PROJECT REPORT

Expedition dates: 2 – 15 February 2014

Report published: January 2015

True white wilderness: tracking lynx, wolf and bear in the Carpathian mountains of Slovakia

Cover image (c) Tomas Hulik

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Matthias Hammer (editor)
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Abstract

There are indications that bear, wolf and lynx population numbers in the Slovak Republic as published by official sources, and based on counts by hunters, may be unreliable. As harvesting quotas for bears and wolves are based on these estimates, they have a very significant conservation impact.

With the aim of collecting biological information to improve management practices for bears (*Ursus arctos*), wolves (*Canis lupus*) and lynx (*Lynx lynx*), fieldwork was conducted in Veľká Fatra National Park and concentrated on the Ľubochnianska valley in northern Slovakia from 2 February to 15 February 2014. The study was a collaboration between the organisations Biosphere Expeditions and Protection of Carpathian Wilderness.

During this expedition, 36 transects were surveyed, with a total length of 548 km (the best result in three years). The average length of a transect was 15 km. The sampled area was divided into 29 cells of 2.5 x 2.5 km size, 22 of which had species recorded in them. In total, 133 tracks and snow-tracked trails were recorded, of which 27 were identified as being left by lynx (20%), 50 by wolf (38%), 50 by bear (38%) and 6 by wildcat (*Felis silvestris*) (4%).

Ten camera traps were placed in the study area in 12 different locations and 660 photos were taken. All target species, the lynx, wolf and bear, were recorded. Fox (*Vulpes vulpes*), marten (*Martes martes*), badger (*Meles meles*), red deer (*Cervus elaphus*) and roe deer (*Capreolus capreolus*) were also photographed.

Twenty-one samples (scat and urine) were collected for DNA analysis. Three samples (14%) were assumed, from tracks, to be from lynx, 5 samples (24%) were assumed to be from bear and 13 samples (62%) were assumed to be from wolf. All are awaiting DNA analysis, which will identify species and individuals. Samples assumed to be from bear were given to the State Forestry Centre to aid their research into bear populations in Slovakia.

The expedition was record-breaking because of the length of monitored transects, as well as the amount of tracks and track paths of target species recorded. In comparison with previous years (2012 and 2013), during which fieldwork took place in both Veľká Fatra and Malá Fatra national parks, there was a surprising increase in the findings of bear track paths, but also of wolf and wildcat track paths. In 2012 and 2013, the amount of tracks and track paths of wolves was half (25 and 20 findings) that of 2014. The difference is even more obvious for bears: 9 tracks and track paths in 2012 and no trace in 2013, while there were 50 findings in 2014. It seems that a very warm winter without snow in 2014 caused the bears to miss their usual winter hibernation. They appear to have been able to find enough food in the woods. The warm winter also changed the usual concentration of hoofed animal in valleys, enabling them to stay at higher elevations. This could have led to the increased presence of wolves, since they had to forage in a bigger area. Temperature changes and mild winters, most likely due to climate change, are therefore undoubtedly having an effect on the large carnivore ecosystem in Slovakia.

Súhrn

Existujú náznaky, že odhady početnosti populácie medveďa, vlka a rysa na Slovensku, vydávané oficiálnymi zdrojmi na základe údajov ščítania zvery poľovníkmi môžu byť nespoľahlivé. To môže mať vážne dôsledky v rámci ochrany veľkých šeliem, pretože kvóty na odstrel medveďov a vlkov sú založené na týchto odhadoch.

Terénny monitoring s cieľom získať biologické informácie a prispieť k zlepšeniu menežmentových opatrení veľkých šeliem ako medveď, vlk a rys, bol uskutočnený v Národnom parku Veľká Fatra. Sústredil sa na Ľubochniansku dolinu na severnom Slovensku v období od 2. februára do 15. februára 2014 ako spolupráca medzi organizáciami Biosphere Expeditions a Ochrana karpatskej divočiny.

Počas terénneho výskumu bolo monitorovaných 36 transektov v celkovej dľžke 547,6 km, čo bol najlepší výsledok za tri roky. Priemerná dĺžka transektu bola 15,19 km. Záujmové územie bolo rozdelené na 29 kvadrantov veľkosti 2,5 x 2,5 km, v 22 kvadrantoch sa zaznamenali záujmové druhy veľkých šeliem. Identifikovaných bolo 133 nálezov stôp a stopových dráh záujmových druhov: 27 patrilo rysovi ostrovidovi (*Lynx lynx*) (20,3%), 50 vlkovi dravému (37,6%), 50 medveďovi hnedému (37,6%) a 6 stopových dráh patrilo mačke divej (4,5%).

V záujmovom území boli na 12 miestach nainštalované fotopasce, ktoré zaznamenali 660 fotografií. Na fotopasci č.3 sa podarilo zachytiť tri fotografie rysa ostrovida(Lynx lynx). Fotopasce zaznamenali aj vlka dravého (*Canis lupus*) na fotopasci č.3 a č.7 a medveďa hnedého (*Ursus arctos*) na fotopasci 4. umiestnenej pri kadáveri jelenice strhnutej vlkmi. Ďaľšie záznamy z fotopascí zachytili líšku hrdzavú (*Vulpes vulpes*), kunu lesnú (*Martes martes*), jazveca (*Meles meles*), jeleňa lesného (*Cervus elaphus*), srnca hôrneho (*Capreolus capreolus*).

Nájdených bolo 21 vzoriek na DNA analýzu (11x trus, 10x moč). 3 vzorky (14,3%) patrili rysovi ostrovidovi (*Lynx lynx*) (určené na základe stôp pri vzorke), 5 vzoriek (23,8%) pochádzalo od medveďa hnedého a 13 vzoriek (61,9%) bol vlk dravý (*Canis lupus*). Vzorky zatiaľ čakajú na DNA analýzu, ktorá by mala identifikovať jednotlivé individuá. Vzorky DNA medveďa hnedého boli poskytnuté Národnému lesníckemu centru na ďalšie spracovanie v rámci ich monitoringu populácie medveďa hnedého na Slovensku

Rok 2014 bol rekordný nielen dĺžkou zmonitorovaných transektov, ale aj počtom nájdených stôp a stopových dráh záujmových druhov zvierat ako rys ostrovid (*Lynx lynx*), vlk dravý (*Canis lupus*), medveď hnedý (*Ursus arctos*) a mačky divej (*Felis sivestris*). V provnaní s predchádzajúcimi rokmi 2012 a 2013, počas ktorých sa konal terénny výskum na území Veľkej a Malej Fatry je veľmi prekvapujúci nárast nálezov stopových dráh medveďa hnedého, ale aj vlka dravého či mačky divej. Kým v roku 2012 a 2013 bola prezencia nálezov stôp a stopových dráh u vlkov polovičná (25 a 20 nálezov) ako v roku 2014 u medveďa je tento rozdiel ešte markantnejší: 9 stôp a stopových dráh v roku 2012 a žiadna v roku 2013 k 50 nálezom v roku 2014. Zdá sa, že veľmi teplá zima bez snehovej pokrývky v roku 2014 zapríčinila, že sa medvede neodobrali na zimnú hibernáciu a v lese nachádzali stále dostatok potravy. Raticová zver sa neskoncentrovala a nestiahla sa do dolín, tak ako to býva zvykom počas zimných mesiacov, ale ostávala na svojich stanovištiach aj vo vyšších polohách, čo mohlo mať za následok zvýšený nález prezencie vlka dravého, keďže v rámci zaobstarávania potravy musel loviť na väčšom území. Klimatické zmeny sa začínajú nepochybne prejavovať aj v rámci ekosystému veľkých šeliem na Slovensku.

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 section, which remains valid and relevant, is 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 Carpathian Mountains of Slovakia (Veľká Fatra National Park) that ran from 2 to 14 February 2014 with the aim of conducting conservation research work on lynx, wolves, bears and wildcats, as well as their interrelationships with prey species.

With rising numbers of wolves, lynx and bears in Slovakia since the second half of the 20th century, conflicts with local people have come to public attention. Negative aspects of their presence often make news headlines, promoting a heightened sense of fear. Wolves sometimes cause considerable losses to livestock, particularly sheep, and hunters think they will wipe out game stocks. Such conflicts often lead to calls for culling, which is the approach that almost eradicated carnivores from Slovakia in the past. The concurrent emergence of new threats to wildlife and habitats presented by economic development means that a more sensitive approach is required, one based on a sound understanding of the place of carnivores in ecosystems, but also considering their impact on local people. As very little modern scientific work has been done on large carnivores in Slovakia, there is much to be done in order to achieve these goals.

1.2. Research area

The Carpathians are a range of mountains forming an arc roughly 1,500 km long across Central and Eastern Europe. They stretch in an arc from the Czech Republic (3% of their range) in the northwest through Slovakia (17%), Poland (10%), Hungary (4%) and Ukraine (11%) to Romania (53%) in the east and on to the River Danube between Romania and Serbia (2%) in the south.

The Western Carpathian Mountains cover much of northern Slovakia, and spread into the Czech Republic with Moravia to the east and southern Poland to the north. They are home to many rare and endemic species of flora and fauna, as well as being a notable staging post for a very large number of migrating birds.

The expedition's study area was the Veľká Fatra National Park. The Bradt Travel Guide has this to say about the park: "The gorgeous Veľká Fatra National Park is a vast 403 square kilometre area of unspoilt, undiscovered natural beauty, and you can walk all day in peace and solitude, feeling like the first explorer to set foot in a beautiful, flower-filled mountain meadow. Most of the area is covered by beech and fir forests, in some places by spruce and pines. The area around Harmanec is the richest yew tree region in Europe."

Figure 1.2a. Flag and location of Slovakia and study area. An overview of Biosphere Expeditions' research sites, assembly points, base camp and office locations is at Google Maps.

The national park and its buffer zone comprise most of the Veľká Fatra range, which is part of the Outer Western Carpathians. The national park was declared on 1 April 2002 as an upgrade from the Protected Landscape Area of the same name established in 1972. The park protects a mountain range with a high percentage of well-preserved Carpathian forests. Ridge-top cattle pastures date back to the 15th century, to the times of the so-called Walachian colonisation. The Veľká Fatra National Park is also an important reservoir of fresh water thanks to high rainfalls and low evaporation in the area. The core of the range is built of granite, which reaches the surface only in places. More common are various slates, creating gentle ridges and summits of the so-called Hôlna Fatra, and limestone and dolomite rocks, creating a rough and picturesque terrain of the so-called Bralná Fatra. There are also many karst features, namely caves. Various rocks and therefore various soils, and diverse types of terrain with gentle upland meadows and pastures, sharp cliffs and deep valleys provide for an extremely rich flora and fauna. All species of large Central European carnivores live abundantly there: brown bear, grey wolf and Eurasian lynx. The UNESCO World Heritage village of Vlkolínec with well-preserved log cabins lies near.

1.3. Dates

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

2 – 8 February | 9 – 15 February 2014

Team members could join for multiple slots (within the periods specified). Dates were chosen to coincide with the best chance for snow cover for tracking purposes.

1.4. Local conditions & support

Expedition base

The expedition team was based in the village of Švošov. During the heydays of the Austro-Hungarian Empire, the area was a popular spa holiday destination, because of its beautiful mountain setting and the presence of hot mineral springs. The team stayed in a comfortable chalet (Chata Dolinka) with all modern amenities. Team members shared twin or double or triple rooms, some with en-suite showers and toilets; breakfast and dinner were provided at base and a lunch pack was supplied for each day spent in the field.

Weather

The weather during the expedition was exceptionally warm and more autumn-like than winter-like with no permanent snow cover (see Appendix I, Table 1).

Field communications

There was mobile phone coverage in Švošov, but there was very little mobile phone coverage in the national park study site. There were hand-held radios for groups working close together. The villa base had WiFi internet. The expedition leader posted a diary with multimedia content on Wordpress and excerpts of this were mirrored on Biosphere Expeditions' social media sites such as Facebook and Google+.

Transport & vehicles

Team members made their own way to Bratislava or Kraľovany. From there onwards and back to Bratislava all transport was provided for the expedition team. Courtesy of Land Rover, the expedition had the use of one Range Rover Evoque and two Land Rover Discovery throughout.

Medical support and incidences

The expedition leader was a trained first aider and the expedition carried a comprehensive medical kit. Further medical support was provided via a network of mountain rescue stations. The nearest hospital was in the nearby town of Ružomberok (30 km from base). In case of immediate need of hospitalisation, and weather permitting, helicopters of the mountain rescue service were also available. Safety and emergency procedures were in place, but did not have to be invoked, as there were no medical or other emergency incidences during the expedition.

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

1.5. Local scientist

Tomas Hulik is a wildlife film maker, photographer and environmentalist. He graduated from the Faculty of Natural Sciences at the University of Komensky, Environmental Department in Bratislava. He has participated in scientific and photographic expeditions to the Far East of Russia, to the island of Sakhalin, as well as to Borneo and Malaysia. Alongside his work as a biologist, he also works in environments such as a television, either as a cameraman or as a producer. His films "Hulik and the beavers", "High Tatras – wilderness frozen in time" and "Miloš and the lynxes" were distributed worldwide. His last project, "Miloš and the lynxes", has brought him back to science. He is now working on the conservation of lynx and other big predators and trying to establish the size of lynx and wolf territories, as well as the ecology of these carnivores, in the Veľká Fatra and Malá Fatra national parks.

1.6. Expedition leader

The expedition was led by Peter Schütte, who was born in Germany. He studied geography and cartography at the University of Bremen (Germany) and Göteborg universitet (Sweden) and geoinformatics in Salzburg (Austria). He has worked on several mapping and remote sensing projects all over the world. In 2004 and 2005 Peter was involved in wildlife conservation projects in Namibia, where he joined Biosphere Expeditions as a member of the team of local scientists and was promptly bitten by the wildlife expeditions bug. He has travelled in Scandinavia, Iceland, Southern Africa, North America and Central Asia. Peter holds First Aid and Off-Road Driving certificates and has been to Namibia, Altai and Oman for Biosphere Expeditions.

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 (with country of residence):

2 – 8 February 2014

Jean-Baptiste Decotte (France), Jeroen & Noor den Hartog (The Netherlands), Nick Farandos (UK), Gabi Feldmann (Switzerland), Sonny Folliot (UK), Agnie Heriot (Australia), Louise Jones (UK), Katie Mather (UK), Helene Rebholz (Austria), Martyn Roberts (UK), David Skeet (UK), Linda Snodden (UK), Thomas Weber (journalist, Austria).

9 – 15 February 2014

Giles & Emily Andre (UK), Clemens Berger (journalist, Austria), Michael Brugger (Austria), Thomas Bührle (Germany), Angie Heriot (Australia), Jade Marquez (USA), Katie Mather (UK), Dieter Platzer (Land Rover, Austria), Ben Rees (UK), Elke Reibetanz (Germany), Kathryn Strang (New Zealand), Aly Wheatley (UK), Fiona Zeiner (Germany).

In addition for some or all of the time: Astrid Callomon (assistant expedition leader, UK) and Milos Majda (Slovakia).

1.8. Expedition budget

Each team member paid towards expedition costs a contribution of £1,180 per person per seven-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	21,524
Expenditure	
Expedition base includes all board & lodging, and extra food & meals	3,637
Transport includes car fuel UK–Slovakia return, car fuel during expedition, train rides	1,303
Equipment and hardware includes research materials & gear etc. purchased in UK & Slovakia	119
Staff includes local and Biosphere Expeditions staff salaries and travel expenses	4,392
Administration includes miscellaneous fees & sundries	208
Team recruitment Slovakia as estimated % of annual PR costs for Biosphere Expeditions	4,472
Income – Expenditure	**7,393**
Total percentage spent directly on project	**66%**

1.9. Acknowledgements

We are grateful to the volunteers, who not only dedicated their spare time to helping but also, through their expedition contributions, funded the research. Thank you also to the staff of the State Forestry Service and Veľká Fatra National Park in Martin, and to all those who provided assistance and information. Vehicles were loaned by Land Rover and optical equipment by Swarovski Optik. Biosphere Expeditions would also like to thank members of the Friends of Biosphere Expeditions and donors, Land Rover and Swarovski Optik for their sponsorship. Finally, thank you to František Pompáš for being such an excellent host and making us feel at home in his house.

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.

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2. Monitoring large carnivores in Ľubochnianska valley

Tomas Hulik
Protection of Carpathian Wilderness

Marcelo Mazzolli
Projeto Puma

M. Hammer (editor)
Biosphere Expeditions

2.1. Introduction

Populations of large predators have recovered during recent decades (Linnell et al. 1998), particularly in Eastern Europe, and this has brought predators in increasing contact with humans again. Conflicts with humans have thus increased, in the form of livestock depredation and fear of large predators in the vicinity of households. Brown bears, for instance, cause the greatest damage to livestock as well as to bee hives, orchards, crops, trees, and even vehicles and buildings (Huber 2013).

Slovakia has one of the most well-preserved populations of indigenous large carnivores in Europe, and even amongst the other Carpathian range countries. From an ecological point of view, the Carpathian arc can be considered a "model area" due to its relatively high percentage of intact forests. Typically, the Carpathian forests are inhabited by bears (*Ursus arctos*), wolves (*Canis lupus*), lynx (*Lynx lynx*) and wildcats (*Felis silvestris*), all of which are indigenous.

In spite of the relatively stable populations of these species, there is always a risk that management practices adopted to control population numbers may compromise their populations if harvesting quotas are based on inaccurate counts or estimates. The risk is obvious since target species have already declined in the past from overhunting. Sometimes specialists claim that the risk does not exist even though they recognise the inflated counts provided by official sources. According to Okarma et al. (2000) the brown bear, for instance, "cannot be considered a threatened species in Slovakia. Its numbers are the highest in the last 150 years, and only 8–10% of the population may be shot annually (47 bears were harvested in 2012 – about 5% of the specialist-based estimated population). The existing system of bear management as well as the favourable attitude of the public make the future of this species secure in the country." This information has been confirmed recently, with estimates of the total number of brown bears in Europe in the range of 17,000 individuals, with the largest population in the Carpathians (> 7,000 bears), mostly in Romania. Slovakia has a specialist-based estimated population of 800–1,100 individuals. In spite of that, the IUCN (International Union for Conservation of Nature) recognises the Carpathian population as Near Threatened. Populations elsewhere in Europe vary from Least Concern to Critically Endangered. Compensation for damages by bears are paid, varying greatly among countries; for example, Slovakia pays as compensation for bear damages a total of €16,000 per year on average (Huber 2013).

In Europe, wolves occur in all countries except in the Benelux countries, Denmark, Hungary and the island states (Ireland, Iceland, United Kingdom, Cyprus, Malta). The estimated total number of wolves in Europe seems to be larger than 10,000 individuals, with the largest populations occuring in the Carpathians and in the Dinaric-Balkan region (> 3,000 wolves). In Slovakia, however, specialist estimates of population numbers range from 200 to 400 individuals (Chapron 2013). Official estimates speak of 2,000 individuals, a fivefold difference from specialist estimates. Considering that the harvesting quota for the year 2012 was 130 individuals and 147 were taken, this could represent a 50% cut down in the Slovakia wolf population if specialist estimates are correct! The wolf is considered widespread over all the Carpathian range of Slovakia, but there is a threat from overhunting. Wolves are hunted and persecuted all over the country including in protected areas. Wolves and livestock are associated with conflicts over the whole of the species‘ range. The rough economic cost (based on reported compensation only) over the whole range of the wolves can be estimated at reaching over 8 million € per year, resulting from at least 20,000 domestic animals being predated. In Slovakia alone, around 16,000 € was the cost of damages in the year 2010 (Huber 2013).

Lynx are found in 23 countries and, based on a range of criteria, can be grouped into ten populations. Five are autochthonous (indigenous rather than descended from migrants or colonists), including the Carpathian population, while the others stem from reintroductions in the 1970s and 1980s (Dinaric, Alpine, Jura, Vosges-Palatinian and Bohemian-Bavarian populations), and from recent reintroductions, such as in the Harz Mountains of central Germany. The total number of lynx in Europe is estimated to be 9,000–10,000 individuals (excluding Russia & Belarus) (von Arx 2004). The largest and most widely distributed populations are found the Scandinavian region and vicinities. The Carpathians harbour around 2,300 individuals, and Slovakia about 400 individuals (von Arx 2004). All the reintroduced populations are of smaller size, with fewer than 200 individuals. The population of greatest conservation concern is the autochthonous Balkan lynx population, which numbers only 40–50 individuals (von Arx 2004). The lynx is, like the wolf, widespread over all the Carpathian range, but is considered to occur in smaller numbers. Specialists believe official population numbers in Slovakia overestimated the true population by as much as 50% during the 1990s (Okarma et al. 2000). The biggest threat to lynx populations is not derived from retaliation after livestock depredation, but from hunting (including illegal) to reduce an assumed impact on ungulates as game animals. This fact has been neglected, and no solution has been implemented towards reducing the problem. The IUCN recognises the Carpathian population as Least Concern. Populations elsewhere in Europe vary from Least Concern to Critically Endangered (von Arx 2004).

In this study a combination of snow-tracking and camera-trapping recording techniques were used to provide information on species presence, use of habitat and relative numbers. Samples such as hair and urine were collect for DNA analysis.

2.2. Study area

The Veľká Fatra National Park (see Fig. 2.2a) is situated between the geographic coordinates N 48°47'–49°09' and E 18°50'–19°18'. The national park belongs to the Inner Western Carpathian subprovince, the Fatransko-Tatranská region and the Veľká Fatra subregion. The mountain range is shaped in an irregular ellipse and stretches along a northeast–southwest pattern. The Veľká Fatra is about 40 km by 22 km in size.

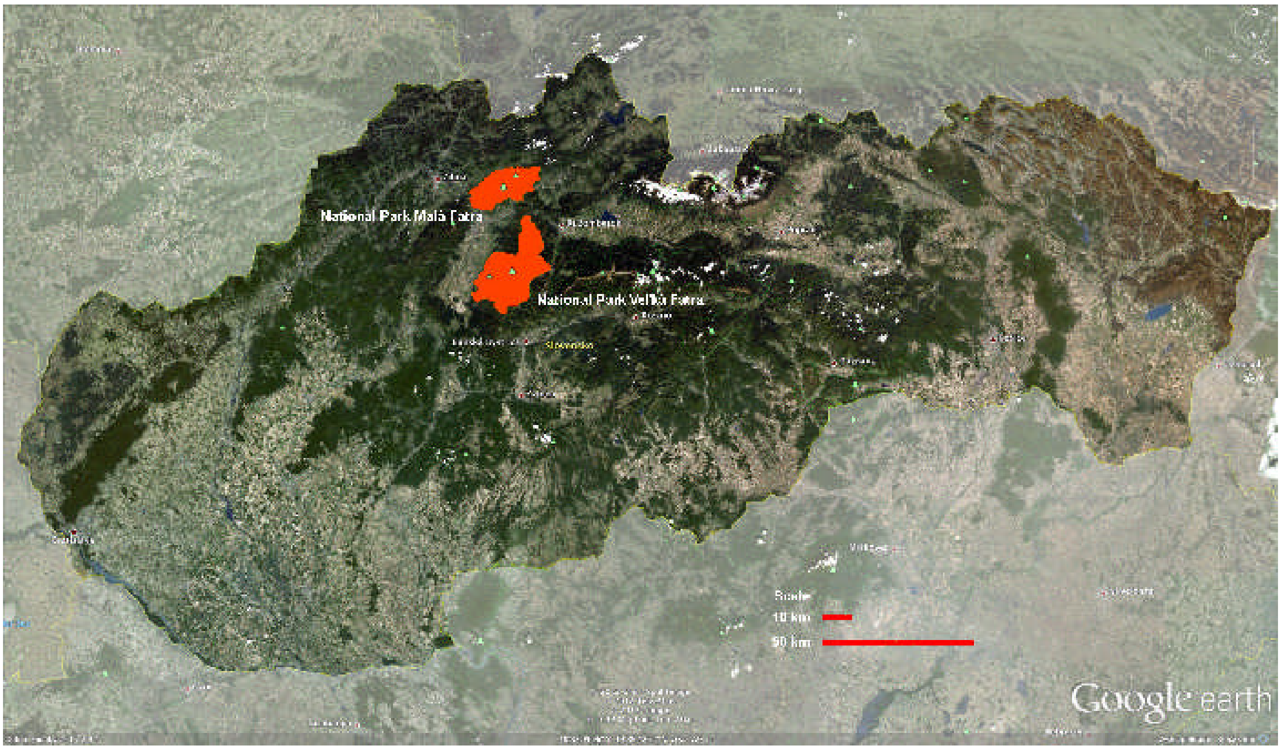

Figure 2.2a. The territory of Slovakia with National Park Malá Fatra and National Park Veľká Fatra in red.

The Veľká Fatra is one of the largest mountain areas of Slovakia. The natural environment is preserved without great anthropogenic impact. A granite core rises to the surface in the Smrekovica and Ľubochnianska valleys and other parts of the area consist mainly of Mesozoic sedimentary rocks. Streams have carved deep valleys into the Mesozoic crystalline rock, the longest valley being the Ľubochnianska. This valley divides the Veľká Fatra Park from south to north and flows to the centre of the Liptov and Turiec area (Vestenický and Vološčuk 1986). The park's lowest point is at the River Vah near Krpelianska dam (420 metres), and the highest peak is Ostredok (1,592 metres).

Factors including geological substrate, landforms, soil and climatic conditions facilitated the evolution of different plant species and communities. More than 1,000 species of vascular plants have been identified in the area (Vestenický and Vološčuk 1986). The Veľká Fatra has retained much of its natural character, especially in the forest communities, which make up about 90% of the land area. The area is a valuable example of the Carpathian type of forest community as there is a high occurrence of rare and endangered species. In the more remote areas, where there are negligible forest management activities, the true ancient primary forest habitat is preserved.

Veľká Fatra consists mainly of beech and spruce forests. Natural spruce forests can be found close to the treeline. The limestone and dolomite ground supports growth of Scots pine (*Pinus sylvestris*) and smaller oaks (*Quercus* spp.). In higher or exposed areas there are reduced-growth trees. Veľká Fatra is characterised by a high occurrence of yew trees (*Taxus baccata*), so much so that the species is on the emblem of the National Park.

The Veľká Fatra is dominated by native mountain animal species. So far over 3,000 species of invertebrates have been discovered including 932 types of butterflies and 350 spiders (Vestenický and Vološčuk 1986). The region is host to eight species of amphibians, including the very rare Carpathian newt (*Triturus montandoni*), seven species of reptiles, six species of fish, 110 species of birds and 60 species of mammals (Vestenický and Vološčuk 1986).

Common mammals include deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*), wild boar (*Sus scrofa*), hare (*Lepus europaeus*) and fox (*Vulpes vulpes*). Large carnivores include the brown bear (*Ursus arctos*), lynx (*Lynx lynx*), wolf (*Canis lupus*) and wildcat (*Felis silvestris*). Chamois (*Rupicapra rupicapra*) occur in the Veľká Fatra too, but are originally from the Alps. Bird species include the rare golden eagle (*Aquila chrysaetos*), capercaillie (*Tetrao urogallus*), black grouse (*Tetrao tetrix*), Alpine accentor (*Prunella collaris*) and wallcreeper (*Tichodroma muraria*).

The climate of Veľká Fatra is temperate/cold, typical of high mountain areas. The highest altitudes of the Veľká Fatra have an extremely cold climate. Precipitation is typically from 800 to 1,200 mm per year. The whole area is characterised by a wealth of surface and groundwater stores, mainly associated with the limestone rocks. Various sources are important for drinking water supplies, so much so that the Veľká Fatra region was declared a protected area of natural water accumulation in 1987.

Ľubochnianska Valley is the longest valley of Veľká Fatra. It contains the Ľubochnianka River and measures 25 km in length. It runs in a north–south direction starting at the village of Ľubochňa (district Ružomberok) and ending along the ridge of Ploská and Čierny kameň.

2.3. Materials and methods

Study design

Study design is one of the most important aspects of a study. Without a proper design, a study is composed of fragments of incoherent information, rather than a construction that allows ecological inferences about the environment and the populations under study.

Analyses of population densities (i.e. the number of individuals per area) are commonly the main issue of a research project, because density relates to the conservation status of a species or population.

Density estimates are, however, commonly and erroneously obtained from simple counts. Counts do not provide density estimates when the observer does not know the fraction of the total population he has counted. The only way to obtain that information is through capture-recapture statistics. This requires animals to be identified individually, either by trapping them or by recognising individuals from photographs, or by using the ‘distance’ procedure. The difference in the counts from the first to the subsequent recaptures gives the statistics necessary to estimate total population size.

However, the current report is not the forum to detail and compare methodological issues. What is of interest for this study is that estimating parameters related to density require something to go back to, to check if what was once seen or recorded is still there, in the same location, in similar frequencies, or found with the same effort as before. This is the basis for ecological inferences, or, as noted above, information will be lost.

Under the umbrella of this theory, short-term expeditions can collect useful information such as the locations where different species were found (and not found), and where they were found more or less frequently. Any combination of recording methods can be used to determine these parameters, be it snow-tracking, camera-trapping or DNA analysis (genotyping at species or individual level).

GPS waypoints (coordinates) are not convenient units to analyse large amounts of data related to the presence of species in certain locations. This is because it is difficult to go back to each individual waypoint to verify recurrence of a species or individual. Another issue is the estimation of track frequency and density during snow-tracking that usually does not take into account autocorrelation – no breaking points are usually established for track counts; that is, tracks are counted continuously, not at established intervals as they should. That is why a grid system is employed here. The size of the grid may vary according to the size of the geographical area. As a rule of thumb, the larger the area and the target species, the larger the grid cell. For example, the European Commission employed cells 10 x 10 km in size to verify the status and distribution for large carnivores on the entire European continent (Kaczensky et al. 2013), and some countries use reincidence of records in each cell to check if populations of species are increasing, declining, or stable.

Putting it simply, cells of a grid can be traced back (revisited) more easily than GPS waypoints, and in theory this is equivalent to a capture-recapture procedure employed for the estimation of population density. This idea was first proposed by MacKenzie et al. (2002), and for management purposes has since often been used as a substitute for population density, also allowing for monitoring of metapopulation dynamics involving local extinctions and recolonisations (MacKenzie et al. 2003).

Alternatively, but following the same reasoning of revisitation of a sampling location, Linnell et al. (2007), in their snow-tracking study of lynx, used over 360 transects crossed by individuals of the species to test indexes employing detection probabilities used in capture-recapture statistics. Instead of grids and cells, they used independent, short transects to detect if lynx were present or not on the transect during consecutive nights.

For this study, presence-absence identification of species using camera traps and track identification, as well as snow-tracking, were the main methods employed to record data. Samples of urine, scats, hairs or blood were also collected for future DNA analysis.

In order to receive standardised data, outputs and maps that could be easily compiled, we used the 10 x 10 km EEA grid system. We downsized the size of the grid to 2.5 x 2.5 km cells. This size is better suited to foot-based volunteer survey effort and is an ecologically more appropriate size to detect and differentiate the target species in the research area of Veľká and Malá Fatra (see Fig. 2.3a). Within this cell grid system, 36 transects were surveyed, with a total length of 548 km.

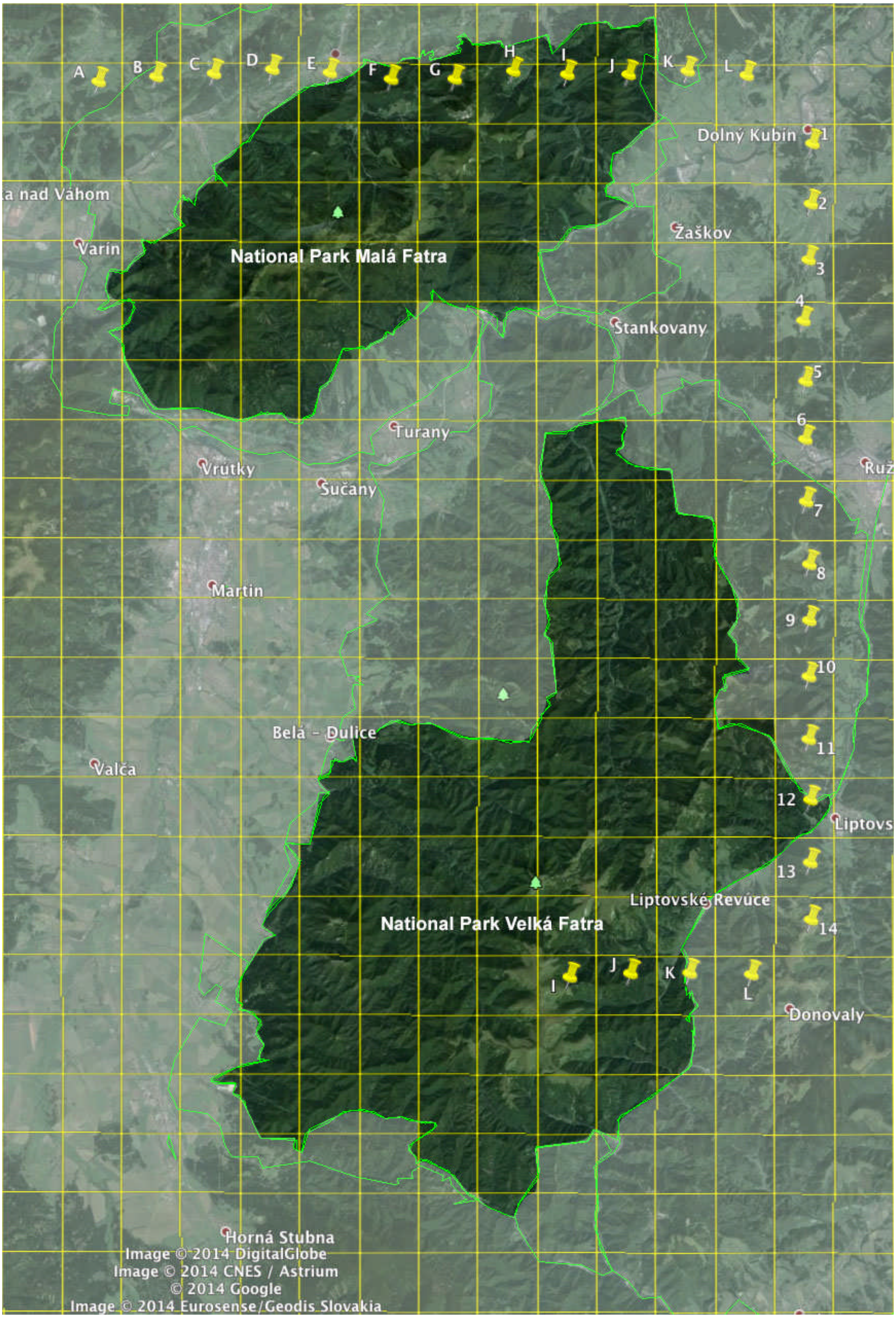

Figure 2.3a. Grid system over the areas of National Park Malá Fatra and National Park Veľká Fatra.

Training of volunteers

The first day of each group was dedicated to the training of volunteers, especially in the identification of signs, including footprints and their recognition/recording on various substrates. Volunteers received training for working with GPS devices and data collection protocols.

The second day of training focussed on identifying tracks and the practical implementation of these skills in the field. During these two training days, volunteers were also instructed in the use of snowshoes and other equipment along with the practical application of the GPS protocol directly in the field.

The following four days in each group were dedicated to field research. The volunteers were divided into four groups.

Each group of volunteers was given field guides, which showed tracks and photos of the target species, a ruler for precise measurements of length and width of footprints, research sheets for recording data, GPS devices (Garmin GPS 60), radios for communication between groups and a plastic box with bags and tubes containing alcohol for collecting samples from which DNA can be obtained (from urine, hair, faeces or blood).

Data recording

Data sheets were used by volunteers to record information, with the exact GPS position and cell number along with details such as species observed, number of individuals (in the case of a sighting), characteristics of tracks and trails left by species (length, width and estimated age of the track), the direction of movement of the individual and the substrate type (condition of snow cover). Route and track data were recorded into a GPS device using the tracklog and waypoint features and these were then backed up and consolidated onto a laptop.

Samples suitable for DNA analysis (excrement, urine, hair or blood) were collected in the field into a tube with concentrated 90% alcohol and sealed into a plastic bag. Great care was taken to avoid direct contact with the sample, as this would cause its contamination and degradation. The sample was then labelled and recorded. Samples were stored at -16°C in a special laboratory of the Slovak Academy of Sciences in Bratislava. DNA markers will be used according to Mestemacher (2006), Schmidt and Kowalczyk (2006) and Downey et al. (2007).

Eight camera traps (Cuddeback Capture IR, ScoutGuard SG 560) were placed in ten locations previously determined as having intensive species activity, such as marking sites or carcasses, following Laass (1999 and 2002).

Data analysis

In case of GPS signal loss due to vegetation or terrain, missing data points were obtained via Google Earth.

Locations where target species had been recorded were visualised in the grid system to check for distribution of populations and to see how different recording methods compared to each other. The frequency of tracks per cell and the number of times a species was recorded in a cell were considered indications of frequency of use of those cells by target species.

2.4. Results

During the expedition period 36 transects were surveyed, with a total length of 548 km, covering 29 cells of the grid system, and encompassing a surveyed area of 181 square kilometres. The average length of a transect was 15 km.

Tracking and snow-tracking allowed researchers to identify and follow lynx (*Lynx lynx*), wolf (*Canis lupus*) and bear (*Ursus arctos*) trails, obtaining information on their occurrence over a large area. Lynx trails were followed over 5.38 km, wolf trails over 5.04 km and bear trails over 2.07 km (details in Appendix I). A sixth record of a wildcat was also obtained. Camera traps also recorded red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*), red fox (*Vulpes vulpes*), grey wolf (*Canis lupus*), pine marten (*Martes martes*), brown bear (*Ursus arctos*), lynx (*Lynx lynx*) and badger (*Meles meles*) (photos and tables in Appendix I). Red deer was also recorded from a single carcass.

Twenty-one samples were collected (11 scats, 10 urine) for DNA analysis: 3 samples (14%) were confirmed, by tracks, to be from lynx, 13 samples (62%) from wolf and 5 samples from bear (24%).

Lynx, wolves, bears and wildcats shared records in only two cells (see first two rows of Table 2.4a). Lynx, wolves and bears shared records in another five cells. Lynx were recorded in 11 cells, wolves in 16 cells, bears in 17 cells and wildcat in 4 cells.

Table 2.4a. Cells in which lynx, wolves, bear and wildcat were recorded (matching cells for all species in blue; matching cells for lynx, wolf and bear in green).

Lynx	Wolf	Bear	Wildcat
I8	I8	I8	I8
I10	I10	I10	I10
I7	I7	I7	J10
J7	J7	J7	K9
I9	I9	I9	
J9	J9	J9	
K11	K11	K11	
J8	J8	K8	
J10	J10	I11	
K8	H2	H2	
I11	K10	K10	
	I12	I12	
	J11	J11	
	K9	K7	
	I2	J12	
	J6	K6	
		C5	

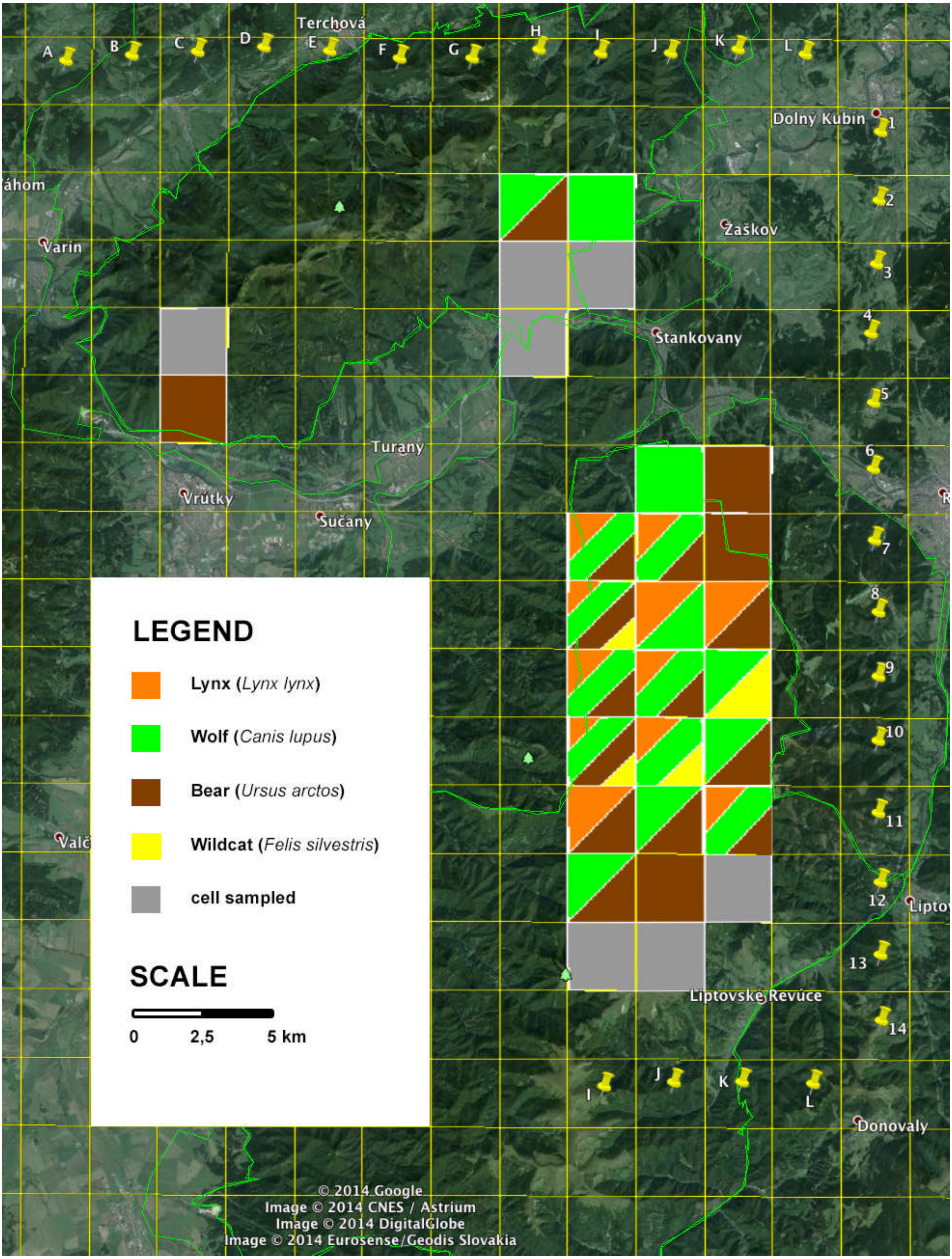

Figure 2.4a. Sampled cells (2.5 x 2.5 km in size) and results of occurrence of lynx, wolves, bears and wildcats per cell.

Lynx (*Lynx lynx*)

Lynx was recorded in 11 out of 29 cells, but only in National Park Veľká Fatra. Snow-tracking contributed to the recording of lynx in 11 cells, while camera-trapping recorded the species in only one cell. Prospective lynx samples were also collected, but can only be confirmed after genotyping/DNA analysis, which is still outstanding.

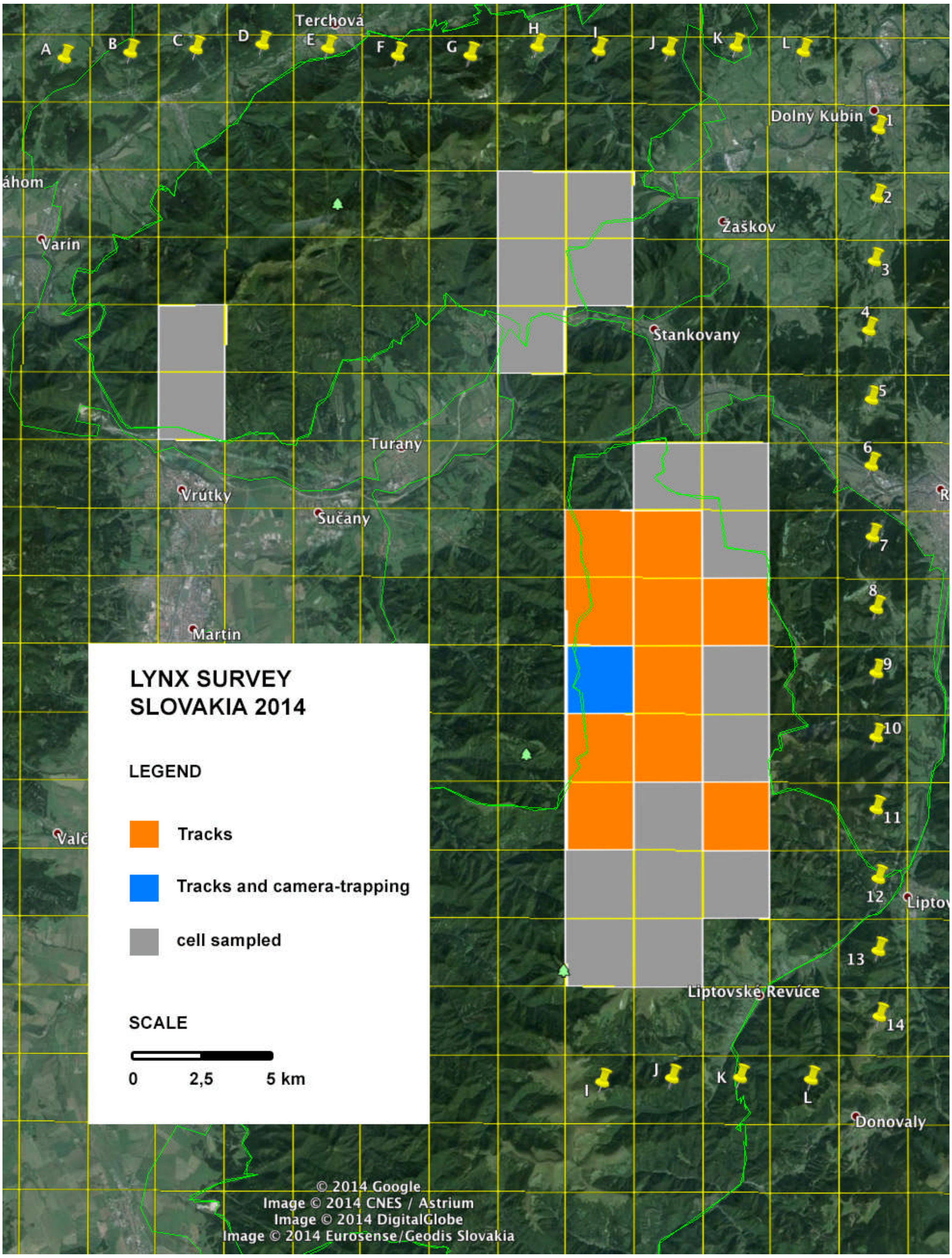

Figure 2.4b. Sampled cells (2.5 x 2.5 km in size) and results of occurrence of lynx per cell according to different recording methods.

Wolf (*Canis lupus*)

Wolves were recorded in both Veľká Fatra and Malá Fatra national parks. The species was recorded in 16 out of 29 cells surveyed. It is also worthwhile to note that snow-tracking contributed to the recording of wolves in 16 cells, while camera-trapping recorded wolves in only two cells. Prospective wolf samples were also collected, but await genotyping analysis.

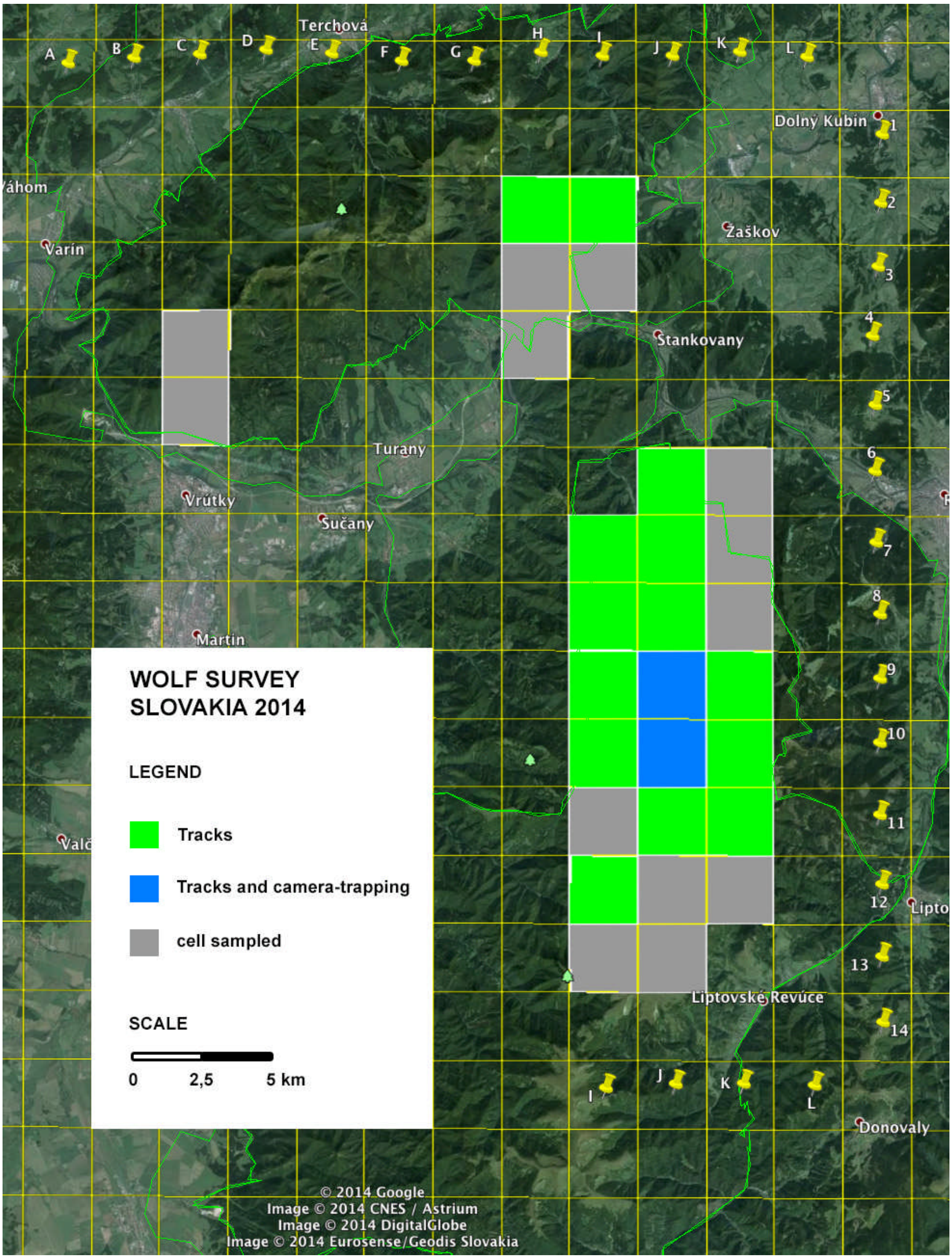

Figure 2.4c. Sampled cells (2.5 x 2.5 km in size) and results of occurrence of wolves per cell according to different recording methods.

Bear (*Ursus arctos*)

Bears were recorded in both Veľká Fatra and Malá Fatra national parks. The species was recorded in 16 out of 29 cells surveyed. Snow-tracking contributed to the recording of bears in 17 cells, while camera-trapping recorded bears in only one cell. Prospective bear samples were also collected, and given to the State Forestry Institute for genotyping analysis for their research about bear populations in Slovakia.

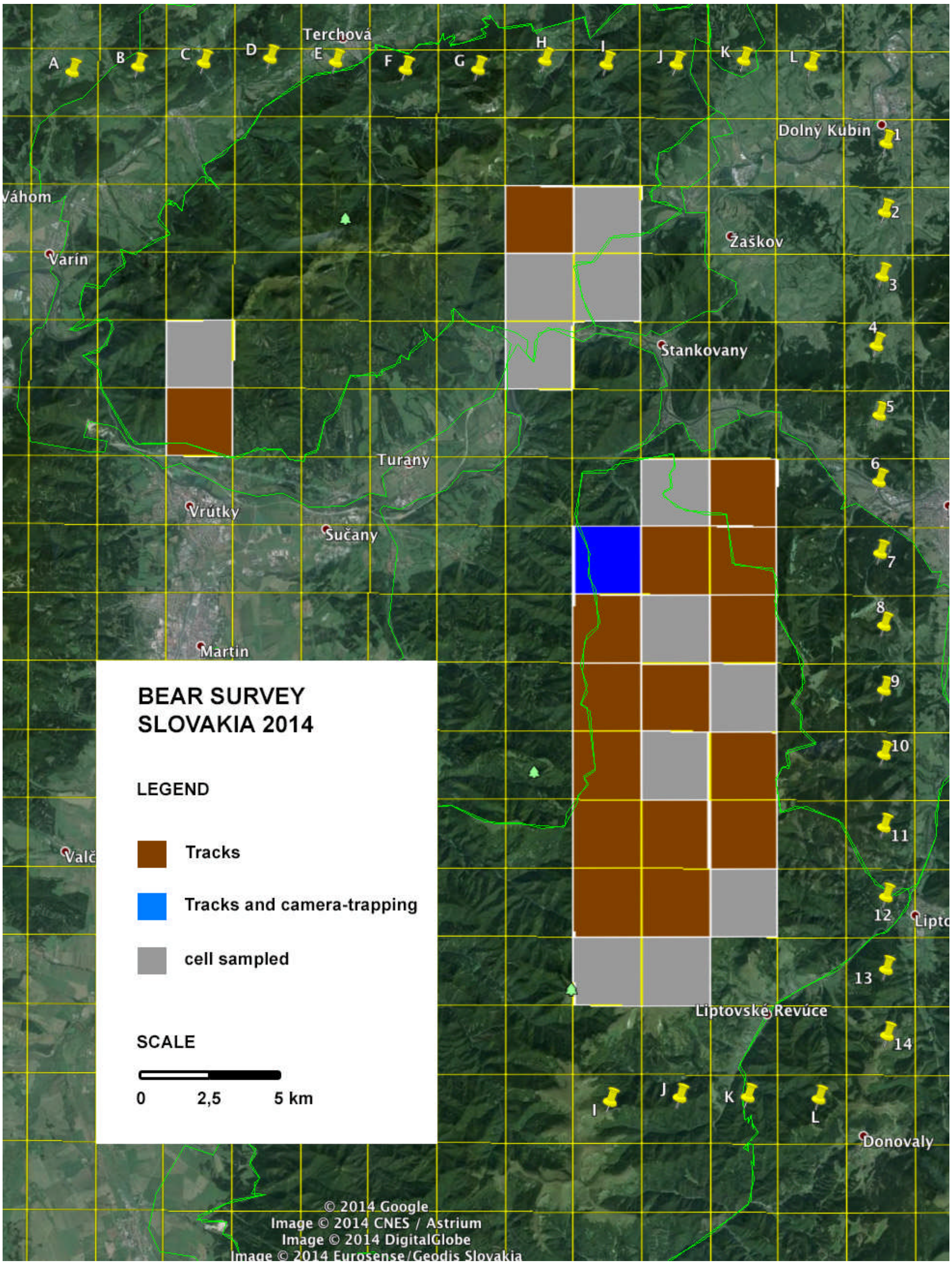

Figure 2.4d. Sampled cells (2.5 x 2.5 km in size) and results of occurrence of bears per cell according to different recording methods.

Wildcat (*Felis silvestris*)

This rare species was recorded by snow-tracking in 4 out of 29 cells, only in National Park Veľká Fatra.

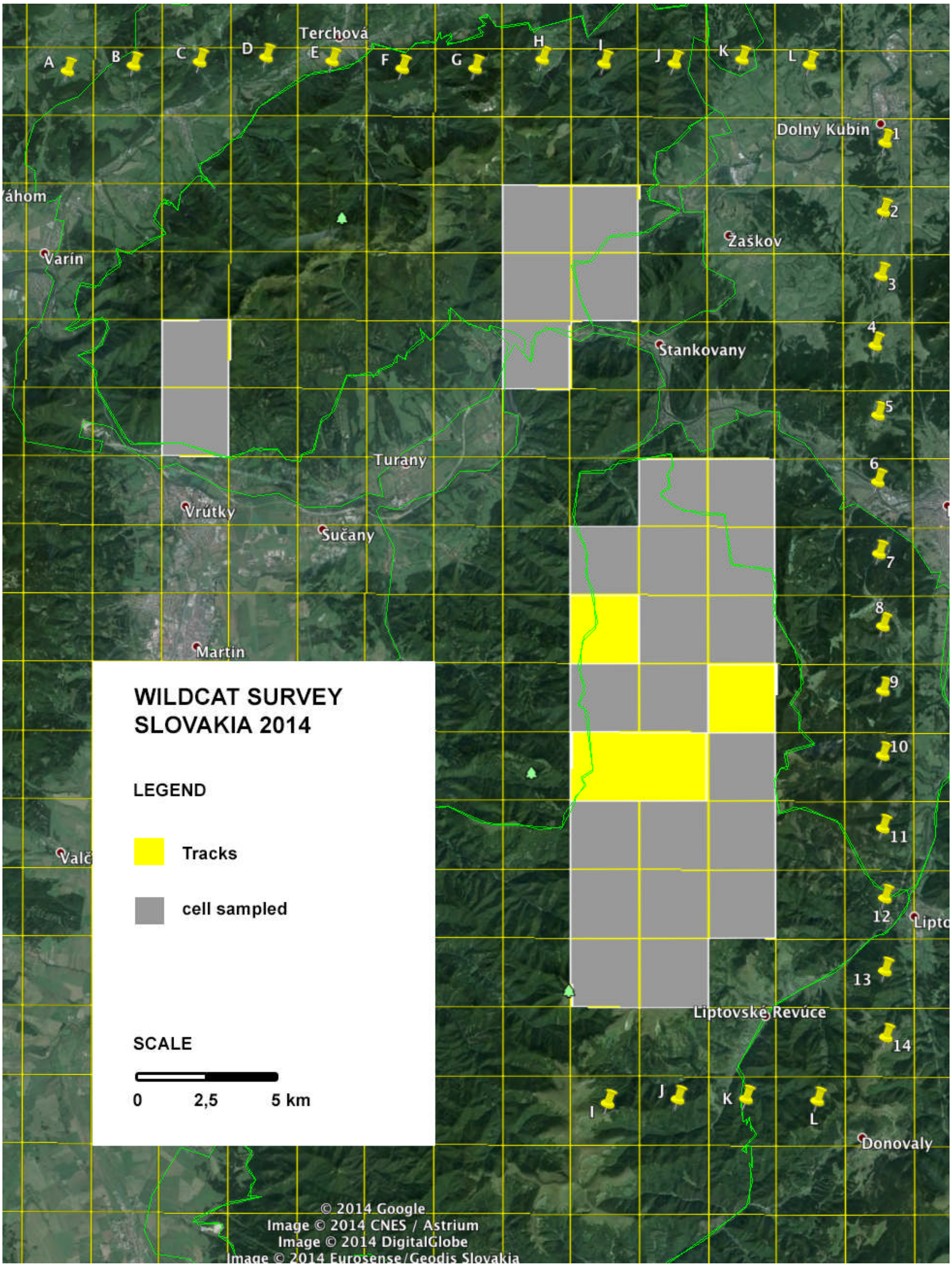

Figure 2.4e. Sampled cells (2.5 x 2.5 km in size) and results of occurrence of wildcats per cell.

Other carnivores

Recording carnivores other than the main target species is important in order to understand how they interact with target species, and may also give an indication of the quality of the ecosystem. Except for the golden eagle (*Aquila chrysaetos*, recorded from observations), otter (*Lutra lutra*, recorded by snow-tracking) and badger (*Meles meles*, recorded by finding a den and camera-trapping), all other species such as pine marten (*Martes martes*) and red fox (*Vulpes vulpes*) were recorded by camera traps. Golden eagle was the most recorded (n=5 cells) followed by otter (n=4 cells). Red foxes were recorded in three cells, and badger and pine marten in two cells each.

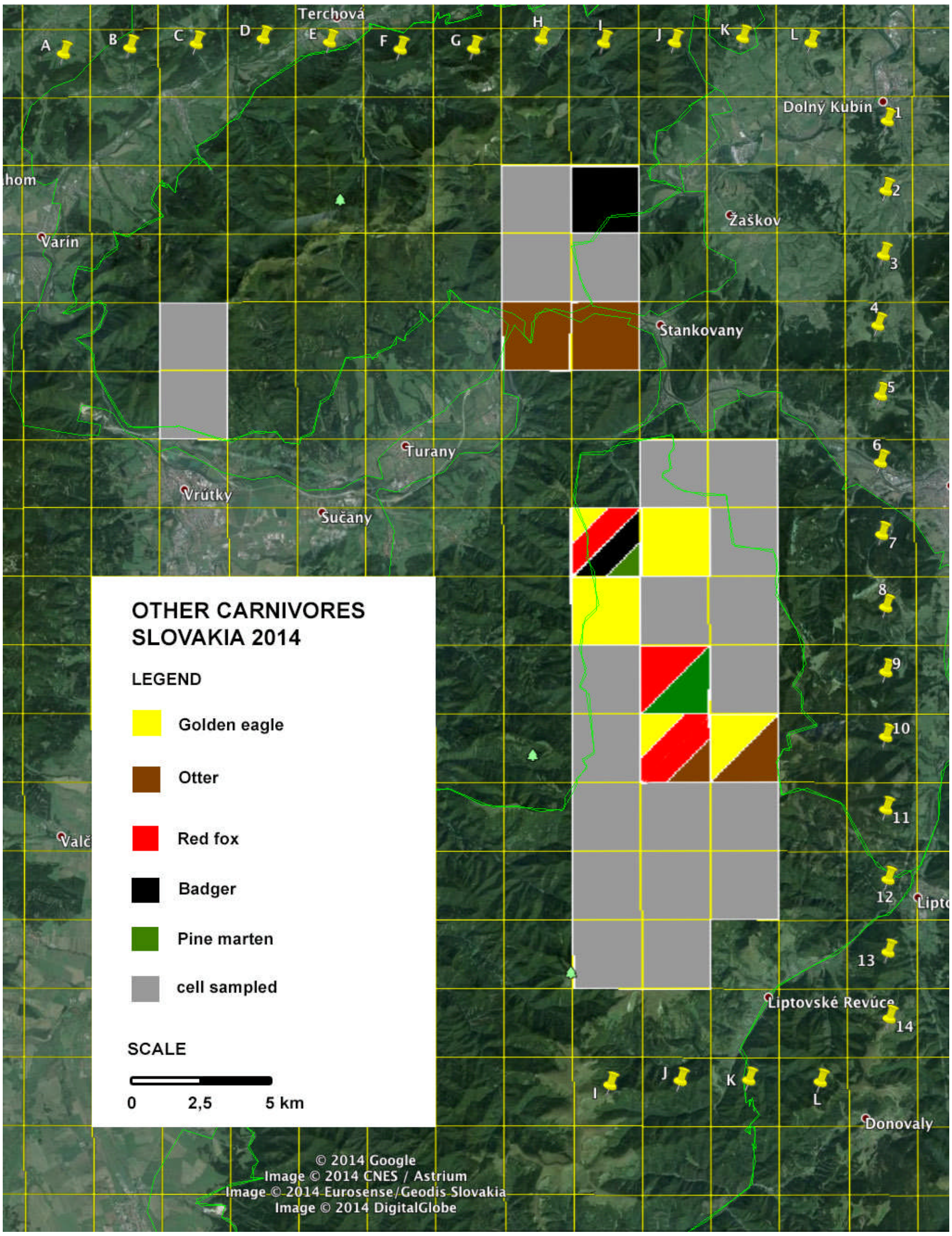

Figure 2.4f. Sampled cells (2.5 x 2.5 km in size) and results of carnivores other than the lynx, wolf, bear and wildcat per cell.

Ungulates: red deer (*Cervus elaphus*) and roe deer (*Capreolus capreolus*)

Red deer and roe deer are major prey species for carnivores, hence recording their presence is important. Red deer were recorded in twelve cells and roe deer in seven cells. Roe deer were recorded from observations, snow-tracking and from camera traps, while red deer were recorded from a carcass and their presence at feeding stations.

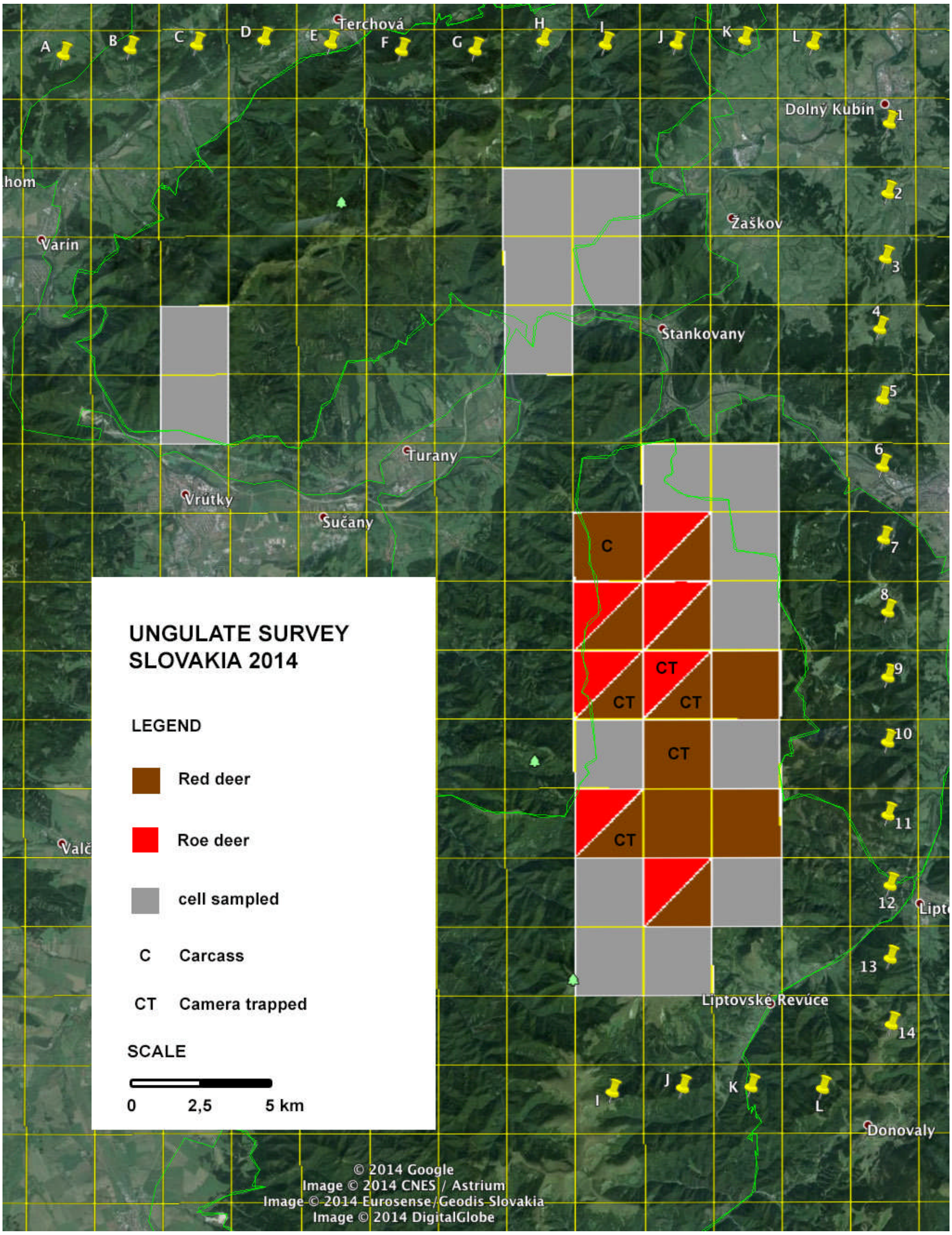

Figure 2.4g. Sampled cells (2.5 x 2.5 km in size) and results of occurrence of roe and red deer per cell according to different recording methods.

2.5. Discussion & conclusions

Recording of signs is probably the most commonly used method in monitoring large carnivores. Tracks, scats, marking points and any other signs of the presence of large carnivores are recorded on transects. Passive recording of signs is the most commonly employed method for obtaining the necessary data concerning the size and structure of populations of large carnivores in Slovakia. Linnell et al. (1998) recommends the use of this method for monitoring reproductive and family groups of lynx and wolf in combination with other approaches. In recent years, the conditions for winter tracking and monitoring have varied, but have not been optimal. The air temperature and snow cover significantly affect the results of the research. Most prominently, this reflects on the presence of brown bears in the area of interest – Ľubochnianska Valley in Veľká Fatra.

While in 2012 we recorded nine tracks and trails of brown bear, mainly due to the extremely low temperatures approaching -30°C, when the cold weather interrupted their hibernation, especially of the young bears (Hulik et al. 2012). We did not see even one trace path of bear in 2013 (Hulik et al. 2013) due to stable winter conditions. Results from the current study show a surprising and interesting number of 50 trails recorded. Near autumn-like conditions and lack of snow cover caused bears of all ages to be able to find enough food in the woods, so they did not need to hibernate at that time. Although bears occurred in a greater number of cells than any other species of interest. Concentration of trails in cells I7, I8, K7 and K8 is interesting. We assume that it is this area where they find enough rest and shelter for winter hibernation.

We link the increased findings of 50 trails of wolf in 2014, compared to 2012 when 25 tracks were recorded and 2013 when 20 tracks were recorded, not only with the increased number of monitored kilometres of transects (2014 – 274 km, 2013 – 153 km and 2012 – 119 km) or with the monitored area (2014 – 181 square km, 2013 – 136 square km), but also and especially with mild winter weather conditions when the wolves' main prey – deer and wild boar (Jędrzejewski et al. 2000, Find'o 2002) – were not forced by high snow to find refuge in the valleys. Therefore the wolves had to hunt in a much larger area than in the previous years, as their occurrence in 16 cells in 2014 confirmed (as opposed to 6 cells in 2013 and again 6 cells in 2012).

Compared to the results of previous expeditions, there are also very interesting findings regarding the lynx. Favourable conditions in the winter of 2014 were reflected in the detection of lynx trails. Although we have not seen as large an increase in trails as for bear and wolf – that is, 27 lynx trails compared to 25 in 2012 and 15 in 2013 – the presence of lynx in 11 cells in Veľká Fatra National Park compared to 4 cells in 2013, and 4 cells in 2012, suggests an increased movement of lynx. Although the movement of lynx is highly dependent on prey distribution and kill sites (Jędrzejewski et al. 2002) it is also likely that a mild winter plays a role, because the main prey of lynx – roe deer (Okarma et al. 1997, Jobin et al. 2000) – was not concentrated in winter herds in the valley at that time, where it is also fed by foresters, but stayed in its non-winter roaming sites. A lynx moves 7.2 kilometres per day on average (Jędrzejewski et al. 2002), except in cases when its prey is less accessible and thus the lynx increases its active movement for hunting (Schmidt 2008).

It will be interesting to observe whether future expeditions confirm the increasing trend of wildcat occurrence in the Ľubochnianska valley in Veľká Fatra. Despite rare findings and the reintroduction of one wildcat in previous years, we did not find a single trail in 2012, but we recorded one wildcat in 2013. In 2014 we found six trails in four cells despite the fact that the central area of the Veľká Fatra is suboptimal for the occurrence of this species. Currently, the Slovak core geographic range of the wildcat is in the southern part of Central Slovakia and in the northeast, near the border with Poland and Ukraine (Hell et al. 2004).

The different recording methods proved that snow-tracking can retrieve a substantially higher amount of information on lynx, wolf, bear and wildcat range than any other observation technique employed. Camera traps are a good tool when the aim is to record unique lynx spot patterns and a wider variety of species. Similar results have been found elsewhere during Biosphere Expeditions studies, where it was also found that DNA scatology (genotyping from scat DNA), like camera traps, helped to broaden the number of species recorded (Mazzolli et al. 2013).

This third year of monitoring of large carnivores in Ľubochnianska Valley, in Veľká Fatra National Park, reached its set goals. Participation of volunteers in conjunction with the authorities of Veľká Fatra National Park and the Ľubochňa Forest Department resulted in gaining further ecological insight into the ecology and behaviour of target species with important implications for their management throughout Slovakia.

Future expeditions should:

1. Set up a closer cooperation with the research team from project "Carpathians Spirits", with use of camera traps to capture specific patterns of lynx spots for identification of individuals.

2. Continue to use the grid cell methodology.

3. Record the revisiting effort, so that it is known whether an index of presence is true or is a product of oversampling one area and undersampling others (capture history of grids and trails).

4. Focus on the area of Ľubochnianska valley in National Park Veľká Fatra only.

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APPENDIX I: Raw data, maps & camera trap photos

Table 1. Overview of temperature values and snowfallat Švošov and Ľubochňa valley.

Date	Temperature in ºC at 7:00 Švošov	Temperature in ºC at 16:00 Švošov	Temperature in ºC at 8:00 valley	Fresh snow in valley (cm)
30. 01. 2014	-2	2	-2	
31. 01. 2014	2.6	4		
01. 02. 2014	1.7	3		
02. 02. 2014	3.1	4.8		
03. 02. 2014	-2.9	-0.3	0	
04. 02. 2014	-5	0.5	-5	
05. 02. 2014	-4.7	3.6	-6	
06. 02. 2014	2.2	0.4	2	
07. 02. 2014	-3.1	4.5	-3	
08. 02. 2014				
09. 02. 2014				
10. 02. 2014		5	2.5	
11. 02. 2014	3.1	5.3	4	
12. 02. 2014	3.2	2.1	3	
13. 02. 2014	0.5	0.7	-1	15 cm
14. 02. 2014	1.1	0	1	1.5 cm
15. 02. 2014	-2.9			

Table 2. Summary of results: transect surveys by group and presence of lynx, wolf, bear and wildcat tracks on transects.

	Transects surveyed			Lynx tracks		Following lynx trail		Wolf tracks		Following wolf trail		Bear tracks		Following bear trail		Wildcat tracks	
	n	km	cells	n	frequency track/km	n	km	n	frequency track/km	n	km	n	frequency track/km	n	km	n	frequency track/km
Group1	18	264.38	24	23	11. 02	4	3.63	41	6.45	6	3.86	26	10.17	5	1.65	2	132.19
Group2	18	283.22	24	4	70.81	1	1.75	9	31.47	3	1.18	24	11.8	2	0.42	4	70.85
Total	36	547.6	29	27	20.28	5	5.38	50	10.95	9	5.04	50	10.95	7	2.07	6	91.27

Table 3. Overview of tracks and trails recorded.

#	Date	Species	Deg	min	sec	Quadrant (Cell)	width (cm)	length (cm)	Direction of travel (bearing)	Age of footprint notes
01	30.01.2014	*Canis lupus*	N49 E19	01 07	52.4 30.06	I 9	9	10.5	from 357 to 238	fresh
02	30.01.2014	*Canis lupus*	N49 E19	04 08	42.7 42.1	I7				carcass
03	30.01.2014	*Ursus arctos*	N49 E19	04 08	59.9 25.2	I7	17		from 200 to 348	very fresh
04	30.01.2014	*Ursus arctos*	N49 E19	04 07	35.4 49.4	I7	13		from 67 to 328	older
05	03.02.2014	*Canis lupus*	N49 E10	04 08	08 17.5	I7	9.5	12	from 100	older
06	03.02.2014	*Lynx lynx*	N49 E19	04 08	08 15.2	I7	7.5		from 100 to 305	fresh
07	03.02.2014	*Lynx lynx*	N49 E19	04 08	59.1 29.3	I7			from 225 to 63	older
08	03.02.2014	*Canis lupus*	N49 E19	04 08	55.6 21.6	I7	11			older old scat not for DNA
09	03.02.2014	*Ursus arctos*	N49 E19	04 08	52.36 16.58	I7	16			very fresh scat
10	03.02.2014	*Lynx lynx*	N49 E19	04 08	49.1 13	I7	8		from 230to 15	very fresh

11	03.02.2014	*Ursus arctos*	N49 E19	04 07	34.35 50	I7	15		from 310 to 170	very fresh
12	03.02.2014	*Ursus arctos*	N49 E19	11 07	07.81 29.16	H2	15			fresh
13	03.02.2014	*Canis lupus*	N49 E19	11 07	06.95 46.15	H2				older
14	03.02.2014	*Canis lupus*	N49 E19	11 08	09.77 25.18	I2				older
15	04.02.2014	*Canis lupus*	N49 E19	03 10	02.4 02.5	J8			from 300 to 90	older
16	04.02.2014	*Lynx lynx*	N49 E19	02 10	51.5 30.7	J8	9	11		older
17	04.02.2014	*Lynx lynx*	N49 E19	02 10	44.7 32.4	K8	6	10	to 80	fresh
18	04.02.2014	*Lynx lynx*	N49 E19	02 10	37.4 41.5	K8	8.5	8.5		older
19	04.02.2014	*Lynx lynx*	N49 E19	02 10	36.1 39.9	K8	10	9		fresh
19A	04.02.2014	*Lynx lynx*	N49 E19	02 10	33.8 38.9	K8	10	11	from 305	fresh
19B	04.02.2014	*Lynx lynx*	N49 E19	02 10	37.2 39.7	K8	10	11	from 150	fresh
20	04.02.2014	*Ursus arctos*	N49 E19	03 08	0 21.8	I7	12.5 2 x 9cm		from 240 to 100	fresh bear with 2 young ones
20A	04.02.2014	*Ursus arctos*	N49 E19	03 08	56.1 39.6	I7	12.5 2x 9cm		to 296	fresh bear with 2yo
20B	04.02.2014	*Ursus arctos*	N49 E19	03 08	54.9 37.8	I7	12.5 2 x 9cm		from 280 to 18	fresh bear with 2yo
20C	04.02.2014	*Ursus arctos*	N49 E19	03 08	53.7 33.7	I8	12.5 2 x 9cm		from 65 to 170	fresh bear with 2yo
06A	04.02.2014	*Lynx lynx*	N49 E19	03 08	54.4 49.2	J7			to 20, following animal tra from 06	
21	04.02.2014	*Ursus arctos*	N49 E19	03 08	54.9 37.8	I8			from 280 to 18	following animal trail
21A	04.02.2014	*Ursus arctos*	N49 E19	03 08	53.7 33.7	I8			from 65 to 170	end following animal trail
22	04.02.2014	*Canis lupus*	N49 E19	03 07	44.8 38.4	I8	8.5		from 3 to 190	
23	04.02.2014	*Ursus arctos*	N49 E19	03 08	56.5 7.8	I7	17			older
23A	04.02.2014	*Ursus arctos*	N49 E19	03 08	52.1 00.9	I8	17		from 310	older

23B	04.02.2014	*Ursus arctos*	N49 E19	03 07	46.3 57.5	I8	17		to 110	older
24	04.02.2014	*Ursus arctos*	N49 E19	03 07	54.2 34.4	I8			from 110 to 280	older
25	04.02.2014	*Ursus arctos*	N49 E19	03 07	58.6 23	I8			from 89 to 3	older
26	04.02.2014	*Ursus arctos*	N49 E19	04 07	0.5 24	I7			from 142 to 312	fresh bear family
27	04.02.2014	*Ursus arctos*	N49 E19	03 07	57.1 21.6	I8	15		from 180 to 360	fresh another bear
28	04.02.2014	*Ursus arctos*	N49 E19	03 07	49 29.4	I8	14		from 180 to 298	fresh
29	04.02.2014	*Ursus arctos*	N49 E19	03 07	49 29.4	I8	13 12		from 190 to 39	fresh two bears
29A	04.02.2014	*Ursus arctos*	N49 E19	03 07	44.2 30.8	I8	13 12		from 285 to 121	fresh two bears
30	04.02.2014	*Canis lupus*	N49 E19	03 07	40.7 34	I8	10 11		to 91	older
31	04.02.2014	*Lynx lynx*	N49 E19	00 09	20.74 33.35	J10			from 200 to 120	older
32	04.02.2014	*Lynx lynx*	N48 E19	59 10	36.34 36.07	K11				older
33	04.02.2014	*Ursus arctos*	N48 E19	59 10	1.57 4.46	K11				older
34	04.02.2014	*Lynx lynx*	N49 E19	00 08	29.3 25.8	J10	7	8	From 100 to 280	fresh
35	04.02.2014	*Canis lupus*	N49 E19	00 08	35.3 24.9	J10	9	11	to 208	older, two animals
36	04.02.2014	*Lynx lynx*	N49 E19	00 08	36.9 20.7	J10	8	9.5	from 150 to 309	old
37	04.02.2014	*Canis lupus*	N49 E19	00 07	41.8 52.2	I10			from 238 to 64	old
38	04.02.2014	*Felis silvestris*	N49 E19	00 07	19 7.3	I10	3.5	3.5	from 320 to 140	older
39	05.02.2014	*Canis lupus*	N49 E19	04 09	9.4 17.7	J6	10	10	from 196 to 81	older following trail
39A	05.02.2014	*Canis lupus*	N49 E19	05 10	8.3 14.7	J6	10	10	from 32 to 143	older end following trail
40	05.02.2014	*Ursus arctos*	N49 E19	04 09	53.7 58.9	J7	17	28	to 224	fresh
41	05.02.2014	*Canis lupus*	N49 E19	04 10	23.9 9.2	J7	9	9.5	from 80 to 234	older

41A	05.02.2014	*Canis lupus*	N49 E19	04 10	22.9 5.9	J7	8-9		from 55 to 235	older
42	05.02.2014	*Canis lupus*	N49 E19	03 10	53.7 24.7	J7	10	13	from 240 to 68	older start following animal trail
42A	05.02.2014	*Canis lupus*	N49 E19	04 10	0.03 46.2	J7	10	13	from 128 to 270	older finished following animal trail
43	05.02.2014	*Ursus arctos*	N49 E19	04 10	14.5 13.9	J7	13		from 245 to 65	fresh
44	05.02.2014	*Canis lupus*	N49 E19	04 10	17.8 20.4	J7	9	12	from 305 to 230	fresh
45	05.02.2014	*Ursus arctos*	N49 E19	04 10	13.9 42.1	J7	14	19	to 205	fresh
46	05.02.2014	*Ursus arctos*	N49 E19	01 08	33.8 48.1	J9				old
47	05.02.2014	*Canis lupus*	N49 E19	01 07	21.4 56.3	I9			from 280 to 180	older start following animal trail
47A	05.02.2014	*Canis lupus*	N49 E19	01 07	21.8 51.7	I9			from 0 to 180	older finished animal trail
48	05.02.2014	*Canis lupus*	N49 E19	01 07	18 15.1	I9	10	13	from 320 to 175	fresh, following animal trail
48A	05.02.2014	*Canis lupus*	N49 E19	00 07	19 17.3	I9			from 245	fresh at least 4 wolves
48B	05.02.2014	*Canis lupus*	N49 E19	01 07	26.4 7.0	I9				fresh, finished following animal trail
49	05.02.2014	*Canis lupus*	N49 E19	01 07	30.5 19.5	I9				scat, very old
50	05.02.2014	*Lynx lynx*	N49 E19	01 07	39.6 48.2	I9	8	9	from 100 to 290	fresh
51	05.02.2014	*Lynx lynx*	N49 E19	01 07	48.6 34.6	I9	8.5	9		older
52	05.02.2014	*Canis lupus*	N49 E19	01 07	56.8 31.6	I9	8.5	10.5		very fresh
53	05.02.2014	*Canis lupus*	N49 E19	01 08	41.6 32.8	J9			from 260 to 80	fresh
54	05.02.2014	*Canis lupus*	N49 E19	00 08	30.4 53.9	J10	10		from 270 to 90	older
55	05.02.2014	*Canis lupus*	N49 E19	00 09	24.9 9.9	J10	10 9			older two animals
56	05.02.2014	*Canis lupus*	N49 E19	00 10	07.5 21.4	K10	9	11	from 250 to 52	fresh two animals
57	05.02.2014	*Canis lupus*	N48 E19	59 11	50.8 24.9	K10			from 308 to 108	fresh, start following animal trail

58	05.02.2014	*Ursus arctos*	N49 E19	00 10	45.4 50.4	K10	14		from 220 to 28	older
59	05.02.2014	*Canis lupus*	N49 E19	01 10	41.5 19.9	J9	9.5		from 280 to 100	older
60	06.02.2014	*Canis lupus*	N49 E19	02 08	8.1 0.1	I9	9		from 330 to 150	older
61	06.02.2014	*Lynx lynx*	N49 E19	02 07	21 32.6	I9			from 270 to 90	older
62	06.02.2014	*Lynx lynx*	N49 E19	02 07	20.5 2.6	I9	10		from 315 to 135	fresh
63	06.02.2014	*Canis lupus*	N48 E19	01 07	50.5 10.2	I9	9		to 235	older
64	06.02.2014	*Felis silvestris*	N49 E19	03 08	2.4 10.8	I8	3.5	4.5	from 85 to 262	fresh
65	06.02.2014	*Canis lupus*	N49 E19	03 07	1.1 46.6	I8	9	9.5	from 310 to 130	older
66	06.02.2014	*Ursus arctos*	N49 E19	03 07	4.3 37.7	I8	15		from 140 to 320	older
67	06.02.2014	*Lynx lynx*	N49 E19	02 06	52.1 56.9	I8	6	7	from 150 to 260	older
68	06.02.2014	*Canis lupus*	N49 E19	02 06	44.8 48.9	I8	7.5	11	from 220 to 20	older
69	06.02.2014	*Canis lupus*	N49 E19	02 07	49.9 48.9	I8	9	12		older
70	06.02.2014	*Canis lupus*	N48 E19	57 07	13.5 15.4	I12	8	11	from 89 to 270	fresh at least 4 wolves
71	06.02.2014	*Ursus arctos*	N48 E19	57 08	14 14.5	J12	15 - 16		from 19.5 to 249	older Bear with young one
72	06.02.2014	*Canis lupus*	N49 E19	59 10	37.9 41.8	K11			from 290 to 110	older
73	06.02.2014	*Canis lupus*	N49 E19	59 10	6.1 44.5	K11				older scat
74	06.02.2014	*Canis lupus*	N48 E19	59 10	21.4 10.9	K11	10 8		from 270 to 90	very fresh
75	07.02.2014	*Lynx lynx*	N48 E19	58 7	35.9 32.7	I11	9.5	10	from 170 to 270	older
76	07.02.2014	*Lynx lynx*	N48 E19	58 6	46.8 57.3	I11	7	8	from 86 to 262	not sure, possibly two lynx

77	07.02.2014	*Ursus arctos*	N48 E19	59 6	35.7 39.1	I11	12			on hunters cabin young bear
78	07.02.2014	*Canis lupus*	N48 E19	59 7	33.6 55.1	J11				old scat
79	07.02.2014	*Canis lupus*	N49 E19	02 11	1.5 43.5	K9	8		from 15 to 125	older
80	07.02.2014	*Canis lupus*	N49 E19	01 11	33.4 26.6	K9	8		from 330 to 160	older
81	07.02.2014	*Lynx lynx*	N49 E19	01 10	28.5 9.3	J9	8		from 10 to 220	older
82	07.02.2014	*Lynx lynx*	N49 E19	01 10	22.2 10.2	J9			to 100	older
83	07.02.2014	*Lynx lynx*	N49 E19	01 09	22.7 41.8	J9	8		from 310 to 130	
84	07.02.2014	*Canis lupus*	N49 E19	02 08	0.7 14.6	I9	10	13	from 8.5 to 190	older
85	07.02.2014	*Ursus arctos*	N49 E19	01 08	59.9 13.9	I9				older mother and cub
86	07.02.2014	*Canis lupus*	N49 E19	01 08	58.8 5.6	I9				old scat
87	07.02.2014	*Lynx lynx*	N49 E19	02 07	10.32 58.08	I9				melted, old, following lynx trail
88	07.02.2014	*Canis lupus*	N49 E19	02 07	36.4 28.6	I9				old melted trail
89	07.02.2014	*Ursus arctos*	N49 E19	03 10	01 46.1	K8			from 122 to 309	fresh
90	07.02.2014	*Ursus arctos*	N49 E19	11 07	6.6 33	H2				observation of two bears
91	07.02.2014	*Ursus arctos*	N49 E19	11 07	4.4 47.6	H2				old trail
92	07.02.2014	*Canis lupus*	N49 E19	11 08	12.8 49.9	I2	10.5	11	from 220 to 0	older

93	10.02.2014	*Ursus arctos*	N49 E19	04 07	37.7 39.9	I7	15.5		from 100 to 281	fresh
94	11.02.2014	*Ursus arctos*	N49 E19	05 11	18.7 07.8	K6	15	21.5	from 156 to 328	fresh
95	11.02.2014	*Ursus arctos*	N49 E19	04 11	46.5 5.3	K7	15	23		older
96	11.02.2014	*Ursus arctos*	N49 E19	04 11	19.5 10.4	K7	15.7	27.5	from 147 to 238	fresh
97	11.02.2014	*Ursus arctos*	N49 E19	04 11	15.8 8.1	K7	15	22	from 176 to 348	older
98	11.02.2014	*Ursus arctos*	N49 E19	03 11	54.1 22.3	K7	12.6	14.9	from 278 to 86	fresh
99	11.02.2014	*Ursus arctos*	N49 E19	03 11	51.7 21.6	K7	14	15.5	from 88 to 278	fresh
100	11.02.2014	*Ursus arctos*	N49 E19	03 11	49.6 21.9	K7	13	15	from 110 to 309	fresh
101	11.02.2014	*Ursus arctos*	N49 E19	03 07	44.9 38	I8	13		from 228 to 38 down stream	fresh
101A	11.02.2014	*Ursus arctos*	N49 E19	03 07	47.2 33.3	I8	13		from 94 to 308	fresh
101B	11.02.2014	*Ursus arctos*	N49 E19	03 07	44.3 31.2	I8	13		from 30 to 234	very fresh
101C	11.02.2014	*Ursus arctos*	N49 E19	03 07	43.1 31.2	I8	13		from 268 to 80	fresh
101D	11.02.2014	*Ursus arctos*	N49 E19	03 08	19.4 4.3	I8	13		from 252 to 114	fresh
102	11.02.2014	*Ursus arctos*	N49 E19	03 08	19.4 4.3	I8	11.5		from 252 to 114	fresh
103	11.02.2014	*Ursus arctos*	N49 E19	00 09	34.5 2.7	I10	14			older
104	11.02.2014	*Felis silvestris*	N49 E19	00 08	30.94 52	J10	4.5		to 90	very fresh male and female together
105	11.02.2014	*Felis silvestris*	N49 E19	00 08	30.94 52	J10	3.5		to 90	very fresh
106	11.02.2014	*Canis lupus*	N49 E19	00 10	8.2 24	K10	11		to 270	fresh male and female
107	11.02.2014	*Canis lupus*	N49 E19	00 10	8.2 24	K10	9.5		to 270	fresh
108	12.02.2014	*Felis silvestris*	N49 E19	01 10	16 40.7	K9	4.5	5		fresh
109	12.02.2014	*Canis lupus*	N49 E19	03 10	09 0.7	J8				older

110	12.02.2014	*Ursus arctos*	N49 E19	02 10	46.1 35.4	K8	13		from 272 to 80	very fresh
110A	12.02.2014	*Ursus arctos*	N49 E19	02 10	45.6 38.5	K8			from 8 to 48	very fresh
111	12.02.2014	*Lynx lynx*	N49 E19	02 10	57.1 41.1	K8	7	9	from 22 to 180	fresh
112	12.02.2014	*Ursus arctos*	N48 E19	59 07	29.8 47.4	I11	15			older
113	12.02.2014	*Ursus arctos*	N48 E19	58 06	43.3 27.7	I11	16.5		from 71 to 193	very fresh
113A	12.02.2014	*Ursus arctos*	N48 E19	58 07	24.5 02.9	I12	16.5		from 141 to 354	fresh
114	12.02.2014	*Ursus arctos*	N48 E19	58 08	47.1 19.2	J11			from 339 to 159	older
115	12.02.2014	*Ursus arctos*	N49 E19	01 09	54.9 07.4	J9	15			very fresh
116	12.02.2014	*Canis lupus*	N49 E19	04 09	14.1 14.9	J7	9			very fresh
117	12.02.2014	*Ursus arctos*	N49 E19	04 09	14.1 14.9	J7	15			very fresh
118	12.02.2014	*Ursus arctos*	N49 E18	08 56	29.9 46.5	C5	17			very fresh
119	12.02.2014	*Ursus arctos*	N49 E18	08 56	36.9 39.4	C5	13			very fresh
120	13.02.2014	*Lynx lynx*	N49 E19	02 08	55.3 55.1	J8	7.5	8.5	from 160 to 351	very fresh
120	13.02.2014	*Lynx lynx*	N49 E19	02 08	29.8 51	J9	8.2	8.5	from 122 to 273	very fresh start following animal trail
120A	13.02.2014	*Lynx lynx*	N49 E19	02 07	52.5 55.2	I8	8.2	8.5	from 90 to 252	very fresh, finished following animal trai
121	13.02.2014	*Felis silvestris*	N49 E19	00 08	33.4 54.2	J10	4.5	4.5		fresh
122	14.02.2014	*Ursus arctos*	N49 E19	04 08	4.4 36.4	I7	10.5	16.5	from 266 to 54	fresh
122A	14.02.2014	*Ursus arctos*	N49 E19	04 08	8.2 31.5	I7	11	16.5	from 328 to 68	fresh, start animal trail
122B	14.02.2014	*Ursus arctos*	N49 E19	04 08	11.8 41.6	I7	11	16.5		fresh, finished animal trail
123	14.02.2014	*Ursus arctos*	N49 E19	04 08	04 33.9	I7	12 7.5	19		very fresh
124	14.02.2014	*Ursus arctos*	N49 E19	04 08	15.3 19.6	I7	14	23	from 106 to 230	fresh

125	14.02.2014	*Canis lupus*	N49 E19	03 10	59.5 5.5	J7	9.5	13	from 97 to 345	fresh
125A	14.02.2014	*Canis lupus*	N49 E19	03 10	45.5 28.6	J7	9.5	13	from 332 to 253	fresh
125B	14.02.2014	*Canis lupus*	N49 E19	03 10	37 39	J8	9.5	13	from 150 to 346	fresh
126	14.02.2014	*Ursus arctos*	N49 E19	03 10	5.1 58.2	K8	16	23	from 329 to 193	older
126A	14.02.2014	*Ursus arctos*	N49 E19	03 10	3.9 58.1	K8	16	23	from 0 to 204	older
127	14.02.2014	*Ursus arctos*	N49 E19	03 10	2.9 53.6	K8	14		from 164 to 324	older
128	14.02.2014	*Lynx lynx*	N49 E19	03 10	4.2 53.6	K8				older footprints lynx marking tree
129	14.02.2014	*Canis lupus*	N49 E19	02 10	53.4 6.9	J8	10	13		older
130	14.02.2014	*Canis lupus*	N49 E19	01 08	21.8 27.4	J9	9	10	from 121 to 290	very fresh
130A	14.02.2014	*Canis lupus*	N49 E19	01 08	21.2 13.1	I9	9	10	from 190 to 5	very fresh
130B	14.02.2014	*Canis lupus*	N49 E19	01 08	22.5 12	I9	9	10	from 146 to 251.5	very fresh start following animal trail
130C	14.02.2014	*Canis lupus*	N49 E19	01 08	22.27 9.38	I9	9	10		very fresh finished following animal trai
130D	14.02.2014	*Canis lupus*	N49 E19	01 07	21.78 59.04	I9	9	10	from 90 to 178	very fresh start following animal trail
130E	14.02.2014	*Canis lupus*	N49 E19	01 07	21.63 50.72	I9	9	10		very fresh finished following animal trai
131	14.02.2014	*Canis lupus*	N49 E19	00 08	20 15	J10	9.5	12.5	from 258 to 157	very fresh start following
131A	14.02.2014	*Canis lupus*	N49 E19	00 08	20 15	J10	9.5	12.5	from 258 to 157	very fresh, finished following
132	14.02.2014	*Canis lupus*	N49 E19	00 07	12.9 48.7	I10	8.5	12.5	from 35 to 250	very fresh 3 wolves
133	14.02.2014	*Lynx lynx*	N49 E19	01 07	1.49 32.77	I10				old

Table 4. Camera trap location, species recorded and trapping effort.

No.	Name	GPS position deg	min	sec	Quadrat (Cell)	Species recorded	Placed on	Recovered on	Trap Nights
CT1	Blatná Seddle	N49 E19	0 9	2.5 56.1	J10	*Vulpes vulpes, Canis lupus, Cervus elaphus, Ursus arctos*	29.01.2014	17.03.2014	48
CT2	Blatná Ridge	N49 E19	0 10	0.6 2.8	J10	-	29.01.2014	04.02.204	7
CT3	Lipová old road	N49 E19	01 07	39.6 46.6	I9	*Lynx lynx, Cervus elaphus,*	30.01.2014	14.02.2014	16
CT4	Wolf Carcass	N49 E19	04 08	42.6 42.5	I7	*Meles meles, Vulpes vulpes, Ursus arctos, Martes martes*	30.01.2014	14.02.2014	16
CT5	Above cottage	N49 E19	01 09	40.2 3	J9	*Cervus elaphus, Capreolus capreolus, Vulpes vulpes*	31.01.2014	14.02.2014	15
CT6	Old lynx trap	N49 E19	02 10	17.2 9	J9	*Martes martes*	31.01.2014	14.02.2014	15
CT7	Hunter path	N49 E19	02 10	22.3 10.5	J9	*Canis lupus*	31.01.2014	14.02.2014	15
CT8	Lynx Trail	N49 E19	04 08	47.9 06.8	I7	-	03.02.2014	14.02.2014	12
CT9	Milos Tree	N49 E19	11 07	07.08 32.17	H2	-	03.02.2014	15.02.2014	13
CT10	Wolfridge	N48 E19	59 07	55.42 10.73	I11	*Cervus elaphus*	04.02.2014	14.02.2014	11
CT11	Old forest road	N49 E19	02 07	38.8 25.6	I8	-	07.02.2014	14.02.2014	8
CT12	Wolf trail Blatna	N49 E19	00 10	07.53 24.14	K10	-	11.02.2014	14.02.2014	4

MAPS

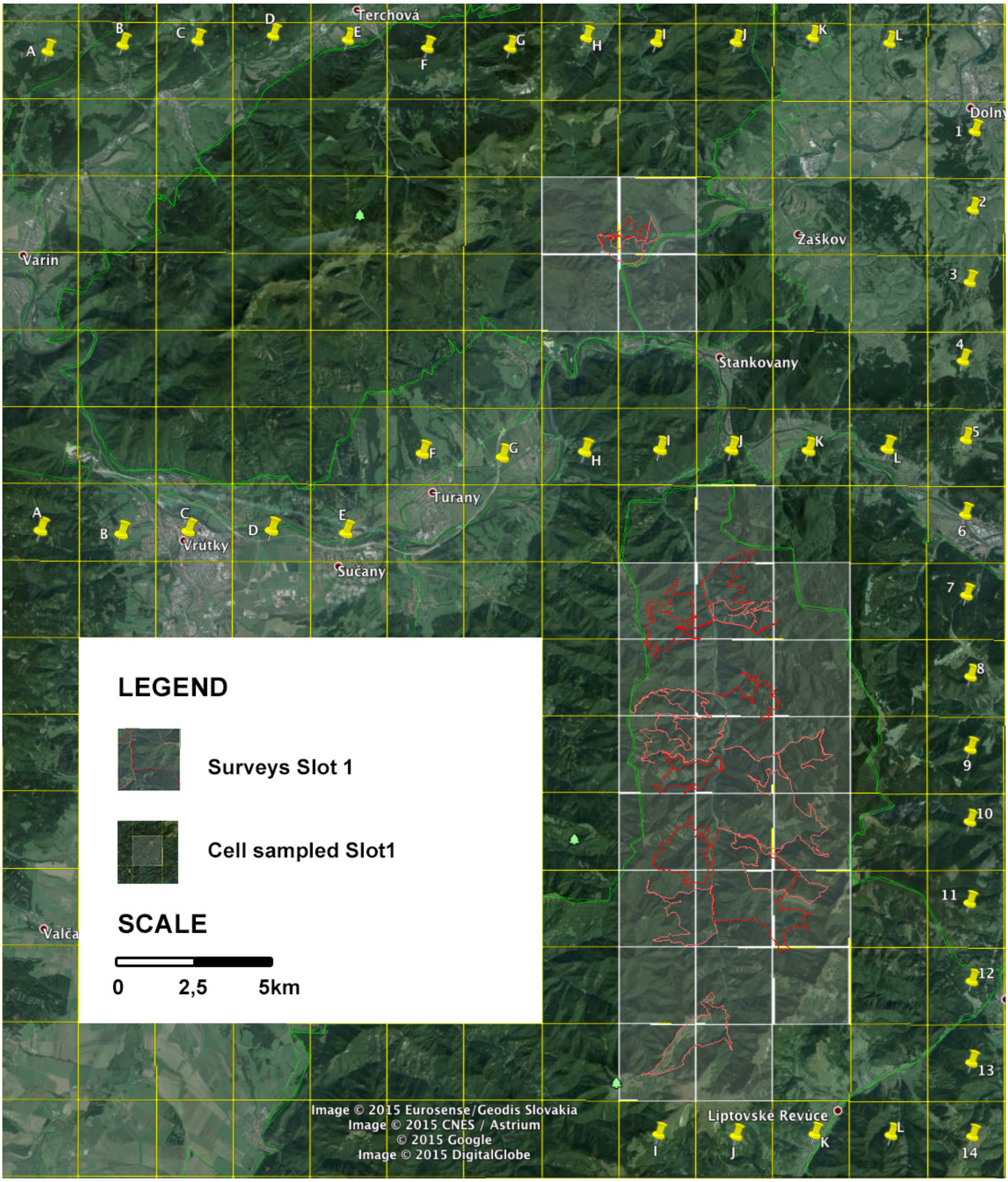

Figure 1. Transects walked by group 1.

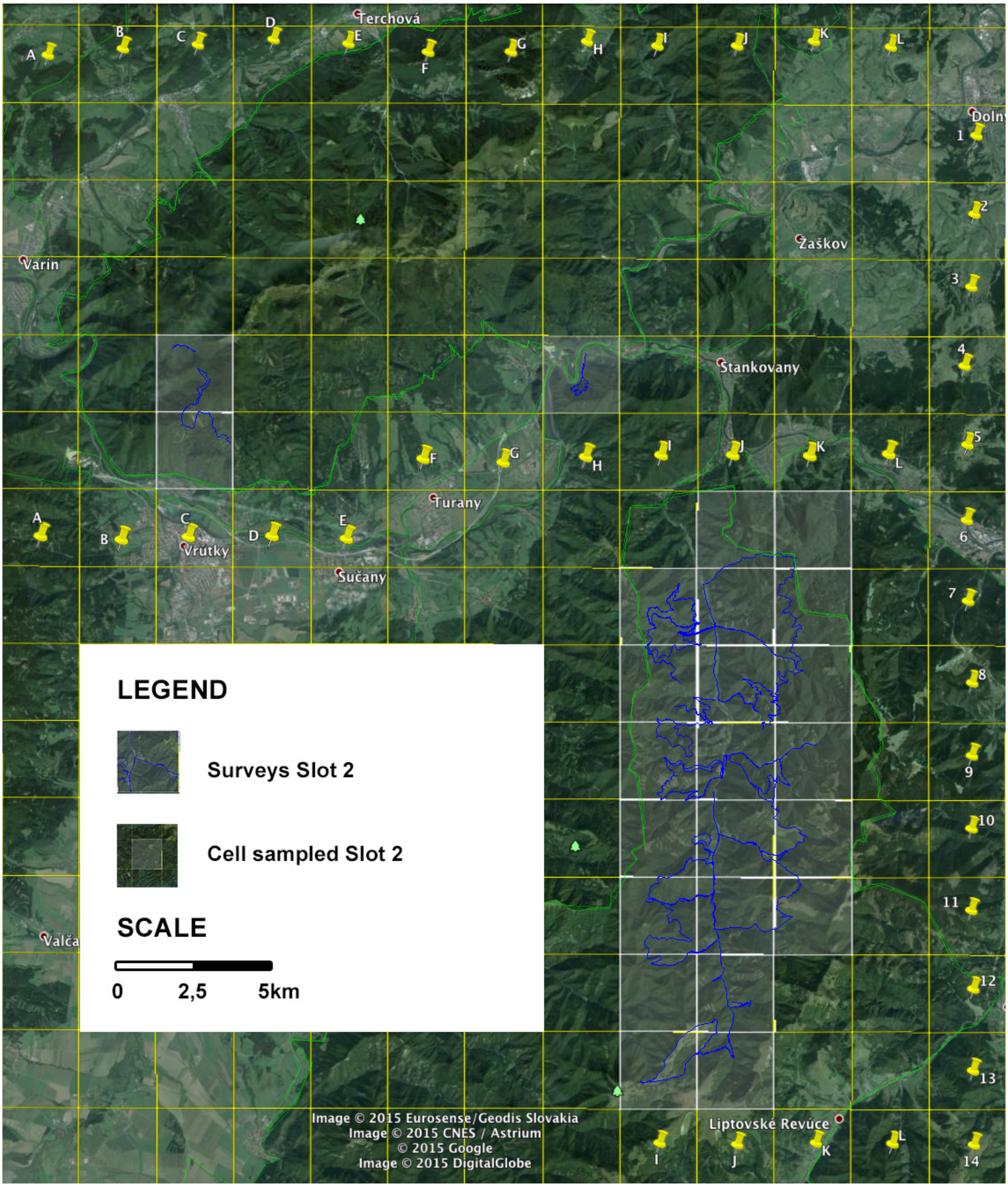

Figure 2. Transects walked by group 2.

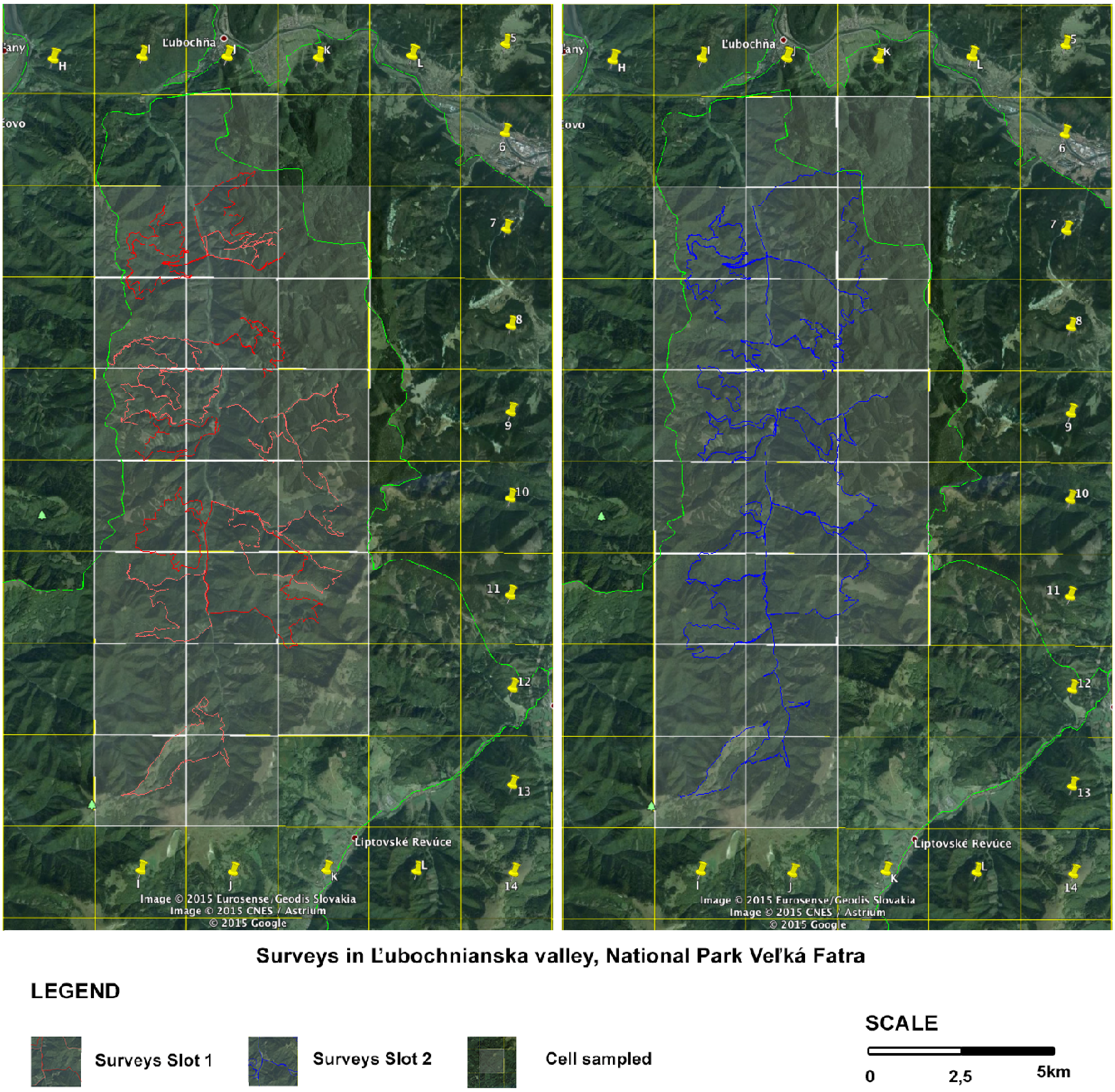

Figure 3. Transects walked by group 1 and group 2 in Ľubochnianska Valley in National Park Veľká Fatra.

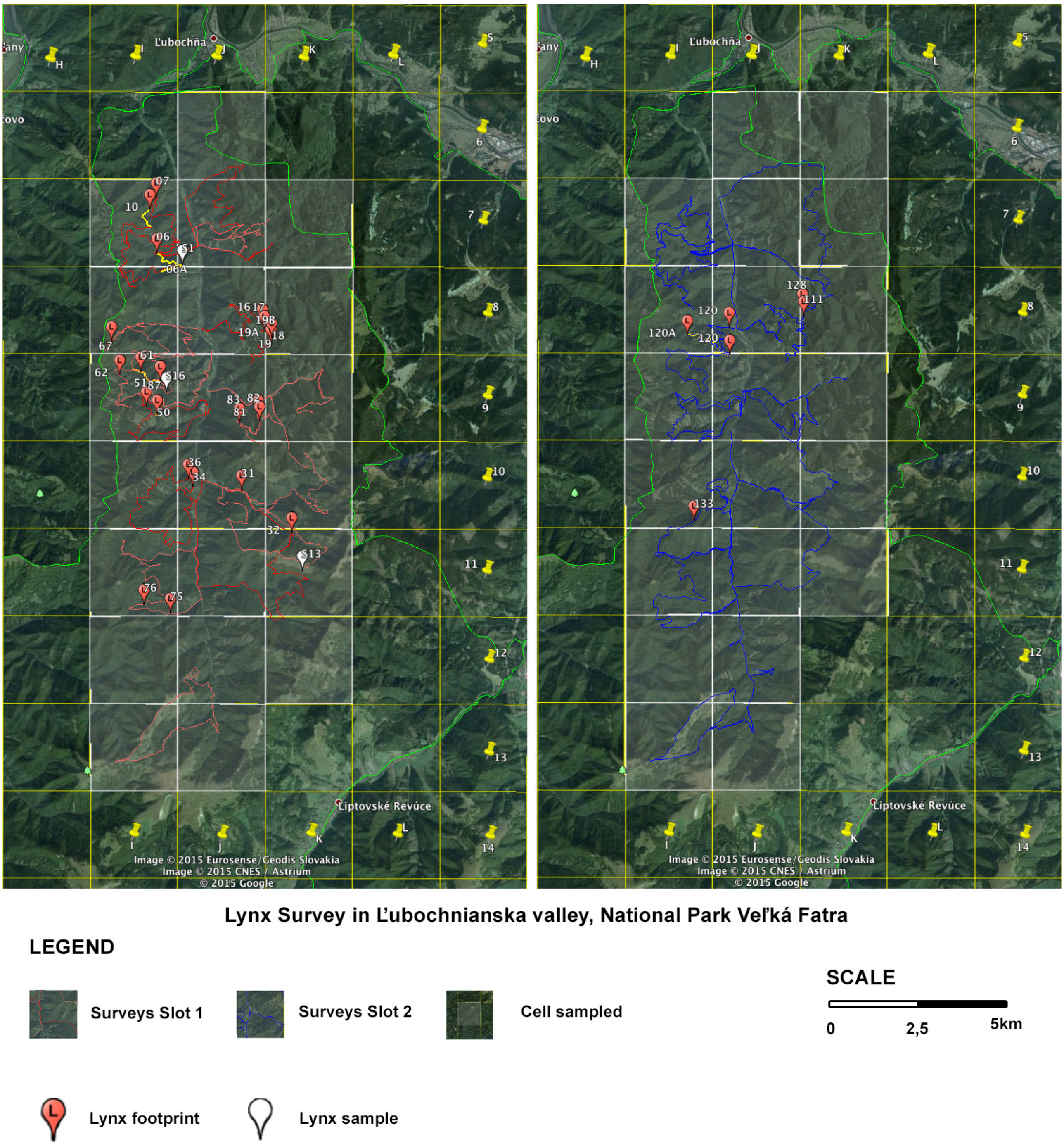

Figure 4. Transects walked by group 1 and group 2 in Ľubochnianska Valley in National Park Veľká Fatra with lynx footprints and samples.

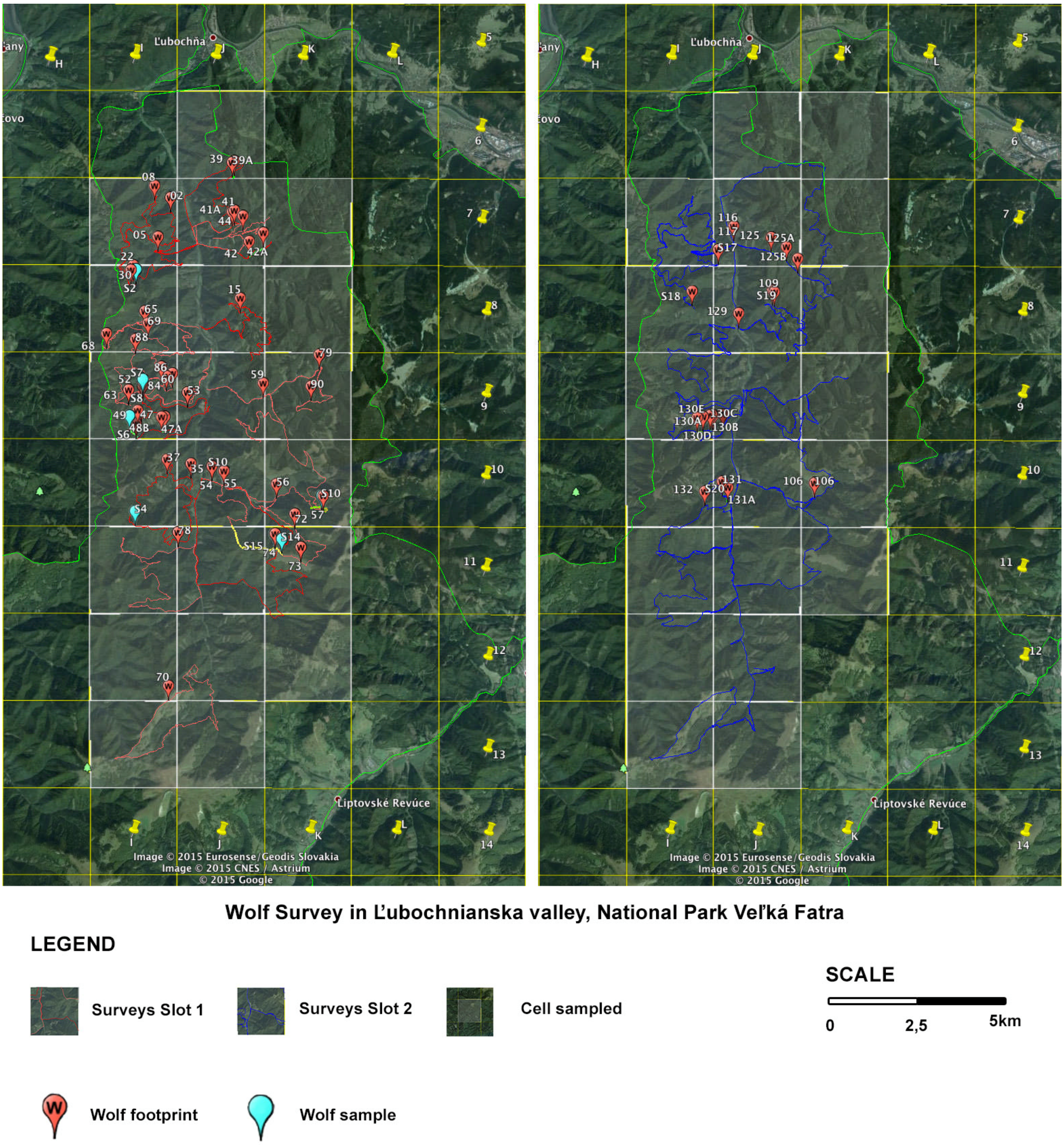

Figure 5. Transects walked by group 1 and group 2 in Ľubochnianska Valley in National Park Veľká Fatra with wolf footprints and samples.

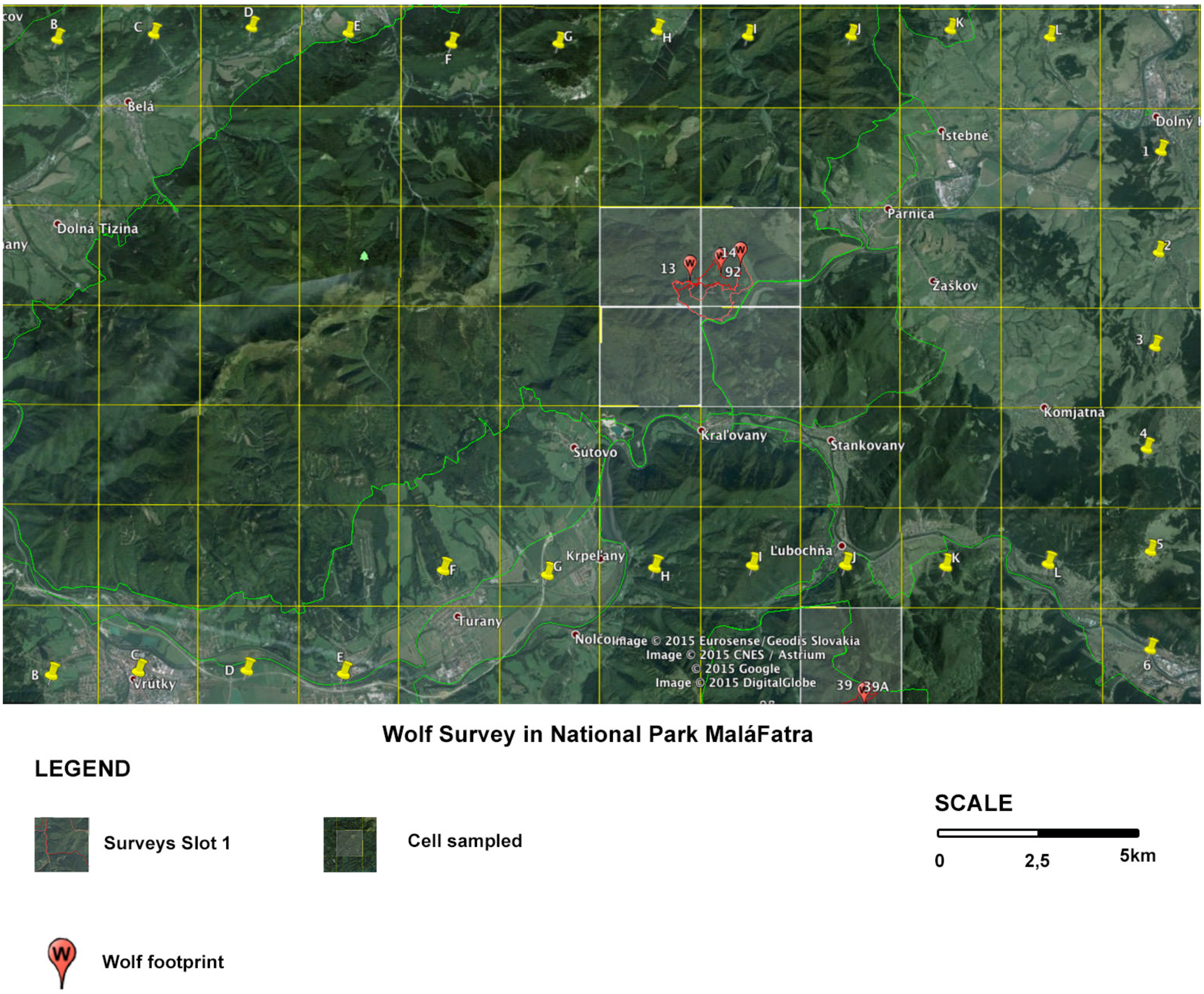

Figure 6. Transects walked by group 1 in National Park Malá Fatra with wolf footprints.

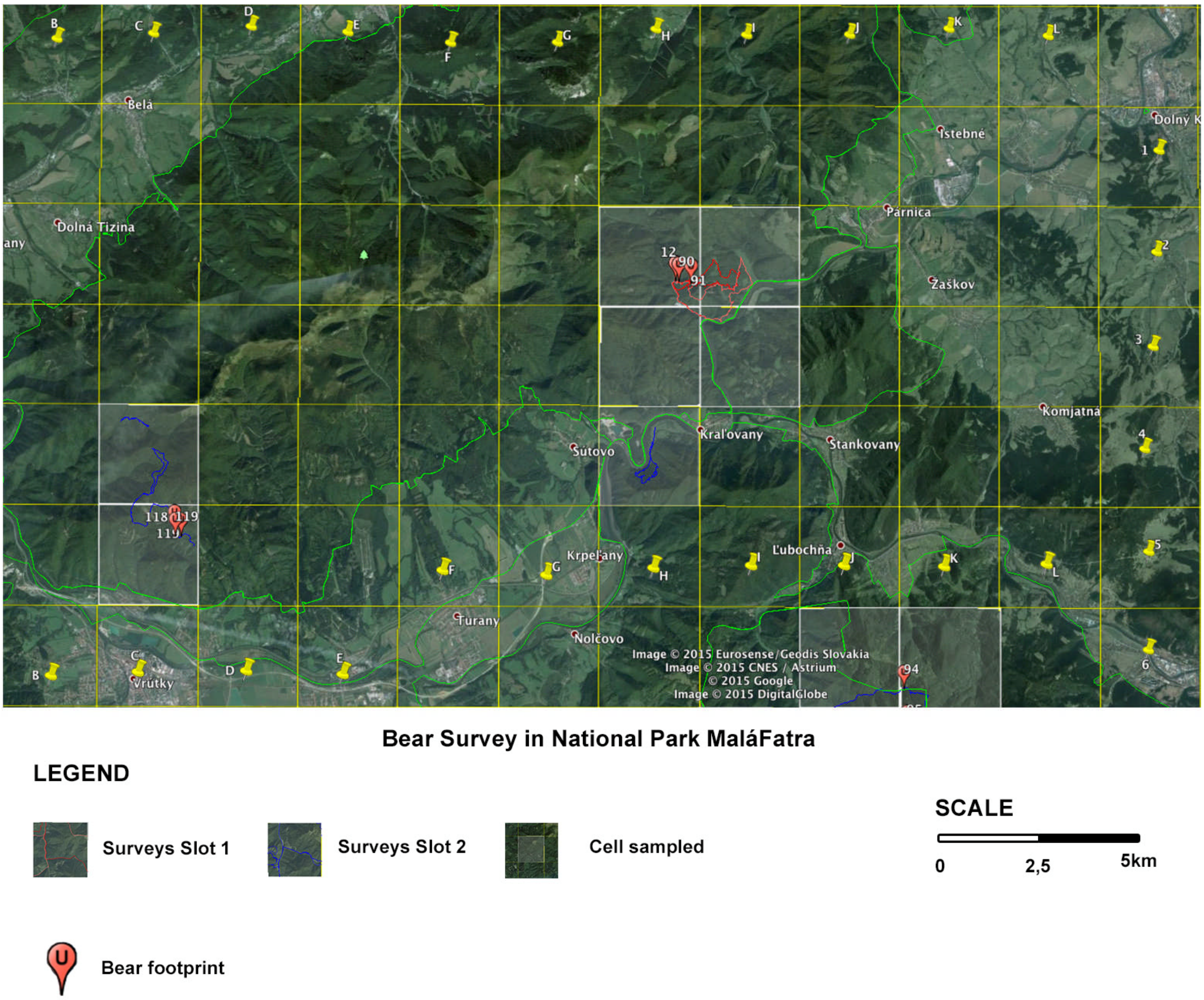

Figure 7. Transects walked by group 1 and group 2 in National Park Malá Fatra with bear footprints.

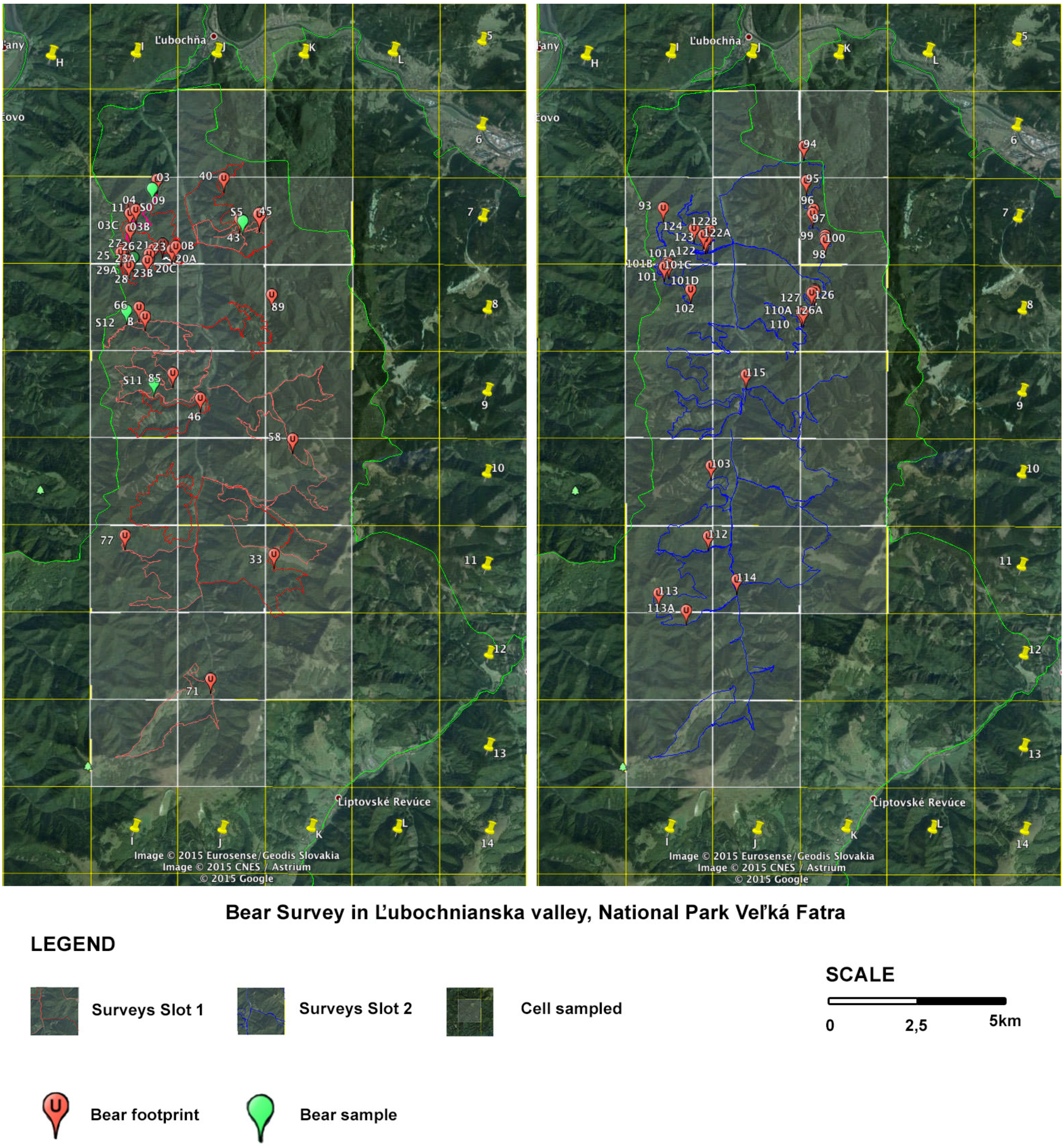

Figure 8. Transects for group 1 and group 2 in Ľubochnianska Valley in National Park Veľká Fatra with bear footprints and samples.

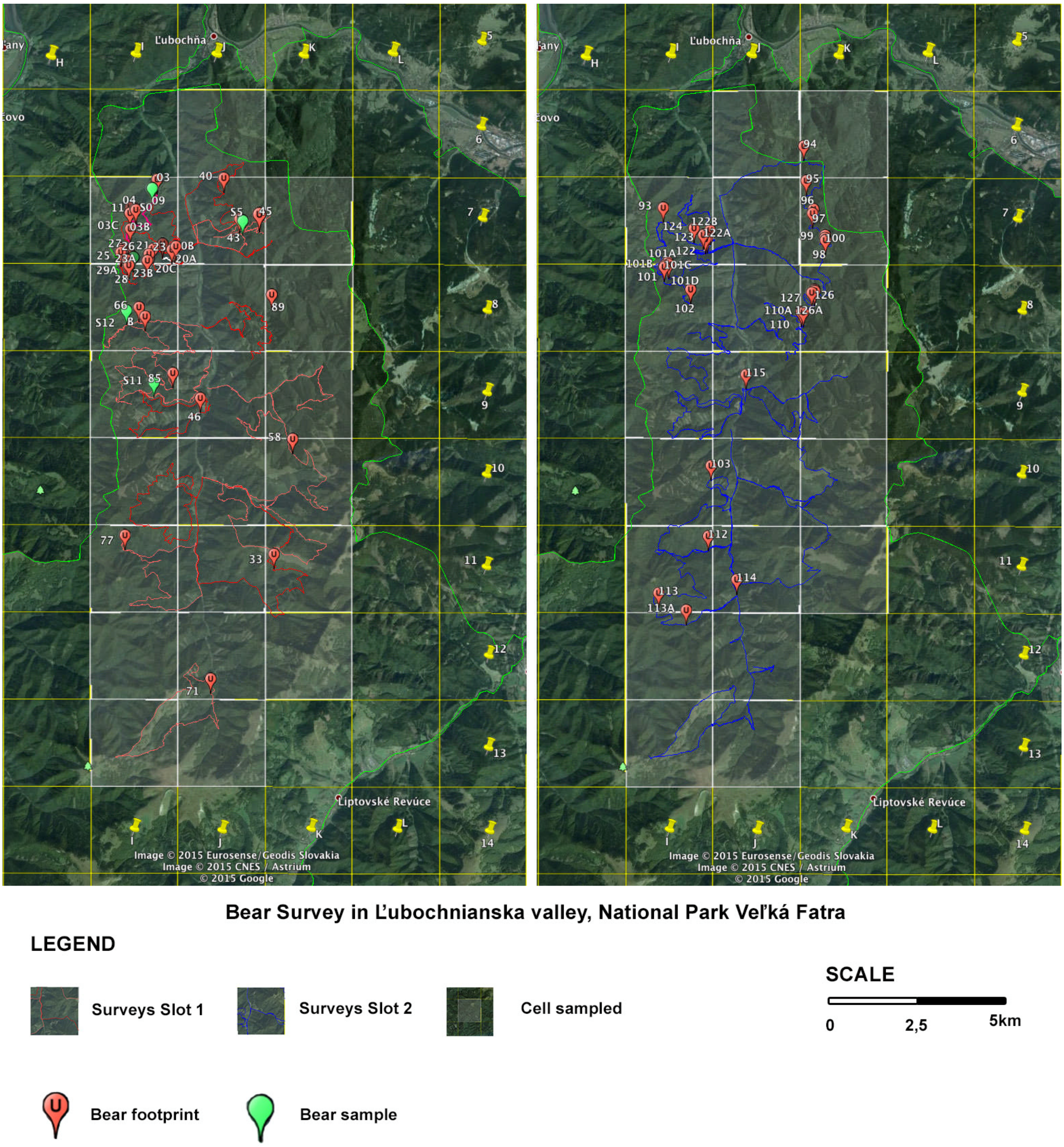

Figure 9. Transects walked by group 1 and group 2 in Ľubochnianska Valley in National Park Veľká Fatra with bear footprints and samples.

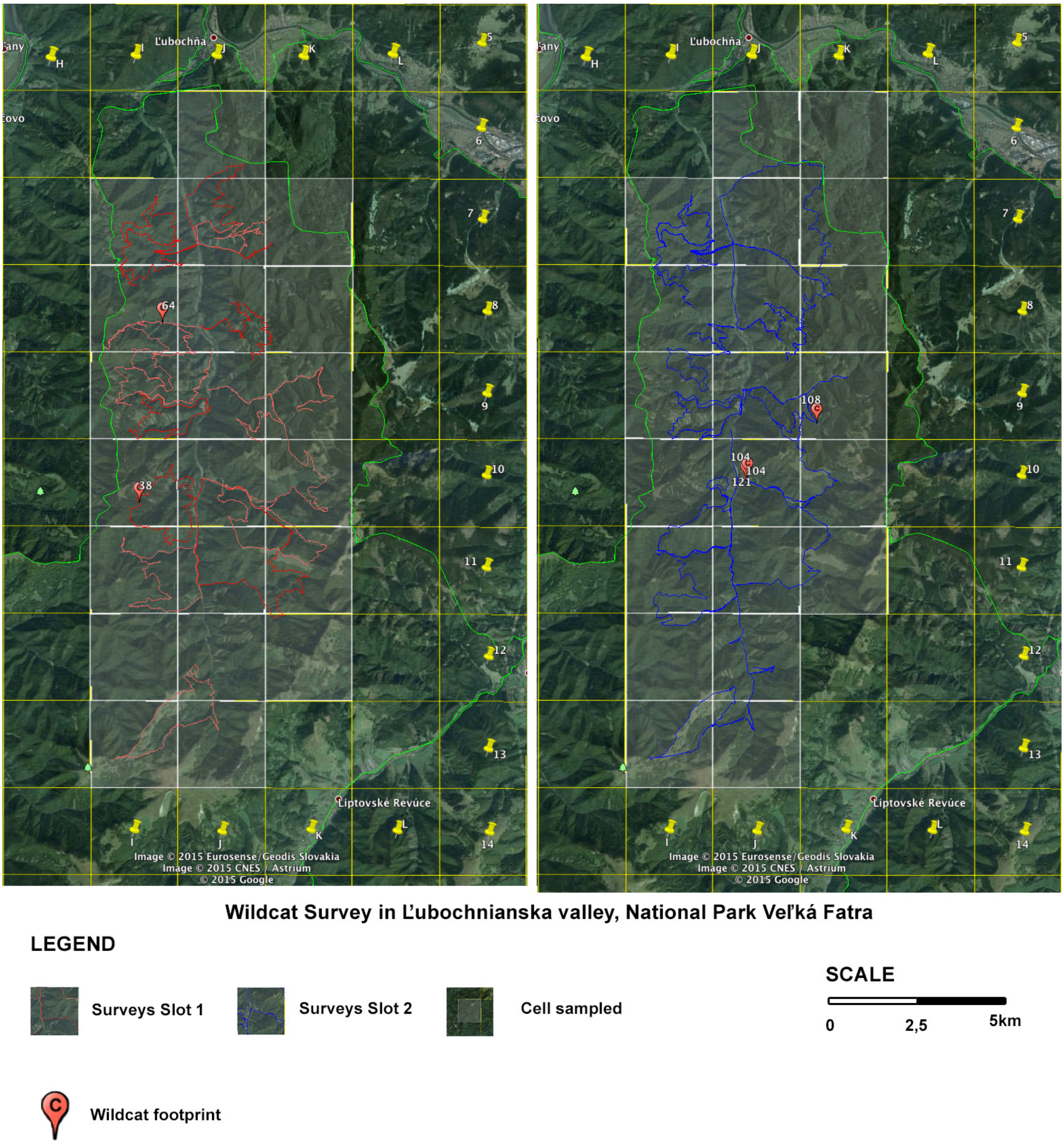

Figure 10. Transects walked by group 1 and group 2 in Ľubochnianska Valley in National Park Veľká Fatra with wildcat footprints.

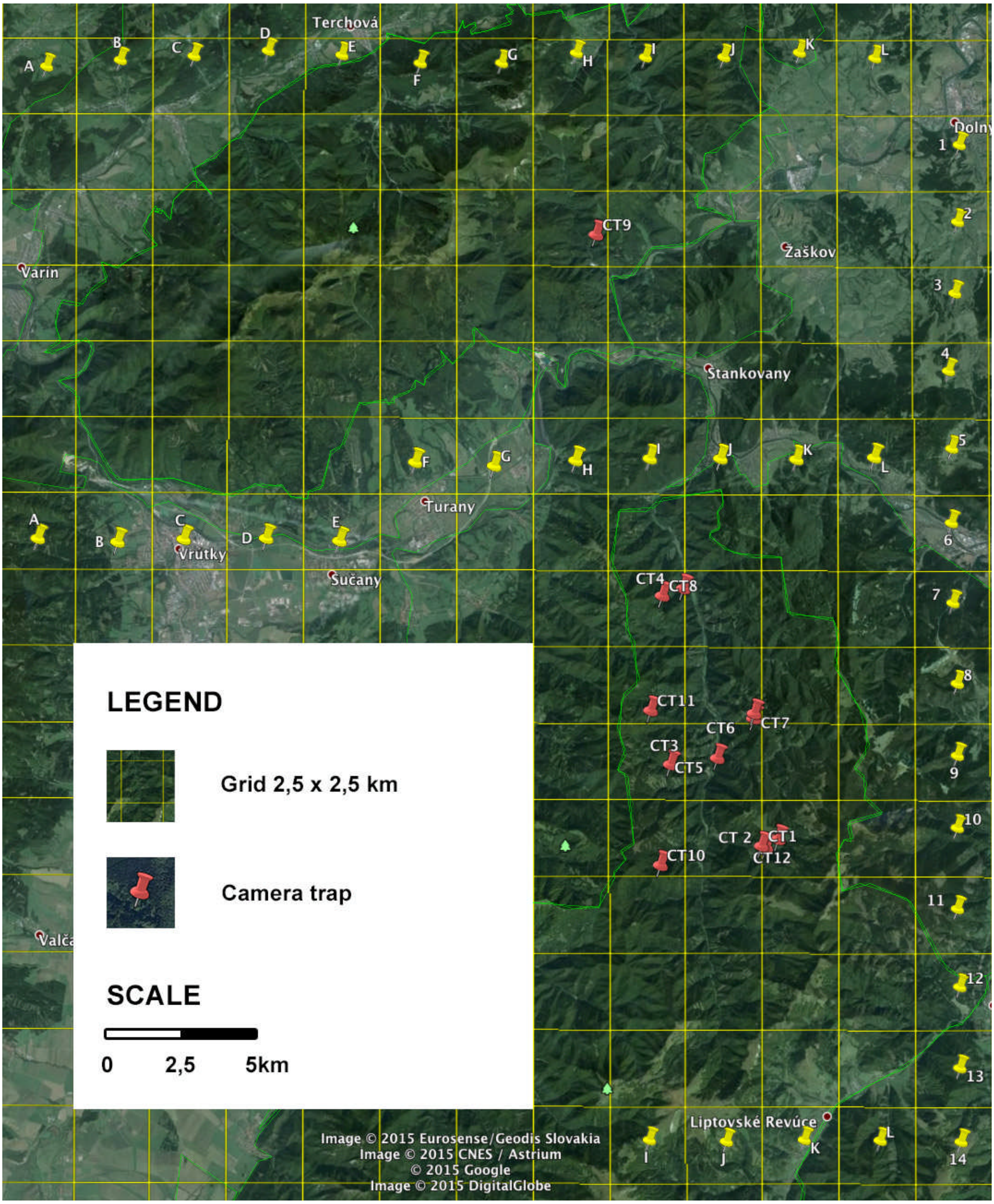

Figure 11. Positions of camera traps.

PHOTOS

Figure 12. Camera trap sample photos.

Camera trap 1 (Blatná Saddle): *Canis lupus 2x, Vulpes vulpes, Ursus arctos*

Camera trap 3 (Lipova old road): *Lynx lynx 2x*

Camera trap 4 (wolf carcass): *Meles meles, Ursus arctos 2x, Vulpes vulpes*

Camera trap 5 (above cottage): *Vulpes vulpes,Cervus elaphus.*

Camera trap 6 (old lynx trap): *Martes martes.*

Camera trap 7 (hunter path): *Canis lupus*

Appendix II: Expedition diary and reports

A multimedia expedition diary is available at https://biosphereexpeditions.wordpress.com/category/expedition-blogs/slovakia-2014/.

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