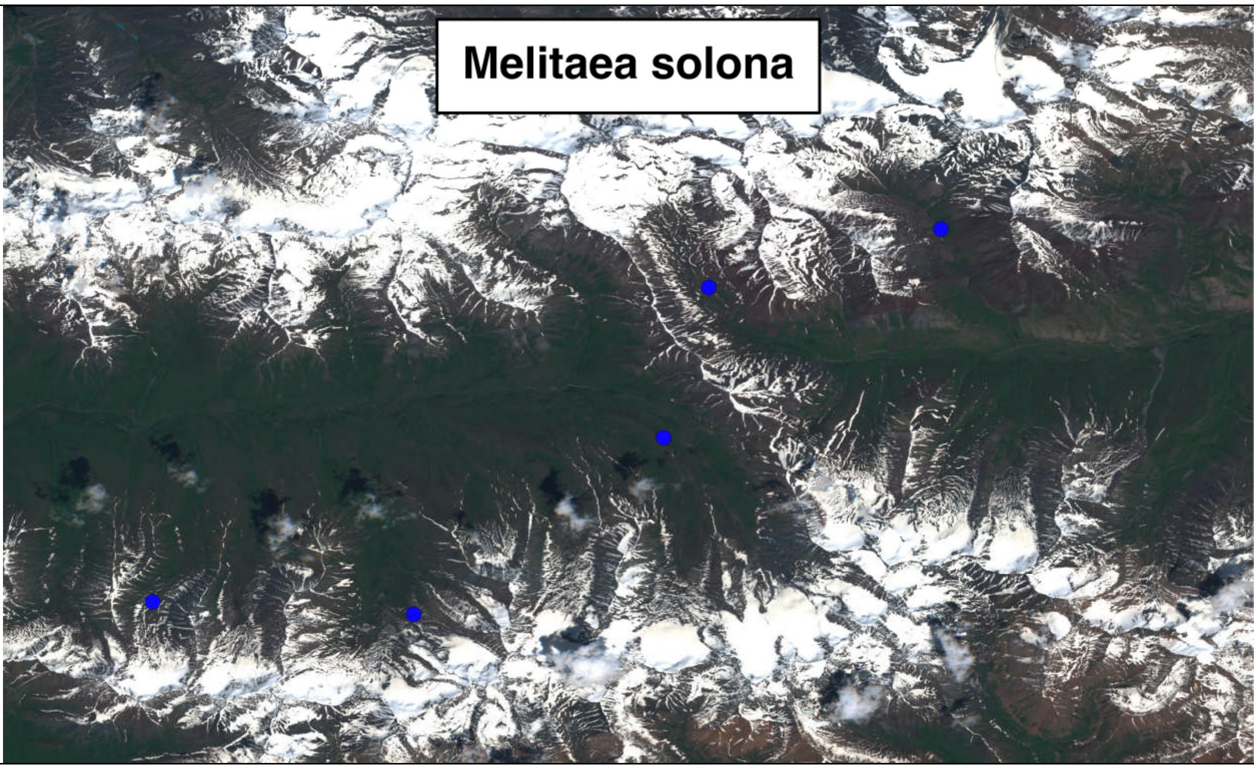




Issoria lathonia — Queen of Spain fritillary			
Flight time	April to October	Elevation (m)	Up to 3,500
Habitat	Low elevation plains up to subalpine biomes		
Food plants	Violaceae (Violets and Pansies)		
Life cycle	Species can overwinter as a larva or pupa. Bivoltine or multivoltine.		

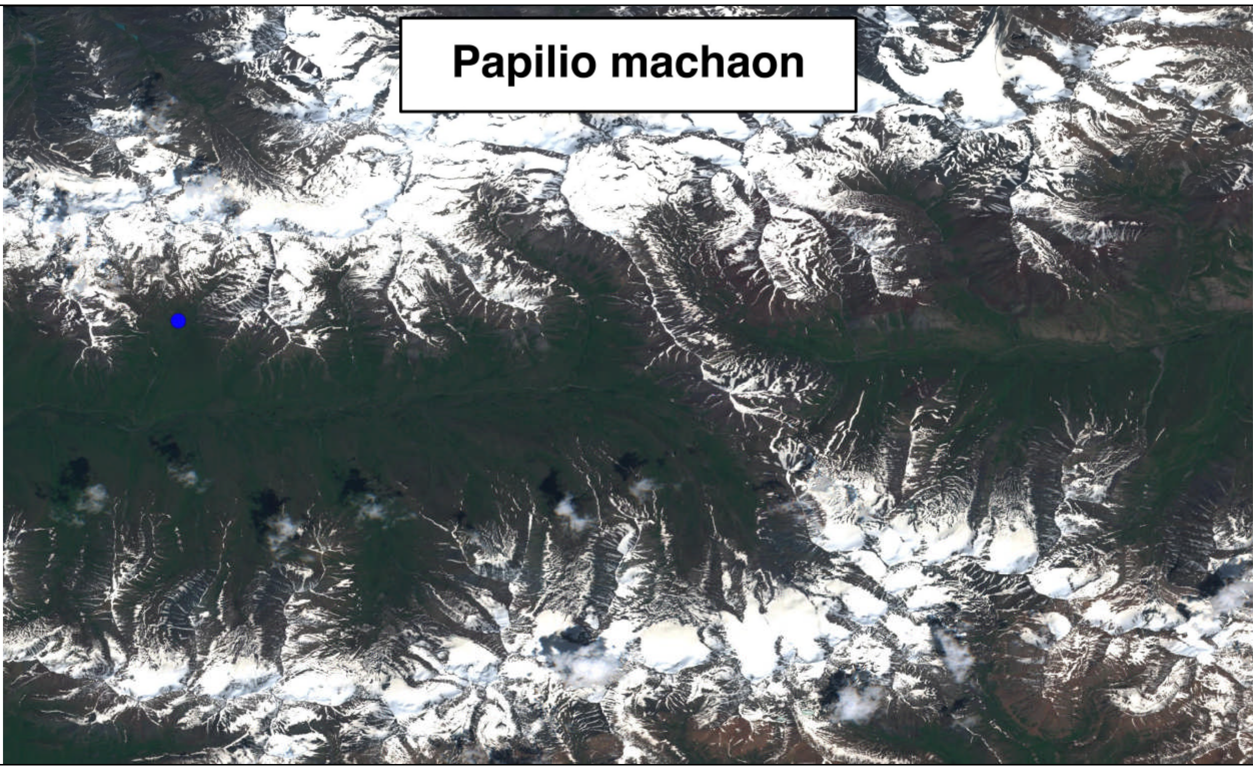


Melitaea solona — NCN			
Flight time	June to July	Elevation (m)	2,700-4,000
Habitat	Humid alpine meadows		
Food plants	*Pedicularis spp.* (Lousewort)		
Life cycle	N/A		

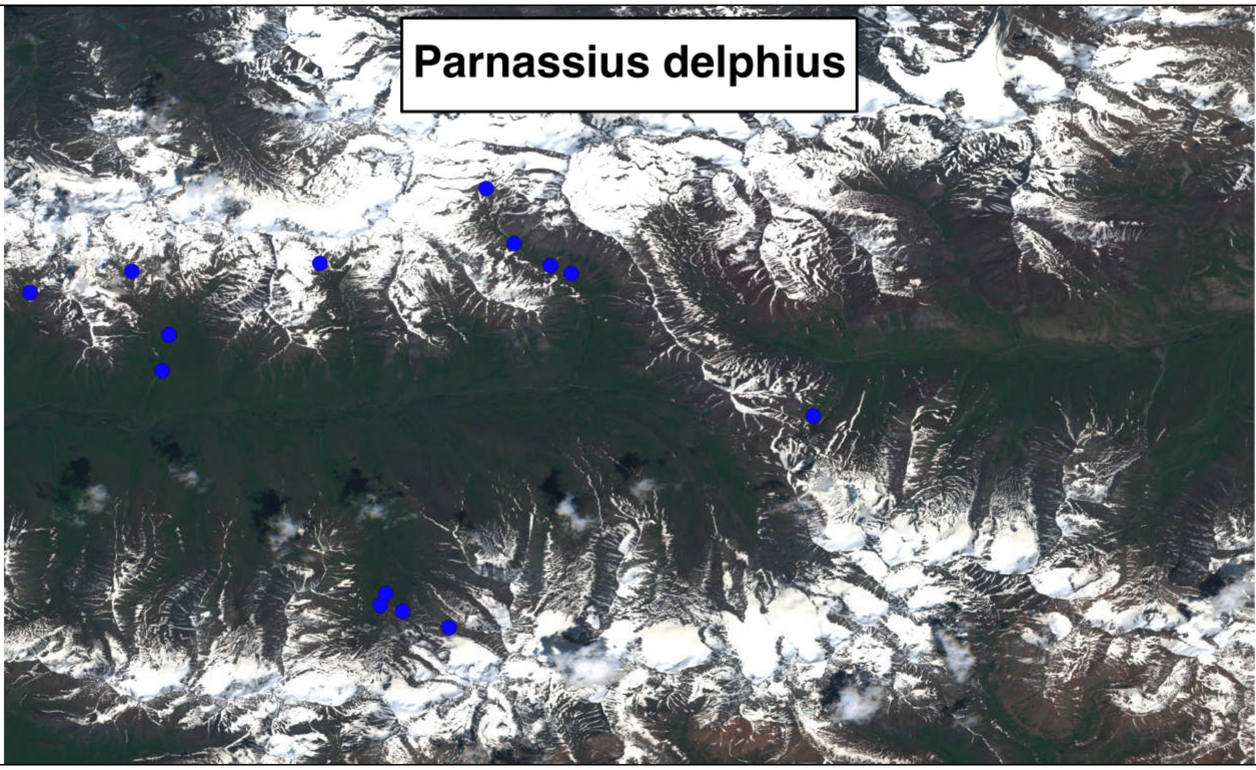


Papilionidae

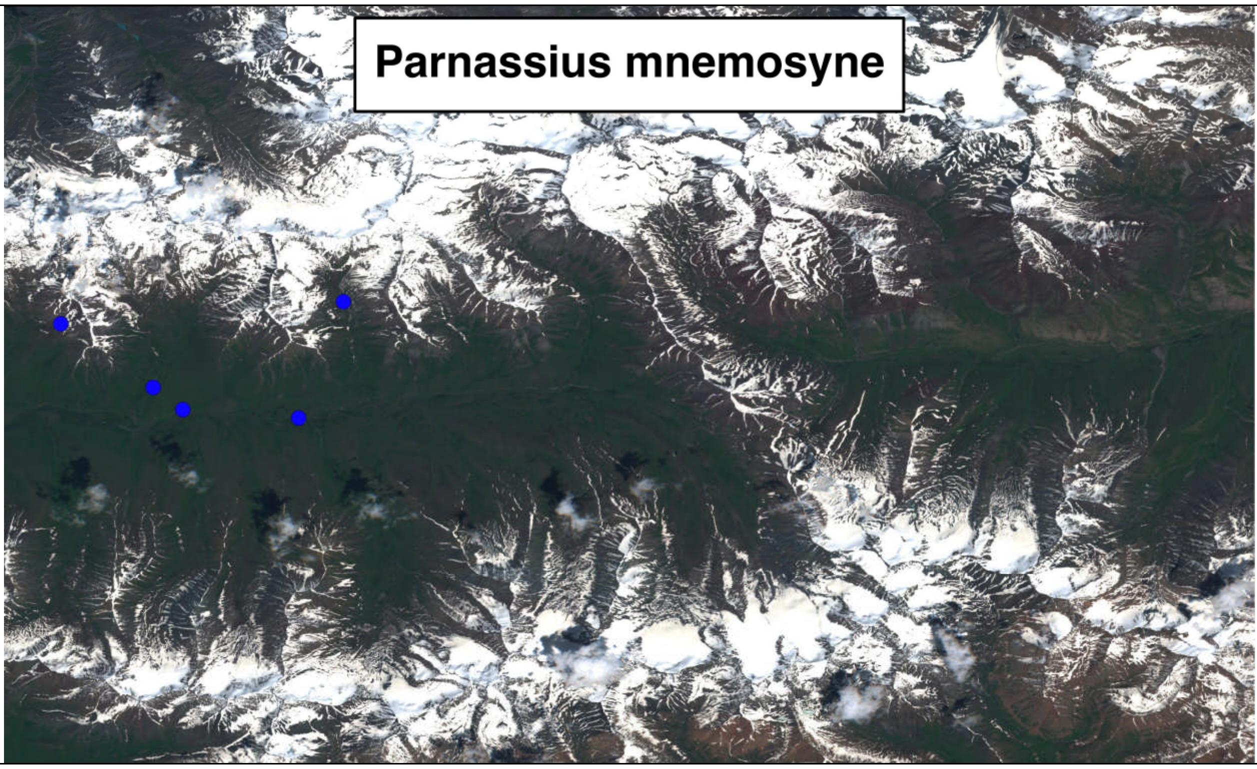
Papilio machaon — Old World swallowtail			
Flight time	April to November	Elevation (m)	Up to 4,000
Habitat	Found in virtually any ecosystem from lowlands to high mountains		
Food plants	*Artemisia spp.* (Wormwood), *Ferula spp., Haplophyllum spp., Prangos spp.*		
Life cycle	Eggs laid singly on host plant. Overwinters as a pupa. Pupal diapause is possible for up to three years before adult emergence. Univoltine or bivoltine depending on location.		



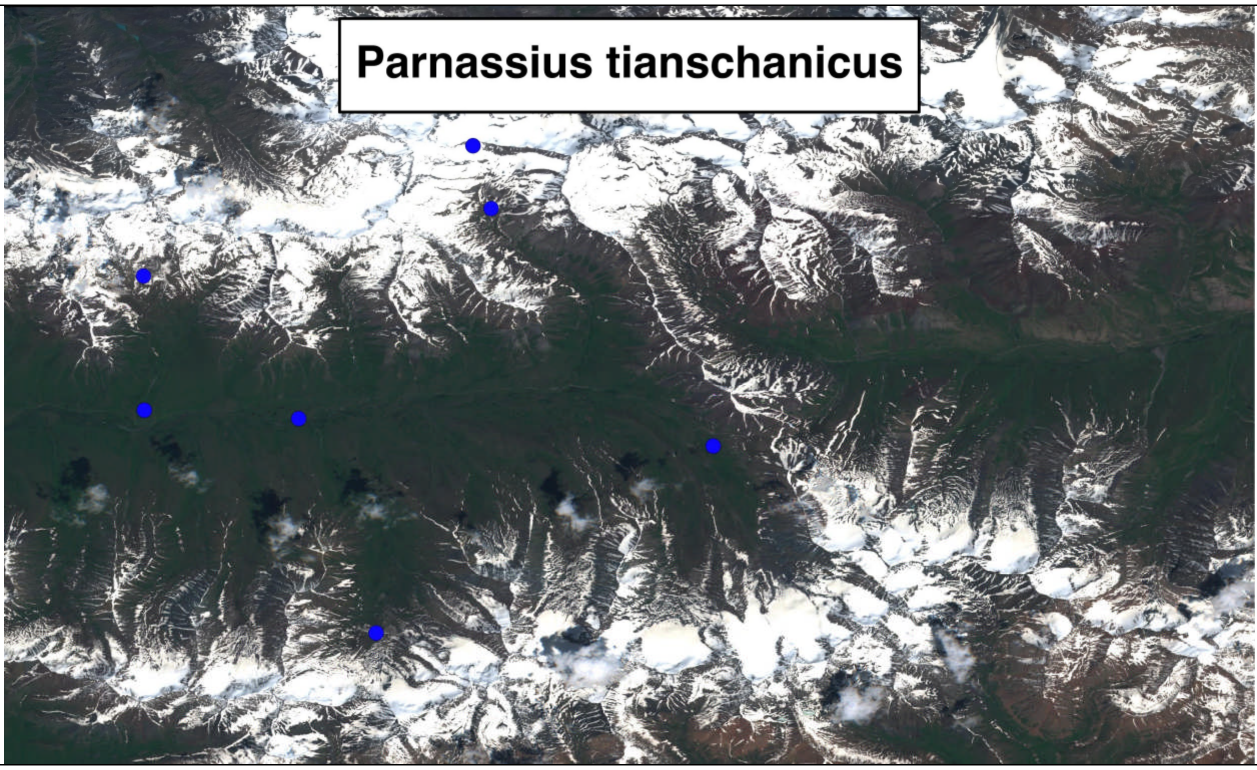
Parnassius delphius — Banded apollo			
Flight time	June to July	Elevation (m)	3,000-4,000
Habitat	Western-facing rocky slopes, scree fields,and mountain meadows		
Food plants	*Cysticorydalis fedtschenkoana*, *Corydalis tenella* (Discreet Corydalis), *Corydalis gortschakovi*		
Life cycle	Follows a two-year 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, Corydalis glaucescens*		
Life cycle	Overwinters as an egg		



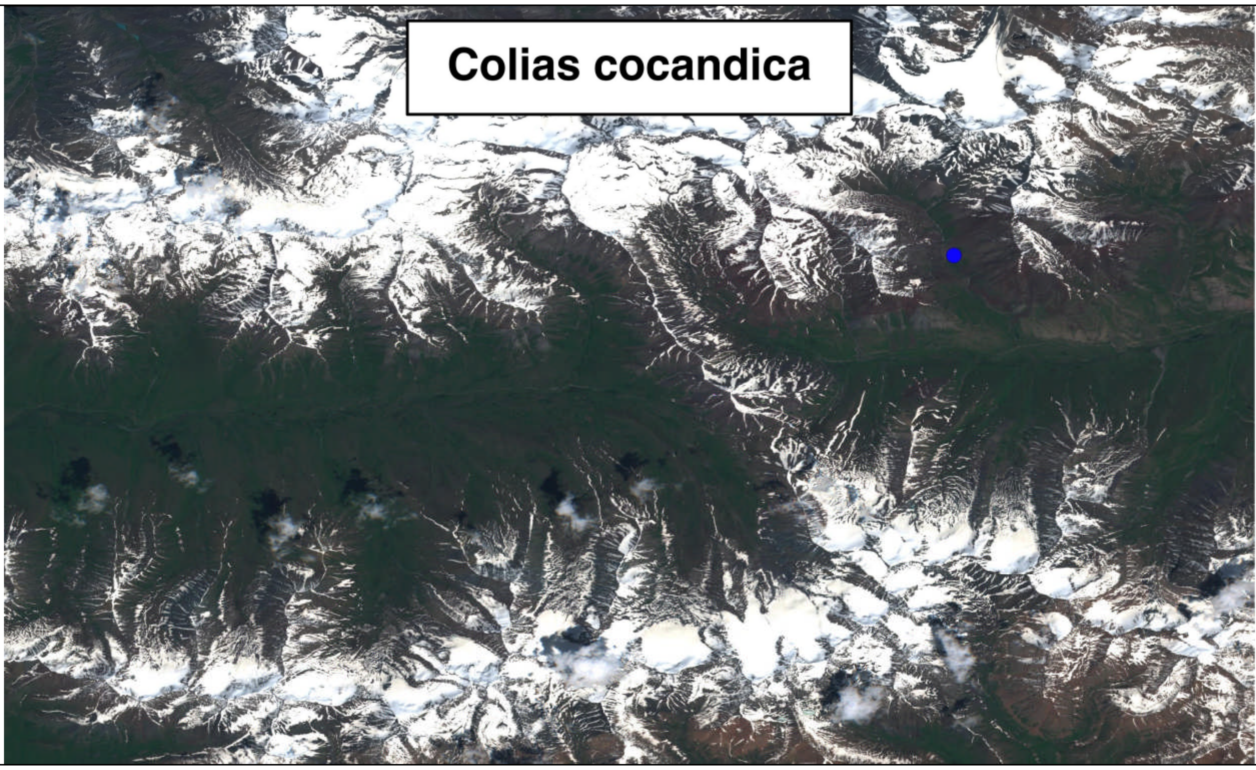
Parnassius tianschanicus — Large-keeled apollo			
Flight time	May to September	Elevation (m)	1,700-3,500
Habitat	East and south-facing rocky slopes in subalpine and alpine areas		
Food plants	*Rhodiola spp.*, *Sedum ewersii* (Stonecrop), *Sedum hybridum*		
Life cycle	Overwinters as a larva		



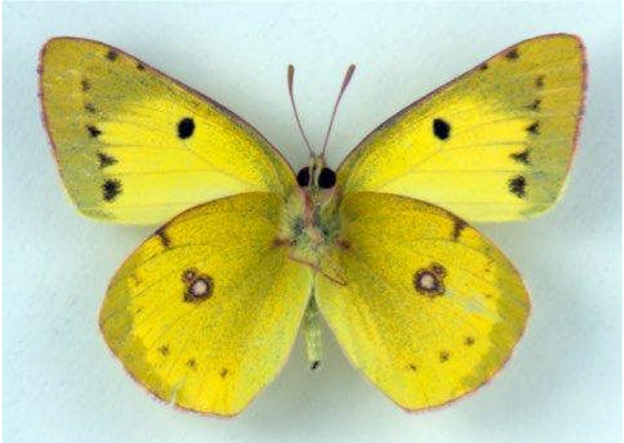
Pieridae

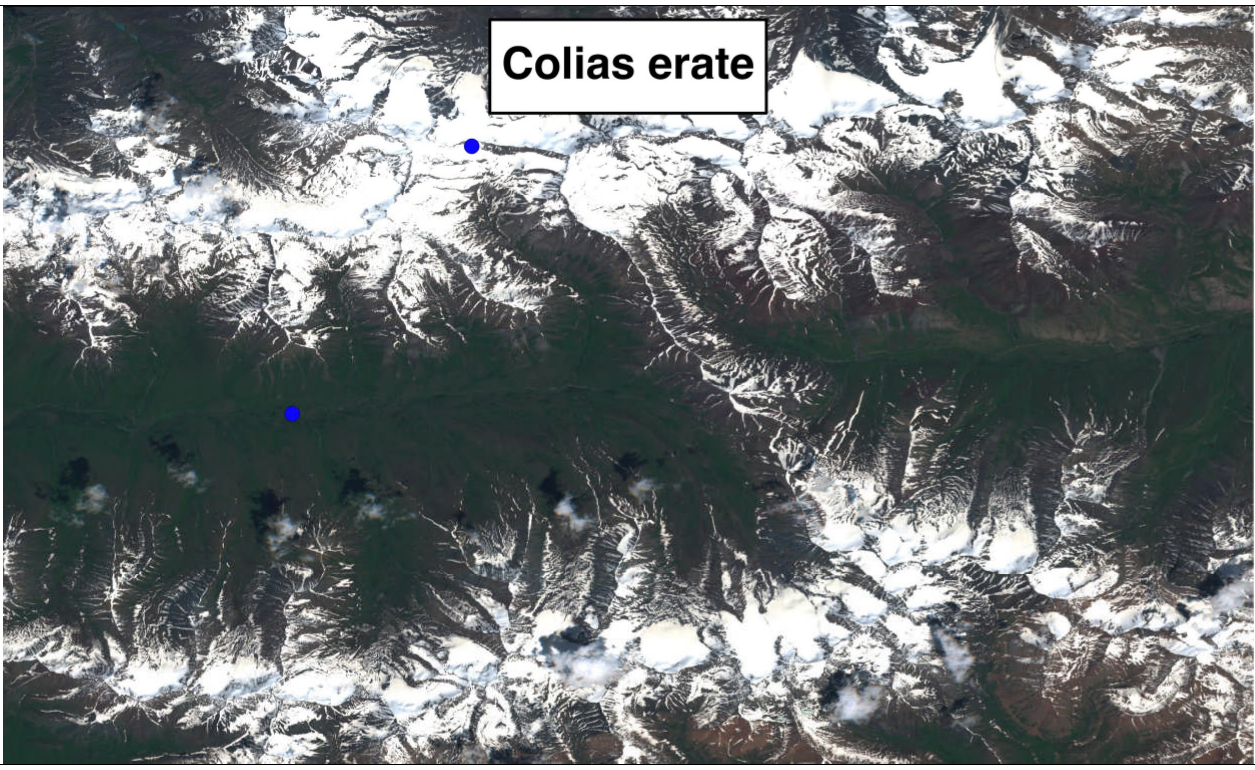
Colias cocandica			
Flight time	June to July	Elevation (m)	3,000 – 4,500
Habitat	Stony slopes and mountain meadows		
Food plants	*Astragalus spp.* (milkvetch)		
Life cycle	Overwinters as a second instar larva		

Photo courtesy of Josef Greishuber - 2005



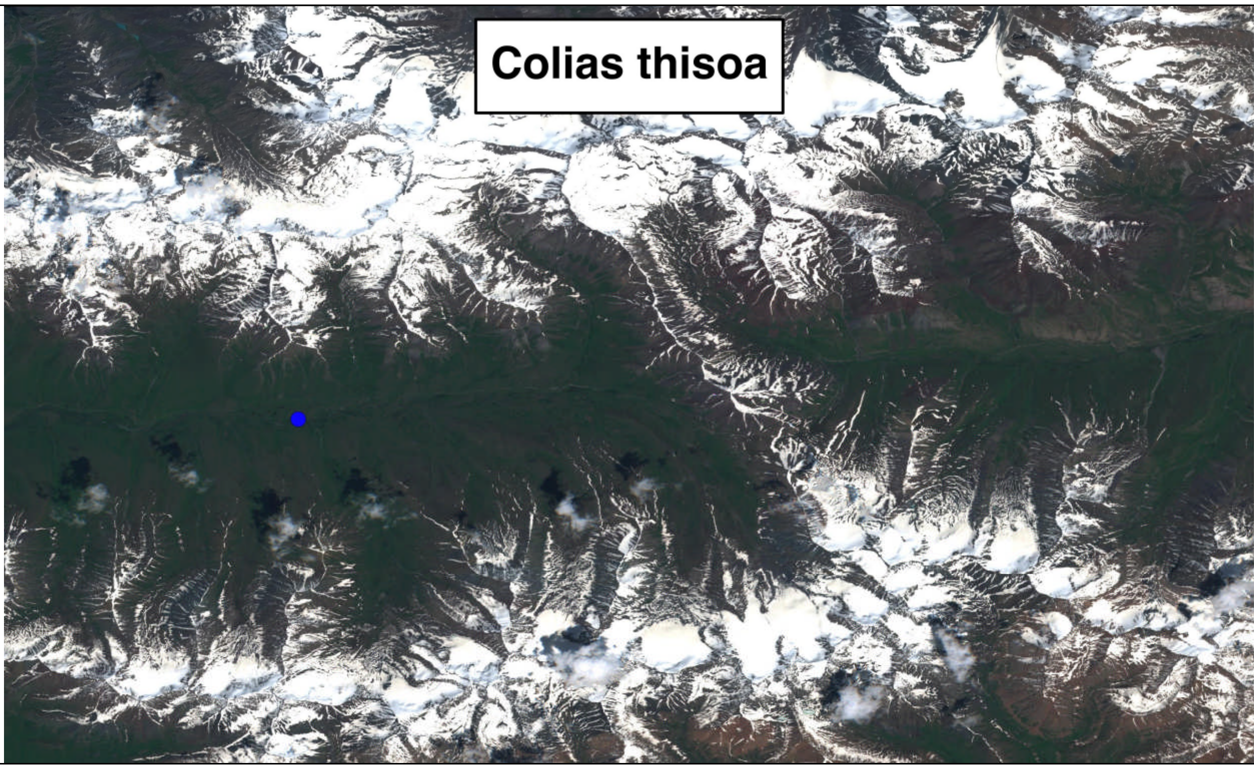
Colias erate — Pale clouded yellow			
Flight time	April to October	Elevation (m)	up to 3,300
Habitat	Steppes, fields, and mountain meadows		
Food plants	*Onobrychis spp.* (Sainfoin), *Medicago spp.* (Burclover), *Trifolium spp* (Clover), *Trigonella spp* (Fenugreek), *Alhagi spp.* (Camelthorn)		
Life cycle	Bivoltine. Overwinters as either a pupa or larva.		



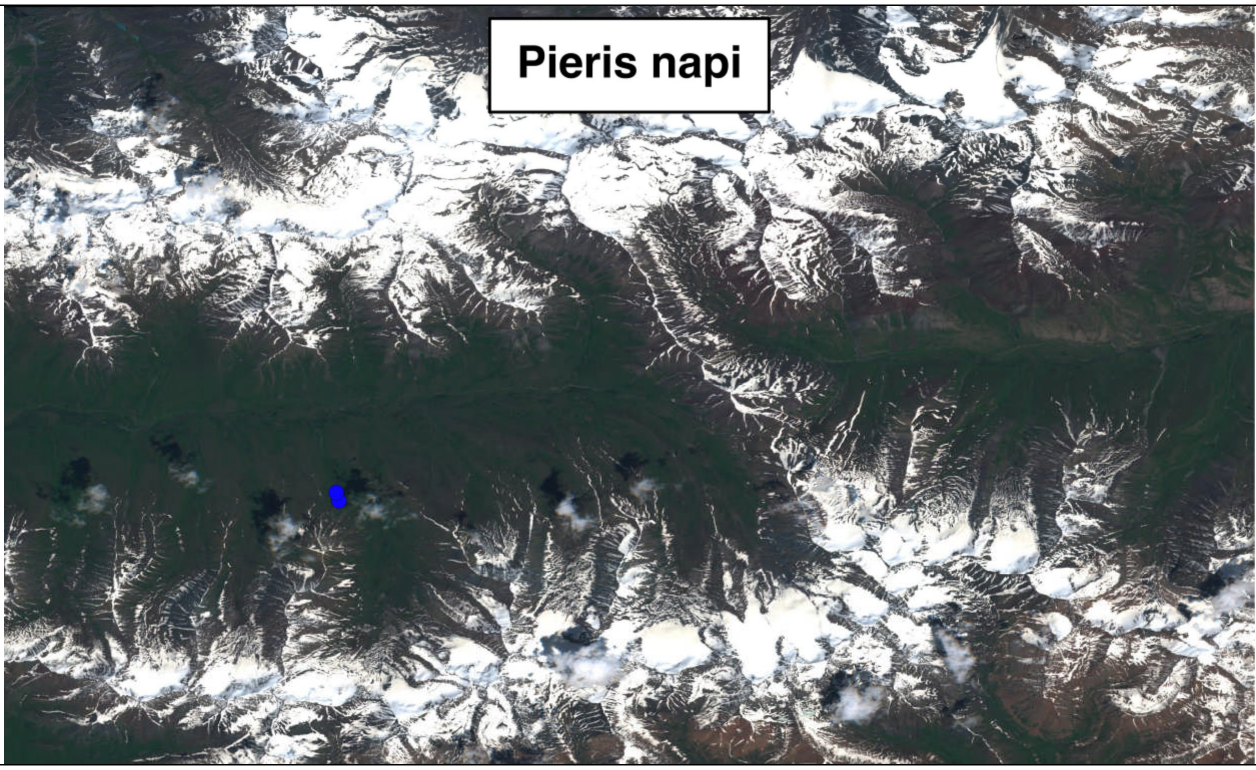


Colias thisoa — Menetries' clouded yellow			
Flight time	June to July	Elevation (m)	2,000-3,400
Habitat	Southern and eastern facing steppe slopes		
Food plants	*Astragalus spp.*		
Life cycle	Hibernates as a second instar larva.		

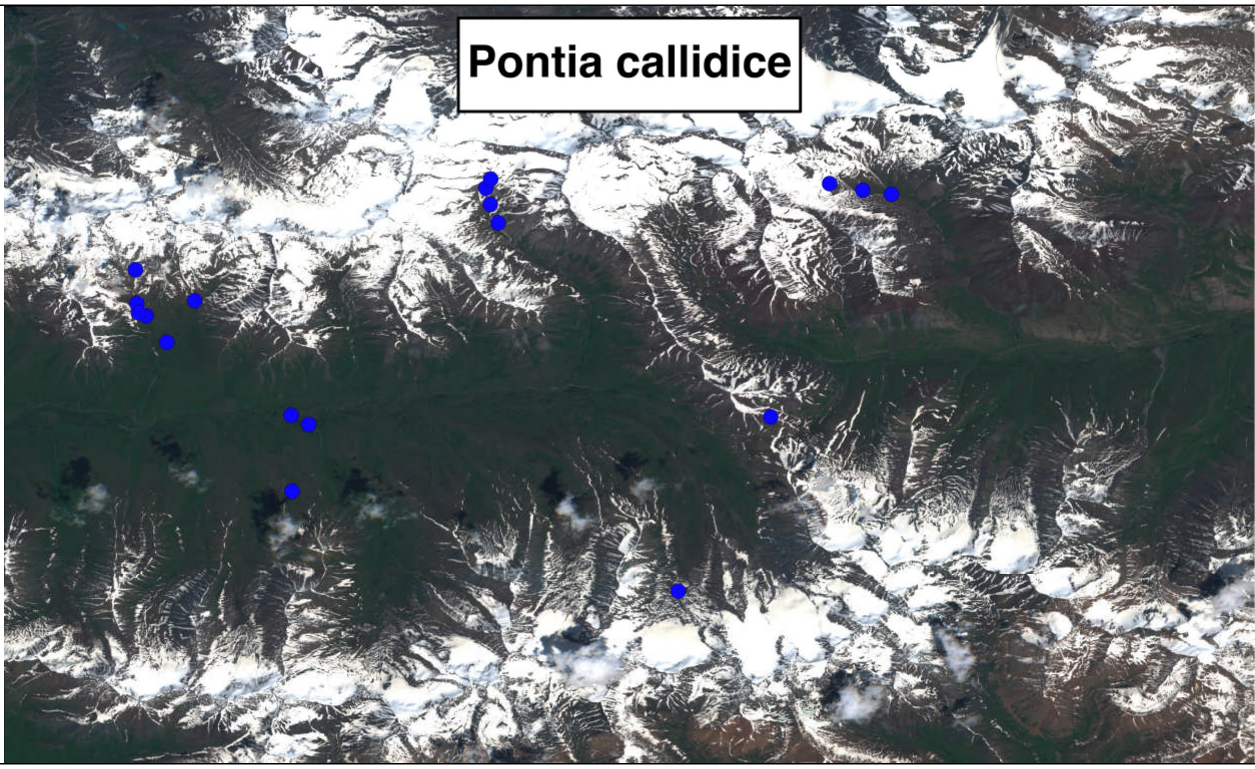
Photos courtesy of Josef Greishuber



Pieris napi — Green-veined white			
Flight time	April to September	Elevation (m)	up to 3,000
Habitat	Meadows and river valleys		
Food plants	*Alyssum spp., Arabis spp.* (Rockcress), *Barbarea spp.* (Winter Cress), *Brassica spp.* (Cabbage), *Cardamine spp.* (Bittercress), *Descuriania spp.* (Tansymustard), *Draba spp.* (Whitlow-grass), *Erysimum spp.* (Wallflower), *Lepidium spp.* (Peppercress), *Reseda lutea* (Wild Mignonette), *Sisymbrium spp.* (Rocket), *Thlaspi spp.* (Pennycress)		
Life cycle	Bivoltine or monovoltine depending on the altitude. Eggs are laid singly. Overwinters as a pupa.		

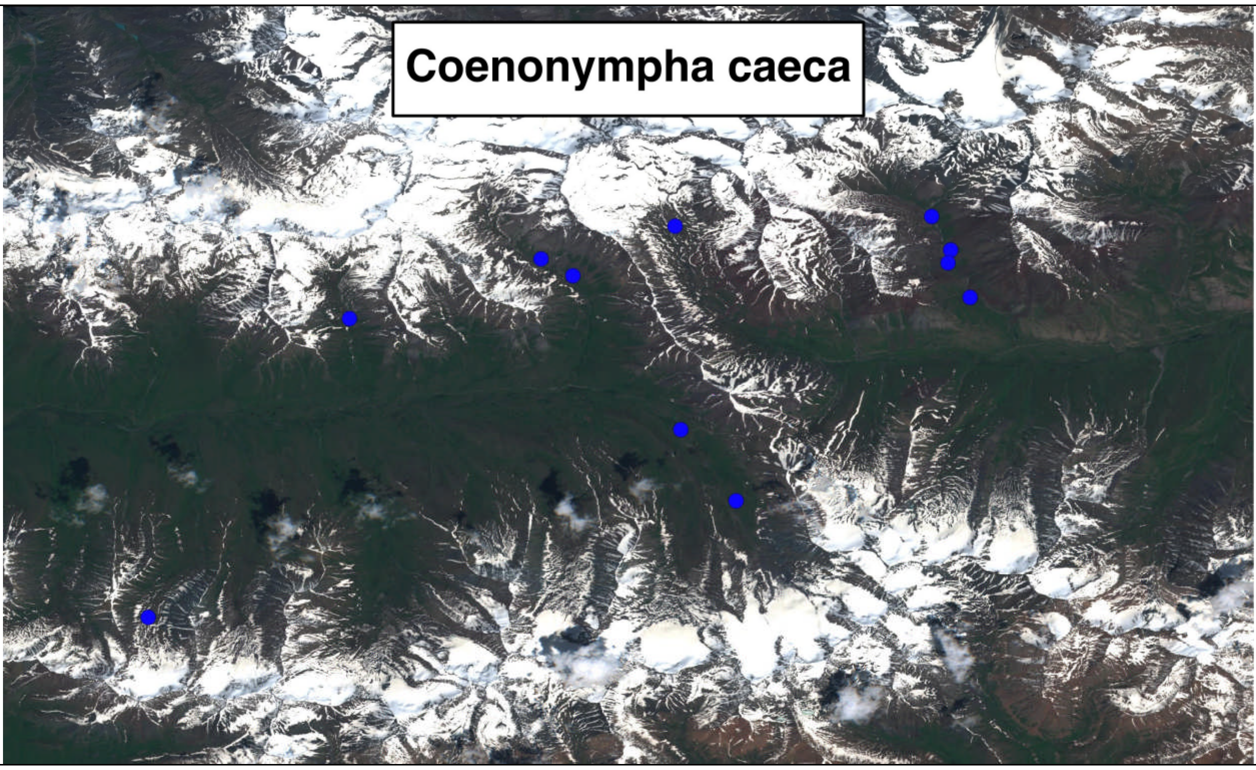


Pontia callidice — Lofty bath white			
Flight time	May to September	Elevation (m)	2,000-4,500
Habitat	South-facing river valleys and steppe slopes		
Food plants	*Brassica spp.* (Cabbage), *Alyssum spp., Arabis spp.* (Rockcress), *Barbarea spp.* (Winter Cress), *Descurainia spp.* (Tansymustard), *Erysimum 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.		

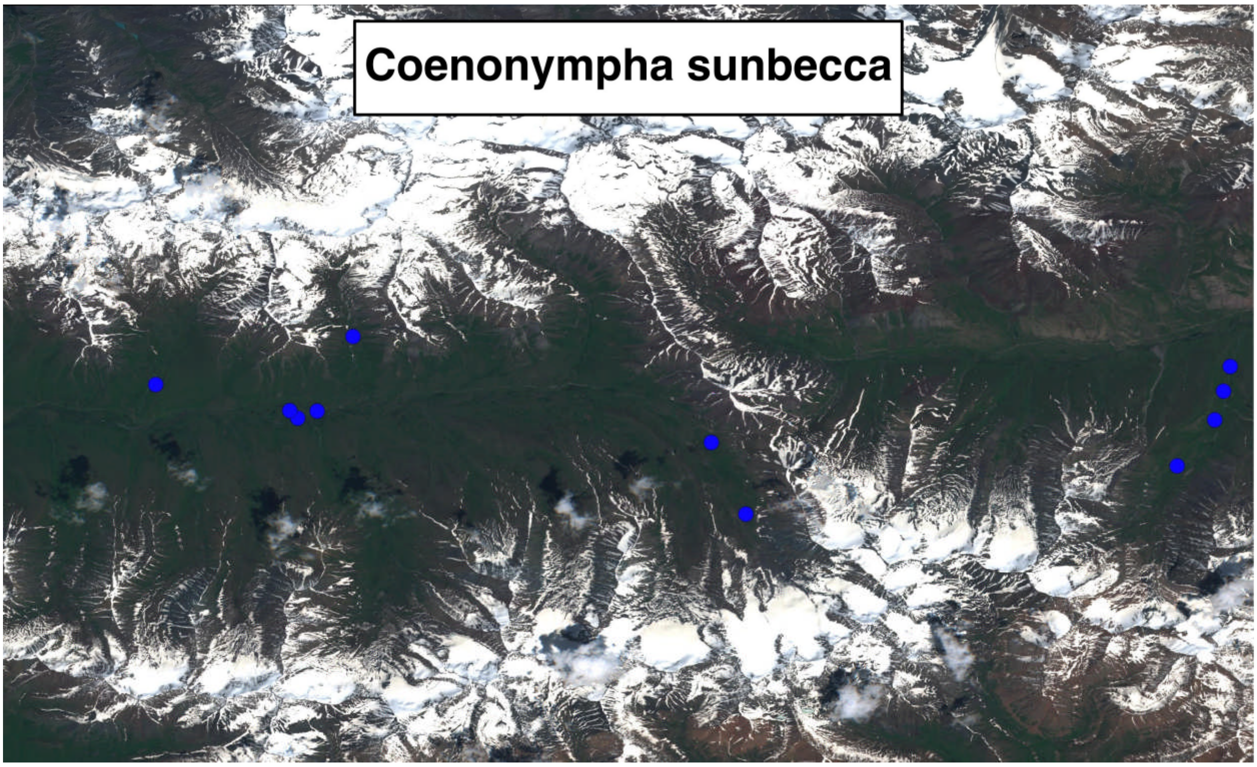


Satyridae

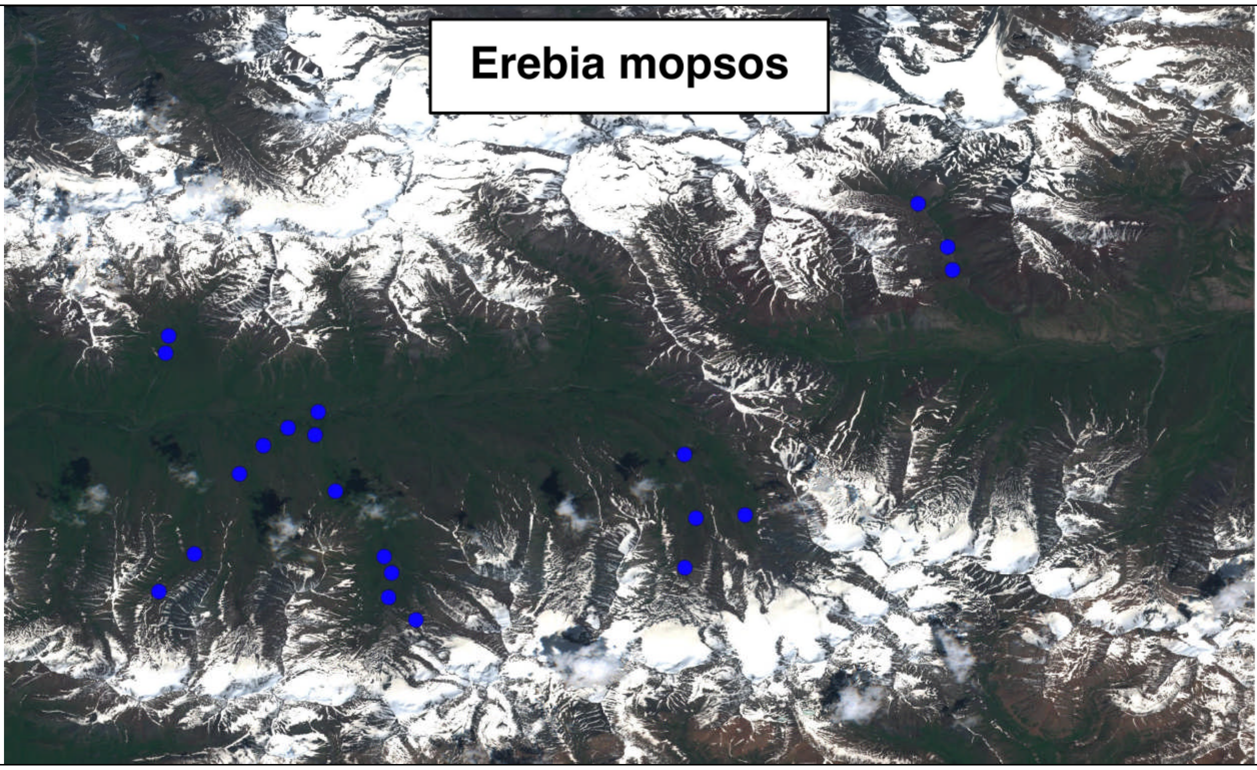
Coenonympha caeca			
Flight time	June to July	Elevation (m)	2,000-3,500
Habitat	Alpine meadows, stream banks, and stony slopes that face eastward		
Food plants	*Carex spp.* (Sedge)		
Life cycle	N/A		



Coenonympha sunbecca			
Flight time	June to August	Elevation (m)	1,500-3,400
Habitat	Sloped meadows and stream banks		
Food plants	Poaceae (Grasses)		
Life cycle	N/A		

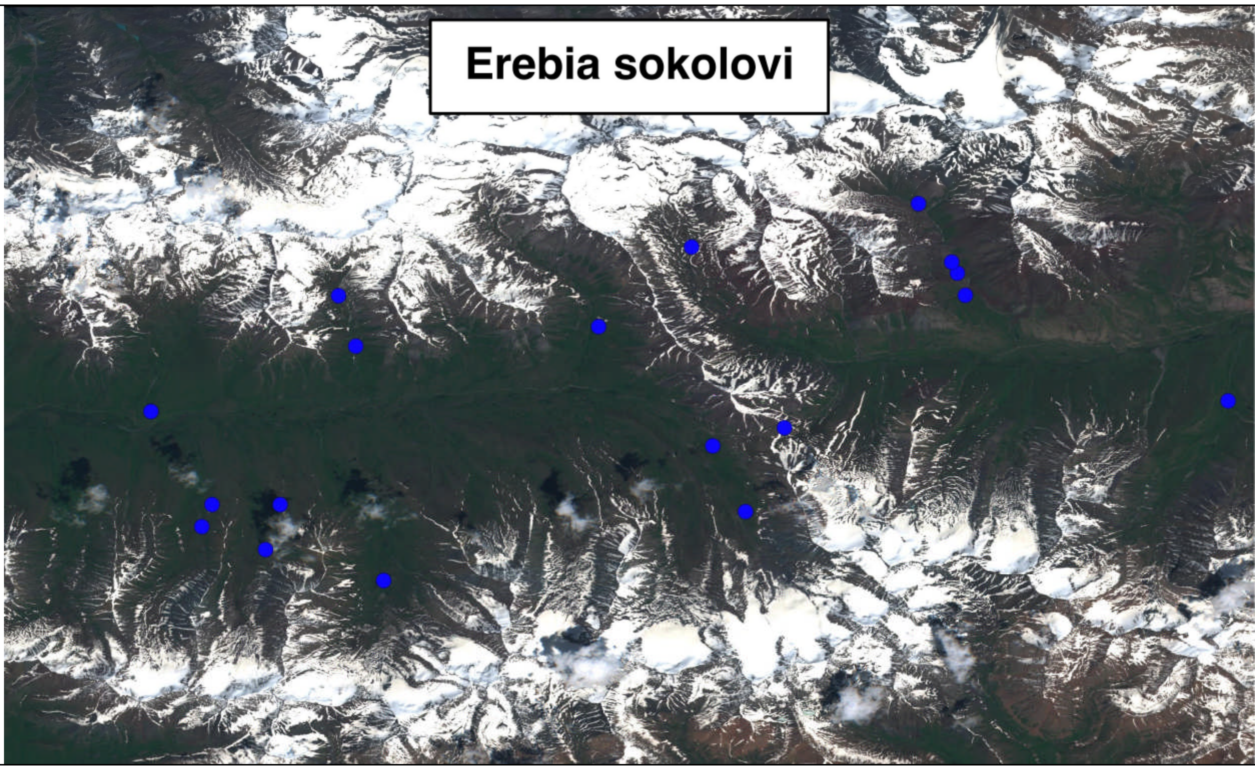


Erebia mopsos			
Flight time	June to July	Elevation (m)	2,800-3,500
Habitat	Meadow slopes in subalpine and alpine areas		
Food plants	*Festuca spp.* (Fescue)		
Life cycle	N/A		

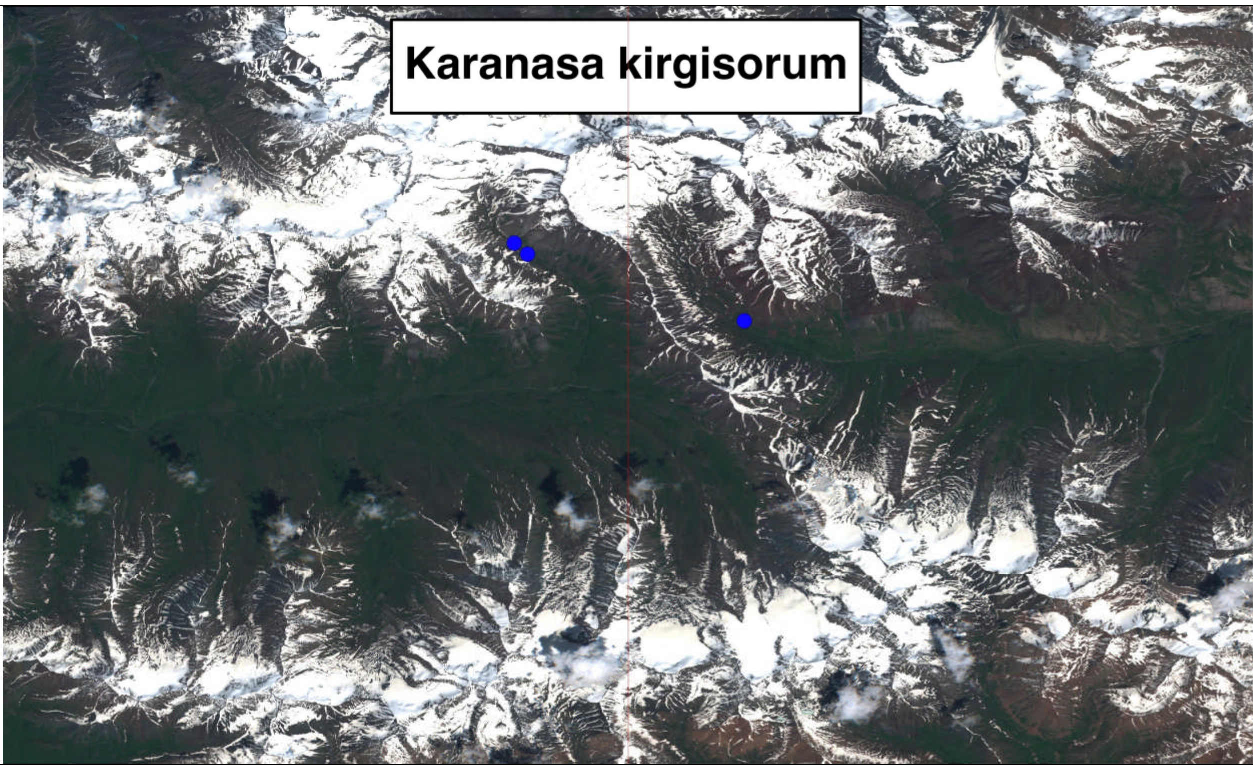


Erebia sokolovi			
Flight time	July to August	Elevation (m)	3,000-3,600
Habitat	Meadow slopes in subalpine and alpine areas		
Food plants	Poaceae (Grasses)		
Life cycle	N/A		

Photo courtesy of Peter Sporrer - 2015



Karanasa kirgisorum — NCN			
Flight time	July to August	Elevation (m)	3,000 – 3,400
Habitat	Steppe slopes and old scree slopes		
Food plants	Poaceae (Grasses)		
Life cycle	N/A		



3.4. Discussion and conclusions

The region studied is alpine in elevation, but there are limits to the elevation at which many butterflies can live. This can be due to a variety of environmental factors such as temperature or host plant availability. A simple analysis was carried out using GIS software to determine the species composition of butterflies living above 3,500 m, an elevation chosen as an approximate halfway mark between the lowest and highest elevation points along the surveys. Of the 26 different species encountered from 2015 - 2017, 14 were found at elevations above 3,500 m.

In 2015 there were nine sightings of seven different species above 3,500 m: *P. tianschanicus* (3 individuals), *P. machaon, C. erate, B. generator, P. callidice, A. urticae,* and *C. erubescens,* each with 1 individual.

2016 saw ten sightings of three different species above 3,500 m: *P. delphius* (5), *P. tianschanicus* (4), and *C. erate* (1).

In 2017 there were 35 sightings of twelve different species above 3,500 m: *P. callidice* (9), *B. generator* (6), *P. delphius* (5), *A. urticae* (5), *P. tianschanicus* (2), *C. caeca* (2), *C. erate, P. mnemosyne, E. mopsos, E. sokolovi, M. solona,* and *A aglaja* (each with 1).

This gives a total of 54 individual sightings of butterflies above 3,500 m from 2015-2017. Using information from various sources, elevation profiles for each species (described above) were used to determine if a species was "alpine" or not. An elevation of 3,500 m was used again for consistency. Any species with an elevation range above 3,500 m was considered alpine. Any species with a range of 3,500 m and below was not considered alpine. Table 3.4a details the alpine species.

Table 3.4a. List of alpine butterflies based on their elevation profiles.

Species	Elevation (in m)
Aglais urticae	up to 4,000
Argynnis aglaja	up to 4,200
Aricia agestis	1,700-3,800
Boloria generator	2,500-4,500
Clossiana erubescens	2,000-3,600
Colias cocandica	3,000-4,500
Erebia sokolovi	3,000-3,600
Melitaea solona	2,700-4,000
Papilio machaon	up to 4,000
Parnassius delphius	3,000-4,000
Pontia callidice	2,000-4,500
Pontia daplidice	500-4,000

Although the sample size is rather small (only 18% of the total number of sightings), we can expect that a significant majority of individuals found above 3,500 m would belong to one of the alpine species. The data show that over the course of the three years of research, 72% of all butterfly individuals collected above 3,500 m are in fact alpine species. This means that 28% of individuals found above 3,500 m are outside their established elevation ranges, suggesting that high alpine habitat is becoming favourable to these species. It is hypothesised that further study will show the %age of non-alpine butterflies found above 3,500m continuing to grow over time as a consequence of climate changes in the alpine environment, most specifically the establishment of host plant populations at higher elevations due to receding glaciers and more favourable growing conditions. Using this model, these two butterfly groups (alpine vs. non-alpine) can be used as indicators of broad changes in the alpine environment due to climate change.

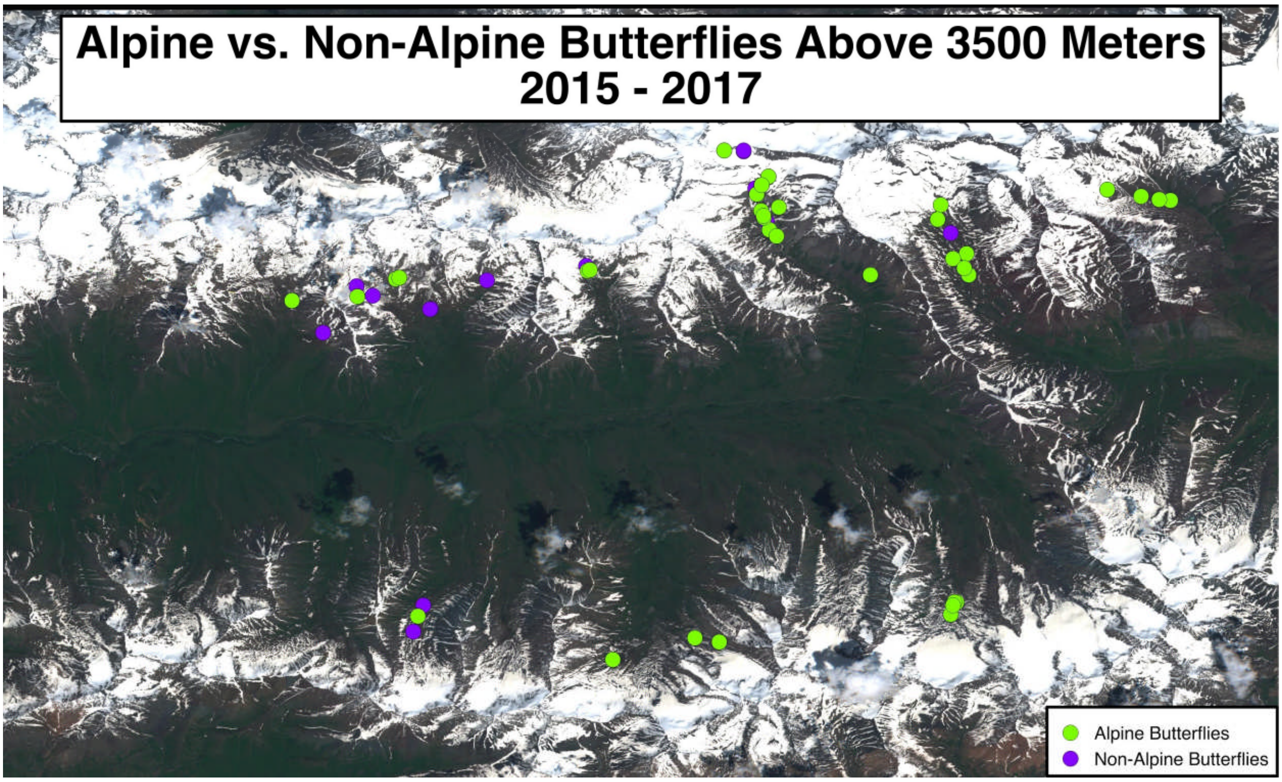


Figure 3.4a. Alpine vs. non-Alpine butterflies above 3,500 m.

Recommendations for the 2018 expedition

The 2018 expedition should continue using “Lapis Guides” to collect data. This worked well in 2017, and with continued improvement to the app, it should work even better in 2018.

The author will continue to conduct training of participants and staff during each expedition group as it is believed that the clearer understanding by expedition participants of the sub-project of collecting information on the observations of butterflies increased the number of sightings in 2017.

Continued testing of the hypothesis that the %age of alpine butterfly individuals above 3,500 m will continue to drop as high alpine habitat becomes more favourable to non alpine butterflies as a result of climate change. This can be done using the smartphone application mentioned above in conjunction with GIS software.
Further research to determine specific habitat locations for *Parnassius delphius* and *Pontia callidice* (two alpine species found in high numbers) within these high alpine elevations. This could include host plant data collection to be cross-referenced with NDVI satellite images for future GIS modelling. An attempt to do this was made in 2017, but the ability of citizen scientists to identify correctly host plants in the field was an issue. With better resources and training, it is hoped that better results can be obtained in 2018.

3.5. Literature used

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Appendix I: List of bird species recorded during the 2017 expedition.

Latin name	**English name**	**Русское название**	**RDB***
Acridotheres tristis	Common myna	Обыкновенная майна	
Actitis hypoleucos	Common sandpiper	Перевозчик	
Aegypius monachus	Cinereous vulture	Чёрный гриф	+
Alectoris chukar	Chukar	Азиатский кеклик	
Anas acuta	Northern pintail	Шилохвость	
Anthus trivialis	Tree pipit	Лесной конёк	
Apus apus	Common swift	Чёрный стриж	
Aquila chrysaetos	Golden eagle	Беркут	+
Buteo rufinus	Long-legged buzzard	Курганник	
Calliope pectoralis	Himalayan rubythroat	Черногрудая красношейка	
Carpodacus erythrinus	Common rosefinch	Обыкновенная чечевица	
Ciconia nigra	Black stork	Чёрный аист	+
Columba rupestris	Hill pigeon	Скалистый голубь	
Corvus corax	Raven	Ворон	
Corvus corone	Carrion crow	Черная ворона	
Coturnix coturnix	Common quail	Обыкновенный перепел	
Cuculus canorus	Common cuckoo	Обыкновенная кукушка	
Delichon urbicum	Northern house martin	Городская ласточка	
Eremophila alpestris	Horned lark	Рогатый жаворонок	
Falco subbuteo	Eurasian hobby	Чеглок	
Falco tinnunculus	Common kestrel	Обыкновенная пустельга	
Gypaetus barbatus	Bearded vulture	Бородач	+
Gyps fulvus (?)	Eurasian griffon	Белоголовый сип	+
Gyps himalayensis	Himalayan griffon	Кумай	+
Hirundo rustica	Barn swallow	Деревенская ласточка	
Lanius phoenicuroides	Turkestan shrike	Туркестанский жулан	
Leucosticte brandti	Brandt's mountain finch	Жемчужный вьюрок	
Leucosticte nemoricola	Plain mountain finch	Гималайский вьюрок	
Monticola saxatilis	Rock thrush	Пестрый каменный дрозд	
Monticola solitarius	Blue rock thrush	Синий каменный дрозд	
Montifringilla nivalis	White-winged snowfinch	Снежный вьюрок	
Motacilla alba	White wagtail	Белая трясогузка	
Motacilla cinerea	Grey wagtail	Горная трясогу́зка	
Motacilla citreola	Citrine wagtail	Желтоголовая трясогузка	
Oenanthe isabellina	Isabelline wheatear	Ка́менка-плясунья	
Oenanthe oenanthe	Northern wheatear	Обыкновенная каменка	
Passer montanus	Eurasian tree sparrow	Полевой воробей	
Pastor roseus	Rosy starling	Розовый скворец	

Phoenicurus erythrogaster	Guldenstadt's redstart	Краснобрюхая горихвостка	
Phoenicurus ochruros	Black redstart	Горихвостка-чернушка	
Pica pica	Magpie	Сорока	
Podiceps sp.	Grebe sp.	Поганка	
Prunella collaris	Alpine accentor	Альпийская завирушка	
Prunella himalayana	Altai accentor	Гималайская завирушка	
Pyrrhocorax graculus	Yellow-billed chough	Альпийская галка	
Pyrrhocorax pyrrhocorax	Red-billed chough	Клушица	
Saxicola torquata	Stonechat	Черноголовый чекан	
Sturnus vulgaris	Common starling	Обыкновенный скворец	
Tachymarptis melba	Alpine swift	Белобрюхий стриж	
Tadorna ferruginea	Ruddy shelduck	Огарь	
Tetraogallus himalayensis	Himalayan snowcock	Гималайский улар	
Tichodroma muraria	Wall creeper	Стенолаз	
Upupa epops	Hoopoe	Удод	

* Red Data Book of the Kyrgyz Republic (Шукуров Э.Дж. (гл. ред.) Кыргыз Республикасынын Кызыл китеби / Красная книга Кыргызской Республики 2-е изд. Бишкек: 2006. – 544 стр. – Текст на кырг., рус., англ. яз.).

Appendix II: Field interview datasheet as used by the expedition

FIELD DATASHEET: INTERVIEWS

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. Emphasise 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	
Place of residence (name of community)		Place of birth (region)	
Occupation		Sex	

	Sheep	Goats	Cows	Horses	Other
If you work with livestock, what kind of animals and how many? (many is optional)					

INFORMATION ABOUT SNOW LEOPARDS

I would like to ask you some questions about snow leopards	YES, seen a snow leopard (ask question A below)	YES, seen signs of a snow leopard (ask question B below)	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

Question A: If you saw a snow leopard, can you tell me about that please.	When did you see it?	Where did you see it?	What was it doing?	How do you feel about having seen a snow leopard? Excited	Not excited

Question B: If you saw signs of a snow leopard, such as tracks in the snow for example (but not an actual snow leopard)	What did you see?	When did you see it?	Where did you see this?	How do you feel about having seen sign of a snow leopard? Excited	Not excited

What impact do you think the presence of snow leopards has on the area	Beneficial	Detrimental	In your view are they good or bad for the country?	Good	Bad

Can you tell me a little more about the impact that snow leopards have on Kyrgyzstan?	
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

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 more frequent in places where snow leopards live near people?	Yes	No	Don't know

How many snow leopards are there in Kyrgyzstan?	Enter estimate	Don't know

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

Do snow leopards reduce the number of <u>large game animals</u> 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?	

Do snow leopards reduce the number of <u>small animals</u> such as marmots and snowcock in the area?

Yes	No	Don't know

If yes, how do snow leopards reduce the numbers of small animals?	

If no, why do you think snow leopards do not reduce the number of small animals?	

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

If snow leopards attracted more tourists to this region, would this be a good thing or a bad thing?

Good	Bad	Don't know

What are your thoughts about how snow leopards might influence tourism?	

ADDITIONAL COMMENTS

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://blog.biosphere-expeditions.org/category/expedition-blogs/tien-shan-2017/

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