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PROJECT REPORT

Expedition dates: 29 January – 18 February 2012

Report published: November 2012

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

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Authors:
Tomas Hulik
Protection of Carpathian Wilderness (PCW)

Matthias Hammer & Adam Stickler (editors)
Biosphere Expeditions

Cover page courtesy of Tomas Hulik

Abstract

There is a clear need for the detailed assessment of the status of large carnivores in Slovakia for management and conservation reasons. For example, whilst official game statistics list more than 1,500 wolves in Slovakia, others claim that the annual winter hunting season leaves fewer than 150 individuals. This hundredfold error margin shows the clear need for reliable, objective methods to estimate numbers of large carnivores in Slovakia.

This report deals with a field research expedition, which was conducted in collaboration between Biosphere Expeditions and Tomas Hulik of the Protection of Carpathian Wilderness. Fieldwork was conducted in Veľká Fatra National Park and concentrated on Ľubochnianska valley in northern Slovakia with Biosphere Expeditions bringing in an international team of volunteers to help with field work from 29 January to 18 February 2012.

During the expedition period 50 transects were surveyed, with a total length of 356 km. The average length of a transect was 7.11 km. 59 footprints and trace tracks were identified on these transects. 25 belonged to lynx (42.4%), 25 to wolf (42.4%) and 9 tracks were made by brown bears (15.2%).

Nine camera traps were placed in the study area at a total of 15 positions. 1,800 photos were captured. Half of the photographs were captured by a female deer carcass (camera trap no. 9), which was frequently visited by wolves and a golden eagle. The equipment also recorded several rare and protected species: bear (camera trap no. 14), lynx (camera trap no. 15), otter (*Lutra lutra*) (camera trap no. 10), stoat (*Mustela erminea*) (camera trap no. 10) and the Eurasian beaver (*Castor fiber*) (camera trap no. 10).

18 samples for DNA analysis were collected (16 urine, 1 scat, 1 hair): 9 samples (50%) were presumed, by tracks, to be from lynx (*Lynx lynx*) and 9 samples (50%), gray wolf (*Canis lupus*). All are awaiting DNA analysis.

When comparing current expedition results to those of monitoring of the years 2008 - 2010, which took place mainly in the central part of Ľubochnianska (between Čierňavy and Blatná), it is interesting to note that sites found to be frequented by large carnivores in 2008 - 2010 were avoided by them in 2012. One reason may be the deep snow during the 2012 expedition, but also heavy hunting activity in the preferred 2008 – 2010 areas. Further monitoring will reveal more about site preferences.

Monitoring in 2012 confirmed the existence of at least two wolf packs in the study area. The number of individuals in each pack could not be determined, but very interesting and valuable evidence of wolf presence is a photo of a wolf on freshly caught prey in Čierňavy valley, taken an hour and a half after the camera trap was installed by volunteers (see wolf photo taken by camera trap no. 9 in Figure 2.4h below).

A major benefit of the expedition was the mapping of lynx presence in Krátko and Kračkov valleys. All three research groups recorded the presence of a female lynx with a litter. Resting places and tracks, probably of other lynx individuals were also found. This conjecture will also be tested by DNA analysis. However, despite intensive monitoring during the expedition in Čierňavy, Lipová and Blatná valleys, no footprints of lynx were found there. This area was monitored intensely in 2008 - 2010. At that time there were three lynxes in the area. Their absence now gives cause for concern and will be investigated further during the 2013 expedition.

Camera trap no. 15, located on the forest road opposite Blatná valley, at the beginning of April captured a lynx feeding on a deer carcass. This location is not far from where a female lynx was camera-trapped in March 2009, also feeding on a wolf-kill deer carcass. These images (see Figure 2.5a. below) are very valuable to start building a database for comparison and identification of individuals by their spot patterns.

One of the most unexpected results were the camera trap photos and tracks of brown bear. Although bears usually hibernate in winter, four incidences were found where this was not the case. Perhaps it was a juvenile lacking experience in building a properly insulated den, whose hibernation was interrupted by the very low temperatures. The second option is connected to the supplementary feeding of deer by the hunting community, which means that bears are able to find plenty of food at the deer feeding stations and are therefore able to survive the winter, even if their hibernation is disrupted.

This first year of monitoring of large carnivores in the National Park Veľká Fatra in the Ľubochnianska valley has reached its set goals and was successful and as such the NGO Protection of Carpathian Wilderness is now planning a multi-year collaboration with Biosphere Expeditions. Participation of volunteers in conjunction with the authorities of Veľká Fatra National Park and Ľubochňa Forest Department allows data collection and implementation of new methods for recording population, as well as ecological and ethological parameters for large carnivores in the territory of Ľubochnianska valley in Veľká Fatra National Park.

Súhrn

V súčastnosti je viac než jasné, že na Slovensku potrebujeme detailný výskum stavu populácie veľkých šeliem, vypracovanie managementových plánov ako aj plán ochrany. Pokiaľ oficiálne štatistiky zahrňajú viac než 1500 vlkov, iné tvrdia, že po zimnej sezóne lovu ostane menej než 150 zvierat. Táto neskutočná odchýlka ukazuje jasnú potrebu spoľahlivých a najmä objektívnych metód na odhad početnosti veľkých šeliem na Slovensku

Táto správa sa venuje terénnemu výskumu, ktorý sa uskutočnil na základe spolupráce Biosphere expedition s Tomášom Hulíkom z Ochrany karpatskej divočiny. Monitoring veľkých šeliem sa odohrával najmä v Ľubochnianskej doline v Národnom parku Veľká Fatra na severe Slovenska, za medzinárodnej účasti dobrovoľníkov z Biosphere expeditions od 29. januára do 18. februára 2012.

Počas terénneho výskumu bolo monitorovaných 50 transektov v celkovej dĺžke 356 km. Priemerná dĺžka transektu bola 7,11 km. Identifikovaných bolo 59 nálezov stôp a stopových dráh záujmových druhov: 25 patrilo rysovi ostrovidovi (42,4%), 25 vlkovi dravému (42,4%) a 9 stôp patrilo medveďovi hnedému (15,2%)

V záujmovom území bolo na 15 miestach nainštalovaných 9 fotopascí. Fotopasce zaznamenali 1800 fotografií. Na polovici z nich bol zachytený kadáver jelenice (camera trap no. 9), ktorá bola často navštevovaná sojkou škriekavou, ale aj vlkom dravým a orlom skalným. Fotopasce zaznamenali aj vzácne a chránené druhy: medveď hnedý (camera trap no. 14), rys ostrovid (camera trap no. 15), vydra riečna (*Lutra lutra*) (camera trap no. 10), lasica hranostaj (*Mustela erminea*) (camera trap no. 10) a bobor eurázijský (*Castor fiber*) (camera trap no. 10).

Nájdených bolo 18 vzoriek na DNA analýzu (16x moč, 1x exkrement, 1x chlp). 9 vzoriek (50%) patrilo rysovi ostrovidovi (*Lynx lynx*) (určené na základe stôp pri vzorke) a 9 vzoriek (50%) bol vlk dravý (*Canis lupus*). Vzorky zatiaľ čakajú na DNA analýzu.

Veľmi zaujímavé je porovnanie tohto terénneho výskumu s monitoringom veľkých šeliem mapujúcim najmä centrálnu časť Ľubochnianskej doliny (medzi dolinami Krátko a Čierňavy) v rokoch 2008 - 2010. Na lokalitách, ktoré boli veľmi často navštevované veľkými šelmami v rokoch 2008 - 2010 sa počas výskumu v roku 2012 nezaznamenal žiadny pohyb. Jednou z príčin by mohla byť vysoká a sypka snehová pokrývka, ale aj časté návštevy poľovníkov na týchto lokalitách. Tieto skutočnosti však potvrdí až budúci výskum.

Monitoring 2012 potvrdil minimálne dve vlčie svorky na záujmovom území. Počet jednotlivcov vo vlčej svorke nebolo možné presne determinovať. Zaujímavým a cenným dôkazom je fotografia vlka dravého na čerstvom kadávery jelenice v Čierňavách. Fotopasca zaznamenala tohto jedinca hodinu a pol po nainštalovaní. (pozri. wolf photo, camera trap no. 9. vo Figure 2.4).

Veľkým prínosom monitoringu bolo zmapovanie prezencie rysa ostrovida v oblasti Krátko a doline Kračkov. Všetky tri skupiny mali možnosť zaznamenať prítomnosť samice rysa ostrovida aj s juvenilom. Našli sa aj oddychové miesta rysov a pravdepodobne stopové dráhy iných jedincov, čo určí a potvrdí až následná DNA analýza. Napriek veľmi intenzívnemu monitoringu v oblasti Lipová, dolinách Čierňavy a Blatná sme tu nezaznamenali žiadnu stopu rysa. Tieto lokality boli predmentom intenzívneho monitoringu a mali sa tu vyskytovať tri jedince rysa ostrovida. Ich absencia resp. prezencia bude predmetom ďaľšieho výskumu v roku 2013.

Fotopasca č. 15 umiestnená na zvážnici oproti doline Blatná zaznamenala začiatkom apríla rysa zaujímajúceho sa o kadáver jelenice. Toto miesto bolo neďaleko miesta, kde sa v marci 2009 podarilo odfotografovať samicu rysa, tak isto kŕmiacu sa na kadávery jelenice strhnutej vlkmi. Tieto obrázky (pozri Figure 2.5a) sú veľmi dôležité pri budovaní porovnávacej databázy rysov na identifikáciu jedincov na základe ich škvrnitosti.

Jedným z najneočakávanejších výsledkov monitoringu boli fotografie z fotopasce a stopy, resp. stopové dráhy medveďa hnedého. Hoci by mali medvede počas zimy hibernovať, zaznamenali sa štyri prípady, keď tomu bolo inak. S najväčšou pravdepodobnosťou sa jednalo o mladé jedince, ktoré nie sú dostatočné skúsené budovaním nory. Zo zimného spánku ich pravdepodobne zobudil silný mráz, resp. dokrmovanie vysokej zvery lesníkmi a poľovníkmi. Medvede mali dostupný zdroj potravy aj počas zimného obdobia.

Prvý rok monitoringu veľkých šeliem Ľubochnianskej doline v Národnom parku Veľká Fatra bol úspešný a dosiahol svoje ciele. Mimovládna organizácia Ochrana karpatskej divočiny plánuje v spolupráci s Biosphere Expeditions viacročnú spoluprácu. Účasť dobrovoľníkov, Správy Národného parku Veľká Fatra a Lesnej správy Ľubochňa vytvára predpoklad na zber dát a implementáciu nových metód na zaznamenanie populačných, ekologických a etologických parametrov veľkých šeliem na území Ľubochnianskej doliny v Národnom Parku Veľká Fatra.

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1. Expedition Review

M. Hammer & A. Stickler (editors)
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 29 January to 18 February 2012 with the aim of conducting conservation research work on lynx, wolf & wildcat, 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

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 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."

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, diverse type of terrain with gentle upland meadows and pastures, sharp cliffs and deep valleys provide for extremely rich flora and fauna. All species of big central European carnivores live abundantly there: brown bear, gray wolf and Eurasian lynx. The UNESCO World Heritage village of Vlkolínec with well-preserved log cabins lies near.

Figure 1.2b. The Tatra mountains in Slovakia. Red arrow marks the location of base.

1.3. Dates

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

29 January - 4 February | 5 -11 February | 12 - 18 February 2012.

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 Ľubochňa, in a 19th century villa built in the heydays of the Austro-Hungarian empire, when the area was a popular spa holiday destination, because of its beautiful mountain setting and the presence of hot mineral springs. Sixteen such villas were built in Ľubochňa and some of them survive today. Team members shared twin or double or triple rooms, some with en-suite showers and toilets; breakfast and dinner were provided at base and at a restaurant in Ľubochňa and a lunch pack was supplied for each day spent in the field.

Weather

The weather during the expedition was exceptionally cold with good snow cover. Temperatures dropped to below -20^{o} C on many days (see Table 2.4a).

Field communications

There was mobile phone coverage in Ľubochňa, but there was very little mobile phone coverage in the national park study site. There were also hand-held radios for groups working closer together. The villa base had WiFi internet. The expedition leader also 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 Land Rover Defender and one 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. Next to 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. Working in lynxes and other big predator conservation and trying to establish the size of lynx and wolf territories, as well as the ecology of these carnivores, in the Veľká Fatra and Mala Fatra National Parks.

1.6. Expedition leader

The expedition was led by Peter Schuette, who was born in Germany. He studied geography and cartography at the University Bremen (Germany) and Göteborg universitet (Sweden) and geoinformatics in Salzburg (Austria). He has worked in 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 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):

19 January – 4 February 2012

Rudolf Abraham (journalist, UK), Robyn Gray (USA), David Guixé (Spain), James Hegarty (Ireland), Louise Milne (UK), Patricia Smith (Belgium).

5 – 11 February 2012

Dawn Abigail (UK), Astrid Mariaschk (Germany), Helene Rebholz (Austria), Martyn Roberts (UK), Linda Snodden (UK), Gordon Thomson (UK), Martin Ziebell (Germany).

12 – 18 February 2012

Anne Schrödter (Germany), Thomas Crabtree (UK), Juliane Drews (Germany), Christine Fenzl (Austria), Peter Gardiner (Australia), Joanne Gardiner (Australia), Erica Gittins (UK), Matthew Leivers (UK).

In addition for some or all of the time: Daniel Twort (trainee expedition leader, UK), Milos Majda (park ranger, Slovakia), Kate Curnow (Biosphere Expeditions staff, Germany), Matthias Hammer (Biosphere Expeditions founder & executive director, Germany), Jürgen Hatzenbichler (journalist, Austria), Thomas Weber (journalist, Austria).

1.8. Expedition budget

Each team member paid towards expedition costs a contribution of £980 per person per 7 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., as well as 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	20,633
Expenditure	
Expdedition base includes all board & lodging, and extra food & meals	5,709
Transport includes car fuel UK – Slovakia return, car fuel during expedition, train rides	1,092
Equipment and hardware includes research materials & gear etc purchased in UK & Slovakia	1,644
Staff includes local and Biosphere Expeditions staff salaries	5,472
Administration includes miscellaneous fees & sundries	165
Team recruitment Slovakia as estimated % of annual PR costs for Biosphere Expeditions	3,842
Income – Expenditure	**2,709**
Total percentage spent directly on project	**87%**

1.9. Acknowledgements

The expedition was conducted jointly by Biosphere Expeditions and PCW (Protection of Carpathian Wilderness). We are grateful to the volunteers, who not only dedicated their spare time to helping but also, through their expedition contributions, funded the research. Thanks 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, Swarovski Optik, Cotswold Outdoor, Motorola and Gerald Arnhold for their sponsorship.

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 below.

2. Monitoring large carnivores in Ľubochnianska valley

2.1. Introduction

Large carnivores are probably subjected to greater public interest than any other group of wild animals. They are also probably the most difficult to manage in terms of conservation in its current form, due to the fragmentation of their habitat.

Based on the recorded recovery of populations of large predators in Europe, there is an increased necessity to develop methods for monitoring them (Linnell et al. 1998). Generally, in areas were large predators are managed by hunters, accurate data are more of a necessity than in areas with applied conservation (Boitani 1995, Breitenmoser 1998, Von Arx et al. 2004). Slovakia has one of the most well-preserved populations of indigenous large carnivores in Europe. 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*), lynxes (*Lynx lynx*) and wildcats (*Felis silvestris*), all of which are indigenous.

Population estimates can be seen as one of the most important tools for the management and conservation of these species. Various methods can be used, but they must be chosen carefully due to the differing ecology and habits of the species. This study aims to monitor a number of parameters: presence/absence, population trend indicators, census/statistical estimates of population size, reproductive trends and trends in health/fitness (Linnell et al. 1998).

Accurate estimates of population size can be obtained using telemetry research methods, multiple recordings with camera traps and genetic research. Due to logistical and financial constraints, the application of these methods is not, in some cases, suitable to use on larger areas. For this reason, practical management can be supported by a combination of independent recording indexes, which are more useful than statistical estimates of population (Linnell et al. 1998). A population index can record the frequency of some parameters (number of tracks, footprints, excrement and observations). The frequency of these parameters will represent the population density of the species. Methods for producing an index, such as the number of footprints within a kilometer transect at a specific time of snow accumulation, can indicate population density but cannot indicate exact numbers of individuals. In general, these indices are used to record changes over time (Kendall et al. 1992) and area (McCarthy & Munkhtsog 1997).

Recording footprints is probably the most widely used method for the monitoring of large carnivores (Jackson & Hunter 1995). On transect, footprints, excrements, marking places and any other signs of presence of large predators are recorded. Passively recording accumulated footprints in suitable substrate is commonly used to derive the abundance of large carnivores (Linnell et al. 2007). The most commonly used method for obtaining data on the size and structure of populations of large carnivores in Slovakia is the recording of footprints; usually by tracking in winter time. This method has been widely used in the territory of the Soviet Union, North America, Asia and Europe for a wide variety of species of large predators, such as the snow leopard (*Panthera uncia*) and bears (*Ursus* sp.). Linnell et al. (1998) recommended using this method, in combination with other approaches, to monitor the family groups and reproductive trends of lynx and wolf.

In several studies footprints and trace paths were used in the identification of individuals, age class and sex by the shape and size of the feet (Smirnov & Miquelle 1998, Karanth, 1995, Miquelle 2005). However, Karanth (1989), Karanth & Nichols (2000) and many other authors criticise this methodology due to deformation of footprints on the substrate, the individual's speed and slope of the terrain. It is possible that distortion of the identifying sign affects subsequent population estimates. The relevance of the data recorded for estimated home range of the population can be compared through telemetry research or recording methods with extensive use use of camera traps (Laass 1999, 2002; Zimmermann et al. 2011).

2.2. Study area

Veľká Fatra national park is situated between the geographic coordinates, north latitude 48 ° 47 '- 49 ° 09' and east longitude 18 ° 50 '- 19 ° 18'. The national park belongs to the Inner Western Carpathian sub-province, 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.

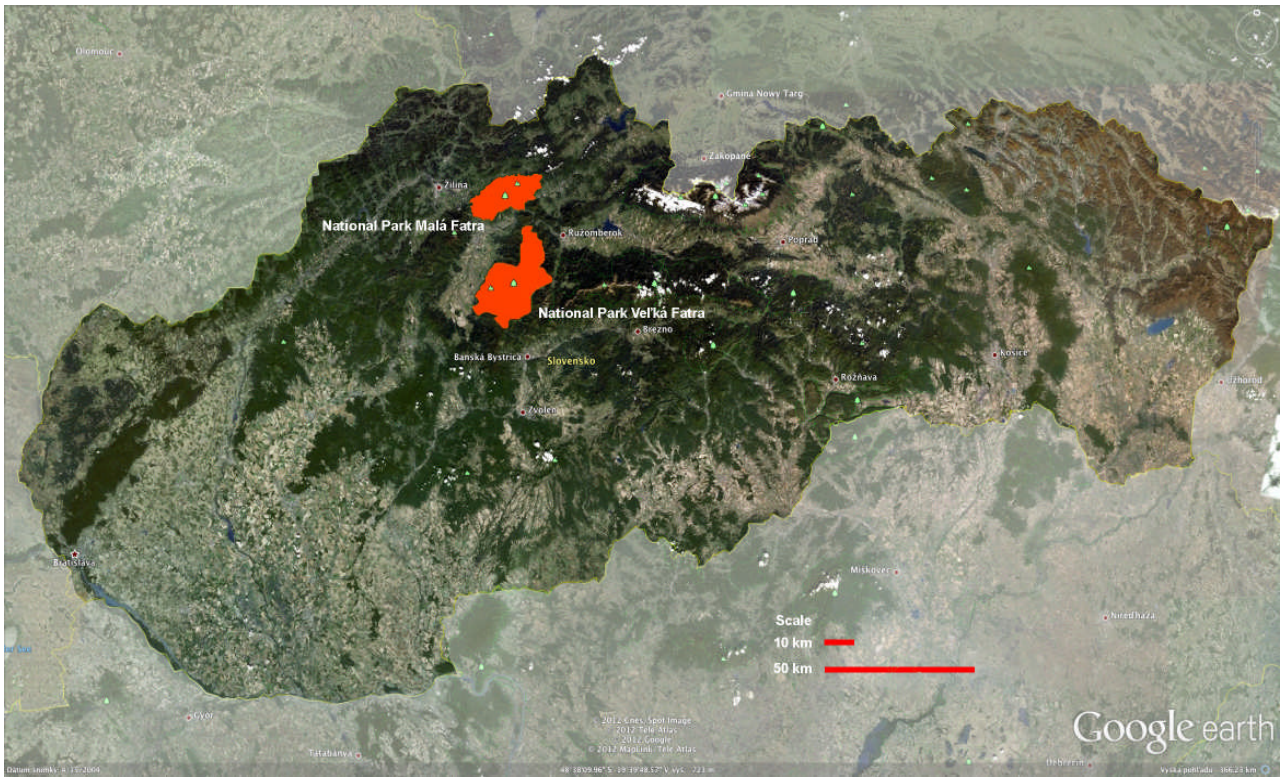

Figure 2.2a. Map: The territory of Slovakia with National Park Malá Fatra and National Park Veľká Fatra in red.

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. Deep streams have carved valleys into the Mesozoic crystalline rock. The longest being the Ľubochnianska. This valley divides the Veľká Fatra Park from south to north and flows to the center of the Liptov and Turiec area (Vestenický, Vološčuk 1986). The park's lowest point is at the river Vah near Krpelianska dam (420 meters), the highest peak is Ostredok (1,592 meters).

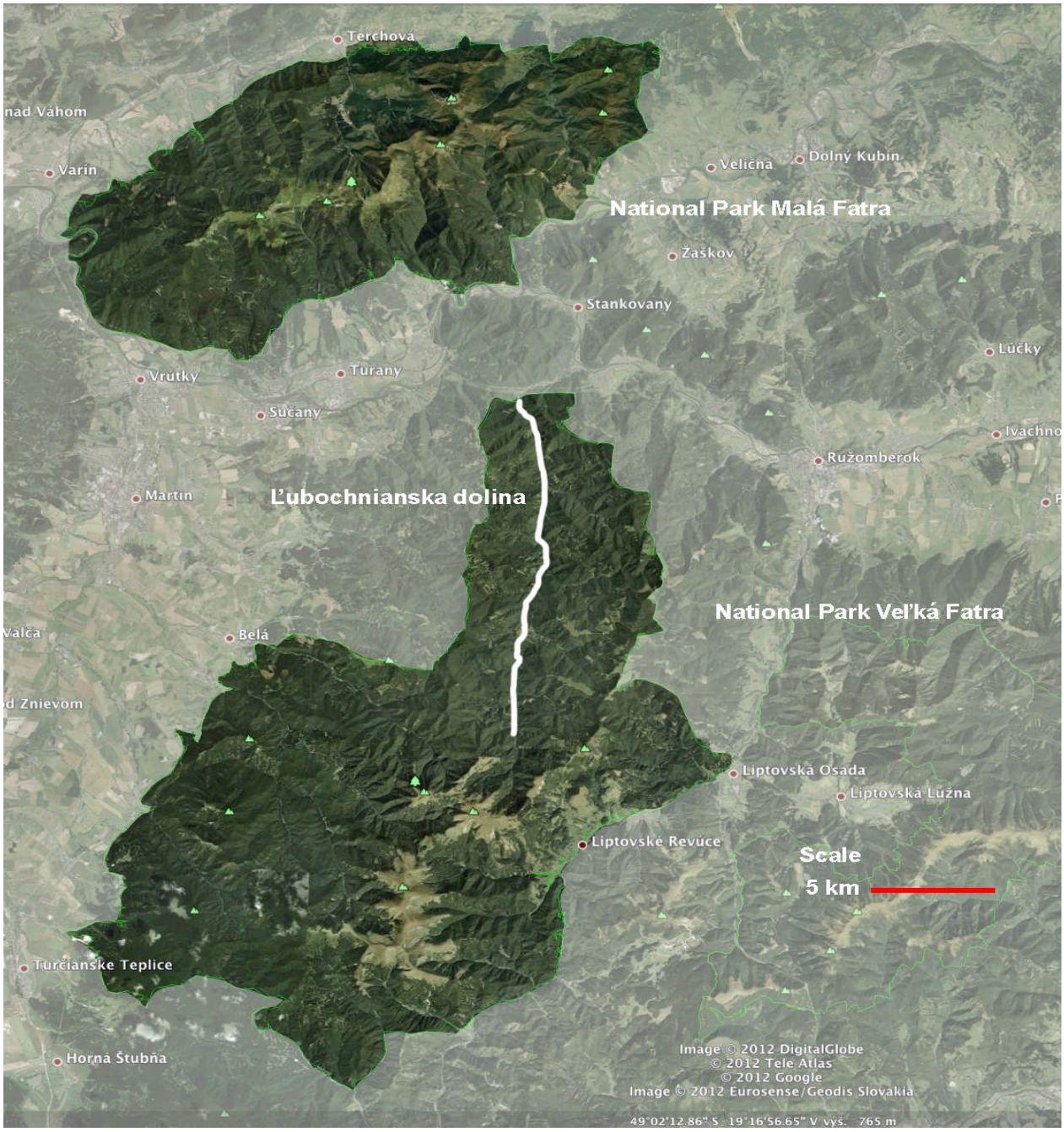

Figure 2.2b. Map: National Park Veľká Fatra with Ľubochnianska Valley and National Park Malá Fatra

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 timberline. The limestone and dolomite ground supports growth of Scot's pine and smaller oaks. In higher or exposed areas there are reduced growth trees. Veľká Fatra is characterised by a high occurrence of yew trees, 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 as well as 60 species of mammals (Vestenický and Vološčuk 1986).

Common mammals include; deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*), wild boar (*Sus scrofa*), hare (*Lepus europeus*) 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 wall-creeper (*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 1200 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 ends along the ridge of Ploská and Čierny kameň.

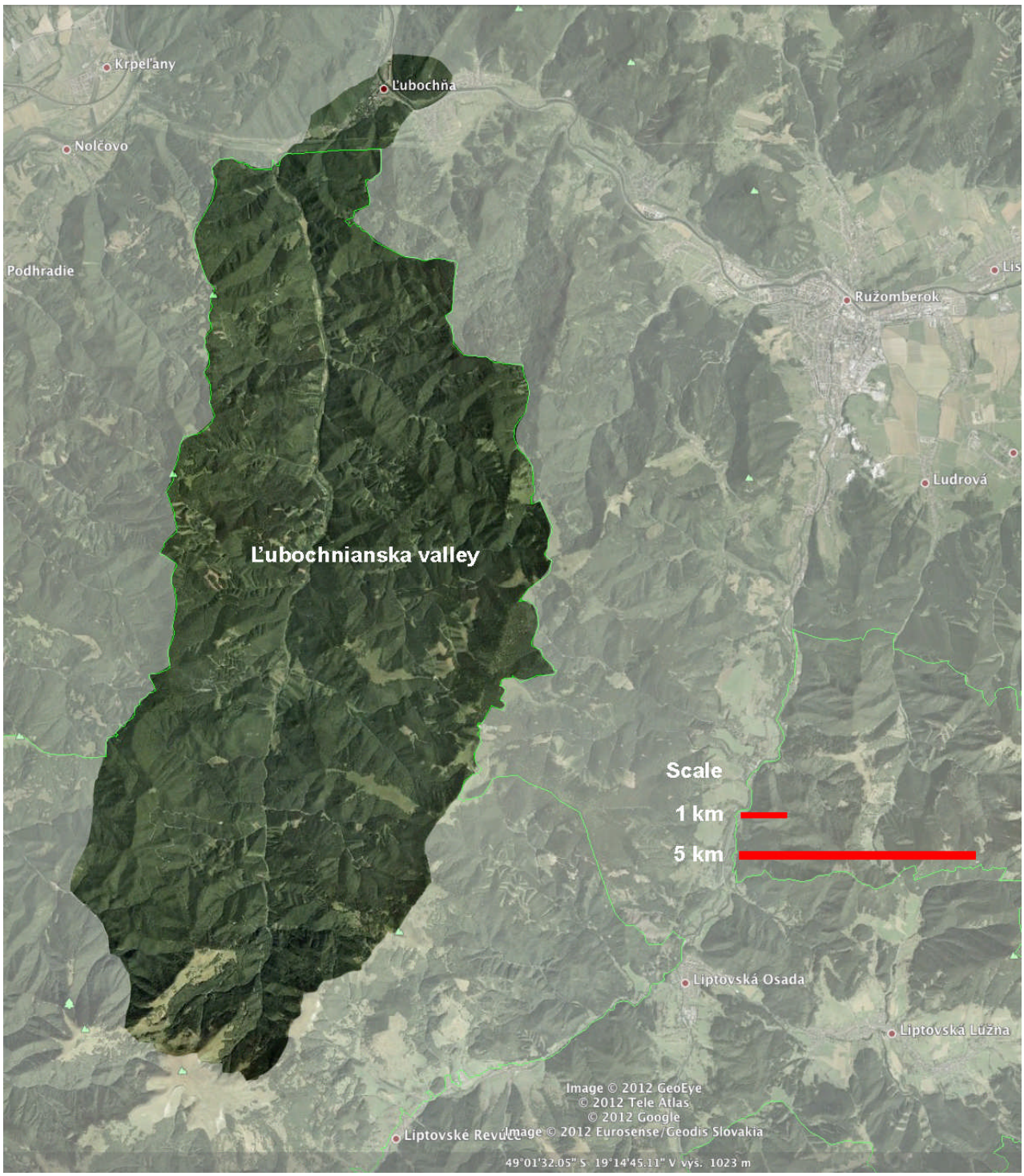

Figure 2.2c. Map of Ľubochnianska Valley

2.3. Materials and methods

Track survey

A focus of the research was to capture trace elements (tracks and trace paths) of species of interest within field monitoring of predetermined transects (Linnell et al. 1998, Miquelle, 2005), based on previous recorded data from monitoring of large carnivores in the years 2008 - 2011. A scientist along with volunteers carried out this activity in the period from 29 January - 18 Februrary 2012 over three separate groups in Ľubochnianska Valley in the Veľká Fatra National Park and selected adjacent areas.

The first two days day of each group was devoted to the training of volunteers. On day one especially identification of trace elements, including footprints and their recognition/recording on various substrates. Volunteers also received training for working with GPS devices and data collection protocols. The second day of training focused on identifying tracks and the practical implementation of these skills in the field. During the two-day training phase, volunteers were also instructed in the use of snowshoes and other equipment along with the practical application of 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 was given diagrams, which showed footprints and photos of the target species that are likely to be confused, a ruler for precise measurements of length and width of footprints, research sheets for recording data, a GPS device (Garmin GPS 60), radios for communication between groups and a plastic box with bags and tubes containing alcohol for collecting samples, from which DNA could be obtained later (e.g. from urine, hair, faeces or blood).

Predators in the study area are elusive and very difficult to observe directly. Therefore transects were established (in Ľubochnianska valley) and monitored systematically by the expedition team. The main valley has several forest roads on both sides. Records of trace elements and samples suitable for DNA analysis were collected and recorded in the research sheets with the exact GPS position along with details of the type, the frequency (in case of a wolf pack or a lynx female with a juvenile), trace elements plus parameters (length, width and estimated age of the track), the direction of movement of the individual and the substrate type and condition of snow cover, where appicable. 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. In case of GPS signal loss due to vegetation or terrain, missing data points were obtained via Google Earth. Recorded transects, tracks and footprints were then imported into ArcGIS (ESRI, USA) and using the MCP method (Mohr 1947), the estimated home range of identified individuals was calculated. During these computations, home range would vary widely when few data points were present, but would approach a constant with more data gathered during the expedition. Once this was the case, the data were further analysed using various methods as described by Miquelle (2005).

Finally, weather is an important factor in field research as it can affect the recording of tracks and trace routes. Activity of large carnivores is limited during periods of heavy snow (Linnell et al. 1998). Data on temperature and weather conditions were used for analysis by the software program ArcGIS (ESRI, USA).

Genetic analysis

Samples suitable for DNA analysis (excrement, urine, hair or blood) were collected in the field into a tube with concentrated 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. DNA markers were identified in accordance with Mastermacher, (2006), Schmidt & Kowalczyk (2006) and Downey et al. (2007). Subsequent genetic analysis using PCR methods is able to identify individuals and confirm species.

Camera trapping

One of the most important components of this research was the application of camera traps (Cuddeback Capture IR). Positions for the camera traps were identified on the basis of previous experience by the expedition scientist and trace elements such as marking sites or carcasses following Laas (1999 and 2002). The expedition laid the foundation for future intensive camera trapping following Karanth (1995) and Zimmermann et al. (2011) with the long-term aim to estimate population parameters of lynx and wolf in the study site.

2.4. Results

Track survey

In 2012, before research commenced, large amounts of snow fell at the end of January 2012. Ľubochnianska received 50 cm of snow in the lower parts of the valley and up to 120 cm in the higher parts. At the beginning of monitoring conditions were optimal for tracking. Towards the end of the research period up to 60 cm of fresh snow fell in the valley. Because moving in deep snow is difficult and energy-demanding for large predators, no animals were observed. Temperature during the entire research period kept well below zero (until the last two days, see Table 2.4a).

During the expedition period 50 transects were surveyed, with a total length of 356 km. The average length of a transect was 7.11 km. Volunteers in group 1 surveyed 132.68 kilometers over 17 transects, averaging 7.8 km per transect. Group 2 surveyed 128.24 km over 17 transects, covering an average of 7.54 km per transect. Group 3 surveyed 94.95 km over 16 transects covering an average of 5.93 km per transect.

59 footprints and trace tracks were identified on these transects. 25 belonged to lynx (42.4%), 25 to wolf (42.4%) and 9 tracks were made by brown bears (15.2%).

Table 2.4a. Overview of temperature values at the Slovak Hydrometeorological Institute, Ružomberok, Ľubochňa.

Date	T max °C	T min °C	T 7.00 °C	T 14.00 °C	T 21.00 °C	T 8.00 °C	T 15.00 °C	T 7.00 °C	Fresh snow
Location	Ružom-berok	Ružom-berok	Ružom-berok	Ružom-berok	Ružom-berok	Ľubo-chňa	Ľubo-chňa	Ľubo-chňa valley	Ružom-berok / Ľubo-chňa valley
29.01.2012	-1.5	-12	-11.6	-3.7	-11.2	-10	-5	-16	
30.12.2012	-3.7	-18.2	-18	-5.8	-12	-14	-7	-19	
31.01.2012	-4.2	-17.8	-17.5	-8	-13.7	-14	-8	-21	
01.02.2012	-9.7	-18.7	-18.5	-9.8	-14.9	-17	-15	-21	
02.02.2012	-11.9	-23	-22.8	-12.3	-20.7	-20	-14	-25	
03.02.2012	-13.1	-24.5	-24.5	-13.2	-17.8	-21	-14	-28	
04.02.2012	-12	-19.3	-19.3	-12.4	-13.6			-22	5
05.02.2012	-8.9	-17.1	-16.3	-9.2	-15.6	-14	-12	-20	-/snow
06.02.2012	-11.4	-21.4	-21.4	-13.2	-14	-17	-12	-23	1
07.02.2012	-8.3	-14.2	-13.4	-9.3	-13	-13	-9	-17	- /3 cm
08.02.2012	-8.8	-18.8	-18.6	-9.7	-11.8	-17	-8	-20	
09.02.2012	-6.6	-16.9	-16.4	-6.8	-10.3	-13	-6	-19	1/-
10.02.2012	-5.5	-19.2	-19.2	-6.5	-14.6	-15	-8	-22	
11.02.2012	-6.8	-23.5	-23.5	-7	-15.4		-8	-24	
12.02.2012	-7	-22.5	-22.5	-7	-17.5	-19		-24	
13.02.2012	-6.5	-22	-21.2	-6.7	-10			-23	-/10 cm
14.02.2012	-1.8	-10.5	-9.4	-1.9	-6.9			-12	6/-
15.02.2012	-1.7	-13	-9.3	-2	-2.4			-7	15/35
16.02.2012	-1.5	-5	-4.5	-1.6	-4.7			-7	2/25
17.02.2012	1	-6.8	-6	0.2	-0.2			-8	3/-
18.02.2012	6.6	-1	-0.3	5	-0.4			-4	-/10

Table 2.4b. Summary of results: transects surveys by group and presence of lynx, wolf and bear tracks on transects.

	Transect surveyed		Lynx tracks		Wolf tracks		Bear tracks	
	n	km	n	frequency track/km	n	frequency track/km	n	frequency track/km
Group 1	17	132.68	5	26.53	15	8.85	7	18.95
Group 2	17	128.24	11	11.66	10	12.82	2	64.12
Group 3	16	94.95	9	10.55	0	0	0	0
Total	**50**	**355.87**	**25**	**14.23**	**25**	**14.23**	**9**	**39.54**

Table 2.4c. Overview of tracks recorded. Lines indicate research groups 1,2 and 3.

No.	Date	Species	GPS			Footprint		Bearing	Age
			Deg	min	sec	width cm	length cm		
1	31.01.2012	*Lynx lynx*	N49	05	15.64				fresh
			E19	8	57.9				
2	31.01.2012	*Lynx lynx*	N49	05	20.1	6	7.5	252	fresh
			E19	10	34.5				
3	31.01.2012	*Lynx lynx*	N49	04	30.3	6	7.5	252	fresh
			E19	09	35.1				
4	31.01.2012	*Ursus arctos*	N49	01	33.3	12.5		125	older
			E19	08	50.9				(one week)
5	31.01.2012	*Ursus arctos*	N49	01	31.7	12.5		325	older
			E19	08	37.9				(one week)
6	31.01.2012	*Ursus arctos*	N49	01	51.8	14		190	older
			E19	08	46.5				(one week)
7	31.01.2012	*Ursus arctos*	N49	01	53.0	12			older
			E19	08	48.5				(one week)
8	01.02.2012	*Ursus arctos*	N49	03	26.4	14	17	111	older
			E19	11	22.9				
9	01.02.2012	*Lynx lynx*	N49	03	11.0				older
			E19	09	49.2				
10	01.02.2012	*Ursus arctos*	N49	02	45.4	14	18	350	older
			E19	10	01.5				
11	01.02.2012	*Canis lupus*	N48	59	54.4	8.5	11.5	60	older
			E19	08	26.0				
12	01.02.2012	*Canis lupus*	N48	00	28.4	10	13.5	250	older
			E19	08	58.1				
13	01.02.2012	*Canis lupus*	N49	00	30				older
			E19	08	47.7				
14	01.02.2012	*Canis lupus*	N49	01	54.4	10	13	210	older
			E19	09	12.6				
15	01.02.2012	*Canis lupus*	N49	01	56.8	10	13		very fresh
			E18	09	24.5				
16	01.02.2012	*Canis lupus*	N49	00	0.0	10			fresh
			E19	06	56.0				
17	01.02.2012	*Canis lupus*	N48	00	12.15				older
			E19	08	26.1				
18	02.02.2012	*Canis lupus*	N49	02	39.3	9.5	11	360	fresh
			E19	09	17.2				
19	02.02.2012	*Lynx lynx*	N49	15	30.9	6.5			older
			E19	06	22.5				
20	02.02.2012	*Canis lupus*	N49	01	39.6			322	older
			E19	10	1.7				
21	02.02.2012	*Canis lupus*	N48	59	53.7	8	9	89	older
			E19	08	23.7				
22	02.02.2012	*Canis lupus*	N49	0	39.4	9	11	20	older
			E19	08	40.4				
23	03.02.2012	*Canis lupus*	N49	04	54.2	9	10	228	older
			E19	09	03.7				
24	02.02.2012	*Canis lupus*	N49	05	05.7	9	10	120	older
			E19	09	02.7				
25	02.02.2012	*Canis lupus*	N49	05	27.4	8	10	286	older
			E19	08	55.9				
26	02.02.2012	*Canis lupus*	N49	05	28.8	8	10	242	older
			E19	08	56.9				
27	03.02.2012	*Lynx lynx*	N49	10	32.9	8			fresh
			E19	04	52.3				
28	03.02.2012	*Ursus arctos*	N49	10	36.4	14			fresh
			E19	04	55.2				
29	06.02.2012	*Lynx lynx*	N49	04	59.9	7.5	7	180	fresh
			E19	09	20.4				
30	06.02.2012	*Lynx lynx*	N49	04	59.9	7.5	8	20	fresh
			E19	09	20.4				

31	06.02.2012	*Lynx lynx*	N49 E19	05 09	04.7 26.1	7	7.5	180	fresh
32	06.02.2012	*Lynx lynx*	N49 E19	05 09	05.3 25.3	6.5	7	280	fresh
33	07.02.2012	*Lynx lynx*	N49 E19	04 09	56.3 08.0	7	7.5	80	very fresh
34	07.02.2012	*Canis lupus*	N49 E19	05 09	36.9 11.4	9.5	12	70	very fresh
35	07.02.2012	*Canis lupus*	N49 E19	01 08	8 34.1	7	11	164	older
36A	07.02.2012	*Canis lupus*	N49 E19	03 09	5.44 1.22	8	11	322	fresh
36B	07.02.2012	*Canis lupus*	N49 E19	03 09	7.19 1.77				fresh
37	07.02.2012	*Canis lupus*	N49 E19	04 09	2 56.7	9	12	180	very fresh
38	08.02.2012	*Canis lupus*	N49 E19	03 10	59.5 05.7	9	10	200	very fresh
39	08.02.2012	*Canis lupus*	N49 E19	03 10	49.7 23.8				older
40	08.02.2012	*Canis lupus*	N49 E19	04 10	10.7 23.0			90	very fresh
41A	08.02.2012	*Canis lupus female*	N49 E19	04 10	12.1 19.4	8	10		fresh
41B	08.02.2012	*Canis lupus male*	N49 E19	04 10	12.1 19.4	10	12		fresh
42	08.02.2012	*Ursus arctos*	N49 E19	00 10	53.7 44.4	9	16	5	fresh
43	09.02.2012	*Lynx lynx*	N49 E19	04 08	09.1 19.5	9	10	100	fresh
44	09.02.2012	*Lynx lynx*	N49 E19	04 08	54.7 53.8	7	7.5	230	fresh
45	09.02.2012	*Lynx lynx*	N49 E19	04 09	27.6 08.7	8	8.5	240	fresh
46	09.02.2012	*Lynx lynx*	N49 E19	05 09	37.3 15.1				very fresh
47	10.02.2012	*Ursus arctos*	N49 E19	11 05	07.5 04.5	15	25		very fresh
48	10.02.2012	*Lynx lynx*	N49 E19	11 05	21.8 00.6				older
49	10.02.2012	*Lynx lynx*	N49 E19	11 05	40.3 56.5				older
50	13.02.2012	*Lynx lynx*	N49 E19	04 09	56.7 09.0	7	7.5	330	very fresh
51	14.02.2012	*Lynx lynx*	N49 E19	04 09	34.2 11.6	7	8	181	very fresh
52	14.02.2012	*Lynx lynx*	N49 E19	04 09	27.3 15.5	7	7.5	328	very fresh
53	14.02.2012	*Lynx lynx*	N49 E19	04 09	27.3 15.5	5.5	6	143	very fresh
54	14.02.2012	*Lynx lynx*	N49 E19	04 08	27.6 45.9	6.5	6.5	315	fresh
55	14.02.2012	*Lynx lynx*	N49 E19	04 08	52.3 57.1	6.5	6.5	260	fresh
56	14.02.2012	*Lynx lynx*	N49 E19	05 09	6.1 3.2	7	7.5		fresh
57	14.02.2012	*Lynx lynx*	N49 E19	05 09	6.6 4.1	7	7.5		older
58	14.02.2012	*Lynx lynx*	N49 E19	05 09	6.1 3.2	6	7		fresh

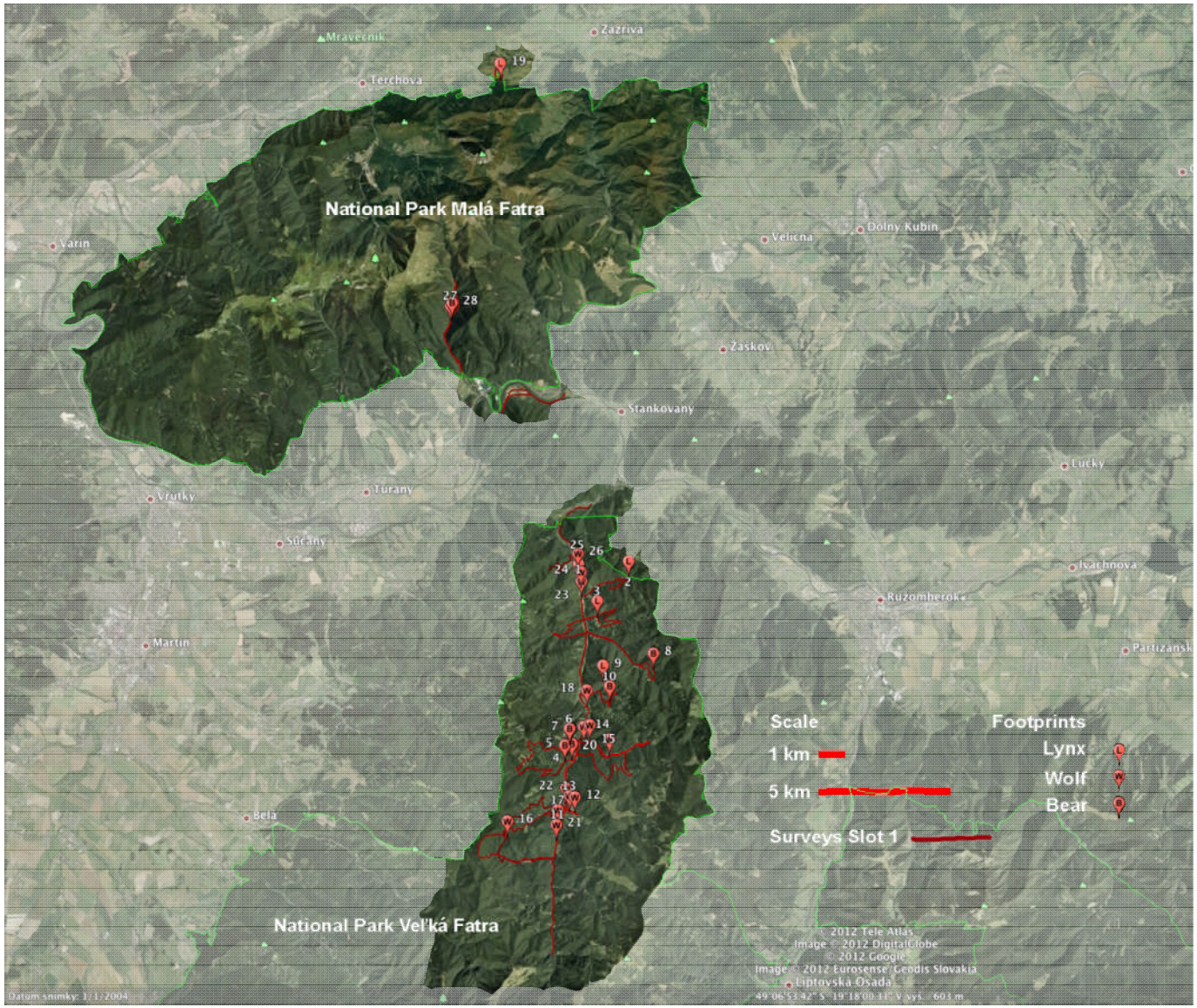

Figure 2.4a. Transects and tracks for group 1.

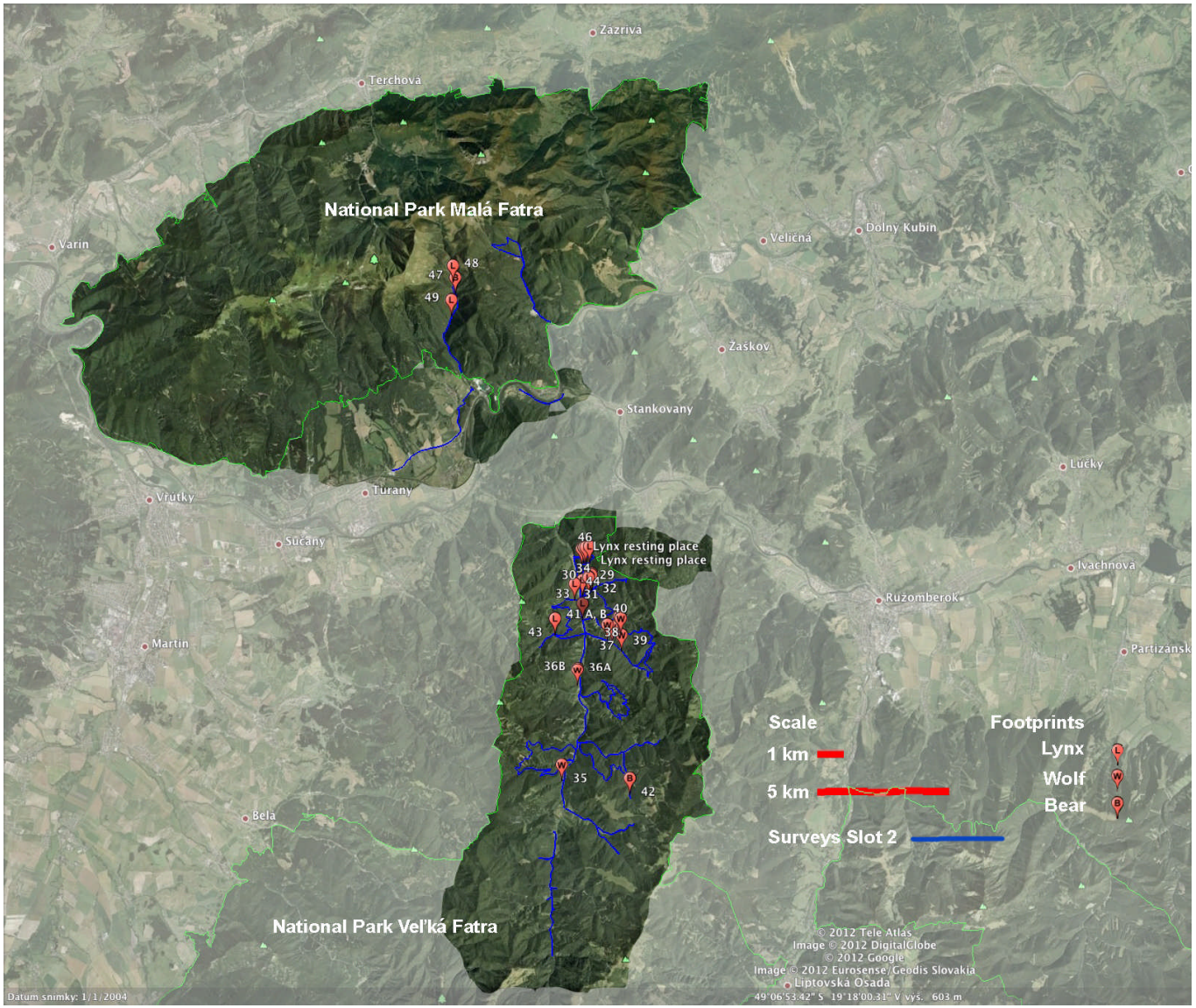

Figure 2.4b. Transects and tracks for group 2.

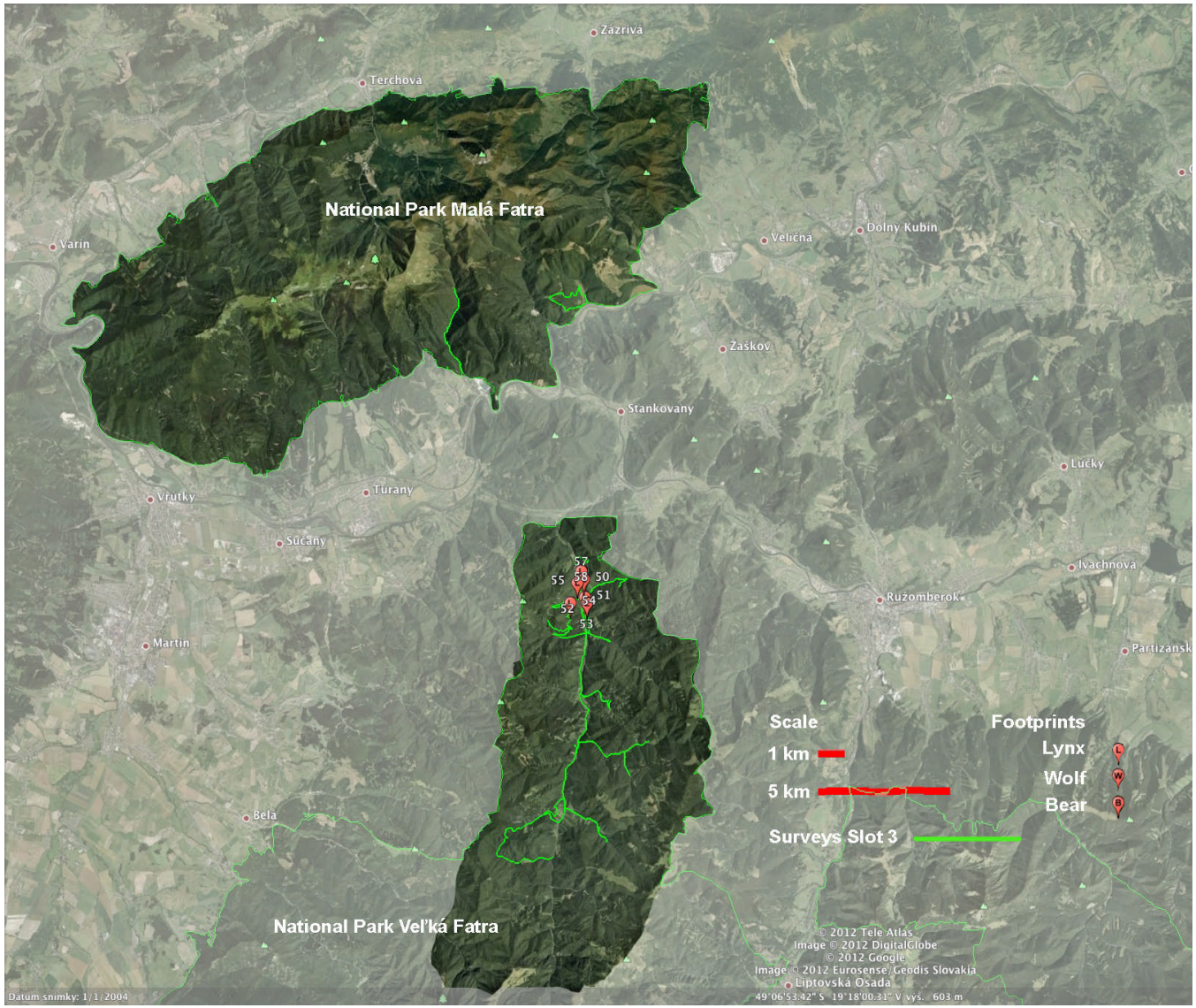

Figure 2.4c. Transects and tracks for group 3.

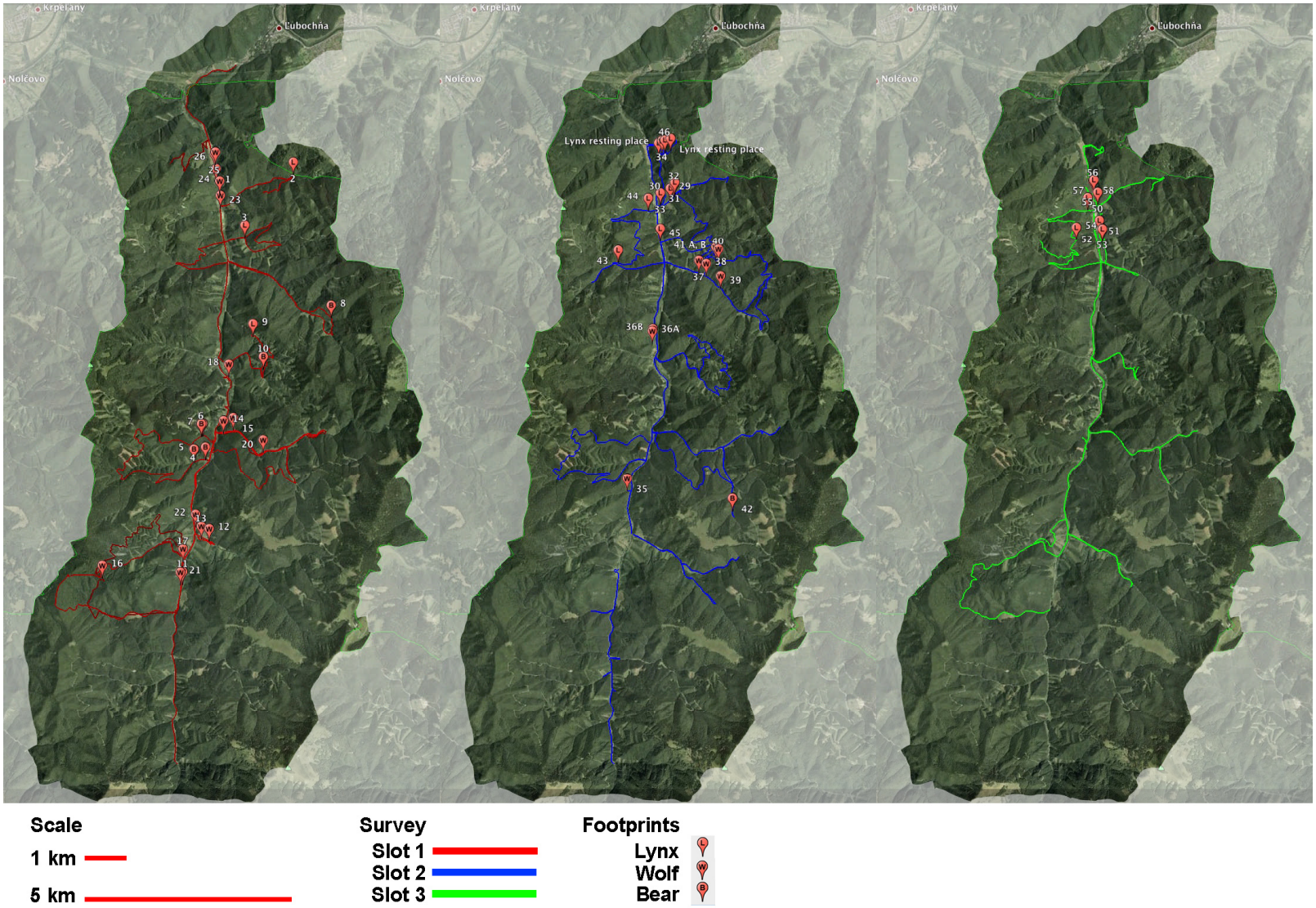

Figure 2.4d. Overview of monitoring transects, all groups.

Samples for DNA analysis

18 samples were collected (16 urine, 1 scat, 1 hair) for DNA analysis: 9 samples (50%) were confirmed, by tracks, to be from lynx (*Lynx lynx*) and 9 samples (50%), gray wolf (*Canis lupus*). Results are summarised in Table 2.4e.

Large carnivore prey records

During the field research carcasses were reported. In some cases it was possible to identificy the predator. Carcass records representing five individual deer (*Cervus elaphus*) and two roe deer (*Capreolus capreolus*) were made. One case of natural death was recorded.

Table 2.4d. Carcasses found by the expedition.

No.	Species of cadaver	Probable cause of death	GPS position			Date of discovery
			deg	min	sec	
1	*Capreolus capreolus female*	Lynx (*Lynx lynx*)	N 49° E 19°	5′ 8′	15.64″ 57.90″	31.01.2012
2	*Cervus elaphus, female*	Wolf (*Canis lupus*)	N 49° E 19°	0′ 8′	28.60″ 58.60″	01.02.2012
3	*Capreolus capreolus female*		N 49° E 19°	1′ 8′	48.00″ 25.00″	01.02.2012
4	*Cervus elaphus, female*	Wolf (*Canis lupus*)	N 49° E 19°	5′ 10′	15.57″ 32.35″	01.02.2012
5	*Cervus elaphus, female*		N 49° E 19°	4′ 9′	58.80″ 20.60″	10.02.2012
6	*Cervus elaphus, male*	Bear (Ursus arctos)	N 49° E 19°	10′ 4′	6.67″ 47.50″	10.02.2012
7	*Cervus elaphus, female*	coldness, deep snow	N 49° E 19°	0′ 8′	30.34″ 9.03″	10.02.2012

Table 2.4e. Summary of DNA samples. Dividing lines indicate research groups 1,2 and 3.

No.	Date	GPS position			Species	Sample type
		deg	min	sec		
1	31.01.2012	49 19	5 10	19.8 36.2	*Lynx lynx*	Urine
2	01.02.2012	49 19	0 8	30.0 57.0	*Canis lupus*	Urine
3	01.02.2012	49 19	0 8	30.0 57.0	*Canis lupus*	Urine
4	01.02.2012	49 19	1 9	55.0 25.0	*Canis lupus*	Urine
5	01.02.2012	49 19	1 9	55.0 25.0	*Canis lupus*	Urine
6	01.02.2012	48 19	59 6	58.81 56.0	*Canis lupus*	Urine
7	01.02.2012	49 19	0 8	11.5 25.57	*Canis lupus*	Urine
8	07.02.2012	49 19	5 9	35.3 6.8	*Lynx lynx*	Urine
9	07.02.2012	49 19	5 9	35.3 6.8	*Lynx lynx*	Hair
10	07.02.2012	49 19	5 9	36.4 8.1	*Lynx lynx*	Urine
11	08.02.2012	49 19	4 9	2 56.7	*Canis lupus*	Urine
12	08.02.2012	49 19	3 10	51.7 19.4	*Canis lupus*	Scat
13	08.02.2012	49 19	4 10	10.7 23.0	*Canis lupus*	Urine
14	09.02.2012	49 19	5 9	37.8 16.0	*Lynx lynx*	Urine
15	09.02.2012	49 19	4 9	43.4 29.6	*Lynx lynx*	Urine
16	09.02.2012	49 19	4 8	18.8 44.2	*Lynx lynx*	Urine
17	14.2.2012	49 19	5 8	8.9 33.9	*Lynx lynx*	Urine
18	14.2.2012	49 19	4 8	27.6 45.9	*Lynx lynx*	Urine

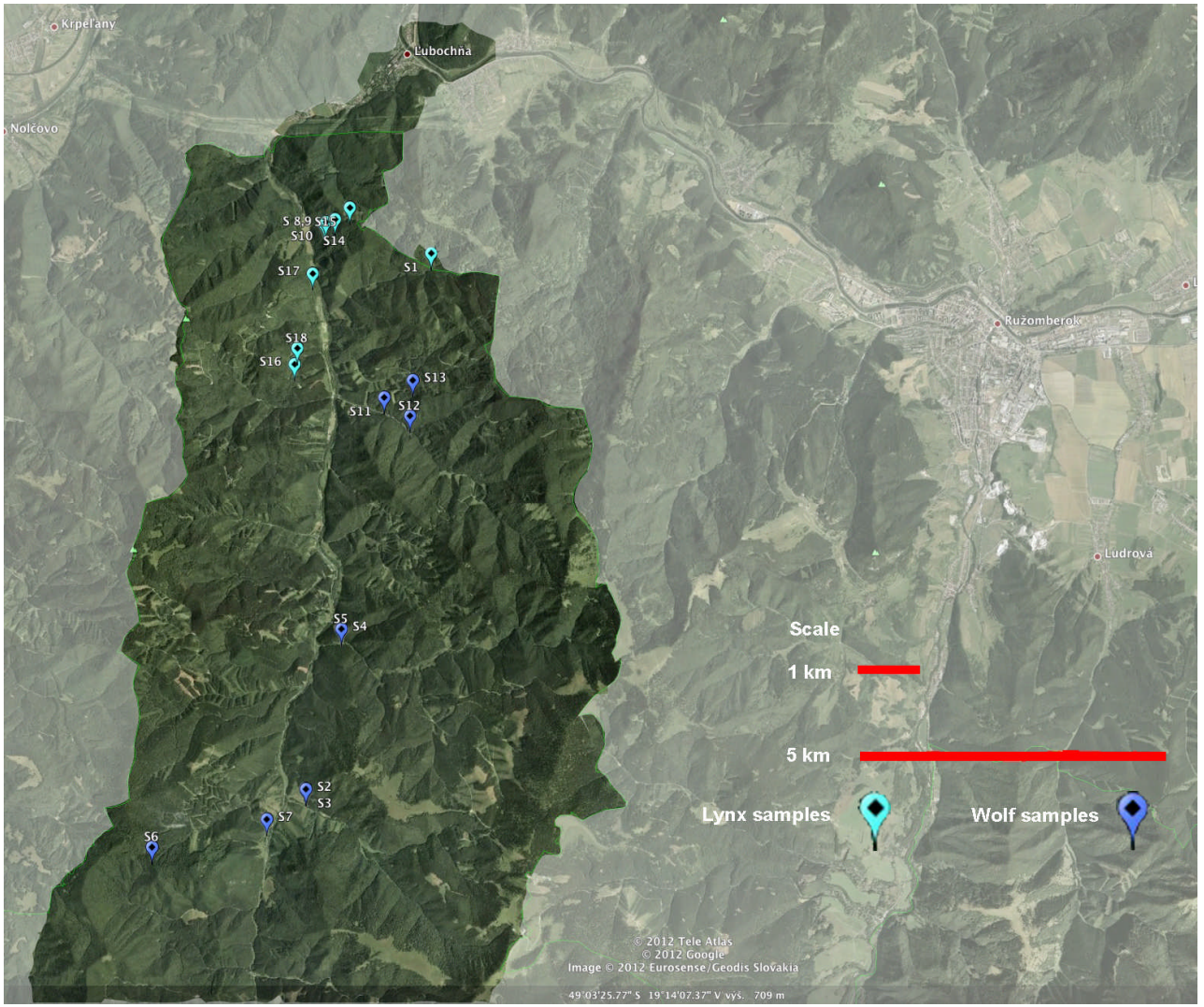

Figure 2.4e. Locations of DNA samples collected.

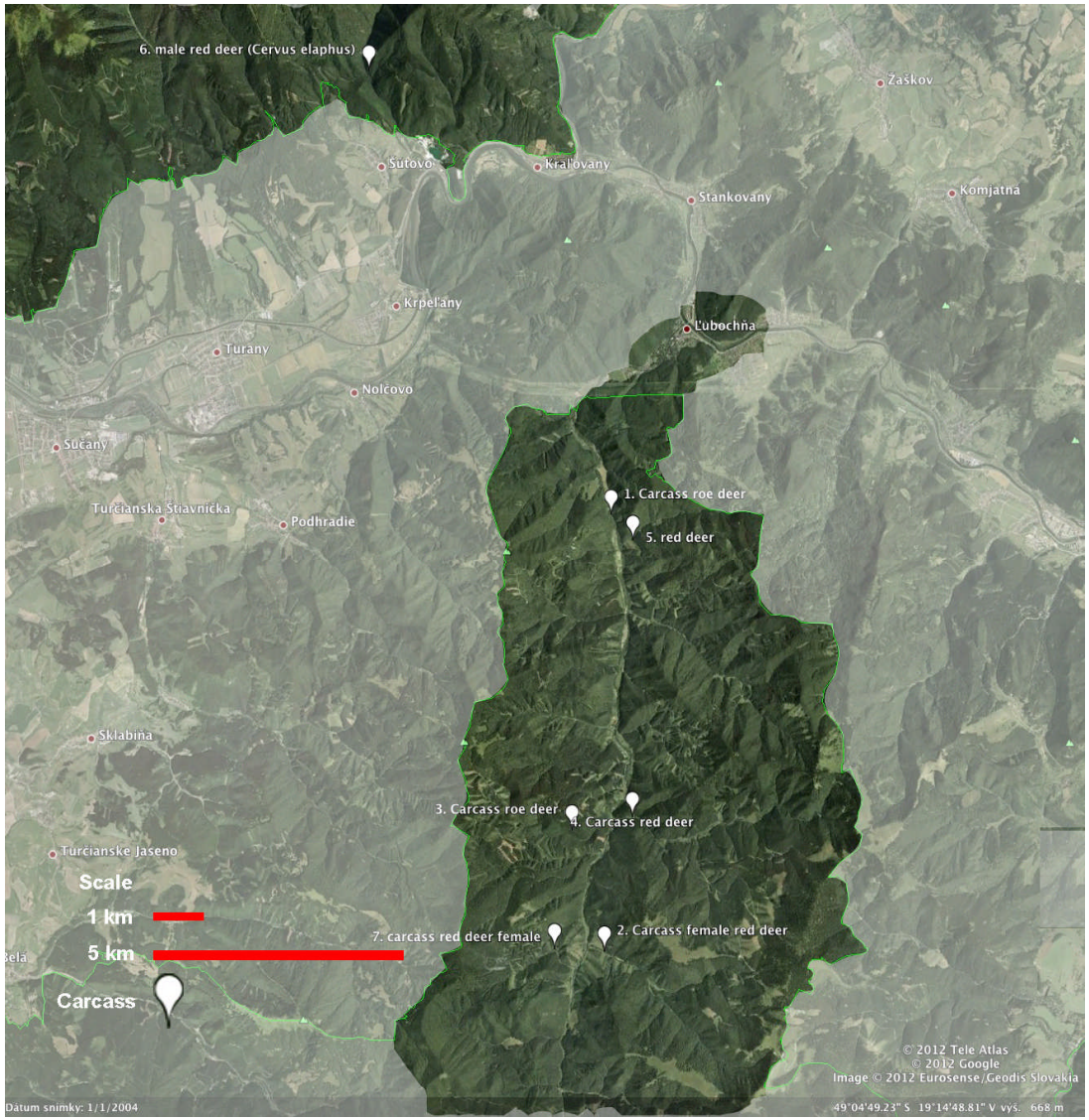

Figure 2.4f. Locations of carcasses found.

Camera trapping

Nine camera traps were placed in the study area at a total of 15 positions. 1,800 photos were captured. Half of the photographs were captured by a female deer carcass (camera trap no. 9), which was frequently visited by wolves and a golden eagle. The equipment recorded several rare and protected species: bear (camera trap no. 14), lynx (camera trap no. 15), otter (*Lutra lutra*) (camera trap no. 10), stoat (*Mustela erminea*) (camera trap no. 10) and the Eurasian beaver (*Castor fiber*) (camera trap no. 10).

Table 2.4f. Camera trap results.

No	Name	GPS position			Placed on	Recovered on
		deg	min	sec		
1	Live trap 1	N 49° E 19°	0′ 9′	5.00″ 57.81″	27.01.2012	07. 02. 2012
2	Live trap Blatna	N 49° E 19°	0′ 9′	1.43″ 56.77″	26.01.2012	08. 02. 2012
3	Above cottage	N 49° E 19°	1′ 9′	40.35″ 4.54″	27.01.2012	07. 02. 2012
4	Deer trail	N 49° E 19°	5′ 10′	15.57″ 32.35″	31.01.2012	06. 02. 2012
5	Lynx carcass	N 49° E 19°	5′ 8′	15.70″ 58.20″	31.01.2012	07.02.2012
6	Blatná carcass	N 49° E 19°	0′ 8′	29.11″ 56.53″	01.02.2012	01. 03. 2012
7	Wolf path	N 48° E 19°	59′ 6′	58.50″ 58.00″	01.02.2012	28.04.2012
8	Wild boar resting place	N 48° E 19°	59′ 6′	37.00″ 39.50″	01.02.2012	29.04.2012
9	Čierňavy carcass	N 49° E 19°	1′ 9′	57.20″ 24.21″	01.02.2012	13.02.2012
10	Otter lodge	N 49° E 19°	9′ 7′	10.71″ 5.13″	07.02.2012	29.04.2012
11	Lynx den	N 49° E 19°	5′ 9′	35.20″ 7.00″	09.02.2012	17.03.2012
12	Lynx marking place	N 49° E 19°	5′ 9′	35.30″ 9.17″	09.02.2012	17.03.2012
13	Deer feeding station Klencovky	N 49° E 19°	0′ 8′	3.01″ 21.00″	10.02.2012	01. 03. 2012
14	Šútovo, carcass, bear tracks	N 49° E 19°	10′ 4′	6.83″ 47.35″	12.02.2012	17.02.2012
15	Dead carcass on the road	N 49° E 19°	0′ 8′	30.21″ 8.99″	15.02.2012	28.04.2012

Figure 2.4g. Camera trap locations.

Lynx (*Lynx lynx*), Camera trap no. 15.

Wolf (*Canis lupus*), Camera trap no. 9.

Bear (*Ursus arctos*), Camera trap no. 14.

Otter (*Lutra lutra*), Camera trap no. 10.

Eurasian beaver (*Castor fiber*), stoat (*Mustela erminea*), red deer (Capreolus capreolus), Camera trap no. 10.

Figure 2.4h. Camera trap sample photos.

Wild boar (*Sus scrofa*), Camera trap no. 8, jay (*Garullus glandarius*), golden eagle (*Aquila chrysaetos*), Camera trap no. 9.

Buzzard (*Buteo buteo*), Camera trap no. 5, deer (*Cervus elaphus*), Camera trap no. 13.

Wild boar (*Sus scrofa*), squirell (*Sciurus vulgaris*) Camera trap no. 12, badger (*Meles meles*), Camera trap no. 11.

Golden eagle (*Aquila chrysaetos*), marten (*Martes martes*), fox (*Vulpes vulpes*) Camera trap no. 15.

Figure 2.4h (continued). Camera trap sample photos.

2.5. Discussion & conclusions

There is a need for detailed assessment of the status of large carnivores in Slovakia. This is to inform management decision-makers about the protection of hunted species and to avoid over-exploitation. Knowledge of the size and structure of populations of a species is needed before conservation plans can be put into action (Bufka et al. 2000). Population size and conservation status are often at conflicts (Blanco & Cortes 2002). Ongoing monitoring and research can contribute significantly by recording the parameters of populations of large carnivores in the study site and assist in evaluating the status of these species in Slovakia.

In several studies footprints and trace paths were used in the identification of a species' age class and sex by the shape and size of their feet (Smirnov & Miquelle 1998, Karanth 1995, Miquelle 2005). However, Karanth (1989), Karanth & Nichols (2000) and many other authors criticise this methodology due to deformation of footprints on the substrate, the individual's speed and slope of the terrain. It is possible that distortion of the identifying sign affects subsequent population estimates. This method therefore has a number of drawbacks, which are mainly due to time, organisational complexity, nature of the substrate, quality of snow and many others. The results obtained by this method tell us very little about the spatial activity of individuals (Bufka et al. 2000) as the data are collected over a limited time during the year. The data do not provide us with a picture of population dynamics over a year, especially total population flux and home range size. Therefore these data should be combined with data using other research (Linnell et al. 2007). Parameters of the population in the future will be compared through telemetry research or multiple recording methods with intensive use of camera traps (Laass 1999, 2002; Zimmermann et al. 2011).

The turn of January and February of 2012 was characterised by extreme weather conditions. Snow depth, but especially strong frost (up to -29 ˚ C) created unfavorable conditions for tracking animals and also negatively affected predator activity. Because of the heavy frost and snowfall, the snow was very loose and deep, making movement for animals and recognition of tracks difficult for humans. Nevertheless much data on large carnivores in Ľubochnianska valley could be gleaned during the three-week monitoring period with the help of international volunteers. These data would have been impossible to collect with the limited resources available locally without using volunteers.

It is interesting to compare the results of monitoring of the years 2008 - 2010, which took place mainly in the central part of Ľubochnianska (between Čierňavy and Blatná) with the 2012 Biosphere Expeditions monitoring results. Sites that were found to be frequented by large carnivores in 2008 - 2010 were avoided by them in 2012. Reasons could include the deep snow during the 2012 expedition, but also heavy hunting activity in the preferred 2008 – 2010 areas. Further monitoring should reveal more about site preferences.

Monitoring in 2012 confirmed the existence of at least two wolf packs in the study area. The number of individuals in each pack could not be determined, but very interesting and valuable evidence of wolf presence is a photo of a wolf on freshly caught prey in Čierňavy valley, taken an hour and a half after the camera trap was installed by volunteers (see wolf photo taken by camera trap no. 9 in Figure 2.4h above). DNA analysis will reveal more about wolf distribution.

A major benefit of the expedition was the mapping of lynx presence in Krátko and Kračkov valleys. All three groups recorded the presence of a female lynx with a litter. Resting places and tracks, probably of other lynx individuals were also found. This conjecture will be tested by DNA analysis.

Despite intensive monitoring during the expedition in Čierňavy, Lipová and Blatná valleys, no footprints of lynx were found. This area was monitored intensely in 2008 - 2010. At that time there were two released lynxes in the area (Lisa and Muro from Ostrava zoo), as well as a resident male in Čierňavy valley. However, forest workers logging in the area have reported tracks before the expedition and during the third slot. These tracks, however, were covered by fresh snow, so their identity could not be confirmed by the expedition. The absence of lynx gives cause for concern and will be investigated further during the 2013 expedition.

Camera trap no. 15, located on the forest road opposite Blatná valley, at the beginning of April captured a lynx feeding on a deer carcass. This location is not far from where a female lynx was camera-trapped in March 2009, also feeding on a wolf-kill deer carcass. These images (see Figure 2.5a. below) are very valuable to start building a database for comparison and identification of individuals by their spot patterns.

One of the most unexpected results were the camera trap photos and tracks of brown bear. Although bears usually hibernate in winter, four incidences were found where this was not the case. Perhaps it was a juvenile lacking experience in building a properly insulated den, whose hibernation was interrupted by the very low temperatures. The second option is connected to the supplementary feeding of deer by the hunting community, which means that bears are able to find plenty of food at the deer feeding stations and are therefore able to survive the winter, even if their hibernation is disrupted.

This first year of monitoring of large carnivores in the National Park Veľká Fatra in the Ľubochnianska valley has reached its set goals and was successful and as such the NGO Protection for Carpathian Wilderness is now planning a multi-year collaboration with Biosphere Expeditions. Participation of volunteers in conjunction with the authorities of Veľká Fatra National Park and Ľubochňa Forest Department allows data collection and implementation of new methods for recording population parameters for large carnivores in the territory of Ľubochnianska valley in Veľká Fatra National Park.

Camera trap no. 15, April 2012.

Camera trap Blatna, March 2009.

Figure 2.5a. Comparison of lynx camera-trapped in roughly the same location on the forest road opposite Blatná valley.

2.6. Literature cited

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Appendix I: Expedition diary and reports

A multimedia expedition diary is available on http://biosphereexpeditions.wordpress.com/category/expedition-blogs/slovakia-2012/.

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